

# Product Delivery Report for K&C Phase 3

Combined Use of SAR, InSAR and Lidar for Measuring Forest Biomass and Structure in the Northeastern United States

> Paul Siqueira University of Massachusetts, Amherst

Science Team meeting #21 – Phase 3 Result Presentations Kyoto Research Park, Kyoto, Japan, December 3-4, 2014

## **Project objectives**

K&C Initiative

An international science collaboration led by JAX

The project objective was to use ALOS/PALSAR data for estimating forest physical characteristics of height, density and biomass. An assessment of the errors associated with these estimates is a critical part of this work. We have been using repeat-pass interferometric ALOS observations over extended areas for estimating Forest Stand Height (FSH).

This project addresses the Carbon cycle science aspect of the original K&C thematic drivers.

# **Results and significant findings**

K&C Initiative

An international science collaboration led by JAX.

- Through the K&C and access to ALOS-1 data, we have developed a method for using repeat-pass InSAR decorrelation magnitude for estimating forest stand height over large region (potentially continental-scale).
- This work began at the beginning of K&C phase 3, to develop the work over the ILCP in Queensland.
- Since then, it was applied to the US state of Maine.

LOS

 More recently we have been applying the algorithm to Colombia

# The BOS provides excellent repeat-coverage for certain regions (here: 17 scenes of 380\_890)

ALOS

**K&C Initiative** An international science collaboration led by JAXA



#### Average Correlation as a function of pair number





## **Visual comparison with LVIS heights**

#### optical

#### LVIS

**INSAR tree height** 

classified water bodies



# Visual comparison and adjustment for temporal decorrelation









# ALOS

## **K&C Initiative** An international science collaboration led by JAXA





# Deliverables – Papers and reports

K&C Initiative

An international science collaboration led by JAX

- To date, there is one paper published, two IGARSS conference presentations (and papers) and a contribution made to the phase 3 K&C report
- Siqueira, P. "Combined Use of SAR, InSAR and Lidar for Measuring Forest Biomass and Structure in the Northeastern United States," K&C Final Report – Phase 3, 4 pp., 2014.
- Lei, Y., P. Siqueira, D. Clewley, and R. Lucas. "Observation of vegetation vertical structure and disturbance using L-band InSAR over the Injune region in Australia." *IEEE Geosci. Rem. Sens. Intl. Symp.*, pp. 1637-1640, Munich, 2012.
- Lei, Y., and P. Siqueira. "An automatic mosaicking algorithm for generating a largescale forest stand height map using spaceborne repeat-pass InSAR coherence." *IEEE Geosci. Rem. Sens. Intl. Symp.,* pp. 84-87. Quebec, 2014.

### **Deliverables – Papers and reports**

Remote Sens. 2014, 6, 10252-10285; doi:10.3390/rs61110252

remote sensing ISSN 2072-4292 www.mdpi.com/journal/remotesensing

**OPEN ACCESS** 

Article

Estimation of Forest Height Using Spaceborne Repeat-Pass L-Band InSAR Correlation Magnitude over the US State of Maine

Yang Lei and Paul Siqueira \*





#### **Qualitative Comparison of Methods**



#### **Quantititave comparison**



LOS

Assuming that forest stand height (FSH) is a proxy for biomass, we can fit observations of RCS, InSAR differential height from the known DEM (phase) and the correlation magnitude height to the LVIS observed heights.

- Low heights work best with RCS.
- Large Heights have best performance with InSAR correlation magnitude



### **Assembling the Mosaic**





## Adjustment for Temporal Decorrelation in the overlap regions





## **Deliverables – Paper in preparation**

- 2 Article
- An automatic mosaicking algorithm for the generation of a
  large-scale forest height map using spaceborne repeat-pass
  InSAR correlation magnitude
- 6 Yang Lei 1, and Paul Siqueira 1\*





### **Advantages of Mosaicking approach**







#### What Next for this approach



#### 20 scenes, 190 interferograms





## 1 km ICESAT-GLAS comparison with ALOS-1





### Improved resolution with ALOS (90m resolution)

**K&C** Initiative An international science collaboration led by JAXA

ALOS



# Deliverables – Data sets and Thematic products

K&C Initiative

An international science collaboration led by JAX

Planned output of the project:

Lidar derived vegetation height map for the Harvard and Howland Forests (done)

Algorithm for using interferometric correlation for estimating effective vegetation heights (done -> journal article)

□ An FSH map for the US state of Maine will be provided by meetings end