TERENO – A network of terrestrial environmental observatories in Germany

Steffen Zacharias
Climate Change in Germany and Vulnerabilities

TERENO – an initiative of the Helmholtz Association

- To bring together scientists from different scientific communities and to integrate disciplines
- To study long-term influence of land use changes, climate changes, socioeconomic developments and human interventions in terrestrial systems
- To analyse the interactions and feedbacks between soil, vegetation and atmosphere from the point to the catchment scale
- To determine effective parameters, fluxes and state variables for different scales
- Bridging the gap between measurement, model and management
TERENO Vision and Challenge
Predicting terrestrial processes from remote information

Multi-scale observations using non-invasive and novel Technologies
- SMOS
- SAR
- Weather-Radar
- Radiometer
- EM

Data Fusion
Upscaling

Terrestrial Processes
- Evapotranspiration
- Soil moisture
- Runoff

Data management
Visualization

Super Computing
Modelling
Remote Sensing Platform

- **Global**: Model based regionalisation
- **Regional**:
  - **Airborne campaigns**
    - EMIRAD, PLMR, SAR
      ⇒ momentary imaging
  - **Test sites**
    - Radiometer and Sensor Networks (SoilNet)
      ⇒ long-term continuous monitoring
- **Local**
  - **Satellites (e.g. SMOS)**
    ⇒ continuous monitoring
- **Hyperspectrum imagery campaign 2008**
TERENO at the UFZ
The Harz/Central German Lowland Observatory
The Hydrological Observatory Bode
Unique infrastructure of sensors operating at different but overlapping scales.

Hydrological processes at different spatial and temporal scales.
DEMMIN Test Site of DLR
TERENO North-East German Lowland Observatory

Infrastructure to calibrate and validate remote sensing sensors, missions, and value added data products.

Multi-scale approach to validate remote sensing information for implementing into environmental models

Remote sensing based monitoring for environmental modelling at different scales

→ Remote sensing value added products
→ In-situ--value added products
→ Stationary monitoring network
→ Lysimeters (SoilCAN)
Coordination Team „Environmental Sensing“

- Collection and coordination of requirements from the different CT’s (CT Environmental Sensing is acting as an interface between the other CT’s)
- Coordination of flights and instruments over regions of interest
- Coordination of common instrument operation over regions of interest
- Inter-comparison of field instruments
- Coordination of airborne/spaceborne data acquisition with ground measurements
- Reporting on data processing status and data quality
- Exchange of inversion procedures for the environmental parameters
- Synergies between different sensors
- Collection, coordination, archiving of different types of data
Soil Moisture Mapping via Remote Sensing

- Mapping/Monitoring surface soil moisture dynamics
  - Minimum 3 flights/year (low and high vegetation cover)
  - Continuously > 5 years
- Mapping/Monitoring regional differences on the Cal/Val sites in TERENO – Rur catchment, Bode catchment, Ucker Catchment
- Instruments: SAR, Radiometer, Hyperspectral (ARES/APEX), Ground Measurements
Geophysical Soil Mapping
The partial least square – discriminate analysis (PLS-DA) enables to distinguish between land-uses that are located on the same soil type and spectrally looks very similar.

T.P.Kagan, A. Karnieli (BGU)
Visualization and Exploratory Modelling
TERENO Data Infrastructure

- Portal Web-Application
  - www.tereno.net
  - Presentation of the TERENO project (public area)
- Provides access to remote data from local database
Soil Moisture related Satellite proxies

**ACROSS**

Spatial distribution of soil moisture in an area covering the pixel size of The SMAP satellite (37 km x 42 km) Measured by COSMOS Rover System (www.gewex.org)

**www.esa.int**

**www.enmap.org**

**aifs.meraka.org**

**www.experimental-hydrology.net**

*MODIS*  
Land surface temperature (°C, 1 km² resolution)

*EnMAP*  
Spectral reflection (30x30 m resolution)

*Tandem-L*

*SMOS*

*MODIS*

*ACROSS - Advanced Remote Sensing – Ground-Truth Demo and Test Facilities*

*EnMAP (Simulation)*
TERENO in the Mediterranean
Integration – The Big Challenge