Miller\_WEPP\_Documentation

File Sourcing

Short Guide

**Watershed shapefiles** were from Tim Youngquist.

**Digital Elevation Maps** were from Brian Gelder.

**Slope File Creation:**

Use Create Steepest Path tool to find path of water droplets from various points at high points of watershed. Use the Interpolate Line tool to approximate the path of a water droplet, making sure it is not directly in the gully and also always has a decreasing slope.

Export the resulting graph into a csv format and calculate the slope between each point, with a maximum of 50 points no fewer than 5 m apart to avoid anomalies that come from over-parametrization.

**Soil Data** was from the SSURGO database.

**Soil Profile Creation:**

Approximate length of each soil type in ArcGIS. Create corresponding segments in your WEPP hillslope profile.

**Climate data** were from Daryl Herzmann from the DEP.

Search for the climate file through WEPP user interface and select it. Make sure desired number of years is selected, and the desired outputs.

**Management data:** Use default for the crop you are using unless you have specific information for the farms. Use site-specific data if possible. If using a crop rotation file, make sure the cycle of the rotation starts on the correct year corresponding to what was actually planted.

**Prairie** type: I used “Good” quality KS bluestem. Certain parameters are critical in sedimentation predictions. I have included a summary of my parameters used below. The number 136 for Darcy-Weisbach comes from Weltz et al., 1992. I calibrated BEINP such that annual prairie plant output matched predictions from Kordbacheh in the STRIPS Landowner Report, which in this case was 16. More on this can be found in the Appendix D of my thesis. If you recalculate this parameter, make sure that when you sum the average total biomass coming off the field every year that you are only counting the biomass grown on the prairie sections of the hillslope. Use a long simulation (~100 years) and discard the first five years from your simulation.

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| **Parameter** | **Assumption/Recommendation** |
| Darcy–Weisbach Minimum Friction Factor (Prairie) | 136. The model is highly sensitive to this parameter. |
| BEINP (Prairie) | 16 kg/MJ for established strips. The model is moderately sensitive to this parameter. |
| Base Daily Air Temperature (Prairie) | 4.4°F |
| Prairie Land Cover Template File | Bluestem Prairie, good condition (KS) |
| Plant Spacing (Prairie) | Not a driving parameter. This study uses a spacing of 0.5 cm. |
| Crop rotation | Make sure the corn-soybean rotation starts on the proper year |
| Slope file | Use Interpolate Line in the ArcGIS Spatial Analyst toolbox to generate a representative profile (not a gully). Points in SLP file should be no closer than 5 m apart. |
| Climate | Use real climate data |
| Soil | Use SSURGO soil data, approximate in ArcGIS |
| Land cover | Use watershed polygons if available, approximate length in ArcGIS |
| Snow Melt | Potentially underpredicted for Year 1 |

More Detail:

Slope:

The resolution of slope data can have a large influence on WEPP estimates (Moore et al. 2007). I used high-resolution elevation shapefiles for major Iowa watershed basins from Brian Gelder,[[1]](#footnote-1) which I converted into one-dimensional slope profiles for each site by creating a representative flowpath. I used the Create Steepest Path tool in the 3-D Analyst toolbar on various points at the top of the basin to track the path a water droplet released there would follow.

Then I used the Interpolate Line tool in the 3-D Analyst toolbar to approximate a representative flowpath based on the paths created above. (Online forums helped me figure out how to turn on the 3-D Analyst toolbar when it wasn’t showing up.) My main analysis was with a profile along the “face” and I added profiles along the “gully” in my sensitivity analysis. I chose the “face” transect rather than one directly in the gully since most water droplets would start on the face of the slope rather than in the lowest elevation path.

The simulation results were not radically sensitive to the choice of transect, but they did have an impact especially on more heterogeneous basins. Brian advised to make the path representative of the geography of the basin as a whole, and make sure that your line always travels downhill and generally follows the path of a water droplet. I recommend making more than one for sensitivity analysis purposes.

Each slope profile was saved as a Microsoft® ExcelTM readable file (Microsoft®, 2018, https://products.office.com/es/excel). I made 48 total, and suggest that for more than a dozen or so files that you instead generate a script in R.

I used the SLOPE function in Excel to calculate the percent slope of each section to generate a series of points approximately five meters apart, with two columns of data: x value and percent slope. Then I went to the WEPP Slope Profile Editor interface and copied and pasted the results to form a WEPP-usable .SLP file. The “Curve” option under “Advanced Settings” was used to smooth the line.[[2]](#footnote-2) The choice of 5 m as the target segment length was the result of consultation with Dr. Brian Gelder to minimize anomalies that arose from over-parameterization in initial runs. A more detailed discussion can be found in Appendix A of my thesis, which is available online at <https://www.nrem.iastate.edu/research/STRIPS/assessing-reduction-soil-erosion-row-crop-prairie-systems-through-mixed-effect-and-simulation>.

Soil:

Soil data comes from the SSURGO database developed by USDA NRCS and is publicly available for download (USDA NRCS, 2014; available at https://catalog.data.gov/dataset/soil-survey-geographic-ssurgo-database-for-various-soil-survey-areas-in-the-united-states-). I imported the soil data into ArcGIS, put the soil layer on top of the watershed, and used the ruler tool to estimate the length in m of each soil type. Use the \_\_\_ database to match the number associated with the region to the soil type it represents.

Land Cover:

Data about the land cover, length, and width of the hillslope were developed in ArcGIS 10.5 (ESRI, https://www.esri.com/en-us/arcgis/products/arcgis-pro/overview). Tim Youngquist had shapefiles representing the extent of each field (a subwatershed with a crest at the top and a drainage point of low elevation at the bottom). I used a mid-range value to estimate length and width of the hillslope as well as the placement and width of prairie strips. I used the ruler tool to measure a mid-range length and width of the field.

Management:

I modified information for the crop areas from the “corn-soybean-notill” file in WEPP. Make sure the rotation schedule matches the year each crop was planted, because it makes a huge difference in the outcome. I modified a file to begin with soybeans, rather than corn, in Julian Year One, to match what was actually grown that year. Timing details such as tilling date, fertilizing date, pesticide application date, and harvest date were not always available for the sites being researched, so I used WEPP’s default management practices. If you have management data, it’s much better to use the real data so that the program doesn’t assume irrational things like planting during a flood, etc.

Climate:

Precipitation and temperature data for the watersheds generated by the Daily Erosion Project, whose model combines and processes NOAA MRMS Radar and Iowa Environmental Mesonet data (Gelder et al., 2017). I contacted Daryl Herzmann for these files, which DEP formats for use in WEPP. Then use the climate file selector within the WEPP interface to choose the file.

Land Cover Type:

There are several kinds of “Bluestem Prairie” built into WEPP, of varying qualities from “poor” to “good” and taken from one of two sites, Kansas or Nebraska. The output is very similar on all of these. For my analysis I chose “good” quality prairie from Kansas as the standard. WEPP consistently overestimated erosion for all cases, but this option was chosen to approximate the health of well-managed prairie strips and for its prediction of low erosion and low displacement.

I kept my results, graphs, and tables in a master Excel file with different tabs for each iteration. I intended to clean up the documentation to CSVs but haven’t gotten around to it.

The mixed effect modeling is in several R files, which I can send in an upcoming email.

1. The citation Brian sent me for the files is B. K. Gelder. 2015. Automation of DEM Cutting for Hydrologic/Hydraulic Modeling. Iowa Highway Research Board Report No. TR-631. [↑](#footnote-ref-1)
2. WEPP slope files contain a maximum of 50 points with paired x-coordinate and percent slope information. [↑](#footnote-ref-2)