CARVE: Alaskan Fire Emissions Database (AKFED), 2001-2013

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Documentation Revision Date: 2015-09-03

Data Set Version: V1

Summary

This data set provides estimates of annual carbon emissions (kg carbon per square meter) from boreal fires at 450-m resolution for the state of Alaska between 2001 and 2013. To produce these data, daily burned area for 2001 to 2013 was mapped using imagery from the Moderate Resolution Imaging Spectroradiometer (MODIS) combined with perimeters from the Alaska Large Fire Database. Carbon consumption was calibrated using available field measurements from black spruce forests in Alaska. Above- and below-ground carbon consumption were modeled based on environmental variables including elevation, day of burning within the fire season, pre-fire tree cover and the differenced normalized burn ratio (dNBR). Modeled uncertainties in carbon consumption are included in the data set. The derived burn area and carbon emissions product, referred to as the Alaskan Fire Emissions Database (AKFED), provides a resource for study of the environmental controls on daily fire dynamics, boreal fire emissions in biogeochemical models, and potential feedbacks from changing fire regimes.

There are 39 data files in GeoTIFF (.tif) format with this data set. There are 13 *.tifs for carbon consumption, 13 *.tifs for carbon consumption uncertainty, and 13 *.tifs for day of burning, one for each year.

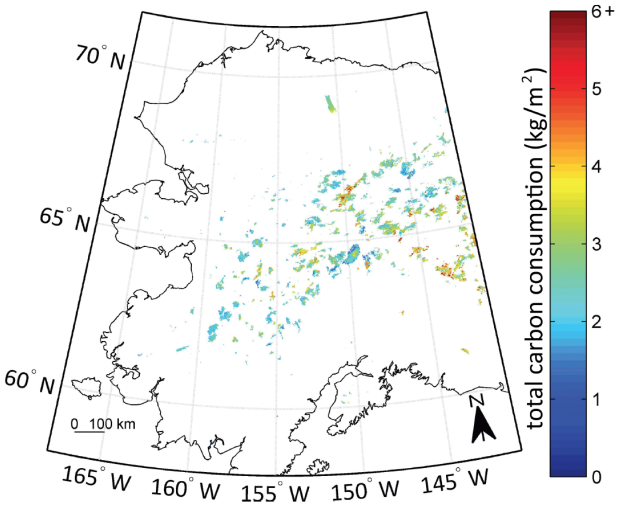

Figure 1. Total pyrogenic carbon consumption estimated from the AKFED between 2001 and 2012 (from Fig. 5 in Veraverbeke et al. 2015).

Citation

Veraverbeke, S., B.M. Rogers, and J.T. Randerson. 2015. CARVE: Alaskan Fire Emissions Database (AKFED), 2001-2013. ORNL DAAC, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/1282

Table of Contents

1. Data Set Overview

Project: Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE)

Investigators: Sander Veraverbeke, B.M. Rogers, and J.T. Randerson.

This data set provides estimates of annual carbon emissions (kg carbon per square meter) from boreal fires at 450-m resolution for the state of Alaska between 2001 and 2013. To produce these data, daily burned area for 2001 to 2013 was mapped using imagery from the Moderate Resolution Imaging Spectroradiometer (MODIS) combined with perimeters from the Alaska Large Fire Database. Carbon consumption was calibrated using available field measurements from black spruce forests in Alaska. Above- and below-ground carbon consumption were modeled based on environmental variables including elevation, day of burning within the fire season, pre-fire tree cover and the differenced normalized burn ratio (dNBR). Modeled uncertainties in carbon consumption are included in the data set. The derived burn area and carbon emissions product, referred to as the Alaskan Fire Emissions Database (AKFED), provides a resource for study of the environmental controls on daily fire dynamics, boreal fire emissions in biogeochemical models, and potential feedbacks from changing fire regimes.

Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE) is collecting detailed measurements of important greenhouse gases on local to regional scales in the Alaskan Arctic and demonstrating new remote sensing and improved modeling capabilities to quantify Arctic carbon fluxes and carbon cycle-climate processes. Ultimately, CARVE will provide an integrated set of data that will provide unprecedented experimental insights into Arctic carbon cycling.

Related Data Sets:

Global Fire Emissions Database, Version 3.1

2. Data Characteristics

Spatial Coverage

Mainland of Alaska excluding the southern part of the Alaska Peninsula and Southeast Alaska, west of British Columbia.

Spatial Resolution

450-m resolution

Temporal Coverage

The data covers the period 2001-01-01 to 2013-12-31.

Temporal Resolution

Annual

Study Area: (All latitudes and longitudes given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Alaska, USA	-168.5	-141	71.4999	58

Data File Information

There are 39 data files in GeoTIFF format (*.tif) with this data set. The files provide spatially-gridded estimates of carbon consumption by fire (kg C/m2 burned area) and uncertainty, and day of burning (day of year) by year. There are 13 files each, one for each year, for carbon consumption, carbon consumption uncertainty, and day of burning.

Example file names:

AKFED_carbon_consumption_2001.tif

AKFED_carbon_consumption_uncertainty_2001.tif

AKFED_fire_doy_2001.tif

Spatial Data Properties

Spatial Representation Type: Raster
Pixel Depth: 32 bit
Pixel Type: floating point
Compression type: LZW
Number of Bands: 1

Raster Format: TIFF
No Data Value: none
Scale Factor: 1
Cell Geometry: area

Number Columns: 3,746
Column Resolution: 450 meter
Number Rows: 3,620
Row Resolution: 450 meter

Spatial Reference Properties

Type: Projected
Geographic Coordinate Reference: NAD83
Projection: Albers_Conic_Equal_Area

Open Geospatial Consortium (OGC) Well Known Text (WKT):

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PROJCS["unnamed",
        GEOGCS["NAD83",
                DATUM["North_American_Datum_1983",
                        SPHEROID["GRS 1980",6378137,298.2572221010042,
                                AUTHORITY["EPSG","7019"]],
                        AUTHORITY["EPSG","6269"]],
                PRIMEM["Greenwich",0],
                UNIT["degree",0.0174532925199433],
                AUTHORITY["EPSG","4269"]],
        PROJECTION["Albers_Conic_Equal_Area"],
        PARAMETER["standard_parallel_1",55],
        PARAMETER["standard_parallel_2",65],
        PARAMETER["latitude_of_center",50],
        PARAMETER["longitude_of_center",-154],
        PARAMETER["false_easting",0],
        PARAMETER["false_northing",0],
        UNIT["metre",1,
                AUTHORITY["EPSG","9001"]]]
```

Extent in the data file coordinate system:

North: 2495174.3196
South: 866174.3196
West: -842644.8858
East: 843055.1142

3. Application and Derivation

The combined time span, time step, spatial resolution, spatial domain and calibration with field observations of this product makes it suitable for use in many atmospheric studies, and unique from other published estimates. The daily burned area data, along with the carbon emission estimates, allow for a daily convolution of burned area and emissions for Alaska.

4. Quality Assessment

Uncertainty in total carbon consumption originated primarily from the belowground fraction. The region-wide standard deviation of the 1,000 simulations that included all uncertainty sources was 0.50 kg C/m2 for total carbon consumption.

The main source of uncertainty was the black spruce model of carbon consumption, followed by the land-cover classification. The scaling factors developed to derive carbon consumption in other land-cover types than black spruce and spatial scaling introduced smaller uncertainties. More information is available in Veraverbeke et al. (2015).

5. Acquisition Materials and Methods

Site Characteristics

The spatial domain covers almost the entire mainland of Alaska with the exclusion of the southern part of the Alaska Peninsula and Southeast Alaska, west of British Columbia. The temporal domain of the study includes the years 2001-2013. Most Alaskan fires occur in the interior of the state, which consists of a mosaic of vegetation types. Black spruce forest dominates on cold, poorly drained, north-oriented or lowland sites, whereas white spruce and deciduous species (mainly aspen and birch) prevail on warmer, better drained, south-oriented sites without permafrost (Viereck, 1973; Bonan, 1989). Grass- and shrubland ecosystems occur in early successional stands, poorly drained sites, steep slopes, and at and above the treeline. The vegetation mosaic in interior Alaska is constantly reshaped by the occurrence of fire and subsequent post-fire succession.

Field Data

The investigators assembled field data of depth of burn from three different publications (Boby et al., 2010; Turetsky et al., 2011; Rogers et al., 2014). Due to limited data availability for other land-cover types than black spruce (five plots in Rogers et al., 2014), they focused on black spruce plots, and retained all plots burned since 2000 for which cloud-free 1-year-postfire differenced normalized burn ratio (dNBR) observations were available in the Monitoring Trends in Burn Severity (MTBS, Eidenshink et al., 2007) database, resulting in a total of 126 plots (see Veraverbeke et al. 2015 for details).

Model Development

The AKFED carbon consumption model was formulated for black spruce based on the relationship between the observed carbon consumption at the field locations and the environmental variables. The investigators extracted the pixel values of elevation, slope, northness, pre-fire tree cover and dNBR at 30-m resolution at the location of the field plots. The day of burning was assigned from the nearest active fire observation. To extrapolate the model in space and time, they used a spatial resolution of 450 m. All analyses were performed within the Albers equal area projection for Alaska: where the central meridian = 154 degrees W,; standard parallel 1 = 55 degrees N; standard parallel 2 = 65degrees N; latitude of origin = 50 degrees N; with North American Datum 1983 (NAD83).

The investigators modeled below- and aboveground carbon consumption separately, based on the relationships between field plot data and environmental variables (elevation, slope, northness, pre-fire tree cover, day of burning and dNBR) at 30-m resolution. Due to the paucity of carbon consumption observations in other land-cover types than black spruce, they developed separate consumption models for these ecosystems that drew upon the data-driven approach for black spruce. Model implementation details are provided in Veraverbeke et al. (2015).

6. Data Access

This data set is available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

CARVE: Alaskan Fire Emissions Database (AKFED), 2001-2013

Contact for Data Center Access Information:

E-mail: uso@daac.ornl.gov
Telephone: +1 (865) 241-3952

7. References

Boby, L. A., Schuur, E. A. G., Mack, M. C., Verbyla, D., and Johnstone, J. F. 2010. Quantifying fire severity, carbon, and nitrogen emissions in Alaska's boreal forest, Ecol. Appl., 20, 1633–1647, doi:10.1890/08-2295.1

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