Sub-Regional Timber Supply Model (SRTS)
User Guide & Documentation

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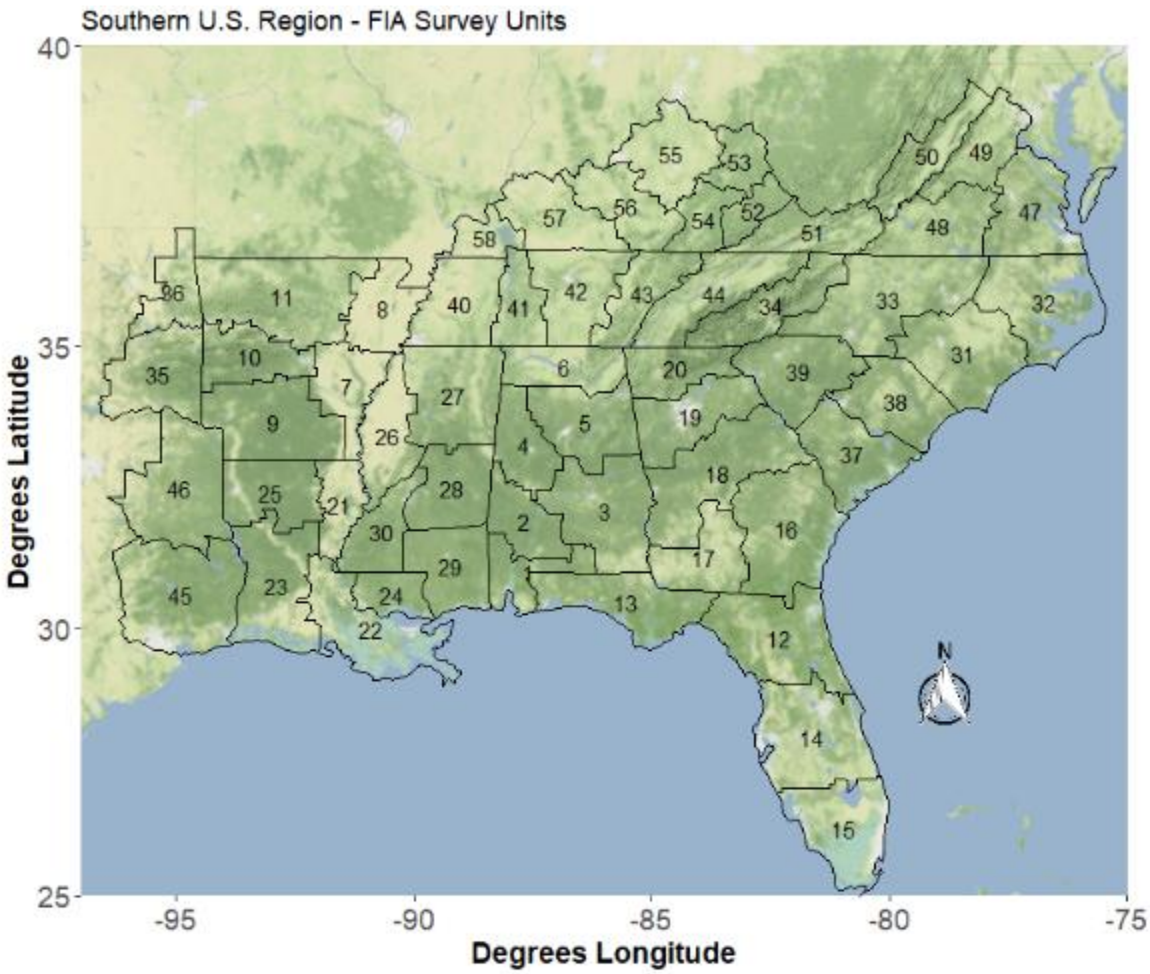
1. Running SRTS

1.1 Introduction

SRTS is an empirical bioeconomic model of timber supply based on detailed Forest Inventory and Analysis (FIA) data[1]. From these data we are able extract forest inventory, removals and biological factors for custom sub-regions that are important to a model client. The flexibility of regional scope makes SRTS applicable to analyzing a variety of problems: from broader policy and sustainability questions to analysis of a small timber basin. The maximum regional extent of the model is the Southern U.S. Region (see the figure below). Appendix A in this document lists the counties that fall within each sub-region. As a model of timber supply in stumpage markets only, it is up to the user to specify demand projections. Procedures to ensure the correct starting point for a demand projection are discussed below. For a detailed review of how the model works, see Abt et al., 2009 (available in the SRTS Documentation folder).



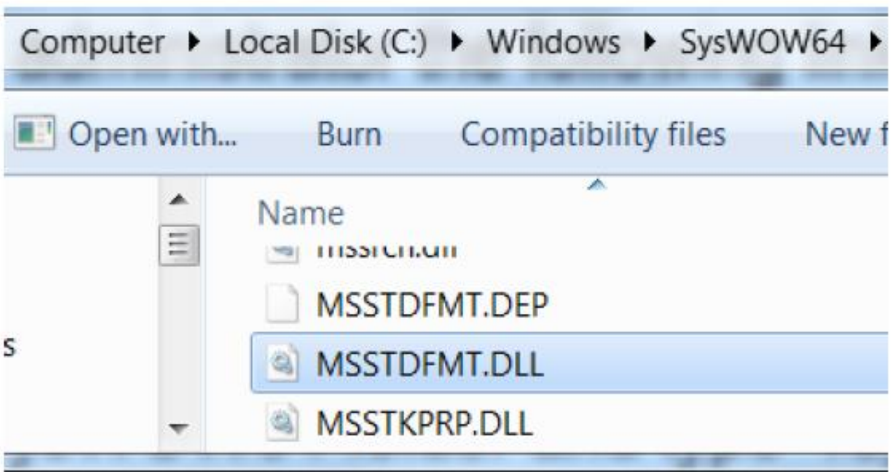
[1] provided by the USDA Forest Service: https://www.fs.usda.gov/research/products/dataandtools/datasets/fia-datamart

1.2 Installation

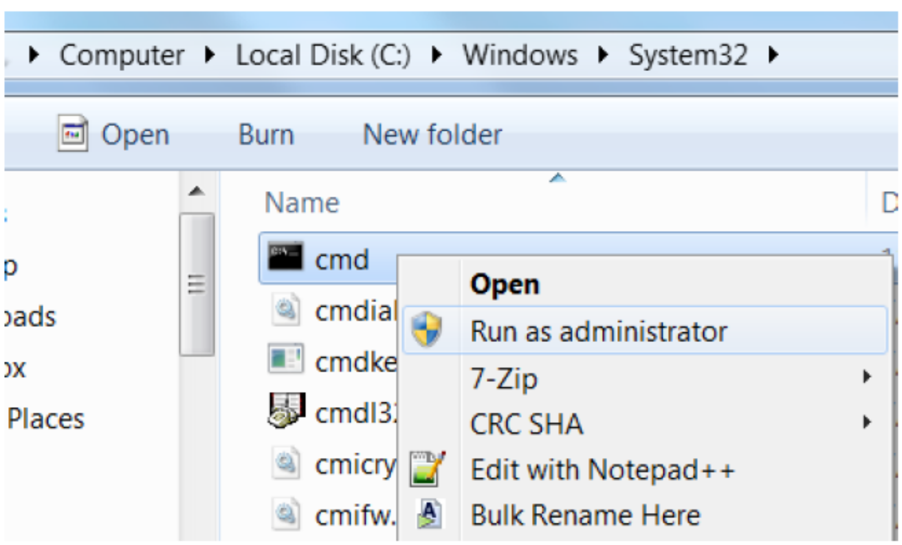
SRTS is a standalone executable written in the Visual Basic programming language. As such, it does not require installation with an installer package. However, some steps need to be taken to ensure proper functionality on 64-bit operating systems. SRTS is compatible with computers running a Windows operating system. Computers running other operating systems have shown mixed compatibility, and support is not guaranteed for those systems.

To apply the fix for 64-bit machines, take the following steps:

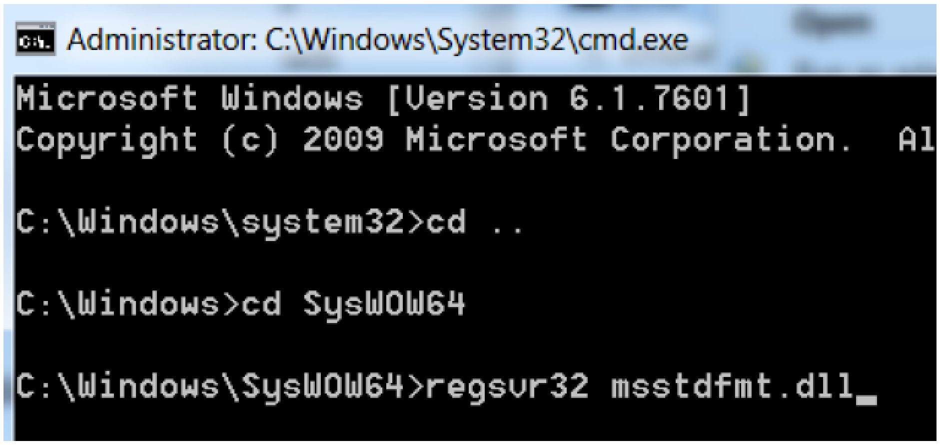
1. Navigate to the Documentation > 64-bit Installation folder.
2. Copy the “MSSTDFMT.DLL” file to the directory: C:\WindowsnSysWOW64\



3. Open cmd.exe as administrator (right-click, Run as administrator)



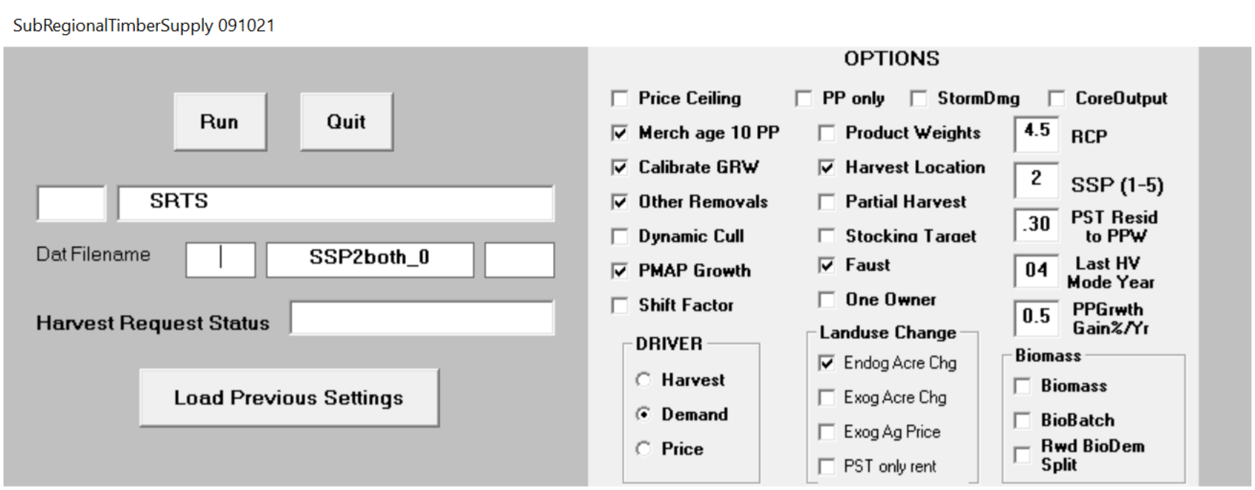
4. Change directories to WindowsnSysWOW64 folder and register the DLL:
    - Type "cd .." and hit Enter.
    - Type "cd SysWOW64" and hit Enter.
    - Type "regsvr32 msstdfmt.dll", hit Enter.



1.3 Running the Model - A Brief Tutorial

The SRTS Distribution comes pre-configured to run a southwide and state-level analyses. To make your first SRTS run, follow these steps.

1. If you have not already read the preceding Installation section, do so now to ensure compatibility of SRTS with your computer.
2. Double-click the SRTS executable in the main SRTS directory: “srts_mmddyy.exe”. The user interface shown below should appear.



3. Click 'Run' and the model should successfully make a run based on a DAT file with the name highlighted in yellow above (i.e. “South35b.DAT”). Note: A 'Not Responding' message in the user interface is nothing to be concerned about.
4. After the model run is complete, the word 'END' will appear on the user interface. Several output files will also appear in the same folder as the SRTS executable.
5. To close SRTS, you must click the 'Quit' button.

After completing the preceding steps, you have technically completed a SRTS run. The remainder of the process is understanding the purpose of the assorted output files.

The remaining documentation discusses the purpose and format of each input and output file. To complete the basic tutorial, however, the following outlines the basic order of preparation for running the model.

1. Identify a region of interest and submit a basin request.
    a. Arrange a comma-delimited 'basin request' file as described in Chapter 2, section 2. Submit this .csv file by email to the SOFAC Research Associate to obtain an inventory file with differentiated ownership (corporate and non-corporate).
    b. The basin request must include a minimum of 5 to 8 counties per sub-region for compliance with an MOU.
    c. Optionally request a History (.Hist) file showing historical merchantable volume.
    d. Alternatively create your own inventory file for 'One-owner mode' runs using the “INVmaker.exe” program located in the Data folder.
2. Set up your .DAT file
    a. Following an included DAT file template and consulting the section describing the .DAT file, create the DAT file for your run.
    b. Use 'MPCONST.PRJ' for your demand projection in this initial construction.
    c. Insure that other input files listed in the .DAT file are located in the Data folder.
    d. Alternatively use the SRTSassistant.exe to create .DAT files and .PRD files.
3. Make a run with your .DAT file
    a. After the run is complete, locate “MPCONST.PRJ” in the Data folder, and open it to edit the file in Excel.
    b. Leave year 0 removals by product unchanged.
    c. Change consecutive years to match your anticipated demand projection.
    d. Save your custom .PRJ file in the Data Folder
4. Prepare other input files
    a. Revise your .DAT file by renaming the .PRJ file to match your custom .PRJ file saved in the last step.
    b. Create additional input files as required for selected model options if necessary.
5. Make your final run
    a. Run SRTS with your new .DAT file
    b. Examine the output files of interest. The main output file is the .GPG file.

1.4 File Structure

The basic SRTS file structure is organized in the following manner:

SRTSv35c (folder)

1. Data (subfolder)
    a. INVmaker (“SRTS_INVmaker_062520.exe”)
    b. Assorted required files (e.g. TPO history files and “MPCONST.PRJ”)
    c. .PRD file
    d. .INV file
    e. .PRJ file
    f. .DBH file
    g. TPO adjustment coefficients: “su_cty_tpoNewLU_2017_tpoadj.csv”
2. Documentation (subfolder)
    a. 64-bit Installation (subfolder)
    b. This user guide.
    c. Other key reference files (“Measurement dates v35c.xlsx”, “PriceElasticities.xlsx”, “BatchRunTemplate.xlsx”)
3. Figures (subfolder)
4. lib (subfolder)
    a. Assorted required files
    b. Default files needed for SRTS Assistant (“elast.default”, “param.default”, “prods.default”, “strng.default”)
    c. Land-Use Change coefficients file (“LUBetaClean.csv”)
    d. Pine Map Growth Carbon Fertilization option coefficients file (“PMap_Grwth3.csv”)
5. Preprocessing (subfolder)
    a. .DC generation script file (“GPGtoDCshare.R”)
    b. SRTS Assistant (R version)
        i. “batchsrts.txt”
        ii. “SRTSAssistant.xlsx”
        iii. SRTSAssistantv3.R”
        iv. SUtoSRTSReg.csv”
        v. “Readme.docx”
6. Postprocessing (subfolder)
    a. Post-run script file for visualizing results (“PostprocessingScript.R”)
    b. Link between county FIPS and Survey-Unit ID numbers (“AddFIAunitIDs.R”)
7. Runs (a subfolder for storing previous runs)
    a. Run 1
        i. Input Files (folder for storing input files for a run)
        ii. Output Files (folder for storing output files from a run)
        iii. Results (folder for storing charts and maps of model results)

b. Run 2
    i. Input Files (folder for storing input files for a run)
    ii. Output Files (folder for storing output files from a run)
    iii. Results (folder for storing charts and maps of model results)
c. Etc...

8. SRTS program file (“srts_mmddyyyy.exe”)
9. CarbonWelfare2020 program file (“CarbonWelfare2020.exe”)
10. SRTS Assistant v.06.11.2020 (“SRTSassistant.exe”)
11. .DAT file(s)
12. Faustmann coefficients file (.FAUST file)
13. Direct Change file (.DC)
14. Partial Harvest file (.PH)
15. Starting prices by product type (“WelfareStrtPrc.csv”)
16. All Output files generated from most recent SRTS run. These can be moved to the “Runs” subfolder for later reference after making a SRTS run.

1.5 Input Files and Model Options

Input files needed to run the model are typically space or comma delimited text files with custom file extensions (e.g. .DAT, .PRD, .INV). To view or edit input files, it is useful to download and install a text editor program like Notepad++ or Wordpad. Right-click the input file and *Open With...* your chosen text editor program. In the sections that follow, you may copy example input files to use as templates for your own input files. Alternatively, you may use SRTSassistant to create .DAT and .PRD files. Inventory (.INV) files are not created manually by the user.

1.5.1 Main Configuration File - *.DAT

This section of the document gives a line-by-line description of the .DAT file and a general description of associated input files. The .DAT file is the run configuration file. This is the file that identifies the parameters and input files for the run. The name of this file is the only input required on the SRTS user interface. The user interface simply concatenates the three .DAT Filename textboxes and looks for the .DAT file extension in the folder where the SRTS application is located. For example, the screen below instructs SRTS to read the configuration file “AL.DAT”. This name is not case sensitive. All of the information required for a basic run is in this file. The user hits the RUN button and at the end of the run either quits or enters a new .DAT file name.

```
AL
"standard5.PRD" "MPCONST.PRJ" "v34a_1in_dbh_gs.csv" "ALStack_34a_gs.inv" "AL"
6 5 2016 44 1
1 "AL-SW_S" 2 "AL-SW_N" 3 "AL-SE" 4 "AL-WCtrl" 5 "AL-NCtrl" 6 "AL-North"
0.3 0.3 0.3 0.3 0.3
0.3 0.4 0.5 0.3 0.5
1.0 1.0 1.0 0.7 0.7
0.3 0.4 0.5 0.5 0.5
```

```
1.0 1.0 0.7 0.7 0.7
```

Saving the .DAT file from a run gives a summary of all of the input filenames, output filenames, regions, and elasticities. After the run a YourRunID.INI file is created that shows all of the menu settings from that run. The “YourOutputFilename.DSC” output file described in the “Output Files” section (below) gives a full description of the run.

By default, SRTS starts with the .DAT file and settings from the last run made. If you put in a .DAT filename from a previous run and then push the “Load Previous Settings” button, the previous settings associated with that .DAT file run are loaded. Note that this requires that the previous run was done with SRTS 3.9 or later, which creates an “.INI" file for every run. You can then enter a new DAT filename and retain the settings from the previous run.

DAT File Contents

The .DAT file is read in list format, so line numbers aren't important as long as the data is in the expected order. Still, organizing a DAT file by lines is useful for troubleshooting and explaining the sections. The following descriptions reference the line numbers in the preceding example .DAT file. Note that the line numbers are not actually part of the file contents.

Run Description (Line 1):

```
ALABAMA - PINE MARKET
```

This is an optional line to describe the run. If the program sees “.PRJ” and “.PRD” on this line, it assumes you don't have a Run Description line. The Run Description line is also used for the advanced OptionFile procedure, discussed in a later section.

File Names (Line 2):

```
"standard5.PRD" "MPCONST.PRJ" "v34a_1in_dbh_gs.csv" "ALStack_34a_gs.inv" "AL"
```

This line name four files that must be located in your “/Data/” folder, followed by an output filename of your choice - a total of five terms. When this example .DAT file is run by SRTS, the four files must be present to avoid errors. Typos are a common mistake related to this line. When SRTS runs successfully, the output files are produced in the same folder as the .DAT file, and they will all be named according to your chosen output file name. Acronyms for the file types are explained below, and a full description of the file contents are described in later sections.

1. .PRD Product Definition File
2. .PRJ Harvest Projection File
3. .csv Diameter Distribution File (diameter at breast height)
    a. For Growing Stock volume with 1” delineation use “v35c_1in_dbh_gs.csv”
    b. For All Live volume with 1” delineation use “v35c_1in_dbh_al.csv”
4. .INV Summarized FIA Inventory Data (can be a .csv file)
5. OUTPUT Filename to be used for output files

Run Parameters (Line 3):

```
6 5 2016 44 1
```

These are parameters for the run. Certain parameters must be consistent with the files listed on line 2 or internally consistent with the DAT file. Check these consistencies to troubleshoot, especially if you get "subscript out of range" errors. Here is a description of each parameters meaning along with places to check for consistency:

Parameter	Meaning	Check for Consistency
6	Number of Regions	SRTS Region Numbers & Labels
5	Number of Products	.PRD file
2016	Starting Year	Avg. re-measurement date for .INV file
44	Number of years to project	.PRJ file row index
1	Interval (years) between detailed report	None

SRTS Region Numbers and Region Labels (Line 4):

```
1 "AL-SW_S" 2 "AL-SW_N" 3 "AL-SE" 4 "AL-WCtrl" 5 "AL-NCtrl" 6 "AL-North"
```

This section follows a format with a SRTS Region Number followed by a Region Label in quotes. The SRTS Region Numbers are specific to these survey units. They are keyed to the "stateunitphyky.txt" file located in the lib subfolder, which allows the program to match DBH distributions to sections (Southeast or South Central) and physiographic regions. Refer to the Southwide input file or the "SRTS REGION LOOKUP.xls" worksheet to select the appropriate SRTS number for any subregion. Alternatively, you can use the SRTSassistant executable to automatically determine the SRTS Region Number that is a custom basin, based on the survey unit that most of the counties fall in.

If you were running just one basin in SE Georgia, for example, you would use SRTS Region Number 16 to key the program to the right diameter distribution. These numbers do not have to be unique; all of the basins in a run could use the same number. Region Labels are used in the output reports. The order of these regions in the .DAT file must match the order of the data in the .INV data file.

Elasticities

Following the regions and labels listing, we list elasticities by product. The number of elasticity measures in each category described below must match the number of products specified on Line 2, and product order must match the product definition file. If the run uses one-owner mode, Lines 19 and 20 should be omitted from the DAT file.

Demand Price Elasticities by Product (Line 5):

```
0.3 0.3 0.3 0.3 0.3
```

The percent change in quantity of stumpage demanded from a percent change in stumpage price. For example, .3 means that a 1% change in price would lower demand by .3%. In harvest driven runs, these numbers don't matter because the model is solving for the price that would be required to meet the requested harvest given what is happening to inventory. In a demand driven run, the demand elasticity dictates the sensitivity of harvest to price.

Supply Price Elasticities by Product for Industrial/Corporate Owners (Line 6):

```
0.3 0.4 0.5 0.3 0.5
```

The percent change in quantity of stumpage supplied from this ownership induced by a percent change in stumpage price. For example, .5 means that a 1% change in price would increase harvest by .5% other thing being equal. These numbers have a direct effect on the price required to achieve a given harvest. There must be as many entries here as there are products.

Supply Inventory Elasticities by Product for Corporate Owners (Line 7):

```
1.0 1.0 1.0 0.7 0.7
```

The percent change in quantity of stumpage supplied from this ownership induced by a percent change in product inventory. For example, 1 means that a 1% change in inventory would increase harvest by 1% other things being equal. These numbers have a direct effect on the price required to achieve a given harvest. There must be as many entries here as there are products. The .7 above for hardwoods implies that if total hardwood inventor goes up by 1%, the timber supply only goes up by .7% to reflect availability restrictions for hardwoods.

Supply Price Elasticities By Product for Non-Corporate Owners (Line 8):

```
0.3 0.4 0.5 0.5 0.5
```

This entry characterizes Non-Corporate Owners and is analogous to Line 6.

Supply Inventory Elasticities By Product for Non-Corporate Owners (Line 9):

```
1.0 1.0 0.7 0.7 0.7
```

This entry characterizes Non-Corporate Owners and is analogous to Line 7.

1.5.2 Product Definition File - *.PRD

Example File “stand5default.PRD”

```
SP PR PROD LABEL MINDBH PCTPULP WGTFACTOR
1 1 "Product1" 5 1.0 35.5
1 2 "Product2" 9 0.5
1 3 "Product3" 12 0.1
```

```
2 1 "Product1" 5 1.0 37
2 2 "Product2" 10 0.25
```

The product definition file is where the merchandizing rules are summarized. The first column is the species group. If there are 2 species groups they are assumed to be pine and hardwood. If there are 3 species groups they are assumed to be pine, soft hardwood, and hard hardwood. Within each product group, products are listed in order from smallest diameter to largest and assigned an index for the product (PR) column. In this case there are 2 pine products and 2 hardwood products. The third column gives the product label. These can be 8 characters long, but should be unique in the first 4 characters because some output files truncate this label.

Column four gives the minimum diameter at breast height (MINDBH) for the product. The standard DBH distribution file (described below) using the standard 2-inch DBH classes starting with 5 inches. In the MINDBH column you list the minimum DBH class that qualifies for this product. The PCTPULP column indicates how much of this product class should be considered pulpwood. The fifth column gives a weight conversion factor by species. All of the input data is in thousands of cubic feet (MCF). Output is multiplied by the WGTFACTOR for each species group just before it is written to the output file. The weights above convert the output units to green tons. If you entered a 1 here, output would be reported in MCF.

1.5.3 Demand Projection File - *.PRJ

The harvest projection file (.PRJ) is an optional file to describe the harvest projection by product. If in the .DAT file, the name “MPCONST.PRJ” is used as the filename for the demand projection, the model will project year zero removals by product for the entirety of the model run. The “MPCONST.PRJ” file will be created during the run. The following is an example of the contents of “MPCONST.PRJ” for the first five years of a southwide run.

```
0 2412149 853842 2448559 930257 1310979
1 2412149 853842 2448559 930257 1310979
2 2412149 853842 2448559 930257 1310979
3 2412149 853842 2448559 930257 1310979
4 2412149 853842 2448559 930257 1310979
5 2412149 853842 2448559 930257 1310979
```

The output units are in thousand cubic feet (MCF) and the product order is determined by the .PRD file. The first column is the projection year; the second is harvest of product 1 in MCF, and so forth.

Custom harvest trends, for example a 1% increase for 5 years before flattening off, can be created by importing this file into Excel and editing appropriately. Save the file with some name other than

"MPCONST.PRJ", specify this name as the harvest projection file in the .DAT file. Do NOT change line "0" since this reflects the starting point of the FIA data in the .INV file.

1.5.4 Diameter Distribution File - *.DBHtxt *or* *.csv

SRTS currently works with 5-year age classes. As of 2020, the new default diameter distribution file uses 1-inch delineations (e.g. "v35c_1in_dbh_gs.csv"), in contrast to a 2-inch default in previous versions. The 2-inch diameter distribution file contained the diameter distribution across the nine 2" DBH classes, starting with 5-6.9" and ending with 19+". The new 1-inch diameter distribution file represents DBH class directly with its measure in inches, beginning at 5 and ending with 28. The Product delineation file (.PRD) should adopt and reference these new 1-inch delineations. However, SRTS currently detects if the old product delineation file format is in use and accounts for this within the model.

Column	Variable	Codes
1	Station	1 = Southeast, 2 = South Central
2	Physiographic Region	1 = Coastal Plain, 2 = Delta, 3 = Mountain, 4 = Piedmont
3	Owner	1 = Corporate, 2= Non-Corporate, 3= Total Private
4	Species Group	1 = Pine, 2 = Hardwood, 3 = Soft Hardwood, 4 = Hard Hardwood
5	Mgt. Type	Type 1 = Plantation, 2 = Natural Pine, 3 = Mixed Pine, 4 = Upland Hardwood, 5 = Lowland Hardwood
6	Age Class	1 = 0-5, 2 = 6-10, 3 = 11-15, 4 = 16-20, 5 = 21-25, 6 = 26-30, ..., 10 = 46-50, 11 = 50+
7	DBH Class	5 = [5"-5.99"), 6 = [6"-6.99"), ...
8	Proportion of Volume in DBH Class	Continuous Number

1.5.5 Inventory File - *.INV *or* *.csv

The .INV file contains the starting inventory, growth, removal and acreage data for the run, summarized from FIA data. The following table identifies the variables by column for the file.

Column	Variable	Codes/Meaning
1	State or Basin Number	NA
2	Sub-Region Number	Ordered by basin request
3	Owner	1 = Corporate, 2= Non- Corporate, 3= Total Private
4	Mgt. Type	1 = Plantation, 2 = Natural Pine, 3 = Mixed Pine, 4 = Upland Hardwood, 5 = Lowland Hardwood

5	Species Group	1 = Pine, 2 = Hardwood, 3 = Soft Hardwood, 4 = Hard Hardwood
6	Age Class	1 = 0-5, 2 = 6-10, 3 = 11-15, 4 = 16-20, 5 = 21-25, 6 = 26-30, ..., 10 = 46-50, 11 = 50+
7	Growing Stock	Inventory in MCF
8	Cell GPA	Actual FIA growth/acre for the unit in cubic feet per acre per year
9	Regressed GPA	Smoothed growth/acre for the unit in cubic feet per acre per year
10	Removals	Removals in MCF
11	Land Use Removals	Removals from forestland conversion in MCF
12	Other Removals	Removals of growing stock from the commercially available inventory by other means (such as land preservation or a conservation easement)
13	Acres	NA

Making a Basin Request

Before running SRTS, a region of interest must be specified. A region, represented by a list of state and county FIPS codes, is used to construct an inventory (.INV) file. The Southern Forest Resource Assessment Consortium (SOFAC) produces .INV files based on basin requests. Model users submit a .csv file (preferred) or Excel file by email, arranged in the following manner:

	A	B	C
1	51		
2	AL-SW_S	1	3
3	AL-SW_S	1	39
4	AL-SW_S	1	53
5	AL-SW_S	1	97
6	AL-SW_S	1	129
7	AL-SW_N	1	23
8	AL-SW_N	1	25
9	AL-SW_N	1	35
10	AL-SW_N	1	91
11	AL-SW_N	1	99
12	AL-SW_N	1	119
13	AL-SW_N	1	131
14	AL-SE	1	1
15	AL-SE	1	5
16	AL-SE	1	11
17	AL-SE	1	13
18	AL-SE	1	17
19	AL-SE	1	21
20	AL-SE	1	31

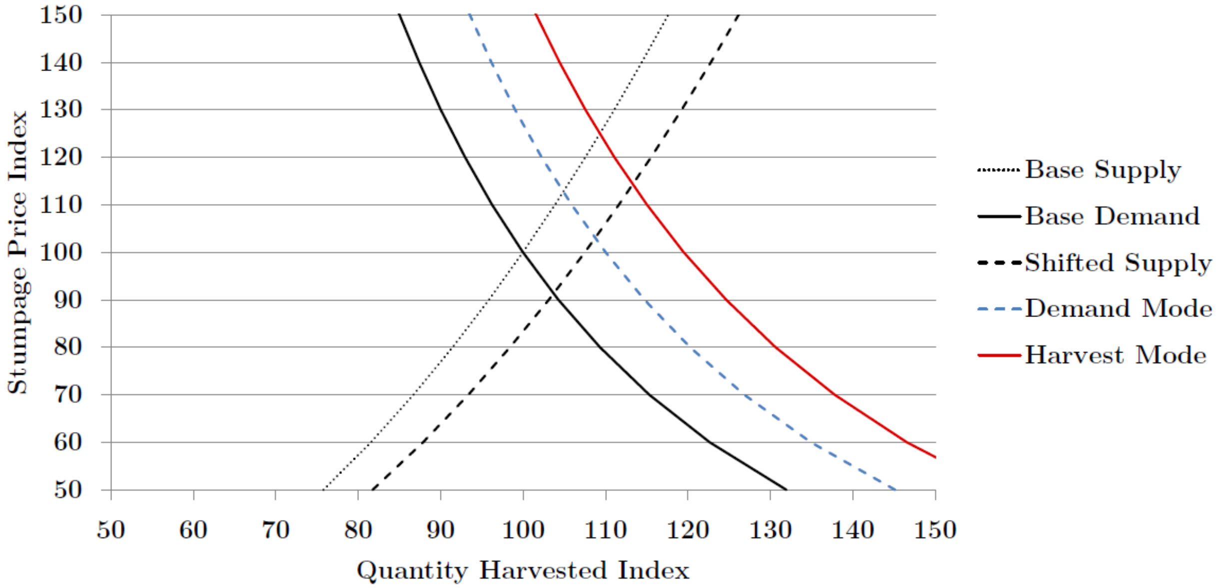
The actual number of counties per basin in a basin request is typically more like twenty or more. Furthermore, the state and county lists should represent a contiguous area. For example, some users use external tools to determine which counties lie within a certain distance from a point of interest. For small basins (e.g. less than 5 counties) we recommend using "one owner" mode, since the USFS is very sensitive to disclosure of ownership data.

1.6 Modeling Options

1.6.1 DRIVER options

Default: *Demand Mode*

Three model driver options are available: *harvest mode*, *demand mode*, and *price mode*. In *harvest mode*, the path of removals specified in the projection (PRJ) file is followed exactly. SRTS shifts the demand curve in order to obtain the requested harvest. In *demand mode* the .PRJ file tells the model how far to shift the demand curve itself. The difference is illustrated in the figure below. *Price mode* is equivalent to the *harvest mode*, except the .PRJ file is interpreted as an explicit pathway of prices.



Stumpage Price Index
150
140
130
120
110
100
90
80
70
60
50
50
60
70
80
90
100
110
120
130
140
150
Quantity Harvested Index
Base Supply
Base Demand
Shifted Supply
Demand Mode
Harvest Mode

1.6.2 Biomass Options

Depending on the application, scenarios exploring the use of biomass can use built-in biomass options or simply use different .DAT files that reference a baseline custom .PRJ file and a custom .PRJ file that adds biomass to the projection.

- **No Options Checked** - default: Demand is based only on the .PRJ file.
- **Biomass**: If this box is checked the model reads a biomass demand file. This biomass demand file has the same filename as the .DAT file but with a ".BM" extension. The format of the biomass file is:

```
"su_logging_09.dat"
Year     BioDemand    PNPCT    PNUTIL   HWUTIL
2010     0     0     0     0
2011     0     0     0     0
2012     0     0     0     0
2013     660000  20    5     5
2014     1320000 20    5     5
2015     1320000 20    5     5
2016     1320000 20    5     5
2017     1320000 20    5     5
2018     1320000 20    5     5
2019     1320000 20    5     5
2020     1320000 20    5     5
```

  The first line of the file specifies the source of the logging residue coefficients by survey unit. This file is based on TPO removal and utilization studies adjusted for stumps. The second line is a descriptor line and is not read. For each year (column 1), a biomass demand (column 2, green tons) is specified. Column three specifies the percentage of the biomass that should come from pine feedstock. Note that "99" is interpreted as a code to use the current pulpwood harvest split between species including consideration of logging residues. A "50" in this column would imply a 50/50 split. The next two columns specify the maximum percentage of logging residues that are assumed to offset biomass demand. In this case 15% of both pine and hardwood logging residues are assumed to offset biomass demand. Biomass demand NOT offset by logging residues are assumed to add to pulpwood demand. Use of the biomass option requires use of an Excel template to compare with and without biomass demand runs including market impacts, residue utilization, displacement/leakage, etc.

- **BioBatch**: This is a custom programming option that allows whole sets of .DAT files to be run in batch mode. Contact David Rossi for details.
- **Rwd Bio Dem Split**: If this box is checked and the model is determining the species split (PNPCT=99), the model bases the split only on the roundwood species split and does not adjust the percentage based on residue availability.

1.6.3 Merch Age 10 PP

Default: ***On***

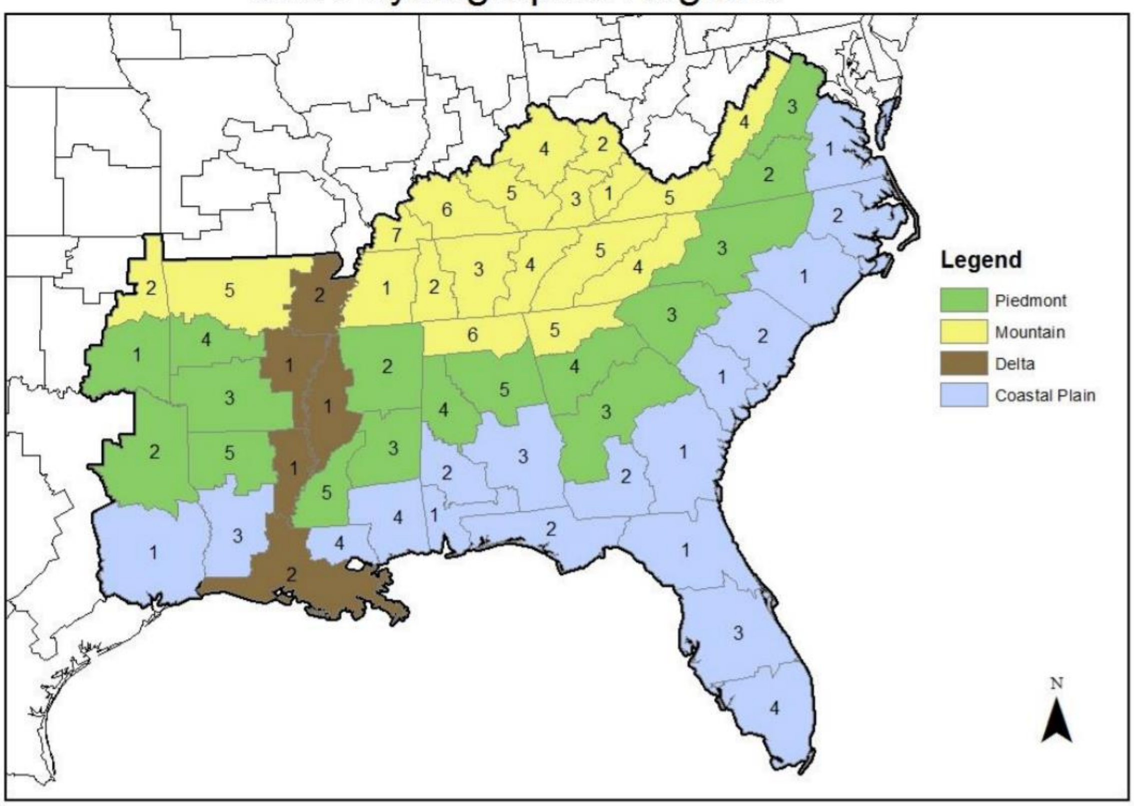
If this box is checked then volume in the 10-15 age class are merchandized in terms of removals and inventory. This increases pulpwood volume more than removals but allow better modeling of first thinning.

1.6.4 Calibrate Growth - Calibrate GRW

Default: ***On***

There are two growth columns in the .INV file. The CELLGPA column shows the growth per acre actually found in the FIA data. The REGGPA column shows the results of a growth regression that uses data by state, physiographic region (coastal plain, piedmont, mountain, delta), management type and owner to develop a smooth growth curve for the model to use. The figure below shows where these physiographic regions lie across the U.S. south.

FIA Survey Units in the US Southeast and Physiographic Regions



Growth calibration calculates the mean growth in pine plantations for ages 15 to 30 for both cell and regression estimates. The regression estimates are then moved up such that the mean of the regression growth is equal to the mean of the cell growth for these ages. This calibrates the smoothed growth curve to match the levels seen in the local data. Growth calibration is implemented unless this option is turned off.

1.6.5 Oth Removals

Default: *On*

The .INV file now contains columns of removals, landuse removals, and other removals. Removals are harvests from land that remains in timberland, landuse removals are removals from land that does not remain in timberland, other removals are land that moves into a category where harvest is restricted (e.g. conservation easement). When this box is checked, landuse removals are added to removals in SRTS. Other removals are not considered part of removals in SRTS.

1.6.6 Dynamic Cull Factor - **Dynamic Cull**

Default: *Off*

This option creates a dynamic cull factor which allows the cull factor from product 2 to product 1 to change over time in relation to the change in price ratio. In a standard four product run, this option would increase the cull from pine sawtimber to pine pulpwood in response to pine pulpwood prices increasing relative to pine sawtimber prices.

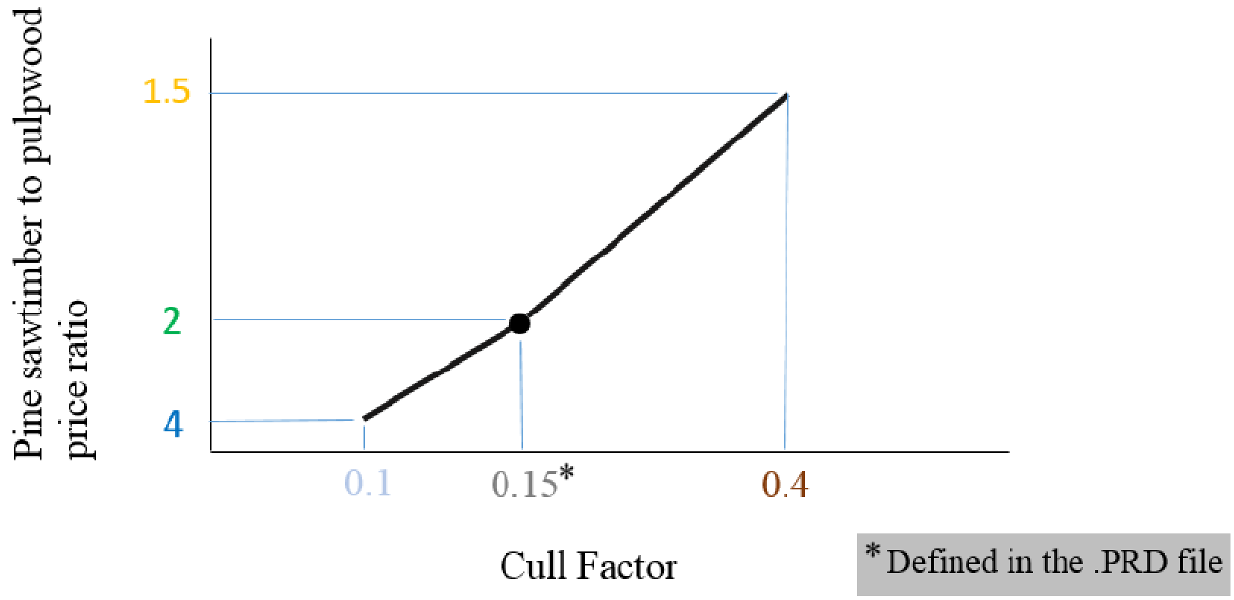
This option requires a ".cull" file which matches the name of the DAT file. The file has six parameters in comma delimited format.

1. The beginning price ratio of product 2 to product 1 (e.g. sawtimber to pulp).
2. The maximum amount the cull factor can change in a given year. This parameter simulates gradual adjustment and prevents the model from oscillating between extremes.
3. The maximum cull proportion of product 2 to product 1. This number should be larger than the cull factor specified in the PRD file (which is the cull factor the model will start with), and it should be less than 1.
4. The minimum price ratio of product 2 to 1.
5. The minimum cull proportion of product 2 to 1.
6. The maximum price ratio of product 2 to 1.

An example format is the following. It can be copied and pasted into a text editor and saved as a ".cull" file:

```
startprcratio,maxcullchg, maxcullprp->,min-price-ratio, mincullprp->, max-price-ratio
2.0,0.08,0.4,1.5,0.1,4.0
```

The following figure shows graphically how the numbers in the cull file are related:



1.6.7 Supply Shift Factor File - *.SF

By default SRTS assumes that demand is mobile and that the market efficiently allocates demand to regions in which supply is increasing. Inventory growth in certain sub-regions may lead to increased removals in that region. If users deem this dynamic to be unreasonable based on knowledge of the region, this effect can be dampened with the supply shift factor option.

```
Product,Region,Owner,DemFctr,SupFctr
1,7,1,1,1
2,1,1,1,0.5
3,7,1,1,0.5
4,4,1,1,0.4
```

The above file dampens the supply shift of products 2-4, corporate owners in regions 1, 7, 4 in the .DAT file order. The first line should not be necessary since the default is "1"

1.6.8 Pinemap Growth ("PMAP Growth")

Default: ***On***

Data from 20 climate models, in addition to biometric data from the PINEMAP project were incorporated into the Physiological Processes Predicting Growth 3-PG model (see Henderson et al., 2020). The model simulated growth across the historic range of southern yellow pine, growing trees for each planting year between 1971 and 2099, and ending in 2099. County level data was then supplied to us, which we aggregated to survey units and across climate models using regression techniques.

The PMAP Growth option in the latest SRTS version accesses the table of regression coefficients, normalizes the growth to the empirical growth determined by the FIA data, and applies future growth increases in the PINEMAP growth data to the forest inventory. These growth increases vary by planting year, annual age, and FIA survey unit. Selecting this option will apply this growth forecast to the forest inventory. Users have the option of selecting either RCP4.5 or RCP8.5 in the SRTS user interface before making a run with the “PMAP Growth” option selected. RCP8.5 reflects a much larger increase in the concentration of greenhouse gases and Carbon Dioxide, whereas RCP4.5 reflects a more moderate rise in greenhouse gas concentration.

1.6.9 Dynamic Supply Elasticity - *.DE (beta)

This option was developed for work on a Southern Forest Futures project. It currently works for a four product run only and allows the user to specify a supply elasticity by year for each product.

This option requires a *.DE file of the following form:

```
A2
2016 0.07 0.18 0.19 0.42
2017 0.07 0.18 0.21 0.44
2018 0.06 0.18 0.22 0.46
2019 0.06 0.18 0.24 0.48
2020 0.05 0.18 0.25 0.50
2021 0.05 0.19 0.24 0.50
2022 0.05 0.19 0.23 0.49
2023 0.06 0.20 0.23 0.49
2024 0.06 0.21 0.22 0.48
2025 0.06 0.22 0.21 0.48
2026 0.06 0.22 0.20 0.47
2027 0.06 0.23 0.19 0.47
2028 0.07 0.24 0.19 0.46
2029 0.07 0.24 0.18 0.46
2030 0.07 0.25 0.17 0.45
2031 0.08 0.25 0.18 0.45
2032 0.08 0.25 0.19 0.45
2033 0.09 0.25 0.21 0.44
2034 0.09 0.25 0.22 0.44
2035 0.10 0.26 0.23 0.44
2036 0.11 0.26 0.24 0.44
```

1.6.10 Product Weights - *.PW

Default: *Off*

After solving for the equilibrium allocation of all products in a region owner, the model uses a goal program to allocate harvest across management types and age classes. The program attempts to meet the new harvest request while maintaining historical harvest patterns. If it can't meet the new harvest request, it relaxes the historical harvest pattern constraint. The goal program is set up with an equal incentive to hit all product requests. If the inventory is significantly depleted (>30%)

it will likely miss harvest requests. The harvest numbers in the .GPG file is the harvest request. If less than 95% of requested harvest is obtained in any year, region, or owner the “CHECK HVMISS FILE” is flagged. This file shows the difference between the request and actual harvest. Actual harvests as determined by the goal program can be found in the .HVMISSPCT file.

If the user wants the program to put a higher priority on meeting the request for one product, the user can change the product weights. Specifying this option requires the presence of an additional file in the model folder. This file must have the same name as the .DAT file, but with a .PW extension (e.g. “South36a.PW”). The format of this file is:

```
RG, Prod, Wgt
1 1 0.5
1 2 2.0
1 3 1
1 4 1
2 1 1
2 2 1
2 3 1
2 4 1
3 1 0.5
3 2 2.0
3 3 1
3 4 1
```

In this example, missing product 1 (based on the order in the .PRD file) in the first and third regions will be weighted by a value of 500 (25% of the weight applied to Product 2 in the first and third regions. All other products (including products 1 and 2 in the second region) will be given the default weight of 1,000. In this example, Product 2 in the first and third regions receives the highest penalty for missing the harvest request (it is given a weight of 2,000 which is 2 times that of the default weight).

Note: when SRTS is run in Harvest Mode, the harvest request is the level of demand specified in the .PRJ file. When instead SRTS is run in Demand Mode, then the harvest request is represented by the competitive equilibrium determined by the equivalence between changes in timber supply and changes in timber demand as specified in the .PRJ file.

1.6.11 Harvest Location - *.DC

Default: *On - Advanced*

This option allows the user to increase or decrease demand or harvest by product in specific regions. In contrast, by default the model moves harvest among regions and owners based on supply and demand. In order to simulate production increases or decreases in specific regions in a specific year, the economic solution - where demand is satisfied at whatever location is optimal -

must be bypassed for that year. After the model finds an optimal solution, in any year where the harvest location option applies, specified harvest in select regions are applied over and above the optimal solution. Regions not specified in the file are held constant for that year.

Specifying this option requires the presence of an additional file in the same folder as the SRTS executable (“srts_mmddyyyy.exe”) is stored. This *Direct Change* file must have the same name as the .DAT file, but with a .DC extension (e.g. “South35b.DC”). The .DC file is formatted with a column for: (1) the year, (2) an index corresponding to regions based on the order of their appearance in the .DAT file (.DAT file number, not the SRTS Region I.D. number), and (3) a column for each product listing the increase or decrease in green tons. The top row is a heading row and is ignored as long no year is included. Below is an example in which:

1. The harvest for all four products, in the first four regions listed in the .DAT file, are changed for the year 2011.
2. In the year 2017, only the fourth listed region is changed, and only pine and hardwood pulpwood are affected.

```
.DC file example
2011 1 55557.97  38867.09  206053.62 -23673.57
2011 2 559926.53 117114.89 139591.76 -74643.65
2011 3 966134.74 376523.45 1049556.71 81459.11
2011 4 -88571.18 38345.73  386071.98  123139.30
2017 4 -6031.08  0         106478.36  0
```

The preceding example presents a way to adjust the starting point for the beginning of a run (assuming 2010 is the beginning) and then to bump up pulpwood demand in 2017 for the fourth listed region only. Note the first line of this file is not read by the SRTS program.

The .DC file in new versions of SRTS automatically adjusts the .PRJ file to be consistent with the .DC file contents. A custom .PRJ can be used in concert with a .DC file, but to avoid double-counting, be sure to remember that the contents of these files need to match – the total change in demand across all units in the .DC file must equate the change in demand levels specified in the .PRJ file. However, in contrast to the volumes reported in the .PRJ file, the .DC file changes are measured in Green Tons, not thousand cubic feet (MCF). The conversion factor used should match what is specified in the .PRD file (the “WGTFACTOR”).

1.6.12 Partial Harvest - *.PH

This option was developed for the northern version of SRTS. It transforms harvest from an age-based classification to a stocking-based system. By management type, it specifies proportion of total forest area that is either partially harvested or clearcut. The file has the following structure:

```
Mtype PHvstProp CCutProp
1 .29 .15
```

```
2 .47 .28
4 .27 .06
5 .17 .02
6 .19 .05
7 .35 .30
8 .46 .17
```

1.6.13 Stocking Target - *.ST

SRTS allocates harvest between thinning and clearcuts based on a stocking (volume per acre) target by owner, forest type, and age class. The default stocking target is the base FIA data from the .INV file. One consequence of using starting stocking as the target is that thinning is probably underestimated in early years since most stands are near their target. Checking this option requires an auxiliary file with the same filename as the DAT file but with a ".ST" extension. The format of the file is shown below. The first line is a descriptor line followed by lines that have the owner group number, management type number, and the relative stocking target. In the file below the stocking target is set at 50% higher than the base volume per acre for corporate pine plantations, but equal to the base stocking target for other forest types.

```
OW MT ST
1 1 1.5
1 2 1
1 3 1
1 4 1
1 5 1
2 1 1
2 2 1
2 3 1
2 4 1
2 5 1
```

1.6.14 One Owner

The default option is to model corporate and non-corporate owners separately. Access to these data by county is restricted. Alternatively total private ownership by county is not restricted. Currently we are creating both two-owner and one-owner datasets. In this structure corporate is owner 1, non-corporate is 2, and combined is 3. If the "One Owner" button is checked SRTS runs in one owner mode and screens out anything that is not owner 3. Owner 3 is available in newer DBH distribution files so the same DBH file can be used in two types of runs.

1.6.15 Price Ceiling

Projected prices can often exceed what could realistically be expected. This is especially true in harvest mode. This option allows the user to specify a price ceiling by product. In a harvest driven run, the harvest trend follows the inventory trend after the ceiling is met. In a demand driven run, demand is assumed to be constant after the price ceiling is met. The price ceiling is expressed relative to the year 2 price.

Specifying this option requires the presence of an additional file in the model folder. This file must have the same name as the .DAT file, but with a .PC extension (e.g. "South35b.PC"). The format of this file is:

```
Price Ceiling Relative to Year 2 Price - Format - Prod, Ceiling
1 1.5
```

In this example, product 1 (based on the order in the .PRD file) will hit its price ceiling when its price increases by 50 percent.

1.6.16 Pine Plantations Only – ("PP Only")

If this option is checked then SRTS only models the pine plantation (Management Type 1) resource. All other parts of the forest base are dropped and all demand must be met from plantations.

1.6.17 Pine Sawtimber Residuals to Pulpwood - PST Resid to PPW

Default: *0.30*

This modeling option allocates a portion of pine sawmill residual chips to offset pine pulpwood roundwood demand. Valid entries are .00 to .99, but the highest value that should be entered is in the range 0.3 - 0.5. The default proportion is 0.30. If a non-zero value is entered, that proportion of pine sawtimber harvest increase is assumed to be available as sawmill residual chips to offset pine pulpwood roundwood demand. Only the increase above the initial pine sawtimber harvest is included in this calculation. Residual sawmill chips are assumed to already be fully allocated in the start year. To provide an example, entering 0.30 means that as pine sawtimber harvest increases, 30 percent of that increase is assumed to offset pine pulpwood demand.

1.7 Landuse Change Options

1.7.1 No Options Checked

The model assumes the total acres by forest type do not change over the projection. Age class distribution changes from year to year, but not total acres.

1.7.2 Endogenous Acre Change

The newest version of SRTS calculates land area shares according to updated equations originally published by Nagubadi, R., and D. Zhang. 2005. Determinants of Timberland Use by Ownership and Forest Type in Alabama and Georgia. *Journal of Agricultural and Applied Economics* 37(1): 173-186. The new Endogenous Acre Change feature allows acreage in each time step to change based on real sawtimber prices, real hardwood sawtimber prices, agricultural rents, population, and real income per capita. To accommodate alternative macroeconomic development and climate scenarios, the Endogenous Acre Change feature can be run under 5 alternative conditions (SSP1, SS2, SSP3, SSP4, and SSP5). Each alternative scenario makes different assumptions about county level changes in population and real income per capita, leading to different rates of land use change and forest inventory.

The system of k land share equations estimated for the Endogenous Acre Change module can be written as:

$$\ln\left(\frac{y_k(t,i)}{y_1(t,i)}\right) = \beta_k{}'X_{it} + \epsilon_{it}$$

Where $y_k(t,u)$ is the observed share land-use for land classification k in year t and in basin i (either developed land, agricultural land pine plantation forest, natural pine forest, mixed oak/pine forest, upland hardwood forest, or lowland hardwood forest). The variable $y_1(t,i)$ represents the observed land-use share of developed land, so that the left-hand side of the above equation presents the natural log of land-use shares relative to developed land. The right-hand side factors X_{it} incorporate macroeconomic variables which characterize each SSP (such as per capita GDP growth, forestland rents, ag land rents, developed land rents and indicators which capture basin and physiographic-region variation in land-use shares). The term ϵ_{it} is an additive idiosyncratic error term, which includes measurement error from cross-equation correlation. The parameters estimated for this module are the β_k, which represent elasticities when the factors X_{it} are in log-form. Taking the exponential of the above equation yields the land use shares in each period and basin:

$$\frac{y_{ki}}{y_{1i}} = \pi_{ki} \cdot (T/A)_i^{\beta_{1k}} \cdot P_i^{\beta_{2k}} \cdot I_i^{\beta_{3k}}$$

Where: $\left(\frac{T}{A}\right)_i$ is pine rent divided by ag rents. P_i is the population. I_i is per capita GDP. These land use shares are computed from the estimated elasticities (β_{1k}), the model-projected relative pine rents $\left(\frac{T}{A}\right)_i$, and the quantities $\pi_{ki} \cdot P_i^{\beta_{2k}} \cdot I_i^{\beta_{3k}}$ which are found in the "/lib" subfolder of the latest SRTS download. These parameters are used to compute the change in annual area of land across a basin across the k land-use classes, given the computed change in forestland rents determined by equilibrium timber prices from the market model (see Section 4 of this user guide).

1.7.3 Exogenous Acre Change - *.AC

The user specifies the acreage change by forest type in an auxiliary file. The filename must be the same as the .DAT filename with an ".AC" extension. The first line of the file is a description line which is not read. The following lines specify the region number, ownership group number, the year of the projection, followed by the annual percentage acreage change by forest type. Note the region number in this case is based on the order in the region list, NOT the SRTS region number used to link to the DBH distribution. The first region listed is region 1, second is region 2, etc.

The .AC file in the example below has been set up for a three basin run, with no land use change assumed to occur in the third region. In the file below, forest management type 1 (pine plantations or “PP”) is specified to expand in corporate plantations only in regions 1 and 2 by 5% in year 2 and by 2% in year 3. Forest management type 2 (natural pine or “NP”) is specified to decline by 1% in years 2 and 3 on corporate lands in regions 1 and 2. Natural pine forests are also specified to decline by 1% in years 2 and 3 on corporate lands in region 1 but decline by 4% in years 2 and 3 on non-corporate lands in region 2.

RG	OW	YR	PP	NP	OP	UH	BH
1	1	1	1	1	1	1	1
1	1	2	1.05	0.99	0.95	0.99	1
1	1	3	1.02	0.99	0.95	0.99	1
2	1	1	1	1	1	1	1
2	1	2	1	0.99	1	1	1
2	1	3	1	0.99	1	1	1
1	2	1	1	1	1	1	1
1	2	2	1.05	0.99	0.95	0.99	1
1	2	3	1.02	0.99	0.95	0.99	1
2	2	1	1	1	1	1	1
2	2	2	1	0.96	1	1	1
2	2	3	1	0.96	1	1	1

Note: any regions, owners, or years that are in your projection but NOT specified in your .AC file will be assumed to have no forestland use change (those buckets of acres will receive a value of 1 as in row one of the above example).

1.7.4 Exogenous Ag Price

The user specifies exogenous ag rent in an auxiliary file “lu_agprc.csv”. Contact Bob Abt for details.

1.7.5 PST Only Rent

If this box is checked pine pulpwood prices are excluded from the timberland rent calculation and only pine sawtimber affects interaction with agriculture.

1.7.6 Ag = For Rent

If this box is checked ag rents are assumed to change with forest rents which dampens the forest agriculture land exchange.

1.7.7 Storm Damage ("StormDmg" - *.BH)

The Storm Damage option requires the 'Optionfile' flag in the .DAT file. SRTS will look for a .BH file (i.e. "before hurricane") in the Data Folder. The .BH file is just a .INV file that has not been altered from what the FIA data says it should be. In a hurricane simulation run, the user is "damaging" the .INV file by removing volume in some age classes. When SRTS initializes, it uses the .INV file to determine what removals by age class should look like. In StormDmg mode, SRTS reads the original .INV file and uses those empirical harvests patterns in the model run.

1.8 Output Files

1.8.1 The Main Output File - *.GPG

The main output file provides summary information about the run across basins and over time. It provides inventory at the start of each year and removals occurring in that year. Removals numbers in this files represent the competitive equilibrium level of harvests in that year. Inventory numbers in this file represent the computed inventory AFTER a goal programming problem has distributed the competitive equilibrium harvest volume across age classes, forest management types, ownership groups and basins. . For example, if the .GPG file tells us that inventory of pine pulpwood (PPW) for a basin was 18 million Green Tons in year 2025 but the competitive equilibrium level of PPW removals in year 2025 was 1 million Green Tons, then the starting inventory of PPW in year 2026 should be approximately 17 million Green Tons (depending on how well the goal program was able to distribute the competitive equilibrium across age classes and forest management types).

If a WGTFACTOR was specified in the .PRD file, then removals and inventory data in this file are expressed in Green Tons. If the WGTFACTOR was set to 1.0 in the .PRD file, then inventory and removal data in this file are in MCF.

The file also computes price changes ($\ln P_t$) for each year of the projection. An initial price for a particular product in the starting year (P_0) of the projection can be used to scale up price changes for any future year t by computing: $P_t = P_{t-1} * e^{\ln P_{t-1}}$.

1.8.2 Configuration Settings File (Initialization) - *.INI

1.8.3 Run Description File - *.DSC

The .DSC file is a run description file that shows all settings from a model run with the same .DAT file name. This file also shows whether the harvest miss files (*.HVMISS or *.HVMISSPCT) should be checked following the completion of the run.

1.8.4 Harvest Miss File - *.HVMISS

After solving for the equilibrium allocation of all products in a region/ownership group, the model uses a goal program to allocate harvest across forest management types and age classes. The program attempts to meet the new harvest request while maintaining historical harvest patterns. By default, the goal program is set up with an equal incentive to hit all product requests (however these weights can be adjusted by reading in a .PW file). If the inventory is significantly depleted (>30%) it will likely miss harvest requests. The harvest in the .GPG file is the harvest request (i.e. the competitive equilibrium of removals). If less than 95% of requested harvest is obtained in any year, region, or owner the "CHECK HVMISS FILE" is flagged. This file shows the difference between the request and actual harvest. The columns of this file are Year, Region, and Owner, followed by a column for the harvest miss in tons for each product, in the same order as the PRD file.

If a WGTFACTOR was specified in the .PRD file, then removals and inventory data in this file are expressed in Green Tons.

1.8.5. Harvest Miss Percentage File - *.HVMISSPCT

The percentage difference between the harvest volume required by the market module ("REM_REQ") and the historical harvest pattern ("ADJ_REM") is found in the .HVMISSPCT file (under the variable header "REMACT/REMREQ"). When this ratio is greater than 1.0, the actual volume of removals exceeds the volume of removals requested by the market module. When this ratio is less than 1.0, the actual volume of removals falls short of the volume requested by the market module.

If a WGTFACTOR was specified in the .PRD file, then removals and inventory data in this file are expressed in Green Tons (except for the "REM_REQ" column, which is unitless).

1.8.6 Harvest Output File – "harvout.DAT"

Fractional changes in inventory, harvest and price by product (Prod Hvst), owner, region, and year.

1.8.7 Growth Adjustment File - *.GRWADJ

When the Calibrate Growth option is checked (by default), this output file reports the growth factors and adjusted growth per acre resulting from the calibration.

1.8.8 Debug File - *.DEBUG

1.8.9 DBH File - *.DBH

Reports organized in table form for growth, removals and volume by DBH class, management type, owner, region, owner, year and species.

1.8.10 DBH List File - *.DBHLST

Flat file version of the DBH file. Growth, removals and volume by DBH class, management type, owner, region, owner, year and species *before cull factors are applied according to the product specifications in the .PRD file*. Aggregate removals for a single species across all size classes and forest management types represents the *actual* level of removals as determined by the goal programming solution (should approximate the “ADJ_REM” column from the .HVMISSPCT file when summed across all products of a certain species.

1.8.11 Rent File - *.RENT

By year, this file gives indexed pine sawtimber and pine pulpwood prices (PSWPrc and PPWPrc), their respective weights in the rent calculation (PSTWgt and PPWWgt), and indexes for timber and agricultural rent (TbrRent and AgRent).

1.8.12 Land Use File - *.LANDUSE

Gives forest and agricultural land area by region and year.

1.8.13 Age File - *.AGE

Reports organized in table form for acres, volume, growth and removals by age class for each species, year, region, owner and management type.

1.8.14 Acres by Age File - *.ACBYAG

A flat file containing volume, growth, removals and acres by age class, management type, owner, region (and region number), species and year. Data on inventory, growth, and removals are expressed in MCF.

1.8.15 Harvest Acres File - *.HVSTAC

Gives clearcut volume (ClearcutVol), thinned volume (ThinVolume(MCF)), clearcut acres (ClearcutAcres), thinned acres (ThinAcres), and total acres (TotalAcres) by region (Rg), owner (Ow), management type (MT), and age class (AgeCls).

1.8.16 Clearcut Acres File - *.CCACRE

Gives acres that have been clearcut (Age0 Acres) by region (Rg), owner, (Ow), management type (MT), and year (Year).

1.8.17 Regional Price Change File - *.RP

In a multi-region run, the model can produce a price output for each region and owner combination, showing how that sub-region alone would react to the demand shift in the .PRJ file. This might be useful to rank supply constraints in sub-regions.

The regional price produced is a spot price that does not correspond to the actual removals from the region. The actual removals from a region come from assuming that one market-clearing price clears all regional markets.

1.8.18 Dynamic Cull Factor File - *.DCF

When the dynamic cull factor option is employed, this file gives the price ratio, cull factor and maximum cull factor change by year.

1.8.19 Linear Program File - ("lpfile.txt")

A printout of the minimized model and constraints. Variable names are abstract.

1.9 OptionFile

Users can employ the OptionFile setting for advanced settings in which the user needs to make many SRTS runs and wishes to reuse input files related to Modeling Options. By default, SRTS looks for optional files with the same name as the .DAT file being run (e.g. for "South35b.DAT" SRTS looks for "South35b.DC" or "South35b.FAUST"). If the user writes the word OptionFile in the Run Description line of the .DAT file, SRTS then looks for an additional filename on the line following the SRTS Region Numbers and Region Labels line. "MyOptionFile" can be any custom name.

```
AL OptionFile
"standard5.PRD" "MPCONST.PRJ" "v34a_1in_dbh_gs.csv" "ALStack_34a_gs.inv" "AL"
6 5 2016 44 1
1 "AL-SW_S" 2 "AL-SW_N" 3 "AL-SE" 4 "AL-WCtrl" 5 "AL-NCtrl" 6 "AL-North"
"MyOptionFile"
0.3 0.3 0.3 0.3 0.3
0.3 0.4 0.5 0.3 0.5
1.0 1.0 1.0 0.7 0.7
0.3 0.4 0.5 0.5 0.5
1.0 1.0 0.7 0.7 0.7
```

2. Connected Models

2.1 Output Visualization

SRTS produces text and csv file outputs. There are a few methods for visualizing results.

2.1.1 Excel

Some example Excel templates are provided in the documentation folder. Read "outputname.GPG" into Excel, where "outputname" is given in the .DAT file before a run.

1. Open as a space- and comma-delimited file.
2. Copy these data over a pre-existing worksheet with price equations, etc.
3. With the new data selected, sort by RegIdx, OwnIdx, ProdIdx (hidden columns) (or columns B, D, and G in the original datafile)

2.1.2 R

A postprocessing routine that plots and maps SRTS results using R has been developed. We are releasing this script file ("Postprocessing.R") with the most recent SRTS distribution. It can be found in the Postprocessing subfolder. Installation of R is necessary to run the code, and can be downloaded from the R-project website: https://www.r-project.org/.

To use the program, first run the SRTS model with a DAT file of your choice. After installation of R (which only needs to be done once), open "Postprocessing.R". Next, find and replace in this script file all instances of the existing working directory to the working directory where your SRTS executable file and corresponding output files from the most recent run are stored. Then to run the program, press "Ctrl + A" in the script file to select all lines of the code, then hit the "Run" symbol at the top left (or type Ctrl+Enter). After running the program, the resulting figures and data will be written to your working directory or the Runs subfolder within the SRTSv35c folder.

2.1.3 Interpreting and Validating Results

It is possible to successfully run the SRTS model, yet produce output that is unexpected. Here are some rules of thumb that should be observed.

1. If inventory is increasing at a faster rate than removals while demand is constant, prices should go down and vice versa.
2. If demand is rising and removals are rising, prices may rise, and inventory increases should counteract those price increases.
3. Under smooth demand projections, sharp year-to-year kinks are not typical.
4. If error codes or the 'Check HVMISS' message are encountered, see the appropriate documentation.
5. Consider using some of the advanced procedures if the model behavior de_es expectations.

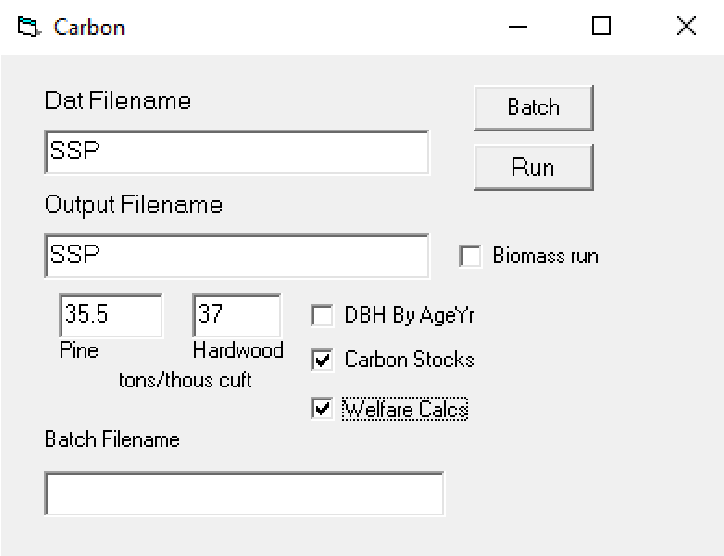
2.2 INVmaker

SRTS developers at North Carolina State University process inventory file requests using the INVmaker program. The INVmaker ("SRTS_INVmaker_062520.exe") executable is located in the Data folder. It looks for a ***basin request file*** (.csv) with three columns (typically supplied by SOFAC members). On the first row and first column, the total number of sub-regions should be designated. Sub-region labels, state FIPS code and county FIPS code should constitute the three columns in the file. The basin request for the entire south, "South35c.csv" located in the Data folder, demonstrates the appropriate format of this file for multiple-basin runs. The following is an excerpt of a basin request file, shown in Microsoft Excel.

	A	B	C
1	51		
2	AL-SW_S	1	3
3	AL-SW_S	1	39
4	AL-SW_S	1	53
5	AL-SW_S	1	97
6	AL-SW_S	1	129
7	AL-SW_N	1	23
8	AL-SW_N	1	25
9	AL-SW_N	1	35
10	AL-SW_N	1	91
11	AL-SW_N	1	99
12	AL-SW_N	1	119
13	AL-SW_N	1	131
14	AL-SE	1	1
15	AL-SE	1	5
16	AL-SE	1	11
17	AL-SE	1	13
18	AL-SE	1	17
19	AL-SE	1	21
20	AL-SE	1	31
21	AL-SE	1	41
22	AL-SE	1	45

2.3 Carbon & Welfare

The Carbon/Welfare post-processor uses output files from SRTS to calculate economic welfare and carbon pools implied by SRTS run results. To run the program, write the .DAT filename and Output filename in the appropriate fields, select the desired output files, and click 'Run'. To run the program for multiple SRTS runs, write the name of a batch file in the 'Batch Filename' field and instead click 'Batch'.



2.3.1 DBH by Age - *.DBHXAGE

From the Carbon/Welfare post-processor, selecting the 'DBH By AgeYr' option produces this file. It is a at file containing growth, volume, acres, removals and acres by DBH class, species, age class, management type, owner, region and year.

2.3.2 Carbon by Age - *.CARB BYAG

From the CarbonWelfare post-processor, selecting the 'Carbon Stocks' option produces this file. By year, region, owner, management type and age class, it gives acres, volume in cubic feet, volume in cubic meters per hectare, hectares, and metric tons for the following carbon pools: live tree, dead tree, understory, down and dead, forest floor and total aboveground carbon (in Megagrams or "metric tons").

```
YR,RG,OW,MTYPE,AgeClass,Acres,VolCuFt,m3/ha,Hectares,Livetree,Deadtree,UndSto
ry,DDead,Floor,Total Mg
```

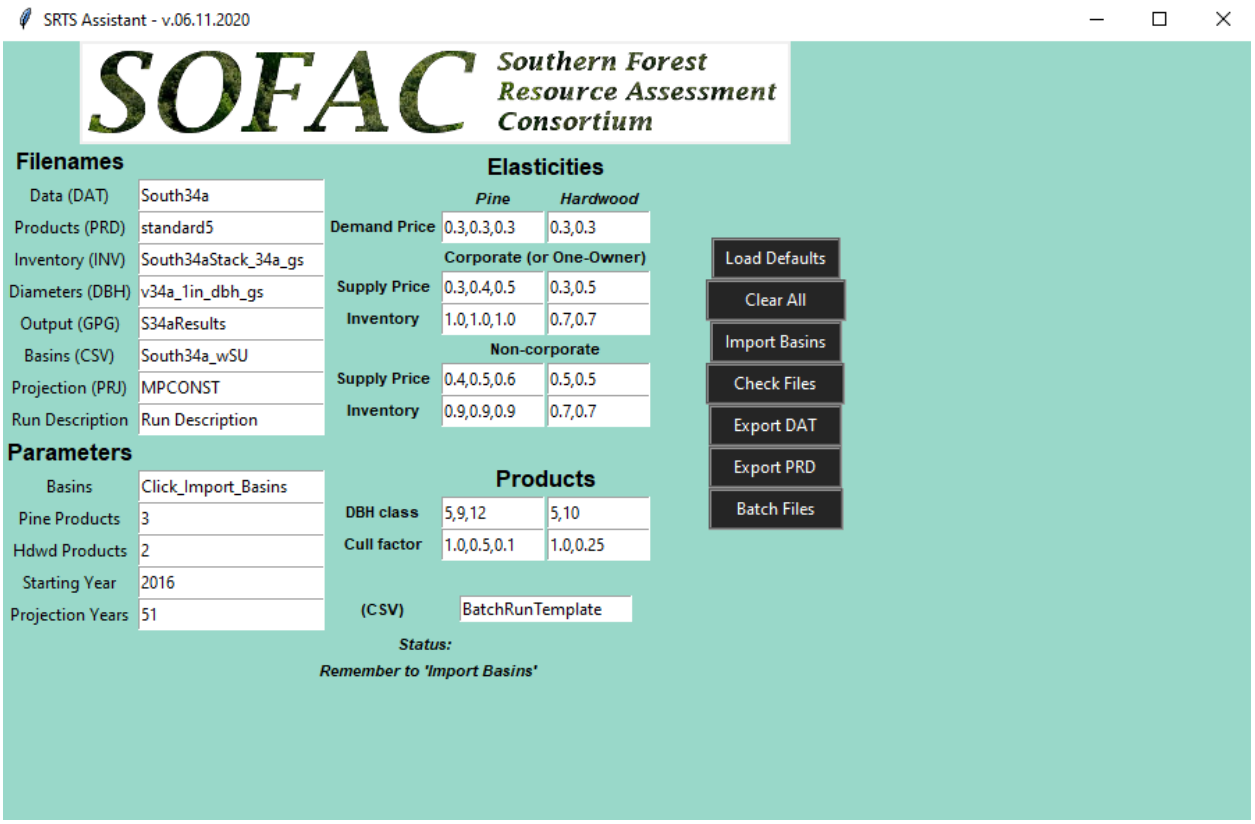
2.3.3 Welfare Analysis File - *.WELFARE

From the CarbonWelfare post-processor, selecting the 'Welfare Calcs' option produces this file. It gives producer surplus, consumer surplus, price and removals by product, owner, region and year.

2.4 SRTSassistant

This standalone executable written in Python is located in the same directory as the SRTS executable. It properly formats .DAT files and .PRD files, ensuring consistency and placing them in the appropriate location. The program automatically finds the SRTS ecoregion number that corresponds to custom basins.

The default values used by the program are found in the Data folder with a default file type. For advanced users, it is possible to manually alter these files using a text editor.



2.5 SRTSassistant (R version)

An R-based version of SRTSassistant is also available. SRTSAssistantv3.r can live anywhere. In the settings you will need to customize the paths to your SRTS directory etc.

SUtoSRTSReg.csv is needed by SRTSAssistanv3, and should be placed in the lib folder. You can overwrite the current version of that file. This file connects counties in the basin file (the file with subscript "_wSU" that is created by INVmaker) to SRTS Numbers which must be listed in the DAT file. The order of basins/sub-region in the basins file matches the order in the INV file, and the SRTS number and region are written in that order in the DAT file automatically by SRTSAssistantv3.r.

SRTSAssistant.xlsx should be placed in the main SRTS directory. It functions as a user interface. When the runs are set up here, and SRTSAssistantv3.r has correct filepaths, you can select all code in the R script and run. This will create and place all the DAT, PRD and INI files created in the appropriate directories.

This current version does not check that INV files for the run are located in the Data folder. This should be verified by the user. NOTE: Google Spreadsheets is not fully compatible with the Excel sheet (CONCAT function in particular). It must be opened in Microsoft Excel.

To use this version, open the file “SRTSassistantv3.R” in R or RStudio. Modify the directory in the following lines to your working directory, as below:

```
# Author: Jesse D. Henderson
# SRTS Assistant 2021
# Purpose: Generate input files for SRTS
# Goals:
# * compatible with HWSRTS
# * produces INI files for Monte Carlo
# * small and fast compared to python executable
library(tidyverse)
library(openxlsx)

# settings
mydir <- "E://SRTSv35c//Preprocessing//SRTS Assistant (R Version)//" # main
SRTS directory
datadir <- "E://SRTSv35c//data//" # SRTS data folder directory
libdir <-  "E://SRTSv35c//lib//" # SRTS lib folder directory
makeDAT <- TRUE
makePRD <- TRUE
makeINI <- TRUE
```

In the working directory (ex: `"E://SRTSv35c//Preprocessing//SRTS Assistant (R Version)//"`) open the file “SRTSAssistant.xlsx” and fill in parameters to characterize one or multiple runs. Then, running the file “SRTSassistantv3.R” in R will create a .DAT file, a .PRD file, and a .INI file needed to run the SRTS program based on the parameters in the accompanying excel file (“SRTSAssistant.xlsx”). For multiple runs, define parameters in a row-wise fashion, as below:

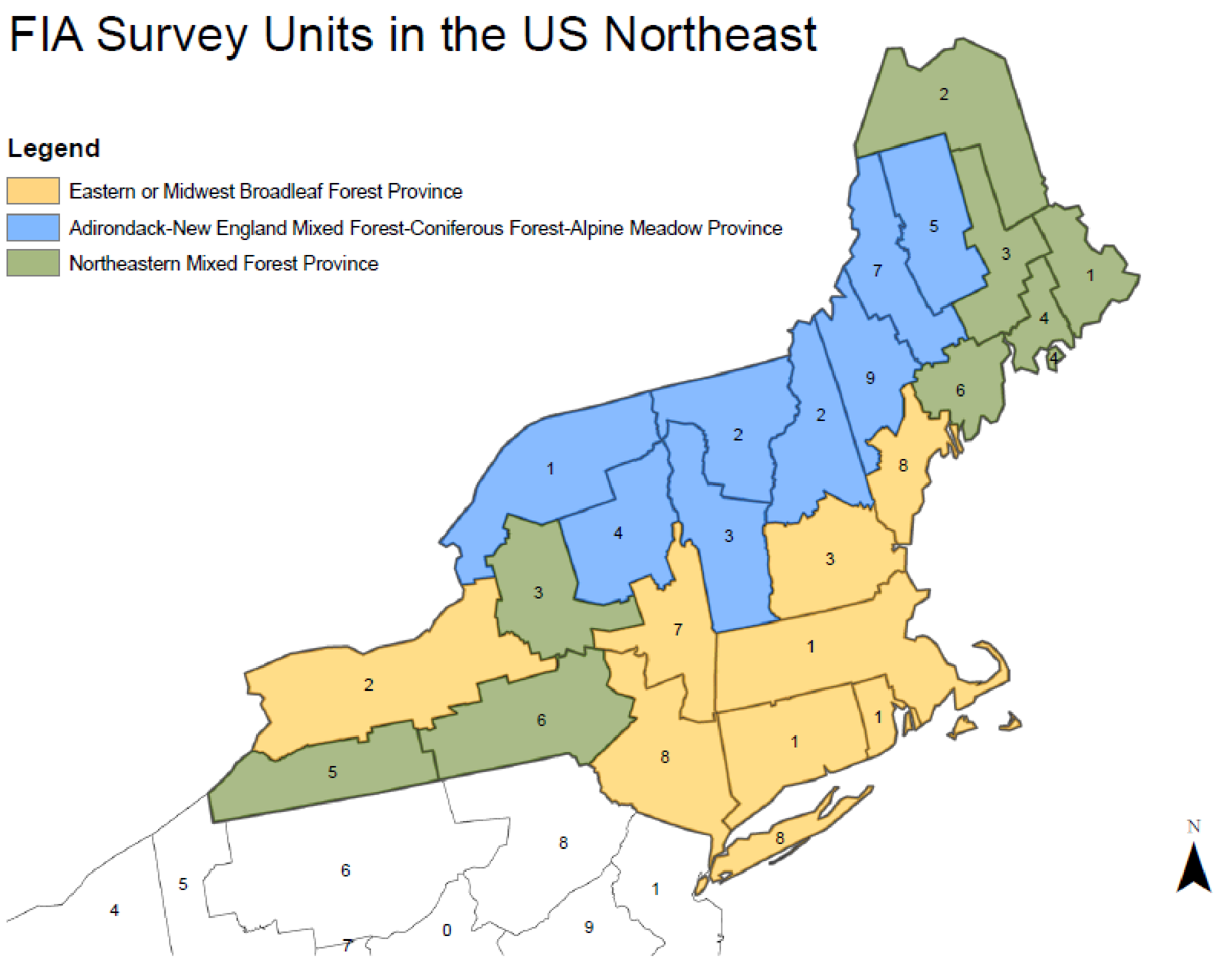
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	DAT file parameters											**Owner**	0	0	0
2												**Species**	1	1	1
3												**Product**	1	2	3
4	*Run*	*DAT*	*PRD*	*INV*	*DBH*	*GPG*	*basinFile*	*PRJ*	*1_Product*	*2_Product*	*startYear*	*projYears*	*0_1_1_DemPrice*	*0_1_2_DemPrice*	*0_1_3_DemPrice*
5	1	DAT1	standard6	NC	v34b_1in_dbh_gs	OUT1	NC_wSU	MPCONST	4	2	2016	2	0.308230163	0.289011085	0.315861178
6	2	DAT2	standard6	NC	v34b_1in_dbh_gs	OUT2	NC_wSU	MPCONST	4	2	2016	2	0.300127567	0.320221762	0.222190898

If multiple runs are specified in this spreadsheet, multiple .DAT files will be generated by “SRTSassistantv3.R”.

3. Extended SRTS Versions

3.1 Northern SRTS

Latest Version - July 2015



Northern SRTS was developed in collaboration with researchers in New Hampshire. It sought to introduce more detail in hardwoods, primarily expressed through partial harvest functionality. This effort contained one hardwood species group category, with 8 management types reflecting more heterogeneity by species.

3.1.1 FIA Survey Units in the US Northeast

Northern SRTS was developed in collaboration with researchers in New Hampshire. It sought to introduce more detail in hardwoods, primarily expressed through partial harvest functionality. This effort contained one hardwood species group category, with 8 management types reflecting more heterogeneity by species.

3.2 Hardwood SRTS

Under Development

A Hardwood SRTS model is being developed to study developing hardwood scarcity issues outside the scope of the standard SRTS model. The following tables show the current proposed species groups, based on a 5% cut-off for species abundance (Table 3.1 and 3.2). Table 3.3 shows forest types, or management types.

Regional Extent of Hardwood SRTS Model with Unit ID Numbers

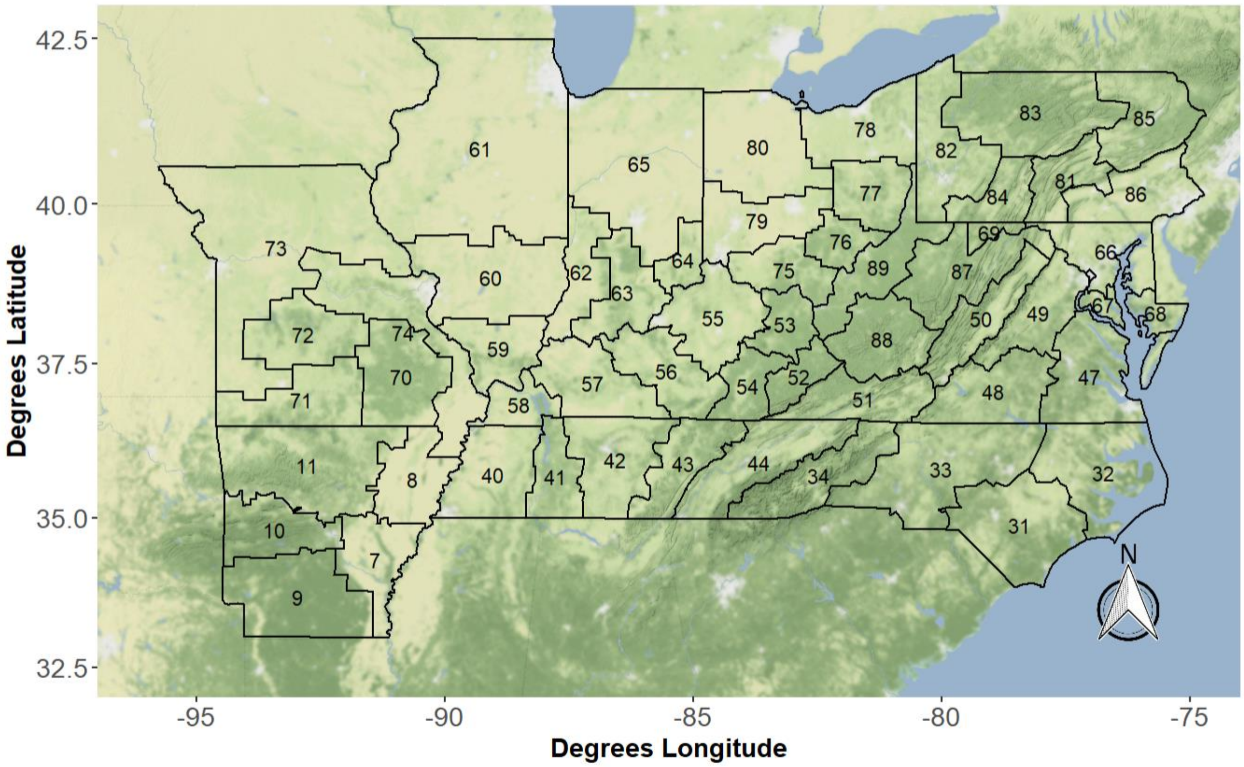


Table 3.1: Selected Species Groups for the Hardwood SRTS Study Region

SPGRPCD	SPGRP_NAME	Percent	Species Code	Species Abbrev.
2	Loblolly and shortleaf pines	9.26	1	SYP
25	Select White Oaks	9.70	2	SWO
39	Yellow-Poplar	12.11	3	POP
28	Other Red Oaks	8.37	4	ORO
32	Soft Maple	8.23	5	MAP
41	Other eastern soft hardwoods	7.35	6	OSH
27	Other White Oaks	6.77	7	OWO
29	Hickory	6.54	8	OHH
26	Select Red Oaks	5.83	9	SRO
31	Hard Maple	4.34	8	OHH
36	Ash	3.08	8	OHH
34	Sweetgum	2.56	6	OSH
3	Other yellow pines	2.12	1	SYP
4	Eastern white and red pines	2.05	10	CON
42	Other eastern hard hardwoods	2.00	8	OHH
33	Beech	1.98	8	OHH
35	Tupelo and blackgum	1.62	6	OSH
7	Eastern hemlock	1.26	10	CON
40	Black Walnut	1.08	8	OHH
38	Basswood	1.00	6	OSH
37	Cottonwood and aspen	0.99	6	OSH
9	Other eastern softwoods	0.83	10	CON
1	Longleaf and slash pines	0.29	3	SYP
8	Cypress	0.28	10	CON
30	Yellow birch	0.26	8	OHH
6	Spruce and balsam fir	0.11	10	CON
5	Jack pine	0.00	10	CON
43	Eastern noncommercial hardwoods	0.00	6	OSH

Table 3.2: Species Codes, Abbreviations and Descriptions

Species Code	Species Apprev.	Species Description
1	SYP	Southern Yellow Pine
2	SWO	Select White Oak
3	POP	Yellow Poplar
4	ORO	Other Red Oaks
5	MAP	Soft Maple
6	OSH	Other Soft Hardwoods
7	OWO	Other White Oak
8	OHH	Other Hard Hardwoods
9	SRO	Select Red Oak
10	CON	Other Softwood Conifers

Table 3.3: Selected Forest Type Groups ("Management Types") for the Hardwood SRTS Study Region

TYPEGRPCD	Name	Type Code
	Southern Yellow Pine + Other SW	**1**
160	Loblolly/shortleaf pine group	
140	Longleaf/slash pine group	
120	Spruce/fir group	
170	Other eastern softwoods group	
200	Douglas-fir group	
260	Fir/Spruce/Mountain Hemlock group	
380	Exotic softwoods group	
390	Other softwoods group	
	Mixed Oak & Pine group	**2**
400	Oak/pine group	
	Oak	**3**
500	Oak/Hickory group	
	Bottomland & Other Hardwoods	**4**
600	Oak/gum/cypress group	
700	Elm/ash/cottonwood group	
960	Other hardwoods group	
990	Exotic hardwoods group	
	Maple & Birch	**5**
800	Maple/beech/birch group	
900	Aspen/birch group	
100	White/red/jack pine group	

Table 3.4: Age Classes the Hardwood SRTS Study Region

Age Class	Years
1	0-10 yrs.
2	11-20 yrs.
3	21-30 yrs.
4	31-40 yrs.
5	41-50 yrs.
6	51-60 yrs
7	61-70 yrs.
8	71-80 yrs.
9	81-90 yrs.
10	91-100 yrs.
11	100+ yrs.

4. Technical Documentation

4.1 Economic model

The Sub-regional Timber Supply Model (SRTS) is a short-run partial-equilibrium economic model that spatially optimizes timber harvests for a market-wide demand, subject to sub-regional supply curves that reflect price and annual inventory constraints.

The economic module in SRTS uses constant elasticity supply and demand curves. For each sub-region (i), owner (o), and product (j) in one-year time steps (t), the supply function (Q^S) is a function of price (P) and total growing stock inventory (V), parameterized by a price elasticity of supply (γ) and an inventory elasticity (τ) as represented in Equation 4.1. A market-wide demand curve (Q^D) in Equation 4.2 is parameterized by a price elasticity of demand (ϵ) and an exogenous demand shifter (G). The model sums sub-regional supply curves to obtain market-wide supply and equates this with the market-wide demand (Equation 4.3).

$$Q^S_{iojt} = \alpha P_{jt}^{\gamma_{oj}} V_{iojt}^{\tau_{oj}} \tag{4.1}$$

$$Q^D_{jt} = \beta P_{jt}^{\epsilon_j} G_{jt}^{\delta_j} \tag{4.2}$$

$$\sum_{ioj} Q^S_{iojt} = Q^D_{jt} \tag{4.3}$$

The model recursively solves for these market equilibria on an annual time step using a binary search algorithm. Given the region-wide market clearing price P_j^* in year t, the basin-level equilibrium harvest quantity is obtained by reading this price off the basin-level supply curve, given that basin's inventory volume ($Q_j^{S^*}$). There are as many equilibrium harvest values ($Q_j^{S^*}$) for a given year, ownership, and basin, as there are products defined in the .PRD file.

4.2. Solution approximation

SRTS must now determine how to distribute the annual (short-run) equilibrium harvest levels for each timber product across the inventory's age class distribution. To accomplish this, the partial equilibrium solutions are used to define a set of competing goals so that SRTS can compute the harvest allocation across alternative forest types and age classes. This defines a weighted linear goal programming problem.

$$\underset{\{x_{gm}:(\mu_j,\nu_j):(s^1_{gm},s^2_{gm})\}}{\text{minimize:}} \left\{ \sum_{j=1}^{J} W_j(\mu_j + \nu_j) + \sum_{g=3}^{11}\sum_{m=1}^{5} Z_{gm}(s^1_{gm} + s^2_{gm}) \right\}$$

$$subject\ to:$$

$$\sum_{g=3}^{11}\sum_{m=1}^{5} c_{jgm}x_{gm} + \mu_j - \eta_j = Q_j^{S^*} \quad \forall j = 1, \dots, J$$

$$x_{gm} + s_{gm}^1 - s_{gm}^2 = \frac{Q_{gm,t-1}^S}{V_{gm,t-1}} \quad \forall g = 3, \dots, 11 \ \& \ \forall m = 1, \dots, 5$$

$$\mu_j \geq 0, \eta_j \geq 0, s_{gm}^1 \geq 0, s_{gm}^2 \geq 0, \ x_{gm} \geq 0 + upperbounds$$

Where:

- x_{gm}: volume of removals relative to inventory in age class g, forest type m.
- c_{jgm}: volume of product j's inventory that is in in age class g, forest type m.
- μ_j, η_j: slack variables. The quantity of harvest above/below the competitive market equilibrium Q_j^*.
- s_{gm}^1, s_{gm}^2: slack variables. The extent of removal intensity above/below last year's intensity
- W_j: "Product Weights." The relative importance of hitting the competitive market equilibrium for product j. *Note: These weights can be adjusted in a .PW file.*
- Z_{gm}: "Path Dependency Weights." The relative importance of harvesting the same removal intensity in age class g, forest type m as last year's removal intensity. *Note: Users cannot currently specify these weights with an additional input file. They are set based on starting conditions observed in the .INV file (starting year FIA data).*

This problem is solved for each basin, ownership group, and year of a SRTS projection. This problem is solve using a variant of the dual-simplex method. The solutions are used to draw down the available inventory within a basin, before the inventory across each age class and forest type in the basin is grown according to the regression per acre data provided in the .INV file.

4.2 Computing basin-level prices from a multi-basin run

By default, SRTS will compute market-wide annual percentage changes in roundwood prices in the .RP file. The market-clearing condition requires:

$$\alpha P_{jt}^{\gamma_j} V_{jt}^{\tau_j} = \beta P_{jt}^{\epsilon_j} G_{jt}^{\delta_j}$$

Taking the natural log of both sides:

$$\ln \alpha + \gamma_j \ln P_{jt} + \tau_j \ln V_{jt} = \ln \beta + \epsilon_j \ln P_{jt} + \delta_j \ln G_{jt}$$

Taking the first-difference of both sides (the annual change from year to year):

$$\gamma_j \Delta \ln P_{jt} + \tau_j \Delta \ln V_{jt} = \epsilon_j \Delta \ln P_{jt} + \delta_j \Delta \ln G_{jt}$$

Re-arrange to solve for price returns:

$$\Delta \ln P_{jt} = \left(\frac{\delta_j}{\gamma_j - \epsilon_j}\right) \Delta \ln G_{jt} - \left(\frac{\tau_j}{\gamma_{oj} - \epsilon_j}\right) \Delta \ln V_{jt}$$

Or as computed from the .RP file:

$$PrcChg = \left(\frac{\delta_j}{\gamma_j - \epsilon_j}\right) * DemChg - \left(\frac{\tau_{oj}}{\gamma_j - \epsilon_j}\right) * InvChg$$

Where: $\epsilon_j < 0; \gamma_j > 0; \tau_j > 0; \delta_j = 1.0$.

Note:

- $\frac{\partial \Delta \ln P_{jt}}{\partial \Delta \ln G_{jt}} = \frac{\delta_j}{\gamma_j - \epsilon_j} > 0$. When demand growth is larger, roundwood price returns will be higher.
- $\frac{\partial \Delta \ln P_{jt}}{\partial \Delta \ln V_{jt}} = -\frac{\tau_j}{\gamma_j - \epsilon_j} < 0$. When inventory growth is larger, roundwood price returns will be lower.

4.3 FIA Summary Procedures

The biology and initial conditions in SRTS are derived from summarized Forest Inventory and Analysis (FIA) plot data for growth, inventory and removals for each sub-region, retaining heterogeneous features of ownership (corporate, non-corporate), management type, species, age class, and diameter- at-breast-height (DBH) distributions by physiographic region.

Management type ("MT" or "MType") is defined by the following conditions of forest type codes (FORTYPCD) and stand origin codes (STDORGCD) available in the FIA data:

1) **Pine Plantation**: STDORGCD=1 and (FORTYPCD<500 or FORTYPCD=999). Planted stands that are a pine/softwood forest type or oak-pine forest type or nonstocked (Nonstocked is assigned to coditions that are <10% stocked so the assignment of MT relies on the forest type assigned by field crews for these plots).
2) **Natural Pine**: STDORGCD=0 and (FORTYPCD<400). Natural stands that are a pine/softwood forest type.
3) **Mixed Pine**: STDORGCD=0 and (FORTYPCD 400-409). Natural stands that are classified as oak-pine forest type.
4) **Upland Hardwood**: (FORTYPCD 500-599 or 800-990). Hardwood stands that are classified as oak-hickory, maple-beech-birch, and other miscellaneous hardwood types.
5) **Bottomland Hardwood**: (FORTYPCD 600-799). Hardwood stands that are classified as oak-gum-cypress or elm-ash-cottonwood forest types.

4.3 Merchandising Procedure

Users define products by their diameter-at-breast-height (DBH) measurement in inches in the .PRD file. DBH distributions by age class and other dimensions, contained in the DBH file, are combined with growing stock and removals information in the INV file to obtain growing stock and removals by product in each age class by species, ownership, and management type.

4.4 Advanced Options

4.5 SRTS Code

SRTS is currently written in Visual Basic. The logical structure of the model is presented below, organized by module components.

4.5.1 Main – ("srtsmmddyy.FRM")

This form file controls the design and variable inputs from the user interface.
Sub-processes:

1. Command1 Click()
   - Calls MakeHvstPrj()
2. LoadSettings Click()
   - Loads the *.ini file
3. Form Load()
   - Loads the setup.id file

4.5.2 GPHARV – ("gphvstmmddyy.BAS")

This module manages harvest calculations.
Sub-processes:

1. GPHVST()
   - Calls the goal program to minimize harvest misses by management type and age class.
2. MakeHvstPrj()
   - Determines removals by product implied by the .INV, .PRD and .DBH files and creates the "MPCONST.PRJ" file.
3. ProdVolByAC()
   - Calculates product volume by age class, merchandizing through the .DBH file.
4. ReadVolByDBH()
   - Reads the .DBH file.
5. RedimArrays()
   - Redimension arrays to save memory.
6. ToAnnual()
   - Annualizes removals and volume data from age class data.

- Makes growth calculations

4.5.3 Module 1 – (“frontkey.bas”)
This module simply provides a license key for the linear programming solver.

4.5.4 MPMAIN – (“mpmainmmddyy.bas”)
This module declares most variables in the model, simulates biology, and handles particular model behaviors related to user settings.

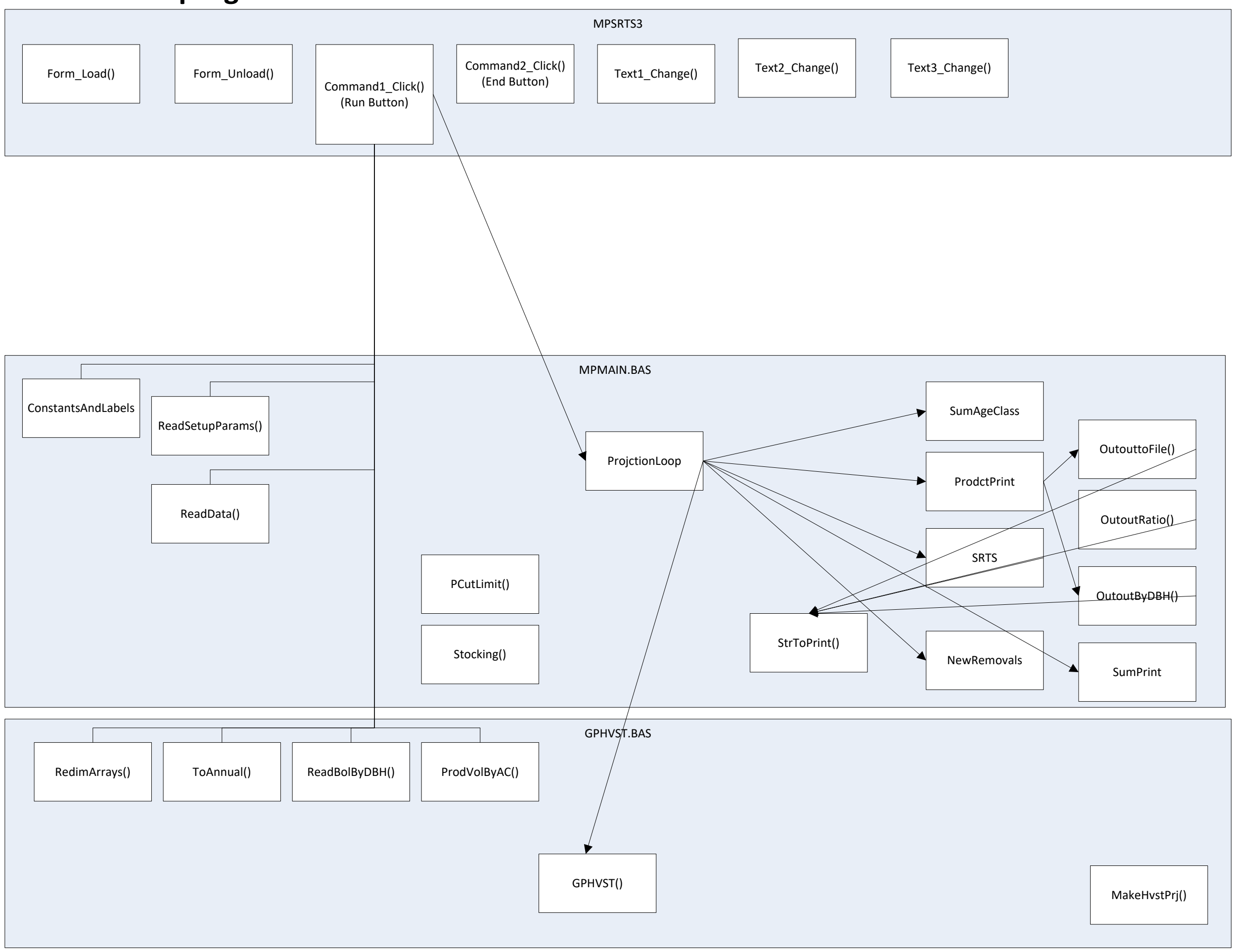
Sub-processes:

1. ConstantsAndLabels()
2. NewRemovals()
3. OutByDBH()
4. OutRatio()
5. OuttoFile()
6. ProdtPrint()
    - Calls OutToFile, OutByDBH
7. ProjectionLoop()
    - Initiates most output files:
        i. “harvout.dat”
        ii. *.GPG
        iii. *.AGE
        iv. *.ACR
        v. *.DBH
        vi. *.ACBYAG
        vii. *.DEBUG
        viii. *.DSC
        ix. *.DBHLST
        x. *.LANDUSE
        xi. *.HVSTAC
        xii. *.CCACRE
        xiii. *.RENT
        xiv. *.DCF
    - Calls other subproceeses:
        i. SumAgeClass
        ii. ProdtoPrint
        iii. SRTS
        iv. GPHVST
        v. NewRemovals,
        vi. SumPrint
8. ReadData()

- Reads the .INV file (var = *DataFile*)
- Creates the *.GRWADJ file

9. ReadSetupParams()
   - Reads the .DAT file
   - Reads Modeling options from the user interface, conditionally looking for supporting files.
10. SRTS()
    - Declares variables and weights for the linear program.
    - Reads in the .PRJ file.
    - Sums across sub-regions to obtain total removals by owner, total removals, and total inventory.
    - Calculates percent of total harvest by owner.
    - Imposes market equilibrium constraints and employs an equilibrium price search loop.
    - Prints the .GPG file and additional output files.
11. PCutLimit() - deprecated(?)
12. Stocking()
    - Calculates volume per acre by species, region, owner, management type, age class, planting year
13. SumAgeClass()
    - Aggregates annual data age classes
    - Grows inventory volume by age class
14. SumPrint()
    - Prints the “harvout.dat” file.

Schematic of program Procedures



4.5.5 SaFrontmip – ("safrontmip.bas")

This file declares functions and variables for the linear programming solution. References Frontmip.DLL.

4.5.6 Annual TPO adjustment coefficients for construction of a .DC file

SRTS relies on a static picture of forest inventory, growth and removals to initialize product-specific harvests in year 0 of a projection. However, this static picture is based on the average measurement date of plots surveyed in the U.S. Forest Service Forest Inventory and Analysis (FIA) program. For version 36a of the southwide U.S. FIA data, this average measurement date occurs in year 2018. To bring the forest inventory up to the current period, a method is needed to estimate the recent historical pattern of removals across sub-regions (from 2018 to the adjusted 2018 estimate, then again from 2019 through 2020). SOFAC uses a method which relies on TPO production information. Recent changes in the TPO survey towards an annual sampling strategy has allowed us to refine this methodology to compute adjustment coefficients for each year where a basin's average plot measurement dates may be.

Our method takes the TPO production data that has been aggregated to the basin level, then computes a set of coefficients for each year, sub-region, and roundwood product. These adjustment coefficients represent the annual percentage change in removals across 4 roundwood product classes: 1) small softwood, 2) large softwood, 3) small hardwood, and 4) large hardwood. Removals data in year 0 (as determined by FIA) is based on an annualized average of the removals measured from re-measured plots over the course of the latest FIA sampling cycle. Therefore, in order for our estimates of removals beyond year 0 to be commensurate with the FIA removal data, we require our TPO adjustment coefficients to be weighted according to a similar scheme. For states with a 5-year FIA cycle, the TPO adjustment coefficients in year t are computed as:

$$Small\ Roundwood: C_t = \frac{(Pulpwood_t + Composite_t + OtherIndustrial_t)}{W_t} - 1,$$

$$where\ W_t = (Pulpwood_t + Composite_t + OtherIndustrial_t) * \left(\frac{1}{30}\right) * \sum_{t}^{t-9} \left(6 - abs\left(\frac{t + (t-9)}{2} - t\right) - 0.5\right)$$

$$Large\ Roundwood: C_t = \frac{(Sawlog_t + Veneer_t)}{W_t} - 1,$$

$$where\ W_t = (Sawlog_t + Veneer_t) * \left(\frac{1}{30}\right) * \sum_{t}^{t-9} \left(6 - abs\left(\frac{t + (t-9)}{2} - t\right) - 0.5\right)$$

These coefficients are identical for both softwood and hardwood products. For states on a 7-year cycle, the weights W_t are computed as:

$$W_t = (Pulpwood_t + Composite_t + OtherIndustrial_t) * \left(\frac{1}{56}\right) * \sum_{t}^{t-13} \left(8 - abs\left(\frac{t + (t-13)}{2} - t\right) - 0.5\right)$$

and

$$W_t = (Sawlog_t + Veneer_t) * \left(\frac{1}{56}\right) * \sum_{t}^{t-13} \left(8 - abs\left(\frac{t + (t-13)}{2} - t\right) - 0.5\right)$$

When a custom-defined basin straddles states with alternative FIA cycle lengths, the coefficient is computed according to whichever state contains the majority of counties within the basin. These TPO adjustment coefficients are used to build a Direct Change (.DC) file. To correctly initialize SRTS in year 1 of a projection (R_1), compute the percentage change from removals in year 0 (given by an MPCONST run) of the corresponding product type by applying the adjustment coefficients for year 0. For example, to compute removals within a basin for year 1 of your projection, you would compute:

$$R_1 = R_0 * (1 + C_0)$$

Where R_0 is the estimate of removals given by FIA data (from an MPCONST run) for year 0 and C_0 is the adjustment coefficient for that year. For example, if the average measurement date in your basin occurs in year 2018, then year 0 removals determined from an MPCONST run represents the unadjusted 2018 removals. Year 1 removals should be the adjusted 2018 removals computed as: $R_{2018} * (1 + C_{2018})$. Then, your SRTS projection would start in year 2017, such that Year 1 of the projection removes the correct 2018 estimate of removals.

To get Year 2 removals (for year 2019 in our example), one can compute the change in unweighted TPO production from 2018 to 2019 (Δ_1). Then compute: $R_2 = R_1 * (1 + \Delta_1)$. Similarly, Year 3 removals (for year 2020 in this example), one can compute the change in unweighted TPO production from 2019 to 2020 (Δ_2). Then compute: $R_3 = R_2 * (1 + \Delta_2)$.

In the SRTS download, you can refer to the Excel-based routine for developing .DC files (found in the "/Documentation" folder) or the R-based routine (found in the "/Preprocessing" folder). Refer to Section 1.6.11 of this User Guide for more information about .DC file construction.

5. Publications (SRTS applications)

The following is a list of papers and publications which have applied the Sub-Regional Timber Supply model (SRTS).

Abt, K.L., Abt, R.C. Galik, C. 2012. Effect of Bioenergy Demands and Supply Response on Markets, Carbon, and Land Use. *Forest Science* 53(5), 523-539. https://doi.org/10.5849/forsci.11-055

Abt, R.C., Abt, K.L., Cubbage, F.W., Henderson, J.D., 2010. Effect of policy-based bioenergy demand on southern timber markets: A case study of North Carolina. *Biomass and Bioenergy*. https://doi.org/10.1016/j.biombioe.2010.05.007

Abt., R.C., Cubbage, F.W., Abt, K.L. 2009. Projecting southern timber supply for multiple products by subregion. *Forest Products Journal* 59(7-8), 7-16. https://www.fs.usda.gov/research/treesearch/36290

Abt, R.C., Cubbage, F.W., Pacheco, G. 2000. Southern Forest Resource Assessment using the Subregional Timber Supply (SRTS) Model. *Forest Products Journal* 50(4), 25-33. https://www.fs.usda.gov/research/treesearch/2289

Abt, R.C., Galik, C.S., Henderson, J.D., 2010. The Near-Term Market and Greenhouse Gas Implications of Forest Biomass Utilization in the Southeastern United States. Nicholas School of the Environment, Duke University. Working Paper. CCPP-10.01. Durham, NC.

Bingham, M.F.., Prestemon, J.P.., MacNair, D.J.., Abt, R.C.., 2003. Market structure in U.S. southern pine roundwood. *Journal of Forest Economics* 9(2), 97-117. https://doi.org/10.1078/1104-6899-00025

Dhungel, G., Rossi, D., Henderson, J., Abt, R., Sheffield, R., Baker, J. 2023. Critical market tipping points for high-grade white oak inventory decline in the central hardwoods region of the United States. *Journal of Forestry*. https://doi.org/10.1093/jofore/fvad005

Duden, A.S., Verweij, P.A., Junginger, H.M., Abt, R.C., Henderson, J.D., Dale, V.H., Kline, K.L., Karssenberg, D., Verstegen, J.A., Faaij, A.P.C., van der Hilst, F., 2017. Modeling the impacts of wood pellet demand on forest dynamics in southeastern United States. *Biofuels Bioproducts & Biorefining* 11, 1007-1029. https://doi.org/10.1002/bbb.1803

Galik, C.S., Abt, R.C., 2016. Sustainability guidelines and forest market response: an assessment of European Union pellet demand in the southeastern United States. *GCB Bioenergy* 8, 658-669. https://doi.org/10.1111/gcbb.12273

Galik, C.S., Abt, R.C., Latta, G., Meley, A., Henderson, J.D., 2016. Meeting renewable energy and land use objectives through public-private biomass supply partnerships. *Applied Energy* 172(5), 264-274. https://doi.org/10.1016/j.apenergy.2016.03.047

Galik, C.S., Abt, R.C., Latta, G., Vegh, T., 2015. The environmental and economic effects of regional bioenergy policy in the southeastern U.S. *Energy Policy* 85, 335-346. https://doi.org/10.1016/J.ENPOL.2015.05.018

Guo, Z., Hodges, D.G., Abt, R.C., 2011. Forest Biomass Supply for Bioenergy Production and Its Impacts on Roundwood Markets in Tennessee. *Southern Journal of Applied Forestry* 35, 80-86. https://doi.org/10.1093/sjaf/35.2.80

Henderson, J.D., R.C. Abt, K.L. Abt, J. Baker, R. Sheffield. 2022. Impacts of hurricanes on forest markets and economic welfare: The case of hurricane Michael. *Forest Policy and Economics* 140: 102735. https://doi.org/10.1016/j.forpol.2022.102735

Henderson, J.D., Parajuli, R., Abt, R.C. 2020. Biological and market responses of pine forests in the US Southeast to carbon fertilization. *Ecological Economics* 169, 106491. https://doi.org/10.1016/j.ecolecon.2019.106491

Murray, B.C., Abt, R.C., 2001. Estimating price compensation requirements for eco-certified forestry. *Ecological Economics* 36(1), 149-163. https://doi.org/10.1016/S0921-8009(00)00224-X

Parajuli, R., Tanger, S., Abt, R., Cubbage, F. 2019. Subregional Timber Supply Projections with Chip-N-Saw Stumpage: Implications for Southern Stumpage Markets. *Forest Science* 65(6), 665-669. https://doi.org/10.1093/forsci/fxz044

Pattanayak, S.K., Abt, R.C., Sommer, A.J., Cubbage, F., Murray, B.C., Yang, J.C., Wear, D., Ahn, S.E., 2004. Forest forecasts: Does individual heterogeneity matter for market and landscape outcomes? *Forest Policy and Economics* 6 (3-4), 243-260. https://doi.org/10.1016/j.forpol.2004.03.017

Rafal, C., Abt, R.C., Jonsson, R., Prestemon, J.P., Cubbage, F.W., 2013. Modeling the Impacts of EU Bioenergy Demand on the Forest Sector of the Southeast U.S *Journal of Energy and Power Engineering* 7, 1073-1081.

Rossi, D., J. Baker, R. Abt. Quantifying additionality thresholds for forest carbon offsets in Mississippi pulpwood markets. *Forest Policy and Economics* 156: 103059. https://doi.org/10.1016/j.forpol.2023.103059

Rossi, D., J. Baker, R. Abt. 2022. Quantifying additionality thresholds for forest carbon offsets in southern pine pulpwood markets. *Selected Paper prepared for presentation at the 2022 AAEA Meeting. Anaheim, CA. July 31-Aug. 2.* 10.22004/ag.econ.322510

Rossi, F.J., Carter, D.R., Abt, R.C., 2010. Woody Biomass for Electricity Generation in Florida: Bioeconomic Impacts under a Proposed Renewable Portfolio Standard (RPS) Mandate Final Report.

Sendak., P.E., Abt, R.C., Turner, R.J. 2003. Timber supply projections for Northern New England and New York: Integrating a market perspective. *Northern Journal of Applied Forestry* 20(4), 175-185. https://doi.org/10.1093/njaf/20.4.175

Young, T.M., Hodges, D.G., Abt, R.C., Hartsell, A.J., Perdue, J.H., 2009. Regional Comparative Advantage for Woody Biofuels Production. Final Rep. US DOT Southeast. Sun Grant Center. Univ. Tennessee, Knoxville. 167p.

Appendix A – County List

Table A.1: Counties within each Sub-Region (see map in Section 1 of this user guide)

Sub-region	Sub-Region number	State	County name	FIPS code
AL-SW_S	1	Alabama	Baldwin	01003
AL-SW_S	1	Alabama	Covington	01039
AL-SW_S	1	Alabama	Escambia	01053
AL-SW_S	1	Alabama	Mobile	01097
AL-SW_S	1	Alabama	Washington	01129
AL-SW_N	2	Alabama	Choctaw	01023
AL-SW_N	2	Alabama	Clarke	01025
AL-SW_N	2	Alabama	Conecuh	01035
AL-SW_N	2	Alabama	Marengo	01091
AL-SW_N	2	Alabama	Monroe	01099
AL-SW_N	2	Alabama	Sumter	01119
AL-SW_N	2	Alabama	Wilcox	01131
AL-SE	3	Alabama	Autauga	01001
AL-SE	3	Alabama	Barbour	01005
AL-SE	3	Alabama	Bullock	01011
AL-SE	3	Alabama	Butler	01013
AL-SE	3	Alabama	Chambers	01017
AL-SE	3	Alabama	Chilton	01021
AL-SE	3	Alabama	Coffee	01031
AL-SE	3	Alabama	Crenshaw	01041
AL-SE	3	Alabama	Dale	01045
AL-SE	3	Alabama	Dallas	01047
AL-SE	3	Alabama	Elmore	01051
AL-SE	3	Alabama	Geneva	01061
AL-SE	3	Alabama	Henry	01067
AL-SE	3	Alabama	Houston	01069
AL-SE	3	Alabama	Lee	01081
AL-SE	3	Alabama	Lowndes	01085
AL-SE	3	Alabama	Macon	01087
AL-SE	3	Alabama	Montgomery	01101
AL-SE	3	Alabama	Pike	01109
AL-SE	3	Alabama	Russell	01113
AL-SE	3	Alabama	Tallapoosa	01123
AL-WCtrl	4	Alabama	Bibb	01007
AL-WCtrl	4	Alabama	Fayette	01057
AL-WCtrl	4	Alabama	Greene	01063
AL-WCtrl	4	Alabama	Hale	01065
AL-WCtrl	4	Alabama	Lamar	01075
AL-WCtrl	4	Alabama	Marion	01093

AL-WCtrl	4	Alabama	Perry	01105
AL-WCtrl	4	Alabama	Pickens	01107
AL-WCtrl	4	Alabama	Tuscaloosa	01125
AL-NCtrl	5	Alabama	Blount	01009
AL-NCtrl	5	Alabama	Calhoun	01015
AL-NCtrl	5	Alabama	Cherokee	01019
AL-NCtrl	5	Alabama	Clay	01027
AL-NCtrl	5	Alabama	Cleburne	01029
AL-NCtrl	5	Alabama	Coosa	01037
AL-NCtrl	5	Alabama	Cullman	01043
AL-NCtrl	5	Alabama	Etowah	01055
AL-NCtrl	5	Alabama	Jefferson	01073
AL-NCtrl	5	Alabama	Randolph	01111
AL-NCtrl	5	Alabama	St. Clair	01115
AL-NCtrl	5	Alabama	Shelby	01117
AL-NCtrl	5	Alabama	Talladega	01121
AL-NCtrl	5	Alabama	Walker	01127
AL-NCtrl	5	Alabama	Winston	01133
AL-North	6	Alabama	Colbert	01033
AL-North	6	Alabama	DeKalb	01049
AL-North	6	Alabama	Franklin	01059
AL-North	6	Alabama	Jackson	01071
AL-North	6	Alabama	Lauderdale	01077
AL-North	6	Alabama	Lawrence	01079
AL-North	6	Alabama	Limestone	01083
AL-North	6	Alabama	Madison	01089
AL-North	6	Alabama	Marshall	01095
AL-North	6	Alabama	Morgan	01103
AR-SDelt	7	Arkansas	Arkansas	05001
AR-SDelt	7	Arkansas	Chicot	05017
AR-SDelt	7	Arkansas	Desha	05041
AR-SDelt	7	Arkansas	Jefferson	05069
AR-SDelt	7	Arkansas	Lee	05077
AR-SDelt	7	Arkansas	Lincoln	05079
AR-SDelt	7	Arkansas	Lonoke	05085
AR-SDelt	7	Arkansas	Monroe	05095
AR-SDelt	7	Arkansas	Phillips	05107
AR-SDelt	7	Arkansas	Prairie	05117
AR-NDelt	8	Arkansas	Clay	05021
AR-NDelt	8	Arkansas	Craighead	05031
AR-NDelt	8	Arkansas	Crittenden	05035
AR-NDelt	8	Arkansas	Cross	05037
AR-NDelt	8	Arkansas	Greene	05055
AR-NDelt	8	Arkansas	Jackson	05067

AR-NDelt	8	Arkansas	Lawrence	05075
AR-NDelt	8	Arkansas	Mississippi	05093
AR-NDelt	8	Arkansas	Poinsett	05111
AR-NDelt	8	Arkansas	St. Francis	05123
AR-NDelt	8	Arkansas	Woodruff	05147
AR-SW	9	Arkansas	Ashley	05003
AR-SW	9	Arkansas	Bradley	05011
AR-SW	9	Arkansas	Calhoun	05013
AR-SW	9	Arkansas	Clark	05019
AR-SW	9	Arkansas	Cleveland	05025
AR-SW	9	Arkansas	Columbia	05027
AR-SW	9	Arkansas	Dallas	05039
AR-SW	9	Arkansas	Drew	05043
AR-SW	9	Arkansas	Grant	05053
AR-SW	9	Arkansas	Hempstead	05057
AR-SW	9	Arkansas	Hot Spring	05059
AR-SW	9	Arkansas	Howard	05061
AR-SW	9	Arkansas	Lafayette	05073
AR-SW	9	Arkansas	Little River	05081
AR-SW	9	Arkansas	Miller	05091
AR-SW	9	Arkansas	Nevada	05099
AR-SW	9	Arkansas	Ouachita	05103
AR-SW	9	Arkansas	Pike	05109
AR-SW	9	Arkansas	Sevier	05133
AR-SW	9	Arkansas	Union	05139
AR-Ouach	10	Arkansas	Garland	05051
AR-Ouach	10	Arkansas	Logan	05083
AR-Ouach	10	Arkansas	Montgomery	05097
AR-Ouach	10	Arkansas	Perry	05105
AR-Ouach	10	Arkansas	Polk	05113
AR-Ouach	10	Arkansas	Pulaski	05119
AR-Ouach	10	Arkansas	Saline	05125
AR-Ouach	10	Arkansas	Scott	05127
AR-Ouach	10	Arkansas	Sebastian	05131
AR-Ouach	10	Arkansas	Yell	05149
AR-Ozark	11	Arkansas	Baxter	05005
AR-Ozark	11	Arkansas	Benton	05007
AR-Ozark	11	Arkansas	Boone	05009
AR-Ozark	11	Arkansas	Carroll	05015
AR-Ozark	11	Arkansas	Cleburne	05023
AR-Ozark	11	Arkansas	Conway	05029
AR-Ozark	11	Arkansas	Crawford	05033
AR-Ozark	11	Arkansas	Faulkner	05045
AR-Ozark	11	Arkansas	Franklin	05047

AR-Ozark	11	Arkansas	Fulton	05049
AR-Ozark	11	Arkansas	Independence	05063
AR-Ozark	11	Arkansas	Izard	05065
AR-Ozark	11	Arkansas	Johnson	05071
AR-Ozark	11	Arkansas	Madison	05087
AR-Ozark	11	Arkansas	Marion	05089
AR-Ozark	11	Arkansas	Newton	05101
AR-Ozark	11	Arkansas	Pope	05115
AR-Ozark	11	Arkansas	Randolph	05121
AR-Ozark	11	Arkansas	Searcy	05129
AR-Ozark	11	Arkansas	Sharp	05135
AR-Ozark	11	Arkansas	Stone	05137
AR-Ozark	11	Arkansas	Van Buren	05141
AR-Ozark	11	Arkansas	Washington	05143
AR-Ozark	11	Arkansas	White	05145
FL-NE	12	Florida	Alachua	12001
FL-NE	12	Florida	Baker	12003
FL-NE	12	Florida	Bradford	12007
FL-NE	12	Florida	Clay	12019
FL-NE	12	Florida	Columbia	12023
FL-NE	12	Florida	Dixie	12029
FL-NE	12	Florida	Duval	12031
FL-NE	12	Florida	Flagler	12035
FL-NE	12	Florida	Gilchrist	12041
FL-NE	12	Florida	Hamilton	12047
FL-NE	12	Florida	Lafayette	12067
FL-NE	12	Florida	Levy	12075
FL-NE	12	Florida	Madison	12079
FL-NE	12	Florida	Marion	12083
FL-NE	12	Florida	Nassau	12089
FL-NE	12	Florida	Putnam	12107
FL-NE	12	Florida	St. Johns	12109
FL-NE	12	Florida	Suwannee	12121
FL-NE	12	Florida	Taylor	12123
FL-NE	12	Florida	Union	12125
FL-NE	12	Florida	Volusia	12127
FL-NW	13	Florida	Bay	12005
FL-NW	13	Florida	Calhoun	12013
FL-NW	13	Florida	Escambia	12033
FL-NW	13	Florida	Franklin	12037
FL-NW	13	Florida	Gadsden	12039
FL-NW	13	Florida	Gulf	12045
FL-NW	13	Florida	Holmes	12059
FL-NW	13	Florida	Jackson	12063

FL-NW	13	Florida	Jefferson	12065
FL-NW	13	Florida	Leon	12073
FL-NW	13	Florida	Liberty	12077
FL-NW	13	Florida	Okaloosa	12091
FL-NW	13	Florida	Santa Rosa	12113
FL-NW	13	Florida	Wakulla	12129
FL-NW	13	Florida	Walton	12131
FL-NW	13	Florida	Washington	12133
FL-Ctrl	14	Florida	Brevard	12009
FL-Ctrl	14	Florida	Citrus	12017
FL-Ctrl	14	Florida	DeSoto	12027
FL-Ctrl	14	Florida	Hardee	12049
FL-Ctrl	14	Florida	Hernando	12053
FL-Ctrl	14	Florida	Highlands	12055
FL-Ctrl	14	Florida	Hillsborough	12057
FL-Ctrl	14	Florida	Indian River	12061
FL-Ctrl	14	Florida	Lake	12069
FL-Ctrl	14	Florida	Manatee	12081
FL-Ctrl	14	Florida	Okeechobee	12093
FL-Ctrl	14	Florida	Orange	12095
FL-Ctrl	14	Florida	Osceola	12097
FL-Ctrl	14	Florida	Pasco	12101
FL-Ctrl	14	Florida	Pinellas	12103
FL-Ctrl	14	Florida	Polk	12105
FL-Ctrl	14	Florida	St. Lucie	12111
FL-Ctrl	14	Florida	Sarasota	12115
FL-Ctrl	14	Florida	Seminole	12117
FL-Ctrl	14	Florida	Sumter	12119
FL-South	15	Florida	Broward	12011
FL-South	15	Florida	Charlotte	12015
FL-South	15	Florida	Collier	12021
FL-South	15	Florida	Dade	12025
FL-South	15	Florida	Glades	12043
FL-South	15	Florida	Hendry	12051
FL-South	15	Florida	Lee	12071
FL-South	15	Florida	Martin	12085
FL-South	15	Florida	Monroe	12087
FL-South	15	Florida	Palm Beach	12099
GA-SE	16	Georgia	Appling	13001
GA-SE	16	Georgia	Atkinson	13003
GA-SE	16	Georgia	Bacon	13005
GA-SE	16	Georgia	Brantley	13025
GA-SE	16	Georgia	Bryan	13029
GA-SE	16	Georgia	Bulloch	13031

GA-SE	16	Georgia	Camden	13039
GA-SE	16	Georgia	Candler	13043
GA-SE	16	Georgia	Charlton	13049
GA-SE	16	Georgia	Chatham	13051
GA-SE	16	Georgia	Clinch	13065
GA-SE	16	Georgia	Coffee	13069
GA-SE	16	Georgia	Dodge	13091
GA-SE	16	Georgia	Echols	13101
GA-SE	16	Georgia	Effingham	13103
GA-SE	16	Georgia	Emanuel	13107
GA-SE	16	Georgia	Evans	13109
GA-SE	16	Georgia	Glynn	13127
GA-SE	16	Georgia	Jeff Davis	13161
GA-SE	16	Georgia	Jenkins	13165
GA-SE	16	Georgia	Johnson	13167
GA-SE	16	Georgia	Laurens	13175
GA-SE	16	Georgia	Liberty	13179
GA-SE	16	Georgia	Long	13183
GA-SE	16	Georgia	McIntosh	13191
GA-SE	16	Georgia	Montgomery	13209
GA-SE	16	Georgia	Pierce	13229
GA-SE	16	Georgia	Screven	13251
GA-SE	16	Georgia	Tattnall	13267
GA-SE	16	Georgia	Telfair	13271
GA-SE	16	Georgia	Toombs	13279
GA-SE	16	Georgia	Treutlen	13283
GA-SE	16	Georgia	Ware	13299
GA-SE	16	Georgia	Wayne	13305
GA-SE	16	Georgia	Wheeler	13309
GA-SW	17	Georgia	Baker	13007
GA-SW	17	Georgia	Ben Hill	13017
GA-SW	17	Georgia	Berrien	13019
GA-SW	17	Georgia	Brooks	13027
GA-SW	17	Georgia	Colquitt	13071
GA-SW	17	Georgia	Cook	13075
GA-SW	17	Georgia	Crisp	13081
GA-SW	17	Georgia	Decatur	13087
GA-SW	17	Georgia	Dooly	13093
GA-SW	17	Georgia	Early	13099
GA-SW	17	Georgia	Grady	13131
GA-SW	17	Georgia	Irwin	13155
GA-SW	17	Georgia	Lanier	13173
GA-SW	17	Georgia	Lowndes	13185
GA-SW	17	Georgia	Miller	13201

GA-SW	17	Georgia	Mitchell	13205
GA-SW	17	Georgia	Seminole	13253
GA-SW	17	Georgia	Thomas	13275
GA-SW	17	Georgia	Tift	13277
GA-SW	17	Georgia	Turner	13287
GA-SW	17	Georgia	Wilcox	13315
GA-SW	17	Georgia	Worth	13321
GA-Ctrl	18	Georgia	Baldwin	13009
GA-Ctrl	18	Georgia	Bibb	13021
GA-Ctrl	18	Georgia	Bleckley	13023
GA-Ctrl	18	Georgia	Burke	13033
GA-Ctrl	18	Georgia	Butts	13035
GA-Ctrl	18	Georgia	Calhoun	13037
GA-Ctrl	18	Georgia	Chattahoochee	13053
GA-Ctrl	18	Georgia	Clay	13061
GA-Ctrl	18	Georgia	Columbia	13073
GA-Ctrl	18	Georgia	Crawford	13079
GA-Ctrl	18	Georgia	Dougherty	13095
GA-Ctrl	18	Georgia	Glascock	13125
GA-Ctrl	18	Georgia	Greene	13133
GA-Ctrl	18	Georgia	Hancock	13141
GA-Ctrl	18	Georgia	Harris	13145
GA-Ctrl	18	Georgia	Houston	13153
GA-Ctrl	18	Georgia	Jasper	13159
GA-Ctrl	18	Georgia	Jefferson	13163
GA-Ctrl	18	Georgia	Jones	13169
GA-Ctrl	18	Georgia	Lamar	13171
GA-Ctrl	18	Georgia	Lee	13177
GA-Ctrl	18	Georgia	Lincoln	13181
GA-Ctrl	18	Georgia	McDuffie	13189
GA-Ctrl	18	Georgia	Macon	13193
GA-Ctrl	18	Georgia	Marion	13197
GA-Ctrl	18	Georgia	Monroe	13207
GA-Ctrl	18	Georgia	Morgan	13211
GA-Ctrl	18	Georgia	Muscogee	13215
GA-Ctrl	18	Georgia	Peach	13225
GA-Ctrl	18	Georgia	Pike	13231
GA-Ctrl	18	Georgia	Pulaski	13235
GA-Ctrl	18	Georgia	Putnam	13237
GA-Ctrl	18	Georgia	Quitman	13239
GA-Ctrl	18	Georgia	Randolph	13243
GA-Ctrl	18	Georgia	Richmond	13245
GA-Ctrl	18	Georgia	Schley	13249
GA-Ctrl	18	Georgia	Stewart	13259

GA-Ctrl	18	Georgia	Sumter	13261
GA-Ctrl	18	Georgia	Talbot	13263
GA-Ctrl	18	Georgia	Taliaferro	13265
GA-Ctrl	18	Georgia	Taylor	13269
GA-Ctrl	18	Georgia	Terrell	13273
GA-Ctrl	18	Georgia	Twiggs	13289
GA-Ctrl	18	Georgia	Upson	13293
GA-Ctrl	18	Georgia	Warren	13301
GA-Ctrl	18	Georgia	Washington	13303
GA-Ctrl	18	Georgia	Webster	13307
GA-Ctrl	18	Georgia	Wilkes	13317
GA-Ctrl	18	Georgia	Wilkinson	13319
GA-NCtrl	19	Georgia	Banks	13011
GA-NCtrl	19	Georgia	Barrow	13013
GA-NCtrl	19	Georgia	Carroll	13045
GA-NCtrl	19	Georgia	Clarke	13059
GA-NCtrl	19	Georgia	Clayton	13063
GA-NCtrl	19	Georgia	Cobb	13067
GA-NCtrl	19	Georgia	Coweta	13077
GA-NCtrl	19	Georgia	DeKalb	13089
GA-NCtrl	19	Georgia	Douglas	13097
GA-NCtrl	19	Georgia	Elbert	13105
GA-NCtrl	19	Georgia	Fayette	13113
GA-NCtrl	19	Georgia	Forsyth	13117
GA-NCtrl	19	Georgia	Franklin	13119
GA-NCtrl	19	Georgia	Fulton	13121
GA-NCtrl	19	Georgia	Gwinnett	13135
GA-NCtrl	19	Georgia	Hall	13139
GA-NCtrl	19	Georgia	Haralson	13143
GA-NCtrl	19	Georgia	Hart	13147
GA-NCtrl	19	Georgia	Heard	13149
GA-NCtrl	19	Georgia	Henry	13151
GA-NCtrl	19	Georgia	Jackson	13157
GA-NCtrl	19	Georgia	Madison	13195
GA-NCtrl	19	Georgia	Meriwether	13199
GA-NCtrl	19	Georgia	Newton	13217
GA-NCtrl	19	Georgia	Oconee	13219
GA-NCtrl	19	Georgia	Oglethorpe	13221
GA-NCtrl	19	Georgia	Paulding	13223
GA-NCtrl	19	Georgia	Polk	13233
GA-NCtrl	19	Georgia	Rockdale	13247
GA-NCtrl	19	Georgia	Spalding	13255
GA-NCtrl	19	Georgia	Troup	13285
GA-NCtrl	19	Georgia	Walton	13297

GA-North	20	Georgia	Bartow	13015
GA-North	20	Georgia	Catoosa	13047
GA-North	20	Georgia	Chattooga	13055
GA-North	20	Georgia	Cherokee	13057
GA-North	20	Georgia	Dade	13083
GA-North	20	Georgia	Dawson	13085
GA-North	20	Georgia	Fannin	13111
GA-North	20	Georgia	Floyd	13115
GA-North	20	Georgia	Gilmer	13123
GA-North	20	Georgia	Gordon	13129
GA-North	20	Georgia	Habersham	13137
GA-North	20	Georgia	Lumpkin	13187
GA-North	20	Georgia	Murray	13213
GA-North	20	Georgia	Pickens	13227
GA-North	20	Georgia	Rabun	13241
GA-North	20	Georgia	Stephens	13257
GA-North	20	Georgia	Towns	13281
GA-North	20	Georgia	Union	13291
GA-North	20	Georgia	Walker	13295
GA-North	20	Georgia	White	13311
GA-North	20	Georgia	Whitfield	13313
LA-NDelt	21	Louisiana	Catahoula	22025
LA-NDelt	21	Louisiana	Concordia	22029
LA-NDelt	21	Louisiana	East Carroll	22035
LA-NDelt	21	Louisiana	Franklin	22041
LA-NDelt	21	Louisiana	Madison	22065
LA-NDelt	21	Louisiana	Morehouse	22067
LA-NDelt	21	Louisiana	Richland	22083
LA-NDelt	21	Louisiana	Tensas	22107
LA-NDelt	21	Louisiana	West Carroll	22123
LA-SDelt	22	Louisiana	Acadia	22001
LA-SDelt	22	Louisiana	Ascension	22005
LA-SDelt	22	Louisiana	Assumption	22007
LA-SDelt	22	Louisiana	Avoyelles	22009
LA-SDelt	22	Louisiana	Cameron	22023
LA-SDelt	22	Louisiana	Iberia	22045
LA-SDelt	22	Louisiana	Iberville	22047
LA-SDelt	22	Louisiana	Jefferson	22051
LA-SDelt	22	Louisiana	Lafayette	22055
LA-SDelt	22	Louisiana	Lafourche	22057
LA-SDelt	22	Louisiana	Orleans	22071
LA-SDelt	22	Louisiana	Plaquemines	22075
LA-SDelt	22	Louisiana	Pointe Coupee	22077
LA-SDelt	22	Louisiana	St. Benard	22087

LA-SDelt	22	Louisiana	St. Charles	22089
LA-SDelt	22	Louisiana	St. James	22093
LA-SDelt	22	Louisiana	St. John the Baptist	22095
LA-SDelt	22	Louisiana	St. Landry	22097
LA-SDelt	22	Louisiana	St. Martin	22099
LA-SDelt	22	Louisiana	St. Mary	22101
LA-SDelt	22	Louisiana	Terrebonne	22109
LA-SDelt	22	Louisiana	Vermilion	22113
LA-SDelt	22	Louisiana	West Baton Rouge	22121
LA-SDelt	22	Louisiana	West Feliciana	22125
LA-SW	23	Louisiana	Allen	22003
LA-SW	23	Louisiana	Beauregard	22011
LA-SW	23	Louisiana	Calcasieu	22019
LA-SW	23	Louisiana	Evangeline	22039
LA-SW	23	Louisiana	Grant	22043
LA-SW	23	Louisiana	Jefferson Davis	22053
LA-SW	23	Louisiana	La Salle	22059
LA-SW	23	Louisiana	Natchitoches	22069
LA-SW	23	Louisiana	Rapides	22079
LA-SW	23	Louisiana	Sabine	22085
LA-SW	23	Louisiana	Vernon	22115
LA-SE	24	Louisiana	East Baton Rouge	22033
LA-SE	24	Louisiana	East Feliciana	22037
LA-SE	24	Louisiana	Livingston	22063
LA-SE	24	Louisiana	St. Helena	22091
LA-SE	24	Louisiana	St. Tammany	22103
LA-SE	24	Louisiana	Tangipahoa	22105
LA-SE	24	Louisiana	Washington	22117
LA-NW	25	Louisiana	Bienville	22013
LA-NW	25	Louisiana	Bossier	22015
LA-NW	25	Louisiana	Caddo	22017
LA-NW	25	Louisiana	Caldwell	22021
LA-NW	25	Louisiana	Claiborne	22027
LA-NW	25	Louisiana	De Soto	22031
LA-NW	25	Louisiana	Jackson	22049
LA-NW	25	Louisiana	Lincoln	22061
LA-NW	25	Louisiana	Ouachita	22073
LA-NW	25	Louisiana	Red River	22081
LA-NW	25	Louisiana	Union	22111
LA-NW	25	Louisiana	Webster	22119
LA-NW	25	Louisiana	Winn	22127
MS-Delta	26	Mississippi	Bolivar	28011
MS-Delta	26	Mississippi	Coahoma	28027
MS-Delta	26	Mississippi	Holmes	28051

MS-Delta	26	Mississippi	Humphreys	28053
MS-Delta	26	Mississippi	Issaquena	28055
MS-Delta	26	Mississippi	Leflore	28083
MS-Delta	26	Mississippi	Quitman	28119
MS-Delta	26	Mississippi	Sharkey	28125
MS-Delta	26	Mississippi	Sunflower	28133
MS-Delta	26	Mississippi	Tallahatchie	28135
MS-Delta	26	Mississippi	Tunica	28143
MS-Delta	26	Mississippi	Warren	28149
MS-Delta	26	Mississippi	Washington	28151
MS-Delta	26	Mississippi	Yazoo	28163
MS-North	27	Mississippi	Alcorn	28003
MS-North	27	Mississippi	Benton	28009
MS-North	27	Mississippi	Calhoun	28013
MS-North	27	Mississippi	Carroll	28015
MS-North	27	Mississippi	Chickasaw	28017
MS-North	27	Mississippi	Choctaw	28019
MS-North	27	Mississippi	Clay	28025
MS-North	27	Mississippi	DeSoto	28033
MS-North	27	Mississippi	Grenada	28043
MS-North	27	Mississippi	Itawamba	28057
MS-North	27	Mississippi	Lafayette	28071
MS-North	27	Mississippi	Lee	28081
MS-North	27	Mississippi	Lowndes	28087
MS-North	27	Mississippi	Marshall	28093
MS-North	27	Mississippi	Monroe	28095
MS-North	27	Mississippi	Montgomery	28097
MS-North	27	Mississippi	Oktibbeha	28105
MS-North	27	Mississippi	Panola	28107
MS-North	27	Mississippi	Pontotoc	28115
MS-North	27	Mississippi	Prentiss	28117
MS-North	27	Mississippi	Tate	28137
MS-North	27	Mississippi	Tippah	28139
MS-North	27	Mississippi	Tishomingo	28141
MS-North	27	Mississippi	Union	28145
MS-North	27	Mississippi	Webster	28155
MS-North	27	Mississippi	Yalobusha	28161
MS-Ctrl	28	Mississippi	Attala	28007
MS-Ctrl	28	Mississippi	Clarke	28023
MS-Ctrl	28	Mississippi	Jasper	28061
MS-Ctrl	28	Mississippi	Kemper	28069
MS-Ctrl	28	Mississippi	Lauderdale	28075
MS-Ctrl	28	Mississippi	Leake	28079
MS-Ctrl	28	Mississippi	Neshoba	28099

MS-Ctrl	28	Mississippi	Newton	28101
MS-Ctrl	28	Mississippi	Noxubee	28103
MS-Ctrl	28	Mississippi	Rankin	28121
MS-Ctrl	28	Mississippi	Scott	28123
MS-Ctrl	28	Mississippi	Simpson	28127
MS-Ctrl	28	Mississippi	Smith	28129
MS-Ctrl	28	Mississippi	Winston	28159
MS-South	29	Mississippi	Covington	28031
MS-South	29	Mississippi	Forrest	28035
MS-South	29	Mississippi	George	28039
MS-South	29	Mississippi	Greene	28041
MS-South	29	Mississippi	Hancock	28045
MS-South	29	Mississippi	Harrison	28047
MS-South	29	Mississippi	Jackson	28059
MS-South	29	Mississippi	Jefferson Davis	28065
MS-South	29	Mississippi	Jones	28067
MS-South	29	Mississippi	Lamar	28073
MS-South	29	Mississippi	Lawrence	28077
MS-South	29	Mississippi	Marion	28091
MS-South	29	Mississippi	Pearl River	28109
MS-South	29	Mississippi	Perry	28111
MS-South	29	Mississippi	Stone	28131
MS-South	29	Mississippi	Walthall	28147
MS-South	29	Mississippi	Wayne	28153
MS-SW	30	Mississippi	Adams	28001
MS-SW	30	Mississippi	Amite	28005
MS-SW	30	Mississippi	Claiborne	28021
MS-SW	30	Mississippi	Copiah	28029
MS-SW	30	Mississippi	Franklin	28037
MS-SW	30	Mississippi	Hinds	28049
MS-SW	30	Mississippi	Jefferson	28063
MS-SW	30	Mississippi	Lincoln	28085
MS-SW	30	Mississippi	Madison	28089
MS-SW	30	Mississippi	Pike	28113
MS-SW	30	Mississippi	Wilkinson	28157
NC-SCP	31	North Carolina	Bladen	37017
NC-SCP	31	North Carolina	Brunswick	37019
NC-SCP	31	North Carolina	Columbus	37047
NC-SCP	31	North Carolina	Cumberland	37051
NC-SCP	31	North Carolina	Duplin	37061
NC-SCP	31	North Carolina	Greene	37079
NC-SCP	31	North Carolina	Harnett	37085
NC-SCP	31	North Carolina	Hoke	37093
NC-SCP	31	North Carolina	Johnston	37101

NC-SCP	31	North Carolina	Jones	37103
NC-SCP	31	North Carolina	Lee	37105
NC-SCP	31	North Carolina	Lenoir	37107
NC-SCP	31	North Carolina	Moore	37125
NC-SCP	31	North Carolina	New Hanover	37129
NC-SCP	31	North Carolina	Onslow	37133
NC-SCP	31	North Carolina	Pender	37141
NC-SCP	31	North Carolina	Richmond	37153
NC-SCP	31	North Carolina	Robeson	37155
NC-SCP	31	North Carolina	Sampson	37163
NC-SCP	31	North Carolina	Scotland	37165
NC-SCP	31	North Carolina	Wayne	37191
NC-NCP	32	North Carolina	Beaufort	37013
NC-NCP	32	North Carolina	Bertie	37015
NC-NCP	32	North Carolina	Camden	37029
NC-NCP	32	North Carolina	Carteret	37031
NC-NCP	32	North Carolina	Chowan	37041
NC-NCP	32	North Carolina	Craven	37049
NC-NCP	32	North Carolina	Currituck	37053
NC-NCP	32	North Carolina	Dare	37055
NC-NCP	32	North Carolina	Edgecombe	37065
NC-NCP	32	North Carolina	Gates	37073
NC-NCP	32	North Carolina	Halifax	37083
NC-NCP	32	North Carolina	Hertford	37091
NC-NCP	32	North Carolina	Hyde	37095
NC-NCP	32	North Carolina	Martin	37117
NC-NCP	32	North Carolina	Nash	37127
NC-NCP	32	North Carolina	Northampton	37131
NC-NCP	32	North Carolina	Pamlico	37137
NC-NCP	32	North Carolina	Pasquotank	37139
NC-NCP	32	North Carolina	Perquimans	37143
NC-NCP	32	North Carolina	Pitt	37147
NC-NCP	32	North Carolina	Tyrrell	37177
NC-NCP	32	North Carolina	Washington	37187
NC-NCP	32	North Carolina	Wilson	37195
NC-Pdm	33	North Carolina	Alamance	37001
NC-Pdm	33	North Carolina	Alexander	37003
NC-Pdm	33	North Carolina	Anson	37007
NC-Pdm	33	North Carolina	Cabarrus	37025
NC-Pdm	33	North Carolina	Caswell	37033
NC-Pdm	33	North Carolina	Catawba	37035
NC-Pdm	33	North Carolina	Chatham	37037
NC-Pdm	33	North Carolina	Cleveland	37045
NC-Pdm	33	North Carolina	Davidson	37057

NC-Pdm	33	North Carolina	Davie	37059
NC-Pdm	33	North Carolina	Durham	37063
NC-Pdm	33	North Carolina	Forsyth	37067
NC-Pdm	33	North Carolina	Franklin	37069
NC-Pdm	33	North Carolina	Gaston	37071
NC-Pdm	33	North Carolina	Granville	37077
NC-Pdm	33	North Carolina	Guilford	37081
NC-Pdm	33	North Carolina	Iredell	37097
NC-Pdm	33	North Carolina	Lincoln	37109
NC-Pdm	33	North Carolina	Mecklenburg	37119
NC-Pdm	33	North Carolina	Montgomery	37123
NC-Pdm	33	North Carolina	Orange	37135
NC-Pdm	33	North Carolina	Person	37145
NC-Pdm	33	North Carolina	Polk	37149
NC-Pdm	33	North Carolina	Randolph	37151
NC-Pdm	33	North Carolina	Rockingham	37157
NC-Pdm	33	North Carolina	Rowan	37159
NC-Pdm	33	North Carolina	Rutherford	37161
NC-Pdm	33	North Carolina	Stanly	37167
NC-Pdm	33	North Carolina	Stokes	37169
NC-Pdm	33	North Carolina	Surry	37171
NC-Pdm	33	North Carolina	Union	37179
NC-Pdm	33	North Carolina	Vance	37181
NC-Pdm	33	North Carolina	Wake	37183
NC-Pdm	33	North Carolina	Warren	37185
NC-Pdm	33	North Carolina	Yadkin	37197
NC-Mtn	34	North Carolina	Alleghany	37005
NC-Mtn	34	North Carolina	Ashe	37009
NC-Mtn	34	North Carolina	Avery	37011
NC-Mtn	34	North Carolina	Buncombe	37021
NC-Mtn	34	North Carolina	Burke	37023
NC-Mtn	34	North Carolina	Caldwell	37027
NC-Mtn	34	North Carolina	Cherokee	37039
NC-Mtn	34	North Carolina	Clay	37043
NC-Mtn	34	North Carolina	Graham	37075
NC-Mtn	34	North Carolina	Haywood	37087
NC-Mtn	34	North Carolina	Henderson	37089
NC-Mtn	34	North Carolina	Jackson	37099
NC-Mtn	34	North Carolina	McDowell	37111
NC-Mtn	34	North Carolina	Macon	37113
NC-Mtn	34	North Carolina	Madison	37115
NC-Mtn	34	North Carolina	Mitchell	37121
NC-Mtn	34	North Carolina	Swain	37173
NC-Mtn	34	North Carolina	Transylvania	37175

NC-Mtn	34	North Carolina	Watuga	37189
NC-Mtn	34	North Carolina	Wilkes	37193
NC-Mtn	34	North Carolina	Yancey	37199
OK-SE	35	Oklahoma	Atoka	40005
OK-SE	35	Oklahoma	Bryan	40013
OK-SE	35	Oklahoma	Choctaw	40023
OK-SE	35	Oklahoma	Coal	40029
OK-SE	35	Oklahoma	Haskell	40061
OK-SE	35	Oklahoma	Latimer	40077
OK-SE	35	Oklahoma	Le Flore	40079
OK-SE	35	Oklahoma	McCurtain	40089
OK-SE	35	Oklahoma	Pittsburg	40121
OK-SE	35	Oklahoma	Pushmataha	40127
OK-NE	36	Oklahoma	Adair	40001
OK-NE	36	Oklahoma	Cherokee	40021
OK-NE	36	Oklahoma	Delaware	40041
OK-NE	36	Oklahoma	McIntosh	40091
OK-NE	36	Oklahoma	Mayes	40097
OK-NE	36	Oklahoma	Muskogee	40101
OK-NE	36	Oklahoma	Ottawa	40115
OK-NE	36	Oklahoma	Sequoyah	40135
SC-SCP	37	South Carolina	Aiken	45003
SC-SCP	37	South Carolina	Allendale	45005
SC-SCP	37	South Carolina	Bamberg	45009
SC-SCP	37	South Carolina	Barnwell	45011
SC-SCP	37	South Carolina	Beaufort	45013
SC-SCP	37	South Carolina	Calhoun	45017
SC-SCP	37	South Carolina	Colleton	45029
SC-SCP	37	South Carolina	Dorchester	45035
SC-SCP	37	South Carolina	Hampton	45049
SC-SCP	37	South Carolina	Jasper	45053
SC-SCP	37	South Carolina	Lexington	45063
SC-SCP	37	South Carolina	Orangeburg	45075
SC-NCP	38	South Carolina	Berkeley	45015
SC-NCP	38	South Carolina	Charleston	45019
SC-NCP	38	South Carolina	Chesterfield	45025
SC-NCP	38	South Carolina	Clarendon	45027
SC-NCP	38	South Carolina	Darlington	45031
SC-NCP	38	South Carolina	Dillon	45033
SC-NCP	38	South Carolina	Florence	45041
SC-NCP	38	South Carolina	Georgetown	45043
SC-NCP	38	South Carolina	Horry	45051
SC-NCP	38	South Carolina	Kershaw	45055
SC-NCP	38	South Carolina	Lee	45061

SC-NCP	38	South Carolina	Marion	45067
SC-NCP	38	South Carolina	Marlboro	45069
SC-NCP	38	South Carolina	Richland	45079
SC-NCP	38	South Carolina	Sumter	45085
SC-NCP	38	South Carolina	Williamsburg	45089
SC-Pdm	39	South Carolina	Abbeville	45001
SC-Pdm	39	South Carolina	Anderson	45007
SC-Pdm	39	South Carolina	Cherokee	45021
SC-Pdm	39	South Carolina	Chester	45023
SC-Pdm	39	South Carolina	Edgefield	45037
SC-Pdm	39	South Carolina	Fairfield	45039
SC-Pdm	39	South Carolina	Greenville	45045
SC-Pdm	39	South Carolina	Greenwood	45047
SC-Pdm	39	South Carolina	Lancaster	45057
SC-Pdm	39	South Carolina	Laurens	45059
SC-Pdm	39	South Carolina	McCormick	45065
SC-Pdm	39	South Carolina	Newberry	45071
SC-Pdm	39	South Carolina	Oconee	45073
SC-Pdm	39	South Carolina	Pickens	45077
SC-Pdm	39	South Carolina	Saluda	45081
SC-Pdm	39	South Carolina	Spartanburg	45083
SC-Pdm	39	South Carolina	Union	45087
SC-Pdm	39	South Carolina	York	45091
TN-West	40	Tennessee	Carroll	47017
TN-West	40	Tennessee	Chester	47023
TN-West	40	Tennessee	Crockett	47033
TN-West	40	Tennessee	Dyer	47045
TN-West	40	Tennessee	Fayette	47047
TN-West	40	Tennessee	Gibson	47053
TN-West	40	Tennessee	Hardeman	47069
TN-West	40	Tennessee	Haywood	47075
TN-West	40	Tennessee	Henderson	47077
TN-West	40	Tennessee	Henry	47079
TN-West	40	Tennessee	Lake	47095
TN-West	40	Tennessee	Lauderdale	47097
TN-West	40	Tennessee	McNairy	47109
TN-West	40	Tennessee	Madison	47113
TN-West	40	Tennessee	Obion	47131
TN-West	40	Tennessee	Shelby	47157
TN-West	40	Tennessee	Tipton	47167
TN-West	40	Tennessee	Weakley	47183
TN-WCtrl	41	Tennessee	Benton	47005
TN-WCtrl	41	Tennessee	Decatur	47039
TN-WCtrl	41	Tennessee	Hardin	47071

TN-WCtrl	41	Tennessee	Hickman	47081
TN-WCtrl	41	Tennessee	Houston	47083
TN-WCtrl	41	Tennessee	Humphreys	47085
TN-WCtrl	41	Tennessee	Lawrence	47099
TN-WCtrl	41	Tennessee	Lewis	47101
TN-WCtrl	41	Tennessee	Perry	47135
TN-WCtrl	41	Tennessee	Stewart	47161
TN-WCtrl	41	Tennessee	Wayne	47181
TN-Ctrl	42	Tennessee	Bedford	47003
TN-Ctrl	42	Tennessee	Cannon	47015
TN-Ctrl	42	Tennessee	Cheatham	47021
TN-Ctrl	42	Tennessee	Clay	47027
TN-Ctrl	42	Tennessee	Coffee	47031
TN-Ctrl	42	Tennessee	Davidson	47037
TN-Ctrl	42	Tennessee	DeKalb	47041
TN-Ctrl	42	Tennessee	Dickson	47043
TN-Ctrl	42	Tennessee	Giles	47055
TN-Ctrl	42	Tennessee	Jackson	47087
TN-Ctrl	42	Tennessee	Lincoln	47103
TN-Ctrl	42	Tennessee	Macon	47111
TN-Ctrl	42	Tennessee	Marshsall	47117
TN-Ctrl	42	Tennessee	Maury	47119
TN-Ctrl	42	Tennessee	Montgomery	47125
TN-Ctrl	42	Tennessee	Moore	47127
TN-Ctrl	42	Tennessee	Robertson	47147
TN-Ctrl	42	Tennessee	Rutherford	47149
TN-Ctrl	42	Tennessee	Smith	47159
TN-Ctrl	42	Tennessee	Sumner	47165
TN-Ctrl	42	Tennessee	Troudsale	47169
TN-Ctrl	42	Tennessee	Williamson	47187
TN-Ctrl	42	Tennessee	Wilson	47189
TN-Plat	43	Tennessee	Bledsoe	47007
TN-Plat	43	Tennessee	Campbell	47013
TN-Plat	43	Tennessee	Cumberland	47035
TN-Plat	43	Tennessee	Fentress	47049
TN-Plat	43	Tennessee	Franklin	47051
TN-Plat	43	Tennessee	Grundy	47061
TN-Plat	43	Tennessee	Marion	47115
TN-Plat	43	Tennessee	Morgan	47129
TN-Plat	43	Tennessee	Overton	47133
TN-Plat	43	Tennessee	Pickett	47137
TN-Plat	43	Tennessee	Putnam	47141
TN-Plat	43	Tennessee	Scott	47151
TN-Plat	43	Tennessee	Sequatchie	47153

TN-Plat	43	Tennessee	Van Buren	47175
TN-Plat	43	Tennessee	Warren	47177
TN-Plat	43	Tennessee	White	47185
TN-East	44	Tennessee	Anderson	47001
TN-East	44	Tennessee	Blount	47009
TN-East	44	Tennessee	Bradley	47011
TN-East	44	Tennessee	Carter	47019
TN-East	44	Tennessee	Claiborne	47025
TN-East	44	Tennessee	Cocke	47029
TN-East	44	Tennessee	Grainger	47057
TN-East	44	Tennessee	Greene	47059
TN-East	44	Tennessee	Hamblen	47063
TN-East	44	Tennessee	Hamilton	47065
TN-East	44	Tennessee	Hancock	47067
TN-East	44	Tennessee	Hawkins	47073
TN-East	44	Tennessee	Jefferson	47089
TN-East	44	Tennessee	Johnson	47091
TN-East	44	Tennessee	Knox	47093
TN-East	44	Tennessee	Loudon	47105
TN-East	44	Tennessee	McMinn	47107
TN-East	44	Tennessee	Meigs	47121
TN-East	44	Tennessee	Monroe	47123
TN-East	44	Tennessee	Polk	47139
TN-East	44	Tennessee	Rhea	47143
TN-East	44	Tennessee	Roane	47145
TN-East	44	Tennessee	Sevier	47155
TN-East	44	Tennessee	Sullivan	47163
TN-East	44	Tennessee	Unicoi	47171
TN-East	44	Tennessee	Union	47173
TN-East	44	Tennessee	Washington	47179
TX-SE	45	Texas	Angelina	48005
TX-SE	45	Texas	Chambers	48071
TX-SE	45	Texas	Grimes	48185
TX-SE	45	Texas	Hardin	48199
TX-SE	45	Texas	Harris	48201
TX-SE	45	Texas	Houston	48225
TX-SE	45	Texas	Jasper	48241
TX-SE	45	Texas	Jefferson	48245
TX-SE	45	Texas	Leon	48289
TX-SE	45	Texas	Liberty	48291
TX-SE	45	Texas	Madison	48313
TX-SE	45	Texas	Montgomery	48339
TX-SE	45	Texas	Newton	48351
TX-SE	45	Texas	Orange	48361

TX-SE	45	Texas	Polk	48373
TX-SE	45	Texas	Sabine	48403
TX-SE	45	Texas	San Augustine	48405
TX-SE	45	Texas	San Jacinto	48407
TX-SE	45	Texas	Trinity	48455
TX-SE	45	Texas	Tyler	48457
TX-SE	45	Texas	Walker	48471
TX-SE	45	Texas	Waller	48473
TX-NE	46	Texas	Anderson	48001
TX-NE	46	Texas	Bowie	48037
TX-NE	46	Texas	Camp	48063
TX-NE	46	Texas	Cass	48067
TX-NE	46	Texas	Cherokee	48073
TX-NE	46	Texas	Franklin	48159
TX-NE	46	Texas	Gregg	48183
TX-NE	46	Texas	Harrison	48203
TX-NE	46	Texas	Henderson	48213
TX-NE	46	Texas	Marion	48315
TX-NE	46	Texas	Morris	48343
TX-NE	46	Texas	Nacogdoches	48347
TX-NE	46	Texas	Panola	48365
TX-NE	46	Texas	Red River	48387
TX-NE	46	Texas	Rusk	48401
TX-NE	46	Texas	Shelby	48419
TX-NE	46	Texas	Smith	48423
TX-NE	46	Texas	Titus	48449
TX-NE	46	Texas	Upshur	48459
TX-NE	46	Texas	Van Zandt	48467
TX-NE	46	Texas	Wood	48499
VA-CP	47	Virginia	Accomack	51001
VA-CP	47	Virginia	Brunswick	51025
VA-CP	47	Virginia	Caroline	51033
VA-CP	47	Virginia	Charles City	51036
VA-CP	47	Virginia	Chesterfield	51041
VA-CP	47	Virginia	Dinwiddie	51053
VA-CP	47	Virginia	Essex	51057
VA-CP	47	Virginia	Gloucester	51073
VA-CP	47	Virginia	Greensville	51081
VA-CP	47	Virginia	Hanover	51085
VA-CP	47	Virginia	Henrico	51087
VA-CP	47	Virginia	Isle of Wright	51093
VA-CP	47	Virginia	James City	51095
VA-CP	47	Virginia	King and Queen	51097
VA-CP	47	Virginia	King George	51099

VA-CP	47	Virginia	King William	51101
VA-CP	47	Virginia	Lancaster	51103
VA-CP	47	Virginia	Mathews	51115
VA-CP	47	Virginia	Middlesex	51119
VA-CP	47	Virginia	New Kent	51127
VA-CP	47	Virginia	Northampton	51131
VA-CP	47	Virginia	Northumberland	51133
VA-CP	47	Virginia	Prince George	51149
VA-CP	47	Virginia	Richmond	51159
VA-CP	47	Virginia	Southampton	51175
VA-CP	47	Virginia	Surry	51181
VA-CP	47	Virginia	Sussex	51183
VA-CP	47	Virginia	Westmoreland	51193
VA-CP	47	Virginia	York	51199
VA-CP	47	Virginia	Chesapeake City	51550
VA-CP	47	Virginia	Hampton City	51650
VA-CP	47	Virginia	Newport News City	51700
VA-CP	47	Virginia	Suffolk City	51800
VA-CP	47	Virginia	Virginia Beach City	51810
VA-SPdm	48	Virginia	Ameilia	51007
VA-SPdm	48	Virginia	Appomattox	51011
VA-SPdm	48	Virginia	Bedford	51019
VA-SPdm	48	Virginia	Buckingham	51029
VA-SPdm	48	Virginia	Campbell	51031
VA-SPdm	48	Virginia	Charlotte	51037
VA-SPdm	48	Virginia	Cumberland	51049
VA-SPdm	48	Virginia	Franklin	51067
VA-SPdm	48	Virginia	Halifax	51083
VA-SPdm	48	Virginia	Henry	51089
VA-SPdm	48	Virginia	Lunenburg	51111
VA-SPdm	48	Virginia	Mecklenburg	51117
VA-SPdm	48	Virginia	Nottoway	51135
VA-SPdm	48	Virginia	Patrick	51141
VA-SPdm	48	Virginia	Pittsylvania	51143
VA-SPdm	48	Virginia	Powhatan	51145
VA-SPdm	48	Virginia	Prince Edward	51147
VA-NPdm	49	Virginia	Albemarle	51003
VA-NPdm	49	Virginia	Amherst	51009
VA-NPdm	49	Virginia	Arlington	51013
VA-NPdm	49	Virginia	Culpeper	51047
VA-NPdm	49	Virginia	Fairfax	51059
VA-NPdm	49	Virginia	Fauquier	51061
VA-NPdm	49	Virginia	Fluvanna	51065
VA-NPdm	49	Virginia	Goochland	51075

VA-NPdm	49	Virginia	Greene	51079
VA-NPdm	49	Virginia	Loudoun	51107
VA-NPdm	49	Virginia	Louisa	51109
VA-NPdm	49	Virginia	Madison	51113
VA-NPdm	49	Virginia	Nelson	51125
VA-NPdm	49	Virginia	Orange	51137
VA-NPdm	49	Virginia	Prince William	51153
VA-NPdm	49	Virginia	Rappahannock	51157
VA-NPdm	49	Virginia	Spotsylvania	51177
VA-NPdm	49	Virginia	Stafford	51179
VA-NMtn	50	Virginia	Alleghany	51005
VA-NMtn	50	Virginia	Augusta	51015
VA-NMtn	50	Virginia	Bath	51017
VA-NMtn	50	Virginia	Botetourt	51023
VA-NMtn	50	Virginia	Clarke	51043
VA-NMtn	50	Virginia	Craig	51045
VA-NMtn	50	Virginia	Frederick	51069
VA-NMtn	50	Virginia	Highland	51091
VA-NMtn	50	Virginia	Page	51139
VA-NMtn	50	Virginia	Roanoke	51161
VA-NMtn	50	Virginia	Rockbridge	51163
VA-NMtn	50	Virginia	Rockingham	51165
VA-NMtn	50	Virginia	Shenandoah	51171
VA-NMtn	50	Virginia	Warren	51187
VA-SMtn	51	Virginia	Bland	51021
VA-SMtn	51	Virginia	Buchanan	51027
VA-SMtn	51	Virginia	Carroll	51035
VA-SMtn	51	Virginia	Dickenson	51051
VA-SMtn	51	Virginia	Floyd	51063
VA-SMtn	51	Virginia	Giles	51071
VA-SMtn	51	Virginia	Grayson	51077
VA-SMtn	51	Virginia	Lee	51105
VA-SMtn	51	Virginia	Montgomery	51121
VA-SMtn	51	Virginia	Pulaski	51155
VA-SMtn	51	Virginia	Russell	51167
VA-SMtn	51	Virginia	Scott	51169
VA-SMtn	51	Virginia	Smyth	51173
VA-SMtn	51	Virginia	Tazewell	51185
VA-SMtn	51	Virginia	Washington	51191
VA-SMtn	51	Virginia	Wise	51195
VA-SMtn	51	Virginia	Wythe	51197
KY-East	52	Kentucky	Floyd	21071
KY-East	52	Kentucky	Harlan	21095
KY-East	52	Kentucky	Knott	21119

KY-East	52	Kentucky	Leslie	21131
KY-East	52	Kentucky	Letcher	21133
KY-East	52	Kentucky	Martin	21159
KY-East	52	Kentucky	Perry	21193
KY-East	52	Kentucky	Pike	21195
KY-NCum	53	Kentucky	Boyd	21019
KY-NCum	53	Kentucky	Carter	21043
KY-NCum	53	Kentucky	Elliot	21063
KY-NCum	53	Kentucky	Greenup	21089
KY-NCum	53	Kentucky	Johnson	21115
KY-NCum	53	Kentucky	Lawrence	21127
KY-NCum	53	Kentucky	Lewis	21135
KY-NCum	53	Kentucky	Magoffin	21153
KY-NCum	53	Kentucky	Menifee	21165
KY-NCum	53	Kentucky	Morgan	21175
KY-NCum	53	Kentucky	Powell	21197
KY-NCum	53	Kentucky	Rowan	21205
KY-NCum	53	Kentucky	Wolfe	21237
KY-SCum	54	Kentucky	Bell	21013
KY-SCum	54	Kentucky	Breathitt	21025
KY-SCum	54	Kentucky	Clay	21051
KY-SCum	54	Kentucky	Estill	21065
KY-SCum	54	Kentucky	Jackson	21109
KY-SCum	54	Kentucky	Knox	21121
KY-SCum	54	Kentucky	Laurel	21125
KY-SCum	54	Kentucky	Lee	21129
KY-SCum	54	Kentucky	McCreary	21147
KY-SCum	54	Kentucky	Owsley	21189
KY-SCum	54	Kentucky	Rockcastle	21203
KY-SCum	54	Kentucky	Whitley	21235
KY-BluG	55	Kentucky	Anderson	21005
KY-BluG	55	Kentucky	Bath	21011
KY-BluG	55	Kentucky	Boone	21015
KY-BluG	55	Kentucky	Bourbon	21017
KY-BluG	55	Kentucky	Boyle	21021
KY-BluG	55	Kentucky	Bracken	21023
KY-BluG	55	Kentucky	Campbell	21037
KY-BluG	55	Kentucky	Carroll	21041
KY-BluG	55	Kentucky	Clark	21049
KY-BluG	55	Kentucky	Fayette	21067
KY-BluG	55	Kentucky	Fleming	21069
KY-BluG	55	Kentucky	Franklin	21073
KY-BluG	55	Kentucky	Gallatin	21077
KY-BluG	55	Kentucky	Garrard	21079

KY-BluG	55	Kentucky	Grant	21081
KY-BluG	55	Kentucky	Harrison	21097
KY-BluG	55	Kentucky	Henry	21103
KY-BluG	55	Kentucky	Jefferson	21111
KY-BluG	55	Kentucky	Jessamine	21113
KY-BluG	55	Kentucky	Kenton	21117
KY-BluG	55	Kentucky	Lincoln	21137
KY-BluG	55	Kentucky	Madison	21151
KY-BluG	55	Kentucky	Mason	21161
KY-BluG	55	Kentucky	Mercer	21167
KY-BluG	55	Kentucky	Montgomery	21173
KY-BluG	55	Kentucky	Nicholas	21181
KY-BluG	55	Kentucky	Oldham	21185
KY-BluG	55	Kentucky	Owen	21187
KY-BluG	55	Kentucky	Pendleton	21191
KY-BluG	55	Kentucky	Robertson	21201
KY-BluG	55	Kentucky	Scott	21209
KY-BluG	55	Kentucky	Shelby	21211
KY-BluG	55	Kentucky	Spencer	21215
KY-BluG	55	Kentucky	Trimble	21223
KY-BluG	55	Kentucky	Washington	21229
KY-BluG	55	Kentucky	Woodford	21239
KY-PNRYL	56	Kentucky	Adair	21001
KY-PNRYL	56	Kentucky	Breckenridge	21027
KY-PNRYL	56	Kentucky	Bullitt	21029
KY-PNRYL	56	Kentucky	Casey	21045
KY-PNRYL	56	Kentucky	Clinton	21053
KY-PNRYL	56	Kentucky	Cumberland	21057
KY-PNRYL	56	Kentucky	Grayson	21085
KY-PNRYL	56	Kentucky	Green	21087
KY-PNRYL	56	Kentucky	Hancock	21091
KY-PNRYL	56	Kentucky	Hardin	21093
KY-PNRYL	56	Kentucky	Hart	21099
KY-PNRYL	56	Kentucky	Larue	21123
KY-PNRYL	56	Kentucky	Marion	21155
KY-PNRYL	56	Kentucky	Meade	21163
KY-PNRYL	56	Kentucky	Metcalfe	21169
KY-PNRYL	56	Kentucky	Nelson	21179
KY-PNRYL	56	Kentucky	Pulaski	21199
KY-PNRYL	56	Kentucky	Russell	21207
KY-PNRYL	56	Kentucky	Taylor	21217
KY-PNRYL	56	Kentucky	Wayne	21231
KY-WCoal	57	Kentucky	Allen	21003
KY-WCoal	57	Kentucky	Barren	21009

KY-WCoal	57	Kentucky	Butler	21031
KY-WCoal	57	Kentucky	Caldwell	21033
KY-WCoal	57	Kentucky	Christian	21047
KY-WCoal	57	Kentucky	Crittenden	21055
KY-WCoal	57	Kentucky	Daviess	21059
KY-WCoal	57	Kentucky	Edmonson	21061
KY-WCoal	57	Kentucky	Henderson	21101
KY-WCoal	57	Kentucky	Hopkins	21107
KY-WCoal	57	Kentucky	Logan	21141
KY-WCoal	57	Kentucky	McLean	21149
KY-WCoal	57	Kentucky	Monroe	21171
KY-WCoal	57	Kentucky	Muhlenberg	21177
KY-WCoal	57	Kentucky	Ohio	21183
KY-WCoal	57	Kentucky	Simpson	21213
KY-WCoal	57	Kentucky	Todd	21219
KY-WCoal	57	Kentucky	Union	21225
KY-WCoal	57	Kentucky	Warren	21227
KY-WCoal	57	Kentucky	Webster	21233
KY-West	58	Kentucky	Ballard	21007
KY-West	58	Kentucky	Calloway	21035
KY-West	58	Kentucky	Carlisle	21039
KY-West	58	Kentucky	Fulton	21075
KY-West	58	Kentucky	Graves	21083
KY-West	58	Kentucky	Hickman	21105
KY-West	58	Kentucky	Livingston	21139
KY-West	58	Kentucky	Lyon	21143
KY-West	58	Kentucky	McCracken	21145
KY-West	58	Kentucky	Marshall	21157
KY-West	58	Kentucky	Trigg	21221