Estimation of Belowground Biomass and Permafrost Active Layer Properties Using Radar and Lidar Measurements

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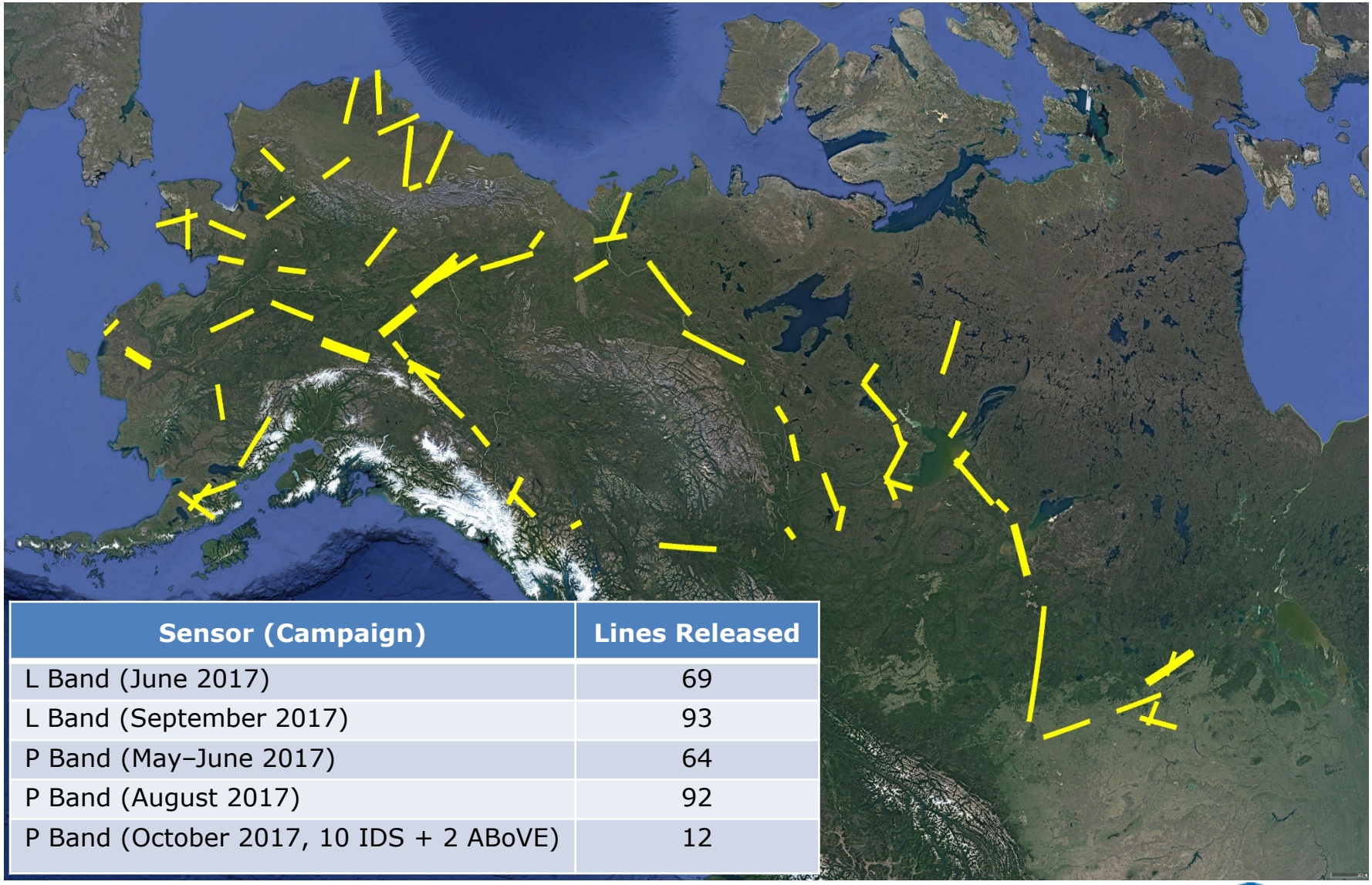
NASA ABoVE ARCTIC BOREAL VULNERABILITY EXPERIMENT

Science Objectives

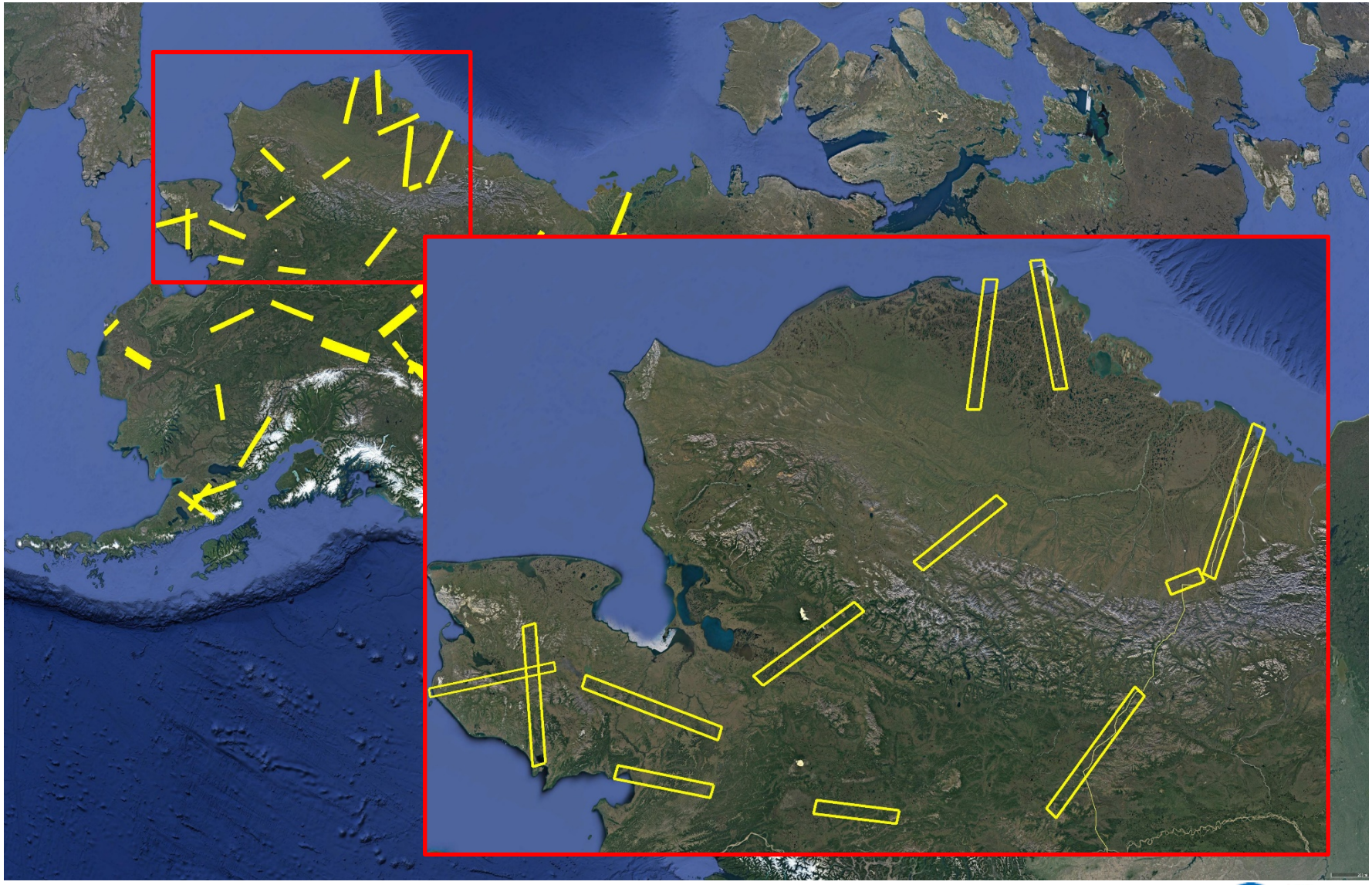
- Develop sophisticated radar scattering models adapted for Alaska and Western Canada permafrost landscapes that account for multilayer soils with a surface organic layer and vegetation roots, and intervening tundra and taiga vegetation.
- Apply the model developed under Objective 1 to develop a regionally refined inverse algorithm to retrieve permafrost properties using dual-frequency P-band and L-band radar imagery; and
- Use combined airborne radar remote sensing from AirMOSS and UAVSAR to retrieve and map belowground biomass, soil moisture profile, and active layer thickness (ALT), and assess the retrieval error and uncertainty using ground truth observations.

ABoVE P- and L-Band Radar Flights



Sensor (Campaign)	Lines Released
L Band (June 2017)	69
L Band (September 2017)	93
P Band (May–June 2017)	64
P Band (August 2017)	92
P Band (October 2017, 10 IDS + 2 ABoVE)	12

Focus Areas



Alaska Fieldwork

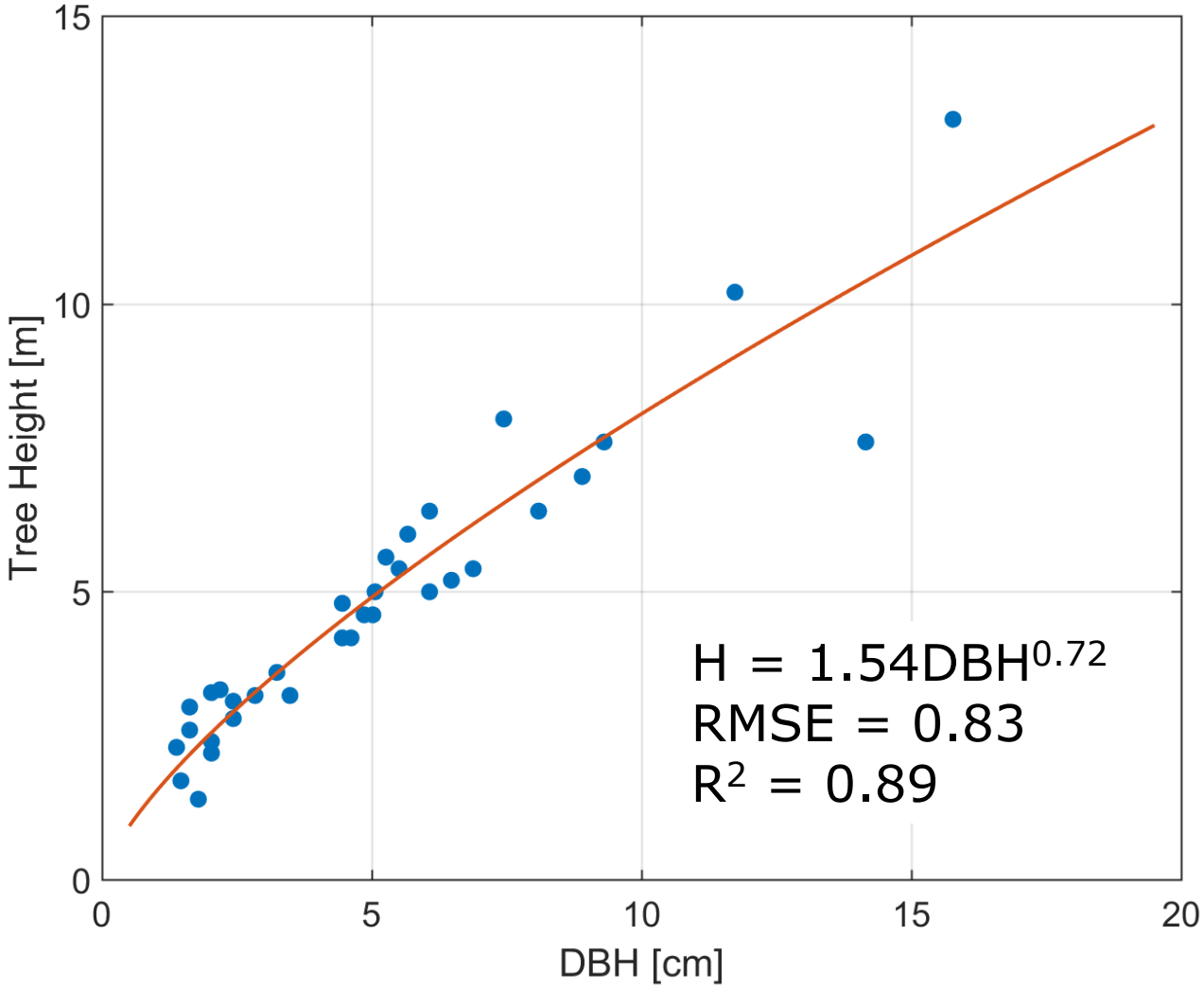
- USC team performed fieldwork along Alaska's Dalton Highway in August 2017 to collect ground measurement in support of the ABoVE Airborne Campaign
- We collected data at Coldfoot, Imnavait Creek Watershed, Happy Valley, and Prudhoe Bay.
  - Coldfoot: Soil and vegetation parameters
  - Imnavait Creek: Soil parameters
  - Happy Valley: Soil and vegetation parameters
  - Prudhoe Bay: Soil parameters

Alaska Fieldwork

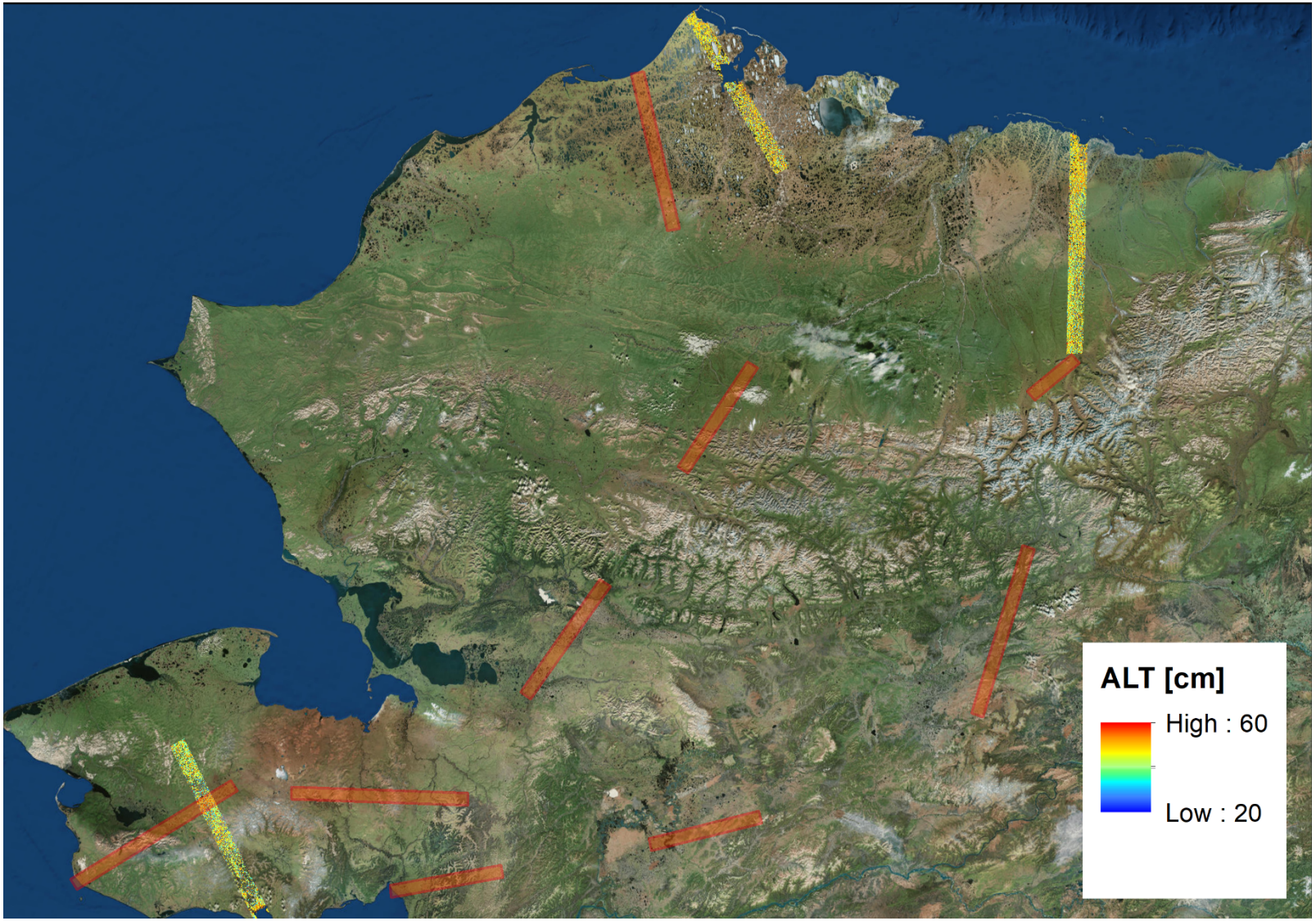
- For vegetation parameters, we measured
  - Tree height, trunk height, trunk density, DBH, branch radius, branch length, branch orientation, and branch density
- For soil, we measured
  - Soil moisture, organic and active layer thicknesses, soil roughness

Alaska Fieldwork

Alaska Fieldwork: Sample Data Analysis



Preliminary Data Products

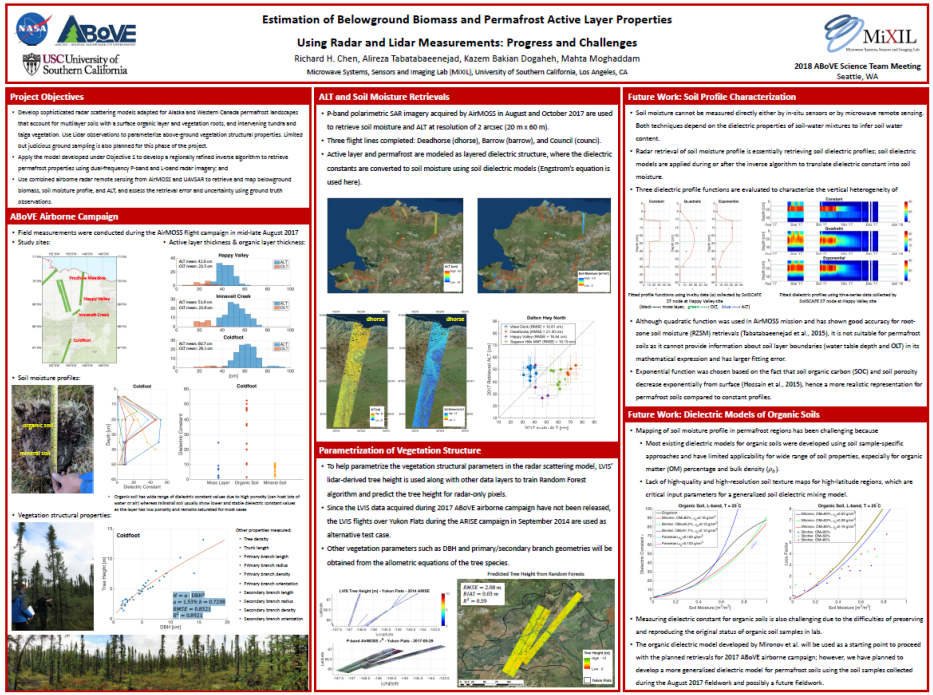


Future Plans

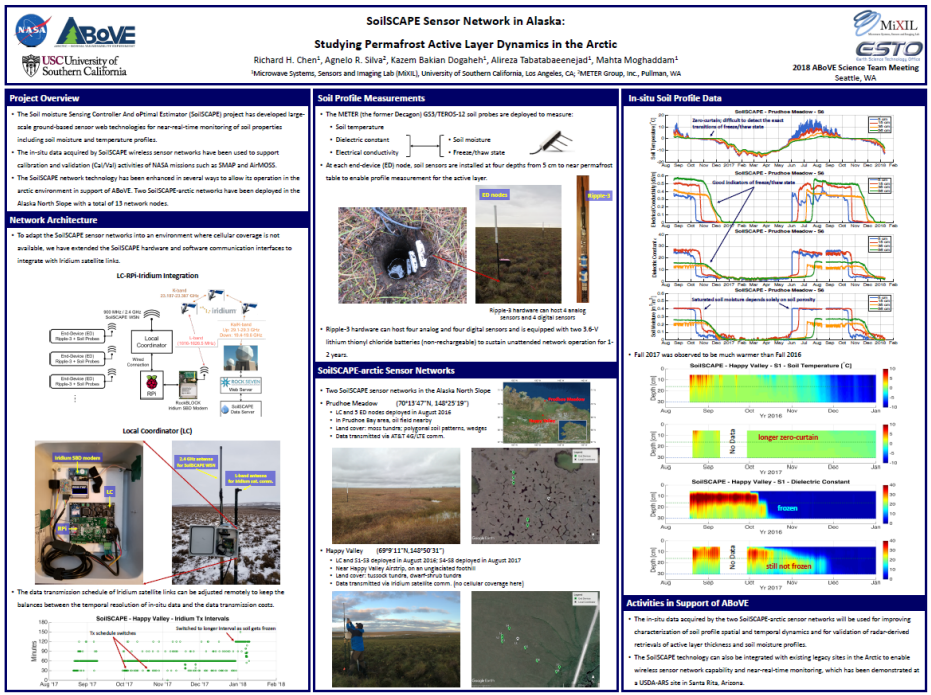
- ❑ Development of dielectric model for organic soil and inclusion of roots
  - The dielectric model for organic soil developed by Mironov *et al.* will be used as a starting point to proceed with the planned retrievals for 2017 ABoVE Airborne Campaign
- ❑ Better characterization of permafrost soil layers and profiles for more accurate retrieval of subsurface *features*
- ❑ Parametrization of vegetation cover using lidar data (from LVIS), Random Forest algorithm, and allometric relationships
- ❑ Retrieval, validation, and reprocessing of lines with new assumptions
- ❑ Comparison with InSAR products

Posters (Session C: Thursday, 4:30 PM)

- The following posters provide more details about the ABoVE project progress and the SoilSCAPE Sensor Network.



Estimation of Belowground Biomass and Permafrost Active Layer Properties Using Radar and Lidar Measurements: Progress and Challenges



SoilSCAPE Sensor Network in Alaska: Studying Permafrost Active Layer Dynamics in the Arctic

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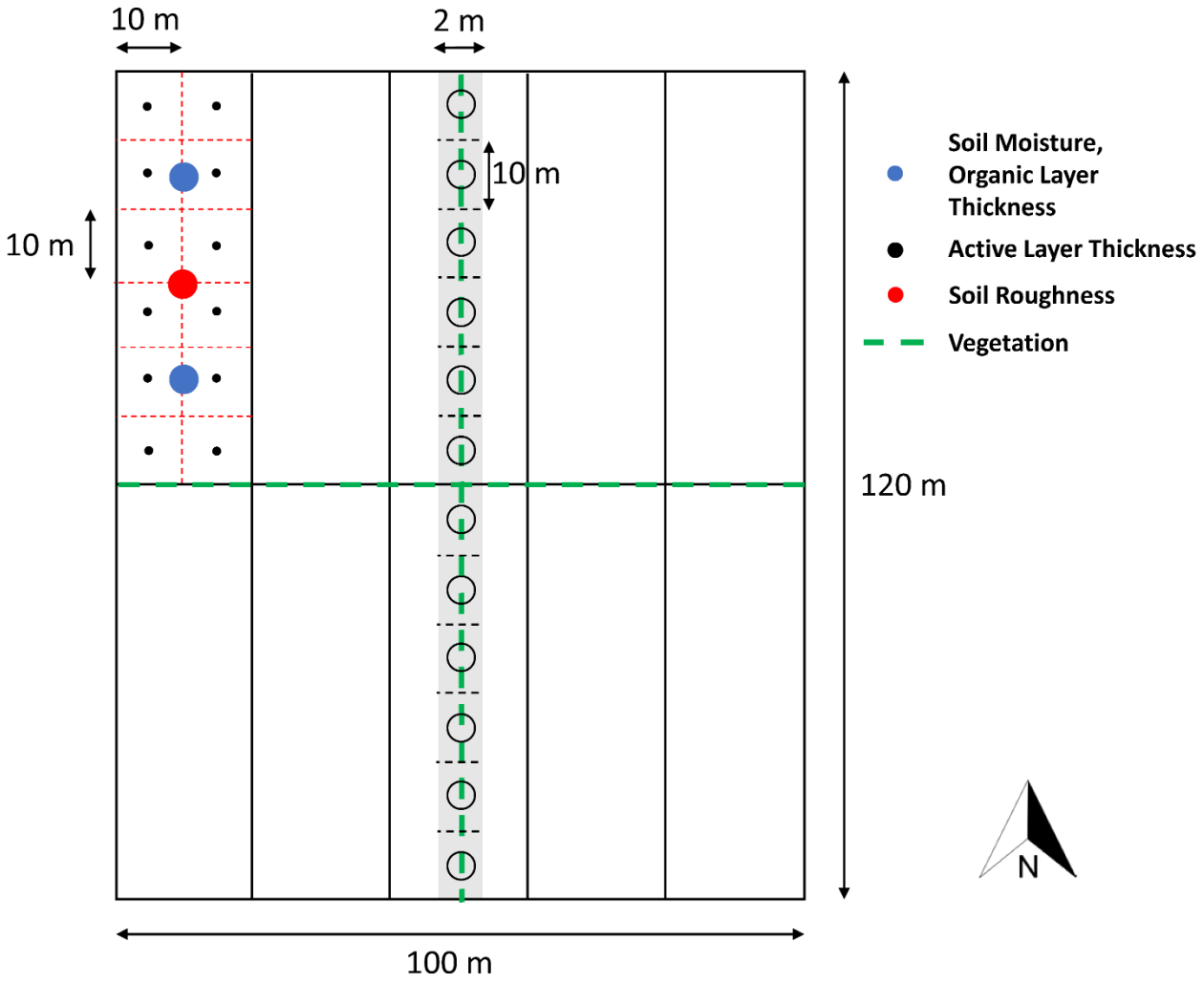
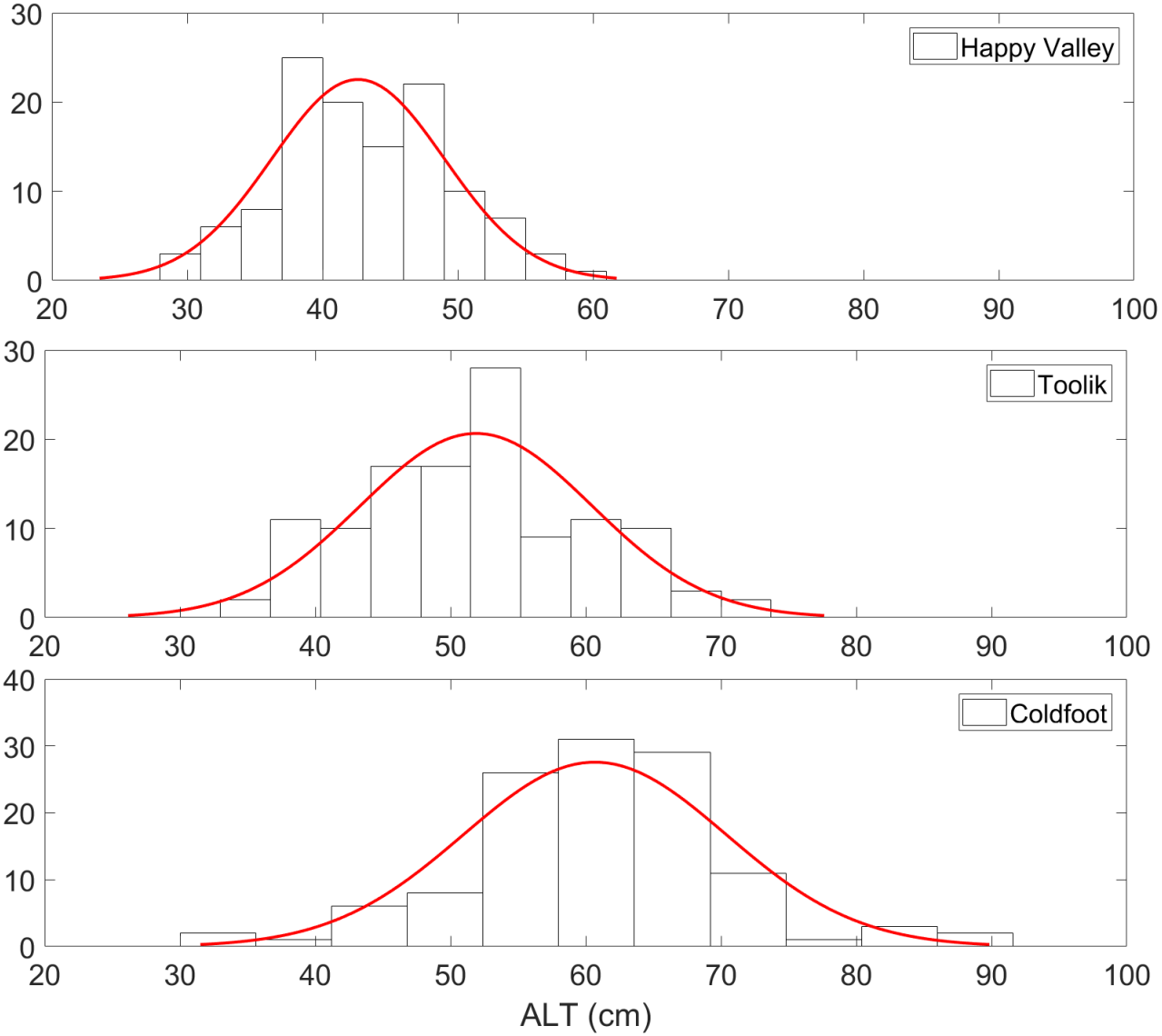
Questions

Alaska Fieldwork: Measuring Plot and Protocol



Alaska Fieldwork: Sample Data Analysis



Future Plans

- Better characterization of permafrost soil layers and profiles for more accurate retrieval of subsurface *features*