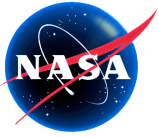# Ground measurements over BERMS during CanEx-SM10

Ruzbeh Akbar, Mariko Burgin, Josh Fisher, Sab Kim,

Mahta Moghaddam
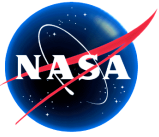
2nd SMAP Cal / Val Workshop

Oxnard, CA

May 3, 2011

CanEx-SM10 @ BERMS

- Visited the Boreal Ecosystem Research Monitoring Sites (BERMS)

- Sites are located north of Prince Albert, in Saskatchewan, Canada, near the southern extent of the boreal forest

- Nearly synchronous ground measurements and UAVSAR data
  - Ground measurements by the vegetation team (1 team of 5) were taken on June 14 – 16, 2010
  - Ground measurements by the soil teams (6 teams of 2) were taken on June 16, 2010
  - UAVSAR data were collected on June 16, 2010

Vegetation Sampling @ BERMS

The vegetation team visited five sites during June 14 – 16, 2010:

Old jack pine (OJP)
at (53.92 N, 104.69 W)
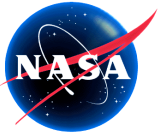
Young jack **pine** (YJP)
also called H02
at (53.95 N, 104.65 W)

Old black spruce (OBS)
at (53.99 N, 105.12 W)

Fen (Fen)
at (53.78 N, 104.62 W)

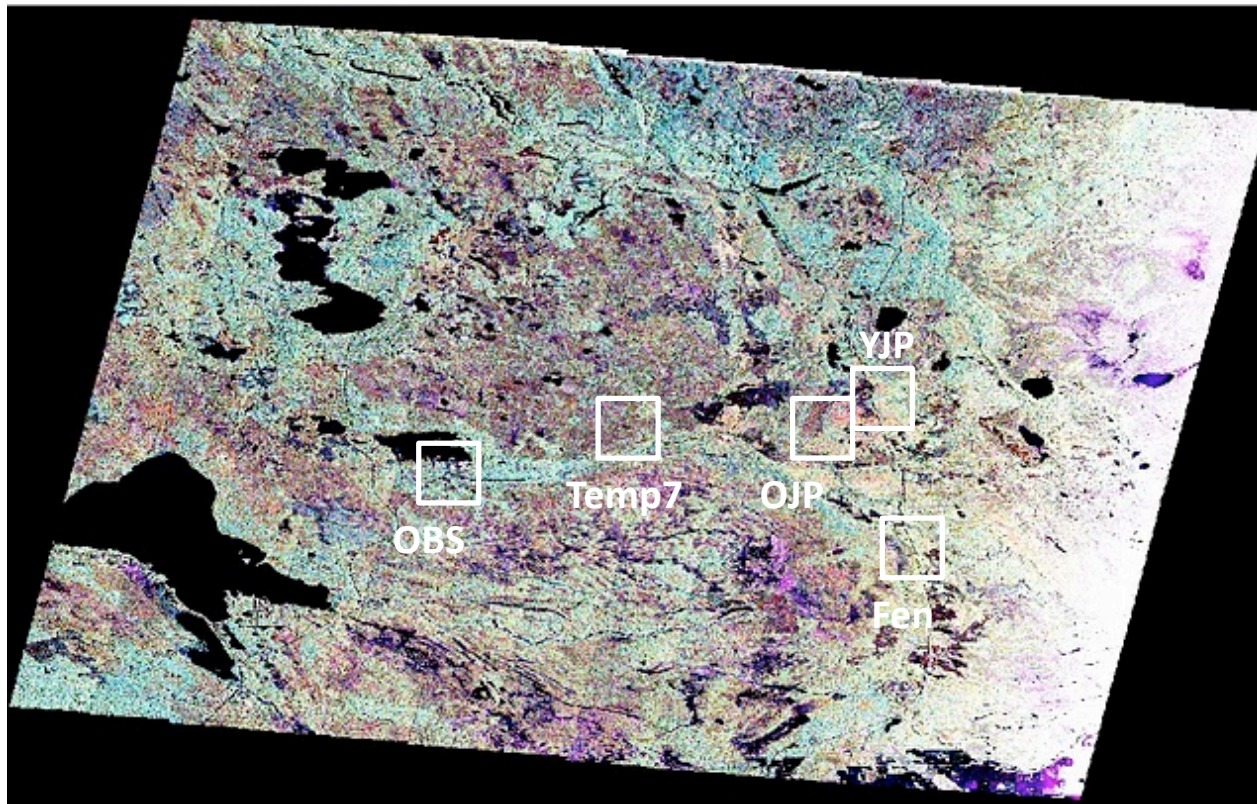Mixed forest (Temp7)
at (53.90 N, 104.88 W)

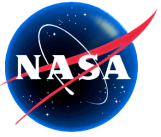# UAVSAR @ BERMS

UAVSAR data over BERMS from June 16, 2010

RGB figure:
HH = red
VV = blue
HV = green

OJP: Old jack pine   **YJP**: Young jack pine   **OBS**: Old black spruce
Fen: Fen   **Temp7**: Mixed forest site

OJP

OBS

YJP

Fen

Temp7

BERMS Sites Visited
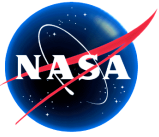
OJP   Old jack pine (coniferous) with lichen understory on dry grounds
          Mean height: 13.4 m

YJP   Harvested jack pine 2002 (H02)
          Ground cover consisting of sparse grass, shrubs and immature jack pine
          seedlings
          Mean height: 1.82 m

OBS   Mature old black spruce with moss and Labrador tea understory on wet
          ground
          Mean height: 7.0 m

Temp7   Mixed forest with pine, fir, and aspen
          Mean height: 6.44 m, 6.87 m and 10.17 m (respectively)

Fen   Flooded vegetation, among others horse tail, grass and 2-3 kinds of shrubs
          Mean height: 35.6 cm, 45.7 cm and 43.2-96.5 cm (respectively)
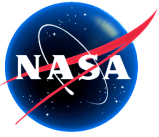
BERMS Sampling Strategy

At each site, a 100 m transect was sampled, along which a starting point is located and several measurements are taken in 10 m intervals.

- At each 10 m step, the following parameters were recorded:
    - Leaf area index (LAI)
    - Soil moisture
    - Percentage of ground cover
    - Percentage of necromass on ground
    - Crown fractional cover
    - Litter depth

- Between the 10 m marks, each tree was recorded if located inside a space of 1m on each side of the transect (arm span). The recorded data were:
    - Number of trees
    - Diameter at breast height (DBH) for each tree
    - Tree height for each tree

- One "average" tree was destructively sampled at each site
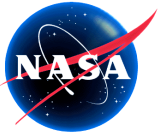
Example Transects

Transects overlain on UAVSAR coordinates:
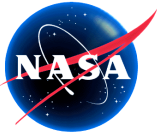
Sample Vegetation Data

- Based on the data set at each location, allometric relations can be established

- Examples shown below for DBH vs. Tree height for OJP and YJP

DBH vs. Tree height

$y = 9.5048x^{1.4875}$
$R^2 = 0.79875$

YJP DBH (mm) vs YJP Tree height (m)

DBH vs. Tree height

$y = 20.352x^{0.7299}$
$R^2 = 0.43611$

OJP DBH (mm) vs OJP Tree height (m)
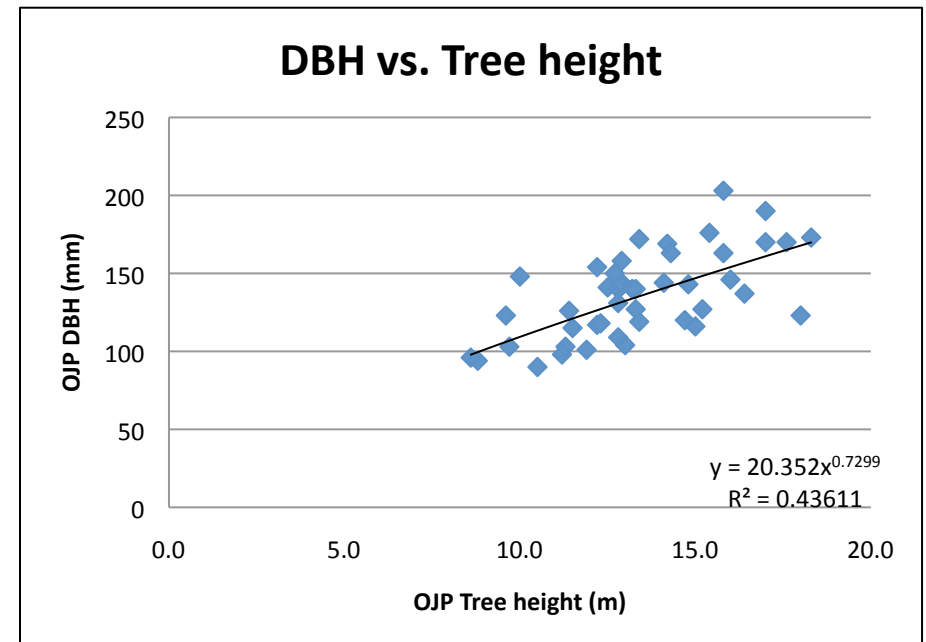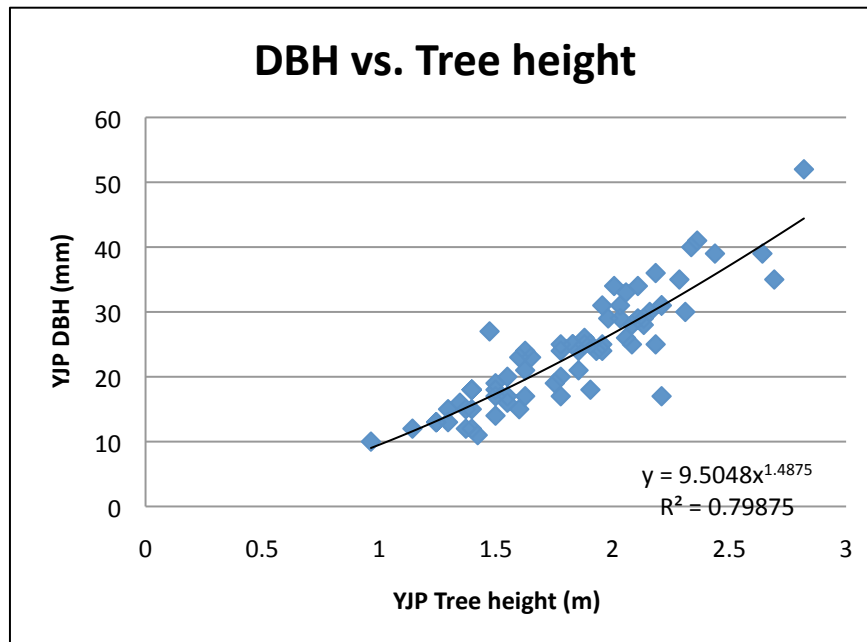
Radar Scattering Model Validation

Each forest stand was modeled by utilizing a discrete microwave scattering model*

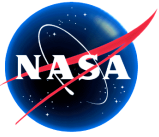The model assumes a rough surface with two overlying layers
• trunk layer containing trunks
• canopy layer populated by large branches, small branches, and needles/leaves

The input parameters are:
• **Canopy height**
• branch <u>dielectric</u>, *length*, *radius*, *density* and *orientation*
• Needle/Leaf <u>dielectric</u>, *length*, *radius*, and *density*
• Trunk <u>dielectric</u>, *length*, *radius* and <u>density</u>
• Soil <u>dielectric</u>, and <u>RMS height</u>
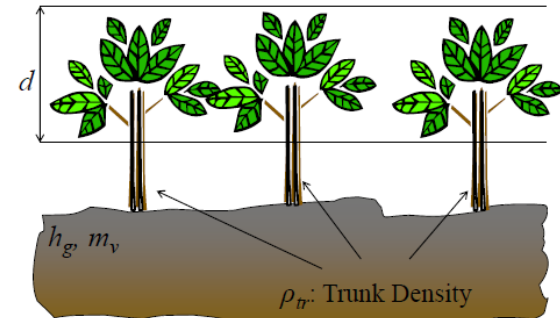
* S. Durden, J. van Zyl, and H. Zebker, "Modeling and observation of the radar polarization signature of forested areas", *IEEE Trans. Geosci. Remote Sens.*, vol. 27, no. 3, pp. 290-301, May 1989.
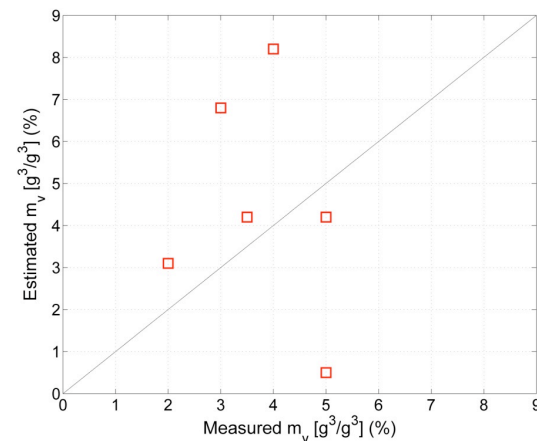
Radar Retrieval Examples

Inversion for soil moisture (amongst other parameters) with UAVSAR data showed good results for OJP and YJP, and acceptable results for OBS.

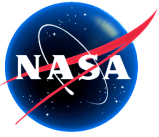Example of inversion results for OJP:
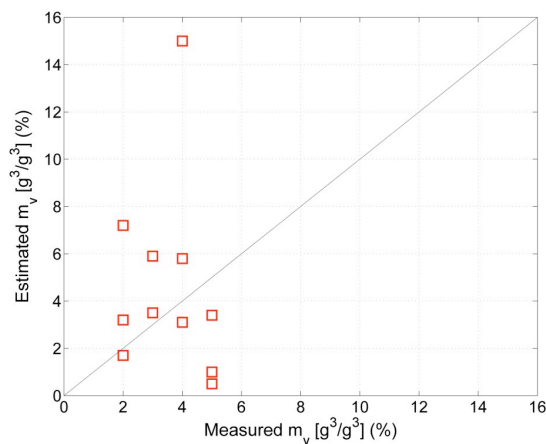
Average error is -1.0% and RMS error is 4.3%. (6m×12m)

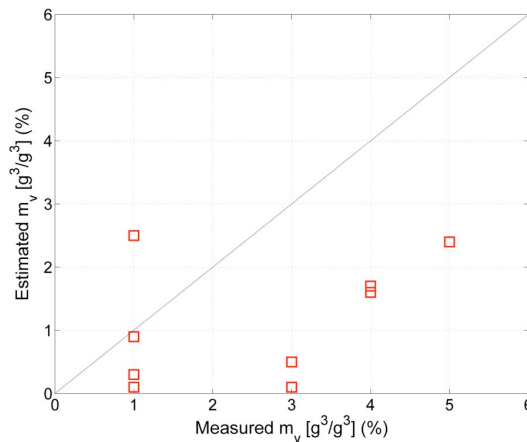Average error is -0.8% and RMS error is 3.0%. (18m×36m)

* A. Tabatabaeenejad, M. Burgin and M. Moghaddam, "Potential of L-band Radar for Retrieval of Canopy and Subcanopy Parameters of Boreal Forests", *IEEE Trans. Geosci. Remote Sens.*, in review.
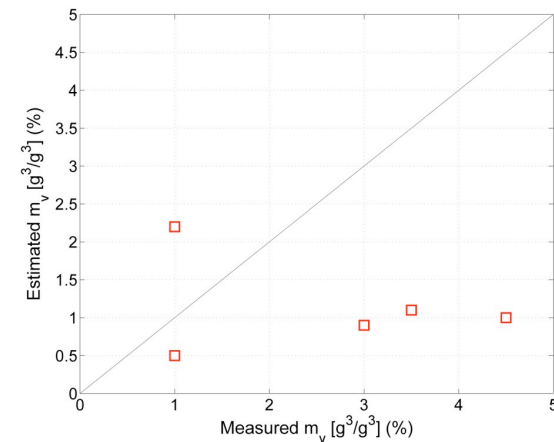
Alireza Tabatabaeenejad

Radar Retrieval Examples

Inversion for soil moisture (amongst other parameters) with UAVSAR data showed good results for OJP and YJP, and acceptable results for OBS.
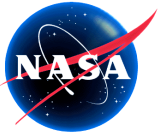
Example for YJP:

Average error is 1.4% and RMS error

is 2.0%. (6m×12m)

Average error is 1.5% and RMS error

is 2.2%. (18m×36m)

* A. Tabatabaeenejad, M. Burgin and M. Moghaddam, "Potential of L-band Radar for Retrieval of Canopy and Subcanopy Parameters of Boreal Forests", *IEEE Trans. Geosci. Remote Sens.*, in review.
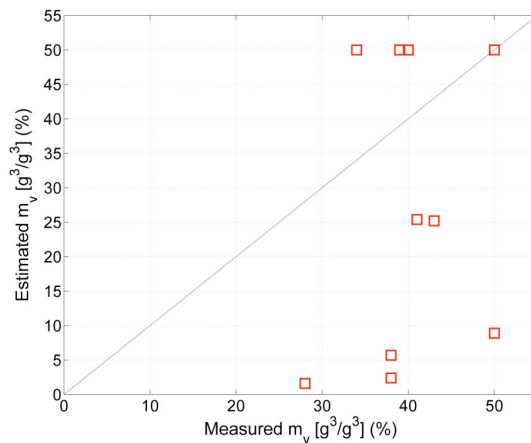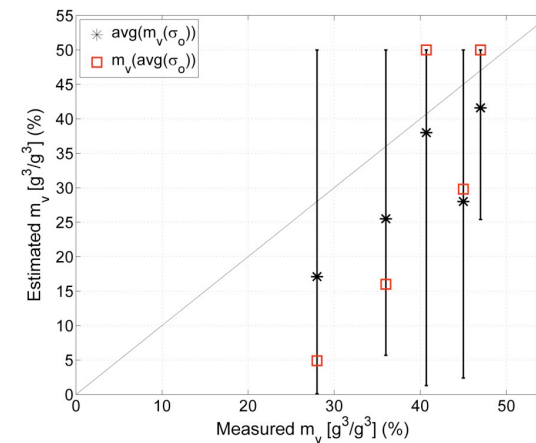
12

Radar Retrieval Examples

Inversion for soil moisture (amongst other parameters) with UAVSAR data showed good results for OJP and YJP, and acceptable results for OBS.

Example for OBS:

Average error is 13.7% and RMS error is 24.3%. (6m×12m)

Average error is 9.2% and RMS error is 15.9%. (18m×36m)

Average error is 9.3% and RMS error is 10.5%. (18m×36m)

* A. Tabatabaeenejad, M. Burgin and M. Moghaddam, "Potential of L-band Radar for Retrieval of Canopy and Subcanopy Parameters of Boreal Forests", *IEEE Trans. Geosci. Remote Sens.*, in review.

13

OJP

YJP

OBS

Fen

Temp7