Ground measurements over BERMS during CanEx-SM10

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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
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 data over BERMS from June 16, 2010

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

RGB figure:
HH = red
VV = blue
HV = green
BERMS Sites Visited

- OJP
- OBS
- YJP
- Temp7
- Fen
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:

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<th>18m×36m</th>
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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**

- YJP
  - Equation: $y = 9.5048x^{1.4875}$
  - $R^2 = 0.79875$

- OJP
  - Equation: $y = 20.352x^{0.7299}$
  - $R^2 = 0.43611$
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 dielectric, length, radius, density and orientation
- Needle/Leaf dielectric, length, radius, and density
- Trunk dielectric, length, radius and density
- Soil dielectric, and RMS height

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)

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:

![Graphs showing radar retrieval examples]

- 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)

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)
