Radar remote sensing plays an important role in Forest growing stock volume (GSV) estimation. Following Forest Dragon algorithm (Cartus et al., 2011), we used the water-cloud model to estimate the GSV in Xunke test site, Heilongjiang province in northeast China. To improve the training of the model, we added the polarimetric entropy from PALSAR FBD C2 matrix to MODIS VCF for classifying dense forest and open area. The multi-temporal estimates were combined by taking the backscatter dynamic range of the forest in each image as weight. The results were validated with forest inventory data. At 5 GSV levels, the overall classification accuracy is 71%. At forest stand level, the multi-temporal estimate has a RMSE of 11.75.

Data:
1. ALOS PALSAR FBD (2007-2008)
2. GDEM
3. MODIS VCF
5. Landcover map (2005)
6. Field work measurement (2012)

1) We followed the way of (Cartus et al., 2011 & 2012) to train the model by taking the mode values of the masked dense forest and open area as canopy backscatter and ground backscatter. In addition to MODIS VCF, we add the entropy image from PALSAR FBD data (Cloud, 2007) itself in the masking process.

The accuracy was assessed with the forest inventory data and field measurements.

In terms of five stem volume levels, the overall classification accuracy is 71.1%.

At forest stand level, the accuracy is assessed by RMSE and relative RMSE:

<table>
<thead>
<tr>
<th>Data</th>
<th>RMSE (m³/ha)</th>
<th>r-RMSE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20070602 HH</td>
<td>54.71</td>
<td>88.11</td>
</tr>
<tr>
<td>20070602 HH</td>
<td>18.41</td>
<td>29.65</td>
</tr>
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<td>20070601 HH</td>
<td>42.16</td>
<td>67.90</td>
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<tr>
<td>20070607 HH</td>
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</tr>
<tr>
<td>20070602 HH</td>
<td>34.00</td>
<td>54.76</td>
</tr>
<tr>
<td>20070602 HH</td>
<td>19.39</td>
<td>31.22</td>
</tr>
<tr>
<td>20070602 HH</td>
<td>11.75</td>
<td>18.92</td>
</tr>
</tbody>
</table>

1. In this work, we tested the former Forest Dragon algorithm on forest stem volume estimation with ALOS PALSAR FBD data and achieved good result in a test site of Northeast China forest.
2. This model-based method is independent of forest inventory data and is adaptable to environmental changes for SAR data acquisition.
3. We introduced PALSAR FBD entropy to enhance the performance of model training.
4. In this work, the result was only validated at forest stand level. More validation is needed.

Method

1) Water-cloud model with gaps for boreal forest (Askne et al., 1995)

\[
\hat{V} = \frac{1}{\beta} \ln \left( \frac{\sigma_{veg}^0 - \sigma_{gr}^0}{\sigma_{veg}^0 - \sigma_{gr}^0} \right)
\]

We combined the individual GSV estimates with different weights following the approach of (Santoro et al., 2011; Cartus et al., 2012; Santoro et al., 2013):

\[
\hat{V}_i = \sum w_i \hat{V}_i, \quad \text{with} \quad w_i = \left( \frac{\sigma_{veg}^0 - \sigma_{gr}^0}{\sigma_{veg}^0 - \sigma_{gr}^0} \right),
\]

Vi is the ith estimate. The weight Wi is the dynamic range of the forest backscatter in each image.

Conclusions & further work

1. In this work, we tested the former Forest Dragon algorithm on forest stem volume estimation with ALOS PALSAR FBD data and achieved good result in a test site of Northeast China forest.
2. This model-based method is independent of forest inventory data and is adaptable to environmental changes for SAR data acquisition.
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Reference