

Scaling ground-based hyperspectral scans to AVIRIS next gen using UAV-based VNIR imaging spectroscopy for mapping arctic and boreal plants in Alaska.

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Introduction: Arctic plants are small in stature, spectrally diverse or highly intermixed, which presents challenges to current NASA missions to visualize effects of disturbance or directional vegetation change via mapping. Remotely sensed data having fine spatial (ca. 10 cm pixels) and spectral grain (eg. “hyperspectral”) could help resolve patches of many arctic plant groups, such as shrubs, dwarf shrubs, bryophytes and lichens and separate them from litter, wood or rock/soil.

Fig. 3: Sequence of Red/Green/Blue (RGB, eg. A.1, A6) and Mixture-Tuned Matched Filtering (MTMF, all other images) class maps for different AVIRIS ng flight lines and UAV-based VNIR imagery showing *Salix alaxensis* where white pixels indicate a better match (greater amount) to the imagery spectra. Imagery from Alaska at the A) Yukon delta near Emmonak B) Blrch Lake near Delta Junction and C) 8 mile Lake near Healy.

Results:

UAV imagery: We flew 20 missions at 5 different general area from central to western Alaska, all under AVIRIS ng acquisitions.

Data Collection: Over 600 scans from >70 plant, moss or lichen species were collected (Fig. 2).

Mixture Tuned Matched Filtering: MTMF recovered general patterns of vegetation occurrence (eg. river bars of willows) in both AVIRIS ng and UAV VNIR imagery (Fig. 3). The pixel size difference between these two types of imagery showed spatial patterns in the UAV imagery not visible in AVIRIS ng.

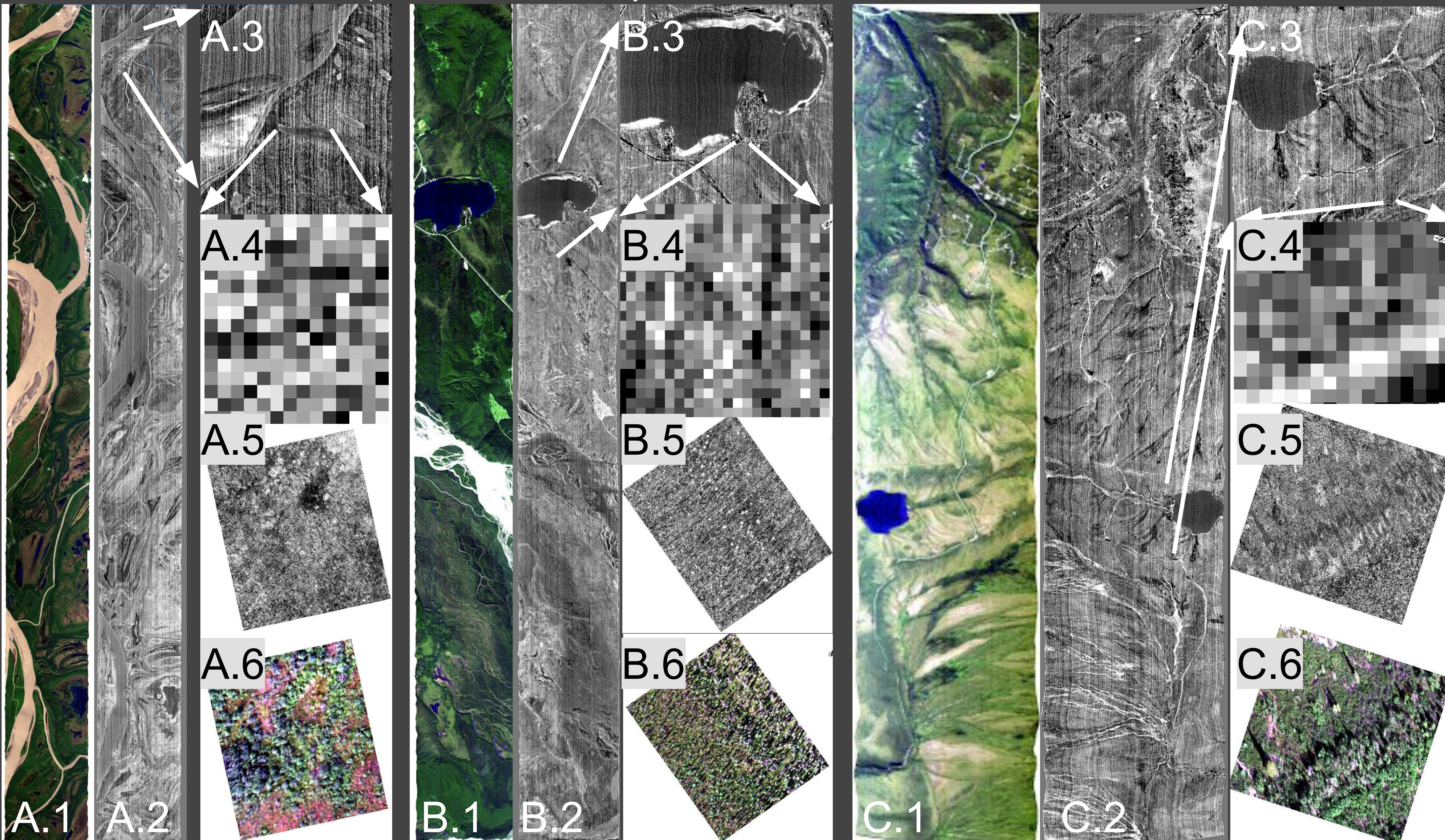
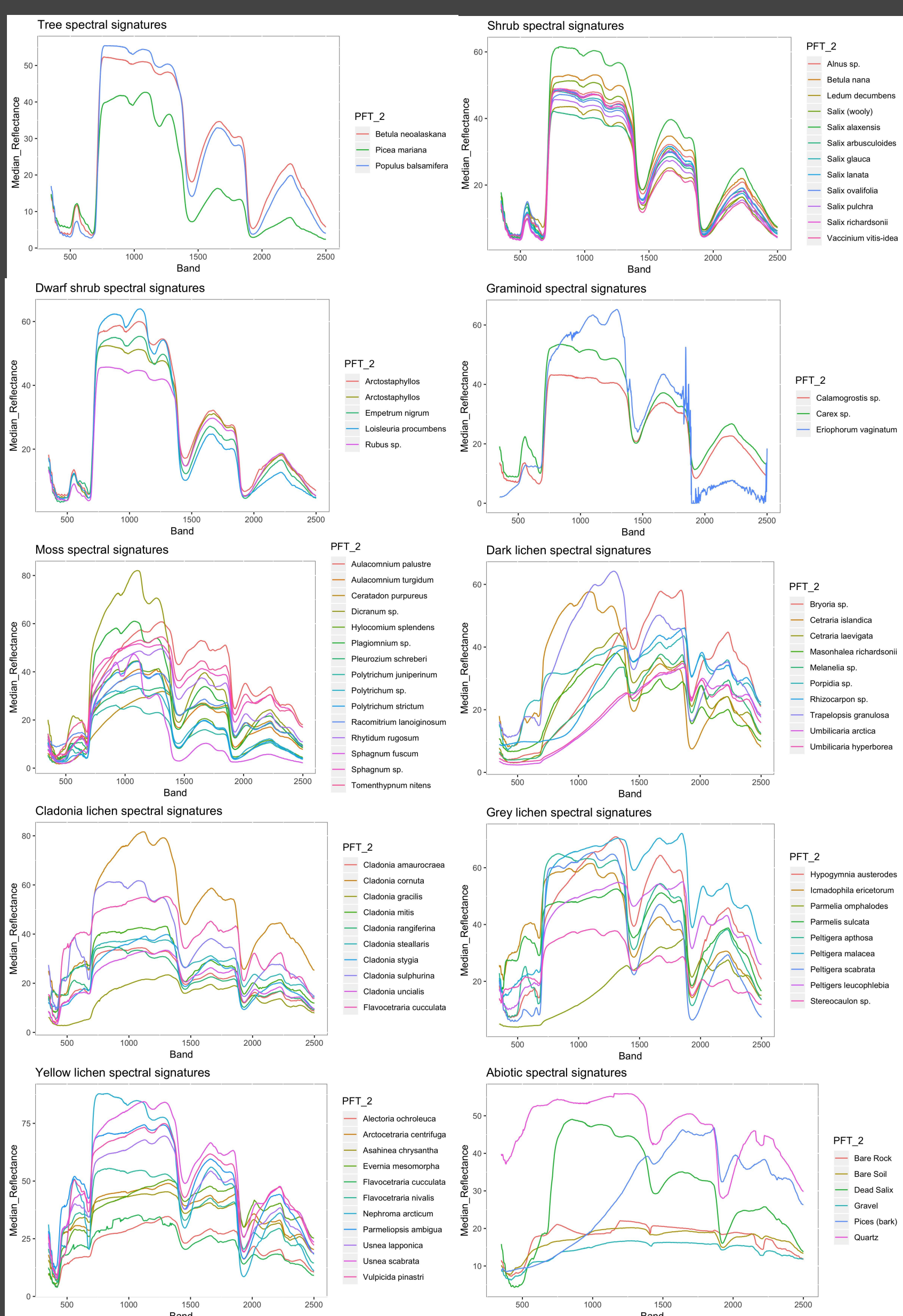
Conclusion: This work reports on the progress to catalog the spectral signatures of plants in Alaska and apply them to different hyperspectral imagery. Attempts to use MTMF with AVIRIS ng were more successful compared to the UAV VNIR imagery based on subjective evaluation of what plant groups were detected compared to RGB imagery. Noise in the higher wavelengths, narrower spectral range and shadows all made using MTMF more difficult for the UAV imagery. Pure-pixel approaches (not shown) provided better results in terms of qualitative assessment of accuracy but poorer matches to spectral library endmembers. Future work will focus on accuracy assessment based on in-situ measurements and workflow automation.

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Fig. 1: Field sites (dots) within Alaska, USA.



Fig. 2: Median reflectance spectral signatures collected in the field with a spectroradiometer. Scans are grouped by plant type.



Methods: In the summer of 2018, sites were selected to be coincident with AVIRIS ng and other ABoVE science team projects (Fig. 1). At each site, we flew a DJI Matrice600 with a Headwall Micro A-series VNIR imaging spectrometer (400-1000 nm, 326 bands) at either 50 or 100m AGL (4-10 cm GSD). At the same time, we collected field spectra of plants, mosses and lichens with a Spectral Evolution PSR+ spectroradiometer (350-2500nm). We compiled a spectral library of all scans and calculated the median reflectance by plant functional type (PFT). UAV imagery was radiometrically calibrated using a white reference calibration tarp in each scene and orthomosaicked in Headwall's SpectralView software. AVIRIS ng reflectance products were downloaded from the online data portal and both UAV and AVIRIS imagery were analyzed using Mixture Tuned Matched Filtering (MTMF) in ENVI 5.5. The spectral library was resampled and rescaled to match each type of imagery.

