Estimation of Grassland Parameters Using SAR Interferometry and Polarimetry

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Outline

▶ Objective of the study
▶ Study area
▶ Satellite data and methods
▶ Results up to now
▶ Conclusions
Objective

- Detect mowing events of grasslands
- Investigate whether SAR is sensitive to change in grass biophysical parameters
Motivation

- Grasslands cover approximately one quarter of the world’s land surface
- Maintenance is usually supported by the authorities – remote sensing can be used for verifying subsidy claims
- And it is an interesting topic from the scientific point of view!
Study area

58°14'55" N
26°17'45" E
Instruments

- Radarsat 2 (x13)
  - 7.5 x 7.5 m
  - HH, HV, VH, VV
- COSMO-SkyMed (x19)
  - 3 x 3 m
  - HH
- TanDEM-X (x12)
  - 3 x 3 m
  - HH, VV
Temporal coverage

T - TanDEM-X; R - Radarsat 2; C - COSMO-SkyMed
<table>
<thead>
<tr>
<th>Field Nr.</th>
<th>Area [ha] (nr of pixels)</th>
<th>min/max height [cm]</th>
<th>min/max biomass, wet and (dry) [g]</th>
<th>min/max soil moist. [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP1</td>
<td>13.0 (29443)</td>
<td>10/70</td>
<td>60/727 (9/180)</td>
<td>4/35</td>
</tr>
<tr>
<td>TP2</td>
<td>24.9 (56522)</td>
<td>10/80</td>
<td>51/857 (12/165)</td>
<td>7/35</td>
</tr>
<tr>
<td>TP3</td>
<td>4.8 (11005)</td>
<td>0/60</td>
<td>0/880 (0/180)</td>
<td>8/39</td>
</tr>
<tr>
<td>TP4</td>
<td>9.3 (21134)</td>
<td>10/120</td>
<td>61/615 (10/135)</td>
<td>7/46</td>
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<tr>
<td>TP5</td>
<td>4.0 (9012)</td>
<td>0/180</td>
<td>0/1166 (0/325)</td>
<td>9/53</td>
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<tr>
<td>TP6</td>
<td>9.1 (20687)</td>
<td>5/100</td>
<td>23/1110 (5/160)</td>
<td>6/40</td>
</tr>
<tr>
<td>TP7</td>
<td>11.3 (25635)</td>
<td>0/60</td>
<td>0/866 (0/150)</td>
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<td>10.1 (22868)</td>
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<td>41/1305 (10/230)</td>
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<td>TP10</td>
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<td>TP11</td>
<td>12.6 (28565)</td>
<td>3/75</td>
<td>101/1830 (15/580)</td>
<td>6/39</td>
</tr>
</tbody>
</table>
Methods

- **Polarimetry**: investigates how objects backscatter signals of different polarization
- **Interferometry**: in this case it provides a measure of stability
Polarimetry

- Entropy $H$: one dominant scatterer (low entropy), several similar scatterers (high entropy)
- Dominant scattering angle $\bar{\alpha}$: from surface ($\bar{\alpha} = 0^\circ$), volume ($\bar{\alpha} = 45^\circ$), dihedral ($\bar{\alpha} = 90^\circ$)
- HH/VV intensity ratio
- Coherence between HH and VV channels
- $T_{12}$ coherence: between HH+VV and HH-VV polarimetric channels
Interferometric coherence

- **Interferometric coherence**: measure of stability
- main sources of decorrelation: geometric and/or temporal
PolSAR results
Modeling: coherence

![Graph showing the relationship between particle anisotropy and polarmetric HH/VV coherence magnitude. The graph includes several curves labeled \(\Delta = 5\), \(\Delta = 25\), \(\Delta = 45\), \(\Delta = 65\), and \(\Delta = 85\).]
Modeling: entropy

![Graph showing the relationship between H2α entropy and particle anisotropy, A_p. The graph includes curves for different values of Δ (Δ = 5, 25, 45, 65, 85) and shows the entropy increasing as particle anisotropy increases.)
InSAR: biomass

The graph shows the relationship between coherence and wet biomass, measured in grams. The x-axis represents wet biomass ranging from 0 to 1200 grams, while the y-axis represents coherence ranging from 0 to 1. The data points indicate a trend where coherence decreases as wet biomass increases.
InSAR: height

- Chart showing the relationship between coherence and grass height (cm).
- HH/VV coherence magnitude and H2$\alpha$ entropy are the most sensitive parameters to mowing events.
- Grass height is not predictable.
Coherence is also dependent on vegetation ground cover.

When a certain level of cover is reached, total decorrelation occurs.

Grass height is not predictable.

However, it might be possible to detect mowing events (if certain conditions are met).
Thank you for your attention!
Questions?

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