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ABoVE: Reflectance Spectra of Tundra Plant Communities across Northern Alaska

Get Data

Documentation Revision Date: 2019-07-19

Dataset Version: 1

Summary

This dataset reports full-spectrum (350-2500 nm) reflectance measurements of diverse plant communities at the plot-level and individual plant species at the leaf-level, at multiple sites across northern Alaska during the 2017 and 2018 summer field seasons. Plot-level reflectance data (1 m²) include an assemblage of vascular and non-vascular species comprising tundra plant communities, while leaf-level scans are specific to one particular tundra species. Reflectance measurements were collected using a HR-1024i spectrometer and data were calibrated using a Spectralon white reference panel during sampling to correct for changing light conditions. Sampling methods and data and metadata structure follow that of the Ecological Spectral Information System (EcoSIS) Spectral Library.

This dataset contain raw reflectance spectra for various tundra vegetation plots and species leaves and has not been analyzed or processed to quantify uncertainty. Measurements are being collected during the 2019 growing season and will be added to this dataset.

There are four data files provided with this dataset, two for each year, including a spectral library file with full-spectrum (350-2500 nm) reflectance observations and a metadata file with corresponding sample characteristics. Companion files include readme *.txt files for most measurement sites with general site descriptions and measurement plot details and photo collections (*.jpg) of most measured plots, plants, and leaf samples.



Figure 1. In situ measurement plot at a Common Garden Ecotype site near Eagle Creek, Alaska. Common garden sites (6 total) were established with different populations of the tussock-forming sedge, *E. vaginatum*, taken from different latitudes in Alaska. Source: EagleCreek_Ecot_170728_Images/DSCN5451.JPG

Citation

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1. Dataset Overview

This dataset reports full-spectrum (350-2500 nm) reflectance measurements of diverse plant communities at the plot-level and individual plant species at the leaf-level, at multiple sites across northern Alaska during the 2017 and 2018 summer field seasons. Plot-level reflectance data (1 m²) include an assemblage of vascular and non-vascular species comprising tundra plant communities, while leaf-level scans are specific to one particular tundra species. Reflectance measurements were collected using a HR-1024i spectrometer and data were calibrated using a Spectralon white reference panel during sampling to correct for changing light conditions. Sampling methods and data and metadata structure follow that of the Ecological Spectral Information System (EcoSIS) Spectral Library. This dataset contain raw reflectance spectra for various tundra vegetation plots and species leaves and has not been analyzed or processed to quantify uncertainty.

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.

Acknowledgements:

NASA ABoVE Grant NNX17AC58A and Research Opportunities in Space and Earth Sciences Program, Grant NNX13AK85A.

2. Data Characteristics

There are four data files provided with this dataset, two for each year, including a spectral library file with full-spectrum (350-2500 nm) reflectance observations and a metadata file with corresponding sample characteristics. Companion files include readme *.txt files for most measurement sites with general site descriptions and measurement plot details and photo collections (*.jpg) of most measured plots, plants, and leaf samples.

Spatial Coverage: Northern Alaska

ABoVE Reference Locations:

Domain: Core ABoVE

ABoVE Grid cells: Ch051v019, Ch049v007, Ch050v007, Ch046v008, Ch048v020, Ch048v021, Ch044v023, Ch044v033

Spatial resolution: Multiple points

Temporal coverage: 2017-07-18 to 2018-08-14

Temporal resolution: one or more measurements during a growing season at each plot

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

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Northern Alaska	-157.412046	-145.51512	71.34615	65.43485

Data File Information

There are four data files provided with this dataset, two for each year, including a spectral library file with full-spectrum (350-2500 nm) reflectance observations and a metadata file with corresponding sample characteristics. Companion files include readme *.txt files for most measurement sites with general site descriptions and measurement plot details and photo collections (*.jpg) of most measured plots, plants, and leaf samples.

Table 1. Data and companion file names and descriptions..

File names	Description	Notes
sel_2017_spectral_library_svc_data.csv	Full-spectrum (350-2500 nm) reflectance measurements of plant communities, plants, and leaves collected in 2017.	Data file structure and content follow that of Ecological Spectral Information System (EcoSIS) Spectral Library. (https://ecosis.org/)
sel_2018_spectral_library_svc_data.csv	Same as above, but data collected in 2018.	
sel_2017_spectral_library_svc_metadata.csv	Metadata file with corresponding sample characteristics for 2017 measurements. Unique row identifier aligns "row for row" with measurement file.	Metadata file structure and content follow that of Ecological Spectral Information System (EcoSIS) Spectral Library. (https://ecosis.org/)
sel_2018_spectral_library_svc_metadata.csv	Same as above, but data collected in 2018.	
Companion Files		
Site and Measurement Readme Files (readme_*.txt) 28 Readme files	General site descriptions and measurement plot details.	See Table 2 for location and site crosswalk to Readme files.
Image Files (*.zip) 24 compressed files	Collections of images of plots, plants, and leaf samples. Note that individual image files (*.jpg) are not always named by plot. Nevertheless, the order of the plot images in a collection, matches the order of the plot measurements in the data/metadata files.	See Table 2 for location and site crosswalk to image files.

Table 2. 2017 and 2018 locations and measurement sites paired with respective Readme files and Collections of site, plant, and leaf images.

2017	Count	2018	Count

location	site_name	Site and Measurement (readme_*.txt)	Image Files (*.zip)	2017	site_name	2018
Atqasuk	CALM- Circumpolar Active Layer Monitoring	Atqasuk_CALM_Spectral_Data_Metadata	Atqasuk_CALM_All_Dates_Images	30	same	64
Atqasuk	LEAF - Plant Leaf Spectra	Atqasuk_LEAF_Spectral_Data	Atqasuk_Leaf_170805_Images	95		
Atqasuk	MISP- Mobile Instrumented Sensor Platform	Atqasuk_MISP_Spectral_Data	Atqasuk_MISP_All_Dates_Images	100	same	50
Atqasuk					PLANT - Plant Spectra: Opportunistic Samples	20
Barrow (Utqiagvik)	BEO- Barrow Environmental Observatory Biocomplexity	Utqiagvik_BEO_Spectral_Data_Metadata	Utqiagvik_BEO_170809_Images	59		
Barrow	BMBV - Barrow Mounds Bowerville	Utqiagvik_Mounds_Site_Spectral_Data_Metadata	Utqiagvik_BMBV_170816_Images	49		
Barrow	BMDC - Barrow Mounds Duck Camp	Utqiagvik_Mounds_Site_Spectral_Data_Metadata	Utqiagvik_BMDC_170816_Images	53		
Barrow	CALM- Circumpolar Active Layer Monitoring	Utqiagvik_CALM_Spectral_Data_Metadata	Utqiagvik_CALM_All_Dates_Images	30	same	11
Barrow	COAST - Chukchi Coast Spectroscopy	Utqiagvik_Chukchi_Coast_Spectral_Data_Metadata	Utqiagvik_Chukchi_Coast_170818_Images	33	same	38
Barrow	COAST - Elson Coast Spectroscopy		Utqiagvik_Elson_Coast_170819_Images	76		
Barrow	DEM- Digital Elevation Model Site	Utqiagvik_DEM_Site_Spectral_Data_Metadata	Utqiagvik_DEM_170814_Images	28		
Barrow	ITEX - International Tundra Experiment (Dry)	Utqiagvik_ITEX_Spectral_Data_Metadata		31		
Barrow					ITEX - (Dry): Site 1 subdivision	24
Barrow					ITEX - (Dry): Site 3 subdivision	18
Barrow	ITEX - International Tundra Experiment (Wet)	Utqiagvik_ITEX_Spectral_Data_Metadata		48	same	15
Barrow	LEAF - Plant Leaf Spectra	Utqiagvik_LEAF_Spectral_Data_Metadata	Utqiagvik_Leaf_170807_Images	85		
Barrow	MetTower - D	Utqiagvik_MetStationD_Spectral_Data_Metadata	Utqiagvik_Met_Tower_170813_Images	25		
Barrow	MICRO - Microtopo Grid (Row A)	Utqiagvik_Microtopo_Historical_Site_Spectral_Data_Metadata		68		
Barrow	MICRO - Microtopo Grid (Row B)	Utqiagvik_Microtopo_Historical_Site_Spectral_Data_Metadata		68		
Barrow	MISP- Mobile Instrumented Sensor Platform	Utqiagvik_MISP_Spectral_Data_Metadata	Utqiagvik_MISP_All_Dates_Images	90	same	25
Barrow	MISP- Mobile Instrumented Sensor Platform (Diurnal Run)	Utqiagvik_MISP_Spectral_Data_Metadata		546		

Barrow	OSLEAF - Oil Spill Plant Leaf Spectra	Utqiagvik_OSLEAF_Spectral_Data_Metadata	Utqiagvik_OSLEAF_170815_Images	118		
Barrow	OSR - Oil Spill Runway	Utqiagvik_OSRW_Spectral_Data_Metadata	Utqiagvik_OSRW_170814_Images	7		
Barrow	PLANT - Plant Spectra	Utqiagvik_Pfrigidus_Spectral_Data_Metadata	Utqiagvik_PetFri_170810_Images	17		
Barrow					Drain Ponds Site: Opportunistic Samples	61
Barrow					Pond Margins Site: Opportunistic Samples	44
Coldfoot	Ecotype	Coldfoot_Ecotype_Spectral_Data_Metadata	Coldfoot_Ecot_170727_Images	85		
Eagle Creek	Ecotype	EagleCreek_Ecotype_Spectral_Data_Metadata	EagleCreek_Ecot_170728_Images	18		
Eagle Creek	LEAF - Plant Leaf Spectra	EagleCreek_LEAF_Spectral_Data_Metadata (*)	EagleCreek_Leaf_170729_Images	90		
Imnavit	MISP- Mobile Instrumented Sensor Platform	Imnavit_MISP_Spectral_Data_Metadata		46		
Imnavit					CALM- Circumpolar Active Layer Monitoring	64
No Name Creek	LEAF - Plant Leaf Spectra	NoNameCreek_LEAF_Spectral_Data_Metadata (*)	NoName_Creek_Leaf_170731_Images	26		
Sagwon	Ecotype	Sagwon_Ecotype_Spectral_Data_Metadata	Sagwon_Ecotype_170725_Images	133		
Sagwon	LEAF - Plant Leaf Spectra	Sagwon_LEAF_Spectral_Data_Metadata	Sagwon_Leaf_170725_Images	30		
Toolik	Ecotype	Toolik_Ecotype_Spectral_Data_Metadata	Toolik_Ecotype_170726_Images	17		
Toolik	LEAF - Plant Leaf Spectra	readme_Toolik_LEAF_Spectral_Data_Metadata	Toolik_Leaf_170724_Images	82		
Toolik	MISP- Mobile Instrumented Sensor Platform	Toolik_MISP_Spectral_Data_Metadata		45		
Toolik					CALM- Circumpolar Active Layer Monitoring	64

(*) Includes general site coordinates.

Data Dictionary for files sel_2017_spectral_library_svc_data.csv (2,258 observations) and sel_2018_spectral_library_svc_data.csv (1,130 observations).

Column number	Column name	Units/format	Description
1	unique_id		Unique row identifier that is the concatenation of location_site_plot_type_date_time_measurement for this observation. There is a matching row of metadata in the corresponding *.metadata.csv file.
2 - 995	wavelengths, 338.1 - 2516.3	nm	Each column contains the reflectance values for the respective wavelength that is the column name. There are 994 columns with intervals between columns ranging from 1.5 - 3.9 nm.

Data Dictionary for files sel_2017_spectral_library_svc_metadata.csv (2,258 observations) and sel_2018_spectral_library_svc_metadata.csv (1,130 observations).

Column name	Units/format	Description
location_site_plot_type_date_time_measurement		Unique row identifier that is the concatenation of location_site_plot_type_date_time_measurement for this observation. There is a matching row of reflectance data in the corresponding *_spectral_library_svc_data.csv file.
location		Location Name
site_name		Site Name
target_name		Target Name
target_scale_level		Target Scale Level. PL=plot, LF=leaf, MD=???

measurement_date	yyyy-mm-dd	Measurement Date
measurement_time_of_day_(utc)	Hh:mm:ss	Measurement Time
measurement_type		Measurement Quantity. Scale for spectral intensity (e.g. DN, radiance, irradiance, reflectance)
proj_title		Project Title
proj_funding_agency		Funding Source
proj_award		Funding Source Grant Number
proj_funding_country		Country
proj_start_year	yyyy	Start Year
proj_end_year	yyyy	End Year
proj_initiative		Initiative
proj_discipline		Theme. Research context for the spectral measurements. Agriculture, Biochemistry, Ecology, Forest, Global Change, Land Cover, Other, Phenology, Physiology, Water Quality
proj_contact_name		Contact Name
proj_contact_role		Contact role
proj_contact_email		Contact Email
proj_institution		Institution
proj_page_link		Website
proj_keywords		Keywords
site_country		Site Country
site_start_year	yyyy	Year
site_ecosystem_type		Ecosystem Type. Alpine, Antarctic, Aquatic, Arctic, Arctic Tundra, Coastal, Crops, Desert, Estuary, Forest, Freshwater, Grassland, Lake, Marine, Montane, Ocean, Pond, Rainforest, River, Savanna, Scrubland, Shrubland, Steppe, Tundra, Urban, Woodland
latitude	Decimal degrees	Latitude
longitude	Decimal degrees	Longitude
measurement_method		Acquisition Method. Minimum measurement unit for your spectra (i.e. contact probe, proximal with X-degree foreoptic, pixel, other).
sample_platform		Sample Platform. Platform from which the spectral measurements were made (e.g. handheld, boom, tram, UAV).
measurement_venue		Measurement Venue. Setting in which the spectral measurements were made. Greenhouse, Laboratory, Other, Outdoor
target_status		Target Status. State of the measurement target. Dried, Fresh, Green, Ground, Liquid, Live, Other, Panel, Standard
wavelength_units		Wavelength Units. Wavelength units (e.g. nm, um, Hz)
light_source		Light Source. Description of the light source used for your spectral measurements. Lamp, Laser, Other, Sun
instrument_manufacturer		Instrument Manufacturer. Spectrometer manufacturer.
instrument_model		Instrument Model. Spectrometer model.
calibration		Calibration (Spectralon Ratio)
data_type		Data Type (processed)
processing_averaged	Y,N	Processing Averaged. Is the measurement an average of multiple measurements?
processing_interpolated	Y,N	Processing Interpolated. Is the measurement interpolated?
processing_resampled	Y,N	Processing Resampled. Is the measurement resampled? (e.g. are multiple wavelengths averaged?)
processing_software		Processing software

3. Application and Derivation

The use of consistent sampling methods and data and metadata structures that follow Ecological Spectral Information System (EcoSIS) Spectral Library (<https://ecosis.org/>) standards ensures comparability of results across sites within this study and across all EcoSIS library data. Full-spectrum (350-2500 nm) reflectance measurements of plant communities at the leaf and plot scales enables

4. Quality Assessment

This dataset contain raw reflectance spectra for various tundra vegetation plots and species leaves and has not been analyzed or processed to quantify uncertainty.

5. Data Acquisition, Materials, and Methods

Sites

Full-spectrum (350-2500 nm) reflectance measurements of diverse plant communities at the plot-level and individual plant species at the leaf-level, were collected at multiple sites across northern Alaska during the 2017 and 2018 summer field seasons. General locations and specific sites are listed in Table 2. The latitude and longitude of each in situ measurement or collected leaf sample is include in the metadata files. The coordinates were acquired using either a DGPS or handheld GPS.

Measurements

In situ reflectance measurements were collected using a HR-1024i spectrometer and data were calibrated using a Spectralon white reference panel during sampling to correct for changing light conditions. Sampling methods and data and metadata structure follow that of Ecological Spectral Information System (EcoSIS) Spectral Library (<https://ecosis.org>).

Leaf spectral reflectance scans were collected in a controlled lab setting using a HR-1024i spectrometer, leaf-clip and fibers. Data were calibrated using a Spectralon white reference panel included in the leaf clip. Samples were collected and scanned the same day during the 2017 summer growing season.

Readme Files

Readme files with general site descriptions and coordinates and measurement plot details or leaf scanning details were prepared for those data and samples collected at established sites. See Table 2.

Those sites and measurements that do not have readme files indicate that the measurements were either at new plots or were simply of interest to the project to collect and don't necessarily pertain to any specific site. In many cases data were collected to expand the spectral library in an effort to capture as much vegetation diversity as possible.

Images

Photographs of plots, plants, and leaf samples were generally taken. See Table 2.

Please be aware that individual image files (*.jpg) are not always named by site - plot within the site collection. But also note, that the order of the in-situ measurement plot photos in a site collection, matches the order of the site - plot measurements in the metadata and data files.

Examples of Readme files:

Below are excerpts of content from selected Readme files and Related Photographs for typical measurement and sample types.

Leaf Clips: readme_Atqasuk_LEAF_Spectral_Data.txt

DATA OVERVIEW

This dataset represents full spectrum (i.e. 350 - 2500nm) leaf spectral reflectance data for species located in Atqasuk, Alaska. Scans were collected in a controlled lab setting using a HR-1024i spectrometer, leaf-clip and fibers. Samples were collected and scanned the same day during the 2017 summer growing season and acquired data were calibrated using a Spectralon white reference panel included in the leaf clip.

Site description:

Leaf samples were collected within a 50 meter squared area radius surrounding the Mobile Instrumented Sensor Platform (MISP) transect (2 x 50 meters). These transects were established at various locations throughout the Arctic

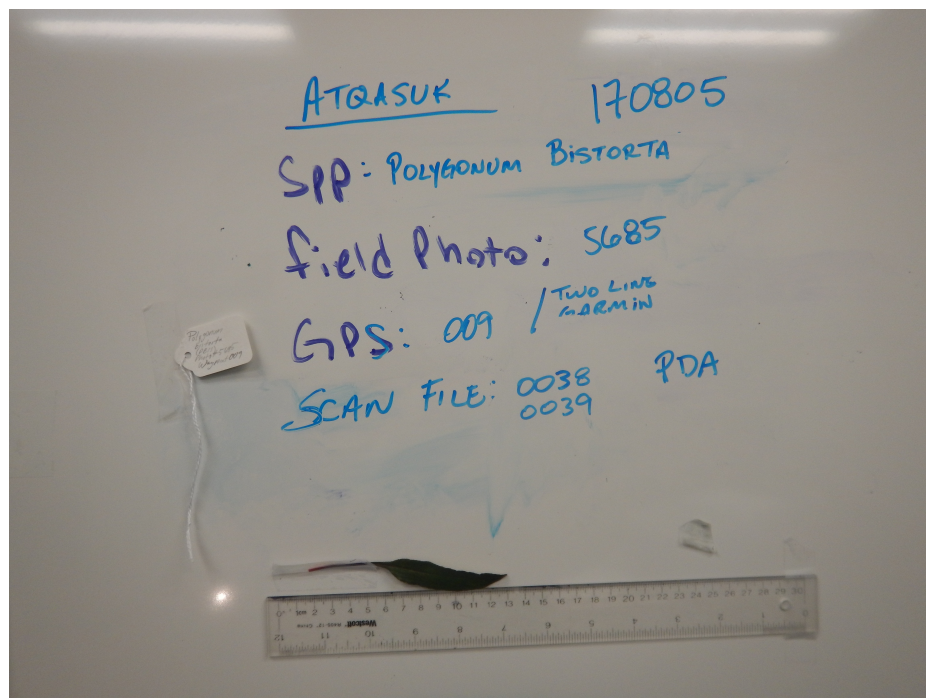


Figure 2. Display of leaf and sample measurement metadata..Source: Atqasuk_Leaf_170805_Images/DSCN5738.JPG



Figure 3. Field plot photo for source of leaf sample. Source: Atqasuk_Leaf_170805_Images /DSCN5685.JPG

In situ Plot Measurements: [readme_Atqasuk_MISP_Spectral_Data.txt](#)

DATA OVERVIEW

This dataset represents full-spectrum (i.e. 350-2500nm) plot-level spectral reflectance data along the Mobile Instrumented Sensor Platform (MISP) transect in Atqasuk, Alaska.

Site description:

Mobile Instrumented Sensor Platform (MISP) transects (2 x 50 meters) were established at various locations throughout the Arctic as a contribution to the US Arctic Observing Network (AON), (Healey, N.C., et al. 2014). Each 50 meter transect was divided into smaller 1 x 2 meter plots and marked with white wooden boards secured to the tundra with 12" metal stakes. The robotic sensor systems collect high spatial and temporal resolution environmental data across a multitude of vegetation functional types and spanning a moisture and latitudinal gradient across the Arctic.

Spatial resolution: spectral reflectance point samples for an approximate 1 meter squared area.



Figure 4. Typical in situ measurement plot photo. Area is approximately 1 m2. Source: Atqasuk_MISP_All_Dates_Images/O_3-4.JPG

In situ Plant Measurements: [readme_Utqiagvik_Pfrigidus_Spectral_Data_Metadata.txt](#)

DATA OVERVIEW

This dataset represents full-spectrum (i.e. 350-2500nm) plot-level spectral reflectance data of *Petasites frigidus* growing near the Mobile Instrumented Sensor Platform (MISP) transect in Utqiagvik, Alaska.

Site description:

Mobile Instrumented Sensor Platform (MISP) transects (2 x 50 meters) were established at various locations

Spatial resolution: average spectral reflectance for an approximate 1 meter squared area.



Figure 5. Photo of in situ measurement plot with predominately *Petasites frigidus*. Area is approximately 1 m². Source: Utqiagvik_PetFri_170810_Images/DSCN6002.JPG

6. Data Access

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

[ABoVE: Reflectance Spectra of Tundra Plant Communities across Northern Alaska](#)

Contact for Data Center Access Information:

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

7. References

Ecological Spectral Information System (EcoSIS) Spectral Library. (<https://ecosis.org/>)



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