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DEMMIN in TERENO NE: The year 2012 - instrumentation and first results

NE German Lowland Observatory

The **Northeastern Lowland observatory (TERENO NE)** is situated in a region shaped by recurring glacial and periglacial processes since at least half a million years. Within this period, three major glaciations covered the entire region, the last time this happened approximately 25 – 15 ka ago (Weichselian glaciation). Since that time, a young morainic landscape developed characterized by many lakes and river systems that are connected to the shallow ground water table.
The main land-use types are arable, pasture, planted pine forests, deciduous forests, and wetlands of high ecological value. The present climate is characterized by rather low annual precipitation between 550 and 650 mm/a. Particularly, this rather low annual precipitation in combination with major reconfigurations of the hydrological system (damming and drainage) in historic times makes this region highly sensitive with regard to climate change impacts.

The test site **DEMMIN** (**D**urable **E**nvironmental **M**ultidisciplinary **M**onitoring **I**nformation **N**etwork)is one of four test areas of the TERENO NE Lowland observatory.

In 1999/2000 **DEMMIN** was founded as a cal./val. test site by the German Aerospace Center (DLR) and the Community of Interests (IG Demmin). Since 2004 an automated agrarian meteorological network with 20 weather stations was installed. In 2009 the test site DEMMIN joined the TERENO NE Lowland observatory.

Main goals of this cooperation is the modeling of evapotranspiration from multispectral- & thermal- remote sensing (RS) data with meteorological data and observation of soil moisture from hyperspectral & radar-RS data.

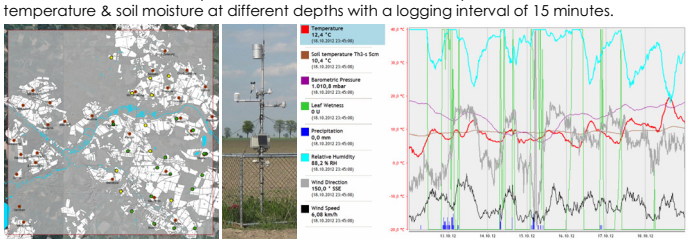
Activities and Results in 2012

The instrumentation of the test site DEMMIN has been started in December 2011.

A) Automated agrarian meteorological network

Monitoring and mapping of the variation of agrarian-meteorological parameters in a landscape area of 30 km x 30 km

- **Continuing construction of the automated agrarian meteorological network to 40 gauging stations (20 DLR, 20 GFZ)** in 2012: Analyzed parameters are precipitation, solar radiance, thermal emission, wind speed & wind direction, air temperature & air moisture, soil temperature & soil moisture at different depths with a logging interval of 15 minutes.



Left: test site DEMMIN with network of meteorological (brown) and soil moisture (green = installed, yellow = planned) stations
Center: meteorological gauging station at Görmin
Right: parameter plot (12.10.-19.10.2012) of the meteorological gauging station at Böken

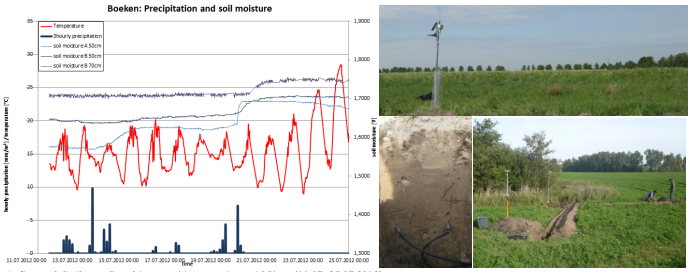
B) Soil moisture measuring network and soil analysis

Monitoring and mapping of soil moisture variability in the vadose zone under agricultural land use with different arable crops & soil texture types

- **Documentation of soil characteristics in 66 soil profiles** (~1 m depth) at location of soil moisture gauging stations: Physical and chemical soil analysis are planed for 2013.

Left: soil profile at Görmin
Right: soil documentation and installation of soil sensors at Marienfelde

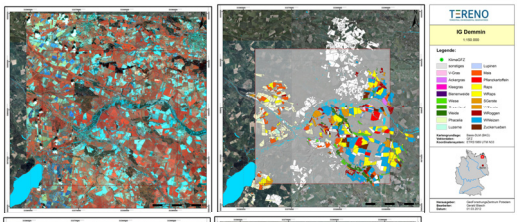
- **Installation of 33 soil moisture stations** in 2012: In total 64 stations are planed until April 2013. Each station with 6 SPADE-sensors based on the frequency domain reflectometry method (FDR), continuous hourly measurements at 50 cm and 70 cm depths.



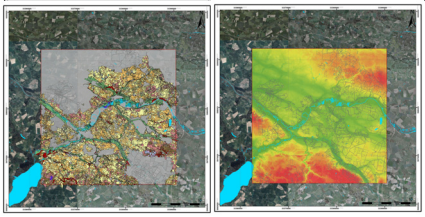
Left: precipitation, soil moisture and temperature at Böken (11.07.-25.07.2012)
Right above: soil moisture gauging station at Görmin
Right below: soil moisture sensor in soil profile (left); installation of soil moisture station and soil documentation

Project Area - Test Site DEMMIN

The test site is an intensively used agricultural ecosystem. In the north the topography with an altitude difference 0 - 84,5 m above sea level is rather flat and in the south hilly to undulating. Cause of significant differences in parent substrate material and relief a high spatial variability of soil types are developed. Cambisols, Luvisols and Albeluvisols are dominating the sand rich regions in the north. From glacial tills Luvisols, Albeluvisols and Stagnosols evolved with less sand, but with significant amount of clay and loam. In the south the soils on glacial tills are often truncated and colluvial sediments have accumulated on the bottom of slopes. The peaty soils of the floodplains were mainly used as grassland.



Left: multispectral image (IKONOS) of test site DEMMIN
Right: agricultural land use with different crops (2012) of test site DEMMIN



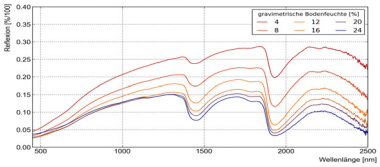
Left: soil substrate map (1:10.000) of test DEMMIN (green: peaty soil; yellow to orange: sandy soils; red to brown: loamy soils; violet: clay soils)
Right: digital elevation model (1:10.000) of test site DEMMIN (green: low; red: high)

C) Remote sensing

Continuous observation of vegetation parameters and spectral characteristics on 25 agricultural and 1 forestal locations

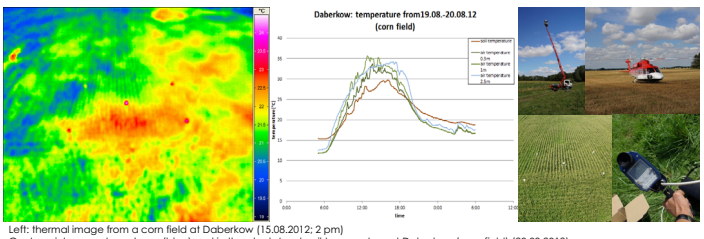
- **Airborne based radar and hyperspectral RS operations** (May 2012): Simultaneous surveying flights over arable land with different crops in conjunction with ground truth surface and soil measurements are used for process development of soil moisture determination from both data systems.

Left: radar image (F-SAR L-Band)from Böken (May 2012)
Center: documentation of soil moisture at a depth of 20 cm at Böken
Right: hyperspectral image from Böken with ground truth soil moisture data profile at Böken



Influence of soil moisture on spectral reflectance in sandy soils of North-eastern Lowland

- **Airborne based thermal and hyperspectral RS operations in cooperation with BGR** (August 2012): Vegetation and arable soil characteristics in their diurnal variations were analyzed in visible (VIS), near infrared(NIR) and short wave infrared (SWIR) spectral range by using hyperspectral sensors and in thermal infrared (TIR) by thermal sensor.



Left: thermal image from a corn field at Daberkow (15.08.2012; 2 pm)
Center: air temperature above (blue) and in the plant stand, soil temperature at Daberkow (corn field) (20.08.2012)
Right above: mobile crane for thermal and hyperspectral images at Daberkow (left); helicopter of BGR with thermal sensor at Bentzin (right)
Right below: view from mobile crane over corn field with calibration plots at Daberkow (left); pyrometer for measuring surface temperature (right)

- **Analyses of soil and plant parameters on agricultural sites**: For TerraSAR-X and RapidEye time series interpretation surface characteristics were documented every eleven days.

Photographic time series for documentation of biometric parameters according to crop development (e.g. potatoes)