



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

H. Vereecken and the TERENO team



New installations/campaigns in 2012:

- Airborne soil moisture campaigns using F-SAR (*see also CT Environmental Sensing*)
- 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)
- 10 Cosmic Ray soil moisture stations installed and calibrated (Rur catchment)
- Additional Eddy-Covariance measurement systems installed at several test sites (Graswang , Fendt, Garmisch-Partenkirchen, Rottenbuch, Schechenfilz, Wulferstedt, Scheyern)
- Chamber crane measuring robots for automatic measurements of GHG exchange installed at Rottenbuch and Fendt (T-Prealpine)
- Ceilometer for determination of boundary layer installed at the Fendt site
- Wireless soil moisture sensor networks installed (Rollesbroich, Scheyern, Hohes Holz, Schäfertal, Gr. Fürstenseer See-Hinnensee, DEMMIN)
- Sedimentological in-lake monitoring installed at lake Tiefer See



Standard Monitoring Stations – Status 2011

	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) - Erkensruhr - 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)



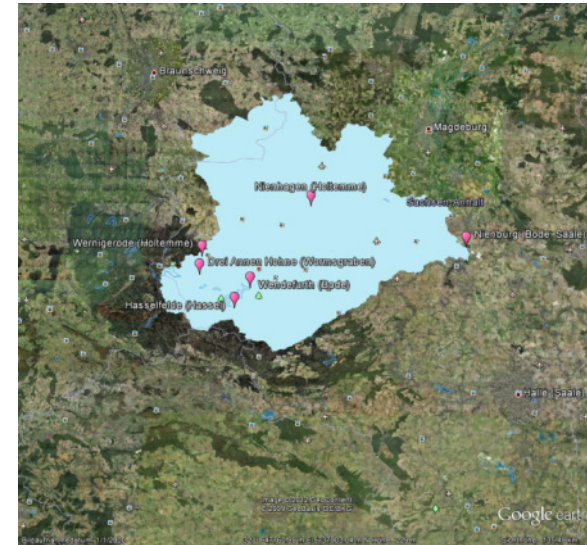
Standard Monitoring Stations – Status 2012

	Established in Eifel/LRV Observatory	Established in Harz/CGL Observatory	Established in Alps/pre-Alps Observatory	Established in 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 - Titz - Rur Aue - Wildenrath - Heinsberg (with DWD) - Aachen (with DWD) - Kall-Sistig (with DWD) 	<ul style="list-style-type: none"> - Kreinitz - Gimritz (no radiation) - Zöberitz - Greifenhagen (no rad.) - Wanzleben - Harsleben - Friedeburg - Hecklingen - Ermsleben - Großes Bruch (EC) - Schlanstedt (in constr.) 	<ul style="list-style-type: none"> - Graswang - Rottenbuch - Fendt - Schechenfilz - Garmisch-Partenkirchen - Höglwald - Bavarian Forest - Scheyern 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 Additional discharge data from local authorities	<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 National Park/ Fürstenseer-See - In-lake monitoring of Lake Tiefer See
Soil monitoring stations Soil water content Soil temperature Soil suction	<ul style="list-style-type: none"> - Schöneiseiffen - Wüstebach (SoilNet, SoilCan, Cos. R.) - Rollesbroich (SoilNet, SoilCan, Cos. R.) - Selhausen (SoilCan) - Merzenhausen (Cos. R.) - Tietz (Cosmic Ray) - Rur Aue (Cosmic Ray) - Wildenrath (Cosmic Ray) - Heinsberg (Cosmic Ray) - Aachen (Cosmic Ray) - Kall-Sistig (Cosmic Ray) 	<ul style="list-style-type: none"> - Kreinitz - Gimritz - Zöberitz - Greifenhagen - Wanzleben - Harsleben - Friedeburg - Hecklingen (SWC, Temp) - Ermsleben (SWC, Temp) - Großes Bruch - Schlanstedt - Schäfertal (SoilNet) - Hohes Holz (SoilNet) 	<ul style="list-style-type: none"> - Höglwald (no soil suction) - Graswang - Rottenbuch - Fendt - Scheyern 	<ul style="list-style-type: none"> - DEMMIN - Müritz National Parc - Fürstenseer-See Planned



Mobile Aquatic Mesocosms (MOBICOS)

- Mobile Containers placed in or at water in which semi-natural investigations and experiments can be carried out
- Six MOBICOS-Containers are implemented within the Bode-Observatory





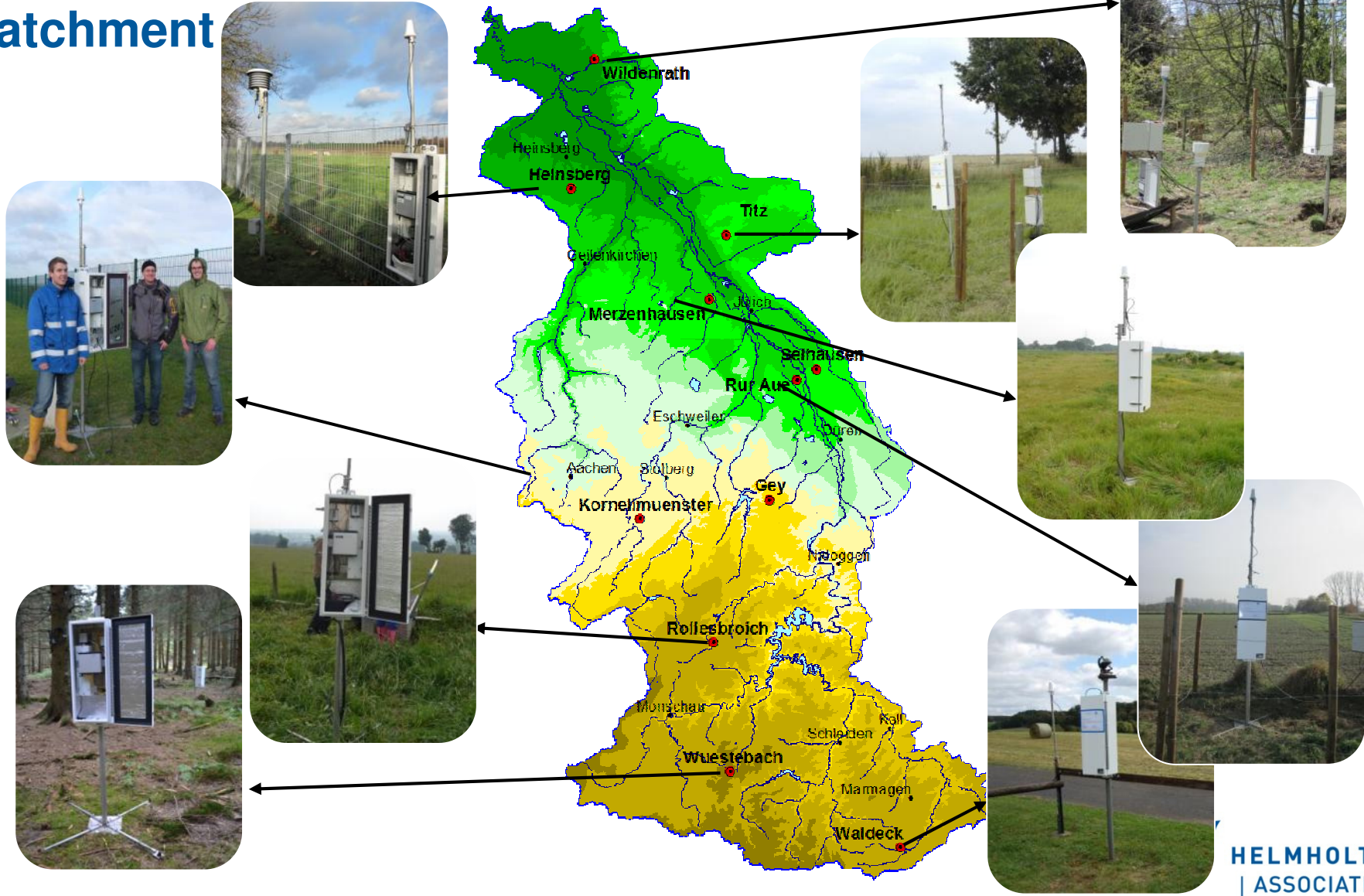
Chamber crane

Automatic measurements of GHG at the TERENO Rottenbuch site (T-Prealpine)





TERENO: Cosmic Ray Probe Network in the Rur catchment





TERENO Data Management

TEODOOR ONLINE DATA PORTAL

Rollesbroich Soilnet End Device 102

Offering	Style
Soil	SoilWaterContent5cmSensor1 [%]
	SoilTemperature5cmSensor1 [degC]
	SoilWaterContent5cmSensor2 [%]
	SoilWaterContent20cmSensor1 [%]
	SoilWaterContent20cmSensor2 [%]

begin: 2011-05-20 10:18:22
 end: 2011-09-21 10:18:22

Information: Result

Graph showing SoilWaterContent5cmSensor1 [%] over time.

- 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

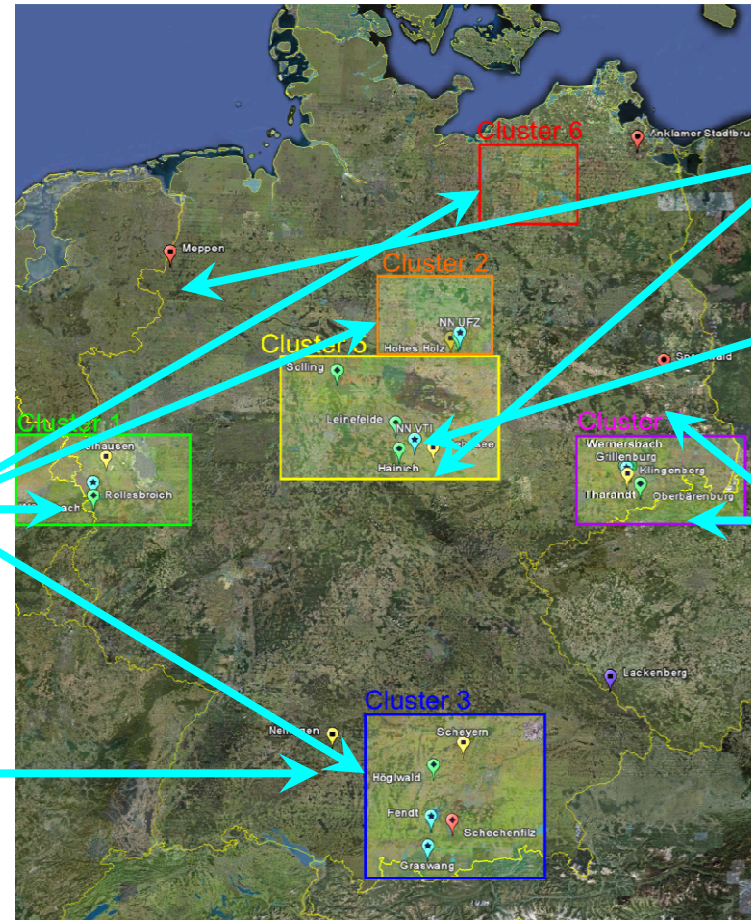
See also CT Datamanagement Presentation



ICOS



- ICOS-D has been approved
- Funding of pilot phase:
6 Mio. € (2013-2014)
- VTi, DWD and HGF are key partners
- 3 TERENO observatories are included





Consultation on Research Infrastructures Topics for Integrating Activities



- ESFRI-Call for Proposals – (FP7 follow-up program)
- Total budget 39 Mio. €
- Two Proposals with TERENO participation
 - A European network of hydrological observatories – Lead: CEH, A. Jenkins
 - LTER-Europe network – Lead: UBA Wien, M. Mirtl





Larger Research Projects in Germany related to TERENO

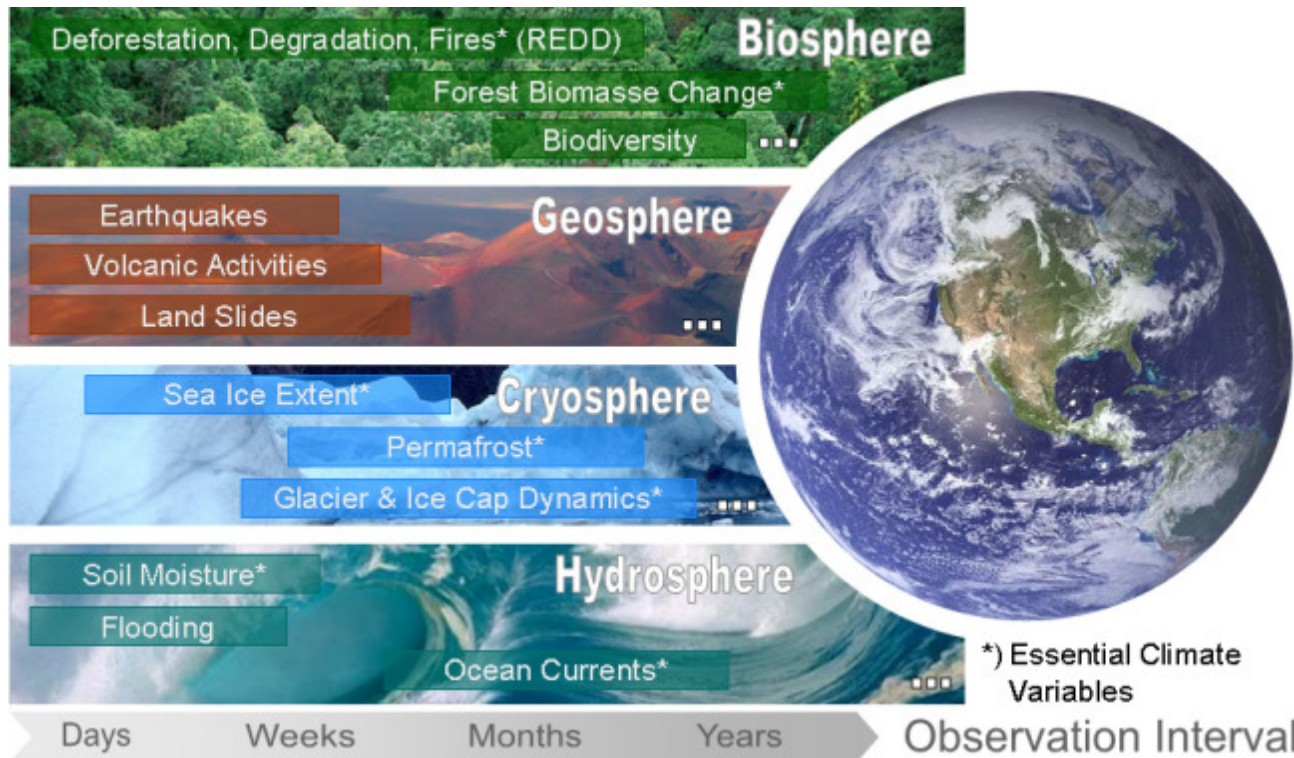
- HGF Allianz: „Remote Sensing and Earth System Dynamics“
- HGF Infrastructure: Advanced Remote Sensing - Ground Truth Demo and Test Facilities Virtual Institute for Integrated Climate and Landscape Evolution Analyses (ACROSS)
- Helmholtz Young Investigators Group TEAM
- Helmholtz Young Investigator Group "Capturing all relevant scales of biosphere-atmosphere exchange – the enigmatic energy balance closure problem (ENCLOSE)“
- Helmholtz Research School on Mechanisms and Interactions of Climate Change in Mountain Regions (MICMoR)
- BMBF project „Integrated Carbon Observation System Germany (ICOS-D)“
- DFG Forschergruppe: Agricultural landscapes under global change - Processes and feedbacks on a regional scale (HMGU: E. Priesack, UHOH: T.Streck)
- Helmholtz Young Investigators Group MicroCene (Microbial communities of the methane cycle as proxies for peatland condition and genesis)
- Water Science Alliance





HGF Allianz: „Remote Sensing and Earth System Dynamics“

- Allianz proposal was fully accepted
- Projects started this year



Principal investigator:

Prof. Moreira (DLR),

Prof. Irena Hajnsek (DLR,
ETH Zürich)

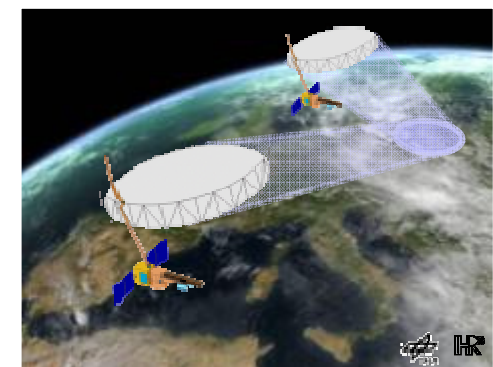
Partners:





HGF Allianz: „Remote Sensing and Earth System Dynamics“

	Tandem-L Science Products	Resolution	Revisit
Biosphere	Forest height	20 - 50 m	16 days – seasonal
	Above ground biomass		
	Vertical forest structure		
Geo-/ Lithosphere	Plate tectonics	5 - 100 m	weekly*
	Volcanoes		
	Landslides		
	Deformation		
Cryo- & Hydrosphere	Glacier flow	50 - 500 m	weekly*
	Soil moisture		weekly*
	Water level change		on demand
	Snow water equivalent		seasonal
	Ice structure change		seasonal
	Ocean currents		weekly*
Global	Digital terrain and surface	20 - 50 m	yearly





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, ^{JL3}) 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: ^{JL4}

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

Folie 14

JL3

Das würde ich nicht schreiben, denn mit GEMIS wollen wir diesen Schritt ja machen. Wenn hier steht, dass das auch ohne global flächendeckende Replikation machen, dann nehmen wir ein wichtiges Argument für GEMIS weg.

Lauterjung, 01/09/2011

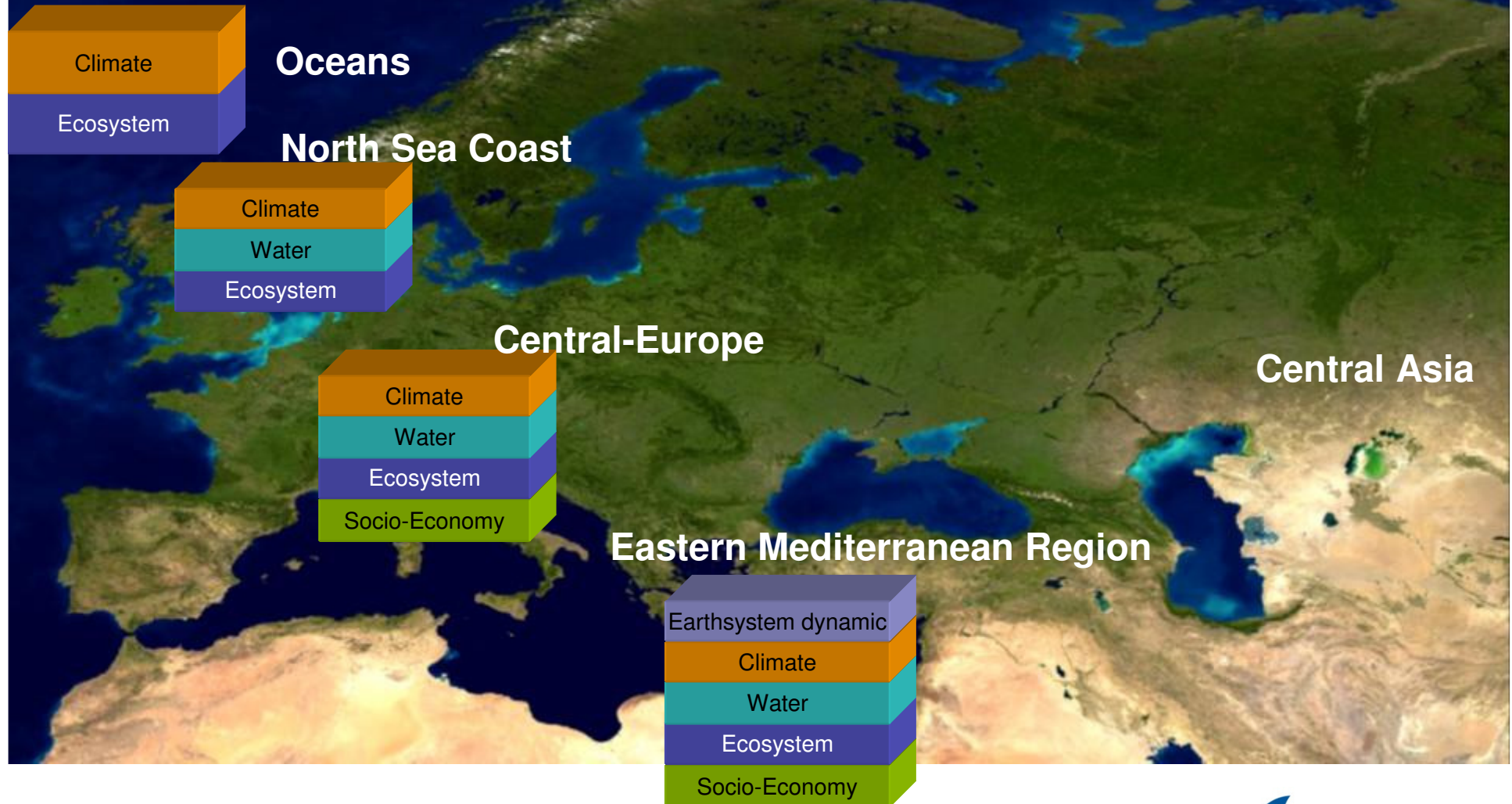
JL4

Hier sollten wir dann auch die gleichen Regionen aufführen wie in den anderen Folien.

Lauterjung, 01/09/2011



ACROSS: Regions und Grand Challenges





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/Tubitak

Coordinator: UFZ

TERENO-partners involved: FZJ, KIT and UFZ

Funding: 50% UFZ, 50% FZJ

Total volume: 6.8 Million euro



Bundesministerium
für Bildung
und Forschung

TERENO
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES



Deutsche Forschungsgemeinschaft

Langzeitperspektiven und Infrastruktur der terrestrischen Forschung Deutschlands – ein systemischer Ansatz

Strategiepapier

Arbeitsgruppe „Infrastruktur für die terrestrische Forschung“
Senatskommission für Stoffe und Ressourcen in der Landwirtschaft
Senatskommission für Wasserforschung
Senatskommission für Zukunftsaufgaben der Geowissenschaften
Nationales Komitee für Global Change Forschung

DFG

 **HELMHOLTZ**
ASSOCIATION



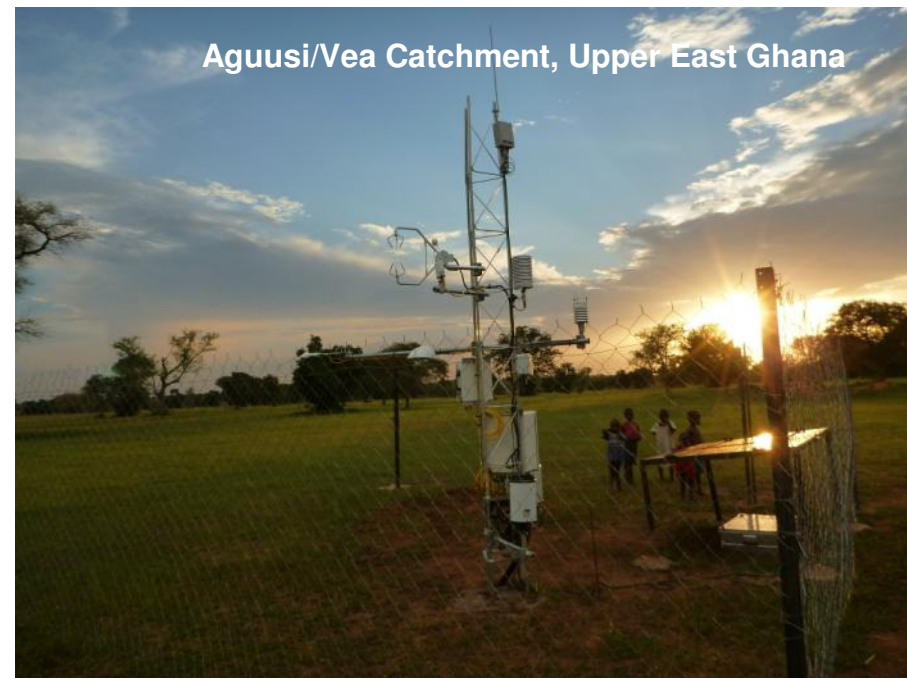
TERENO Outreach: WASCAL

Establishment of EC-Stations in Ghana and Burkina Faso

October 2012 (still ongoing)



10° 55' 5.84" N
1° 19' 14.75" W

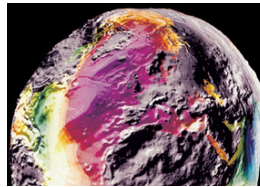


10° 50' 43.80" N
0° 55' 8.72" W



TERENO and Research Field Earth and Environment

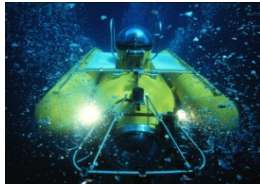
Research Programmes



- Geosystem: The Changing Earth (GFZ)



- Marine, Coastal and Polar Systems



- Oceans: From the Deep Sea to the Atmosphere



- Atmosphere and Climate (KIT)

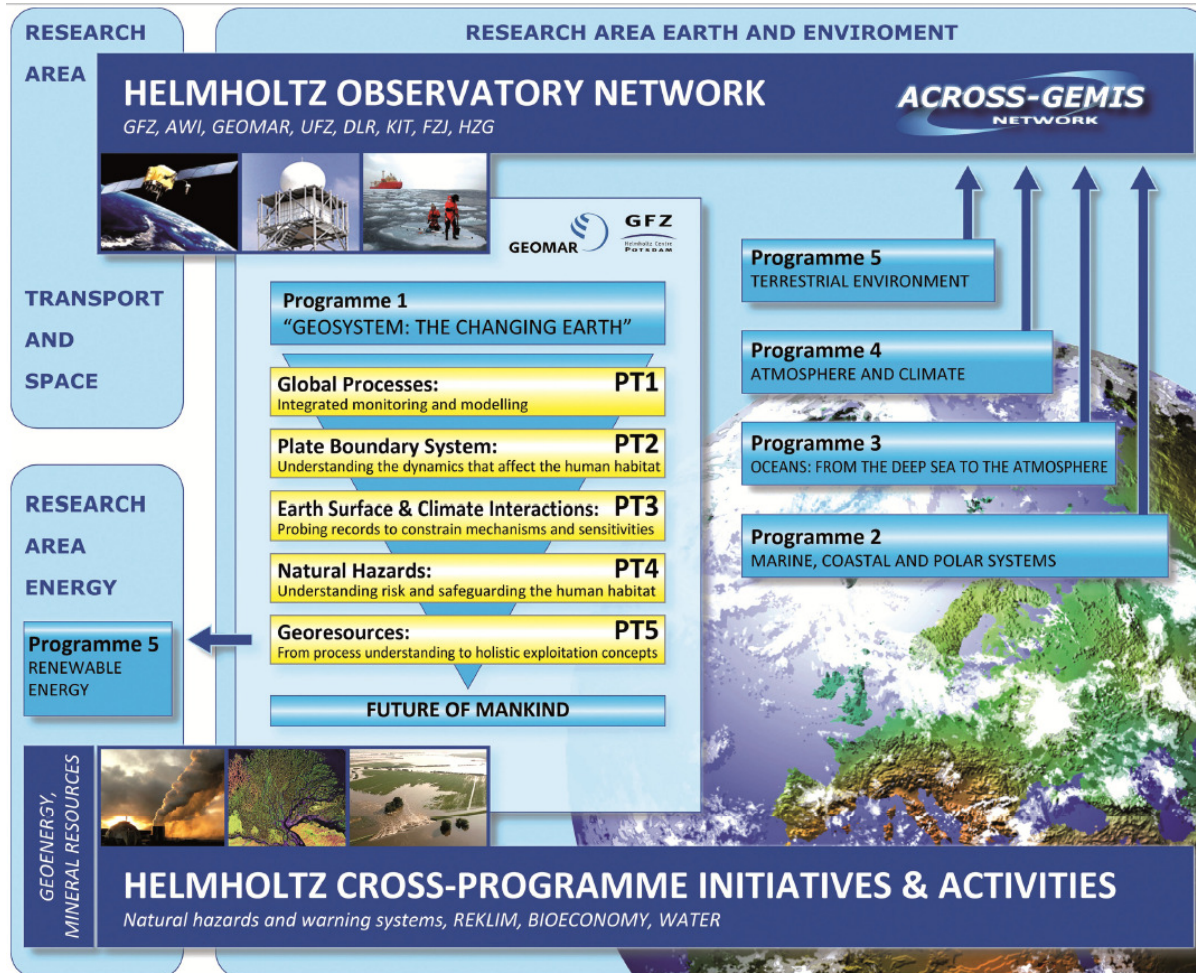


- Terrestrial Environmental (FZJ, UFZ, HMGU)





Programme Geosystem: The Changing Earth



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Programme Atmosphere and Climate

**T1: CLOUD AND WEATHER RESEARCH
(KIT, GFZ)**

**T2: LAND SURFACE PROCESSES IN THE
CLIMATE SYSTEM (KIT)**

**ST: Effects of land use and climate change on
regional matter fluxes**

ST: Vegetation in the climate- and land use system

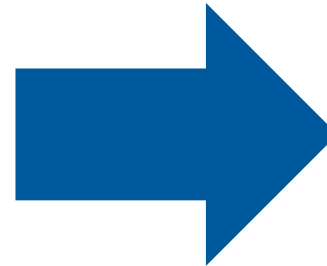
ST: Regional Climate- and Water Cycle Variability

ST: Urban-Rural Interactions

**ST: Atmospheric Exchange Processes in Complex
Terrain**

**T3: TROPOSPHERIC TRACE SUBSTANCES AND
THEIR TRANSFORMATION (FZJ, KIT)**

**T4: COMPOSITION AND DYNAMICS OF THE
UPPER TROPOSPHERE AND MIDDLE
ATMOSPHERE (KIT, FZJ, GFZ)**



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Programme Terrestrial Environment

T1: LAND USE, BIODIVERSITY, AND ECOSYSTEM SERVICES: SUSTAINING HUMAN LIVELIHOODS

- IP: Emerging ecosystems: functional dynamics under global change
- IP: Mitigating land use conflicts – between land sparing and land sharing
- IP: Urban transformations – sustainable urban development towards resource efficiency, quality of life and resilience
- IP: Land use aspects of transforming the energy system: sustainable options for a renewable energy era

UFZ

T2: SUSTAINABLE PLANT PRODUCTION IN A CHANGING ENVIRONMENT

- IP: Abiotic stress resistance and resource use efficiency
- IP: Biotic interactions – signalling mechanisms in plant defence
- IP: Bioproduction and sustainable use of resources

HMGU
UFZ

T3: SUSTAINABLE WATER RESOURCES MANAGEMENT

- IP: Water and matter flux dynamics in catchments
- IP: Healthy aquatic ecosystems
- IP: Dynamics of groundwater ecosystem services
- IP: Water scarcity

UFZ
HMGU

T4: CHEMICALS IN THE ENVIRONMENT: TOWARDS ECO-COMPATIBILITY AND ENVIRONMENTAL HEALTH

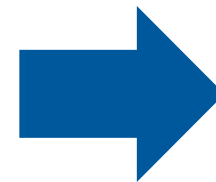
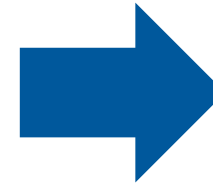
- IP: Controlling chemicals' fate
- IP: Exposome – impact of environmental perturbation on health

UFZ

T5: TERRESTRIAL SYSTEMS: FROM OBSERVATION TO PREDICTION

- IP: Linking novel measurement methodologies to models across scales
- IP: Critical Zone controls on hydrological and biogeochemical processes and fluxes
- IP: From local scale processes to regional prediction

FZJ
UFZ
HMGU



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Publications and phd-students

TERENO-related publications:

	2010	2011	2012	in press
GFZ	0	4	3	2
KIT	0	2	2	2
FZJ	1	5	4	2
HMGU	0	1	1	0
UFZ	0	3	5	1
DLR	0	0	1	1
total	1	15	16	8

Phd-students:

	2010	2011	2012	ongoing
GFZ	0	0	0	5
KIT	0	0	2	6
FZJ	0	1	2	17
HMGU	0	0	2	6
UFZ	0	0	1	19
DLR	0	0	0	0
total	0	1	7	53



Further developments



Global Integrated Earth observation and Validation system (GEMIS)

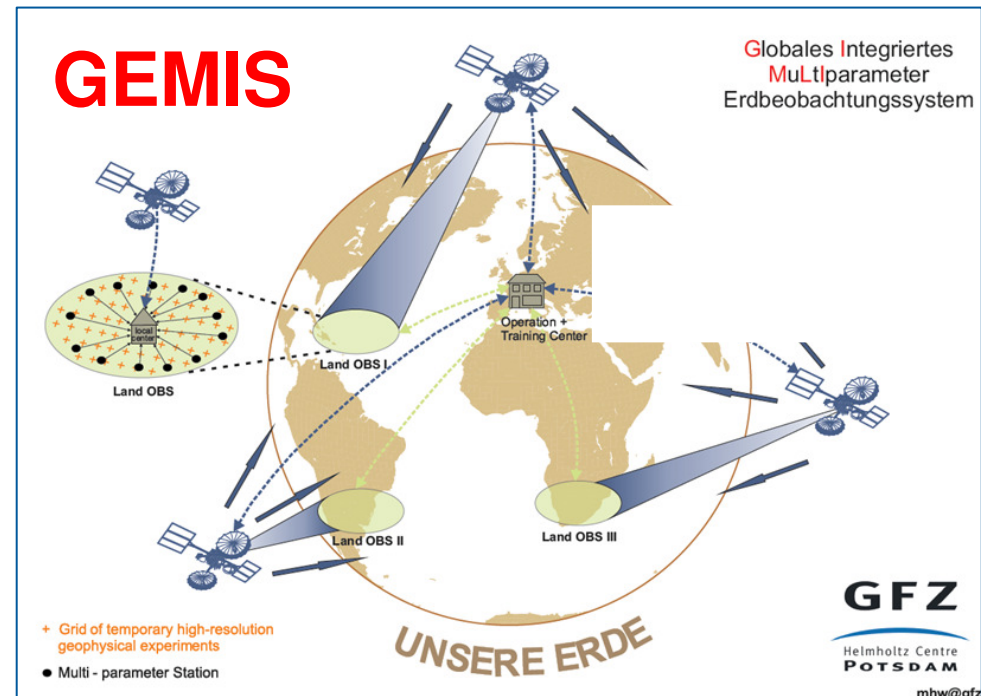
GEMIS will consists of different components

- 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

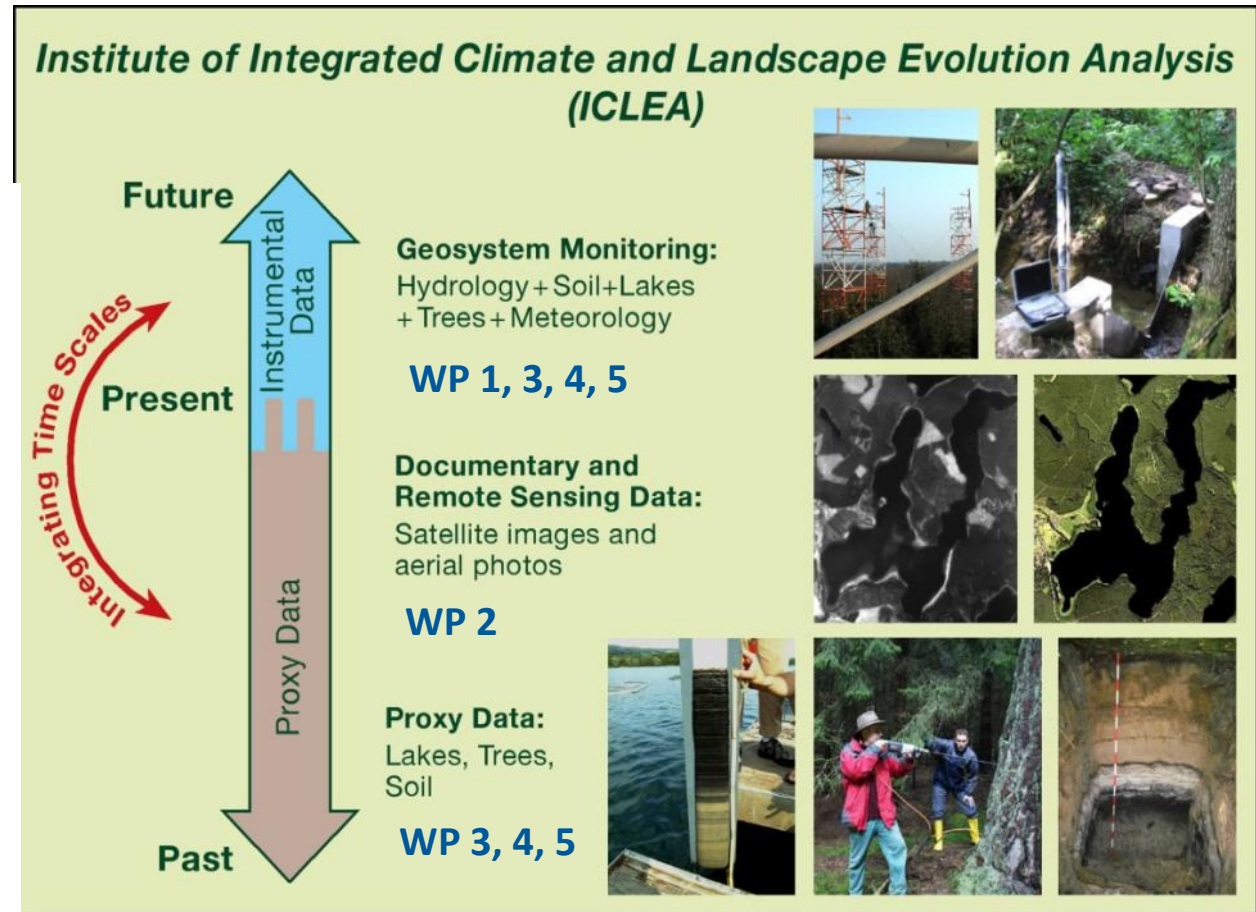


Appendix



Virtual Institute for Integrated Climate and Landscape Evolution Analyses

- **Helmholtz-Funding:** Start 01/2012 (3+2 yrs.)
- **Leader:** GFZ
- **New unique concept:** Integration of hydrologic and climatic **instrumental monitoring data** (TERENO) with **proxy data** from natural environmental and climatic archives at all relevant time scales, as well as with **historical remote sensing data** sets.
- **Region:** Northern-Central European Lowlands as natural lab for landscape evolution.





Helmholtz Young Investigators Group TEAM

Trace Gas Exchange in the Earth-Atmosphere System on Multiple Scales






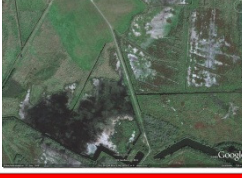
- **Multi-scale** direct **measurements** of GHG flux
- Quantification and understanding of interactions **across temporal and spatial scales**
- **Modeling and scaling** from local to regional

Group Leader: Torsten Sachs/GFZ

Funding period: 2012-2016

Study sites: Several peatlands and lakes in NE Germany (TERENO NE)



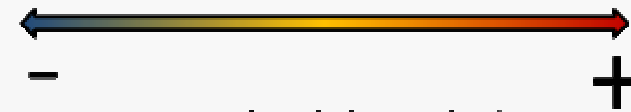
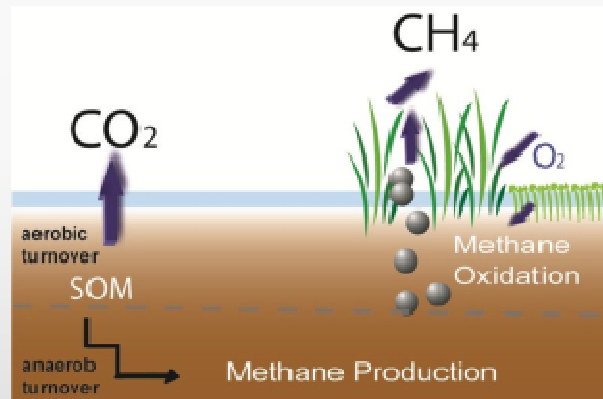
Method		TERENO Site
	Airborne eddy covariance regional (1000–100.000 km ²)	
	Airborne eddy covariance subregional (10 – 10.000 km ²)	
	Ground-based eddy covariance Ecosystem scale (0,01 – 10 km ²)	



Microbial communities of the methane cycle as proxies for peatland condition and genesis

Section 4.5 Geomicrobiology & Helmholtz Young Investigators Group *MicroCene*

Goal



Peatland degradation,
eutrophication and pH

LINK

Composition and activity of microbial
communities of the methane cycle

Sites

- Peatlands Müritz National Park & Ucker Catchment (to be specified)
- Test Site DEMMIN

Staff: Dirk Wagner,
Susanne Liebner, PhD
(N.N.)

Methods

Molecular community screening, Enzyme assays, Plot-scale methane emissions, Pore water analysis

Duration: Jan 2013- Dec
2015 plus...?



Helmholtz Young Investigator Group approved:

"Capturing all relevant scales of biosphere-atmosphere exchange – the enigmatic energy balance closure problem (ENCLOSE)"

Partners: University Hannover, KIT Institute of Geography and Geoecology (IfGG)

Funding period: 5 years

Funding volume: 1.5 Mio €

Start: February 2012

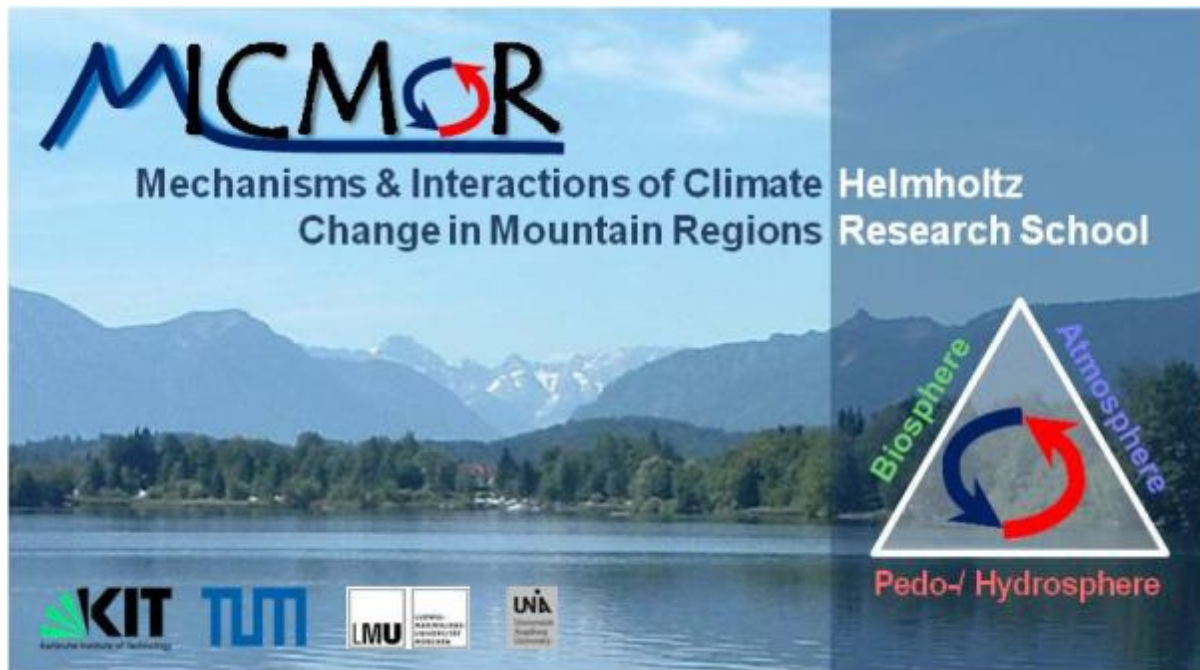


Helmholtz Research School on

Mechanisms and Interactions of Climate Change in Mountain Regions (MICMoR)

Research at Atmosphere– Biosphere–Pedo-/Hydrosphere Interfaces

Approved and started this year



Principal Applicant:

Karlsruhe Institute of Technology (KIT) –
Alpine Campus (IMK-IFU),
Garmisch-Partenkirchen

Chair: Prof. Dr. Hans Peter Schmid

Core Partners:

Technische Universität München (TUM)
Ludwig-Maximilian-University Munich (LMU)
University of Augsburg (UA)

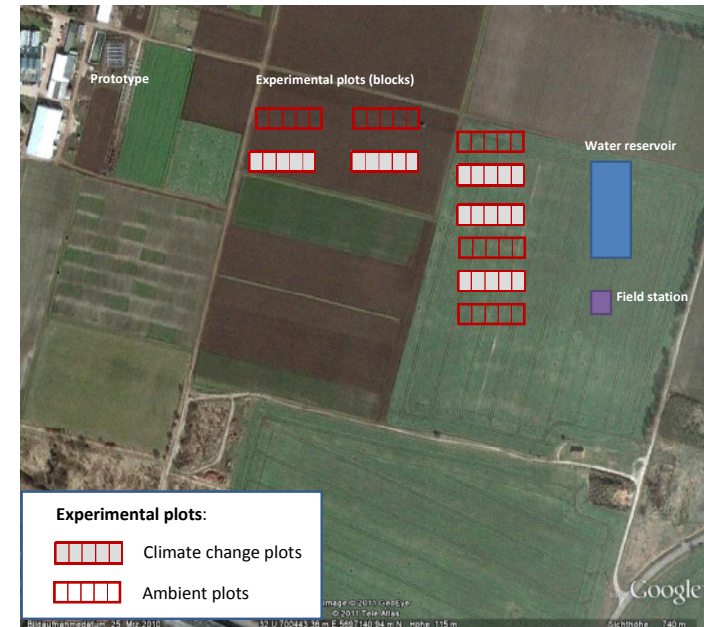
Associated Partners:

University Bayreuth
University Würzburg
DLR
HMGU



Global Change Experimental Facility

- Large-scale field-based experimental platform to assess the effects of climate change under different land use scenarios on the functioning of ecosystems and the provisioning of ecosystem services by ecological communities
- Parallel manipulation of land use and climate at plots of practice-related size
- Construction started 2012, start of operation 2013





Peer reviewed papers 2012

Bauer, J., Weihermüller, L., Huisman, J.A., Herbst, M., Graf, A., Sequis, J.M., Vereecken H., 2012. Inverse determination of soil heterotrophic respiration dependency on temperature and water content under field conditions, *Biogeochemistry* 108:119-134. DOI 10.1007/s10533-011-9583-1

Bittner, S., Legner, N., Beese, F., Priesack, E.: Individual tree branch-level simulation of light attenuation and water flow of three *F. sylvatica* L. trees. *Journal of Geophysical Research* 117 (2012), G1, G01037.

Chwala, C., Gmeiner, A., Qiu, W., Hipp, S., Nienaber, D., Siart, U., Eibert, T., Pohl, M., Seltmann, J., Fritz, J., Kunstmann, H. (2012) Precipitation observation using microwave backhaul links in the alpine and pre-alpine region of Southern Germany, *Hydrology and Earth System Sciences*, 16, 2647–2661, doi:10.5194/hess-16-2647-2012

Kaiser, K., Lorenz, S., Germer, S., Juschus, O., Küster, M., Libra, J., Bens, O., Hüttl, R.F. (2012): Late Quaternary evolution of rivers, lakes and peatlands in northeast Germany reflecting past climatic and human impact – an overview. *E&G Quaternary Science Journal* 61, 103-132. doi:10.3285/eg.61.2.01

Kolditz, O., Rink, K., Shao, H., Kalbacher T., Kunkel, R., Zacharias, S., Dietrich, P. (2012): International viewpoint and news: data and modelling platforms in environmental Earth sciences. *Env. Earth Sci.* 66, 1279-1284

Kunkel, R., Sorg, J., Gasche, R., Klump, J., Kolditz, O., Frenzel, M., Neidl, F., 2012. TEODOOR: Geodateninfrastruktur zur Verwaltung und Veröffentlichung von terrestrischen Beobachtungsdaten der HGF Infrastrukturmaßnahme TERENO aus verteilten Quellen, *WissKom2012 - Vernetztes Wissen – Daten, Menschen, Systeme*, Jülich, Germany

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- Benjamin Wolpert** (2012): „Emission and abundance of biogenic volatile organic compounds in wind-throw areas of upland spruce forests in Bavaria“
- Wie Qiu** (2012): “Copula-Based Rainfall Estimation by Combining Radar and Gauge Data and Microwave Attenuation Data”
- 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.
- Fabian Eder** (ongoing): "Measurement and scale analysis of convective transport in the Atmospheric Boundary Layer over heterogeneous terrain"
- Katja Heidbach** (ongoing): "Spatial representativeness of micrometeorological measurements of the biosphere-atmosphere-exchange"
- Janina Hommeltenberg** (ongoing): „Net ecosystem exchange of a natural and a drained temperate peatland forest“
- Hanna Post**: Upscaling of biogeochemical fluxes to characterize regional carbon balance
- Wittaya Kessomiat**: Joint assimilation of eddy covariance and soil moisture data to improve estimates with land surface models
- Sebastian Gebler**: Multi-variate data assimilation to improve hydrological modelling at the small catchment scale



continued

Christian Chwala (ongoing): “Precipitation intensity and humidity estimation by a fully coherent monostatic transmission experiment”

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 ”

Christian Biernath: Modelling climate change impacts on the yield and quality of crops based on leaf photosynthesis with acclimation to elevated CO₂.

Christian Klein (ongoing): Coupling of a regional climate model to a soil-vegetation model by use of the Expert-N model system.

Peter Hoffmann (ongoing): Modelling effects of regional differentiated climate change on crop growth and soil-plant water regime of forest ecosystems.

Florian Heinlein (ongoing): Modelling climate change impacts on crop growth based on explicit simulation of plant internal transport processes.

Christoph Thieme (ongoing): Modelling N₂O emissions from agricultural soils under changing climatic conditions.

Sun Han-Yin (ongoing) Organic matter dynamics and transformation towards soil quality and carbon sequestration by climate change adapted soil management.

Philipp Koal (start in November) Household of greenhouse gases in global change adapted agricultural soil-plant systems.

Gerald Blasch (ongoing): Updating and specification of soil maps by means of satellite-derived time series.

Anne Clasen (ongoing): Phenological and structural parameters in forest spectral behavior.

Christina Tecklenburg (ongoing): Groundwater-surface water interactions in a lake catchment in NE Germany.

Wei Liang (ongoing): Confocal laser scanning microscopy for developing long chronologies of cell structure measurements.

Henriette Wilke (ongoing): Hydrogeology of a lake catchment in NE Germany.

Christian von Hebel (ongoing): Large scale estimation of evaporation and groundwater recharge from soil moisture content using Multi-configuration Electromagnetic Induction sensing

Max Oberrohrmann (ongoing): Soil moisture content estimation by horizontal borehole GPR data

Achim Mester (ongoing): Monitoring of soil water content with multi-frequency threecomponent induction sensor array

Sebastian Rudolph (ongoing): Non-invasive characterization of plant stress at the field scale

Sebastian Busch (ongoing): Full-waveform inversion of surface GPR data for hydrogeological Applications

Shurong Liu (ongoing): Process studies on greenhouse gas exchange and nitrogen loss under changing environmental conditions.