Development and use of the Wildland Fire Emissions Information System for quantifying and mapping fire emissions for North America

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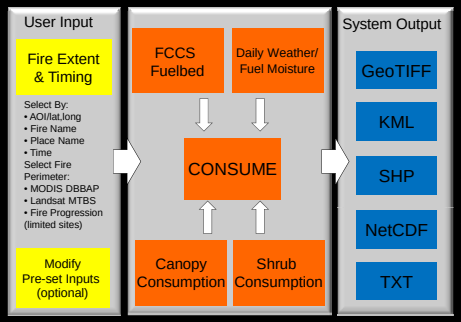
The Wildland Fire Emissions Information System (WFEIS) is a web-based tool that provides a simple user interface for computing wildland fire emissions across North America at landscape to regional scales (1-km spatial resolution). WFEIS provides access to fire perimeter maps along with corresponding fuel loading data layers and fuel consumption models to compute fuel consumption and fire emissions for user-specified locations and date ranges. The system currently allows calculation of emissions from fires within the United States for 1982 to 2009.



Provides easy access to data sets and models to estimate carbon emissions from fire

Improved Data:

-- Provides access to data at moderate spatial scales and for multiple timeframes for landscape to regional applications;

-- Improved maps of fuel loading/biomass than previously available;

-- Accessibility & user choice of fire perimeter maps for quantification of burn area;

-- Only required user input to compute fire emissions is location and time of interest.

http://wfeis.mtri.org/

Easy Access to Models & Results:

-- Includes both a GUI calculator and web-API access to the WFEIS modeling framework;

-- Access via web through url-formatted requests facilitates query flexibility & scripting;

-- Allows a variety of spatial and tabular outputs;

-- Developed with multiple users in mind.

Built with open-source technology to facilitate development of the web-accessible data and emissions modeling framework

-- GeoDjango: Web framework

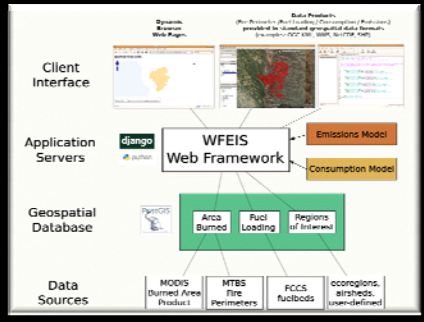
-- GDAL/OGR: Raster/vector manipulation libraries

-- Proj4: Projection library

-- PostGIS: Geospatial relational client-server database

-- Python: Scripting language for integrating components

-- Ubuntu: Linux operating system distribution

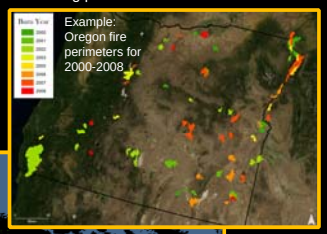


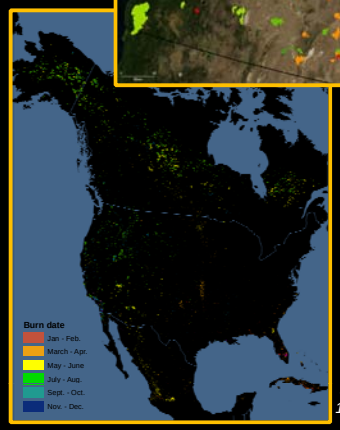
Burned Area Products

Burn Area is user-chosen within WFEIS from two remote sensing products:

Landsat MTBS

(http://mtbs.gov/)





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

(Giglio, et al. 2009 Rem. Sens. Environ., 113(2), 408-420)

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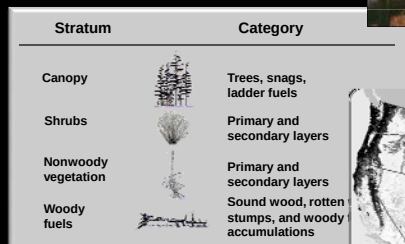
Fuel Loading/ Biomass Map

The Fuel Characteristic Classification System

was developed by the US Forest Service and provides a comprehensive description of fuelbeds. Fuelbed characteristics are compiled from scientific literature, fuel photo series, fuel-inventory databases, and expert opinion, and calculated from allometric equations. Although FCCS fuelbeds can represent multiple scales, they were mapped at 1km for this continental-scale application. Fire-behavior equations in the FCCS calculate surface, crown, and available-fuel fire potentials, reaction intensity, flame length and rate of spread for each fuelbed.

http://www.fs.fed.us/pnw/fera/fccs/



Fuel Consumption and Emissions Model

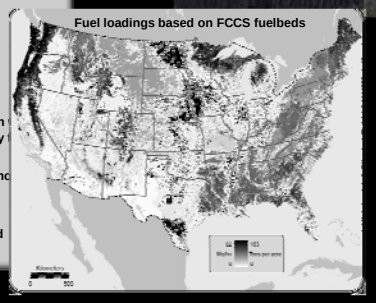
Consume

is a US Forest Service model which estimates fuel consumption and emissions for prescribed and wildland fire. It imports fuelbed data directly from the FCCS. Consume can be used for all forest, shrub, and grassland types in North America. Model inputs needed:

-- Fuel moisture – derived daily from weather on the date of the fire

-- Fuel type (FCCS) – determines biomass pools and crown fire consumption based on crown fire potential

http://www.fs.fed.us/pnw/fera/research/smoke/consume/



Study: Comparison of Emissions Models

Five fire events:

-- 2002 Biscuit fire in southern Oregon

-- 2003 Montreal Lake central Saskatchewan

-- 2004 Boundary fire in interior Alaska

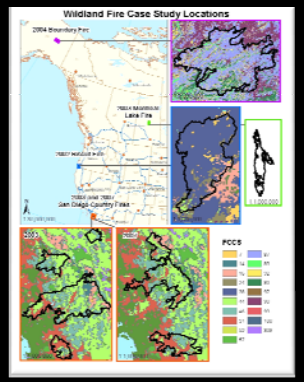
-- San Diego County, California 2003 and 2007

Six fire emissions models:

-- CONSUME 3.0 -- CanFIRE

-- FOFEM 5.7 -- Canadian FBP

-- WFEIS -- GFED



Study Results & Conclusions:

-- Models generally agree (within 25% of each other, see graph lower right).

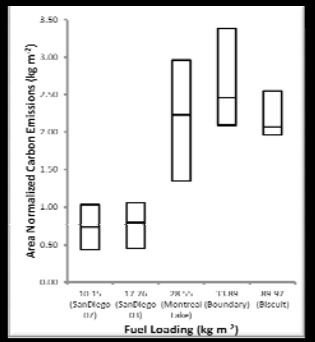
-- Model assumptions results in spread of results.

-- Vegetation fuel density, structure, and condition (fuel moisture) are important drivers of emissions variability.

-- Global-scale GFED modeled emissions are consistent with landscape/regional-scale estimates.

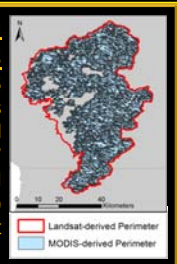
-- The models reviewed are sufficiently structured to include the variables that drive carbon emissions.

-- For all models, improved data on fuels and fire conditions are required for accurate emissions quantification, in addition to burn area.



Effect of Burned Area on Carbon Emissions

For the Biscuit fire case, the WFEIS model was run with two burn area maps (see figure, right). The area-normalized emissions are similar (**3.06 and 3.07 kgC m^{-2}**), but the total carbon emitted is higher with the Landsat-based map by about 17% (6.13 TgC with Landsat and 5.22 TgC with MODIS).



French, N.H.F. et al. (2011), "Model comparisons for estimating carbon emissions from North American wildland fire," *Journal of Geophysical Research, 116, G00K05.*

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