

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

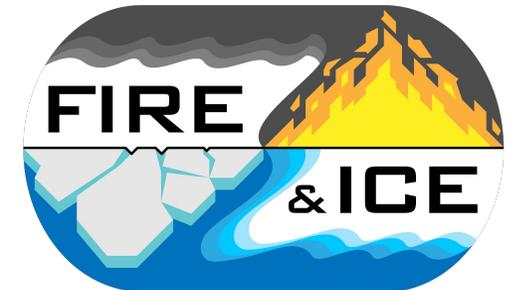
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Jennifer Barnes, Robert Ziel, Teresa Hollingsworth, Jamie Hollingsworth

NASA ABoVE Project, Polar Geospatial Center (U. of Minnesota)

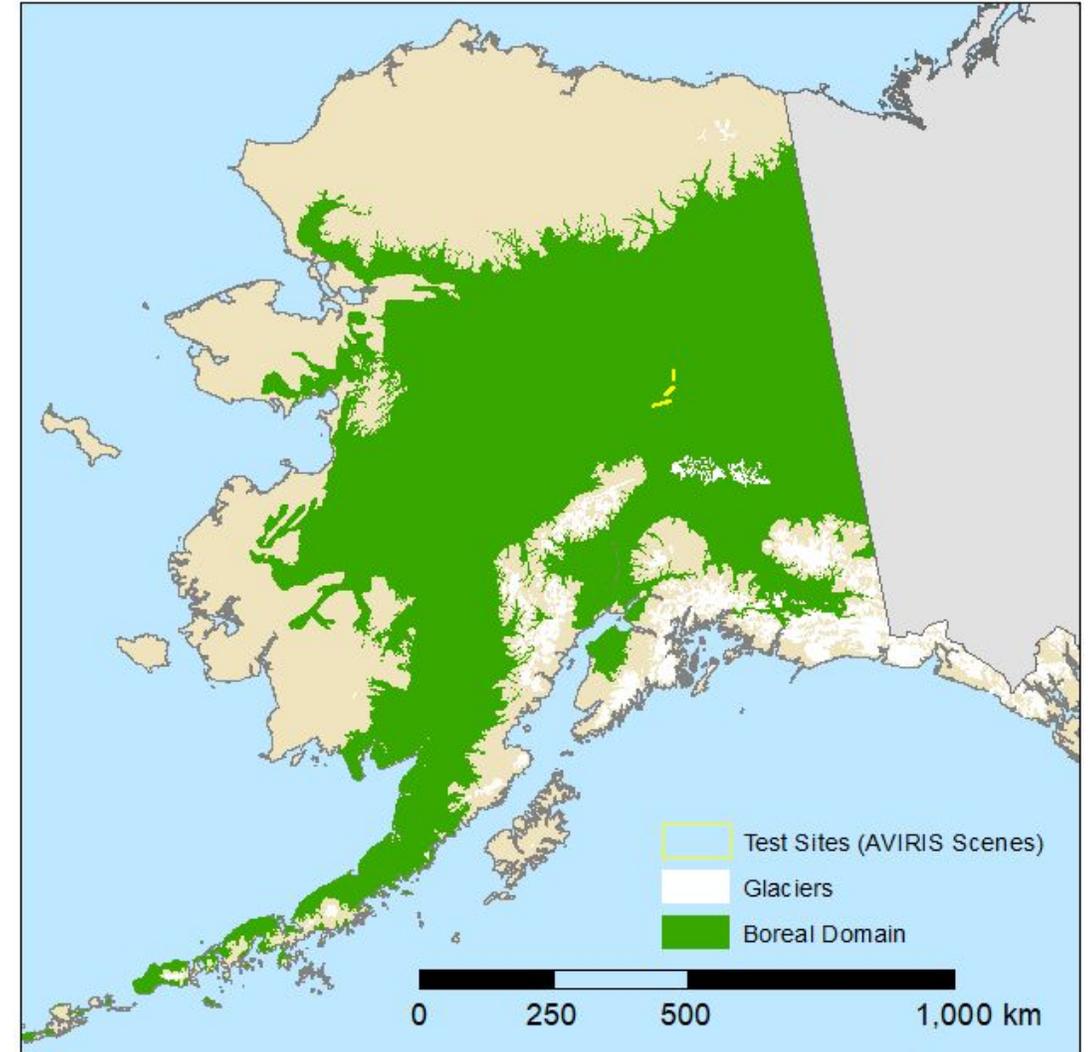


Improve vegetation and fuel types mapping, Bonanza Creek, AK

Chris Smith, Santosh Panda, Uma Bhatt, Robert Haan

Goals:

1. Improve vegetation and fire fuel maps for Bonanza Creek, AK
2. Use scaling up methods to create an improved vegetation and fire fuel maps for the Boreal forest





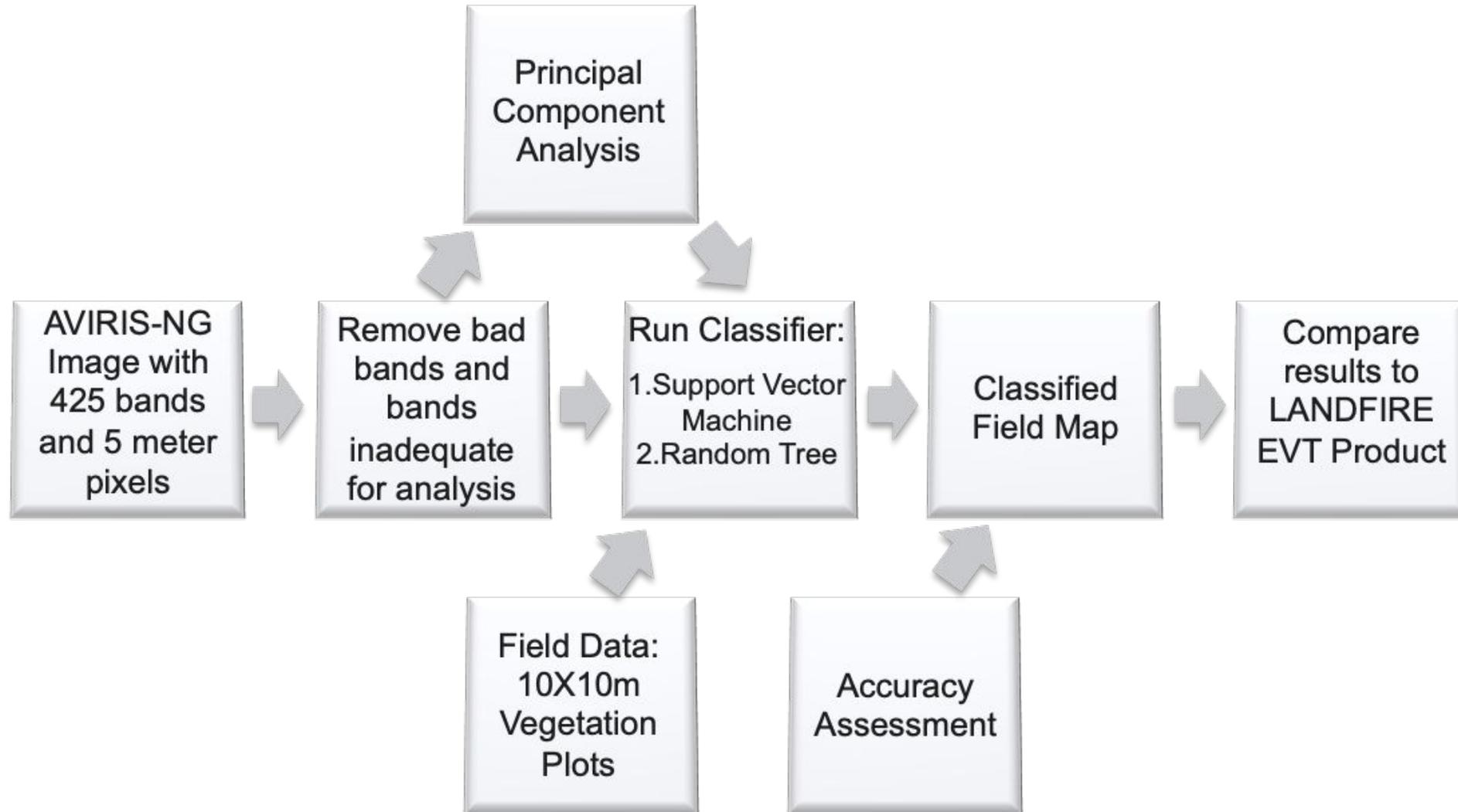
Data:

- 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)

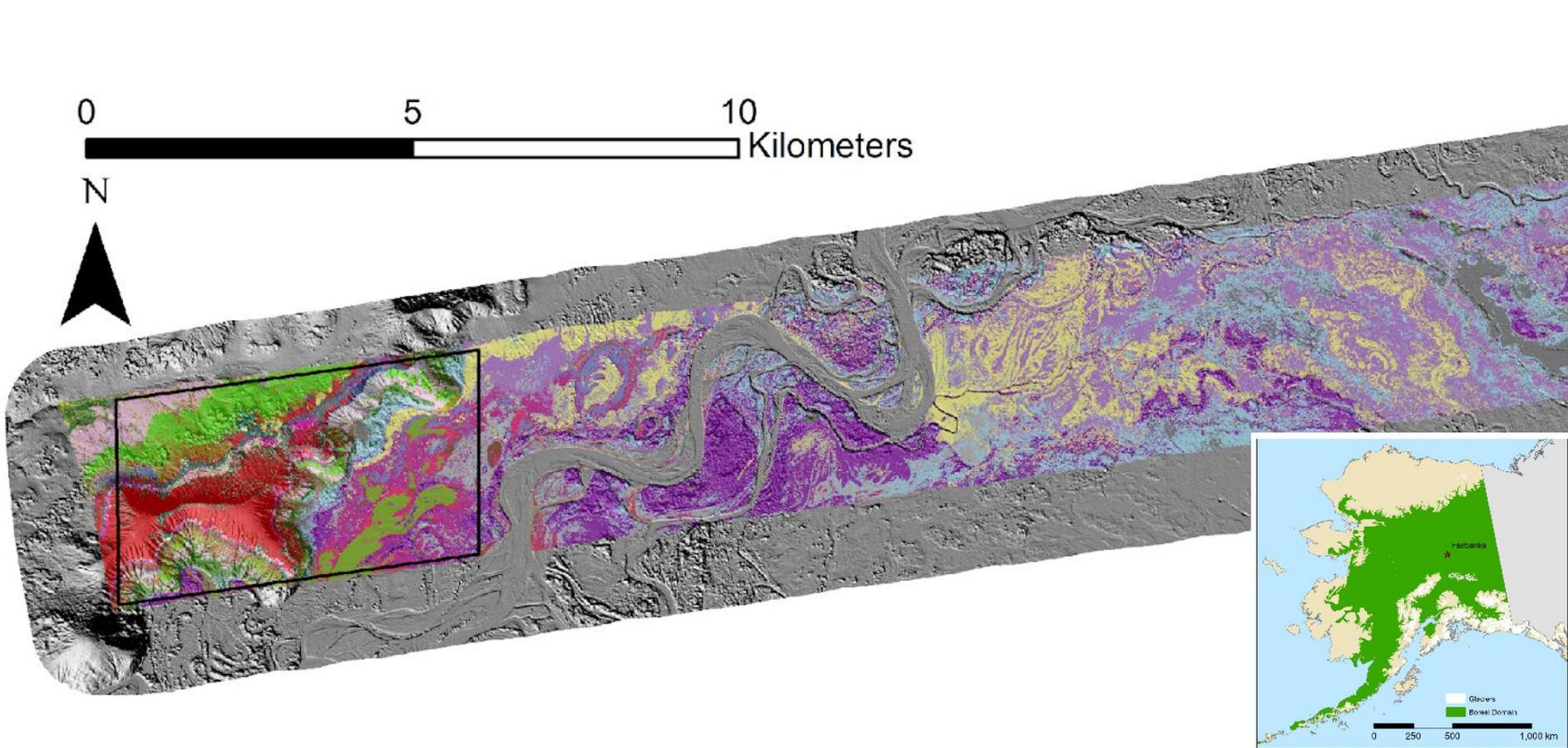
AVIRIS-NG: Airborne Visible InfraRed Imaging Spectrometer - Next Generation is a hyperspectral sensor developed by NASA. The sensor measures wavelengths from **380-2500 nm** with a spatial sampling of 5 nm. Pixel size: 5 – 8 m.



AVIRIS Image Processing and Vegetation Classification Workflow



Initial Results: ~95% classification accuracy (vegetation type)



Vegetation Class

- Tussock Tundra
- Open White Spruce
- Open Tall Alder
- Open Spruce/Paper Birch Forest
- Open Quaking Aspen/Spruce Forest
- Open Black Spruce
- Closed White Spruce
- Closed Spruce/Paper Birch/Aspen Forest
- Closed Quaking Aspen/White Spruce Forest
- Closed Quaking Aspen Forest
- Closed Paper Birch
- Closed Black/White Spruce Forest
- Closed Black Spruce
- Bluejoint/Shrub & Bluejoint Herb
- Wetlands
- Wet Sedge Meadows
- Closed Tall Shrub Birch/Willow Shrub
- Closed Tall Alder
- Bluejoint
- Post Harvest Bluejoint
- Closed Spruce/Paper Birch Forest
- Shrub/Bare
- Black Spruce/ Tammarack Forest
- Black Spruce Woodland with Tussocks
- Open Tall Shrub Birch Shrub

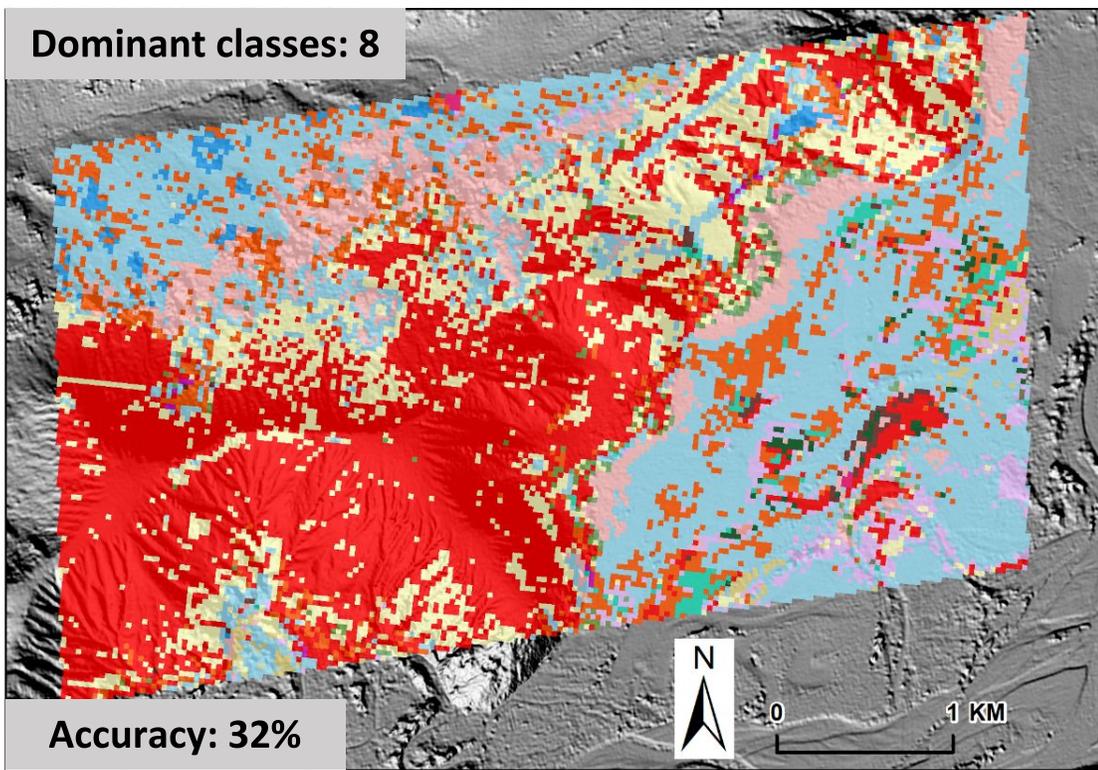
Vegetation map derived from 2018 NASA AVIRIS-NG image

Vegetation survey: 41 plots (10 m x 10 m)

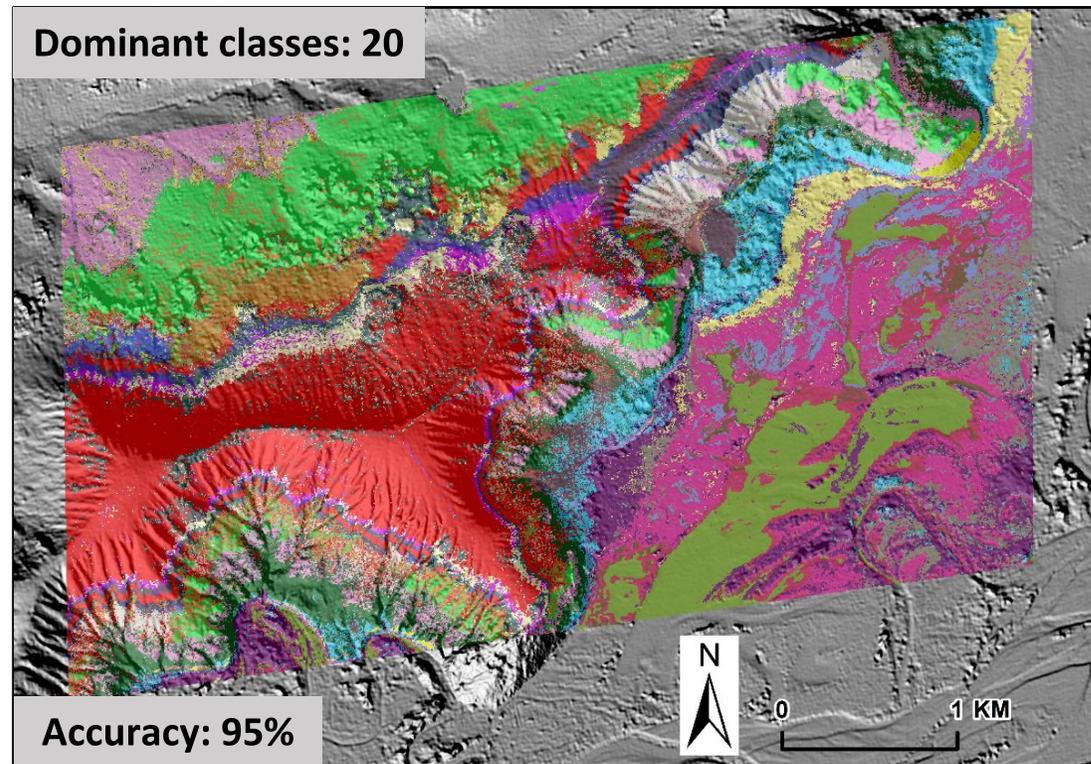
Vegetation classes: 25 at Alaska Vegetation Classification Viereck level IV

Accuracy (using training data): ~95% at Viereck level IV; 97% at Barnes (2018) fuel type

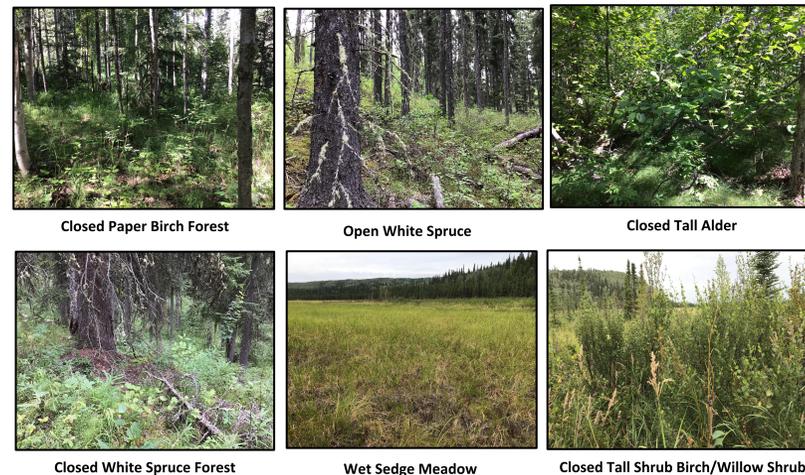
LANDFIRE Existing Vegetation Type (EVT)



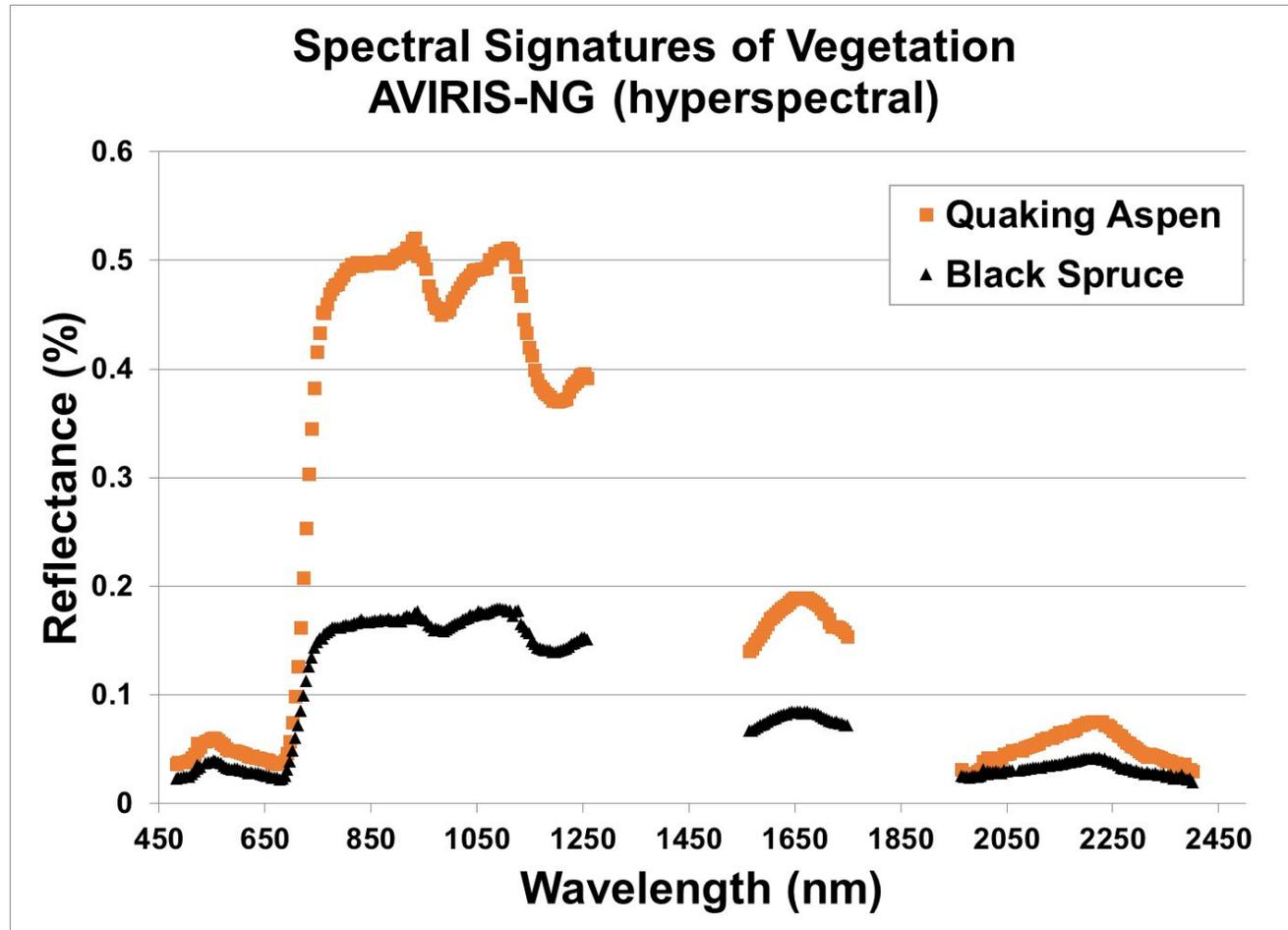
Vegetation classes from AVIRIS-NG



LANDFIRE EVT (Landsat)	AVIRIS-NG Veg. Class
<u>Pixel size:</u> 30 m	5 m
<u>Dominant classes (% cover > 1):</u> 8	20
<u>Top 3 dominant classes (% cover):</u>	
1. Birch-Aspen forest (33)	1. Closed Birch forest (16)
2. Black spruce forest (26)	2. Open White Spruce forest (9)
3. Birch-Willow shrubland (15)	3. Closed tall shrub (9)



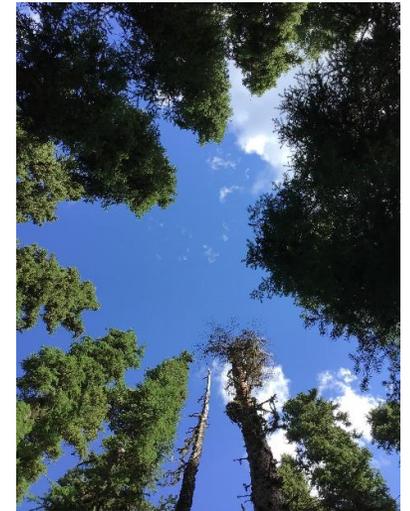
Examples of hyperspectral vegetation reflectance signatures



AVIRIS: Airborne Visible / Infrared Imaging Spectrometer

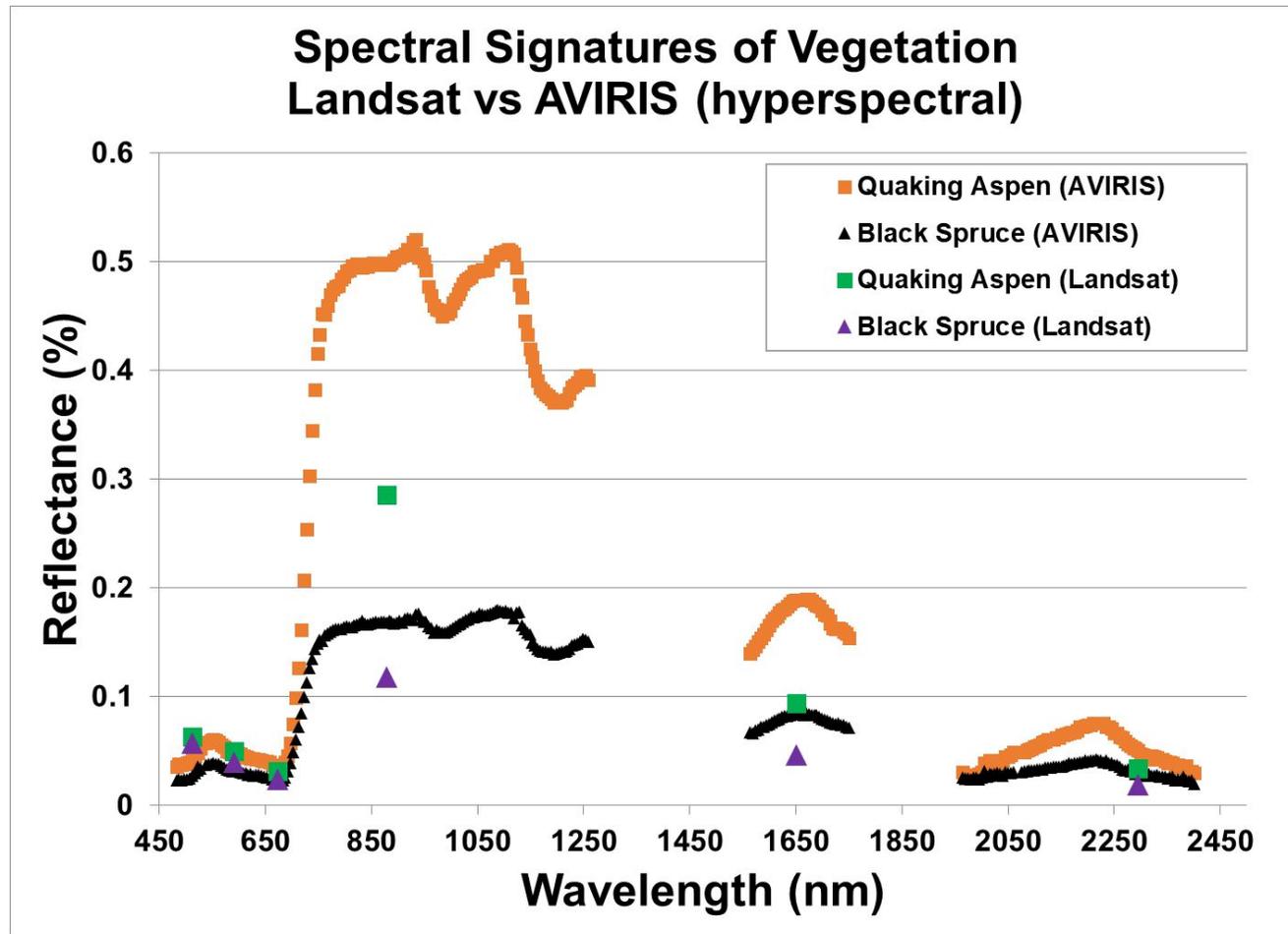


Quaking
Aspen



Black
Spruce

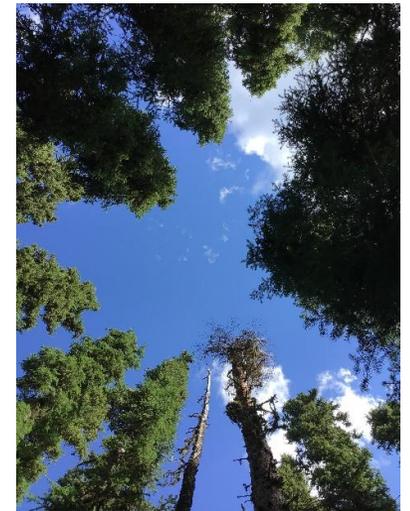
Hyperspectral versus multispectral vegetation signatures



AVIRIS: Airborne Visible / Infrared Imaging Spectrometer



Quaking
Aspen



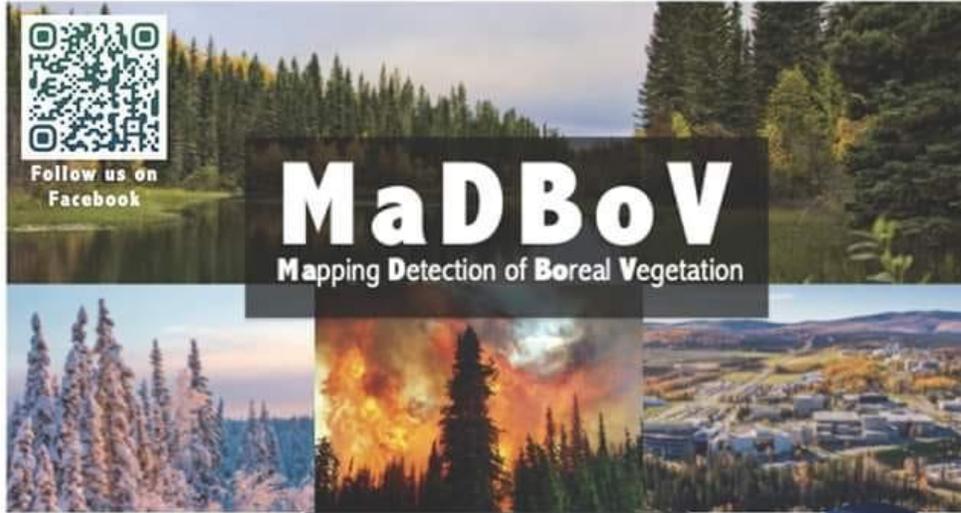
Black
Spruce

Key Findings

- For **Bonanza Creek** Experimental Forest (BCEF) site, AVIRIS-NG 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 AVIRIS-NG 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

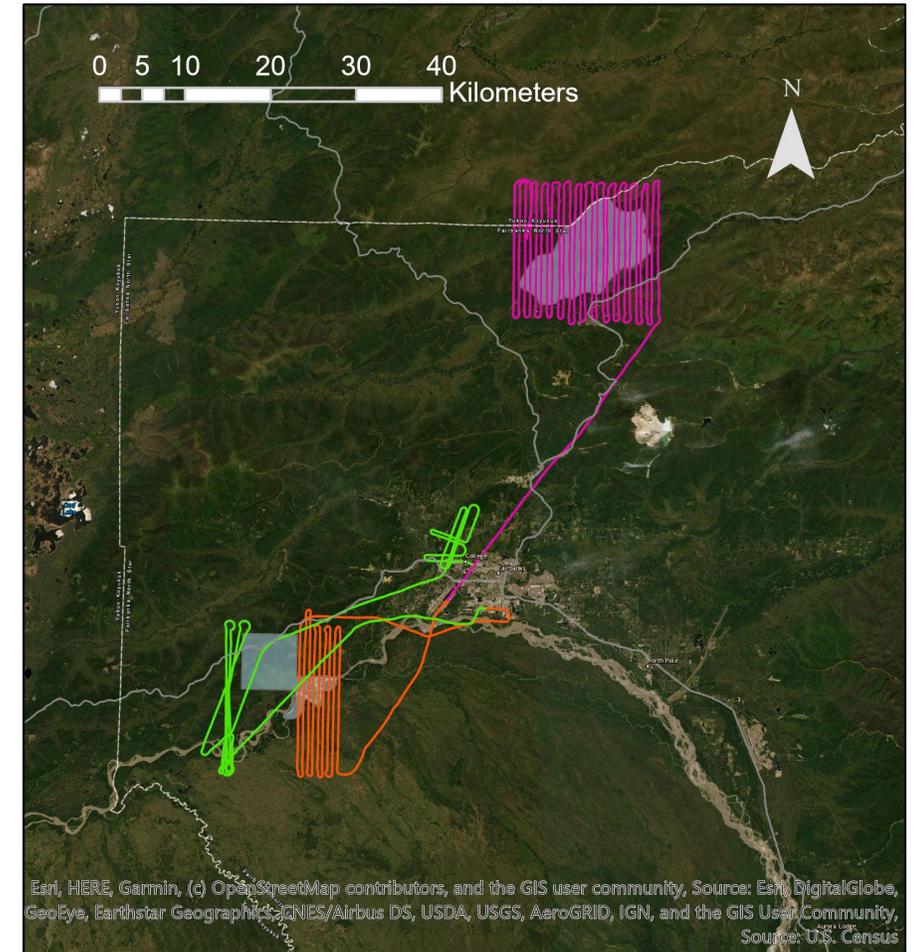
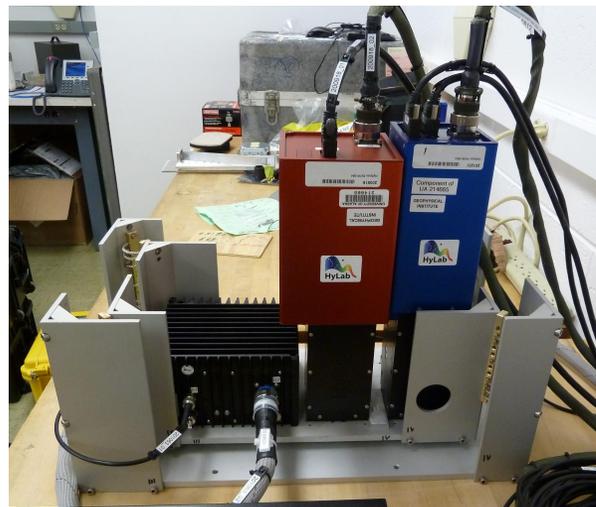
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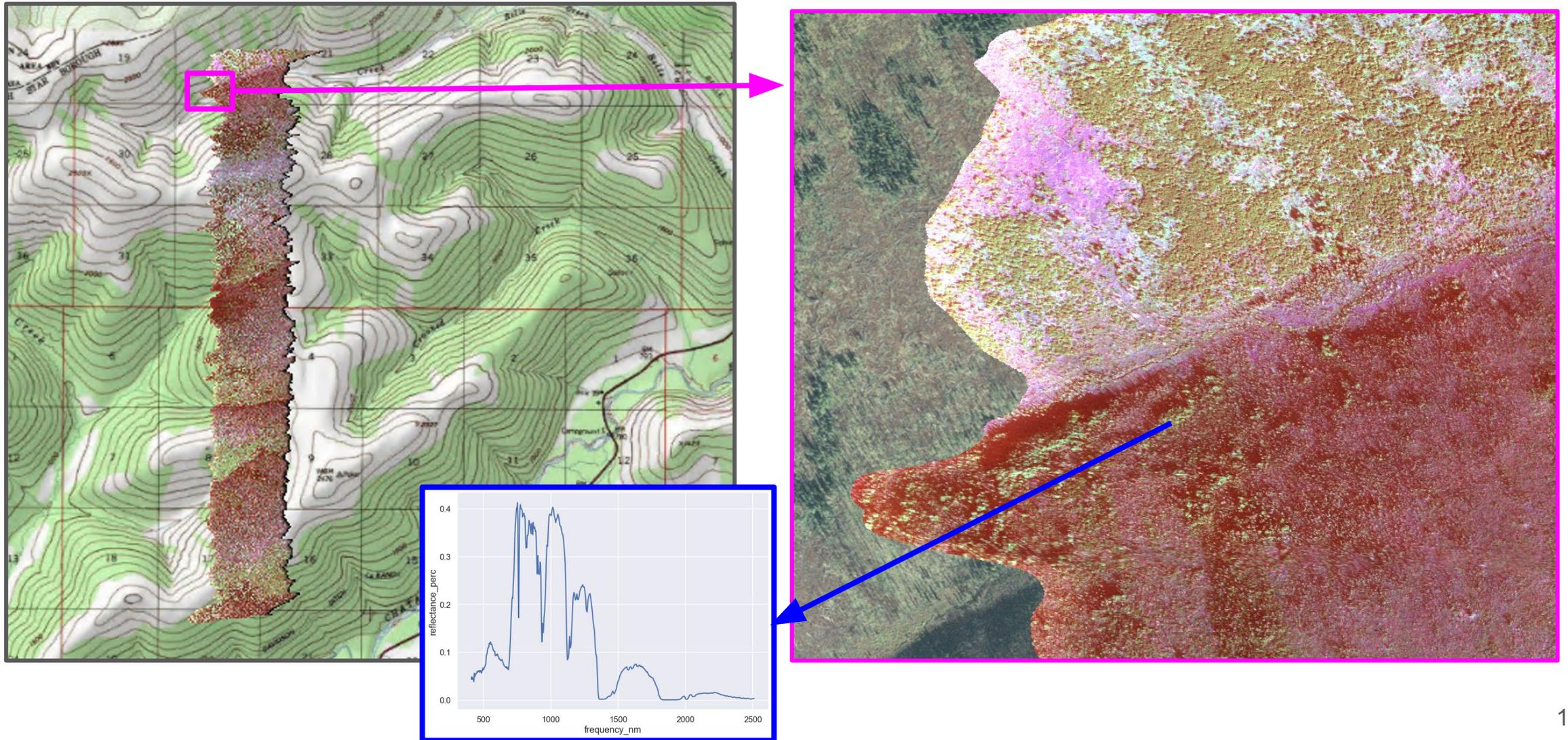
Vegetation surveys using UAF's own hyperspectral camera (HySpex) in fixed-wing aircraft (credit: Martin Stuefer)

- Goal is similar to AVIRIS-NG work
- Capacity to acquire imagery on-demand with 1m resolution
- Fuel mapping, burn severity mapping, active fire imaging (where possible)
- Ongoing: calibration/processing



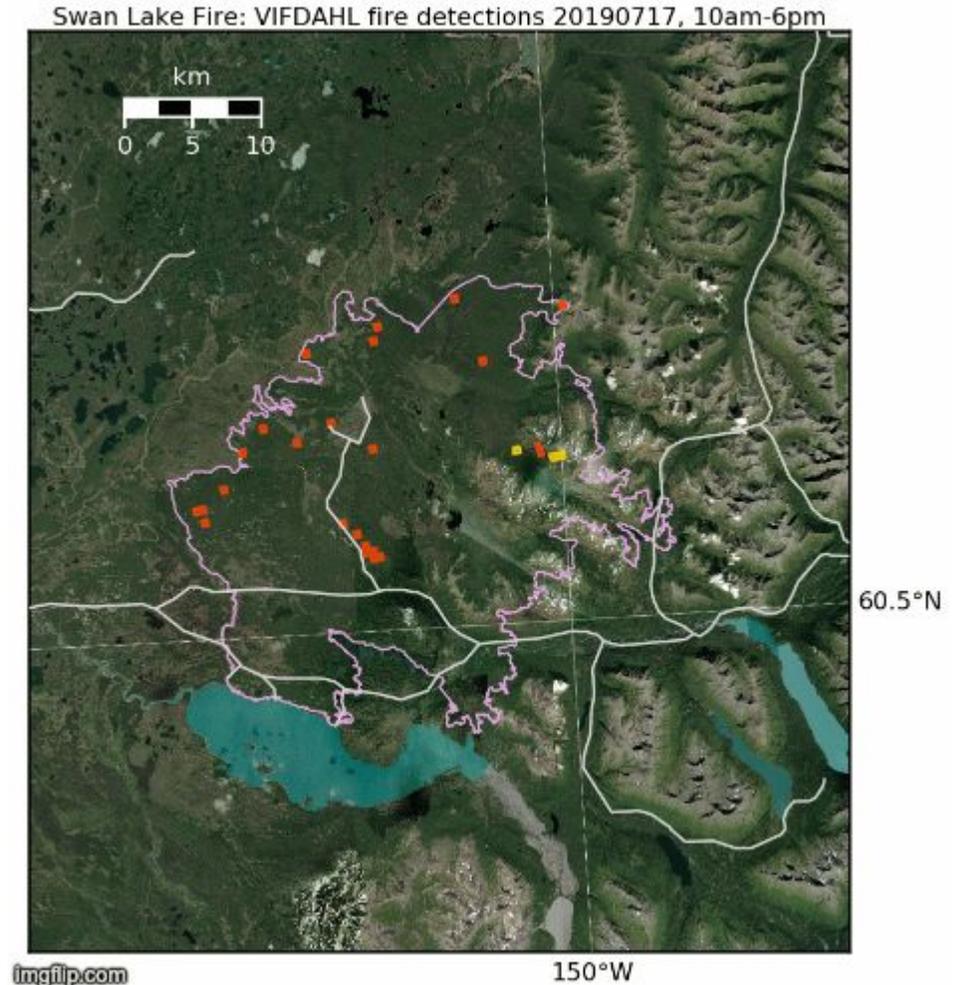
2019 EPSCoR hyperspectral flights

2019: 35 flightlines were acquired over two test sites
2020 priorities: complete test sites, fly over 2019 burn scars



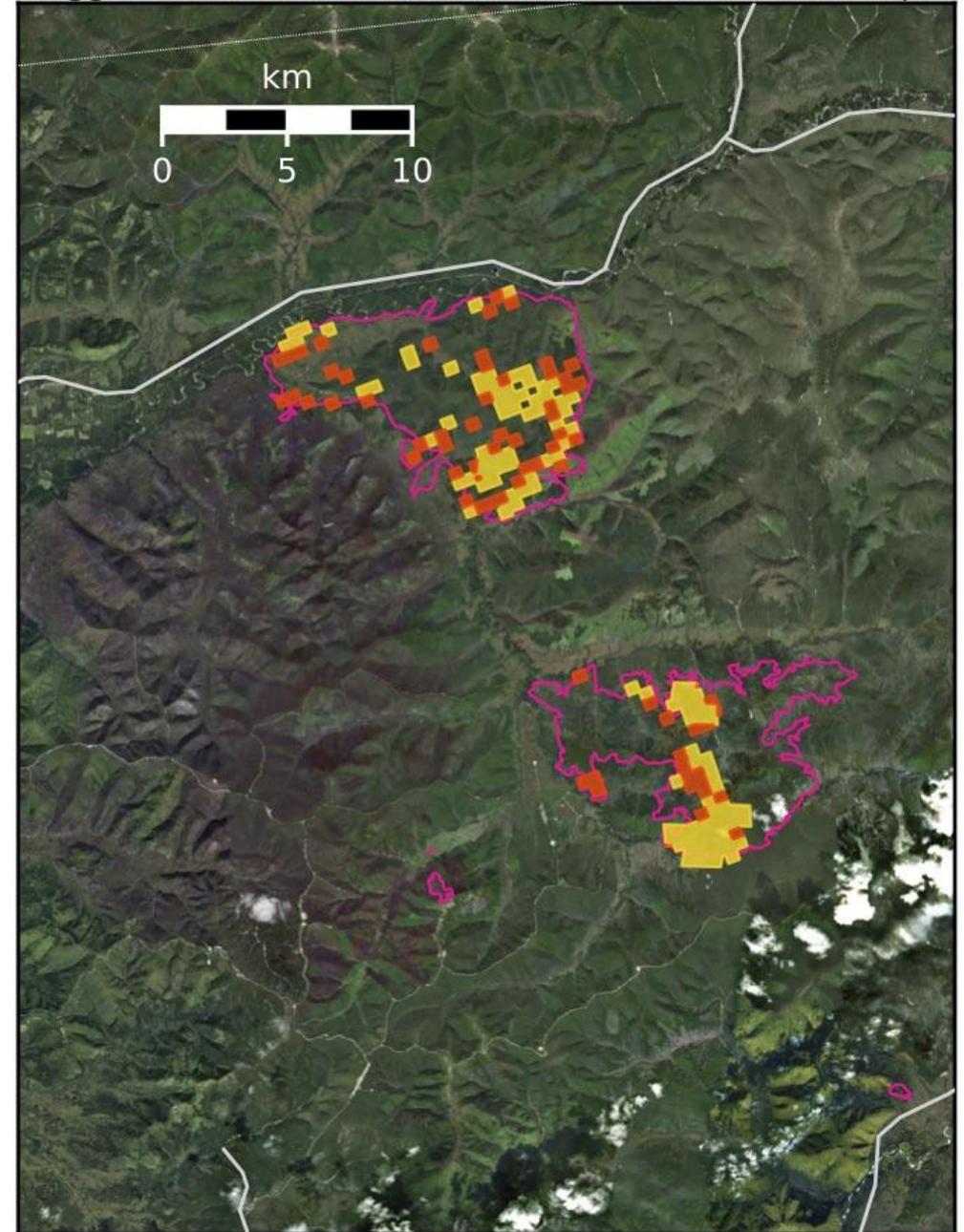
Active fire detections from satellite-borne VIIRS sensor

- VIFDAHL (VIIRS I-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)

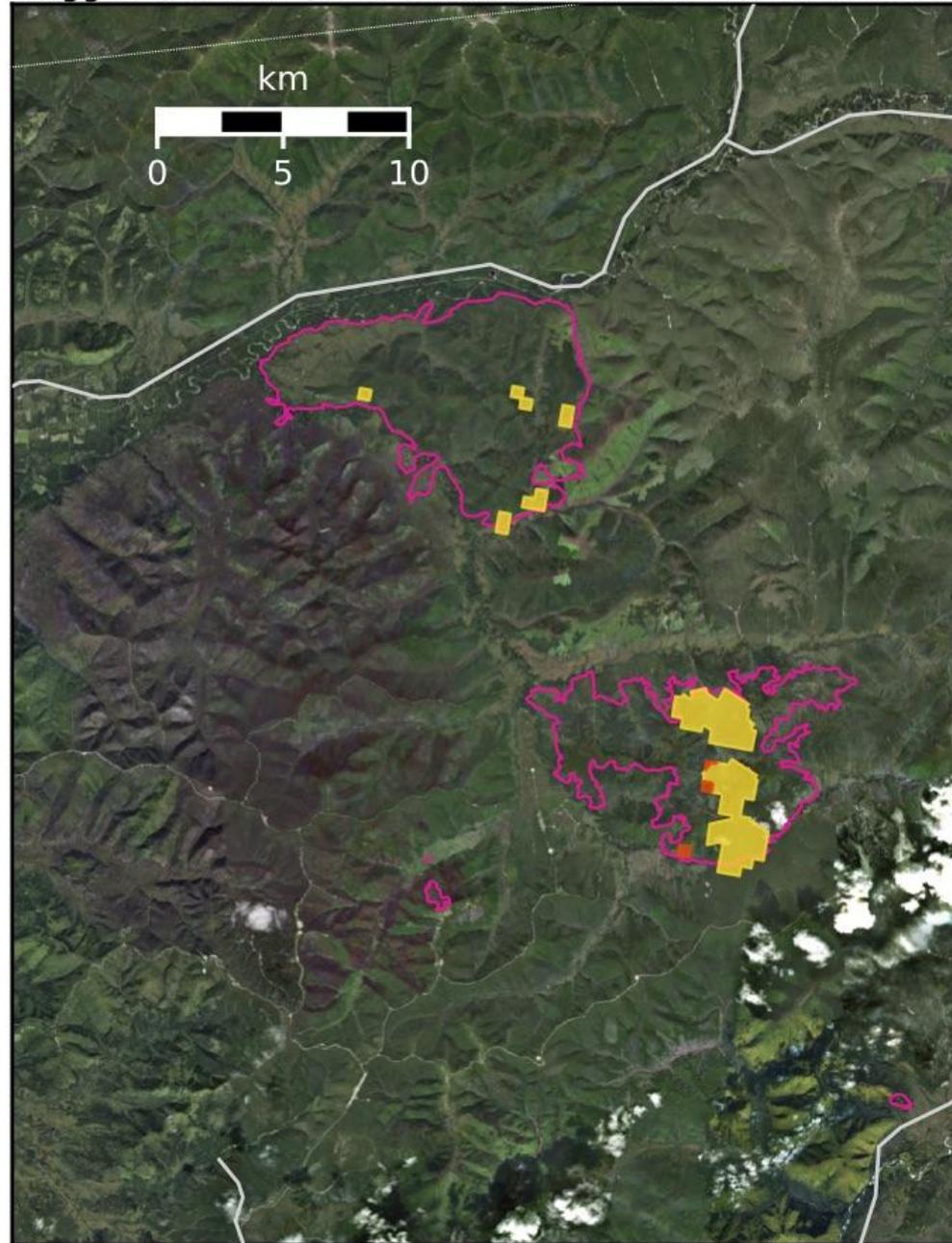


Fire season 2020: produce 2x daily VIFDAHL fire detection GIS data

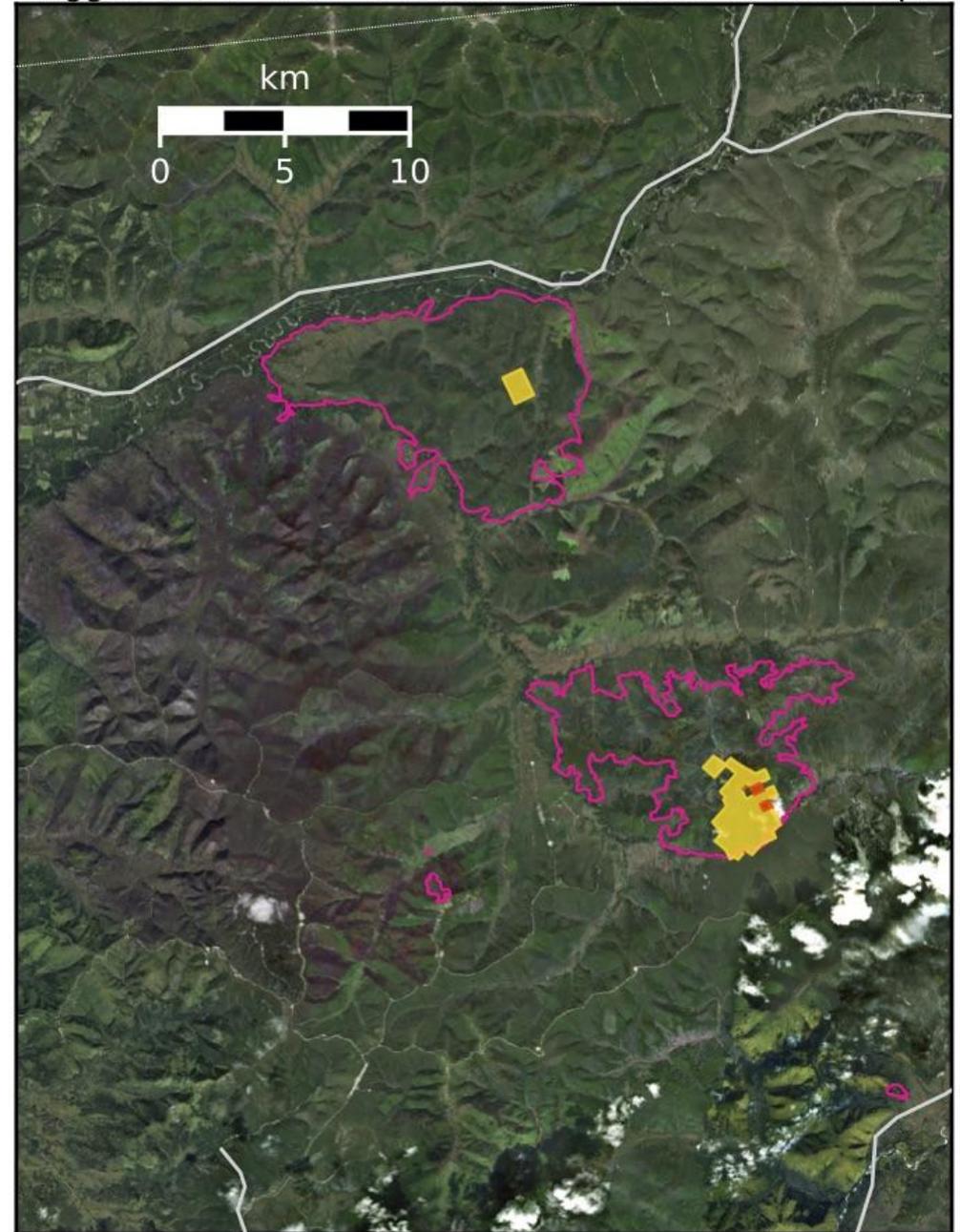
- aggregate high (yellow) and low (orange) intensity fires into polygons
- aggregate detections into 8h time slots:
 - 2 am → 10 am AKDT
 - 10 am → 6 pm AKDT
 - (almost no satellite overpasses between 6 pm and 2 am)
- data available via web, potentially Web Feature Service (TBD)



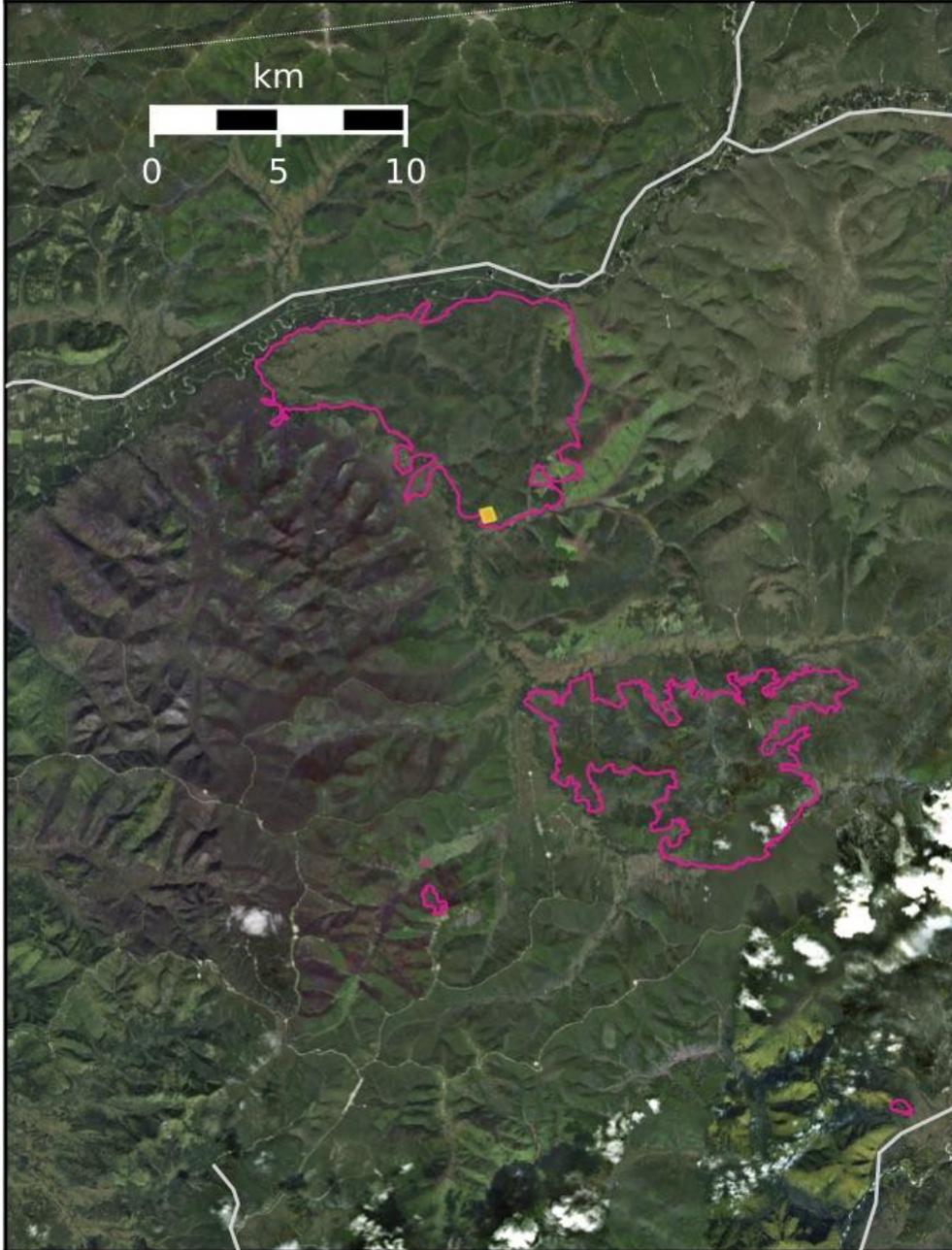
Nugget Creek Fire: fire detections 20190710, 2am-10am



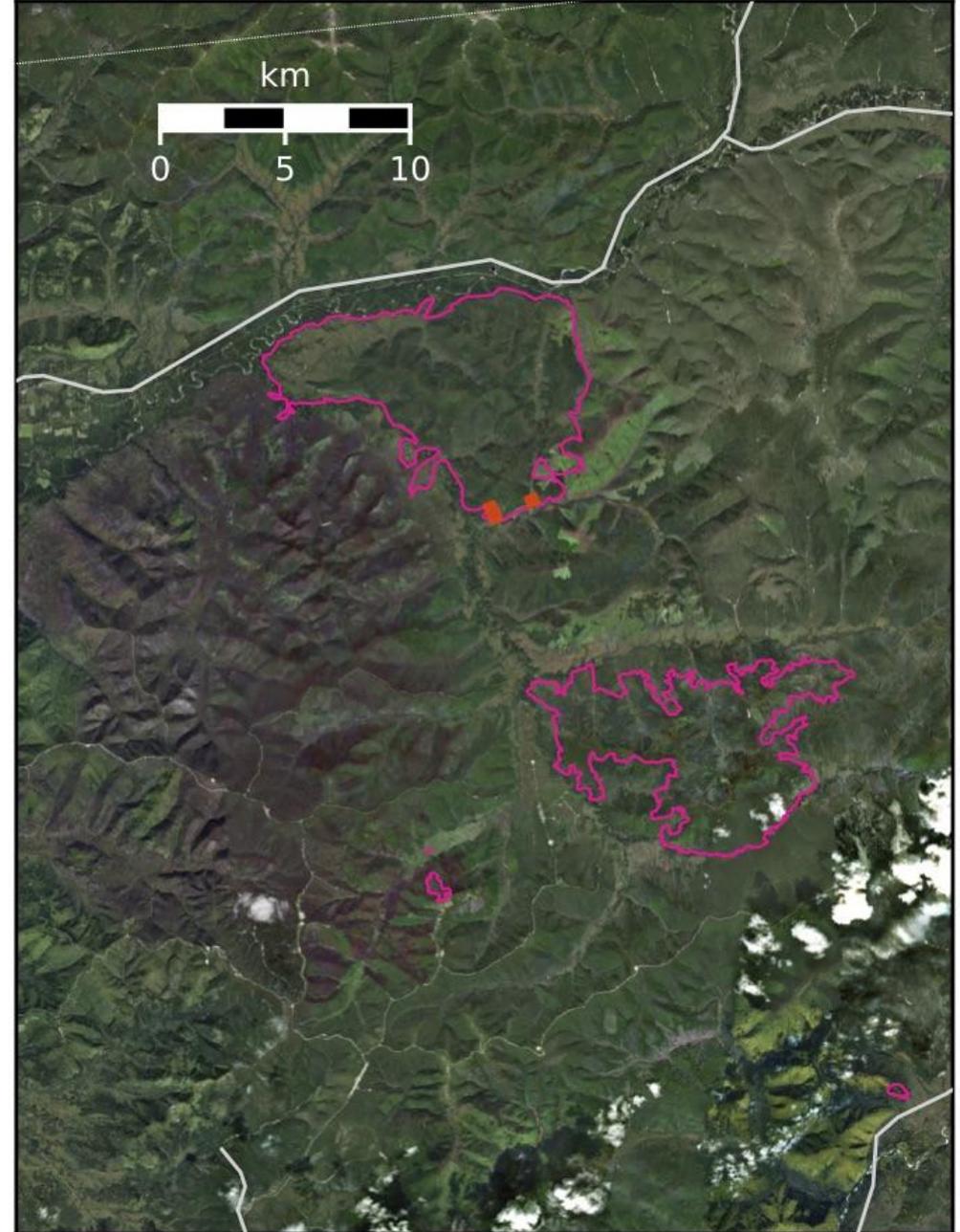
Nugget Creek Fire: fire detections 20190710, 10am-6pm



Nugget Creek Fire: fire detections 20190713, 10am-6pm



Nugget Creek Fire: fire detections 20190715, 10am-6pm



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)