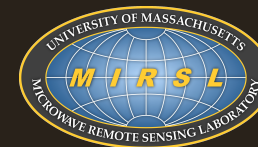


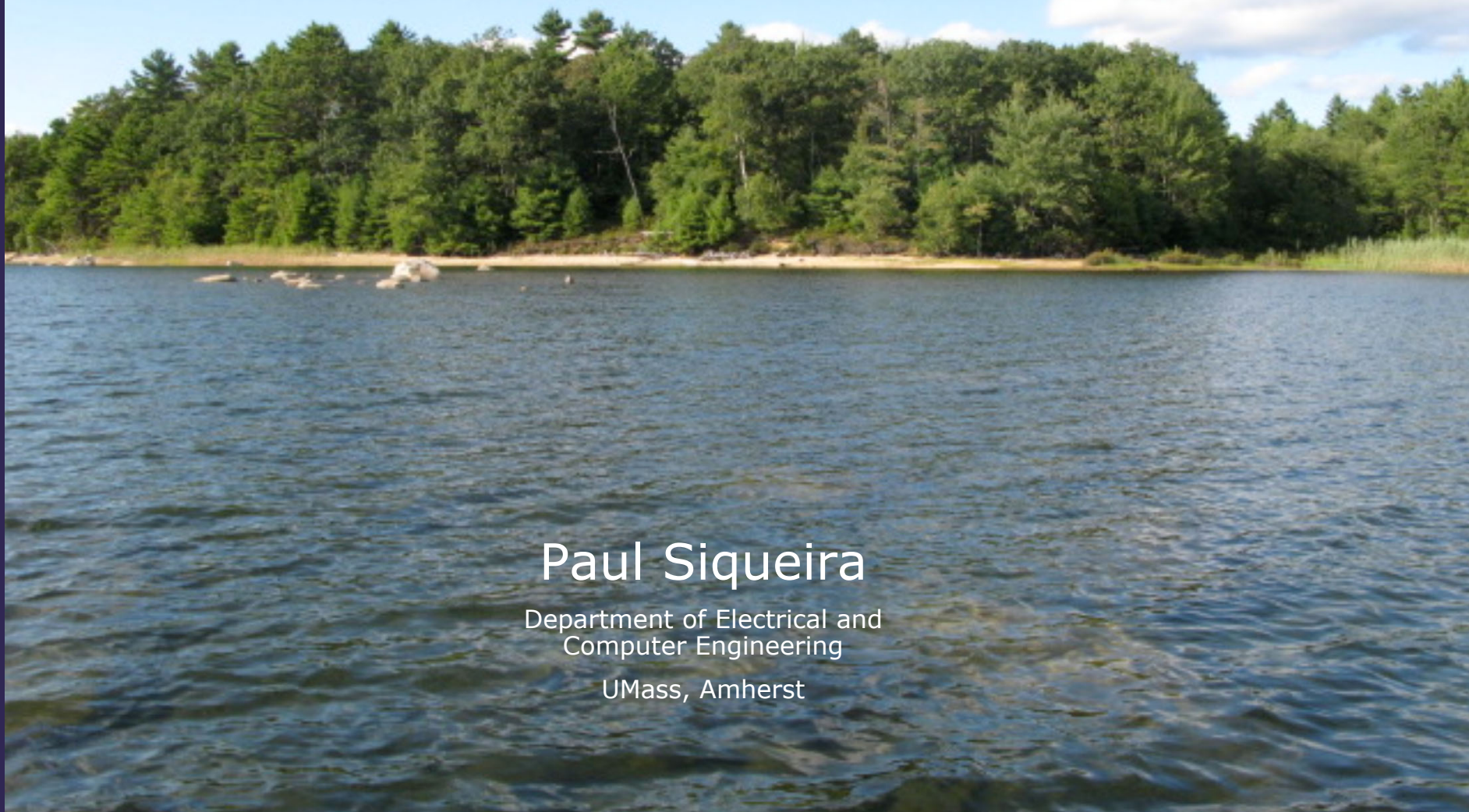


# HARVARD FOREST

Established 1907  
Harvard University's 3500 acre laboratory & classroom  
Long Term Ecological Research Site since 1988



## *Applications of UAVSAR for characterizing above-ground vegetation in the northeastern United States*



Paul Siqueira

Department of Electrical and  
Computer Engineering

UMass, Amherst

UAVSAR Workshop: 27 March 2013





# General Information

1200 ha in Western Massachusetts, New England Upland Region (200 - 400 m elevation), mean precipitation of 110 cm/year. Transition Hardwoods, White Pine and Hemlocks.

## Dominant Species

Red Oak, Red Maple, White Pine, Eastern Hemlock

## Secondary Species

White and Black Oak, Sugar Maple

- Region was heavily forested in early 20th century.
- Donated in 1907 to Harvard University to study sustainable forestry.





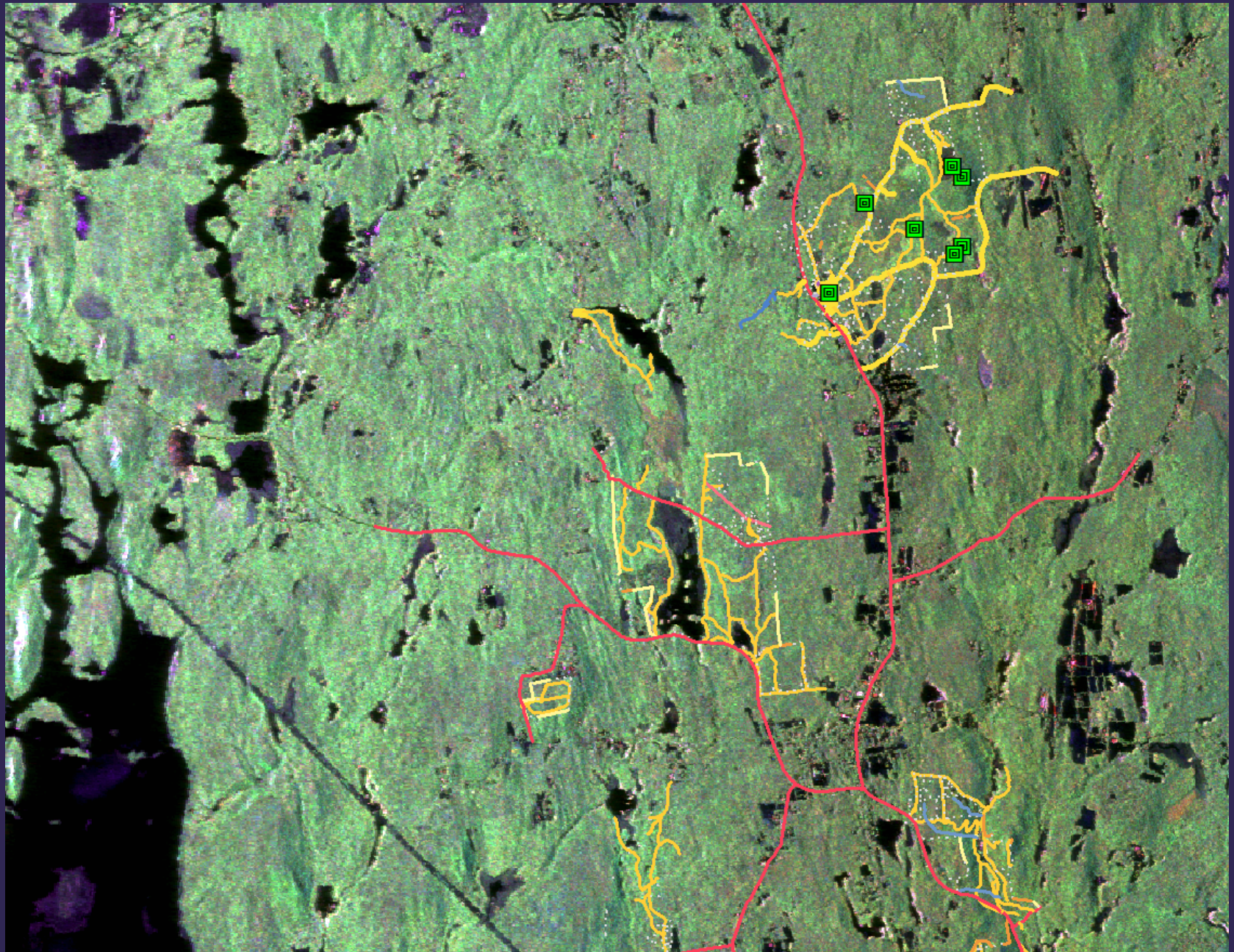
# A brief photographic history







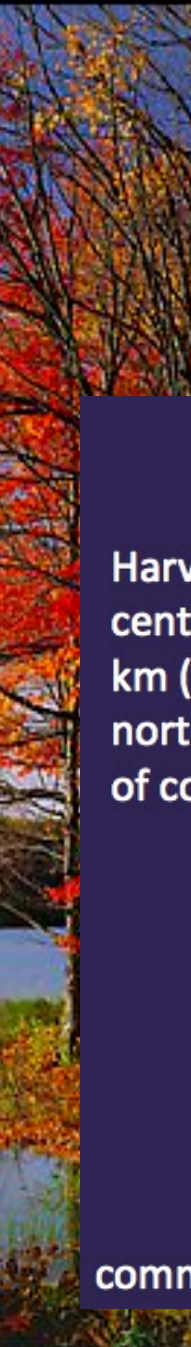
# Resources at the Harvard Forest



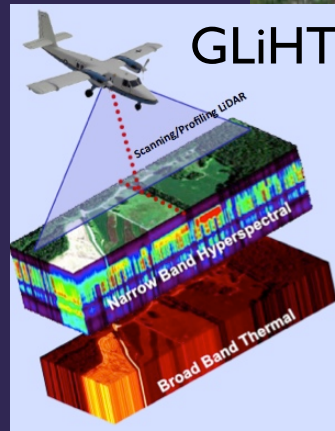




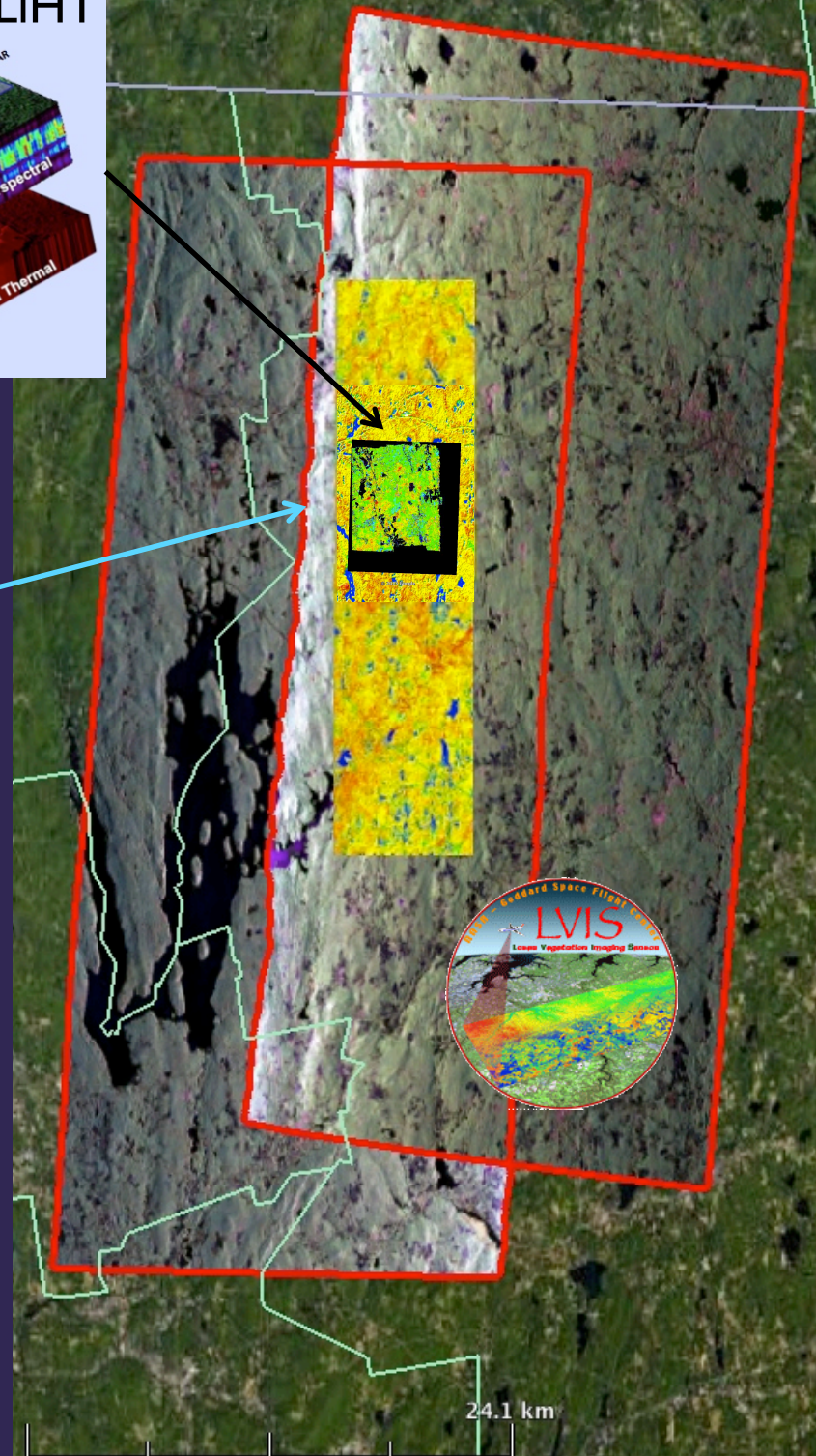
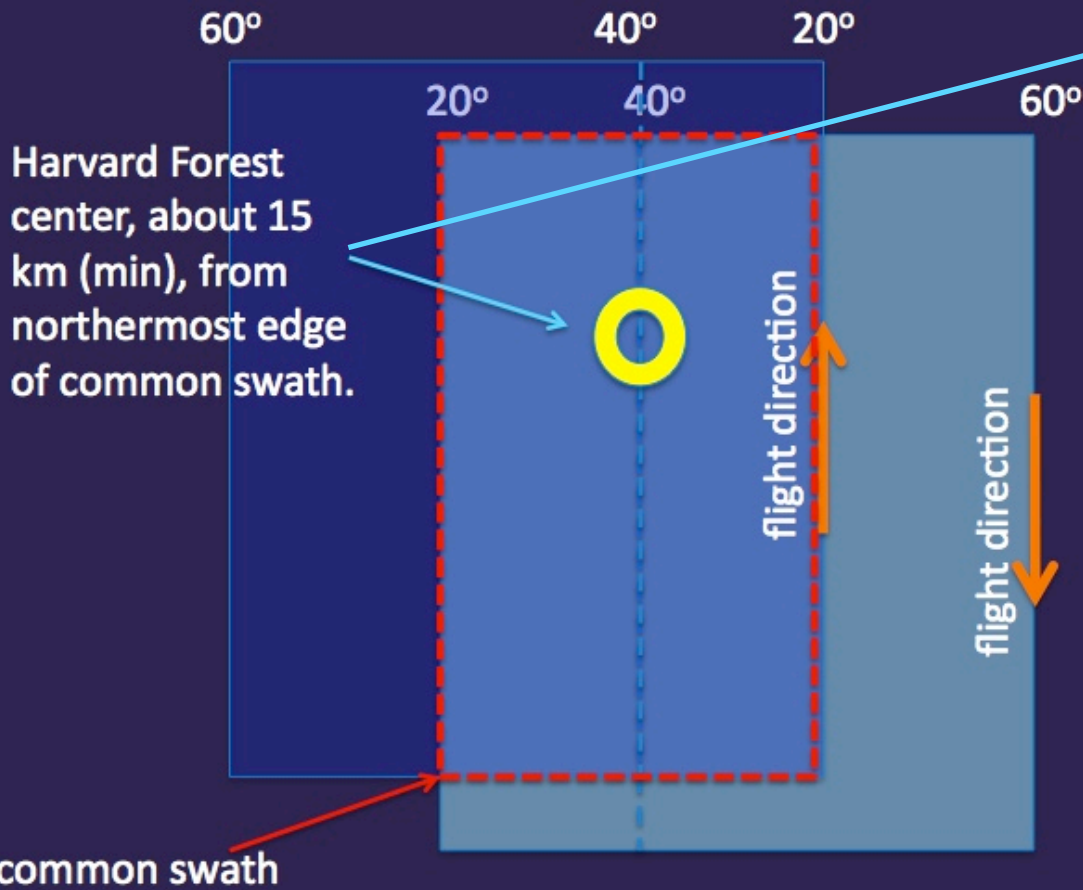
# Collected data



UAVSAR

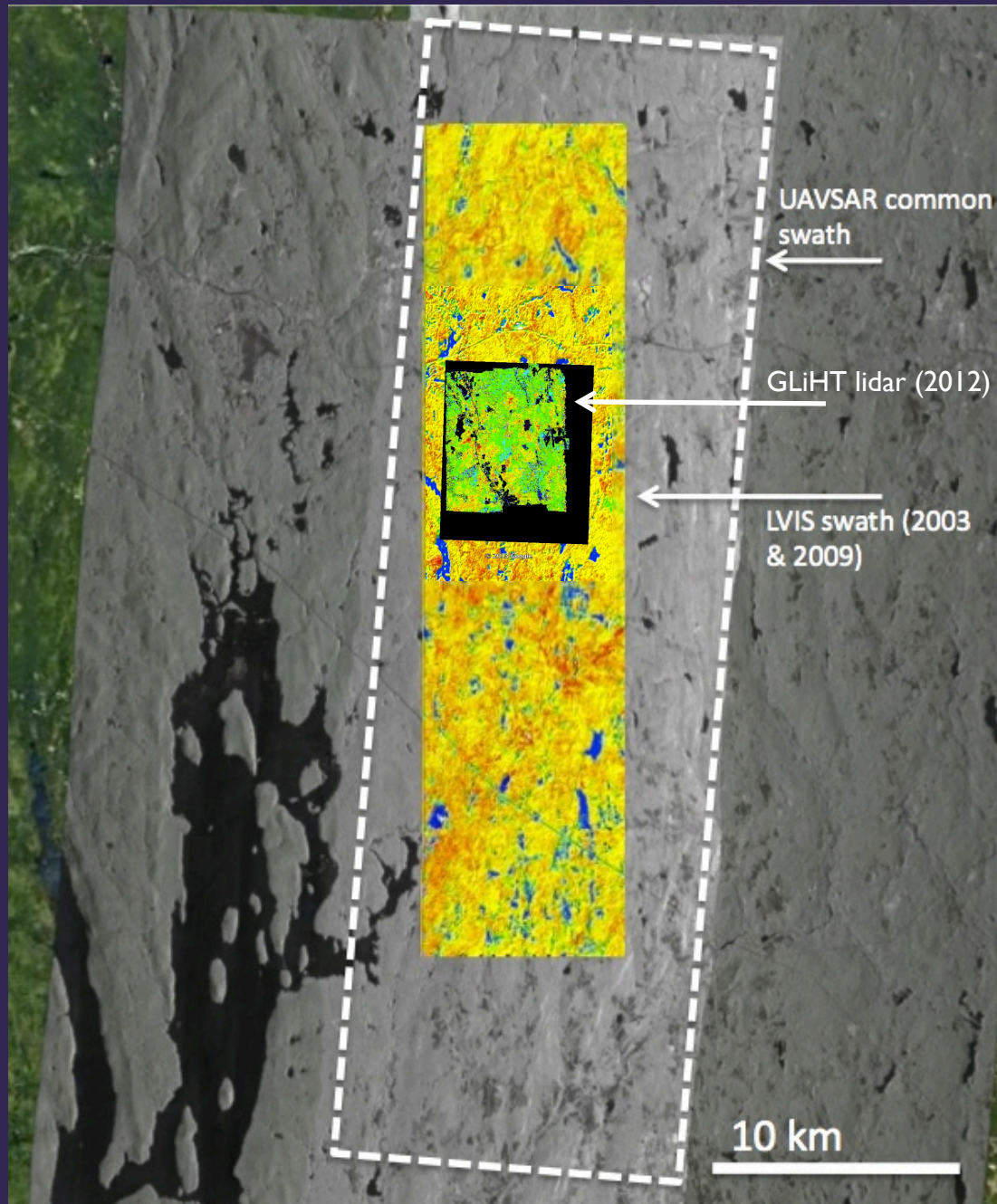


GLiHT



24.1 km







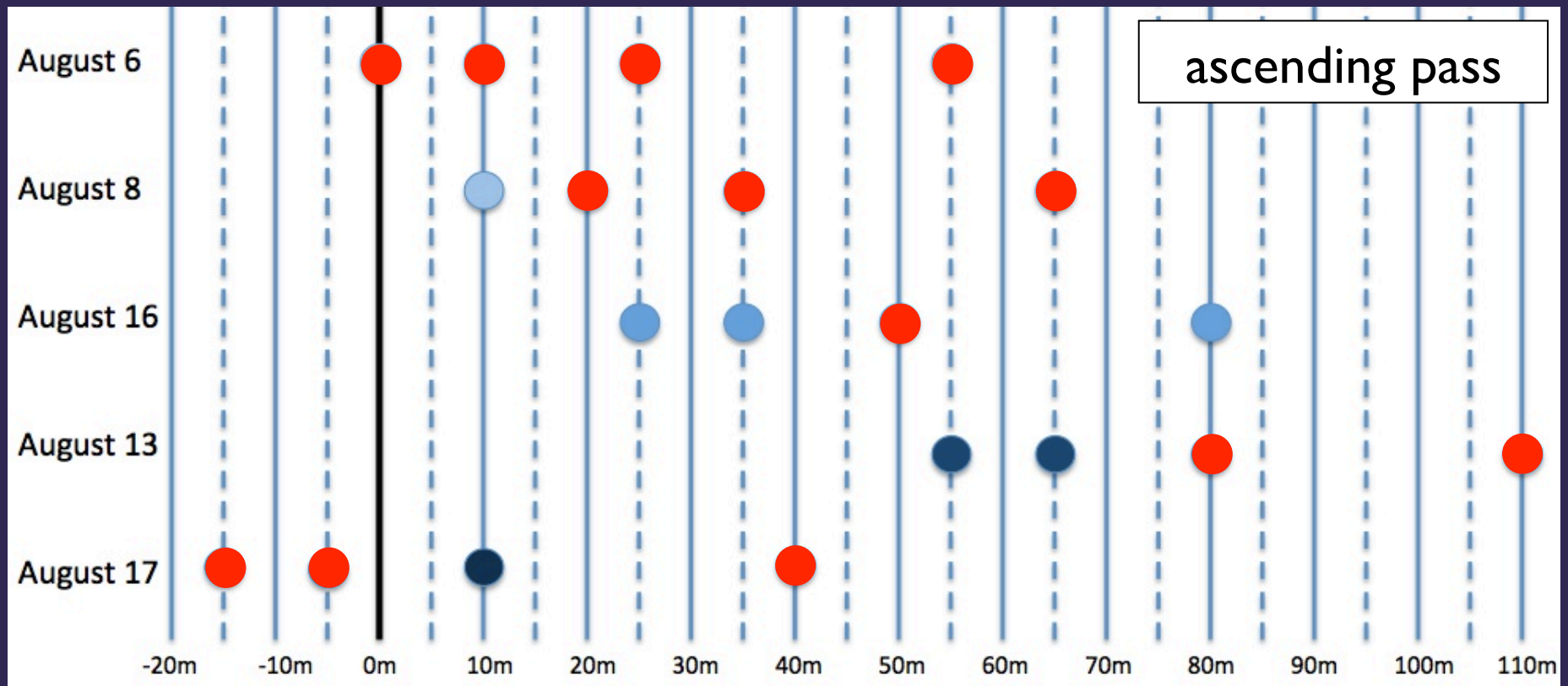


# Ascending Pass

UAVSAR Flown over the region in August 2009

Four tracks per ascending/desending pass

Baseline offsets used to provide redundancy and multibaseline observations







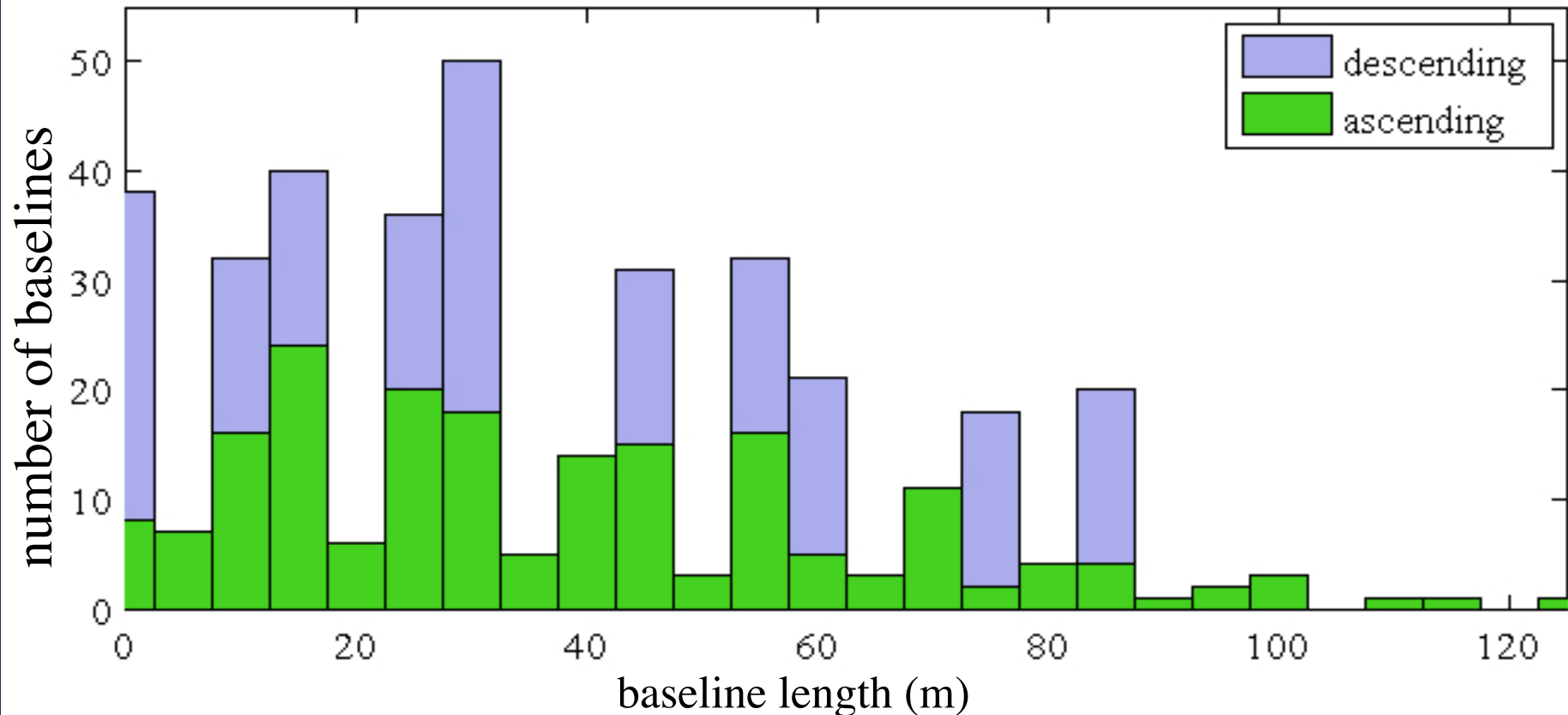
# Repeat-pass **repeat** baselines

Redundant baselines can be used to

explore the effects of temporal decorrelation

ascending and descending passes should provide the same correlation measures

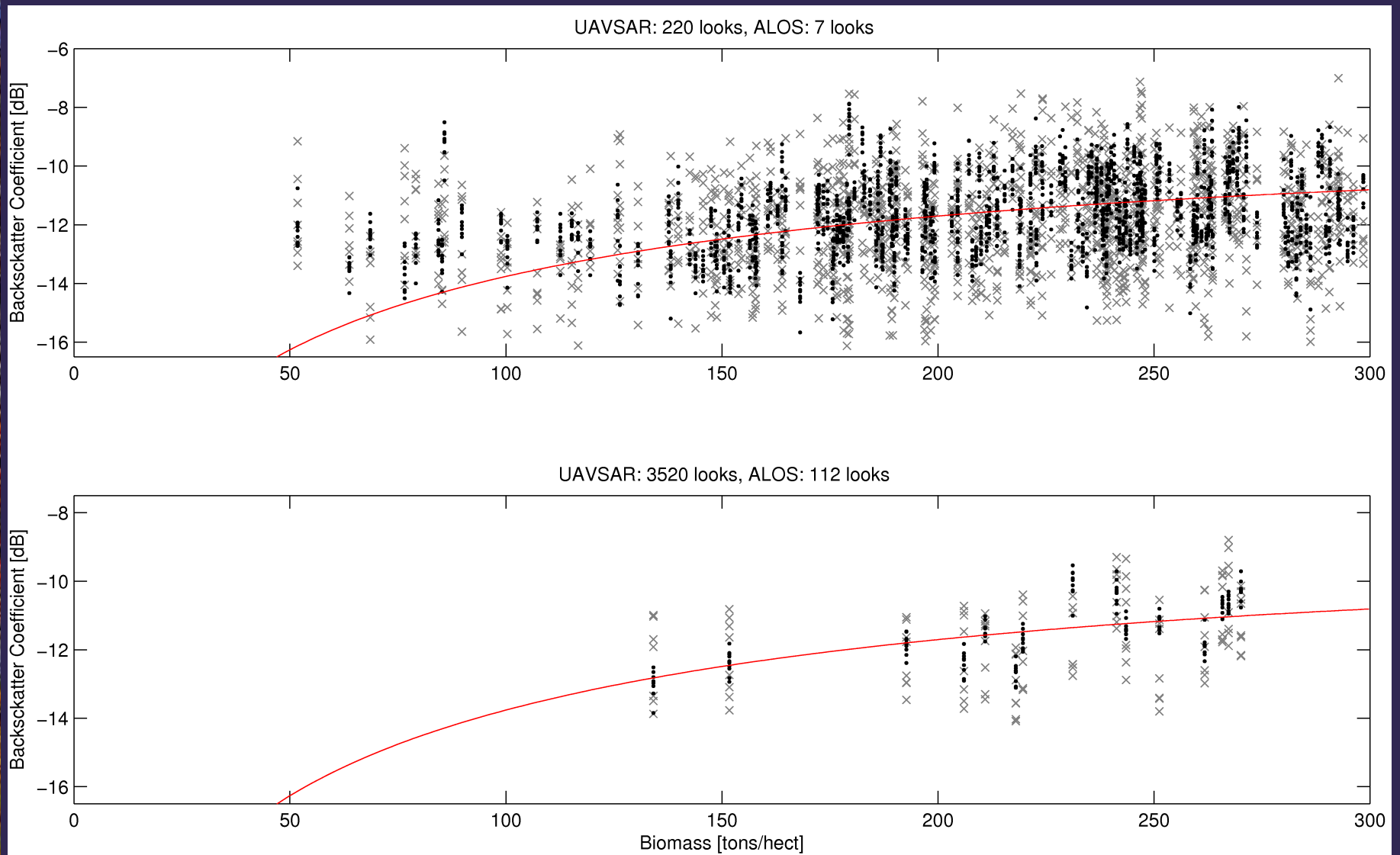
choice of repeat tracks intended provide both baseline diversity and redundant baselines over a wide variety of combinations







# Backscatter (HV) and biomass



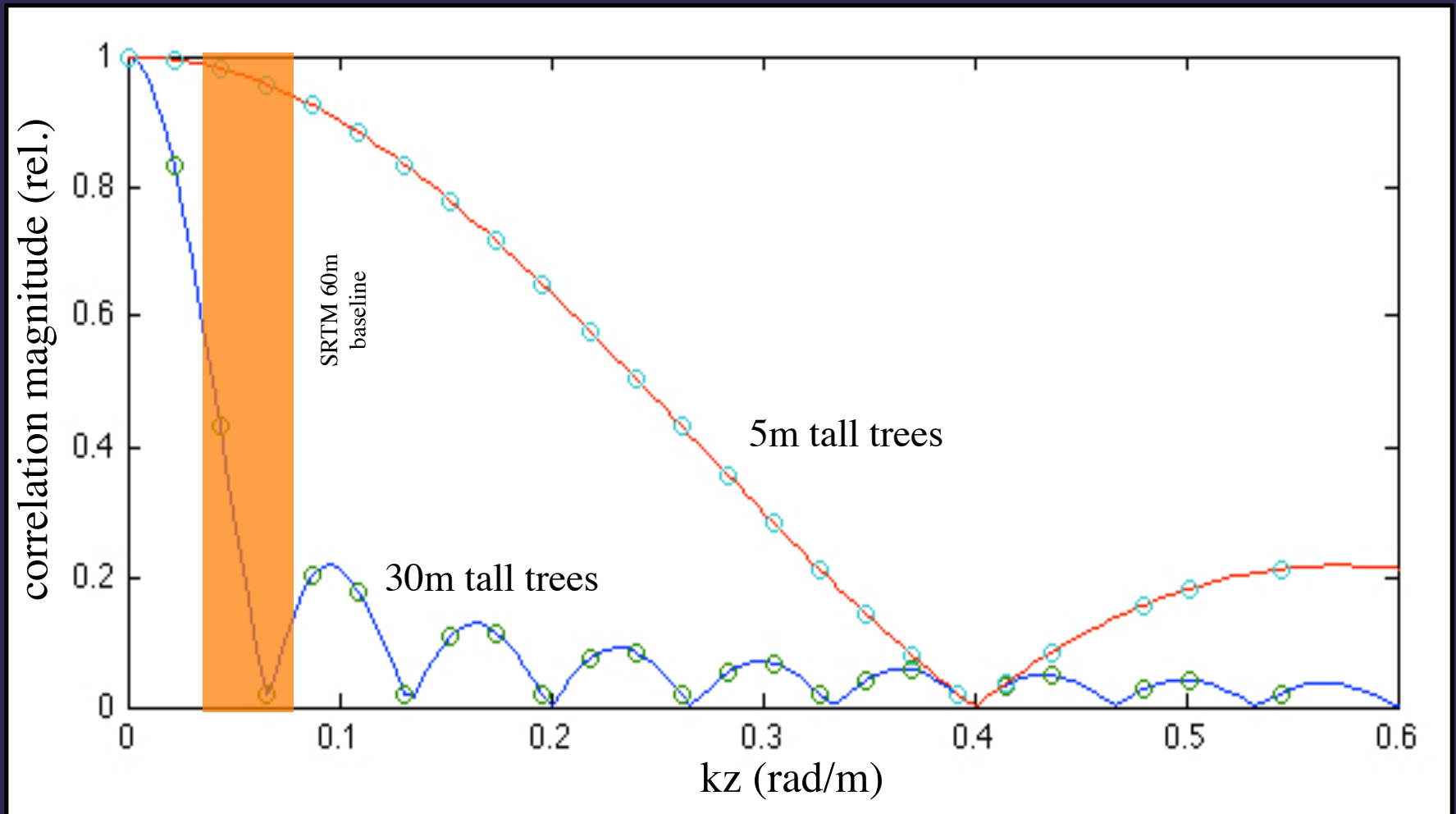




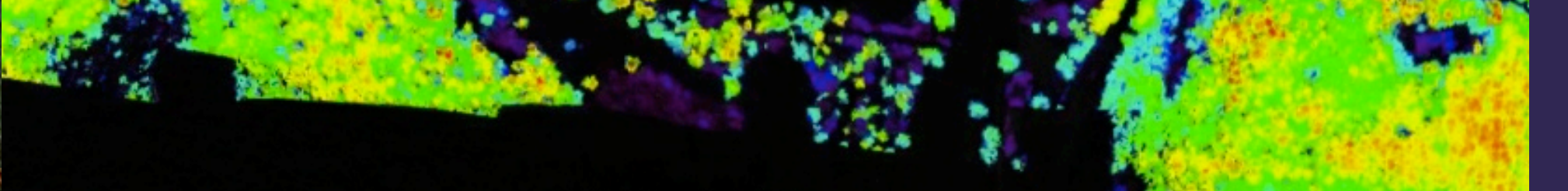
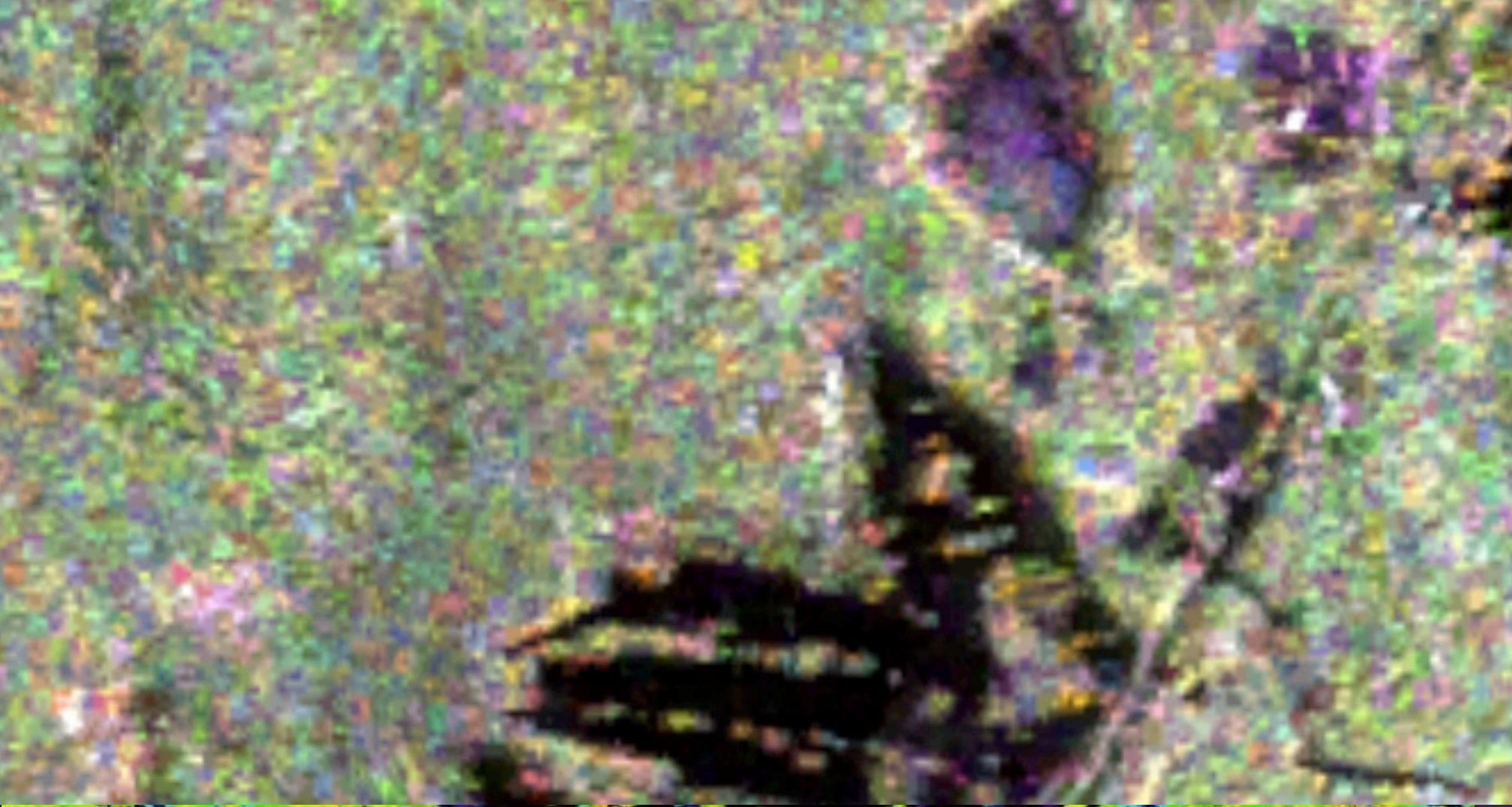
# Multibaseline diversity

Baseline diversity is used to distinguish one vertical profile from another

Plot shows interferometric response to different types of uniform reflectivity



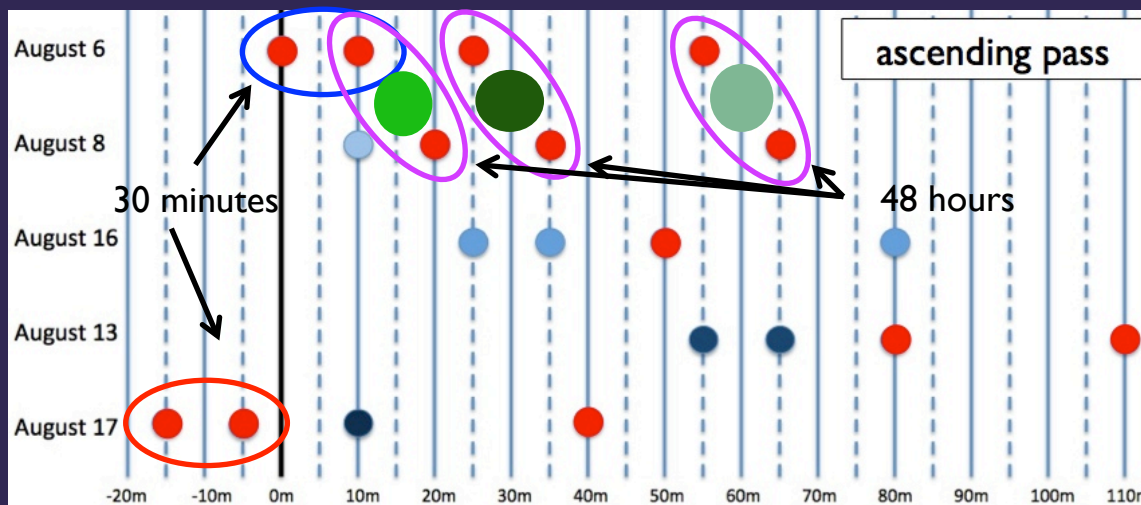
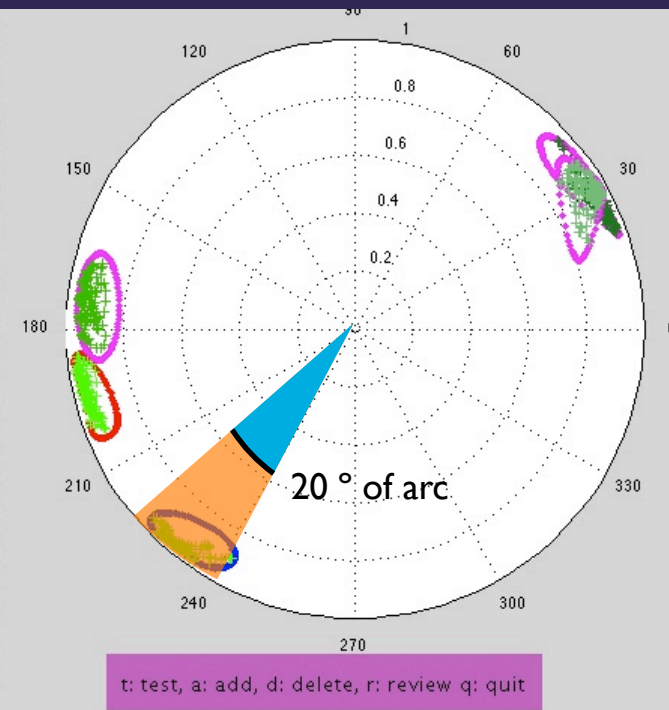
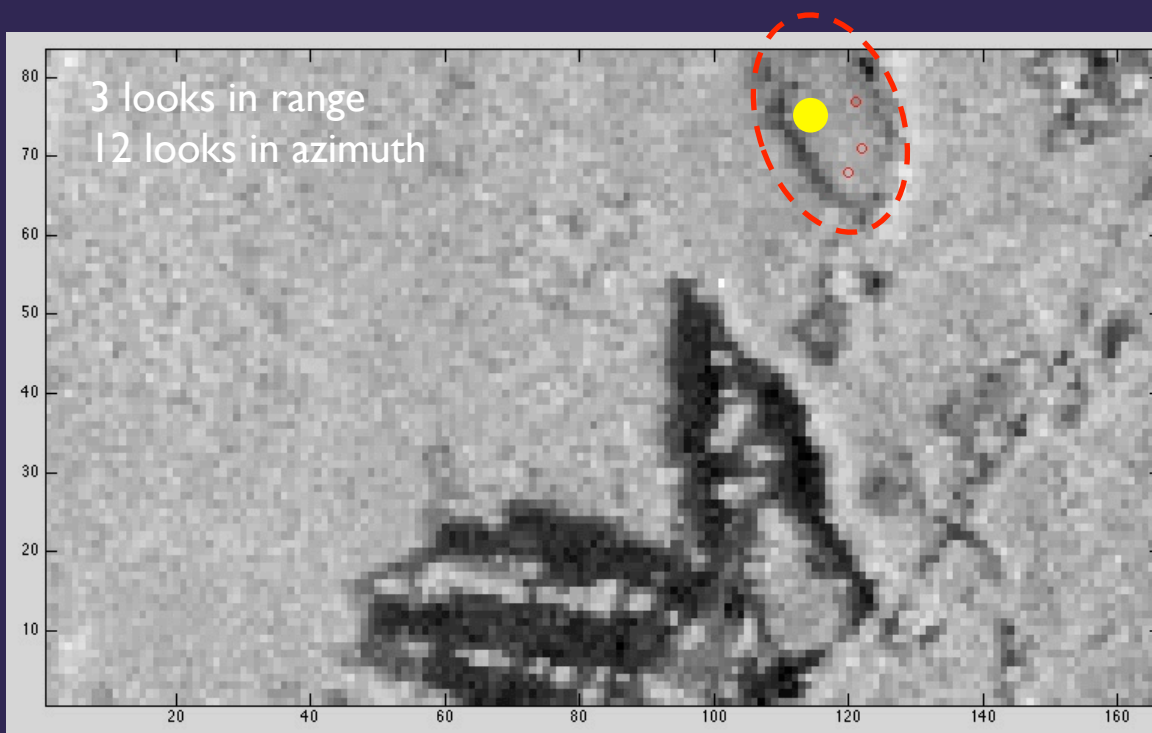








# PoInSAR signatures



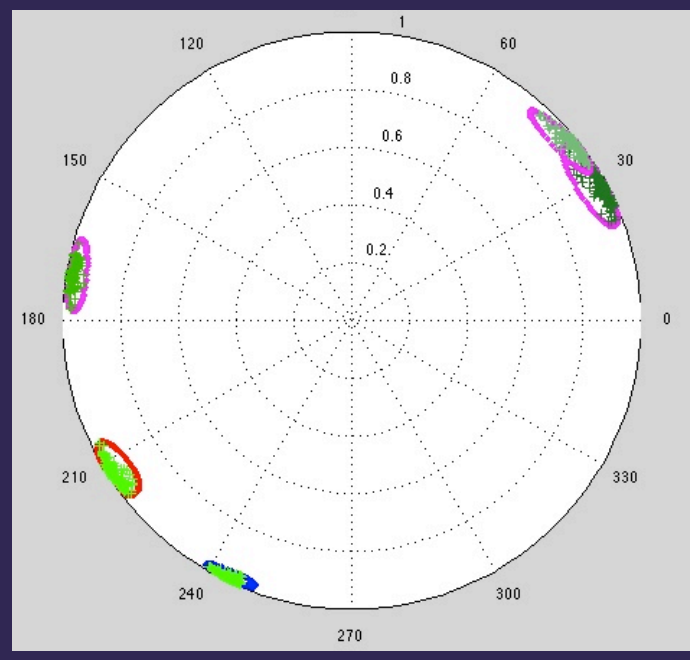
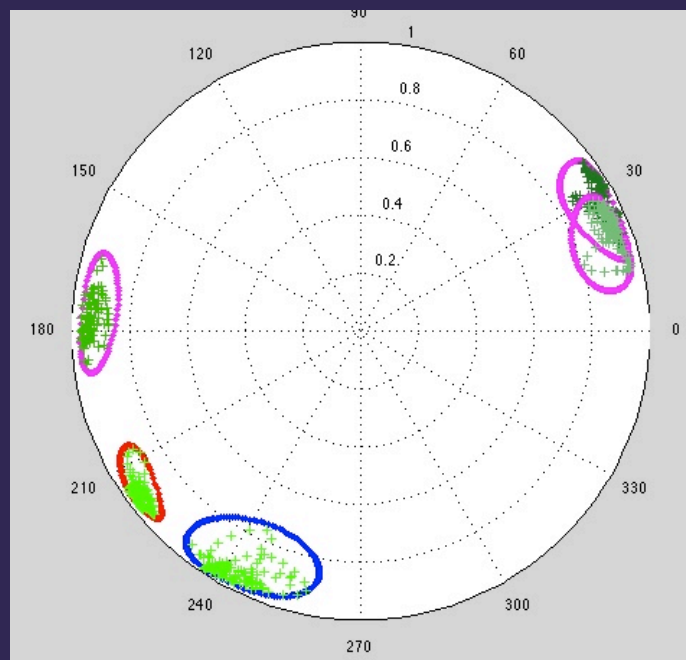
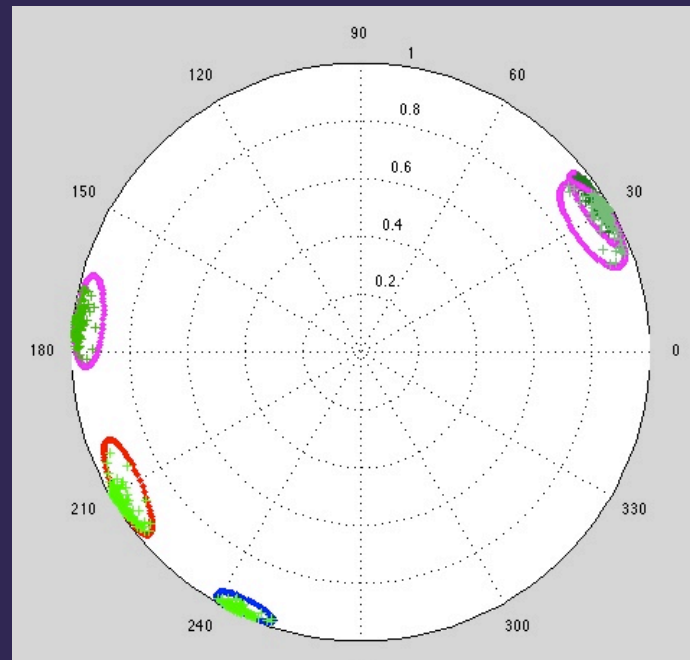
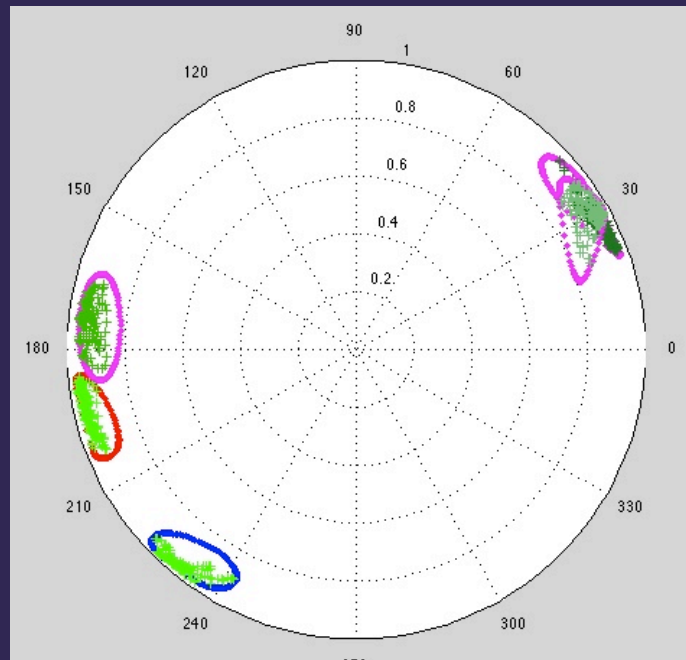
$kz = 0.044$  rad/m  
(10 m baseline)

20° of arc  
→ 4 m of height change  
→ less than 10 dB SNR





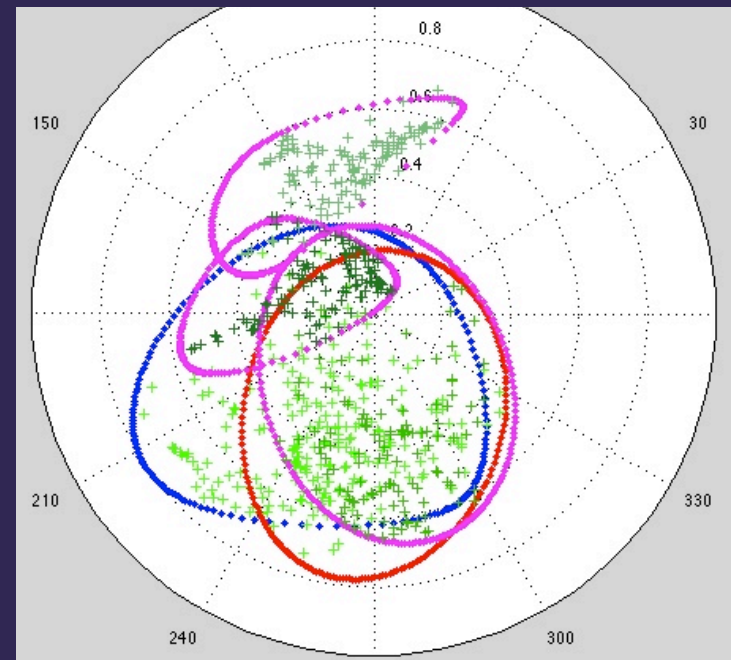
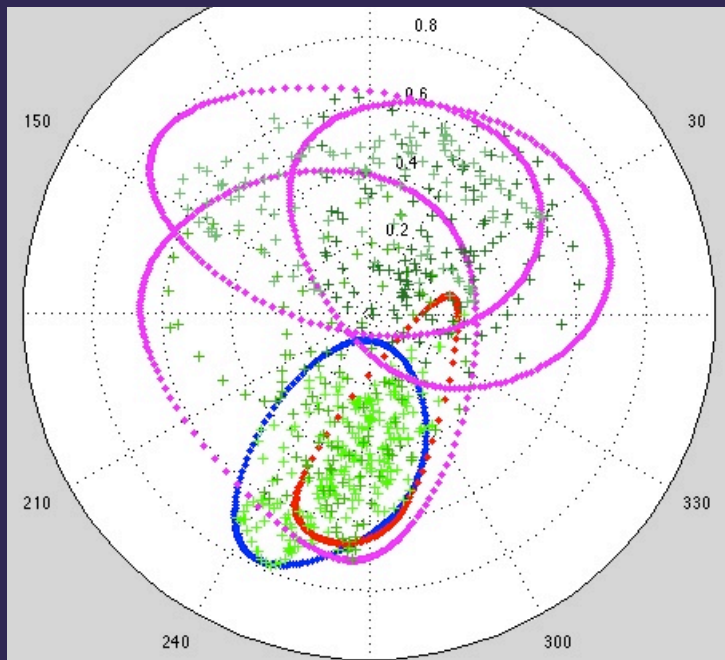
# Flat swamp polarimetric signatures







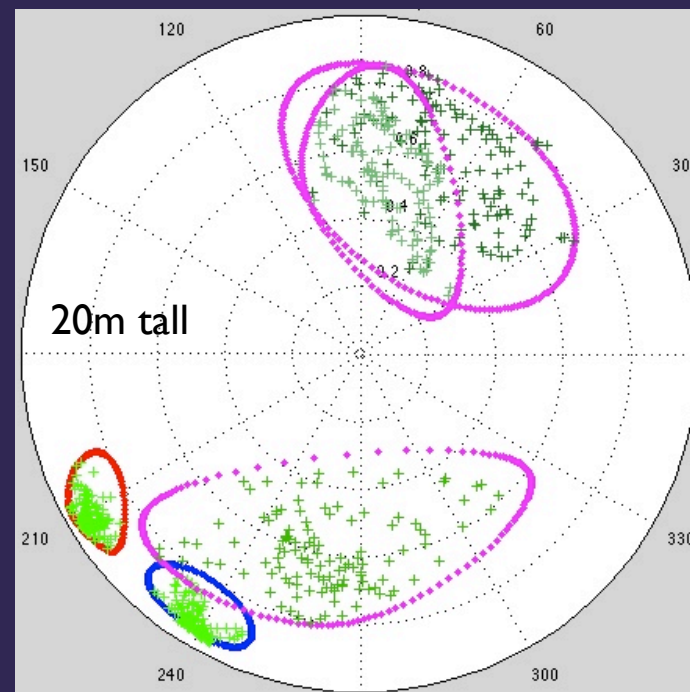
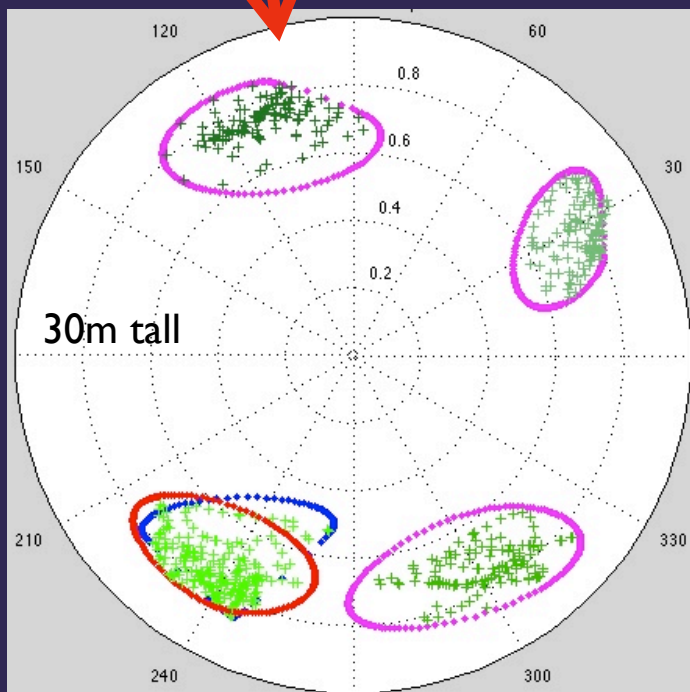
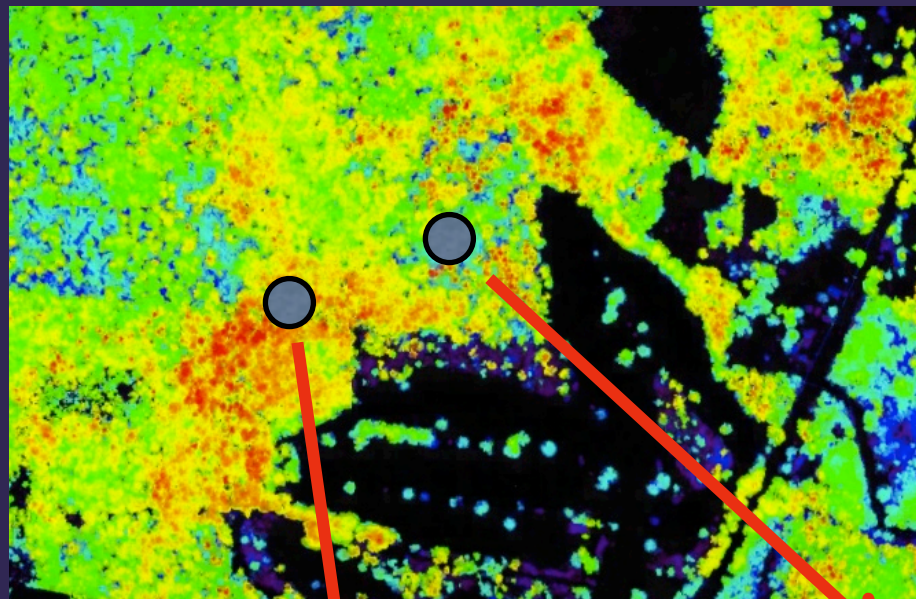
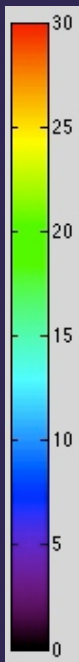
# Golf Course







# Trees







# Expanding over a larger region

We would like to better demonstrate use of interferometry over a large region

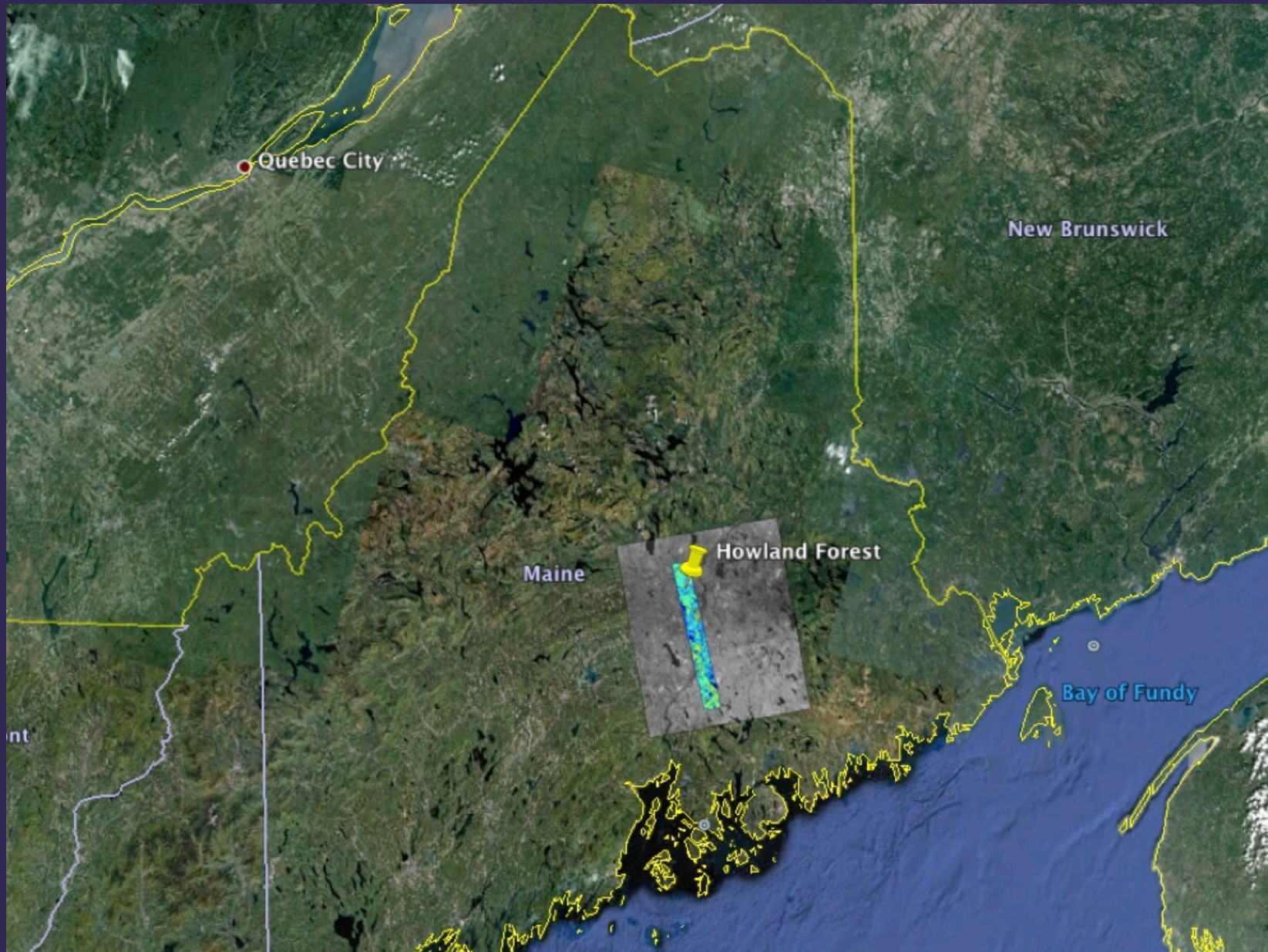
- Address needs of DESDynI-R and ALOS-2
- Provide a reference point for characterizing errors
- Continued algorithm development

Choose an area where consistent ALOS FBD & FBS data have been collected and lidar data is available

In Maine (Howland and Penobscott), there are 17 ALOS FBS/FBD scenes collected over four years and over the same region where LVIS data was collected in 2009



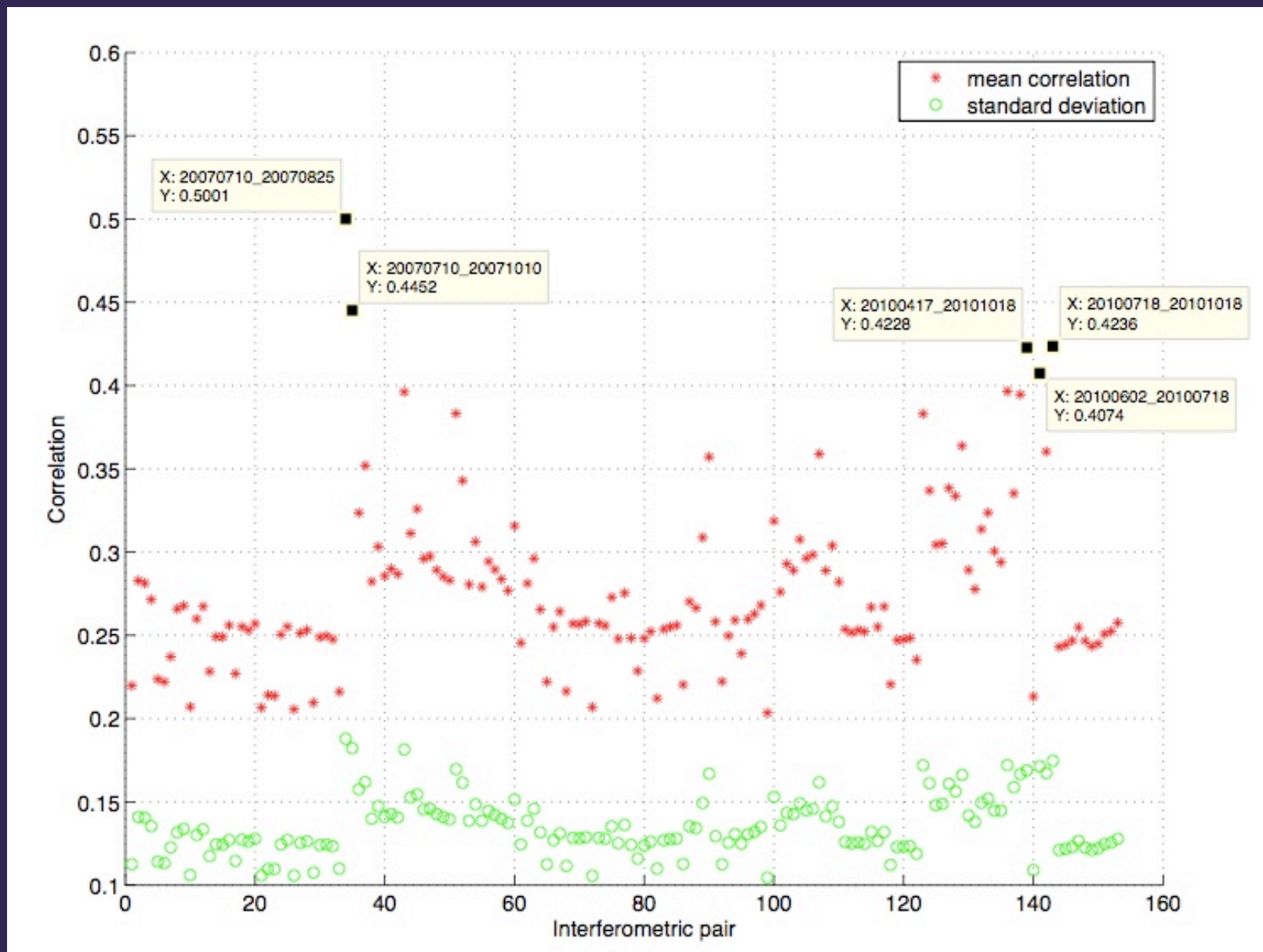








# Correlation of 157 possible combinations



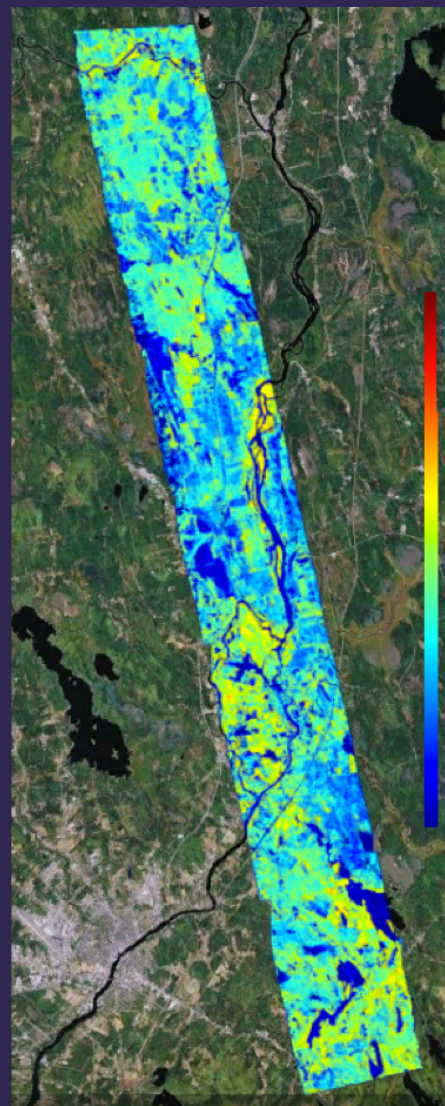




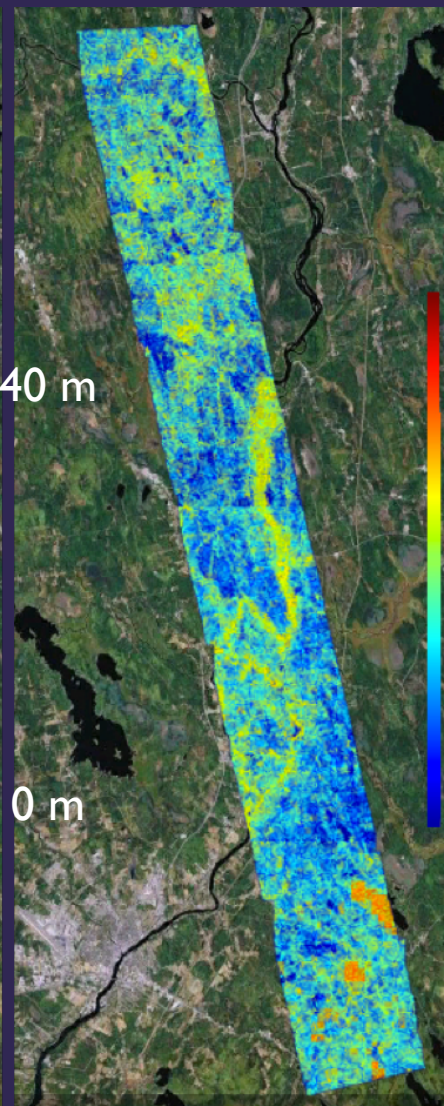
# Comparison with lidar data



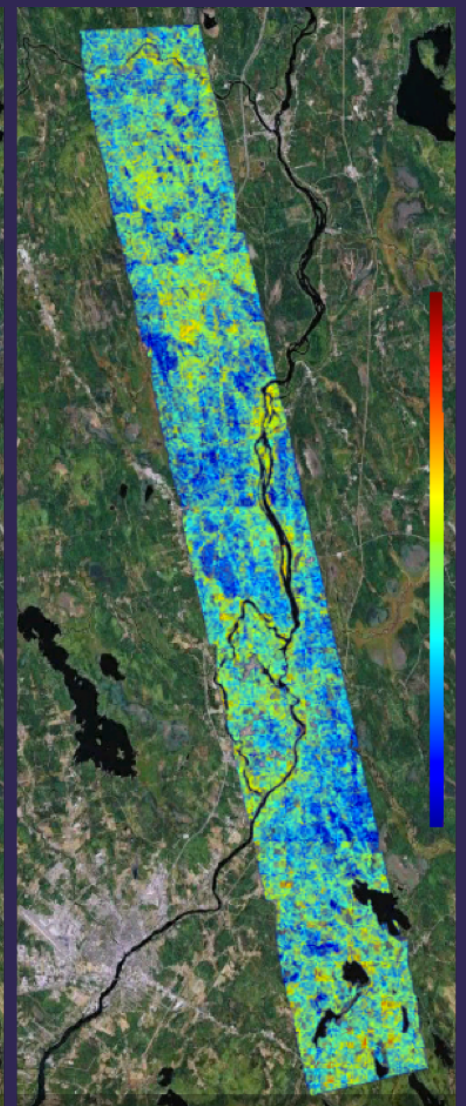
GoogleEarth



LVIS heights



Correlation Heights

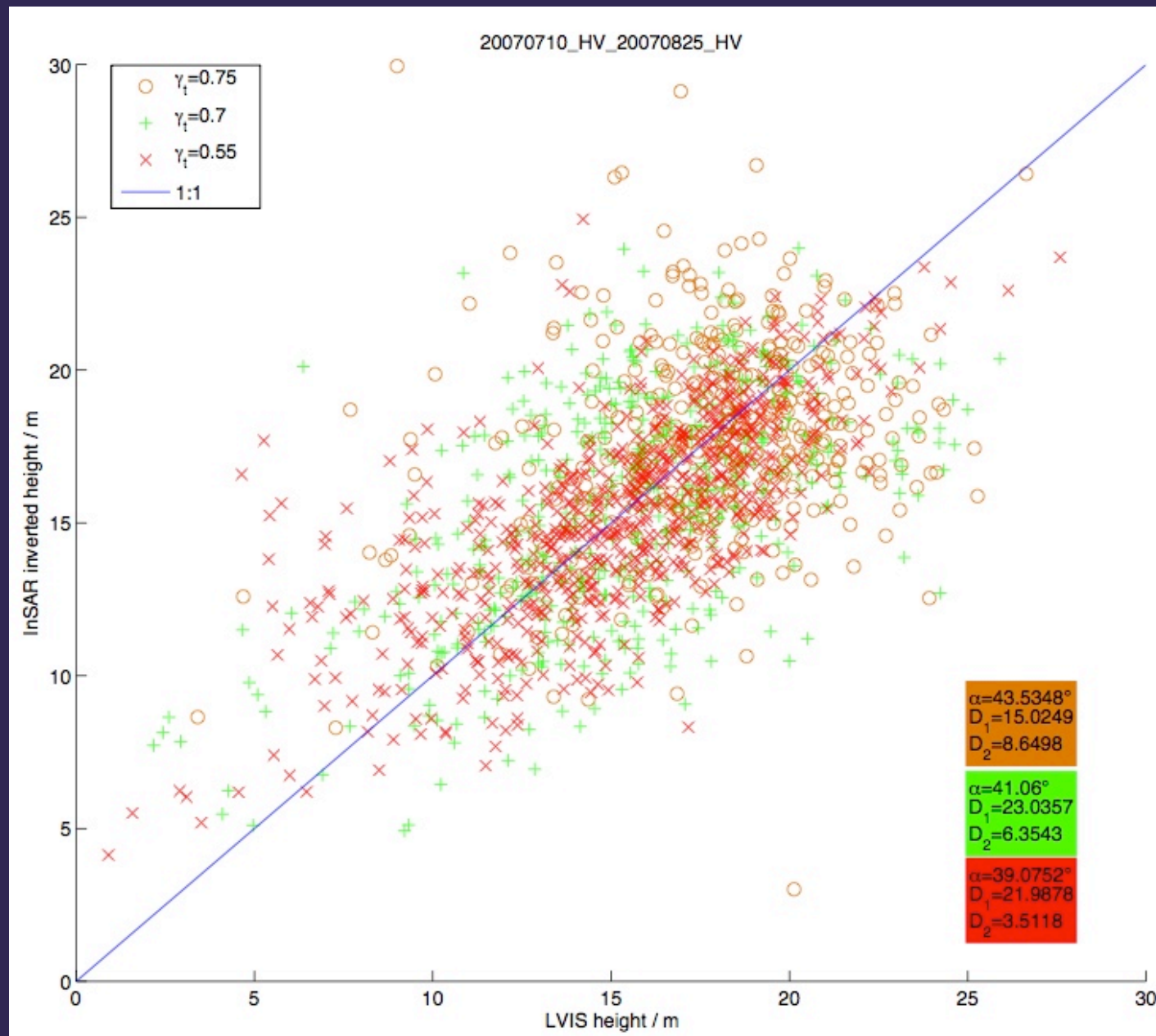


Correlation Heights  
& Landcover  
classification





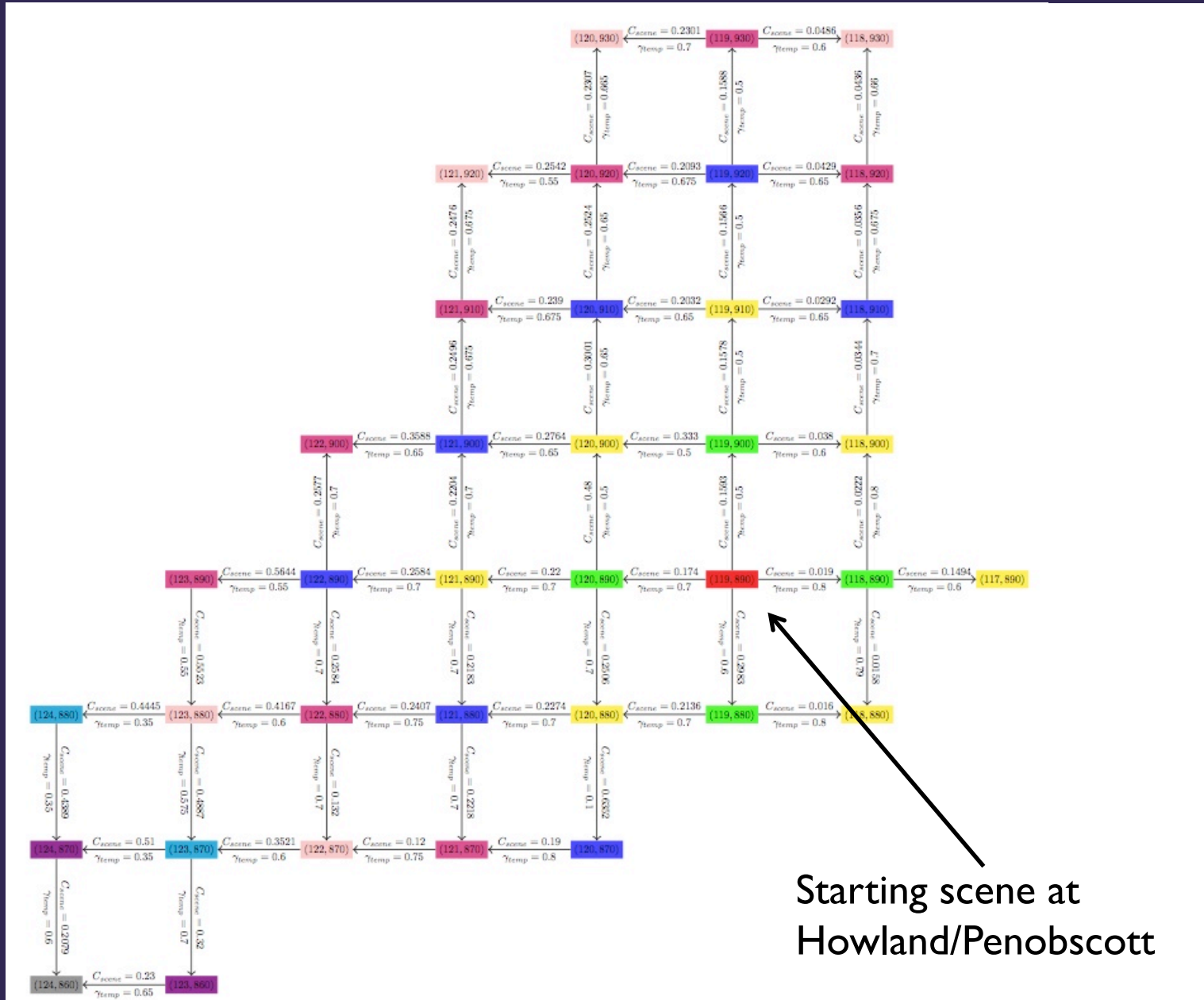
# Quantitative comparison with LVIS



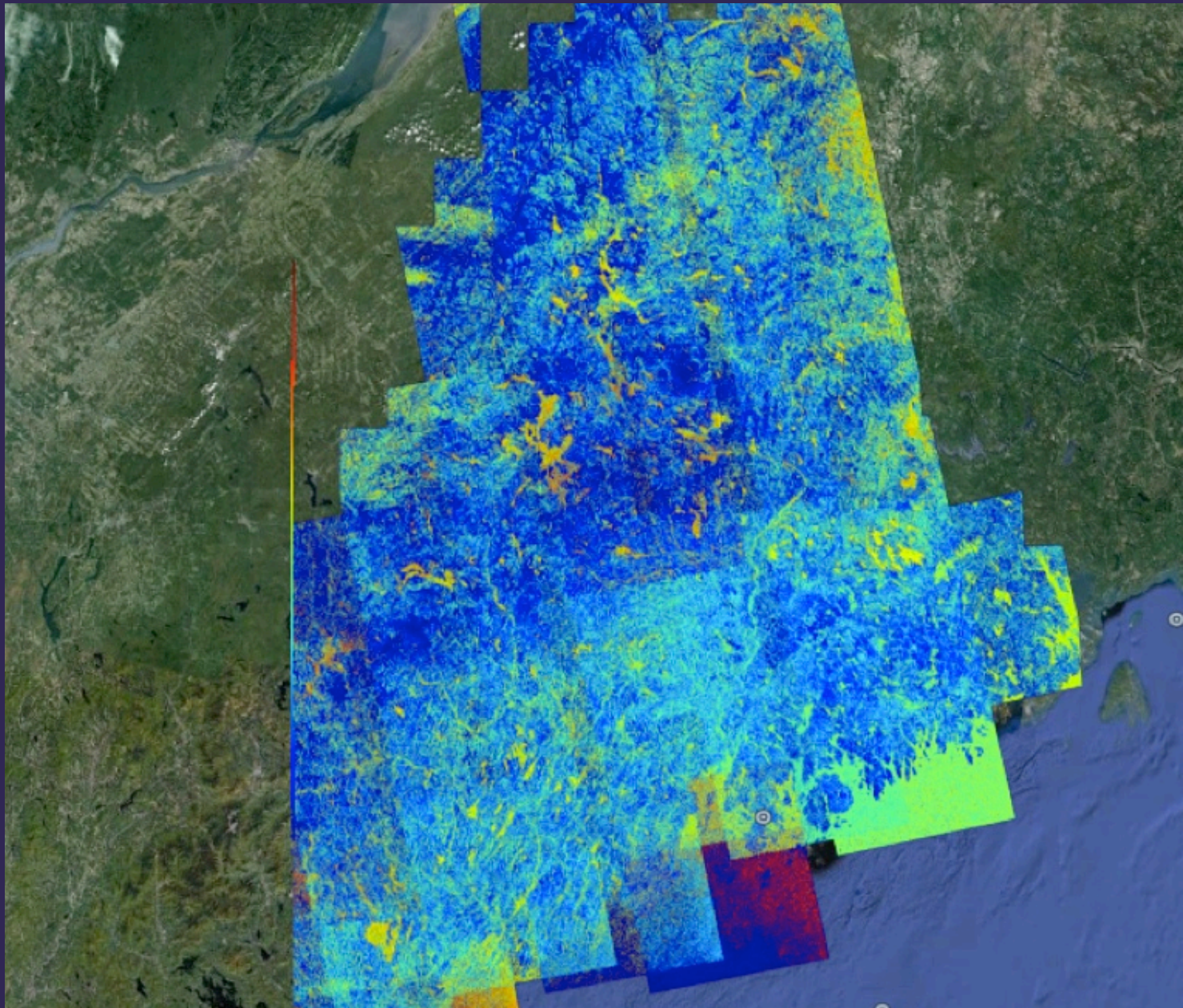




# Expanding the coverage











# Summary

We have made good use of the UAVSAR data thus far for characterizing

- Polarimetric RCS signatures of the forest
- Analysis of temporal changes in both the RCS and interferometric observations
- Polarimetric segmentation (**not shown today**)
- PolInSAR initial analyses

Some errors (motion or ambiguities) in the non-zero baseline **non-standard** processing make it difficult to interpret the data

Thank you to **Scott Hensley** and **JPL** for processing data and making resources available

Application of interferometric measures of vegetation height over the state of Maine is under development

**Other News...**

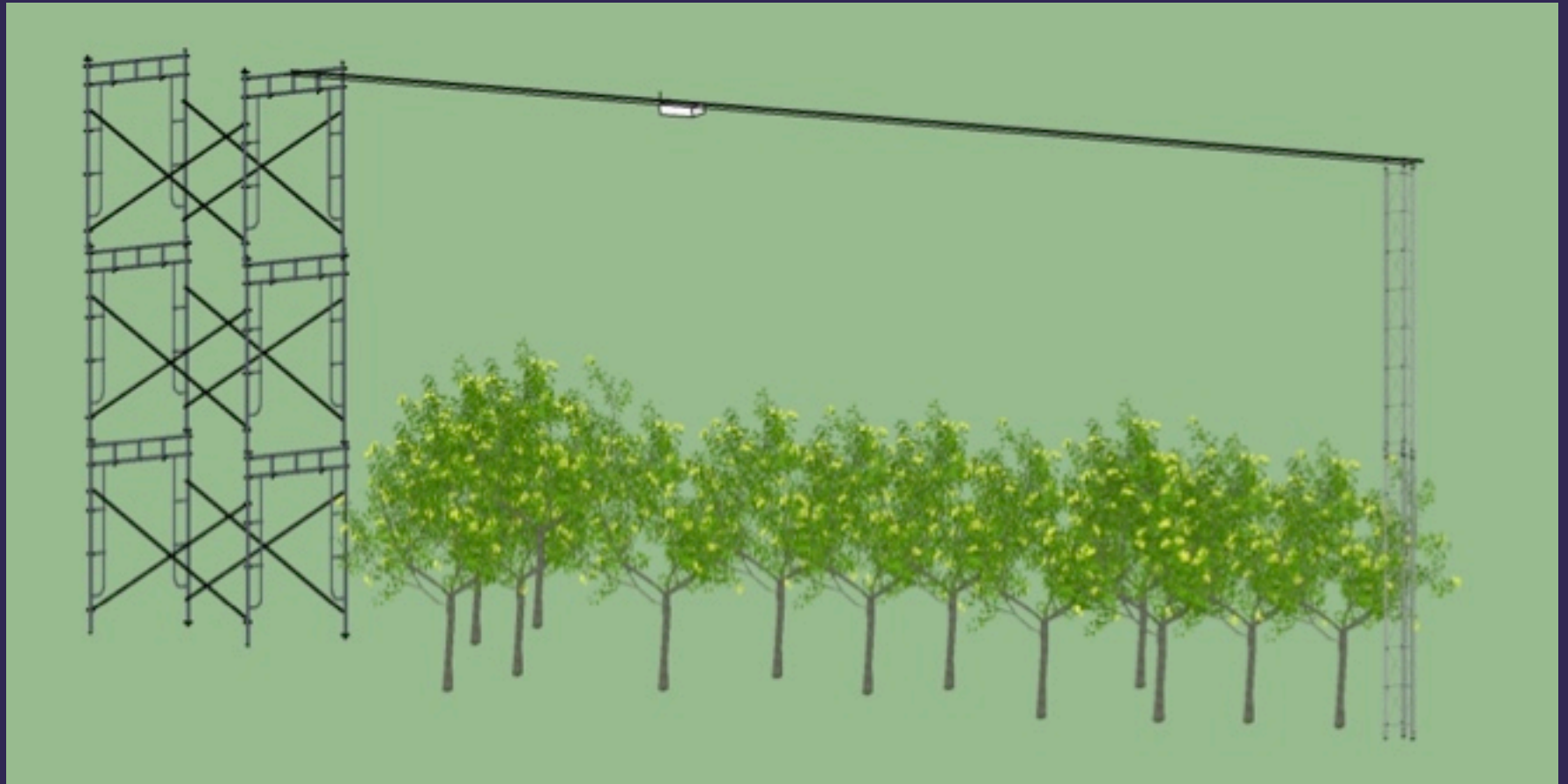




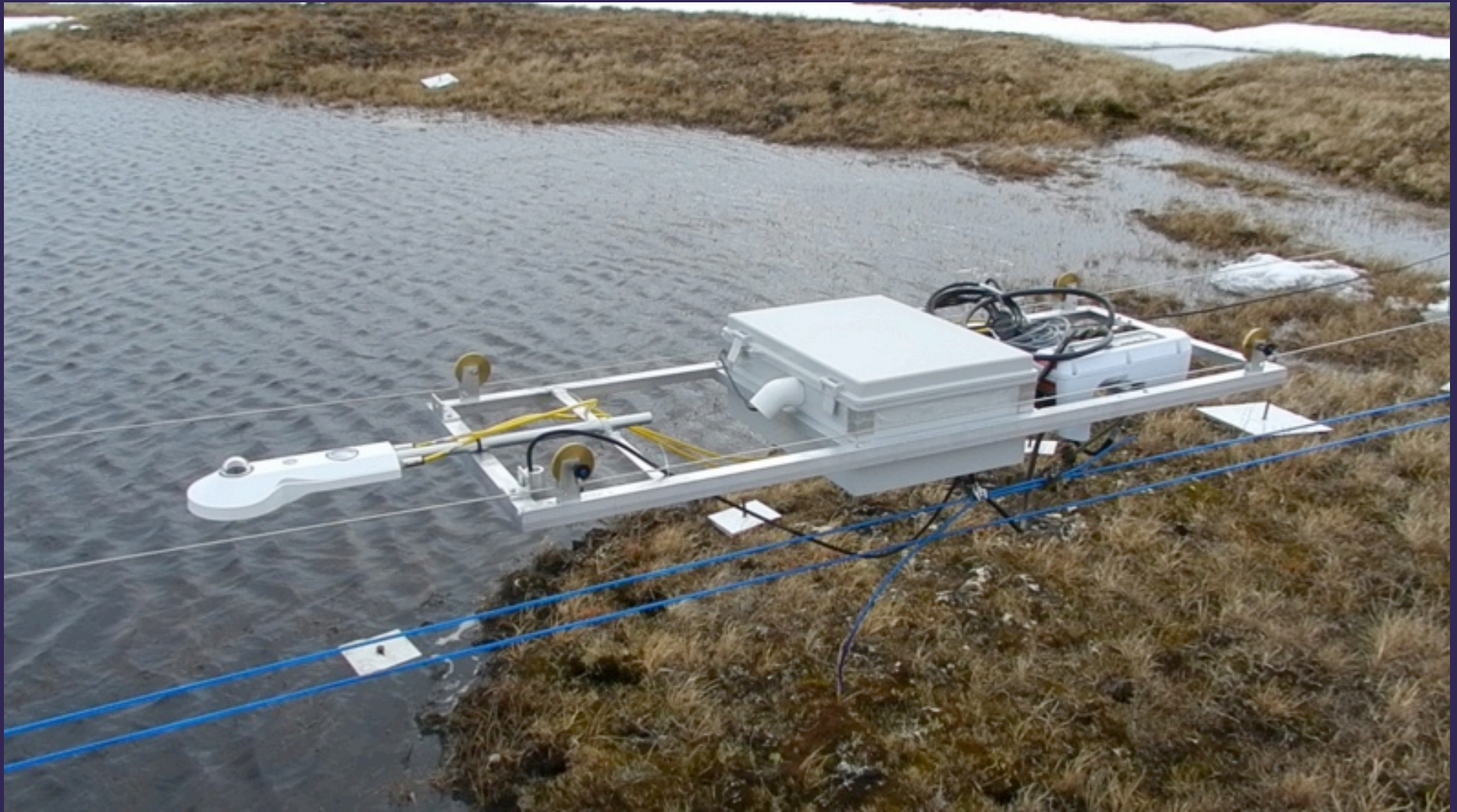


# Other News

This summer, we will be installing an automated “tram” in one of the clearcut-regrowth plots. There will be a number of instruments on board and measurements are intended to be made on an hourly basis over a 50m length, throughout the year, daytime and nighttime (possibly)











# Sensors and computers

simple computer



spectral



Upwelling and downwelling radiation



Data Logger



Optical camera

An **L-band low-power radar** for measuring moisture variations (not shown)





# Location of the Tram

