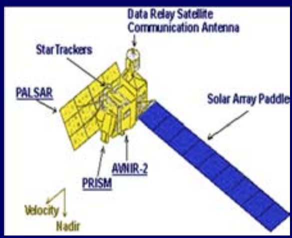
Estimation of Snow Covered Area Using ALOS's PALSAR Data

PI #132: Jiancheng Shi
University of California, Santa Barbara, U.S.A

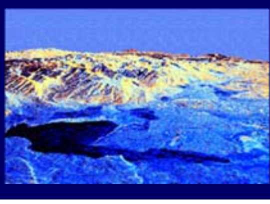


Outline

1. Summary on the current status of snow mapping with SAR;
2. Background on snow mapping with PALSAR/ALOS;
3. Study site description;
4. Initial snow mapping results using PALSAR and comparison with MODIS derived snow maps;
5. Summary.

Problems & Status in SAR Snow Mapping

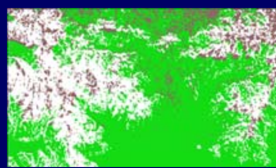
- All single-polarization C-band SARs are limited to map wet snow
- C-band polarization properties can be used to map wet snow without DEM
  - Can't discriminate dry snow from bare surface and short vegetation
  - Wet snow cover is confused with smooth surface
- Multi-frequency & polarization with DEM can map dry snow by using backscattering, polarization, frequency ratio, and synthesis techniques
  - Terrain effects
  - Limited to a certain scale
  - Supervised classification



SAR Measurement Properties

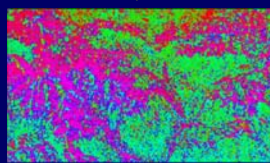
1. Backscattering Intensity
2. Polarization Properties
3. Interferometric Properties

TM



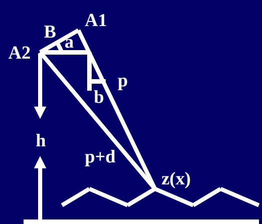
Intensity

Polarization



Interferometric SAR Measurements

Surface topography	z(x)
Sensor altitude	h
Baseline distance	B
Slant range	p
Look angle	b
Baseline angle	a
Path length difference	d
Sensor location	A1 & A2



Correlation Measurement

$$\rho = \frac{<|c_1 * c_2^*|>}{\sqrt{<|c_1|^2><|c_2|^2>}}$$

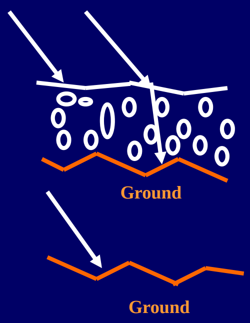
Properties of Interferometric Coherence

- Highly correlated if no change
- Decorrelations
  1. Thermal or system noise decorrelation
  2. Spatial decorrelations
     - Baseline (look angle)
     - Rotation (azimuth angle)
  3. Temporal decorrelations
     - surface change
     - radar frequency

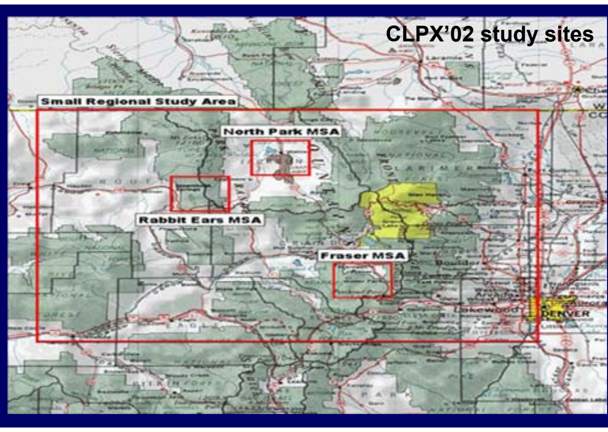
     → time scale

Characteristics of Coherence Measurements over Snow Cover

1. Both images from wet snow
   High coherence: C-band > L-band
2. Both images from dry snow
   High coherence: L-band > C-band
3. One from wet & one from dry snow
   Very low coherence in both bands
4. One from dry snow & one without
   Very low coherence in both bands
5. One from wet snow and one without
   Very low coherence in both bands



Study Site Description - CLPX



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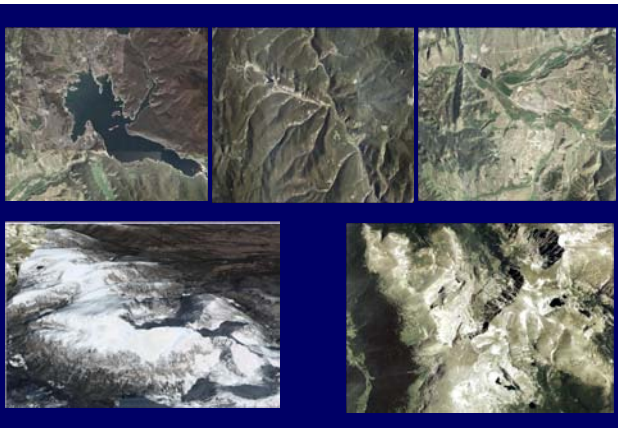
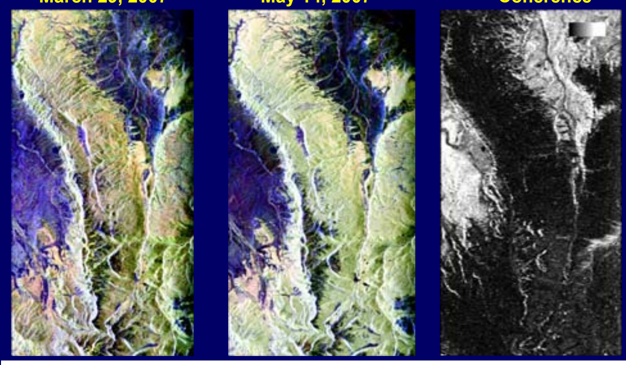
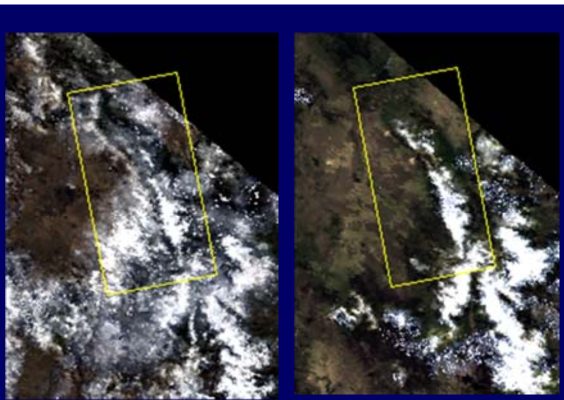


PALSAR Data and Coherence

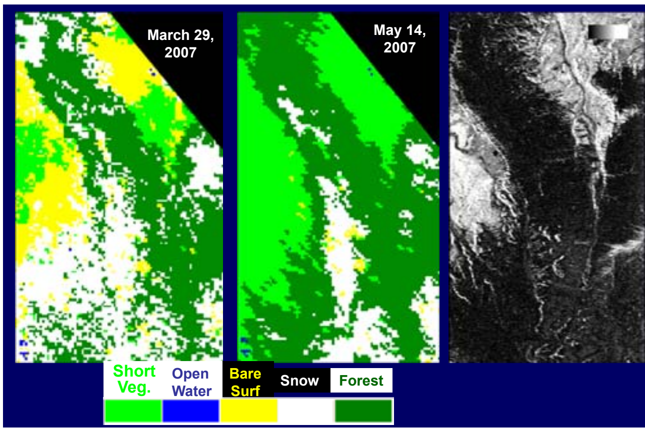


Red → |Shh -Svv| →Double- or even-bounce;
Green → |Shv + Svh| →Volume scattering; Blue → |Shh + Svv| → Single- or odd-bounce.

MODIS images on March 29 and May 14

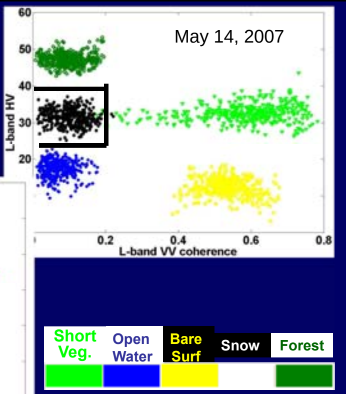


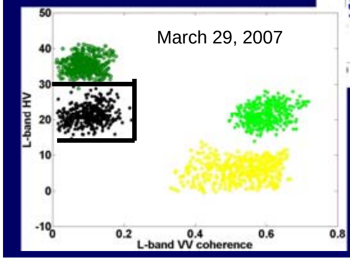
Comparison of MODIS Classifications and PALSAR's Coherence



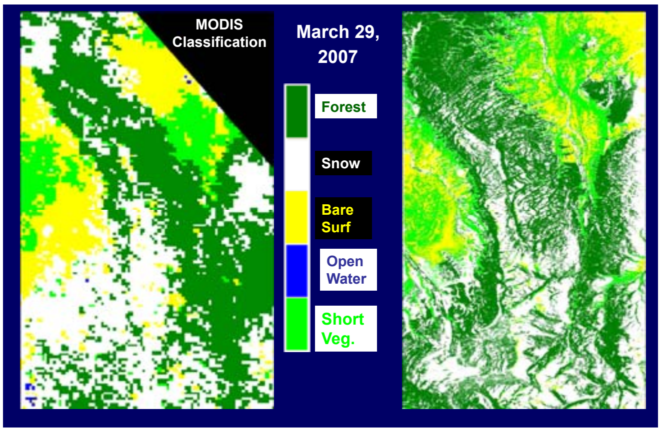
Major Characteristics of Ground Samples in PALSAR's Measurements

1. Bare & short vegetation have higher coherence
2. Snow & lake have low coherence
3. Forest has wide range of coherence





Initial Snow Map Derived from Repeat Pass PALSAR Measurements



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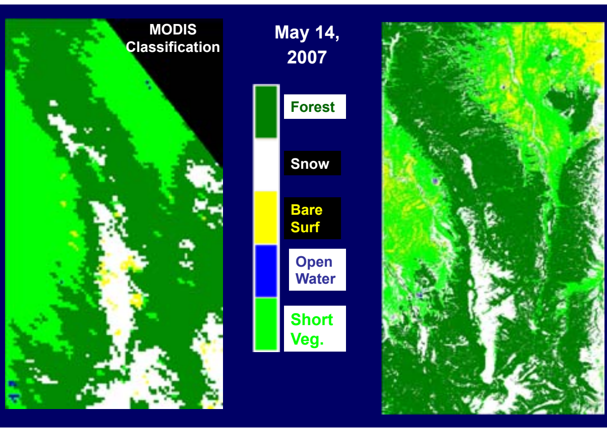

Summary

Interferometric coherence measurement provide a great discriminator for separating snow with bare and short vegetated surfaces, those are the major problems in snow mapping with intensity and polarization SAR measurements.

Repeat pass L-band PALSAR can map both dry and wet snow

1) using coherence measurement - separate snow, water, forest with others;

2) using backscattering - separate snow with water and forest.