Multispectral Imagery, NDVI, and Terrain Models, Big Trail Lake, Fairbanks, AK, 2019

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Documentation Revision Date: 2021-04-29

Dataset Version: 1

Summary

This dataset provides multispectral reflectance imagery (green at 550 nm, red at 660 nm, red edge at 735 nm, and near-infrared at 790 nm), normalized difference vegetation index (NDVI), and digital surface and terrain models for a 0.5 km2 area surrounding Big Trail Lake (BTL) in the Goldstream Creek Valley north of Fairbanks, Alaska. These high spatial resolution maps (13 cm x 13 cm) were generated by unmanned aerial vehicle (UAV) imagery collected on 2019-08-04. Raw images (n=908) were combined into mosaic layers that incorporated ground control points with centimeter accuracy. These layers were then used to generate vegetation, water body, and elevation maps and then combined with in situ measurements of methane flux to improve upscaling models of greenhouse gas emissions.

This dataset includes seven files in GeoTIFF (*.tif) format, two shapefiles bundles in compressed (*.zip) format, and one companion file.

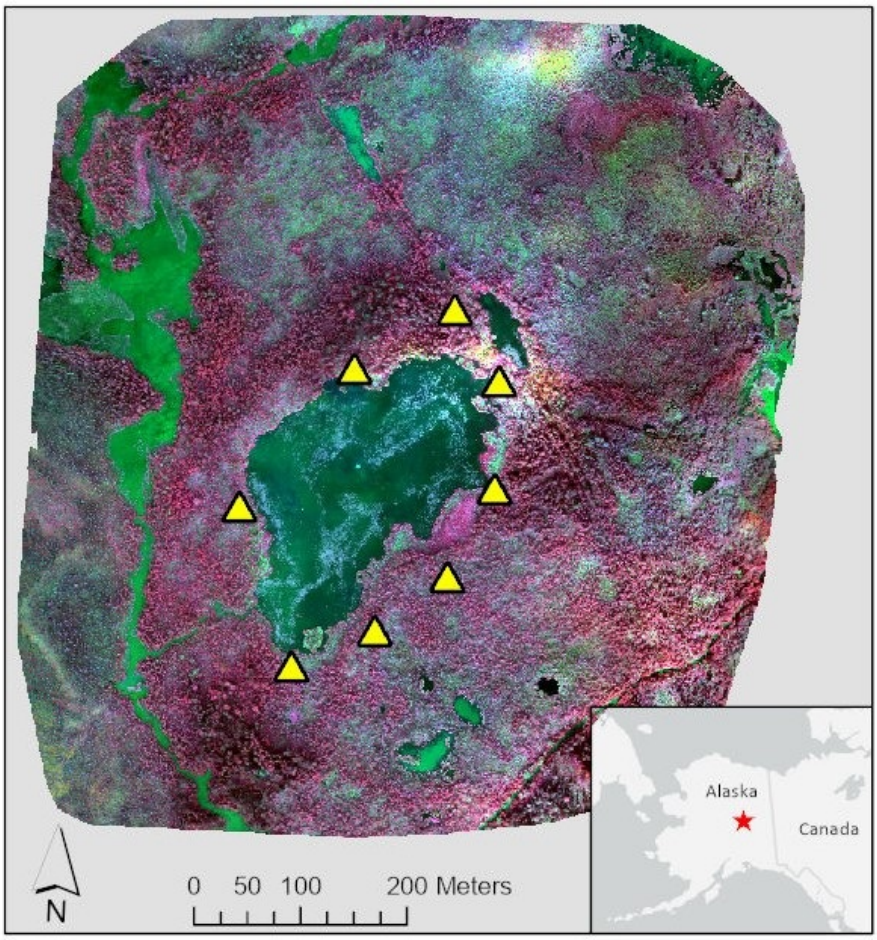

Figure 1. Color infrared image of Big Trail Lake in the Goldstream Creek Valley north of Fairbanks, Alaska. Ground control points (yellow triangles) surround the lake. This image was produced from dataset files BTL_NIR.tif (red), BTL_Red.tif (green), and BTL_Green.tif (blue).

Citation

Barnes, N., H. Webb, M.K. Farina, S. Powell, and J.D. Watts. 2021. Multispectral Imagery, NDVI, and Terrain Models, Big Trail Lake, Fairbanks, AK, 2019. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1834

Table of Contents

1. Dataset Overview

This dataset provides multispectral reflectance imagery (green at 550 nm, red at 660 nm, red edge at 735 nm, and near-infrared at 790 nm), normalized difference vegetation index (NDVI), and digital surface and terrain models for a 0.5 km^2 area surrounding Big Trail Lake (BTL) in the Goldstream Creek Valley north of Fairbanks, Alaska. These high spatial resolution maps (13 cm x 13 cm) were generated by unmanned aerial vehicle (UAV) imagery collected on 2019-08-04. Raw images (n=908) were combined into mosaic layers that incorporated ground control points with centimeter accuracy. These layers were then used to generate vegetation, water body, and elevation maps and then combined with in situ measurements of methane flux to improve upscaling models of greenhouse gas emissions.

Related Publication

Walter Anthony, K.M., P. Lindgren, P. Hanke, M. Engram, P. Anthony, R. Daanen, A.C. Bondurant, A.K. Liljedahl, J. Lenz, G. Grosse, B.M. Jones, L. Brosius, S.R. James, B.J. Minsley, N.J. Pastick, J. Munk, J. Chanton, C.E. Miller, and F.J. Meyer. 2020. Decadal-scale hotspot methane ebullition within lakes following abrupt permafrost thaw. Environmental Research Letters 16:035010. http://doi.org/10.1088/1748-9326/abc848

Related Dataset

Elder, C., P. Hanke, K.W. Anthony, D.R. Thompson, C.E. Miller, and A.K. Thorpe. 2020. ABoVE: Methane Flux across Two Thermokarst Lake Ecosystems, Interior Alaska, 2018. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1778

Acknowledgments

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2. Data Characteristics

Spatial Coverage: A 0.5-km^2 area near Fairbanks, Alaska, USA.

Spatial Resolution: 13 cm and 65.5 cm

Temporal Coverage: 2019-08-04

Temporal Resolution: One-time estimate

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

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Big Trail Lake near Fairbanks, Alaska	-147.829	-147.813	65.9233	65.9162

Data File Information

This dataset includes seven files in GeoTIFF (*.tif) format, two shapefiles bundles in compressed (*.zip) format, and one companion file.

Table 1. File names and descriptions.

File Name	Units	Description
BTL_DSM.tif	meters	Digital surface model (DSM). Pixel values designate the predicted surface and above ground vegetation elevation based on ground control points.
BTL_DTM.tif	meters	Digital terrain model (DTM). Pixel values designate the predicted surface elevation based on the input ground control points.
BTL_Green.tif	reflectance	Spectral reflectance in green band (550 nm).
BTL_NDVI.tif	unitless	Normalized difference vegetation index (NDVI) calculated as (NIR+red)/(NIR-red).
BTL_NIR.tif	reflectance	Spectral reflectance in near infrared band (790 nm).
BTL_Red.tif	reflectance	Spectral reflectance in red band (660 nm).
BTL_RedEdge.tif	reflectance	Spectral reflectance in red-edge band (735 nm).
BTL_CL.zip	UTM coordinates	Shapefile bundle of soil collar point locations (CL) for measuring carbon flux of related ecosystems. Each feature is named by a unique collar number and letter which designates its transect location. See Elder et al., (2020) for soil collar information.
BTL_GCP.zip	UTM coordinates	Shapefile bundle of 8 ground control points (GCP) for orthorectification and ground truthing. Each feature is labeled as GCP1-8, which corresponds to the GCP labeling in the drone imagery processing report.
BTL_DroneProcessingReport.pdf		Processing details of the UAV data are provided as a companion file.

Data File Details

- All files use the UTM zone 6N WGS84 datum.

- Spectral images and the DSM have a spatial resolution of 13.1 cm/pixel. The digital terrain model has a horizontal resolution of 65.5 cm, five times lower than the DSM.

3. Application and Derivation

This dataset provides products of high spatial resolution and accuracy for the area of Big Trail Lake (BTL) and adjacent portions of the Goldstream Creek Valley. This area is considered a methane emission hotspot (Walter Anthony et al., 2020). These data can be used to create vegetation, water, and elevation maps to improve models of ecosystem patterns and dynamics.

4. Quality Assessment

The drone images were georeferenced and rectified using ground control points. The spatial accuracy of the single band GeoTIFFs was calculated based on the root mean square difference between the image location and the location of the ground control points. There were seven ground control points used in the processing with a mean x-error of 0.0341 m, a mean y-error of 0.0260 m, a mean z-error of 0.0731 m, and an overall root mean square error (RMSE) of 0.042 m.

For the soil collar locations, the uncertainty for each point feature was measured by the difference between the GPS location measured in the field and the Online Positioning User Service (OPUS; https://geodesy.noaa.gov/OPUS/) corrected location after post-processing. These uncertainty values are reported in the *H_Prec_Obs* and *V_Prec_Obs* attributes of each point feature of the shapefile.

5. Data Acquisition, Materials, and Methods

Image Processing

The study area was a 0.5 km^2 area surrounding Big Trail Lake (BTL) in the Goldstream Creek Valley north of Fairbanks, Alaska. Raw multispectral images (n=908) were acquired on August 4, 2019, using an Airnov multiSpec 4C sensor deployed on an eBee Classic fixed-wing drone. Spectral bands included green (550 nm), red (660 nm), red edge (735 nm), and near-infrared (790 nm). The raw images were radiometrically corrected for sensor and sun irradiance biases then mosaiced and georeferenced with Pix4DMaper (Version 4.5.6; https://www.pix4d.com) using seven ground control points (GCP).

The resulting spectral images and digital surface model had high spatial resolution (13.1 cm/pixel) and accuracy (RMSE=4.2 cm). The digital terrain model had a horizontal resolution of 65.5 cm. Details on data processing are provided in the companion file BTL_DroneProcessingReport.pdf.

Point Locations

Coordinates were measured with a survey-grade GPS (Trimble R8 model 4 with TSC3 Controller) and post-processed with OPUS to achieve centimeter accuracy. Each of 8 ground control points (GCP) in the corresponding shapefile is labeled as GCP1-8 to correspond with the GCP labeling in the drone imagery processing report

Each of 27 soil collar point locations (CL) in the corresponding shapefile is identified by a unique collar number and letter which designates its transect location. See Elder et al., (2020) for soil collar information.

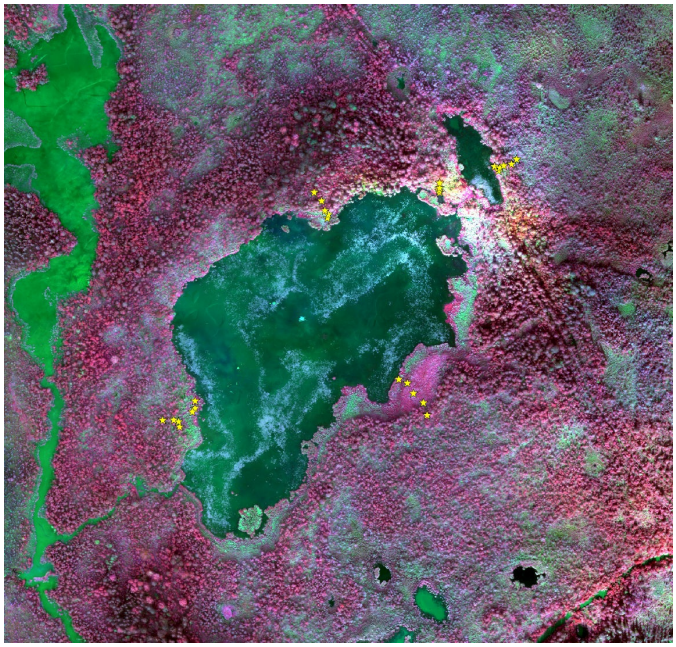

Figure 2. Soil collar locations (CL) (gold stars). Source: BTL_CL.zip

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

Elder, C., P. Hanke, K.W. Anthony, D.R. Thompson, C.E. Miller, and A.K. Thorpe. 2020. ABoVE: Methane Flux across Two Thermokarst Lake Ecosystems, Interior Alaska, 2018. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1778

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