



Carbon Emissions from North American Wildland Fires: Development and demonstration of the Wildland Fire Emissions Information System (WFEIS), a tool for scientists and land managers

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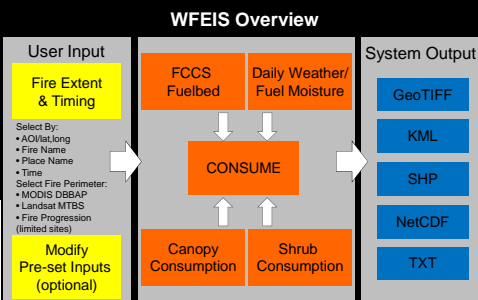
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The Wildland Fire Emissions Information System (WFEIS) provides information for mapping fire-derived carbon emissions across North America using NASA data and products and by adapting existing Forest Service models and tools. Shown is preliminary outputs of the project for the continental U.S. using the USFS-developed fuels data and emissions model. The project will eventually include data sets and information across all of North America, including Alaska, Canada, and Mexico.



<http://wfeis.mtri.org/>

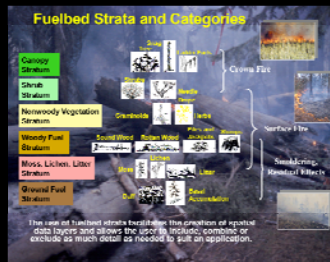
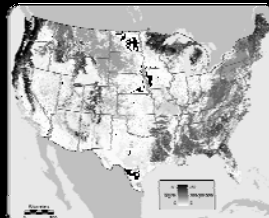


WFEIS is a flexible, open source, web-based system to estimate carbon emissions from fire across North America.

- Provides information at moderate spatial scales and for multiple timeframes for landscape to regional applications
- Allows a choice of fire perimeter map for quantification of burn area
- Only required user input is location and time of interest; custom inputs are possible
- Variety of spatial (GeoTIFF, KML, SHP, NetCDF) and tabular outputs, including total and daily estimates where applicable

Fuel Loading: Fuel Characterization Classification System (FCFS)

The **Fuels Characterization Classification System** has been developed by the US Forest Service to provide a comprehensive description of fuel layers. FCFS fuels represent fuels across the US and Mexico. They were compiled from scientific literature, fuels photo series, fuels inventories, and expert opinion, and represent fuel conditions at multiple scales, from single plots to 1-km cells or larger. Fuelbeds have been mapped at many scales from including 1-km for this continental-scale application. Allometric equations in the FCFS calculator produce fuel loadings, other plot-level metrics, and fire-hazard potential.
<http://www.fs.fed.us/pnw/fera/fccs/>



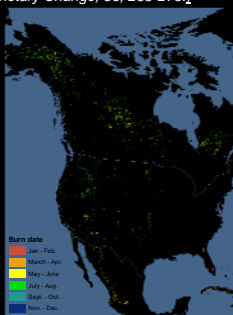
Fuel Consumption and Emissions Factors: Consume

CONSUME estimates fuel consumption and emissions for prescribed and wildland fire. It imports fuelbed data directly from the FCFS. Consume can be used for all forest, shrub, and grassland types in North America.
<http://www.fs.fed.us/pnw/fera/research/smoke/consume/>

Burned Area Products: MODIS DBBAP, Landsat MTBS, Fire Progression

Burned Area Products available within WFEIS:
– MODIS DBBAP (*Giglio, L. et al. 2009 Rem. Sens. Environ., 113(2), 408-420*)
– Landsat MTBS (<http://mtbs.gov/>)
– Fire Progression (*Loboda, T., and I. Csizsar 2007, Global and Planetary Change, 56, 258-273.*)

MODIS Direct Broadcast Burned Area Product (DBBAP)*
2000-2009



2002 Biscuit Fire Example Data Sources and WFEIS Output



Fuel Data: A map of fuels and fuel loadings, derived from the USFS Fuel Characteristic Classification System (FCFS), is integrated into WFEIS at a 1-km spatial resolution.

- FCFS**
- 17 Douglas-fir, sugar pine, tanoak forest
 - 18 Jeffrey pine, ponderosa pine, Douglas-fir, California black oak forest
 - 24 Pacific ponderosa pine-Douglas-fir forest
 - 28 Douglas-fir, madrone-tanoak forest
 - 44 Scrub oak chaparral shrubland

Burned Area Product: For the 2002 Biscuit Fire all three burned area product options are available. The figure below shows MODIS DDAP (left) versus Landsat MTBS (middle) versus Fire Progression (right) burned area perimeters.



Fuel Consumption and Emission Model: The USFS CONSUME model is an empirically-based model to estimate fuel consumption and emissions, including total carbon.

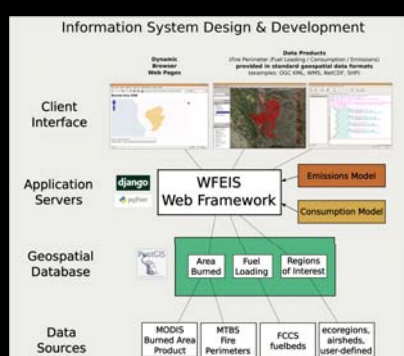
Fuel Moisture Inputs: Weather station data is used to interpolate duff and 1,000-hour fuel moisture values required by the CONSUME module. Calculations are made daily or by fire, depending on the burned area product selection.

MODIS DBBAP: Total Carbon Emissions: 5.22 Tg-C
Area Normalized Carbon Emissions: 3.07 kg-C m⁻²

Landsat MTBS: Total Carbon Emissions: 6.20 Tg-C
Area Normalized Carbon Emissions: 3.10 kg-C m⁻²

Fire Progression: Total Carbon Emissions: 6.13 Tg-C
Area Normalized Carbon Emissions: 3.06 kg-C m⁻²

- Built using open-source technology**
- GeoDjango - Web framework
 - GDAL / OGR - Raster / vector manipulation libraries
 - Proj4 - Projection library
 - PostGIS - Geospatial relational client-server database
 - Python - Scripting language for integrating components
 - Ubuntu - Linux operating system distribution



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