



TERENO General Overview – Status, Network Activities, Accessibility and International Integration

H. Vereecken and the TERENO team



Installations and/or testing at most sites: still ongoing

- Hydrological equipment (e.g. soil moisture sensor networks, cosmic ray probes) at several test sites (Rollesbroich, Scheyern, Schäfertal, Hohes Holz etc.)
- Eddy-Covariance measurement systems at several test sites (e.g. Rollesbroich, Wüstebach, Merzenhausen, Grasswang etc.) (*see also CT Atmosphere*)
- Airborne soil moisture campaigns using F-SAR and PLMR2 (*see also CT Environmental Sensing*)
- New water quality monitoring installations in the Bode catchment (*see also CT Hydrosphere Presentation*)
- Biodiversity assessments across all TERENO biodiversity monitoring sites (*see also CT Biodiversity Presentation*)
- Lysimeter network and chamber crane for automatic measurements of GHG exchange
- Palaeoclimate investigations (*see also CT Palaeoclimate Presentation*)
- Online stable Isotope Monitoring Station installed (Rur catchment)
- 8 Cosmic Ray soil moisture stations installed (Rur catchment)
- Mobotix-cameras for LAI-Measurement installed (T-Prealpine)
- Atmospheric Emitted Radiation Interferometer (AERI) for vertical water vapor distribution in boundary layer soon be installed (T-Prealpine)
- 12 new climate stations with 300 SWC sensors in operation (DEMMIN)



Standard Monitoring Stations - Status

	Established in Eifel/LRV Observatory	Established in Harz/CGL Observatory	Established in Alps/pre-Alps Observatory	Planned in NE German Lowland Observatory
Meteorological stations Incoming short wave radiation Precipitation Air humidity Air temperature Windspeed/ -direction	<ul style="list-style-type: none"> - Schöneiseiffen - Wüstebach - Rollesbroich - Selhausen - Merzenhausen - Tietz Planned 2011-12: 5 further stations	<ul style="list-style-type: none"> - Kreinitz (no radiation) - Gimritz (no radiation) - Zöberitz - Greifenhagen (no rad) Planned 2011-12: 7 further stations	<ul style="list-style-type: none"> - Graswang - Rottenbuch - Fendt - Schechenfilz - Garmisch-Partenkirchen - Höglwald - Bavarian Forest EC-Stations ¹ (as above, at Garmisch in construction)	<ul style="list-style-type: none"> - DEMMIN Planned 2011-12: 20 climate stations <ul style="list-style-type: none"> - Müritz Nationalpark Fürstenseer-See 4 climate stations plus throughfall and stemflow
Hydrological stations Streamflow discharge Water temperature Electrical conductivity pH Redox potential Chlorophyll a Dissolved organic matter	<ul style="list-style-type: none"> - Wüstebach (3 stations) - Erkersruhr - Rollesbroich Planned 2012: 1 further station (BMBF project "Huminstoffe")	<ul style="list-style-type: none"> - Meisdorf - Silberhütte - Hausneindorf - Hadmersleben - Sauerbach - Athensleben - Staßfurt - Rappbode Observatory 	Discharge data will be available from local authorities	<ul style="list-style-type: none"> - Müritz NLP Fürstenseer-See Planned (2011-12) Water levels in lake and groundwater, temperatures, EC <ul style="list-style-type: none"> - Uecker Catchment Planned
Soil monitoring stations Soil water content Soil temperature Soil suction Soil organic matter	<ul style="list-style-type: none"> - Schöneiseiffen - Wüstebach - Rollesbroich - Selhausen - Merzenhausen - Tietz Planned 2011-12: 5 further stations	<ul style="list-style-type: none"> - Kreinitz (no SOM) - Gimritz (no SOM) - Zöberitz (no SOM) - Greifenhagen (no SOM) Planned 2011-12: 7 further stations	<ul style="list-style-type: none"> - Höglwald (no soil suction) - Graswang - Rottenbuch - Fendt 	<ul style="list-style-type: none"> - DEMMIN Planned 2011-12: SoilNet system (design to be defined) <ul style="list-style-type: none"> - Müritz NP Fürstenseer-See Planned (2011-12)



TERENO Data Management



TEODOOR ONLINE DATA PORTAL

Navigation menu (left): HELMHOLTZ GEMEINSCHAFT, AIDA_WMS, Weatherdata_vms, AIDAGeoconer, Überblick, Koordinatensysteme, Observatorien, TERENO Forum, TERENO Newsletter, TEODOOR Online Data Portal, Workshop, Downloads, Links, Kontakt, Report problems.

Map: Shows Europe with monitoring stations marked by colored dots. A pop-up window for 'Rohlfenzsch Solarfeld End Device 102' is visible.

Query Interface:

- Offering: Soil
- begin: 2011-05-20 10:18:22
- end: 2011-09-21 10:18:22
- Selected Sensor: SoilWaterContent5cmSensor1 [%]

Information:

- SoilTemperature5cmSensor1 [degC]
- SoilWaterContent5cmSensor2 [%]
- SoilWaterContent20cmSensor1 [%]
- SoilWaterContent20cmSensor2 [%]

Result:

- SoilWaterContent5cmSensor1 [%]

Graph: Shows soil moisture percentage over time from 11-8-20 13:00 to 11-9-20 06:00. The y-axis ranges from 0.00 to 0.39.

- TEODOOR Data Portal is online and functional
- Free Data Access (hourly data)
- The Following Monitoring Stations are online:
 - Runoff gauging stations
 - Sensor networks
 - Climate stations
 - Cosmic ray stations
 - Weather radar

See also CT Datamanagement Presentation



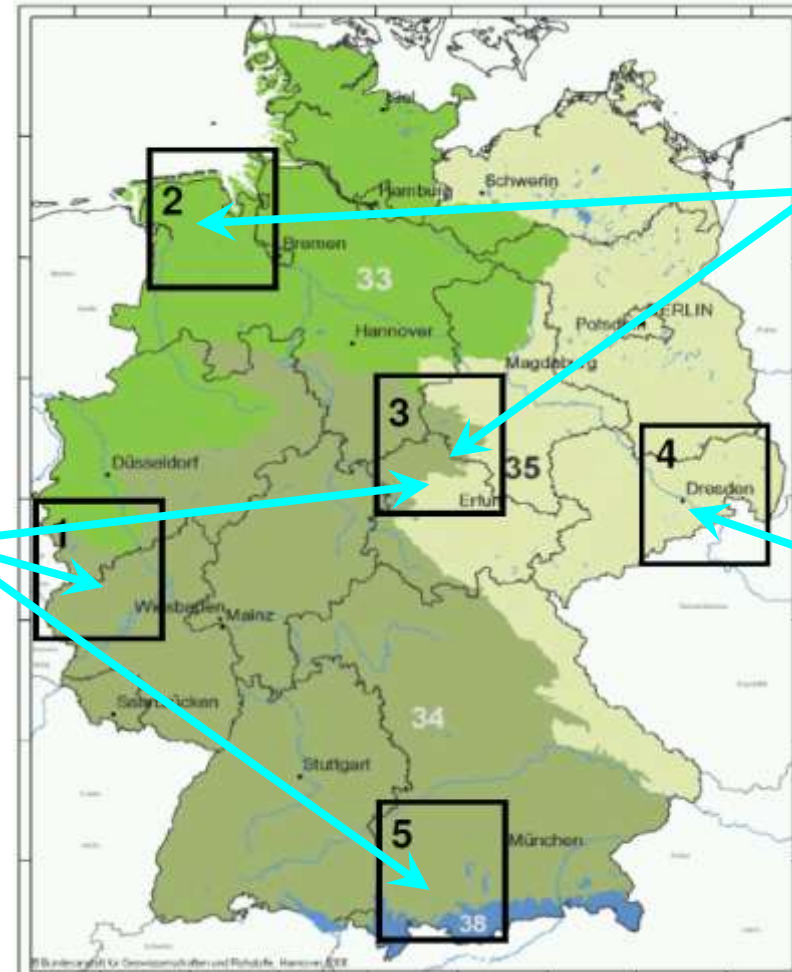
ICOS



A European infrastructure dedicated to high precision monitoring of greenhouse gas fluxes



- ICOS-D is expected to be approved 1.11.2011.
- Funding: 9 Mio. € (2012-2015)
- VTi, DWD and HGF are key partners
- 3 TERENO observatories are included
- EC-Stations of NE-Observatory according to ICOS standard



Uni Göttingen



TECHNISCHE
UNIVERSITÄT
DRESDEN

See also ICOS Presentation of HaPe Schmid

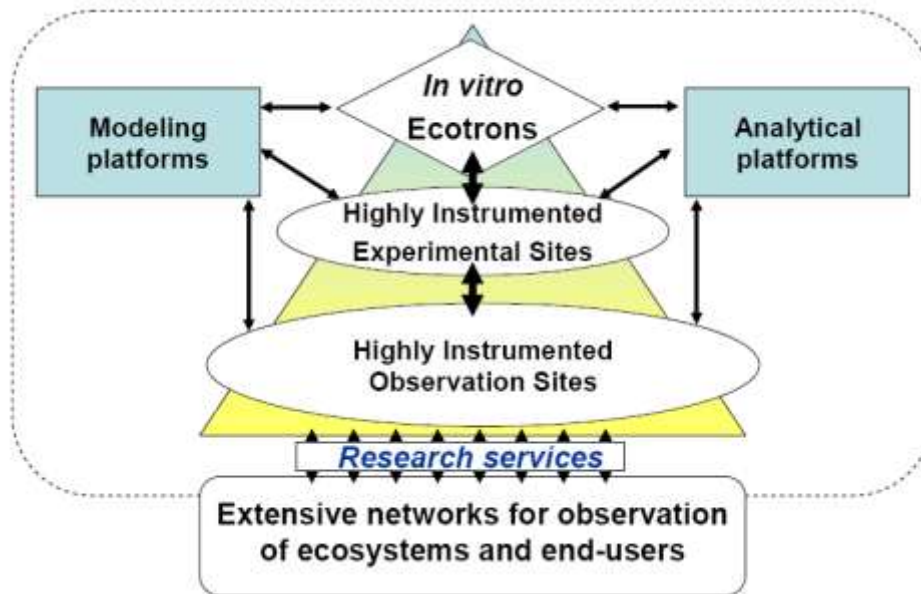




EXPEER



- ExpeER represents research infrastructures in Europe both for experimental and observational ecosystem research
- In total 37 Partners are involved
- 3 TERENO sites are involved
- The Transnational Access (TNA) program has started last year
- TNA funds the access to the involved sites and platforms





Larger Research Projects in Germany related to TERENO

- TR-32 on „Patterns in soil-plant-atmosphere systems: monitoring, modelling and data assimilation“ (Aachen, Bonn, Cologne and Jülich) – Second phase approved ✓
- HGF: Virtual Institute PROCEMA (KIT: Prof. Kunstmann) approved ✓
- HGF: New research group approved: “Capturing all relevant scales of biosphere-atmosphere exchange - the enigmatic energy balance closure problem“ (KIT: Dr. Mauder) ✓
- HGF: Helmholtz Research School MICMoR “Mechanisms and Interactions of Climate Change in Mountain Regions“ (KIT: Prof. Schmid, Dr. Bleher) ✓
- HGF: “Trace Gas Exchange in the Earth – Atmosphere System on Multiple Scales (TEAM)“ (GFZ: Torsten Sachs) ✓
- BMBF: Medium term climate prediction (MiKlip) (FZJ: Dr. Bogena) ✓
- StMWFK: FORKAST (KIT: Prof. Schmid, Papen, TUM: Kögel-Knabner) ✓
- ESA: SMASPARES: SMos data ASsimilation for PARAmeter ESTimation in radiative transfer models (FZJ: Dr. Montzka) ✓
- BMWi: Validation of SMOS Level-2-Prozessor with data assimilation (FZJ: Dr. Montzka) ✓
- BMBF: CLIENT (FZJ: Prof. Vereecken) under approval ✓
- DFG-Forschergruppe on data assimilation (invited for submission of full proposal until Dec. 2011) Contributions from UFZ (Prof. Attinger), KIT (Prof. Kunstmann) and FZJ (Profs. Hendricks Franssen and Vereecken) ✓
- DFG-Forschergruppe “ From Catchments as Organised Systems to Models based on Dynamic Functional Units – CAOS”. Contributions from UFZ (Prof. Dietrich), KIT (Prof. Zehe), GFZ (Dr. Blume) ✓
- DFG-Forschergruppe „Girdling in Forests“ (in preparation)
- VIP-Antrag TomSpek "Entwicklung und Validierung eines Systems zur Messung der Räumlichen Verteilung Atmosphärischer Spurengase", Antrag eingereicht, see also presentation M. Schwank (Session 1). ✓



Helmholtz virtual institute approved:

„Institute of Integrated Climate & Landscape Evolution Analysis“ (ICLEA)

Separation of

- ⇒ Natural and anthropogenic climate signatures
- ⇒ short-term and long-term trends

by means of combining multi-proxy data from natural archives (laminated sea sediments, tree rings,...)

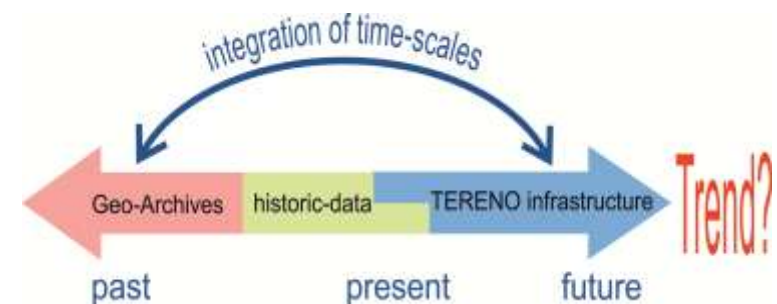
Staffing: 8 PhD's; 5 Postdocs

Partners: GFZ, BTU, U Greifswald, PAS Torun,
16 associated Partners

Funding volume: 4.5 Mio€

Funding period: 5 Jahre

Start: January 2012



Helmholtz young investigator group approved:

“Trace Gas Exchange in the Earth – Atmosphere System on Multiple Scales (TEAM)

Staffing : Group leader, 2 PhD; 1 Postdoc, 1 Engineer

Partners: Universities Braunschweig, Bremen, Hamburg, Berlin; AWI; Geo.X; NASA;...

Funding period: 5 years

Funding volume: 1.8 Mio€

Start: Januar 2012



Helmholtz virtual institute applied:

„Sustainable bioeconomy under a changing climate: The impact of plant–soil–microorganism interactions on greenhouse gas emissions and its implications for agricultural management” (BIOECON-GHG)

Objectives:

- Clarify the role of plant–soil–microorganism interactions in governing soil processes involved in GHG production and consumption at varying environmental conditions, and to assess their importance for the total GHG balance (CO₂, CH₄, N₂O) of agriculturally based biomass production of wheat, sugar beet, maize and Miscanthus.
- Improve agricultural management practices and adaptation strategies for a sustainable biomass production under a changing climate.
- Reduction of anthropogenic greenhouse gas emissions

Partners: FZJ (IBG-3 & IBG-2), KIT (IMK-IFU), HMGU, Uni Bonn, Uni Göttingen, UC de Louvain

Funding volume: 2 Mio €

Funding period: 4 Jahre



Application for a HGF Allianz: „Remote Sensing and Earth System Dynamics“

Objectives:

- Entwicklung innovativer Umweltprodukte durch die nächste Generation satellitengestützter Fernerkundungsdaten
- Integration innovativer Umweltprodukte in Erdsystemmodelle
- Verbesserung des Wissenstands und der Vorhersage von dynamischen Prozessen in der Biosphäre, Hydrosphäre, Kryosphäre und Geosphäre
- Aufbau eines Forschungsnetzwerks zwischen den Helmholtz-Zentren UFZ, AWI, FZJ, GFZ, HMGU, KIT und DLR
- Etablierung eines einzigartigen Forums zur Ausbildung von Nachwuchswissenschaftlern

Principal investigator: Prof. Moreira (DLR), Prof. Irena Hajsek (DLR, ETH Zürich)

Partners:

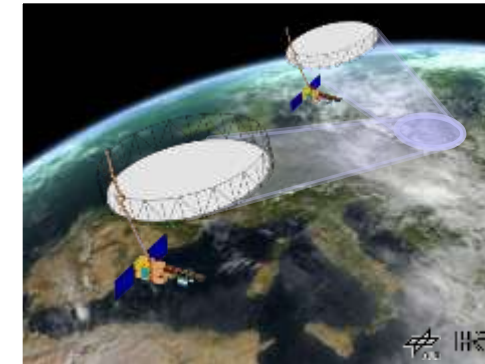


Helmholtz-Zentrum für Umweltforschung (**UFZ**),
Forschungszentrum Jülich (**FZJ**), Helmholtz-
Zentrum Potsdam (**GFZ**), Helmholtz-Zentrum
München (**HZM**), Karlsruher Institut für
Technologie (**KIT**), Alfred-Wegener-Institut für
Polar- und Meeresforschung (**AWI**), Deutsches
Zentrum für Luft- und Raumfahrt (**DLR**), Max-
Planck-Institut für Meteorologie (**MPI-M**,
Hamburg), Technische Universität München
(**TUM**), Friedrich-Schiller-Universität Jena
(**FSU**), Universität Innsbruck, Forest
Stewardship Council (**FSC Bonn**),
Eidgenössische Technische Hochschule Zürich
(**ETH Zürich**)



Application for a HGF Allianz: „Remote Sensing and Earth System Dynamics“

	Potentielle Produkte	Auflösung	Wiederholrate
Biosphäre	Waldhöhe	20 – 50m	16 Tage - saisonal
	Oberirdische Biomasse		
	Vertikale Waldstruktur		
Geo-/ Lithosphäre	Tektonische Veränderungen	5 - 100m	wöchentlich
	Vulkanbeobachtung		
	Erd-/Hangrutschungen		
	Deformation		
Kryo- & Hydro- sphäre	Gletscher-Dynamik	50 - 500m	wöchentlich
	Bodenfeuchte		wöchentlich
	Wasserspiegeländerungen		auf Nachfrage
	Schneewasseräquivalent		saisonal
	Änderungen der Eisstruktur		saisonal
	Meeresströmungen		wöchentlich
Global	Digitales Gelände- /Oberflächenmodell	20 - 50m	jährlich





Activities and Initiatives in Germany

- Improved integration with Länder and federal authorities involved in the observation of the terrestrial systems: e.g. LANUV, DWD,...
- Improved interaction with CSC and REKLIM within the framework of HGF
- Integrated in Portfolio and Pakt-II programmes: Water, Bio-Economy, Earth system dynamics and risks and Earth-System Knowledge Platform
- Establishment of an infrastructural research programme (SPP) by the DFG (Arbeitsgruppe Terrestrial Research Platforms)
- Interaction with GEO-D /GEOSS (Registration of TEODOOR data portal in GEOSS)
- Water Science Alliance (Coordination UFZ) and WESS
- BioEconomy: e.g. BioEconomy Science Center, ...
- HTS 2020: Sustainable production food: soil-plant interactions (Experiment and modelling)
- FONA: Near Real Time Forecasting of Soil Moisture for Water Resources Management in the Heihe River Basin, China
- Cooperation with the Global Soil Moisture Network



Peer reviewed papers: published, in press, accepted

- Zacharias et al.** (2011) A network of terrestrial environmental observatories in Germany. *Vadose Zone J.* 10:955-973
- Laux et al.** (2011) Copula-based statistical refinement of precipitation in RCM simulations over complex terrain, HESS, doi:10.5194/hess-15-2401-2011
- Rosenbaum U., J.A. Huisman, J. Vrba, H. Vereecken, and H.R. Bogena** (2011) Correction of temperature and electrical conductivity effects on dielectric permittivity measurements with ECH2O sensors. *Vadose Zone J.* 10. 582–593. doi:10.2136/vzj2010.0083.
- Bauer J., L. Weihermüller, J.A. Huisman, M. Herbst, A. Graf, J. M. Sequaris, H. Vereecken** (2011) Inverse determination of heterotrophic soil respiration response to temperature and water content under field conditions. *Biogeochemistry*. doi:10.1007/s10533-011-9583-1
- Jonard F., L. Weihermüller, K.Z. Jadoon, M. Schwank, H. Vereecken, S. Lambot** (2011) Mapping Field-Scale Soil Moisture With L-Band Radiometer and Ground-Penetrating Radar Over Bare Soil. *IEEE transactions on Geoscience and Remote Sensing.* 49(8): 2863-2875.
- David T., P. Krebs, D. Borchardt and W. von Tümpling** (2011) Element patterns for particulate matter in stormwater effluent. *Water Science & Technology* 2011. 3013-3019
- Mester A., J.v.d. Kruk, E. Zimmermann and Harry Vereecken** (2011) Quantitative two-layer conductivity inversion of multi-configuration electromagnetic induction measurements, *Vadose Zone Journal*, accepted for publication.
- Rivera Villareyes et al.** (2011) Integral quantification of seasonal soil moisture changes in farmland by cosmic-ray neutron. *Hydrol. Earth Syst. Sci.*, 15, 3843-3859
- Scharnagl B., J.A. Vrugt, H. Vereecken, and M. Herbst** (2011) Bayesian inverse modelling of in situ soil water dynamics: Using prior information about the soil hydraulic properties. *Hydrol. Earth Syst. Sci.*, 15, 3043-3059
- S. Germer, K. Kaiser, O. Bens, and R. F. Hüttl**, "Water balance changes and responses of ecosystems and society in the berlin-Brandenburg region - a review," *Die Erde*, vol. 142, pp. 65-95
- Rink, K., Kalbacher, T., Kolditz, O.** 2011. Visual Data Exploration for Hydrological Analysis. *Environmental Earth Sciences*, DOI:10.1007/s12665-011-1230-6



Peer reviewed papers: submitted, in preparation

- Lausch et al.** (2011) A new multi-scale approach for monitoring vegetation using remote sensing-based indicators in laboratory, field, and landscape. Landscape Monitoring and Assessment. submitted.
- David T., D. Borchardt, W. Tümping and P. Krebs** (2011) Urban wet weather discharge as source of sediment associated elements in a river bed. Water Environment Research. submitted.
- Rosenbaum U., H.R. Bogaen, M. Herbst, J.A. Huisman, T.J. Peterson, A.W. Western and H. Vereecken** (2011) Seasonal and event dynamics of spatial soil moisture patterns at the small catchment scale. submitted to Water Resources Research.
- Montzka C., H.R. Bogaen, L. Weihermüller, F. Jonard, C. Bouzinac, J. Kainulainen, J.E. Balling, A. Loew, J.T. dall'Amico, E. Rouhe, J. Vanderborght and H. Vereecken** (2011) Brightness temperature validation at different scales during the SMOS Validation Campaign in the Rur and Erft catchments, Germany. Submitted to IEEE Transactions on Geosciences and Remote Sensing.
- Prolingheuer N., M. Herbst, B. Scharnagl, A. Graf and H. Vereecken** (2011) Contributions of the heterotrophic and the rhizospheric component to the variability of soil respiration in winter wheat. Submitted to Geoderma.
- Wloczyk, Carolin und Borg, Erik und Richter, Rudolf und Miegel, Konrad** (2011) Estimation of instantaneous air temperature above vegetation and soil surfaces from Landsat 7 ETM+ data in northern Germany. International Journal of Remote Sensing, 32 (24), Seiten 9119-9136. Taylor & Francis. DOI: 10.1080/01431161.2010.550332. ISSN 0143-1161 print / 1366-5901 online.



Completed and ongoing Phd studies

- Philip Rosenkranz** (2010) Einfluss von Waldökosystemtyp und Waldumbaumaßnahmen auf mikrobielle Stickstoffumsetzungsprozesse in Waldböden und den Biosphäre-Atmosphäre-Spurgasaustausch von Wäldern.
- Boris Matejek** (2010) Aufklärung der die kleinräumliche Heterogenität von Nitrat-Produktion, -Konsumption und –Austrag bestimmenden mikrobiellen Prozesse in Böden eines Fichten-Altbestandes sowie einer Kahlschlagsfläche.
- Ulrike Rosenbaum** (2011) Analysis of spatial soil moisture dynamics using wireless sensor networks
- Katja Kothieringer** (2011) Soil-borne gaseous C- and N-isotopic fluxes in a Bavarian spruce forest ecosystem.
- Sebastian Unteregelsbacher** (ongoing) Auswirkung von Klimaänderung, Wasserstress und Trockenperioden auf die bodenmikrobiologischen N- und C-Umsetzungen und die daran gekoppelten Spurengasemissionen aus Böden von Grünlandökosystemen im Ammereinzugsgebiet.
- Wei Qu** (ongoing) Improving remote sensing information using wireless sensor network technology.
- Sayeh Hasan** (ongoing) Synergies of passive and active microwave sensors for soil moisture retrieval.
- Markus Czymzik** (ongoing) Reconstruction of a 6000 year flood frequency record from the Lake Ammersee varved sediments.
- Roland Baatz** (ongoing) Improving soil moisture states and vegetation parameters of a coupled land surface model using cosmic ray and remote sensing information.
- Michael Stockinger** (ongoing) Using stable isotopes to infer transition and retention times of water in a mesoscale catchment.
- Benedikt Scharnagl** (ongoing) Characterizing spatio-temporal patterns of water and C-fluxes at field scale
- Nils Prolingheuer** (ongoing) Contributions of the heterotrophic and the rhizospheric component to the variability of soil respiration in winter wheat
- Nele Van Gaelen** (ongoing) Transport of dissolved organic matter from soils to surface water in agricultural areas: identifying and modeling the pathways and processes.
- Marin Dimitrov** (ongoing) Spatio-temporal patterns of evaporation, infiltration, and redistribution at the lysimeter and field plot scale.
- Christian Steenpass** (ongoing) Modelling of coupled heat and water fluxes in a field soil.
- Edoardo Martini** (ongoing) Analysis of hydrological fluxes at the hillslope scale using wires sensor networks



continued

- Christian Chwala** (ongoing: “Precipitation intensity and humidity estimation by a fully coherent monostatic transmission experiment”)
- Wie Qiu** (ongoing): “Copula-Based Rainfall Estimation by Combining Radar and Gauge Data and Microwave Attenuation Data”
- Florian Marshall** (ongoing): “Joint water and energy flux modeling in complex terrain”
- Thomas Rummeler** (ongoing: “High resolution joint atmosphere-terrestrial hydrology simulations in complex terrain ”)



Further developments



Opportunity proposals

- Helmholtz Allianz "Remote Sensing and Earth System Dynamics"
- **ANAEE** Development of a distributed experimental research infrastructure on continental ecosystems in order to analyse the response of ecosystem functions and services to climate and anthropogenic forcing and to develop simulation models for forecasting their evolution under different scenarios.
- **LifeWatch**: Construction of an e-Science research infrastructure to explore, describe and understand the complexity of the biodiversity system.
- **NOHA** Creation of a network of hydrological observation platforms on the basis of an interdisciplinary and long-term research program in close cooperation with leading European institutions in hydrology
- **ACROSS**
- **GEMIS**



Advanced Remote Sensing - Ground Truth Demo and Test Facilities (ACROSS)

Aim: Development of methods and technologies for ground-truth validation and calibration of complex, area-wide satellite data

ACROSS delivers highly integrated data and scenarios

ACROSS is the connection between local and regional scale operated process observatories (e.g. TERENO, ICOS, Fluxnet, GCO-ZA, DESIRE, ...) and the needed scenarios at the global scale

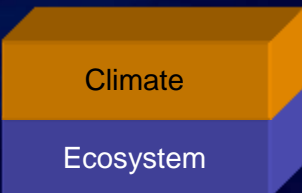
ACROSS uses existing infrastructures of selected demonstrator regions with different thematic themes (e.g. polar region (Arctic), Atlantic, Central-Europe, Mideast and Central-Asia)

Time plan and costs:

- Construction: 2013-2016 (costs: 18,5 M€)
- Operation: 2015-2020 (costs: 1,5 M€/a)

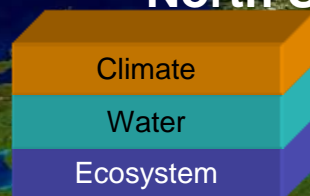


ACROSS: Regions und Grand Challenges



Oceans

North Sea Coast

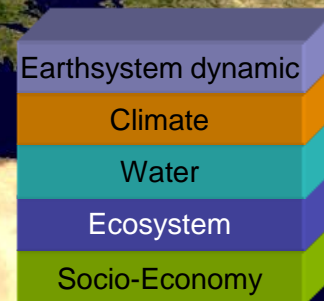


Central-Europe



Central Asia

Eastern Mediterranean Region





Global Integrated Earth observation and Validation system (GEMIS)

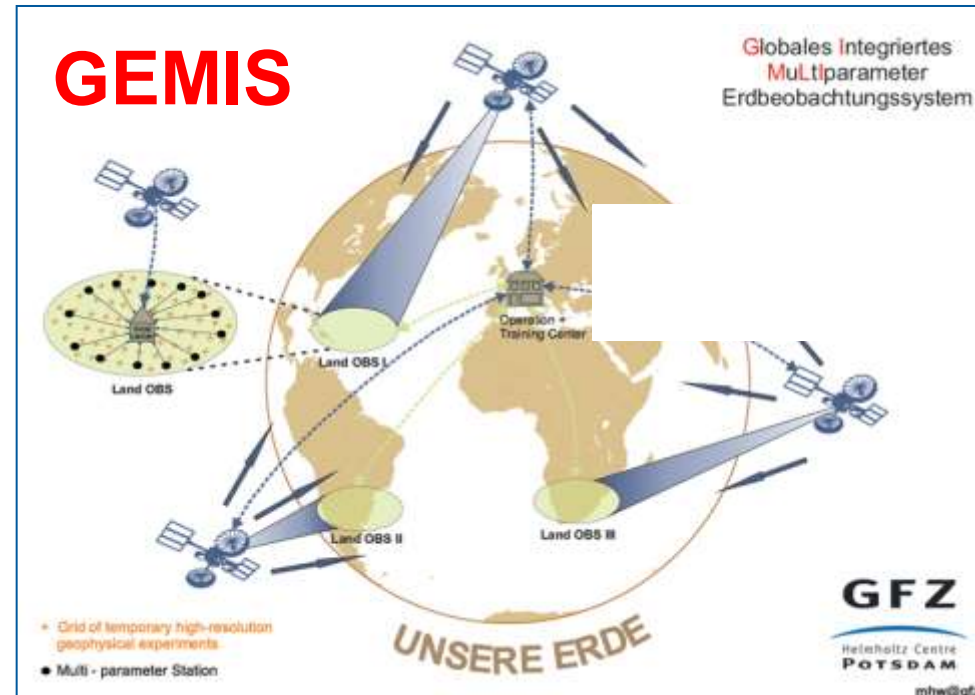
GEMIS will consists of different components

- Land- and sea-borne multi-parameter observatories coupled with temporal arrays
- System of mini-satellites for global and quasi real-time coverage
- Validation/calibration sites for airborne and satellite borne sensors
- Centre for operating the infrastructure and for capacity development

Operation time: min. 15 years

Costs:

- 5 Mio € Preparatory phase
- 400 Mio. € Implementation phase
- 7 Mio. € / a Operation



GEMIS will be developed from ACROSS



TERENO-MED - Global Change Observatory Network for the Mediterranean Region

Objectives: To study the long term effect of climate change and anthropogenic changes on Mediterranean terrestrial systems

Countries to be involved: Spain, Marocco, Italy, Turkey, Greece, Cyprus, Israel, Egypt

Partners contacted:

Spain: CIEMAT (Centro de Investigaciones Energetica, Medioambientales y Tecnologicas), Doñana Biological Station-CSIC

Italy: ENEA (Italian National agency for new technologies, Energy and sustainable economic development)

Cyprus: The Cyprus Institute: Energy, Environment and Water Research Center

Greece: NTU Athens, University of Patras

France: INRA (SupAgro Laboratoire sur les Interactions Sol-Agrosystème-Hydrosystème)

Turkey: Metu/Tubikak

Coordinator: UFZ

TERENO-partners involved: FZJ, KIT and UFZ

Funding: 50% UFZ, 50% FZJ

Total volume: 6.8 Million euro