ABoVE: Ecosystem Map, Great Slave Lake Area, Northwest Territories, Canada, 1997-2011

Get Data

Documentation Revision Date: 2019-11-06

Dataset Version: 1

Summary

This dataset provides an ecosystem type map at 12.5 meter resolution for the area surrounding Great Slave Lake, Northwest Territories, Canada for the time period 1997 to 2011. The map includes nine classes for peatland, wetland, and upland areas derived from a Random Forest classification trained on multi-date, multi-sensor remote sensing images across the study extent, and using field data and high-resolution Worldview-2 image interpretation for training and validation. The nine classes are: Water, Marsh, Swamp, Open Fen, Treed Fen, Bog, Deciduous, Coniferous, and Sparsely Vegetated. A tenth map class identifies areas of historical fires (prior to 2011) that are currently undergoing post-fire successional revegetation. This data provides an ecosystem type map of the area before the large fire season of 2014 to better understand the effects of fires in the area.

The remote sensing data were comprised of 143 Landsat 5 images and 129 L-Band PALSAR images from spring, summer, and fall with dates ranging from 1997-2011. The images were combined into 48 raster stacks and each was classified by Random Forests, then the classified maps were mosaicked and smoothed. To train and validate the Random Forest classification, 12,000+ polygons were created and classified using high resolution Worldview-2 imagery georeferenced to the Landsat and PALSAR datastacks and recent field data: 80% of the polygons were used for model training and 20% were used for validation. Overall Random Forests classification accuracy is 89.5%.

This dataset includes one file of ecosystem classes in GeoTIFF (.tif) format and two shapefiles (.shp) provided in compressed format (.zip) with training and validation polygons. Two companion files in .csv format are also included: one file provides all PALSAR and Landsat 5 images used for classification, and the other file provides the classification error matrix.

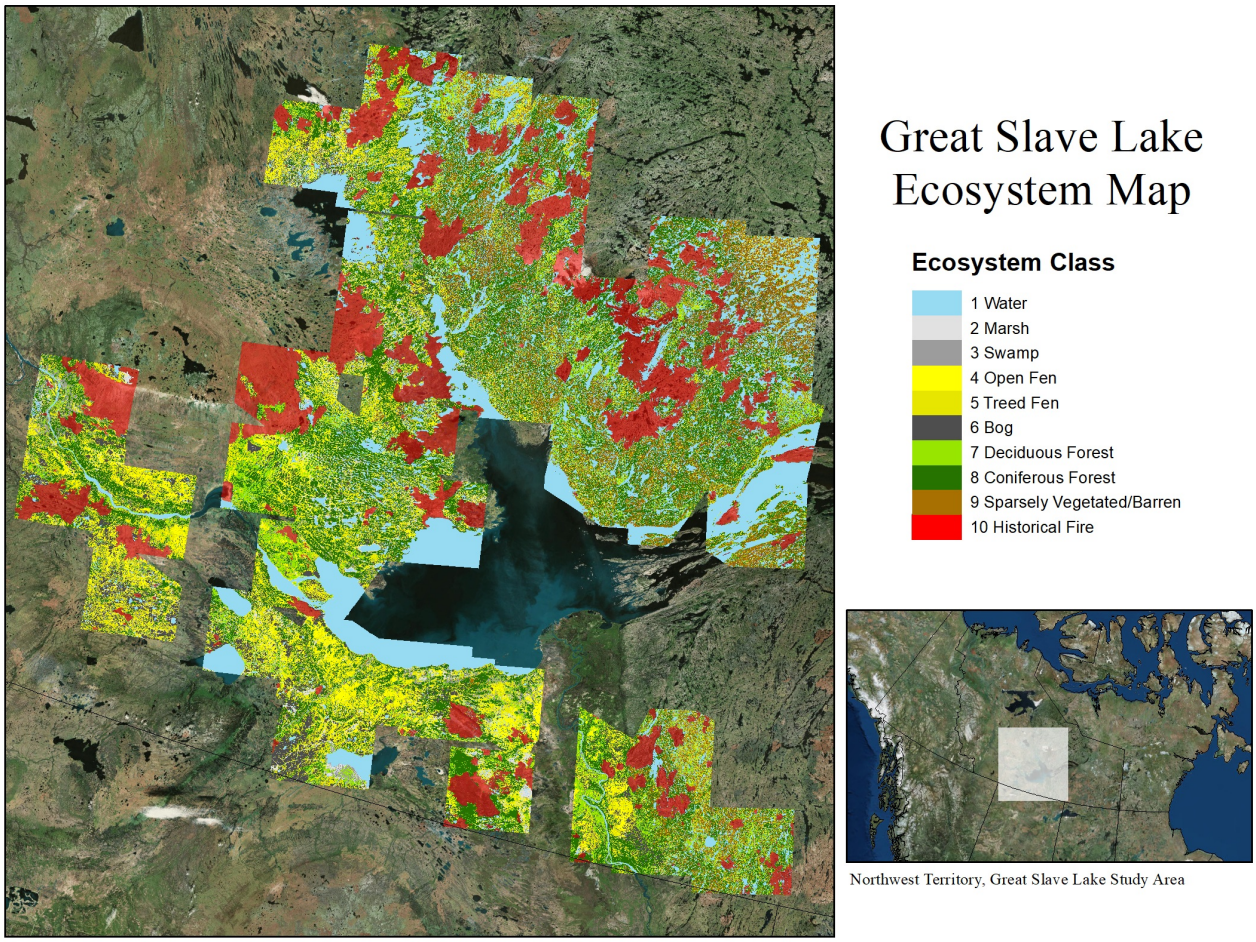

Figure 1. Ecosystem map for the Great Slave Lake area, NWT, Canada for the period 1997-2011.

Citation

Bourgeau-Chavez, L.L., J.A. Graham, S. Endres, N.H.F. French, M. Battaglia, D. Hansen, and D. Tanzer. 2019. ABoVE: Ecosystem Map, Great Slave Lake Area, Northwest Territories, Canada, 1997-2011. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1695

Table of Contents

1. Dataset Overview

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The remote sensing data were comprised of 143 Landsat 5 images and 129 L-Band PALSAR images from spring, summer, and fall with dates ranging from 1997-2011. The images were combined into 48 raster stacks and each was classified by Random Forests, then the classified maps were mosaicked and smoothed. To train and validate the Random Forest classification, 12,000+ polygons were created and classified using high resolution Worldview-2 imagery georeferenced to the Landsat and PALSAR datastacks and recent field data: 80% of the polygons were used for model training and 20% were used for validation. Overall Random Forests classification accuracy is 89.5%.

Project: Arctic-Boreal Vulnerability Experiment

The Arctic-Boreal Vulnerability Experiment (ABoVE) is a NASA Terrestrial Ecology Program field campaign taking place in Alaska and western Canada between 2016 and 2021. Climate change in the Arctic and Boreal region is unfolding faster than anywhere else on Earth, resulting in reduced Arctic sea ice, thawing of permafrost soils, decomposition of long-frozen organic matter, widespread changes to lakes, rivers, coastlines, and alterations of ecosystem structure and function. ABoVE seeks a better understanding of the vulnerability and resilience of ecosystems and society to this changing environment.

Related Datasets:

Bourgeau-Chavez, L.L., N.H.F. French, S. Endres, L. Jenkins, M. Battaglia, E. Serocki, and M. Billmire. 2016. ABoVE: Burn Severity, Fire Progression, Landcover and Field Data, NWT, Canada, 2014. ORNL DAAC, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/1307

Bourgeau-Chavez, L.L., S. Endres, L. Jenkins, M. Battaglia, E. Serocki, and M. Billmire. 2017. ABoVE: Burn Severity, Fire Progression, and Field Data, NWT, Canada, 2015-2016. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1548

Bourgeau-Chavez, L.L., M. Battaglia, E.S. Kane, L.M. Cohen, and D. Tanzer. 2019. ABoVE: Post-Fire and Unburned Vegetation Community and Field Data, NWT, Canada, 2018. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1703

Acknowledgement:

This research was funded by the NASA Arctic and Boreal Vulnerability Experiment, grant number NNX15AT83A.

2. Data Characteristics

Spatial Coverage: Northwest Territories, Canada

ABoVE reference locations:

Domain: Core ABoVE

State/territory: NWT

Region: Great Slave Lake

Locale: Yellowknife

Grid cells: Ah2v1.Bh0v5, Ah2v1.Bh1v4, Ah2v1.Bh1v5, Ah2v1.Bh2v5, and Ah2v2.Bh0v0

Spatial Resolution: 12.5 x 12.5 meters

Temporal Coverage: 1997-09-25 to 2011-09-14

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

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Northwest Territories, Canada	-123.036	-109.463	65.14894	58.79665

Data File Information

This dataset includes one file of ecosystem classes in GeoTIFF (.tif) format and two shapefiles provided in compressed format (.zip) containing the training and validation polygons. The spatial reference for all files is EPSG: 102001.

Companion files are also included: one .csv file provides all PALSAR and Landsat 5 images used for classification, and the other .csv file provides the classification error matrix. A .pdf copy of this user guide is also included.

File name	Description
great_slave_lake_ecosystemclassification.tif	A mosaic of gridded ecosystem classes at 12.5-m resolution. Properties: No data value = 128, Ecosystem class values range from 1 - 10, See Table 1 for definitions. Map units: meters
great_slave_lake_validation_polygons.zip	A shapefile (.shp) with the locations and classifications of the 2,149 uniquely defined validation polygons. See Table 2 and User Note below.
ecosystem_training_and_validation_polygons.zip	A shapefile (.shp) with 12,000+ polygons. Containing both the training and model validation polygons. See Table 3 and User Note below.
Companion files	
Landsat_SAR_AOI_stack_info.csv	The PALSAR and Landsat 5 images used for classification
Great_Slave_Lake_mf4half2_err_mat.csv	Classification error matrix.
Great_Slave_Lake_Ecosystem_Map.pdf	A pdf of this guide document

Table 1. Ecosystem classes in *great_slave_lake_ecosystemclassification.tif*

Class	Ecosystem	Ecosystem Description	# Polygons used for model training
1	Water	Lakes, rivers, and any other types of open water.	929
2	Marsh	Non-woody plant wetlands lacking the substratum depth or composition to be identified as a peatland. Typically emergent vegetation adjacent to shallow water bodies, ephemeral marl ponds, and graminoid and forb dominated meadows.	737
3	Swamp	Woody plant wetlands on mineral rich soil that may experience periodic inundation.	349
4	Open Fen	Peatlands lacking trees that are hydrologically connected to the surrounding landscape, with water source from groundwater or the surrounding landscape. Generally graminoid, shrub dominated, or	1,425

		bryophyte dominated. The water table is typically near the surface.	
5	Treed Fen	Same definition as open fen with the exception that trees are abundant. Picea mariana (Black Spruce) and Larix laricina (Tamarack, Larch) are the tree species most frequently found in these ecosystems.	1,046
6	Bog	Peatlands that typically are uninfluenced by nutrient rich groundwater or throughflow. This class can be tree covered by P. mariana, or less frequently L. laricina, or open. Also includes peat plateau bogs and polygonal peat bog.	1,184
7	Deciduous	Mineral soil upland with a sparse to abundant canopy of primarily (>50%) deciduous trees.	1,112
8	Coniferous	Mineral soil upland with a sparse to abundant canopy of primarily (>50%) coniferous trees.	1,774
9	Sparsely Vegetated	Broad category that includes exposed rock outcrops, graminoid or dwarf shrub dominated uplands with approximately less than 20 trees per hectare, barren sandy soils, and glacial till.	1,387
10	Masked	Recently burned areas (prior to the Landsat and SAR image collection dates) that are currently undergoing post-fire successional revegetation. Areas north of 62 N are masked by fires that occurred since 1975 and areas south of 62 N are masked by since 1985.	Training data were not collected for these regenerating areas and due to the dynamic regrowing vegetation patterns, classification often yields spurious results.

Table 2. File attributes for *great_slave_lake_validation_polygons.shp*

Attribute	Description
FID	
Shape	polygon
type_id	Ecosystem class (1-9)
AOI	Area of interest as identified by Investigator

Table 3. File attributes for *ecosystem_training_and_validation_polygons.shp*

Attribute	Description
FID	
Shape	polygon
split	Either 0 or 1. 0 means it was used as training and 1 is a validation polygon.
type_id	Ecosystem class (1-9)
AOI	Area of interest as identified by Investigator

Shapefile User Notes:

The final mosaicked ecosystem classification product (*.tif) covering the full extent of the study area is the product of separate random forest classifications for each of the 48 data stacks used to cover the study area. Each data stack had it's own training/validation polygon dataset. In areas where the data stacks overlap, training and validation polygons can be both duplicated (when the intersected data was directly copied) and just partially overlapping when the analyst happened to digitize over an area previously digitized for a different, but overlapping AOI. When all the training and validation polygons are merged together, the 12,000+ polygons in the *ecosystem_training_and_validation_polygons.shp* file, there are duplicate and partially overlapping polygons present in the shapefile. Also, since the hold out validation polygons were randomly chosen during each classification, the combination of all the training and validation polygons, from all the AOIs, have overlapping and duplicate features that may be 0 and/or 1.

Note that in *great_slave_lake_validation_polygons.shp*, the data provider removed the duplicated and overlapping features of all the validation polygons. This was necessary to run an error analysis (confusion matrix) on the mosaicked dataset without counting the same locations twice. As such, the number of unique validation polygons is 2,149, and that is the number used for the final error matrix. But in the merged total polygon dataset. the number of validation polygons is 2,763, which reflects the number of validation features used in total for all 48 classifications prior to merging.

3. Application and Derivation

These data provide an ecosystem type map of the area before the large fire season of 2014 to better understand the effects of fires in the area.

4. Quality Assessment

A standard map accuracy assessment was applied using independent validation data. Twenty percent of the 12,000+ polygons were withheld from the model training to be used as validation polygons for final validation. The final confusion matrix was generated using all reserved validation polygons from the 48 mapping tiles pooled together for testing on the smoothed classified final mosaic.

Overall classification accuracy is 89.5%. Per class accuracy is: Water 99.5%, Marsh 84.3%, Swamp 73.0%, Open Fen 82.4%, Treed Fen 87.1%, Bog 92.3%, Deciduous 92.9%, Coniferous 91.8%, Sparsely Veg 94.3%.

5. Data Acquisition, Materials, and Methods

The area surrounding Great Slave Lake, Northwest Territories, Canada experienced several large wildfires in 2014. The nine-class peatland, wetland, upland ecosystem map was developed for the time period 1997 to 2011 to better understand the effects of the 2014 wildfires on land cover and ecosystems in the area.

The map was derived from random forest classifiers trained on multi-date, multi-sensor remote sensing images across the study extent, using field data (Bourgeau-Chavez et al., 2016, 2017, and 2019) and high-resolution Worldview-2 image interpretation for training and validation. The remote sensing data were comprised of a total of 143 Landsat 5 images (Earth Explorer) and 129 L-Band PALSAR images (ALOS PALSAR from Alaska Satellite Facility and PALSAR-2 data from JAXA) from spring, summer, and fall with dates ranging from 1997-2011. The data were combined into 48 raster stacks for classification by random forests. Classified maps were mosaicked and smoothed with two passes of a four-window half rule majority filter. A total of 12,000+ training polygons were created using high resolution worldview imagery georeferenced to the Landsat and PALSAR datastacks. From the training data 20% of the polygons were withheld from the model training for final validation.

Recently burned areas (prior to the Landsat and SAR image collection dates) that are currently undergoing post-fire successional revegetation were masked (Map Class 10). Areas north of 62 N were masked by fires that occurred since 1975 and areas south of 62 N were masked by fires since 1985. Training data were not collected for these regenerating areas and due to the dynamic regrowing vegetation patterns, classification often yields spurious results.

6. Data Access

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

ABoVE: Ecosystem Map, Great Slave Lake Area, Northwest Territories, Canada, 1997-2011

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
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7. References

Bourgeau-Chavez, L.L., N.H.F. French, S. Endres, L. Jenkins, M. Battaglia, E. Serocki, and M. Billmire. 2016. ABoVE: Burn Severity, Fire Progression, Landcover and Field Data, NWT, Canada, 2014. ORNL DAAC, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/1307

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