Understanding How the Large Fire Module (LFM) Processes Fuels Treatment Prescriptions FLS_011_WP

Topic

Understanding how the Large Fire Module (LFM) processes fuels treatment prescriptions.

Introduction

The FPA Interagency Science Team (IST) designed the Large Fire module as a two-stage modeling process in order to minimize computer run/wait time and Fire Planning Unit (FPU) Planner workload during their analysis. The FPU Planners have two tasks in providing inputs to the Large Fire module. The first is to provide the FPA Project with simple typical fuel treatment prescriptions (objectives). The second is to identify a weather station[1] that typifies the general weather conditions under which large fires spread in their FPU.

The fuel prescriptions are the FPU's three or four most common fuels treatment prescriptions. They are used in Stage 1, to "train" the LFM on the effect fuels treatments have on large fire behavior. This is done in order to generate the statistical predictor of fire behavior's response to treatments. The statistical predictor will be incorporated into the LFM in Stage 2 for use by the FPU Planners to analyze their candidate investment alternatives.

Background

The LFM incorporates five separate fire behavior simulations that provide predictor equations used to calculate expected large fire size, intensity, and costs. The LFM uses a modified FSPro (Fire Spread Probability) application for its fire behavior simulations. FSPro is a spatial fire spread model that calculates the probability of burning from a current fire perimeter or ignition point, using as key inputs:

- Landscape characteristics, such as surface fuel model, aspect, elevation, slope, and canopy.
- Historic Energy Release Component (ERC) and wind data from a representative weather station.

The LFM uses outputs from the FSPro analyses, including an FSPro simulation of the effect of fuels treatments, to develop predictor equations for use in evaluating FPU investment alternatives.

Discussion

Considerations in Developing Fuels Treatment Prescriptions

FPUs should consider the following when forming the three or four most common annual fuels treatments that occur on their lands:

[1] http://www.fpa.nifc.gov/Library/Papers/Docs/FPA_2/Tech_Single_Weather_Station_08_1_18_final.pdf

- The number of acres of completed projects over the past five to ten years.
- The most common prescriptions in terms of total FPU fuels program acres, not in terms of the numbers of planned or completed projects.
- Fuels layer changes that are important to meet the objectives of their fuels program. FPUs can use either the standard FBPS 13 or the Scott and Burgan 40 surface fuel models, and canopy characteristics (i.e. stand height, canopy cover, canopy base height, and canopy bulk density).

For example, an FPU might define its most common treatment, Treatment #1, in the following way: "Change surface fuel model 10 to 8; change canopy base height to 25 feet; change canopy cover to 60%. This treatment accounts for 50% of the total treatment acres."

FPUs should include canopy characteristics when these data are important to the outcomes of the fuels treatment program, especially when the objective is to modify crown fire behavior. Canopy characteristics are important considerations because:

- Timber fuel models use canopy characteristics to simulate the initiation and spread rate of crown fires.
- Canopy base height can be significant in the initiation of crown fire.
- Canopy bulk density is important to the spread of crown fire.
- Canopy cover affects the surface wind speed and drying of surface fuels.

In example Treatment #2, where canopy characteristics are not part of a fuels treatment, FPUs need only identify the surface fuel model in their prescription, e.g. "Change surface fuel model 4 to 5. This treatment accounts for 35% of the total treatment acres."

Fuels Treatment Landscape File

The LFM begins the process of creating the "fuels treatment landscape" file by modifying the current condition, or standard landscape file created from LANDFIRE or similar data. The system creates a "treated" landscape by applying the general fuels treatment prescriptions to 15%[2] of the landscape.

[2] 15% is a number chosen in collaboration with the IST. Experimentation found that 15% generates data needed for the statistical portion of LFM. One of the data elements needed to estimate the spatial burn probability is the percent of the area treated within a given radius of a point. 15% of the landscape treated generates enough treated cells so that LFM can model the entire range (from 0% to 100%) of the area treated within the radius. For example, a cell far from a treatment block has 0% of the area around it treated, while a cell located inside a treatment block may have 100% of the area around it treated. The actual 15% treated is not used anywhere in the module; it generates "enough" treatments in a statistical sense.

For example, if an FPU contains 1,000,000 acres, a total of 150,000 acres of the fuel treatment landscape is changed. Of these 150,000 acres, if Treatment #1 ("Change surface fuel model 10 to 8; change canopy base height to 25 feet; change canopy cover to 60%.") is 50% of the total acres of the FPU's fuels program, then 75,000 acres change using this prescription. The model randomly seeks aggregations of cells (500 to 1000 acres in size) within the FPU with surface fuel model 10 and converts them to fuel model 8. For these same areas, canopy cover is changed to 60%, and crown base height is adjusted to 25 feet. Cells not affected by the 15% treatment remain unchanged.

When an FPU identifies a prescription that includes a change only in the surface fuel model, (e.g. "Change fuel model 4 to fuel model 5."), that is the only change the model processes. Any pre-existing canopy characteristics remain the same.

Fuels Treatment Simulation

After adjusting the FPU fuel landscape according to treatment prescriptions, the LFM runs a simulation using the newly created landscape. (See Understanding the Fire Program Analysis (FPA) Large Fire Module LF_012_WP for further information about each of the LFM five simulations.) The fuels treatment simulation outputs (burn probability, final fire sizes, intensity, and duration) are compared to the standard run to model the effects of fuels treatments.

Using Predictor Equations: Formulating Investment Alternatives

During operational use of FPA, FPUs will develop a set of fuels options to be evaluated as part of fire program investment alternatives (preparedness options form the other portion of the investment alternatives). A fuels option consists of a set of fuels treatments, the number of acres proposed to be treated, and the costs associated with the option. For each fuels option, FPUs will define the number of acres treated by fuel model for each Fire Workload Area (FWA.) The model translates acreages into percentages of fuel models treated in each FWA.

For each FPU-developed alternative, the LFM statistical analysis will provide final outputs that predict intensity (in fire intensity level), burn probability, final fire size, and cost estimates for large fires. These data will help the FPUs quantify the effectiveness, efficiency, and performance measures of their investment alternatives.

See Also

- Building a Fuels Treatment Prescription for FPA Large Fire Module Simulation FL_002_TP
- Understanding the Fire Program Analysis (FPA) Large Fire Module LF_012_WP

Review History:

Date	Initials	Change Summary
March 10, 2008	DKS	Approved
March 5, 2008	KSH	Editorial review.
March 4, 2008	GB	AK, MA, GB edits for clarity
February 25, 2008	KSH	Spoke with Jim and made additional edits based on his suggestions.
February 20, 2008	KSH	Edited for clarity and readability.
February 20, 2008	JH	Revision, Comments from JD, GP
February 15, 2008	JH	Initial Draft (with comments from JD, GB)