ABoVE: Landsat-derived Burn Scar dNBR across Alaska and Canada, 1985-2015

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Documentation Revision Date: 2018-07-18

Data Set Version: 1

Summary

This dataset contains differenced Normalized Burned Ratio (dNBR) at 30-m resolution calculated for burn scars from fires that occurred within the Arctic Boreal and Vulnerability Experiment (ABoVE) Project domain in Alaska and Canada during 1985-2015. The fire perimeters were obtained from the Alaskan Interagency Coordination Center (AICC) and the Natural Resources Canada (NRC) fire occurrence datasets. Only burns with an area larger than 200-ha were included. The dNBR for each burn scar at 30-m pixel resolution was derived from pre- and post-burn Landsat 5, 7, and 8 scenes within a 5-km buffered area surrounding each burn scar using Landsat LEDAPS surface reflection image pairs.

In each fire year, 1985-2015, every burn scar was assigned a burn ID (BID) and each 30-m pixel in a burn scar was assigned that respective BID value. The BID links to a separate data file with the specific burn scar area and lists the original Landsat image pair used to calculate the dNBR for that BID. Similarly, in each fire year, every 30-m pixel in a burn scar was assigned a Landsat image pair ID (PID), indicating the original Landsat image pair that was used to calculate the dNBR in that pixel for that fire year. The PID links to a separate data file with the original Landsat image pair information.

There are 4,625 data files with this dataset. This includes 4,623 dNBR, BID, and PID data files in GeoTIFF (.tif) format and two files in comma separated (.csv) format with the BID and PID Landsat scene data utilized. The dNBR, BID, and PID data are provided in the ABoVE 30-m reference grid system and extend across 128 ABoVE grid tiles. For each dNBR data file, there is a BID data file and a PID data file for burn scars in each year (1985-2015) in the ABoVE domain. The two .csv files are BID and PID data lookup tables.

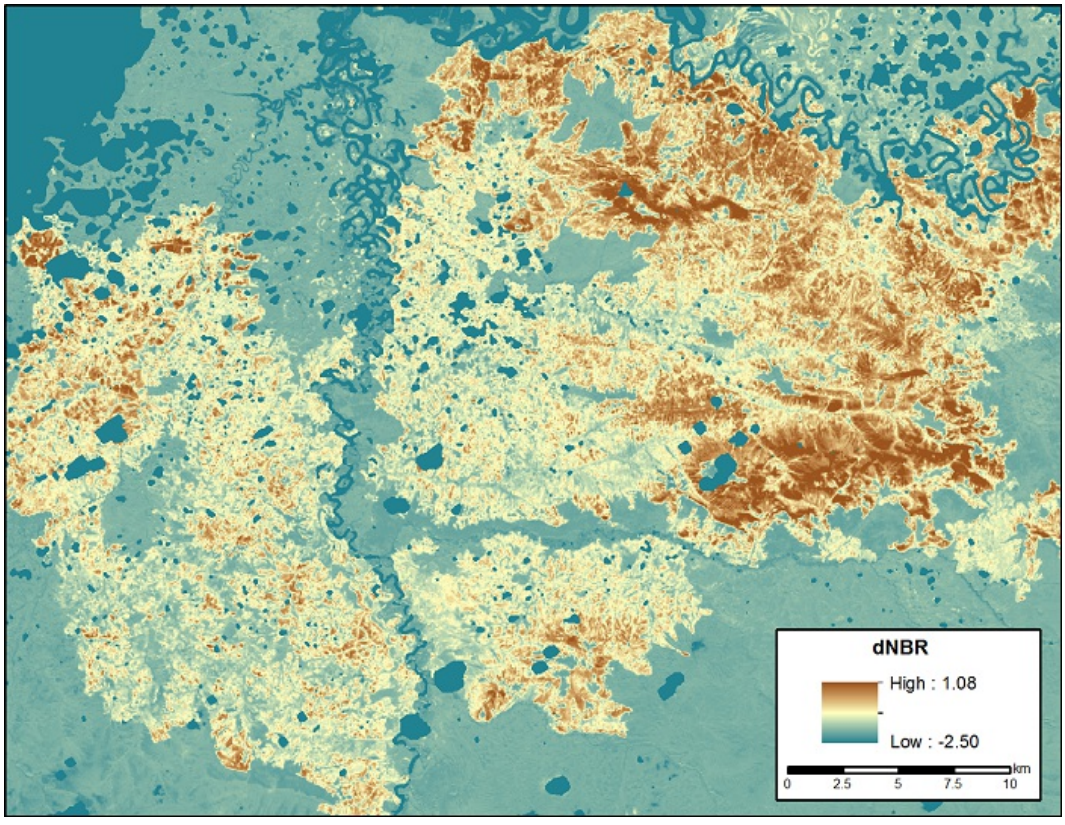

Figure 1.This figure shows the differenced Normalized Burned Ratio (dNBR) for a burn scar in 2015. The data were gridded to the 30-m ABoVE reference grid system (Loboda et al., 2017). These data are located in grid tile Bh05Bv03.

Citation

Loboda, T.V., D. Chen, J.V. Hall, and J. He. 2018. ABoVE: Landsat-derived Burn Scar dNBR across Alaska and Canada, 1985-2015. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1564

Table of Contents

1. Data Set Overview

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In each fire year, 1985-2015, every burn scar was assigned a burn ID (BID) and each 30-m pixel in a burn scar was assigned that respective BID value. The BID links to a separate data file with the specific burn scar area and lists the original Landsat image pair used to calculate the dNBR for that BID. Similarly, in each fire year, every 30-m pixel in a burn scar was assigned a Landsat image pair ID (PID), indicating the original Landsat image pair that was used to calculate the dNBR in that pixel for that fire year. The PID links to a separate data file with the original Landsat image pair information.

Project: Arctic-Boreal Vulnerability Experiment

The Arctic-Boreal Vulnerability Experiment (ABoVE) is a NASA Terrestrial Ecology Program field campaign based in Alaska and western Canada between 2016 and 2021. 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 and societal implications.

Acknowledgments

This research received funding from the NASA Terrestrial Ecology Program, grant number NNX13AK44G.

2. Data Characteristics

Spatial Coverage: ABoVE core domain in Alaska and Canada

ABoVE Reference Locations:

Domain: Core ABoVE

State/territory: Alaska and the Northwest Territories, CA

ABoVE grid cells (128):

Bh01v03	Bh05v04	Bh08v07	Bh10v13	Bh12v14
Bh01v04	Bh05v05	Bh08v08	Bh10v14	Bh12v15
Bh01v05	Bh05v06	Bh08v09	Bh10v15	Bh12v16
Bh01v06	Bh06v01	Bh08v10	Bh10v16	Bh13v08
Bh01v07	Bh06v02	Bh08v11	Bh11v05	Bh13v09
Bh02v02	Bh06v03	Bh08v13	Bh11v06	Bh13v10
Bh02v03	Bh06v04	Bh09v04	Bh11v07	Bh13v11
Bh02v04	Bh06v05	Bh09v05	Bh11v08	Bh13v12
Bh02v05	Bh06v06	Bh09v06	Bh11v09	Bh13v13
Bh02v06	Bh06v07	Bh09v07	Bh11v10	Bh13v14
Bh03v03	Bh06v08	Bh09v08	Bh11v11	Bh13v15
Bh03v04	Bh07v02	Bh09v09	Bh11v12	Bh14v08
Bh03v05	Bh07v03	Bh09v10	Bh11v13	Bh14v09
Bh03v06	Bh07v04	Bh09v11	Bh11v14	Bh14v10
Bh03v07	Bh07v05	Bh09v12	Bh11v15	Bh14v11
Bh04v01	Bh07v06	Bh09v13	Bh11v16	Bh14v12
Bh04v02	Bh07v07	Bh09v14	Bh12v05	Bh14v13

Bh04v03	Bh07v08	Bh10v05	Bh12v06	Bh14v14
Bh04v04	Bh07v09	Bh10v06	Bh12v07	Bh14v15
Bh04v05	Bh07v10	Bh10v07	Bh12v08	Bh15v11
Bh04v06	Bh08v02	Bh10v08	Bh12v09	Bh15v12
Bh04v07	Bh08v03	Bh10v09	Bh12v10	Bh15v13
Bh05v01	Bh08v04	Bh10v10	Bh12v11	Bh15v14
Bh05v02	Bh08v05	Bh10v11	Bh12v12	Bh15v15
Bh05v03	Bh08v06	Bh10v12	Bh12v13	Bh16v11
				Bh16v12
				Bh16v13
				Bh16v14

Spatial Resolution: 30-m

Temporal Coverage: 1985-01-01 to 2015-12-31

Temporal Resolution: annual

Study Areas (All latitude and longitude given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Alaska and Canada	-168.4236111	- 101.7455556	71.35583333	50.25417

Data File Information

There are a total of 4,625 data files with this dataset. This includes 4,623 dNBR, BID, and PID data files in GeoTIFF (.tif) format and two files in comma-separated format (.csv) with the original Landsat image pair information used to calculate the dNBR at each pixel in each fire year and in an ABoVE grid tile.

- dNBR values were calculated for each burn scar in each fire year
- Landsat image pair ID (PID) files indicate the original Landsat image pair that was used to calculate the dNBR at each pixel in each fire year
- BID files contain the burn IDs (BID) for each fire scar in each fire year. Each BID is a unique 4-digit number assigned to an individual burn scar in the form of XYYY. Where X is 1 or 2, representing burn scars from AICC or NRC, respectively, and YYY is a three-digit ID unique identifier for a given burn scar within a fire year

File names

The files are named according to the following naming convention: **ABoVE.XXX.YYYY.BhZvZ.003.proddatetime.tif**

where:

ABoVE – refers to the campaign

XXX – refers to the file product type: dNBR, PID, or BID

YYYY – refers to the year of burn: 1985 - 2015

BhZvZ – refers to the grid B tile ID, where “Z” is a number (see Fig. 2, the ABOVE grid, and Loboda et al. 2017)

003 – refers to the version of the product

proddatetime – refers to the production date and time (YYYYDDDHHMMSS)

Example file names:

ABoVE.dNBR.2015.Bh16v14.003.2018020230204.tif

ABoVE.PID.2015.Bh16v14.003.2018020230204.tif

ABoVE.BID.2015.Bh16v14.003.2018020230204.tif

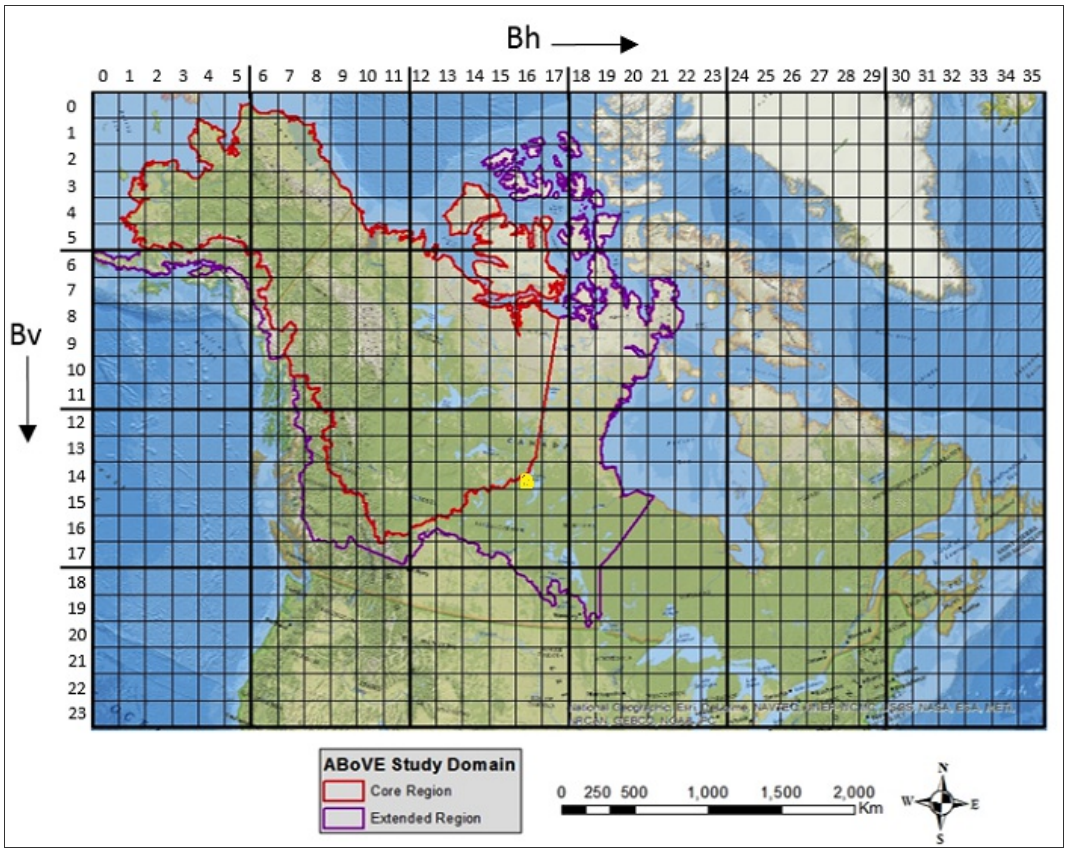

Figure 2. The ABoVE 30-m reference grid. The tile Bh16v14, in the file name examples above, is indicated with the yellow circle in the map (Loboda et al., 2017).

GeoTiff files

Table 1. Properties of the GeoTIFF files

File type	Data Type	Valid Range (min to max)	Fill value
dNBR	16-bit signed integer	-2999 to 2993	-3000
BID	16-bit signed integer	1000 to 3000	0
PID	16-bit signed integer	0 to 242	0

BID and PID lookup-tables in .csv format

Two .csv files are provided with this dataset, containing BID and PID reference lookup-tables.

Burn ID (BID)

Every burn scar was assigned a burn ID (BID) and each 30-m pixel in a burn scar was assigned that respective BID value.

This file (*.csv) provides the areas of the fire scars, pre-burn and post burn path/row, year, and date of Landsat imagery used in the study. YYYY = year from 1985-2015.

Example file name: dNBR_reference_table_YYYY_BID.csv

Table 2. BID file information

Column Heading	Units/format	Description
fire_year	YYYY	Year of fire from AICC and NRC sources
BID	XYYY	BID is a unique 4-digit number assigned to an individual burn scar in the form of XYYY. Where X is 1 or 2, representing burn scars from AICC or NRC sources, respectively. YYY is a three-digit ID unique identifier for a given burn scar within a fire year.

Column Heading	Units/format	Description
region		Alaska or Canada
area_ha	ha	Burn scar area
satellite_pre-burn_pair1		Landsat 5, Landsat 7, or Landsat 8
path_row_pre-burn_pair1	PPPRRR	Path/Row of Landsat pre-burn image used to calculate the dNBR. Note leading zero.
image_year_pre-burn_pair1	YYYY	Year pre-burn image acquired
image_julian_date_pre-burn_pair1	DDD	Julian date pre-burn image acquired
image_cal_date_pre-burn_pair1	DD/MM/YYYY	Calendar date pre-burn image acquired
satellite_post-burn_pair1		Landsat 5, Landsat 7, or Landsat 8
path_row_post-burn_pair1	PPPRRR	Path/Row of Landsat post-burn image used to calculate the dNBR
image_year_post-burn_pair1	YYYY	Year post-burn image acquired
image_julian_date_post-burn_pair1	DDD	Julian date post-burn image acquired
image_cal_date_post-burn_pair1	DD/MM/YYYY	Calendar date post-burn image acquired
satellite_pre-burn_pair2		Landsat 5, Landsat 7, or Landsat 8
path_row_pre-burn_pair2	PPPRRR	Path/Row of Landsat pre-burn image used to calculate the dNBR. Note leading zero.
image_year_pre-burn_pair2	YYYY	Year pre-burn image acquired
image_julian_date_pre-burn_pair2	DDD	Julian date pre-burn image acquired
image_cal_date_pre-burn_pair2	DD/MM/YYYY	Calendar date pre-burn image acquired
satellite_post-burn_pair2		Landsat 5, Landsat 7, or Landsat 8
path_row_post-burn_pair2	PPPRRR	Path/Row of Landsat post-burn image used to calculate the dNBR. Note leading zero.
image_year_post-burn_pair2	YYYY	Year post-burn image acquired
image_julian_date_post-burn_pair2	DDD	Julian date post-burn image acquired
image_cal_date_post-burn_pair2	DD/MM/YYYY	Calendar date post-burn image acquired
Notes		

Landsat image pair ID (PID)

In each fire year, every 30-m pixel in a burn scar was assigned a Landsat image pair ID (PID), indicating the original Landsat image pair that was used to calculate the dNBR in that pixel for that fire year. Landsat images from 1984 were used also to derive the 1985 GeoTIFFs and are included in the file; there are no data files for 1984.

This file (*.csv) provides a cross reference from the assigned Landsat image pair ID (PID) to the respective pre-burn and post burn path, row, year, and date of Landsat imagery used in the study. YYYY=year from 1985-2015.

Example file name: dNBR_reference_table_YYYY_PID.csv DD/MM/YYYY

Table 3. PID file information

Column Heading	Units/format	Description
image_year_pre-burn	YYYY	Year pre-burn image acquired
PID		In each fire year, every 30-m pixel in a burn scar was assigned a Landsat image pair ID (PID), indicating the original Landsat image pair that was used to calculate the dNBR in that pixel for that fire year.
landsat_pre-burn		Landsat 5, Landsat 7, or Landsat 8

Column Heading	Units/format	Description
path_row_pre-burn	PPPRRR	Path/Row of Landsat pre-burn image used to calculate the dNBR. Note leading zero.
image_julian_date_pre-burn	DDD	Julian date pre-burn image acquired
image_cal_date_pre-burn	DD/MM/YYYY	Calendar date pre-burn image acquired
landsat_post-burn		Landsat 5, Landsat 7, or Landsat 8
path_row_post-burn	PPPRRR	Path/Row of Landsat post-burn image used to calculate the dNBR. Note leading zero.
image_year_post-burn	YYYY	Year post-burn image acquired
image_julian_date_post-burn	DDD	Julian date post-burn image acquired
image_cal_date_post-burn	DD/MM/YYYY	Calendar date post-burn image acquired

Companion files

There are two companion files with this dataset described below.

Table 4. Companion files

File name	Description
ABoVE_Fire_Severity_dNBR.pdf	A pdf of this guide document
ABoVE_Burn_Severity_Product_Users_Guide.pdf	A user's guide in pdf format of the ABoVE Burn Severity Product (as sets of three-band GEOTIFF images)

3. Application and Derivation

These data are designed to quantify fire-induced changes in tundra with a specific aim to assess the region's vulnerability to on-going and future environmental change and the changes to carbon cycling in this ecosystem.

4. Quality Assessment

Caveats and Known Problems

For a small number of fires, the dNBR was unable to be calculated for a portion or the entirety of the fire perimeters due to a lack of valid data inputs.

5. Data Acquisition, Materials, and Methods

Overview

The differenced Normalized Burned Ratio (dNBR) was calculated for each burn scar from fires that occurred within the Arctic Boreal Vulnerability Experiment (ABoVE) Project domain in Alaska and Canada during 1985-2015. The fire perimeters were obtained from the Alaskan Interagency Coordination Center (AICC; https://fire.ak.blm.gov/) and the Natural Resources Canada (NRC; https://www.nrcan.gc.ca/) datasets. Only burns within the core ABoVE domain and whose areas are larger than 200-ha were included.

Annual dNBR data were derived from pre- and post-burn Landsat 5, 7, and 8 scenes over the burn scars. Pre- and post-fire products used in this study were from Landsat 5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper Plus (ETM+), and Landsat 8 Operational Land Imager (OLI)/Thermal Infrared Sensor (TIRS).

The annual dNBR data were gridded to the ABoVE 30-m grid system, resulting in 128 grid tiles with burn scars and derived dNBR for the study period. Data files include the specific ABoVE grid designation and the year.

Pre- and Post-burn Image Selection

The pre- and post-burn images were selected based on the following criteria:

1. Images must contain a minimal amount of clouds and cloud shadows within the burn scars.
2. The following combinations of the pre- and post-image pairs are allowed: OLI-OLI, TM-TM, ETM+-ETM+, TM-ETM+, ETM+-TM. The combination of OLI and non-OLI images was excluded because of the differences in band ranges between the OLI and prior sensors.
3. The preferred acquisition date for the pre- (post-) burn images was chosen based on the following strategy: Mid-May to late-June of the year before (after) fire > early-July to mid-September (before snow onset) of the year before (after) fire > snow-free image from the year of fire before (after) fire occurs.

The Monitoring Trends in Burn Severity (MTBS; https://www.mtbs.gov/) image pairs over Alaska were used as a basis for the chosen Landsat pairs over the Alaskan burn scars; however, any MTBS image pairs that did not meet our criteria were dropped and new image pairs were chosen (refer also to the companion file **ABoVE_Burn_Severity_Product_Users_Guide.pdf**).

dNBR Calculations

The Normalized Burn Ratio differencing (dNBR) was calculated within a 5-km buffered area surrounding each burn scar using Landsat LEDAPS (Masek et al., 2006) surface reflection image pairs:

$$dNBR = NBR_{pre\text{-}burn} - NBR_{post\text{-}burn}$$

where,

$$NBR = (\text{near-infrared (NIR)} - \text{shortwave-infrared } (SWIR)_{2.1}) / (NIR + SWIR_{2.1})$$

The dNBR values were set to -2500 for those pixels that were affected by invalid land observations (i.e. cloud, cloud shadow, ice/snow and water) according to the QA bands associated with LEDAPS surface reflectance data. In cases where scars were in close proximity and there could have been image overlapping, the dNBR of the overlapping regions were set to the highest value at each pixel.

6. Data Access

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

ABoVE: Landsat-derived Burn Scar dNBR across Alaska and Canada, 1985-2015

Contact for Data Center Access Information:

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

7. References

Loboda, T.V., E.E. Hoy, and M.L. Carroll. 2017. ABoVE: Study Domain and Standard Reference Grids, Version 2. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1527

Masek, J.G., Vermote, E.F., Saleous, N.E., Wolfe, R., Hall, F.G., Huemmrich, K.F., Feng, G., Kutler, J., & Teng-Kui, L. (2006). A Landsat surface reflectance dataset for North America, 1990-2000. *Geoscience and Remote Sensing Letters, IEEE, 3*, 68-72. https://doi.org/10.1109/LGRS.2005.857030