Forest Characterization and Biomass Estimation Using ALOS Data

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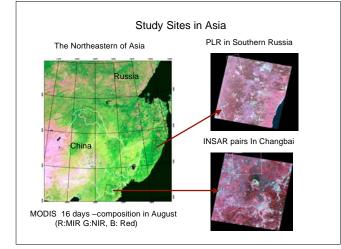PI No. 64, 88, 369

OUTLINE

- Research Objectives
- Study Sites
- Data Acquisition
- Data Processing and Preliminary Results
- Future Works

Research Objectives

- Map forest structure parameters from PALSAR data by using vegetation vertical structure sampled by Lidar, and
- Characterize forest dynamics at high-resolution using multi-sensor data

Study Sites

- Howland (45° 12' N, 60° 08' W), Maine, USA
- Changbai (42.5^o N, 127.8^o E) and Daxinanling (52.5^o N, 124° E), Northeastern China
- Central Siberia and Fareast, Russia

Study Sites in Asia

The Northeastern of Asia

Russia

China

MODIS 16 days –composition in August
(R:MIR G:NIR, B: Red)

PLR in Southern Russia

INSAR pairs In Changbai

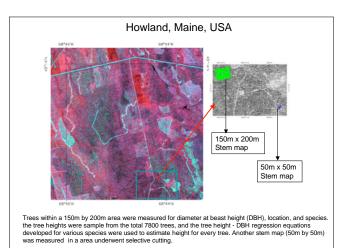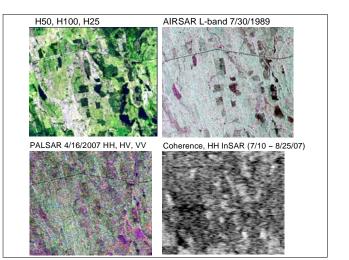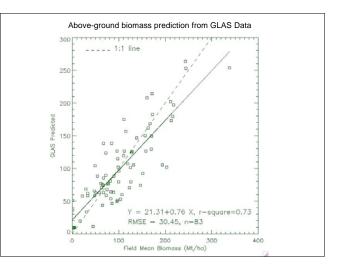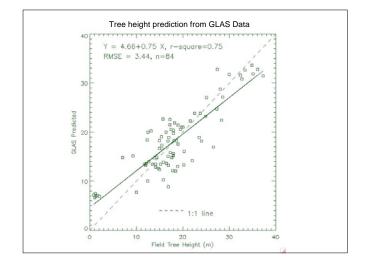# Data Acquisition

PALSAR
- Dual-pl L1.1 InSAR data
- PLR L1.1 InSAR data
- PLR L1.5 SAR data

Lidar data

DEM

Field Measurements

INSAR pairs in our Study Area.

path	frame	Master Obs. date	Slave Obs.date	B_para	B_perp	Mater. ID	Slave. ID	OBS.mode
428	1060	03/09/2007	19/07/2007	493.92	262.4	ALPSRP085701060	ALPSRP078991060	FBD
433	1050	27/08/2007	12/07/2007	434.88	331.42	ALPSRP084681050	ALPSRP077971050	FBD
434	1040	29/07/2007	13/06/2007	-189.66	278.28	ALPSRP080451040	ALPSRP073741040	FBD
425	830	14/07/2007	29/05/2007	90.67	704.76	ALPSRP078260830	ALPSRP071550830	FBD
425	830	29/08/2007	14/07/2007	476.77	433.34	ALPSRP084970830	ALPSRP078260830	FBD
425	840	14/07/2007	29/05/2007	86.75	702.21	ALPSRP078260840	ALPSRP071550840	FBD
425	840	29/08/2007	14/07/2007	479.15	432.9	ALPSRP084970840	ALPSRP078260840	FBD
120	890	27/07/2007	11/06/2007	-245.91	252.5	ALPSRP080090890	ALPSRP073380890	FBD
119	890	25/08/2007	10/07/2007	230.35	136.02	ALPSRP084320890	ALPSRP077610890	FBD
406	950	13/07/2007	28/05/2007	38.14	646.79	ALPSRP078110950	ALPSRP071400950	FBD
406	950	28/08/2007	13/07/2007	458.51	383.83	ALPSRP084820950	ALPSRP078110950	FBD
402	1000	06/08/2007	21/06/2007	-37.24	346.67	ALPSRP081611000	ALPSRP074901000	FBD
401	1000	04/09/2007	20/07/2007	468.54	225.38	ALPSRP085841000	ALPSRP079131000	FBD

The Angle for each scene is the same as 34.3 degrees

Howland, Maine, USA

150m x 200m
Stem map

50m x 50m
Stem map

Trees within a 150m by 200m area were measured for diameter at beast height (DBH), location, and species.
the tree heights were sample from the total 7800 trees, and the tree height - DBH regression equations
developed for various species were used to estimate height for every tree. Another stem map (50m by 50m)
was measured in a area underwent selective cutting.

H50, H100, H25   AIRSAR L-band 7/30/1989

PALSAR 4/16/2007 HH, HV, VV   Coherence, HH InSAR (7/10 ~ 8/25/07)

Above-ground biomass prediction from GLAS Data

$Y = 21.31 + 0.76 \, X$, r-square=0.73
RMSE = 30.45, n=83

Tree height prediction from GLAS Data
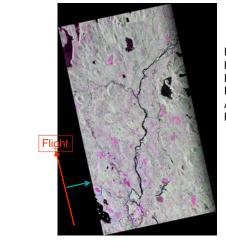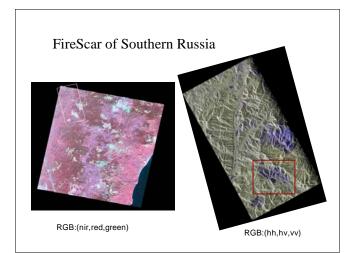
$Y = 4.66 + 0.75 \, X$, r-square=0.75
RMSE = 3.44, n=84

The use of lidar and radar instruments to measure forest structure attributes such as height and biomass are being considered for future Earth Observation satellite missions. Large footprint lidar makes a direct measurement of the heights of scatterers in the illuminated footprint and can yield information about the vertical profile of the canopy. Synthetic Aperture Radar (SAR) is known to sense the canopy volume, especially at longer wavelengths and is useful for estimating biomass. Interferometric SAR (InSAR) has been shown to yield some forest canopy height information.
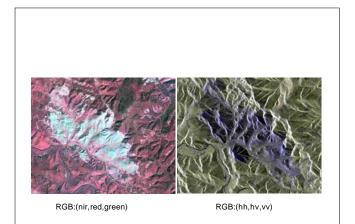
Lidar sampling and radar mapping capabilities will be combined for Forest biomass estimation, and PALSAR data will be the radar data To be used in our studies.
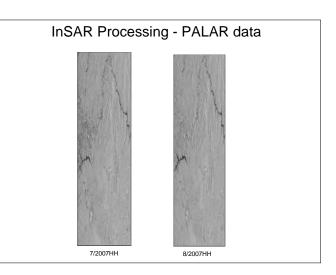
The processing of PALSAR PolSAR and InSAR data is being conducted And preliminary results are presented in following slides.
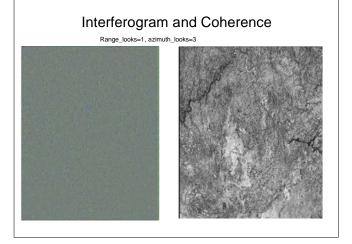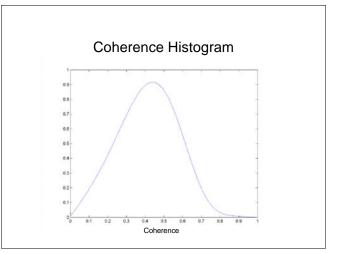
PALSAR data in
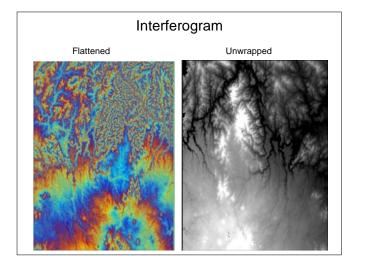Howland, Maine:
PLR Mode
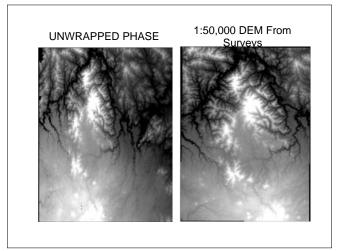Incidence angle 24
Ascending
HH. VV. VH

Flight

FireScar of Southern Russia

RGB:(nir,red,green)

RGB:(hh,hv,vv)

RGB:(nir,red,green)   RGB:(hh,hv,vv)

InSAR Processing - PALAR data

7/2007HH   8/2007HH

Interferogram and Coherence

Range_looks=1, azimuth_looks=3

Coherence Histogram

Coherence

Interferogram

Flattened

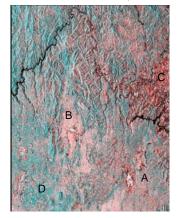Unwrapped

UNWRAPPED PHASE

1:50,000 DEM From Surveys

HH Coherence, intensity

A. Built-up
B. Mature Pine
C. Bush
D. Mixed

Future Works

Polarimetric Data

Ortho-rectification and Terrain-effect radiometric correction (L1.1 data and DEM)

Under current data acquisition plans we will only get very limited polarimetric data. We would like to have polarimetric InSAR data.

InSAR Data

Modify the software and convert unwrapped phase image to surface elevation.

Data Fusion

Forest structural parameters from SAR and lidar data