Wildland Fire Potential 2012

A Tool for Wildfire Risk Assessment and Fuels Prioritization

The wildland fire potential (WFP) map is a raster geospatial product produced by the USDA Forest Service, Fire Modeling Institute that is intended to be used in analyses of wildfire risk or hazardous fuels prioritization at large landscapes (100s of square miles) up through regional or national scales. The WFP map builds upon, and integrates, estimates of burn probability and conditional probabilities of fire intensity levels generated for the national interagency Fire Program Analysis system (FPA) using a simulation modeling system called the Large Fire Simulator (FSim). ***The specific objective of the 2012 WFP map is to depict the relative potential for wildfire that would be difficult for suppression resources to contain***, based on past fire occurrence, 2008 fuels data from LANDFIRE, and estimates of wildfire likelihood and intensity generated from FSim in 2012. ***Areas with higher WFP values, therefore, represent fuels with a higher probability of experiencing high-intensity fire with torching, crowning, and other forms of extreme fire behavior under conducive weather conditions.***

On its own, WFP does not provide an explicit map of wildfire threat or risk, because no information on the effects of wildfire on specific values such as habitats, structures or infrastructure is incorporated in its development. However, the WFP map could be used to create value-specific risk maps when paired with spatial data depicting highly valued resources (Thompson et al. 2011a, Thompson et al. 2011b). It is also important to note that the WFP is also not a forecast or wildfire outlook for any particular season, as it does not include any information on current or forecasted weather or fuel moisture conditions. It is instead intended for long-term strategic planning and fuels management. We do not intend for the WFP map to take the place of any of the FSim products; rather, we hope that it provides a useful addition to the information available to managers, policy makers, and scientists interested in wildland fire risk analysis in the United States.

Input Data Sources

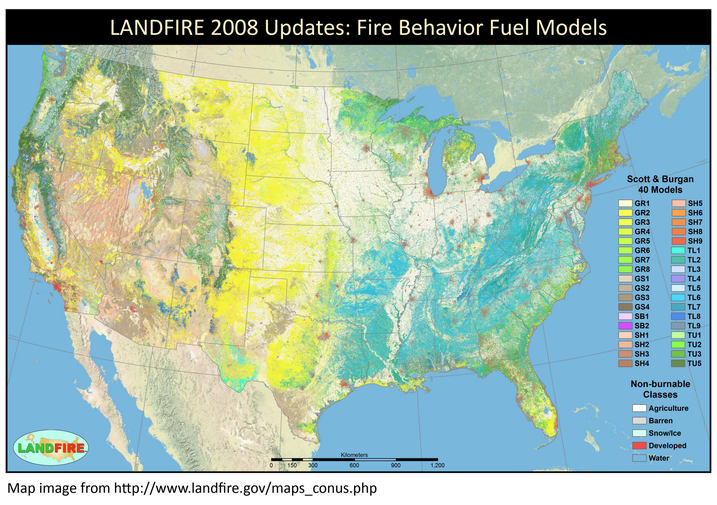
LANDFIRE

The Landscape Fire and Resource Management Planning Tools Program (LANDFIRE) is an interagency mapping program sponsored by the US Department of Interior and US Department of Agriculture, Forest Service (www.landfire.gov). LANDFIRE produces a suite of nationally-consistent 30m-resolution raster datasets depicting vegetation and fuels conditions in the United States. As of 2012, the most current LANDFIRE products represent 2008 landscape conditions. Several LANDFIRE data layers provide critical input to both the simulation of burn probability (see right) and subsequent processing to produce the WFP map. These layers include:

- Fire Behavior Fuel Model 40 (Scott and Burgan models)
- Existing Vegetation Type
- Existing Vegetation Cover
- Forest Canopy Cover
- Forest Canopy Height
- Forest Canopy Base Height

We resampled LANDFIRE data to a 270m cell size to match the resolution of other input data sources.

LANDFIRE 2008 Updates: Fire Behavior Fuel Models



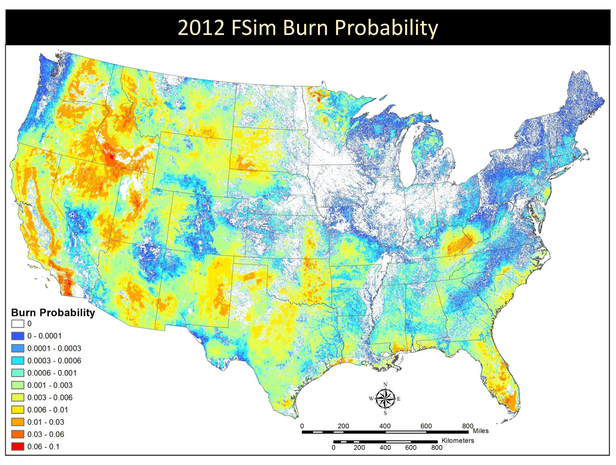
Map image from http://www.landfire.gov/maps_conus.php

Large Fire Simulator (FSim)

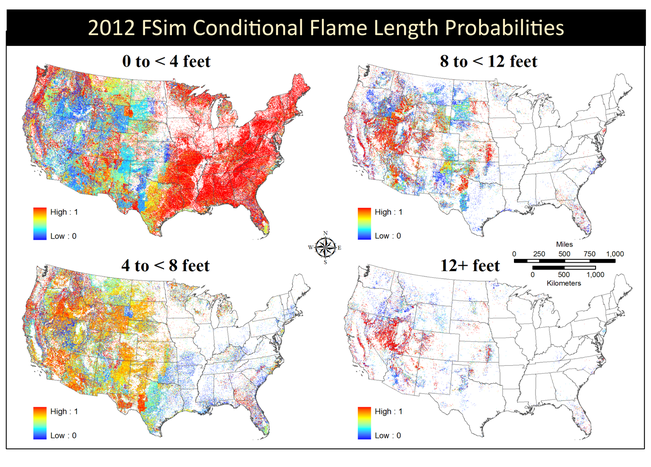
The Large Fire Simulator (FSim) is a simulation modeling system developed by the US Forest Service, Rocky Mountain Research Station to produce estimates of the probabilistic components of wildfire risk (Finney et al. 2011). FSim is applied nationally for FPA using a system of Fire Planning Units (FPUs), and calibrated using large fire occurrence records since 1992. In each FPU, daily ignitions and fire spread are modeled over at least 20,000 simulations of a contemporary fire season, given weather conditions that are statistically possible based on observations from recent decades. The primary outputs from FSim that we use to map WFP are 270m-resolution raster geospatial datasets for the conterminous United States (CONUS), depicting:

- burn probability
- conditional probabilities of distinct fire intensity levels, defined by flame lengths.

2012 FSim Burn Probability



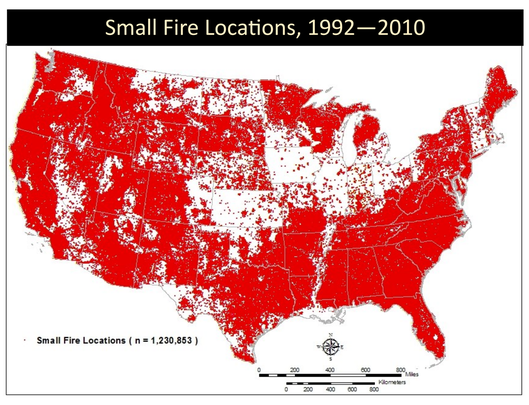
2012 FSim Conditional Flame Length Probabilities



Small Fire Occurrence Locations

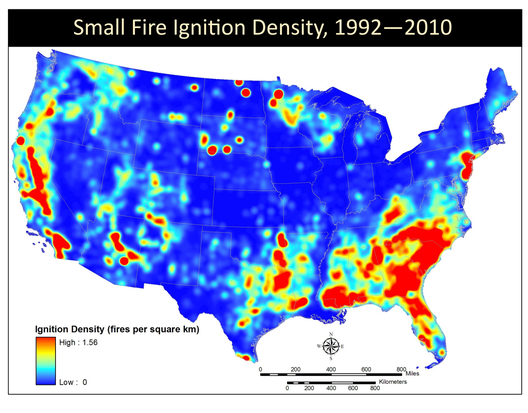
FSim modeling focuses on large fires because they account for over 90% of total area burned in wildfires. As such, simulated fires are more likely to grow large in areas where large fires have been more common on the landscape, based on the ignition density of fires > 50 to 300 acres since 1992. For the WFP, however, we wanted to reflect that areas with predominantly small fires in recent decades also represent some potential for future fires. As a simplistic way to account for this, we created an ignition density surface for fires < 300 acres.

Small Fire Locations, 1992—2010



Using FPA's point fire occurrence database (FOD, July 2012), we first selected out all fires with a final size < 300 acres.

Small Fire Ignition Density, 1992—2010

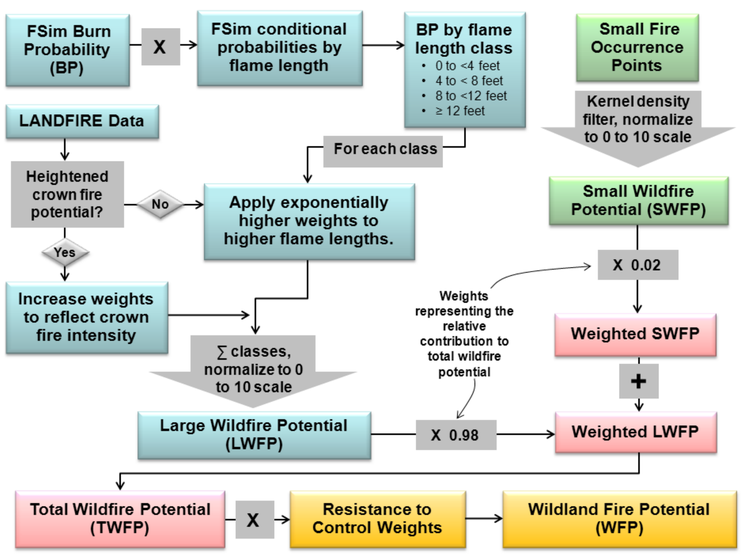


Next, we applied the kernel density tool in ArcGIS to the small fire points , with a search radius of 50km and an output cell size of 270m to match the resolution of FSim model outputs.

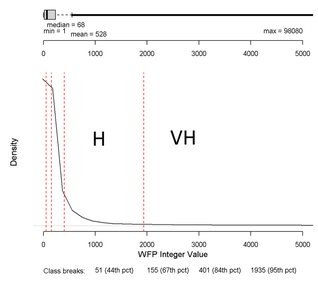
Data Analysis: From burn probability to wildland fire potential

The process we used to create the WFP map can be summarized as follows:

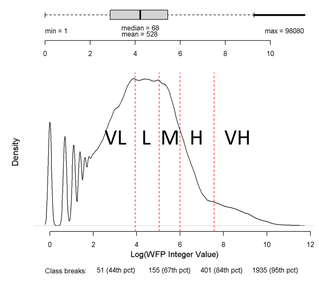
1. **Calculate a large wildfire potential** using the CONUS FSim modeling outputs generated for FPA in 2012 (blue boxes below). We first integrate burn probability and conditional probability for each flame length class, then weight the resulting flame length probabilities by the fireline intensities they represent, with exponentially higher weight given to higher flame lengths. We also use LANDFIRE vegetation and fuels data to apply higher weights to areas more likely to experience crown fire.
2. **Create a separate surface of small wildfire potential** based on ignition locations for fires smaller than 300 acres (green boxes below).
3. **Integrate the large wildfire potential and the small wildfire potential** by weighting each according to its relative contribution to total wildfire potential and summing the weighted values (pink boxes below).
4. **Apply a final set of resistance to control weights** based on fireline construction rates in different fuel types (orange boxes below). We again use the LANDFIRE fuels and vegetation data to apply these weights spatially.



The product that results from the process above is a 270m-resolution raster layer, with values representing wildland fire potential on a continuous scale from 0 to 10. Those values, which we convert to integer by multiplying by 100,000, are strongly positively skewed (below left). By plotting the distribution on a log scale (below right) we are able to better visualize percentile breaks to classify the final WFP product into five discrete classes: very low, low, moderate, high, and very high.



Probability distribution of continuous WFP integer values. The upper tail has been truncated here at 5,000 but the full distribution extends to more than 98,000.



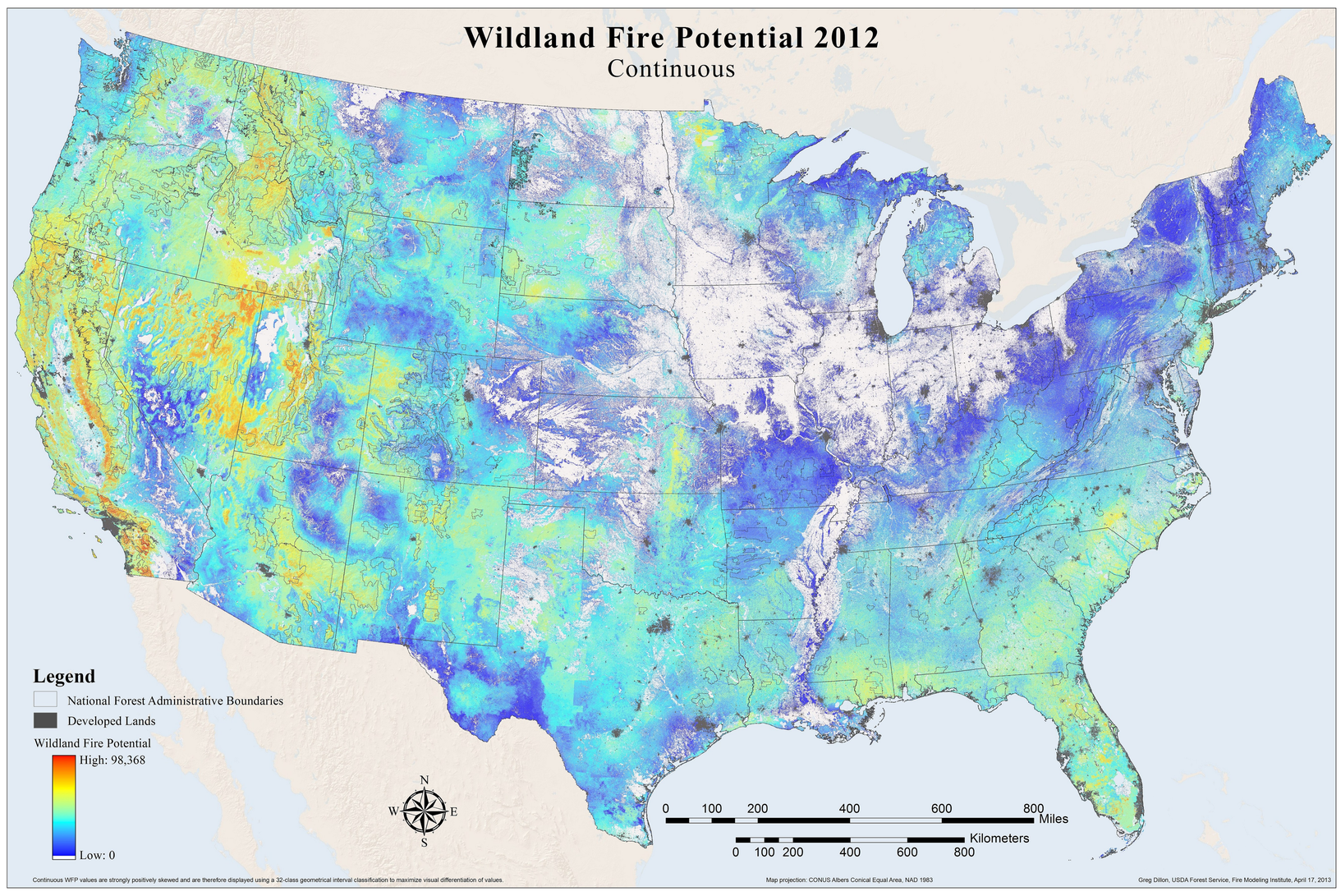
Probability distribution of log-transformed WFP integer values. Dashed red lines on both plots indicate class breaks used in creating the classified WFP map., with percentiles given along the bottom.

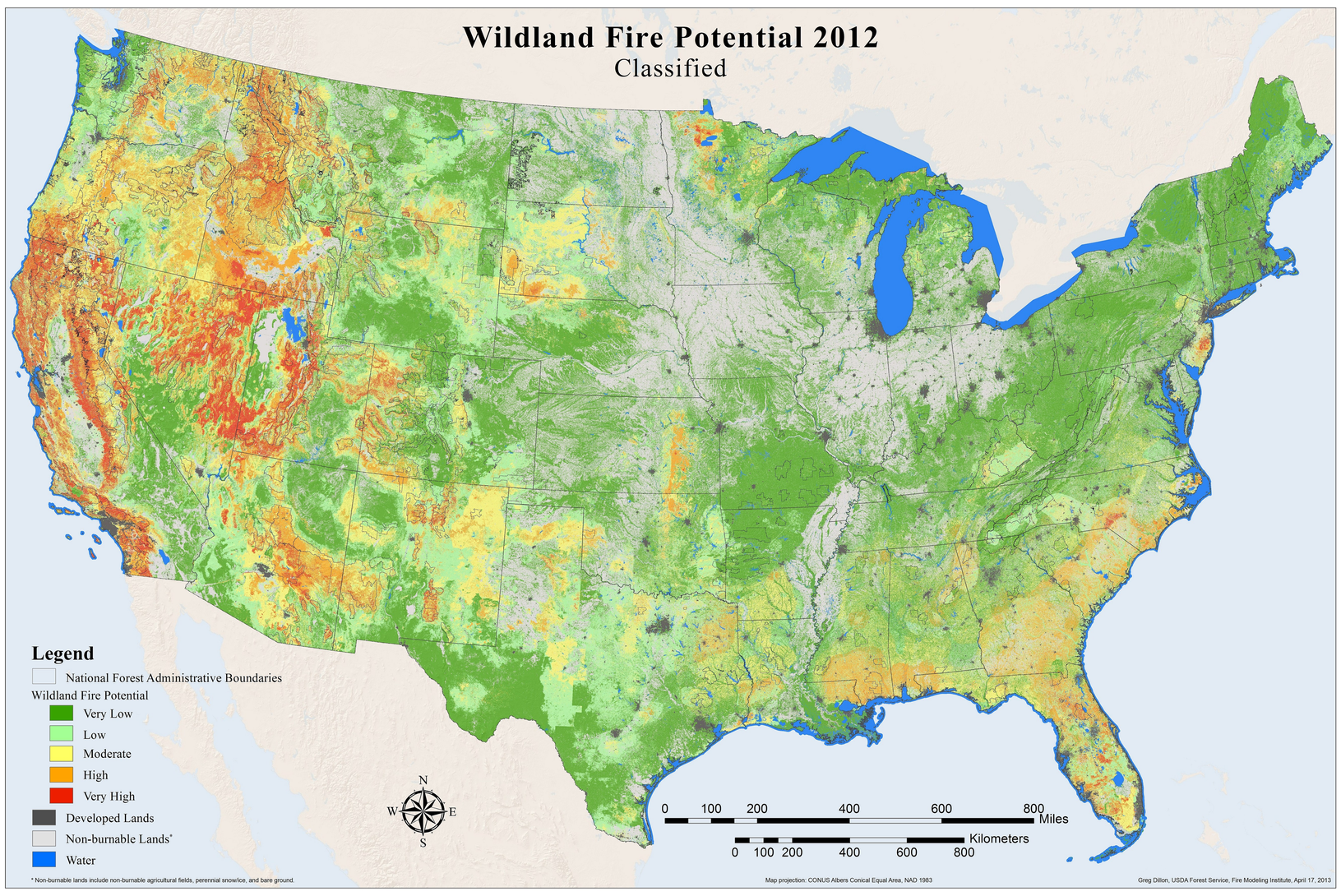
The Wildland Fire Potential map leverages several nationally-consistent geospatial products into one easily-interpretable map that can be applied to broad-scale strategic wildland fire and fuels management. Along with other geospatial data depicting highly valued resources, the WFP map provides one way to assess wildland fire risk at regional and national scales.

This current version of the WFP map represents landscape conditions as of 2008. While it draws on the strengths of the input data sources, it is also limited by their weaknesses and inaccuracies. As a result, some abrupt transitions are visible in this WFP map along FPU boundaries, ignition density contours, and LANDFIRE fuel model delineations. As updated LANDFIRE data and subsequent FPA FSim outputs become available, the WFP will also be updated to reflect both changes on the landscape and improvements in mapping and modeling.

For more information, including links to GIS data, map graphics, an ESRI map service for the classified WFP map, reference material, and more, visit:

http://www.firelab.org/fmi/data-products/229-wildland-fire-potential-wfp





Acknowledgements

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References

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