Project Gigaton Soil-Health Greenhouse-Gas Accounting Methodology

Version 1.00

Dominic Woolf[a,b*], Peter Woodbury[a,b*], Christina Tonitto[c*]

June 25, 2020

[a] School of Integrative Plant Sciences, Cornell University, Ithaca NY 14853.

[b]Cornell Atkinson Center for Sustainability, Cornell University, Ithaca NY 14853.

[c] Department of Global Development, Cornell University, Ithaca NY 14853.

[*]These authors contributed equally to development of the method.

Acknowledgments

We would like to thank the Cornell Atkinson Center for Sustainability for funding the development of this methodology. We thank our external[1] and internal[2] advisory committee members for many useful comments and suggestions throughout the methodology development. This work represents the views of the listed authors.

[1]External advisory committee was comprised of Doria Gordon and Joseph Rudek from Environmental Defense Fund, and Lesley Atwood, Joseph Fargione, and Stephen Wood from The Nature Conservancy.

[2]Internal advisory committee was comprised of Johannes Lehmann and Andrew McDonald from Cornell University, with additional feedback received from Cornell faculty Rebecca Nelson, Matt Ryan, and Harold Van Es.

Contents

List of Equations

List of Tables

List of Figures

1 General methods applicable to all emissions

The greenhouse gas (GHG) accounting methodology described here covers impacts of cover cropping, reduced tillage, and nitrogen (N) fertilizer management on agricultural GHG emissions for major commodity grain crops in the continental USA. Two major GHGs are considered—carbon dioxide (CO_2) and nitrous oxide (N_2O). These are the most important GHGs in the systems considered here. Extension of a future version of the methodology to also include livestock, manure management and wetlands (such as paddy-rice cultivation or peatland restoration) would need to additionally consider methane (CH_4) emissions, but this is not required for the scope of the current method.

Net emissions of different greenhouse gases are aggregated into a single metric of tonnes CO2-equivalent (Mg CO_2e), as shown in Eq.1. Note that Metric (SI) units are used throughout this document. If the final user interface is to be provided in alternative units (e.g. US Imperial units), appropriate conversion factors will need to be used in construction of the web-interface.

Equation 1: Net Greenhouse Gas reduction from soil health practices

$$\Delta GHG = \sum_{r,m,z,s} \left[A_{r,m,z,s} \cdot \left(\Delta \mathrm{CO2}_{r,m,z,s} + \Delta \mathrm{N2O}_{r,m,z,s} \cdot \mathrm{GWP}_{N2O} \right) \right]$$

Where:

$\Delta GHG =$ Net avoided GHG emissions (Mg CO_2e yr^{-1}),

$r =$ Crop rotation,

$m =$ Management intervention,

$z =$ Climate zone,

$s =$ Soil class,

$A_{r,m,z,s} =$ Area of land being reported, for each combination of climate, management, soil, and crop rotation,

$\Delta \mathrm{CO2} =$ Net avoided CO_2 emissions, Mg CO_2 ha^{-1} yr^{-1}, (see Eq. 2),

$\Delta \mathrm{N2O} =$ Net avoided N_2O emissions, Mg N_2O ha^{-1} yr^{-1}(see Eq. 6),

$\mathrm{GWP}_{N2O} =$ Global warming potential of N_2O (see Table 1).

Table 1: *Values of constants.*

Constant	Description	Value	Unit
GWP_{N_2O}	Global warming potential of N_2O	298	Mg CO_2e Mg^{-1} N_2O
α	Conversion factor from carbon to CO_2	3.67	Mg CO_2 $Mg^{-1}C$

1.1 Supporting Information

Note that this document provides a summary of the equations and parameter values required to calculate the net avoided GHG emissions. A detailed account of the published literature and method derivation underlying this methodology is shown in the Technical Appendices C (Tillage), D (cover crops, non-soil carbon aspects), E (soil carbon in cover crops), and F (nitrogen fertilizer and nitrous oxide emissions), accompanying this document.

1.2 Sign convention

The sign convention adopted in this methodology is that positive values indicate a removal of GHGs from the atmosphere or a reduction in emissions. Conversely, increased emissions are negative. Thus, the method measures the net avoided emissions, with positive values indicating an improvement relative to current practices.

1.3 Area of practice

Each unique combination of management, crop-rotation, climate, and soil-type should be reported as a separate entry in the calculator. Total GHG mitigation impact across the whole reported supply chain is then calculated as the arithmetic sum of the GHG impact in each of these areas. Total area under cover crops and/or improved tillage within these areas should be reported. This includes early-adopter farms that had begun implementation of the soil-health practice prior to the project baseline year of 2015, because 1) continuation of the practice is an ongoing annual decision; and 2) even though a fraction of the net SOC sequestration potential will have occurred prior to the baseline year, continuation of practice is required to prevent those early gains from being reversed.

1.4 Climate zones

The climate zones defined for this method comprise a factorial combination of dry/moist and warm/cool, resulting in four zones: warm–dry, warm–moist, cool–dry, and cool–

moist. Warm locations are defined as having a mean annual temperature greater than or equal to 10 °C. Moist regions are defined as having mean annual precipitation (MAP) greater than or equal to potential evapo-transpiration (PET). Default emission factors for each US State and County are based on the climate zone that covers the largest fraction of the area within that jurisdiction. Default climate zones by State (Fig. 1) and County (Fig. 2) are listed in appendices A and B, respectively.

1.5 Soil classes

The method uses three soil classes: sandy, loamy and clayey, defined using the USDA soil-texture classification. Sand, loamy-sand, sandy-loam, sandy-clay loam and sandy-clay soils are classed together as "sandy" soils in this methodology. Clay and clay-loam soils are classed as "clayey". All other soil textures are classed as "silty". Figure 3 shows the USDA soil texture triangle with examples of average soil texture class by county. For specific soil classification, by state and county see Appendices A and B, respectively.

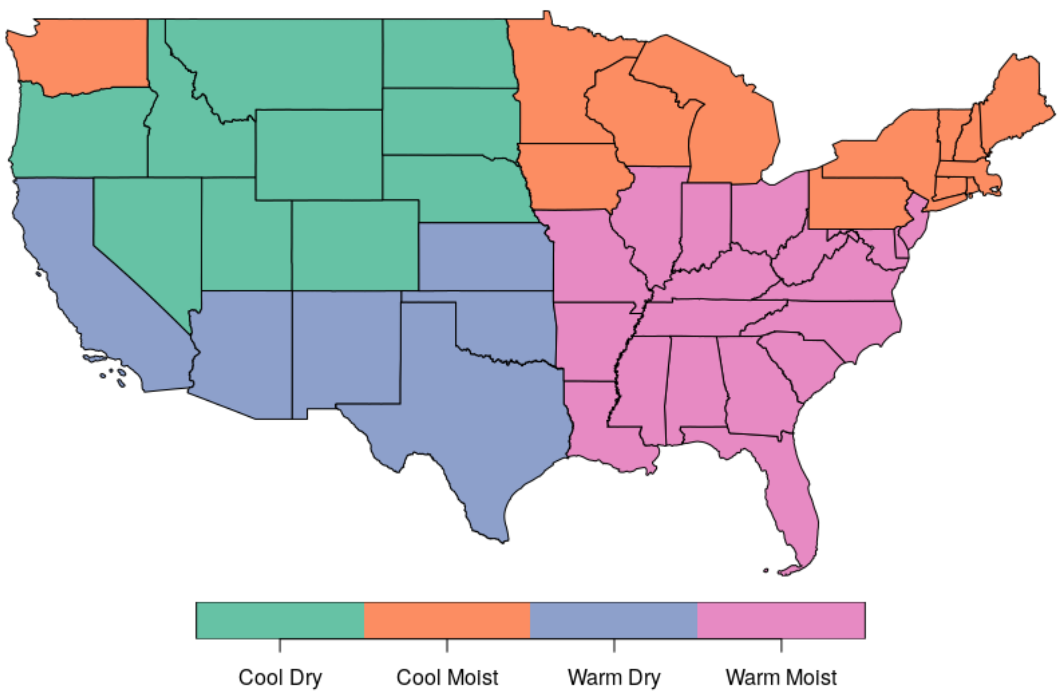

Figure 1: *Default climate zones in the coterminous USA, by State.*

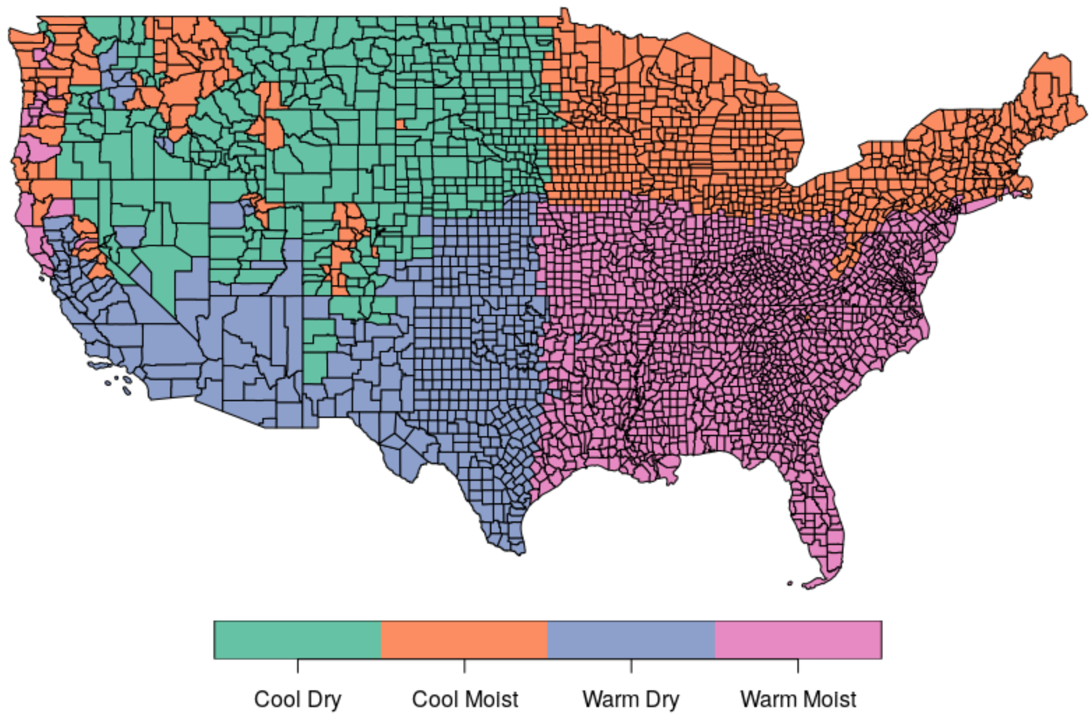

Figure 2: *Default climate zones in the coterminous USA, by County.*

2 Tillage

The classifications of tillage practices are defined in Table 2. These definitions are based on the percentage of the soil surface covered by residues between crop harvest and planting of the subsequent crop, in order to allow verification by visual inspection or remote sensing.

Table 2: *Definitions of tillage classes, based on surface coverage of crop residues.*

Tillage class	Definition for corn (Surface residue cover)	Definition for other crops (Surface residue cover)
Conventional	0-15%	0-15%
Reduced tillage	16-50%	16-30%
No-till	51-100%	31-100%

Source: Applied Geosolutions. 2019. Mapping Conservation Practices and Outcomes in the Corn Belt - Final Report, a collaborative project between Applied Geosolutions LLC, Dagan, Inc., The Nature Conservancy, and the Conservation Technology Information Center, 10 September 2019.: 24 p.

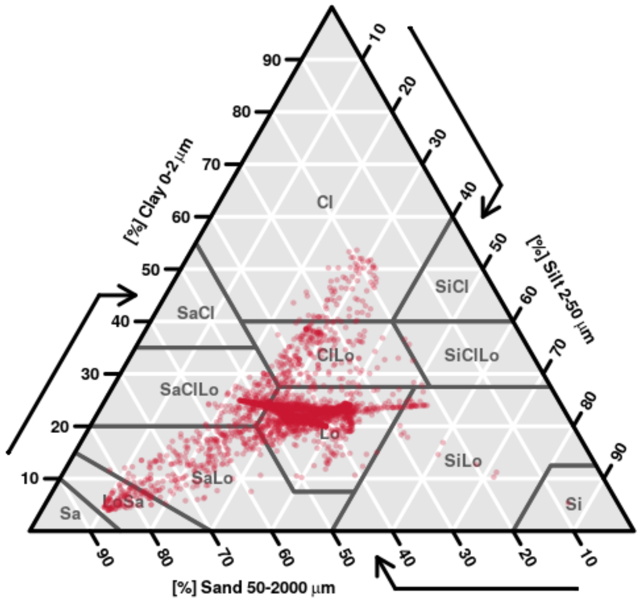

Figure 3: *Default texture classes (USDA classification), by county, for soils in the coterminous USA. Sand, loamy-sand, sandy-loam, sandy-clay loam and sandy-clay soils are classed together as "sandy" soils in this methodology. Clay and clay-loam soils are classed as "clayey". All other soil textures are classed as "silty". For specific soil classification, by state and county see Appendices A and B, respectively.*

3 Cover crops

Cover crops are defined here as the addition of a winter cover crop into the annual crop rotation, where previously there was a bare fallow period. Note that this includes early adopters, as described in Section 1.3. Also note that this methodology does not account for "double cropping" systems in which a harvested cash crop is introduced to replace a bare fallow season. Emission factors for the GHG impacts of cover crops are shown in Sections 4–6 for each GHG source and sink, including any changes to nitrogen-fertilizer inputs (Section 6.4).

4 Carbon dioxide emissions

The net avoided CO_2 emissions (ΔCO_2) are calculated according to Eq. 2. Avoided CO_2 emissions must be calculated separately for each management intervention (reduced tillage and/or introduction of cover crops) in each climate zone.

Equation 2: Net carbon dioxide reduction from soil health practices

$$\Delta CO2 = \alpha \cdot (1 - R) \cdot \Delta SOC + \Delta CO2_F + \Delta CO2_I + \Delta CO2_N + \Delta CO2_L$$

Where:

ΔCO2 = Net avoided CO_2 emissions, Mg CO_2 ha^{-1} yr^{-1},

ΔSOC = Sequestered soil organic carbon, Mg C ha^{-1} yr^{-1}),

R = Risk of reversal of SOC sequestration,

α = Conversion factor from carbon to CO_2 (see table 1),

$\Delta CO2_F$ = Change in CO_2 emissions from machinery use in field operations (Mg CO_2 ha^{-1} yr^{-1}),

$\Delta CO2_I$ = Change in CO_2 emissions from agricultural inputs, excluding nitrogen fertilizer (Mg CO_2 ha^{-1} yr^{-1}),

$\Delta CO2_N$ = Change in CO_2 emissions from nitrogen fertilizer production (Mg CO_2 ha^{-1} yr^{-1}),

$\Delta CO2_L$ = Change in CO_2 emissions from leakage (Mg CO_2 ha^{-1} yr^{-1}),

4.1 Soil organic carbon

Soil organic carbon sequestration rate is assumed to be the arithmetic sum of SOC sequestration due to cover crops and due to reduced tillage (Equation 3). That is, there is assumed to be no interaction between tillage and cover crops.

Equation 3: Soil organic carbon sequestration

$$\Delta SOC = \left(f_{100_{CC}} \cdot \Delta SOC_{CC}\right) + \left(f_{100_T} \cdot \Delta SOC_T\right)$$

Where:

ΔSOC_{CC} = Sequestered soil organic carbon from cover crops, Mg C ha^{-1} yr^{-1},

ΔSOC_T = Sequestered soil organic carbon from tillage, Mg C ha^{-1} yr^{-1}.

f_{100} = SOC adjustment factor to account for the fact that annual sequestration rates diminish over time. $f_{100_{CC}}$ and f_{100_T} apply to cover crops and tillage, respectively.

4.1.1 SOC reversal risk

If the cover-crop or improved-tillage practice is discontinued at any time, the accumulated SOC will be lost again as the SOC levels return to the same amount as they would under conventional practice. The default value for the discontinuation risk (R) is 0.5. The risk value R is intended to represent the fraction of area reported as conducting a soil health practice that will cease to do so within 100 years—a time frame that is consistent with the treatment of "permanent removals" in the Intergovernmental Panel on Climate Change (IPCC) and United Nations Framework Convention on Climate Change (UNFCCC) reporting frameworks.

Users may be given the option to enter a risk assessment value other than the default if they self-certify that a risk assessment has been conducted. A lower value will typically be justified only if there are demonstrable factors in place that mitigate the risk. If users wish to enter their own value to over-ride the default they will be required to click a checkbox to certify that a risk appraisal has been conducted. If they check this box they will also be required to identify the method used and to upload supporting documentation which will form part of the public annotations to their report. The tool will only allow modification of the default value if these steps are followed.

4.1.2 SOC sequestration in cover crops

SOC sequestration rate under cover crops is a factor of the moisture regime (i.e., dry or moist climate), as shown in Table 3

Table 3: *Default SOC accumulation rates for cover crops (Mg C ha^{-1} yr^{-1}).*

Moisture	ΔSOC_{CC}
Dry	0.00
Moist	0.19

4.1.3 SOC sequestration in reduced tillage

SOC sequestration rate for tillage is a factor of the tillage practice (Table 2), climate (Section 1.4), and soil texture (whether the soil is classed as sandy or not). Tillage-related SOC sequestration rates are given in Table 4

4.1.4 SOC adjustment factors

The SOC adjustment factors to account for the fact that annual sequestration rates diminish over time ($f_{100_{CC}}$ and f_{100_T}) are given in Table 5. See Technical Appendix C (tillage) and

Table 4: *Default SOC accumulation rates for tillage practices (Mg C ha^{-1} yr^{-1}), relative to a baseline of SOC in conventional tillage. Soil texture is classed as either "Sandy" or "Other", the latter including both silty and clayey soils.*

Tillage Practice	Temperature	Moisture	Soil	ΔSOC_T
Conventional	All	All	All	0.00
Reduced-till	Cool	Dry	Other	0.02
Reduced-till	Cool	Dry	Sandy	0.07
Reduced-till	Cool	Moist	Other	0.07
Reduced-till	Cool	Moist	Sandy	0.17
Reduced-till	Warm	Dry	Other	0.19
Reduced-till	Warm	Dry	Sandy	0.09
Reduced-till	Warm	Moist	Other	0.30
Reduced-till	Warm	Moist	Sandy	0.18
No-till	Cool	Dry	Other	0.02
No-till	Cool	Dry	Sandy	0.08
No-till	Cool	Moist	Other	0.08
No-till	Cool	Moist	Sandy	0.18
No-till	Warm	Dry	Other	0.21
No-till	Warm	Dry	Sandy	0.10
No-till	Warm	Moist	Other	0.33
No-till	Warm	Moist	Sandy	0.21

Technical Appendix E (soil organic carbon in cover crops) for the derivation of f_{100_T} and $f_{100_{CC}}$, respectively.

Table 5: *SOC adjustment factor to account for the fact that annual sequestration rates diminish over time. $f_{100_{CC}}$ and f_{100_T} apply to cover crops and tillage, respectively.*

Temperature	Moisture	$f_{100_{CC}}$	f_{100_T}
Warm	Moist	0.26	0.25
Warm	Dry	0.26	0.25
Cool	Moist	0.28	0.25
Cool	Dry	0.29	0.25

4.2 Energy use in field operations

Emission factors for the impact of cover crops on farm fuel use ($\Delta CO2_F$) are given in Table 6. Emission factors for the impact of tillage practices on farm fuel use ($\Delta CO2_F$) are given in Table 7. If both cover crops and improved tillage are implemented together then the net impact is the arithmetic sum of the fuel-use emissions from both.

Table 6: *Cover-crop emission-factors for agricultural inputs, excluding fertilizer ($\Delta CO2_I$), and farm fuel use ($\Delta CO2_F$) (Mg CO_2e ha^{-1} yr^{-1}). Agricultural inputs include seed production (all systems) and herbicide production (no-till systems, chemical cover crop termination). Fertilizer production is accounted for separately in the fertilizer optimization section. Farm energy use includes field operations for sowing, mechanical termination of cover crop (conventional tillage systems) and herbicide application (no-till systems).*

Cover crop	Tillage Practice	$\Delta CO2_I$	$\Delta CO2_F$
Non-legume	Conventional	-0.037	-0.040
Non-legume	Reduced-till	-0.059	-0.029
Non-legume	No-till	-0.059	-0.029
Legume	Conventional	-0.017	-0.040
Legume	Reduced-till	-0.039	-0.029
Legume	No-till	-0.039	-0.029

Table 7: *Tillage emission factors for agricultural inputs ($\Delta CO2_I$), and farm fuel use ($\Delta CO2_F$) (Mg CO_2e ha^{-1} yr^{-1}). Agricultural inputs include only herbicide production. Fertilizer is accounted for separately in the fertilizer optimization section. On-farm fuel use ($\Delta CO2_F$) is lowered by the reduction in tillage operations.*

Tillage Practice	Crop	$\Delta CO2_I$	$\Delta CO2_F$
Reduced-till	Maize	0.00	0.08
Reduced-till	Wheat	-0.01	0.08
Reduced-till	Soybean	0.00	0.08
No-till	Maize	-0.01	0.10
No-till	Wheat	-0.02	0.10
No-till	Soybean	-0.01	0.10

4.3 Production of agricultural inputs

Agricultural inputs accounted for in this section include seed, herbicide, and pesticide. Note that nitrogen fertilizer inputs are accounted for separately according to the methods described in Section 6. It is assumed that application rates of phosphorus, potassium or other plant nutrients and of agricultural lime are unchanged by the practices in this methodology.

Emission factors for the impact of cover crops and tillage practices on agricultural inputs ($\Delta CO2_I$) are given in Tables 6 and 7, respectively. If both cover crops and improved tillage are implemented together then the net impact is the arithmetic sum of the fuel-use emissions from both.

4.4 Leakage

Leakage refers to indirect impacts on GHG emissions that occur outside of the project area itself. Any changes to crop yield caused by introduction of soil health practices will cause an indirect response in the overall food commodity supply chain to accommodate the change in local production levels. A reduction in yield in the soil-health program area will tend to cause an increase in demand from elsewhere. Conversely, an increase in yield within the soil health program area will reduce demand from elsewhere. The impact of this leakage on GHGs will be comprised of several factors. Firstly there are the emissions associated with crop production itself. The direct emissions from any increase or decrease in production outside the program should be accounted for. Secondly, the change in demand outside the program area may drive either a conversion of unused marginal lands into agricultural production (if yield decreases), or, conversely, abandonment of marginal agricultural lands elsewhere if yield increases. Such indirect land use change (ILUC) has associated impacts on GHG fluxes due to the difference in carbon stocks sequestered in cropland compared to other land uses. The extent to which a change in demand outside the program area drives ILUC depends on both 1) the price elasticity of demand and 2) on the extent to which change in production will be accomplished by changing production-intensity versus through land-use change.

GHG emissions due to change in yield in the soil health program are calculated according to Equation 4 below. The same sign convention is applied here that positive values indicate a net reduction in emissions.

4.4.1 Change in yield

Change in crop yield due to introduction of soil health practices is calculated according to Equation 5. Default yields (Y_0) under conventional practice for each state, county and crop are shown in Appendices A and B. Grain yield is reported and used in the methodology for standard moisture contents as follows: maize = 15.5%, soybean = 13% and wheat =13.5%.

Values of $F_{Y_{CC}}$ (relative change in yield due to introduction of cover crops) are shown in Table 8. Values of F_{Y_T} (relative change in yield due to tillage practice) are shown in Table 9, below.

Equation 4: Carbon dioxide emissions from yield changes due to soil health practices

$$\Delta CO2_L = \sum_c \left[f_c \cdot \Delta Y_c \cdot \left(F_p + (1 - f_i) \cdot F_i \right) \right]$$

Where:

c = Each crop in the rotation,

f_c = Fraction of the rotation for which crop c is grown,

ΔY_c = Change in yield of crop c, kg grain ha^{-1} yr^{-1},

F_p = Production emission factor, Mg CO_{2e} kg^{-1} grain,

f_i = intensification factor, i.e., the fraction of leakage that is accommodated by a change in intensification rather than extensification,

F_i = Indirect land use change emission factor, Mg CO_{2e} kg^{-1} grain.

Equation 5: Yield change due to soil health practices

$$\Delta Y = Y_0 \cdot \left(F_{Y_{CC}} + F_{Y_T} \right)$$

Where:

ΔY = Change in yield, kg grain ha^{-1} yr^{-1},

Y_0 = Baseline yield, without soil health practices

$F_{Y_{CC}}$ = Relative change in yield due to cover crop practice (%). Defined as zero for conventional rotations without cover crops.

F_{Y_T} = Relative change in yield due to tillage practice (%). Defined as zero for conventional tillage.

Table 8: *Default change in cash crop yield due to introduction of cover crops (%).*

Crop	Moisture	$F_{Y_{CC}}$
Maize	All	0.0
Wheat	Moist	0.0
Wheat	Dry	NA
Soybean	All	3.8

Table 9: *Default change in crop yield due to tillage management (F_{Y_T}, expressed in units of % of initial yield).*

Tillage Practice	Crop	Moisture	Rotation	F_{Y_T}
No-till	Maize	All	Maize-Soybean	-1.67
No-till	Maize	All	Continuous Maize	-6.31
No-till	Soybean	All	All	0.00
No-till	Wheat	Moist	All	-4.00
No-till	Wheat	Dry	All	4.30
Reduced-till	Maize	All	Maize-Soybean	-0.84
Reduced-till	Maize	All	Continuous Maize	-3.15
Reduced-till	Soybean	All	All	0.00
Reduced-till	Wheat	Moist	All	-2.00
Reduced-till	Wheat	Dry	All	2.15

5 Indirect land use change

The indirect land use change emission factor (F_i), expressed as Mg CO_{2e} kg^{-1} grain, is shown in Table 10 as a function of crop type. The intensification factor (f_i), i.e., the fraction of leakage that is accommodated by a change in intensification rather than extensification, is 0.49 for all crop types.

6 Nitrogen fertilizer

Nitrogen (N) is an essential plant nutrient, and all agriculture requires N inputs, whether from an exogenous source (such as N-fertilizer, or manure), and/or from N-fixation in leguminous crops or cover crops. A small fraction of any N added to soil is inevitably volatilized as the potent GHG nitrous oxide (N_2O). Methods aimed at reducing N_2O emissions typically work by increasing the nitrogen-use efficiency (NUE) of the crop production, thereby allowing farmers to reduce N inputs while maintaining yield. Reducing excess reactive nitrogen is the key management pathway for reducing N loss

Table 10: *Indirect land use change emission factors for the net GHG emissions on new cropland (outside of the program area) that is brought into production in response to a decline in yield within the program area. The indirect emissions are comprised of both the carbon opportunity cost from land conversion (F_i), and the production emissions on the new cropland (F_p). Both F_p and F_i are expressed in units of Mg CO_2e Mg^{-1} grain (fresh weight).*

Crop	F_i	F_p
Maize	2.21	0.46
Wheat	2.22	0.69
Soybean	5.58	0.26

from agricultural systems. Optimal N application rates should provide N to maintain crop yield as well as N to maintain SOM stocks. To achieve optimal N rates, a farmer manages system N balance, the difference between system N inputs and N harvested in crop biomass. The modeling approach applied here is based on quantifying the change in N inputs and using published formulae that estimate N_2O emissions per unit N input. The choice of models is explained in more detail in the Nitrogen Technical Appendix.

N_2O emissions can be classified as either direct emissions (emitted from the field where the N is applied) or indirect (downstream emissions from N that is exported from the field either by leaching or by volatilization). The total change in N_2O emissions is calculated as the sum of the change in direct and indirect N_2O emissions (Equation 6).

Equation 6: Change in total nitrous oxide emissions (ΔN2O), Mg N_2O ha^{-1} yr^{-1}.

$$\Delta N2O = (\Delta N2O_d + \Delta N2O_i)/1000$$

Where:

ΔN2O = Net avoided N_2O emissions, Mg N_2O ha^{-1} yr^{-1}

$\Delta N2O_d$ = Change in direct N_2O emissions, kg N_2O ha^{-1} yr^{-1},

$\Delta N2O_i$ = Change in indirect N_2O emissions, kg N_2O ha^{-1} yr^{-1}.

Furthermore, GHG emissions are also associated with the production of N fertilizer ($\Delta CO2_N$). These are calculated as described in Section 6.3.

6.1 Direct nitrous oxide emissions

The change in direct N_2O emissions ($\Delta N2O_d$) is calculated using Equation 7.

Values for the emission factor for direct N_2O emissions due to N-fertilizer application

Equation 7: Change in direct nitrous oxide emissions ($\Delta N2O_d$, kg N_2O ha^{-1} yr^{-1}).

$$\Delta N2O_d = f_{Nd} \cdot \Delta N + f_{ONd} \cdot \Delta N_O$$

Where:

f_{Nd} = Emission factor for direct N_2O emissions due to mineral N-fertilizer application (kg N_2O kg N^{-1}).

f_{ONd} = Emission factor for direct N_2O emissions due to organic-N application (kg N_2O kg N^{-1}).

ΔN = Change in mineral nitrogen-fertilizer application rate (kg N ha^{-1} yr^{-1}).

ΔN_O = Change in organic-nitrogen application rate (kg N ha^{-1} yr^{-1}).

(f_{Nd}) are provided in Table 11. Emission factors for direct N_2O emissions due to organic N application (f_{ONd}) are provided in Table 12.

Table 11: *Emission factors for direct N_2O emissions due to N-fertilizer application (f_{Nd}), kg N_2O kg^{-1} N. Default values for clay (the clay fraction of the soil), as required for moist-climate corn production, are provided in Appendices A and B for each State and County in the coterminous USA, respectively.*

Crop	Moisture class	f_{Nd}
Corn	Moist	$0.085 \cdot clay$
Corn	Dry	0.0079
Wheat	Moist	0.0251
Wheat	Dry	0.0079
Soybean	Moist	0.0251
Soybean	Dry	0.0079

Table 12: *Emission factor for direct (f_{ONd}) and indirect (f_{ONv}, f_{ONl}) N_2O emissions due to organic nitrogen additions, kg N_2O kg^{-1} N.*

Moisture	f_{ONd}	f_{ONv}	f_{ONl}
Dry	0.0079	0	0.00000
Moist	0.0094	0	0.00415

6.2 Indirect nitrous oxide emissions

The change in indirect N_2O emissions ($\Delta N2O_i$) is calculated using Equation 8.

Equation 8: Change in indirect nitrous oxide emissions ($\Delta N2O_i$, kg N_2O ha^{-1} yr^{-1}).

$$\Delta N2O_i = f_{Nv} \cdot \Delta N + f_{Nl} \cdot (1 - f_{up}) \cdot \Delta N + f_{ONv} \cdot \Delta N_O + f_{ONl} \cdot (1 - f_{up}) \cdot \Delta N_O$$

Where:

f_{Nv} = Emission factor for indirect N_2O emissions from volatilization due to mineral N-fertilizer application (kg N_2O kg N^{-1}),

f_{Nl} = Emission factor for indirect N_2O emissions from leaching due to mineral N-fertilizer application (kg N_2O kg N^{-1}),

f_{ONv} = Emission factor for indirect N_2O emissions from volatilization due to organic N inputs (kg N_2O kg N^{-1}),

f_{ONl} = Emission factor for indirect N_2O emissions from leaching due to organic N inputs (kg N_2O kg N^{-1}),

f_{up} = Reduction in leaching due to soil health practices (proportion),

ΔN = Change in mineral nitrogen-fertilizer application rate (kg N ha^{-1} yr^{-1}),

ΔN_O = Change in organic-nitrogen inputs (kg N ha^{-1} yr^{-1}).

Emission factors for indirect N_2O emissions due to N-fertilizer application (f_{Nv} and f_{Nl}) or organic N (f_{ONv} and f_{ONl}) are provided in Tables 13 and 12. Factors for the relative reduction in N leaching due to soil health practices (f_{up}) are provided in Table 14.

Table 13: *Emission factors for indirect N_2O emissions due to N-fertilizer application from volatilisation (f_{Nv}) and leaching (f_{Nl}), kg N_2O kg^{-1} N.*

Crop	Moisture	f_{Nv}	f_{Nl}
Maize	Moist	0.00242	0.00415
Maize	Dry	0.00086	0.00000
Wheat	Moist	0.00242	0.00415
Wheat	Dry	0.00086	0.00000
Soybean	Moist	0.00242	0.00415
Soybean	Dry	0.00086	0.00000

Table 14: *Relative reduction in nitrogen leaching due to soil health practices (f_{up}), expressed as a fraction.*

Cover Crop	Tillage	f_{up}
Non-legume	All	0.540
Legume	All	0.400
None	Conventional	0.000
None	No-till	0.250
None	Reduced till	0.125

6.3 Emissions from fertilizer production

The change in CO_2-equivalent GHG emissions from nitrogen fertilizer production ($\Delta CO2_N$) is calculated using Equation 9.

Equation 9: Change in CO_2-equivalent GHG emissions from nitrogen fertilizer production ($\Delta CO2_N$).

$$\Delta CO2_N = f_{Np} \cdot \Delta N$$

Where:

f_{Np} = Emission factor for N-fertilizer production (Mg CO_2e kg^{-1} N).

ΔN = Net reduction in nitrogen fertilizer application rate (Mg N ha^{-1}), from both soil-health and fertilizer-management practices (Eq. 10).

The default value for f_{Np} is 0.00441 Mg CO_2e kg^{-1} N.

6.4 Nitrogen fertilizer application rate

In this section we provide default methods for calculating the change in mineral-nitrogen fertilizer inputs (ΔN). For fertilizer N-optimization practices, the method assumes that farmer goals are to maintain optimal cash-crop yield. This assumption is in line with application of N-optimization methods in which N optimization led to neutral or positive impact on yield (see N technical appendix for N optimization references). For cover crops and tillage, yield changes are described in Section 4.4.1. Default methods for calculating change in mineral-nitrogen fertilizer inputs (ΔN) are provided in Table 15. These values measure the reduction in N input (i.e. a positive value indicates that N fertilizer was reduced).

The basis of these values is summarized below for each practice. For more details see the nitrogen technical appendix.

Legume cover crops: It is assumed that fixed nitrogen in the cover crop can substitute for mineral-N fertilizer. It is also assumed that legume cover crops will adjust their N-fixation rate based on the amount of residual N (and ultimately by the amount of N leaching they prevent, ΔL). The average amount of fixed-N is assumed to be 52 kg N ha^{-1} yr^{-1}. It is assumed that organic-N in the cover crop can substitute only a fraction (f_{NUE}) of the equivalent mineral-N fertilizer, due to the lower N use efficiency of organic-N. The default value of f_{NUE} is 0.87. The amount of N sequestered in soil organic matter is then subtracted to provide the plant-available N from the cover crop. N sequestered in soil is calculated by multiplying the SOC sequestration rate by the average N/C content of soil (0.072 Mg N Mg^{-1} C). Finally, in calculating ΔN for leguminous cover crops, any change in crop yield is multiplied by the grain N fraction (f_{Ng}; see Table 16) to estimate the change in crop N uptake.

Non-legume cover crops: These do not provide fixed nitrogen. It is assumed that nitrogen loss by leaching is reduced by an amount ΔL (see Section 6.5). The average non-legume cover crop biomass is set as 22 kg N ha^{-1} yr^{-1}. Non-legume cover-crop biomass N is assumed to be the source of ΔSON, non-legume biomass N is not counted as a source of N for cash crop growth. Non-legume cover crop biomass N is achieved from residual N following prior-season cash-crop harvest, calculated as the amount of avoided leaching due to cover crop management. If uptake of residual N is insufficient for this assumed average cover-crop biomass accumulation, it is assumed a farmer adds N fertilizer to achieve this average biomass N. If there is a surplus from residual N uptake after cover crop biomass N accounting, it is assumed that organic-N from the non-legume cover crop can substitute only a fraction (f_{NUE}) of the equivalent mineral-N fertilizer, due to the lower N use efficiency of organic-N. The default value of f_{NUE} is 0.87. For non-legume cover crops, it is assumed that the amount of N sequestered in soil organic matter is acquired from the average non-legume biomass N accumulated in the system. As for legumes, in calculating ΔN for non-leguminous cover crops, any change in cash crop yield is multiplied by the grain N fraction (f_{Ng}; see Table 16) to estimate the change in crop N uptake.

Tillage: It is assumed that the amount of N sequestered in soil organic matter is an additional N requirement in the system. It is also assumed that nitrogen loss by leaching is reduced by an amount ΔL (see Section 6.5). Sequestered N in soil organic matter and the change in cash crop yield resulting from tillage management are implemented as in legume cover crop management. N sequestered in soil is calculated by multiplying the SOC sequestration rate by the average N/C content of soil (0.072 Mg N Mg^{-1} C). Any change in crop yield is multiplied by the grain N fraction (f_{Ng}; see Table 16) to estimate the change in crop N uptake. No-till or reduced tillage do not provide an N credit for the following cash crop.

Cover crop and tillage interaction: It is assumed that if both cover crop and no-till or reduced till management occur concurrently, that the reduction in leaching, ΔL, is limited to the largest reduction calculated, namely the ΔL calculated due to cover crop management (see Section 6.5).

Model-based N optimization: Use of models (such as, for example, Adapt-N) to optimize fertilizer rates and timing is assumed to reduce N inputs, on average, by 13%.

Sensor / Variable Rate Technology (VRT) N optimization: Use of various techniques to optimize fertilizer rates (precision agriculture, optical sensors, in-field N rate tests) is assumed to reduce N inputs, on average, by 13% in maize and 26% in wheat.

Timing: Improved N fertilizer timing, such as switching from fall to spring application or from pre-plant to side-dress application, is assumed to reduce N fertilizer rate by 9%.

Other N-optimization practices: No default value for ΔN is provided for other N management practices. If users wish to report reduced N inputs that have been achieved through other methods than listed above, they must collect data on the actual change in N rate and crop yield that was achieved, and enter the average ΔN value explicitly. The tool should require user input of both the practice employed and the claimed value of ΔN for that practice.

6.4.1 Combined impact of several practices

The ΔN values in Table 15 are classified into separate "Combination groups". These combination groups are used for calculating the overall impact when more than one practice is employed simultaneously. Only one ΔN value from each group may be used and the combined impact of these practices is calculated according to the following method shown in Equation 10.

In Equation 10, only the largest applicable ΔN from combination group C is used. For example if both "Model-based N-rate optimization" and "Timing optimization" are used simultaneously, the ΔN value for group C will be the larger of these, which is "Model-based N-rate optimization".

6.5 Reduced nitrogen leaching

In humid systems it is assumed that 24% of added N is leached under normal practice (the IPCC default value). It is assumed that non-leguminous cover crops reduce leaching

Equation 10: Method to calculate combined change in N fertilizer application rate (ΔN) when more than one practice is employed simultaneously.

If any N-optimization practice in group D is reported then

$$\Delta N = \Delta N_D,$$

otherwise,

$$\Delta N = \Delta N_A + \Delta N_B + \Delta N_C$$

Where:

$\Delta N_A =$ Change in nitrogen fertilizer rate from practices in group A,

$\Delta N_B =$ Change in nitrogen fertilizer rate from practices in group B,

$\Delta N_C =$ Change in nitrogen fertilizer rate from practices in group C,

$\Delta N_D =$ Change in nitrogen fertilizer rate from practices in group D,

The following procedure is used to apply this formula:

1. If a practice from group D is reported, the net change in nitrogen-fertilization rate (ΔN_{tot}) is equal to ΔN_D. Do not proceed to step 2.
2. If leguminous or non-leguminous cover crops are used, ΔN_A is the corresponding ΔN value from group A.
3. If a mixed leguminous/non-leguminous cover crop is used, ΔN_A is the average of these two ΔN values from group A.
4. If reduced tillage or no-till is used, ΔN_B is the corresponding ΔN value from group B.
5. If any practices from group C are employed, ΔN_C is equal to the largest ΔN from these. f_O is the corresponding coefficient in Table 15.
6. If no N-optimization practices from Group C are applied, then ΔN_C is equal to zero.
7. The net change in nitrogen-fertilization rate (ΔN_{tot}) is then calculated using Equation 10.

by 54%. It is assumed that legume cover crops reduce leaching by 40%. For humid no-till systems it is assumed that leaching is reduced by 25%. Reduced tillage is assumed to reduce leaching by only half this amount (12.5%). In dry systems we use the default IPCC approximation that no N is leached. Changes in leached nitrogen due to introduction of a

Table 15: *Default change in nitrogen fertilizer rate (ΔN) resulting from soil-health or fertilizer-optimization practices. ΔN represents the amount by which N fertilizer inputs are reduced in kg N ha^{-1} yr^{-1} (positive values indicate an improvement (reduction) in N fertilizer rates; negative values indicate an increase in fertilizer application). The availability of organic N from cover crop biomass is reduced by factor fNUE= 0.87. Note that group C values are expressed as a proportion (f_O) of applied N, provided in the final column. Default N inputs by crop and State are provided in appendix A. The N rate used in group C equations is adjusted from the default value by the change in N rate due to cover cropping, tillage practice or change in yield before the f_O factor is applied. ΔY is the change in crop yield (Equation 5). f_{Ng} is the nitrogen content of the crop (Table 16).*

Practice	Group	ΔN	f_O
Leguminous Cover Crops	A	$52 \cdot f_{NUE} - 72 \cdot \Delta SOC_c - \Delta Y \cdot f_{Ng}$	
Non-legume cover crops	A	$(\Delta L - 22 - \Delta Y \cdot f_{Ng}) \cdot f_{NUE}$	
Reduced Tillage or No-till (no cover crop)	B	$\Delta L - 72 \cdot \Delta SOC_t - \Delta Y \cdot f_{Ng}$	
Reduced Tillage or No-till (combined with cover crop)	B	$-72 \cdot \Delta SOC_t$	
Model-based optimization	C	$f_O \cdot (N - \Delta N_A - \Delta N_B)$	0.13
VRT (maize)	C	$f_O \cdot (N - \Delta N_A - \Delta N_B)$	0.13
VRT (wheat)	C	$f_O \cdot (N - \Delta N_A - \Delta N_B)$	0.26
Timing optimization	C	$f_O \cdot (N - \Delta N_A - \Delta N_B)$	0.09
Other N-optimization practices	D	Provided by user	

Table 16: *Nitrogen content of crops (f_{Ng}), kg N kg^{-1} grain.*

Crop	f_{Ng}
Maize	0.012
Wheat	0.021
Soybean	0.059

practice(s) are summarized in Table 17.

6.6 Organic nitrogen application rate

Default methods for calculating change in organic-nitrogen inputs are shown in Table 18.

7 Mixed cover crops and crop rotations

If cover crops are a mixture of leguminous and non-leguminous plants, then the above methods should be applied for each type and the overall impact is calculated as the average (mean) GHG reduction from leguminous and non-leguminous cover crops.

Table 17: *Change in leached nitrogen (ΔL, kg N ha^{-1} yr^{-1}), due to introduction of a practice, calculated as a fraction of applied fertilizer-N (N). Note that ΔL is calculated differently for Soybean to other crops, as N is adjusted to also include the organic nitrogen in soybean residues, assumed to be 60 kg N ha^{-1}. Equations for soybean and other crops are shown in separate columns in the table.*

Cover Crop	Tillage Practice	Climate	ΔL (Soybean)	ΔL (Maize or wheat)
Non-legume	Any	Moist	$0.13 \cdot (N + 60)$	$0.13 \cdot N$
Legume	Any	Moist	$0.1 \cdot (N + 60)$	$0.1 \cdot N$
None	Reduced tillage	Moist	$0.03 \cdot (N + 60)$	$0.03 \cdot N$
None	No-till	Moist	$0.06 \cdot (N + 60)$	$0.06 \cdot N$
None	Conventional	Any	0.0	0.0
Any	Any	Dry	0.0	0.0

Table 18: *Default change in organic nitrogen inputs (ΔON) resulting from soil-health practices. Note that ΔON represents the amount by which N inputs are reduced (in kg N ha^{-1} yr^{-1}), thus negative values indicate an increase in ON inputs.*

Practice	Crop	Moisture	Soil	ΔON
Legume Cover Crops	All	Moist	All	-52
Non-legume cover crops	All	Moist	All	-22
Reduced Tillage or No-till	All	All	All	0.0

If more than one main crop is grown in the rotation, then the above methods should be applied for each crop and the overall impact is calculated as the average (mean) of their GHG reductions.

Appendices

A State level factors

[Note: Default crop yields and N rates still to be entered in these tables.]

Table 19: *Default parameter values for each State in the continental USA. SOC is in Mg C / ha. Sand, silt and clay are fractions.*

State	Sand	Silt	Clay	Soil	SOC	Climate
Alabama	0.48	0.26	0.27	Sandy	29.0	Warm Moist
Arizona	0.56	0.27	0.17	Sandy	13.7	Warm Dry
Arkansas	0.44	0.27	0.28	Clayey	27.5	Warm Moist
California	0.50	0.28	0.22	Silty	29.3	Warm Dry
Colorado	0.41	0.38	0.21	Silty	35.0	Cool Dry
Connecticut	0.62	0.24	0.13	Sandy	87.1	Cool Moist
Delaware	0.52	0.29	0.19	Silty	85.8	Warm Moist
Florida	0.75	0.14	0.10	Sandy	78.8	Warm Moist
Georgia	0.54	0.24	0.22	Sandy	41.6	Warm Moist
Idaho	0.41	0.38	0.20	Silty	41.6	Cool Dry
Illinois	0.40	0.37	0.23	Silty	60.5	Warm Moist
Indiana	0.43	0.35	0.22	Silty	60.6	Warm Moist
Iowa	0.41	0.37	0.22	Silty	75.6	Cool Moist
Kansas	0.39	0.38	0.23	Silty	44.4	Warm Dry
Kentucky	0.46	0.31	0.23	Silty	34.4	Warm Moist
Louisiana	0.41	0.29	0.30	Clayey	67.7	Warm Moist
Maine	0.75	0.19	0.06	Sandy	104.8	Cool Moist
Maryland	0.48	0.31	0.21	Silty	58.9	Warm Moist
Massachusetts	0.72	0.20	0.09	Sandy	108.3	Cool Moist
Michigan	0.67	0.20	0.12	Sandy	87.4	Cool Moist
Minnesota	0.37	0.40	0.23	Silty	96.8	Cool Moist
Mississippi	0.40	0.27	0.33	Clayey	32.7	Warm Moist
Missouri	0.44	0.33	0.23	Silty	41.3	Warm Moist
Montana	0.38	0.41	0.21	Silty	37.0	Cool Dry
Nebraska	0.52	0.31	0.17	Silty	40.0	Cool Dry
Nevada	0.48	0.32	0.20	Silty	16.5	Cool Dry
New Hampshire	0.81	0.14	0.06	Sandy	111.3	Cool Moist
New Jersey	0.55	0.27	0.19	Sandy	64.6	Warm Moist

Table 19: *Default parameter values for each State in the continental U (continued)*

State	Sand	Silt	Clay	Soil	SOC	Climate
New Mexico	0.46	0.33	0.20	Silty	18.4	Warm Dry
New York	0.53	0.30	0.17	Sandy	84.3	Cool Moist
North Carolina	0.48	0.30	0.23	Silty	59.4	Warm Moist
North Dakota	0.31	0.46	0.24	Silty	69.5	Cool Dry
Ohio	0.45	0.33	0.23	Silty	53.8	Warm Moist
Oklahoma	0.42	0.36	0.22	Silty	31.5	Warm Dry
Oregon	0.44	0.34	0.21	Silty	48.1	Cool Dry
Pennsylvania	0.44	0.35	0.21	Silty	47.2	Cool Moist
Rhode Island	0.66	0.23	0.10	Sandy	100.4	Cool Moist
South Carolina	0.48	0.30	0.22	Silty	41.8	Warm Moist
South Dakota	0.32	0.38	0.31	Clayey	52.7	Cool Dry
Tennessee	0.46	0.27	0.26	Sandy	30.3	Warm Moist
Texas	0.41	0.30	0.28	Clayey	32.6	Warm Dry
Utah	0.37	0.43	0.20	Silty	24.7	Cool Dry
Vermont	0.78	0.15	0.07	Sandy	111.2	Cool Moist
Virginia	0.45	0.32	0.23	Silty	39.7	Warm Moist
Washington	0.43	0.39	0.19	Silty	63.3	Cool Moist
West Virginia	0.42	0.38	0.20	Silty	40.9	Warm Moist
Wisconsin	0.53	0.29	0.18	Sandy	79.6	Cool Moist
Wyoming	0.47	0.31	0.23	Silty	27.4	Cool Dry

B County level factors

Table 20: *Default parameter values for each county in the continental USA. SOC is in Mg C / ha. Sand, silt and clay are fractions.*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Alabama	Autauga	0.37	0.29	0.35	Clayey	26.1	Warm Moist
Alabama	Baldwin	0.46	0.29	0.25	Silty	59.1	Warm Moist
Alabama	Barbour	0.51	0.24	0.26	Sandy	25.1	Warm Moist
Alabama	Bibb	0.43	0.27	0.30	Clayey	25.6	Warm Moist
Alabama	Blount	0.49	0.27	0.24	Sandy	23.4	Warm Moist
Alabama	Bullock	0.47	0.26	0.28	Sandy	24.9	Warm Moist
Alabama	Butler	0.48	0.24	0.28	Sandy	27.4	Warm Moist
Alabama	Calhoun	0.49	0.27	0.24	Sandy	21.2	Warm Moist
Alabama	Chambers	0.46	0.28	0.26	Silty	21.4	Warm Moist
Alabama	Cherokee	0.49	0.27	0.24	Sandy	23.9	Warm Moist
Alabama	Chilton	0.40	0.28	0.32	Clayey	25.1	Warm Moist
Alabama	Choctaw	0.49	0.25	0.27	Sandy	29.6	Warm Moist
Alabama	Clarke	0.51	0.23	0.26	Sandy	30.7	Warm Moist
Alabama	Clay	0.48	0.27	0.25	Sandy	20.5	Warm Moist
Alabama	Cleburne	0.49	0.27	0.24	Sandy	21.1	Warm Moist
Alabama	Coffee	0.52	0.24	0.25	Sandy	32.1	Warm Moist
Alabama	Colbert	0.50	0.24	0.26	Sandy	25.7	Warm Moist
Alabama	Conecuh	0.51	0.24	0.25	Sandy	32.0	Warm Moist
Alabama	Coosa	0.42	0.28	0.30	Clayey	23.1	Warm Moist
Alabama	Covington	0.51	0.24	0.24	Sandy	32.8	Warm Moist
Alabama	Crenshaw	0.48	0.24	0.28	Sandy	26.7	Warm Moist
Alabama	Cullman	0.50	0.26	0.24	Sandy	24.7	Warm Moist
Alabama	Dale	0.52	0.23	0.25	Sandy	30.8	Warm Moist
Alabama	Dallas	0.39	0.27	0.34	Clayey	27.6	Warm Moist
Alabama	DeKalb	0.49	0.27	0.24	Sandy	24.7	Warm Moist
Alabama	Elmore	0.37	0.29	0.34	Clayey	25.0	Warm Moist
Alabama	Escambia	0.51	0.25	0.24	Sandy	39.3	Warm Moist
Alabama	Etowah	0.49	0.27	0.24	Sandy	23.1	Warm Moist
Alabama	Fayette	0.51	0.24	0.25	Sandy	25.9	Warm Moist
Alabama	Franklin	0.51	0.24	0.25	Sandy	25.6	Warm Moist
Alabama	Geneva	0.51	0.25	0.24	Sandy	37.4	Warm Moist
Alabama	Greene	0.44	0.26	0.30	Clayey	27.9	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Alabama	Hale	0.41	0.27	0.32	Clayey	27.8	Warm Moist
Alabama	Henry	0.53	0.22	0.25	Sandy	27.0	Warm Moist
Alabama	Houston	0.52	0.23	0.25	Sandy	34.2	Warm Moist
Alabama	Jackson	0.50	0.26	0.24	Sandy	26.7	Warm Moist
Alabama	Jefferson	0.50	0.26	0.25	Sandy	23.6	Warm Moist
Alabama	Lamar	0.52	0.24	0.25	Sandy	26.1	Warm Moist
Alabama	Lauderdale	0.49	0.25	0.26	Sandy	26.1	Warm Moist
Alabama	Lawrence	0.51	0.25	0.24	Sandy	26.0	Warm Moist
Alabama	Lee	0.46	0.28	0.27	Silty	22.3	Warm Moist
Alabama	Limestone	0.51	0.25	0.24	Sandy	26.4	Warm Moist
Alabama	Lowndes	0.39	0.27	0.33	Clayey	26.9	Warm Moist
Alabama	Macon	0.43	0.28	0.29	Clayey	24.0	Warm Moist
Alabama	Madison	0.50	0.26	0.24	Sandy	26.2	Warm Moist
Alabama	Marengo	0.43	0.26	0.31	Clayey	28.8	Warm Moist
Alabama	Marion	0.52	0.24	0.25	Sandy	25.7	Warm Moist
Alabama	Marshall	0.49	0.27	0.24	Sandy	24.3	Warm Moist
Alabama	Mobile	0.47	0.28	0.25	Silty	61.6	Warm Moist
Alabama	Monroe	0.52	0.23	0.26	Sandy	30.8	Warm Moist
Alabama	Montgomery	0.40	0.28	0.33	Clayey	25.9	Warm Moist
Alabama	Morgan	0.50	0.26	0.24	Sandy	25.5	Warm Moist
Alabama	Perry	0.40	0.27	0.33	Clayey	27.3	Warm Moist
Alabama	Pickens	0.50	0.24	0.26	Sandy	27.0	Warm Moist
Alabama	Pike	0.50	0.24	0.27	Sandy	26.1	Warm Moist
Alabama	Randolph	0.48	0.27	0.25	Sandy	20.1	Warm Moist
Alabama	Russell	0.49	0.26	0.25	Sandy	23.1	Warm Moist
Alabama	Shelby	0.46	0.27	0.27	Sandy	22.9	Warm Moist
Alabama	St. Clair	0.49	0.27	0.24	Sandy	22.0	Warm Moist
Alabama	Sumter	0.46	0.26	0.27	Sandy	28.3	Warm Moist
Alabama	Talladega	0.48	0.27	0.25	Sandy	20.8	Warm Moist
Alabama	Tallapoosa	0.43	0.28	0.29	Clayey	22.6	Warm Moist
Alabama	Tuscaloosa	0.49	0.25	0.26	Sandy	26.0	Warm Moist
Alabama	Walker	0.50	0.25	0.24	Sandy	24.9	Warm Moist
Alabama	Washington	0.52	0.23	0.25	Sandy	37.1	Warm Moist
Alabama	Wilcox	0.46	0.25	0.30	Sandy	28.6	Warm Moist
Alabama	Winston	0.51	0.25	0.24	Sandy	25.5	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Arizona	Apache	0.41	0.38	0.21	Silty	14.4	Warm Dry
Arizona	Cochise	0.61	0.22	0.17	Sandy	17.6	Warm Dry
Arizona	Coconino	0.40	0.38	0.21	Silty	15.3	Warm Dry
Arizona	Gila	0.52	0.28	0.19	Silty	16.1	Warm Dry
Arizona	Graham	0.55	0.26	0.19	Sandy	15.7	Warm Dry
Arizona	Greenlee	0.48	0.31	0.21	Silty	16.0	Warm Dry
Arizona	La Paz	0.78	0.11	0.11	Sandy	6.9	Warm Dry
Arizona	Maricopa	0.74	0.14	0.12	Sandy	9.6	Warm Dry
Arizona	Mohave	0.61	0.23	0.16	Sandy	12.7	Warm Dry
Arizona	Navajo	0.40	0.39	0.21	Silty	13.9	Warm Dry
Arizona	Pima	0.68	0.17	0.14	Sandy	13.0	Warm Dry
Arizona	Pinal	0.72	0.15	0.14	Sandy	11.9	Warm Dry
Arizona	Santa Cruz	0.64	0.19	0.17	Sandy	19.0	Warm Dry
Arizona	Yavapai	0.61	0.22	0.17	Sandy	16.0	Warm Dry
Arizona	Yuma	0.70	0.20	0.10	Sandy	7.6	Warm Dry
Arkansas	Arkansas	0.36	0.26	0.37	Clayey	29.8	Warm Moist
Arkansas	Ashley	0.42	0.26	0.32	Clayey	31.5	Warm Moist
Arkansas	Baxter	0.51	0.25	0.25	Sandy	25.5	Warm Moist
Arkansas	Benton	0.48	0.27	0.25	Sandy	31.3	Warm Moist
Arkansas	Boone	0.51	0.24	0.25	Sandy	26.0	Warm Moist
Arkansas	Bradley	0.46	0.25	0.29	Sandy	31.1	Warm Moist
Arkansas	Calhoun	0.50	0.25	0.25	Sandy	30.4	Warm Moist
Arkansas	Carroll	0.52	0.23	0.25	Sandy	27.5	Warm Moist
Arkansas	Chicot	0.36	0.27	0.37	Clayey	31.4	Warm Moist
Arkansas	Clark	0.50	0.26	0.24	Sandy	27.4	Warm Moist
Arkansas	Clay	0.48	0.29	0.23	Silty	31.4	Warm Moist
Arkansas	Cleburne	0.45	0.27	0.28	Clayey	25.9	Warm Moist
Arkansas	Cleveland	0.46	0.25	0.29	Sandy	29.4	Warm Moist
Arkansas	Columbia	0.50	0.26	0.24	Sandy	29.8	Warm Moist
Arkansas	Conway	0.48	0.27	0.24	Sandy	24.5	Warm Moist
Arkansas	Craighead	0.40	0.29	0.32	Clayey	29.0	Warm Moist
Arkansas	Crawford	0.43	0.33	0.24	Silty	26.6	Warm Moist
Arkansas	Crittenden	0.22	0.29	0.49	Clayey	27.3	Warm Moist
Arkansas	Cross	0.28	0.28	0.44	Clayey	27.9	Warm Moist
Arkansas	Dallas	0.50	0.25	0.25	Sandy	29.0	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Arkansas	Desha	0.36	0.26	0.38	Clayey	30.7	Warm Moist
Arkansas	Drew	0.41	0.26	0.33	Clayey	31.0	Warm Moist
Arkansas	Faulkner	0.47	0.27	0.26	Sandy	25.6	Warm Moist
Arkansas	Franklin	0.44	0.32	0.24	Silty	25.0	Warm Moist
Arkansas	Fulton	0.50	0.26	0.24	Sandy	27.1	Warm Moist
Arkansas	Garland	0.49	0.27	0.24	Sandy	24.7	Warm Moist
Arkansas	Grant	0.50	0.25	0.25	Sandy	27.5	Warm Moist
Arkansas	Greene	0.46	0.28	0.26	Silty	29.6	Warm Moist
Arkansas	Hempstead	0.49	0.27	0.24	Sandy	27.7	Warm Moist
Arkansas	Hot Spring	0.50	0.26	0.24	Sandy	25.6	Warm Moist
Arkansas	Howard	0.48	0.28	0.24	Silty	25.3	Warm Moist
Arkansas	Independence	0.43	0.27	0.30	Clayey	27.2	Warm Moist
Arkansas	Izard	0.49	0.26	0.25	Sandy	26.5	Warm Moist
Arkansas	Jackson	0.36	0.28	0.37	Clayey	28.1	Warm Moist
Arkansas	Jefferson	0.43	0.26	0.32	Clayey	28.9	Warm Moist
Arkansas	Johnson	0.46	0.30	0.24	Silty	24.3	Warm Moist
Arkansas	Lafayette	0.49	0.27	0.24	Sandy	29.2	Warm Moist
Arkansas	Lawrence	0.42	0.28	0.30	Clayey	28.4	Warm Moist
Arkansas	Lee	0.32	0.27	0.41	Clayey	28.3	Warm Moist
Arkansas	Lincoln	0.41	0.26	0.33	Clayey	30.1	Warm Moist
Arkansas	Little River	0.48	0.28	0.24	Silty	27.9	Warm Moist
Arkansas	Logan	0.44	0.32	0.24	Silty	23.8	Warm Moist
Arkansas	Lonoke	0.42	0.26	0.32	Clayey	27.7	Warm Moist
Arkansas	Madison	0.50	0.26	0.25	Sandy	26.0	Warm Moist
Arkansas	Marion	0.51	0.24	0.25	Sandy	25.3	Warm Moist
Arkansas	Miller	0.49	0.27	0.24	Sandy	28.8	Warm Moist
Arkansas	Mississippi	0.31	0.30	0.39	Clayey	28.8	Warm Moist
Arkansas	Monroe	0.34	0.27	0.39	Clayey	29.3	Warm Moist
Arkansas	Montgomery	0.48	0.28	0.24	Silty	23.3	Warm Moist
Arkansas	Nevada	0.50	0.26	0.24	Sandy	28.4	Warm Moist
Arkansas	Newton	0.50	0.26	0.24	Sandy	24.9	Warm Moist
Arkansas	Ouachita	0.50	0.25	0.24	Sandy	29.6	Warm Moist
Arkansas	Perry	0.48	0.27	0.24	Sandy	24.9	Warm Moist
Arkansas	Phillips	0.34	0.27	0.39	Clayey	28.5	Warm Moist
Arkansas	Pike	0.49	0.27	0.24	Sandy	24.5	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Arkansas	Poinsett	0.30	0.29	0.41	Clayey	28.2	Warm Moist
Arkansas	Polk	0.46	0.30	0.24	Silty	23.4	Warm Moist
Arkansas	Pope	0.47	0.29	0.24	Silty	24.3	Warm Moist
Arkansas	Prairie	0.37	0.27	0.36	Clayey	28.3	Warm Moist
Arkansas	Pulaski	0.46	0.26	0.28	Sandy	27.2	Warm Moist
Arkansas	Randolph	0.48	0.28	0.24	Silty	29.3	Warm Moist
Arkansas	Saline	0.49	0.26	0.25	Sandy	26.1	Warm Moist
Arkansas	Scott	0.44	0.32	0.24	Silty	24.0	Warm Moist
Arkansas	Searcy	0.50	0.26	0.24	Sandy	24.7	Warm Moist
Arkansas	Sebastian	0.41	0.35	0.24	Silty	25.3	Warm Dry
Arkansas	Sevier	0.48	0.28	0.24	Silty	25.4	Warm Moist
Arkansas	Sharp	0.47	0.27	0.26	Sandy	28.0	Warm Moist
Arkansas	St. Francis	0.30	0.28	0.42	Clayey	28.1	Warm Moist
Arkansas	Stone	0.48	0.26	0.26	Sandy	25.5	Warm Moist
Arkansas	Union	0.50	0.26	0.25	Sandy	31.0	Warm Moist
Arkansas	Van Buren	0.48	0.27	0.25	Sandy	24.8	Warm Moist
Arkansas	Washington	0.47	0.28	0.25	Silty	28.6	Warm Moist
Arkansas	White	0.39	0.27	0.33	Clayey	27.0	Warm Moist
Arkansas	Woodruff	0.31	0.28	0.41	Clayey	28.3	Warm Moist
Arkansas	Yell	0.46	0.30	0.24	Silty	23.7	Warm Moist
California	Alameda	0.40	0.36	0.23	Silty	46.5	Warm Dry
California	Alpine	0.46	0.31	0.23	Silty	34.8	Cool Moist
California	Amador	0.45	0.32	0.23	Silty	42.5	Warm Dry
California	Butte	0.45	0.32	0.23	Silty	38.3	Warm Dry
California	Calaveras	0.45	0.31	0.24	Silty	47.2	Warm Dry
California	Colusa	0.42	0.35	0.23	Silty	39.6	Warm Dry
California	Contra Costa	0.40	0.36	0.23	Silty	53.7	Warm Dry
California	Del Norte	0.46	0.30	0.24	Silty	61.6	Cool Moist
California	El Dorado	0.43	0.35	0.22	Silty	39.1	Cool Moist
California	Fresno	0.42	0.30	0.28	Clayey	28.7	Warm Dry
California	Glenn	0.45	0.32	0.24	Silty	39.0	Warm Dry
California	Humboldt	0.46	0.30	0.24	Silty	56.7	Warm Moist
California	Imperial	0.67	0.20	0.13	Sandy	10.9	Warm Dry
California	Inyo	0.53	0.25	0.22	Sandy	10.5	Warm Dry
California	Kern	0.43	0.27	0.30	Clayey	20.1	Warm Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
California	Kings	0.34	0.32	0.34	Clayey	29.5	Warm Dry
California	Lake	0.43	0.34	0.24	Silty	45.6	Warm Moist
California	Lassen	0.47	0.30	0.24	Silty	28.3	Cool Dry
California	Los Angeles	0.53	0.25	0.21	Sandy	19.8	Warm Dry
California	Madera	0.46	0.29	0.25	Silty	30.7	Warm Dry
California	Marin	0.39	0.38	0.23	Silty	59.5	Warm Moist
California	Mariposa	0.47	0.29	0.24	Silty	34.3	Warm Dry
California	Mendocino	0.45	0.31	0.24	Silty	50.4	Warm Moist
California	Merced	0.44	0.32	0.24	Silty	34.8	Warm Dry
California	Modoc	0.42	0.34	0.23	Silty	34.0	Cool Dry
California	Mono	0.49	0.28	0.23	Silty	28.0	Cool Dry
California	Monterey	0.39	0.37	0.25	Silty	38.6	Warm Dry
California	Napa	0.40	0.36	0.23	Silty	52.4	Warm Dry
California	Nevada	0.41	0.37	0.22	Silty	38.2	Warm Moist
California	Orange	0.49	0.30	0.21	Silty	20.8	Warm Dry
California	Placer	0.42	0.36	0.22	Silty	37.9	Cool Moist
California	Plumas	0.48	0.28	0.23	Silty	33.4	Cool Moist
California	Riverside	0.68	0.18	0.14	Sandy	10.4	Warm Dry
California	Sacramento	0.42	0.35	0.23	Silty	52.3	Warm Dry
California	San Benito	0.39	0.36	0.25	Silty	37.0	Warm Dry
California	San Bernardino	0.74	0.13	0.13	Sandy	8.3	Warm Dry
California	San Diego	0.53	0.28	0.19	Sandy	17.2	Warm Dry
California	San Francisco	0.39	0.38	0.23	Silty	51.5	Warm Dry
California	San Joaquin	0.43	0.34	0.23	Silty	48.8	Warm Dry
California	San Luis Obispo	0.36	0.35	0.30	Clayey	34.1	Warm Dry
California	San Mateo	0.39	0.37	0.23	Silty	40.1	Warm Dry
California	Santa Barbara	0.37	0.35	0.28	Clayey	32.8	Warm Dry
California	Santa Clara	0.41	0.35	0.23	Silty	36.6	Warm Dry
California	Santa Cruz	0.40	0.37	0.23	Silty	37.0	Warm Dry
California	Shasta	0.48	0.28	0.24	Silty	37.0	Warm Moist
California	Sierra	0.46	0.32	0.22	Silty	31.5	Cool Moist
California	Siskiyou	0.47	0.29	0.24	Silty	46.5	Cool Moist
California	Solano	0.41	0.36	0.23	Silty	54.7	Warm Dry
California	Sonoma	0.41	0.36	0.23	Silty	56.0	Warm Moist
California	Stanislaus	0.44	0.33	0.24	Silty	39.8	Warm Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
California	Sutter	0.41	0.37	0.22	Silty	40.0	Warm Dry
California	Tehama	0.48	0.28	0.24	Silty	39.0	Warm Dry
California	Trinity	0.47	0.29	0.24	Silty	45.5	Cool Moist
California	Tulare	0.39	0.28	0.33	Clayey	21.4	Warm Dry
California	Tuolumne	0.47	0.29	0.24	Silty	38.5	Cool Moist
California	Ventura	0.40	0.33	0.27	Silty	25.6	Warm Dry
California	Yolo	0.41	0.36	0.23	Silty	48.1	Warm Dry
California	Yuba	0.42	0.36	0.22	Silty	38.3	Warm Dry
Colorado	Adams	0.37	0.41	0.22	Silty	35.3	Cool Dry
Colorado	Alamosa	0.38	0.43	0.19	Silty	46.5	Cool Dry
Colorado	Arapahoe	0.38	0.40	0.21	Silty	35.4	Cool Dry
Colorado	Archuleta	0.40	0.40	0.19	Silty	59.0	Cool Moist
Colorado	Baca	0.56	0.21	0.23	Sandy	25.0	Warm Dry
Colorado	Bent	0.55	0.23	0.23	Sandy	23.7	Warm Dry
Colorado	Boulder	0.37	0.43	0.21	Silty	38.3	Cool Dry
Colorado	Broomfield	0.37	0.43	0.21	Silty	37.9	Cool Dry
Colorado	Chaffee	0.37	0.44	0.19	Silty	41.3	Cool Dry
Colorado	Cheyenne	0.49	0.28	0.23	Silty	29.8	Warm Dry
Colorado	Clear Creek	0.37	0.43	0.20	Silty	38.2	Cool Moist
Colorado	Conejos	0.38	0.43	0.19	Silty	51.6	Cool Dry
Colorado	Costilla	0.37	0.43	0.19	Silty	37.3	Cool Dry
Colorado	Crowley	0.51	0.28	0.21	Silty	24.8	Warm Dry
Colorado	Custer	0.40	0.41	0.19	Silty	34.5	Cool Dry
Colorado	Delta	0.39	0.40	0.21	Silty	34.3	Cool Dry
Colorado	Denver	0.37	0.42	0.21	Silty	37.0	Cool Dry
Colorado	Dolores	0.42	0.36	0.21	Silty	40.6	Cool Dry
Colorado	Douglas	0.38	0.43	0.20	Silty	37.5	Cool Dry
Colorado	Eagle	0.37	0.43	0.20	Silty	35.1	Cool Moist
Colorado	El Paso	0.42	0.38	0.20	Silty	32.6	Cool Dry
Colorado	Elbert	0.42	0.37	0.21	Silty	34.7	Cool Dry
Colorado	Fremont	0.39	0.42	0.19	Silty	37.4	Cool Dry
Colorado	Garfield	0.36	0.42	0.21	Silty	28.8	Cool Dry
Colorado	Gilpin	0.37	0.43	0.21	Silty	38.7	Cool Moist
Colorado	Grand	0.37	0.43	0.21	Silty	39.2	Cool Moist
Colorado	Gunnison	0.38	0.42	0.20	Silty	44.7	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Colorado	Hinsdale	0.41	0.40	0.20	Silty	61.6	Cool Moist
Colorado	Huerfano	0.40	0.40	0.19	Silty	29.8	Cool Dry
Colorado	Jackson	0.37	0.41	0.21	Silty	36.4	Cool Moist
Colorado	Jefferson	0.37	0.43	0.20	Silty	38.0	Cool Dry
Colorado	Kiowa	0.54	0.23	0.23	Sandy	25.9	Warm Dry
Colorado	Kit Carson	0.44	0.33	0.23	Silty	32.2	Cool Dry
Colorado	La Plata	0.43	0.38	0.19	Silty	51.3	Cool Dry
Colorado	Lake	0.37	0.44	0.19	Silty	34.4	Cool Moist
Colorado	Larimer	0.36	0.42	0.21	Silty	35.9	Cool Dry
Colorado	Las Animas	0.46	0.33	0.20	Silty	26.3	Warm Dry
Colorado	Lincoln	0.47	0.31	0.22	Silty	30.9	Cool Dry
Colorado	Logan	0.36	0.41	0.23	Silty	32.4	Cool Dry
Colorado	Mesa	0.40	0.39	0.22	Silty	27.4	Cool Dry
Colorado	Mineral	0.39	0.41	0.19	Silty	60.0	Cool Moist
Colorado	Moffat	0.41	0.35	0.23	Silty	24.3	Cool Dry
Colorado	Montezuma	0.43	0.37	0.20	Silty	33.1	Cool Dry
Colorado	Montrose	0.41	0.37	0.22	Silty	39.9	Cool Dry
Colorado	Morgan	0.36	0.41	0.23	Silty	32.6	Cool Dry
Colorado	Otero	0.51	0.28	0.21	Silty	23.4	Warm Dry
Colorado	Ouray	0.41	0.38	0.21	Silty	54.3	Cool Dry
Colorado	Park	0.37	0.44	0.19	Silty	37.0	Cool Dry
Colorado	Phillips	0.37	0.40	0.23	Silty	32.9	Cool Dry
Colorado	Pitkin	0.37	0.43	0.20	Silty	31.6	Cool Moist
Colorado	Prowers	0.57	0.19	0.24	Sandy	24.7	Warm Dry
Colorado	Pueblo	0.46	0.34	0.20	Silty	26.2	Warm Dry
Colorado	Rio Blanco	0.37	0.41	0.22	Silty	28.9	Cool Dry
Colorado	Rio Grande	0.37	0.44	0.19	Silty	55.9	Cool Dry
Colorado	Routt	0.38	0.40	0.22	Silty	34.3	Cool Moist
Colorado	Saguache	0.38	0.43	0.19	Silty	51.3	Cool Dry
Colorado	San Juan	0.42	0.38	0.20	Silty	59.1	Cool Moist
Colorado	San Miguel	0.42	0.36	0.22	Silty	41.6	Cool Dry
Colorado	Sedgwick	0.39	0.39	0.22	Silty	32.5	Cool Dry
Colorado	Summit	0.37	0.43	0.20	Silty	37.5	Cool Moist
Colorado	Teller	0.38	0.43	0.19	Silty	35.8	Cool Moist
Colorado	Washington	0.38	0.39	0.23	Silty	32.8	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Colorado	Weld	0.36	0.42	0.22	Silty	33.6	Cool Dry
Colorado	Yuma	0.37	0.40	0.23	Silty	33.4	Warm Dry
Connecticut	Fairfield	0.49	0.32	0.19	Silty	73.5	Cool Moist
Connecticut	Hartford	0.77	0.15	0.08	Sandy	97.4	Cool Moist
Connecticut	Litchfield	0.67	0.21	0.12	Sandy	86.8	Cool Moist
Connecticut	Middlesex	0.67	0.22	0.11	Sandy	90.7	Cool Moist
Connecticut	New Haven	0.56	0.29	0.16	Sandy	81.6	Cool Moist
Connecticut	New London	0.64	0.24	0.12	Sandy	91.9	Cool Moist
Connecticut	Tolland	0.78	0.15	0.07	Sandy	101.3	Cool Moist
Connecticut	Windham	0.75	0.18	0.08	Sandy	103.8	Cool Moist
Delaware	Kent	0.58	0.24	0.17	Sandy	76.7	Warm Moist
Delaware	New Castle	0.56	0.25	0.19	Sandy	52.6	Warm Moist
Delaware	Sussex	0.49	0.32	0.19	Silty	96.0	Warm Moist
Florida	Alachua	0.81	0.10	0.09	Sandy	76.3	Warm Moist
Florida	Baker	0.74	0.14	0.12	Sandy	93.3	Warm Moist
Florida	Bay	0.64	0.20	0.17	Sandy	57.4	Warm Moist
Florida	Bradford	0.80	0.11	0.09	Sandy	80.9	Warm Moist
Florida	Brevard	0.85	0.10	0.05	Sandy	74.4	Warm Moist
Florida	Broward	0.76	0.15	0.10	Sandy	114.9	Warm Moist
Florida	Calhoun	0.61	0.20	0.20	Sandy	54.1	Warm Moist
Florida	Charlotte	0.82	0.12	0.06	Sandy	67.1	Warm Moist
Florida	Citrus	0.83	0.10	0.07	Sandy	75.5	Warm Moist
Florida	Clay	0.81	0.11	0.08	Sandy	81.6	Warm Moist
Florida	Collier	0.77	0.14	0.09	Sandy	117.7	Warm Moist
Florida	Columbia	0.73	0.14	0.13	Sandy	87.2	Warm Moist
Florida	DeSoto	0.83	0.11	0.05	Sandy	65.0	Warm Moist
Florida	Dixie	0.81	0.11	0.09	Sandy	73.5	Warm Moist
Florida	Duval	0.81	0.12	0.08	Sandy	91.1	Warm Moist
Florida	Escambia	0.46	0.30	0.25	Silty	56.4	Warm Moist
Florida	Flagler	0.84	0.10	0.06	Sandy	74.8	Warm Moist
Florida	Franklin	0.81	0.12	0.07	Sandy	69.8	Warm Moist
Florida	Gadsden	0.57	0.20	0.23	Sandy	54.8	Warm Moist
Florida	Gilchrist	0.79	0.11	0.10	Sandy	76.8	Warm Moist
Florida	Glades	0.81	0.12	0.07	Sandy	80.0	Warm Moist
Florida	Gulf	0.79	0.13	0.08	Sandy	67.5	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Florida	Hamilton	0.66	0.17	0.17	Sandy	83.4	Warm Moist
Florida	Hardee	0.84	0.11	0.05	Sandy	62.9	Warm Moist
Florida	Hendry	0.79	0.13	0.08	Sandy	98.5	Warm Moist
Florida	Hernando	0.84	0.10	0.06	Sandy	73.1	Warm Moist
Florida	Highlands	0.83	0.11	0.06	Sandy	73.5	Warm Moist
Florida	Hillsborough	0.85	0.10	0.05	Sandy	59.5	Warm Moist
Florida	Holmes	0.50	0.25	0.24	Sandy	40.2	Warm Moist
Florida	Indian River	0.84	0.10	0.06	Sandy	71.5	Warm Moist
Florida	Jackson	0.52	0.23	0.25	Sandy	41.6	Warm Moist
Florida	Jefferson	0.61	0.19	0.20	Sandy	61.7	Warm Moist
Florida	Lafayette	0.74	0.14	0.13	Sandy	73.6	Warm Moist
Florida	Lake	0.84	0.10	0.06	Sandy	75.5	Warm Moist
Florida	Lee	0.80	0.12	0.07	Sandy	82.5	Warm Moist
Florida	Leon	0.61	0.19	0.20	Sandy	59.5	Warm Moist
Florida	Levy	0.82	0.10	0.08	Sandy	73.6	Warm Moist
Florida	Liberty	0.65	0.18	0.17	Sandy	58.0	Warm Moist
Florida	Madison	0.63	0.18	0.19	Sandy	71.5	Warm Moist
Florida	Manatee	0.85	0.11	0.05	Sandy	55.9	Warm Moist
Florida	Marion	0.83	0.10	0.07	Sandy	75.8	Warm Moist
Florida	Martin	0.78	0.13	0.08	Sandy	82.1	Warm Moist
Florida	Miami-Dade	0.75	0.15	0.10	Sandy	124.5	Warm Moist
Florida	Monroe	0.75	0.15	0.10	Sandy	129.5	Warm Moist
Florida	Nassau	0.79	0.13	0.08	Sandy	96.8	Warm Moist
Florida	Okaloosa	0.49	0.28	0.23	Silty	48.5	Warm Moist
Florida	Okeechobee	0.82	0.11	0.06	Sandy	75.1	Warm Moist
Florida	Orange	0.85	0.10	0.05	Sandy	74.4	Warm Moist
Florida	Osceola	0.85	0.10	0.05	Sandy	68.8	Warm Moist
Florida	Palm Beach	0.77	0.14	0.09	Sandy	94.5	Warm Moist
Florida	Pasco	0.84	0.10	0.06	Sandy	68.1	Warm Moist
Florida	Pinellas	0.85	0.10	0.05	Sandy	58.7	Warm Moist
Florida	Polk	0.85	0.10	0.04	Sandy	63.5	Warm Moist
Florida	Putnam	0.83	0.10	0.07	Sandy	75.5	Warm Moist
Florida	Santa Rosa	0.48	0.29	0.23	Silty	51.8	Warm Moist
Florida	Sarasota	0.84	0.11	0.05	Sandy	56.2	Warm Moist
Florida	Seminole	0.84	0.10	0.06	Sandy	77.8	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Florida	St. Johns	0.84	0.10	0.06	Sandy	79.8	Warm Moist
Florida	St. Lucie	0.81	0.12	0.07	Sandy	77.7	Warm Moist
Florida	Sumter	0.84	0.10	0.06	Sandy	73.9	Warm Moist
Florida	Suwannee	0.73	0.14	0.13	Sandy	79.3	Warm Moist
Florida	Taylor	0.72	0.14	0.13	Sandy	68.7	Warm Moist
Florida	Union	0.78	0.12	0.10	Sandy	84.2	Warm Moist
Florida	Volusia	0.84	0.10	0.06	Sandy	77.8	Warm Moist
Florida	Wakulla	0.70	0.16	0.14	Sandy	63.5	Warm Moist
Florida	Walton	0.53	0.26	0.21	Sandy	49.0	Warm Moist
Florida	Washington	0.51	0.26	0.23	Sandy	47.6	Warm Moist
Georgia	Appling	0.60	0.22	0.18	Sandy	63.6	Warm Moist
Georgia	Atkinson	0.59	0.22	0.19	Sandy	63.9	Warm Moist
Georgia	Bacon	0.64	0.20	0.15	Sandy	75.9	Warm Moist
Georgia	Baker	0.52	0.23	0.25	Sandy	37.4	Warm Moist
Georgia	Baldwin	0.50	0.26	0.24	Sandy	22.4	Warm Moist
Georgia	Banks	0.49	0.27	0.24	Sandy	25.6	Warm Moist
Georgia	Barrow	0.49	0.27	0.24	Sandy	22.9	Warm Moist
Georgia	Bartow	0.49	0.27	0.24	Sandy	25.1	Warm Moist
Georgia	Ben Hill	0.54	0.25	0.22	Sandy	41.8	Warm Moist
Georgia	Berrien	0.56	0.23	0.21	Sandy	51.7	Warm Moist
Georgia	Bibb	0.50	0.26	0.24	Sandy	22.2	Warm Moist
Georgia	Bleckley	0.51	0.25	0.24	Sandy	28.8	Warm Moist
Georgia	Brantley	0.70	0.17	0.13	Sandy	95.1	Warm Moist
Georgia	Brooks	0.54	0.22	0.24	Sandy	57.8	Warm Moist
Georgia	Bryan	0.62	0.21	0.17	Sandy	74.9	Warm Moist
Georgia	Bulloch	0.59	0.23	0.18	Sandy	59.8	Warm Moist
Georgia	Burke	0.51	0.26	0.22	Sandy	34.4	Warm Moist
Georgia	Butts	0.49	0.27	0.24	Sandy	19.3	Warm Moist
Georgia	Calhoun	0.52	0.23	0.25	Sandy	31.4	Warm Moist
Georgia	Camden	0.80	0.13	0.08	Sandy	104.7	Warm Moist
Georgia	Candler	0.56	0.24	0.20	Sandy	50.6	Warm Moist
Georgia	Carroll	0.49	0.27	0.24	Sandy	20.0	Warm Moist
Georgia	Catoosa	0.50	0.26	0.24	Sandy	28.7	Warm Moist
Georgia	Charlton	0.72	0.15	0.12	Sandy	94.0	Warm Moist
Georgia	Chatham	0.69	0.18	0.13	Sandy	117.9	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Georgia	Chattahoochee	0.50	0.26	0.24	Sandy	22.5	Warm Moist
Georgia	Chattooga	0.49	0.27	0.24	Sandy	26.0	Warm Moist
Georgia	Cherokee	0.49	0.27	0.24	Sandy	25.4	Warm Moist
Georgia	Clarke	0.49	0.27	0.24	Sandy	22.7	Warm Moist
Georgia	Clay	0.53	0.23	0.25	Sandy	27.3	Warm Moist
Georgia	Clayton	0.49	0.27	0.24	Sandy	19.7	Warm Moist
Georgia	Clinch	0.64	0.19	0.17	Sandy	81.2	Warm Moist
Georgia	Cobb	0.49	0.27	0.24	Sandy	22.7	Warm Moist
Georgia	Coffee	0.58	0.23	0.19	Sandy	55.8	Warm Moist
Georgia	Colquitt	0.52	0.24	0.24	Sandy	44.5	Warm Moist
Georgia	Columbia	0.49	0.27	0.24	Sandy	22.7	Warm Moist
Georgia	Cook	0.54	0.23	0.22	Sandy	51.3	Warm Moist
Georgia	Coweta	0.49	0.27	0.24	Sandy	19.5	Warm Moist
Georgia	Crawford	0.51	0.25	0.24	Sandy	22.1	Warm Moist
Georgia	Crisp	0.51	0.25	0.24	Sandy	28.4	Warm Moist
Georgia	Dade	0.50	0.26	0.24	Sandy	27.1	Warm Moist
Georgia	Dawson	0.49	0.27	0.24	Sandy	28.1	Warm Moist
Georgia	DeKalb	0.49	0.27	0.24	Sandy	21.8	Warm Moist
Georgia	Decatur	0.53	0.22	0.25	Sandy	46.4	Warm Moist
Georgia	Dodge	0.52	0.25	0.23	Sandy	33.1	Warm Moist
Georgia	Dooly	0.51	0.25	0.24	Sandy	26.1	Warm Moist
Georgia	Dougherty	0.51	0.24	0.24	Sandy	33.3	Warm Moist
Georgia	Douglas	0.49	0.27	0.24	Sandy	20.8	Warm Moist
Georgia	Early	0.53	0.22	0.25	Sandy	29.4	Warm Moist
Georgia	Echols	0.63	0.19	0.19	Sandy	80.6	Warm Moist
Georgia	Effingham	0.64	0.21	0.16	Sandy	78.1	Warm Moist
Georgia	Elbert	0.49	0.27	0.24	Sandy	22.2	Warm Moist
Georgia	Emanuel	0.52	0.25	0.23	Sandy	38.2	Warm Moist
Georgia	Evans	0.59	0.22	0.19	Sandy	62.7	Warm Moist
Georgia	Fannin	0.50	0.26	0.24	Sandy	32.1	Warm Moist
Georgia	Fayette	0.49	0.27	0.24	Sandy	19.4	Warm Moist
Georgia	Floyd	0.49	0.27	0.24	Sandy	24.8	Warm Moist
Georgia	Forsyth	0.49	0.27	0.24	Sandy	25.7	Warm Moist
Georgia	Franklin	0.49	0.27	0.24	Sandy	24.4	Warm Moist
Georgia	Fulton	0.49	0.27	0.24	Sandy	21.9	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Georgia	Gilmer	0.49	0.26	0.24	Sandy	29.6	Warm Moist
Georgia	Glascock	0.49	0.27	0.24	Sandy	24.2	Warm Moist
Georgia	Glynn	0.76	0.14	0.10	Sandy	113.7	Warm Moist
Georgia	Gordon	0.49	0.27	0.24	Sandy	26.7	Warm Moist
Georgia	Grady	0.53	0.23	0.25	Sandy	49.1	Warm Moist
Georgia	Greene	0.49	0.27	0.24	Sandy	20.6	Warm Moist
Georgia	Gwinnett	0.49	0.27	0.24	Sandy	24.0	Warm Moist
Georgia	Habersham	0.49	0.27	0.24	Sandy	30.4	Warm Moist
Georgia	Hall	0.49	0.27	0.24	Sandy	26.0	Warm Moist
Georgia	Hancock	0.49	0.27	0.24	Sandy	21.8	Warm Moist
Georgia	Haralson	0.49	0.27	0.24	Sandy	21.7	Warm Moist
Georgia	Harris	0.49	0.27	0.24	Sandy	21.2	Warm Moist
Georgia	Hart	0.49	0.27	0.24	Sandy	23.2	Warm Moist
Georgia	Heard	0.49	0.27	0.24	Sandy	19.7	Warm Moist
Georgia	Henry	0.49	0.27	0.24	Sandy	19.6	Warm Moist
Georgia	Houston	0.51	0.25	0.24	Sandy	24.5	Warm Moist
Georgia	Irwin	0.54	0.24	0.21	Sandy	44.8	Warm Moist
Georgia	Jackson	0.49	0.27	0.24	Sandy	23.8	Warm Moist
Georgia	Jasper	0.49	0.27	0.24	Sandy	19.8	Warm Moist
Georgia	Jeff Davis	0.59	0.23	0.18	Sandy	55.4	Warm Moist
Georgia	Jefferson	0.50	0.26	0.24	Sandy	29.9	Warm Moist
Georgia	Jenkins	0.53	0.25	0.22	Sandy	39.7	Warm Moist
Georgia	Johnson	0.50	0.26	0.24	Sandy	30.5	Warm Moist
Georgia	Jones	0.50	0.26	0.24	Sandy	21.0	Warm Moist
Georgia	Lamar	0.49	0.26	0.24	Sandy	20.2	Warm Moist
Georgia	Lanier	0.59	0.21	0.20	Sandy	67.1	Warm Moist
Georgia	Laurens	0.51	0.25	0.23	Sandy	32.5	Warm Moist
Georgia	Lee	0.51	0.25	0.24	Sandy	29.2	Warm Moist
Georgia	Liberty	0.70	0.17	0.13	Sandy	114.7	Warm Moist
Georgia	Lincoln	0.49	0.27	0.24	Sandy	22.3	Warm Moist
Georgia	Long	0.69	0.18	0.13	Sandy	105.2	Warm Moist
Georgia	Lowndes	0.58	0.21	0.21	Sandy	67.1	Warm Moist
Georgia	Lumpkin	0.49	0.27	0.24	Sandy	28.8	Warm Moist
Georgia	Macon	0.51	0.25	0.24	Sandy	23.6	Warm Moist
Georgia	Madison	0.49	0.27	0.24	Sandy	23.1	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Georgia	Marion	0.50	0.25	0.24	Sandy	23.7	Warm Moist
Georgia	McDuffie	0.49	0.27	0.24	Sandy	24.6	Warm Moist
Georgia	McIntosh	0.75	0.14	0.10	Sandy	128.5	Warm Moist
Georgia	Meriwether	0.49	0.27	0.24	Sandy	20.4	Warm Moist
Georgia	Miller	0.53	0.22	0.25	Sandy	35.1	Warm Moist
Georgia	Mitchell	0.52	0.24	0.25	Sandy	39.6	Warm Moist
Georgia	Monroe	0.50	0.26	0.24	Sandy	20.7	Warm Moist
Georgia	Montgomery	0.55	0.24	0.21	Sandy	46.1	Warm Moist
Georgia	Morgan	0.49	0.27	0.24	Sandy	20.1	Warm Moist
Georgia	Murray	0.50	0.26	0.24	Sandy	28.3	Warm Moist
Georgia	Muscogee	0.49	0.27	0.25	Sandy	22.1	Warm Moist
Georgia	Newton	0.49	0.27	0.24	Sandy	19.9	Warm Moist
Georgia	Oconee	0.49	0.27	0.24	Sandy	22.7	Warm Moist
Georgia	Oglethorpe	0.49	0.27	0.24	Sandy	21.8	Warm Moist
Georgia	Paulding	0.49	0.27	0.24	Sandy	22.5	Warm Moist
Georgia	Peach	0.51	0.25	0.24	Sandy	23.7	Warm Moist
Georgia	Pickens	0.49	0.27	0.24	Sandy	27.4	Warm Moist
Georgia	Pierce	0.67	0.19	0.14	Sandy	86.7	Warm Moist
Georgia	Pike	0.49	0.26	0.24	Sandy	20.5	Warm Moist
Georgia	Polk	0.49	0.27	0.24	Sandy	23.2	Warm Moist
Georgia	Pulaski	0.51	0.25	0.24	Sandy	28.7	Warm Moist
Georgia	Putnam	0.49	0.27	0.24	Sandy	20.8	Warm Moist
Georgia	Quitman	0.52	0.23	0.25	Sandy	25.2	Warm Moist
Georgia	Rabun	0.49	0.27	0.24	Sandy	35.5	Warm Moist
Georgia	Randolph	0.52	0.23	0.25	Sandy	26.0	Warm Moist
Georgia	Richmond	0.49	0.27	0.23	Sandy	27.4	Warm Moist
Georgia	Rockdale	0.49	0.27	0.24	Sandy	20.9	Warm Moist
Georgia	Schley	0.51	0.25	0.24	Sandy	25.3	Warm Moist
Georgia	Screven	0.55	0.25	0.20	Sandy	45.9	Warm Moist
Georgia	Seminole	0.53	0.22	0.25	Sandy	40.8	Warm Moist
Georgia	Spalding	0.49	0.27	0.24	Sandy	19.8	Warm Moist
Georgia	Stephens	0.49	0.27	0.24	Sandy	27.1	Warm Moist
Georgia	Stewart	0.51	0.25	0.24	Sandy	24.2	Warm Moist
Georgia	Sumter	0.51	0.25	0.24	Sandy	27.2	Warm Moist
Georgia	Talbot	0.50	0.26	0.24	Sandy	21.7	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Georgia	Taliaferro	0.49	0.27	0.24	Sandy	21.1	Warm Moist
Georgia	Tattnall	0.61	0.22	0.18	Sandy	68.6	Warm Moist
Georgia	Taylor	0.50	0.26	0.24	Sandy	21.9	Warm Moist
Georgia	Telfair	0.55	0.24	0.21	Sandy	45.8	Warm Moist
Georgia	Terrell	0.52	0.24	0.25	Sandy	27.6	Warm Moist
Georgia	Thomas	0.52	0.23	0.25	Sandy	51.8	Warm Moist
Georgia	Tift	0.52	0.25	0.23	Sandy	40.1	Warm Moist
Georgia	Toombs	0.56	0.24	0.20	Sandy	50.2	Warm Moist
Georgia	Towns	0.49	0.27	0.24	Sandy	35.9	Warm Moist
Georgia	Treutlen	0.51	0.25	0.23	Sandy	35.1	Warm Moist
Georgia	Troup	0.48	0.27	0.25	Sandy	20.4	Warm Moist
Georgia	Turner	0.51	0.25	0.23	Sandy	35.0	Warm Moist
Georgia	Twiggs	0.50	0.25	0.24	Sandy	25.8	Warm Moist
Georgia	Union	0.49	0.27	0.24	Sandy	32.2	Warm Moist
Georgia	Upson	0.50	0.26	0.24	Sandy	21.1	Warm Moist
Georgia	Walker	0.50	0.26	0.24	Sandy	27.5	Warm Moist
Georgia	Walton	0.49	0.27	0.24	Sandy	21.9	Warm Moist
Georgia	Ware	0.67	0.18	0.15	Sandy	83.6	Warm Moist
Georgia	Warren	0.49	0.27	0.24	Sandy	22.1	Warm Moist
Georgia	Washington	0.50	0.26	0.24	Sandy	25.8	Warm Moist
Georgia	Wayne	0.68	0.18	0.13	Sandy	97.0	Warm Moist
Georgia	Webster	0.51	0.24	0.24	Sandy	26.0	Warm Moist
Georgia	Wheeler	0.54	0.25	0.22	Sandy	41.9	Warm Moist
Georgia	White	0.49	0.27	0.24	Sandy	30.4	Warm Moist
Georgia	Whitfield	0.50	0.26	0.24	Sandy	29.9	Warm Moist
Georgia	Wilcox	0.52	0.25	0.23	Sandy	34.6	Warm Moist
Georgia	Wilkes	0.49	0.27	0.24	Sandy	21.7	Warm Moist
Georgia	Wilkinson	0.50	0.26	0.24	Sandy	24.1	Warm Moist
Georgia	Worth	0.51	0.25	0.24	Sandy	33.0	Warm Moist
Idaho	Ada	0.47	0.30	0.24	Silty	35.0	Warm Dry
Idaho	Adams	0.36	0.41	0.24	Silty	41.6	Cool Moist
Idaho	Bannock	0.36	0.42	0.22	Silty	42.8	Cool Dry
Idaho	Bear Lake	0.35	0.44	0.21	Silty	43.7	Cool Dry
Idaho	Benewah	0.38	0.42	0.20	Silty	59.0	Cool Moist
Idaho	Bingham	0.38	0.39	0.22	Silty	39.1	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Idaho	Blaine	0.44	0.33	0.24	Silty	33.8	Cool Dry
Idaho	Boise	0.45	0.32	0.23	Silty	41.3	Cool Moist
Idaho	Bonner	0.44	0.42	0.13	Silty	54.3	Cool Moist
Idaho	Bonneville	0.37	0.42	0.22	Silty	43.0	Cool Dry
Idaho	Boundary	0.51	0.39	0.11	Silty	58.1	Cool Moist
Idaho	Butte	0.38	0.39	0.23	Silty	34.2	Cool Dry
Idaho	Camas	0.49	0.27	0.24	Sandy	35.7	Cool Dry
Idaho	Canyon	0.43	0.34	0.23	Silty	33.7	Warm Dry
Idaho	Caribou	0.36	0.43	0.21	Silty	46.8	Cool Dry
Idaho	Cassia	0.40	0.37	0.23	Silty	31.4	Cool Dry
Idaho	Clark	0.38	0.40	0.22	Silty	43.4	Cool Dry
Idaho	Clearwater	0.42	0.42	0.15	Silty	61.2	Cool Moist
Idaho	Custer	0.40	0.39	0.21	Silty	36.0	Cool Dry
Idaho	Elmore	0.50	0.26	0.24	Sandy	34.5	Cool Dry
Idaho	Franklin	0.35	0.44	0.21	Silty	43.5	Cool Dry
Idaho	Fremont	0.37	0.41	0.22	Silty	43.2	Cool Moist
Idaho	Gem	0.44	0.32	0.23	Silty	39.9	Cool Dry
Idaho	Gooding	0.55	0.21	0.24	Sandy	27.6	Cool Dry
Idaho	Idaho	0.40	0.42	0.18	Silty	48.3	Cool Moist
Idaho	Jefferson	0.37	0.40	0.23	Silty	37.2	Cool Dry
Idaho	Jerome	0.51	0.25	0.24	Sandy	27.2	Cool Dry
Idaho	Kootenai	0.40	0.42	0.19	Silty	56.8	Cool Moist
Idaho	Latah	0.38	0.42	0.19	Silty	60.2	Cool Moist
Idaho	Lemhi	0.42	0.41	0.16	Silty	39.0	Cool Dry
Idaho	Lewis	0.38	0.42	0.20	Silty	59.1	Cool Moist
Idaho	Lincoln	0.51	0.26	0.24	Sandy	28.2	Cool Dry
Idaho	Madison	0.37	0.41	0.22	Silty	40.3	Cool Dry
Idaho	Minidoka	0.47	0.30	0.23	Silty	29.0	Cool Dry
Idaho	Nez Perce	0.37	0.42	0.21	Silty	56.0	Cool Dry
Idaho	Oneida	0.36	0.42	0.22	Silty	41.0	Cool Dry
Idaho	Owyhee	0.44	0.33	0.23	Silty	26.3	Cool Dry
Idaho	Payette	0.42	0.35	0.23	Silty	37.0	Cool Dry
Idaho	Power	0.39	0.39	0.22	Silty	39.0	Cool Dry
Idaho	Shoshone	0.43	0.42	0.15	Silty	61.0	Cool Moist
Idaho	Teton	0.37	0.42	0.22	Silty	42.3	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Idaho	Twin Falls	0.44	0.33	0.23	Silty	28.2	Cool Dry
Idaho	Valley	0.39	0.40	0.21	Silty	38.6	Cool Moist
Idaho	Washington	0.38	0.38	0.23	Silty	38.7	Cool Dry
Illinois	Adams	0.46	0.33	0.21	Silty	48.8	Warm Moist
Illinois	Alexander	0.46	0.30	0.24	Silty	34.2	Warm Moist
Illinois	Bond	0.45	0.34	0.22	Silty	45.5	Warm Moist
Illinois	Boone	0.38	0.39	0.23	Silty	72.4	Cool Moist
Illinois	Brown	0.45	0.33	0.21	Silty	52.2	Warm Moist
Illinois	Bureau	0.39	0.38	0.23	Silty	68.9	Cool Moist
Illinois	Calhoun	0.46	0.32	0.21	Silty	44.8	Warm Moist
Illinois	Carroll	0.41	0.37	0.23	Silty	62.5	Cool Moist
Illinois	Cass	0.43	0.35	0.22	Silty	57.6	Warm Moist
Illinois	Champaign	0.36	0.41	0.24	Silty	78.5	Warm Moist
Illinois	Christian	0.42	0.36	0.22	Silty	60.5	Warm Moist
Illinois	Clark	0.41	0.38	0.21	Silty	56.1	Warm Moist
Illinois	Clay	0.42	0.37	0.21	Silty	45.4	Warm Moist
Illinois	Clinton	0.43	0.35	0.22	Silty	41.1	Warm Moist
Illinois	Coles	0.40	0.38	0.22	Silty	61.3	Warm Moist
Illinois	Cook	0.36	0.40	0.24	Silty	75.3	Cool Moist
Illinois	Crawford	0.42	0.38	0.20	Silty	46.9	Warm Moist
Illinois	Cumberland	0.42	0.37	0.21	Silty	53.5	Warm Moist
Illinois	De Witt	0.36	0.40	0.24	Silty	79.8	Warm Moist
Illinois	DeKalb	0.36	0.40	0.24	Silty	72.2	Cool Moist
Illinois	Douglas	0.38	0.39	0.23	Silty	68.6	Warm Moist
Illinois	DuPage	0.35	0.41	0.24	Silty	75.0	Cool Moist
Illinois	Edgar	0.38	0.40	0.23	Silty	67.1	Warm Moist
Illinois	Edwards	0.40	0.38	0.22	Silty	40.9	Warm Moist
Illinois	Effingham	0.44	0.36	0.21	Silty	48.8	Warm Moist
Illinois	Fayette	0.44	0.35	0.21	Silty	47.1	Warm Moist
Illinois	Ford	0.35	0.41	0.24	Silty	81.8	Warm Moist
Illinois	Franklin	0.40	0.37	0.23	Silty	36.8	Warm Moist
Illinois	Fulton	0.42	0.36	0.22	Silty	63.2	Warm Moist
Illinois	Gallatin	0.40	0.36	0.23	Silty	35.8	Warm Moist
Illinois	Greene	0.46	0.33	0.21	Silty	49.4	Warm Moist
Illinois	Grundy	0.35	0.41	0.24	Silty	79.8	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Illinois	Hamilton	0.39	0.38	0.23	Silty	37.1	Warm Moist
Illinois	Hancock	0.46	0.33	0.21	Silty	52.9	Warm Moist
Illinois	Hardin	0.41	0.35	0.24	Silty	34.3	Warm Moist
Illinois	Henderson	0.46	0.33	0.21	Silty	55.0	Warm Moist
Illinois	Henry	0.41	0.36	0.22	Silty	63.8	Cool Moist
Illinois	Iroquois	0.35	0.41	0.24	Silty	84.5	Cool Moist
Illinois	Jackson	0.43	0.34	0.24	Silty	35.7	Warm Moist
Illinois	Jasper	0.43	0.37	0.21	Silty	47.8	Warm Moist
Illinois	Jefferson	0.40	0.37	0.22	Silty	38.9	Warm Moist
Illinois	Jersey	0.47	0.32	0.21	Silty	46.0	Warm Moist
Illinois	Jo Daviess	0.41	0.36	0.22	Silty	61.3	Cool Moist
Illinois	Johnson	0.42	0.34	0.24	Silty	34.3	Warm Moist
Illinois	Kane	0.35	0.41	0.24	Silty	73.9	Cool Moist
Illinois	Kankakee	0.35	0.41	0.24	Silty	84.7	Cool Moist
Illinois	Kendall	0.35	0.41	0.24	Silty	76.8	Cool Moist
Illinois	Knox	0.42	0.36	0.22	Silty	64.7	Warm Moist
Illinois	LaSalle	0.35	0.41	0.24	Silty	77.7	Cool Moist
Illinois	Lake	0.37	0.36	0.27	Silty	74.7	Cool Moist
Illinois	Lawrence	0.41	0.38	0.21	Silty	44.5	Warm Moist
Illinois	Lee	0.38	0.39	0.23	Silty	68.2	Cool Moist
Illinois	Livingston	0.35	0.41	0.24	Silty	81.9	Warm Moist
Illinois	Logan	0.38	0.39	0.23	Silty	72.5	Warm Moist
Illinois	Macon	0.38	0.39	0.23	Silty	72.5	Warm Moist
Illinois	Macoupin	0.45	0.34	0.21	Silty	52.3	Warm Moist
Illinois	Madison	0.46	0.32	0.22	Silty	44.1	Warm Moist
Illinois	Marion	0.42	0.36	0.22	Silty	43.8	Warm Moist
Illinois	Marshall	0.39	0.38	0.23	Silty	71.1	Warm Moist
Illinois	Mason	0.41	0.37	0.23	Silty	64.7	Warm Moist
Illinois	Massac	0.43	0.33	0.24	Silty	32.1	Warm Moist
Illinois	McDonough	0.44	0.34	0.22	Silty	57.8	Warm Moist
Illinois	McHenry	0.37	0.39	0.24	Silty	74.2	Cool Moist
Illinois	McLean	0.36	0.40	0.24	Silty	79.6	Warm Moist
Illinois	Menard	0.41	0.36	0.22	Silty	63.3	Warm Moist
Illinois	Mercer	0.44	0.35	0.22	Silty	62.0	Warm Moist
Illinois	Monroe	0.44	0.32	0.24	Silty	35.9	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Illinois	Montgomery	0.45	0.34	0.21	Silty	52.0	Warm Moist
Illinois	Morgan	0.44	0.34	0.22	Silty	55.7	Warm Moist
Illinois	Moultrie	0.38	0.39	0.23	Silty	70.0	Warm Moist
Illinois	Ogle	0.38	0.38	0.23	Silty	67.4	Cool Moist
Illinois	Peoria	0.40	0.37	0.23	Silty	68.9	Warm Moist
Illinois	Perry	0.41	0.35	0.24	Silty	36.1	Warm Moist
Illinois	Piatt	0.36	0.41	0.24	Silty	79.8	Warm Moist
Illinois	Pike	0.46	0.33	0.21	Silty	47.8	Warm Moist
Illinois	Pope	0.42	0.34	0.24	Silty	33.8	Warm Moist
Illinois	Pulaski	0.45	0.31	0.24	Silty	33.8	Warm Moist
Illinois	Putnam	0.37	0.39	0.23	Silty	74.7	Cool Moist
Illinois	Randolph	0.43	0.33	0.24	Silty	35.4	Warm Moist
Illinois	Richland	0.41	0.37	0.21	Silty	44.9	Warm Moist
Illinois	Rock Island	0.43	0.35	0.22	Silty	62.5	Cool Moist
Illinois	Saline	0.40	0.36	0.23	Silty	35.8	Warm Moist
Illinois	Sangamon	0.41	0.36	0.22	Silty	62.9	Warm Moist
Illinois	Schuyler	0.44	0.34	0.22	Silty	56.2	Warm Moist
Illinois	Scott	0.45	0.34	0.22	Silty	52.7	Warm Moist
Illinois	Shelby	0.42	0.36	0.21	Silty	58.0	Warm Moist
Illinois	St. Clair	0.44	0.33	0.23	Silty	38.6	Warm Moist
Illinois	Stark	0.40	0.37	0.23	Silty	67.5	Cool Moist
Illinois	Stephenson	0.40	0.37	0.23	Silty	64.1	Cool Moist
Illinois	Tazewell	0.39	0.38	0.23	Silty	71.1	Warm Moist
Illinois	Union	0.44	0.32	0.24	Silty	34.9	Warm Moist
Illinois	Vermilion	0.35	0.41	0.24	Silty	78.7	Warm Moist
Illinois	Wabash	0.40	0.38	0.22	Silty	42.1	Warm Moist
Illinois	Warren	0.44	0.34	0.22	Silty	60.1	Warm Moist
Illinois	Washington	0.41	0.35	0.23	Silty	37.9	Warm Moist
Illinois	Wayne	0.40	0.38	0.22	Silty	40.9	Warm Moist
Illinois	White	0.39	0.38	0.23	Silty	37.3	Warm Moist
Illinois	Whiteside	0.41	0.37	0.23	Silty	63.3	Cool Moist
Illinois	Will	0.35	0.41	0.24	Silty	80.3	Cool Moist
Illinois	Williamson	0.41	0.36	0.23	Silty	35.8	Warm Moist
Illinois	Winnebago	0.39	0.38	0.23	Silty	69.1	Cool Moist
Illinois	Woodford	0.37	0.39	0.23	Silty	75.4	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Indiana	Adams	0.47	0.32	0.21	Silty	68.7	Cool Moist
Indiana	Allen	0.47	0.32	0.21	Silty	73.0	Cool Moist
Indiana	Bartholomew	0.46	0.32	0.22	Silty	46.8	Warm Moist
Indiana	Benton	0.36	0.40	0.24	Silty	83.0	Cool Moist
Indiana	Blackford	0.46	0.33	0.21	Silty	68.1	Cool Moist
Indiana	Boone	0.41	0.37	0.23	Silty	66.2	Warm Moist
Indiana	Brown	0.45	0.33	0.22	Silty	47.8	Warm Moist
Indiana	Carroll	0.40	0.38	0.23	Silty	77.1	Warm Moist
Indiana	Cass	0.40	0.37	0.23	Silty	79.6	Cool Moist
Indiana	Clark	0.46	0.31	0.24	Silty	39.2	Warm Moist
Indiana	Clay	0.41	0.37	0.22	Silty	56.8	Warm Moist
Indiana	Clinton	0.40	0.37	0.23	Silty	72.2	Warm Moist
Indiana	Crawford	0.42	0.34	0.24	Silty	37.8	Warm Moist
Indiana	Daviess	0.42	0.36	0.22	Silty	42.4	Warm Moist
Indiana	DeKalb	0.47	0.32	0.21	Silty	75.2	Cool Moist
Indiana	Dearborn	0.48	0.30	0.22	Silty	43.8	Warm Moist
Indiana	Decatur	0.47	0.31	0.22	Silty	45.7	Warm Moist
Indiana	Delaware	0.45	0.34	0.22	Silty	64.4	Warm Moist
Indiana	Dubois	0.42	0.35	0.23	Silty	39.3	Warm Moist
Indiana	Elkhart	0.43	0.35	0.22	Silty	76.6	Cool Moist
Indiana	Fayette	0.47	0.32	0.22	Silty	54.6	Warm Moist
Indiana	Floyd	0.44	0.32	0.24	Silty	38.5	Warm Moist
Indiana	Fountain	0.36	0.40	0.24	Silty	77.7	Warm Moist
Indiana	Franklin	0.47	0.31	0.22	Silty	49.2	Warm Moist
Indiana	Fulton	0.41	0.36	0.22	Silty	79.6	Cool Moist
Indiana	Gibson	0.40	0.38	0.22	Silty	39.6	Warm Moist
Indiana	Grant	0.44	0.34	0.22	Silty	69.7	Cool Moist
Indiana	Greene	0.43	0.35	0.21	Silty	45.7	Warm Moist
Indiana	Hamilton	0.42	0.36	0.22	Silty	64.3	Warm Moist
Indiana	Hancock	0.44	0.34	0.22	Silty	61.3	Warm Moist
Indiana	Harrison	0.44	0.32	0.24	Silty	36.6	Warm Moist
Indiana	Hendricks	0.42	0.36	0.22	Silty	58.9	Warm Moist
Indiana	Henry	0.45	0.33	0.22	Silty	60.4	Warm Moist
Indiana	Howard	0.42	0.36	0.22	Silty	70.1	Cool Moist
Indiana	Huntington	0.45	0.34	0.22	Silty	73.4	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Indiana	Jackson	0.45	0.32	0.22	Silty	44.3	Warm Moist
Indiana	Jasper	0.37	0.39	0.23	Silty	83.7	Cool Moist
Indiana	Jay	0.47	0.32	0.21	Silty	65.5	Cool Moist
Indiana	Jefferson	0.47	0.30	0.23	Silty	40.7	Warm Moist
Indiana	Jennings	0.47	0.31	0.22	Silty	42.9	Warm Moist
Indiana	Johnson	0.44	0.34	0.22	Silty	52.6	Warm Moist
Indiana	Knox	0.41	0.38	0.21	Silty	44.1	Warm Moist
Indiana	Kosciusko	0.43	0.35	0.22	Silty	77.0	Cool Moist
Indiana	LaGrange	0.45	0.34	0.22	Silty	77.1	Cool Moist
Indiana	LaPorte	0.39	0.38	0.23	Silty	77.2	Cool Moist
Indiana	Lake	0.36	0.40	0.24	Silty	80.4	Cool Moist
Indiana	Lawrence	0.44	0.33	0.23	Silty	42.6	Warm Moist
Indiana	Madison	0.43	0.35	0.22	Silty	65.4	Warm Moist
Indiana	Marion	0.43	0.35	0.22	Silty	57.4	Warm Moist
Indiana	Marshall	0.41	0.36	0.22	Silty	78.0	Cool Moist
Indiana	Martin	0.43	0.35	0.22	Silty	43.1	Warm Moist
Indiana	Miami	0.42	0.36	0.22	Silty	75.7	Cool Moist
Indiana	Monroe	0.45	0.33	0.22	Silty	46.9	Warm Moist
Indiana	Montgomery	0.38	0.39	0.23	Silty	70.7	Warm Moist
Indiana	Morgan	0.43	0.35	0.22	Silty	53.9	Warm Moist
Indiana	Newton	0.36	0.40	0.24	Silty	85.6	Cool Moist
Indiana	Noble	0.45	0.34	0.22	Silty	76.2	Cool Moist
Indiana	Ohio	0.48	0.30	0.23	Silty	40.7	Warm Moist
Indiana	Orange	0.43	0.34	0.23	Silty	40.2	Warm Moist
Indiana	Owen	0.43	0.36	0.21	Silty	51.7	Warm Moist
Indiana	Parke	0.38	0.39	0.23	Silty	67.2	Warm Moist
Indiana	Perry	0.42	0.34	0.24	Silty	36.4	Warm Moist
Indiana	Pike	0.41	0.38	0.22	Silty	41.8	Warm Moist
Indiana	Porter	0.37	0.39	0.23	Silty	79.4	Cool Moist
Indiana	Posey	0.40	0.37	0.23	Silty	36.6	Warm Moist
Indiana	Pulaski	0.39	0.38	0.23	Silty	82.1	Cool Moist
Indiana	Putnam	0.41	0.37	0.22	Silty	61.1	Warm Moist
Indiana	Randolph	0.47	0.32	0.21	Silty	63.0	Cool Moist
Indiana	Ripley	0.48	0.30	0.22	Silty	43.0	Warm Moist
Indiana	Rush	0.46	0.32	0.22	Silty	53.1	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Indiana	Scott	0.46	0.31	0.23	Silty	41.4	Warm Moist
Indiana	Shelby	0.45	0.33	0.22	Silty	54.0	Warm Moist
Indiana	Spencer	0.41	0.36	0.23	Silty	36.9	Warm Moist
Indiana	St. Joseph	0.41	0.36	0.22	Silty	76.3	Cool Moist
Indiana	Starke	0.39	0.38	0.23	Silty	79.6	Cool Moist
Indiana	Steuben	0.47	0.32	0.21	Silty	77.5	Cool Moist
Indiana	Sullivan	0.42	0.38	0.21	Silty	48.7	Warm Moist
Indiana	Switzerland	0.48	0.29	0.23	Silty	40.1	Warm Moist
Indiana	Tippecanoe	0.38	0.39	0.23	Silty	76.3	Warm Moist
Indiana	Tipton	0.42	0.35	0.22	Silty	67.7	Warm Moist
Indiana	Union	0.47	0.31	0.21	Silty	53.9	Warm Moist
Indiana	Vanderburgh	0.39	0.38	0.23	Silty	37.6	Warm Moist
Indiana	Vermillion	0.37	0.40	0.23	Silty	72.9	Warm Moist
Indiana	Vigo	0.40	0.38	0.22	Silty	58.3	Warm Moist
Indiana	Wabash	0.43	0.35	0.22	Silty	75.5	Cool Moist
Indiana	Warren	0.36	0.40	0.24	Silty	80.4	Warm Moist
Indiana	Warrick	0.40	0.37	0.23	Silty	37.4	Warm Moist
Indiana	Washington	0.44	0.32	0.23	Silty	40.9	Warm Moist
Indiana	Wayne	0.47	0.32	0.21	Silty	59.2	Warm Moist
Indiana	Wells	0.46	0.33	0.21	Silty	70.0	Cool Moist
Indiana	White	0.38	0.39	0.23	Silty	81.2	Cool Moist
Indiana	Whitley	0.45	0.34	0.22	Silty	75.4	Cool Moist
Iowa	Adair	0.37	0.39	0.23	Silty	68.5	Cool Moist
Iowa	Adams	0.37	0.39	0.23	Silty	64.0	Cool Moist
Iowa	Allamakee	0.42	0.36	0.22	Silty	62.3	Cool Moist
Iowa	Appanoose	0.40	0.37	0.23	Silty	56.1	Warm Moist
Iowa	Audubon	0.37	0.39	0.23	Silty	72.8	Cool Moist
Iowa	Benton	0.39	0.38	0.23	Silty	75.2	Cool Moist
Iowa	Black Hawk	0.39	0.38	0.23	Silty	82.8	Cool Moist
Iowa	Boone	0.39	0.38	0.23	Silty	87.1	Cool Moist
Iowa	Bremer	0.39	0.38	0.23	Silty	85.1	Cool Moist
Iowa	Buchanan	0.40	0.37	0.23	Silty	74.6	Cool Moist
Iowa	Buena Vista	0.54	0.28	0.18	Sandy	93.2	Cool Moist
Iowa	Butler	0.39	0.38	0.23	Silty	92.0	Cool Moist
Iowa	Calhoun	0.45	0.34	0.21	Silty	89.2	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Iowa	Carroll	0.39	0.38	0.23	Silty	79.3	Cool Moist
Iowa	Cass	0.37	0.39	0.23	Silty	67.3	Cool Moist
Iowa	Cedar	0.42	0.36	0.22	Silty	64.3	Cool Moist
Iowa	Cerro Gordo	0.39	0.38	0.23	Silty	99.7	Cool Moist
Iowa	Cherokee	0.53	0.29	0.18	Sandy	84.9	Cool Moist
Iowa	Chickasaw	0.39	0.38	0.23	Silty	85.3	Cool Moist
Iowa	Clarke	0.37	0.39	0.23	Silty	64.9	Cool Moist
Iowa	Clay	0.50	0.32	0.19	Silty	98.8	Cool Moist
Iowa	Clayton	0.42	0.35	0.22	Silty	64.4	Cool Moist
Iowa	Clinton	0.41	0.36	0.22	Silty	63.5	Cool Moist
Iowa	Crawford	0.39	0.38	0.23	Silty	73.4	Cool Moist
Iowa	Dallas	0.38	0.39	0.23	Silty	78.0	Cool Moist
Iowa	Davis	0.42	0.36	0.22	Silty	54.6	Warm Moist
Iowa	Decatur	0.37	0.39	0.24	Silty	60.4	Cool Moist
Iowa	Delaware	0.42	0.36	0.22	Silty	66.3	Cool Moist
Iowa	Des Moines	0.46	0.33	0.21	Silty	57.2	Warm Moist
Iowa	Dickinson	0.40	0.39	0.21	Silty	102.8	Cool Moist
Iowa	Dubuque	0.42	0.36	0.22	Silty	62.7	Cool Moist
Iowa	Emmet	0.40	0.39	0.22	Silty	106.3	Cool Moist
Iowa	Fayette	0.41	0.37	0.23	Silty	75.4	Cool Moist
Iowa	Floyd	0.39	0.38	0.23	Silty	93.1	Cool Moist
Iowa	Franklin	0.39	0.38	0.23	Silty	97.4	Cool Moist
Iowa	Fremont	0.36	0.40	0.24	Silty	59.1	Warm Moist
Iowa	Greene	0.39	0.38	0.23	Silty	83.2	Cool Moist
Iowa	Grundy	0.38	0.38	0.23	Silty	88.1	Cool Moist
Iowa	Guthrie	0.38	0.39	0.23	Silty	74.9	Cool Moist
Iowa	Hamilton	0.39	0.38	0.23	Silty	94.4	Cool Moist
Iowa	Hancock	0.40	0.38	0.23	Silty	105.3	Cool Moist
Iowa	Hardin	0.39	0.38	0.23	Silty	91.4	Cool Moist
Iowa	Harrison	0.37	0.40	0.24	Silty	61.3	Cool Moist
Iowa	Henry	0.46	0.33	0.21	Silty	57.1	Warm Moist
Iowa	Howard	0.38	0.38	0.23	Silty	82.5	Cool Moist
Iowa	Humboldt	0.45	0.34	0.21	Silty	100.3	Cool Moist
Iowa	Ida	0.46	0.33	0.20	Silty	79.4	Cool Moist
Iowa	Iowa	0.40	0.37	0.23	Silty	69.6	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Iowa	Jackson	0.41	0.36	0.22	Silty	63.0	Cool Moist
Iowa	Jasper	0.38	0.39	0.23	Silty	76.7	Cool Moist
Iowa	Jefferson	0.43	0.35	0.22	Silty	58.8	Warm Moist
Iowa	Johnson	0.41	0.36	0.22	Silty	65.9	Cool Moist
Iowa	Jones	0.41	0.36	0.22	Silty	64.4	Cool Moist
Iowa	Keokuk	0.41	0.37	0.23	Silty	63.8	Cool Moist
Iowa	Kossuth	0.42	0.36	0.22	Silty	105.8	Cool Moist
Iowa	Lee	0.46	0.33	0.21	Silty	52.4	Warm Moist
Iowa	Linn	0.40	0.37	0.23	Silty	69.0	Cool Moist
Iowa	Louisa	0.45	0.34	0.22	Silty	60.0	Warm Moist
Iowa	Lucas	0.38	0.38	0.23	Silty	63.2	Cool Moist
Iowa	Lyon	0.39	0.40	0.21	Silty	84.6	Cool Dry
Iowa	Madison	0.38	0.39	0.23	Silty	70.2	Cool Moist
Iowa	Mahaska	0.39	0.38	0.23	Silty	65.8	Cool Moist
Iowa	Marion	0.39	0.38	0.23	Silty	68.1	Cool Moist
Iowa	Marshall	0.38	0.39	0.23	Silty	83.2	Cool Moist
Iowa	Mills	0.36	0.40	0.24	Silty	59.9	Cool Moist
Iowa	Mitchell	0.38	0.39	0.23	Silty	91.4	Cool Moist
Iowa	Monona	0.39	0.38	0.23	Silty	64.1	Cool Dry
Iowa	Monroe	0.40	0.37	0.23	Silty	60.9	Warm Moist
Iowa	Montgomery	0.37	0.40	0.24	Silty	62.6	Cool Moist
Iowa	Muscatine	0.44	0.35	0.22	Silty	61.7	Cool Moist
Iowa	O'Brien	0.49	0.32	0.19	Silty	90.5	Cool Moist
Iowa	Osceola	0.40	0.39	0.21	Silty	94.9	Cool Moist
Iowa	Page	0.36	0.40	0.24	Silty	60.7	Warm Moist
Iowa	Palo Alto	0.47	0.33	0.20	Silty	102.9	Cool Moist
Iowa	Plymouth	0.52	0.30	0.18	Silty	74.2	Cool Dry
Iowa	Pocahontas	0.50	0.31	0.19	Silty	97.7	Cool Moist
Iowa	Polk	0.38	0.38	0.23	Silty	79.2	Cool Moist
Iowa	Pottawattamie	0.37	0.40	0.24	Silty	62.9	Cool Moist
Iowa	Poweshiek	0.38	0.39	0.23	Silty	73.1	Cool Moist
Iowa	Ringgold	0.37	0.40	0.24	Silty	61.0	Warm Moist
Iowa	Sac	0.47	0.33	0.20	Silty	84.5	Cool Moist
Iowa	Scott	0.42	0.36	0.22	Silty	63.0	Cool Moist
Iowa	Shelby	0.37	0.40	0.24	Silty	68.0	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Iowa	Sioux	0.48	0.33	0.19	Silty	79.8	Cool Dry
Iowa	Story	0.39	0.38	0.23	Silty	86.3	Cool Moist
Iowa	Tama	0.38	0.39	0.23	Silty	81.0	Cool Moist
Iowa	Taylor	0.37	0.40	0.24	Silty	61.1	Warm Moist
Iowa	Union	0.37	0.39	0.23	Silty	64.7	Cool Moist
Iowa	Van Buren	0.44	0.34	0.22	Silty	54.7	Warm Moist
Iowa	Wapello	0.41	0.36	0.22	Silty	59.3	Warm Moist
Iowa	Warren	0.38	0.39	0.23	Silty	70.5	Cool Moist
Iowa	Washington	0.43	0.35	0.22	Silty	62.1	Warm Moist
Iowa	Wayne	0.38	0.38	0.23	Silty	58.5	Cool Moist
Iowa	Webster	0.42	0.36	0.22	Silty	92.4	Cool Moist
Iowa	Winnebago	0.39	0.38	0.23	Silty	107.3	Cool Moist
Iowa	Winneshiek	0.40	0.37	0.23	Silty	72.8	Cool Moist
Iowa	Woodbury	0.47	0.33	0.20	Silty	70.8	Cool Dry
Iowa	Worth	0.39	0.38	0.23	Silty	99.9	Cool Moist
Iowa	Wright	0.40	0.37	0.23	Silty	101.6	Cool Moist
Kansas	Allen	0.37	0.40	0.23	Silty	55.8	Warm Moist
Kansas	Anderson	0.37	0.40	0.23	Silty	58.6	Warm Moist
Kansas	Atchison	0.36	0.40	0.24	Silty	58.9	Warm Moist
Kansas	Barber	0.40	0.38	0.22	Silty	34.8	Warm Dry
Kansas	Barton	0.36	0.41	0.23	Silty	43.6	Warm Dry
Kansas	Bourbon	0.37	0.39	0.23	Silty	54.4	Warm Moist
Kansas	Brown	0.36	0.40	0.24	Silty	58.6	Warm Moist
Kansas	Butler	0.38	0.40	0.23	Silty	50.8	Warm Dry
Kansas	Chase	0.37	0.40	0.23	Silty	55.7	Warm Dry
Kansas	Chautauqua	0.38	0.39	0.23	Silty	49.0	Warm Moist
Kansas	Cherokee	0.39	0.37	0.24	Silty	46.7	Warm Moist
Kansas	Cheyenne	0.37	0.40	0.23	Silty	34.7	Warm Dry
Kansas	Clark	0.40	0.37	0.23	Silty	31.2	Warm Dry
Kansas	Clay	0.37	0.40	0.23	Silty	54.5	Warm Dry
Kansas	Cloud	0.37	0.40	0.23	Silty	52.4	Warm Dry
Kansas	Coffey	0.37	0.40	0.23	Silty	57.8	Warm Moist
Kansas	Comanche	0.40	0.37	0.22	Silty	32.6	Warm Dry
Kansas	Cowley	0.40	0.38	0.22	Silty	46.8	Warm Dry
Kansas	Crawford	0.38	0.39	0.24	Silty	50.9	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Kansas	Decatur	0.36	0.41	0.23	Silty	39.3	Warm Dry
Kansas	Dickinson	0.37	0.40	0.23	Silty	53.6	Warm Dry
Kansas	Doniphan	0.35	0.40	0.24	Silty	59.1	Warm Moist
Kansas	Douglas	0.36	0.40	0.24	Silty	58.8	Warm Moist
Kansas	Edwards	0.37	0.40	0.23	Silty	37.6	Warm Dry
Kansas	Elk	0.38	0.39	0.23	Silty	52.2	Warm Moist
Kansas	Ellis	0.36	0.41	0.23	Silty	42.9	Warm Dry
Kansas	Ellsworth	0.36	0.41	0.23	Silty	48.4	Warm Dry
Kansas	Finney	0.44	0.33	0.23	Silty	32.3	Warm Dry
Kansas	Ford	0.39	0.38	0.23	Silty	34.1	Warm Dry
Kansas	Franklin	0.37	0.40	0.24	Silty	59.0	Warm Moist
Kansas	Geary	0.37	0.40	0.23	Silty	56.1	Warm Dry
Kansas	Gove	0.37	0.40	0.23	Silty	38.1	Warm Dry
Kansas	Graham	0.36	0.41	0.23	Silty	41.1	Warm Dry
Kansas	Grant	0.51	0.26	0.23	Sandy	29.1	Warm Dry
Kansas	Gray	0.43	0.34	0.23	Silty	32.3	Warm Dry
Kansas	Greeley	0.50	0.27	0.24	Sandy	28.8	Warm Dry
Kansas	Greenwood	0.37	0.40	0.23	Silty	55.4	Warm Moist
Kansas	Hamilton	0.53	0.23	0.24	Sandy	27.1	Warm Dry
Kansas	Harper	0.41	0.38	0.21	Silty	38.7	Warm Dry
Kansas	Harvey	0.36	0.41	0.23	Silty	48.2	Warm Dry
Kansas	Haskell	0.47	0.30	0.23	Silty	30.7	Warm Dry
Kansas	Hodgeman	0.37	0.40	0.23	Silty	36.6	Warm Dry
Kansas	Jackson	0.36	0.40	0.24	Silty	58.5	Warm Moist
Kansas	Jefferson	0.36	0.40	0.24	Silty	58.7	Warm Moist
Kansas	Jewell	0.36	0.41	0.23	Silty	50.1	Warm Dry
Kansas	Johnson	0.36	0.40	0.24	Silty	58.1	Warm Moist
Kansas	Kearny	0.49	0.27	0.23	Sandy	29.4	Warm Dry
Kansas	Kingman	0.39	0.39	0.22	Silty	41.2	Warm Dry
Kansas	Kiowa	0.39	0.39	0.23	Silty	35.3	Warm Dry
Kansas	Labette	0.37	0.39	0.23	Silty	49.9	Warm Moist
Kansas	Lane	0.39	0.38	0.23	Silty	35.9	Warm Dry
Kansas	Leavenworth	0.35	0.41	0.24	Silty	58.7	Warm Moist
Kansas	Lincoln	0.37	0.40	0.23	Silty	49.5	Warm Dry
Kansas	Linn	0.37	0.40	0.23	Silty	57.4	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Kansas	Logan	0.39	0.38	0.23	Silty	34.7	Warm Dry
Kansas	Lyon	0.37	0.40	0.23	Silty	57.8	Warm Moist
Kansas	Marion	0.36	0.40	0.23	Silty	51.8	Warm Dry
Kansas	Marshall	0.36	0.41	0.23	Silty	56.7	Warm Dry
Kansas	McPherson	0.36	0.41	0.23	Silty	49.1	Warm Dry
Kansas	Meade	0.43	0.34	0.23	Silty	30.2	Warm Dry
Kansas	Miami	0.36	0.40	0.24	Silty	58.1	Warm Moist
Kansas	Mitchell	0.37	0.40	0.23	Silty	50.1	Warm Dry
Kansas	Montgomery	0.37	0.39	0.23	Silty	50.3	Warm Moist
Kansas	Morris	0.37	0.40	0.23	Silty	56.4	Warm Dry
Kansas	Morton	0.55	0.22	0.23	Sandy	26.7	Warm Dry
Kansas	Nemaha	0.36	0.41	0.24	Silty	58.1	Warm Moist
Kansas	Neosho	0.37	0.40	0.23	Silty	53.6	Warm Moist
Kansas	Ness	0.36	0.40	0.23	Silty	38.4	Warm Dry
Kansas	Norton	0.36	0.41	0.23	Silty	41.2	Warm Dry
Kansas	Osage	0.37	0.40	0.23	Silty	58.4	Warm Moist
Kansas	Osborne	0.36	0.41	0.23	Silty	46.9	Warm Dry
Kansas	Ottawa	0.37	0.40	0.23	Silty	52.2	Warm Dry
Kansas	Pawnee	0.36	0.41	0.23	Silty	40.3	Warm Dry
Kansas	Phillips	0.36	0.41	0.23	Silty	44.1	Warm Dry
Kansas	Pottawatomie	0.37	0.40	0.24	Silty	57.9	Warm Moist
Kansas	Pratt	0.38	0.40	0.23	Silty	38.6	Warm Dry
Kansas	Rawlins	0.36	0.41	0.23	Silty	36.9	Warm Dry
Kansas	Reno	0.37	0.40	0.23	Silty	43.9	Warm Dry
Kansas	Republic	0.36	0.41	0.23	Silty	52.4	Warm Dry
Kansas	Rice	0.36	0.41	0.23	Silty	46.7	Warm Dry
Kansas	Riley	0.37	0.40	0.23	Silty	56.3	Warm Dry
Kansas	Rooks	0.36	0.41	0.23	Silty	44.0	Warm Dry
Kansas	Rush	0.36	0.41	0.23	Silty	41.5	Warm Dry
Kansas	Russell	0.36	0.41	0.23	Silty	45.7	Warm Dry
Kansas	Saline	0.37	0.40	0.23	Silty	50.8	Warm Dry
Kansas	Scott	0.42	0.35	0.23	Silty	33.4	Warm Dry
Kansas	Sedgwick	0.38	0.39	0.22	Silty	45.9	Warm Dry
Kansas	Seward	0.48	0.29	0.23	Silty	29.4	Warm Dry
Kansas	Shawnee	0.36	0.40	0.24	Silty	58.5	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Kansas	Sheridan	0.36	0.41	0.23	Silty	39.2	Warm Dry
Kansas	Sherman	0.39	0.38	0.23	Silty	34.5	Warm Dry
Kansas	Smith	0.36	0.41	0.23	Silty	47.0	Warm Dry
Kansas	Stafford	0.36	0.41	0.23	Silty	41.5	Warm Dry
Kansas	Stanton	0.55	0.22	0.23	Sandy	26.9	Warm Dry
Kansas	Stevens	0.52	0.25	0.23	Sandy	28.5	Warm Dry
Kansas	Sumner	0.41	0.38	0.21	Silty	42.8	Warm Dry
Kansas	Thomas	0.36	0.41	0.23	Silty	37.4	Warm Dry
Kansas	Trego	0.36	0.41	0.23	Silty	40.9	Warm Dry
Kansas	Wabaunsee	0.37	0.40	0.23	Silty	58.0	Warm Moist
Kansas	Wallace	0.44	0.32	0.23	Silty	32.0	Warm Dry
Kansas	Washington	0.36	0.41	0.23	Silty	54.3	Warm Dry
Kansas	Wichita	0.46	0.31	0.23	Silty	30.9	Warm Dry
Kansas	Wilson	0.37	0.40	0.23	Silty	53.5	Warm Moist
Kansas	Woodson	0.37	0.40	0.23	Silty	55.4	Warm Moist
Kansas	Wyandotte	0.36	0.41	0.24	Silty	57.5	Warm Moist
Kentucky	Adair	0.49	0.27	0.24	Sandy	33.1	Warm Moist
Kentucky	Allen	0.48	0.28	0.24	Sandy	31.7	Warm Moist
Kentucky	Anderson	0.48	0.28	0.24	Silty	36.0	Warm Moist
Kentucky	Ballard	0.44	0.32	0.24	Silty	32.8	Warm Moist
Kentucky	Barren	0.49	0.27	0.24	Sandy	32.1	Warm Moist
Kentucky	Bath	0.46	0.30	0.24	Silty	36.1	Warm Moist
Kentucky	Bell	0.47	0.30	0.23	Silty	33.7	Warm Moist
Kentucky	Boone	0.48	0.30	0.23	Silty	40.7	Warm Moist
Kentucky	Bourbon	0.47	0.29	0.24	Silty	36.8	Warm Moist
Kentucky	Boyd	0.44	0.34	0.22	Silty	37.1	Warm Moist
Kentucky	Boyle	0.48	0.28	0.24	Silty	35.2	Warm Moist
Kentucky	Bracken	0.47	0.30	0.22	Silty	38.8	Warm Moist
Kentucky	Breathitt	0.44	0.34	0.22	Silty	35.5	Warm Moist
Kentucky	Breckinridge	0.45	0.31	0.24	Silty	34.0	Warm Moist
Kentucky	Bullitt	0.45	0.31	0.24	Silty	36.0	Warm Moist
Kentucky	Butler	0.47	0.29	0.24	Silty	31.3	Warm Moist
Kentucky	Caldwell	0.43	0.33	0.24	Silty	31.3	Warm Moist
Kentucky	Calloway	0.46	0.32	0.23	Silty	30.4	Warm Moist
Kentucky	Campbell	0.48	0.30	0.22	Silty	40.3	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Kentucky	Carlisle	0.45	0.32	0.23	Silty	31.8	Warm Moist
Kentucky	Carroll	0.47	0.29	0.23	Silty	39.5	Warm Moist
Kentucky	Carter	0.46	0.32	0.23	Silty	36.9	Warm Moist
Kentucky	Casey	0.48	0.28	0.24	Silty	34.6	Warm Moist
Kentucky	Christian	0.44	0.32	0.24	Silty	30.8	Warm Moist
Kentucky	Clark	0.47	0.29	0.24	Silty	36.2	Warm Moist
Kentucky	Clay	0.45	0.33	0.22	Silty	35.1	Warm Moist
Kentucky	Clinton	0.48	0.28	0.24	Silty	31.4	Warm Moist
Kentucky	Crittenden	0.42	0.34	0.24	Silty	32.6	Warm Moist
Kentucky	Cumberland	0.49	0.27	0.24	Sandy	32.2	Warm Moist
Kentucky	Daviess	0.43	0.34	0.24	Silty	34.4	Warm Moist
Kentucky	Edmonson	0.49	0.27	0.24	Sandy	31.8	Warm Moist
Kentucky	Elliott	0.45	0.32	0.23	Silty	36.6	Warm Moist
Kentucky	Estill	0.46	0.31	0.23	Silty	35.8	Warm Moist
Kentucky	Fayette	0.48	0.28	0.24	Silty	36.3	Warm Moist
Kentucky	Fleming	0.47	0.30	0.23	Silty	36.6	Warm Moist
Kentucky	Floyd	0.43	0.36	0.21	Silty	34.9	Warm Moist
Kentucky	Franklin	0.48	0.28	0.24	Silty	37.2	Warm Moist
Kentucky	Fulton	0.47	0.31	0.22	Silty	31.1	Warm Moist
Kentucky	Gallatin	0.48	0.29	0.23	Silty	39.6	Warm Moist
Kentucky	Garrard	0.48	0.29	0.24	Silty	35.4	Warm Moist
Kentucky	Grant	0.48	0.29	0.23	Silty	38.6	Warm Moist
Kentucky	Graves	0.45	0.32	0.23	Silty	30.8	Warm Moist
Kentucky	Grayson	0.47	0.28	0.24	Silty	32.1	Warm Moist
Kentucky	Green	0.49	0.27	0.24	Sandy	33.6	Warm Moist
Kentucky	Greenup	0.45	0.33	0.22	Silty	37.2	Warm Moist
Kentucky	Hancock	0.43	0.33	0.24	Silty	35.0	Warm Moist
Kentucky	Hardin	0.47	0.29	0.24	Silty	34.3	Warm Moist
Kentucky	Harlan	0.45	0.33	0.22	Silty	34.8	Warm Moist
Kentucky	Harrison	0.47	0.30	0.23	Silty	37.8	Warm Moist
Kentucky	Hart	0.48	0.28	0.24	Silty	32.7	Warm Moist
Kentucky	Henderson	0.41	0.36	0.23	Silty	35.6	Warm Moist
Kentucky	Henry	0.47	0.29	0.23	Silty	38.7	Warm Moist
Kentucky	Hickman	0.46	0.32	0.22	Silty	30.8	Warm Moist
Kentucky	Hopkins	0.42	0.33	0.24	Silty	31.9	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Kentucky	Jackson	0.46	0.32	0.22	Silty	35.6	Warm Moist
Kentucky	Jefferson	0.45	0.31	0.24	Silty	37.4	Warm Moist
Kentucky	Jessamine	0.48	0.29	0.24	Silty	35.8	Warm Moist
Kentucky	Johnson	0.44	0.35	0.22	Silty	35.8	Warm Moist
Kentucky	Kenton	0.48	0.30	0.22	Silty	40.3	Warm Moist
Kentucky	Knott	0.43	0.36	0.21	Silty	34.6	Warm Moist
Kentucky	Knox	0.47	0.30	0.23	Silty	34.1	Warm Moist
Kentucky	Larue	0.47	0.29	0.24	Silty	34.0	Warm Moist
Kentucky	Laurel	0.46	0.31	0.23	Silty	34.8	Warm Moist
Kentucky	Lawrence	0.44	0.33	0.22	Silty	36.6	Warm Moist
Kentucky	Lee	0.45	0.32	0.22	Silty	35.8	Warm Moist
Kentucky	Leslie	0.44	0.34	0.22	Silty	34.8	Warm Moist
Kentucky	Letcher	0.43	0.36	0.21	Silty	34.5	Warm Moist
Kentucky	Lewis	0.46	0.31	0.23	Silty	37.3	Warm Moist
Kentucky	Lincoln	0.48	0.28	0.24	Silty	35.0	Warm Moist
Kentucky	Livingston	0.43	0.33	0.24	Silty	31.7	Warm Moist
Kentucky	Logan	0.47	0.30	0.24	Silty	31.1	Warm Moist
Kentucky	Lyon	0.44	0.32	0.24	Silty	31.2	Warm Moist
Kentucky	Madison	0.47	0.30	0.23	Silty	35.7	Warm Moist
Kentucky	Magoffin	0.43	0.35	0.22	Silty	35.2	Warm Moist
Kentucky	Marion	0.48	0.28	0.24	Silty	34.6	Warm Moist
Kentucky	Marshall	0.44	0.32	0.23	Silty	31.1	Warm Moist
Kentucky	Martin	0.43	0.36	0.21	Silty	36.3	Warm Moist
Kentucky	Mason	0.47	0.30	0.23	Silty	38.0	Warm Moist
Kentucky	McCracken	0.44	0.33	0.24	Silty	32.4	Warm Moist
Kentucky	McCreary	0.48	0.28	0.24	Silty	32.6	Warm Moist
Kentucky	McLean	0.42	0.34	0.24	Silty	33.7	Warm Moist
Kentucky	Meade	0.44	0.32	0.24	Silty	35.3	Warm Moist
Kentucky	Menifee	0.46	0.30	0.23	Silty	36.1	Warm Moist
Kentucky	Mercer	0.48	0.28	0.24	Silty	35.8	Warm Moist
Kentucky	Metcalfe	0.49	0.27	0.24	Sandy	32.3	Warm Moist
Kentucky	Monroe	0.48	0.28	0.24	Silty	31.5	Warm Moist
Kentucky	Montgomery	0.47	0.29	0.24	Silty	36.1	Warm Moist
Kentucky	Morgan	0.45	0.32	0.23	Silty	36.1	Warm Moist
Kentucky	Muhlenberg	0.45	0.31	0.24	Silty	31.5	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Kentucky	Nelson	0.47	0.29	0.24	Silty	35.3	Warm Moist
Kentucky	Nicholas	0.47	0.29	0.24	Silty	36.6	Warm Moist
Kentucky	Ohio	0.45	0.31	0.24	Silty	32.8	Warm Moist
Kentucky	Oldham	0.46	0.30	0.24	Silty	38.1	Warm Moist
Kentucky	Owen	0.48	0.29	0.23	Silty	38.4	Warm Moist
Kentucky	Owsley	0.45	0.33	0.22	Silty	35.6	Warm Moist
Kentucky	Pendleton	0.47	0.30	0.23	Silty	38.7	Warm Moist
Kentucky	Perry	0.44	0.35	0.22	Silty	35.1	Warm Moist
Kentucky	Pike	0.42	0.38	0.20	Silty	34.4	Warm Moist
Kentucky	Powell	0.47	0.30	0.23	Silty	35.9	Warm Moist
Kentucky	Pulaski	0.48	0.29	0.23	Silty	34.3	Warm Moist
Kentucky	Robertson	0.47	0.30	0.23	Silty	37.7	Warm Moist
Kentucky	Rockcastle	0.47	0.30	0.23	Silty	35.3	Warm Moist
Kentucky	Rowan	0.46	0.31	0.23	Silty	36.5	Warm Moist
Kentucky	Russell	0.49	0.27	0.24	Sandy	32.4	Warm Moist
Kentucky	Scott	0.48	0.29	0.24	Silty	37.0	Warm Moist
Kentucky	Shelby	0.47	0.29	0.24	Silty	37.4	Warm Moist
Kentucky	Simpson	0.48	0.28	0.24	Silty	31.4	Warm Moist
Kentucky	Spencer	0.47	0.29	0.24	Silty	36.2	Warm Moist
Kentucky	Taylor	0.49	0.27	0.24	Sandy	34.1	Warm Moist
Kentucky	Todd	0.46	0.31	0.24	Silty	30.8	Warm Moist
Kentucky	Trigg	0.44	0.32	0.24	Silty	30.9	Warm Moist
Kentucky	Trimble	0.47	0.30	0.23	Silty	39.7	Warm Moist
Kentucky	Union	0.41	0.35	0.24	Silty	34.1	Warm Moist
Kentucky	Warren	0.48	0.28	0.24	Silty	31.5	Warm Moist
Kentucky	Washington	0.48	0.28	0.24	Silty	35.6	Warm Moist
Kentucky	Wayne	0.48	0.28	0.24	Silty	32.2	Warm Moist
Kentucky	Webster	0.41	0.35	0.24	Silty	33.9	Warm Moist
Kentucky	Whitley	0.48	0.29	0.23	Silty	33.1	Warm Moist
Kentucky	Wolfe	0.46	0.31	0.23	Silty	35.9	Warm Moist
Kentucky	Woodford	0.48	0.28	0.24	Silty	36.4	Warm Moist
Louisiana	Acadia	0.51	0.29	0.20	Silty	78.2	Warm Moist
Louisiana	Allen	0.41	0.37	0.22	Silty	51.6	Warm Moist
Louisiana	Ascension	0.35	0.29	0.36	Clayey	89.8	Warm Moist
Louisiana	Assumption	0.40	0.25	0.34	Clayey	107.5	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Louisiana	Avoyelles	0.39	0.33	0.28	Clayey	40.0	Warm Moist
Louisiana	Beauregard	0.42	0.35	0.23	Silty	48.1	Warm Moist
Louisiana	Bienville	0.49	0.27	0.24	Sandy	30.9	Warm Moist
Louisiana	Bossier	0.49	0.27	0.24	Sandy	29.2	Warm Moist
Louisiana	Caddo	0.49	0.27	0.24	Sandy	28.3	Warm Moist
Louisiana	Calcasieu	0.46	0.29	0.25	Silty	68.1	Warm Moist
Louisiana	Caldwell	0.43	0.28	0.29	Clayey	31.8	Warm Moist
Louisiana	Cameron	0.57	0.19	0.24	Sandy	99.9	Warm Moist
Louisiana	Catahoula	0.39	0.28	0.33	Clayey	30.3	Warm Moist
Louisiana	Claiborne	0.49	0.27	0.24	Sandy	31.2	Warm Moist
Louisiana	Concordia	0.37	0.30	0.34	Clayey	33.1	Warm Moist
Louisiana	De Soto	0.49	0.27	0.24	Sandy	28.1	Warm Moist
Louisiana	East Baton Rouge	0.32	0.33	0.36	Clayey	59.5	Warm Moist
Louisiana	East Carroll	0.35	0.28	0.37	Clayey	31.1	Warm Moist
Louisiana	East Feliciana	0.31	0.33	0.37	Clayey	44.6	Warm Moist
Louisiana	Evangeline	0.38	0.38	0.24	Silty	47.3	Warm Moist
Louisiana	Franklin	0.39	0.28	0.33	Clayey	31.0	Warm Moist
Louisiana	Grant	0.47	0.28	0.24	Silty	32.8	Warm Moist
Louisiana	Iberia	0.53	0.21	0.26	Sandy	113.9	Warm Moist
Louisiana	Iberville	0.37	0.30	0.34	Clayey	78.0	Warm Moist
Louisiana	Jackson	0.48	0.27	0.25	Sandy	32.4	Warm Moist
Louisiana	Jefferson	0.26	0.32	0.42	Clayey	125.3	Warm Moist
Louisiana	Jefferson Davis	0.52	0.27	0.21	Sandy	80.1	Warm Moist
Louisiana	LaSalle	0.44	0.28	0.28	Clayey	31.8	Warm Moist
Louisiana	Lafayette	0.46	0.29	0.24	Silty	77.9	Warm Moist
Louisiana	Lafourche	0.30	0.30	0.40	Clayey	138.7	Warm Moist
Louisiana	Lincoln	0.49	0.27	0.24	Sandy	32.5	Warm Moist
Louisiana	Livingston	0.32	0.31	0.36	Clayey	71.8	Warm Moist
Louisiana	Madison	0.34	0.29	0.37	Clayey	30.7	Warm Moist
Louisiana	Morehouse	0.41	0.27	0.32	Clayey	31.8	Warm Moist
Louisiana	Natchitoches	0.49	0.27	0.24	Sandy	30.6	Warm Moist
Louisiana	Orleans	0.27	0.32	0.41	Clayey	107.1	Warm Moist
Louisiana	Ouachita	0.44	0.27	0.28	Clayey	32.5	Warm Moist
Louisiana	Plaquemines	0.24	0.34	0.42	Clayey	134.4	Warm Moist
Louisiana	Pointe Coupee	0.34	0.34	0.32	Clayey	48.3	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Louisiana	Rapides	0.43	0.33	0.24	Silty	40.3	Warm Moist
Louisiana	Red River	0.49	0.27	0.24	Sandy	29.7	Warm Moist
Louisiana	Richland	0.39	0.28	0.33	Clayey	31.7	Warm Moist
Louisiana	Sabine	0.48	0.28	0.24	Silty	30.8	Warm Moist
Louisiana	St. Bernard	0.28	0.33	0.39	Clayey	110.9	Warm Moist
Louisiana	St. Charles	0.29	0.31	0.40	Clayey	109.9	Warm Moist
Louisiana	St. Helena	0.31	0.32	0.37	Clayey	46.5	Warm Moist
Louisiana	St. James	0.35	0.28	0.37	Clayey	101.0	Warm Moist
Louisiana	St. John the Baptist	0.31	0.31	0.38	Clayey	94.2	Warm Moist
Louisiana	St. Landry	0.39	0.36	0.25	Silty	54.9	Warm Moist
Louisiana	St. Martin	0.42	0.29	0.28	Clayey	77.7	Warm Moist
Louisiana	St. Mary	0.49	0.22	0.29	Sandy	126.0	Warm Moist
Louisiana	St. Tammany	0.31	0.32	0.38	Clayey	78.0	Warm Moist
Louisiana	Tangipahoa	0.32	0.32	0.37	Clayey	53.8	Warm Moist
Louisiana	Tensas	0.35	0.29	0.36	Clayey	30.3	Warm Moist
Louisiana	Terrebonne	0.34	0.29	0.38	Clayey	145.4	Warm Moist
Louisiana	Union	0.48	0.26	0.25	Sandy	32.3	Warm Moist
Louisiana	Vermilion	0.63	0.19	0.18	Sandy	108.9	Warm Moist
Louisiana	Vernon	0.44	0.32	0.23	Silty	38.2	Warm Moist
Louisiana	Washington	0.34	0.30	0.36	Clayey	51.2	Warm Moist
Louisiana	Webster	0.49	0.27	0.24	Sandy	30.3	Warm Moist
Louisiana	West Baton Rouge	0.33	0.33	0.34	Clayey	58.3	Warm Moist
Louisiana	West Carroll	0.36	0.28	0.36	Clayey	31.3	Warm Moist
Louisiana	West Feliciana	0.32	0.33	0.35	Clayey	41.5	Warm Moist
Louisiana	Winn	0.48	0.27	0.25	Sandy	31.9	Warm Moist
Maine	Androscoggin	0.75	0.18	0.06	Sandy	103.8	Cool Moist
Maine	Aroostook	0.69	0.25	0.06	Sandy	95.7	Cool Moist
Maine	Cumberland	0.73	0.20	0.07	Sandy	100.4	Cool Moist
Maine	Franklin	0.79	0.16	0.05	Sandy	114.0	Cool Moist
Maine	Hancock	0.77	0.17	0.06	Sandy	108.2	Cool Moist
Maine	Kennebec	0.77	0.17	0.06	Sandy	106.3	Cool Moist
Maine	Knox	0.61	0.29	0.10	Sandy	100.1	Cool Moist
Maine	Lincoln	0.66	0.25	0.09	Sandy	101.0	Cool Moist
Maine	Oxford	0.81	0.14	0.05	Sandy	107.7	Cool Moist
Maine	Penobscot	0.82	0.13	0.05	Sandy	106.6	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Maine	Piscataquis	0.75	0.20	0.05	Sandy	103.7	Cool Moist
Maine	Sagadahoc	0.66	0.25	0.09	Sandy	100.0	Cool Moist
Maine	Somerset	0.71	0.23	0.06	Sandy	107.9	Cool Moist
Maine	Waldo	0.77	0.17	0.06	Sandy	107.9	Cool Moist
Maine	Washington	0.80	0.15	0.05	Sandy	110.1	Cool Moist
Maine	York	0.77	0.17	0.06	Sandy	106.3	Cool Moist
Maryland	Allegany	0.43	0.35	0.21	Silty	36.9	Warm Moist
Maryland	Anne Arundel	0.59	0.23	0.18	Sandy	54.9	Warm Moist
Maryland	Baltimore	0.55	0.26	0.19	Sandy	46.3	Warm Moist
Maryland	Baltimore	0.54	0.27	0.19	Sandy	45.2	Warm Moist
Maryland	Calvert	0.50	0.29	0.21	Silty	62.9	Warm Moist
Maryland	Caroline	0.56	0.26	0.18	Sandy	75.3	Warm Moist
Maryland	Carroll	0.47	0.33	0.20	Silty	38.6	Warm Moist
Maryland	Cecil	0.56	0.25	0.19	Sandy	53.0	Warm Moist
Maryland	Charles	0.49	0.29	0.22	Silty	53.7	Warm Moist
Maryland	Dorchester	0.47	0.31	0.21	Silty	78.9	Warm Moist
Maryland	Frederick	0.44	0.35	0.21	Silty	35.5	Warm Moist
Maryland	Garrett	0.43	0.36	0.21	Silty	38.6	Cool Moist
Maryland	Harford	0.54	0.27	0.19	Sandy	47.6	Warm Moist
Maryland	Howard	0.50	0.29	0.20	Silty	41.0	Warm Moist
Maryland	Kent	0.61	0.21	0.17	Sandy	56.4	Warm Moist
Maryland	Montgomery	0.48	0.31	0.21	Silty	39.9	Warm Moist
Maryland	Prince George's	0.52	0.27	0.21	Sandy	49.7	Warm Moist
Maryland	Queen Anne's	0.60	0.22	0.17	Sandy	63.5	Warm Moist
Maryland	Somerset	0.40	0.37	0.23	Silty	89.8	Warm Moist
Maryland	St. Mary's	0.44	0.33	0.23	Silty	70.4	Warm Moist
Maryland	Talbot	0.55	0.26	0.20	Sandy	65.4	Warm Moist
Maryland	Washington	0.43	0.36	0.21	Silty	34.8	Warm Moist
Maryland	Wicomico	0.41	0.37	0.22	Silty	99.7	Warm Moist
Maryland	Worcester	0.37	0.41	0.23	Silty	111.2	Warm Moist
Massachusetts	Barnstable	0.69	0.23	0.08	Sandy	107.3	Cool Moist
Massachusetts	Berkshire	0.63	0.24	0.12	Sandy	92.3	Cool Moist
Massachusetts	Bristol	0.68	0.23	0.09	Sandy	107.8	Cool Moist
Massachusetts	Dukes	0.71	0.20	0.09	Sandy	100.0	Warm Moist
Massachusetts	Essex	0.77	0.16	0.07	Sandy	120.7	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Massachusetts	Franklin	0.70	0.20	0.10	Sandy	107.5	Cool Moist
Massachusetts	Hampden	0.76	0.16	0.08	Sandy	100.3	Cool Moist
Massachusetts	Hampshire	0.71	0.19	0.10	Sandy	103.7	Cool Moist
Massachusetts	Middlesex	0.76	0.17	0.07	Sandy	119.2	Cool Moist
Massachusetts	Nantucket	0.77	0.17	0.07	Sandy	103.2	Cool Moist
Massachusetts	Norfolk	0.71	0.21	0.08	Sandy	114.6	Cool Moist
Massachusetts	Plymouth	0.68	0.23	0.09	Sandy	110.8	Cool Moist
Massachusetts	Suffolk	0.73	0.19	0.08	Sandy	117.4	Cool Moist
Massachusetts	Worcester	0.75	0.17	0.08	Sandy	112.4	Cool Moist
Michigan	Alcona	0.71	0.20	0.09	Sandy	96.0	Cool Moist
Michigan	Alger	0.77	0.18	0.05	Sandy	92.4	Cool Moist
Michigan	Allegan	0.52	0.24	0.25	Sandy	74.6	Cool Moist
Michigan	Alpena	0.74	0.18	0.08	Sandy	96.9	Cool Moist
Michigan	Antrim	0.80	0.12	0.08	Sandy	86.0	Cool Moist
Michigan	Arenac	0.65	0.23	0.12	Sandy	81.0	Cool Moist
Michigan	Baraga	0.84	0.12	0.04	Sandy	96.2	Cool Moist
Michigan	Barry	0.59	0.24	0.17	Sandy	77.4	Cool Moist
Michigan	Bay	0.63	0.24	0.12	Sandy	78.9	Cool Moist
Michigan	Benzie	0.58	0.17	0.24	Sandy	79.5	Cool Moist
Michigan	Berrien	0.39	0.37	0.23	Silty	74.2	Cool Moist
Michigan	Branch	0.48	0.32	0.21	Silty	80.0	Cool Moist
Michigan	Calhoun	0.53	0.28	0.18	Sandy	79.6	Cool Moist
Michigan	Cass	0.44	0.34	0.22	Silty	75.4	Cool Moist
Michigan	Charlevoix	0.80	0.13	0.07	Sandy	98.7	Cool Moist
Michigan	Cheboygan	0.83	0.12	0.05	Sandy	92.8	Cool Moist
Michigan	Chippewa	0.84	0.11	0.04	Sandy	94.3	Cool Moist
Michigan	Clare	0.83	0.13	0.05	Sandy	78.4	Cool Moist
Michigan	Clinton	0.61	0.24	0.15	Sandy	78.4	Cool Moist
Michigan	Crawford	0.84	0.11	0.04	Sandy	83.0	Cool Moist
Michigan	Delta	0.82	0.12	0.06	Sandy	113.3	Cool Moist
Michigan	Dickinson	0.85	0.11	0.04	Sandy	107.4	Cool Moist
Michigan	Eaton	0.59	0.25	0.15	Sandy	78.8	Cool Moist
Michigan	Emmet	0.81	0.13	0.06	Sandy	94.8	Cool Moist
Michigan	Genesee	0.49	0.30	0.20	Silty	79.3	Cool Moist
Michigan	Gladwin	0.75	0.17	0.08	Sandy	79.6	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Michigan	Gogebic	0.65	0.27	0.08	Sandy	88.3	Cool Moist
Michigan	Grand Traverse	0.73	0.14	0.13	Sandy	80.6	Cool Moist
Michigan	Gratiot	0.66	0.22	0.12	Sandy	78.4	Cool Moist
Michigan	Hillsdale	0.47	0.32	0.21	Silty	79.8	Cool Moist
Michigan	Houghton	0.77	0.18	0.05	Sandy	95.8	Cool Moist
Michigan	Huron	0.47	0.34	0.19	Silty	81.6	Cool Moist
Michigan	Ingham	0.54	0.28	0.18	Sandy	79.0	Cool Moist
Michigan	Ionia	0.66	0.21	0.13	Sandy	77.6	Cool Moist
Michigan	Iosco	0.60	0.27	0.13	Sandy	89.4	Cool Moist
Michigan	Iron	0.84	0.11	0.04	Sandy	98.2	Cool Moist
Michigan	Isabella	0.78	0.15	0.07	Sandy	78.0	Cool Moist
Michigan	Jackson	0.50	0.31	0.20	Silty	79.7	Cool Moist
Michigan	Kalamazoo	0.52	0.29	0.20	Silty	77.6	Cool Moist
Michigan	Kalkaska	0.82	0.12	0.07	Sandy	79.5	Cool Moist
Michigan	Kent	0.64	0.18	0.18	Sandy	75.1	Cool Moist
Michigan	Keweenaw	0.68	0.26	0.06	Sandy	91.3	Cool Moist
Michigan	Lake	0.68	0.15	0.17	Sandy	73.3	Cool Moist
Michigan	Lapeer	0.44	0.31	0.24	Silty	79.7	Cool Moist
Michigan	Leelanau	0.69	0.15	0.16	Sandy	93.0	Cool Moist
Michigan	Lenawee	0.46	0.33	0.21	Silty	79.0	Cool Moist
Michigan	Livingston	0.48	0.31	0.20	Silty	79.3	Cool Moist
Michigan	Luce	0.83	0.13	0.05	Sandy	96.9	Cool Moist
Michigan	Mackinac	0.82	0.12	0.06	Sandy	98.3	Cool Moist
Michigan	Macomb	0.36	0.32	0.32	Clayey	78.5	Cool Moist
Michigan	Manistee	0.58	0.18	0.24	Sandy	76.0	Cool Moist
Michigan	Marquette	0.82	0.14	0.04	Sandy	99.7	Cool Moist
Michigan	Mason	0.54	0.20	0.26	Sandy	71.9	Cool Moist
Michigan	Mecosta	0.75	0.15	0.11	Sandy	75.9	Cool Moist
Michigan	Menominee	0.79	0.13	0.08	Sandy	108.6	Cool Moist
Michigan	Midland	0.71	0.19	0.10	Sandy	78.4	Cool Moist
Michigan	Missaukee	0.82	0.12	0.07	Sandy	78.3	Cool Moist
Michigan	Monroe	0.42	0.34	0.25	Silty	77.4	Cool Moist
Michigan	Montcalm	0.71	0.18	0.11	Sandy	77.5	Cool Moist
Michigan	Montmorency	0.85	0.11	0.04	Sandy	92.2	Cool Moist
Michigan	Muskegon	0.52	0.21	0.27	Sandy	72.2	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Michigan	Newaygo	0.66	0.16	0.18	Sandy	73.0	Cool Moist
Michigan	Oakland	0.42	0.32	0.25	Silty	79.0	Cool Moist
Michigan	Oceana	0.54	0.20	0.26	Sandy	70.5	Cool Moist
Michigan	Ogemaw	0.77	0.16	0.07	Sandy	85.0	Cool Moist
Michigan	Ontonagon	0.68	0.26	0.06	Sandy	86.7	Cool Moist
Michigan	Osceola	0.78	0.13	0.09	Sandy	76.2	Cool Moist
Michigan	Oscoda	0.83	0.12	0.05	Sandy	89.8	Cool Moist
Michigan	Otsego	0.84	0.11	0.04	Sandy	86.5	Cool Moist
Michigan	Ottawa	0.52	0.21	0.27	Sandy	74.0	Cool Moist
Michigan	Presque Isle	0.79	0.14	0.06	Sandy	94.4	Cool Moist
Michigan	Roscommon	0.82	0.13	0.05	Sandy	80.9	Cool Moist
Michigan	Saginaw	0.60	0.25	0.15	Sandy	78.9	Cool Moist
Michigan	Sanilac	0.39	0.34	0.27	Silty	80.4	Cool Moist
Michigan	Schoolcraft	0.81	0.12	0.07	Sandy	111.3	Cool Moist
Michigan	Shiawassee	0.56	0.27	0.17	Sandy	78.8	Cool Moist
Michigan	St. Clair	0.35	0.32	0.33	Clayey	79.6	Cool Moist
Michigan	St. Joseph	0.46	0.33	0.21	Silty	78.0	Cool Moist
Michigan	Tuscola	0.53	0.29	0.18	Sandy	79.4	Cool Moist
Michigan	Van Buren	0.45	0.31	0.24	Silty	74.4	Cool Moist
Michigan	Washtenaw	0.45	0.33	0.22	Silty	79.1	Cool Moist
Michigan	Wayne	0.39	0.33	0.28	Clayey	77.7	Cool Moist
Michigan	Wexford	0.71	0.14	0.14	Sandy	76.8	Cool Moist
Minnesota	Aitkin	0.55	0.31	0.15	Sandy	95.6	Cool Moist
Minnesota	Anoka	0.46	0.33	0.21	Silty	87.4	Cool Moist
Minnesota	Becker	0.28	0.36	0.36	Clayey	94.8	Cool Moist
Minnesota	Beltrami	0.29	0.41	0.30	Clayey	119.6	Cool Moist
Minnesota	Benton	0.45	0.34	0.21	Silty	93.6	Cool Moist
Minnesota	Big Stone	0.23	0.53	0.24	Silty	94.9	Cool Dry
Minnesota	Blue Earth	0.38	0.39	0.23	Silty	108.3	Cool Moist
Minnesota	Brown	0.33	0.44	0.23	Silty	108.5	Cool Moist
Minnesota	Carlton	0.44	0.40	0.16	Silty	92.3	Cool Moist
Minnesota	Carver	0.43	0.35	0.22	Silty	96.1	Cool Moist
Minnesota	Cass	0.47	0.32	0.21	Silty	99.1	Cool Moist
Minnesota	Chippewa	0.27	0.49	0.24	Silty	100.7	Cool Dry
Minnesota	Chisago	0.47	0.32	0.21	Silty	83.9	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Minnesota	Clay	0.19	0.45	0.36	Silty	92.8	Cool Dry
Minnesota	Clearwater	0.26	0.40	0.34	Clayey	110.8	Cool Moist
Minnesota	Cook	0.60	0.33	0.08	Sandy	72.8	Cool Moist
Minnesota	Cottonwood	0.30	0.46	0.24	Silty	107.0	Cool Moist
Minnesota	Crow Wing	0.57	0.25	0.18	Sandy	95.3	Cool Moist
Minnesota	Dakota	0.44	0.34	0.22	Silty	84.7	Cool Moist
Minnesota	Dodge	0.40	0.37	0.23	Silty	89.5	Cool Moist
Minnesota	Douglas	0.34	0.41	0.25	Silty	96.2	Cool Moist
Minnesota	Faribault	0.38	0.39	0.23	Silty	109.9	Cool Moist
Minnesota	Fillmore	0.38	0.39	0.23	Silty	76.6	Cool Moist
Minnesota	Freeborn	0.39	0.38	0.23	Silty	103.6	Cool Moist
Minnesota	Goodhue	0.44	0.35	0.22	Silty	78.3	Cool Moist
Minnesota	Grant	0.25	0.48	0.27	Silty	95.7	Cool Dry
Minnesota	Hennepin	0.45	0.34	0.22	Silty	89.9	Cool Moist
Minnesota	Houston	0.40	0.37	0.23	Silty	64.2	Cool Moist
Minnesota	Hubbard	0.37	0.32	0.31	Clayey	101.3	Cool Moist
Minnesota	Isanti	0.47	0.32	0.21	Silty	87.9	Cool Moist
Minnesota	Itasca	0.37	0.48	0.15	Silty	101.8	Cool Moist
Minnesota	Jackson	0.34	0.44	0.23	Silty	105.4	Cool Moist
Minnesota	Kanabec	0.49	0.31	0.19	Silty	89.9	Cool Moist
Minnesota	Kandiyohi	0.33	0.44	0.23	Silty	102.9	Cool Moist
Minnesota	Kittson	0.29	0.44	0.27	Silty	112.5	Cool Dry
Minnesota	Koochiching	0.32	0.41	0.28	Silty	106.8	Cool Moist
Minnesota	Lac qui Parle	0.23	0.53	0.24	Silty	95.7	Cool Dry
Minnesota	Lake	0.41	0.48	0.11	Silty	70.5	Cool Moist
Minnesota	Lake of the Woods	0.31	0.37	0.33	Clayey	127.3	Cool Moist
Minnesota	Le Sueur	0.41	0.37	0.22	Silty	101.5	Cool Moist
Minnesota	Lincoln	0.25	0.51	0.24	Silty	93.2	Cool Dry
Minnesota	Lyon	0.27	0.49	0.24	Silty	99.3	Cool Dry
Minnesota	Mahnomen	0.23	0.40	0.37	Clayey	103.2	Cool Moist
Minnesota	Marshall	0.30	0.44	0.27	Silty	115.8	Cool Dry
Minnesota	Martin	0.35	0.42	0.23	Silty	108.6	Cool Moist
Minnesota	McLeod	0.39	0.39	0.22	Silty	101.2	Cool Moist
Minnesota	Meeker	0.37	0.41	0.23	Silty	101.7	Cool Moist
Minnesota	Mille Lacs	0.49	0.31	0.20	Silty	91.7	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Minnesota	Morrison	0.47	0.32	0.21	Silty	94.3	Cool Moist
Minnesota	Mower	0.38	0.39	0.23	Silty	89.7	Cool Moist
Minnesota	Murray	0.29	0.48	0.24	Silty	100.1	Cool Moist
Minnesota	Nicollet	0.36	0.41	0.23	Silty	106.1	Cool Moist
Minnesota	Nobles	0.33	0.44	0.23	Silty	97.9	Cool Moist
Minnesota	Norman	0.20	0.44	0.37	Silty	98.7	Cool Dry
Minnesota	Olmsted	0.40	0.37	0.23	Silty	79.1	Cool Moist
Minnesota	Otter Tail	0.32	0.36	0.32	Clayey	92.3	Cool Moist
Minnesota	Pennington	0.27	0.42	0.31	Clayey	118.0	Cool Dry
Minnesota	Pine	0.46	0.35	0.18	Silty	88.2	Cool Moist
Minnesota	Pipestone	0.28	0.49	0.24	Silty	91.0	Cool Moist
Minnesota	Polk	0.23	0.44	0.33	Clayey	104.1	Cool Dry
Minnesota	Pope	0.31	0.46	0.23	Silty	99.2	Cool Dry
Minnesota	Ramsey	0.46	0.33	0.21	Silty	84.0	Cool Moist
Minnesota	Red Lake	0.25	0.42	0.33	Clayey	113.3	Cool Dry
Minnesota	Redwood	0.29	0.47	0.24	Silty	105.3	Cool Dry
Minnesota	Renville	0.31	0.45	0.23	Silty	106.0	Cool Moist
Minnesota	Rice	0.42	0.36	0.22	Silty	91.8	Cool Moist
Minnesota	Rock	0.33	0.45	0.23	Silty	87.9	Cool Dry
Minnesota	Roseau	0.30	0.40	0.30	Clayey	125.4	Cool Moist
Minnesota	Scott	0.43	0.35	0.22	Silty	95.9	Cool Moist
Minnesota	Sherburne	0.46	0.33	0.21	Silty	92.0	Cool Moist
Minnesota	Sibley	0.38	0.39	0.23	Silty	103.2	Cool Moist
Minnesota	St. Louis	0.41	0.45	0.15	Silty	85.9	Cool Moist
Minnesota	Stearns	0.39	0.39	0.22	Silty	97.7	Cool Moist
Minnesota	Steele	0.40	0.37	0.23	Silty	96.8	Cool Moist
Minnesota	Stevens	0.25	0.51	0.24	Silty	97.5	Cool Dry
Minnesota	Swift	0.26	0.50	0.24	Silty	98.7	Cool Dry
Minnesota	Todd	0.42	0.34	0.25	Silty	95.1	Cool Moist
Minnesota	Traverse	0.23	0.52	0.25	Silty	94.5	Cool Dry
Minnesota	Wabasha	0.43	0.35	0.22	Silty	72.3	Cool Moist
Minnesota	Wadena	0.47	0.24	0.29	Sandy	92.4	Cool Moist
Minnesota	Waseca	0.40	0.37	0.23	Silty	104.2	Cool Moist
Minnesota	Washington	0.46	0.33	0.21	Silty	80.8	Cool Moist
Minnesota	Watonwan	0.33	0.44	0.23	Silty	109.3	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Minnesota	Wilkin	0.20	0.47	0.33	Clayey	92.2	Cool Dry
Minnesota	Winona	0.41	0.37	0.23	Silty	68.1	Cool Moist
Minnesota	Wright	0.42	0.36	0.22	Silty	97.1	Cool Moist
Minnesota	Yellow Medicine	0.25	0.51	0.24	Silty	98.8	Cool Dry
Mississippi	Adams	0.34	0.30	0.36	Clayey	31.8	Warm Moist
Mississippi	Alcorn	0.43	0.25	0.32	Clayey	24.5	Warm Moist
Mississippi	Amite	0.33	0.30	0.37	Clayey	37.8	Warm Moist
Mississippi	Attala	0.41	0.27	0.33	Clayey	27.7	Warm Moist
Mississippi	Benton	0.37	0.26	0.37	Clayey	25.2	Warm Moist
Mississippi	Bolivar	0.35	0.26	0.38	Clayey	29.9	Warm Moist
Mississippi	Calhoun	0.46	0.24	0.30	Sandy	26.3	Warm Moist
Mississippi	Carroll	0.36	0.27	0.37	Clayey	27.8	Warm Moist
Mississippi	Chickasaw	0.51	0.23	0.27	Sandy	25.7	Warm Moist
Mississippi	Choctaw	0.46	0.24	0.30	Sandy	27.5	Warm Moist
Mississippi	Claiborne	0.33	0.29	0.38	Clayey	29.5	Warm Moist
Mississippi	Clarke	0.50	0.25	0.25	Sandy	29.9	Warm Moist
Mississippi	Clay	0.51	0.22	0.26	Sandy	26.7	Warm Moist
Mississippi	Coahoma	0.35	0.26	0.38	Clayey	28.3	Warm Moist
Mississippi	Copiah	0.34	0.29	0.38	Clayey	29.0	Warm Moist
Mississippi	Covington	0.41	0.25	0.33	Clayey	31.9	Warm Moist
Mississippi	DeSoto	0.25	0.28	0.46	Clayey	26.7	Warm Moist
Mississippi	Forrest	0.45	0.26	0.29	Clayey	47.3	Warm Moist
Mississippi	Franklin	0.33	0.29	0.38	Clayey	31.8	Warm Moist
Mississippi	George	0.50	0.26	0.24	Sandy	57.4	Warm Moist
Mississippi	Greene	0.52	0.24	0.24	Sandy	44.4	Warm Moist
Mississippi	Grenada	0.40	0.25	0.35	Clayey	27.0	Warm Moist
Mississippi	Hancock	0.35	0.31	0.34	Clayey	78.7	Warm Moist
Mississippi	Harrison	0.40	0.30	0.30	Clayey	78.7	Warm Moist
Mississippi	Hinds	0.33	0.30	0.37	Clayey	28.7	Warm Moist
Mississippi	Holmes	0.35	0.28	0.37	Clayey	27.9	Warm Moist
Mississippi	Humphreys	0.34	0.28	0.38	Clayey	29.1	Warm Moist
Mississippi	Issaquena	0.33	0.29	0.38	Clayey	30.4	Warm Moist
Mississippi	Itawamba	0.52	0.23	0.25	Sandy	25.2	Warm Moist
Mississippi	Jackson	0.44	0.29	0.27	Silty	76.7	Warm Moist
Mississippi	Jasper	0.45	0.26	0.29	Clayey	29.4	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Mississippi	Jefferson	0.33	0.29	0.38	Clayey	29.2	Warm Moist
Mississippi	Jefferson Davis	0.37	0.27	0.37	Clayey	31.1	Warm Moist
Mississippi	Jones	0.46	0.24	0.30	Sandy	32.6	Warm Moist
Mississippi	Kemper	0.49	0.26	0.25	Sandy	28.1	Warm Moist
Mississippi	Lafayette	0.41	0.25	0.34	Clayey	25.8	Warm Moist
Mississippi	Lamar	0.41	0.27	0.33	Clayey	41.9	Warm Moist
Mississippi	Lauderdale	0.48	0.27	0.25	Sandy	28.8	Warm Moist
Mississippi	Lawrence	0.34	0.27	0.38	Clayey	30.7	Warm Moist
Mississippi	Leake	0.40	0.29	0.32	Clayey	27.9	Warm Moist
Mississippi	Lee	0.53	0.22	0.25	Sandy	25.0	Warm Moist
Mississippi	Leflore	0.35	0.26	0.38	Clayey	28.0	Warm Moist
Mississippi	Lincoln	0.34	0.28	0.38	Clayey	30.6	Warm Moist
Mississippi	Lowndes	0.52	0.23	0.25	Sandy	26.9	Warm Moist
Mississippi	Madison	0.34	0.30	0.36	Clayey	27.9	Warm Moist
Mississippi	Marion	0.36	0.28	0.36	Clayey	40.7	Warm Moist
Mississippi	Marshall	0.33	0.27	0.41	Clayey	25.8	Warm Moist
Mississippi	Monroe	0.52	0.23	0.25	Sandy	25.9	Warm Moist
Mississippi	Montgomery	0.42	0.25	0.33	Clayey	27.5	Warm Moist
Mississippi	Neshoba	0.44	0.27	0.29	Clayey	28.0	Warm Moist
Mississippi	Newton	0.44	0.28	0.28	Clayey	28.5	Warm Moist
Mississippi	Noxubee	0.51	0.24	0.25	Sandy	27.6	Warm Moist
Mississippi	Oktibbeha	0.50	0.23	0.26	Sandy	27.5	Warm Moist
Mississippi	Panola	0.35	0.26	0.39	Clayey	26.6	Warm Moist
Mississippi	Pearl River	0.40	0.29	0.32	Clayey	53.8	Warm Moist
Mississippi	Perry	0.49	0.25	0.26	Sandy	48.7	Warm Moist
Mississippi	Pike	0.33	0.29	0.38	Clayey	38.7	Warm Moist
Mississippi	Pontotoc	0.48	0.23	0.28	Sandy	25.3	Warm Moist
Mississippi	Prentiss	0.49	0.23	0.28	Sandy	24.6	Warm Moist
Mississippi	Quitman	0.34	0.27	0.39	Clayey	27.5	Warm Moist
Mississippi	Rankin	0.34	0.30	0.36	Clayey	28.3	Warm Moist
Mississippi	Scott	0.39	0.29	0.32	Clayey	28.2	Warm Moist
Mississippi	Sharkey	0.34	0.29	0.38	Clayey	29.9	Warm Moist
Mississippi	Simpson	0.35	0.28	0.37	Clayey	28.7	Warm Moist
Mississippi	Smith	0.40	0.27	0.32	Clayey	29.0	Warm Moist
Mississippi	Stone	0.46	0.28	0.27	Sandy	60.7	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Mississippi	Sunflower	0.35	0.27	0.38	Clayey	28.9	Warm Moist
Mississippi	Tallahatchie	0.35	0.26	0.38	Clayey	27.5	Warm Moist
Mississippi	Tate	0.30	0.28	0.43	Clayey	26.6	Warm Moist
Mississippi	Tippah	0.42	0.25	0.34	Clayey	24.6	Warm Moist
Mississippi	Tishomingo	0.48	0.24	0.28	Sandy	25.0	Warm Moist
Mississippi	Tunica	0.33	0.27	0.40	Clayey	27.7	Warm Moist
Mississippi	Union	0.46	0.24	0.30	Sandy	25.0	Warm Moist
Mississippi	Walthall	0.34	0.29	0.38	Clayey	39.6	Warm Moist
Mississippi	Warren	0.33	0.29	0.38	Clayey	29.7	Warm Moist
Mississippi	Washington	0.34	0.27	0.38	Clayey	30.5	Warm Moist
Mississippi	Wayne	0.51	0.23	0.26	Sandy	33.4	Warm Moist
Mississippi	Webster	0.46	0.24	0.30	Sandy	27.2	Warm Moist
Mississippi	Wilkinson	0.33	0.31	0.36	Clayey	36.7	Warm Moist
Mississippi	Winston	0.47	0.25	0.28	Sandy	27.7	Warm Moist
Mississippi	Yalobusha	0.40	0.25	0.35	Clayey	26.5	Warm Moist
Mississippi	Yazoo	0.33	0.30	0.37	Clayey	28.7	Warm Moist
Missouri	Adair	0.40	0.37	0.23	Silty	50.2	Warm Moist
Missouri	Andrew	0.35	0.40	0.24	Silty	58.9	Warm Moist
Missouri	Atchison	0.36	0.40	0.24	Silty	59.2	Warm Moist
Missouri	Audrain	0.45	0.34	0.22	Silty	43.1	Warm Moist
Missouri	Barry	0.48	0.27	0.25	Sandy	32.8	Warm Moist
Missouri	Barton	0.39	0.37	0.24	Silty	47.6	Warm Moist
Missouri	Bates	0.38	0.39	0.23	Silty	52.1	Warm Moist
Missouri	Benton	0.41	0.37	0.22	Silty	42.0	Warm Moist
Missouri	Bollinger	0.49	0.27	0.24	Sandy	35.7	Warm Moist
Missouri	Boone	0.44	0.34	0.22	Silty	41.4	Warm Moist
Missouri	Buchanan	0.35	0.40	0.24	Silty	58.7	Warm Moist
Missouri	Butler	0.49	0.28	0.23	Silty	32.9	Warm Moist
Missouri	Caldwell	0.36	0.40	0.24	Silty	55.4	Warm Moist
Missouri	Callaway	0.46	0.33	0.22	Silty	39.2	Warm Moist
Missouri	Camden	0.44	0.33	0.22	Silty	33.1	Warm Moist
Missouri	Cape Girardeau	0.46	0.29	0.24	Silty	35.9	Warm Moist
Missouri	Carroll	0.38	0.39	0.23	Silty	52.0	Warm Moist
Missouri	Carter	0.49	0.27	0.24	Sandy	32.0	Warm Moist
Missouri	Cass	0.37	0.40	0.23	Silty	54.4	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Missouri	Cedar	0.40	0.37	0.23	Silty	44.8	Warm Moist
Missouri	Chariton	0.40	0.37	0.23	Silty	49.3	Warm Moist
Missouri	Christian	0.49	0.26	0.25	Sandy	31.1	Warm Moist
Missouri	Clark	0.45	0.34	0.22	Silty	51.3	Warm Moist
Missouri	Clay	0.36	0.40	0.24	Silty	56.2	Warm Moist
Missouri	Clinton	0.36	0.40	0.24	Silty	56.9	Warm Moist
Missouri	Cole	0.45	0.32	0.22	Silty	34.6	Warm Moist
Missouri	Cooper	0.42	0.36	0.22	Silty	42.9	Warm Moist
Missouri	Crawford	0.49	0.27	0.24	Sandy	30.8	Warm Moist
Missouri	Dade	0.42	0.34	0.24	Silty	42.2	Warm Moist
Missouri	Dallas	0.46	0.31	0.23	Silty	34.3	Warm Moist
Missouri	Daviess	0.36	0.40	0.24	Silty	56.0	Warm Moist
Missouri	DeKalb	0.36	0.40	0.24	Silty	57.5	Warm Moist
Missouri	Dent	0.49	0.27	0.24	Sandy	31.2	Warm Moist
Missouri	Douglas	0.51	0.25	0.24	Sandy	28.4	Warm Moist
Missouri	Dunklin	0.44	0.29	0.26	Silty	30.6	Warm Moist
Missouri	Franklin	0.47	0.29	0.23	Silty	34.3	Warm Moist
Missouri	Gasconade	0.48	0.29	0.23	Silty	33.0	Warm Moist
Missouri	Gentry	0.36	0.40	0.24	Silty	58.2	Warm Moist
Missouri	Greene	0.46	0.30	0.24	Silty	36.4	Warm Moist
Missouri	Grundy	0.36	0.40	0.24	Silty	55.7	Warm Moist
Missouri	Harrison	0.36	0.40	0.24	Silty	57.8	Warm Moist
Missouri	Henry	0.38	0.39	0.22	Silty	47.4	Warm Moist
Missouri	Hickory	0.42	0.35	0.23	Silty	38.5	Warm Moist
Missouri	Holt	0.36	0.40	0.24	Silty	59.4	Warm Moist
Missouri	Howard	0.42	0.36	0.22	Silty	44.5	Warm Moist
Missouri	Howell	0.50	0.26	0.24	Sandy	28.8	Warm Moist
Missouri	Iron	0.48	0.28	0.24	Silty	33.4	Warm Moist
Missouri	Jackson	0.36	0.40	0.24	Silty	55.6	Warm Moist
Missouri	Jasper	0.41	0.35	0.24	Silty	44.2	Warm Moist
Missouri	Jefferson	0.45	0.31	0.24	Silty	34.1	Warm Moist
Missouri	Johnson	0.38	0.39	0.23	Silty	50.2	Warm Moist
Missouri	Knox	0.42	0.35	0.22	Silty	49.1	Warm Moist
Missouri	Laclede	0.48	0.29	0.23	Silty	30.6	Warm Moist
Missouri	Lafayette	0.37	0.39	0.23	Silty	52.1	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Missouri	Lawrence	0.44	0.31	0.24	Silty	38.9	Warm Moist
Missouri	Lewis	0.45	0.34	0.22	Silty	49.0	Warm Moist
Missouri	Lincoln	0.47	0.32	0.21	Silty	41.1	Warm Moist
Missouri	Linn	0.38	0.38	0.23	Silty	51.6	Warm Moist
Missouri	Livingston	0.37	0.39	0.24	Silty	53.4	Warm Moist
Missouri	Macon	0.41	0.36	0.22	Silty	47.6	Warm Moist
Missouri	Madison	0.48	0.28	0.24	Silty	35.3	Warm Moist
Missouri	Maries	0.47	0.30	0.23	Silty	30.8	Warm Moist
Missouri	Marion	0.45	0.33	0.21	Silty	46.0	Warm Moist
Missouri	McDonald	0.46	0.30	0.24	Silty	35.9	Warm Moist
Missouri	Mercer	0.37	0.39	0.24	Silty	57.5	Warm Moist
Missouri	Miller	0.46	0.32	0.22	Silty	31.1	Warm Moist
Missouri	Mississippi	0.46	0.31	0.23	Silty	32.1	Warm Moist
Missouri	Moniteau	0.44	0.34	0.22	Silty	36.4	Warm Moist
Missouri	Monroe	0.45	0.34	0.22	Silty	44.5	Warm Moist
Missouri	Montgomery	0.47	0.32	0.21	Silty	39.8	Warm Moist
Missouri	Morgan	0.42	0.36	0.22	Silty	38.4	Warm Moist
Missouri	New Madrid	0.48	0.30	0.23	Silty	31.8	Warm Moist
Missouri	Newton	0.44	0.32	0.24	Silty	39.3	Warm Moist
Missouri	Nodaway	0.36	0.40	0.24	Silty	59.8	Warm Moist
Missouri	Oregon	0.49	0.27	0.24	Sandy	30.1	Warm Moist
Missouri	Osage	0.47	0.31	0.23	Silty	34.4	Warm Moist
Missouri	Ozark	0.51	0.25	0.24	Sandy	27.1	Warm Moist
Missouri	Pemiscot	0.44	0.30	0.26	Silty	30.7	Warm Moist
Missouri	Perry	0.44	0.31	0.24	Silty	35.6	Warm Moist
Missouri	Pettis	0.40	0.37	0.23	Silty	45.9	Warm Moist
Missouri	Phelps	0.48	0.28	0.23	Silty	30.3	Warm Moist
Missouri	Pike	0.47	0.32	0.21	Silty	43.5	Warm Moist
Missouri	Platte	0.35	0.41	0.24	Silty	58.5	Warm Moist
Missouri	Polk	0.43	0.34	0.23	Silty	39.5	Warm Moist
Missouri	Pulaski	0.48	0.29	0.23	Silty	29.8	Warm Moist
Missouri	Putnam	0.39	0.38	0.23	Silty	54.8	Warm Moist
Missouri	Ralls	0.46	0.33	0.21	Silty	44.3	Warm Moist
Missouri	Randolph	0.42	0.36	0.22	Silty	46.0	Warm Moist
Missouri	Ray	0.36	0.40	0.24	Silty	54.5	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Missouri	Reynolds	0.49	0.27	0.24	Sandy	33.3	Warm Moist
Missouri	Ripley	0.49	0.27	0.24	Sandy	30.8	Warm Moist
Missouri	Saline	0.40	0.37	0.23	Silty	48.8	Warm Moist
Missouri	Schuyler	0.40	0.37	0.23	Silty	52.2	Warm Moist
Missouri	Scotland	0.42	0.35	0.22	Silty	51.3	Warm Moist
Missouri	Scott	0.47	0.30	0.24	Silty	34.2	Warm Moist
Missouri	Shannon	0.49	0.27	0.24	Sandy	32.2	Warm Moist
Missouri	Shelby	0.44	0.35	0.22	Silty	46.7	Warm Moist
Missouri	St. Charles	0.47	0.31	0.22	Silty	39.1	Warm Moist
Missouri	St. Clair	0.39	0.38	0.22	Silty	44.7	Warm Moist
Missouri	St. Francois	0.46	0.29	0.24	Silty	34.0	Warm Moist
Missouri	St. Louis	0.46	0.31	0.23	Silty	39.1	Warm Moist
Missouri	St. Louis	0.45	0.32	0.23	Silty	39.5	Warm Moist
Missouri	Ste. Genevieve	0.45	0.31	0.24	Silty	34.9	Warm Moist
Missouri	Stoddard	0.48	0.28	0.23	Silty	34.4	Warm Moist
Missouri	Stone	0.48	0.28	0.25	Silty	33.5	Warm Moist
Missouri	Sullivan	0.38	0.38	0.23	Silty	52.9	Warm Moist
Missouri	Taney	0.50	0.25	0.25	Sandy	28.8	Warm Moist
Missouri	Texas	0.50	0.26	0.24	Sandy	30.7	Warm Moist
Missouri	Vernon	0.38	0.38	0.23	Silty	50.9	Warm Moist
Missouri	Warren	0.47	0.31	0.22	Silty	37.3	Warm Moist
Missouri	Washington	0.48	0.28	0.24	Silty	32.1	Warm Moist
Missouri	Wayne	0.49	0.27	0.24	Sandy	34.7	Warm Moist
Missouri	Webster	0.48	0.27	0.24	Sandy	32.9	Warm Moist
Missouri	Worth	0.36	0.40	0.24	Silty	59.4	Warm Moist
Missouri	Wright	0.50	0.26	0.24	Sandy	30.1	Warm Moist
Montana	Beaverhead	0.41	0.41	0.18	Silty	47.5	Cool Dry
Montana	Big Horn	0.38	0.41	0.21	Silty	26.1	Cool Dry
Montana	Blaine	0.35	0.41	0.23	Silty	32.7	Cool Dry
Montana	Broadwater	0.37	0.43	0.20	Silty	43.5	Cool Dry
Montana	Carbon	0.36	0.42	0.21	Silty	32.3	Cool Dry
Montana	Carter	0.48	0.28	0.24	Silty	29.8	Cool Dry
Montana	Cascade	0.36	0.42	0.22	Silty	39.7	Cool Dry
Montana	Chouteau	0.35	0.41	0.24	Silty	35.2	Cool Dry
Montana	Custer	0.35	0.42	0.23	Silty	27.0	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Montana	Daniels	0.35	0.42	0.22	Silty	40.4	Cool Dry
Montana	Dawson	0.36	0.41	0.22	Silty	31.9	Cool Dry
Montana	Deer Lodge	0.42	0.43	0.15	Silty	46.7	Cool Dry
Montana	Fallon	0.32	0.45	0.23	Silty	32.0	Cool Dry
Montana	Fergus	0.34	0.42	0.24	Silty	32.2	Cool Dry
Montana	Flathead	0.41	0.42	0.17	Silty	47.3	Cool Moist
Montana	Gallatin	0.36	0.42	0.22	Silty	42.2	Cool Moist
Montana	Garfield	0.35	0.42	0.23	Silty	25.2	Cool Dry
Montana	Glacier	0.38	0.40	0.22	Silty	49.0	Cool Dry
Montana	Golden Valley	0.35	0.42	0.24	Silty	31.7	Cool Dry
Montana	Granite	0.42	0.43	0.15	Silty	46.7	Cool Moist
Montana	Hill	0.36	0.41	0.23	Silty	35.4	Cool Dry
Montana	Jefferson	0.38	0.43	0.19	Silty	45.4	Cool Dry
Montana	Judith Basin	0.35	0.42	0.23	Silty	39.5	Cool Dry
Montana	Lake	0.42	0.43	0.15	Silty	47.0	Cool Moist
Montana	Lewis and Clark	0.37	0.43	0.20	Silty	41.3	Cool Dry
Montana	Liberty	0.36	0.41	0.23	Silty	35.6	Cool Dry
Montana	Lincoln	0.44	0.43	0.14	Silty	53.7	Cool Moist
Montana	Madison	0.38	0.41	0.20	Silty	47.2	Cool Dry
Montana	McCone	0.36	0.41	0.22	Silty	29.2	Cool Dry
Montana	Meagher	0.36	0.43	0.21	Silty	41.9	Cool Dry
Montana	Mineral	0.45	0.43	0.12	Silty	55.5	Cool Moist
Montana	Missoula	0.42	0.43	0.14	Silty	48.3	Cool Moist
Montana	Musselshell	0.34	0.42	0.24	Silty	27.3	Cool Dry
Montana	Park	0.36	0.42	0.22	Silty	38.9	Cool Moist
Montana	Petroleum	0.34	0.42	0.24	Silty	26.7	Cool Dry
Montana	Phillips	0.36	0.41	0.23	Silty	29.2	Cool Dry
Montana	Pondera	0.38	0.40	0.22	Silty	39.4	Cool Dry
Montana	Powder River	0.53	0.25	0.22	Sandy	27.1	Cool Dry
Montana	Powell	0.39	0.44	0.18	Silty	44.6	Cool Moist
Montana	Prairie	0.41	0.43	0.16	Silty	28.3	Cool Dry
Montana	Ravalli	0.44	0.43	0.13	Silty	46.3	Cool Moist
Montana	Richland	0.36	0.41	0.23	Silty	37.0	Cool Dry
Montana	Roosevelt	0.36	0.41	0.23	Silty	39.4	Cool Dry
Montana	Rosebud	0.41	0.37	0.22	Silty	25.5	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Montana	Sanders	0.44	0.43	0.13	Silty	54.7	Cool Moist
Montana	Sheridan	0.36	0.42	0.23	Silty	47.9	Cool Dry
Montana	Silver Bow	0.41	0.43	0.16	Silty	47.7	Cool Dry
Montana	Stillwater	0.36	0.42	0.23	Silty	31.7	Cool Dry
Montana	Sweet Grass	0.36	0.41	0.23	Silty	35.3	Cool Dry
Montana	Teton	0.37	0.41	0.21	Silty	38.6	Cool Dry
Montana	Toole	0.37	0.40	0.23	Silty	39.8	Cool Dry
Montana	Treasure	0.36	0.41	0.23	Silty	25.7	Cool Dry
Montana	Valley	0.36	0.41	0.23	Silty	30.7	Cool Dry
Montana	Wheatland	0.35	0.42	0.23	Silty	37.8	Cool Dry
Montana	Wibaux	0.35	0.42	0.23	Silty	34.7	Cool Dry
Montana	Yellowstone	0.35	0.42	0.23	Silty	27.5	Cool Dry
Nebraska	Adams	0.36	0.41	0.23	Silty	47.6	Warm Dry
Nebraska	Antelope	0.65	0.22	0.13	Sandy	45.6	Cool Dry
Nebraska	Arthur	0.65	0.23	0.12	Sandy	29.0	Cool Dry
Nebraska	Banner	0.37	0.41	0.22	Silty	31.4	Cool Dry
Nebraska	Blaine	0.81	0.12	0.07	Sandy	29.7	Cool Dry
Nebraska	Boone	0.63	0.24	0.13	Sandy	44.6	Cool Dry
Nebraska	Box Butte	0.45	0.35	0.19	Silty	31.6	Cool Dry
Nebraska	Boyd	0.52	0.30	0.18	Silty	46.1	Cool Dry
Nebraska	Brown	0.78	0.15	0.08	Sandy	32.2	Cool Dry
Nebraska	Buffalo	0.41	0.38	0.21	Silty	42.9	Cool Dry
Nebraska	Burt	0.39	0.38	0.23	Silty	55.9	Cool Dry
Nebraska	Butler	0.41	0.38	0.22	Silty	52.5	Warm Dry
Nebraska	Cass	0.36	0.41	0.23	Silty	56.4	Warm Moist
Nebraska	Cedar	0.44	0.35	0.20	Silty	59.8	Cool Dry
Nebraska	Chase	0.43	0.36	0.20	Silty	33.3	Cool Dry
Nebraska	Cherry	0.64	0.23	0.13	Sandy	31.1	Cool Dry
Nebraska	Cheyenne	0.39	0.39	0.21	Silty	32.0	Cool Dry
Nebraska	Clay	0.36	0.41	0.23	Silty	50.1	Warm Dry
Nebraska	Colfax	0.46	0.34	0.20	Silty	52.4	Cool Dry
Nebraska	Cuming	0.45	0.34	0.20	Silty	54.9	Cool Dry
Nebraska	Custer	0.64	0.23	0.13	Sandy	35.3	Cool Dry
Nebraska	Dakota	0.46	0.34	0.20	Silty	61.2	Cool Dry
Nebraska	Dawes	0.42	0.35	0.23	Silty	32.1	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Nebraska	Dawson	0.53	0.30	0.17	Sandy	37.4	Cool Dry
Nebraska	Deuel	0.42	0.37	0.21	Silty	32.0	Cool Dry
Nebraska	Dixon	0.47	0.33	0.20	Silty	63.6	Cool Dry
Nebraska	Dodge	0.42	0.37	0.21	Silty	54.1	Cool Dry
Nebraska	Douglas	0.37	0.40	0.23	Silty	56.7	Warm Dry
Nebraska	Dundy	0.38	0.40	0.22	Silty	34.8	Warm Dry
Nebraska	Fillmore	0.36	0.41	0.23	Silty	51.7	Warm Dry
Nebraska	Franklin	0.36	0.41	0.23	Silty	46.0	Warm Dry
Nebraska	Frontier	0.48	0.33	0.19	Silty	36.5	Cool Dry
Nebraska	Furnas	0.39	0.39	0.22	Silty	40.6	Warm Dry
Nebraska	Gage	0.36	0.41	0.23	Silty	55.7	Warm Dry
Nebraska	Garden	0.54	0.30	0.16	Sandy	31.0	Cool Dry
Nebraska	Garfield	0.79	0.14	0.07	Sandy	36.6	Cool Dry
Nebraska	Gosper	0.46	0.34	0.19	Silty	39.2	Cool Dry
Nebraska	Grant	0.69	0.21	0.11	Sandy	28.6	Cool Dry
Nebraska	Greeley	0.64	0.23	0.13	Sandy	41.8	Cool Dry
Nebraska	Hall	0.36	0.41	0.23	Silty	46.0	Cool Dry
Nebraska	Hamilton	0.36	0.41	0.23	Silty	49.5	Warm Dry
Nebraska	Harlan	0.37	0.40	0.22	Silty	43.6	Warm Dry
Nebraska	Hayes	0.47	0.34	0.19	Silty	34.6	Cool Dry
Nebraska	Hitchcock	0.39	0.39	0.22	Silty	36.7	Warm Dry
Nebraska	Holt	0.66	0.22	0.12	Sandy	41.8	Cool Dry
Nebraska	Hooker	0.79	0.14	0.08	Sandy	26.7	Cool Dry
Nebraska	Howard	0.47	0.34	0.19	Silty	44.2	Cool Dry
Nebraska	Jefferson	0.36	0.41	0.23	Silty	54.1	Warm Dry
Nebraska	Johnson	0.36	0.41	0.24	Silty	57.1	Warm Moist
Nebraska	Kearney	0.37	0.40	0.22	Silty	45.0	Warm Dry
Nebraska	Keith	0.56	0.28	0.15	Sandy	30.4	Cool Dry
Nebraska	Keya Paha	0.68	0.20	0.12	Sandy	37.2	Cool Dry
Nebraska	Kimball	0.36	0.41	0.23	Silty	31.6	Cool Dry
Nebraska	Knox	0.49	0.33	0.18	Silty	51.5	Cool Dry
Nebraska	Lancaster	0.36	0.41	0.23	Silty	54.9	Warm Dry
Nebraska	Lincoln	0.62	0.24	0.13	Sandy	31.6	Cool Dry
Nebraska	Logan	0.74	0.17	0.09	Sandy	29.7	Cool Dry
Nebraska	Loup	0.80	0.13	0.07	Sandy	32.9	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Nebraska	Madison	0.60	0.25	0.15	Sandy	48.1	Cool Dry
Nebraska	McPherson	0.73	0.17	0.10	Sandy	28.2	Cool Dry
Nebraska	Merrick	0.43	0.37	0.21	Silty	47.7	Warm Dry
Nebraska	Morrill	0.45	0.36	0.19	Silty	31.6	Cool Dry
Nebraska	Nance	0.48	0.33	0.19	Silty	47.6	Cool Dry
Nebraska	Nemaha	0.36	0.41	0.24	Silty	58.4	Warm Moist
Nebraska	Nuckolls	0.36	0.41	0.23	Silty	50.7	Warm Dry
Nebraska	Otoe	0.36	0.41	0.24	Silty	57.3	Warm Moist
Nebraska	Pawnee	0.36	0.41	0.24	Silty	57.4	Warm Moist
Nebraska	Perkins	0.49	0.33	0.18	Silty	31.8	Cool Dry
Nebraska	Phelps	0.42	0.37	0.21	Silty	42.1	Warm Dry
Nebraska	Pierce	0.54	0.29	0.17	Sandy	50.9	Cool Dry
Nebraska	Platte	0.52	0.31	0.18	Silty	49.7	Cool Dry
Nebraska	Polk	0.39	0.39	0.22	Silty	50.7	Warm Dry
Nebraska	Red Willow	0.39	0.39	0.22	Silty	38.6	Warm Dry
Nebraska	Richardson	0.36	0.40	0.24	Silty	58.7	Warm Moist
Nebraska	Rock	0.75	0.16	0.09	Sandy	35.5	Cool Dry
Nebraska	Saline	0.36	0.41	0.23	Silty	53.7	Warm Dry
Nebraska	Sarpy	0.36	0.41	0.24	Silty	57.1	Warm Dry
Nebraska	Saunders	0.38	0.40	0.23	Silty	54.8	Warm Dry
Nebraska	Scotts Bluff	0.37	0.41	0.22	Silty	31.2	Cool Dry
Nebraska	Seward	0.36	0.41	0.23	Silty	53.2	Warm Dry
Nebraska	Sheridan	0.48	0.34	0.19	Silty	32.2	Cool Dry
Nebraska	Sherman	0.50	0.32	0.18	Silty	42.0	Cool Dry
Nebraska	Sioux	0.43	0.34	0.23	Silty	30.7	Cool Dry
Nebraska	Stanton	0.53	0.30	0.17	Sandy	51.6	Cool Dry
Nebraska	Thayer	0.36	0.41	0.23	Silty	52.2	Warm Dry
Nebraska	Thomas	0.81	0.13	0.07	Sandy	27.8	Cool Dry
Nebraska	Thurston	0.42	0.37	0.22	Silty	58.2	Cool Dry
Nebraska	Valley	0.66	0.22	0.12	Sandy	39.4	Cool Dry
Nebraska	Washington	0.37	0.39	0.23	Silty	57.1	Cool Dry
Nebraska	Wayne	0.50	0.32	0.19	Silty	55.2	Cool Dry
Nebraska	Webster	0.36	0.41	0.23	Silty	48.4	Warm Dry
Nebraska	Wheeler	0.76	0.16	0.09	Sandy	40.3	Cool Dry
Nebraska	York	0.36	0.41	0.23	Silty	51.3	Warm Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Nevada	Carson City	0.45	0.33	0.22	Silty	28.3	Cool Dry
Nevada	Churchill	0.44	0.35	0.21	Silty	14.3	Warm Dry
Nevada	Clark	0.71	0.15	0.13	Sandy	6.4	Warm Dry
Nevada	Douglas	0.45	0.33	0.22	Silty	28.8	Cool Dry
Nevada	Elko	0.43	0.36	0.21	Silty	23.5	Cool Dry
Nevada	Esmeralda	0.50	0.29	0.22	Silty	10.9	Warm Dry
Nevada	Eureka	0.44	0.35	0.20	Silty	20.5	Cool Dry
Nevada	Humboldt	0.46	0.34	0.19	Silty	19.9	Cool Dry
Nevada	Lander	0.42	0.38	0.20	Silty	17.3	Cool Dry
Nevada	Lincoln	0.51	0.29	0.20	Silty	12.8	Warm Dry
Nevada	Lyon	0.46	0.32	0.22	Silty	23.4	Cool Dry
Nevada	Mineral	0.47	0.31	0.22	Silty	19.3	Cool Dry
Nevada	Nye	0.49	0.30	0.20	Silty	10.4	Cool Dry
Nevada	Pershing	0.42	0.37	0.21	Silty	15.9	Cool Dry
Nevada	Storey	0.46	0.32	0.22	Silty	22.8	Cool Dry
Nevada	Washoe	0.44	0.34	0.22	Silty	22.6	Cool Dry
Nevada	White Pine	0.47	0.32	0.21	Silty	18.9	Cool Dry
New Hampshire	Belknap	0.84	0.11	0.05	Sandy	107.5	Cool Moist
New Hampshire	Carroll	0.84	0.12	0.04	Sandy	102.8	Cool Moist
New Hampshire	Cheshire	0.69	0.20	0.10	Sandy	112.7	Cool Moist
New Hampshire	Coos	0.81	0.14	0.05	Sandy	118.1	Cool Moist
New Hampshire	Grafton	0.85	0.11	0.04	Sandy	103.5	Cool Moist
New Hampshire	Hillsborough	0.78	0.15	0.07	Sandy	119.3	Cool Moist
New Hampshire	Merrimack	0.80	0.13	0.06	Sandy	111.1	Cool Moist
New Hampshire	Rockingham	0.80	0.14	0.06	Sandy	120.2	Cool Moist
New Hampshire	Strafford	0.83	0.12	0.05	Sandy	111.0	Cool Moist
New Hampshire	Sullivan	0.77	0.16	0.07	Sandy	106.8	Cool Moist
New Jersey	Atlantic	0.56	0.26	0.18	Sandy	78.8	Warm Moist
New Jersey	Bergen	0.46	0.33	0.21	Silty	64.0	Warm Moist
New Jersey	Burlington	0.60	0.23	0.17	Sandy	62.8	Warm Moist
New Jersey	Camden	0.60	0.22	0.17	Sandy	67.4	Warm Moist
New Jersey	Cape May	0.54	0.28	0.18	Sandy	91.2	Warm Moist
New Jersey	Cumberland	0.59	0.24	0.17	Sandy	76.6	Warm Moist
New Jersey	Essex	0.49	0.30	0.21	Silty	59.7	Warm Moist
New Jersey	Gloucester	0.61	0.22	0.17	Sandy	63.2	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
New Jersey	Hudson	0.49	0.31	0.21	Silty	63.1	Warm Moist
New Jersey	Hunterdon	0.55	0.26	0.19	Sandy	54.1	Warm Moist
New Jersey	Mercer	0.59	0.23	0.18	Sandy	54.9	Warm Moist
New Jersey	Middlesex	0.56	0.26	0.19	Sandy	56.8	Warm Moist
New Jersey	Monmouth	0.57	0.25	0.18	Sandy	59.4	Warm Moist
New Jersey	Morris	0.47	0.32	0.21	Silty	58.5	Cool Moist
New Jersey	Ocean	0.56	0.26	0.18	Sandy	68.5	Warm Moist
New Jersey	Passaic	0.47	0.32	0.21	Silty	61.9	Warm Moist
New Jersey	Salem	0.59	0.24	0.18	Sandy	61.6	Warm Moist
New Jersey	Somerset	0.51	0.28	0.20	Silty	57.7	Warm Moist
New Jersey	Sussex	0.45	0.33	0.22	Silty	58.8	Cool Moist
New Jersey	Union	0.51	0.29	0.20	Silty	60.9	Warm Moist
New Jersey	Warren	0.49	0.30	0.21	Silty	53.2	Cool Moist
New Mexico	Bernalillo	0.50	0.29	0.21	Silty	14.2	Warm Dry
New Mexico	Catron	0.44	0.34	0.22	Silty	15.0	Cool Dry
New Mexico	Chaves	0.46	0.34	0.20	Silty	20.4	Warm Dry
New Mexico	Cibola	0.47	0.32	0.21	Silty	13.2	Cool Dry
New Mexico	Colfax	0.39	0.41	0.19	Silty	24.1	Cool Dry
New Mexico	Curry	0.43	0.35	0.21	Silty	29.0	Warm Dry
New Mexico	De Baca	0.43	0.36	0.21	Silty	22.1	Warm Dry
New Mexico	Dona Ana	0.49	0.31	0.20	Silty	12.9	Warm Dry
New Mexico	Eddy	0.49	0.32	0.19	Silty	18.3	Warm Dry
New Mexico	Grant	0.48	0.31	0.21	Silty	14.5	Warm Dry
New Mexico	Guadalupe	0.46	0.33	0.21	Silty	19.9	Warm Dry
New Mexico	Harding	0.45	0.34	0.20	Silty	22.3	Warm Dry
New Mexico	Hidalgo	0.51	0.29	0.20	Silty	16.5	Warm Dry
New Mexico	Lea	0.62	0.22	0.16	Sandy	21.7	Warm Dry
New Mexico	Lincoln	0.41	0.37	0.22	Silty	17.6	Warm Dry
New Mexico	Los Alamos	0.47	0.33	0.21	Silty	18.0	Cool Dry
New Mexico	Luna	0.50	0.31	0.19	Silty	13.1	Warm Dry
New Mexico	McKinley	0.45	0.34	0.21	Silty	12.9	Cool Dry
New Mexico	Mora	0.42	0.39	0.20	Silty	20.2	Cool Dry
New Mexico	Otero	0.45	0.34	0.21	Silty	15.1	Warm Dry
New Mexico	Quay	0.46	0.32	0.21	Silty	25.8	Warm Dry
New Mexico	Rio Arriba	0.43	0.37	0.20	Silty	31.6	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
New Mexico	Roosevelt	0.51	0.31	0.19	Silty	26.9	Warm Dry
New Mexico	San Juan	0.44	0.35	0.20	Silty	21.3	Warm Dry
New Mexico	San Miguel	0.48	0.31	0.21	Silty	19.9	Warm Dry
New Mexico	Sandoval	0.48	0.31	0.21	Silty	15.6	Warm Dry
New Mexico	Santa Fe	0.48	0.32	0.21	Silty	17.4	Warm Dry
New Mexico	Sierra	0.46	0.32	0.22	Silty	12.7	Warm Dry
New Mexico	Socorro	0.47	0.31	0.22	Silty	13.6	Warm Dry
New Mexico	Taos	0.40	0.41	0.19	Silty	27.3	Cool Dry
New Mexico	Torrance	0.48	0.31	0.21	Silty	16.1	Warm Dry
New Mexico	Union	0.46	0.33	0.20	Silty	23.1	Warm Dry
New Mexico	Valencia	0.50	0.29	0.21	Silty	14.0	Warm Dry
New York	Albany	0.46	0.35	0.18	Silty	85.9	Cool Moist
New York	Allegany	0.44	0.37	0.19	Silty	66.5	Cool Moist
New York	Bronx	0.47	0.32	0.21	Silty	65.3	Warm Moist
New York	Broome	0.42	0.38	0.20	Silty	68.1	Cool Moist
New York	Cattaraugus	0.47	0.35	0.18	Silty	66.6	Cool Moist
New York	Cayuga	0.47	0.33	0.20	Silty	80.4	Cool Moist
New York	Chautauqua	0.55	0.29	0.16	Sandy	71.0	Cool Moist
New York	Chemung	0.42	0.38	0.20	Silty	65.1	Cool Moist
New York	Chenango	0.43	0.36	0.20	Silty	74.5	Cool Moist
New York	Clinton	0.66	0.20	0.13	Sandy	109.3	Cool Moist
New York	Columbia	0.60	0.26	0.13	Sandy	85.5	Cool Moist
New York	Cortland	0.45	0.34	0.21	Silty	78.7	Cool Moist
New York	Delaware	0.44	0.37	0.19	Silty	72.7	Cool Moist
New York	Dutchess	0.58	0.27	0.15	Sandy	77.7	Cool Moist
New York	Erie	0.61	0.25	0.14	Sandy	78.6	Cool Moist
New York	Essex	0.77	0.15	0.08	Sandy	112.1	Cool Moist
New York	Franklin	0.67	0.20	0.13	Sandy	107.4	Cool Moist
New York	Fulton	0.49	0.33	0.18	Silty	92.7	Cool Moist
New York	Genesee	0.56	0.28	0.16	Sandy	82.9	Cool Moist
New York	Greene	0.52	0.32	0.17	Silty	81.3	Cool Moist
New York	Hamilton	0.65	0.24	0.12	Sandy	103.1	Cool Moist
New York	Herkimer	0.55	0.29	0.16	Sandy	95.3	Cool Moist
New York	Jefferson	0.51	0.32	0.17	Silty	83.8	Cool Moist
New York	Kings	0.50	0.30	0.20	Silty	64.1	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
New York	Lewis	0.57	0.28	0.15	Sandy	95.0	Cool Moist
New York	Livingston	0.47	0.34	0.19	Silty	78.7	Cool Moist
New York	Madison	0.45	0.34	0.21	Silty	82.6	Cool Moist
New York	Monroe	0.56	0.27	0.17	Sandy	80.9	Cool Moist
New York	Montgomery	0.45	0.36	0.19	Silty	87.4	Cool Moist
New York	Nassau	0.47	0.32	0.21	Silty	67.0	Warm Moist
New York	New York	0.48	0.31	0.21	Silty	64.7	Warm Moist
New York	Niagara	0.67	0.19	0.13	Sandy	80.0	Cool Moist
New York	Oneida	0.49	0.32	0.18	Silty	88.0	Cool Moist
New York	Onondaga	0.46	0.33	0.21	Silty	83.0	Cool Moist
New York	Ontario	0.46	0.34	0.20	Silty	83.3	Cool Moist
New York	Orange	0.49	0.32	0.19	Silty	67.0	Cool Moist
New York	Orleans	0.63	0.22	0.14	Sandy	80.0	Cool Moist
New York	Oswego	0.45	0.34	0.20	Silty	81.0	Cool Moist
New York	Otsego	0.44	0.36	0.20	Silty	80.5	Cool Moist
New York	Putnam	0.51	0.30	0.19	Silty	70.5	Cool Moist
New York	Queens	0.49	0.31	0.20	Silty	65.3	Warm Moist
New York	Rensselaer	0.50	0.33	0.17	Silty	92.8	Cool Moist
New York	Richmond	0.52	0.28	0.19	Silty	61.9	Warm Moist
New York	Rockland	0.47	0.32	0.21	Silty	67.5	Warm Moist
New York	Saratoga	0.52	0.32	0.16	Silty	96.2	Cool Moist
New York	Schenectady	0.44	0.37	0.20	Silty	86.9	Cool Moist
New York	Schoharie	0.44	0.36	0.20	Silty	83.1	Cool Moist
New York	Schuyler	0.43	0.37	0.20	Silty	72.3	Cool Moist
New York	Seneca	0.45	0.34	0.20	Silty	80.4	Cool Moist
New York	St. Lawrence	0.66	0.21	0.12	Sandy	102.3	Cool Moist
New York	Steuben	0.43	0.37	0.20	Silty	69.0	Cool Moist
New York	Suffolk	0.45	0.35	0.19	Silty	73.7	Warm Moist
New York	Sullivan	0.46	0.35	0.19	Silty	66.6	Cool Moist
New York	Tioga	0.42	0.37	0.20	Silty	68.4	Cool Moist
New York	Tompkins	0.45	0.35	0.21	Silty	76.0	Cool Moist
New York	Ulster	0.52	0.32	0.17	Silty	74.4	Cool Moist
New York	Warren	0.75	0.18	0.08	Sandy	109.4	Cool Moist
New York	Washington	0.61	0.26	0.13	Sandy	102.1	Cool Moist
New York	Wayne	0.51	0.31	0.18	Silty	80.4	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
New York	Westchester	0.52	0.30	0.18	Silty	73.9	Warm Moist
New York	Wyoming	0.52	0.31	0.17	Silty	78.9	Cool Moist
New York	Yates	0.44	0.35	0.21	Silty	79.0	Cool Moist
North Carolina	Alamance	0.49	0.27	0.24	Sandy	25.7	Warm Moist
North Carolina	Alexander	0.49	0.27	0.24	Sandy	30.3	Warm Moist
North Carolina	Alleghany	0.47	0.30	0.23	Silty	32.2	Warm Moist
North Carolina	Anson	0.49	0.27	0.24	Sandy	29.7	Warm Moist
North Carolina	Ashe	0.48	0.28	0.24	Silty	34.8	Warm Moist
North Carolina	Avery	0.49	0.27	0.24	Sandy	35.8	Cool Moist
North Carolina	Beaufort	0.44	0.33	0.23	Silty	103.2	Warm Moist
North Carolina	Bertie	0.44	0.32	0.23	Silty	89.3	Warm Moist
North Carolina	Bladen	0.46	0.33	0.22	Silty	71.8	Warm Moist
North Carolina	Brunswick	0.50	0.32	0.18	Silty	86.9	Warm Moist
North Carolina	Buncombe	0.49	0.27	0.24	Sandy	39.9	Warm Moist
North Carolina	Burke	0.49	0.27	0.24	Sandy	33.3	Warm Moist
North Carolina	Cabarrus	0.49	0.27	0.24	Sandy	25.9	Warm Moist
North Carolina	Caldwell	0.49	0.27	0.24	Sandy	33.2	Warm Moist
North Carolina	Camden	0.40	0.37	0.23	Silty	110.4	Warm Moist
North Carolina	Carteret	0.51	0.31	0.18	Silty	100.4	Warm Moist
North Carolina	Caswell	0.49	0.27	0.24	Sandy	24.0	Warm Moist
North Carolina	Catawba	0.49	0.27	0.24	Sandy	29.5	Warm Moist
North Carolina	Chatham	0.49	0.27	0.24	Sandy	30.1	Warm Moist
North Carolina	Cherokee	0.49	0.26	0.24	Sandy	37.7	Warm Moist
North Carolina	Chowan	0.43	0.34	0.23	Silty	94.1	Warm Moist
North Carolina	Clay	0.49	0.27	0.24	Sandy	37.7	Warm Moist
North Carolina	Cleveland	0.49	0.27	0.24	Sandy	28.8	Warm Moist
North Carolina	Columbus	0.43	0.36	0.22	Silty	76.5	Warm Moist
North Carolina	Craven	0.49	0.30	0.21	Silty	95.1	Warm Moist
North Carolina	Cumberland	0.47	0.29	0.24	Silty	47.3	Warm Moist
North Carolina	Currituck	0.39	0.38	0.23	Silty	117.3	Warm Moist
North Carolina	Dare	0.37	0.40	0.23	Silty	131.6	Warm Moist
North Carolina	Davidson	0.49	0.27	0.24	Sandy	25.1	Warm Moist
North Carolina	Davie	0.49	0.27	0.24	Sandy	26.8	Warm Moist
North Carolina	Duplin	0.51	0.29	0.20	Silty	78.2	Warm Moist
North Carolina	Durham	0.49	0.27	0.24	Sandy	28.1	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
North Carolina	Edgecombe	0.48	0.28	0.24	Silty	64.7	Warm Moist
North Carolina	Forsyth	0.49	0.27	0.24	Sandy	24.8	Warm Moist
North Carolina	Franklin	0.49	0.28	0.24	Silty	41.1	Warm Moist
North Carolina	Gaston	0.49	0.27	0.24	Sandy	25.7	Warm Moist
North Carolina	Gates	0.43	0.34	0.23	Silty	86.7	Warm Moist
North Carolina	Graham	0.49	0.27	0.24	Sandy	39.6	Warm Moist
North Carolina	Granville	0.49	0.27	0.24	Sandy	28.9	Warm Moist
North Carolina	Greene	0.48	0.28	0.24	Silty	75.4	Warm Moist
North Carolina	Guilford	0.49	0.27	0.24	Sandy	24.5	Warm Moist
North Carolina	Halifax	0.48	0.29	0.24	Silty	56.0	Warm Moist
North Carolina	Harnett	0.49	0.27	0.24	Sandy	38.3	Warm Moist
North Carolina	Haywood	0.49	0.27	0.24	Sandy	40.2	Warm Moist
North Carolina	Henderson	0.49	0.27	0.24	Sandy	39.2	Warm Moist
North Carolina	Hertford	0.45	0.32	0.23	Silty	72.9	Warm Moist
North Carolina	Hoke	0.47	0.29	0.24	Silty	44.9	Warm Moist
North Carolina	Hyde	0.41	0.37	0.23	Silty	122.4	Warm Moist
North Carolina	Iredell	0.49	0.27	0.24	Sandy	28.0	Warm Moist
North Carolina	Jackson	0.49	0.27	0.24	Sandy	40.1	Warm Moist
North Carolina	Johnston	0.49	0.27	0.24	Sandy	50.1	Warm Moist
North Carolina	Jones	0.52	0.28	0.20	Silty	88.1	Warm Moist
North Carolina	Lee	0.49	0.27	0.24	Sandy	34.6	Warm Moist
North Carolina	Lenoir	0.49	0.28	0.22	Silty	80.9	Warm Moist
North Carolina	Lincoln	0.49	0.27	0.24	Sandy	27.9	Warm Moist
North Carolina	Macon	0.49	0.27	0.24	Sandy	39.9	Warm Moist
North Carolina	Madison	0.49	0.27	0.24	Sandy	39.0	Warm Moist
North Carolina	Martin	0.46	0.31	0.23	Silty	83.0	Warm Moist
North Carolina	McDowell	0.49	0.27	0.24	Sandy	36.0	Warm Moist
North Carolina	Mecklenburg	0.49	0.27	0.24	Sandy	26.3	Warm Moist
North Carolina	Mitchell	0.49	0.27	0.24	Sandy	36.3	Warm Moist
North Carolina	Montgomery	0.49	0.27	0.24	Sandy	28.3	Warm Moist
North Carolina	Moore	0.49	0.27	0.24	Sandy	34.7	Warm Moist
North Carolina	Nash	0.48	0.28	0.24	Silty	49.3	Warm Moist
North Carolina	New Hanover	0.52	0.31	0.17	Silty	88.0	Warm Moist
North Carolina	Northampton	0.47	0.30	0.23	Silty	59.1	Warm Moist
North Carolina	Onslow	0.56	0.27	0.17	Sandy	91.8	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
North Carolina	Orange	0.49	0.27	0.24	Sandy	26.9	Warm Moist
North Carolina	Pamlico	0.46	0.33	0.21	Silty	108.4	Warm Moist
North Carolina	Pasquotank	0.41	0.36	0.23	Silty	110.5	Warm Moist
North Carolina	Pender	0.55	0.29	0.16	Sandy	90.5	Warm Moist
North Carolina	Perquimans	0.41	0.36	0.23	Silty	108.5	Warm Moist
North Carolina	Person	0.49	0.27	0.24	Sandy	24.0	Warm Moist
North Carolina	Pitt	0.47	0.30	0.23	Silty	82.6	Warm Moist
North Carolina	Polk	0.49	0.27	0.24	Sandy	35.5	Warm Moist
North Carolina	Randolph	0.49	0.27	0.24	Sandy	26.1	Warm Moist
North Carolina	Richmond	0.48	0.28	0.24	Silty	33.3	Warm Moist
North Carolina	Robeson	0.44	0.33	0.23	Silty	57.4	Warm Moist
North Carolina	Rockingham	0.49	0.28	0.24	Silty	23.9	Warm Moist
North Carolina	Rowan	0.49	0.27	0.24	Sandy	26.4	Warm Moist
North Carolina	Rutherford	0.49	0.27	0.24	Sandy	34.0	Warm Moist
North Carolina	Sampson	0.48	0.29	0.23	Silty	62.0	Warm Moist
North Carolina	Scotland	0.47	0.29	0.24	Silty	41.5	Warm Moist
North Carolina	Stanly	0.49	0.27	0.24	Sandy	26.3	Warm Moist
North Carolina	Stokes	0.48	0.28	0.24	Silty	25.2	Warm Moist
North Carolina	Surry	0.48	0.28	0.24	Silty	28.9	Warm Moist
North Carolina	Swain	0.49	0.27	0.24	Sandy	40.8	Warm Moist
North Carolina	Transylvania	0.49	0.27	0.24	Sandy	39.0	Warm Moist
North Carolina	Tyrrell	0.40	0.37	0.23	Silty	123.8	Warm Moist
North Carolina	Union	0.49	0.27	0.24	Sandy	27.4	Warm Moist
North Carolina	Vance	0.49	0.27	0.24	Sandy	31.8	Warm Moist
North Carolina	Wake	0.49	0.27	0.24	Sandy	36.6	Warm Moist
North Carolina	Warren	0.48	0.28	0.24	Silty	38.1	Warm Moist
North Carolina	Washington	0.41	0.36	0.23	Silty	112.2	Warm Moist
North Carolina	Watauga	0.49	0.27	0.24	Sandy	35.3	Warm Moist
North Carolina	Wayne	0.49	0.28	0.23	Silty	68.2	Warm Moist
North Carolina	Wilkes	0.49	0.27	0.24	Sandy	32.8	Warm Moist
North Carolina	Wilson	0.48	0.28	0.24	Silty	59.0	Warm Moist
North Carolina	Yadkin	0.49	0.27	0.24	Sandy	28.4	Warm Moist
North Carolina	Yancey	0.49	0.27	0.24	Sandy	38.4	Warm Moist
North Dakota	Adams	0.34	0.42	0.23	Silty	44.9	Cool Dry
North Dakota	Barnes	0.24	0.52	0.24	Silty	83.4	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
North Dakota	Benson	0.25	0.52	0.24	Silty	80.8	Cool Dry
North Dakota	Billings	0.36	0.41	0.22	Silty	41.8	Cool Dry
North Dakota	Bottineau	0.27	0.50	0.24	Silty	79.5	Cool Dry
North Dakota	Bowman	0.32	0.44	0.23	Silty	36.8	Cool Dry
North Dakota	Burke	0.35	0.42	0.23	Silty	69.8	Cool Dry
North Dakota	Burleigh	0.34	0.43	0.23	Silty	65.5	Cool Dry
North Dakota	Cass	0.22	0.52	0.27	Silty	88.9	Cool Dry
North Dakota	Cavalier	0.25	0.50	0.25	Silty	89.7	Cool Dry
North Dakota	Dickey	0.31	0.44	0.24	Silty	79.5	Cool Dry
North Dakota	Divide	0.35	0.42	0.23	Silty	58.7	Cool Dry
North Dakota	Dunn	0.36	0.41	0.23	Silty	51.1	Cool Dry
North Dakota	Eddy	0.23	0.53	0.24	Silty	80.7	Cool Dry
North Dakota	Emmons	0.36	0.41	0.23	Silty	61.1	Cool Dry
North Dakota	Foster	0.24	0.52	0.24	Silty	79.4	Cool Dry
North Dakota	Golden Valley	0.24	0.51	0.25	Silty	37.6	Cool Dry
North Dakota	Grand Forks	0.24	0.50	0.25	Silty	91.3	Cool Dry
North Dakota	Grant	0.36	0.41	0.23	Silty	51.9	Cool Dry
North Dakota	Griggs	0.23	0.53	0.24	Silty	83.1	Cool Dry
North Dakota	Hettinger	0.35	0.42	0.23	Silty	47.6	Cool Dry
North Dakota	Kidder	0.32	0.45	0.23	Silty	71.1	Cool Dry
North Dakota	LaMoure	0.29	0.47	0.24	Silty	79.2	Cool Dry
North Dakota	Logan	0.34	0.43	0.23	Silty	69.4	Cool Dry
North Dakota	McHenry	0.28	0.48	0.24	Silty	76.9	Cool Dry
North Dakota	McIntosh	0.35	0.42	0.23	Silty	68.7	Cool Dry
North Dakota	McKenzie	0.36	0.41	0.23	Silty	47.6	Cool Dry
North Dakota	McLean	0.35	0.42	0.23	Silty	66.5	Cool Dry
North Dakota	Mercer	0.36	0.41	0.23	Silty	57.6	Cool Dry
North Dakota	Morton	0.36	0.41	0.23	Silty	56.6	Cool Dry
North Dakota	Mountrail	0.35	0.42	0.23	Silty	67.9	Cool Dry
North Dakota	Nelson	0.24	0.52	0.24	Silty	86.3	Cool Dry
North Dakota	Oliver	0.36	0.41	0.23	Silty	60.5	Cool Dry
North Dakota	Pembina	0.27	0.47	0.26	Silty	96.4	Cool Dry
North Dakota	Pierce	0.25	0.51	0.24	Silty	79.6	Cool Dry
North Dakota	Ramsey	0.25	0.51	0.24	Silty	84.9	Cool Dry
North Dakota	Ransom	0.24	0.51	0.25	Silty	86.7	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
North Dakota	Renville	0.31	0.45	0.23	Silty	75.0	Cool Dry
North Dakota	Richland	0.22	0.49	0.28	Clayey	90.8	Cool Dry
North Dakota	Rolette	0.23	0.53	0.24	Silty	83.6	Cool Dry
North Dakota	Sargent	0.26	0.49	0.25	Silty	86.8	Cool Dry
North Dakota	Sheridan	0.31	0.46	0.23	Silty	72.3	Cool Dry
North Dakota	Sioux	0.36	0.41	0.23	Silty	53.9	Cool Dry
North Dakota	Slope	0.33	0.44	0.23	Silty	39.9	Cool Dry
North Dakota	Stark	0.36	0.41	0.23	Silty	49.4	Cool Dry
North Dakota	Steele	0.22	0.54	0.24	Silty	85.8	Cool Dry
North Dakota	Stutsman	0.27	0.49	0.24	Silty	77.5	Cool Dry
North Dakota	Towner	0.24	0.52	0.24	Silty	85.2	Cool Dry
North Dakota	Traill	0.21	0.51	0.28	Clayey	91.2	Cool Dry
North Dakota	Walsh	0.28	0.48	0.24	Silty	91.7	Cool Dry
North Dakota	Ward	0.32	0.45	0.23	Silty	73.7	Cool Dry
North Dakota	Wells	0.27	0.49	0.24	Silty	75.7	Cool Dry
North Dakota	Williams	0.36	0.41	0.23	Silty	56.4	Cool Dry
Ohio	Adams	0.46	0.32	0.22	Silty	38.2	Warm Moist
Ohio	Allen	0.47	0.32	0.21	Silty	67.0	Cool Moist
Ohio	Ashland	0.47	0.32	0.21	Silty	55.5	Cool Moist
Ohio	Ashtabula	0.39	0.32	0.29	Clayey	67.6	Cool Moist
Ohio	Athens	0.43	0.36	0.20	Silty	38.0	Warm Moist
Ohio	Auglaize	0.47	0.32	0.21	Silty	65.4	Cool Moist
Ohio	Belmont	0.44	0.35	0.21	Silty	38.3	Warm Moist
Ohio	Brown	0.47	0.32	0.21	Silty	40.8	Warm Moist
Ohio	Butler	0.47	0.31	0.22	Silty	48.3	Warm Moist
Ohio	Carroll	0.46	0.33	0.21	Silty	45.4	Cool Moist
Ohio	Champaign	0.47	0.32	0.21	Silty	60.1	Warm Moist
Ohio	Clark	0.47	0.32	0.21	Silty	56.7	Warm Moist
Ohio	Clermont	0.47	0.31	0.22	Silty	41.3	Warm Moist
Ohio	Clinton	0.47	0.32	0.21	Silty	46.8	Warm Moist
Ohio	Columbiana	0.47	0.32	0.21	Silty	46.7	Cool Moist
Ohio	Coshocton	0.46	0.33	0.21	Silty	45.7	Warm Moist
Ohio	Crawford	0.47	0.32	0.21	Silty	60.3	Cool Moist
Ohio	Cuyahoga	0.36	0.32	0.32	Clayey	65.0	Cool Moist
Ohio	Darke	0.47	0.32	0.21	Silty	60.2	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Ohio	Defiance	0.47	0.32	0.21	Silty	74.0	Cool Moist
Ohio	Delaware	0.47	0.32	0.21	Silty	54.9	Warm Moist
Ohio	Erie	0.39	0.33	0.29	Clayey	65.9	Cool Moist
Ohio	Fairfield	0.46	0.33	0.21	Silty	45.1	Warm Moist
Ohio	Fayette	0.47	0.32	0.21	Silty	51.1	Warm Moist
Ohio	Franklin	0.47	0.32	0.21	Silty	50.8	Warm Moist
Ohio	Fulton	0.46	0.33	0.21	Silty	75.5	Cool Moist
Ohio	Gallia	0.44	0.36	0.21	Silty	37.5	Warm Moist
Ohio	Geauga	0.40	0.32	0.28	Clayey	60.9	Cool Moist
Ohio	Greene	0.47	0.32	0.21	Silty	52.4	Warm Moist
Ohio	Guernsey	0.44	0.35	0.21	Silty	40.0	Warm Moist
Ohio	Hamilton	0.48	0.31	0.22	Silty	43.3	Warm Moist
Ohio	Hancock	0.47	0.32	0.21	Silty	66.5	Cool Moist
Ohio	Hardin	0.47	0.32	0.21	Silty	63.3	Cool Moist
Ohio	Harrison	0.45	0.34	0.21	Silty	40.9	Warm Moist
Ohio	Henry	0.46	0.33	0.21	Silty	72.7	Cool Moist
Ohio	Highland	0.47	0.32	0.21	Silty	41.6	Warm Moist
Ohio	Hocking	0.45	0.34	0.21	Silty	41.4	Warm Moist
Ohio	Holmes	0.46	0.33	0.21	Silty	49.8	Cool Moist
Ohio	Huron	0.45	0.32	0.23	Silty	59.7	Cool Moist
Ohio	Jackson	0.44	0.35	0.21	Silty	37.2	Warm Moist
Ohio	Jefferson	0.45	0.34	0.21	Silty	41.4	Warm Moist
Ohio	Knox	0.47	0.32	0.21	Silty	50.7	Cool Moist
Ohio	Lake	0.34	0.31	0.35	Clayey	70.0	Cool Moist
Ohio	Lawrence	0.44	0.35	0.21	Silty	37.6	Warm Moist
Ohio	Licking	0.47	0.32	0.21	Silty	48.3	Warm Moist
Ohio	Logan	0.47	0.32	0.21	Silty	62.2	Cool Moist
Ohio	Lorain	0.37	0.32	0.31	Clayey	65.2	Cool Moist
Ohio	Lucas	0.40	0.33	0.27	Silty	74.9	Cool Moist
Ohio	Madison	0.47	0.32	0.21	Silty	51.3	Warm Moist
Ohio	Mahoning	0.46	0.31	0.23	Silty	52.1	Cool Moist
Ohio	Marion	0.47	0.32	0.21	Silty	59.4	Cool Moist
Ohio	Medina	0.45	0.32	0.23	Silty	56.2	Cool Moist
Ohio	Meigs	0.43	0.37	0.20	Silty	38.1	Warm Moist
Ohio	Mercer	0.47	0.32	0.21	Silty	65.5	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Ohio	Miami	0.47	0.32	0.21	Silty	59.7	Warm Moist
Ohio	Monroe	0.43	0.37	0.20	Silty	37.9	Warm Moist
Ohio	Montgomery	0.47	0.32	0.21	Silty	52.9	Warm Moist
Ohio	Morgan	0.44	0.36	0.20	Silty	39.9	Warm Moist
Ohio	Morrow	0.47	0.32	0.21	Silty	54.4	Cool Moist
Ohio	Muskingum	0.46	0.34	0.21	Silty	43.4	Warm Moist
Ohio	Noble	0.43	0.36	0.20	Silty	38.2	Warm Moist
Ohio	Ottawa	0.40	0.33	0.27	Silty	70.7	Cool Moist
Ohio	Paulding	0.47	0.32	0.21	Silty	71.4	Cool Moist
Ohio	Perry	0.45	0.34	0.21	Silty	42.5	Warm Moist
Ohio	Pickaway	0.46	0.33	0.21	Silty	47.1	Warm Moist
Ohio	Pike	0.45	0.34	0.21	Silty	37.8	Warm Moist
Ohio	Portage	0.45	0.32	0.23	Silty	52.7	Cool Moist
Ohio	Preble	0.47	0.31	0.21	Silty	53.4	Warm Moist
Ohio	Putnam	0.47	0.32	0.21	Silty	69.3	Cool Moist
Ohio	Richland	0.47	0.32	0.21	Silty	55.5	Cool Moist
Ohio	Ross	0.46	0.33	0.21	Silty	42.2	Warm Moist
Ohio	Sandusky	0.43	0.33	0.24	Silty	67.5	Cool Moist
Ohio	Scioto	0.45	0.33	0.21	Silty	37.5	Warm Moist
Ohio	Seneca	0.46	0.32	0.22	Silty	64.2	Cool Moist
Ohio	Shelby	0.47	0.32	0.21	Silty	63.7	Warm Moist
Ohio	Stark	0.47	0.32	0.21	Silty	49.0	Cool Moist
Ohio	Summit	0.43	0.32	0.25	Silty	56.4	Cool Moist
Ohio	Trumbull	0.43	0.32	0.25	Silty	57.4	Cool Moist
Ohio	Tuscarawas	0.46	0.34	0.21	Silty	45.0	Cool Moist
Ohio	Union	0.47	0.32	0.21	Silty	57.6	Warm Moist
Ohio	Van Wert	0.47	0.32	0.21	Silty	68.9	Cool Moist
Ohio	Vinton	0.44	0.35	0.21	Silty	38.5	Warm Moist
Ohio	Warren	0.47	0.31	0.21	Silty	47.8	Warm Moist
Ohio	Washington	0.43	0.37	0.20	Silty	38.2	Warm Moist
Ohio	Wayne	0.47	0.32	0.21	Silty	52.6	Cool Moist
Ohio	Williams	0.46	0.32	0.21	Silty	76.6	Cool Moist
Ohio	Wood	0.45	0.33	0.22	Silty	72.3	Cool Moist
Ohio	Wyandot	0.47	0.32	0.21	Silty	62.8	Cool Moist
Oklahoma	Adair	0.44	0.32	0.24	Silty	29.4	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Oklahoma	Alfalfa	0.46	0.35	0.19	Silty	34.7	Warm Dry
Oklahoma	Atoka	0.42	0.35	0.23	Silty	27.8	Warm Moist
Oklahoma	Beaver	0.42	0.35	0.23	Silty	28.2	Warm Dry
Oklahoma	Beckham	0.41	0.36	0.23	Silty	26.8	Warm Dry
Oklahoma	Blaine	0.47	0.33	0.20	Silty	30.9	Warm Dry
Oklahoma	Bryan	0.43	0.34	0.23	Silty	30.7	Warm Dry
Oklahoma	Caddo	0.40	0.37	0.23	Silty	31.3	Warm Dry
Oklahoma	Canadian	0.42	0.36	0.22	Silty	31.8	Warm Dry
Oklahoma	Carter	0.40	0.38	0.23	Silty	32.2	Warm Dry
Oklahoma	Cherokee	0.42	0.34	0.24	Silty	31.9	Warm Moist
Oklahoma	Choctaw	0.44	0.32	0.23	Silty	28.0	Warm Moist
Oklahoma	Cimarron	0.53	0.25	0.22	Sandy	24.9	Warm Dry
Oklahoma	Cleveland	0.37	0.40	0.23	Silty	32.6	Warm Dry
Oklahoma	Coal	0.40	0.37	0.23	Silty	28.9	Warm Dry
Oklahoma	Comanche	0.38	0.39	0.23	Silty	32.1	Warm Dry
Oklahoma	Cotton	0.37	0.40	0.23	Silty	32.5	Warm Dry
Oklahoma	Craig	0.40	0.36	0.24	Silty	42.8	Warm Moist
Oklahoma	Creek	0.38	0.39	0.23	Silty	35.0	Warm Dry
Oklahoma	Custer	0.43	0.35	0.22	Silty	29.1	Warm Dry
Oklahoma	Delaware	0.44	0.32	0.24	Silty	36.3	Warm Moist
Oklahoma	Dewey	0.45	0.35	0.21	Silty	29.0	Warm Dry
Oklahoma	Ellis	0.38	0.39	0.23	Silty	26.9	Warm Dry
Oklahoma	Garfield	0.50	0.32	0.17	Silty	33.9	Warm Dry
Oklahoma	Garvin	0.38	0.39	0.23	Silty	32.4	Warm Dry
Oklahoma	Grady	0.38	0.39	0.23	Silty	32.2	Warm Dry
Oklahoma	Grant	0.46	0.34	0.19	Silty	37.2	Warm Dry
Oklahoma	Greer	0.39	0.38	0.23	Silty	27.4	Warm Dry
Oklahoma	Harmon	0.37	0.40	0.23	Silty	26.9	Warm Dry
Oklahoma	Harper	0.39	0.38	0.23	Silty	29.2	Warm Dry
Oklahoma	Haskell	0.39	0.37	0.23	Silty	28.3	Warm Moist
Oklahoma	Hughes	0.39	0.38	0.23	Silty	30.7	Warm Dry
Oklahoma	Jackson	0.37	0.40	0.23	Silty	29.3	Warm Dry
Oklahoma	Jefferson	0.39	0.38	0.23	Silty	33.2	Warm Dry
Oklahoma	Johnston	0.41	0.37	0.23	Silty	30.4	Warm Dry
Oklahoma	Kay	0.45	0.36	0.20	Silty	40.5	Warm Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Oklahoma	Kingfisher	0.47	0.34	0.19	Silty	32.6	Warm Dry
Oklahoma	Kiowa	0.39	0.38	0.23	Silty	30.1	Warm Dry
Oklahoma	Latimer	0.41	0.36	0.23	Silty	27.2	Warm Moist
Oklahoma	Le Flore	0.43	0.34	0.23	Silty	25.2	Warm Moist
Oklahoma	Lincoln	0.41	0.38	0.21	Silty	34.3	Warm Dry
Oklahoma	Logan	0.46	0.35	0.19	Silty	33.9	Warm Dry
Oklahoma	Love	0.41	0.36	0.23	Silty	32.8	Warm Dry
Oklahoma	Major	0.49	0.33	0.18	Silty	30.9	Warm Dry
Oklahoma	Marshall	0.42	0.35	0.23	Silty	31.5	Warm Dry
Oklahoma	Mayes	0.42	0.33	0.24	Silty	36.1	Warm Moist
Oklahoma	McClain	0.37	0.40	0.23	Silty	32.6	Warm Dry
Oklahoma	McCurtain	0.46	0.30	0.24	Silty	25.8	Warm Moist
Oklahoma	McIntosh	0.39	0.38	0.23	Silty	30.9	Warm Moist
Oklahoma	Murray	0.39	0.38	0.23	Silty	31.4	Warm Dry
Oklahoma	Muskogee	0.40	0.37	0.23	Silty	31.5	Warm Moist
Oklahoma	Noble	0.49	0.33	0.18	Silty	35.6	Warm Dry
Oklahoma	Nowata	0.38	0.38	0.24	Silty	43.6	Warm Moist
Oklahoma	Okfuskee	0.39	0.39	0.23	Silty	32.4	Warm Dry
Oklahoma	Oklahoma	0.40	0.38	0.22	Silty	33.0	Warm Dry
Oklahoma	Okmulgee	0.38	0.39	0.23	Silty	33.4	Warm Moist
Oklahoma	Osage	0.39	0.39	0.22	Silty	41.7	Warm Dry
Oklahoma	Ottawa	0.41	0.35	0.24	Silty	43.1	Warm Moist
Oklahoma	Pawnee	0.42	0.37	0.21	Silty	37.2	Warm Dry
Oklahoma	Payne	0.45	0.35	0.20	Silty	35.6	Warm Dry
Oklahoma	Pittsburg	0.40	0.37	0.23	Silty	28.8	Warm Moist
Oklahoma	Pontotoc	0.39	0.38	0.23	Silty	30.4	Warm Dry
Oklahoma	Pottawatomie	0.38	0.39	0.23	Silty	32.4	Warm Dry
Oklahoma	Pushmataha	0.43	0.34	0.23	Silty	25.4	Warm Moist
Oklahoma	Roger Mills	0.40	0.37	0.23	Silty	26.3	Warm Dry
Oklahoma	Rogers	0.40	0.37	0.24	Silty	37.2	Warm Moist
Oklahoma	Seminole	0.38	0.39	0.23	Silty	31.5	Warm Dry
Oklahoma	Sequoyah	0.40	0.36	0.23	Silty	28.4	Warm Moist
Oklahoma	Stephens	0.38	0.39	0.23	Silty	32.9	Warm Dry
Oklahoma	Texas	0.49	0.28	0.22	Silty	27.4	Warm Dry
Oklahoma	Tillman	0.36	0.41	0.23	Silty	31.4	Warm Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Oklahoma	Tulsa	0.39	0.38	0.23	Silty	34.7	Warm Dry
Oklahoma	Wagoner	0.40	0.36	0.24	Silty	34.0	Warm Moist
Oklahoma	Washington	0.38	0.39	0.23	Silty	44.1	Warm Dry
Oklahoma	Washita	0.41	0.35	0.23	Silty	29.3	Warm Dry
Oklahoma	Woods	0.45	0.35	0.20	Silty	32.0	Warm Dry
Oklahoma	Woodward	0.42	0.37	0.21	Silty	28.6	Warm Dry
Oregon	Baker	0.36	0.41	0.23	Silty	37.3	Cool Dry
Oregon	Benton	0.44	0.33	0.24	Silty	98.8	Warm Moist
Oregon	Clackamas	0.45	0.33	0.21	Silty	69.0	Cool Moist
Oregon	Clatsop	0.41	0.36	0.23	Silty	118.6	Cool Moist
Oregon	Columbia	0.42	0.34	0.23	Silty	98.3	Cool Moist
Oregon	Coos	0.47	0.29	0.24	Silty	86.0	Warm Moist
Oregon	Crook	0.44	0.35	0.21	Silty	35.2	Cool Dry
Oregon	Curry	0.47	0.29	0.24	Silty	72.1	Cool Moist
Oregon	Deschutes	0.42	0.36	0.22	Silty	41.9	Cool Dry
Oregon	Douglas	0.47	0.29	0.24	Silty	72.6	Warm Moist
Oregon	Gilliam	0.48	0.36	0.16	Silty	34.5	Warm Dry
Oregon	Grant	0.39	0.39	0.22	Silty	34.1	Cool Dry
Oregon	Harney	0.43	0.37	0.21	Silty	24.8	Cool Dry
Oregon	Hood River	0.46	0.34	0.20	Silty	56.6	Cool Moist
Oregon	Jackson	0.48	0.28	0.24	Silty	52.8	Cool Moist
Oregon	Jefferson	0.53	0.29	0.18	Sandy	49.0	Cool Dry
Oregon	Josephine	0.47	0.29	0.24	Silty	62.3	Cool Moist
Oregon	Klamath	0.52	0.27	0.21	Sandy	41.0	Cool Dry
Oregon	Lake	0.51	0.31	0.19	Silty	28.1	Cool Dry
Oregon	Lane	0.44	0.32	0.23	Silty	76.3	Cool Moist
Oregon	Lincoln	0.44	0.32	0.24	Silty	111.4	Warm Moist
Oregon	Linn	0.44	0.34	0.23	Silty	75.0	Cool Moist
Oregon	Malheur	0.41	0.38	0.22	Silty	26.9	Cool Dry
Oregon	Marion	0.43	0.34	0.22	Silty	79.8	Warm Moist
Oregon	Morrow	0.41	0.40	0.18	Silty	32.1	Cool Dry
Oregon	Multnomah	0.44	0.34	0.22	Silty	72.5	Warm Moist
Oregon	Polk	0.43	0.34	0.23	Silty	103.1	Warm Moist
Oregon	Sherman	0.48	0.36	0.17	Silty	39.0	Cool Dry
Oregon	Tillamook	0.42	0.35	0.23	Silty	116.8	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Oregon	Umatilla	0.36	0.42	0.22	Silty	34.8	Warm Dry
Oregon	Union	0.35	0.41	0.23	Silty	39.5	Cool Moist
Oregon	Wallowa	0.35	0.41	0.24	Silty	45.5	Cool Moist
Oregon	Wasco	0.53	0.30	0.17	Sandy	47.8	Cool Dry
Oregon	Washington	0.42	0.34	0.23	Silty	95.0	Warm Moist
Oregon	Wheeler	0.53	0.30	0.17	Sandy	35.8	Cool Dry
Oregon	Yamhill	0.42	0.34	0.23	Silty	103.6	Warm Moist
Pennsylvania	Adams	0.43	0.37	0.21	Silty	35.3	Warm Moist
Pennsylvania	Allegheny	0.46	0.32	0.22	Silty	43.6	Warm Moist
Pennsylvania	Armstrong	0.46	0.32	0.22	Silty	43.3	Cool Moist
Pennsylvania	Beaver	0.47	0.31	0.22	Silty	45.4	Cool Moist
Pennsylvania	Bedford	0.44	0.35	0.21	Silty	36.5	Cool Moist
Pennsylvania	Berks	0.47	0.32	0.21	Silty	42.9	Warm Moist
Pennsylvania	Blair	0.44	0.35	0.21	Silty	37.1	Cool Moist
Pennsylvania	Bradford	0.41	0.39	0.20	Silty	57.1	Cool Moist
Pennsylvania	Bucks	0.59	0.23	0.18	Sandy	51.9	Warm Moist
Pennsylvania	Butler	0.47	0.30	0.22	Silty	47.8	Cool Moist
Pennsylvania	Cambria	0.45	0.33	0.22	Silty	38.5	Cool Moist
Pennsylvania	Cameron	0.42	0.38	0.20	Silty	52.3	Cool Moist
Pennsylvania	Carbon	0.44	0.36	0.21	Silty	45.6	Cool Moist
Pennsylvania	Centre	0.42	0.38	0.20	Silty	37.0	Cool Moist
Pennsylvania	Chester	0.52	0.28	0.20	Silty	45.2	Warm Moist
Pennsylvania	Clarion	0.46	0.33	0.22	Silty	48.0	Cool Moist
Pennsylvania	Clearfield	0.44	0.35	0.21	Silty	40.1	Cool Moist
Pennsylvania	Clinton	0.41	0.38	0.20	Silty	42.2	Cool Moist
Pennsylvania	Columbia	0.41	0.39	0.20	Silty	41.8	Cool Moist
Pennsylvania	Crawford	0.43	0.34	0.23	Silty	63.9	Cool Moist
Pennsylvania	Cumberland	0.42	0.38	0.20	Silty	35.0	Warm Moist
Pennsylvania	Dauphin	0.43	0.37	0.21	Silty	37.6	Warm Moist
Pennsylvania	Delaware	0.58	0.24	0.19	Sandy	50.4	Warm Moist
Pennsylvania	Elk	0.43	0.36	0.21	Silty	50.0	Cool Moist
Pennsylvania	Erie	0.52	0.29	0.20	Silty	71.6	Cool Moist
Pennsylvania	Fayette	0.44	0.34	0.22	Silty	40.1	Cool Moist
Pennsylvania	Forest	0.44	0.35	0.21	Silty	55.9	Cool Moist
Pennsylvania	Franklin	0.42	0.38	0.20	Silty	34.0	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Pennsylvania	Fulton	0.43	0.37	0.21	Silty	34.9	Warm Moist
Pennsylvania	Greene	0.44	0.34	0.21	Silty	40.1	Warm Moist
Pennsylvania	Huntingdon	0.42	0.37	0.21	Silty	35.7	Cool Moist
Pennsylvania	Indiana	0.45	0.33	0.22	Silty	40.6	Cool Moist
Pennsylvania	Jefferson	0.45	0.33	0.22	Silty	43.7	Cool Moist
Pennsylvania	Juniata	0.41	0.38	0.20	Silty	35.5	Warm Moist
Pennsylvania	Lackawanna	0.42	0.37	0.21	Silty	57.2	Cool Moist
Pennsylvania	Lancaster	0.47	0.32	0.21	Silty	40.5	Warm Moist
Pennsylvania	Lawrence	0.47	0.31	0.22	Silty	50.0	Cool Moist
Pennsylvania	Lebanon	0.43	0.36	0.21	Silty	39.1	Warm Moist
Pennsylvania	Lehigh	0.48	0.32	0.20	Silty	46.6	Warm Moist
Pennsylvania	Luzerne	0.42	0.38	0.20	Silty	49.4	Cool Moist
Pennsylvania	Lycoming	0.41	0.39	0.20	Silty	45.0	Cool Moist
Pennsylvania	McKean	0.42	0.38	0.20	Silty	58.5	Cool Moist
Pennsylvania	Mercer	0.45	0.32	0.23	Silty	56.2	Cool Moist
Pennsylvania	Mifflin	0.42	0.38	0.20	Silty	35.1	Cool Moist
Pennsylvania	Monroe	0.44	0.35	0.21	Silty	51.2	Cool Moist
Pennsylvania	Montgomery	0.56	0.25	0.19	Sandy	48.2	Warm Moist
Pennsylvania	Montour	0.41	0.39	0.20	Silty	41.9	Cool Moist
Pennsylvania	Northampton	0.47	0.32	0.21	Silty	51.9	Cool Moist
Pennsylvania	Northumberland	0.41	0.39	0.20	Silty	38.7	Cool Moist
Pennsylvania	Perry	0.42	0.38	0.20	Silty	35.5	Warm Moist
Pennsylvania	Philadelphia	0.62	0.21	0.17	Sandy	54.2	Warm Moist
Pennsylvania	Pike	0.44	0.35	0.21	Silty	58.8	Cool Moist
Pennsylvania	Potter	0.41	0.39	0.20	Silty	54.5	Cool Moist
Pennsylvania	Schuylkill	0.43	0.37	0.21	Silty	41.4	Cool Moist
Pennsylvania	Snyder	0.41	0.38	0.20	Silty	37.0	Cool Moist
Pennsylvania	Somerset	0.45	0.33	0.22	Silty	38.2	Cool Moist
Pennsylvania	Sullivan	0.41	0.39	0.20	Silty	49.0	Cool Moist
Pennsylvania	Susquehanna	0.41	0.39	0.20	Silty	61.8	Cool Moist
Pennsylvania	Tioga	0.41	0.39	0.20	Silty	55.0	Cool Moist
Pennsylvania	Union	0.41	0.39	0.20	Silty	37.2	Cool Moist
Pennsylvania	Venango	0.45	0.33	0.21	Silty	56.1	Cool Moist
Pennsylvania	Warren	0.43	0.36	0.20	Silty	61.8	Cool Moist
Pennsylvania	Washington	0.45	0.33	0.22	Silty	41.7	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Pennsylvania	Wayne	0.42	0.38	0.20	Silty	62.8	Cool Moist
Pennsylvania	Westmoreland	0.45	0.33	0.22	Silty	40.5	Cool Moist
Pennsylvania	Wyoming	0.41	0.38	0.20	Silty	56.9	Cool Moist
Pennsylvania	York	0.45	0.34	0.21	Silty	38.1	Warm Moist
Rhode Island	Bristol	0.67	0.24	0.10	Sandy	105.8	Cool Moist
Rhode Island	Kent	0.68	0.22	0.10	Sandy	104.0	Cool Moist
Rhode Island	Newport	0.64	0.25	0.12	Sandy	94.6	Warm Moist
Rhode Island	Providence	0.70	0.21	0.09	Sandy	107.5	Cool Moist
Rhode Island	Washington	0.65	0.24	0.11	Sandy	97.6	Cool Moist
South Carolina	Abbeville	0.49	0.27	0.24	Sandy	21.6	Warm Moist
South Carolina	Aiken	0.49	0.28	0.23	Silty	28.3	Warm Moist
South Carolina	Allendale	0.54	0.25	0.20	Sandy	44.6	Warm Moist
South Carolina	Anderson	0.49	0.27	0.24	Sandy	23.3	Warm Moist
South Carolina	Bamberg	0.50	0.28	0.22	Silty	40.3	Warm Moist
South Carolina	Barnwell	0.50	0.28	0.23	Silty	33.0	Warm Moist
South Carolina	Beaufort	0.60	0.24	0.16	Sandy	79.6	Warm Moist
South Carolina	Berkeley	0.44	0.35	0.22	Silty	52.6	Warm Moist
South Carolina	Calhoun	0.46	0.31	0.23	Silty	34.6	Warm Moist
South Carolina	Charleston	0.48	0.33	0.19	Silty	60.3	Warm Moist
South Carolina	Cherokee	0.49	0.27	0.24	Sandy	27.9	Warm Moist
South Carolina	Chester	0.49	0.27	0.24	Sandy	24.2	Warm Moist
South Carolina	Chesterfield	0.48	0.28	0.24	Silty	32.4	Warm Moist
South Carolina	Clarendon	0.43	0.33	0.23	Silty	42.2	Warm Moist
South Carolina	Colleton	0.53	0.28	0.19	Sandy	54.6	Warm Moist
South Carolina	Darlington	0.47	0.30	0.23	Silty	42.5	Warm Moist
South Carolina	Dillon	0.43	0.33	0.23	Silty	56.6	Warm Moist
South Carolina	Dorchester	0.50	0.31	0.20	Silty	53.8	Warm Moist
South Carolina	Edgefield	0.49	0.27	0.24	Sandy	24.4	Warm Moist
South Carolina	Fairfield	0.49	0.27	0.24	Sandy	23.6	Warm Moist
South Carolina	Florence	0.43	0.34	0.23	Silty	52.8	Warm Moist
South Carolina	Georgetown	0.38	0.39	0.23	Silty	64.9	Warm Moist
South Carolina	Greenville	0.49	0.27	0.24	Sandy	28.1	Warm Moist
South Carolina	Greenwood	0.49	0.27	0.24	Sandy	22.7	Warm Moist
South Carolina	Hampton	0.57	0.24	0.19	Sandy	54.1	Warm Moist
South Carolina	Horry	0.39	0.38	0.23	Silty	71.2	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
South Carolina	Jasper	0.62	0.22	0.16	Sandy	77.0	Warm Moist
South Carolina	Kershaw	0.48	0.28	0.24	Silty	30.3	Warm Moist
South Carolina	Lancaster	0.49	0.27	0.24	Sandy	27.1	Warm Moist
South Carolina	Laurens	0.49	0.27	0.24	Sandy	22.6	Warm Moist
South Carolina	Lee	0.46	0.30	0.23	Silty	38.8	Warm Moist
South Carolina	Lexington	0.48	0.28	0.24	Silty	26.6	Warm Moist
South Carolina	Marion	0.42	0.35	0.23	Silty	59.0	Warm Moist
South Carolina	Marlboro	0.47	0.30	0.24	Silty	43.0	Warm Moist
South Carolina	McCormick	0.49	0.27	0.24	Sandy	21.9	Warm Moist
South Carolina	Newberry	0.49	0.27	0.24	Sandy	22.2	Warm Moist
South Carolina	Oconee	0.49	0.27	0.24	Sandy	30.6	Warm Moist
South Carolina	Orangeburg	0.46	0.31	0.23	Silty	37.8	Warm Moist
South Carolina	Pickens	0.49	0.27	0.24	Sandy	31.7	Warm Moist
South Carolina	Richland	0.47	0.29	0.24	Silty	30.5	Warm Moist
South Carolina	Saluda	0.49	0.27	0.24	Sandy	23.5	Warm Moist
South Carolina	Spartanburg	0.49	0.27	0.24	Sandy	28.5	Warm Moist
South Carolina	Sumter	0.46	0.31	0.23	Silty	36.7	Warm Moist
South Carolina	Union	0.49	0.27	0.24	Sandy	25.3	Warm Moist
South Carolina	Williamsburg	0.41	0.36	0.23	Silty	53.1	Warm Moist
South Carolina	York	0.49	0.27	0.24	Sandy	25.3	Warm Moist
South Dakota	Aurora	0.31	0.37	0.32	Clayey	57.1	Cool Dry
South Dakota	Beadle	0.32	0.42	0.26	Silty	68.6	Cool Dry
South Dakota	Bennett	0.44	0.32	0.24	Silty	33.2	Cool Dry
South Dakota	Bon Homme	0.39	0.39	0.22	Silty	56.8	Cool Dry
South Dakota	Brookings	0.28	0.48	0.24	Silty	84.9	Cool Dry
South Dakota	Brown	0.33	0.43	0.24	Silty	79.6	Cool Dry
South Dakota	Brule	0.29	0.35	0.36	Clayey	52.6	Cool Dry
South Dakota	Buffalo	0.26	0.36	0.38	Clayey	54.4	Cool Dry
South Dakota	Butte	0.33	0.30	0.36	Clayey	32.8	Cool Dry
South Dakota	Campbell	0.36	0.41	0.23	Silty	62.1	Cool Dry
South Dakota	Charles Mix	0.40	0.34	0.26	Silty	51.8	Cool Dry
South Dakota	Clark	0.31	0.46	0.24	Silty	78.2	Cool Dry
South Dakota	Clay	0.42	0.37	0.21	Silty	66.6	Cool Dry
South Dakota	Codington	0.27	0.49	0.24	Silty	85.5	Cool Dry
South Dakota	Corson	0.35	0.41	0.24	Silty	50.4	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
South Dakota	Custer	0.42	0.33	0.25	Silty	31.3	Cool Dry
South Dakota	Davison	0.33	0.39	0.28	Clayey	62.2	Cool Dry
South Dakota	Day	0.29	0.47	0.24	Silty	83.8	Cool Dry
South Dakota	Deuel	0.25	0.51	0.24	Silty	89.5	Cool Dry
South Dakota	Dewey	0.27	0.37	0.36	Clayey	47.2	Cool Dry
South Dakota	Douglas	0.36	0.36	0.27	Silty	56.1	Cool Dry
South Dakota	Edmunds	0.35	0.41	0.25	Silty	70.0	Cool Dry
South Dakota	Fall River	0.45	0.31	0.24	Silty	30.9	Cool Dry
South Dakota	Faulk	0.34	0.40	0.26	Silty	66.4	Cool Dry
South Dakota	Grant	0.24	0.52	0.24	Silty	91.2	Cool Dry
South Dakota	Gregory	0.45	0.29	0.26	Silty	45.7	Cool Dry
South Dakota	Haakon	0.19	0.34	0.47	Clayey	37.3	Cool Dry
South Dakota	Hamlin	0.28	0.48	0.24	Silty	82.9	Cool Dry
South Dakota	Hand	0.32	0.39	0.28	Clayey	63.3	Cool Dry
South Dakota	Hanson	0.35	0.40	0.24	Silty	67.3	Cool Dry
South Dakota	Harding	0.33	0.41	0.26	Silty	35.7	Cool Dry
South Dakota	Hughes	0.23	0.35	0.41	Clayey	50.5	Cool Dry
South Dakota	Hutchinson	0.37	0.39	0.24	Silty	61.2	Cool Dry
South Dakota	Hyde	0.29	0.38	0.33	Clayey	58.0	Cool Dry
South Dakota	Jackson	0.26	0.34	0.40	Clayey	35.3	Cool Dry
South Dakota	Jerauld	0.29	0.38	0.33	Clayey	59.7	Cool Dry
South Dakota	Jones	0.19	0.33	0.48	Clayey	41.7	Cool Dry
South Dakota	Kingsbury	0.31	0.45	0.24	Silty	76.8	Cool Dry
South Dakota	Lake	0.32	0.44	0.23	Silty	77.4	Cool Dry
South Dakota	Lawrence	0.42	0.28	0.29	Clayey	31.2	Cool Moist
South Dakota	Lincoln	0.40	0.39	0.21	Silty	75.9	Cool Dry
South Dakota	Lyman	0.23	0.33	0.44	Clayey	46.8	Cool Dry
South Dakota	Marshall	0.28	0.47	0.25	Silty	86.3	Cool Dry
South Dakota	McCook	0.36	0.42	0.23	Silty	71.3	Cool Dry
South Dakota	McPherson	0.35	0.42	0.24	Silty	72.5	Cool Dry
South Dakota	Meade	0.25	0.33	0.42	Clayey	33.7	Cool Dry
South Dakota	Mellette	0.30	0.30	0.40	Clayey	38.1	Cool Dry
South Dakota	Miner	0.34	0.42	0.24	Silty	71.2	Cool Dry
South Dakota	Minnehaha	0.34	0.43	0.23	Silty	78.4	Cool Dry
South Dakota	Moody	0.30	0.47	0.23	Silty	84.2	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
South Dakota	Oglala Lakota	0.35	0.38	0.28	Clayey	32.9	Cool Dry
South Dakota	Pennington	0.30	0.35	0.35	Clayey	32.9	Cool Dry
South Dakota	Perkins	0.30	0.40	0.31	Clayey	41.1	Cool Dry
South Dakota	Potter	0.30	0.39	0.31	Clayey	56.8	Cool Dry
South Dakota	Roberts	0.25	0.50	0.25	Silty	91.2	Cool Dry
South Dakota	Sanborn	0.32	0.40	0.28	Clayey	66.2	Cool Dry
South Dakota	Spink	0.34	0.42	0.24	Silty	72.4	Cool Dry
South Dakota	Stanley	0.20	0.34	0.46	Clayey	42.6	Cool Dry
South Dakota	Sully	0.26	0.37	0.37	Clayey	52.7	Cool Dry
South Dakota	Todd	0.48	0.26	0.26	Sandy	35.4	Cool Dry
South Dakota	Tripp	0.46	0.25	0.29	Sandy	40.2	Cool Dry
South Dakota	Turner	0.38	0.40	0.22	Silty	69.0	Cool Dry
South Dakota	Union	0.47	0.34	0.20	Silty	69.3	Cool Dry
South Dakota	Walworth	0.34	0.40	0.26	Silty	59.7	Cool Dry
South Dakota	Yankton	0.38	0.40	0.22	Silty	62.1	Cool Dry
South Dakota	Ziebach	0.22	0.35	0.42	Clayey	39.9	Cool Dry
Tennessee	Anderson	0.49	0.27	0.24	Sandy	31.9	Warm Moist
Tennessee	Bedford	0.51	0.25	0.24	Sandy	28.8	Warm Moist
Tennessee	Benton	0.47	0.29	0.24	Silty	28.7	Warm Moist
Tennessee	Bledsoe	0.50	0.25	0.24	Sandy	30.5	Warm Moist
Tennessee	Blount	0.49	0.27	0.24	Sandy	37.3	Warm Moist
Tennessee	Bradley	0.51	0.25	0.24	Sandy	31.5	Warm Moist
Tennessee	Campbell	0.48	0.28	0.24	Silty	31.8	Warm Moist
Tennessee	Cannon	0.50	0.26	0.24	Sandy	30.2	Warm Moist
Tennessee	Carroll	0.44	0.29	0.26	Silty	27.6	Warm Moist
Tennessee	Carter	0.48	0.28	0.24	Silty	36.5	Warm Moist
Tennessee	Cheatham	0.48	0.29	0.23	Silty	30.5	Warm Moist
Tennessee	Chester	0.38	0.27	0.35	Clayey	24.9	Warm Moist
Tennessee	Claiborne	0.48	0.28	0.24	Silty	33.0	Warm Moist
Tennessee	Clay	0.48	0.28	0.24	Silty	31.3	Warm Moist
Tennessee	Cocke	0.49	0.27	0.24	Sandy	37.6	Warm Moist
Tennessee	Coffee	0.51	0.25	0.24	Sandy	29.2	Warm Moist
Tennessee	Crockett	0.40	0.30	0.30	Clayey	28.1	Warm Moist
Tennessee	Cumberland	0.49	0.27	0.24	Sandy	30.6	Warm Moist
Tennessee	Davidson	0.48	0.28	0.24	Silty	30.7	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Tennessee	DeKalb	0.49	0.27	0.24	Sandy	30.4	Warm Moist
Tennessee	Decatur	0.45	0.27	0.28	Clayey	26.9	Warm Moist
Tennessee	Dickson	0.48	0.29	0.23	Silty	29.9	Warm Moist
Tennessee	Dyer	0.45	0.30	0.25	Silty	29.7	Warm Moist
Tennessee	Fayette	0.28	0.28	0.44	Clayey	25.5	Warm Moist
Tennessee	Fentress	0.48	0.28	0.24	Silty	30.6	Warm Moist
Tennessee	Franklin	0.51	0.25	0.24	Sandy	28.4	Warm Moist
Tennessee	Gibson	0.44	0.30	0.26	Silty	28.1	Warm Moist
Tennessee	Giles	0.51	0.25	0.24	Sandy	27.2	Warm Moist
Tennessee	Grainger	0.49	0.27	0.24	Sandy	34.1	Warm Moist
Tennessee	Greene	0.49	0.27	0.24	Sandy	37.2	Warm Moist
Tennessee	Grundy	0.51	0.25	0.24	Sandy	29.3	Warm Moist
Tennessee	Hamblen	0.49	0.27	0.24	Sandy	35.2	Warm Moist
Tennessee	Hamilton	0.50	0.25	0.24	Sandy	29.4	Warm Moist
Tennessee	Hancock	0.48	0.28	0.24	Silty	34.4	Warm Moist
Tennessee	Hardeman	0.35	0.26	0.39	Clayey	24.4	Warm Moist
Tennessee	Hardin	0.42	0.25	0.32	Clayey	25.0	Warm Moist
Tennessee	Hawkins	0.48	0.28	0.24	Silty	35.7	Warm Moist
Tennessee	Haywood	0.33	0.29	0.38	Clayey	26.3	Warm Moist
Tennessee	Henderson	0.42	0.27	0.31	Clayey	26.1	Warm Moist
Tennessee	Henry	0.47	0.31	0.22	Silty	29.3	Warm Moist
Tennessee	Hickman	0.49	0.27	0.24	Sandy	28.3	Warm Moist
Tennessee	Houston	0.47	0.30	0.23	Silty	29.7	Warm Moist
Tennessee	Humphreys	0.48	0.29	0.23	Silty	29.1	Warm Moist
Tennessee	Jackson	0.48	0.28	0.24	Silty	31.2	Warm Moist
Tennessee	Jefferson	0.49	0.27	0.24	Sandy	33.8	Warm Moist
Tennessee	Johnson	0.47	0.29	0.23	Silty	35.6	Warm Moist
Tennessee	Knox	0.49	0.27	0.24	Sandy	34.3	Warm Moist
Tennessee	Lake	0.46	0.30	0.24	Silty	30.6	Warm Moist
Tennessee	Lauderdale	0.34	0.30	0.37	Clayey	28.3	Warm Moist
Tennessee	Lawrence	0.51	0.25	0.24	Sandy	26.8	Warm Moist
Tennessee	Lewis	0.51	0.25	0.24	Sandy	27.4	Warm Moist
Tennessee	Lincoln	0.51	0.25	0.24	Sandy	27.7	Warm Moist
Tennessee	Loudon	0.49	0.27	0.24	Sandy	35.3	Warm Moist
Tennessee	Macon	0.48	0.28	0.24	Silty	31.5	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Tennessee	Madison	0.36	0.28	0.36	Clayey	25.6	Warm Moist
Tennessee	Marion	0.50	0.25	0.24	Sandy	28.8	Warm Moist
Tennessee	Marshall	0.50	0.26	0.24	Sandy	28.7	Warm Moist
Tennessee	Maury	0.50	0.26	0.24	Sandy	28.3	Warm Moist
Tennessee	McMinn	0.50	0.26	0.24	Sandy	34.5	Warm Moist
Tennessee	McNairy	0.39	0.26	0.35	Clayey	24.4	Warm Moist
Tennessee	Meigs	0.50	0.25	0.24	Sandy	32.0	Warm Moist
Tennessee	Monroe	0.50	0.26	0.24	Sandy	37.0	Warm Moist
Tennessee	Montgomery	0.47	0.30	0.23	Silty	30.5	Warm Moist
Tennessee	Moore	0.51	0.25	0.24	Sandy	28.6	Warm Moist
Tennessee	Morgan	0.49	0.27	0.24	Sandy	30.7	Warm Moist
Tennessee	Obion	0.47	0.31	0.22	Silty	30.2	Warm Moist
Tennessee	Overton	0.48	0.28	0.24	Silty	30.5	Warm Moist
Tennessee	Perry	0.46	0.27	0.28	Sandy	26.7	Warm Moist
Tennessee	Pickett	0.48	0.28	0.24	Silty	31.2	Warm Moist
Tennessee	Polk	0.50	0.26	0.24	Sandy	34.0	Warm Moist
Tennessee	Putnam	0.48	0.28	0.24	Silty	30.7	Warm Moist
Tennessee	Rhea	0.50	0.26	0.24	Sandy	31.4	Warm Moist
Tennessee	Roane	0.49	0.27	0.24	Sandy	32.8	Warm Moist
Tennessee	Robertson	0.47	0.29	0.24	Silty	31.0	Warm Moist
Tennessee	Rutherford	0.50	0.26	0.24	Sandy	30.0	Warm Moist
Tennessee	Scott	0.48	0.28	0.24	Silty	31.1	Warm Moist
Tennessee	Sequatchie	0.51	0.25	0.24	Sandy	30.1	Warm Moist
Tennessee	Sevier	0.49	0.27	0.24	Sandy	37.9	Warm Moist
Tennessee	Shelby	0.21	0.29	0.50	Clayey	26.5	Warm Moist
Tennessee	Smith	0.48	0.28	0.24	Silty	31.2	Warm Moist
Tennessee	Stewart	0.46	0.31	0.23	Silty	30.2	Warm Moist
Tennessee	Sullivan	0.48	0.28	0.24	Silty	37.2	Warm Moist
Tennessee	Sumner	0.48	0.28	0.24	Silty	31.4	Warm Moist
Tennessee	Tipton	0.24	0.29	0.46	Clayey	26.8	Warm Moist
Tennessee	Trousdale	0.48	0.28	0.24	Silty	31.6	Warm Moist
Tennessee	Unicoi	0.49	0.27	0.24	Sandy	38.0	Warm Moist
Tennessee	Union	0.49	0.27	0.24	Sandy	32.7	Warm Moist
Tennessee	Van Buren	0.50	0.26	0.24	Sandy	30.2	Warm Moist
Tennessee	Warren	0.50	0.26	0.24	Sandy	30.0	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Tennessee	Washington	0.49	0.28	0.24	Silty	37.6	Warm Moist
Tennessee	Wayne	0.48	0.25	0.27	Sandy	26.3	Warm Moist
Tennessee	Weakley	0.46	0.31	0.22	Silty	29.1	Warm Moist
Tennessee	White	0.49	0.27	0.24	Sandy	30.3	Warm Moist
Tennessee	Williamson	0.49	0.27	0.24	Sandy	29.7	Warm Moist
Tennessee	Wilson	0.48	0.28	0.24	Silty	31.2	Warm Moist
Texas	Anderson	0.42	0.29	0.29	Clayey	27.0	Warm Moist
Texas	Andrews	0.68	0.17	0.15	Sandy	23.3	Warm Dry
Texas	Angelina	0.48	0.28	0.24	Silty	27.1	Warm Moist
Texas	Aransas	0.26	0.26	0.48	Clayey	37.3	Warm Dry
Texas	Archer	0.37	0.40	0.23	Silty	32.4	Warm Dry
Texas	Armstrong	0.36	0.41	0.23	Silty	31.5	Warm Dry
Texas	Atascosa	0.21	0.30	0.49	Clayey	37.0	Warm Dry
Texas	Austin	0.24	0.28	0.48	Clayey	38.4	Warm Moist
Texas	Bailey	0.51	0.29	0.19	Silty	33.2	Warm Dry
Texas	Bandera	0.23	0.30	0.46	Clayey	41.8	Warm Dry
Texas	Bastrop	0.19	0.29	0.51	Clayey	34.6	Warm Dry
Texas	Baylor	0.38	0.39	0.23	Silty	30.8	Warm Dry
Texas	Bee	0.27	0.28	0.45	Clayey	35.0	Warm Dry
Texas	Bell	0.24	0.32	0.44	Clayey	36.1	Warm Dry
Texas	Bexar	0.19	0.32	0.49	Clayey	38.5	Warm Dry
Texas	Blanco	0.18	0.32	0.50	Clayey	38.5	Warm Dry
Texas	Borden	0.69	0.16	0.15	Sandy	28.7	Warm Dry
Texas	Bosque	0.35	0.34	0.30	Clayey	37.0	Warm Dry
Texas	Bowie	0.48	0.28	0.24	Silty	28.9	Warm Moist
Texas	Brazoria	0.31	0.23	0.46	Clayey	59.1	Warm Moist
Texas	Brazos	0.32	0.27	0.41	Clayey	29.8	Warm Moist
Texas	Brewster	0.53	0.26	0.21	Sandy	25.3	Warm Dry
Texas	Briscoe	0.36	0.41	0.23	Silty	33.3	Warm Dry
Texas	Brooks	0.57	0.24	0.19	Sandy	23.1	Warm Dry
Texas	Brown	0.39	0.38	0.23	Silty	39.5	Warm Dry
Texas	Burleson	0.29	0.27	0.44	Clayey	31.5	Warm Dry
Texas	Burnet	0.21	0.33	0.46	Clayey	38.6	Warm Dry
Texas	Caldwell	0.18	0.31	0.52	Clayey	35.0	Warm Dry
Texas	Calhoun	0.20	0.26	0.53	Clayey	45.3	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Texas	Callahan	0.46	0.32	0.22	Silty	35.8	Warm Dry
Texas	Cameron	0.52	0.20	0.28	Sandy	24.9	Warm Dry
Texas	Camp	0.48	0.28	0.24	Silty	27.7	Warm Moist
Texas	Carson	0.36	0.41	0.24	Silty	29.4	Warm Dry
Texas	Cass	0.48	0.28	0.24	Sandy	28.4	Warm Moist
Texas	Castro	0.41	0.37	0.22	Silty	36.0	Warm Dry
Texas	Chambers	0.32	0.24	0.45	Clayey	66.4	Warm Moist
Texas	Cherokee	0.47	0.28	0.25	Silty	24.8	Warm Moist
Texas	Childress	0.37	0.40	0.23	Silty	27.3	Warm Dry
Texas	Clay	0.38	0.39	0.23	Silty	33.1	Warm Dry
Texas	Cochran	0.68	0.17	0.15	Sandy	30.1	Warm Dry
Texas	Coke	0.46	0.32	0.22	Silty	36.5	Warm Dry
Texas	Coleman	0.40	0.37	0.23	Silty	39.7	Warm Dry
Texas	Collin	0.46	0.30	0.24	Silty	33.5	Warm Dry
Texas	Collingsworth	0.38	0.39	0.23	Silty	27.3	Warm Dry
Texas	Colorado	0.21	0.28	0.51	Clayey	39.5	Warm Moist
Texas	Comal	0.18	0.32	0.50	Clayey	38.3	Warm Dry
Texas	Comanche	0.41	0.35	0.24	Silty	37.6	Warm Dry
Texas	Concho	0.35	0.38	0.27	Silty	42.6	Warm Dry
Texas	Cooke	0.42	0.35	0.23	Silty	33.7	Warm Dry
Texas	Coryell	0.27	0.36	0.37	Clayey	38.3	Warm Dry
Texas	Cottle	0.39	0.38	0.22	Silty	28.5	Warm Dry
Texas	Crane	0.39	0.37	0.24	Silty	26.1	Warm Dry
Texas	Crockett	0.40	0.37	0.23	Silty	38.6	Warm Dry
Texas	Crosby	0.59	0.24	0.18	Sandy	30.5	Warm Dry
Texas	Culberson	0.41	0.37	0.22	Silty	20.6	Warm Dry
Texas	Dallam	0.49	0.30	0.21	Silty	24.7	Warm Dry
Texas	Dallas	0.46	0.30	0.24	Silty	33.0	Warm Dry
Texas	Dawson	0.75	0.12	0.14	Sandy	27.3	Warm Dry
Texas	DeWitt	0.19	0.29	0.52	Clayey	39.3	Warm Dry
Texas	Deaf Smith	0.42	0.35	0.22	Silty	33.0	Warm Dry
Texas	Delta	0.47	0.29	0.24	Silty	31.9	Warm Moist
Texas	Denton	0.44	0.32	0.24	Silty	34.1	Warm Dry
Texas	Dickens	0.52	0.28	0.19	Silty	29.5	Warm Dry
Texas	Dimmit	0.33	0.26	0.41	Clayey	32.1	Warm Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Texas	Donley	0.36	0.40	0.23	Silty	29.5	Warm Dry
Texas	Duval	0.51	0.25	0.24	Sandy	30.4	Warm Dry
Texas	Eastland	0.46	0.31	0.23	Silty	35.5	Warm Dry
Texas	Ector	0.49	0.30	0.21	Silty	24.4	Warm Dry
Texas	Edwards	0.33	0.29	0.38	Clayey	42.2	Warm Dry
Texas	El Paso	0.46	0.37	0.17	Silty	15.5	Warm Dry
Texas	Ellis	0.45	0.30	0.26	Silty	32.8	Warm Dry
Texas	Erath	0.43	0.32	0.25	Silty	35.8	Warm Dry
Texas	Falls	0.28	0.32	0.40	Clayey	33.2	Warm Dry
Texas	Fannin	0.46	0.31	0.24	Silty	31.9	Warm Moist
Texas	Fayette	0.21	0.29	0.50	Clayey	36.0	Warm Dry
Texas	Fisher	0.53	0.27	0.20	Sandy	31.5	Warm Dry
Texas	Floyd	0.44	0.35	0.21	Silty	32.7	Warm Dry
Texas	Foard	0.38	0.39	0.23	Silty	28.8	Warm Dry
Texas	Fort Bend	0.24	0.26	0.50	Clayey	50.6	Warm Moist
Texas	Franklin	0.48	0.28	0.24	Silty	29.1	Warm Moist
Texas	Freestone	0.36	0.31	0.33	Clayey	29.7	Warm Moist
Texas	Frio	0.23	0.29	0.48	Clayey	35.7	Warm Dry
Texas	Gaines	0.78	0.10	0.12	Sandy	24.6	Warm Dry
Texas	Galveston	0.35	0.22	0.44	Clayey	68.0	Warm Moist
Texas	Garza	0.66	0.18	0.16	Sandy	29.3	Warm Dry
Texas	Gillespie	0.20	0.33	0.48	Clayey	41.0	Warm Dry
Texas	Glasscock	0.47	0.31	0.22	Silty	32.3	Warm Dry
Texas	Goliad	0.22	0.28	0.50	Clayey	38.4	Warm Dry
Texas	Gonzales	0.18	0.30	0.52	Clayey	35.9	Warm Dry
Texas	Gray	0.37	0.39	0.24	Silty	27.9	Warm Dry
Texas	Grayson	0.44	0.32	0.24	Silty	33.1	Warm Dry
Texas	Gregg	0.48	0.28	0.24	Silty	25.3	Warm Moist
Texas	Grimes	0.34	0.27	0.39	Clayey	29.9	Warm Moist
Texas	Guadalupe	0.18	0.32	0.50	Clayey	37.3	Warm Dry
Texas	Hale	0.48	0.31	0.20	Silty	34.3	Warm Dry
Texas	Hall	0.36	0.41	0.23	Silty	29.9	Warm Dry
Texas	Hamilton	0.34	0.37	0.29	Clayey	38.8	Warm Dry
Texas	Hansford	0.43	0.35	0.22	Silty	27.6	Warm Dry
Texas	Hardeman	0.37	0.40	0.23	Silty	28.1	Warm Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Texas	Hardin	0.42	0.29	0.28	Clayey	47.4	Warm Moist
Texas	Harris	0.27	0.26	0.46	Clayey	47.1	Warm Moist
Texas	Harrison	0.49	0.27	0.24	Sandy	27.1	Warm Moist
Texas	Hartley	0.45	0.33	0.22	Silty	27.3	Warm Dry
Texas	Haskell	0.43	0.35	0.22	Silty	30.5	Warm Dry
Texas	Hays	0.18	0.32	0.51	Clayey	37.3	Warm Dry
Texas	Hemphill	0.38	0.38	0.24	Silty	26.3	Warm Dry
Texas	Henderson	0.43	0.29	0.28	Clayey	28.9	Warm Moist
Texas	Hidalgo	0.59	0.22	0.19	Sandy	24.9	Warm Dry
Texas	Hill	0.38	0.32	0.30	Clayey	34.8	Warm Dry
Texas	Hockley	0.71	0.15	0.14	Sandy	31.9	Warm Dry
Texas	Hood	0.45	0.30	0.25	Silty	34.9	Warm Dry
Texas	Hopkins	0.48	0.28	0.24	Silty	30.5	Warm Moist
Texas	Houston	0.44	0.29	0.28	Clayey	26.4	Warm Moist
Texas	Howard	0.61	0.21	0.18	Sandy	30.2	Warm Dry
Texas	Hudspeth	0.43	0.38	0.19	Silty	19.0	Warm Dry
Texas	Hunt	0.47	0.29	0.24	Silty	32.2	Warm Dry
Texas	Hutchinson	0.39	0.38	0.23	Silty	28.3	Warm Dry
Texas	Irion	0.38	0.37	0.24	Silty	39.2	Warm Dry
Texas	Jack	0.41	0.36	0.23	Silty	33.7	Warm Dry
Texas	Jackson	0.19	0.27	0.54	Clayey	45.7	Warm Moist
Texas	Jasper	0.44	0.31	0.25	Silty	44.3	Warm Moist
Texas	Jeff Davis	0.42	0.38	0.21	Silty	24.0	Warm Dry
Texas	Jefferson	0.40	0.22	0.37	Clayey	76.8	Warm Moist
Texas	Jim Hogg	0.58	0.24	0.18	Sandy	25.4	Warm Dry
Texas	Jim Wells	0.42	0.26	0.32	Clayey	30.7	Warm Dry
Texas	Johnson	0.45	0.30	0.26	Silty	34.4	Warm Dry
Texas	Jones	0.48	0.31	0.21	Silty	32.5	Warm Dry
Texas	Karnes	0.20	0.29	0.51	Clayey	37.2	Warm Dry
Texas	Kaufman	0.46	0.29	0.25	Silty	30.9	Warm Dry
Texas	Kendall	0.19	0.33	0.49	Clayey	40.5	Warm Dry
Texas	Kenedy	0.59	0.21	0.20	Sandy	19.6	Warm Dry
Texas	Kent	0.58	0.24	0.18	Sandy	29.4	Warm Dry
Texas	Kerr	0.24	0.32	0.44	Clayey	42.3	Warm Dry
Texas	Kimble	0.26	0.34	0.40	Clayey	43.6	Warm Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Texas	King	0.46	0.33	0.21	Silty	28.5	Warm Dry
Texas	Kinney	0.35	0.25	0.40	Clayey	37.5	Warm Dry
Texas	Kleberg	0.47	0.24	0.29	Sandy	25.7	Warm Dry
Texas	Knox	0.40	0.37	0.22	Silty	28.9	Warm Dry
Texas	La Salle	0.36	0.27	0.38	Clayey	33.7	Warm Dry
Texas	Lamar	0.46	0.30	0.24	Silty	30.3	Warm Moist
Texas	Lamb	0.52	0.29	0.20	Silty	35.4	Warm Dry
Texas	Lampasas	0.27	0.36	0.36	Clayey	39.5	Warm Dry
Texas	Lavaca	0.19	0.29	0.52	Clayey	39.2	Warm Dry
Texas	Lee	0.24	0.28	0.48	Clayey	33.8	Warm Dry
Texas	Leon	0.37	0.29	0.34	Clayey	28.4	Warm Moist
Texas	Liberty	0.37	0.26	0.37	Clayey	51.1	Warm Moist
Texas	Limestone	0.31	0.32	0.36	Clayey	31.9	Warm Dry
Texas	Lipscomb	0.37	0.40	0.23	Silty	26.6	Warm Dry
Texas	Live Oak	0.32	0.28	0.41	Clayey	34.6	Warm Dry
Texas	Llano	0.20	0.33	0.47	Clayey	40.6	Warm Dry
Texas	Loving	0.45	0.33	0.22	Silty	19.4	Warm Dry
Texas	Lubbock	0.66	0.18	0.16	Sandy	31.3	Warm Dry
Texas	Lynn	0.75	0.12	0.14	Sandy	29.0	Warm Dry
Texas	Madison	0.37	0.28	0.35	Clayey	28.8	Warm Moist
Texas	Marion	0.48	0.28	0.24	Sandy	27.8	Warm Moist
Texas	Martin	0.66	0.18	0.16	Sandy	27.5	Warm Dry
Texas	Mason	0.23	0.34	0.43	Clayey	42.2	Warm Dry
Texas	Matagorda	0.25	0.24	0.50	Clayey	55.2	Warm Moist
Texas	Maverick	0.36	0.24	0.40	Clayey	32.1	Warm Dry
Texas	McCulloch	0.32	0.38	0.30	Clayey	42.1	Warm Dry
Texas	McLennan	0.29	0.35	0.36	Clayey	35.7	Warm Dry
Texas	McMullen	0.34	0.28	0.38	Clayey	34.7	Warm Dry
Texas	Medina	0.22	0.30	0.48	Clayey	38.8	Warm Dry
Texas	Menard	0.29	0.36	0.36	Clayey	43.6	Warm Dry
Texas	Midland	0.48	0.30	0.21	Silty	28.1	Warm Dry
Texas	Milam	0.27	0.29	0.44	Clayey	32.7	Warm Dry
Texas	Mills	0.34	0.39	0.26	Silty	40.7	Warm Dry
Texas	Mitchell	0.56	0.25	0.19	Sandy	32.3	Warm Dry
Texas	Montague	0.40	0.37	0.23	Silty	33.7	Warm Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Texas	Montgomery	0.35	0.27	0.38	Clayey	36.2	Warm Moist
Texas	Moore	0.42	0.36	0.22	Silty	28.4	Warm Dry
Texas	Morris	0.48	0.28	0.24	Silty	28.1	Warm Moist
Texas	Motley	0.41	0.37	0.22	Silty	30.7	Warm Dry
Texas	Nacogdoches	0.48	0.28	0.24	Silty	25.3	Warm Moist
Texas	Navarro	0.39	0.31	0.30	Clayey	31.7	Warm Dry
Texas	Newton	0.44	0.32	0.24	Silty	38.4	Warm Moist
Texas	Nolan	0.50	0.29	0.21	Silty	34.6	Warm Dry
Texas	Nueces	0.38	0.25	0.37	Clayey	29.3	Warm Dry
Texas	Ochiltree	0.40	0.37	0.23	Silty	27.2	Warm Dry
Texas	Oldham	0.43	0.35	0.23	Silty	30.4	Warm Dry
Texas	Orange	0.44	0.24	0.31	Clayey	74.5	Warm Moist
Texas	Palo Pinto	0.45	0.31	0.23	Silty	34.0	Warm Dry
Texas	Panola	0.48	0.28	0.24	Sandy	26.3	Warm Moist
Texas	Parker	0.46	0.31	0.24	Silty	34.2	Warm Dry
Texas	Parmer	0.43	0.35	0.22	Silty	34.2	Warm Dry
Texas	Pecos	0.40	0.37	0.23	Silty	28.2	Warm Dry
Texas	Polk	0.46	0.29	0.25	Silty	32.1	Warm Moist
Texas	Potter	0.38	0.38	0.23	Silty	30.6	Warm Dry
Texas	Presidio	0.55	0.28	0.17	Sandy	23.0	Warm Dry
Texas	Rains	0.47	0.29	0.24	Silty	30.0	Warm Dry
Texas	Randall	0.38	0.38	0.23	Silty	33.2	Warm Dry
Texas	Reagan	0.39	0.37	0.24	Silty	34.9	Warm Dry
Texas	Real	0.28	0.29	0.43	Clayey	42.9	Warm Dry
Texas	Red River	0.47	0.29	0.24	Silty	28.8	Warm Moist
Texas	Reeves	0.40	0.37	0.23	Silty	21.6	Warm Dry
Texas	Refugio	0.25	0.27	0.48	Clayey	37.3	Warm Dry
Texas	Roberts	0.38	0.38	0.23	Silty	27.4	Warm Dry
Texas	Robertson	0.31	0.29	0.40	Clayey	30.7	Warm Dry
Texas	Rockwall	0.47	0.29	0.24	Silty	32.3	Warm Dry
Texas	Runnels	0.41	0.36	0.23	Silty	39.6	Warm Dry
Texas	Rusk	0.48	0.28	0.24	Silty	25.3	Warm Moist
Texas	Sabine	0.47	0.29	0.24	Silty	30.7	Warm Moist
Texas	San Augustine	0.47	0.29	0.24	Silty	29.2	Warm Moist
Texas	San Jacinto	0.45	0.28	0.28	Clayey	31.4	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Texas	San Patricio	0.32	0.26	0.41	Clayey	32.1	Warm Dry
Texas	San Saba	0.27	0.37	0.36	Clayey	40.8	Warm Dry
Texas	Schleicher	0.34	0.37	0.29	Clayey	42.6	Warm Dry
Texas	Scurry	0.62	0.21	0.17	Sandy	30.0	Warm Dry
Texas	Shackelford	0.47	0.31	0.22	Silty	33.0	Warm Dry
Texas	Shelby	0.49	0.27	0.24	Sandy	26.5	Warm Moist
Texas	Sherman	0.47	0.32	0.22	Silty	26.5	Warm Dry
Texas	Smith	0.47	0.28	0.25	Silty	26.1	Warm Moist
Texas	Somervell	0.43	0.31	0.26	Silty	35.5	Warm Dry
Texas	Starr	0.61	0.23	0.16	Sandy	26.5	Warm Dry
Texas	Stephens	0.46	0.32	0.23	Silty	33.6	Warm Dry
Texas	Sterling	0.45	0.33	0.22	Silty	35.7	Warm Dry
Texas	Stonewall	0.50	0.30	0.20	Silty	29.5	Warm Dry
Texas	Sutton	0.34	0.35	0.32	Clayey	43.0	Warm Dry
Texas	Swisher	0.38	0.39	0.23	Silty	34.8	Warm Dry
Texas	Tarrant	0.46	0.30	0.24	Silty	34.1	Warm Dry
Texas	Taylor	0.47	0.32	0.22	Silty	35.8	Warm Dry
Texas	Terrell	0.47	0.30	0.24	Silty	32.1	Warm Dry
Texas	Terry	0.81	0.07	0.12	Sandy	28.8	Warm Dry
Texas	Throckmorton	0.41	0.36	0.22	Silty	31.8	Warm Dry
Texas	Titus	0.48	0.28	0.24	Silty	28.6	Warm Moist
Texas	Tom Green	0.38	0.37	0.25	Silty	40.6	Warm Dry
Texas	Travis	0.18	0.30	0.51	Clayey	36.6	Warm Dry
Texas	Trinity	0.46	0.28	0.26	Silty	27.4	Warm Moist
Texas	Tyler	0.46	0.30	0.24	Silty	34.4	Warm Moist
Texas	Upshur	0.48	0.28	0.24	Silty	26.5	Warm Moist
Texas	Upton	0.39	0.37	0.24	Silty	30.2	Warm Dry
Texas	Uvalde	0.27	0.28	0.46	Clayey	38.7	Warm Dry
Texas	Val Verde	0.46	0.25	0.29	Sandy	37.0	Warm Dry
Texas	Van Zandt	0.47	0.29	0.24	Silty	28.8	Warm Moist
Texas	Victoria	0.20	0.27	0.52	Clayey	42.3	Warm Dry
Texas	Walker	0.41	0.28	0.31	Clayey	29.9	Warm Moist
Texas	Waller	0.27	0.27	0.46	Clayey	37.5	Warm Moist
Texas	Ward	0.39	0.37	0.24	Silty	22.3	Warm Dry
Texas	Washington	0.29	0.27	0.44	Clayey	33.8	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Texas	Webb	0.51	0.23	0.25	Sandy	30.7	Warm Dry
Texas	Wharton	0.21	0.27	0.52	Clayey	46.0	Warm Moist
Texas	Wheeler	0.39	0.37	0.24	Silty	26.3	Warm Dry
Texas	Wichita	0.36	0.41	0.23	Silty	32.1	Warm Dry
Texas	Wilbarger	0.37	0.40	0.23	Silty	30.3	Warm Dry
Texas	Willacy	0.59	0.21	0.21	Sandy	21.2	Warm Dry
Texas	Williamson	0.20	0.30	0.50	Clayey	35.8	Warm Dry
Texas	Wilson	0.20	0.30	0.50	Clayey	37.1	Warm Dry
Texas	Winkler	0.47	0.32	0.21	Silty	21.5	Warm Dry
Texas	Wise	0.42	0.34	0.24	Silty	34.2	Warm Dry
Texas	Wood	0.48	0.28	0.24	Silty	27.5	Warm Dry
Texas	Yoakum	0.77	0.11	0.12	Sandy	27.0	Warm Dry
Texas	Young	0.40	0.37	0.23	Silty	33.0	Warm Dry
Texas	Zapata	0.62	0.22	0.16	Sandy	27.3	Warm Dry
Texas	Zavala	0.27	0.27	0.46	Clayey	34.0	Warm Dry
Utah	Beaver	0.47	0.31	0.22	Silty	23.3	Cool Dry
Utah	Box Elder	0.25	0.60	0.15	Silty	32.0	Cool Dry
Utah	Cache	0.29	0.54	0.18	Silty	41.4	Cool Dry
Utah	Carbon	0.36	0.41	0.23	Silty	28.4	Cool Dry
Utah	Daggett	0.33	0.43	0.24	Silty	21.9	Cool Dry
Utah	Davis	0.08	0.86	0.05	Silty	36.1	Warm Dry
Utah	Duchesne	0.32	0.46	0.22	Silty	30.8	Cool Dry
Utah	Emery	0.37	0.40	0.23	Silty	22.1	Cool Dry
Utah	Garfield	0.38	0.39	0.23	Silty	20.0	Cool Dry
Utah	Grand	0.39	0.38	0.23	Silty	21.6	Warm Dry
Utah	Iron	0.44	0.34	0.21	Silty	23.3	Cool Dry
Utah	Juab	0.45	0.33	0.22	Silty	23.5	Cool Dry
Utah	Kane	0.36	0.42	0.22	Silty	18.1	Warm Dry
Utah	Millard	0.46	0.32	0.21	Silty	20.6	Cool Dry
Utah	Morgan	0.17	0.72	0.11	Silty	39.5	Cool Moist
Utah	Piute	0.41	0.36	0.23	Silty	25.4	Cool Dry
Utah	Rich	0.29	0.52	0.18	Silty	40.3	Cool Dry
Utah	Salt Lake	0.18	0.72	0.10	Silty	35.2	Warm Dry
Utah	San Juan	0.40	0.38	0.22	Silty	18.7	Warm Dry
Utah	Sanpete	0.37	0.40	0.23	Silty	27.8	Cool Dry

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Utah	Sevier	0.39	0.38	0.23	Silty	23.8	Cool Dry
Utah	Summit	0.23	0.60	0.17	Silty	35.4	Cool Moist
Utah	Tooele	0.35	0.50	0.15	Silty	22.8	Warm Dry
Utah	Uintah	0.36	0.41	0.23	Silty	25.0	Cool Dry
Utah	Utah	0.36	0.43	0.21	Silty	33.1	Cool Dry
Utah	Wasatch	0.29	0.53	0.19	Silty	37.3	Cool Moist
Utah	Washington	0.42	0.37	0.21	Silty	19.4	Warm Dry
Utah	Wayne	0.38	0.39	0.23	Silty	20.1	Warm Dry
Utah	Weber	0.20	0.68	0.13	Silty	39.8	Cool Moist
Vermont	Addison	0.83	0.12	0.05	Sandy	110.5	Cool Moist
Vermont	Bennington	0.62	0.25	0.13	Sandy	103.4	Cool Moist
Vermont	Caledonia	0.85	0.11	0.04	Sandy	116.4	Cool Moist
Vermont	Chittenden	0.79	0.14	0.07	Sandy	112.5	Cool Moist
Vermont	Essex	0.84	0.12	0.04	Sandy	118.1	Cool Moist
Vermont	Franklin	0.77	0.16	0.08	Sandy	116.0	Cool Moist
Vermont	Grand Isle	0.72	0.18	0.11	Sandy	112.7	Cool Moist
Vermont	Lamoille	0.83	0.12	0.05	Sandy	115.3	Cool Moist
Vermont	Orange	0.85	0.11	0.04	Sandy	106.3	Cool Moist
Vermont	Orleans	0.82	0.13	0.05	Sandy	119.5	Cool Moist
Vermont	Rutland	0.78	0.15	0.06	Sandy	107.3	Cool Moist
Vermont	Washington	0.85	0.11	0.04	Sandy	111.7	Cool Moist
Vermont	Windham	0.62	0.25	0.13	Sandy	106.1	Cool Moist
Vermont	Windsor	0.77	0.16	0.07	Sandy	104.9	Cool Moist
Virginia	Accomack	0.39	0.38	0.23	Silty	82.6	Warm Moist
Virginia	Albemarle	0.46	0.31	0.23	Silty	29.0	Warm Moist
Virginia	Alexandria	0.50	0.29	0.22	Silty	46.2	Warm Moist
Virginia	Alleghany	0.43	0.37	0.21	Silty	38.8	Warm Moist
Virginia	Amelia	0.48	0.28	0.24	Silty	32.7	Warm Moist
Virginia	Amherst	0.46	0.32	0.22	Silty	28.8	Warm Moist
Virginia	Appomattox	0.48	0.28	0.24	Silty	24.9	Warm Moist
Virginia	Arlington	0.50	0.29	0.21	Silty	44.8	Warm Moist
Virginia	Augusta	0.44	0.35	0.21	Silty	33.3	Warm Moist
Virginia	Bath	0.42	0.37	0.21	Silty	39.7	Warm Moist
Virginia	Bedford	0.46	0.31	0.23	Silty	27.0	Warm Moist
Virginia	Bland	0.42	0.37	0.21	Silty	31.5	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Virginia	Botetourt	0.44	0.34	0.22	Silty	31.5	Warm Moist
Virginia	Bristol	0.46	0.32	0.22	Silty	35.7	Warm Moist
Virginia	Brunswick	0.48	0.28	0.24	Silty	37.8	Warm Moist
Virginia	Buchanan	0.42	0.38	0.20	Silty	33.6	Warm Moist
Virginia	Buckingham	0.48	0.29	0.23	Silty	26.8	Warm Moist
Virginia	Buena Vista	0.45	0.33	0.22	Silty	31.5	Warm Moist
Virginia	Campbell	0.49	0.28	0.24	Silty	24.1	Warm Moist
Virginia	Caroline	0.48	0.28	0.24	Silty	41.6	Warm Moist
Virginia	Carroll	0.47	0.31	0.23	Silty	30.2	Warm Moist
Virginia	Charles City	0.45	0.31	0.23	Silty	47.5	Warm Moist
Virginia	Charlotte	0.49	0.27	0.24	Sandy	26.0	Warm Moist
Virginia	Charlottesville	0.46	0.32	0.22	Silty	28.6	Warm Moist
Virginia	Chesapeake	0.41	0.36	0.23	Silty	88.4	Warm Moist
Virginia	Chesterfield	0.48	0.29	0.24	Silty	38.5	Warm Moist
Virginia	Clarke	0.43	0.36	0.21	Silty	34.8	Warm Moist
Virginia	Colonial Heights	0.47	0.29	0.24	Silty	41.0	Warm Moist
Virginia	Covington	0.43	0.37	0.21	Silty	38.8	Warm Moist
Virginia	Craig	0.43	0.36	0.21	Silty	35.3	Warm Moist
Virginia	Culpeper	0.46	0.32	0.22	Silty	33.7	Warm Moist
Virginia	Cumberland	0.48	0.28	0.24	Silty	29.5	Warm Moist
Virginia	Danville	0.48	0.28	0.24	Silty	24.5	Warm Moist
Virginia	Dickenson	0.42	0.38	0.20	Silty	33.7	Warm Moist
Virginia	Dinwiddie	0.48	0.28	0.24	Silty	38.0	Warm Moist
Virginia	Emporia	0.48	0.28	0.24	Silty	45.1	Warm Moist
Virginia	Essex	0.45	0.31	0.24	Silty	56.5	Warm Moist
Virginia	Fairfax	0.47	0.31	0.22	Silty	38.7	Warm Moist
Virginia	Fairfax	0.47	0.31	0.22	Silty	38.1	Warm Moist
Virginia	Falls Church	0.49	0.30	0.21	Silty	42.3	Warm Moist
Virginia	Fauquier	0.45	0.33	0.22	Silty	34.6	Warm Moist
Virginia	Floyd	0.45	0.33	0.22	Silty	28.3	Warm Moist
Virginia	Fluvanna	0.47	0.30	0.23	Silty	30.3	Warm Moist
Virginia	Franklin	0.45	0.32	0.23	Silty	65.4	Warm Moist
Virginia	Franklin	0.46	0.31	0.23	Silty	26.7	Warm Moist
Virginia	Frederick	0.42	0.37	0.21	Silty	35.4	Warm Moist
Virginia	Fredericksburg	0.48	0.29	0.24	Silty	38.0	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Virginia	Galax	0.46	0.31	0.23	Silty	31.2	Warm Moist
Virginia	Giles	0.43	0.36	0.21	Silty	32.3	Warm Moist
Virginia	Gloucester	0.42	0.35	0.23	Silty	60.4	Warm Moist
Virginia	Goochland	0.48	0.28	0.24	Silty	34.3	Warm Moist
Virginia	Grayson	0.46	0.31	0.23	Silty	33.0	Warm Moist
Virginia	Greene	0.45	0.33	0.22	Silty	29.9	Warm Moist
Virginia	Greensville	0.48	0.28	0.24	Silty	43.4	Warm Moist
Virginia	Halifax	0.49	0.27	0.24	Sandy	24.1	Warm Moist
Virginia	Hampton	0.41	0.36	0.23	Silty	70.2	Warm Moist
Virginia	Hanover	0.48	0.28	0.24	Silty	35.4	Warm Moist
Virginia	Harrisonburg	0.44	0.35	0.21	Silty	31.9	Warm Moist
Virginia	Henrico	0.47	0.29	0.24	Silty	41.2	Warm Moist
Virginia	Henry	0.48	0.29	0.23	Silty	24.9	Warm Moist
Virginia	Highland	0.42	0.37	0.21	Silty	39.5	Cool Moist
Virginia	Hopewell	0.47	0.29	0.24	Silty	41.0	Warm Moist
Virginia	Isle of Wight	0.43	0.34	0.23	Silty	67.1	Warm Moist
Virginia	James City	0.44	0.33	0.23	Silty	53.2	Warm Moist
Virginia	King George	0.47	0.30	0.23	Silty	52.0	Warm Moist
Virginia	King William	0.46	0.30	0.24	Silty	48.0	Warm Moist
Virginia	King and Queen	0.45	0.32	0.24	Silty	54.0	Warm Moist
Virginia	Lancaster	0.42	0.34	0.23	Silty	65.0	Warm Moist
Virginia	Lee	0.47	0.30	0.23	Silty	34.5	Warm Moist
Virginia	Lexington	0.44	0.34	0.22	Silty	34.4	Warm Moist
Virginia	Loudoun	0.44	0.34	0.22	Silty	34.6	Warm Moist
Virginia	Louisa	0.48	0.29	0.23	Silty	32.9	Warm Moist
Virginia	Lunenburg	0.49	0.28	0.24	Silty	31.4	Warm Moist
Virginia	Lynchburg	0.47	0.30	0.23	Silty	26.5	Warm Moist
Virginia	Madison	0.45	0.32	0.22	Silty	32.1	Warm Moist
Virginia	Manassas	0.46	0.31	0.22	Silty	36.7	Warm Moist
Virginia	Manassas Park	0.47	0.31	0.22	Silty	38.7	Warm Moist
Virginia	Martinsville	0.48	0.29	0.23	Silty	24.9	Warm Moist
Virginia	Mathews	0.41	0.36	0.23	Silty	66.1	Warm Moist
Virginia	Mecklenburg	0.49	0.27	0.24	Sandy	30.0	Warm Moist
Virginia	Middlesex	0.42	0.35	0.23	Silty	65.1	Warm Moist
Virginia	Montgomery	0.44	0.34	0.22	Silty	29.2	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Virginia	Nelson	0.46	0.31	0.23	Silty	27.2	Warm Moist
Virginia	New Kent	0.46	0.31	0.24	Silty	49.2	Warm Moist
Virginia	Newport News	0.42	0.35	0.23	Silty	65.9	Warm Moist
Virginia	Norfolk	0.40	0.37	0.23	Silty	76.9	Warm Moist
Virginia	Northampton	0.39	0.38	0.23	Silty	69.4	Warm Moist
Virginia	Northumberland	0.42	0.35	0.23	Silty	69.9	Warm Moist
Virginia	Norton	0.44	0.34	0.22	Silty	35.1	Warm Moist
Virginia	Nottoway	0.48	0.28	0.24	Silty	33.9	Warm Moist
Virginia	Orange	0.47	0.30	0.23	Silty	33.2	Warm Moist
Virginia	Page	0.44	0.35	0.22	Silty	31.5	Warm Moist
Virginia	Patrick	0.47	0.30	0.23	Silty	27.1	Warm Moist
Virginia	Petersburg	0.47	0.29	0.23	Silty	42.2	Warm Moist
Virginia	Pittsylvania	0.48	0.29	0.23	Silty	24.8	Warm Moist
Virginia	Poquoson	0.41	0.36	0.23	Silty	67.2	Warm Moist
Virginia	Portsmouth	0.41	0.36	0.23	Silty	76.3	Warm Moist
Virginia	Powhatan	0.48	0.28	0.24	Silty	32.8	Warm Moist
Virginia	Prince Edward	0.49	0.28	0.24	Silty	27.8	Warm Moist
Virginia	Prince George	0.47	0.30	0.23	Silty	43.5	Warm Moist
Virginia	Prince William	0.46	0.31	0.23	Silty	37.3	Warm Moist
Virginia	Pulaski	0.43	0.36	0.21	Silty	30.3	Warm Moist
Virginia	Radford	0.44	0.34	0.22	Silty	29.2	Warm Moist
Virginia	Rappahannock	0.44	0.35	0.22	Silty	33.7	Warm Moist
Virginia	Richmond	0.48	0.29	0.24	Silty	39.3	Warm Moist
Virginia	Richmond	0.44	0.33	0.24	Silty	64.2	Warm Moist
Virginia	Roanoke	0.45	0.33	0.22	Silty	29.1	Warm Moist
Virginia	Roanoke	0.44	0.34	0.22	Silty	30.8	Warm Moist
Virginia	Rockbridge	0.45	0.34	0.22	Silty	32.3	Warm Moist
Virginia	Rockingham	0.43	0.36	0.21	Silty	33.5	Warm Moist
Virginia	Russell	0.44	0.34	0.22	Silty	34.6	Warm Moist
Virginia	Salem	0.44	0.34	0.22	Silty	30.8	Warm Moist
Virginia	Scott	0.46	0.31	0.23	Silty	36.1	Warm Moist
Virginia	Shenandoah	0.43	0.36	0.21	Silty	33.2	Warm Moist
Virginia	Smyth	0.44	0.34	0.22	Silty	33.3	Warm Moist
Virginia	Southampton	0.46	0.31	0.23	Silty	59.1	Warm Moist
Virginia	Spotsylvania	0.48	0.28	0.24	Silty	35.0	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Virginia	Stafford	0.48	0.29	0.24	Silty	41.2	Warm Moist
Virginia	Staunton	0.44	0.34	0.22	Silty	32.4	Warm Moist
Virginia	Suffolk	0.43	0.34	0.23	Silty	76.9	Warm Moist
Virginia	Surry	0.44	0.32	0.23	Silty	53.8	Warm Moist
Virginia	Sussex	0.47	0.30	0.23	Silty	48.7	Warm Moist
Virginia	Tazewell	0.42	0.38	0.20	Silty	32.6	Warm Moist
Virginia	Virginia Beach	0.40	0.37	0.23	Silty	91.3	Warm Moist
Virginia	Warren	0.43	0.36	0.21	Silty	34.8	Warm Moist
Virginia	Washington	0.46	0.32	0.22	Silty	34.9	Warm Moist
Virginia	Waynesboro	0.45	0.33	0.22	Silty	29.5	Warm Moist
Virginia	Westmoreland	0.44	0.32	0.24	Silty	63.6	Warm Moist
Virginia	Williamsburg	0.43	0.33	0.23	Silty	54.0	Warm Moist
Virginia	Winchester	0.42	0.37	0.21	Silty	35.4	Warm Moist
Virginia	Wise	0.43	0.35	0.21	Silty	34.6	Warm Moist
Virginia	Wythe	0.45	0.34	0.22	Silty	31.1	Warm Moist
Virginia	York	0.42	0.34	0.23	Silty	59.1	Warm Moist
Washington	Adams	0.36	0.43	0.21	Silty	33.4	Cool Dry
Washington	Asotin	0.36	0.42	0.23	Silty	50.6	Cool Dry
Washington	Benton	0.40	0.43	0.18	Silty	27.7	Warm Dry
Washington	Chelan	0.43	0.41	0.16	Silty	66.9	Cool Moist
Washington	Clallam	0.55	0.29	0.17	Sandy	94.9	Cool Moist
Washington	Clark	0.44	0.33	0.23	Silty	75.1	Warm Moist
Washington	Columbia	0.35	0.42	0.23	Silty	43.3	Cool Moist
Washington	Cowlitz	0.43	0.34	0.23	Silty	81.9	Cool Moist
Washington	Douglas	0.41	0.43	0.16	Silty	36.9	Cool Dry
Washington	Ferry	0.44	0.43	0.14	Silty	40.6	Cool Dry
Washington	Franklin	0.37	0.43	0.20	Silty	28.6	Warm Dry
Washington	Garfield	0.35	0.43	0.22	Silty	49.5	Cool Dry
Washington	Grant	0.39	0.43	0.18	Silty	29.7	Warm Dry
Washington	Grays Harbor	0.41	0.36	0.23	Silty	95.4	Cool Moist
Washington	Island	0.42	0.36	0.22	Silty	103.3	Cool Dry
Washington	Jefferson	0.44	0.35	0.22	Silty	87.3	Cool Moist
Washington	King	0.43	0.38	0.20	Silty	86.7	Cool Moist
Washington	Kitsap	0.41	0.36	0.23	Silty	92.8	Warm Moist
Washington	Kittitas	0.43	0.40	0.17	Silty	47.9	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Washington	Klickitat	0.44	0.39	0.17	Silty	39.2	Cool Dry
Washington	Lewis	0.43	0.34	0.22	Silty	81.7	Cool Moist
Washington	Lincoln	0.36	0.43	0.21	Silty	36.0	Cool Dry
Washington	Mason	0.41	0.36	0.23	Silty	88.7	Warm Moist
Washington	Okanogan	0.44	0.43	0.13	Silty	47.8	Cool Dry
Washington	Pacific	0.41	0.36	0.23	Silty	117.1	Cool Moist
Washington	Pend Oreille	0.47	0.41	0.12	Silty	50.8	Cool Moist
Washington	Pierce	0.43	0.35	0.22	Silty	79.8	Cool Moist
Washington	San Juan	0.51	0.32	0.17	Silty	105.9	Cool Moist
Washington	Skagit	0.43	0.38	0.18	Silty	104.8	Cool Moist
Washington	Skamania	0.45	0.35	0.20	Silty	61.4	Cool Moist
Washington	Snohomish	0.43	0.39	0.19	Silty	100.7	Cool Moist
Washington	Spokane	0.37	0.41	0.21	Silty	49.2	Cool Dry
Washington	Stevens	0.44	0.42	0.14	Silty	45.7	Cool Dry
Washington	Thurston	0.43	0.34	0.23	Silty	88.1	Warm Moist
Washington	Wahkiakum	0.42	0.35	0.23	Silty	109.4	Cool Moist
Washington	Walla Walla	0.35	0.43	0.22	Silty	34.5	Warm Dry
Washington	Whatcom	0.51	0.33	0.15	Silty	107.8	Cool Moist
Washington	Whitman	0.35	0.42	0.22	Silty	48.7	Cool Dry
Washington	Yakima	0.44	0.39	0.17	Silty	41.8	Cool Moist
West Virginia	Barbour	0.41	0.38	0.20	Silty	42.0	Warm Moist
West Virginia	Berkeley	0.43	0.36	0.21	Silty	34.9	Warm Moist
West Virginia	Boone	0.42	0.38	0.21	Silty	43.0	Warm Moist
West Virginia	Braxton	0.41	0.39	0.20	Silty	43.5	Warm Moist
West Virginia	Brooke	0.45	0.33	0.21	Silty	41.6	Warm Moist
West Virginia	Cabell	0.43	0.35	0.21	Silty	39.4	Warm Moist
West Virginia	Calhoun	0.41	0.39	0.20	Silty	41.4	Warm Moist
West Virginia	Clay	0.41	0.39	0.20	Silty	46.4	Warm Moist
West Virginia	Doddridge	0.41	0.38	0.20	Silty	39.4	Warm Moist
West Virginia	Fayette	0.41	0.39	0.20	Silty	48.9	Warm Moist
West Virginia	Gilmer	0.41	0.39	0.20	Silty	40.8	Warm Moist
West Virginia	Grant	0.41	0.38	0.20	Silty	38.3	Cool Moist
West Virginia	Greenbrier	0.41	0.38	0.20	Silty	44.9	Cool Moist
West Virginia	Hampshire	0.42	0.38	0.20	Silty	36.3	Warm Moist
West Virginia	Hancock	0.46	0.32	0.22	Silty	44.1	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
West Virginia	Hardy	0.42	0.38	0.20	Silty	35.4	Warm Moist
West Virginia	Harrison	0.42	0.38	0.20	Silty	40.6	Warm Moist
West Virginia	Jackson	0.42	0.38	0.20	Silty	39.6	Warm Moist
West Virginia	Jefferson	0.43	0.36	0.21	Silty	34.9	Warm Moist
West Virginia	Kanawha	0.42	0.38	0.20	Silty	46.1	Warm Moist
West Virginia	Lewis	0.41	0.39	0.20	Silty	41.9	Warm Moist
West Virginia	Lincoln	0.43	0.36	0.21	Silty	41.6	Warm Moist
West Virginia	Logan	0.42	0.37	0.21	Silty	39.1	Warm Moist
West Virginia	Marion	0.42	0.37	0.21	Silty	41.6	Warm Moist
West Virginia	Marshall	0.44	0.35	0.21	Silty	39.4	Warm Moist
West Virginia	Mason	0.43	0.37	0.21	Silty	38.5	Warm Moist
West Virginia	McDowell	0.41	0.39	0.20	Silty	34.2	Warm Moist
West Virginia	Mercer	0.41	0.38	0.20	Silty	36.3	Warm Moist
West Virginia	Mineral	0.42	0.37	0.21	Silty	37.1	Warm Moist
West Virginia	Mingo	0.42	0.37	0.21	Silty	36.7	Warm Moist
West Virginia	Monongalia	0.43	0.35	0.21	Silty	41.0	Warm Moist
West Virginia	Monroe	0.43	0.37	0.21	Silty	36.5	Warm Moist
West Virginia	Morgan	0.43	0.36	0.21	Silty	35.5	Warm Moist
West Virginia	Nicholas	0.41	0.39	0.20	Silty	48.1	Warm Moist
West Virginia	Ohio	0.44	0.34	0.21	Silty	39.8	Warm Moist
West Virginia	Pendleton	0.42	0.37	0.21	Silty	36.7	Cool Moist
West Virginia	Pleasants	0.42	0.38	0.20	Silty	37.9	Warm Moist
West Virginia	Pocahontas	0.41	0.39	0.20	Silty	44.3	Cool Moist
West Virginia	Preston	0.42	0.37	0.21	Silty	40.4	Cool Moist
West Virginia	Putnam	0.43	0.36	0.21	Silty	41.4	Warm Moist
West Virginia	Raleigh	0.41	0.39	0.20	Silty	43.7	Warm Moist
West Virginia	Randolph	0.41	0.39	0.20	Silty	42.5	Cool Moist
West Virginia	Ritchie	0.41	0.39	0.20	Silty	38.1	Warm Moist
West Virginia	Roane	0.41	0.38	0.20	Silty	42.2	Warm Moist
West Virginia	Summers	0.42	0.38	0.20	Silty	40.1	Warm Moist
West Virginia	Taylor	0.42	0.38	0.20	Silty	41.8	Warm Moist
West Virginia	Tucker	0.41	0.39	0.20	Silty	40.2	Cool Moist
West Virginia	Tyler	0.42	0.37	0.20	Silty	38.6	Warm Moist
West Virginia	Upshur	0.41	0.39	0.20	Silty	43.5	Warm Moist
West Virginia	Wayne	0.43	0.35	0.22	Silty	38.6	Warm Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
West Virginia	Webster	0.41	0.39	0.20	Silty	46.5	Cool Moist
West Virginia	Wetzel	0.43	0.36	0.21	Silty	39.5	Warm Moist
West Virginia	Wirt	0.41	0.39	0.20	Silty	39.0	Warm Moist
West Virginia	Wood	0.42	0.38	0.20	Silty	37.5	Warm Moist
West Virginia	Wyoming	0.41	0.39	0.20	Silty	38.3	Warm Moist
Wisconsin	Adams	0.61	0.24	0.15	Sandy	74.6	Cool Moist
Wisconsin	Ashland	0.50	0.40	0.10	Silty	79.9	Cool Moist
Wisconsin	Barron	0.47	0.32	0.21	Silty	82.4	Cool Moist
Wisconsin	Bayfield	0.39	0.49	0.12	Silty	80.1	Cool Moist
Wisconsin	Brown	0.58	0.21	0.22	Sandy	80.1	Cool Moist
Wisconsin	Buffalo	0.43	0.35	0.22	Silty	69.0	Cool Moist
Wisconsin	Burnett	0.46	0.33	0.20	Silty	84.1	Cool Moist
Wisconsin	Calumet	0.57	0.23	0.20	Sandy	77.9	Cool Moist
Wisconsin	Chippewa	0.47	0.32	0.21	Silty	76.7	Cool Moist
Wisconsin	Clark	0.48	0.31	0.21	Silty	78.6	Cool Moist
Wisconsin	Columbia	0.56	0.27	0.17	Sandy	72.2	Cool Moist
Wisconsin	Crawford	0.44	0.34	0.22	Silty	61.5	Cool Moist
Wisconsin	Dane	0.47	0.33	0.20	Silty	69.4	Cool Moist
Wisconsin	Dodge	0.52	0.29	0.19	Silty	77.0	Cool Moist
Wisconsin	Door	0.66	0.16	0.19	Sandy	93.2	Cool Moist
Wisconsin	Douglas	0.40	0.46	0.15	Silty	85.5	Cool Moist
Wisconsin	Dunn	0.47	0.32	0.21	Silty	73.8	Cool Moist
Wisconsin	Eau Claire	0.46	0.32	0.21	Silty	70.2	Cool Moist
Wisconsin	Florence	0.85	0.11	0.04	Sandy	101.6	Cool Moist
Wisconsin	Fond du Lac	0.56	0.25	0.19	Sandy	77.6	Cool Moist
Wisconsin	Forest	0.82	0.13	0.05	Sandy	96.9	Cool Moist
Wisconsin	Grant	0.42	0.36	0.22	Silty	61.1	Cool Moist
Wisconsin	Green	0.40	0.37	0.23	Silty	65.5	Cool Moist
Wisconsin	Green Lake	0.63	0.23	0.14	Sandy	77.8	Cool Moist
Wisconsin	Iowa	0.44	0.35	0.21	Silty	61.5	Cool Moist
Wisconsin	Iron	0.56	0.33	0.11	Sandy	88.9	Cool Moist
Wisconsin	Jackson	0.48	0.31	0.20	Silty	69.3	Cool Moist
Wisconsin	Jefferson	0.44	0.34	0.22	Silty	75.4	Cool Moist
Wisconsin	Juneau	0.59	0.25	0.16	Sandy	70.2	Cool Moist
Wisconsin	Kenosha	0.39	0.33	0.28	Clayey	75.2	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Wisconsin	Kewaunee	0.54	0.20	0.26	Sandy	79.2	Cool Moist
Wisconsin	La Crosse	0.44	0.34	0.21	Silty	60.7	Cool Moist
Wisconsin	Lafayette	0.41	0.36	0.22	Silty	60.9	Cool Moist
Wisconsin	Langlade	0.71	0.19	0.10	Sandy	90.8	Cool Moist
Wisconsin	Lincoln	0.64	0.23	0.14	Sandy	95.3	Cool Moist
Wisconsin	Manitowoc	0.48	0.24	0.28	Sandy	74.3	Cool Moist
Wisconsin	Marathon	0.55	0.28	0.18	Sandy	88.8	Cool Moist
Wisconsin	Marinette	0.77	0.14	0.09	Sandy	100.0	Cool Moist
Wisconsin	Marquette	0.63	0.23	0.14	Sandy	75.0	Cool Moist
Wisconsin	Menominee	0.67	0.20	0.13	Sandy	84.1	Cool Moist
Wisconsin	Milwaukee	0.40	0.29	0.31	Clayey	75.8	Cool Moist
Wisconsin	Monroe	0.52	0.29	0.18	Silty	65.4	Cool Moist
Wisconsin	Oconto	0.70	0.17	0.13	Sandy	88.6	Cool Moist
Wisconsin	Oneida	0.72	0.19	0.10	Sandy	99.0	Cool Moist
Wisconsin	Outagamie	0.62	0.21	0.17	Sandy	80.4	Cool Moist
Wisconsin	Ozaukee	0.42	0.28	0.31	Clayey	74.0	Cool Moist
Wisconsin	Pepin	0.46	0.33	0.21	Silty	69.5	Cool Moist
Wisconsin	Pierce	0.46	0.33	0.21	Silty	69.8	Cool Moist
Wisconsin	Polk	0.47	0.32	0.21	Silty	79.7	Cool Moist
Wisconsin	Portage	0.55	0.27	0.18	Sandy	82.2	Cool Moist
Wisconsin	Price	0.60	0.25	0.15	Sandy	98.0	Cool Moist
Wisconsin	Racine	0.39	0.31	0.29	Clayey	76.0	Cool Moist
Wisconsin	Richland	0.49	0.32	0.20	Silty	62.7	Cool Moist
Wisconsin	Rock	0.40	0.37	0.23	Silty	71.3	Cool Moist
Wisconsin	Rusk	0.49	0.31	0.20	Silty	88.2	Cool Moist
Wisconsin	Sauk	0.52	0.29	0.18	Silty	64.9	Cool Moist
Wisconsin	Sawyer	0.47	0.35	0.18	Silty	89.9	Cool Moist
Wisconsin	Shawano	0.63	0.22	0.15	Sandy	83.1	Cool Moist
Wisconsin	Sheboygan	0.43	0.27	0.30	Clayey	72.3	Cool Moist
Wisconsin	St. Croix	0.47	0.32	0.21	Silty	73.4	Cool Moist
Wisconsin	Taylor	0.53	0.29	0.18	Sandy	89.3	Cool Moist
Wisconsin	Trempealeau	0.44	0.34	0.22	Silty	65.5	Cool Moist
Wisconsin	Vernon	0.48	0.32	0.20	Silty	61.5	Cool Moist
Wisconsin	Vilas	0.72	0.20	0.08	Sandy	95.9	Cool Moist
Wisconsin	Walworth	0.39	0.37	0.24	Silty	75.3	Cool Moist

Table 20: *Default parameter values for each county in the continental US (continued)*

State	County	Sand	Silt	Clay	Soil	SOC	Climate
Wisconsin	Washburn	0.45	0.36	0.19	Silty	86.5	Cool Moist
Wisconsin	Washington	0.48	0.29	0.24	Silty	76.3	Cool Moist
Wisconsin	Waukesha	0.42	0.32	0.26	Silty	76.2	Cool Moist
Wisconsin	Waupaca	0.62	0.23	0.14	Sandy	81.5	Cool Moist
Wisconsin	Waushara	0.63	0.23	0.14	Sandy	79.0	Cool Moist
Wisconsin	Winnebago	0.62	0.22	0.16	Sandy	79.8	Cool Moist
Wisconsin	Wood	0.52	0.29	0.19	Silty	79.9	Cool Moist
Wyoming	Albany	0.46	0.31	0.23	Silty	27.4	Cool Dry
Wyoming	Big Horn	0.40	0.39	0.21	Silty	25.5	Cool Dry
Wyoming	Campbell	0.54	0.23	0.23	Sandy	25.7	Cool Dry
Wyoming	Carbon	0.53	0.24	0.23	Sandy	21.8	Cool Dry
Wyoming	Converse	0.56	0.20	0.24	Sandy	22.2	Cool Dry
Wyoming	Crook	0.51	0.22	0.27	Sandy	29.7	Cool Dry
Wyoming	Fremont	0.48	0.28	0.23	Silty	28.3	Cool Dry
Wyoming	Goshen	0.43	0.34	0.23	Silty	28.2	Cool Dry
Wyoming	Hot Springs	0.47	0.31	0.22	Silty	31.8	Cool Dry
Wyoming	Johnson	0.47	0.30	0.23	Silty	22.0	Cool Dry
Wyoming	Laramie	0.39	0.39	0.22	Silty	30.3	Cool Dry
Wyoming	Lincoln	0.38	0.41	0.21	Silty	35.8	Cool Dry
Wyoming	Natrona	0.56	0.21	0.24	Sandy	18.5	Cool Dry
Wyoming	Niobrara	0.54	0.23	0.24	Sandy	26.3	Cool Dry
Wyoming	Park	0.38	0.42	0.20	Silty	39.5	Cool Dry
Wyoming	Platte	0.50	0.27	0.24	Sandy	24.6	Cool Dry
Wyoming	Sheridan	0.43	0.36	0.21	Silty	23.4	Cool Dry
Wyoming	Sublette	0.39	0.38	0.22	Silty	38.5	Cool Dry
Wyoming	Sweetwater	0.48	0.28	0.24	Silty	17.9	Cool Dry
Wyoming	Teton	0.36	0.43	0.21	Silty	45.0	Cool Moist
Wyoming	Uinta	0.29	0.51	0.20	Silty	30.4	Cool Dry
Wyoming	Washakie	0.47	0.31	0.22	Silty	22.5	Cool Dry
Wyoming	Weston	0.54	0.23	0.24	Sandy	27.4	Cool Dry

Appendix C: Tillage Methods

Table of Contents

1. Overview: Tillage

The overall scope is for US crops of corn, wheat, and soybean production, and crops commonly grown in rotation with these crops, and crops grown as cover crops with these crops. For "tillage", the focus is on tillage alone, we examine other practices such as cover cropping separately. There are many types of conservation tillage. We include in our analysis both a strict no-till as well as a reduced-till (defined below).

2. Soil carbon stock change due to reduced-till and no-till

Two recent meta-analyses found small increases in SOC with the use of no-till or reduced-till. Ogle et al. (2019), find an average for strict no-till of 0.94 Mg CO_2e ha^{-1} y^{-1} while Meurer et al. (2018) find an average value of 0.25 Mg CO_2e ha^{-1} y^{-1}. The average length of the experiments in these studies is 20 years (Ogle et al. 2019) and 16-18 years (Meurer et al. 2018). The Ogle et al (2019) estimate is for a depth of between 0–30 and 0–70 cm, depending on whether there was a significant difference below 30 cm (see their Table 1). In contrast, Meurer et al. (2018) report to an average depth of 60 cm. Importantly, Meurer et al. (2018) found that strict no-till to 30 cm depth averaged 0.86 Mg CO_2e ha^{-1} y^{-1}, which is close to the Ogle et al. (2019) value of 0.94 for variable depths. Because Ogle et al. (2019) calculated values for different soil textural classes and climatic conditions; we will use Ogle's values, but adjust them to 60 cm depth using the ratio of Meurer values for 60 versus 30 cm, with the adjustment depending on the depth to which Ogle et al. (2018) calculated the change in SOC. For reduced-till, we used the results of Meurer et al. (2018), who examined both no-till and reduced-till. Based on their results, reduced-till had 90%

of the increase in SOC found with no-till, so we multiplied our results for no-till by that factor to estimate the effects of reduced-till. It should be noted, however, that significant uncertainty remains even in these average values. Ogle et al. (2019) note that there is still insufficient information to “make precise estimates of the ΔSOC, particularly deeper in the soil profile”, and that “there is also a chance that ΔSOC may be negative according to our confidence intervals”. Therefore, GHG abatement programs need to consider the risk associated with the uncertainty in ΔSOC from no-till adoption.

Even if reduced tillage is practiced indefinitely, it is anticipated that a new steady state SOC level will be reached in a few decades, with no further increase in SOC (Chung et al. 2008, Stewart et al. 2007, Stewart et al. 2008). The steady-state level within a specific soil may increase with no-till compared to conventional tillage, but is still expected to approach a quasi-steady-state (Stewart et al. 2007). Based on a review by West & Six (2007), the effect of reducing tillage will reach a quasi-steady-state after 21 years, on average. Based on a review by Meurer et al. (2018, Figure 3), there is very little additional SOC sequestration after 25 to 30 years. Based on these two results, we selected a value of 25 years as the average time by which a new quasi-steady-state of SOC will be reached after reduction in tillage.

3. Effects of occasional tillage on SOC

Continuous no-till (NT) may not be practiced indefinitely on commercial farms due to problems such as weed control, stratification of SOC and nutrients, or compaction. We therefore reviewed the literature to determine the effect of occasional tillage (circa every 10 years) on SOC accumulation in no-till cropping. This topic was recently reviewed Blanco-Canqui & Wortmann (2020), but we found 70% more studies that were not included in their review. We also extracted additional information from each study and the results are summarized in Table [OT]. In sum, there was no effect of occasional tillage on SOC (no change in 11 studies, increase in 2 studies, decrease in 2 studies). The median time in no-till prior to occasional tillage was 13.5 years (range 6-20) and the median time after occasional tillage before soil sampling was 1.5 years (range 1-8). There was also no clear effect on yield (no change in 5 studies, increase in 2 studies, decrease in 2 studies, not reported in the others). We conclude that occasional tillage (circa every 10 to 15 years) does not decrease SOC on average compared to strict no-till, nor does it change yield.

Table [OT]. Effects of occasional tillage after many years of continuous no-till on soil organic carbon and yield[1].

Country	Region, State, location	Soil Description	Years under NT (yr)	Tillage Method (depth, cm)	Maximum time after OT (y)	Depth of Sampling (cm)	SOC units	Effect of Occasional Tillage on Soil Organic C	Effect of Occasional Tillage on yield	Notes	Citation
Australia	Northeast	5 Vertisols, 1 Sodosol, 1 Dermosol	9 to 43	Chisel, disk, scarifier, and cultivator	2.0	10	Equivalent soil mass	None	*None*	7 on-farm experiments. Soil sampled to 30 cm, but SOC reported to 10 cm. Overlap with Crawford et al. 2015?	Dang et al. 2018
Australia	New South Wales	Vertisol (sandy clay loam)	15	Chisel (10 cm) or disk (15 cm)	1.0	30	g kg^{-1}	None	*None*		Liu et al. 2016
Australia	Northern grain regions	Five soils	7-44	Primarily chisel	1.0	30	Equivalent soil mass	None	*None in 9 site-years, Increase in 1 site-year*	5 experiments, apparently on-farm. Overlap with Dang et al. 2018?	Crawford et al. 2015
Brazil	Pato Branco, Paraná	Oxisol, Clayey	17	Disk plow and harrow	1.7	20	g kg^{-1}	Increase	*None*	Statistically significant only for 10-20 cm.	Fidalski et al., 2015
Canada	La Pocatiere, Quebec	Gleysol (clay)	24	MP	1.0	20	Equivalent soil mass	None	*Increase*		Malhi et al. 2018
Canada	Saskatchewan	Brown Chernozem (loam), Black Chernozem (fine loam), Gray Luvisol (silty clay loam/clay loam)	10-12	Cultivator, disk	0.0	10	Equivalent soil mass	n/a	*Increase, but under herbicide-free management*	Soil sampling occurred immediately after the last tillage treatement.	Baan et al. 2009
Canada	Ontario, Southern	sandy loam, sandy clay loam, silty clay loam, well- and poorly drained (Mollic Aqualf, Typic Hapludalf	22	MP (20 cm)	1.5	Circa 40	Equivalent soil mass	None in 3 soils, Decrease in 1 soil	*Not reported*	Only the low carbon sandy loam soil had a significant change in SOC.	VandenBygaart & Kay 2004
Canada	Ontario, Woodslee	Clay (Typic Argiaquoll)	13	MP (17-20 cm)	n/a, see notes	20-60 cm	Equivalent soil mass	None, despite 8 years of MP.	*Not reported*	NOT a one-time plowing, but rather 8 years of MP after 13 years of NT, and still no significant change in SOC. Soils were sampled to 60 cm, but reported on the basis of 3000 Mg ha-1, which was circa 20 cm in the NT treatment.	Yang et al. 2008
Germany	Lower Saxony	Silt loam (Typic Hapludalf)	20	Moldboard plow (MP)	1.5	50	g kg^{-1}	Decrease, but CT and MT not significantly different prior to OT	*Not reported*	Minimum till = 6-8 cm rotary harrow or rototiller	Stockfisch et al., 1999
Spain	Alange-Badajoz	Loam (Eutric Leptosol)	11	MP (30 cm) and disc harrow (15 cm)	3.0	25	kg C ha^{-1}	Decrease to 25 cm, not clear if statistically significant (see text p. 184)	*Possible decrease (may not be signficant)*	On-farm, pseudo-replication within one treatment strip. SOC reported data shallower than MP depth.	López-Garrido et al. 2011
Spain	Jerez de la Frontera (Cadiz)	Clay loam (Leptic Typic Xerorthent)	8	MP (25 cm) and for reduced-till chisel (15 cm)	1.3	25	g kg^{-1}	None	*Not reported*	See Table 2.	Melero et al., 2011
Turkey	Adana (southern)	Clay (Haplic Vertisol)	9	MP	1.0	30	g kg^{-1}	Increase	*Decrease for wheat, none for soybean*	Statistically significant for 10-20 and 20-30 cm.	Celik et al., 2019
USA	NE, Eastern (Sidney)	Silt loam (Aridic Argiustoll)	20	MP (15 cm)	5.0	30	Mg ha^{-1}	None	*Increase 30% year 1 and 9% year 3*		Kettler et al., 2000
USA	NE, 2 sites, Eastern	2 silty clay loams	7, 12	MP, miniMP, and chisel or disk (20 cm)	5.0	30	Equivalent soil mass	None	*None*	Wortmann results presented herein because they were longer term.	Quincke et al., 2007b; Wortmann et al., 2010
USA	MI, East Lansing	Loam	6, 7		5.0	20	kg m^{-3}	None	*Not reported*	I summed SOC from all depths (from Table 6).	Pierce et al. 1994
USA	IN, West Lafayette	Silty clay loam (Typic Endoaquoll)	6-18	MP	n/a, see notes	100	Equivalent soil mass	None,despite 6 years of tillage.	*Not reported*	Treatments were long-term NT vs CP converted to NT for 6 years.	Omonode et al. 2006
USA	KY, Princeton	Silt loam (Fluventic Hapludoll)	20	Chisel, disc	8.0	20	g kg^{-1}	None, despite 4 tillage events over 8 years	*Out of 20 crop/seasons, none in 13, decrease in 5, increase in 2*	Tillage occurred 4 times in 8 years, not just once.	Diaz-Zorita 2004
SUMMARY	**From USA and Canada**	**56%**	**Median years of NT = 13.5 (range 6-20)**		**Median years after OT = 1.5 (range 1-8)**	**Mostly 20 to 30 cm**		**None = 12 Increase = 2 Decrease = 2**	**None = 5 Increase = 2 Decrease = 2**		

[1] After Table 3 of Blanco-Canqui 2020 but with all values derived from original literature and additional information added to the table such as yield as well as 70% more studies included.

4. Machinery use

No-till and reduced-till reduce GHG emissions in comparison to conventional tillage due to reducing emissions from combustion of fuel from machinery such as tractors. We used results from the USDA based on national farm survey data from thousands of farms to estimate this reduction. The value for no-till was 0.10 Mg $CO2_{eq}$ ha^{-1} yr^{-1}, and for reduced-till was 0.08 Mg CO_2eq ha^{-1} yr^{-1} (USDA-NRCS (2016). These values occur each year indefinitely as long as the practice is continued. These values do not include embedded energy in equipment, which are expected to be a small fraction of that associated with fuel use, especially amortized over many decades. These values are slightly lower than older values from the literature (Marland et al. 2003, Dyer & Desjardins 2005), probably because they reflect more recent and more detailed data on the different types of equipment used in both conventional and reduced tillage.

5. Herbicide use

It is commonly expected that no-till requires more herbicide than conventional tillage because reducing tillage also reduces weed control, thus requiring additional herbicide use for weed management. We therefore used data on the change in herbicide application rates for different crops as follows. For maize, we used USDA-NASS (2019a) and for soybean, we used USDA-NASS (2019b). For wheat, we used Camargo et al. (2013). For changes in herbicide use with no-till, we used West & Marland (2002).

To estimate the change in GHG emissions for a given amount of herbicide, we used the average of three of four values from the FEAT model (Camargo et al. 2013). One value was not used because it was from Europe and was much lower. Total changes in GHG emissions for no-till were -0.01 Mg $CO2_{eq}$ ha^{-1} yr^{-1} for maize and soybean and -0.02 Mg $CO2_{eq}$ ha^{-1} yr^{-1} for wheat (negative values are GHG emission). Total changes for reduced-till were zero for maize and soybean and -0.01 Mg $CO2_{eq}$ ha^{-1} yr^{-1} for wheat.

6. Crop yield

Several meta-analyses suggest that there are, on average, decreases in yield from no-till experiments for some crops and regions (Pittelkow et al. 2015, Huang et al. 2018, Toliver et al. 2012). This conclusion is important because decreases in yield are expected to increase GHG emissions due to displacing crop production to other locations (i.e., indirect land use change, see subsequent section). It is unlikely that users of the Gigaton Soil Health Tool would have site-specific data about the effect of no-till or reduced-till on yields, because it would require controlled trials to compare yields with and without no-till or reduced-till. Therefore, we provide default estimates of yield impacts for use when site-specific data are not available.

The effects of tillage on crop yield vary substantially with crop type, climate, moisture regime, and the number of years since conventional tillage (e.g. Pittelkow et al. 2015). In a global study, no-till generally did not reduce yields under rainfed conditions in dry climates, but for irrigated and dry, rainfed and humid, and irrigated and humid conditions, yield was reduced for most crop groups, although not for cotton, legumes, and oilseeds (Pittelkow et al. 2015). In humid climates, crop rotation and residue return did not ameliorate yield reductions (Pittelkow et al. 2015).

To represent US production of maize, wheat, and soybean, we selected two studies as sources of estimates of the long-term effect of no-till on crop yields (Daigh et al. 2018; Pittelkow et al. 2015).

For maize and soybean we used the results from Daigh et al., (2018) because they are from multiple long-term experiments with yield results averaged over many years in the Midwest. Daigh et al. (2018) reported the site-specific, 5-year yield difference as statistically significant for some, but not all sites studied. We estimated the change in yield between NT and CT practices using the observed 5-year average yield difference averaged across all long-term no-till sites (Daigh et al. 2018). The results were changes in yield of -1.7% for maize rotated with soybean and -6.3% for continuous maize (Daigh et al., (2018).

We apply 0% change in soybean yield under NT relative to CT for all locations in the USA. Daigh et al. (2018) reported no change in soybean yield under NT relative to CT across multiple long-term experiments in the U.S. Midwest. Pittelkow et al. (2015) found that legumes generally have no yield response to NT in both humid and dryland systems. Toliver et al. (2012) found that mean value for all regions and soil textural types for shorter-term studies was -0.1%

For wheat, we apply results of Pittelkow et al. (2015) after more than 10 years of NT, reported separately for moist and dry climatic regions because effects on yield were significant in both cases, with decreases of 4.0% in humid areas and increases of 4.3% in dry areas.

We did not find suitable data for effects of reduced-till systems on yield. Under the assumption that reduced-till can ameliorate some production challenges that occur with no-till, we assumed that effects on yield from reduced-till were half of those found for no-till.

7. Indirect land use change

If crop yields are reduced, GHG emissions will increase due to displacement of the crop production to another location, i.e., indirect land use change, also called leakage. We use the results of Searchinger et al. (2018) to calculate both the effect of replacing the lost production and also the "carbon opportunity cost" which is the foregone potential of the land to sequester carbon were it not converted to cropland. This method estimates worldwide average values of the carbon opportunity cost, which is appropriate for crops such as maize, wheat, and soybean that are traded globally.

Lost crop production will be made up with a combination of intensification and extensification. Intensification means increasing yield on existing cropland. Extensification means planting crops on new cropland converted from some other use. Intensification can occur by different mechanisms, such as increased crop yield, double cropping, or bringing fallow cropland into production. The Searchinger et al. (2018) method has a parameter for the ratio of expected intensification to extensification, but does not provide a value for this parameter, because such information is scarce in the literature. We searched the literature and found one suitable publication from which we can estimate this ratio for US commodity crop production. This publication uses a global economic computable general equilibrium model (GTAP-BIO) to estimate the global indirect land use change caused by increasing demand for either maize grain or soybean in the USA (Taheripour et al. 2018). The analysis uses two models, one that does not include intensification ("old model") and one that does include intensification ("new model").

For the new model, the analysis develops estimates of the degree of intensification for each region of the world based on historical data on crop yield and harvested area. The analysis includes four scenarios of increased demand in the USA, two for maize and two for soybean, using different time periods and with different total new demand (i.e. shock). Each of the four scenarios is analyzed using both the old and new models. We estimate the ratio of intensification to extensification by calculating the average results for the two models for each of the four scenarios. The four ratios are as follows (in units of 1000 ha of new cropland): 69.4/154.8 (Table 2.B.1), 36.2/72.1 (Table 2.B.3), 510.9/1076.5 (Table 2.3), and 62.2/114.8 (Table 2.5) resulting in an average of 0.49. Thus for an increase in crop demand (which could be caused by a decrease in crop yield), about half of the new demand is predicted by GTAP-BIO to be met by intensification and about half to be met by intensification.

8. Tillage effect on N_2O emissions

Available data:
A number of reviews of this topic, especially meta-analyses, have been conducted over the last decade. Not all reviews are representative of U.S. commodity cropping systems. Below we discuss our process of extracting data for supporting Gigaton Soil Health Tool development.

Overall van Kessel et al. (2013) conducted meta-analyses including data that are most representative of U.S. commodity grain systems. Van Kessel et al. 2013 is particularly useful for the Gigaton soil health tool development because it provided analysis of tillage and yield impact across a range of subcategories for both management (long-term vs. short-term reduced (RT)/no-till (NT); shallow vs. deep N placement) and site properties (humid vs. dry). Van Kessel et al. (2013) analyzed data that are from the U.S. (29% of publications), Canada (29%), Europe (23%), Asia (10%), and other locations (10%). These data are 55% maize, 13% soybean and 45% wheat studies (note, some systems are corn-soybean or wheat-soybean). Van Kessel et al. (2013) used strict selection criteria for inclusion of a study in their analysis; of 239 studies analyzed all but 5 had the same N rate across CT and NT treatments, and no study differed by more than 15 kg N /ha /yr. Therefore, van Kessel et al. 2013 is the foundation of our tool development. We discuss details of van Kessel et al. (2013) relevant to Gigaton development below and in Table 1.

Observed trends:
Van Kessel et al. (2013, Figure 1) found an overall neutral impact of reduced tillage or no-till on area-scaled N_2O emissions. Though they report a small decline in yield under reduced tillage or no-till, they also find a neutral response to yield-scaled N_2O emissions (Van Kessel et al. 2013, Figure 1). However, when looking at subcategories of the data, distinct N_2O and yield trends emerge in response to tillage for dry compared to humid climates, and for long- compared to short-duration management of RT or NT.

Based on the van Kessel et al. (2013) analysis, overall humid systems demonstrate neutral N_2O emissions response to RT or NT. In humid systems, if RT or NT is a short-term management practice, then neutral response is the best summary value; if there is long-term RT or NT management, a humid system averaged a 10% decrease in N_2O emissions relative to the conventionally tilled system but with a confidence interval overlapping zero (van Kessel et al. 2013, Figure 2). In contrast, a dry system may have increased N_2O emissions under RT or NT;

van Kessel et al. (2013, Figure 1) shows a mean 20% increase in N_2O emissions, but with CI overlapping zero. Short-term RT or NT management in dry systems led to an average 38% increase in N_2O emissions, while long-term RT or NT in dry systems resulted in an average reduction in N_2O emissions of 34% (van Kessel et al. 2013). Table 1 outlines N_2O emission trajectories based on the duration of management. In the Soil Health Method we based N_2O emission on total system N additions. Because dry systems often require N addition to achieve the credited SOC accumulation, this additional N can be a source of additional N_2O emission.

Table 1. Effects of no-till or reduced till on N_2O emissions (units: proportional change in emissions relative to conventional tillage).

Practice	GHG source	Temperature Regime	Moisture Regime	Soil Texture	Practice duration (years)	Direction	Proportional change relative to conventional tillage	Source	
No-till / Reduced till	N_2O	Cool / Warm	Dry	all	<10	increase	0.38	Van Kessel et al. 2013	Fig. 2
No-till / Reduced till	N_2O	Cool / Warm	Dry	all	>=10	decrease	-0.34	Van Kessel et al. 2013	Fig. 2
No-till / Reduced till	N_2O	Cool / Warm	Moist	all	<10	neutral	0	Van Kessel et al. 2013	Fig. 2
No-till / Reduced till	N_2O	Cool / Warm	Moist	all	>=10	decrease	-0.1	Van Kessel et al. 2013	Fig. 2

The overall result of neutral impact of no-till or reduced-till is supported by other meta-analysis studies, though there is variability in N_2O emission trends when viewing data subsets. Han et al. (2017, Figure 1) demonstrated an overall neutral impact of RT on N_2O emissions. However, a subset of the Han et al. 2017 data demonstrated that RT resulted in an average increase in N_2O emissions of 4.3% in rainfed systems, and an average decrease of 3% in irrigated systems. A subset of the Mei et al. (2018) data that is applicable to U.S. commodity grains demonstrated that tillage impact on N_2O emissions is neutral in cool, temperate climates, as well as for systems applying N at <=150 kg N ha^{-1}. General trends of tillage impact on N_2O emissions found in Mei et al. (2018) are not directly relevant to U.S. commodity grains because they include tropical systems or systems with a high N rate. Similarly, averaged over all studies, Huang et al. (2018) found that no-till can result in higher N_2O emissions. But when the data are categorized, it is evident that high N_2O emissions are driven by fine textured soils and excessive N rates. Huang et al. (2018) included a wide range of N application rates, and they find that studies applying >200 kg N ha^{-1} are the primary source of increased N_2O emission. Therefore, this study is not directly applicable to typical U.S. commercial grain systems. Furthermore, Huang et al. (2018) included studies from North America, Europe, India, and China, but did not provide a concise description of site properties and management applied across studies. Nonetheless, general trends from Huang et al. (2018) confirm our expectations based on mechanistic understanding of N_2O drivers. Namely, Huang et al. (2018, Figure 4) found that N_2O emissions are greatly increased under no-till management relative to conventional tillage for fine textured soils, but medium and coarse textured soils have neutral trends.

A modeling study by Lugato et al. (2018) discussed the possibility that net impact of reduced till is not properly accounting for the role of N_2O emissions. In particular, this model analysis seeks to quantify the role N_2O emission plays during the initial transition to RT/NT, when SOC is aggrading, through the phase of SOC stabilization under long-term RT/NT. Our approach to considering the impact of RT/NT has been to explicitly account for SOC sequestration using a 100-year mean rates. Based on the results of van Kessel et al. (2013), we do not see evidence for N_2O emissions increasing under long-term RT/NT, with increased SOC. Rather, van Kessel et al. (2013) demonstrates long-term RT/NT led to reduced N_2O emissions in both humid and dry systems.

9. Literature Cited

Blanco-Canqui, H., and C. S. Wortmann. 2020. Does occasional tillage undo the ecosystem services gained with no-till? A review. Soil & Tillage Research **198**.

Camargo, G. G. T., M. R. Ryan, and T. L. Richard. 2013. Energy Use and Greenhouse Gas Emissions from Crop Production Using the Farm Energy Analysis Tool. Bioscience **63**:263-273.

Çelik, İ., H. Günal, M. Acar, N. Acir, Z. Bereket Barut, and M. Budak. 2019. Strategic tillage may sustain the benefits of long-term no-till in a Vertisol under Mediterranean climate. Soil and tillage research **185**:17-28.

Chung, H. G., J. H. Grove, and J. Six. 2008. Indications for soil carbon saturation in a temperate agroecosystem. Soil Science Society of America Journal **72**:1132-1139.

Crawford, M. H., V. Rincon-Florez, A. Balzer, Y. P. Dang, L. C. Carvalhais, H. Liu, and P. M. Schenk. 2015. Changes in the soil quality attributes of continuous no-till farming systems following a strategic tillage. Soil Research **53**:263-273.

Daigh, A. L. M., W. A. Dick, M. J. Helmers, R. Lal, J. G. Lauer, E. Nafziger, C. H. Pederson, J. Strock, M. Villamil, A. Mukherjee, and R. Cruse. 2018. Yields and yield stability of no-till and chisel-plow fields in the Midwestern US Corn Belt. Field Crops Research **218**:243-253.Dang, Y. P., A. Balzer, M. Crawford, V. Rincon-Florez, H. W. Liu, A. Melland, D. Antille, S. Kodur, M. J. Bell, J. P. M. Whish, Y. R. Lai, N. Seymour, L. C. Carvalhais, and P. Schenk. 2018. Strategic tillage in conservation agricultural systems of north-eastern Australia: why, where, when and how? Environmental Science and Pollution Research **25**:1000-1015.

Diaz-Zorita, M., J. H. Grove, L. Murdock, J. Herbeck, and E. Perfect. 2004. Soil structural disturbance effects on crop yields and soil properties in a no-till production system. Agronomy Journal **96**:1651-1659.

Dyer, J. A., and R. L. Desjardins. 2005. A simple meta-model for assessing the contribution of liquid fossil fuel for on-farm fieldwork to agricultural greenhouse gases in Canada. Journal of Sustainable Agriculture **27**:71-90.

Fidalski, J., R. Yagi, and C. A. Tormena. 2015. Occasional Soil Turnover and Liming in a Clayey Oxisol Under a Consolidated No-tillage System. Revista Brasileira De Ciencia Do Solo **39**:1483-1489.

Han, Z., Walter, M.T. & Drinkwater, L.E. 2017. N2O emissions from grain cropping systems: a meta-analysis of the impacts of fertilizer-based and ecologically-based nutrient management strategies. Nutrient Cycling Agroecosystems 107, 335–355. doi:10.1007/s10705-017-9836-z

Huang, Y. W., W. Ren, L. X. Wang, D. F. Hui, J. H. Grove, X. J. Yang, B. Tao, and B. Goff. 2018. Greenhouse gas emissions and crop yield in no-tillage systems: A meta- analysis. Agriculture Ecosystems & Environment **268**:144-153.

Kettler, T. A., D. J. Lyon, J. W. Doran, W. L. Powers, and W. W. Stroup. 2000. Soil Quality Assessment after Weed-Control Tillage in a No-Till Wheat–Fallow Cropping System. Soil Science Society Of America Journal **64**:339-346.

Liu, H. W., M. Crawford, L. C. Carvalhais, Y. P. Dang, P. G. Dennis, and P. M. Schenk. 2016. Strategic tillage on a Grey Vertosol after fifteen years of no-till management had no short-term impact on soil properties and agronomic productivity. Geoderma **267**:146-155.

López-Garrido, R., E. Madejón, J. M. Murillo, and F. Moreno. 2011. Soil quality alteration by mouldboard ploughing in a commercial farm devoted to no-tillage under Mediterranean conditions. Agriculture, Ecosystems & Environment **140**:182-190.

Lugato, E., et al. 2018. Mitigation potential of soil carbon management overestimated by neglecting N2O emissions. Nature Climate Change **8** (3): 219-+.

Malhi, S. S., A. Legere, A. Vanasse, and G. Parent. 2018. Effects of long-term tillage, terminating no-till and cropping system on organic C and N, and available nutrients in a Gleysolic soil in Quebec, Canada. Journal Of Agricultural Science **156**:472-480.

Marland, G., T. O. West, B. Schlamadinger, and L. Canella. 2003. Managing soil organic carbon in agriculture: the net effect on greenhouse gas emissions. Tellus Series B-Chemical and Physical Meteorology **55**:613-621.

Mei, K., Z. F. Wang, H. Huang, C. Zhang, X. Shang, R. A. Dahlgren, M. H. Zhang, and F. Xia. 2018. Stimulation of N2O emission by conservation tillage management in agricultural lands: A meta-analysis. Soil & Tillage Research 182:86-93.

Melero, S., M. Panettieri, E. Madejón, H. G. Macpherson, F. Moreno, and J. M. Murillo. 2011. Implementation of chiselling and mouldboard ploughing in soil after 8 years of no-till management in SW, Spain: Effect on soil quality. Soil and tillage research **112**:107-113.

Meurer, K. H. E., N. R. Haddaway, M. A. Bolinder and T. Katterer (2018). "Tillage intensity affects total SOC stocks in boreo-temperate regions only in the topsoil-A systematic review using an ESM approach." Earth-Science Reviews **177**: 613-622.

Ogle, S. M., C. Alsaker, J. Baldock, M. Bernoux, F. J. Breidt, B. McConkey, K. Regina and G. G. Vazquez-Amabile (2019). "Climate and Soil Characteristics Determine Where No-Till Management Can Store Carbon in Soils and Mitigate Greenhouse Gas Emissions." Scientific Reports **9**(1): 11665.

Omonode, R. A., A. Gal, D. E. Stott, T. S. Abney, and T. J. Vyn. 2006. Short-term Versus Continuous Chisel and No-till Effects on Soil Carbon and Nitrogen. Soil Sci Soc Am J **70**:419-425.

Pittelkow, C. M., B. A. Linquist, M. E. Lundy, X. Q. Liang, K. J. van Groenigen, J. Lee, N. van Gestel, J. Six, R. T. Venterea, and C. van Kessel. 2015. When does no-till yield more? A global meta-analysis. Field Crops Research **183**:156-168.

Quincke, J. A., C. S. Wortmann, M. Mamo, T. Franti, and R. A. Drijber. 2007. Occasional tillage of no-till systems: Carbon dioxide flux and changes in total and labile soil organic carbon. Agronomy Journal **99**:1158-1168.

Searchinger, T. D., S. Wirsenius, T. Beringer, and P. Dumas. 2018. Assessing the efficiency of changes in land use for mitigating climate change. Nature **564**:249-253.

Stewart, C. E., K. Paustian, R. T. Conant, A. F. Plante, and J. Six. 2007. Soil carbon saturation: concept, evidence and evaluation. Biogeochemistry **86**:19-31.

Stewart, C. E., A. F. Plante, K. Paustian, R. T. Conant, and J. Six. 2008. Soil carbon saturation: Linking concept and measurable carbon pools. Soil Science Society of America Journal **72**:379-392.

Stockfisch, N., T. Forstreuter, and W. Ehlers. 1999. Ploughing effects on soil organic matter after twenty years of conservation tillage in Lower Saxony, Germany. Soil & Tillage Research **52**:91-101.

Taheripour, F., H. Cui, and W. E. Tyner. 2018. An Exploration of Agricultural Land Use Change at Intensive and Extensive Margins: Implications for Biofuel-Induced Land Use Change Modeling. Pages 19-37 *in* Z. Qin, U. Mishra, and A. Hastings, editors. Bioenergy and Land Use Change.

Toliver, D. K., J. A. Larson, R. K. Roberts, B. C. English, D. G. D. Ugarte, and T. O. West. 2012. Effects of No-Till on Yields as Influenced by Crop and Environmental Factors. Agronomy Journal **104**:530-541.

Tran, D. Q., and L. A. Kurkalova. 2019. Persistence in tillage decisions: Aggregate data analysis. International Soil and Water Conservation Research **7**:109-118.USDA-NASS. 2019. 2018 Agricultural chemical use survey -- Corn. No. 2019-1, United States Department of Agriculture, National Agricultural Statistics Service.

USDA-NASS. 2019. 2018 Agricultural chemical use survey -- Soybean. No. 2019-1, United States Department of Agriculture, National Agricultural Statistics Service.

USDA-NRCS (2016). Reduction in Annual Fuel Use from Conservation Tillage, Natural Resources Conservation Service, Conservation Effects Assessment Project (CEAP): 4.

van Kessel, C., R. Venterea, J. Six, M. A. Adviento-Borbe, B. Linquist, and K. J. van Groenigen. 2013. Climate, duration, and N placement determine N2O emissions in reduced tillage systems: a meta-analysis. Global Change Biology **19**:33-44.

VandenBygaart, A. J., and B. D. Kay. 2004. Persistence of soil organic carbon after plowing a long-term no-till field in southern Ontario, Canada. Soil Science Society Of America Journal **68**:1394-1402.

West, T. O., and G. Marland. 2002. A synthesis of carbon sequestration, carbon emissions, and net carbon flux in agriculture: comparing tillage practices in the United States. Agriculture Ecosystems & Environment **91**:217-232.

Wortmann, C. S., R. A. Drijber, and T. G. Franti. 2010. One-Time Tillage of No-Till Crop Land Five Years Post-Tillage. Agronomy Journal **102**:1302-1307.

Yang, X. M., C. F. Drury, W. D. Reynolds, and C. S. Tan. 2008. Impacts of long-term and recently imposed tillage practices on the vertical distribution of soil organic carbon. Soil & Tillage Research **100**:120-124.

Appendix D: Cover crop management (non-SOC methods)

Table of Contents

1 Overview: Cover crop management

1.1 Project scope

The overall scope for this first phase of the Gigaton Soil Health project is for U.S. crops of maize, wheat, and soybean production, crops commonly grown in rotation with these crops, and crops grown as cover crops with these crops. We focused on crop-rotation management that reduces the duration of bare-fallow periods by including cover crops.

In humid systems, cover crop management is the primary practice to reduce fallow periods. For "cover crop management" the focus is on addition of a cover crop to the annual crop rotation compared to an annual crop rotation with a fallow period. However, a cover crop rotation may also interact with other practices (such as residue return, tillage, and additional N amendment). For Gigaton project accounting, changes to rotation-scale N balance are an important parameter for N_2O emission estimates (McLellan et al., 2018; Eagle et al., 2020, Tonitto et al. in press), while cover crop growth (and subsequent residue return) are the main drivers of soil organic carbon (SOC) dynamics relative to a bare-fallow (see further discussion in the SOC Methods Appendix). While there are numerous choices for implementing cover crop rotations, the most common cover crop practices on commercial farms tend to also be those that have received the most attention in the literature. For the purposes of calculating net N balance, it is also important to know whether cover crop species are leguminous, non-leguminous, or a mixture of legume and non-legume species (bi-culture).

Common cover cropping systems for maize include: continuous maize-cereal rye, maize - cereal rye- soybean – cereal rye, maize- cereal rye – bean – cereal rye. For soybean, systems include: maize – cereal rye – soybean – cereal rye. For wheat, systems include winter wheat – clover.

In dry (arid) systems, which commonly support wheat cropping systems, the efficient method of reducing fallow periods is to diversify rotations. Diversified rotations result in fewer seasons of wheat growth, but overall more grain or forage production.

1.2 Baseline management practice

The baseline conventional rotation in U.S. commodity grain systems is an annual crop growing season followed by bare fallow; this is also the baseline in most studies that compare the impact of diversified rotations. In the U.S., the most common conventional commodity grain rotations are: 1) maize cropping systems: continuous maize, maize-soybean, or maize-bean, 2) soybean cropping systems: maize-soybean, and 3) wheat cropping systems: winter wheat-fallow or spring wheat - fallow.

2 Methods

2.1 Criteria, sources of data, lines of evidence

The highest quality data available for cover crop management analysis are systematic literature reviews, especially from carefully conducted meta-analyses.

The highest quality observations for N_2O dynamics result from sampling over the entire year, including the winter. Absent full-year data, studies that include N_2O sampling before and after the growing season (spring through fall) provide the best available data on distribution of N_2O emissions, as spring thaw has been observed to provide a large pulse of N_2O emissions (e.g. Wagner-Riddle et al. 2017; Quesnel et al. 2019). Additionally, studies with frequent sampling are more likely to capture the "hot moments" of N_2O production, especially following events that increase soil available N (fertilization, tillage) or soil moisture (precipitation). A common sampling frequency for N_2O chamber studies is every two weeks pre-planting and post-harvest, and weekly during the growing season. Experiments focused on peak events schedule sampling following precipitation events. Because full-year N_2O sampling is uncommon, most observations are from spring through fall or growing season experiments. While long-term experiments of N_2O emissions can help outline the frequency of large N_2O emission events, N_2O sampling studies are generally 1-3 years in duration. Repeated sampling of N_2O is limited to a few well-studied research sites (for example, the Kellogg Biological Station Long-Term Ecological Research site, KBS). In our analysis we focused on N_2O reviews that analyzed observations from U.S. and Canadian cropping system and that included the commodity grains (maize, soybean, and wheat).

2.2 Estimating cover crop impact on N_2O emissions.

2.2.1 Observed cover crop impact on N_2O emissions

We assessed the impact of cover crop management on N_2O emission using multiple review manuscripts (Abdalla et al. 2018; Basche et al. 2014; Han et al. 2017). For application in the Gigaton tool, we considered the Han et al. (2017) analysis to be most representative of U.S. commodity crops as they focused their analysis on comparing systems that received commercially viable N amendment rates. In addition, the data analyzed in Han et al. (2017) are from relevant geographies and cropping systems, including data that are from U.S. (43% of the data), Canada (14.5%), Europe (28%), and Japan (14.5%). Han et al. (2017) data include maize (43% of the data), soybean (13%), winter grains (17%) and other (27%).

2.3 Observed cover crop impact on cash crop yield

We assessed the impact of cover crop management on cash crop yields using multiple review publications. For U.S. maize, a meta-analysis by Miguez and Bollero (2005) is the most applicable reference, reporting cover crop impact on maize yield in the U.S. (84% of studies) and Canada (16% of studies); these data are predominantly rainfed agricultural regions (34 of the studies), but include studies from drier regions (2 from WA and 1 from NE). This meta-analysis was updated by Marcillo and Miguez (2017) to include 27 additional U.S. studies and 1 Canadian study. Additional relevant review literature includes a meta-analysis that compared cover-crop management practices restricted to N management consistent with commercial practices (Tonitto et al. 2006).

In addition to meta-analysis results, long-term observations of cereal rye cover crop management in maize-soybean systems of Michigan outlined long-term cash crop yield response to cover crop management (Snapp and Surapur 2018). For dryland cropping systems, various field observations were assessed to compare the impact of wheat-fallow conventional systems to systems that reduce the frequency of a fallow period (Mohammed and Chen 2018; Holman et al. 2018; Rosenzweig et al. 2018).

Finally, a national-scale survey of U.S. farmers provides additional information regarding cash crop yield trends following cover crop management in fields under commercial management (CTIC 2017).

2.4 Cover crop impact on farm-scale energy use

We estimated the energy budget of cover crop management relative to a conventional rotation with bare fallow using energy values established in the FEAT model (Camargo et al. 2013). We used average values from FEAT (FEAT_1_2_7.xlsx Excel model). We considered energy use for cover crop management resulting from inputs (cover crop seed production, herbicide for cover crop termination) using energy values from the AgInputs worksheet of the model. We considered cover crop management impact on farm-scale machine usage (cover crop planting, herbicide application, mechanical cover crop termination) using values from the AgInputs worksheet. These input and machine use values were converted to energy use and GHG equivalent values using the ENERGY and GHG worksheets. We assumed inputs and machine usage for cash crop management (e.g. cash crop seeds, tillage, cash crop planting, herbicide application, or crop harvest) remains the same across bare-fallow or cover crop management scenarios; changes in fertilizer N rate as a result of cover crop management are addressed in the Nitrogen technical Appendix.

3 Results

3.1 Cover crop impact on N_2O emission depends on total system N amendments

3.1.1 Non-legume cover crop observations

Recent meta-analyses of area-scaled N_2O emissions under cover cropping in temperate agricultural systems found that, in aggregate, non-legume cover crops did not alter N_2O emissions, when the control and treatment fields have the same N amendment rate (Section 3.2 in Abdalla et al. 2018; Figure 4 in Basche et al. 2014; Figure 4 in Han et al. 2017).

3.1.2 Legume cover crop observations

There are limited data addressing N_2O emissions under legume cover crop management. Legumes can add >200 kg N ha^{-1} to the cropping system. Legume analysis that is relevant to U.S. commercial cropping systems must take into account the total N inputs. Studies that include comparisons of legume cover cropping to a 0N addition control cannot be used to establish the change in N_2O under legume cover crops relative to a bare fallow commercial cropping system.

A meta-analysis by Han et al. (2017) compared different N management scenarios, including cover cropping. Overall, Han et al. (2017) concluded that changes to N rate had the largest impact on a change in N_2O emissions. Specific to legume cover crop management, Han et al. (2017) studied systems representative of commercial cropping systems, namely a legume cover cropping system compared to controls that include bare fallow and the application of inorganic N fertilizer. We performed an unpublished re-analysis of the dataset in Han et al. (2017) to examine subsets of the data. For all rainfed legume cover cropping systems in which the control received inorganic N fertilizer we found an average of 3.9% reduction in N_2O emissions. For the same data but removing a study comparing cover crop growing season N_2O emission we found an average of 6% increase in N_2O emissions. For legume cover crop data from rainfed observations with yield data we found a 30% reduction in yield-scaled N_2O emissions under legume cover crops relative to fertilized bare fallow systems. Due to the limited number of studies and the inclusion of studies in which control and treatment have differing total N input rates, it is difficult to establish a robust estimate of average N_2O emission response to legume cover crops for the same total N addition rate.

Overall bi-culture (legume+non-legume) cover crop N_2O observations are very limited. Studies suggest that bi-culture cover cropping systems do not alter N_2O emissions (Section 3.2 in Abdalla et al. 2018; Figure 4 in Basche et al. 2014).

3.1.3 Estimating N_2O emissions under cover cropping

In summary, evidence supports N rate as the strongest driver of N_2O emissions, and there is no clear evidence that non-legume or legume cover crop management alters N_2O emissions if control and treatment sites have the same total N input, or if the systems follow BMPs for total N input (Table 1). Available data supports estimating the impact of cover crop management on N_2O emissions based on how management changes total N additions to the cropping system. Total system N input will be used to estimate N_2O emissions under non-legume, legume, or bi-culture cropping systems.

Table 1. Average observed response of N_2O emission following cover crop management.

Practice	GHG source	Temperature Regime	Moisture Regime	Soil Texture	Region	Cover crop type	Cash crop	Change in N2O following cover crop (%)	Source
Cover Crop	N_2O	Cool / Warm	any	any	Global	non-legume	annual crops	0%	Abdalla et al. 2018; Basche et al. 2014; Han et al. 2017

3.2 Cover crop management generally maintains or increases cash crop yield in systems without water limitation

3.2.1 Rainfed cropping systems

Various lines of evidence indicate that cover cropping has a neutral, or potentially positive, impact on cash crop yield. Figure 3 in Miguez and Bollero (2005) and Figure 1 in Marcillo and Miguez (2017) demonstrated that, on average, non-legume cover crops had a neutral impact on cash crop yield. A neutral impact of non-legume cover crops on cash crop yield was also reported by Tonitto et al. (2006) in a meta-analysis that compared cover crop management practices restricted to N management consistent with commercial practices (in particular cash crops receiving the same N fertilizer application in both fallow and non-leguminous cover crop systems). Similarly, a long-term study of cereal rye cover crop management in maize-soybean systems of MI found that cover crops led to no statistically significant change in maize yields (Snapp and Surapur 2018).

While yield trends under non-leguminous cover crops are supported by multiple lines of evidence (Marcillo and Miguez 2017; Miguez and Bollero 2005; Snapp and Surapur 2018; Tonitto et al. 2006), yield response under leguminous cover crop management is more difficult to generalize. Legumes can be used as the sole N source in organic cropping systems or can be used to supplement inorganic N amendments. Experimental treatments do not necessarily reflect optimal N management of the control or treatment system; for example, a legume cover crop treatment may be compared to a 0N control treatment. Because many control-treatment comparisons are not designed to compare a best-case N management scenario in both the control and treatment plots, meta-analysis results can indicate that legume cover crops provide a high average yield increase, but this is misleading if control treatments included sub-optimal N fertilization (Miguez and Bollero 2005).

A comparison of optimal N management strategies in conventional bare fallow compared to legume cover cropping systems demonstrated that cash-crop yield outcomes depended on legume cover-crop establishment. A meta-analysis comparing legume cover-crop management (as the sole source of cropping system N addition) to conventional cropping systems (managed with winter bare fallow and recommended inorganic N fertilizer rates) found that cropping systems fertilized with legume cover crops averaged a 10% reduction in cash-crop yield across all studies (Figure 3 in Tonitto et al. 2006).For systems in which the legume cover crop provided > 110 kg N ha^{-1} as input, there was (on average) no yield decline (Figure 6 in Tonitto et al. 2006). Yield decline following N amendment from legume cover crops largely occurred in systems with poor legume establishment, which tended to be northern climates with short growing seasons and cold winters (Tonitto et al. 2006). Yield decline resulting from inadequate soil available N following cover crop management can be managed by developing BMPs for N fertilization that ensures the cash crop receives adequate nutrition. In particular, for a system in which a legume cover crop is providing the cash crop N, a farmer would plan to supplement with additional N fertilizer if the legume cover crop did not establish well prior to spring planting.

Additional support for a positive impact of cover crop management on yield include a broad survey of cover crop ecosystem services which found that cover crop management led to improved cash crop yield relative to systems managed with a bare fallow (Figure 10 and Table 10 in Daryanto et al. 2018). This was true of systems with or without N fertilizer addition, as well as for leguminous or non-leguminous cover crops. However, the authors did not strictly compare cover crop management to conventional bare fallow management consistent with N BMPs for a commercial farm. A survey of U.S. farmers that used cover crops indicated that 51% of farmers reported an advantage to cash crop yield, 41% reported neutral yield impact and 7% reported a disadvantage to cash crop yield (CTIC 2017, p14). This survey indicated, at the national scale, cover crop management led to a cash crop yield increase of 1.3% for maize, 3.8% for soybean, and 2.8% for wheat (CTIC 2017), but state-scale yield changes across the Midwest were largely not significant for maize or wheat. State-scale analysis was conducted for IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, SD, and WI. Increased soybean yield under cover cropping was statistically significant for IL, IN, IA, KS, MI, MN, MO, NE, OH, and SD (CTIC 2017).

Observations indicated that cover cropping has generally beneficial or neutral impact on yield in humid, rainfed cropping systems. Because, cover crop management requires farmers to gain skill in implementing the practice, there can be a yield decline during this learning phase. In addition, cover cropping can be perceived as a risky management practice due to the possibility that heavy spring precipitation prevents tillage or other incorporation of the cover crop prior to the optimal cash crop planting schedule. However, in situations where wet soils delay planting, cover crops can reduce soil moisture, facilitating earlier access to fields. For example, Basche et al. (2016) studied detailed soil water properties under long-term (8-14 years), no-till maize-soybean management across a time period with extreme high and low precipitation relative to historic records. In this no-till system maize and soybean yields were statistically similar with or without cereal rye cover crop. The cover crop system tended toward reduced 0-15 cm soil moisture early in the spring, but generally had similar 0-15 cm moisture at crop planting; the reduced soil moisture documented in the early spring could be beneficial for field management (Basche et al. 2016). Furthermore, the cover crop system generally had higher soil moisture at 15-30 cm during the summer, providing protection against late summer water stress (Basche et al. 2016).

3.2.2 Dryland cropping systems

It is more common for cover cropping to be used in rainfed systems and therefore much of the data analyzed in literature reviews is limited to rainfed agriculture. In water-limited systems cover crops can reduce wheat yield (e.g. Mohammed and Chen 2018; Holman et al. 2018). Water stress is a key reason for wheat yield decline. For example, the removal of the fallow period in a Kansas wheat system resulted in a 1mm loss of plant available water (PAW) for each 125 kg/ha of cover crop or forage crop biomass (Holman et al. 2018).

Cropping system diversification, rather than cover-crop management, is an ecologically and economically viable strategy for reducing fallow periods in dryland systems. Diversified dryland rotations have been observed as more profitable and productive systems (Holman et al. 2018; Rosenzweig et al. 2018). Overall, diversified dryland systems that reduced fallow to every 3 or 4 years, or removed fallow altogether can increase productivity across the whole rotation, though wheat in these systems may be less productive than a wheat-fallow rotation (Rosenzweig et al. 2018).

Cover cropping in dryland systems will not be given GHG credit in this version of Gigaton Soil Health Tool. Diversified cropping systems will not be given credit in this version of the Gigaton Soil Health Tool because of their complexities and because of possible leakage due to reduced wheat yield. Accounting methods for diversified cropping systems could be considered for future improvements to the tool.

3.2.3 Data extracted for tool development

We found non-legume cover crop management to have neutral impact on maize yield based on the results of Marcillo and Miguez (2017) and Miguez and Bollero (2005). We found non-legume cover crop management to have positive impact on soybean yield (3.8 % increase) using the national average reported in the farmer survey (CTIC 2017), based on statistically significant yield increase for soybean at both the national and state scale. We generalized non-legume cover crop management to have neutral impact on wheat yield using the farmer survey (CTIC 2017). This survey indicated that, at the state-scale, cover crops had a neutral or positive impact on humid system wheat yield, but the state-scale trends were not significant. While at the national scale cover crop management was reported to increase maize (1.3 %), soybean (3.8 %), and wheat (2.8 %) yields, only the soybean yield increase was significant at the state-scale across most Midwestern states (IL, IN, IA, KS, MI, MN, MO, NE, SD, and OH) (CTIC 2017). Though average state-scale yield response was generally reported as neutral or positive, yield reductions were reported for maize (-6 % for NE, -1 % for OH), soybean (-2 % ND, -1 % WI), and wheat (-3 % ND). The larger yield decline reported in dry regions (NE and ND), though not statistically significant, suggests that arid systems may not maintain yield under cover cropping.

Table 2 National-scale yield response to cover cropping based on literature review. (NR indicates 'not reported')

Practice	GHG source	Temperature Regime	Moisture Regime	Soil Texture	Region	Cover crop type	Cash crop	Change in yield following cover crop (%)	Source
Cover Crop	yield	Cool / Warm	Moist	any	US and Canada	non-legume	maize	0%	Miguez and Bollero 2005; Marcillo and Miguez 2017; aggregate response ratio
Cover Crop	yield	Cool / Warm	any	any	US	NR	soybean	3.80%	CTIC 2017; average yield change in U.S. national survey
Cover Crop	yield	Cool / Warm	any	any	US	NR	wheat	0%	CTIC 2017; average yield change in U.S. national survey

3.3 Cover crop impact on farm-scale energy use

Annual cropping systems managed with a winter cover crop have higher energy use than those managed with a winter bare fallow.

Using values from the FEAT model (Camargo et al. 2013) we estimated cover crop management increased energy use (in kg CO_2e ha^{-1} yr^{-1}) on the order of: 37.24 (rye seed), 17.02 (red clover seed), herbicide production (21.73, chemical cover crop termination), cover crop planting (28.15 assuming a no-till drill), 6.18 (herbicide application, chemical cover crop termination), 13.2 (mechanical cover crop termination), for a total energy increase ranging from 73-79 kg CO_2e ha^{-1} yr^{-1} due to inputs and farm machinery (Table 3 Energy use).

Table 3. Energy use for cover crop management. All data are from the FEAT model (Camargo et al. 2013).

Practice	GHG source	Temperature Regime	Moisture Regime	Soil Texture	Cover crop type	Energy use relative to bare fallow	Change in energy use, (kg CO2e ha-1 y-1)	Gigaton GHG reduction benefit (kg CO2e/ha)	Gigaton GHG reduction benefit (Mg CO2e/ha)
Cover crop	seed energy	all	all	all	rye	increase	37.24	-37.24	-0.037
Cover crop	seed energy	all	all	all	red clover	increase	17.02	-17.02	-0.017
Cover crop	herbicide energy (CC chemical termination)	all	all	all	all	increase	21.73	-21.73	-0.022
Cover crop	Planting into prepared seedbed	all	all	all	all	increase	15.48	-15.48	-0.015
Cover crop	Drilling into prepared seedbed	all	all	all	all	increase	12.24	-12.24	-0.012
Cover crop	Planting into no-till seedbed	all	all	all	all	increase	23.03	-23.03	-0.023
Cover crop	No-till grain drill	all	all	all	all	increase	28.15	-28.15	-0.028
Cover crop	herbicide application (CC chemical termination)	all	all	all	all	increase	6.18	-6.18	-0.006
Cover crop	CC mechanical termination	all	all	all	all	increase	13.2	-13.20	-0.013
Cover crop	Low end energy inrease	all	all	all		increase	73.07	-73.07	-0.073
Cover crop	High end energy increase	all	all	all		increase	78.59	-78.59	-0.079

Gigaton tool default values assume rye as the dominant non-legume and clover as the dominant legume cover crop in U.S. commodity grain systems (Table 4).

Table 4. Cover crop management in U.S. landscapes based on results from the 2016 national farmer cover crop survey (CTIC 2017).

	2016 national survey of cover crop species			
cover crop	**acreage**	**proportion of all cover crops**	**proportion of grass cover**	**proportion of non-legume cover**
cereal rye	289,068	0.23	0.42	0.29
oat	159,607	0.13	0.23	0.16
winter wheat	93,899	0.08	0.14	0.09
annual ryegrass	76,148	0.06	0.11	0.08
triticale	36,001	0.03	0.05	0.04
winter barley	26,824	0.02	0.04	0.03
			proportion of brassica cover	
radish	139,476	0.11	0.43	0.14
rapeseed	98,577	0.08	0.31	0.10
turnip	70,002	0.06	0.22	0.07
canola	14,503	0.01	0.04	0.01
			proportion of legume cover	
crimson clover	74,352	0.06	0.31	
winter pea	42,355	0.03	0.18	
hairy vetch	39,266	0.03	0.16	
other clovers	24,096	0.02	0.10	
cowpea	22,129	0.02	0.09	
red clover	21,561	0.02	0.09	
sunn hemp	11,406	0.01	0.05	
other vetches	6,089	0.00	0.03	

4 References

Abdalla M, Hastings A, Cheng K, et al (2019) A critical review of the impacts of cover crops on nitrogen leaching , net greenhouse gas balance and crop productivity. Glob Chang Biol 25:1–14. doi: 10.1111/gcb.14644

Alvarez R, Steinbach HS, De Paepe JL (2017) Cover crop effects on soils and subsequent crops in the pampas : A meta-analysis. Soil Tillage Res 170:53–65. doi: 10.1016/j.still.2017.03.005

Basche AD, Miguez FE, Kaspar TC, Castellano MJ (2014) Do cover crops increase or decrease nitrous oxide emissions ? A meta-analysis. J Soil Water Conserv 69:471–482. doi: 10.2489/jswc.69.6.471

Basche AD, Kaspar TC, Archontoulis S V, et al (2016) Soil water improvements with the long-term use of a winter rye cover crop. Agric Water Manag 172:40–50. doi: 10.1016/j.agwat.2016.04.006

Camargo GGT, Ryan MR, Richard TL (2013) Energy use and greenhouse gas emissions from crop production using the Farm Energy Analysis Tool. Bioscience 63:263–273. doi: 10.1525/bio.2013.63.4.6

CTIC (2017) Report of the 2016-17 National Cover Crop Survey. Joint publication of the Conservation Technology Information Center, the North Central Region Sustainable Agriculture Research and Education Program, and the American Seed Trade Association. West Lafayette, IN. (Accessed June 3, 2020, https://www.ctic.org/files/2017CTIC_CoverCropReport-FINAL.pdf)

Daryanto S, Fu B, Wang L, et al (2018) Quantitative synthesis on the ecosystem services of cover crops. Earth-Science Rev 185:357–373. doi: 10.1016/j.earscirev.2018.06.013

Eagle AJ, Mclellan EL, Brawner EM, et al (2020) Quantifying on - farm nitrous oxide emission reductions in food - supply chains. Earth Sp Sci Open Arch. doi: 10.1002/essoar.10502712.1

Han Z, Walter MT, Drinkwater LE (2017) N2O emissions from grain cropping systems : a meta-analysis of the impacts of fertilizer-based and ecologically-based nutrient management strategies. Nutr Cycl Agroecosystems 107:335–355. doi: 10.1007/s10705-017-9836-z

Holman JD, Arnet K, Dille J, et al (2018) Can cover or forage crops replace fallow in the semiarid Central Great Plains ? Crop Sci 58:932–944. doi: 10.2135/cropsci2017.05.0324

Marcillo GS, Miguez FE (2017) Corn yield response to winter cover crops : An updated meta-analysis. J Soil Water Conserv 72:226–239. doi: 10.2489/jswc.72.3.226

McLellan EL, Cassman KG, Eagle AJ, et al (2018) The nitrogen balancing act: Tracking the environmental performance of food production. Bioscience 68:194–203. doi: 10.1093/biosci/bix164

Miguez FE, Bollero GA (2005) Review of corn yield response under winter cover cropping systems using meta-analytic methods. Crop Sci 45:2318–2329

Mohammed YA, Chen C (2018) Cropping systems affect wheat yields, nitrogen use efficiency, and nitrous oxide emission. Agron J 110:1147–1156. doi: 10.2134/agronj2017.06.0367

Quesnel J, Vanderzaag AC, Crolla A, et al (2019) Surface and subsurface N 2 O losses from dairy cropping systems. Nutr Cycl Agroecosystems 114:277–293. doi: 10.1007/s10705-019-10004-5

Rosenzweig ST, Stromberger ME, Schipanski ME (2018) Intensified dryland crop rotations support greater grain production with fewer inputs. Agric Ecosyst Environ 264:63–72. doi: 10.1016/j.agee.2018.05.017

Snapp S, Surapur S (2018) Rye cover crop retains nitrogen and doesn't reduce corn yields. Soil Tillage Res 180:107–115. doi: 10.1016/j.still.2018.02.018

Tonitto C, David MB, Drinkwater LE (2006) Replacing bare fallows with cover crops in fertilizer-intensive cropping systems: A meta-analysis of crop yield and N dynamics. Agric Ecosyst Environ 112:58–72. doi: 10.1016/j.agee.2005.07.003

Wagner-riddle C, Congreves KA, Abalos D, et al (2017) Globally important nitrous oxide emissions from croplands induced by freeze – thaw cycles. Nat Geosci 10:279–283. doi: 10.1038/NGEO2907

Appendix F

Soil Organic Carbon Sequestration from Cover Crops

Dominic Woolf, Peter Woodbury, Christina Tonitto

Jun 8, 2020

Summary

Currently-available published data do not support model-derived or statistical dis-aggregation of soil organic carbon (SOC) accumulation under cover crops by soil, cover-crop type or cash-crop type. We therefore use the average of published values as the best available estimate, dis-aggregated into groups for dry and moist climate zones.

The average rate of SOC accumulation in moist climates is 0.19 Mg C ha^{-1} yr^{-1}. No SOC-sequestration credit is given for cover cropping in dry-land systems, primarily because measured SOC in dry climates was not significantly different from zero, but also because use of cover crops in dry-lands is expected to deplete soil water. This would, in turn, lead to a loss in yield of the main crop and/or an increase in irrigation demand. Not only would these considerations make cover crops impractical in drylands, but would also lead to indirect land use change (ILUC) emissions greater than the on-site SOC sequestration.

These average SOC sequestration rates are derived from published measurements, filtered to include only data (a) using annual cover crops (b) in non-organic systems, (c) after at least 3 years of cover-cropping, (d) where there was no difference between tillage or manure inputs between control and cover-crop treatment, (e) excluding Histosols, and (f) excluding implausible outliers where reported rates of SOC sequestration were higher than 1.5 times estimated potential net primary production.

The average length of cover-crop treatment over which this sequestration was measured was seven years. To calculate the CO_2-equivalent credit provided in the Project Gigaton method the SOC sequestration during the first years after conversion to cover cropping is multiplied by a factor $f100_{CC}$, to account for the facts that annual sequestration rates diminish over time, and that long-term implementation is required to ensure permanence of the sequestered carbon. $f100_{CC}$ is calculated as the cumulative SOC sequestered over 100 years, expressed as a fraction of the SOC that would be sequestered if the initial annual sequestration rate remained constant over 100 years. $f100_{CC}$ is 0.26 in warm-moist climates, and 0.28 in cool-moist climates. Values of $f100_{CC}$ were also calculated for dry climates (0.26 in warm-dry, and 0.29 in cool-dry), however it should be noted that these will not affect the net credit given, since the default SOC sequestration rate in dry climates is zero.

Methods

The soil health database, version 3 (Jian et al. 2020) was used to find published studies on cover crops. Data were also added from cover crop studies that were absent from the database (Astier et al. 2006, Goyal et al. 1999; Hansen et al. 2000; Hermawan and Bomke, 1997; Kuo et al. 1997; Mandal et al. 2003; N'Dayegamiye and Tran, 2001; and Utomo et al. 1990). This yielded a total of 5927 measurements from 329 studies. Studies were then identified from this database that met the following criteria:

1. All of the following parameters were reported: location; SOM and/or SOC; number of years of experiment.
2. We excluded experiments from organic systems, agroforestry, orchards, vegetables, and perennial crops.
3. We excluded experiments where there was a difference in tillage or manure inputs between the control and cover-crop treatments.

After sub-setting the data by these criteria, the final dataset comprised 64 studies (Abdallahi & N'dayegamiye, 2000; Abdollahi & Munkholm, 2014; Abunyewa & Padi, 2003; Alessandria et al., 2013; Amado, Bayer, Conceição, Spagnollo, Campos, et al., 2006; Amado, Bayer, Conceição, Spagnollo, De Campos, et al., 2006; Astier et al., 2006; Bandick & Dick, 1999; Bayer et al., 2009, 2015; Beare & Russell Bruce, 1993; Benjamin et al., 2007; Blanco-Canqui et al., 2011, 2013; Brown et al., 2000; Campbell, Biederbeck, et al., 1991; Campbell, Zentner, et al., 1991; Clark et al., 2017; Constantin et al., 2010; Curtin et al., 2000; Drinkwater et al., 1998; Eckert, 1991; Goyal et al., 1999; Hansen et al., 2000; Haque et al., 2013; Hargrove, 1986; Hermawan & Bomke, 1997; Hubbard et al., 2013; Idowu et al., 2009; W. Jokela et al., 2011; W. E. Jokela et al., 2009; Kaho et al., 2004; Kim et al., 2013; Kuo et al., 1997; Langdale et al., 1992; Mandal et al., 2003; Marriott & Wander, 2006; Mazzoncini et al., 2011; Mbuthia et al., 2015; McVay et al., 1989; Metay et al., 2007; Mitchell, 1996; Moore et al., 2014; Muleba, 1999; Myaka et al., 2006; Nascente et al., 2013; N'Dayegamiye & Tran, 2001; Ndiaye et al., 2000; Nyakatawa et al., 2001; Olson et al., 2014; Onim et al., 1990; Osborne et al., 2014; Poeplau & Don, 2015; Sadat-Dastegheibi, 1974; Sainju et al., 2006; Scott et al., 1990; Smestad et al., 2002; Steele et al., 2012; Terra et al., 2005; Thomsen & Christensen, 2004; Utomo et al., 1990; Veum et al., 2015; Villamil et al., 2006, 2006; Wilson et al., 1982; Yu et al., 2014; Zimmer & Roschke, 2001)

Where the original studies reported Soil Organic Matter (SOM) rather than SOC, we used a conversion factor of 0.58 to convert to SOC. Where the original studies used the Walkley-Black method to measure SOC, we applied a conversion factor of 1.3.

The cover-crop soil health database was the analyzed using machine learning, process modeling, and analysis of variance, as described in the following sections. Of these methods, analysis of variance was found to provide the most robust results and was therefore used as the basis for the final results of SOC sequestration rates reported here.

Machine learning

Random forest regression tree models of SOC sequestration rate were conducted using the Ranger package of the R Statistical Programming language, using a range of explanatory variables including:

1. e**xperimental treament**: time after cover crop introduction; cover crop group; grain crop group; cover crop biomass (which was only reported in a few studies and imputed as the mean for other cases).
2. **climatic**: mean annual temperature, mean annual precipitation, reference evapo-transpiration. aridity, and USDA climate zone.
3. **bioclimatic**: mean diurnal range, isothermality, temperature seasonality, maximum temperature in warmest month, minimum temperature in coldest month, temperature range, mean temperature in wettest quarter, mean temperature in driest quarter, mean temperature in warmest quarter, mean temperature in coldest quarter, precipitation in wettest month, precipitation in driest month, precipitation seasonality, precipitation in wettest quarter, precipitation in driest quarter, precipitation in warmest quarter, and precipitation in coldest quarter
4. **Net Primary Production (NPP)**: Annual mean NPP (MODIS), Annual potential NPP (estimated by Community Land Model v4.5 20^{th} century mean), monthly potential NPP (estimated by Community Land Model v4.5 20^{th} century mean), and potential NPP in cover-crop growing months (estimated by Community Land Model v4.5 20^{th} century mean).
5. **Soil**: clay, sand, silt, bulk density, cation exchange capacity, mean annual soil moisture (estimated by Community Land Model v4.5 20^{th} century mean), and mean annual soil temperature (estimated by Community Land Model v4.5 20^{th} century mean).

Spatial distribution of these co-variates is shown in section 5 below.

Out-of-bag prediction R^2 was 0.20, which is not considered high enough for robust extrapolation of the model to the whole of the USA. The predictors with greatest importance (by permutation), in decreasing order of importance, were: clay, SOC, precipitation seasonality, precipitation in wettest quarter, precipitation in the coldest quarter, mean soil temperature, minimum temperature in the coldest month, mean annual temperature, and maximum temperature in the warmest month. Given the low R^2 value, the machine learning approach was rejected as a method to predict geospatially-referenced SOC sequestration rates from available spatial data-sets.

4. Process modeling

The RothC soil carbon model (Coleman & Jenkinson, 2008) has previously been shown to correlate with cover crop SOC sequestration, using an smaller dataset than the one applied here (Poeplau & Don, 2015). We therefore investigated the use of RothC as a means to predict spatio-temporal variability in SOC accumulation under cover crops.

First, organic carbon inputs were estimated for each experimental treatment, by minimizing the squared variance between measured and modeled SOC using numerical optimization with carbon inputs as the control parameter. The optimization method was “Brent”, using the “optimise” function in R, with a 100-year spin-up length from an initial SOC estimate set to the measured control SOC. Once carbon inputs had been calculated, the next step was to simulate measured change in SOC after introduction of cover cropping. Several modeling protocols were tried for this, including optimizing the change in organic matter inputs, (i) as a fraction of control organic matter input, (ii) as a fraction of annual NPP, (iii) as a fraction of potential NPP during the cover crop season. The optimization objective function was the sum of squares of residuals in SOC sequestration, expressed as (i) mean annual change in SOC stocks to standardized depth, (ii) total change in SOC stocks to standardized depth, (iii) annual change in SOC concentration, and (iv) total change in SOC concentration. In none of these cases was an R^2 of greater than around 5% achieved. Therefore, it was concluded that, despite process modeling with RothC providing a good fit for a small subset of these data in earlier studies (Poeplau & Don, 2015), the large variance in the current dataset was not readily explainable using this method. This is likely because the actual production of cover-crop organic matter, in practice, is a complex interaction of weather during the experimental seasons, establishment and growing management practices, varietal selections, pest and disease pressure, seed germination rates and establishment viability etc., with these parameters not being adequately predictable using available spatial correlates.

5. Analysis of variance

Having shown both machine learning and process modeling to provide low correlation with observed variability in SOC accumulation under cover crops, our estimates of average SOC sequestration rates were based on sample means of the observations. ANOVA models were generated for rate of change of SOC stocks to a standardized (30 cm) depth as a function of USDA climate zone, moisture zone (i.e. dry versus moist climates in the USDA classification), cover-crop type, and main-crop type, using the function “aov” in R. Means were grouped using Tukey HSD for unbalanced data (using function “HSD.test” from the agricolae package in R). SOC sequestration rate did not vary significantly (at 95% confidence) with climate zone or cover crop type (Figs. 1 and 3). However, a significant difference was found between sequestration rates in dry versus moist climates (Fig. 2), with the rate in dry climates not being significantly different from zero.. Although continuous soybean showed a different mean to cereals or mixed cropping rotations (Fig. 4) none of the continuous soy data were from the USA, and random forest analysis (see next section) did not show main crop type as a significant predictor when multiple interactive effects between parameters are also considered. We therefore disaggregate SOC sequestration rates only by moisture zone.

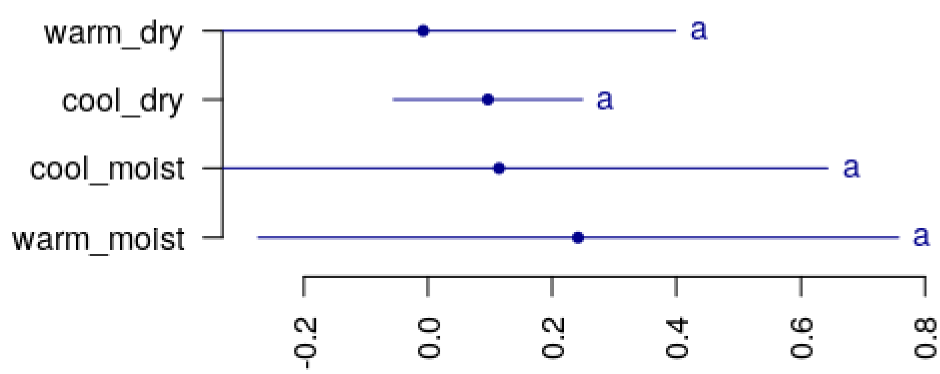

Figure 1: Mean and standard deviation of carbon sequestration rate (Mg C ha^{-1} yr^{-1}), dis-aggregated by USDA climate zone, with ANOVA groups determined by Tukey HSD for unbalanced data (using agricolae package in R).

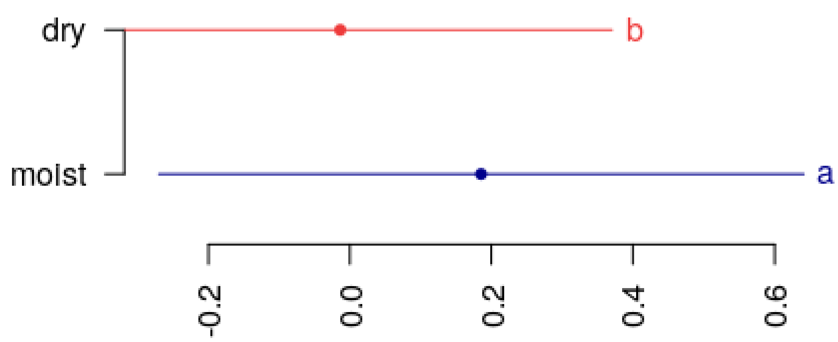

Figure 2: Mean and standard deviation of carbon sequestration rate (Mg C ha^{-1} yr^{-1}), dis-aggregated by moisture zone, with ANOVA groups determined by Tukey HSD for unbalanced data (using agricolae package in R).

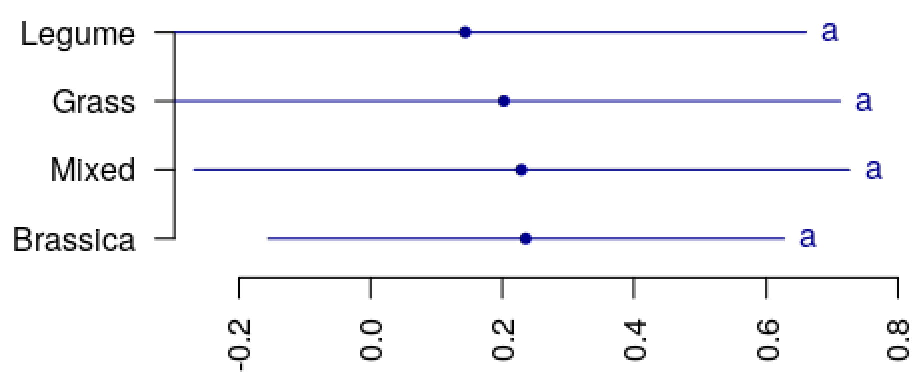

Figure 3: Mean and standard deviation of carbon sequestration rate (Mg C ha^{-1} yr^{-1}), dis-aggregated by cover-crop type, with ANOVA groups determined by Tukey HSD for unbalanced data (using agricolae package in R).

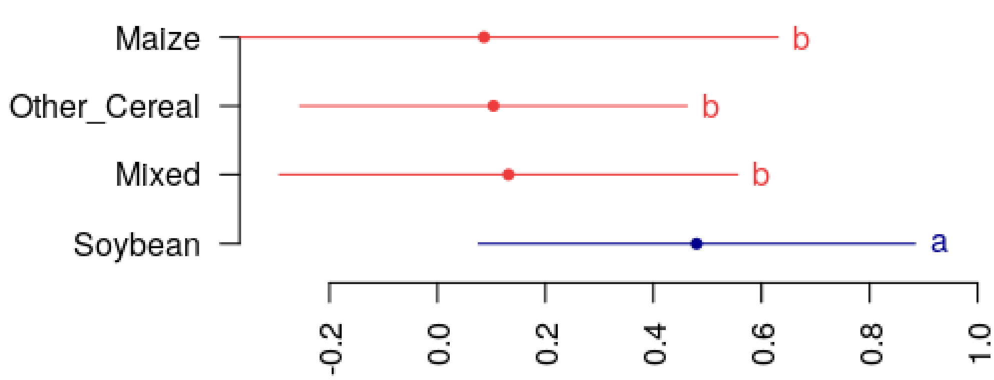

Figure 4: Mean and standard deviation of carbon sequestration rate (Mg C ha^{-1} yr^{-1}), dis-aggregated by main-crop type, with ANOVA groups determined by Tukey HSD for unbalanced data (using agricolae package in R).

6. Accounting for sequestration rate variation with time

As described in the Overall Methods document, annualized SOC credits are attenuated by an SOC adjustment factor ($f100_{CC}$) to account for the fact that annual sequestration rates diminish over time. It is calculated as the cumulative SOC sequestered over 100 years, expressed as a fraction of the SOC that would be sequestered if the initial annual sequestration rate remained constant over 100 years:

$$f100_{CC} = \Delta SOC_{100} / (100 * \Delta SOC_1)$$

where,

ΔSOC_{100} is the net cumulative carbon sequestered over 100 years, and

ΔSOC_1 is the initial annual carbon sequestration rate (averaged over the first 8 years, which is the mean length of the experiments used in deriving the empirical estimate).

ΔSOC100 was calculated using the RothC model, spun up over 1000 years to current SOC stocks, then forced by a step change in carbon input to give a value of ΔSOC1 equal to the empirical estimate of 0.19 Mg C ha-1 yr-1 from published cover crop trials. Current SOC was estimated using the FAO / Global Soil Partnership GSOC version 1.5.0 (Global Soil Partnership, 2018). Monthly temperature, precipitation and potential evapotranspiration were estimated using Climatic Research Unit (CRU) Time-Series (TS) version 4.03 of high-resolution gridded data of month-by-month variation in climate. Soil texture (clay content) was estimated using the gridded harmonized world soils database (Wieder et al., 2014).

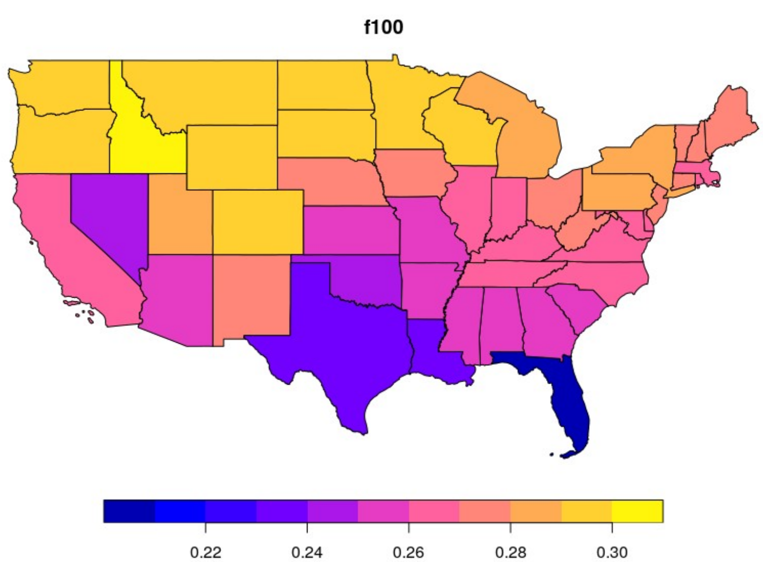

Figure 5: Adjustment factor ($f100_{cc}$) to account for reduced sequestration rates over time, for each State in the coterminous USA.

Table 1: Adjustment factor ($f100_{cc}$) to account for reduced sequestration rates over time, for each State in the coterminous USA.

NAME	$f100_{cc}$	NAME	$f100_{cc}$
Alabama	0.25	Nebraska	0.27
Arizona	0.26	Nevada	0.24
Arkansas	0.26	New Hampshire	0.27
California	0.27	New Jersey	0.27
Colorado	0.29	New Mexico	0.27
Connecticut	0.27	New York	0.28
Delaware	0.26	North Carolina	0.26
Florida	0.21	North Dakota	0.29
Georgia	0.25	Ohio	0.28
Idaho	0.30	Oklahoma	0.25
Illinois	0.26	Oregon	0.29
Indiana	0.27	Pennsylvania	0.29
Iowa	0.27	Rhode Island	0.27
Kansas	0.26	South Carolina	0.25
Kentucky	0.26	South Dakota	0.29
Louisiana	0.24	Tennessee	0.27
Maine	0.28	Texas	0.24
Maryland	0.27	Utah	0.28
Massachusetts	0.27	Vermont	0.28
Michigan	0.28	Virginia	0.27
Minnesota	0.30	Washington	0.30
Mississippi	0.25	West Virginia	0.28
Missouri	0.26	Wisconsin	0.29
Montana	0.30	Wyoming	0.29

7. Environmental covariates

Several environmental parameters (related to climate, soil properties and net primary production) were explored as potential explanatory variables of variance in SOC sequestration. Spatial distributions of these environmental parameters are shown in Figs. 6 -

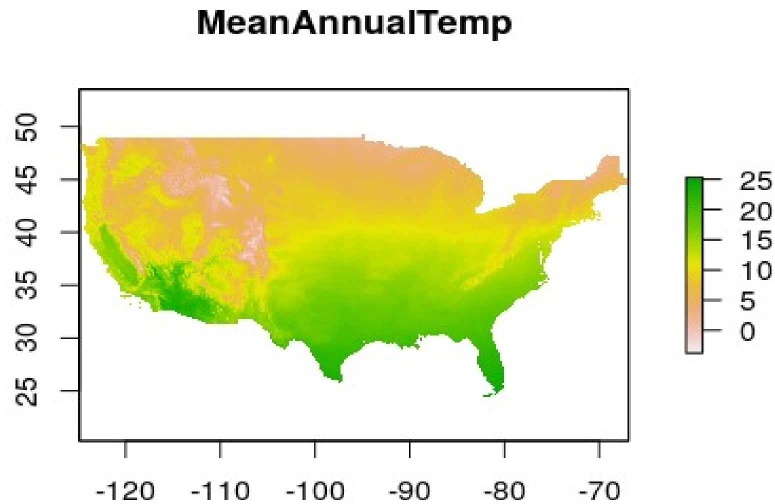

Figure 6: Mean Annual Temperature (WorldClim).

39.

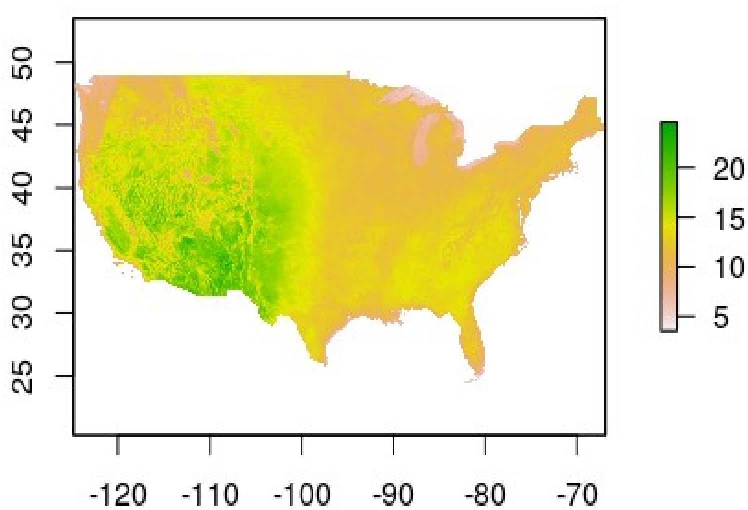

Figure 7: Mean diurnal range (WorldClim).

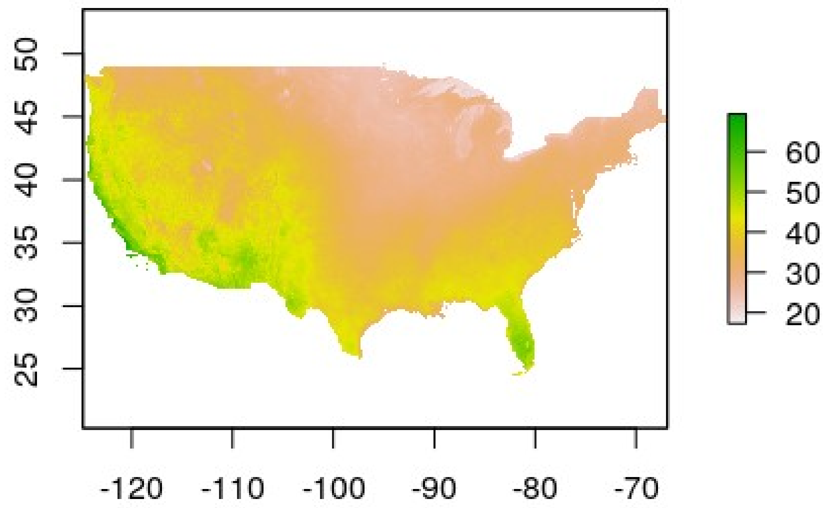

Figure 8: Isothermality (WorldClim).

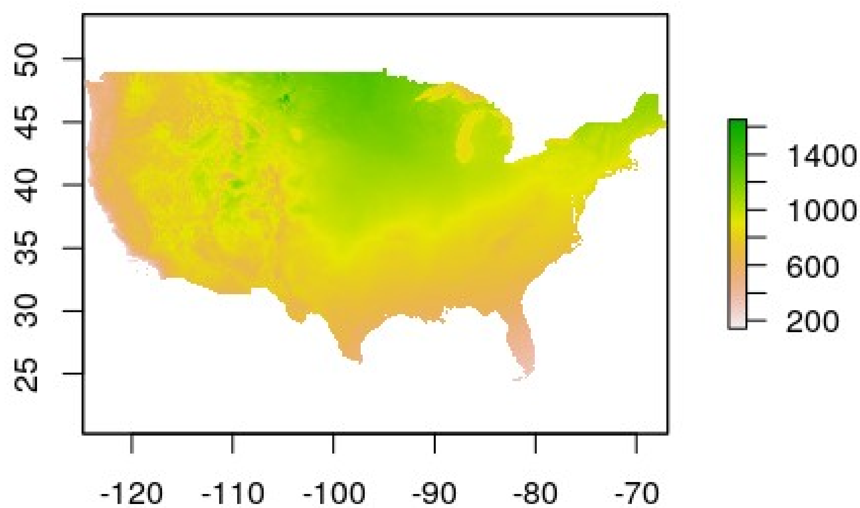

Figure 9: Mean temperature seasonality (WorldClim).

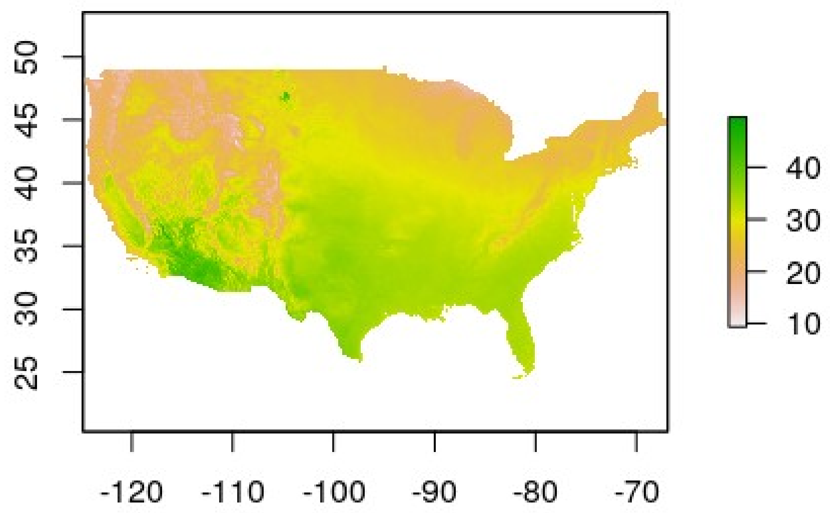

Figure 10: Maximum temperature in the warmest month (WorldClim).

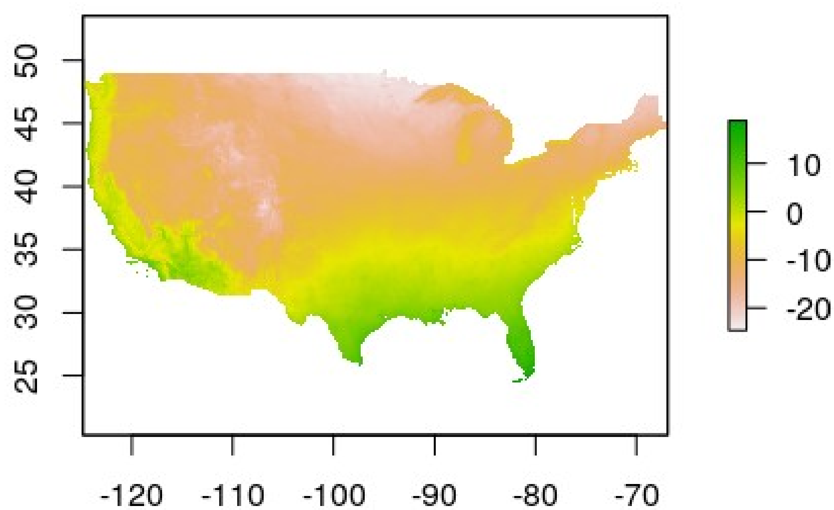

Figure 11: Minimum temperature in coldest month (WorldClim).

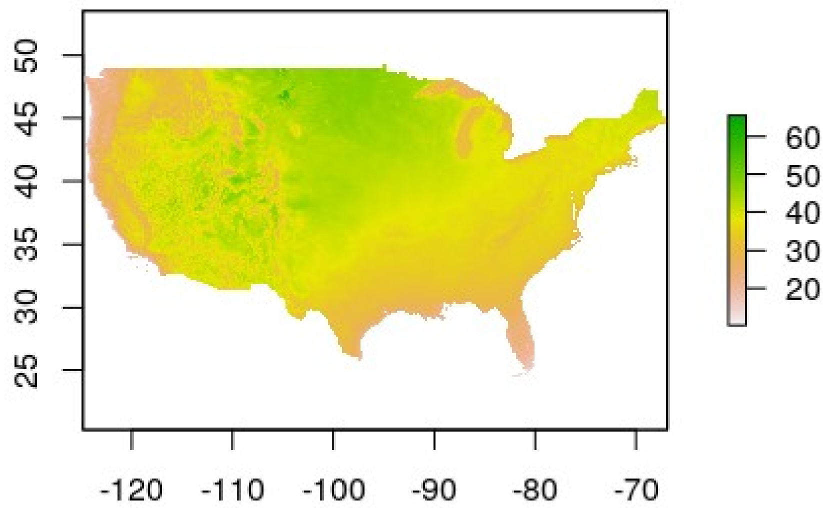

Figure 12: Mean temperature range (WorldClim).

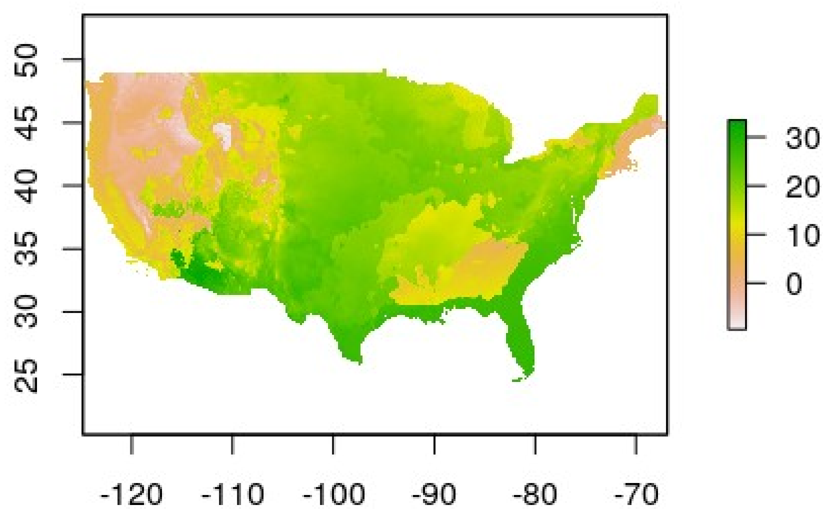

Figure 13: Mean temperature in wettest quarter (WorldClim).

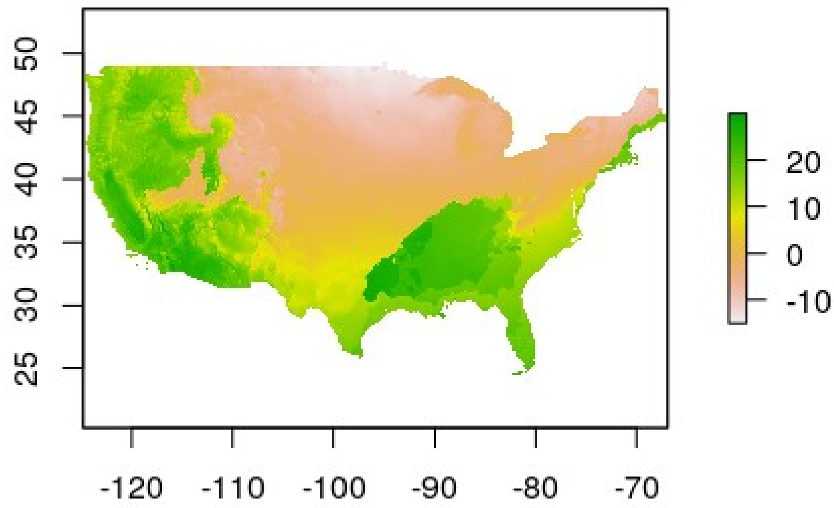

Figure 14: Mean temperature in driest quarter (WorldClim).

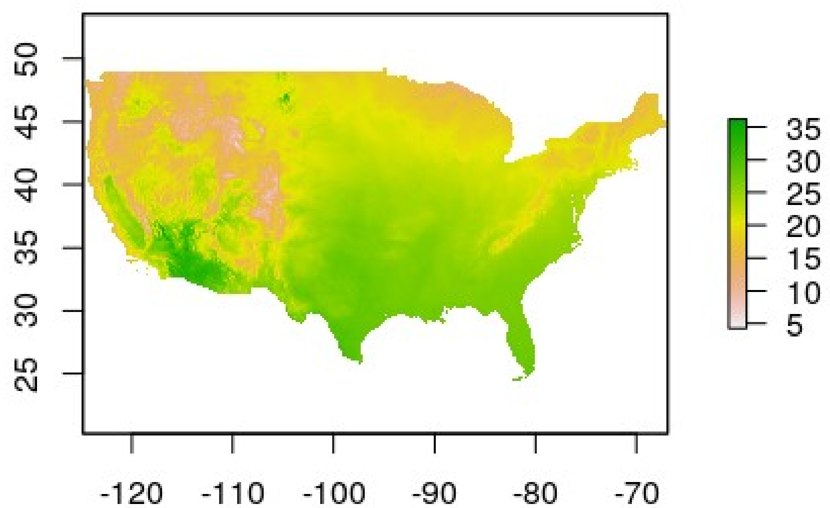

Figure 15: Mean temperature in warmest quarter (WorldClim).

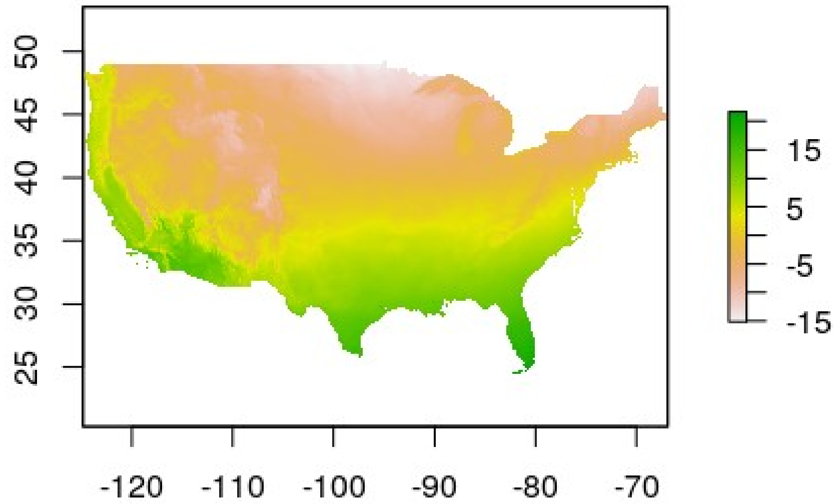

Figure 16: Mean temperature in coldest quarter (WorldClim).

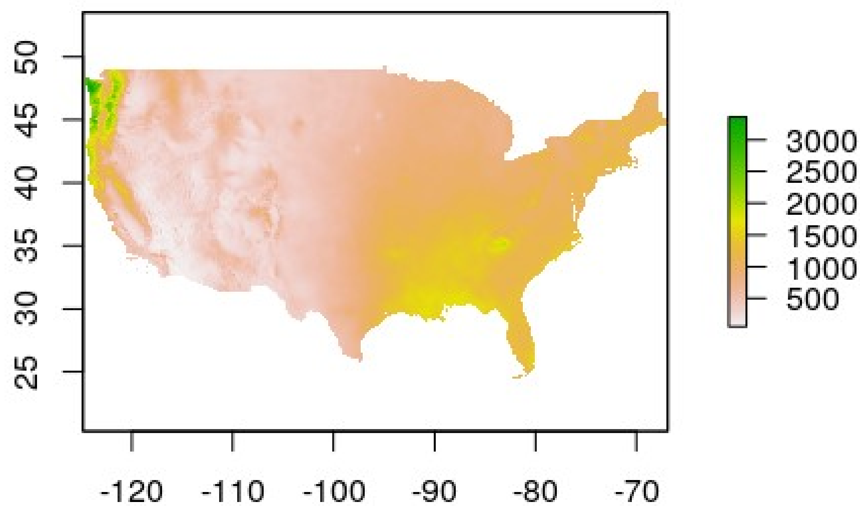

Figure 17: Mean annual precipitation (WorldClim).

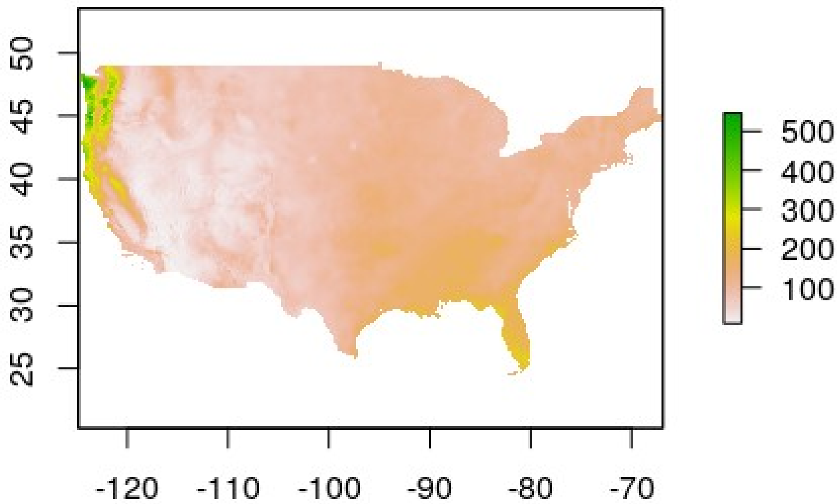

Figure 18: Mean precipitation in wettest month (WorldClim).

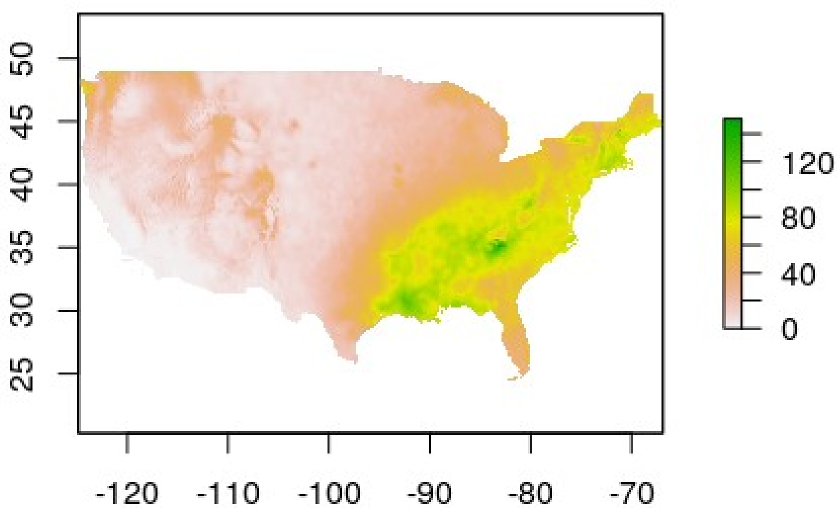

Figure 19: Mean precipitation in driest month (WorldClim).

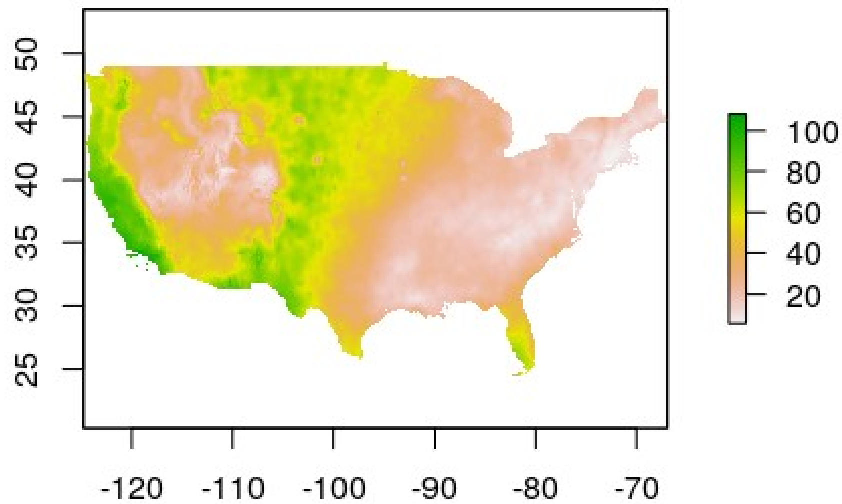

Figure 20: Precipitation seasonality (WorldClim).

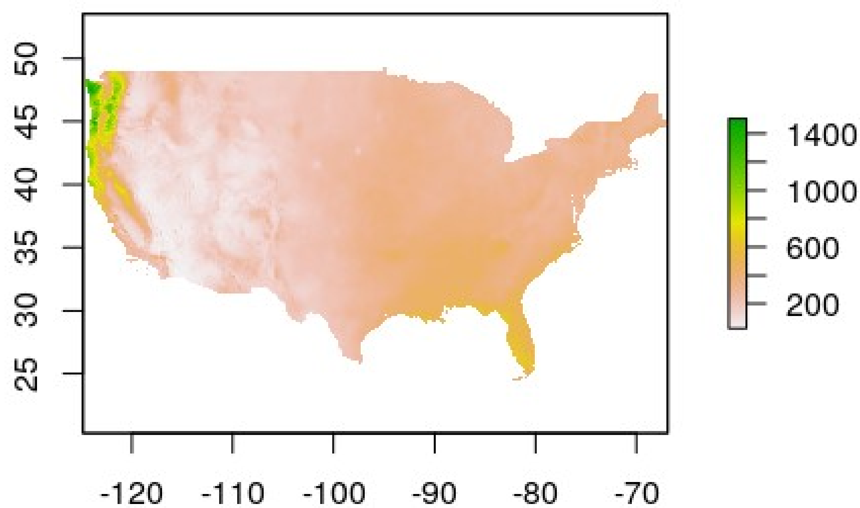

Figure 21: Mean precipitation in wettest quarter (WorldClim).

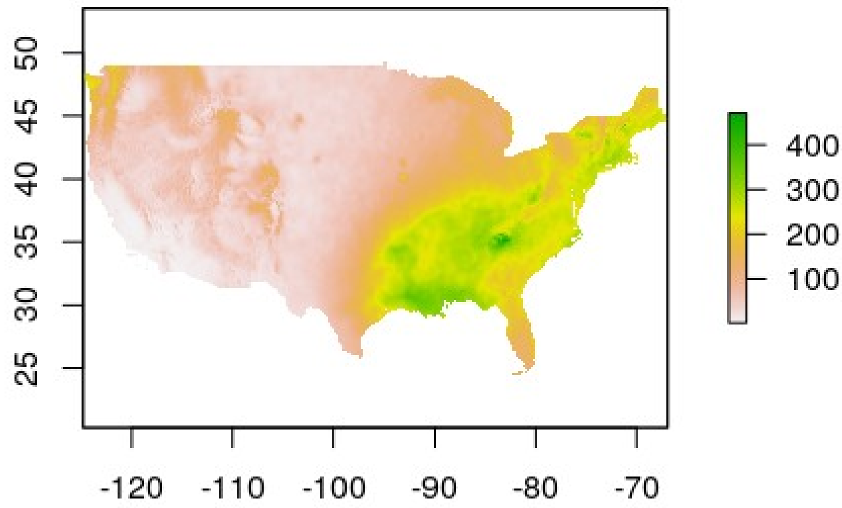

Figure 22: Mean precipitation in driest quarter (WorldClim).

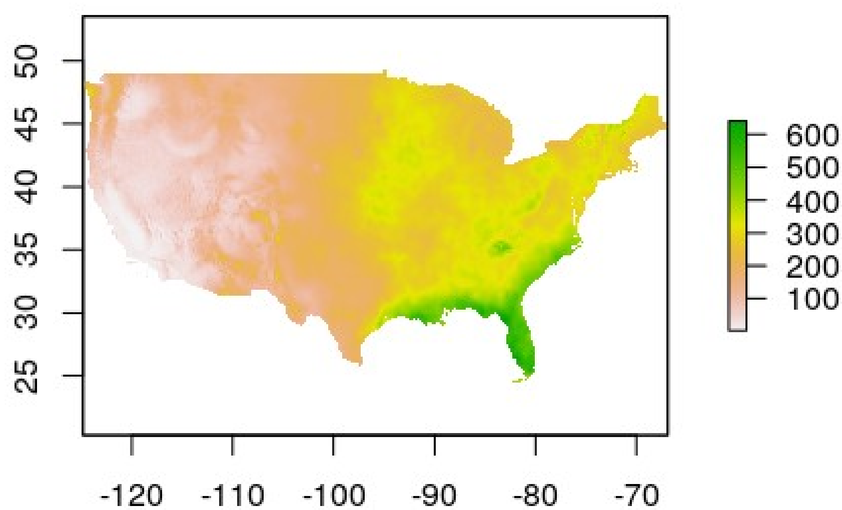

Figure 23: Mean precipitation in warmest quarter (WorldClim).

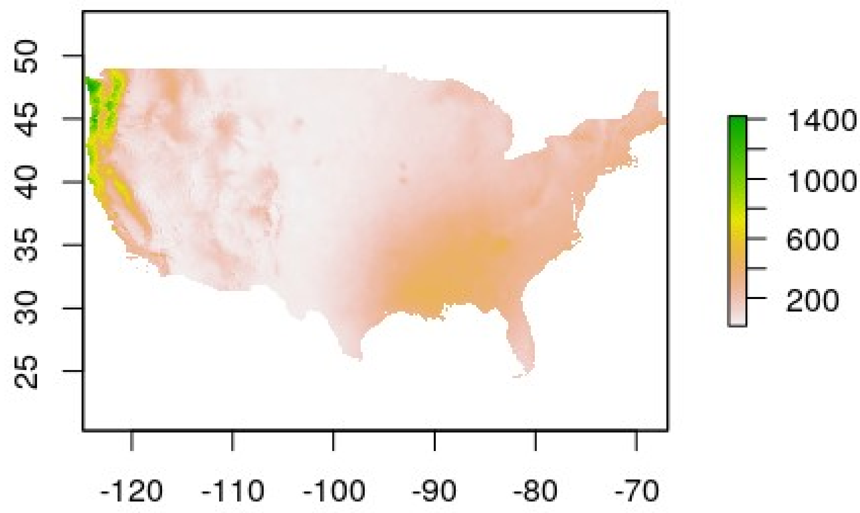

Figure 24: Mean precipitation in coldest quarter (WorldClim).

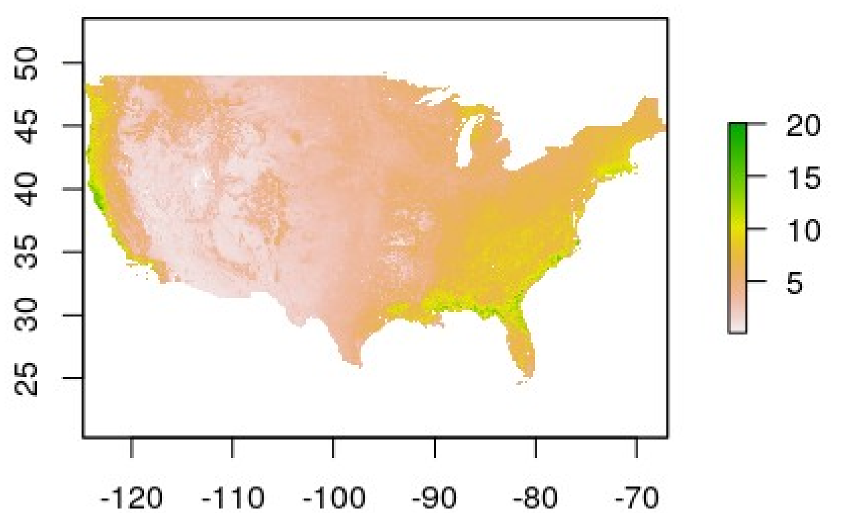

Figure 25: Mean annual net primary production 2000-2015 (NASA MODIS MOD17a3).

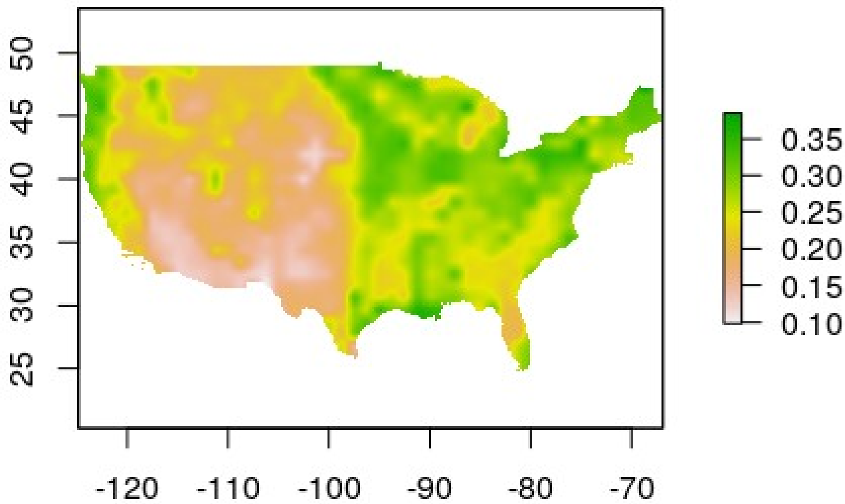

Figure 26: Mean soil moisture 0-30cm. Derived from Community Land Model 4.5 20th century historic runs.

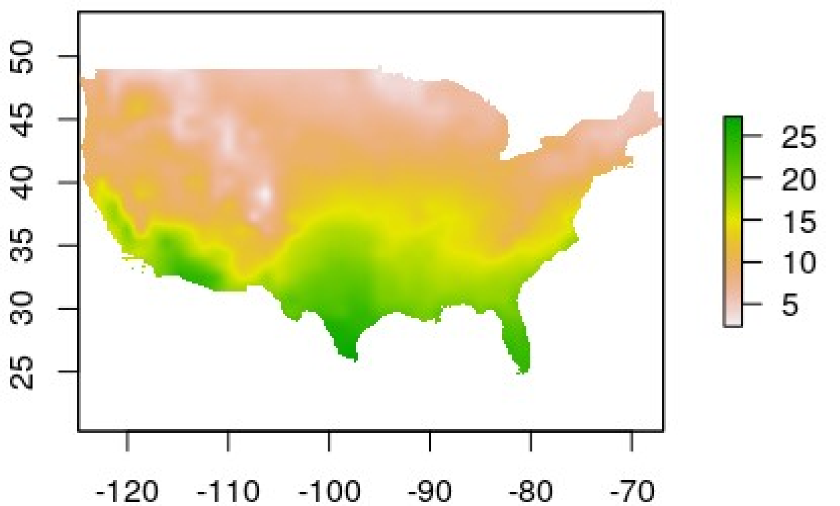

Figure 27: Mean soil temperature 0-30cm. Derived from Community Land Model 4.5 20th century historic runs.

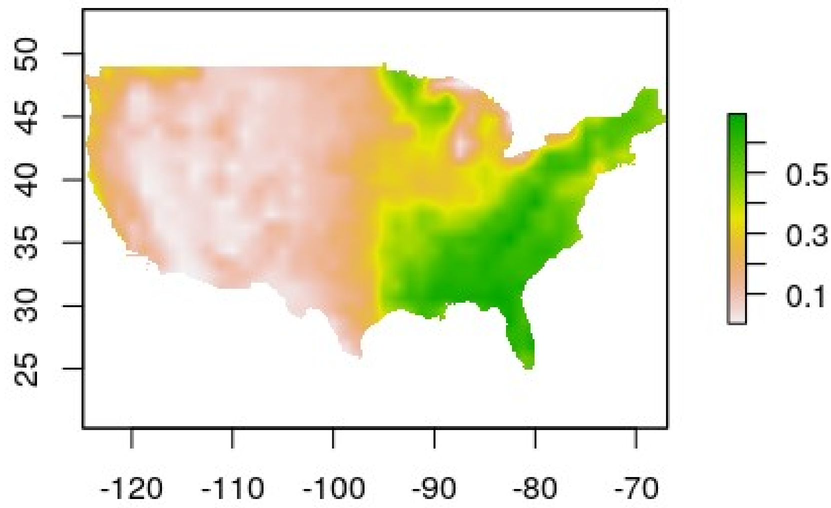

Figure 28: Potential net primary production (monthly mean). Derived from Community Land Model 4.5 20th century historic runs.

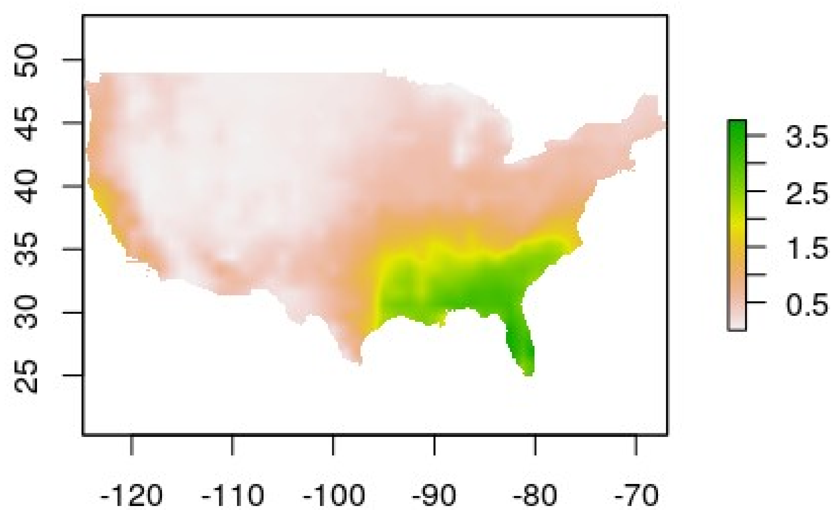

Figure 29: Potential net primary production during Oct-Mar. Derived from Community Land Model 4.5 20th century historic runs.

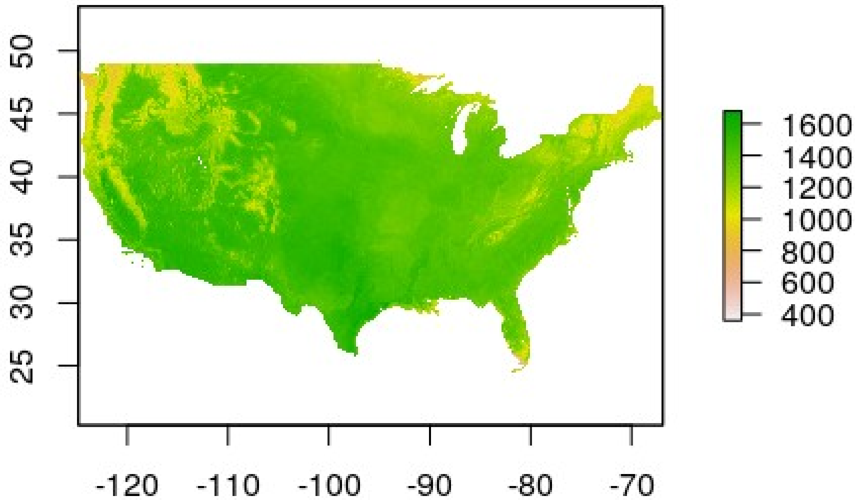

Figure 30: Bulk density (g/m^3). (SoilGrids).

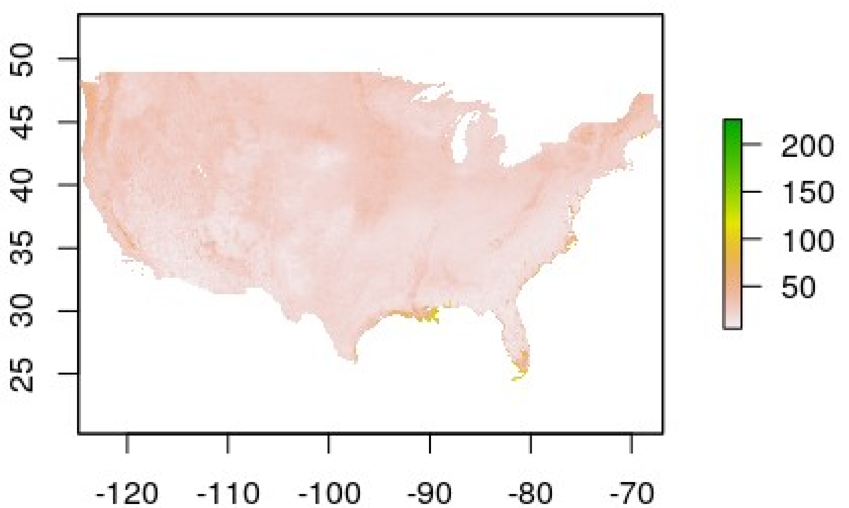

Figure 31: Cation exchange capacity (SoilGrids).

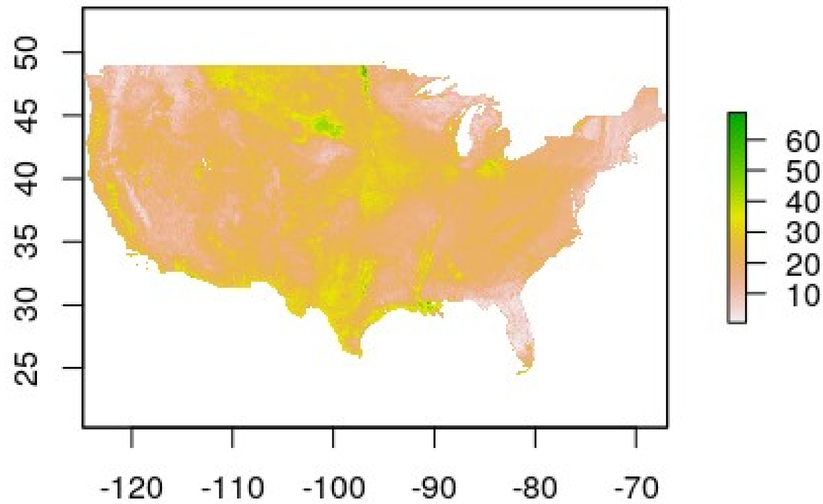

Figure 32: Clay content (SoilGrids).

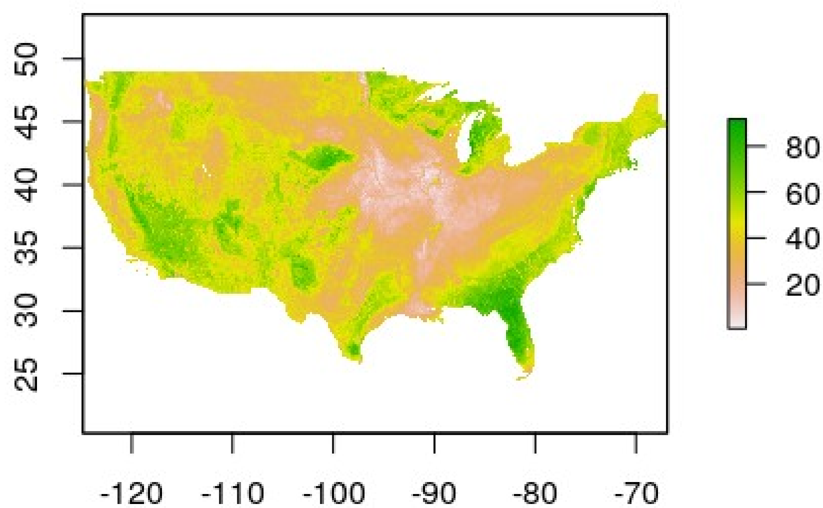

Figure 33: Sand content (SoilGrids).

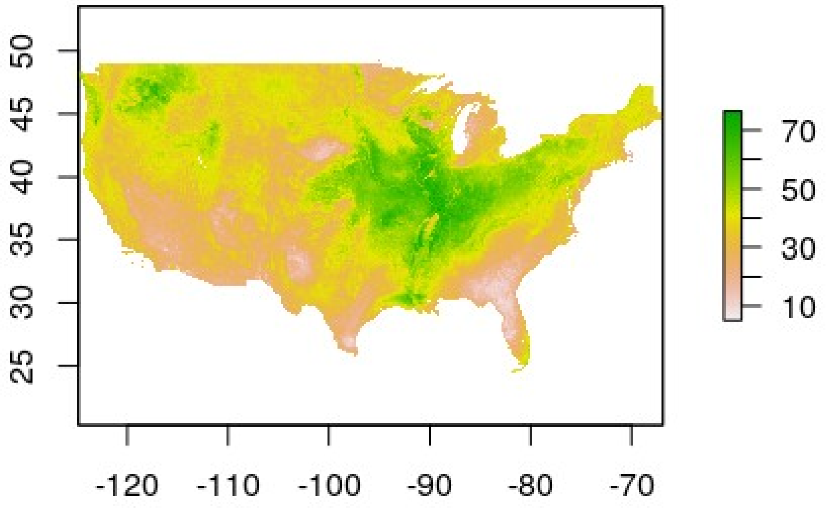

Figure 34: Silt content (SoilGrids).

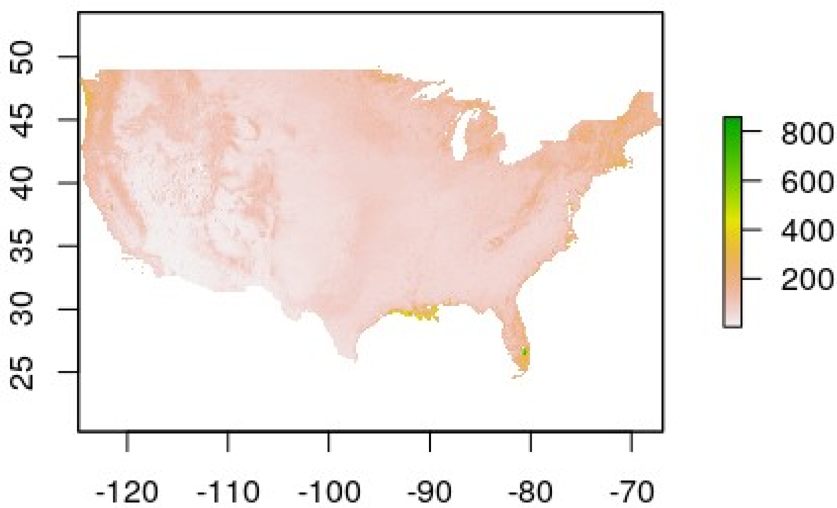

Figure 35: Soil carbon stocks to 30 cm (Mg/ha). (SoilGrids). Note that high end of range corresponds to histosols.

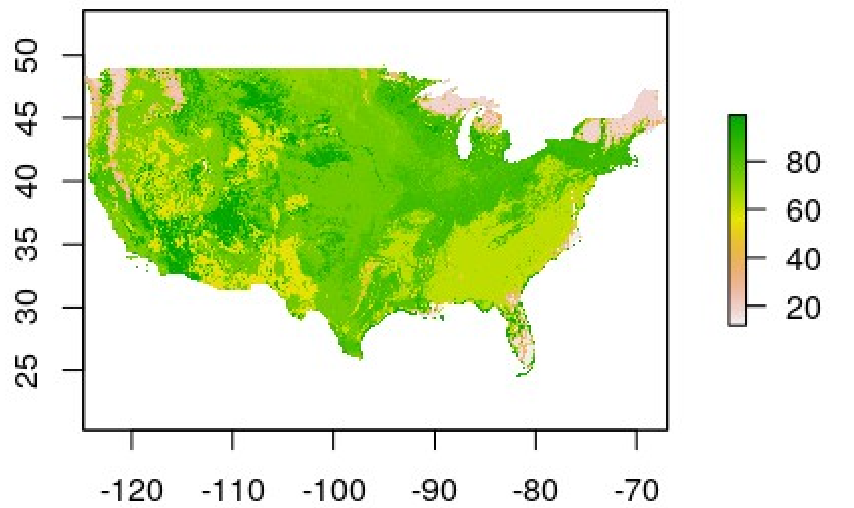

Figure 36: Soil taxonomy (USDA). Refer to SoilGrids.org for conversion from numeric values to classes

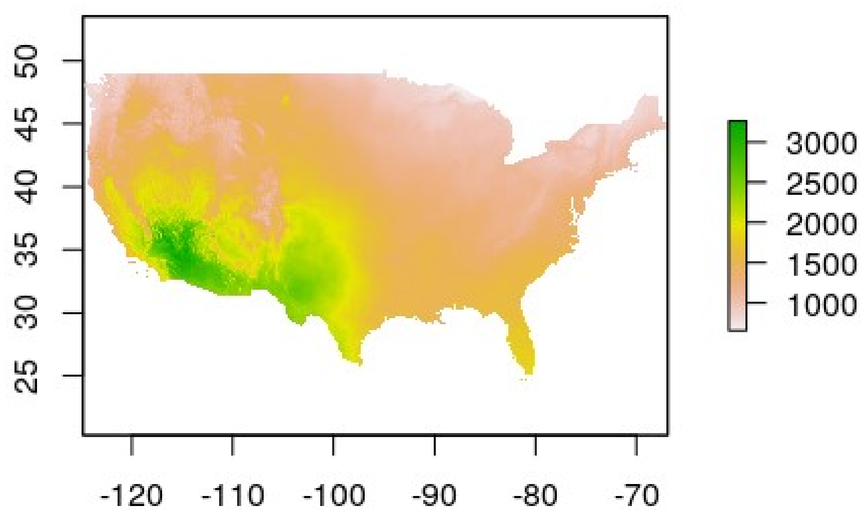

Figure 37: Annual reference evapotranspiration (mm).

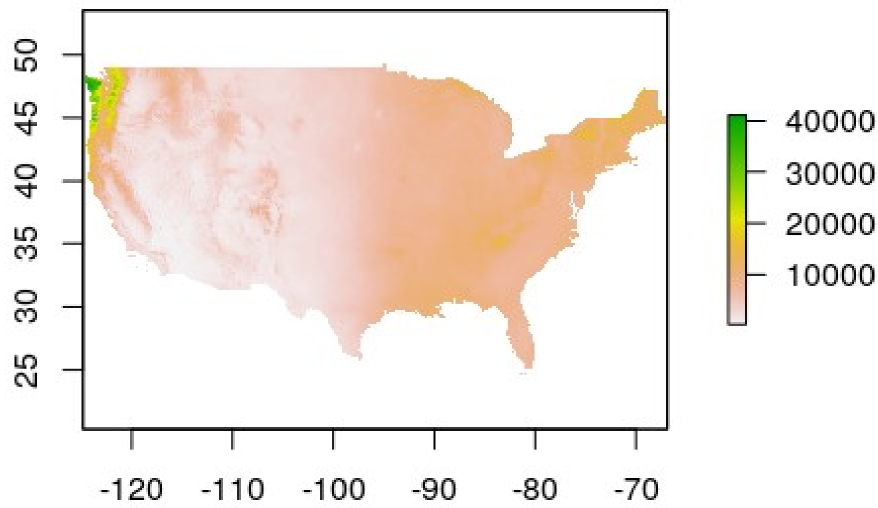

*Figure 38: Aridity Index (annual precipitation/ reference evapotranspiration * 10000). Note scale factor of 10,000.*

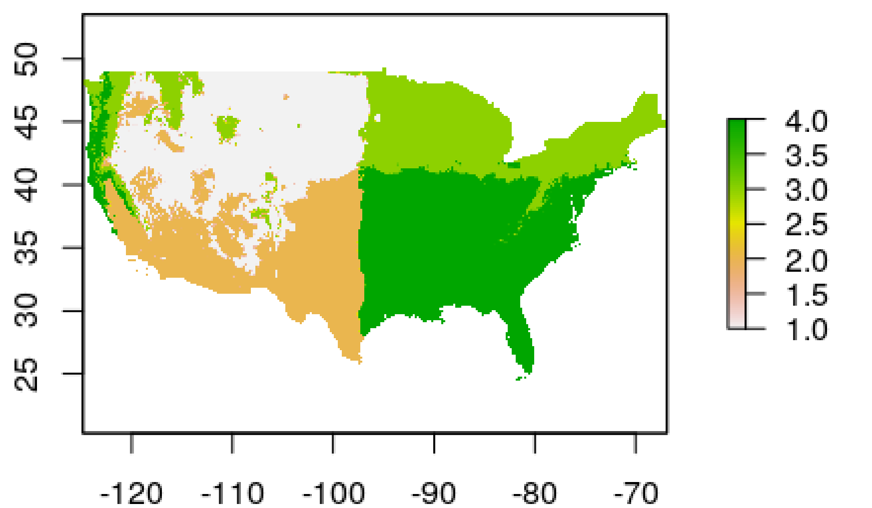

Figure 39: Climate zone. 1 = cool-dry. 2 = warm-dry. 3 = cool-moist. 4 = warm-moist.

8. References

Abdallahi, M. M., & N’dayegamiye, A. (2000). Effets de deux incorporations d’engrais verts sur le rendement et la nutrition en azote du blé (Triticum aestivum L.), ainsi que sur les propriétés physiques et biologiques du sol. *Canadian Journal of Soil Science*, *80*(1), 81–89.

Abdollahi, L., & Munkholm, L. J. (2014). Tillage System and Cover Crop Effects on Soil Quality: I. Chemical, Mechanical, and Biological Properties. *Soil Science Society of America Journal*, *78*(1), 262–270. https://doi.org/10.2136/sssaj2013.07.0301

Abunyewa, A. A., & Padi, F. K. (2003). Changes in soil fertility and Striga hermonthica prevalence associated with legume and cereal cultivation in the Sudan savannah zone of Ghana. *Land Degradation & Development*, *14*(3), 335–343. https://doi.org/10.1002/ldr.555

Alessandria, E., Arborno, Leguía, M., Pietrarelli, L., Sanchez, J., & Zamar, J. (2013). Introducción de cultivos de cobertura en agroecosis-temas extensivos de la región central de Córdoba. *Cultivos de Cobertura*, *128*.

Amado, T. J. C., Bayer, C., Conceição, P. C., Spagnollo, E., Campos, B.-H. C. de, & Veiga, M. da. (2006). Potential of Carbon Accumulation in No-Till Soils with Intensive Use and Cover Crops in Southern Brazil. *Journal of Environmental Quality*, *35*(4), 1599–1607. https://doi.org/10.2134/jeq2005.0233

Amado, T. J. C., Bayer, C., Conceição, P. C., Spagnollo, E., De Campos, B.-H. C., & Da Veiga, M. (2006). Potential of carbon accumulation in no-till soils with intensive use and cover crops in southern Brazil. *Journal of Environmental Quality*, *35*(4), 1599–1607.

Astier, M., Maass, J. M., Etchevers-Barra, J. D., Peña, J. J., & González, F. de L. (2006). Short-term green manure and tillage management effects on maize yield and soil quality in an Andisol. *Soil and Tillage Research*, *88*(1), 153–159. https://doi.org/10.1016/j.still.2005.05.003

Bandick, A. K., & Dick, R. P. (1999). Field management effects on soil enzyme activities. *Soil Biology and Biochemistry*, *31*(11), 1471–1479. https://doi.org/10.1016/S0038-0717(99)00051-6

Bayer, C., Dieckow, J., Amado, T. J. C., Eltz, F. L. F., & Vieira, F. C. B. (2009). Cover Crop Effects Increasing Carbon Storage in a Subtropical No-Till Sandy Acrisol. *Communications in Soil Science and Plant Analysis*, *40*(9–10), 1499–1511. https://doi.org/10.1080/00103620902820365

Bayer, C., Gomes, J., Zanatta, J. A., Vieira, F. C. B., Piccolo, M. de C., Dieckow, J., & Six, J. (2015). Soil nitrous oxide emissions as affected by long-term tillage, cropping systems and nitrogen fertilization in Southern Brazil. *Soil and Tillage Research*, *146*, 213–222. https://doi.org/10.1016/j.still.2014.10.011

Beare, M. H., & Russell Bruce, R. (1993). A comparison of methods for measuring water-stable aggregates: Implications for determining environmental effects on soil structure. *Geoderma*, *56*(1), 87–104. https://doi.org/10.1016/0016-7061(93)90102-Q

Benjamin, J. G., Mikha, M., Nielsen, D. C., Vigil, M. F., Calderón, F., & Henry, W. B. (2007). Cropping Intensity Effects on Physical Properties of a No-till Silt Loam. *Soil Science Society of America Journal*, *71*(4), 1160–1165. https://doi.org/10.2136/sssaj2006.0363

Blanco-Canqui, H., Holman, J. D., Schlegel, A. J., Tatarko, J., & Shaver, T. M. (2013). Replacing Fallow with Cover Crops in a Semiarid Soil: Effects on Soil Properties. *Soil Science Society of America Journal*, *77*(3), 1026–1034. https://doi.org/10.2136/sssaj2013.01.0006

Blanco-Canqui, H., Mikha, M. M., Presley, D. R., & Claassen, M. M. (2011). Addition of Cover Crops Enhances No-Till Potential for Improving Soil Physical Properties. *Soil*

Science Society of America Journal, *75*(4), 1471–1482. https://doi.org/10.2136/sssaj2010.0430

Brown, S. M. A., Cook, H. F., & Lee, H. C. (2000). Topsoil Characteristics from a Paired Farm Survey of Organic versus Conventional Farming in Southern England. *Biological Agriculture & Horticulture*, *18*(1), 37–54. https://doi.org/10.1080/01448765.2000.9754863

Campbell, C. A., Biederbeck, V. O., Zentner, R. P., & Lafond, G. P. (1991). Effect of crop rotations and cultural practices on soil organic matter, microbial biomass and respiration in a thin Black Chernozem. *Canadian Journal of Soil Science*, *71*(3), 363–376.

Campbell, C. A., Zentner, R. P., Bowren, K. E., Townley-Smith, L., & Schnitzer, M. (1991). Effect of crop rotations and fertilization on soil organic matter and some biochemical properties of a thick Black Chernozem. *Canadian Journal of Soil Science*, *71*(3), 377–387.

Clark, K. M., Boardman, D. L., Staples, J. S., Easterby, S., Reinbott, T. M., Kremer, R. J., Kitchen, N. R., & Veum, K. S. (2017). Crop Yield and Soil Organic Carbon in Conventional and No-till Organic Systems on a Claypan Soil. *Agronomy Journal*, *109*(2), 588–599. https://doi.org/10.2134/agronj2016.06.0367

Coleman, K., & Jenkinson, D. (2008). *ROTHC-26.3*. Rothamsted Research, Harpenden, Herts, UK.

Constantin, J., Mary, B., Laurent, F., Aubrion, G., Fontaine, A., Kerveillant, P., & Beaudoin, N. (2010). Effects of catch crops, no till and reduced nitrogen fertilization on nitrogen leaching and balance in three long-term experiments. *Agriculture, Ecosystems & Environment*, *135*(4), 268–278.

Curtin, D., Wang, H., Selles, F., Zentner, R. P., Biederbeck, V. O., & Campbell, C. A. (2000). Legume green manure as partial fallow replacement in semiarid Saskatchewan: Effect on carbon fluxes. *Canadian Journal of Soil Science*, *80*(3), 499–505.

Drinkwater, L. E., Wagoner, P., & Sarrantonio, M. (1998). Legume-based cropping systems have reduced carbon and nitrogen losses. *Nature*, *396*(6708), 262–265. https://doi.org/10.1038/24376

Eckert, D. J. (1991). Chemical attributes of soils subjected to no-till cropping with rye cover crops. *Soil Science Society of America Journal*, *55*(2), 405–409.

Global Soil Partnership. (2018). *Global Soi lOrganic Carbon Map*. FAO.

Goyal, S., Chander, K., Mundra, M. C., & Kapoor, K. K. (1999). Influence of inorganic fertilizers and organic amendments on soil organic matter and soil microbial properties under tropical conditions. *Biology and Fertility of Soils*, *29*(2), 196–200. https://doi.org/10.1007/s003740050544

Hansen, E. M., Kristensen, K., & Djurhuus, J. (2000). Yield Parameters as Affected by Introduction or Discontinuation of Catch Crop Use. *Agronomy Journal*, *92*(5), 909–914. https://doi.org/10.2134/agronj2000.925909x

Haque, M. M., Kim, S. Y., Pramanik, P., Kim, G.-Y., & Kim, P. J. (2013). Optimum application level of winter cover crop biomass as green manure under considering methane emission and rice productivity in paddy soil. *Biology and Fertility of Soils*, *49*(4), 487–493.

Hargrove, W. L. (1986). Winter Legumes as a Nitrogen Source for No-Till Grain Sorghum1. *Agronomy Journal*, *78*(1), 70–74. https://doi.org/10.2134/agronj1986.00021962007800010016x

Hermawan, B., & Bomke, A. A. (1997). Effects of winter cover crops and successive spring tillage on soil aggregation. *Soil and Tillage Research*, *44*(1), 109–120. https://doi.org/10.1016/S0167-1987(97)00043-3

Hubbard, R. K., Strickland, T. C., & Phatak, S. (2013). Effects of cover crop systems on soil physical properties and carbon/nitrogen relationships in the coastal plain of southeastern USA. *Soil and Tillage Research*, *126*, 276–283.

Idowu, O. J., Van Es, H. M., Abawi, G. S., Wolfe, D. W., Schindelbeck, R. R., Moebius-Clune, B. N., & Gugino, B. K. (2009). Use of an integrative soil health test for evaluation of soil management impacts. *Renewable Agriculture and Food Systems*, *24*(3), 214–224.

Jokela, W. E., Grabber, J. H., Karlen, D. L., Balser, T. C., & Palmquist, D. E. (2009). Cover Crop and Liquid Manure Effects on Soil Quality Indicators in a Corn Silage System. *Agronomy Journal*, *101*(4), 727–737. https://doi.org/10.2134/agronj2008.0191

Jokela, W., Posner, J., Hedtcke, J., Balser, T., & Read, H. (2011). Midwest cropping system effects on soil properties and on a soil quality index. *Agronomy Journal*, *103*(5), 1552–1562.

Kaho, F., Yemefack, M., Nguimgo, B. A. K., & Zonkeng, C. G. (2004). The Effect of Short Rotation Desmodium distortum Planted Fallow on the Productivity of Uitisols in Centre Cameroon. *Tropicultura*, *22*(2), 49–55.

Kim, S. Y., Lee, C. H., Gutierrez, J., & Kim, P. J. (2013). Contribution of winter cover crop amendments on global warming potential in rice paddy soil during cultivation. *Plant and Soil*, *366*(1–2), 273–286.

Kuo, S., Sainju, U. M., & Jellum, E. J. (1997). Winter Cover Crop Effects on Soil Organic Carbon and Carbohydrate in Soil. *Soil Science Society of America Journal*, *61*(1), 145–152. https://doi.org/10.2136/sssaj1997.03615995006100010022x

Langdale, G. W., West, L. T., Bruce, R. R., Miller, W. P., & Thomas, A. W. (1992). Restoration of eroded soil with conservation tillage. *Soil Technology*, *5*(1), 81–90. https://doi.org/10.1016/0933-3630(92)90009-P

Mandal, U. K., Singh, G., Victor, U. S., & Sharma, K. L. (2003). Green manuring: Its effect on soil properties and crop growth under rice–wheat cropping system. *European Journal of Agronomy*, *19*(2), 225–237. https://doi.org/10.1016/S1161-0301(02)00037-0

Marriott, E. E., & Wander, M. (2006). Qualitative and quantitative differences in particulate organic matter fractions in organic and conventional farming systems. *Soil Biology and Biochemistry*, *38*(7), 1527–1536.

Mazzoncini, M., Sapkota, T. B., Bàrberi, P., Antichi, D., & Risaliti, R. (2011). Long-term effect of tillage, nitrogen fertilization and cover crops on soil organic carbon and total nitrogen content. *Soil and Tillage Research*, *114*(2), 165–174. https://doi.org/10.1016/j.still.2011.05.001

Mbuthia, L. W., Acosta-Martínez, V., DeBruyn, J., Schaeffer, S., Tyler, D., Odoi, E., Mpheshea, M., Walker, F., & Eash, N. (2015). Long term tillage, cover crop, and fertilization effects on microbial community structure, activity: Implications for soil quality. *Soil Biology and Biochemistry*, *89*, 24–34.

McVay, K. A., Radcliffe, D. E., & Hargrove, W. L. (1989). Winter legume effects on soil properties and nitrogen fertilizer requirements. *Soil Science Society of America Journal*, *53*(6), 1856–1862.

Metay, A., Moreira, J. A. A., Bernoux, M., Boyer, T., Douzet, J.-M., Feigl, B., Feller, C., Maraux, F., Oliver, R., & Scopel, E. (2007). Storage and forms of organic carbon in a no-tillage under cover crops system on clayey Oxisol in dryland rice production (Cerrados, Brazil). *Soil and Tillage Research*, *94*(1), 122–132.

Mitchell, C. C. (1996). America's Oldest Cotton Study—A 100 Year Perspective. *Proceedings of the Beltwide Cotton Conferences*, 12.

Moore, E. B., Wiedenhoeft, M. H., Kaspar, T. C., & Cambardella, C. A. (2014). Rye cover crop effects on soil quality in no-till corn silage–soybean cropping systems. *Soil Science Society of America Journal*, *78*(3), 968–976.

Muleba, N. (1999). Effects of cowpea, crotalaria and sorghum crops and phosphorus fertilizers on maize productivity in semi-arid West Africa. *The Journal of Agricultural Science*, *132*(1), 61–70. https://doi.org/10.1017/S0021859698006182

Myaka, F. M., Sakala, W. D., Adu-Gyamfi, J. J., Kamalongo, D., Ngwira, A., Odgaard, R., Nielsen, N. E., & Høgh-Jensen, H. (2006). Yields and accumulations of N and P in farmer-managed intercrops of maize–pigeonpea in semi-arid Africa. *Plant and Soil*, *285*(1–2), 207–220.

Nascente, A. S., Crusciol, C. A. C., Cobucci, T., & Velini, E. D. (2013). Cover crop termination timing on rice crop production in a no-till system. *Crop Science*, *53*(6), 2659–2669.

N'Dayegamiye, A., & Tran, T. S. (2001). Effects of green manures on soil organic matter and wheat yields and N nutrition. *Canadian Journal of Soil Science*, *81*(4), 371–382. https://doi.org/10.4141/S00-034

Ndiaye, E. L., Sandeno, J. M., McGrath, D., & Dick, R. P. (2000). Integrative biological indicators for detecting change in soil quality. *American Journal of Alternative Agriculture*, *15*(1), 26–36.

Nyakatawa, E. Z., Reddy, K. C., & Sistani, K. R. (2001). Tillage, cover cropping, and poultry litter effects on selected soil chemical properties. *Soil and Tillage Research*, *58*(1–2), 69–79.

Olson, K., Ebelhar, S. A., & Lang, J. M. (2014). Long-term effects of cover crops on crop yields, soil organic carbon stocks and sequestration. *Open Journal of Soil Science*, *2014*.

Onim, J. F. M., Mathuva, M., Otieno, K., & Fitzhugh, H. A. (1990). Soil fertility changes and response of maize and beans to green manures of leucaena, sesbania and pigeonpea. *Agroforestry Systems*, *12*(2), 197–215.

Osborne, S. L., Johnson, J. M. F., Jin, V. L., Hammerbeck, A. L., Varvel, G. E., & Schumacher, T. E. (2014). The Impact of Corn Residue Removal on Soil Aggregates and Particulate Organic Matter. *BioEnergy Research*, *7*(2), 559–567. https://doi.org/10.1007/s12155-014-9413-0

Poeplau, C., & Don, A. (2015). Carbon sequestration in agricultural soils via cultivation of cover crops – A meta-analysis. *Agriculture, Ecosystems & Environment*, *200*, 33–41. https://doi.org/10/f3p3g2

Sadat-Dastegheibi, B. (1974). *Untersuchengen zur Stoffdynamik in Ackerboden in Abhangigkeit von verschiedner organischer Dungung und Stickstoffdungung* [Dissertation]. Giessen.

Sainju, U. M., Singh, B. P., Whitehead, W. F., & Wang, S. (2006). Carbon supply and storage in tilled and nontilled soils as influenced by cover crops and nitrogen fertilization. *Journal of Environmental Quality*, *35*(4), 1507–1517.

Scott, H. D., Keisling, T. C., Waddle, B. A., Williams, R. W., & Frans, R. E. (1990). Effects of winter cover crops on yield of cotton and soil properties. *Bulletin. Arkansas Agricultural Experiment Station*, *924*.

Smestad, B. T., Tiessen, H., & Buresh, R. J. (2002). Short fallows of Tithonia diversifolia and Crotalaria grahamiana for soil fertility improvement in western Kenya. *Agroforestry Systems*, *55*(3), 181–194.

Steele, M. K., Coale, F. J., & Hill, R. L. (2012). Winter annual cover crop impacts on no-till soil physical properties and organic matter. *Soil Science Society of America Journal*, *76*(6), 2164–2173.

Terra, J. A., Reeves, D. W., Shaw, J. N., & Raper, R. L. (2005). Impacts of landscape attributes on carbon sequestration during the transition from conventional to conservation management practices on a Coastal Plain field. *Journal of Soil and Water Conservation*, *60*(6), 438–446.

Thomsen, I. K., & Christensen, B. T. (2004). Yields of wheat and soil carbon and nitrogen contents following long-term incorporation of barley straw and ryegrass catch crops. *Soil Use and Management*, *20*(4), 432–438. https://doi.org/10.1111/j.1475-2743.2004.tb00393.x

Utomo, M., Frye, W. W., & Blevins, R. L. (1990). Sustaining soil nitrogen for corn using hairy vetch cover crop. *Agronomy Journal*, *82*(5), 979–983.

Veum, K. S., Kremer, R. J., Sudduth, K. A., Kitchen, N. R., Lerch, R. N., Baffaut, C., Stott, D. E., Karlen, D. L., & Sadler, E. J. (2015). Conservation effects on soil quality indicators in the Missouri Salt River Basin. *Journal of Soil and Water Conservation*, *70*(4), 232–246. https://doi.org/10.2489/jswc.70.4.232

Villamil, M. B., Bollero, G. A., Darmody, R. G., Simmons, F. W., & Bullock, D. G. (2006). No-till corn/soybean systems including winter cover crops. *Soil Science Society of America Journal*, *70*(6), 1936–1944.

Wieder, W., Boehnert, J., Bonan, G. B., & Langseth, M. (2014). *Regridded Harmonized World Soil Database v1.2*. ORNL Distributed Active Archive Center.

Williams, M. M., Mortensen, D. A., & Doran, J. W. (2000). No-tillage soybean performance in cover crops for weed management in the western Corn Belt. *Journal of Soil and Water Conservation*, *55*(1), 79–84.

Wilson, G. F., Lal, R., & Okigbo, B. N. (1982). Effects of cover crops on soil structure and on yield of subsequent arable crops grown under strip tillage on an eroded alfisol. *Soil and Tillage Research*, *2*(3), 233–250. https://doi.org/10.1016/0167-1987(82)90013-7

Yu, Y., Xue, L., & Yang, L. (2014). Winter legumes in rice crop rotations reduces nitrogen loss, and improves rice yield and soil nitrogen supply. *Agronomy for Sustainable Development*, *34*(3), 633–640.

Zimmer, J., & Roschke, M. (2001). Einfache Reproduktion der organischen Bodensubstanz – Erfahrungen aus Dauerversuchen im Land Brandenburg. *VDLUFA-Schriftenreihe*, *57*, 481–489.

Appendix F: Nitrogen technical appendix

Table of Contents

1 Overview

1.1 N management and GHG emissions

N management accounting includes: 1) cropping system N rate changes due to soil health practices (tillage or cover cropping), 2) N rate changes due to N optimization methods (for example, precision agriculture or model N optimization recommendations), 3) GHG emissions from fertilizer production, 4) change in direct N_2O emissions resulting from change in N rate, and 5) change in indirect N_2O emission due to a change in N rate.

Reducing excess reactive nitrogen is the key management pathway for reducing N loss from agricultural systems. Optimal N application rates should provide N to maintain crop yield as well as N to maintain SOM stocks. To achieve optimal N rates, a farmer manages system N balance, the difference between system N inputs and N harvested in crop biomass. While N rate recommendations from N-optimization methods generally reduce N balance, the use of these methods does not guarantee that a farmer has implemented the specific N rate recommendation nor does it give a precise value for the magnitude of the N rate reduction. To ensure that a reduction in N rate has occurred, the most accurate estimate of N_2O emission resulting from agricultural management requires N application rate information. We recommend N rate information as a minimum requirement for estimating agricultural management impact on N_2O emissions.

However, information on N rate may be difficult to obtain for voluntary supply chain GHG mitigation efforts. Therefore, in this appendix, we outline default values that could be applied in the absence of user-provided N management data.

2 Nitrogen management methods

2. 1 Cover crop rotations and N fertilizer management

We searched the Extension and peer-reviewed literature using search terms 'cover crop' and 'nitrogen management'. We used Google Scholar and https://impact.extension.org/ to search the Extension literature; we used Web of Science to search the academic literature. We reviewed relevant articles from literature searches, however current results are not an exhaustive review of all relevant sources.

2. 2 Tillage and N fertilizer management

Similar to cover-crop analysis, we conducted a review of the Extension and peer-reviewed literature to assess how use of no-till or reduced-till alters farmer N management decisions. For tillage, we used search terms including: 'tillage impact on N fertilizer', or 'tillage and nitrogen management', as well as 'corn' and 'wheat' to limit the search to relevant references. We reviewed relevant articles from literature searches, however current results are not an exhaustive review of all relevant sources.

2. 3 N fertilizer optimization

N accounting and default N rates

For all management practices (cover crop, reduced- or no-till, or N optimization), the reduction in N_2O attributed to a practice is calculated as a function of N rate. As with other recommendations in this methodology, the most accurate GHG accounting will result if real data (either farm-scale or aggregated) are available, in particular N rate, crop yield, information about soil health techniques (cover crops or tillage), and information about N optimization practices (such as side-dressing, precision agriculture, or professional consultation to improve nitrogen use efficiency (NUE)).

Baseline N fertilization rates representing conventional management practices can be estimated from state-scale average fertilizer application data. We recommend USDA ERS fertilizer rate data as the most reliable source of average N fertilizer application rate (https://www.ers.usda.gov/data-products/fertilizer-use-and-price/). These N fertilizer data do not include estimates of N from manure sources, which are a substantial proportion of N applied in regions with livestock. However, using ERS data does indicate the change in inorganic N fertilizer rate. Additionally, in regions with high livestock production we expect higher rates of silage maize and hay production, both of which are currently excluded from this Phase 1 Soil Health Gigaton (SHG) method.

Estimating N rate change

We estimate the average observed N rate reduction that resulted from the implementation of a few well studied N optimization techniques. These default N rate reduction values will be available for a SHG method user to select. For users who provide specific information about N rate a more detailed accounting is available. In either case, the change in N rate will be used to estimate potential N_2O losses for a given practice.

We reviewed the literature to quantify the impact of N best management practices (BMPs) on reducing N rate. Estimates of N rate reduction due to N management methods was summarized from experiments documented in the peer-reviewed literature. We searched 'Web of Science' using terms 'precision agriculture or nitrogen optimization' and 'corn' or 'wheat'. We extracted key synthesis literature and traced articles that cited these manuscripts.

2. 4 Energy from N fertilizer production

Net GHG emissions from N fertilizer production vary widely across N type. In the SHG method, we applied the average GHG emission associated with N fertilizer production of 4.41 kg CO_2 kg N^{-1}, from the recent US national Natural Climate Solutions analysis of emissions reduction potential from agriculture, forests, and wetlands (Fargione et al. 2018).

2. 5 Estimating N_2O emissions from agricultural management

We estimate both direct and indirect N_2O emissions associated with agricultural N management. In Phase 1 applications of the Soil Health Gigaton method, we expect users will infrequently provide field-scale estimates of N rate and N harvested in grain. Because we anticipate users will frequently rely on default values, we apply N-rate based approaches to quantifying N_2O emission rather than N balance approaches.

For direct N_2O emissions in wheat and dryland maize cropping systems we apply the Intergovernmental Panel on Climate Change (IPCC) methodology (IPCC 2019). For direct N_2O emissions in moist maize cropping systems we apply a statistical, linear mixed-effects (LME) model derived for U.S. maize systems (Tonitto et al. 2020). This LME statistical modeling approach for estimating N_2O emission was developed using both N-rate and N-balance, with the N-balance approach giving slightly more precise predictions.

For the soybean production years of a rotation, we do not calculate a change in N_2O emission resulting from N management changes under soil health practices or N optimization. Soybean is typically grown without N fertilizer additions. Current literature review (see cover crop appendix) indicates that N rate, rather than N source, is the largest driver of a change in N_2O emission for all management scenarios, including systems applying soil health management practices. If management does not change N rate, there is no basis in our method for calculating N_2O emission change in soybean years of a rotation.

For indirect N_2O emission estimates, we apply the IPCC methodology (IPCC 2019).

3 Accounting for N management

3.1 N fertilizer and cover crop management

3.1.1 Sources of cover crop management information:

University Extension and outreach publications provide limited information for managing N with cover crops. All major agricultural states provide cover crop publications, outreach, and links to resources. However, cover crop publications and resources often focus on selecting cover crop species, planting techniques, and cover crop termination, rather than nutrient management.

In addition to individual state Extension outreach, cover crop management recommendations are provided through regional organizations such as the Midwest Cover Crops Council (MCCC, http://mccc.msu.edu/), Northeast Cover Crops Council (NECCC, http://northeastcovercrops.com/), Southern Cover Crops Council (SCCC, https://southerncovercrops.org/), or at the national level through USDA Sustainable Agriculture Research & Education (SARE, https://www.sare.org/). Regional organic farming resources, such as the Northeast Organic Farming Association (NOFA, https://nofa.org/) are additional resources regarding nutrient accessibility from cover crops, but organic systems have different N dynamics as they do not receive inorganic fertilizer.

Regional cover crop association resources have the highest quantity of user-friendly information regarding: choosing cover crop varieties based on management goals, planting techniques, termination techniques, and cash crop planting following cover crop management. There is less information provided on nutrient management of the cash crop following cover crop management.

Penn State University provides various tools to support cover crop management. Cover crop management is extensively discussed in The Agronomy Guide (https://extension.psu.edu/the-penn-state-agronomy-guide) developed at PSU. In addition, the PSU website includes cover crop management in their on-line N management tool (though documentation of the data behind this model is not transparent).

Maryland has extensive support for cover crop adoption to reduce nutrient losses to the Chesapeake Bay (MDA, https://mda.maryland.gov/resource_conservation/pages/cover_crop.aspx). The MDA cover crop program is widely accessed by farmers throughout the state.

3.1.2 Cover crop management: Fertilizer amendment at planting and management timing

Cover crop management is often promoted as a way to reduce post-harvest N losses from annual cropping systems. Therefore, general recommendations are no N fertilizer amendment at fall planting. For compliance with cover crop initiatives to reduce nitrate leaching, no fall fertilizer N amendment is a requirement in fertilizer-based row cropping systems (https://mda.maryland.gov/resource_conservation/pages/cover_crop.aspx). However, following survey information indicating interest in cover crops in systems that include animals, MD has changed cover crop guidelines to include cover cropping systems that receive fall manure and to allow for spring harvest of the cover crop as forage.

In continuous maize, maize-soybean, or maize-bean cropping systems, cover-crop management in cool, moist regions is recommended without fall N-fertilization (Iowa state Extension, MCCC, MD cover crop protocol). In southern warm, moist regions these maize or maize-bean systems are also managed without fall N fertilization to the cover crop. For other cropping systems, the SCCC includes fall N fertilizer recommendations to optimize cover crop growth; the SCCC recommendation is 25-50 lb N ac^{-1} (28 – 56 kg N ha^{-1}) to the fall cover crop in rotations that do not include maize. Optimizing cover crop NPP is logical if the cover crop is harvested or being used as forage, as this rotation would be akin to double cropping.

We use the MD cover crop program as an example, because it is the cover crop program with the broadest participation (https://mda.maryland.gov/resource_conservation/counties/2019CCBrochure_F.pdf). In order to maximize cover crop N uptake, management timing is a key compliance point in the MD cover crop program. Different monetary compensation rates are listed for planting early. Planting deadlines differ by cover crop type and method. Cover crop termination is allowed between March 1 to June 1 (which allows flexibility to optimize cover crop biomass mineralization or weed issues), but higher payments are offered if termination occurs after May 1.

Extension recommendations indicate that cover crops are easily managed as part of a no-till or strip-till practice (Kaspar and Licht 2020). Planting cover crop recommendations include aerial seeding before cash crop harvest or drilling into residue. Purdue Extension (and others) also recommend no-till drill or broadcast of rye seed.

3.1.3 Fertilizer amendment rate changes for cash crop growth

To avoid nutrient insufficiency during early cash crop growth due to N immobilization during cover crop OM decomposition, farmers may alter the timing of cover crop termination or increase the total rate of N fertilizer addition following cover crop use. For example, additional N fertilizer amendment for successful cash crop growth is allowed for compliance with nutrient reduction efforts in MD.

Cover crop termination timing is critical for successful cover crop management. Cover crop management guidelines emphasize terminating the cover crop during the vegetative growth phase when cover crop residue is more readily decomposed. Guidelines also emphasize termination of cereal cover crops at least two weeks prior to planting maize or soybean (Basche et al. 2016). For example, specific recommendations for Iowa are to terminate when the rye crop is 6-12 inches (15-30 cm) tall, actively growing, and at least 10 days before planting soybean, whichever comes first (Kaspar and Licht 2020).

N fertilizer timing is also important for successful cover crop management. Iowa State Extension does not recommend increasing total N applied if the N rate applied to maize is at least 150 lb N ac^{-1} (168 kg N ha^{-1}); for an N rate <150 lb N ac^{-1} (<168 kg N ha^{-1}) starter fertilizer is recommended and a 10 % increase in N fertilizer rate is recommended to prevent corn N deficit (Basche 2016).

Observations of optimal N rate across Corn Belt experiments have been variable. Observations of optimal N rate across four sites over three years in Iowa indicated that systems managed with a rye cover crop should apply 3.5 lb N ac^{-1} (3.9 kg N ha^{-1}) more than bare fallow systems (Basche et al. 2016). On the other hand, N rate trials in Wisconsin testing winter rye, triticale, and oat cover crops prior to sweet corn indicated that systems using cover crops required 29 lb N ac^{-1} (32.5 kg N ha^{-1}) less than bare fallow systems and that yields were 22 bu ac^{-1} (1.4 Mg ha^{-1}) higher under cover crops relative to bare fallow (Basche et al. 2016). Research from IL indicated that radish cover crops returned 91% of fall applied N as inorganic N compared to 66% for the control treatment and 57% for the winter rye treatment (Basche et al. 2016).

The PSU maize N fertilizer recommendation calculator assesses N rate changes due to cover cropping (https://extension.psu.edu/nitrogen-recommendations-for-corn). The model is sensitive to soil clay content. For intermediate to high clay soils, the model recommends additional N relative to rates under bare fallow. For sandier soils, cover crops (including non-legume cover crops) provide an N credit.

3.1.4 Cover crop management combined with no-till

Observations of no-till combined with cover crop management suggest this is a viable option in moist, cold regions. However, in many studies the data suggest that no-till management leads to a small yield decline, the combination of no-till and cover cropping does not increase this yield decline.

- In a long-term study in Indiana (Purdue University Agronomy Center for Research and Education, ACRE) from 2003-2011, Anderson et al. (2020) reported no difference in average yield for maize or soybean following the same N amendment rate (though N rate was not reported) across a comparison of conventional tillage (fall chisel plow and spring disk) to no-till or no-till and rye cover.

- Otte et al. (2019) compared no-till maize with and without a rye cover at the USDA Beltsville Agricultural Research Center in Maryland. N was applied at a rate of 56 kg N-UAN ha^{-1} at planting and side-dress of 112 kg N- UAN ha^{-1} in June. Their goal was to compare timing of rye termination. Early termination led to statistically similar yield to no-till without cover crop treatment in both experimental years; late termination resulted in a small maize grain yield decline in the first experimental year.

- Waring et al. (2020) compared cover crop and no-tillage management in Iowa maize-soybean rotations. Winter cereal rye was drill seeded into both no-till and chisel till plots in mid-October. Nitrogen side-dress was applied to maize in mid-June at a rate of 168 kg N ha^{-1} to all plots. Both no-till and cover crop (and combined no-till and cover crop) reduced nitrate leachate concentration a similar magnitude (25-35 % reduction). Soybean yield was similar across conventional-till, no-till, and cover cropped systems; maize yield was highest in the conventional-till, and statistically equivalent in no-till, conventional-till with cover crop, or no-till with cover crop systems.

- Another Indiana study at ACRE (Nevins et al. 2020) concluded that microbial enzyme activity during maize emergence through tassling indicated the possibility that N immobilization under cover cropping could reduce plant available N. This study demonstrated no yield impact on soybean yield for no-till compared to chisel plow, with or without rye cover. However, relative to the chisel plow and fallow system, no-till maize had lower yields as did cover crop on chisel plow; relative to chisel plow and fallow, no-till and no-till with cover crop had equivalent yield decline.

- Patel et al. (2019) tested tillage, cover crop, and starter N fertilizer effect on maize yield in Iowa. They concluded that maize-soybean rotations managed with cover crops had improved yield under tillage, but did not benefit from additional starter fertilizer. In this work management of a rye cover crop and tillage resulted in <1.5% yield decline in maize relative to tillage management without cover crop. The no-till system averaged a 3.1% yield decline with or without rye cover crop, this decline in yield was not improved by additional starter fertilizer.

3.1.5 Soil Health Gigaton cover crop N amendment accounting

The SHG methods require **N rate** to calculate changes in N_2O emission and change in net GHG emission due to fertilizer production. Because we expect that the typical Soil Health Gigaton method user may have information on the use of cover crops, but not the details of cover crop species and management, the SHG methods use default values for cover crop species. For continuous maize or maize-bean rotations, we assume non-legume cover crops to be cereal rye (or other similar winter-hardy cereal) and legume cover crops to be clover (using red clover as an example). Cover crops are not credited in wheat systems.

We cannot derive a standard N addition practice following cover cropping based on the reviewed literature. One could assume no additional N is added based on Extension recommendations (Basche 2016) and experimental results (Anderson et al. 2020; Otte et al. 2019; Patel et al. 2019). However, other N rate tools recommend additional N under certain circumstances, for example the PSU N rate calculator recommends applying additional N to maize following winter cover crop depending on soil texture. We based N addition for cash crop management (over that applied to the bare fallow system) on achieving the SON required to accumulate the SOC credited under cover crops as indicated below.

The default SOC accumulation rate under cover crop management is the average observed SOC accumulation from many experimental studies across disparate soil textures and climates. We assume this increase in SOC is associated with SOM of an average C:N ratio of 13.8 (from Table 1 in Cleveland and Liptzin 2007). To conserve N mass balance, we assume the N required to build this average annual SOM (ΔSON = 0.07 x ΔSOC) will be acquired either due to sufficient N surplus from the cash crop system, or by assuming additional inorganic N was added to the cropping system.

For legume systems we assume the SON necessary to achieve observed average SOC accumulation results from N-fixation. Because clover species are the most common legume cover crop, we derive default values assuming red clover is the species grown. We assume an average clover biomass of 1.87 Mg yr^{-1} (Poeplea and Don 2015) and 2.8% N (Phyllis2 database). We assume a farmer would reduce inorganic N fertilizer rate by (0.052 Mg N – ΔSON) in response to this legume N credit. We assume that in attaining this average biomass and %N, the legume adjusts its N-fixation rate depending on how much residual N is available during the cover crop growing season.

For non-legume cover crops, we apply the IPCC indirect N_2O equations (IPCC 2019, see section 3.5.2) to estimate N uptake due to cover crops. The N to support ΔSON accumulation under cover crop management is derived from residual N uptake by cover crops. For cover crops following a cash crop that receives inorganic N fertilizer (such as maize cash crop) we apply IPCC (2019) indirect equations as follows: in humid systems nitrate leaching potential is 24% of applied N and we assume cover crops take up 54% of this residual N on average (Woodbury et al. 2018). If N uptake cannot satisfy the N need for ΔSON accumulation, then we assume the farmer ads more inorganic N to accommodate SON accumulation.

For cover crops following an N-fixing cash crop (such as soybean cash crop), we apply IPCC (2019) crop residue equations to estimate potential N lost following soybean harvest and subsequent uptake of N by cover crops (see section 3.5.3 for equations). In humid systems nitrate leaching potential is 24% of crop residue N (IPCC 2019) and we assume cover crops take up 54% of this residual N on average (Woodbury et al. 2018). If N uptake cannot satisfy the N need for ΔSON accumulation, then we assume the farmer ads more inorganic N to accommodate SON accumulation.

3.2 N fertilizer management with no-till and reduced-till

3.2.1 Fertilizer N rate changes to cash crop management

Increased N application may be recommended with no-till management. Reasons for increased N recommendation include: 1) for coarser soils, increased moisture due to no-till may lead to increased crop yield, and 2) increased SOC due to no-till results in more SON stored in the soil. Long-term studies of dryland wheat systems suggest increased N rate for 15 years may be needed to off-set crop yield decline (McConkey et al. 2002) due to N needed for SOM accumulation.

Reducing tillage can reduce the mixing of plant available nutrients throughout the root zone, leading to nutrient stratification and different plant rooting patterns (Beegle 1996; Dinkins et al. 2014). Furthermore, surface application of urea in no-till systems is inefficient as it can lead to high N loss through volatilization (Beegle 1996; Dinkins et al. 2014). Subsurface fertilizer injection can both reduce N losses to volatilization as well as potential N immobilization by decomposing residue (Beegle 1996; Dinkins et al. 2014).

A review of N dynamics under no-till management using ^{15}N tracer studies concluded that no-till had little impact on ^{15}N fertilizer recovery or the mineralization of 'native' soil organic matter (Smith and Chalk 2019). There was no consistent pattern of tillage effect on gross or net N mineralization and immobilization (Smith and Chalk 2019). These tracer studies were predominantly conducted on wheat and maize cropping systems, but also included barley, sorghum, and cotton systems.

Application of an N-optimization modeling tool (Adapt-N) recommended an increased N rate of 10 kg N ha^{-1} for no-till vs plow-till (181 vs 171 kg N ha^{-1}, respectively) in moist maize systems in NY (van Es et al. 2020).

Long-term studies of tillage demonstrate that optimal N rate (and the yield-benefit of no-till) shows large variation depending on weather. A long-term (30-year) study of maize tillage management in Nebraska demonstrated that in dry and normal years, no-till fields had higher yields than disked or plowed fields, and no-till had an optimum N rate of 120 kg N ha^{-1} (no benefit was observed for the highest 160 kg N ha^{-1} rate tested (Shekhar and Shapiro 2019). In wet years, the plowed or disked fields had highest yield, and optimum N rate was calculated as 150 kg N ha^{-1} for maize-soybean and 220 kg N ha^{-1} for continuous maize systems (Shekhar and Shapiro 2019).

Montana Extension provides an N rate calculator for adjusting N rate based on stubble calculations. Prior season grain is used to estimate crop biomass, and therefore stubble remaining, with 10 lb N/1000 lb stubble (4.5 kg N / 454 kg stubble) recommended, up to 40 lb N ac^{-1} (45 kg N ha^{-1}) (Dinkins et al. 2014).

3.2.2 Soil Health Gigaton no-till and reduced-till fertilizer N accounting

No-till has been broadly adopted in dryland systems. University of Missouri Extension promotes no-till for increased yields due to reduce soil erosion, decreased water runoff, reduced fuel costs, and reduce management time. Montana is predominantly under no-till management (64 %), with remaining croplands split between minimum till (16 %) and conventional tillage (18 %) (Dinkins et al. 2014). We expect no-till or reduced till management to be more common in dryland wheat systems due to the need to prevent soil erosion. In humid maize systems, the combined practice of no-till and cover cropping is promoted, but these soil health practices have limited adoption.

As in cover crop systems, we cannot define a standard change in cash crop N management practice due to no-till or reduce tillage. Similar to cover crop systems, the anticipated SOM increase due to no-till or reduced till management results in more N remaining in the soil. Recent studies in humid, tile-drained Corn Belt regions indicate that no-till has similar capacity to cover crops for reducing nitrate leaching following harvest (Waring et al. 2020). The ability of no-till systems to reduce nitrate leaching suggests that in rainfed systems N accumulation in SOM can be attained from avoided nitrate leaching of excess N following crop harvest. This is also supported by studies that found conventional till and no-till maize had comparable yields (Anderson et al. 2020; Otte et al. 2019). Though reviews of crop yield found that both short-term (Tolliver et al. 2012) and long-term (Daigh et al. 2018) no-till management in maize systems resulted in reduced yields, N rate experiments indicated that when yield decline is present in no-till humid maize systems, additional N fertilizer does not reliably eliminate the yield reduction (Patel et al. 2019).

In dryland agriculture observations suggest that additional N application is beneficial to offset yield decline during the initial high rate of SOM accumulation (McConkey et al. 2002). In dryland agricultural states with widespread no-till adoption, N rate calculators are promoted to calculate N required to offset immobilization in no-till stubble (Dinkins et al. 2014).

We define default farmer practice as no additional N applied in no-till or reduce-till systems if the system N balance can meet the N required to support annual SOM accumulation. As for cover crop systems, we assume the observed average increase in SOC due to tillage management is associated with SOM of an average C:N ratio of 13.8 (from Table 1 in Cleveland and Liptzin 2007). To conserve N mass balance, we assume the N required to build this average annual SOM will be acquired either due to sufficient N surplus from the cash crop system, or by assuming additional N was added to the cropping system. As in cover crop systems, following a cash crop that received N fertilizer we apply the IPCC indirect N_2O equations (IPCC 2019, see section 3.5.2) to estimate nitrate leaching as 24% of N applied in humid systems. Following an N-fixing cash crop we apply the IPCC 2019 crop residue equations and indirect leaching equations (see section 3.5.3), with leaching estimated as 24% of crop residue N. Based on Waring et al (2020) we assume that no-till can reduce nitrate leaching by 25% and reduced-till by 12.5%. If residual N uptake is insufficient to account for the SOM increase assumed under no-till, then we assume the N difference is added during cash crop management.

3.3 N fertilizer optimization

3.3.1 Observed benefits of N fertilizer optimization techniques

Variable rate N application: Precision agriculture, sensor technologies, and N reference plots

A variety of low-tech and technology-based methods exist to tailor N rate recommendations during the crop growing season to optimize NUE and reduce excess N application. One low-tech method requires a farmer to manage small reference plots or strips with varying rates of N, with these reference areas being used to compare the sufficiency of a given N rate for crop need. In the simplest case, a farmer looks at crop greenness (or biomass) and chooses the lowest N application rate at which no visual difference is noticed between the rate and the higher N rates. A more complex approach uses the same N reference areas, but includes the use of hand-held sensors to distinguish crop greenness. More complex variable rate N methods use equipment-mounted sensors to spatially vary N rate combined with side-dress N application based on crop growth to temporally vary N rate. Corti et al. (2018) reviewed the use of sensors in crop management and concluded that passive sensors averaged $R^2 = 0.49$, active sensors averaged $R^2 = 0.63$, overall sensors averaged $R^2 = 0.56$ in comparison of crop spectral properties to optimum N rate. This result indicates current sensor technologies have moderate ability to accurately predict crop N needs.

Thirty-year N rate trials in Oklahoma demonstrated high variation in optimal N rate, ranging from 0 to >140 kg N ha^{-1}, with an average deviation between average and annual optimal N rate of 44 kg N ha^{-1} (Girma et al. 2007). Given the large annual change in wheat growth potential, there is large potential to improve fertilizer N rate beyond the common practice of field-averaged N rate recommendations. Trials using reference N rate methods demonstrated that visual assessment reduced N rate by at least 40 kg N ha^{-1} and sensor-based assessment reduce N rate by at least 60 kg N ha^{-1}, relative to farmer practice and maintained yields (Girma et al. 2007). These trials indicate that significant reduction in N rate is accessible to all scales of farming.

Similarly, in on-farm N rate trials for winter wheat in Oklahoma, Butchee et al. (2011) found sensor-based N rate management reduced N application by 20.2 lbs N ac^{-1} (or -34.6 %, 22.6 kg N ha^{-1}) on average.

Scharf et al. (2011) found sensor-based N rates led to average reductions of 16 kg N ha^{-1} (or 8.2 %) for on-farm maize trials on 55 sites in Missouri from 2004-2008. They indicated that sensor-based N management was most effective if fields received limited (<75 kg N ha^{-1}) of N amendment prior to planting. Fields that met this condition had an average of 24 kg N ha^{-1} reduction in total N rate. In periods when N rate was reduced, yield was not affected. In the relatively moist year (2008) the sensor-based management recommended additional N for many sites, but this was justified as additional N resulted in an average of 526 kg ha^{-1} increase in yields.

Using outcomes summarized in a review of sensor-based N rate trials (Colaço and Bramley 2018), we estimate mean reduction in N rate of 13% for maize and 26% for wheat for in-season sensor-based N rate application, relative to farmer practice. Values are derived by weighting the average value reported for each study by the number of trials in a study. The total number of trial sites was 91 (maize) and 129 (wheat)] This decrease in N rate has resulted in a weighted average increase in yield of 1.1% for maize and 1.8% for wheat, as well as a weighted increase in Partial Factor Productivity (PFP = kg yield per kg N applied) of 22% for maize and 40% for wheat.

Interactions between N rate and timing

In Ottawa maize field trials Ma et al. (2014) observed NUE response to canopy-reflectance-based N rate and N timing; they concluded that increased NUE resulted from applying N as side-dressing. In these trials, reduced N fertilization as 1) side-dress management (80kg N ha^{-1}) and 2) pre-plant (30 kgN ha^{-1}) plus side-dress (80 kgN ha^{-1}) had the same yields as fields managed as pre-plant fertilized system (at 180 kg N ha^{-1}), indicating side-dress management can reduce N rate by 70 kg N $ha.^{-1}$

Model-based N optimization using real time data

Adapt-N is one example of field-calibrated modeling tools that use management information and real-time weather data to predict N crop needs. Adapt-N has been broadly tested for application in U.S. maize systems. These field trials can be used to quantify average N rate benefits of model-based N optimization.

Specific results from Adapt-N field trials include:

1) Adapt-N field evaluation in NY and Iowa from 2011-2014 recommended on average 45 kg N ha^{-1} lower application compared to conventional grower practice (Sela et al. 2016).

2) Adapt-N trials in grain maize and silage maize across IA, IN, WI, OH, NY, ME, and NC demonstrated an average of 32% reduction in N rate recommended by Adapt-N relative to farmer practice with no impact on yield (Sela et al. 2018b).

3) Adapt-N nitrogen rate trials in IN (12 trials), OH (1 trial), and WI (3 trials) during 2013-14 growing seasons resulted in an average 13% reduction in N rate relative to MRTN N rate calculations while maintaining maize yield (Sela et al. 2018a).

4) Adapt-N trials in NY comparing no-till and plow-till on clay loam and loamy sand showed average N rate reduction of 66 kg N ha^{-1} (-46%) for Adapt-N relative to NY CNC tool (van Es et al. 2020).

Adapt-N trials have repeatedly demonstrated the ability to optimize N rate relative to baseline grower practice. Based on Adapt-N field trials, a low-end average estimate of 13% reduction in N rate (or a high-end estimate of 32% N rate reduction) could be applied as an N optimization credit for use of model-based N optimization tools. Because Adapt-N is a tool for optimizing side-dress N rates, it may represent a combination of improved timing and reduced rate compared to conventional practice.

3.3.2 Default N rate reduction for N optimization in the SHG method

Based on peer-reviewed N optimization observations, we recommend crediting a default N rate reduction for a few well-studied techniques as follows:

- N optimization using variable rate technology (VRT) methods results in an average N rate reduction of:
    - 13% in maize systems (Colaço and Bramley 2018)
    - 26% in wheat systems (Colaço and Bramley 2018)
- N optimization using models coupled to real-time data (such as Adapt-N) results in an average N rate reduction of 13% (Sela et al. 2018a).
- Improved N fertilizer timing reduces N rate by 9% (Eagle et al. 2012).

3.3.3 Additional N optimization practices

To receive further N optimization reduction credits a user must provide N rate and yield information when applying the Soil Health Gigaton method.

3.4 Emissions from fertilizer production

Reduction or increase of N fertilizer rate is converted to CO_{2e} for net GHG accounting as described above in Section 2.4.

3.5 N_2O from fertilizer application

3.5.1 Direct N_2O emissions

Nitrous oxide emissions are estimated based on the rate of N applied to maize and wheat systems. In rainfed maize systems we calculate N_2O emission using the N-rate equation described in Tonitto et al. (2020, supplement). This model was developed using rainfed maize data from the U.S. and Canada, including N rate and soil texture as fixed effects. This model analysis demonstrated that clay explained a large amount of observed variation in N_2O emission. Equation 1 and Figure 1 demonstrate the relationship between N rate, soil texture, and predicted N_2O emission.

Equation 1:

N_2O flux (kg N/ha) = 1.1280 - 0.00000007602 × N rate (kg N/ha) + 0.6678 × clay proportion + 0.05368 × N rate × clay proportion

To calculate the change in N_2O flux resulting from a change in N fertilizer rate, we assume the N-rate coefficient is negligible and derive the change in N_2O flux from the interaction term as follows (Equation 2).

Equation 2:

Δ N_2O flux (kg N / ha) = 0.054 x ΔN rate (kg N / ha) x clay proportion

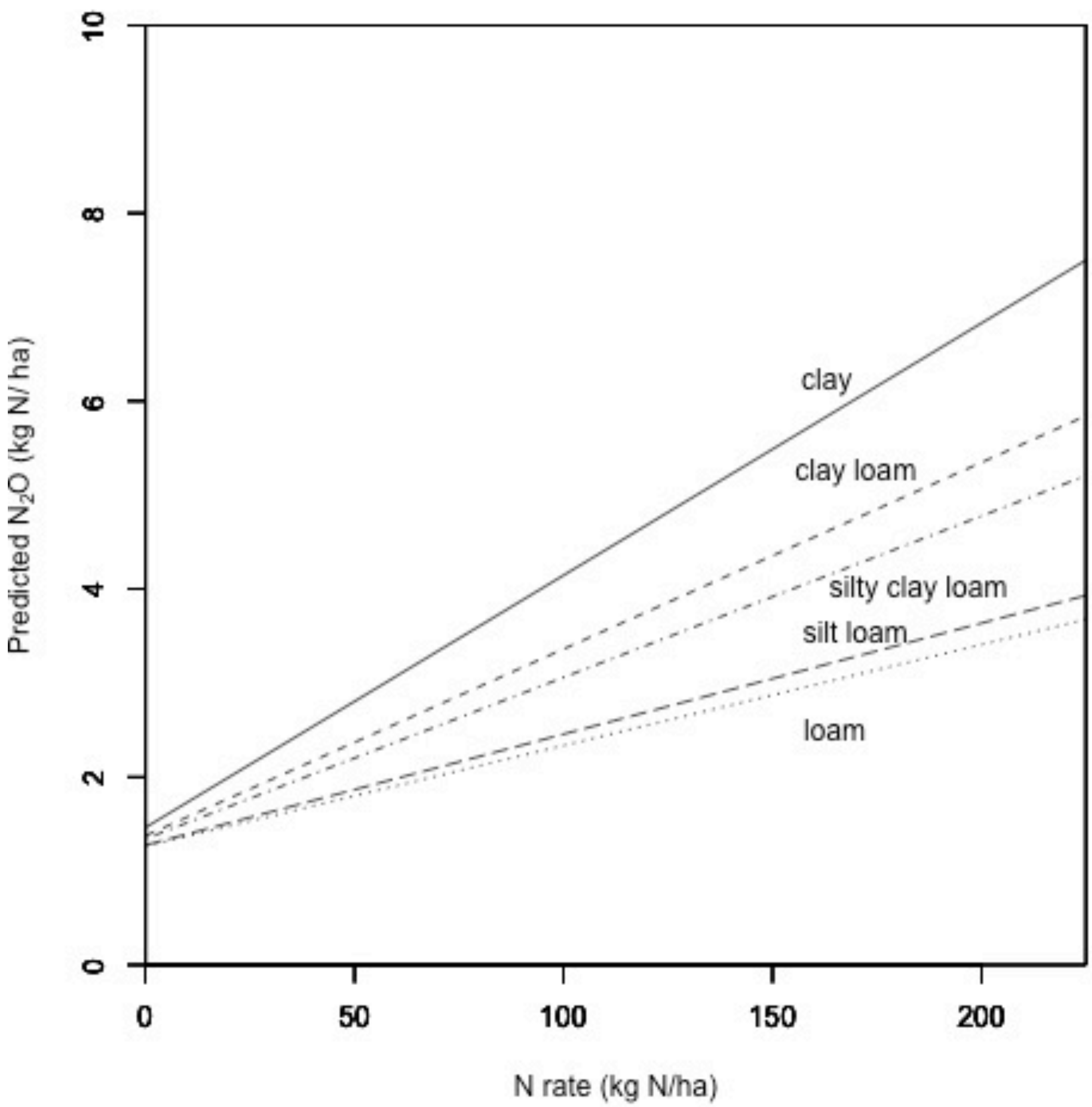

Figure 1. Modeled area-scaled N_2O emission (kg N-N_2O / ha) across gradients of N rate (kg N / ha), presented for soil textural classes observed in the data set. The maize N_2O emission equation is applied using the mean clay proportion in the U.S. Corn Belt for each soil textural class (0.20, 0.22, 0.32, 0.37, and 0.50 for loam, silt loam, silty clay loam, clay loam, and clay soils, respectively).

For wheat systems and dryland maize we use IPCC N_2O accounting methods (IPCC 2019; Hergoualc'h et al. 2019). The 2019 IPCC revision applies direct N_2O EF values: 1) EF_{dry} = 0.005 for all N input in dry climates, 2) EF_{wet} = 0.016 for synthetic fertilizer in wet systems, and 3) EF_{wet_other} = 0.006 for other N inputs in wet climates. In the SHG method we assess N_2O emissions resulting from a change in fertilizer N inputs or organic N inputs due to soil heath management practices.

Equation 3. Application of IPCC direct N_2O emission equations (Eq. 11.1 and 11.2 in Hergoualc'h et al. 2019)

$N_2O\text{-}N_{direct}$ (kg N_2O-N yr^{-1}) = [$N_{fertilizer}$ + $N_{organic}$ + $N_{crop\ residue}$ + N_{SOM}] x EF_1

For:

$N_2O\text{-}N_{direct}$ (kg N_2O-N yr^{-1}) = annual direct N_2O-N produced from agricultural soils.

$N_{fertilizer}$ (kg N yr^{-1}) = annual synthetic fertilizer N application

$N_{organic}$ (kg N yr^{-1}) = organic N additions including animal manure, compost, sewer sludge

$N_{crop\ residue}$ (kg N yr^{-1}) = annual return of N in crop residues (above- and below-ground)

N_{SOM} (kg N yr^{-1}) = annual N mineralized from loss of SOC due to land use change or management

EF_1 (kg N_2O-N / kg N inputs) = emission factor for N_2O emissions from N inputs

N_2O_{direct} = $N_2O\text{-}N_{direct}$ x 44/28

Table 1. IPCC direct N_2O EF values (see Table 11.1 in Hergoualc'h et al. 2019)

Parameter	Disaggregated	value
EF1	default	0.01
	wet climate, synthetic N	0.016
	wet climate, other N	0.006
	dry climate, all N	0.005

3.5.2 Indirect N_2O emissions

Indirect N_2O emissions in maize and wheat cropping systems are estimated using IPCC methods (2019; Hergoualc'h et al. 2019).

We calculate indirect emissions resulting from inorganic N fertilization and changes in organic N additions resulting from soil health practices. Indirect N_2O includes emissions resulting from N volatilization (IPCC 2019; Hergoualc'h et al. 2019, Equation 11.9, 11.11) and N loss as nitrate leaching and runoff (IPCC 2019; Hergoualc'h et al. 2019, Equation 11.10).

The 2019 IPCC revision applies indirect N_2O EF values: 1) EF_{dry} = 0.005 for volatilized synthetic N fertilizer in dry climates, 2) EF_{wet} = 0.014 for volatilized synthetic N fertilizer in wet climates, and 3) $EF_{leachate}$ = 0.011 for nitrate leachate. Rate of volatilization for synthetic gas is defined as: 1) $Frac_{GASF}$ = 0.11 for any unknown N fertilizer type, 2) $Frac_{GASF}$ = 0.15 for urea, 3) $Frac_{GASF}$ = 0.08 for ammonium-based fertilizer, 4) $Frac_{GASF}$ = 0.01 for nitrate-based fertilizer, and $Frac_{GASF}$ = 0.05 for ammonium-nitrate based fertilizer. Based on the distribution of N fertilizer type used in Fargione et al. (2018, Table 2) we apply a weighted average $Frac_{GASF}$ = 0.11. Rate of leaching is assumed to be zero in dry climates, $Frac_{LEACH}$ = 0.24 in wet systems (IPCC 2019). Substantial evidence demonstrates that cover crops reduce nitrate leaching (e.g. Tonitto et al. 2006; Waring et al. 2020; Woodbury et al. 2018), we reduce $Frac_{LEACH}$ by 54% in in cover cropping systems based on a review of observed reductions under cereal rye in U.S. cropping systems (Woodbury et al. 2018). Based on recent evidence that no-till reduced nitrate leaching in tile-drained maize systems (Waring et al. 2020), we reduce $Frac_{LEACH}$ by 25% in no-till systems and 12.5% in reduced-till systems.

Table 2. Distribution of N fertilizer type used in U.S. cropping systems (developed for Fargione et al. 2018).

Type	Current N fertilizer use
Anhydrous ammonia	31.03%
Aqueous ammonia	0.28%
Ammonium nitrate	2.76%
Urea	27.06%
Urea-ammonium nitrate	30.75%
Ammonium sulfate	2.83%
Other	5.29%

Equation 4. Indirect N_2O resulting from volatilization, applying IPCC volatilization Eq 11.9 (Hergoualc'h et al. 2019)

$N_2O\text{-}N_{volatilization}$ (kg N_2O-N yr^{-1})= $[N_{fertilizer} \times Frac_{GASF} + N_{organic} \times Frac_{GASM}] \times EF_4$

For:

$N_2O\text{-}N_{volatilization}$ (kg N_2O-N yr^{-1}) = annual N_2O-N produced from atmospheric deposition of N volatilized from agricultural soils.

$N_{fertilizer}$ (kg N yr^{-1}) = annual synthetic fertilizer N application

$N_{organic}$ (kg N yr^{-1}) = organic N additions including animal manure, compost, sewer sludge

$Frac_{GASF}$ = fraction of synthetic fertilizer N that volatilizes to NH_3 and NO_x (kg N volatilized / kg N addition)

$Frac_{GASM}$ = fraction of organic N that volatilizes to NH_3 and NO_x (kg N volatilized / kg N addition)

EF_4 (kg N_2O-N / kg NH_3-N + kg NO_x-N volatilized) = emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces.

$N_2O_{volatilization} = N_2O\text{-}N_{volatilization} \times 44/28$

Equation 5. Indirect N_2O resulting from leaching, applying IPCC leaching 11.10 (Hergoualc'h et al. 2019)

$N_2O\text{-}N_{leaching} = (N_{fertilizer} + N_{organic} + N_{crop\ residue} + N_{SOM}) \times Frac_{Leach\text{-}H} \times EF_5$

For:

$N_2O\text{-}N_{leaching}$ (kg N_2O-N yr^{-1}) = annual N_2O-N produced from N lost through leaching or runoff from agricultural soils.

$N_{fertilizer}$ (kg N yr^{-1}) = annual synthetic fertilizer N application.

$N_{organic}$ (kg N yr^{-1}) = annual organic N additions including animal manure, compost, sewer sludge.

$N_{crop\ residue}$ (kg N yr^{-1}) = annual return of N in crop residues (above- and below-ground) in regions where leaching or runoff occur.

N_{SOM} (kg N yr^{-1}) = annual N mineralized from loss of SOC due to land use change or management in regions where leaching or runoff occur.

$Frac_{Leach\text{-}H}$ = fraction of N addition or N mineralized that is lost through leaching or runoff in kg N / kg N additions.

EF_5 (kg N2O-N / kg N addition) = emission factor for N_2O emissions from N lost through leaching or runoff.

$N_2O_{leaching} = N_2O\text{-}N_{leaching} \times 44/28$

Table 3. IPCC indirect parameter values (see Table 11.3 in Hergoualc'h et al. 2019)

Parameter	Disaggregated	value
EF4	default	0.01
EF4	wet climate	0.014
EF4	dry climate	0.005
EF5	default	0.011
$Frac_{GASF}$	Default	0.11
	Urea	0.15
	Ammonium-based	0.08
	Nitrate-based	0.01
	Ammonium-nitrate-based	0.05
$Frac_{GASM}$		0.21
$Frac_{Leach\text{-}H}$	wet climate	0.24
	dry climate	0

3.5.3 Calculating N-fixing cash crop residue N

In order to estimate N uptake following N-fixing cash crops (such as soybeans), we apply the IPCC crop residue methods (IPCC 2019) to estimate residue N (Equation 6) and subsequent leaching potential (Table 6). Cover crops are estimated to take up 54% of leachable N (Woodbury et al. 2018), no-till is estimated to take up 25% of leachable N (Waring et al. 2020), and reduced-till is estimated to take up12.5% of leachable N.

As an example, for an average soybean yield of 3220 kg ha^{-1}, the IPCC 2019 crop residue equations estimate 63 kg N ha^{-1} in total residues, resulting in 15 kg N ha^{-1} in potential N leaching. Therefore, in humid systems we estimate and average N uptake of 8.1 kg N per ha for cover crops, 3.8 kg N per ha for no-till, and 1.9 kg N per ha for reduced-till (Table 6).

Equation 6. Crop residue N estimated from applying IPCC 2019 (see Eq 11.6 and 11.7 in Hergoualc'h et al. 2019)

$F_{cr} = AGR \times N_{AG} \times (1 - Frac_{Removed}) + BGR \times N_{BG}$

$AGR = AG_{DM} \times Area$
$BGR = (Crop + AG_{DM}) \times RS \times Area$
$AG_{DM} = Crop \times R_{AG}$
Crop (kg dry matter ha^{-1}) = Yield x DRY

For:

F_{cr} (kg N yr^{-1}) = annual N in crop residue (above and below ground)
AGR (kg dry matter yr^{-1}) = annual total aboveground crop residue
BGR = annual total belowground residue (kg dry matter yr^{-1})

$Frac_{Remove}$ = annual fraction of aboveground residue of crop removed
N_{AG} = N content of aboveground crop residue (kg N kg^{-1} dry matter)
N_{BG} = N content of belowground crop residue (kg N kg^{-1} dry matter)
RS = ratio of belowground root biomass to aboveground shoot biomass for crop (kg dry matter per ha / kg dry matter per ha)

AG_{DM} (kg ha^{-1}) = aboveground residue dry matter
R_{AG} = ratio of aboveground residue dry matter to harvested yield for crop (AG kg dry matter per ha / kg crop dm per ha)

Crop = harvested annual dry matter yield (kg dry matter ha^{-1})
Yield = harvested fresh yield (kg fresh mass ha^{-1})
DRY = dry matter fraction of harvested crop (kg dry matter per kg fresh weight)

Area = harvested area (ha yr^{-1})

Table 4. IPCC crop residue parameters for soybean (see Table 11.1A in Hergoualc'h et al. 2019)

Parameter	Description	Value
N_{AG}	N content above ground (AG) residue	0.008
N_{BG}	N content below ground (BG) residue	0.008
$Frac_{Remove}$	Fraction of AG residue removed	0
R_{AG}	Ratio AG residue dry matter : harvested yield	2.1
RS	Ratio BG biomass : AG biomass	0.19
DRY	Dry mater fraction of harvest product	0.91

Table 5. IPCC crop residue equations applied to soybean

Parameter	Soybean values	Units
Yield	3220	kg fresh/ha
Crop DM	2930	kg dry /ha
AG DM	6153	kg AG /ha
BGR	1726	kg BG / ha
Ncr	63	kg N /ha

Table 6. Potential leaching and N uptake following soybean harvest based on IPCC crop residue estimates

N loss and uptake potential	Rate (kg per ha)
Soybean residue N leaching	15
Cover crop N uptake	8.1
No-till N uptake	3.8
Reduced-till N uptake	1.9

3.5.4 N-fixation observations

N fixation was studied using ^{15}N tracers on deep fertile soil profiles with shallow water tables in Iowa. Córdova et al. (2019) reported:

1) Soybean biological N fixation (BNF) averaged 45% of the total aboveground N accumulation, ranging from 23-65%.
2) Soybean N-fixation can supply up to 3 kg N/ha/day while soil inorganic N supplied up to 4.6 kg N /ha/day in Iowa cropping systems.
3) BNF can be estimated from biomass accumulation. Soil inorganic N or moisture was not as useful for predicting BNF.
4) On average soybean BNF resulted in 0.013 kg N / kg biomass produced.

References

Anderson AE, Hammac WA, Stott DE, Tyner WE (2020) An analysis of yield variation under soil conservation practices. J Soil Water Conserv 75:103–111. doi: 10.2489/jswc.75.1.103

Basche A., Roesch-McNally G., Clay R., and Miguez F (2016) Answering common producer questions on cover crop use in Iowa. Iowa State University Extension and Outreach. CROP 3104 June 2016. (Accessed June 3, 2020, https://store.extension.iastate.edu/Product/Iowa-Cover-Crop-Resource-Guide)

Beegle D (1996) Nutrient management in convservation tillage systems. The Pennsylvania State University. (Accessed June 3, 2020, https://extension.psu.edu/nutrient-management-in-conservation-tillage-systems)

Butchee K, Arnall B (2011) Sensor based nitrogen management reduced nitrogen and maintained yield crop management. Crop Manag 25 July: doi: 10.1094/CM-2011-0725-01-RS

Cleveland CC, Liptzin D (2007) C : N : P stoichiometry in soil : is there a'" Redfield ratio"' for the microbial biomass? Biogeochemistry 85:235–252. doi: 10.1007/s10533-007-9132-0

Colaço AF, Bramley RG V (2018) Do crop sensors promote improved nitrogen management in grain crops? F Crop Res 218:126–140. doi: 10.1016/j.fcr.2018.01.007

Córdova SC, Castellano MJ, Dietzel R, et al (2019) Soybean nitrogen fixation dynamics in Iowa, USA. F Crop Res 236:165–176. doi: 10.1016/j.fcr.2019.03.018

Corti M, Cavalli D, Cabassi G, et al (2018) Does remote and proximal optical sensing successfully estimate maize variables ? A review. Eur J Agron 99:37–50. doi: 10.1016/j.eja.2018.06.008

Daigh ALM, Dick WA, Helmers MJ, et al (2018) Yields and yield stability of no-till and chisel-plow fields in the Midwestern US Corn Belt. F Crop Res 218:243–253. doi: 10.1016/j.fcr.2017.04.002

Dinkins CP, Jones C, McVay K, Olson-Rutz K (2014) Nutrient management in no-till and minimum till systems.Montana State University Extension. EB0182. (Accessed June 3, 2020, http://landresources.montana.edu/soilfertility/documents/PDF/pub/No-tillNutMgtEB0182.pdf)

Eagle A, Olander L, Henry LR, et al (2012) Greenhouse gas mitigation potential of agricultural land management in the United States A synthesis of the literature. Durham, NC

Fargione JE, Bassett S, Boucher T, et al (2018) Natural climate solutions for the United States. Sci Adv 4:eaat1869. doi: 10.1126/sciadv.aat1869

Girma K, Mack C, Taylor R, et al (2007) Improving estimation of N top-dressing by addressing temporal variability in winter wheat. J Agric Sci 145:45–53. doi: 10.1017/S0021859606006708

Hergoualc'h K, Akiyama H, Bernoux M, et al (2019) Volume 4, Chapter 11, N2O emissions from management soils, and CO2 emissions from lime and urea application. In: Calvo Buendia E, Tanabe K, Kranjc A, et al. (eds) Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Intergovernmental Panel on Climate Change, pp 1–48

IPCC 2019 (2019) Refinement to the 2006 IPCC guidelines for national greenhouse gas inventories, Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize, S., Osako, A., Pyrozhenko, Y., Shermanau, P. and Federici, S. (eds). Published: IPCC, Switzerland.

Kaspar T and Licht M. (2020) Post corn silage, going to soybean: use cereal rye. Iowa State University Extension and Outreach. CROP 3166. MCCC-122. (Accessed June 3, 2020, https://store.extension.iastate.edu/product/Post-Corn-Silage-Going-to-Soybean-Use-Cereal-Rye)

Ma B, Wu T, Shang J (2014) On-farm comparison of variable rates of nitrogen with uniform application to maize on canopy reflectance, soil nitrate, and grain yield. J Plant Nutr Soil Sci 177:216–226. doi: 10.1002/jpln.201200338

McConkey BG, Curtin D, Campbell CA, et al (2002) Crop and soil nitrogen status of tilled and no-tillage systems in semiarid regions of Saskatchewan. Can J Soil Sci 82:489–498. doi: 10.4141/S01-036

Nevins CJ, Lacey C, Armstrong S (2020) The synchrony of cover crop decomposition , enzyme activity , and nitrogen availability in a corn agroecosystem in the Midwest United States. Soil Tillage Res 197:104518. doi: 10.1016/j.still.2019.104518

Otte B, Mirsky S, Schomberg H, et al (2019) Effect of cover Crop termination timing on pools and fluxes of inorganic nitrogen in no-till corn. Agron J 111:2832–2842. doi: 10.2134/agronj2018.10.0699

Patel S, Sawyer JE, Lundvall JP (2019) Can management practices enhance corn productivity in a rye cover crop system? Agron J 111:3161–3171. doi: 10.2134/agronj2019.03.0158

Phyllis2, database for (treated) biomass, algae, feedstocks for biogas production and biochar, https://phyllis.nl/

Pittelkow CM, Linquist BA, Lundy ME, et al (2015) When does no-till yield more? A global meta-analysis. F Crop Res 183:156–168. doi: 10.1016/j.fcr.2015.07.020

Poeplau C, Don A (2015) Carbon sequestration in agricultural soils via cultivation of cover crops – A meta-analysis. Agric Ecosyst Environ 200:33–41. doi: 10.1016/j.agee.2014.10.024

Scharf PC, Shannon DK, Palm HL, et al (2011) Sensor-based nitrogen applications out-per- formed producer-chosen rates for corn in on-farm demonstrations. Agron J 103:1683–1691. doi: 10.2134/agronj2011.0164

Sela S, Es HM Van, Moebius-clune BN, et al (2018a) Dynamic model-based recommendations increase the precision and sustainability of N fertilization in midwestern US maize production. Comput Electron Agric 153:256–265. doi: 10.1016/j.compag.2018.08.010

Sela S, Woodbury PB, van Es HM (2018b) Dynamic model-based N management reduces surplus nitrogen and improves the environmental performance of corn production. Environ Res Lett 13:054010. doi: 10.1088/1748-9326/aab908

Sela S, Es HM van, Moebius-Clune BN, et al (2016) Adapt-N outperforms grower-selected nitrogen rates in Northeast and Midwestern United States strip trials. Agron J 108:1726–1734. doi: 10.2134/agronj2015.0606

Shekhar A, Shapiro CA (2019) What do meteorological indices tell us about a long-term tillage study? Soil Tillage Res 193:161–170. doi: 10.1016/j.still.2019.06.004

Smith CJ, Chalk PM (2020) The role of ^{15}N in tracing N dynamics in agro-ecosystems under alternative systems of tillage management: A review. Soil Tillage Res 197:104496. doi: 10.1016/j.still.2019.104496

Toliver DK, Larson JA, Roberts RK, et al (2012) Effects of no-till on yields as influenced by crop and environmental factors. Agron J 104:530–541. doi: 10.2134/agronj2011.0291

Tonitto C, David MB, Drinkwater LE (2006) Replacing bare fallows with cover crops in fertilizer-intensive cropping systems: A meta-analysis of crop yield and N dynamics. Agric Ecosyst Environ 112:58–72. doi: 10.1016/j.agee.2005.07.003

Tonitto C, Woodbury PB, Carter E (2020). Predicting greenhouse gas benefits of improved nitrogen management in North American maize. J of Environ Qual.

van Es H, Ristow A, Nunes MR, et al (2020) Nitrate leaching reduced with Dynamic-Adaptive nitrogen management under contrasting soils and tillage. Soil Sci Soc Am J 84:220–231. doi: 10.1002/saj2.20031

Waring ER, Lagzdins A, Pederson C, Helmers MJ (2020) Influence of no-till and a winter rye cover crop on nitrate losses from tile-drained row-crop agriculture in Iowa. J Environ Qual 49:292–303. doi: 10.1002/jeq2.20056

Woodbury PB, Kemanian AR, Jacobson M, Langholtz M (2018) Improving water quality in the Chesapeake Bay using payments for ecosystem services for perennial biomass for bioenergy and biofuel production. Biomass and Bioenergy 114:132–142. doi: 10.1016/j.biombioe.2017.01.024