# LANDFIRE MoD-FIS: Near Real-Time Monitoring of Fuel Conditions

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The Landscape Fire and Resource Management Planning Tools (LANDFIRE) program, a shared effort between the wildland fire management programs of the U.S. Department of Agriculture Forest Service and U.S. Department of the Interior, provides landscape scale geo-spatial products to support cross-boundary planning, management, and operations.

LANDFIRE produces consistent and relevant fire behavior fuel model products across the United States that are used for predicting fire spread and intensity. LANDFIRE products are useful for a range of applications including tactical incident support, strategic planning, historical context, and fire effects modeling.

User feedback of LANDFIRE data indicated that static fuel model layers, which represent average fire conditions, have limited utility in regions in which seasonal conditions greatly impact the amount of fuels available for combustion. Changes in inter- and intra-annual precipitation, vegetation phenology, changing water table levels, and long term climatological trends can all impact fuel conditions, and each region of the country is impacted by different factors.

To address this issue, the LANDFIRE team developed processes to quantify seasonal changes in vegetation that affect fuels conditions for different regions. This strategy is known as the Modeling Dynamic Fuels with an Index System (MoD-FIS) effort within LANDFIRE. Two regions were chosen to demonstrate these processes and test the resultant products' ability to better represent current fuel conditions.

The two prototypes areas are the Southeast United States and the Great Basin / Southwest United States.

## The Problem in the Southeast United States

## MoD-FIS in the Southeast United States.

As wildland fuels dry out, additional fuel materials are available for combustion and heat release. In terms of climate, drought can be used to express this relationship between dry conditions and increased fuel availability. Available fuel in the Southeast varies as results of seasonal trends, vegetation phenology, and changing water table levels.

Fuel models in the Southeast were found to be inconsistent with actual fire behavior. MoD-FIS, comprised of additive fuel weight by size class and fuel bed depth, vegetation type that influences the fuel model transitions, and drought increments that are applied to the transitions, was developed to adjust fuel models based on environmental conditions. In the Southeast, conditions are most notably affected by drought.

**Methods used:**

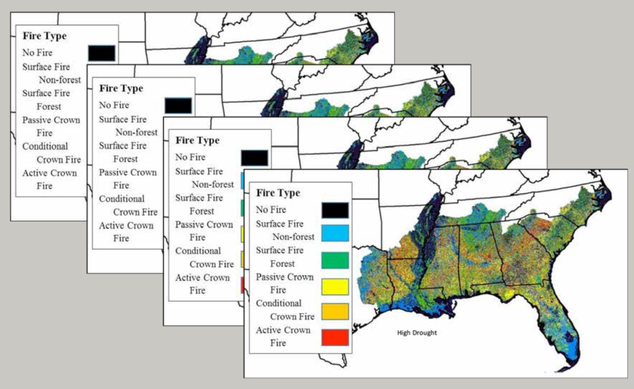
- The National Fire Danger Rating System-Revision of 1988 (NFDRS88) method was used to generate a table of fire behavior fuel model 40 (FBFM40) under four classes of drought condition: no drought, low drought, moderate drought, and high drought.
- LANDFIRE Existing Vegetation Type (EVT), FBFM40 layers and the NFDRS88 fuel model map for the Southeast from the Wildland Fire Assessment System (WFAS) were visually compared to guide assignment of FBFM40 transitions.

## Solution

$$\text{Fuel Load}_{dyn} = \text{Fuel Load}_{stc} + \text{NFDRS}_{KBDI}$$

| KBDI Index | Drought Classes | NFDRS88 Fuel Models |
|---|---|---|
| 0 – 200 | None | None (uses the static FBFM40 fuel model) |
| 201 – 400 | Low | 20% of additional weight and depth added |
| 401 – 600 | Moderate | 55% of additional weight and depth added |
| 601 – 800 | High | 100% of additional weight and depth added |

## Results




- A climatological assessment of KBDI was completed for the map zones using the Remote Automated Weather Station (RAWS) data. This helped determined to which areas this method would apply.
- The total fuel weight and depth for each drought class was calculated for each NFDRS88 fuel model. The additional fuel weight and depth were calculated proportionally, added to NFDRS88 models and were correlated to FBFM40 by total fuel load, 1 hr fuel load, live fuel load, fuel bed depth, and moisture of extinction (MXT).
- A look-up-table (LUT) was developed, which can then be used to update FBFM40 models in near real time for current moisture conditions.

**Testing results**
Improved functionality of the fuel products for fire behavior modeling by transitioning the landscape to classes that more favorably represented actual fire behavior.

**Data Distribution**
Wildland Fire Decision Support system (WFDSS):
https://wfdss.usgs.gov/wfdss_help/WFDSSHelp_KBDI.html

## The Problem in the Great Basin and Southwest United States

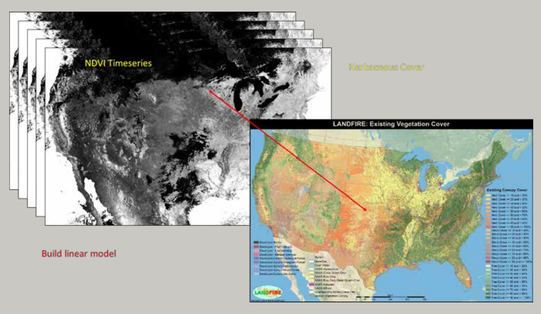
## MoD-FIS in the Great Basin and Southwest United States

Seasonal variations of fine fuels (herbaceous and shrubs) in the Great Basin and Southwest U.S. are driven by winter and spring precipitation and greatly affect fire behavior once the vegetation is cured. Knowing in advance, which areas have a greater than normal annual herbaceous fuel loading is very helpful for fire planning and fire response.

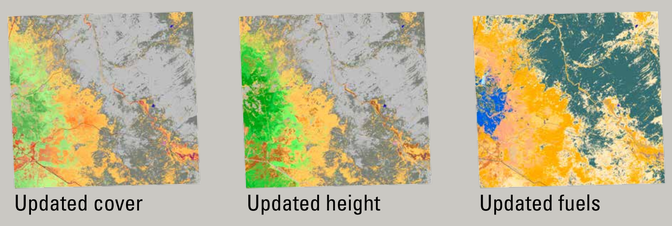
**Methods used:**
Normalized Differenced Vegetation Index (NDVI) derived from Landsat imagery and its relationship to vegetation cover has been well studied and is well understood. LANDFIRE embarked on a multi-step process to predict changes in fire behavior

- Analyzed ten years of Web-Enabled Landsat Data (WELD), to determine the average and range of values for each pixel across the region. These values were correlated with measures of LANDFIRE herbaceous cover to determine abundance of fine fuels.
- Established the relationship of Landsat NDVI to LANDFIRE Existing Vegetation Cover (EVC) using the 10-year stacks of WELD for each map zone.
- Maximum NDVI imagery for the current year was produced and the established relationship applied to EVC so that current year estimates for EVC could be made.
- Once EVC has been updated, then FBFM40 can be updated based upon changes in EVC for current year conditions.

## Solution




## Results



Updated cover | Updated height | Updated fuels

Refinements in cover estimates for sparse areas are also possible using this approach.

**Testing results**
Results included: more intense fire behavior were predicted when the region received a greater than normal amount of precipitation; better modeling results; better characterization of actual fuel conditions; and more representative of landscape conditions.

LANDFIRE MoD-FIS data for the Great Basin and Southwest U.S. have been released as provisional products to allow further testing and review by operational users of LANDFIRE fuels data. Feedback is sought from users and any further refinements needed to the MoD-FIS data will be considered before the data and processes are finalized.

**Data distribution**
LANDIRE Website, MoD-FIS Availability:
https://www.landfire.gov/modfis_downloads.php

LANDFIRE Data Access Tool:
https://www.landfire.gov/datatool.php

U.S. Department of the Interior
U.S. Geological Survey

May 2018