Microwave remote sensing of soil moisture and surface state

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Microwave missions for soil moisture
WACMOS/CCI merging methodology

1. Individual radiometer products

2. Individual scatterometer products

3. Scaling and merging passive products to climatology AMSR-E

4. Scaling and merging active products to climatology ASCAT

5. Rescale active and passive to GLDAS-NoahSSM reference

6. Test sensitivity to vegetation density

7. Blend rescaled active and passive datasets
Merging active and passive observations

- For areas with moderate to dense vegetation we use active
- For (semi-)arid areas we use passive
- In transition zones we use both by averaging
- Ranking maps are dynamic over time, depending on available sensors
Data density over time

Dorigo et al., 2013, RSE
Validation using ERA-Land SM estimates

- a) Correlation values between ECV_SM and ERA-Land over 1980-2010 (p-value<0.05),
- b) size of the 95% confidence interval
- c) number of observations used for the comparison

- poor scores at high latitudes, altitude and in arid areas,
- good scores obtained in the tropics and close to the Equator, and over Australia (strong seasonal cycle)
Global anomalies


Parinussa et al., 2013, BAMS
Is ECV_SM good enough to capture trends?

1988-2010 trends

CCI ECV_SM

NDVI GIMMS 3g

Dorigo, et al. (2012), GRL
Comparison of the leading Empirical Orthogonal Function (EOF) of six updated tree-ring chronologies of Araucaria with (A) regional satellite-observed summer (Dec–Feb) soil moisture and (B) correlation field between this EOF and summer soil moisture variability across southern South America from 1979 to 2000.

Muñoz et al. (2013), Austral Ecology
**MW soil moisture for better understanding of land atmosphere interaction**

<table>
<thead>
<tr>
<th></th>
<th>Observations</th>
<th>Models</th>
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<tbody>
<tr>
<td></td>
<td>AMSP-E CNORPH</td>
<td>ASCAT CNORPH</td>
</tr>
<tr>
<td>Moist tropics</td>
<td>89.5 (587)</td>
<td>13.8 (196)</td>
</tr>
<tr>
<td>Savanna</td>
<td>1.13 (1298)</td>
<td>&lt;0.01 (6666)</td>
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<tr>
<td>Semi-arid</td>
<td>&lt;0.1 (2345)</td>
<td>&lt;0.1 (7880)</td>
</tr>
<tr>
<td>Arid</td>
<td>&lt;0.1 (1881)</td>
<td>&lt;0.1 (3752)</td>
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<tr>
<td>Temperate</td>
<td>58.1 (6224)</td>
<td>0.12 (427)</td>
</tr>
<tr>
<td>Continental</td>
<td>9.5 (1161)</td>
<td>&lt;0.01 (6514)</td>
</tr>
</tbody>
</table>

Microwave Remote Sensing of Surface State

- Mirror reflection makes MW a potential water body detector

- ENVISAT ASAR Wide swath
  - 150 m resolution
  - ~10 day revisit time
  - C-Band – sensitivity to weather in case of this specific application – more than 50% affected

Continuity with Sentinel 1

Bartsch et al., 2012
Microwave Remote Sensing of Surface State

- Dielectric conductivity of ice much lower than for water → makes MW a good “frost detector”

![Graph and map showing different states on the surface](image-url)
Microwave Remote Sensing of Surface State

- **ASCAT Surface State Flag product**

Naeimi et al., 2012
Microwave Remote Sensing of Surface State

- Start/end of the season

Naeimi et al., 2012
Thank you for your attention