SnowEx23 Apr23 IOP HyLab Airborne Surface Spectral Reflectance, Version 1 Technical Reference

1 DATA DESCRIPTION

1.1 Summary

This dataset provides surface spectral reflectance imagery which demonstrates snow albedo and snow optical properties during the NASA SnowEx 2023 field campaign that took place in Alaska between 7 April 2023 and 5 May 2023. Imagery was collected across several snow-covered boreal forest environments on April 20th, 2023, near Fairbanks, Alaska, including Farmers Loop Creamers Field (FLCF), and Caribou Poker Creek Research Watershed (CPCRW).

1.2 File Information

1.2.1 Format

The data are available in BSQ format (.bsq; band sequential). Each image file has a corresponding header metadata file (.hdr) in ASCII format. RGB preview files are also provided with jpeg format (.jpg) for each flight line.

Note: After downloading, both the BSQ file (.bsq) and the header file (.hdr) must be stored in the same directory in order to use the data with certain tools.

1.2.2 File Contents

The .bsq files present each flight line as an orthocorrected, georeferenced spectral data cube, where each pixel contains a stack of unitless spectral reflectance values. This data structure is accommodated by formatting the data as band sequential files. For each .bsq file, there is a corresponding .hdr header file that contains spatial information, wavelength data, and additional metadata. For each flight line, both the .bsq file and the .hdr file are required to view and process the spectral data. True RGB preview files are also provided with .jpg format for each flight line. Please note that these RGB jpeg files are created based on VNIR camera, which covers a slightly broader area than the combined VNIR and SWIR.bsq hyperspectral images.

1.2.3 Naming Convention

The data files are named according to the following convention, and as described in Table 1.

`SNEX23_HYLAB_[YYYYmmdd]t[HHMMSS]_[site]_rfl_v[nn.n].[ext]`

Table 1. Final naming convention

Variable	Description
`SNEX23_HYLAB`	SnowEx 2023 UAF HyLab HySpex surface spectral reflectance data
`[YYYYmmdd]`	Airborne survey start dates: 4-digit year, 2-digit month, 2-digit day
`[HHMMSS]`	Airborne survey acquisition start time, 2-digit hour, 2-digit minute, 2-digit second
`rfl`	Indicates data is orthocorrected, scaled reflectance
`[site]`	Site names: Farmers Loop Creamers Field (FLCF), and Caribou Poker Creek Research Watershed (CPCRW)
`v<nn.n>`	Indicates version number of the data set
`.[ext]`	File extension (.bsq, .hdr, or .jpg)

1.3 Spatial Information

1.3.1 Coverage

Data were collected from study sites near Fairbanks, Alaska. The study sites named: Farmers Loop Creamers Field (FLCF), and Caribou Poker Creek Research Watershed (CPCRW) are represented by the bounding boxes identified in Table 2.

Table 2. Study area extents

Spatial Extent	FLCF	CPCRW
Northernmost Latitude	64.8903268° N	65.1702045° N
Southernmost Latitude	64.8598472° N	65.1472303° N
Westernmost Longitude	147.7491983° W	147.5588507° W
Easternmost Longitude	147.6910594° W	147.4506291° W

1.3.2 Resolution

The spatial resolution is 50 cm.

1.3.3 Geolocation

This data set conforms to the WGS 84/UTM Zone 6N coordinate reference system (EPSG 32606).

1.4 Temporal Information

1.4.1 Coverage

Data was acquired on 20 April 2023. Data was collected opportunistically within the month-long campaign when weather conditions were favorable. Ideal data acquisition conditions are during cloud-free weather at times close to solar noon.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

The apparent surface spectral reflectance data described here include georeferenced, orthocorrected and overlapping flight lines which can be used to understand the optical properties of snow and snow albedo.

These data were collected on 20 April 2023 as part of the NASA SnowEx 2023 Alaska field campaign.

2.2 Acquisition

The HySpex hyperspectral imaging system (Norsk Elektro Optikk, NEO) was deployed in a single-engine Cessna 185 aircraft for airborne data collection using VNIR-1800 and SWIR-384 pushbroom sensors integrated with a Data Acquisition Unit (DAU) and a Inertial Measurement Unit (IMU). The VNIR-1800 records 182 spectral channels from 400–1000 nm with 1800 spatial pixels, while the SWIR-384 captures 288 channels from 950–2500 nm with 384 spatial pixels; both operate at 16-bit radiometric resolution. Field-expander optics increased the sensors' fields of view to 34° (VNIR) and 32° (SWIR), enabling high signal-to-noise imaging of dynamic scenes (Cristóbal et al., 2021).

Hyperspectral data were collected on 20 April 2023 during the SnowEx April 2023 campaign under favorable weather conditions. At the Creamer's Field site, flights were conducted at ~4,000 feet above sea level (asl) along 12 equally spaced, racetrack-oriented flight lines, each 3.3 km long. At the Caribou Poker Flats region, flights were conducted at ~8,000 feet asl along 11 flight lines, each approximately 2.5 km long.

2.3 Processing

The raw spectrometer data were processed in conjunction with corresponding navigation data to produce the surface spectral reflectance data products available in this data set. For geocoding and atmospheric correction ReSe software including PARGE® and ATCOR® are used.

2.4 Quality Errors and Limitations

2.4.1 Atmospheric Conditions

The presence of atmospheric gases and aerosols can interfere with accurate estimation of surface reflectance. To account for these effects, atmospheric corrections were applied to the HySpex measurements using the ATCOR-4 rugged terrain procedures. In some pixels, however, spectral reflectance values may exceed 1 due to slight inaccuracies in the interferometric SAR–derived elevation model used by ATCOR to calculate topographic effects on reflected radiance.

2.4.2 Illumination Conditions

Illuminations conditions, such as clouds, low sun angle, shadows, surface roughness, topographic variability and mixed pixels, affect accuracy of snow reflectance measurements. To minimize effects of varying solar zenith angle, all measurements were taken within two hours of solar noon. Ground and airborne measurements were only collected and analyzed if clear sky conditions existed. These conditions prevailed during the data acquisition on April 20th, 2023.

3 REFERENCES

Cristóbal, J., Graham, P., Prakash, A., Buchhorn, M., Gens, R., Guldager, N., & Bertram, M. (2021). Airborne Hyperspectral Data Acquisition and Processing in the Arctic: A Pilot Study Using the Hyspex Imaging Spectrometer for Wetland Mapping. Remote Sensing, 13(6), 1178. https://doi.org/10.3390/rs13061178

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