TERENO - CT Environmental Sensing

Activities Since the Last Workshop in 2011…

Airborne Campaigns
• Planning of airborne and the associated ground measurements campaigns (3 Observatories: Rur, Ammer, Bode)
• Conduction of the airborne campaigns (May/June 2011)
• Processing of the ground and airborne data
• Model inversion to soil moisture (polarimetric SAR Data)

CT Environmental Sensing
• Meeting at the 29.11.2011
• Coordination of the acquired data distribution and exchange of ground meas.
• Discussion about common research interests and coordination of research interests
• Planning and coordination of airborne campaigns in spring 2012

Satellite Data Acquisition
• TerraSAR-X and TanDEM-X data collection
• Rapid Eye Data collection
## Common Airborne Campaigns within TERENO

<table>
<thead>
<tr>
<th>Year</th>
<th>Observatory</th>
<th>Optic</th>
<th>SAR</th>
<th>Radiometry</th>
<th>In Situ</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2008</td>
<td>Rur</td>
<td>---</td>
<td>E-SAR L-band</td>
<td>PLMR EMIRAD-2</td>
<td>Soil Moisture</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HUT-2D</td>
<td></td>
</tr>
<tr>
<td>May-June 2011</td>
<td>Rur</td>
<td>---</td>
<td>F-SAR L-band</td>
<td>PLMR</td>
<td>Soil Moisture</td>
</tr>
<tr>
<td></td>
<td>Bode</td>
<td>Hyper-spectral</td>
<td>F-SAR L-band</td>
<td>---</td>
<td>Soil Moisture</td>
</tr>
<tr>
<td></td>
<td>Ammer</td>
<td>Thermal Infrared</td>
<td>F-SAR L-band</td>
<td>---</td>
<td>Soil Moisture</td>
</tr>
</tbody>
</table>
Overview of TERENO Campaign 2011

DLR’s SAR Sensor: F-SAR
- Frequency L-band
- Fully polarimetric
- Spatial Resolution (r/a): 2mx0.6
- Date: KW 21-22 (23.05.-03.06.2011)

TERENO Observatories
- Ammer – KIT
- Bode – UFZ/WESS
- Rur – FZJ

Ground Measurements
…were conducted by the research institutes of the observatories. DLR supported activities at Ammer and Bode catchment.

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Date</th>
<th>Data acquisition @ local time</th>
<th>No. of scenes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rur</td>
<td>30/05/2011</td>
<td>09:35-12:26</td>
<td>13</td>
</tr>
<tr>
<td>Bode</td>
<td>31/05/2011</td>
<td>09:12-10:41</td>
<td>8</td>
</tr>
<tr>
<td>Ammer</td>
<td>07/06/2011</td>
<td>10:26-11:33</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Date</th>
<th>Ground measurements exchange</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rur</td>
<td>30/05/2011</td>
<td>Soil moisture (SoilNet cluster, mobile probes)</td>
</tr>
<tr>
<td>Bode</td>
<td>31/05/2011</td>
<td>Soil moisture (mobile probes, GPR), vegetation height, phenology, biomass, VWC, LAI</td>
</tr>
<tr>
<td>Ammer</td>
<td>07/06/2011</td>
<td>Soil moisture (mobile probes)</td>
</tr>
</tbody>
</table>
Airborne SAR Acquisitions within TERENO 2011 Campaign

Rur

\[ R: 0.5 \left| S_{HH} - S_{VV} \right|^2 \text{ [dB]} \]
\[ G: \quad 2 \left| S_{XX} \right|^2 \text{ [dB]} \]

Bode

\[ R: 0.5 \left| S_{HH} - S_{VV} \right|^2 \text{ [dB]} \]
\[ G: \quad 2 \left| S_{XX} \right|^2 \text{ [dB]} \]

Ammer

\[ R: 0.5 \left| S_{HH} - S_{VV} \right|^2 \text{ [dB]} \]
\[ G: \quad 2 \left| S_{XX} \right|^2 \text{ [dB]} \]
Test Site – Rur Watershed

- Triangular Flight configuration
- Active/passive experiment
- ~ 160 km of data acquisition
- Field measurements by FZJ:
  - Soil moisture,
  - Vegetation,
  - SoilNet:
    - grassland (Rollesbroich),
    - forest (Wüstebach))
- Mobile TDR/FDR probes (Merzenhausen)
PMLR Campaign 2011 (FZJ)

- Flight tracks coordinated with F-SAR
- 4 different altitudes:
  - 1200m AGL, 1000m AGL, 700m AGL, 300m AGL
Validation of SAR-Derived Soil Moisture (DLR)

- Validation with SoilNet cluster in Rollesbroich

Results submitted to IGARSS 2012

Please see poster of Miguel Kohling and Thomas Jagdhuber
Test site – Bode Watershed

- SAR flight strip: 10 x 3 km
- Field measurements by UFZ/WESS/DLR:
  - Soil moisture (FDR, Geoelectric)
  - Soil roughness (Laser scanning)
  - Vegetation (height, phenology, biomass, VWC, LAI)
Hyperspectral Sensor – UFZ/WESS

- AISA-DUAL (AISA-HAWK & AISA-EAGLE)
Test site – Ammer/Rott Watershed

- Flight strip of F-SAR: 11 x 3 km
- Field measurements by KIT/DLR:
  Soil moisture (mobile FDR/TDR probes)
Activities of KIT, Alpine/Prealpine Observatory

- Airborne measurements of aerosol size distributions and spatial distribution
- Relevant for cloud microphysics and precipitation
- Additional instrumentation
  - Energy balance (upwelling and downwelling radiation UV > IR)
  - Latent and sensitive heat flux
  - NDVI
  - Soil temperature
- From February 2012: regular flights between Zugspitze and Augsburg (starting from airfield Ohlstadt)
Modeling Results (GeoTop) (KIT)

Aim: Spatial intercomparison with SAR and in-situ data

Discharge

LatH

SensH

SoilMoist
Next Steps for the 2011 Campaigns

• Processing of TERENO 2011 data:
  • F-SAR until January 2012
  • AISA-DUAL until January 2012
  • PLMR2 until Spring 2012

• Provision/exchange of the collected and acquired data

• Forward modeling and inversion of bio/geo-physical environmental

• Validation of derived parameter

• Hopefully – integration into small scale integrative models!
TERENO-NO DEMMIN: Evaluation of changes in moisture status on vegetation development and land use (DLR Neustrelitz, GFZ, TU Berlin)

Characteristic of region:
Agricultural used lowland (partly high groundwater level) with high variability in soil type and large field parcels, expected reduction in precipitation

Instrumentation:
Agrometeorological stations (32 → 50) on all typical soil and land use units
Corresponding and closer mashed soil moisture net (in preparation)
Crane and tower (in prep.) for ground based remote sensing (spectrometry of crop types and trees; radiometry, long term thermography and multispectral analyses of crop types)

Remote sensing data:
- Multispectral RapidEye-Data of whole testsite, several dates during vegetation period
- Hyperspectral, radar and thermal airborne data of subsets in campaigns
- Hyperspectral images and fieldspectrometer data from ground and crane
- Satellite radar data (in prep.)
- Corresponding ground truth data of soil and vegetation status (starting from 2012)

Expected results:
- clarification of the relationships of moisture status and spectral signal
- Usage of spectral information for modeling of evapo-ration in regional scale (in time and space variability)
TERENO-NO DEMMIN: Fieldspectrometry from crane and hyperspectral airborne images - first data

Beech: ASD- field spectra, AISA image spectra and contact measurement of single leaf

ASD: 10m und 1m Sensorabstand Kontaktmessung Blatt AISA

Comparison of AISA image spectra: Buche- beech, Esche - ash and Erle - alder

Field of view ASD: 14 cm diameter at 1m distance sensor-target
1,4 m diameter at 10 m distance sensor-target
Pixel size AISA-Eagle+Hawk (airborne sensor): 3mx3 m
Flight Campaigns Planned for 2012

First Multisensor Platform Campaign

- Instruments on airborne platforms:
  - DLR-DO228: F-SAR, PLMR, DigiTHERM
  - DLR- CESSNA: HYSPEX
  - Ultralight: KIT-Instrument

- Test sites:
  - Rur, Bode, Ammer, (Demmin)

- Time schedule:

- Inclusion of the Uecker catchment in TERNO 2012 campaign (Decision until 03/2012)
Satellite Data – First Complete TanDEM-X Coverage

More about @ http://www.dlr.de

Iceland

TanDEM-X Coverage (red > one acquisition)
## TerraSAR-X Science Acquisitions

<table>
<thead>
<tr>
<th>Time</th>
<th>Observatory</th>
<th>Polarization</th>
<th>Acquisition Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-04-2010</td>
<td>Ammer</td>
<td>Quad-Pol (HH/HV/VH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>11-05-2010</td>
<td>Ammer</td>
<td>Quad-Pol (HH/HV/VH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>11-04-2010</td>
<td>Bode</td>
<td>Quad-Pol (HH/HV/VH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>23-04-2010</td>
<td>Bode</td>
<td>Quad-Pol (HH/HV/VH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>03-05-2010</td>
<td>Bode</td>
<td>Quad-Pol (HH/HV/VH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>18-04-2010</td>
<td>Rur</td>
<td>Quad-Pol (HH/HV/VH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>29-04-2010</td>
<td>Rur</td>
<td>Quad-Pol (HH/HV/VH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>10-05-2010</td>
<td>Rur</td>
<td>Quad-Pol (HH/HV/VH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>17-04-2010</td>
<td>Uecker</td>
<td>Quad-Pol (HH/HV/VH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>28-04-2010</td>
<td>Uecker</td>
<td>Quad-Pol (HH/HV/VH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>09-05-2010</td>
<td>Uecker</td>
<td>Quad-Pol (HH/HV/VH/VV)</td>
<td>Processed</td>
</tr>
</tbody>
</table>
## TanDEM-X Science Acquisitions

<table>
<thead>
<tr>
<th>Time</th>
<th>Observatory</th>
<th>Polarization</th>
<th>Acquisition Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-10-2011</td>
<td>Ammer</td>
<td>Single-Pol (HH)</td>
<td>Processed</td>
</tr>
<tr>
<td>06-07-2011</td>
<td>Bode</td>
<td>Single-Pol (HH)</td>
<td>Processed</td>
</tr>
<tr>
<td>27-04-2011</td>
<td>Rur</td>
<td>Dual-Pol (HH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>08-05-2011</td>
<td>Rur</td>
<td>Dual-Pol (HH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>24-07-2011</td>
<td>Rur</td>
<td>Dual-Pol (HH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>12-04-2011</td>
<td>Uecker</td>
<td>Dual-Pol (HH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>04-05-2011</td>
<td>Uecker</td>
<td>Dual-Pol (HH/VV)</td>
<td>Processed</td>
</tr>
<tr>
<td>15-05-2011</td>
<td>Uecker</td>
<td>Dual-Pol (HH/VV)</td>
<td>Processed</td>
</tr>
</tbody>
</table>
Other Actions within the CT in 2012

Presentations of results at the following conference:

1. Tereno Session at EGU - April 2012
   Session Chair: Heye Bogena (FZJ)

2. Tereno Session at IGARSS – July 2012
   Session Chairs: Carsten Montzka (FZJ) und Marion Pause (WESS)