Updates from EPSCoR Boreal Fires Remote Sensing Team:  
Active fire/post-fire analyses, and using hyperspectral data to improve fuels mapping  
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Goals:

1. Improve vegetation and fire fuel maps for Bonanza Creek, AK

1. Use scaling up methods to create an improved vegetation and fire fuel maps for the Boreal forest
Data:

- AVIRIS-NG Hyperspectral image
- Plot-scale vegetation survey (10 m x 10 m)
- RTK GPS data
- 2 m Arctic DEM (Source: Polar Geospatial Center, Univ. of Minnesota)

**AVIRIS-NG:** Airborne Visible Infrared Imaging Spectrometer - Next Generation is a hyperspectral sensor developed by NASA. The sensor measures wavelengths from 380-2500 nm with a spatial sampling of 5 nm. Pixel size: 5 – 8 m.
AVIRIS Image Processing and Vegetation Classification Workflow

AVIRIS-NG Image with 425 bands and 5 meter pixels → Remove bad bands and bands inadequate for analysis → Run Classifier: 1. Support Vector Machine 2. Random Tree → Classified Field Map → Compare results to LANDFIRE EVT Product

Field Data: 10X10m Vegetation Plots → Accuracy Assessment
Initial Results: ~95% classification accuracy (vegetation type)

Vegetation map derived from 2018 NASA AVIRIS-NG image
Vegetation survey: 41 plots (10 m x 10 m)
Vegetation classes: 25 at Alaska Vegetation Classification Viereck level IV
Accuracy (using training data): ~95% at Viereck level IV; 97% at Barnes (2018) fuel type
**LANDFIRE Existing Vegetation Type (EVT)**

- **Dominant classes:** 8
- **Pixel size:** 30 m
- **Top 3 dominant classes (% cover > 1):**
  1. Birch-Aspen forest (33)
  2. Black spruce forest (26)
  3. Birch-Willow shrubland (15)
- **Accuracy:** 32%

**Vegetation classes from AVIRIS-NG**

- **Dominant classes:** 20
- **Accuracy:** 95%
- **Pixel size:** 5 m
- **Top 3 dominant classes (% cover > 1):**
  1. Closed Birch forest (16)
  2. Open White Spruce forest (9)
  3. Closed tall shrub (9)

**Legend:**
- Closed Paper Birch Forest
- Open White Spruce
- Closed Tall Alder
- Wet Sedge Meadow
- Closed Tall Shrub Birch/Willow Shrub
- Closed White Spruce Forest
Examples of hyperspectral vegetation reflectance signatures

Spectral Signatures of Vegetation
AVIRIS-NG (hyperspectral)

Reflectance (%)

Wavelength (nm)

Quaking Aspen
Black Spruce

AVIRIS: Airborne Visible / Infrared Imaging Spectrometer
Hyperspectral versus multispectral vegetation signatures

Spectral Signatures of Vegetation
Landsat vs AVIRIS (hyperspectral)

AVIRIS: Airborne Visible / Infrared Imaging Spectrometer
Key Findings

• For Bonanza Creek Experimental Forest (BCEF) site, AVIRISNG hyperspectral data can identify with an accuracy of:
  • 95% at a Vireck level IV (vegetation type)
  • 97% at a Barnes et al. (2018) (fuel type)
• Hyperspectral remote sensing is highly effective and accurate in mapping vegetation/fuel type and improving the granularity of boreal landcover maps.

Future Work

• Expand class signature database
• Repeat classification techniques at two other sites and compare results
• Calculate spruce and grass fraction (or %) in a pixel (spectral unmixing)
• Map canopy moisture
• Scale up from AVIRISNG to Landsat/Sentinel
• Assessing burn severity
Want to be part of a community-based research project that will help improve Alaskan fire fuel maps?

The following are 3 easy steps to get involved:

1. Find a spot in the Alaskan forest (anywhere outside with natural vegetation)
2. On your smartphone make sure location is turned on (this geotags the photo for analysis) and then snap a picture of the ground vegetation and tree trunks so we can identify plant species.
3. Send the geotagged pictures to mad.bov2020@gmail.com

Contact us or visit our Facebook page for more information: mad.bov2020@gmail.com @mad.bov2020
Vegetation surveys using UAF's own hyperspectral camera (HySpex) in fixed-wing aircraft (credit: Martin Stuefer)

- Goal is similar to AVIRISNG work
- Capacity to acquire imagery on-demand with 1m resolution
- Fuel mapping, burn severity mapping, active fire imaging (where possible)
- Ongoing: calibration/processing
2019: 35 flightlines were acquired over two test sites
2020 priorities: complete test sites, fly over 2019 burn scars
Active fire detections from satellite-borne VIIRS sensor

- VIFDAHL (VIIRS-band Fire Detection Algorithm for high latitudes) is adapted to wildfire in the North American boreal forest.
- Detection sensitivity for low-intensity fires is tuneable. Sensitivity can be increased to detect residual burning (downside: higher chance of false detections in areas with no fire).
- Generated within UAF EPSCoR team using directly downlinked VIIRS satellite data from GINA (Geographic Information Network of Alaska).
Fire season 2020: produce 2x daily VIFDAHL fire detection GIS data

- aggregate high (yellow) and low (orange) intensity fires into polygons
- aggregate detections into 8h time slots:
  - 2 am → 10 am AKDT
  - 10 am → 6 pm AKDT
  - (almost no satellite overpasses between 6 pm and 2 am)
- data available via web, potentially Web Feature Service (TBD)
Applications of EPSCoR Boreal Fires remote sensing data

- Daily products of use for community resilience and fire management
- (work in progress) Improved boreal vegetation, fuel, burn severity maps
- (work in progress) Improved probabilistic outputs from active fire behavior models: from instantaneous active fire mapping and new fuel maps (great thanks to Robert Ziel)