

K&C Phase 4 – Final Report

*Sensitivity of Vegetation and Agriculture Physical
Characterization to Repeat-Pass ALOS Observations*

*Paul Siqueira
University of Massachusetts, Amherst*

Project outline and objectives

To characterize 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, (done)
 2. regions in South America where ground validation data is available (done)
 3. agricultural regions in the US and elsewhere (done)
- 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 was done, but because of weather effects, the results were not promising as a reliable algorithm.
 - Develop a methodology for using time series observations over short-repeat periods for the characterization of agriculture and inundated regions, for the geographic areas detailed above (done)

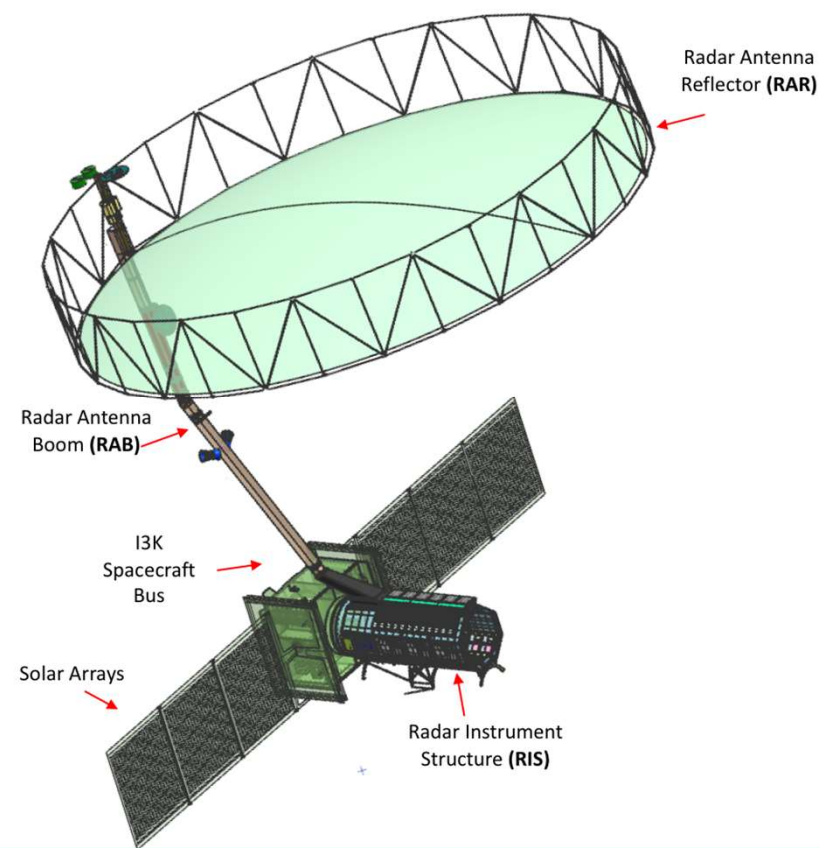
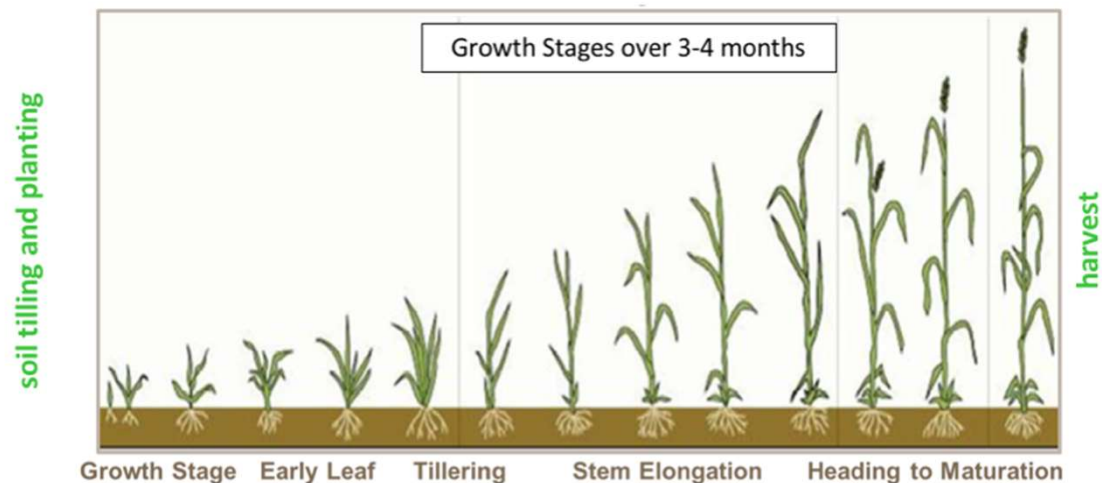
This work supported *the 4 K&C thematic drivers of* Carbon cycle science, the GEO initiative for global agricultural monitoring (GEOGLAM & JECAM) and Environmental Conservation as it applies to permanent land cover conversion.

NISAR Development: Ecosystems

- Biomass
- Disturbance
- Inundation
- Agriculture



Dense-time series of L-band data (dual-pol)



The logo for the Advanced Land Observing Satellite (ALOS) mission, featuring the letters 'ALOS' in a white, serif font against a dark blue background.A banner for the Knowledge and Capacity (K&C) Initiative, featuring a satellite-style map of a river delta in shades of green and blue. The text 'K&C Initiative' is in a white serif font, and 'An international science collaboration led by JAXA' is in a smaller, italicized white serif font below it.

K&C Initiative
An international science collaboration led by JAXA

Results and significant findings



Phase A studies for agriculture Methods for detecting agricultural activity

Regions of current agricultural activity detected by

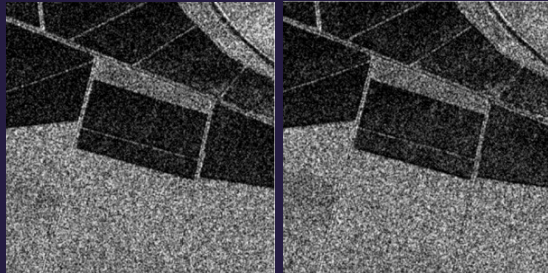
1. changes in RCS signatures of
HH, HV and HH/HV

2. interferometric
correlation

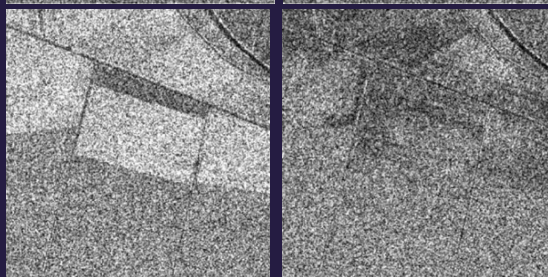
3. polarimetric signatures



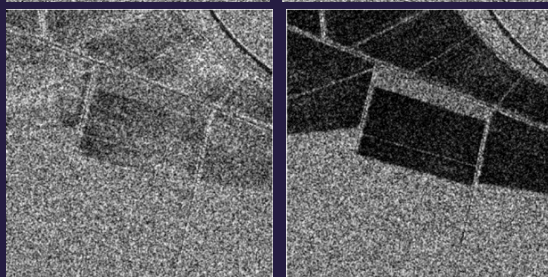
10 Jun 08



13 Jun 08

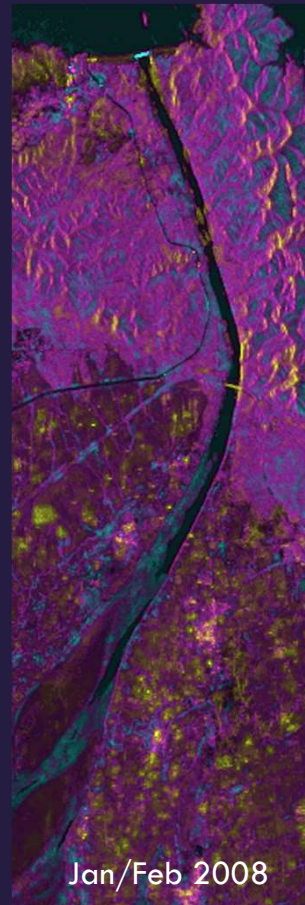


26 Aug 08

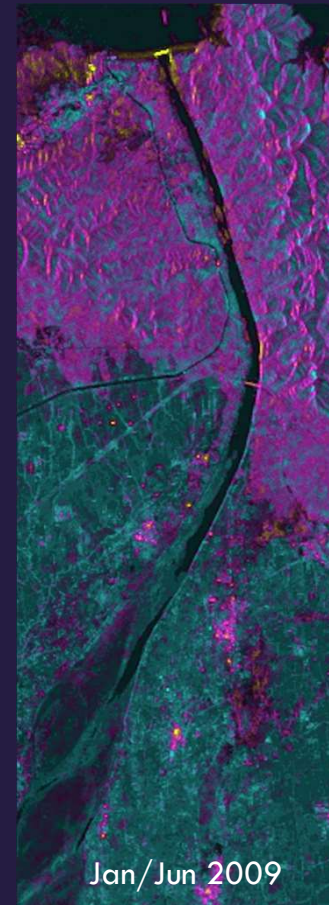


HH

VV



Jan/Feb 2008



Jan/Jan 2009





SAR for Crop Area Determination Madhya Pradesh Region in North-Central India

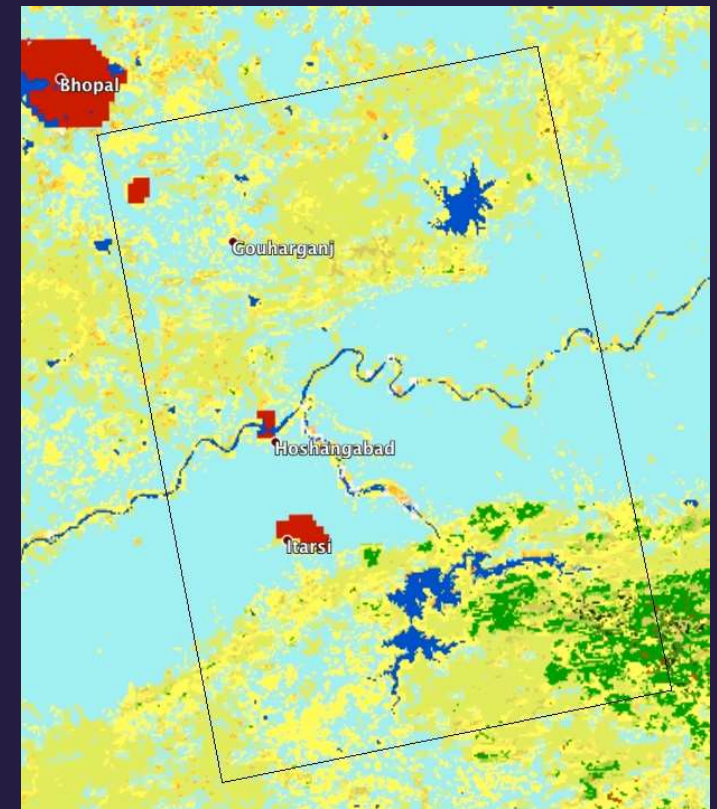
Region chosen because it has a combination of intensive/diverse agricultural activity, forested regions and urban settings.



map



optical

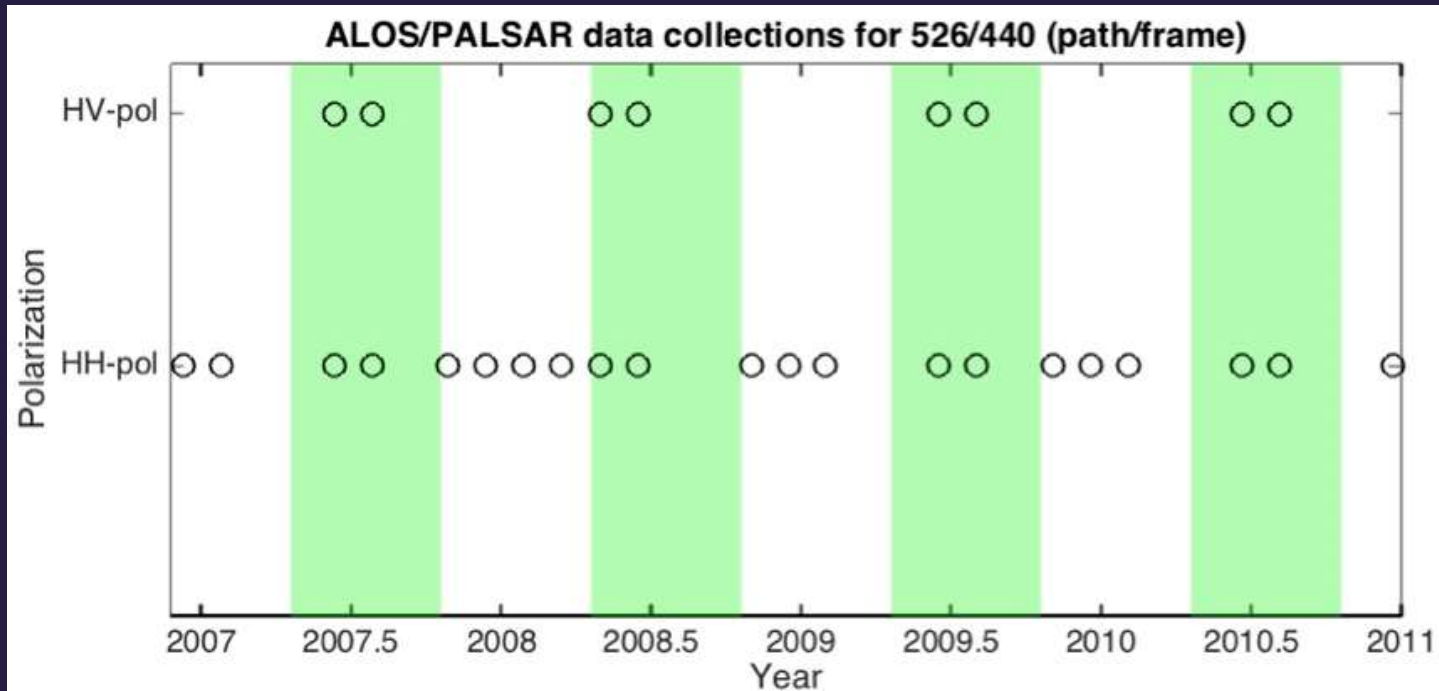


GLOBCOVER



L-band coverage from ALOS-1

A four-year time series obtained from ALOS-1
2007 - 2011



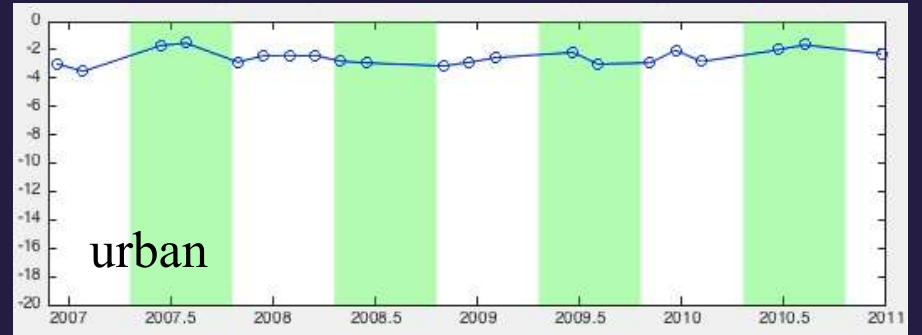
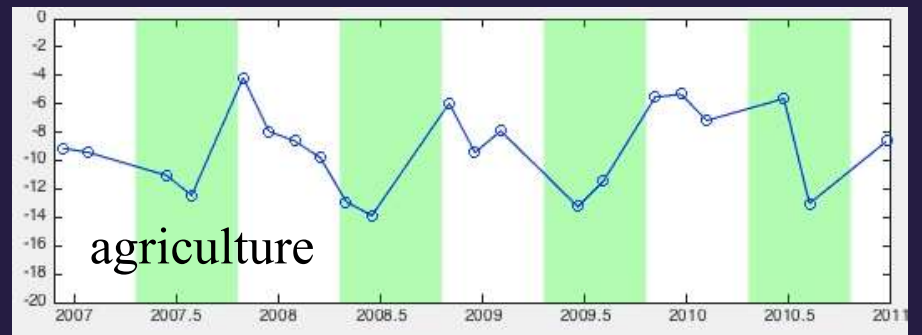
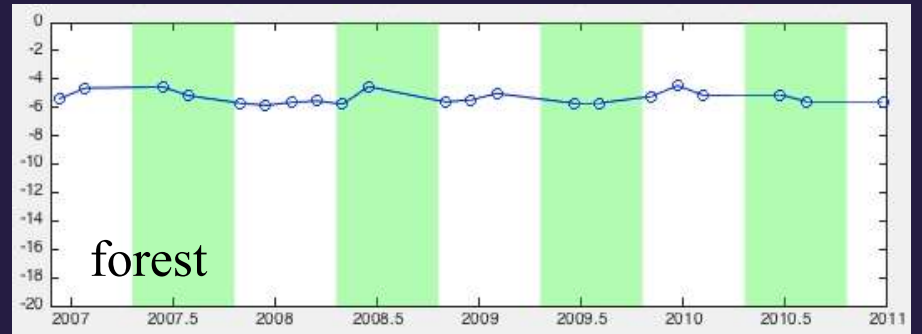
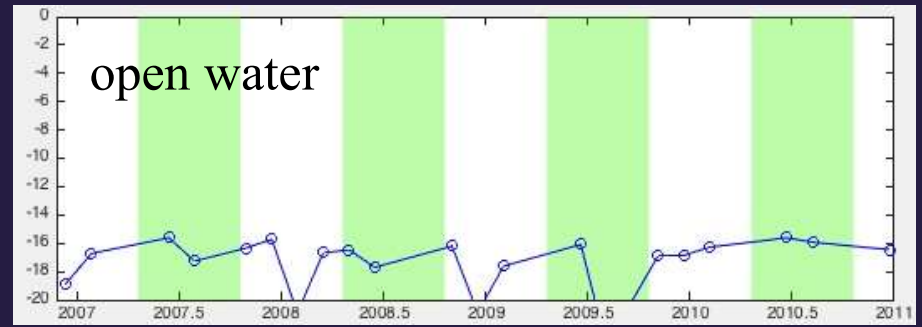
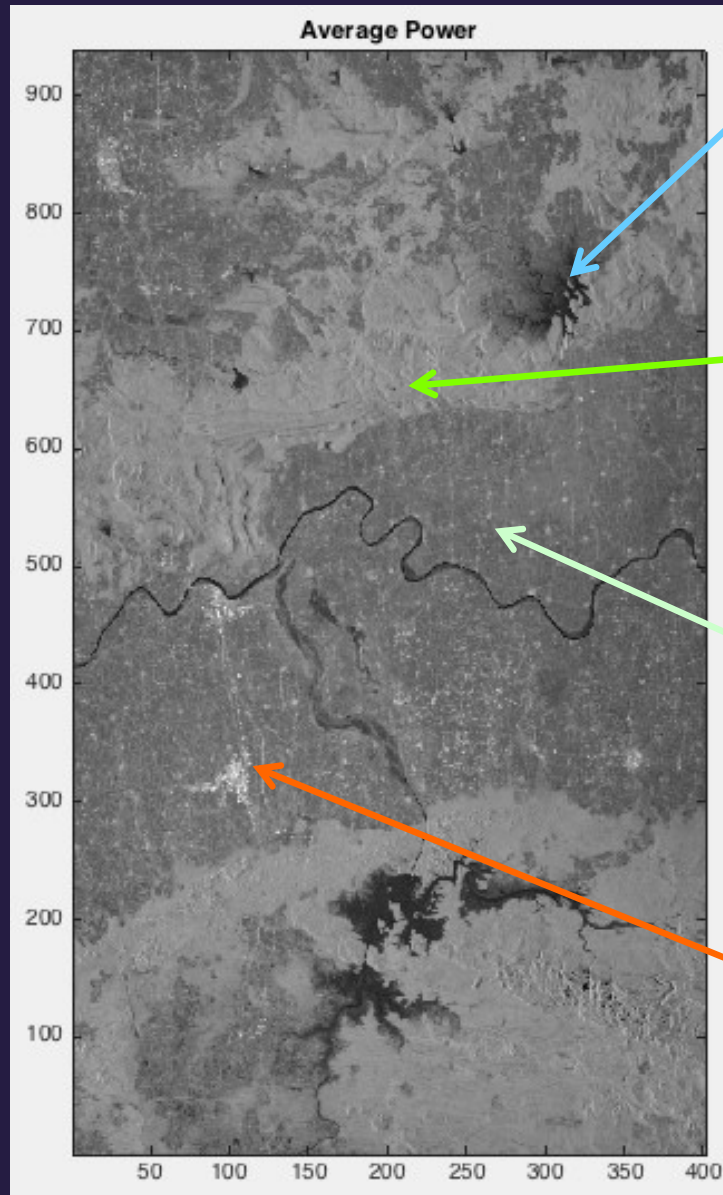
8 cross-pol scenes

21 co-pol scenes

Colored bands indicate 6-month intervals centered around mid-year



Radar signature changes over time

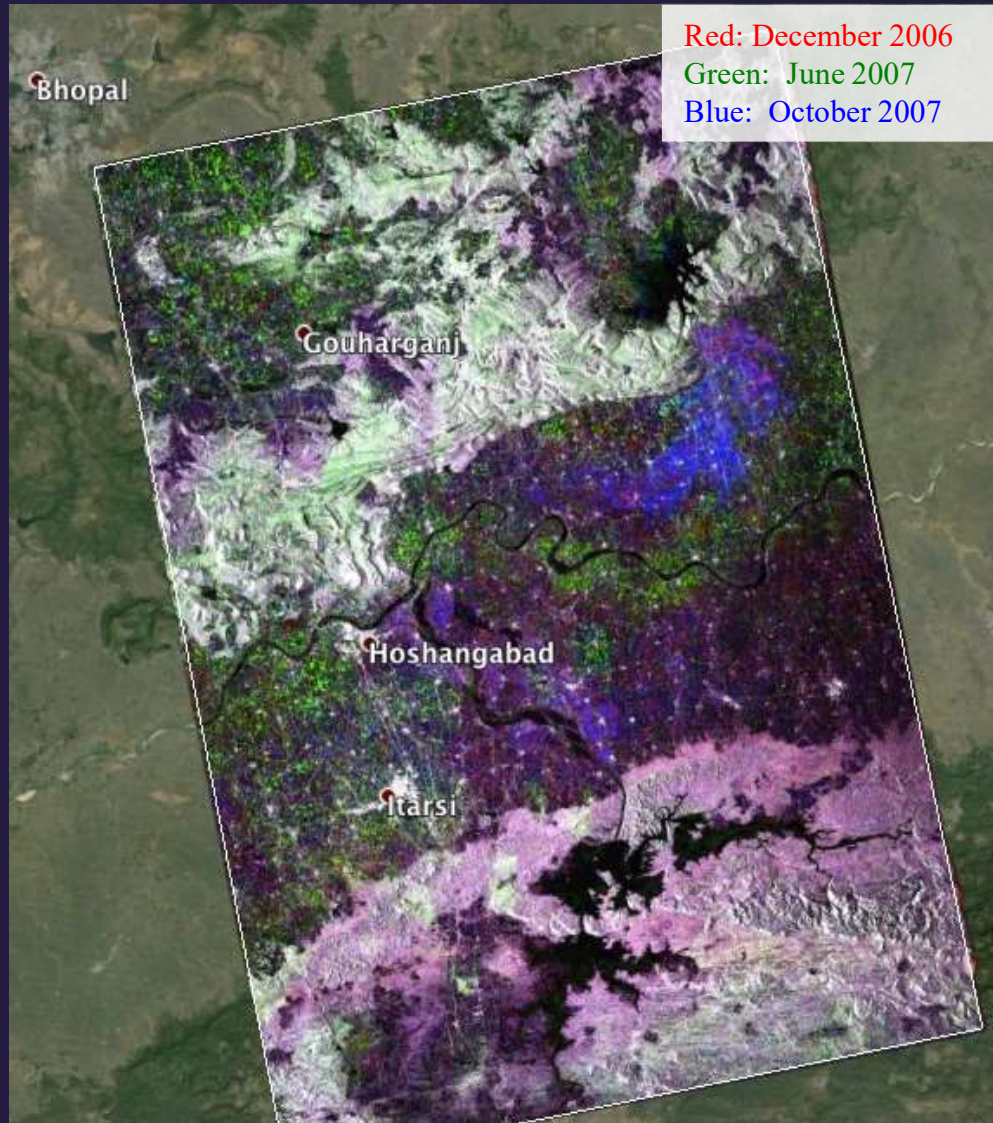


As an intensely managed landscape, agricultural fields are identified by the variation in radar signature (sensitive to structure of landcover) over time

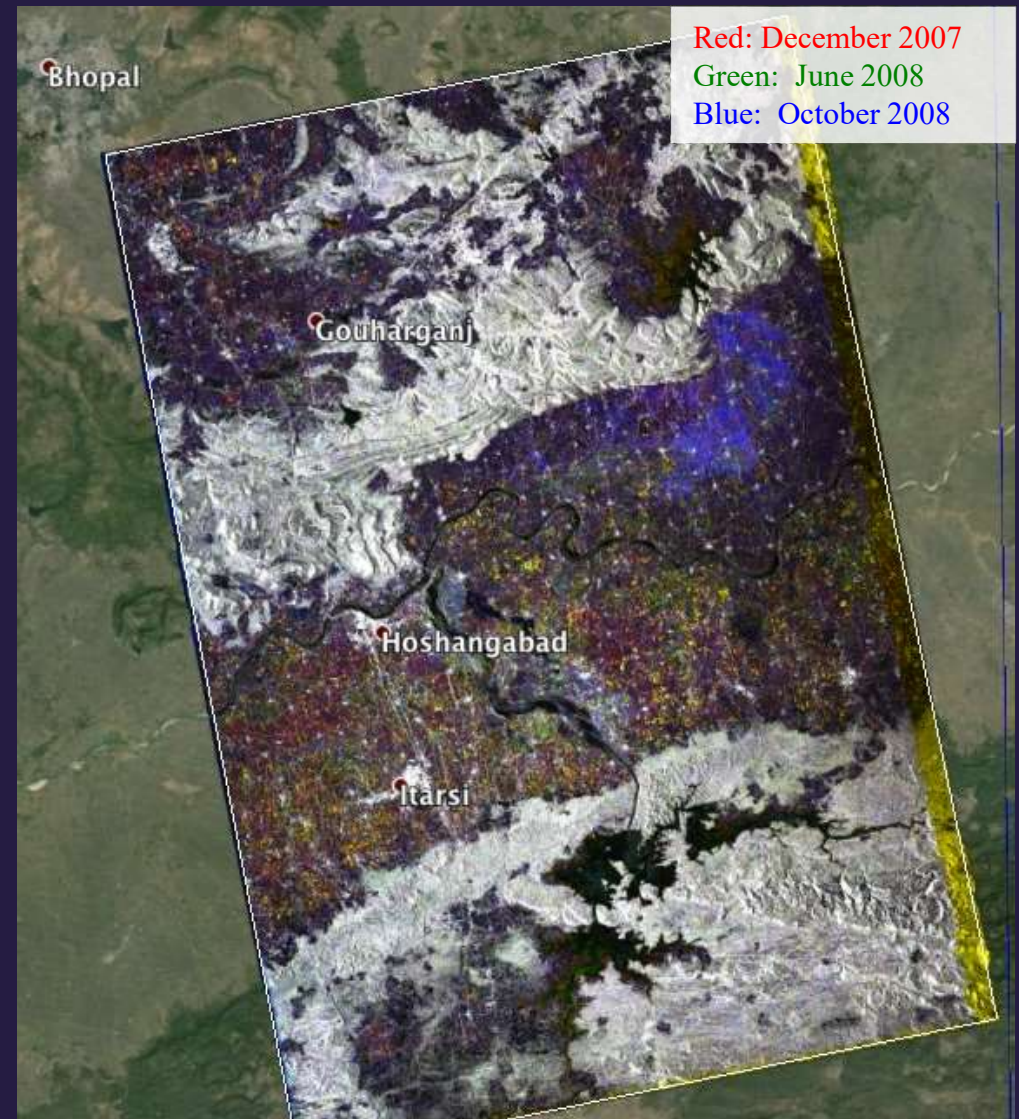
Methods for detecting agricultural activity

False color imagery year to year indicates variations that will complicate nominal approaches to classification

2007 time series

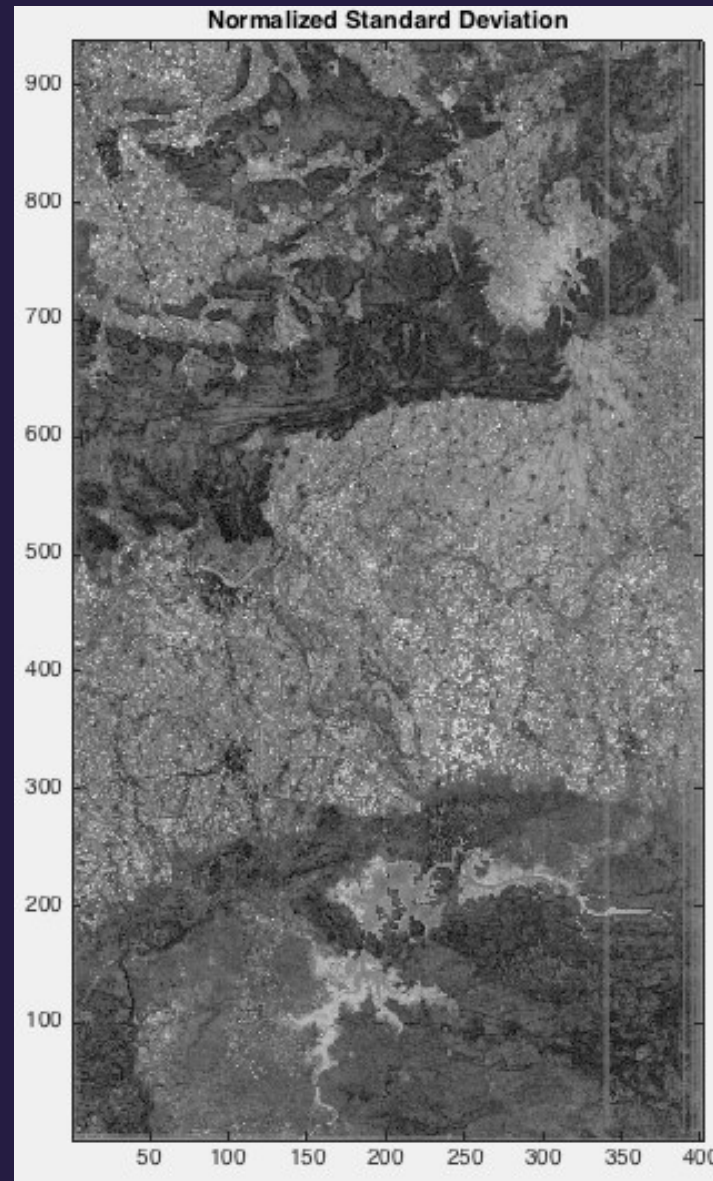
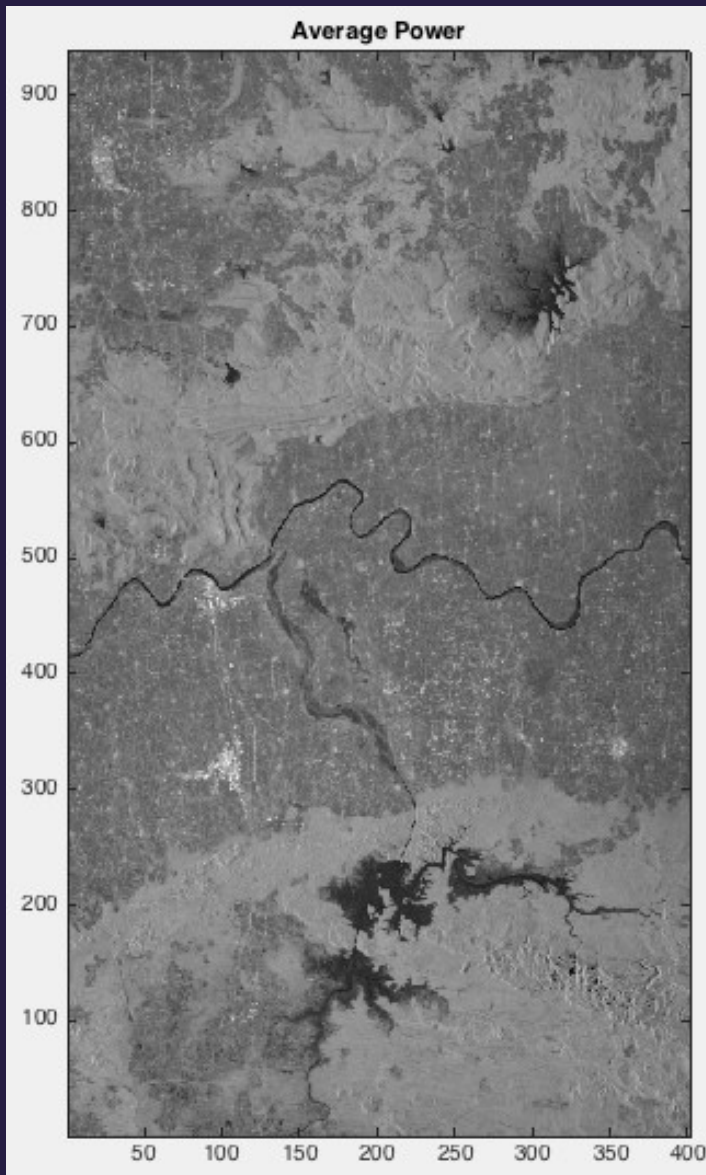


2008 time series



Methods for detecting agricultural activity

The Coefficient of Variation



Average power image used to identify general regions of landcover

Per-pixel standard deviation is a measure of the change over time

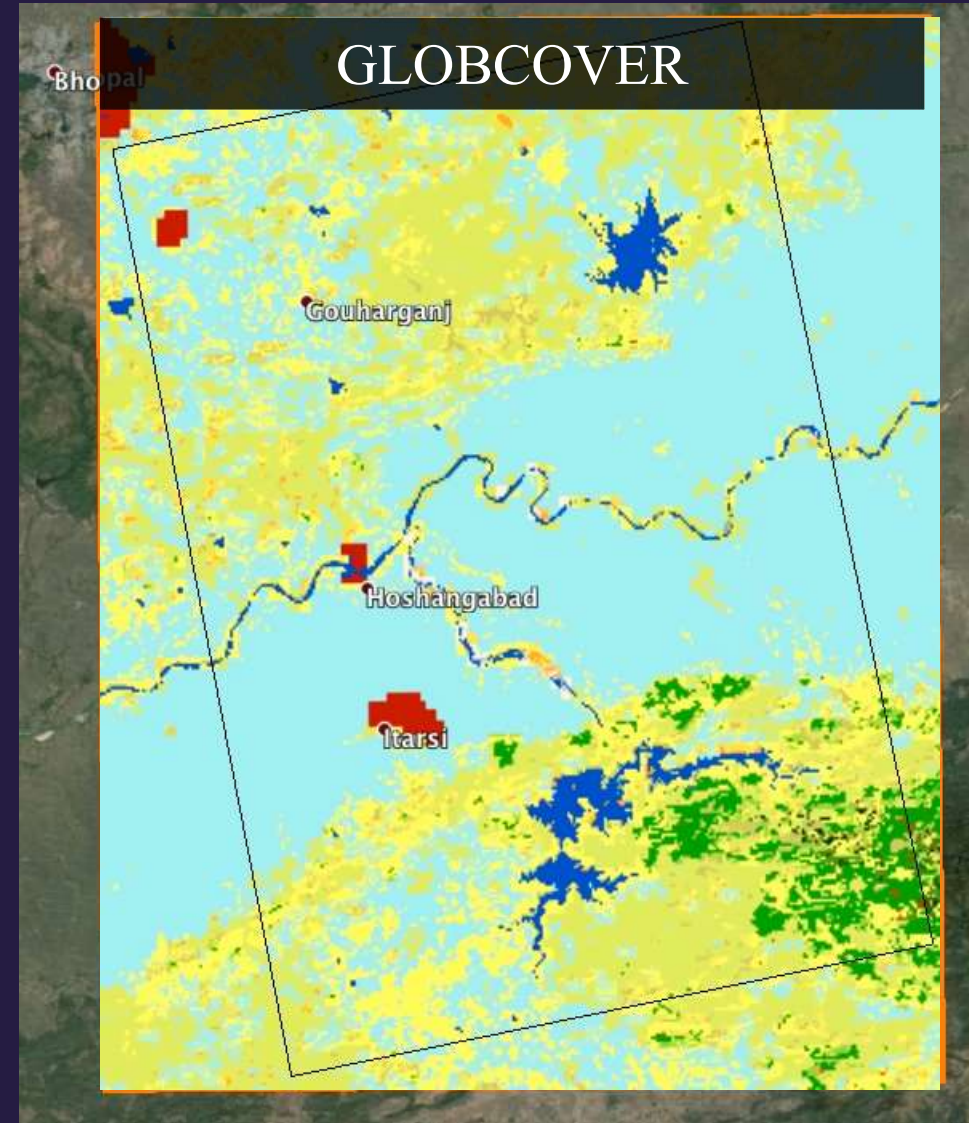
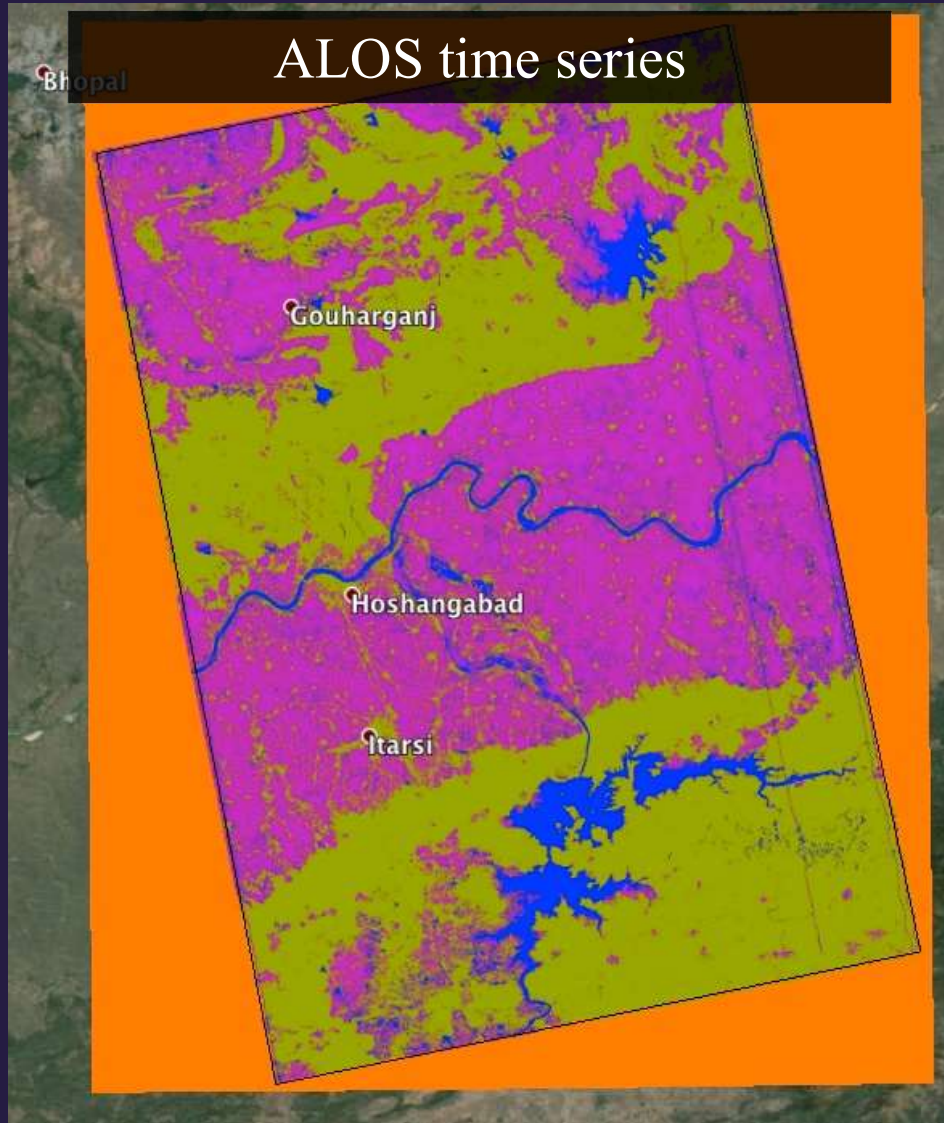
$$\text{metric} = \frac{\text{std. dev.}}{\text{mean}}$$

change metric highlights those areas where the image-to-image variation is unusually large

Methods for detecting agricultural activity

Coefficient of Variation

- Total classification accuracy, including errors in GLOBCOVER, are better than 80%.
- Noted accuracy in differentiating small developments and fixed structures (roads and towns) from agricultural landscapes





1



Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse



JAXA

Use of time-series L-band UAVSAR data for the classification of agricultural fields in the San Joaquin Valley



Tracy Whelen, Paul Siqueira*

Department of Electrical and Computer Engineering, University of Massachusetts, Amherst, MA 01003, United States

Paper topic explores ALOS data collected over the US and shows that even a sporadic time-series can be used to identify crop and no - crop regions over a diverse set of regions across the US.



2



Int J Appl Earth Obs Geoinformation

journal homepage: www.elsevier.com/locate/jag



Coefficient of variation for use in crop area classification across multiple climates



Tracy Whelen, Paul Siqueira*

3



REMOTE SENSING LETTERS, 2018
VOL. 9, NO. 5, 411–420
<https://doi.org/10.1080/2150704X.2018.1430393>



Taylor & Francis
Taylor & Francis Group

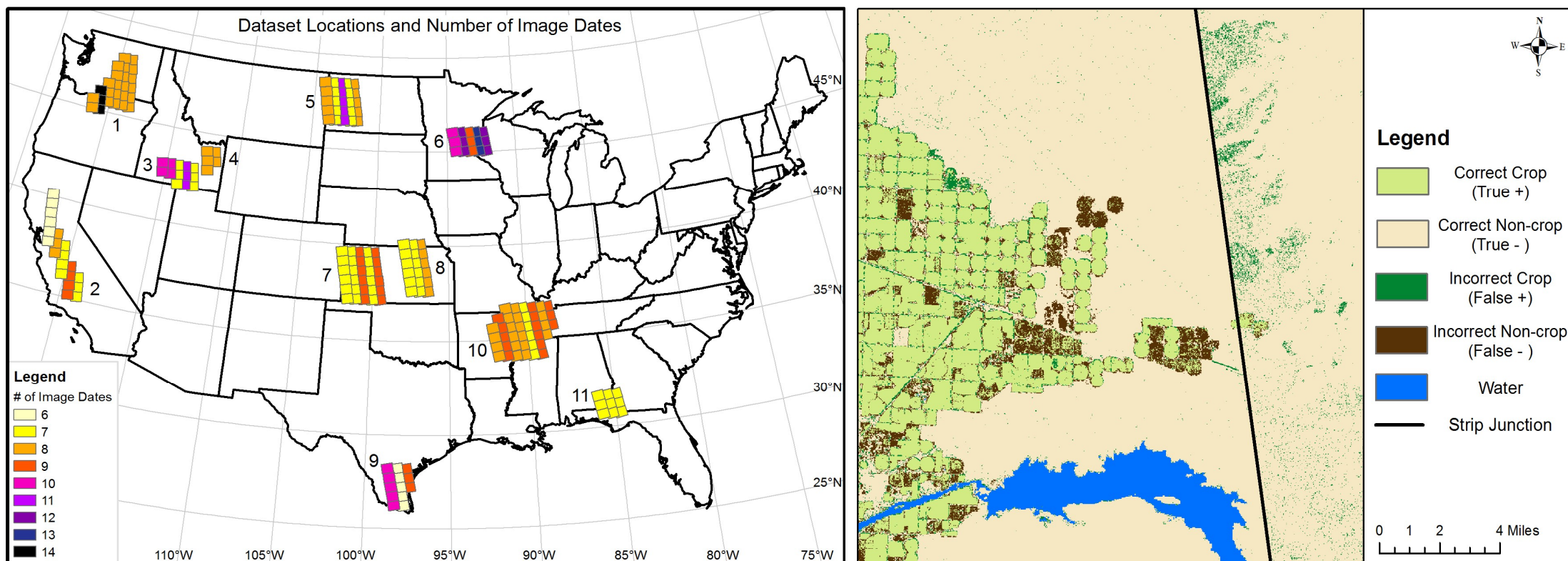


Time-series classification of Sentinel-1 agricultural data over North Dakota

Tracy Whelen  and Paul Siqueira 

Crop Area Determination

- Use coefficient of variation and a simple threshold to detect regions of land management
- ALOS-1 archive used to sample geographically disperse regions in the US where ground validation (USDA's CropScape) is available



Deliverables & Milestones (and comments to JAXA)

- Coefficient of variation paper (RSE) in 2018
- Two other papers on related topics also published
 - * Repeat-pass UAVSAR in California's central valley
used for crop identification
 - * Sentinel-1 time-series used for crop classification
it is likely that an ALOS-2 or NISAR time-series could do similarly and even perform better
- **Lack of consistent ALOS-1 or ALOS-2 data prevents use of long-term time series for creating global products from JAXA data.**

PALSAR/PALSAR-2 data access

Please list the PALSAR/PALSAR-2 data you have requested and obtained

Data over central India, the US, and in the ABoVE domain.

Have you had sufficient data to complete your research (according to your K&C agreement)? **Yes!!**

For KC members who have submitted
proposal for Post-KC

Post-KC proposal

L-band Sensitivity to Biomass and Landcover Structure in the ABoVE domain

Paul Siqueira

University of Massachusetts, Amherst

Curtis Woodcock, BU & Laura Borgeau-Chavez, MTRI

- Project objectives:** study the estimation of biomass in the ABoVE domain. The region is complicated by low biomass and exposure of the radar signature to variations in soil moisture and roughness characteristics.
- Project area(s):** Ecosystem characterization and carbon monitoring
- Satellite data requested from JAXA :** ALOS-2 & MOLI (when available)
- Other data sources to be used:** GEDI & UAVSAR
- Relevance to the 4 K&C thematic drivers:** Carbon cycle science & Environmental Conservation
- Expected outcomes and deliverables:** Map of landcover and biomass estimation over selected regions in the ABoVE domain.

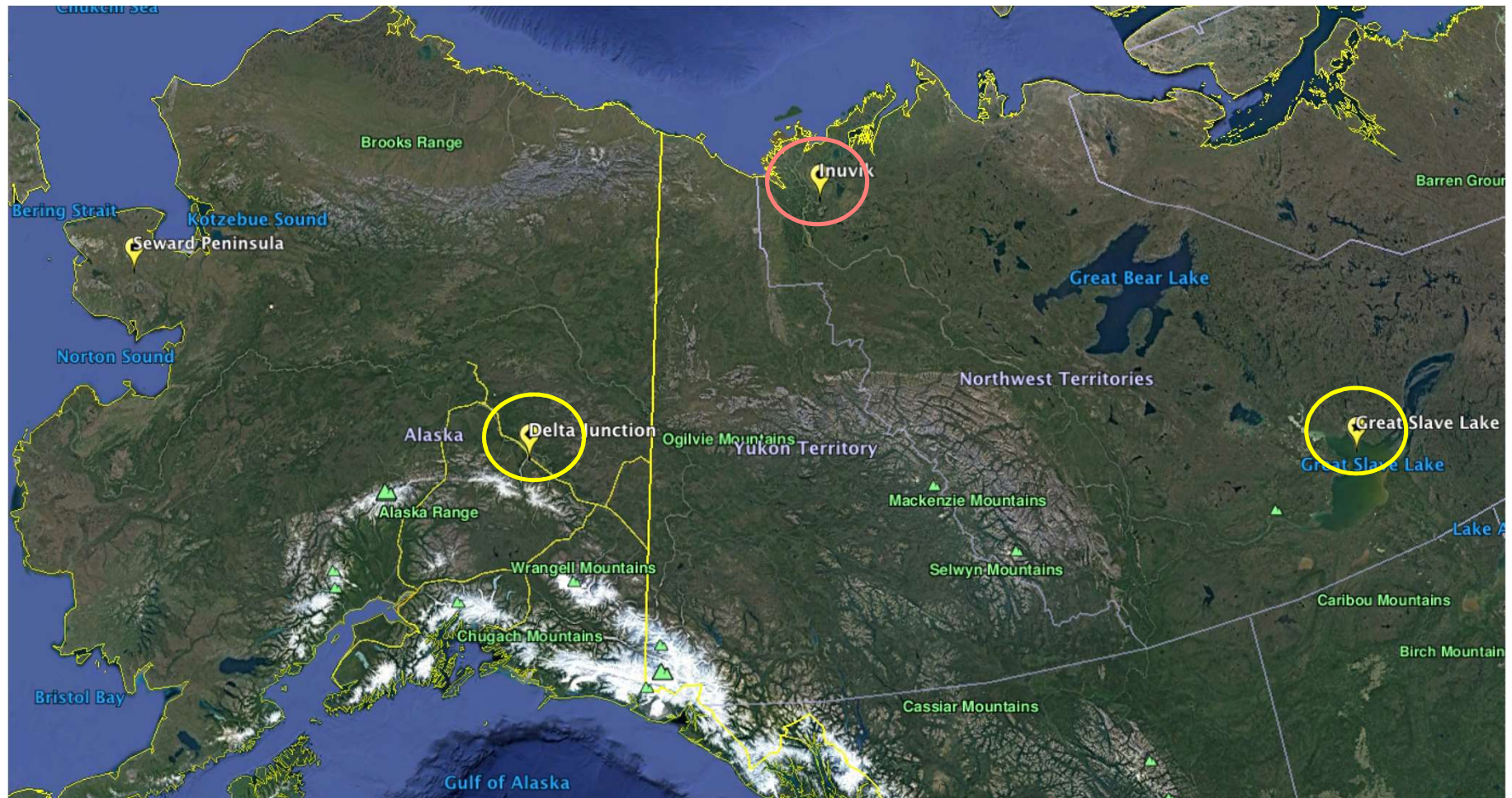
ALOS-2 & ABoVE

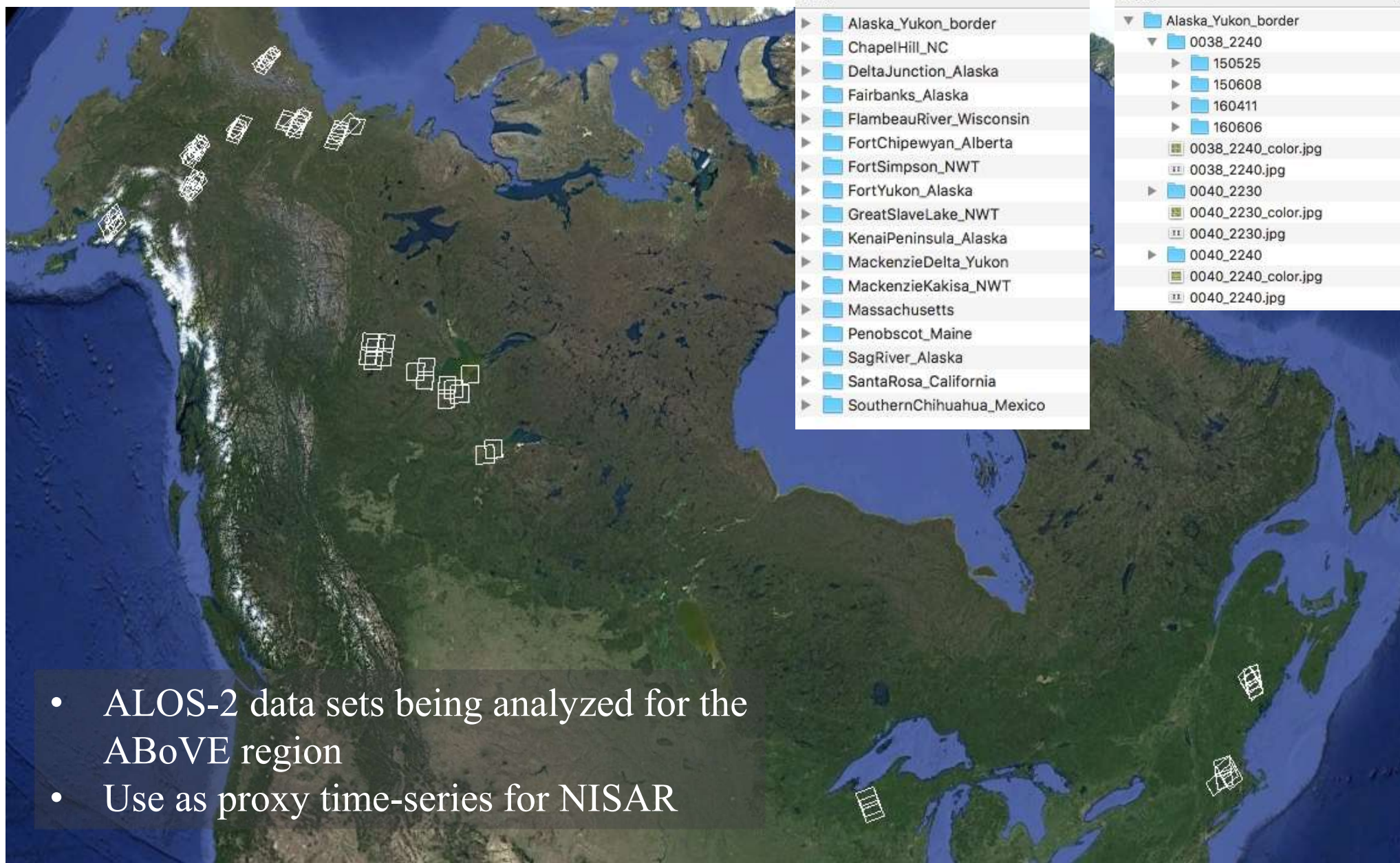
- NASA is in the midst of the **Arctic Boreal Vulnerability Experiment (ABoVE)** intended to study the ecologic consequences of climate change in the boreal region in Alaska and Canada
- Research focus areas on
 - ê Hydrology
 - ê Disturbance (fire, insect)
 - ê Disturbance History (biological succession)
 - ê Permafrost & Landscape effects
 - ê Habitat changes and effects on wildlife



Some study sites in ABoVE

- Intensive air campaign in the ABoVE region in summer 2017
- Snow characterization at Inuvik in March 2018





- ALOS-2 data sets being analyzed for the ABoVE region
- Use as proxy time-series for NISAR