NDVI, Species Cover, and LAI, Burned and Unburned sites, Interior Alaska, 2017-2018

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Documentation Revision Date: 2021-10-28

Dataset Version: 1

Summary

This dataset provides leaf area index (LAI), tree species and canopy cover, normalized difference vegetation index (NDVI), and NDVI trends for boreal forests in interior Alaska, U.S. These data were collected to investigate NDVI trends with forest structure and composition as influenced by disturbance and succession. The data are from 102 sites surveyed in 2017 and 2018 and include locations with and without a fire since 1940. A time series of NDVI was developed from Landsat (1999-2018) to measure NDVI trends. The field data cover the period 2017-08-29 to 2018-08-20. The surveyed forest stands spanned a distance of over 425 km across interior Alaska. The sites were selected before visiting the field to include locations with and without a fire since 1940. Recently burned sites were selected to span a range of years since fire, while sites without a recent fire were selected to include a range of Landsat NDVI trends. For each year, the median NDVI during the growing season was calculated. Then, a simple linear regression trend was calculated for years 1999-2018.

There are two data files in comma-separated text (*.csv) format included in this dataset. Also included are two companion files: one each in Keyhole Markup Language (*.kml) and Portable Document (*.pdf) format.

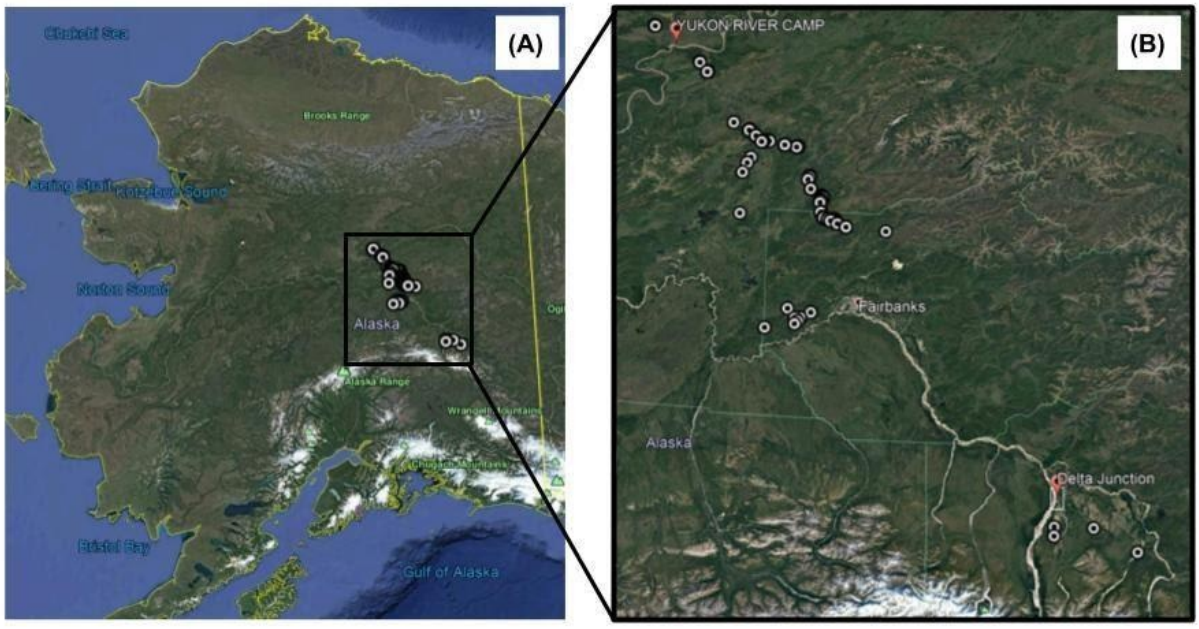

Figure 1. Locations of boreal forest stands in interior Alaska where forest structure and composition were measured and compared to remotely-sensed NDVI trends (Fiore et al., 2020). The locations are available as a companion file. Source: Google Earth

Citation

Fiore, N., S. Pedron, M. Tayo, C.I. Czimczik, and M.L. Goulden. 2021. NDVI, Species Cover, and LAI, Burned and Unburned sites, Interior Alaska, 2017-2018. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1797

Table of Contents

1. Dataset Overview

This dataset provides leaf area index (LAI), tree species and canopy cover, normalized difference vegetation index (NDVI), and NDVI trends for boreal forests in interior Alaska, U.S. These data were collected to investigate NDVI trends with forest structure and composition as influenced by disturbance and succession. The data are from 102 sites surveyed in 2017 and 2018 and include locations with and without a fire since 1940. A time series of NDVI was developed from Landsat (1999–2018) to measure NDVI trends. The field data cover the period 2017-08-29 to 2018-08-20. The surveyed forest stands spanned a distance of over 425 km across interior Alaska. The sites were selected before visiting the field to include locations with and without a fire since 1940. Recently burned sites were selected to span a range of years since fire, while sites without a recent fire were selected to include a range of Landsat NDVI trends. For each year, the median NDVI during the growing season was calculated. Then, a simple linear regression trend was calculated for years 1999–2018.

Project: Arctic-Boreal Vulnerability Experiment

The Arctic-Boreal Vulnerability Experiment (ABoVE) is a NASA Terrestrial Ecology Program field campaign being conducted in Alaska and western Canada, for 8 to 10 years, starting in 2015. Research for ABoVE links field-based, process-level studies with geospatial data products derived from airborne and satellite sensors, providing a foundation for improving the analysis, and modeling capabilities needed to understand and predict ecosystem responses to, and societal implications of, climate change in the Arctic and Boreal regions.

Related Publications

Fiore, N.M., M.L. Goulden, C.I. Czimczik, S.A. Pedron, and M.A. Tayo. 2020. Do recent NDVI trends demonstrate boreal forest decline in Alaska? Environmental Research Letters 15:095007. https://doi.org/10.1088/1748-9326/ab9c4c

Acknowledgments

This research was funded by the NASA ABoVE program (grant 14-TE14-0094).

2. Data Characteristics

Spatial Coverage: Interior Alaska (Fairbanks area)

> **ABoVE Reference Locations**
>
> Domain: Core ABoVE
>
> Grid Cells: The data are in the 5 m “C” tiles listed below (within the larger, 240 m grid tile Ah00v01): Ch039v032, Ch040v027, Ch040v029, Ch040v037, Ch040v038, Ch041v028, Ch041v030

Spatial Resolution: Points

Temporal Coverage: 2017-08-29 to 2018-08-20

Temporal Resolution: One-time estimates

Site Boundaries: Latitude and longitude are given in decimal degrees.

Sites	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Alaska	-149.959	-144.955	65.96196	63.81758

Data file information

There are two data files in comma-separated text (*.csv) format included in this dataset. Also included are two companion files: one each in Keyhole Markup Language (*.kml) and Portable Document (*.pdf) format.

Table 1. File names and descriptions.

File Name	Description
Data Files	
Alaska_Leaf_Area_Index.csv	Provides leaf area index
Alaska_ForestAge_Cover_NDVI_NDVITrends.csv	Provides NDVI, NDVI trends, and age
Companion Files	
NDVI_Forest_Structure.pdf	A PDF version of this user guide.
survey_sites.kml	Locations of the study sites for viewing in Google Earth

Data File Details

Missing data are reported as -9999.

Table 2. Variables in the file Alaska_Leaf_Area_Index.csv.

Variable	Units	Description
survey_location_id		ID number of field survey location
latitude	Decimal degrees	Latitude in decimal degrees, GPS of location of measurements
longitude	Decimal degrees	Longitude of decimal degrees, GPS of location of measurements
date	YYYY-MM-DD	Date of measurements
lai	LAI	Leaf area index measured with LAI-2000 plant canopy analyzer, LI-COR

Table 3. Variables in the file Alaska_ForestAge_Cover_NDVI_NDVITrends.csv.

Variable	Units	Description
survey_location_id		ID number of field survey location
date	YYYY-MM_DD	Date data were acquired
latitude	Decimal degrees	Latitude in decimal degrees
longitude	Decimal degrees	Longitude of decimal degrees
age	Years	Age (in calendar years) of forest stand based on fire history and tree cores
white_spruce	Percent	Fractional cover of ground by white spruce trees in the upper canopy
deciduous	Percent	Fractional cover of ground by deciduous trees and shrubs in the upper canopy
black_spruce	Percent	Fractional cover of ground by black spruce trees in the upper canopy
total_canopy_cover	Percent	Fractional cover of ground by trees and shrubs
fraction_ deciduous	Percent	Fractional cover of upper canopy by deciduous trees and shrubs
forest_type		Type of forest, defined by fractional cover of ground by deciduous trees and shrubs, white or black spruce. Forest types: BS = black spruce forest D = deciduous forest Recent fire = burned after 2005; 0–13 years since fire Early recovery = burned between 1985–2005; 13–33 years since fire WS = white spruce forest
landsat_ndvi_2018_yearmedian	1	Median NDVI during the growing season in 2018
landsat_ndvi_trend_1999_2018	1	Simple linear regression trend in NDVI between 1999 and 2018

3. Application and Derivation

Remote sensing analyses of boreal forest regions have found widespread decreasing or increasing trends in NDVI. Initially, these trends were attributed to climate change induced shifts in primary productivity. It is emerging, however, that fire disturbance and subsequent succession also strongly impact the optical properties of boreal forests. NDVI time series data from Landsat were paired with surveys of 102 forest stands with known recent fire history to investigate the relationship between NDVI and forest structure during succession. Additional field studies are needed to better interpret observed changes in remotely sensed vegetation indices (Fiore et al., 2020).

4. Quality Assessment

No information is provided.

5. Data Acquisition, Materials, and Methods

NDVI Extraction & Temporal Trend Analysis

Landsat imagery for 1999–2018 was used to calculate NDVI for this analysis. June-August Collection 1, Level 1 Landsat 5, 7, and 8, Surface Reflectance and Brightness Temperature images for WRS2 Paths 66-72 and rows 14-16 were downloaded from the US Geological Survey (https://espa.cr.usgs.gov). Images with less than 30% cloud cover were selected and reprojected to 0.0002695° resolution. The images were masked for snow, cloud and cloud shadow. Subsequent analyses focused on 1999-2018 due to large gaps in the earlier record. For each year, the median NDVI during the growing season was calculated (Goulden and Bales, 2019). Then, a simple linear regression trend was calculated for the years 1999 to 2018.

Field Sites

A survey of 102 forest stands across interior Alaska was conducted, spanning a distance over 425 km (Figure 1) in August 2017 and 2018. The sites were selected before visiting the field to include locations with and without a fire since 1940. Potential sample locations were identified using the 1940-2018 Alaskan fire perimeter database produced by the Alaska Fire Service (AFS) acquired from the Alaska Interagency Coordination Center (https://fire.ak.blm.gov/incinfo/aklgfire.php). Recently burned sites were selected to span a range of years since fire, while sites without a recent fire were selected to include a range of Landsat NDVI trends. Sites were further screened to avoid large topographic and land-use gradients and to allow efficient access.

Two perpendicular 60 m transects were established at each site, and forest properties were measured at 10 m-intervals (12 observations/site). Observations included upper canopy species composition, canopy cover, and leaf area index (LAI-2000 plant canopy analyzer, LI-COR).

To estimate tree age and growth history of each site, multiple tree cores were collected from representative trees of each species (2-4 trees/species) with 4.3 mm outer diameter increment borers. Tree cores were mounted, sanded manually, and analyzed using Lignovision software (Rinntech 2020). Observations also included leaf area index (LAI-2000 plant canopy analyzer, LI-COR).

The sites visited were subsequently sorted into five groups based on stand age and species composition of the upper canopy: (1) Recently burned (fire after 2005; ≤13 years since fire), (2) Early fire recovery (burned between 1985-2005; 13-33 years since fire), (3) Mid-to-late successional, deciduous stand, (4) Mid-to-late successional, white spruce stand, and (5) Mid-to-late successional, black spruce stand (Fiore et al., 2020).

Further details of this investigation are available in Fiore et al. (2020).

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

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Contact for Data Center Access Information:

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

7. References

Fiore, N.M., M.L. Goulden, C.I. Czimczik, S.A. Pedron, and M.A. Tayo. 2020. Do recent NDVI trends demonstrate boreal forest decline in Alaska? Environmental Research Letters 15:095007. https://doi.org/10.1088/1748-9326/ab9c4c

Goulden, M.L., and R.C. Bales. 2019. California forest die-off linked to multi-year deep soil drying in 2012–2015 drought. Nature Geoscience 12:632–637. https://doi.org/10.1038/s41561-019-0388-5

Rinntech. 2020. LignoVision^{tm}: tree-ring analysis on wood surfaces. Rinntech, Inc.; St. Charles, Illinois, USA. https://rinntech.info/products/lignovision/