Field-Based and Airborne Hyperspectral Imaging for Applied Research in the State of Alaska

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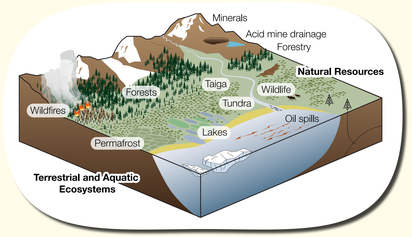
What is the HyLab?

- An NSF funded research facility at the Geophysical Institute (GI), University of Alaska Fairbanks (UAF).
- Provides low-cost, in-state field-based and airborne hyperspectral data acquisition capabilities.
- Supports data acquisition, processing, and analysis for resource exploration and ecological research (see lower box for an overview of our expertises).
- Coordinates education, training and public outreach activities related to technique and application of imaging spectroscopy.

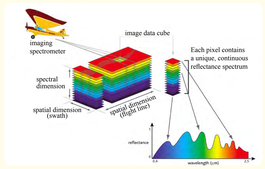


Would you like to know more?

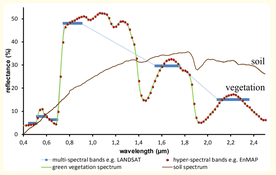
www.hyperspectral.alaska.edu

What is hyperspectral imaging?

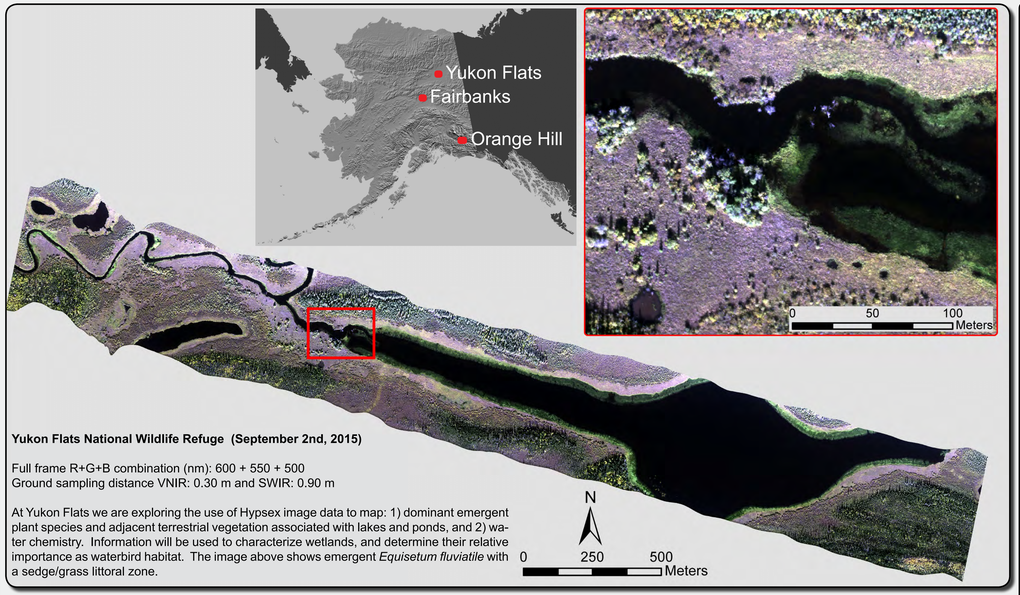
- Also known as Imaging Spectroscopy, it is a remote sensing technique where images are acquired in many contiguous and narrow spectral regions, so that each pixel contains a reflectance spectrum.



- Reflectance spectra provide the basis for the discrimination and characterization of different target materials.
- Hyperspectral imaging provides a means for detailed mapping of materials and the derivation of physical, chemical, and biological variables with unprecedented accuracy.



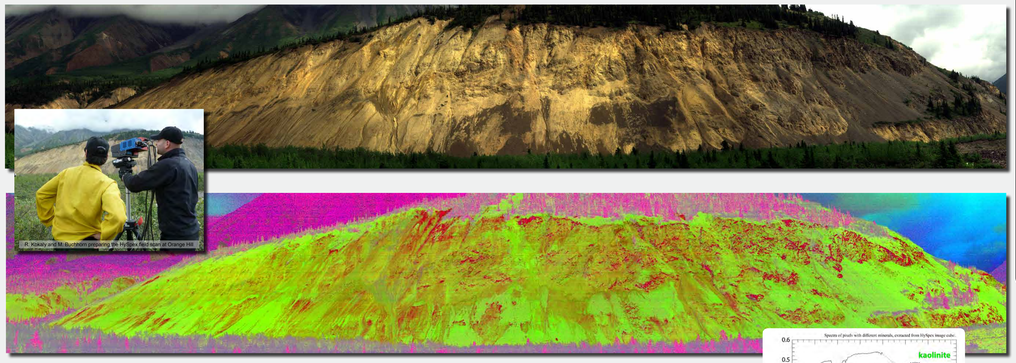
Hyperspectral imagery acquired using Hyspex VNIR-1800 and SWIR-384 camera systems have provided unique information on terrestrial and aquatic biogeochemical parameters, and diagnostic mineral properties in exposed outcrops in selected sites in the state of Alaska. The Hyspex system was configured for in-situ and field scanning by attaching it to a gimbal-mounted rotational stage on a robust tripod. Scans of vertical faces of vegetation and rock outcrops were made close to the campus of the University of Alaska Fairbanks, in an abandoned mine near Fairbanks, and on exposures of Orange Hill in Wrangell-St. Elias National Park. Atmospherically corrected integrated VNIR_SWIR spectra were extracted which helped to study varying nitrogen content in the vegetation, and helped to distinguish the various micas. Processed imagery highlighted carbonates, clays, sulfates, and alteration-related minerals. The same instrument was also mounted in airborne configuration on two different aircrafts, a DeHavilland Beaver and a Found Bush Hawk. Test flights were flown over urban and wilderness areas that presented a variety of landcover types. Processed imagery shows promise in mapping man-made surfaces, phytoplankton, and dissolved materials in inland water bodies.



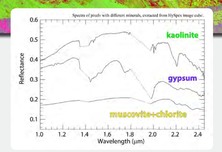
Yukon Flats National Wildlife Refuge (September 2nd, 2015)

Full frame R+G+B combination (nm): 600 + 550 + 500
Ground sampling distance VNIR: 0.30 m and SWIR: 0.90 m

At Yukon Flats we are exploring the use of Hypsex image data to map: 1) dominant emergent plant species and adjacent terrestrial vegetation associated with lakes and ponds, and 2) water chemistry. Information will be used to characterize wetlands, and determine their relative importance as waterbird habitat. The image above shows emergent *Equisetum fluviatile* with a sedge/grass littoral zone.



The **images above** show a true-color composite together with false-color composite image of an outcrop scan at Orange Hill, Nabesna area. This false-color composite shows vegetation in magenta and kaolinite & muscovite/clay/carbonate combinations in yellow-green. Reddish parts indicate montmorillonite.
This scan was performed using the HySpex camera system in field configuration mounted on a tripod for vertical scans. Ground sampling distance VNIR: 0.08 m and SWIR: 0.30 m



University of Alaska Fairbanks (September 2nd, 2015)

Full frame R+G+B combination (nm): 736 + 1700 + 650
Notice sensor overlapping at the image edges (purple)
Ground sampling distance VNIR: 0.30 m and SWIR: 0.90 m

Our tools

The HySpex instrument (field-based & airborne)

- VNIR-1800 and SWIR-384 cameras (400 - 2,500 nm);
- pushbroom HS cameras with low stray light levels, low sensitivity to polarization, and low smile and keystone effects;
- across track FOV of 17° and 16° respectively that can be increased to 34° and 32° (using a FOV expander).

In airborne mode the instrument:

- is mounted with a passive vibration dampening to an Aviat Husky A-1B airplane or similar airplanes (Beaver, Bushhawk, etc.);
- is connected to an IMAR iTrace RT-F400 IMU/GPS (Inertial Measurement Unit / Global Positioning System) unit;
- is controlled by a compact, high-performance data acquisition unit (DAU), connected with a 1 terabyte solid state drive and a compact, touch screen flat-panel monitor.

In the field configuration:

- the two HS cameras are mounted on an automated rotation stage affixed to a surveyors-grade tripod;
- the horizontal swaths of HS data are possible for targets at a distance of ~3 meters to hundred's meters;
- a rugged, field portable data acquisition unit is used to control the rotation stage and cameras during in-situ imaging;
- power supply is provided by a generator.

PSR+3500 Spectro-Radiometer (field-based & lab)

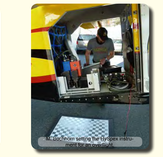
- Fast, full-spectrum UV-VIS-NIR measurements (350 - 2,500 nm).
- High resolution field portable spectroradiometer with 512 element Si array and two 256 element extended InGaAs arrays.
- Various optics ranging from 1° to 25° for reflectance, radiance and irradiance measurements.

Field-based operation:

- the PSR+ spectro-radiometer is powered by batteries and connected to a rugged PDA which provides GPS, photo tagging, and voice notes;
- our self-developed software allows in-field mineral identification and classification;
- usage of handheld contact probe allows field measurements on outcrops or mapping open pits even at cloudy conditions.

Laboratory operation:

- high signal-to-noise ratio for improved reflectance values by using full-range tungsten lamps;
- detailed analysis of field samples in order to detect pathfinder minerals for exploration of gold, silver, iron, nickel, copper, and more.



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