ALOS

K&C Initiative
An international science collaboration led by JAXA

K&C Phase 4 – Status report

Use of short-period ALOS-2 observations for vegetation characterization and classification

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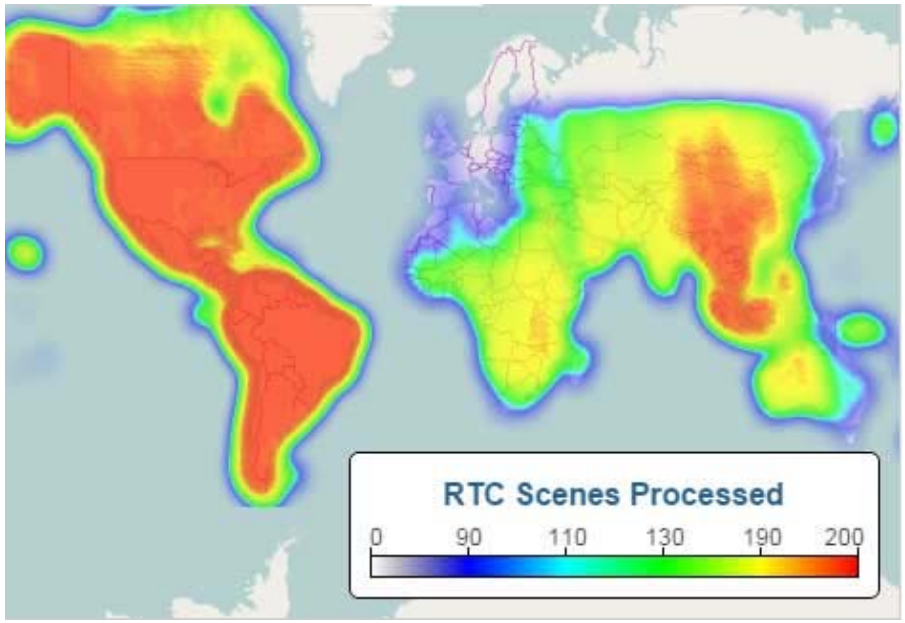
University of Massachusetts, Amherst

Science Team meeting #22
Tokyo, Japan, February 16-18, 2016

A Quick Notice

- Since 2015, The Alaska Satellite Facility has been processing ALOS-1 data into a Radiometric Terrain Correction (RTC) Product to remove geometric and radiometric distortion due to topography
- Data is accessible by getting a simple account at the NASA DAAC.
- Data can be browsed using the GUI, or accessed through the API
- Sentinel-1A data also being distributed. SAOCOM to be distributed post-launch
- Data distributed in 12.5 m and 30 m GeoTIFF format
- coregistered DEM and incidence angle map also available



UAF Alaska Satellite Facility
Making remote-sensing data accessible since 1991

asf.alaska.edu

Project outline and objectives

To characterizie the RCS (co- and cross-polarization) of stable and changing targets over time. These are important components for the development of segmentation and detection algorithms necessary for change detection and target identification.

These would be done over:

1. the northeastern US,
2. regions in South America where ground validation data is available and
3. agricultural regions in the US and elsewhere

- To characterize temporal decorrelation related to interferometry; an important error source for deformation studies that the use of volumetric decorrelation for estimating forest vertical structure (especially for multi-baseline observations). This will be done for forested and bare-surface regions over the geographic areas detailed above
- Develop a methodology for using time series observations over short-repeat periods (14 days) for the characterization of agriculture and inundated regions, for the geographic areas detailed above.

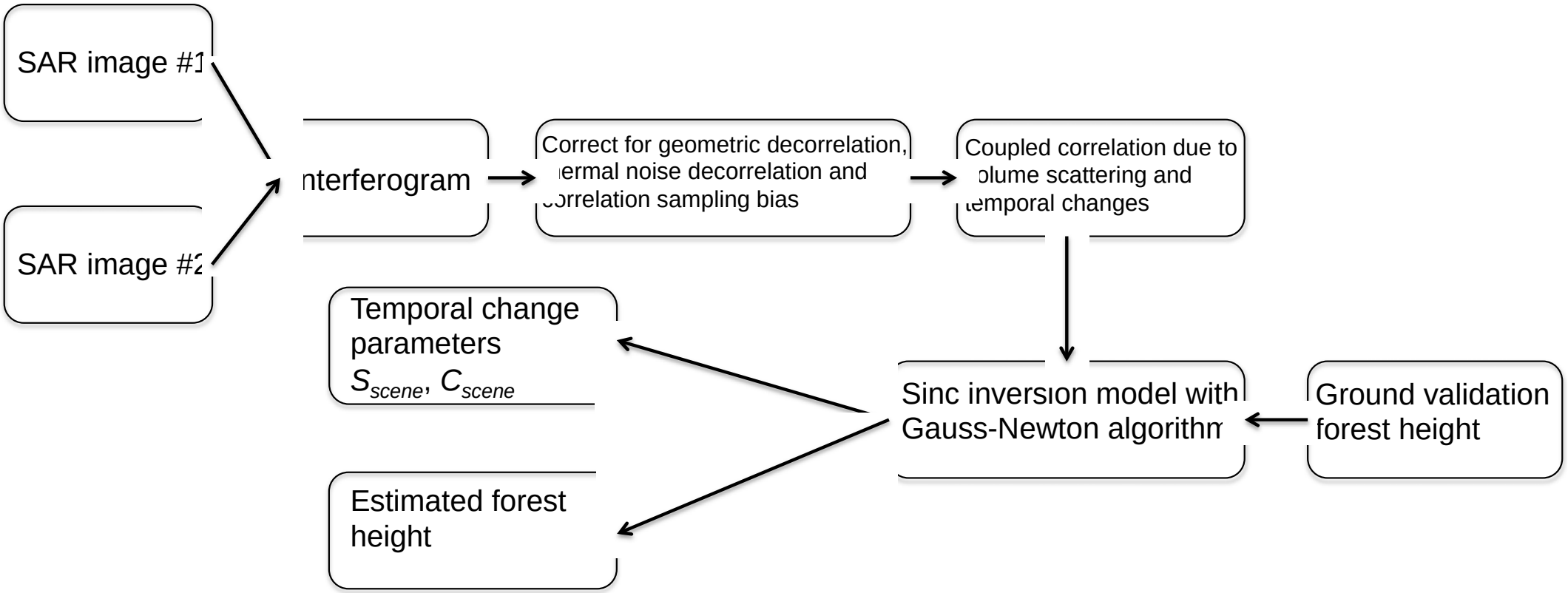
This work supports *the 4 K&C thematic drivers of* **C**arbon cycle science, the GEO initiative for global agricultural monitoring (GEOGLAM & JECAM) and Environmental **C**onservation as it applies to permanent land cover conversion.

Forest Stand Height (FSH) Estimation

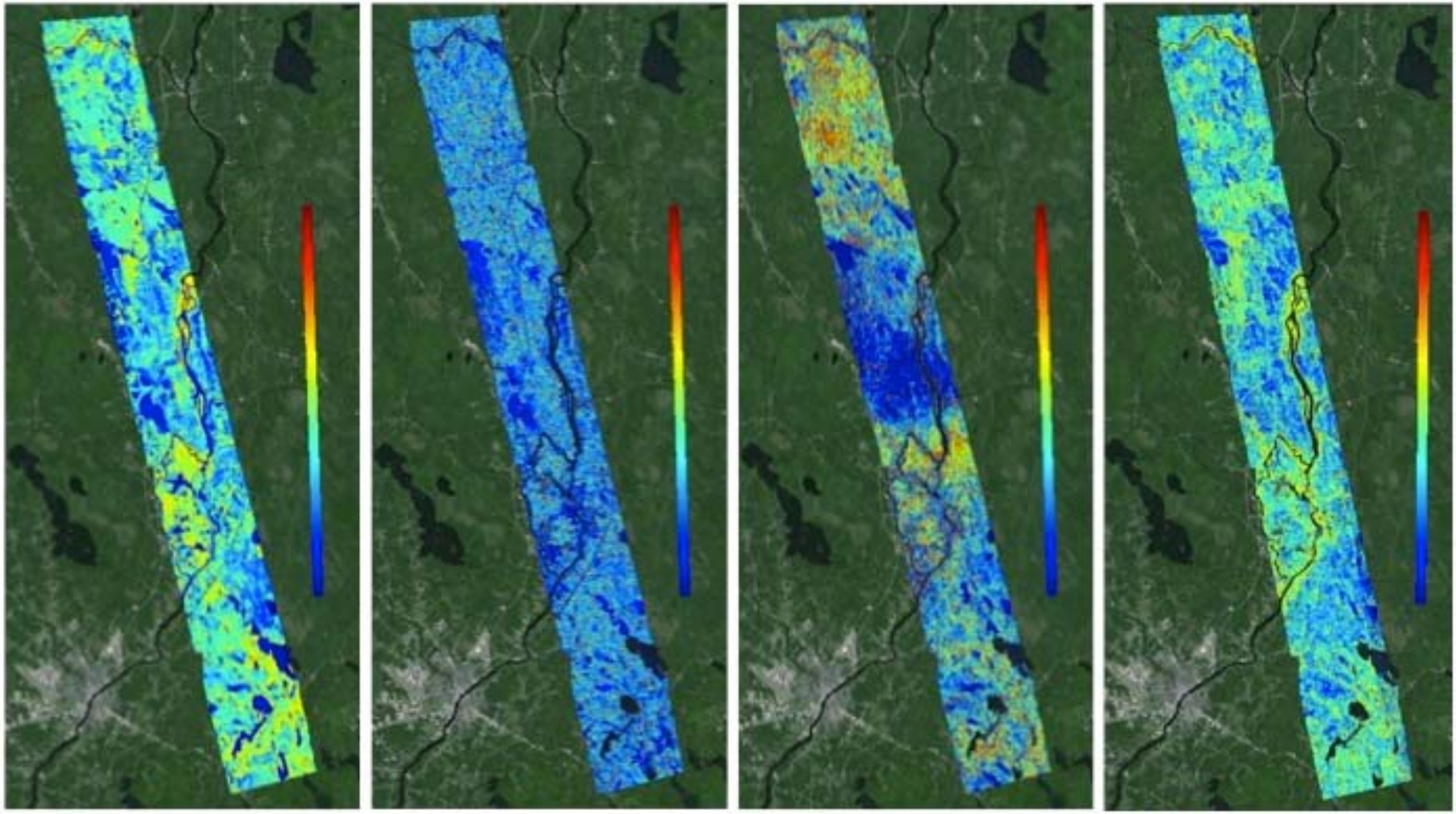
- Use of Repeat Pass Interferometry and Temporal Decorrelation to estimate tree height
- Have used the ALOS data archive to identify scene pairs with maximum correlation
- Algorithms have been automated to
  - go through an archive
  - identify scenes with maximum correlation
  - include ground validation (e.g. vegetation height from lidar)
  - automate the mosaicking process
- Dominant error sources are non-height related sources of temporal decorrelation
  - e.g. Forest degradation, Deforestation and Tilling

Algorithm

$$\gamma_{obs} = \gamma_{SNR} \cdot \gamma_{vol} \cdot \gamma_{temporal} \cdot \gamma_{geom} \quad \Rightarrow \quad \gamma_{v\&t} \approx \frac{\gamma_{obs}}{\gamma_{SNR}\gamma_{geom}} \propto (h_v)^{-1}$$



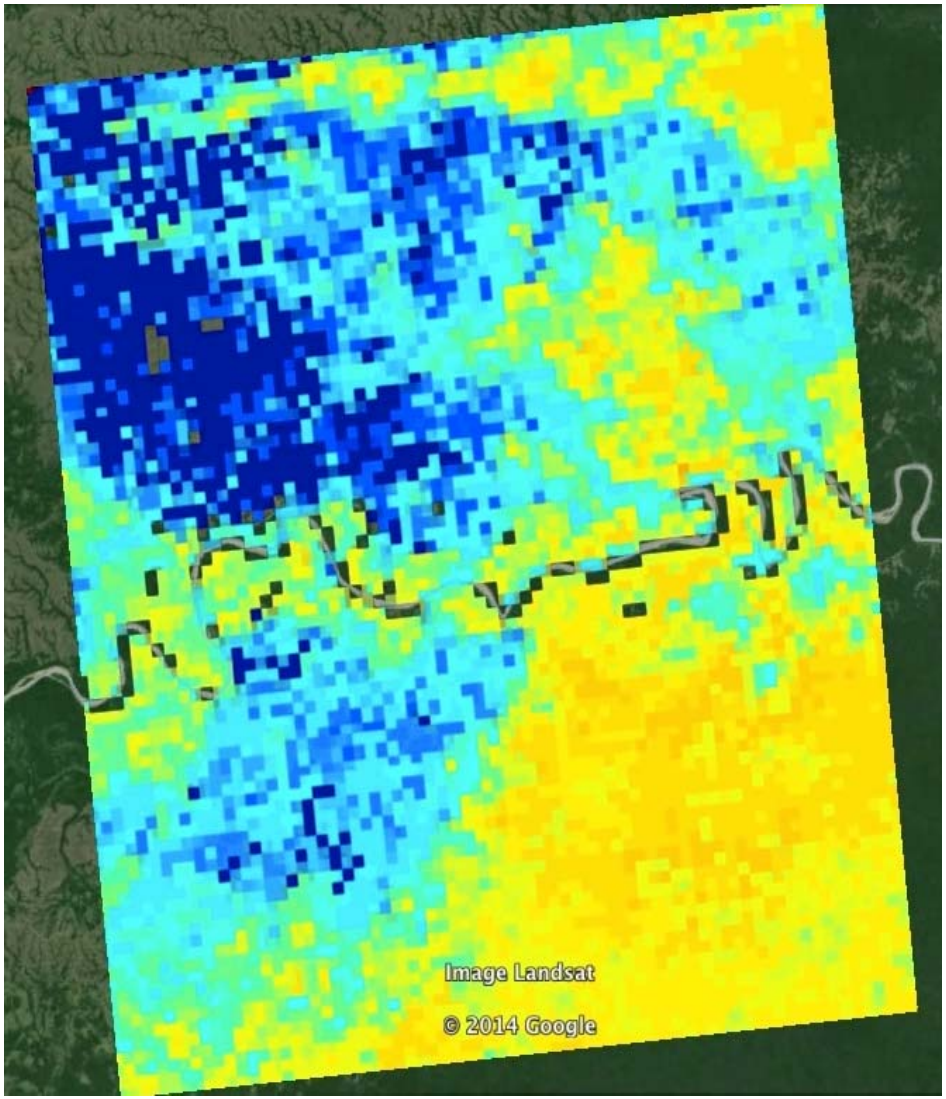
Some Examples



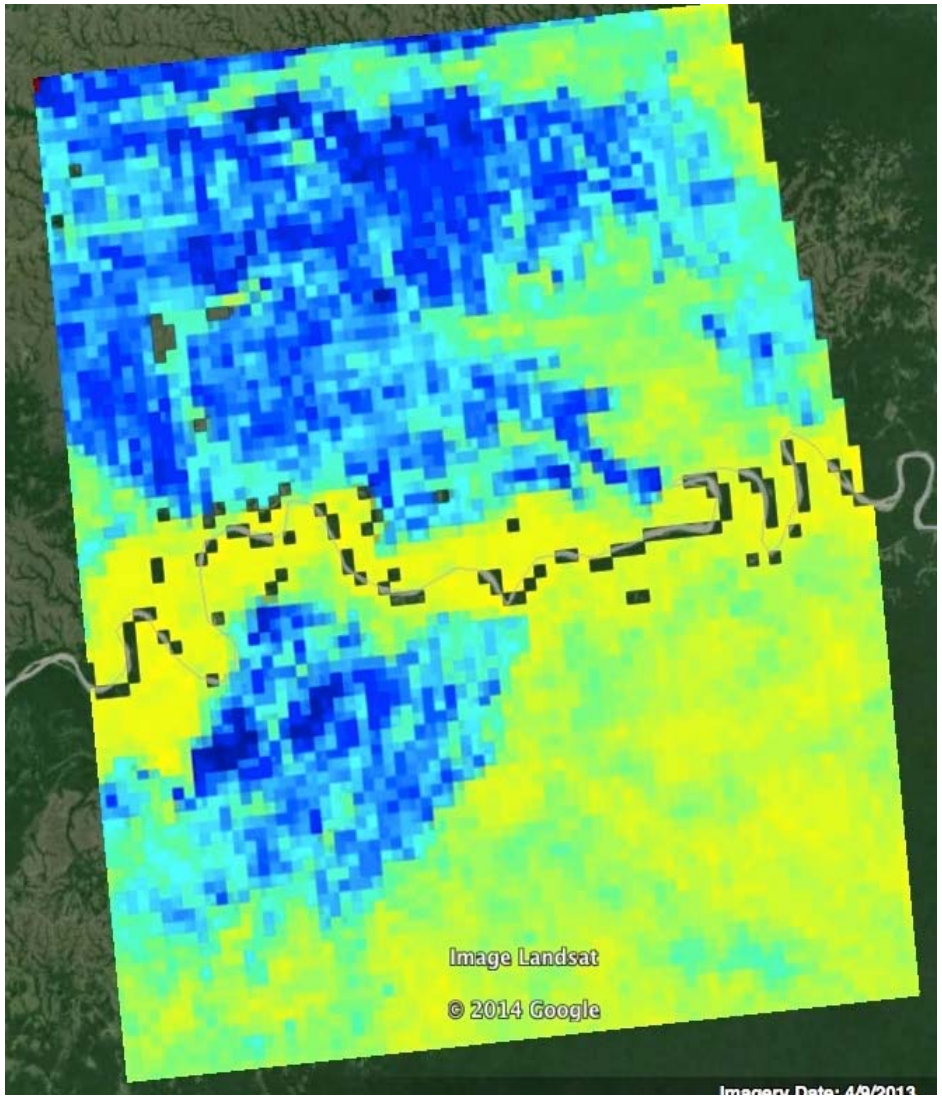
LVIS | SAR backscatter power | InSAR phase | InSAR correlation magnitude

Colombia

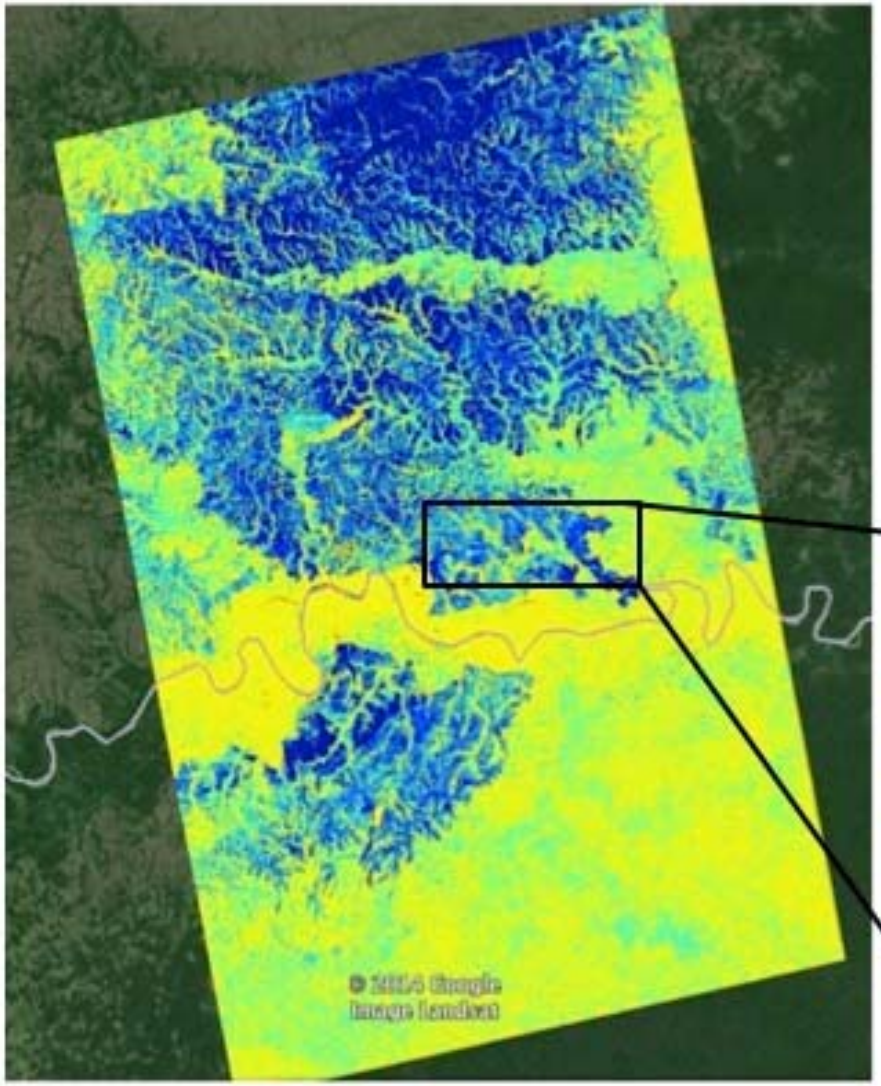
ICESAT

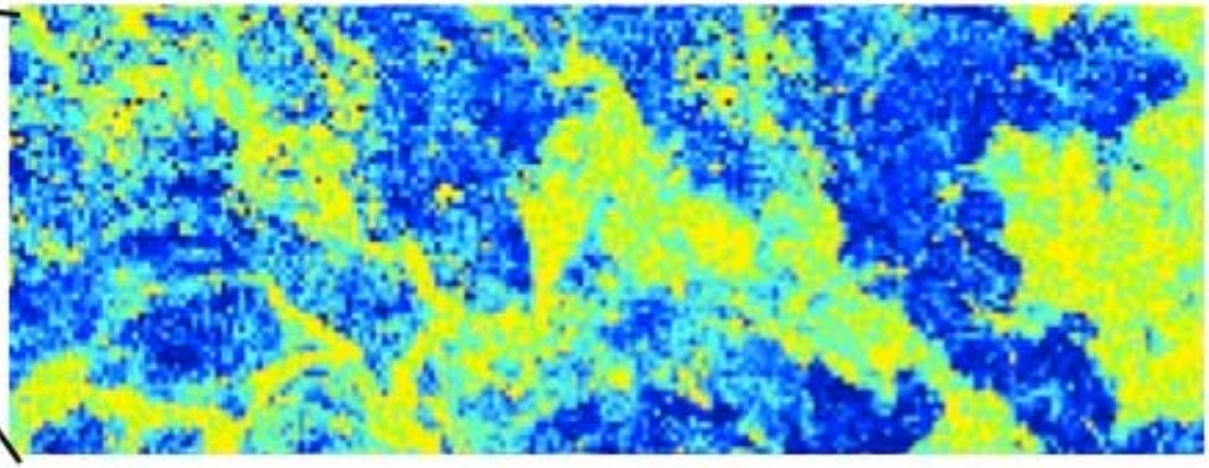


ALOS-1 Correlation



Improved resolution over ICESAT



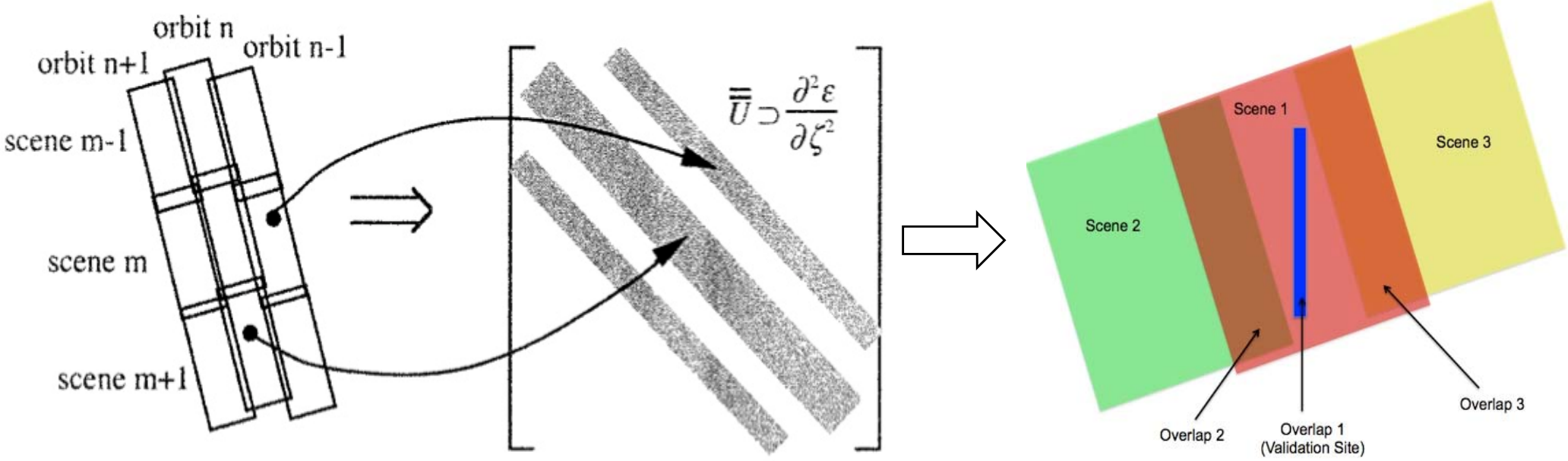


Automated Approach for Mosaicking

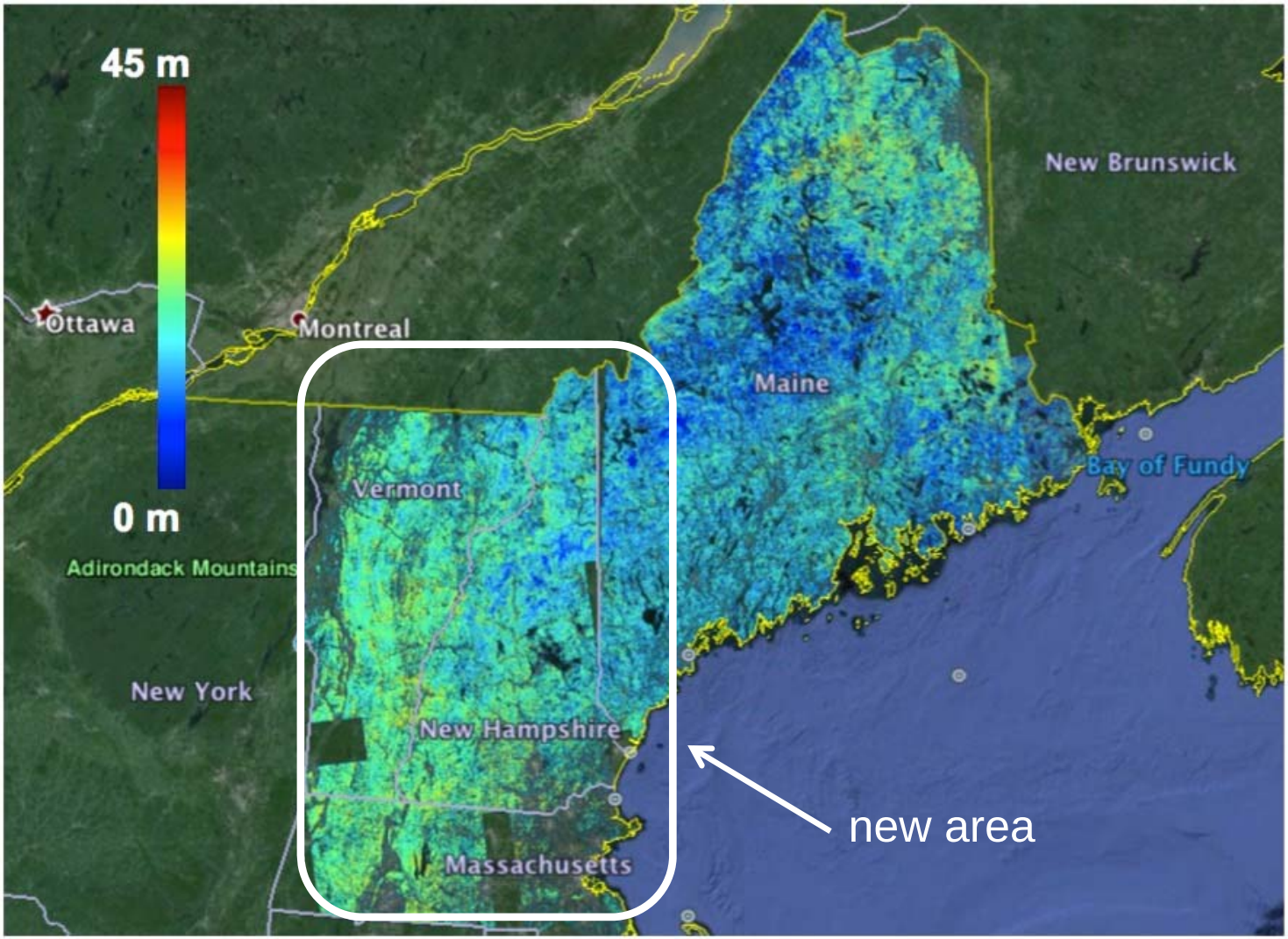
2 *Article*

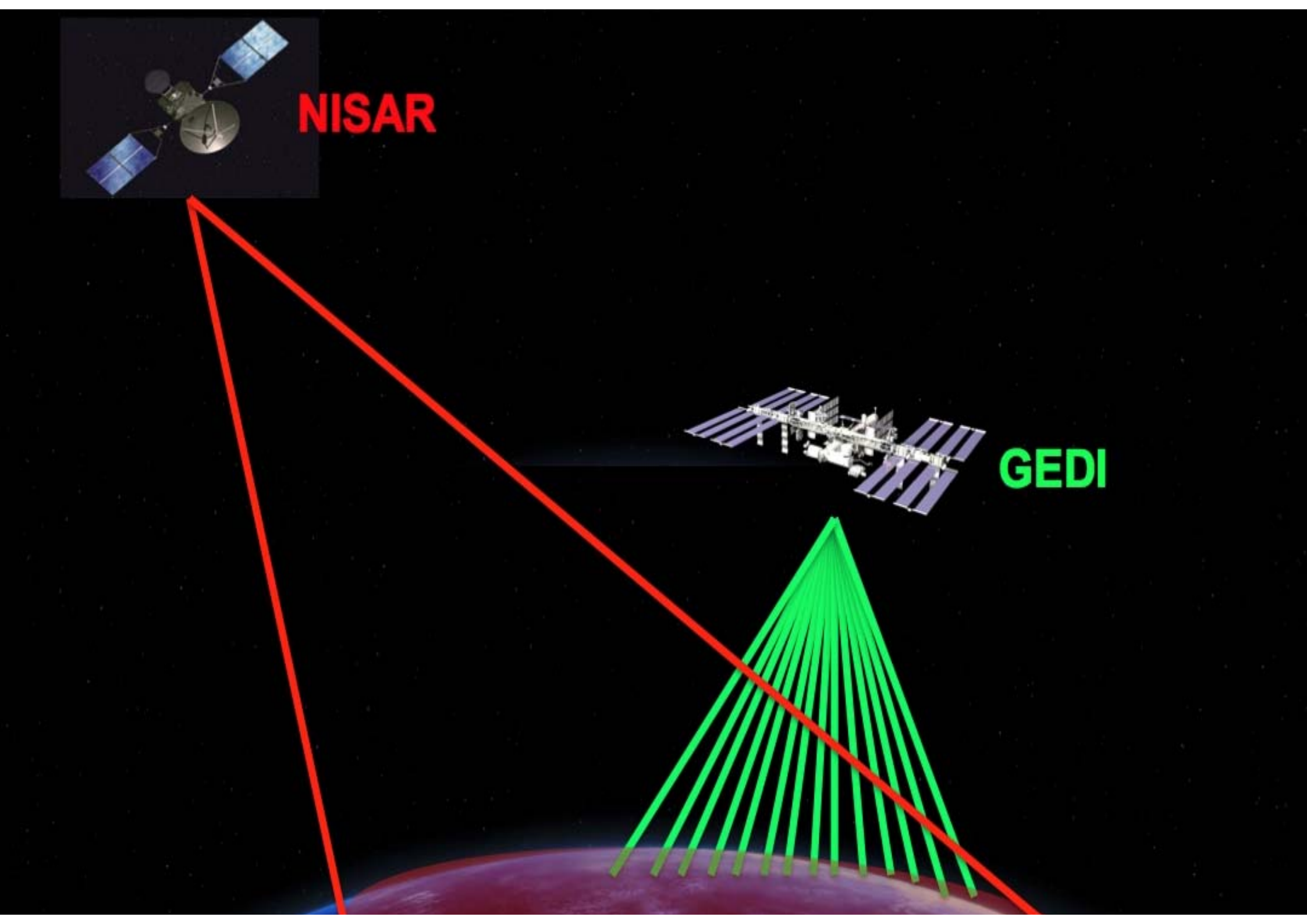
3 **An automatic mosaicking algorithm for the generation of a**
4 **large-scale forest height map using spaceborne repeat-pass**
5 **InSAR correlation magnitude**

6 **Yang Lei [1], and Paul Siqueira [1]***

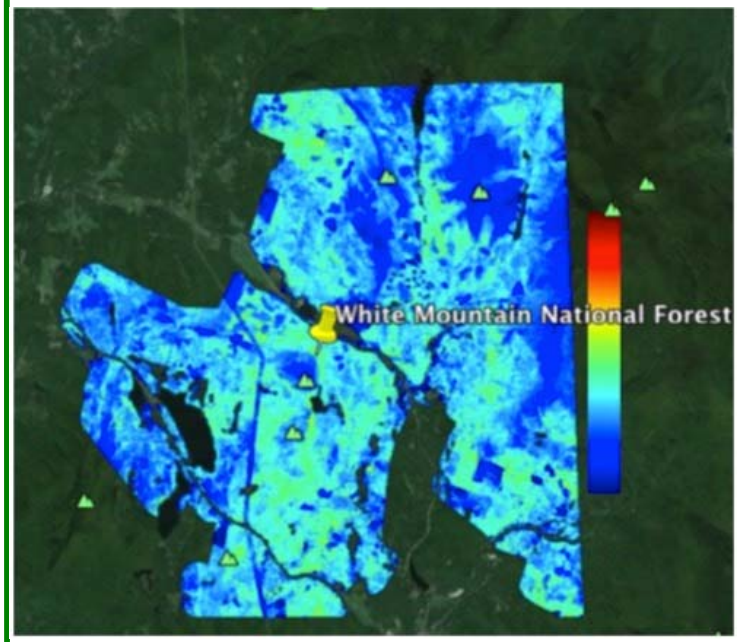


Application of mosaicking

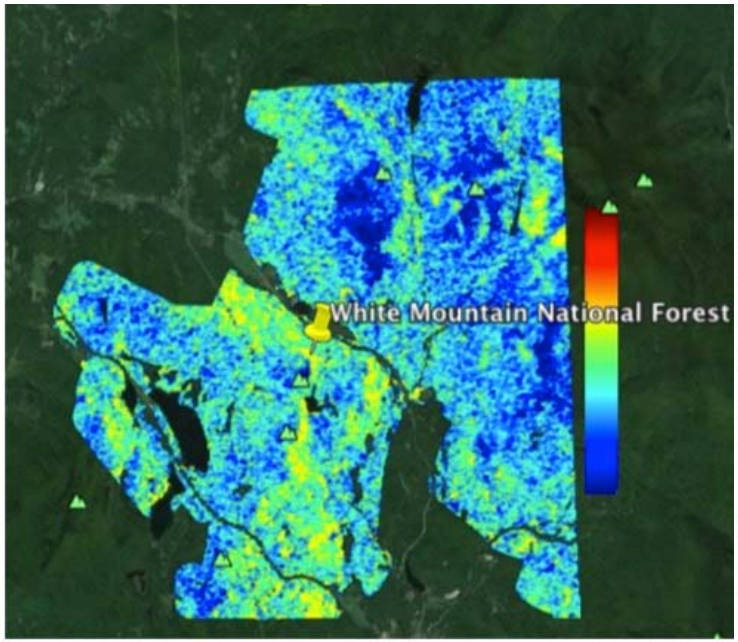



NISAR
GEDI

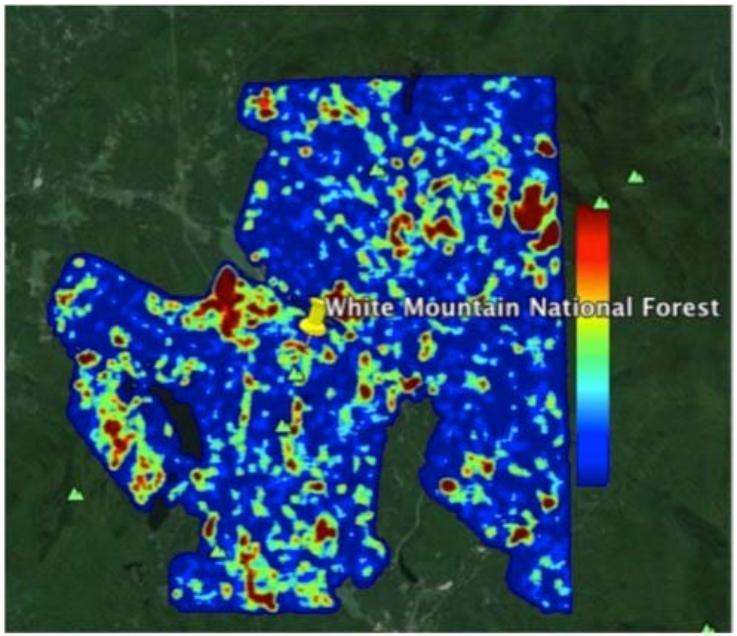
Disturbance monitoring



lidar



ALOS



difference

Difference between external measure and FSH estimation used to identify likely regions of disturbance

K&C Connection to NISAR

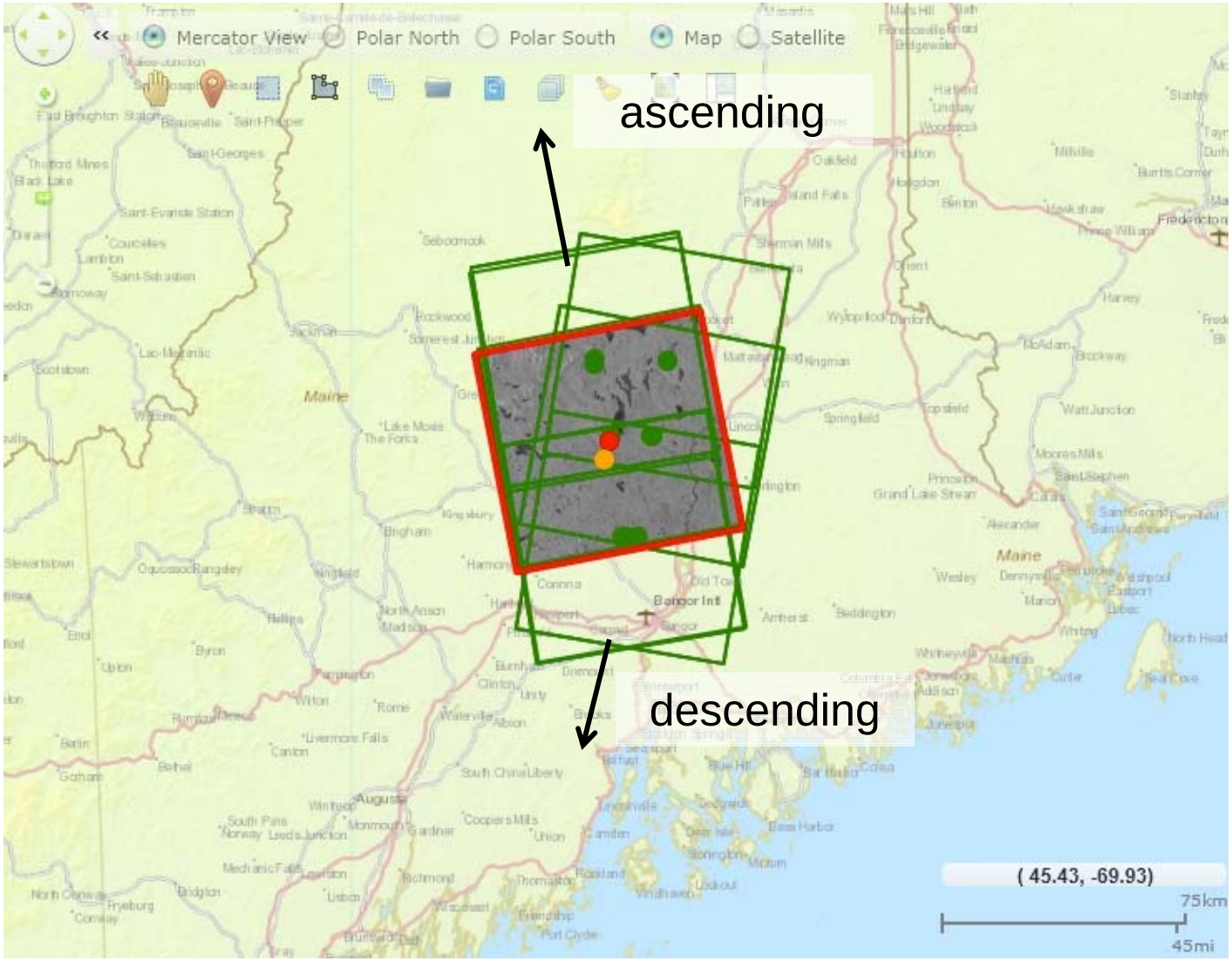
USAID FROM THE AMERICAN PEOPLE

FOREST SURVEY OF INDIA
Ministry of Environment, Forest & Climate Change
भारतीय वन सर्वेक्षण

Indian Space Research Organisation

- In July 2015, USAID sponsored a two-week study tour to the University of Massachusetts for training and interaction on ecosystems applications of SAR
- Inputs from UMass and Applied GeoSolutions
- Attendees were from ISRO, FSI and Iora Ecological Solutions
- Connection has been fostered by ALOS K&C Meetings and this work

ALOS-2 FBD Temporal Decorrelation Studies in Northeastern US



Ascending (36_900)
17 Sept 2014
26 Nov 2014: 5(30m)
04 Feb 2015: 5(17m)
08 July 2015: 11(150m)

Descending (139_2710)
07 June 2015
21 June 2015: 1(240m)

cycles

baseline

ALOS

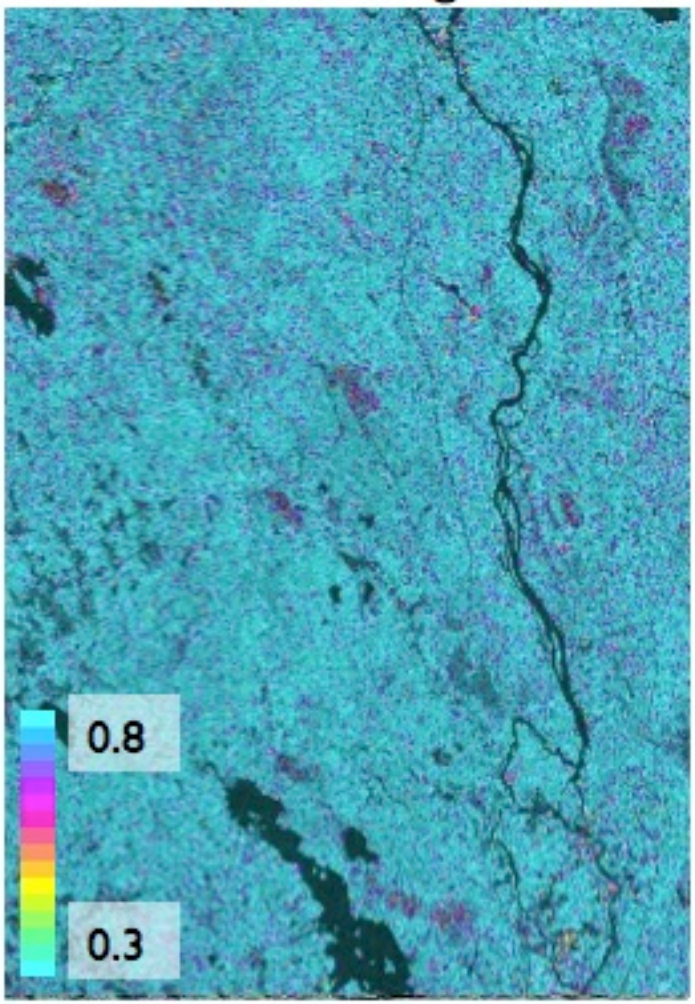
K&C Initiative

An international science collaboration led by JAXA

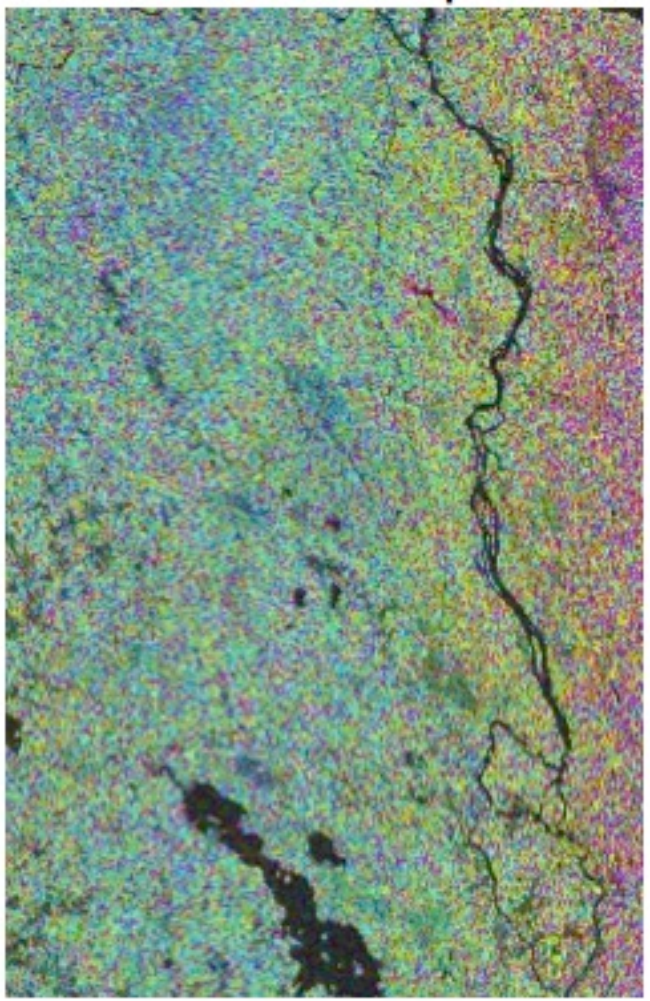
14 day repeat interferogram – June 2015
240 m baseline (kz = 0.24)

Google Earth Image

Correlation magnitude



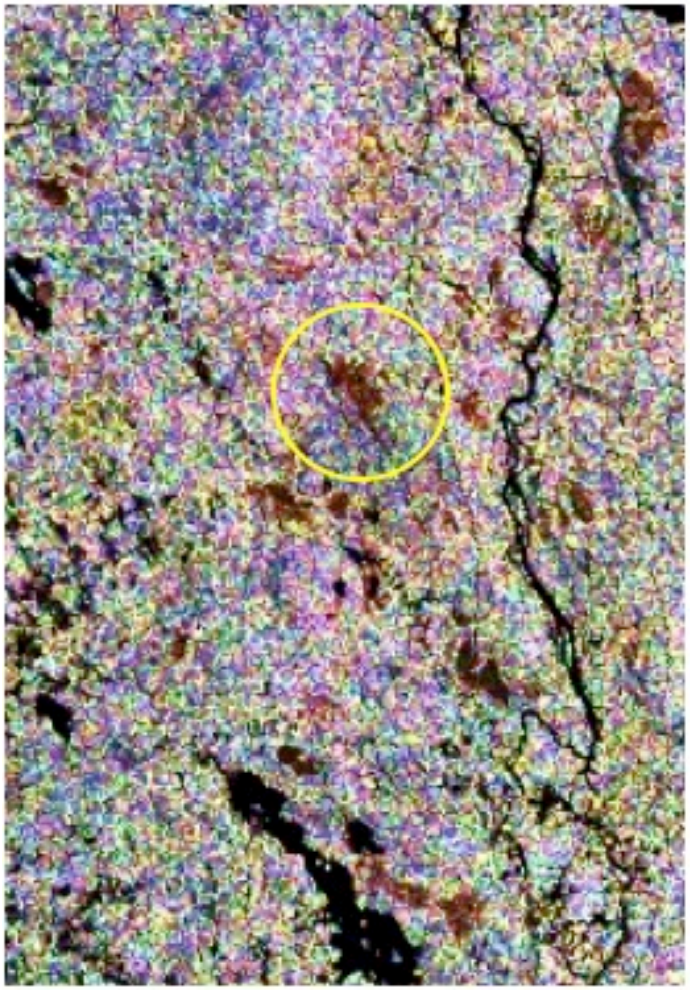
Interferometric phase



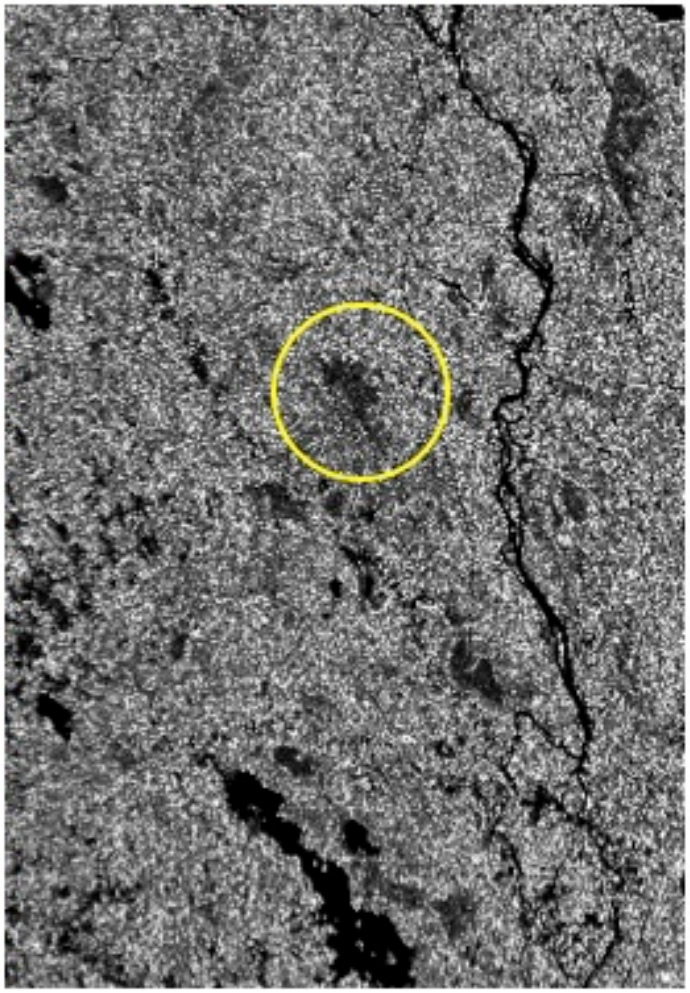
RCS Image Overlays

June time period indicates a greening of the landscape, which leads to large temporal decorrelation

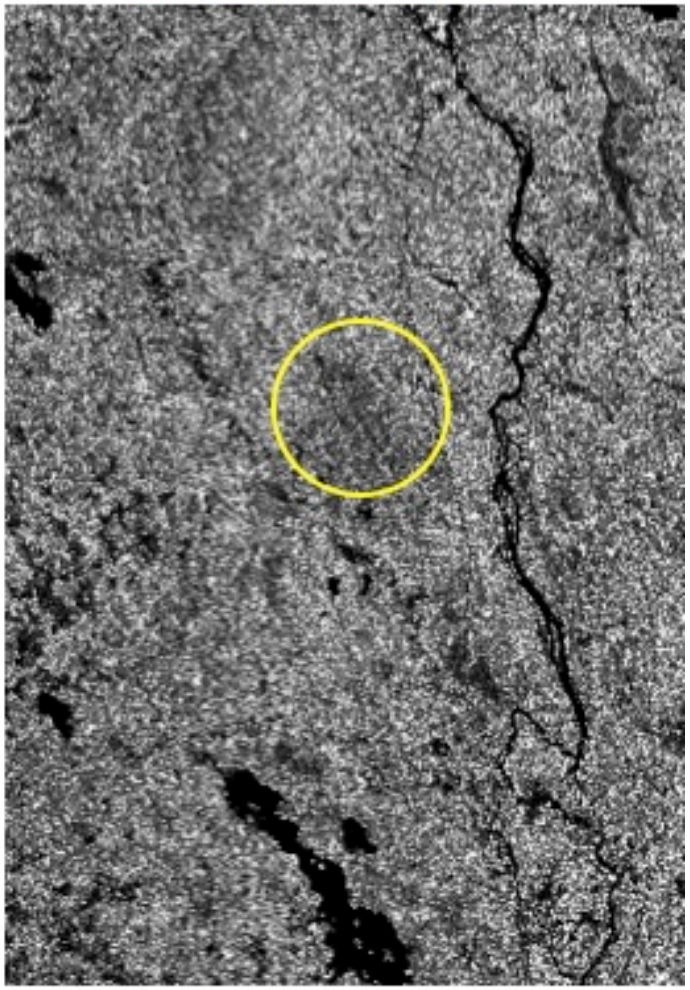
HH1, HV1, HH2



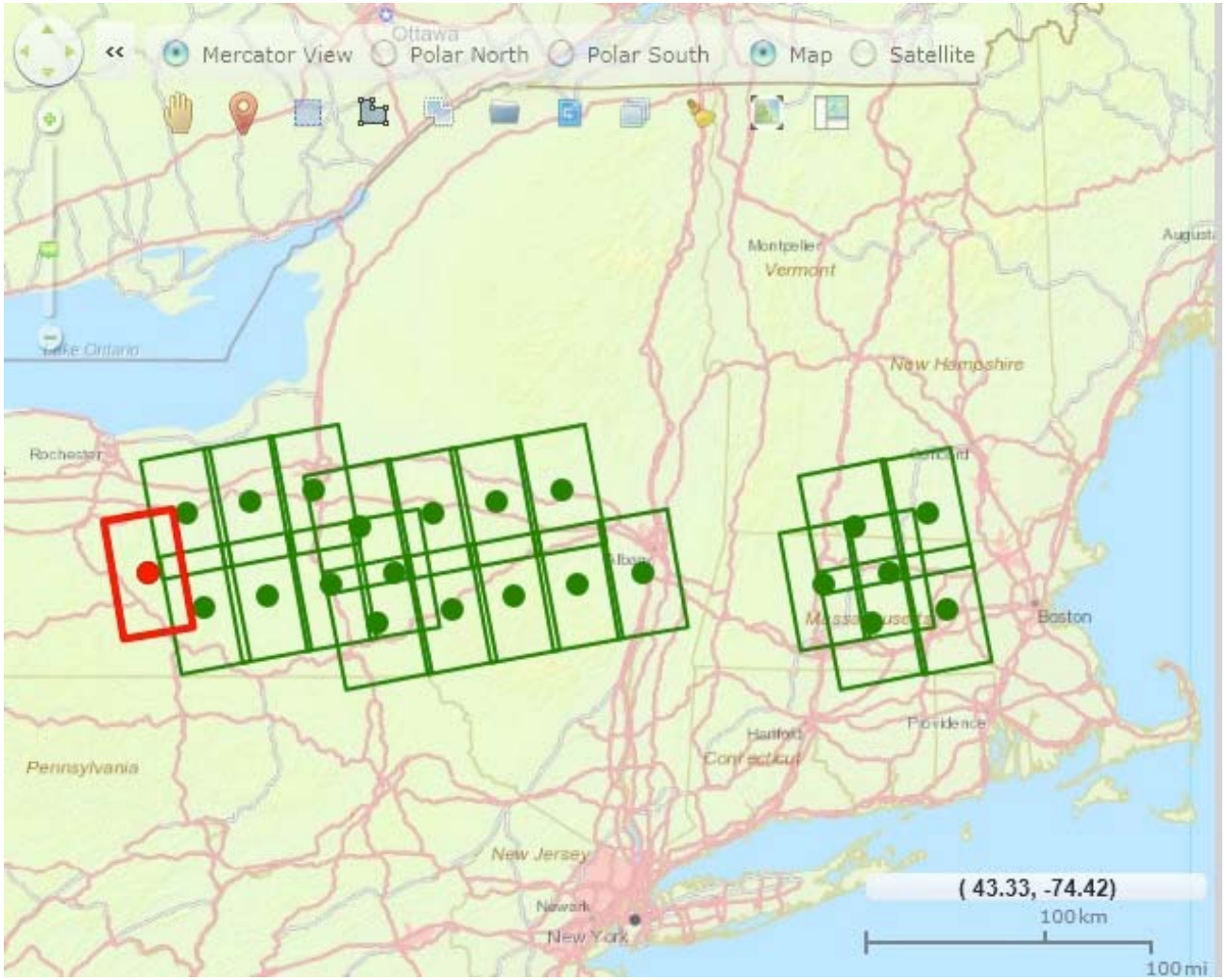
HH1: June 7, 2015



HH2: June 21, 2015



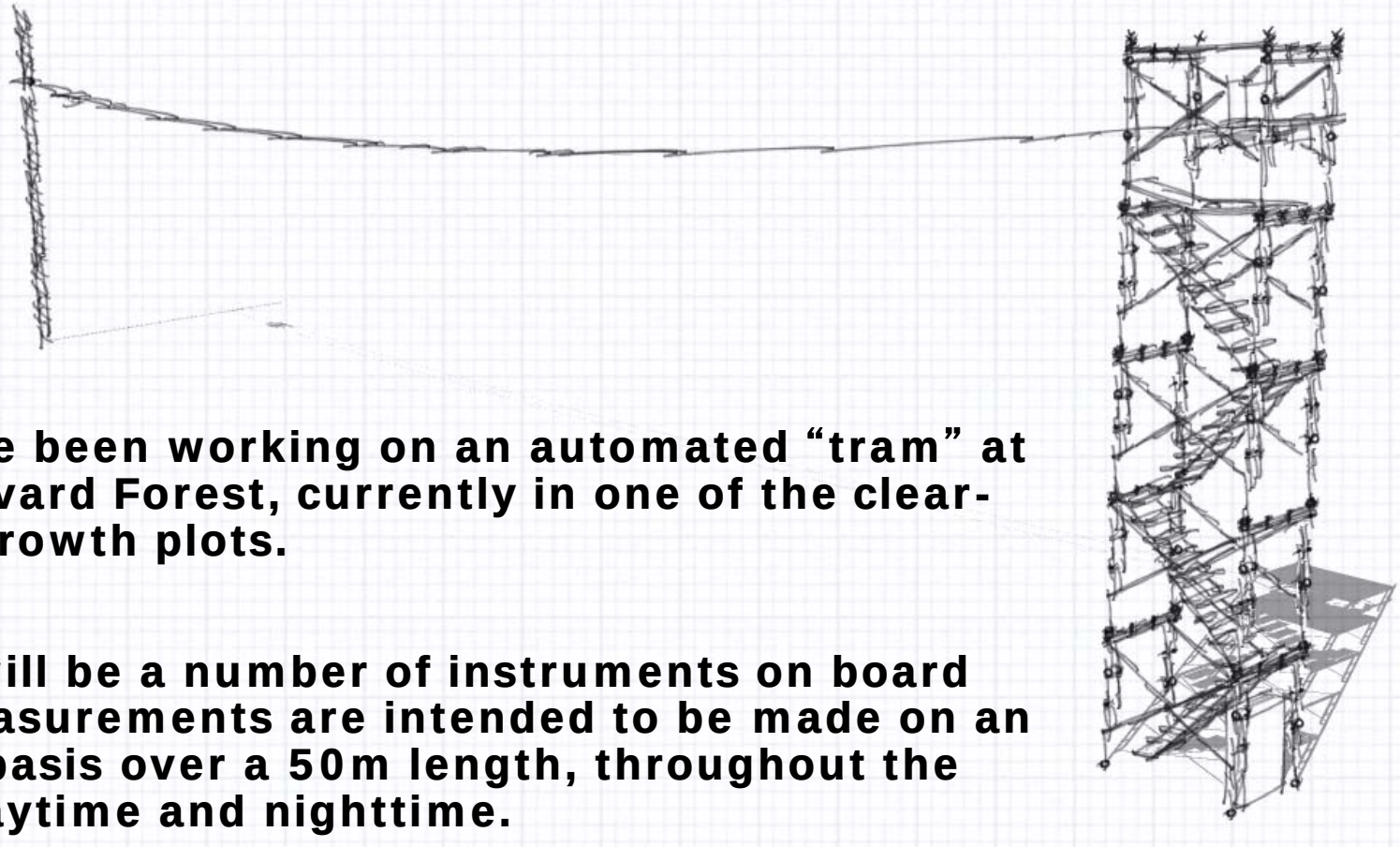
What next: Explore the Quad-pol data in the Northeastern US



Single-pass quad pol data collected March – June 2015.

Goal: process the data and compare with ground validation sites in Massachusetts, New Hampshire and Maine

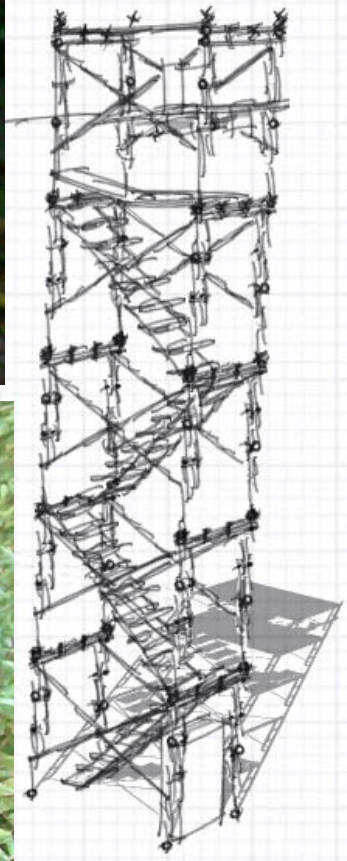
Other K&C Related News



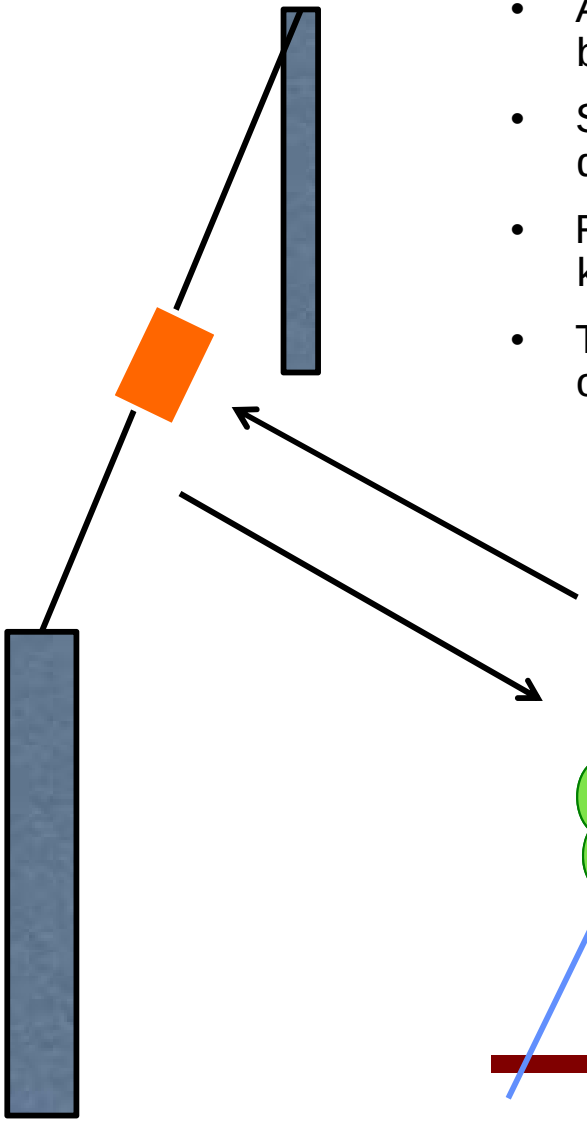
- **We have been working on an automated “tram” at the Harvard Forest, currently in one of the clear-cut / regrowth plots.**

- **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.**

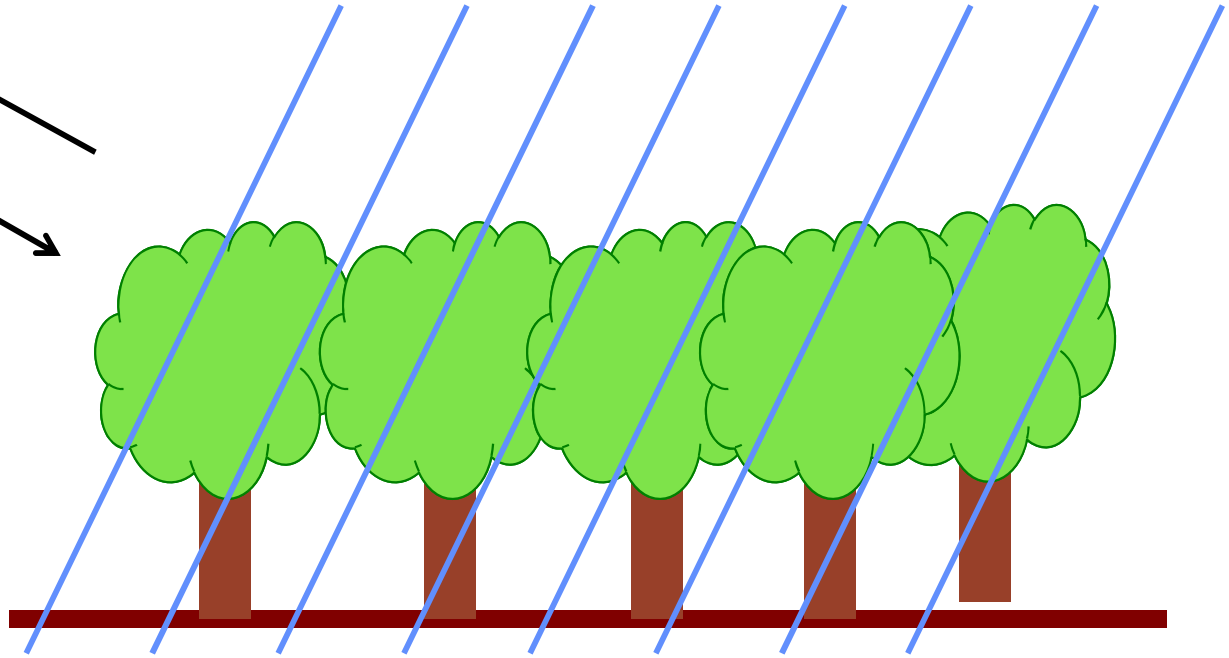
S



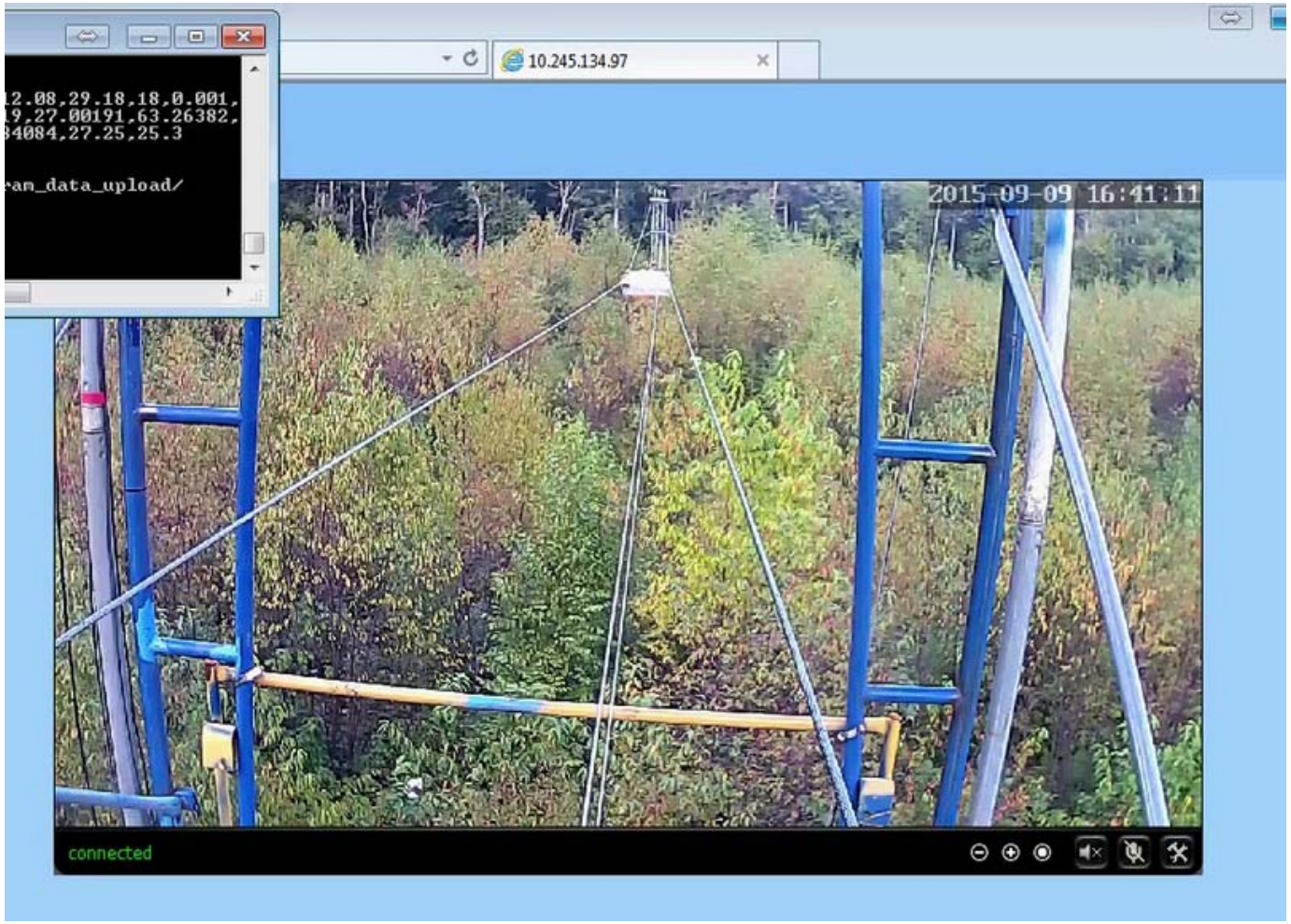
A radar on the tram



- A signal would travel a distance, hit groups of trees, and then bounce back to the tram.
- Since the target shape is relatively constant over time, the dominant signature would be of the moisture flow in the trees.
- Radar signals, such as those discussed here, would travel several kilometers
- The tram path would be used to create a two dimensional image of these changes over time.



Tram: The Movie

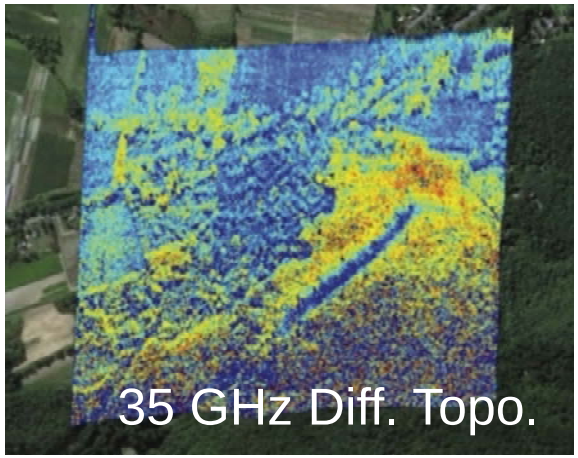


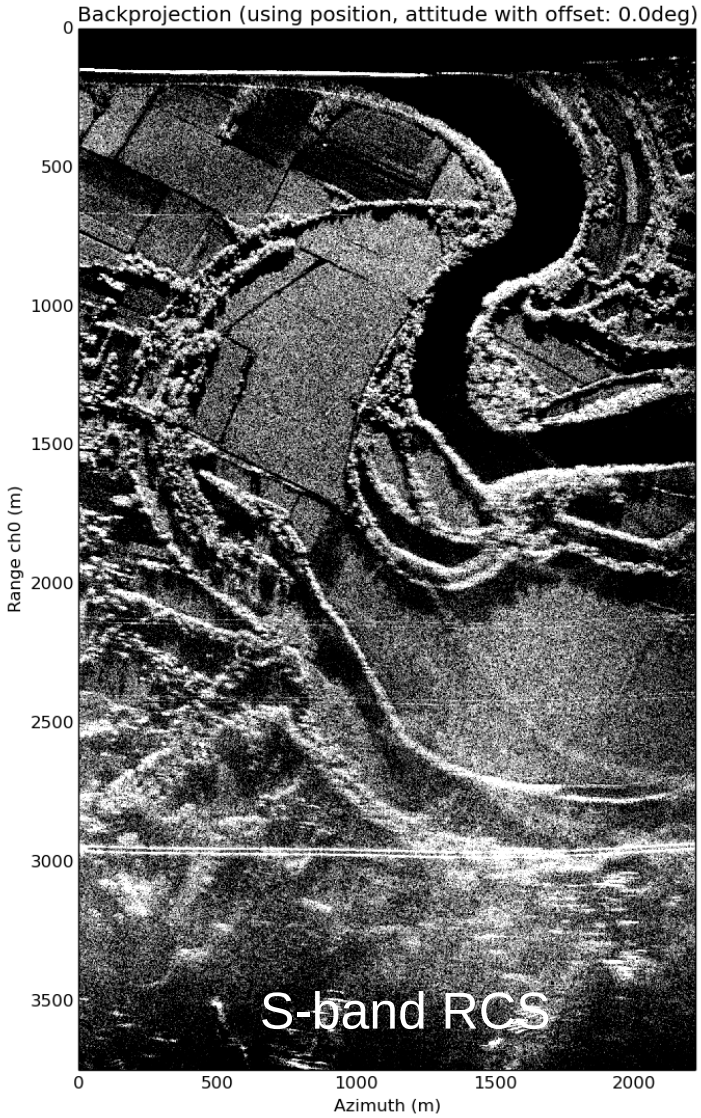
Airborne SAR Development

- Ka-band (35 GHz) and S-band (3.5 GHz)
- Cessna 206 Aircraft
- Both frequencies work well independently
- Currently working on a two-frequency InSAR

Data from the UMass Systems

- Working on systematizing the system so that data can be requested and processed for modest cost (~$0.50/ha; 50¥/ha)
- Ideal for collecting time series of
  - reflectivity
  - polarimetry
  - interferometry
  - differential penetration depth





Data sharing & Deliverables

- Data from the tram and airborne observations over the Harvard Forest in Western Massachusetts as processing algorithms mature
- Analysis of short-repeat period (14 days) and quad-pol data in Northeastern US to be presented at future K&C meetings