Computer Models
For
Fire and Smoke

Model Name: ArcFuels

Version: ArcFuels9 v 3/23/12; ArcFuels10 v 1.0.12

Date: 2/5/14 –ArcFuels9 v 3/23/12; ArcFuels10 2/5/14

Model Actively Supported?: ArcFuels 9 is no longer supported unless bugs are addressed; ArcFuels 10 is actively supported to fix bugs and enhance the capabilities of the model as needed to support research and planning applications.

Classification: Planning/field model

Very Short Description: ArcFuels is a streamlined fuel management planning and wildfire risk assessment toolbar implemented in ArcMap which creates a trans-scale (stand to large landscape) interface to apply various forest growth (e.g., Forest Vegetation Simulator) and fire behavior models (e.g., FlamMap) to design and test fuel treatment alternatives.

Modeler(s), Organization(s): Alan Ager – USFS, PNW, WWETAC; Nicole Vaillant – USFS, PNW, WWETAC; John Anderson -

User's Guide: ArcFuels9 – Vaillant, N.M., Ager, A.A., Anderson, J., Miller, L. 2013. ArcFuels User Guide and Tutorial: for Use with ArcGIS 9. Gen. Tech. Rep. PNW-GTR-877. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 256 p. ArcFuels10- Vaillant, N.M., Ager, A.A. 2014. ArcFuels 10 online help system. http://arcfuels.org/HTML5/Default.htm

Technical References: Ager, A.A.; Vaillant, N.M.; Finney, M.A. 2011. Integration of fire behavior modeling tools and GIS for wildland fire risk assessment and fuel management planning. Journal of Combustion. Article ID 572452, 19 p.

Vaillant, N.M.; Ager, A.A.; Anderson, J.; Miller, L. 2013. ArcFuels User Guide and Tutorial: for use with ArcGIS 9. Gen. Tech. Rep. PNW-GTR-877. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 256 p.

Vaillant, N.M.; Ager, A.A.; Anderson, J. 2013. ArcFuels10 system overview. Gen. Tech. Rep. PNW-GTR-875. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 65 p.

Validation References: N/A

Availability: http://www.fs.fed.us/wwetac/arcfuels/

Price: Free

Necessary Hardware: No hardware needed, but ArcGIS is required.

Computer Language: ArcFuels 9 – VBA; ArcFuels10-.NET

Size: ArcFuels 9 – 6 MB; ArcFuels 10 – 1.5 MB

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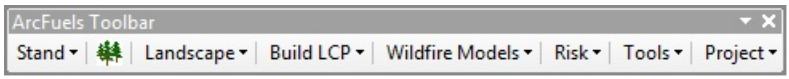
Detailed Description:
ArcFuels is a custom toolbar designed for use with ArcMap. The ArcMap framework helps users incorporate data from a variety of sources to address project-specific issues that typify many fuel treatment projects. ArcFuels was built to accommodate both ArcGIS raster data (such as LANDFIRE data), and/or forest inventory data.



ArcFuels toolbar.

The ArcFuels toolbar consists of multiple menus with many options.

Menu	Description
Stand	Set up options for FVS/FFE-FVS. Includes applying fuel treatment prescriptions, treatment analysis, and treatment comparison tools. External linkage to open SVS.
Stand Select Tool	Toggle button to select individual stands within the landscape to run FVS/FFE-FVS.
Landscape	Multiple functions: (1) apply prescriptions to the landscape, (2) set up and running of FVS/FFE-FVS, (3) complete a treatment analysis with FVS/FFE-FVS, (4) a tool to join FVS/FFE-FVS outputs to a stand shapefile, and (5) the inclusion of the LTD program.
Build LCP	Used to build landscape files (LCP) for FlamMap/FARSITE from FVS/FFE-FVS databases, rasters (i.e. LANDFIRE), an attributed shapefile, or a combination of data sources.

Menu	Description
Wildfire models	External linkage to open select (NEXUS, FARSITE, FlamMap, BehavePlus, FOFEM, and Fire Family Plus) fire behavior models. Internally coded version of BehavePlus ("Behave Calculator") for quick stand-level comparisons of fire behavior.
Risk	Tools to streamline wildfire risk assessments coupled with FlamMap5 outputs.
Tools	A mixture of tools to modify raster values, convert ASCII files to rasters, and export attributes to Excel.
Project	Forms to import, update, and export project settings linking ArcFuels to the programs listed in table 1 and linking spatial data to programs.

ArcFuels provides a logical flow from stand to landscape analyses of vegetation, fuel, and fire behavior, using a number of different models in a simple user interface within ArcMap. Specific functionality of ArcFuels includes:

1. An interactive system within ArcMap to simulate fuel treatment prescriptions with the Fire and Fuels Extension to the Forest Vegetation Simulator (FFE-FVS);

2. Automated generation of Excel workbooks and Stand Visualization System (SVS) images showing how fuel treatments change wildfire behavior and stand conditions over time after FFE-FVS modeling;

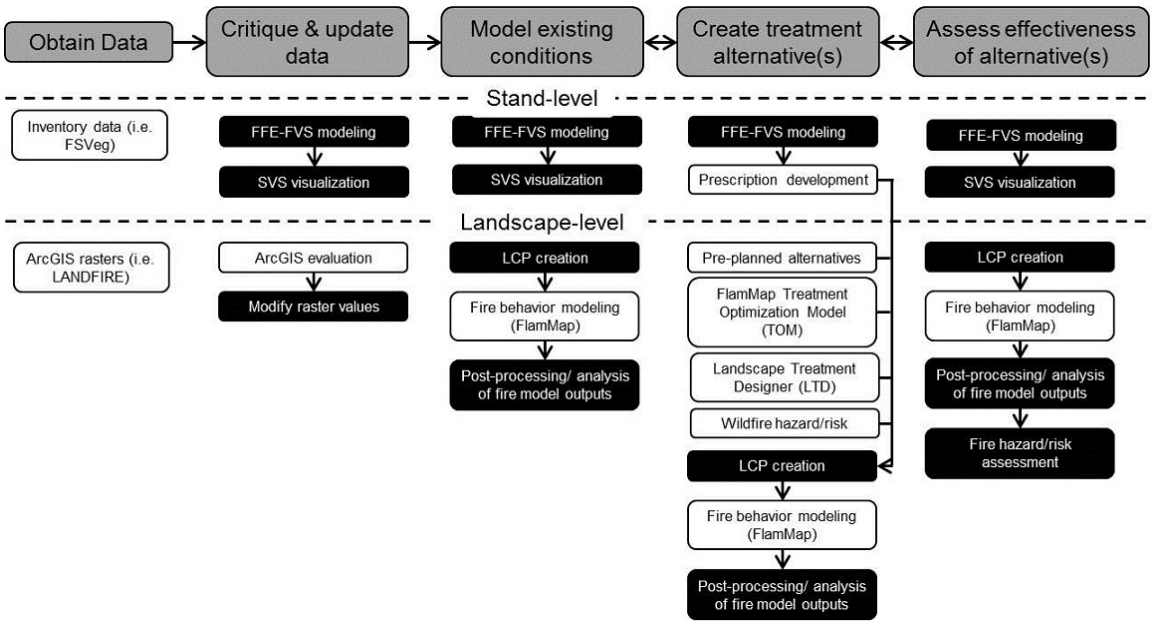
3. Scale-up of stand-specific treatments to simulate landscape changes in vegetation and fuel from proposed management activities;

4. The ability to modify and re-evaluate fuel treatment scenarios;

5. Pre- and post-processing of files for/from FlamMap to simulate landscape-scale fire behavior and to measure fuel treatment performance in terms of wildfire probabilities, spread rates, and fireline intensity;

6. Viewing and analyzing spatial fire behavior outputs in ArcMap; and

7. Tools to aid wildfire risk assessments.



The ArcFuels toolbar has been set up to follow a typical fuel treatment planning work flow (gray boxes). Steps include: obtaining data, critiquing and updating data, modeling existing conditions, creating treatment alternative(s), and assessing the effectiveness of the alternative(s). Different processes are possible at the stand and landscape levels and are shown accordingly. Black boxes are specific to ArcFuels functionality.

ArcFuels leverages pre-existing models and packages them into an ArcMap toolbar to aid in vegetation management, fuel treatment planning, wildfire modeling and wildfire risk assessments.

Description of forest growth and fire behavior models linked to ArcFuels (adapted from table 1 in Ager et al. 2011). FVS, FFE-FVS, SVS and FlamMap are the programs most frequently used with ArcFuels.

Model	Description	Linkage within ArcFuels
Forest Vegetation Simulator	Individual-tree, distance-independent growth and yield model	Calls the program, creates input data, processes output data, plus allows interaction in execution
Fire and Fuels Extension to FVS	Stand-level simulations of fuel dynamics, potential fire behavior and fire effects over time	Calls the program, creates input data, processes output data, plus allows interaction in execution
Stand Visualization System	Generates graphics depicting stand conditions	Calls the program, creates input data
NEXUS	Stand-level spreadsheet that links surface and crown fire prediction models	Opens the program, creates input data
BehavePlus	Stand-level fire behavior, fire effects, and fire environment modeling system	Opens the program; SURFACE module fully integrated in the Behave Calculator
FlamMap	Landscape-level fire behavior mapping and analysis program	Opens the program, creates input data, processes output data
Fire Area Simulator	Landscape-level fire spread	Opens the program, creates input

Model	Description	Linkage within ArcFuels
(FARSITE)	simulator	data, processes output data
First Order Fire Effects Model (FOFEM)	Stand-level first order fire effects modeling system	Opens the program
Fire Family Plus	Analysis of fire danger indices and weather	Opens the program
Landscape Treatment Designer (LTD)	Landscape-level fuel treatment planning system	Opens the program