





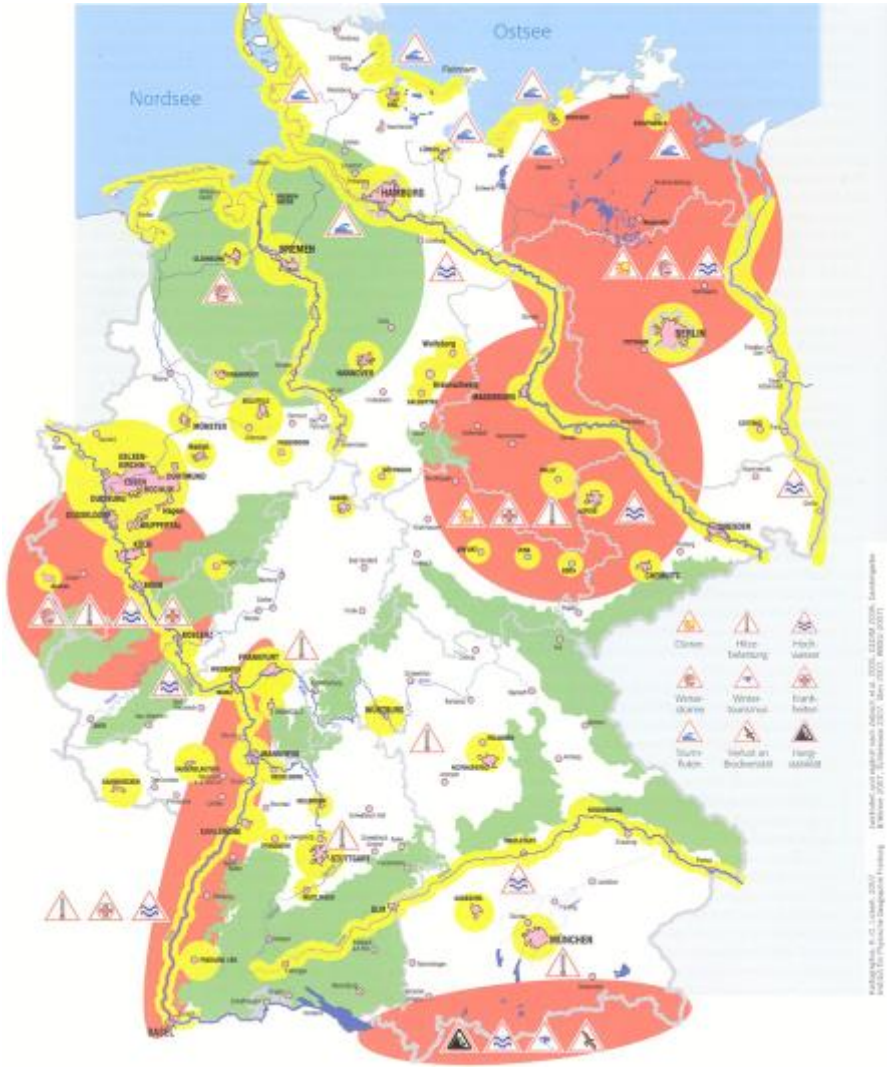


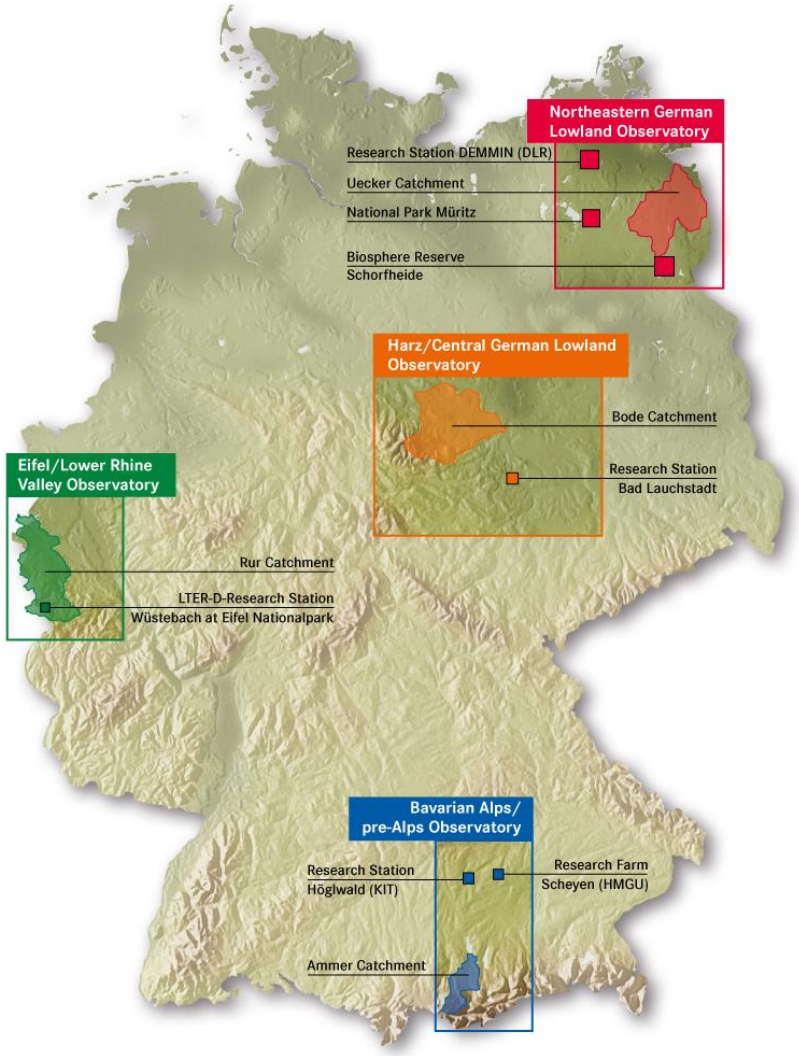

TERENO - a German example for integrated environmental monitoring and research

Steffen Zacharias and the TERENO team

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

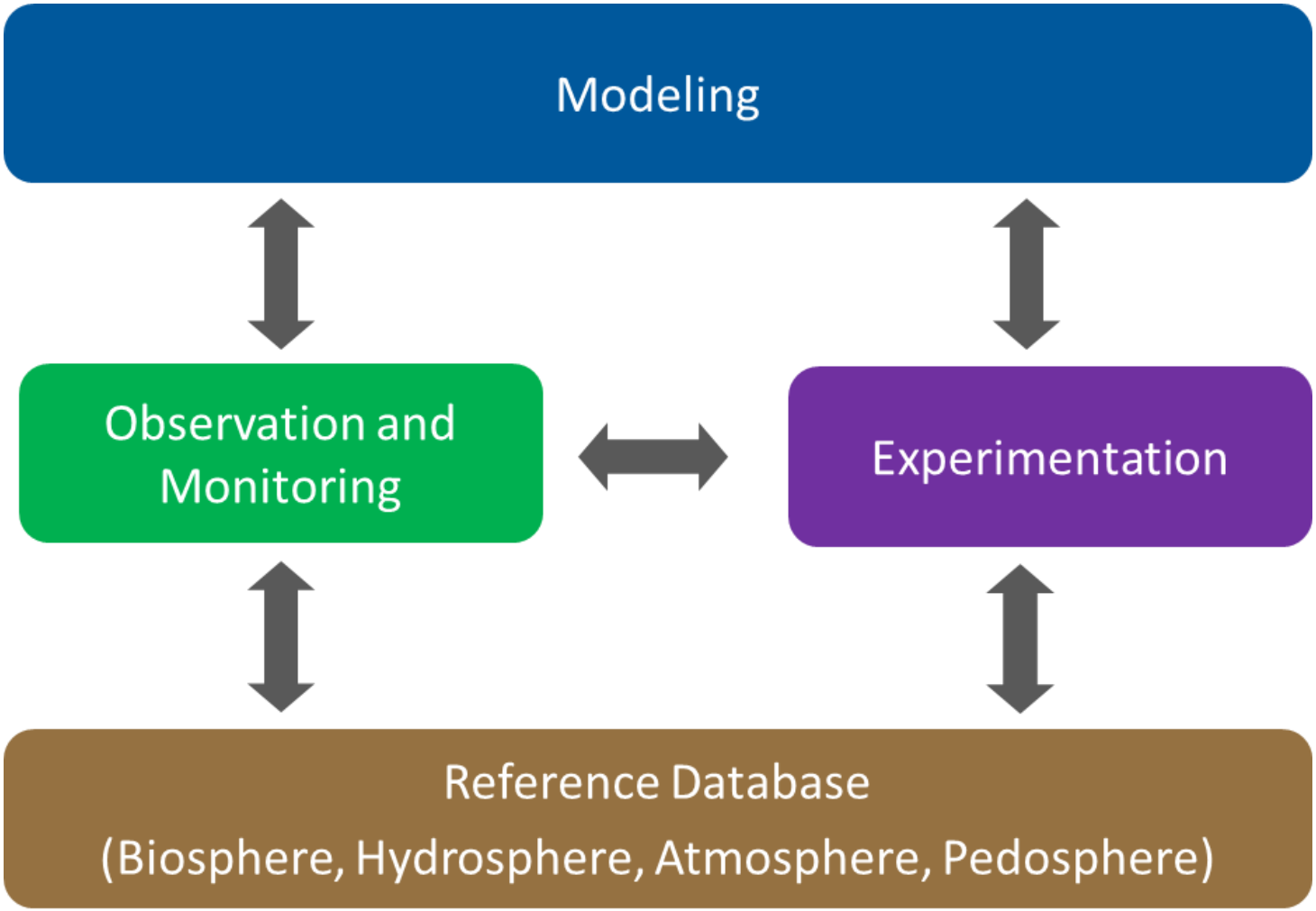
Climate Change in Germany



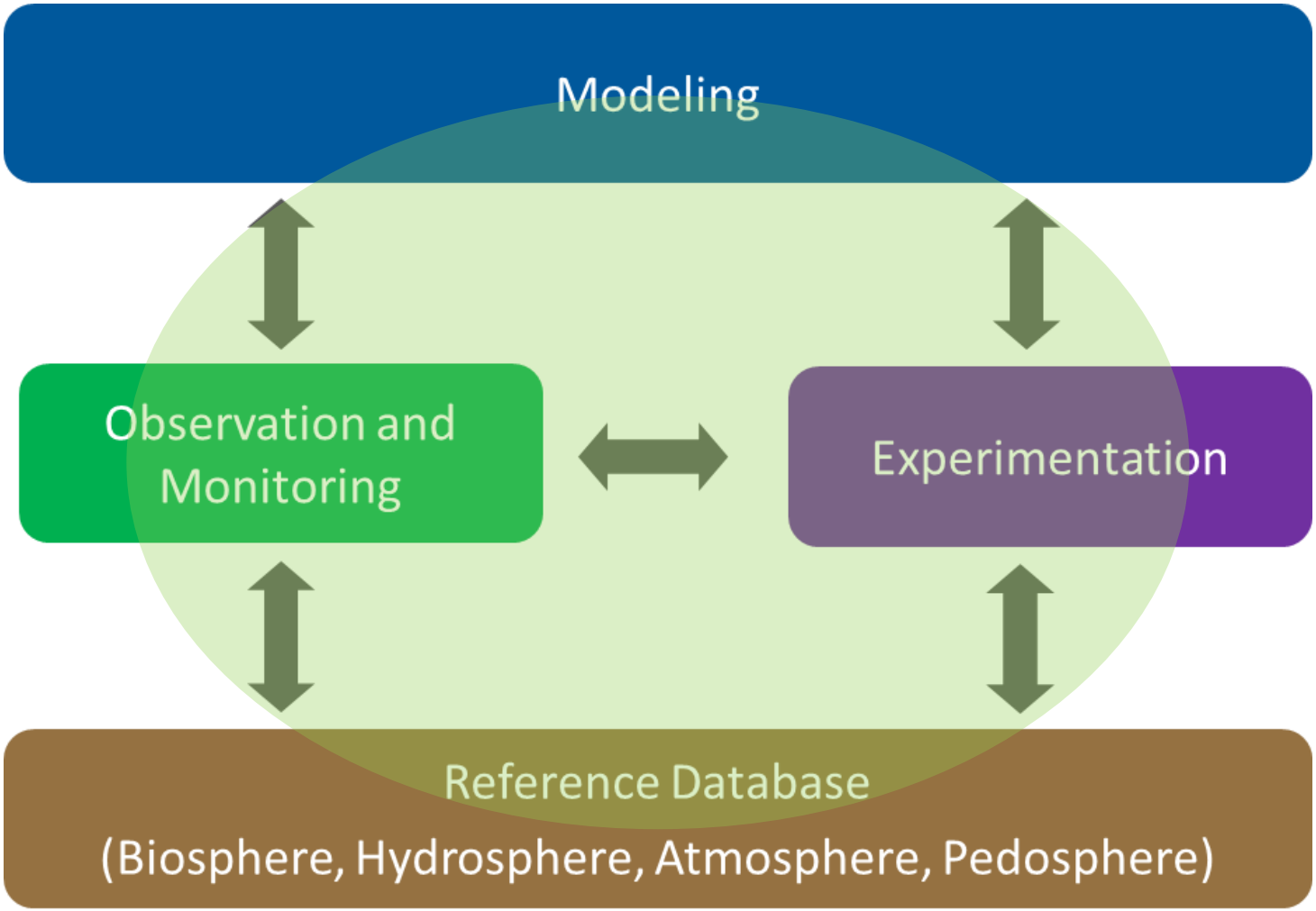


Source: R. Glaser 2008: Klimageschichte Mitteleuropas – 1200 Jahre Wetter, Klima, Katastrophen mit Prognosen für das 21. Jahrhundert.

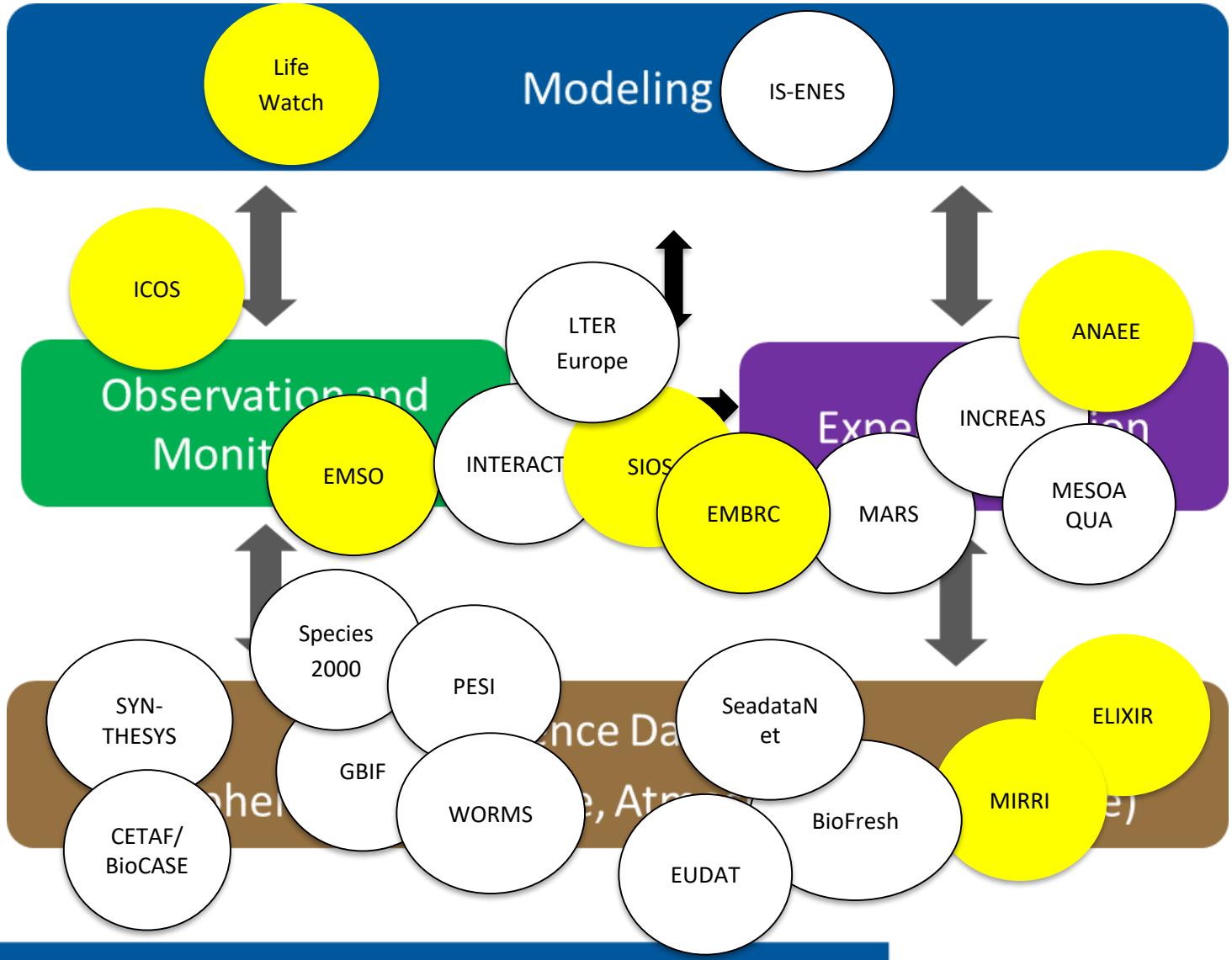
How to conceptualize?



Integration



Integration – Quo vadis



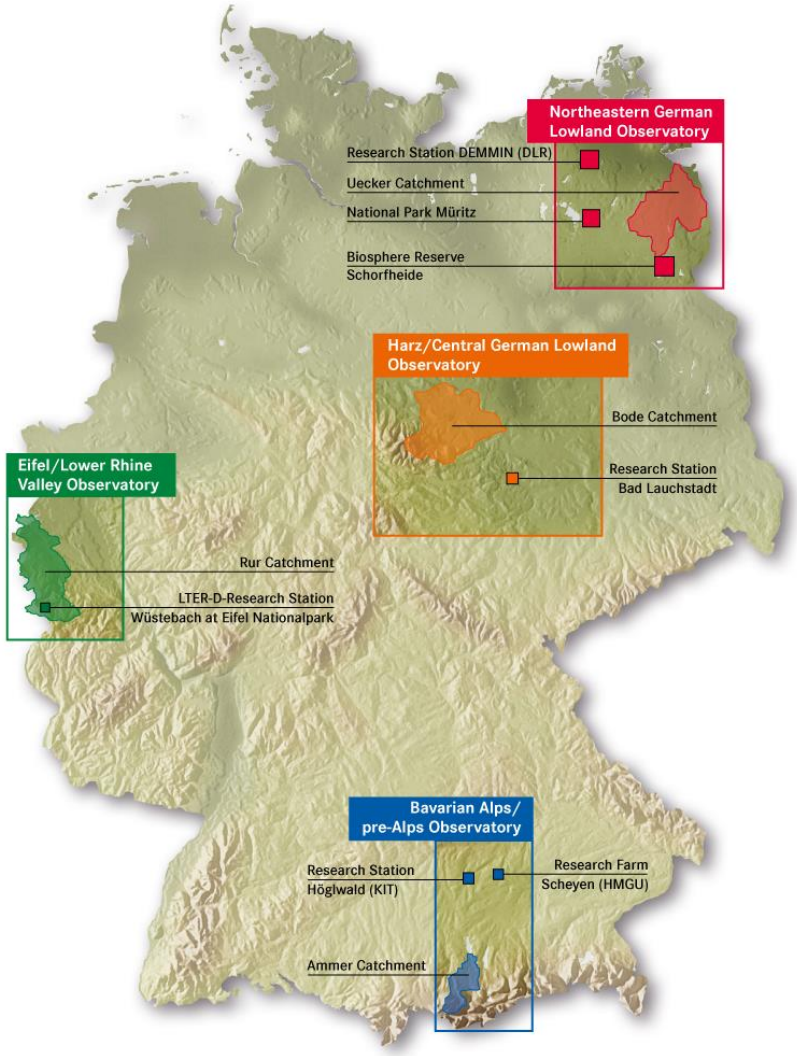
Mirtl, 2016

TERENO – The concept

- To bring together scientists from different scientific communities and to integrate disciplines
- To exploit the availability of novel technologies and high performance computer facilities for terrestrial research
- To establish common measurement platforms as the basis for long term data sets
- To combine observation and experimentation

TERENO – an initiative of the Helmholtz Association

- To provide long-term environmental data in a multi-scale and multi-temporal mode
- 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

Prediciting terrestrial processes from remote information

Multi-scale observations using non-invasive and novel Technologies

SMOS

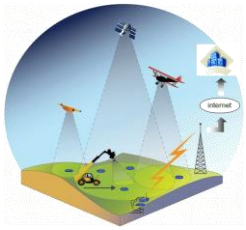
SAR

Weather-Radar

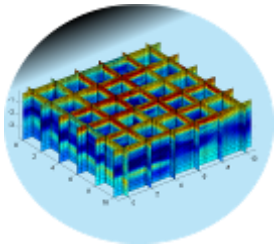
Radio-meter

EM

Data Fusion
Upscaling



Super Computing



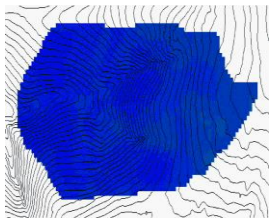
Data management
Visualization

Modelling

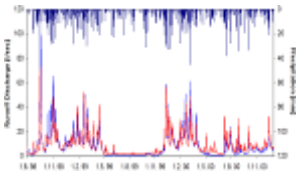
Terrestrial Processes

Evapotranspiration

Soil moisture

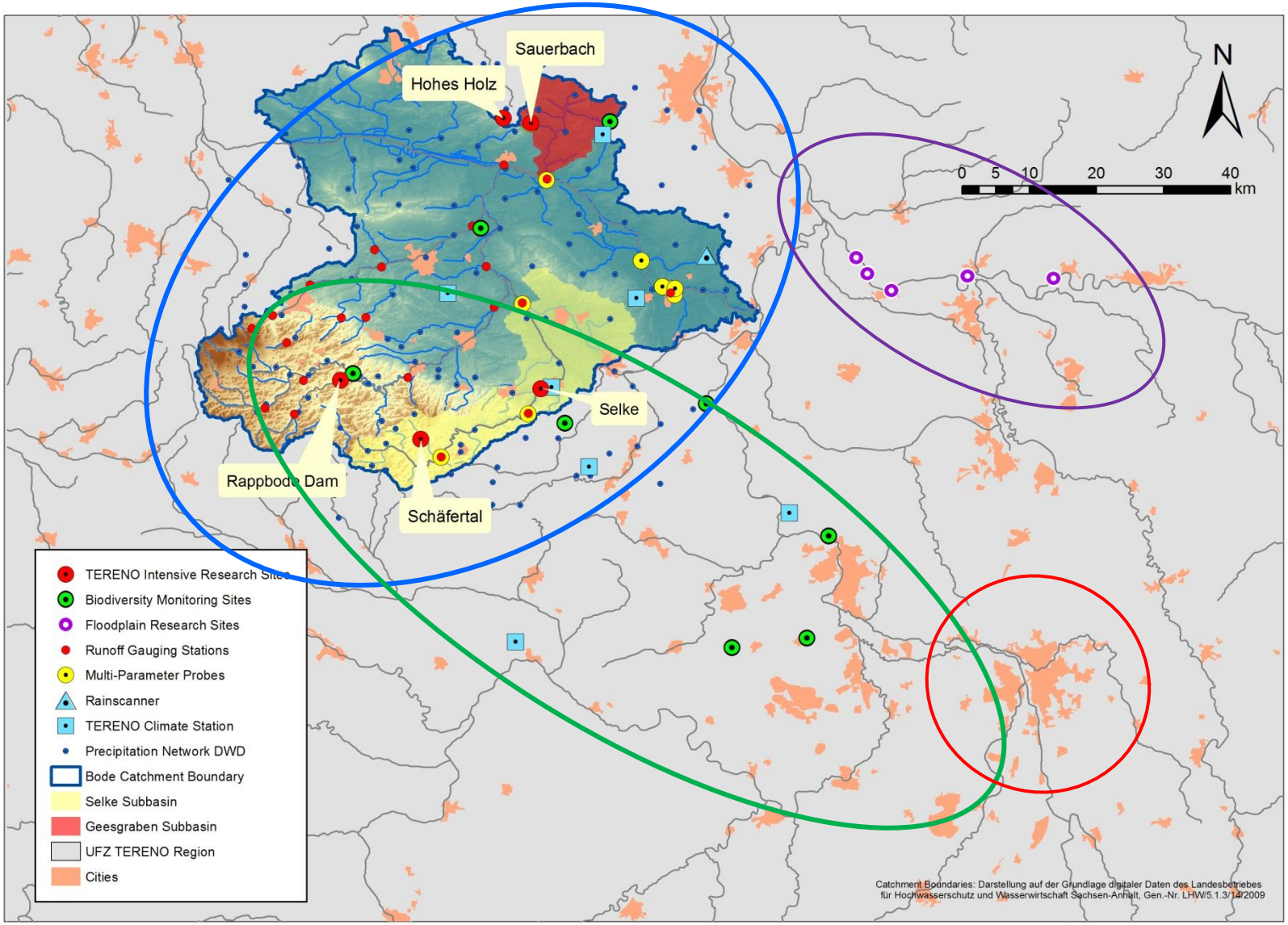


Runoff

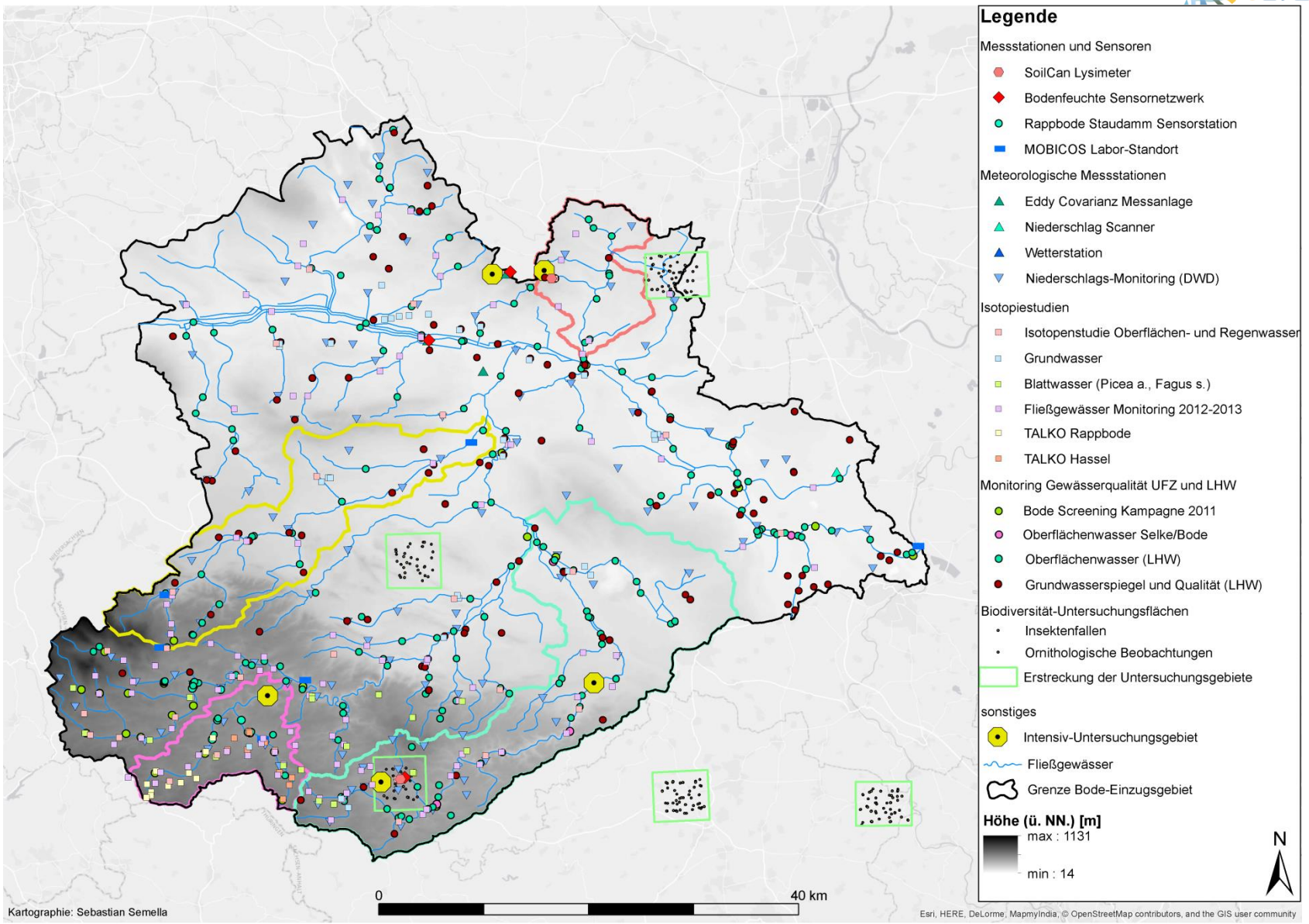


TERENO at the UFZ

The Harz/Central German Lowland Observatory



The Hydrological Observatory Bode



TERENO and Integrated Research-Projects at the UFZ

Topic – Land Use, Biodiversity, and Ecosystem Services

- Emerging ecosystems: functional dynamics under global change
- Mitigating land use conflicts – between land sparing and land sharing
- Urban transformations − sustainable urban development towards resource efficiency, quality of life and resilience

Topic – Sustainable Water Resources Management

- Water and matter flux dynamics in catchments
- Healthy aquatic ecosystems
- Water Scarcity

Topic – Chemicals in the Environment

- Controlling chemicals' fate

Topic – Terrestrial Systems: From Observation to Prediction

- Linking novel measurement methodologies to models across scales
- From local scale process models to regional prediction

TERENO is embedded in several international research networks

CRITICAL ZONE EXPLORATION NETWORK

ICOS integrated carbon observation system

ExpeER Ecosystem Research

eLTER

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

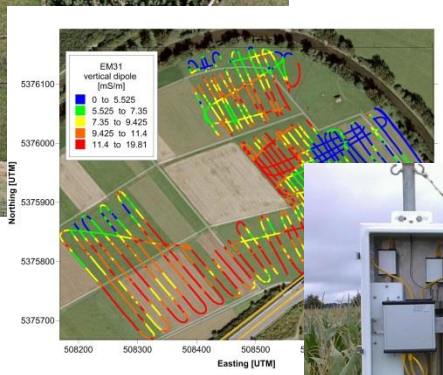
TERENO CZO - Intensive Site “Schäfertal Catchment“

Understanding the Functioning of the Terrestrial System and Landscape Water Balance Using Novel Observation and Modelling Techniques

→ lysimeters

→ wireless soil water content monitoring network

→ geophysical monitoring campaigns



→ cosmic ray probes

point scale

→ airborne & space borne remote sensing (e.g. F-SAR & hyper-spectral RS campaigns)

Multi-scale approach for monitoring soil water content (& snow)

small catchment scale

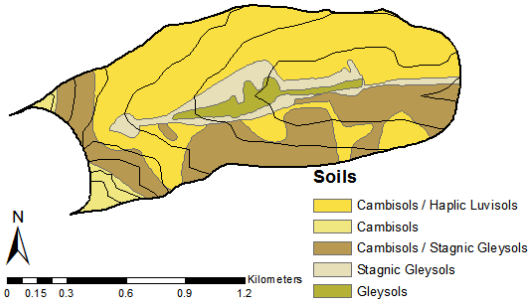
Soil-Landscape Modelling

How to transfer process understanding from the pedon scale to the landscape scale?

soil properties → spatially heterogeneous, but:

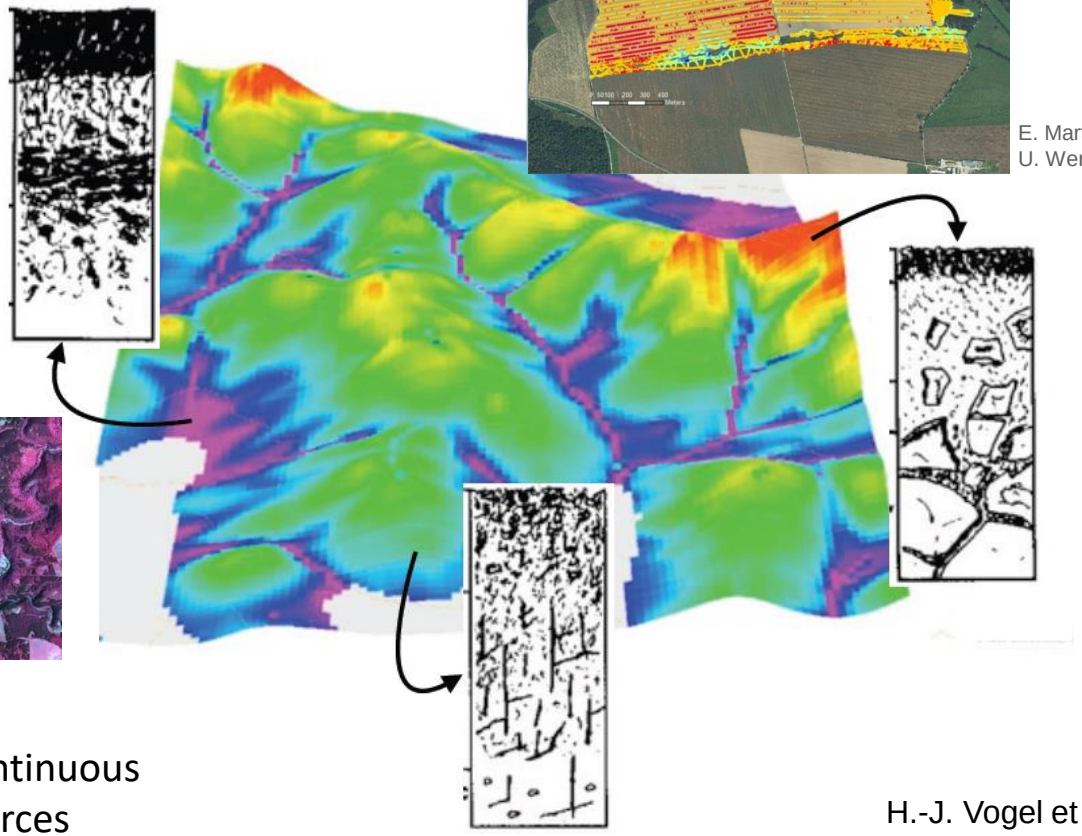
spatial distribution of soil types is not random (Jenny, 1942)

f(parent material, climate, relief, vegetation, age, …)

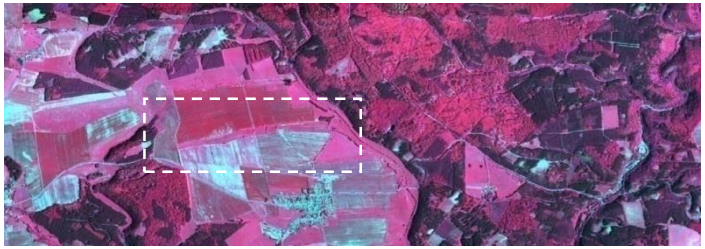


after Ollesch (2008)

E. Martini, U. Werban



H.-J. Vogel et al.



M. Pause, A. Lausch

→ joint evaluation of spatially continuous information from different sources

TERENO SoilCan

- Experimental infrastructure to observe long-term effects of land use change and climate change on soils
- Exchange of soil cores within the TERENO observatories along existing climatic gradients and in accordance with the projected climate change
- 126 lysimeters across all TERENO observatories (30 lysimeters at three sites in the Harz/Central German Lowland observatory)
- One of the experimental platforms for the EU-FP7 Project EXPEER (Distributed Infrastructure for EXPErimentation in Ecosystem Research)

MOBICOS – Mobile Aquatic Mesocosms

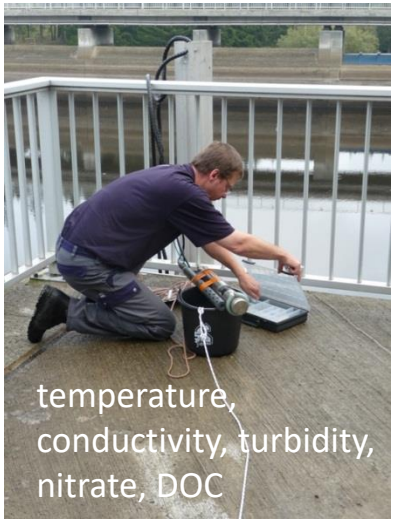
- Analysis of mechanisms by experimental manipulations under natural background
- Simulation of global change scenarios
- Control of communities and processes by multiple drivers and their interactions (factorial design)
- Complex on-site analyses for monitoring (effects based analyses, process monitoring)

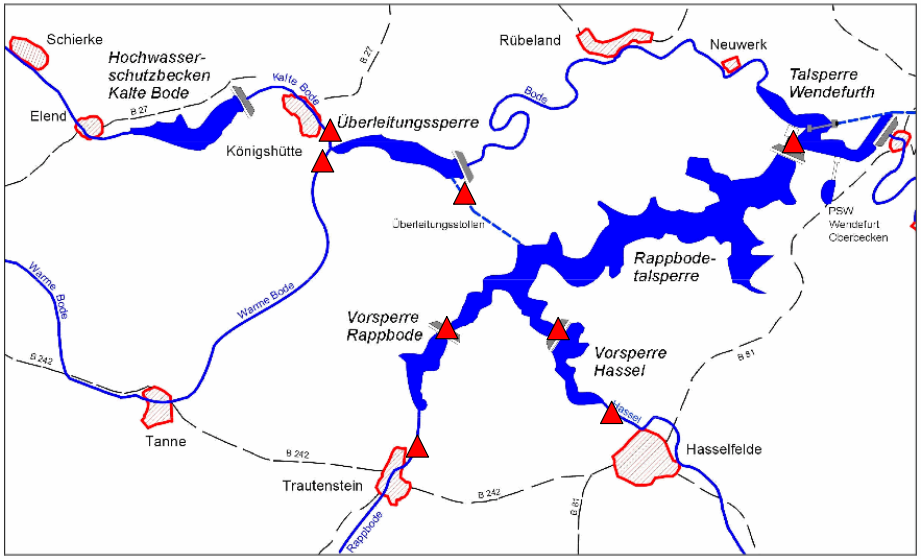
Norf, Weitere, et al.

Intensive Site “Rappbode Dam”

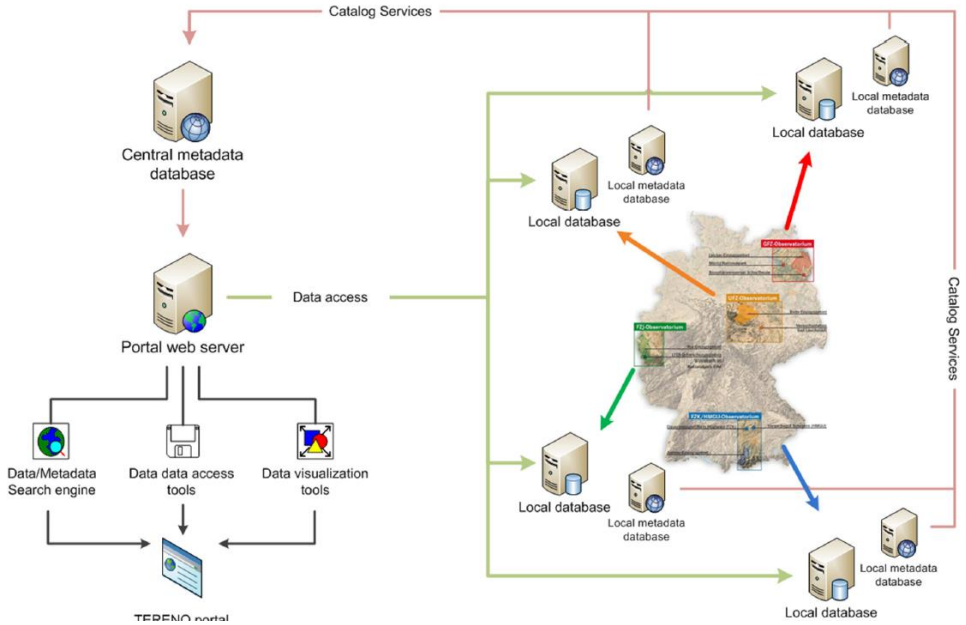
Understanding of dissolved organic carbon flux at the catchment scale

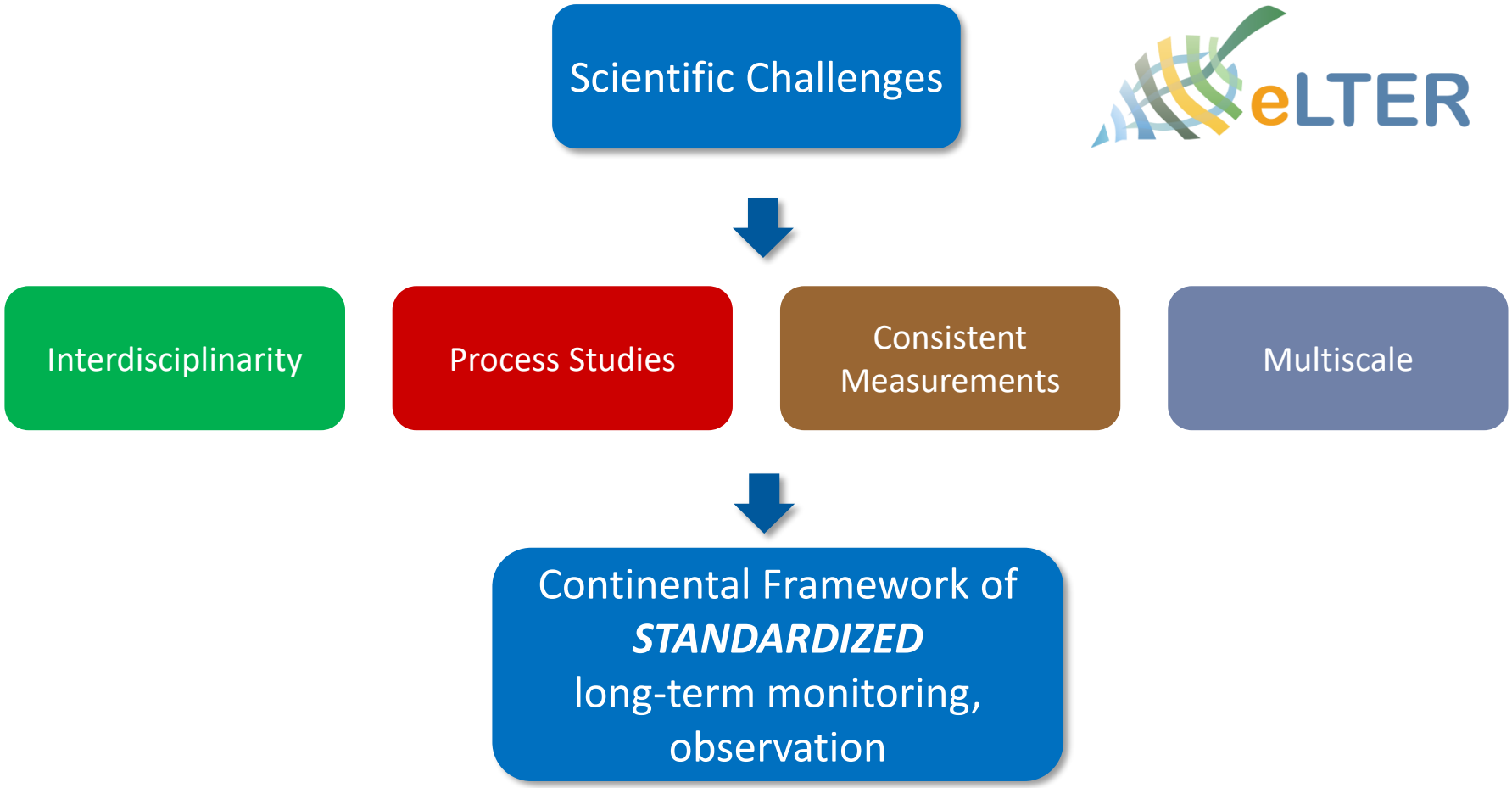
- One of the intensive research sites within the hydrological observatory Bode
- Integrative research on DOC dynamics in surface water systems (impact of land use and climate change on DOC dynamics and transformation processes)
- Close collaboration with local water supply companies



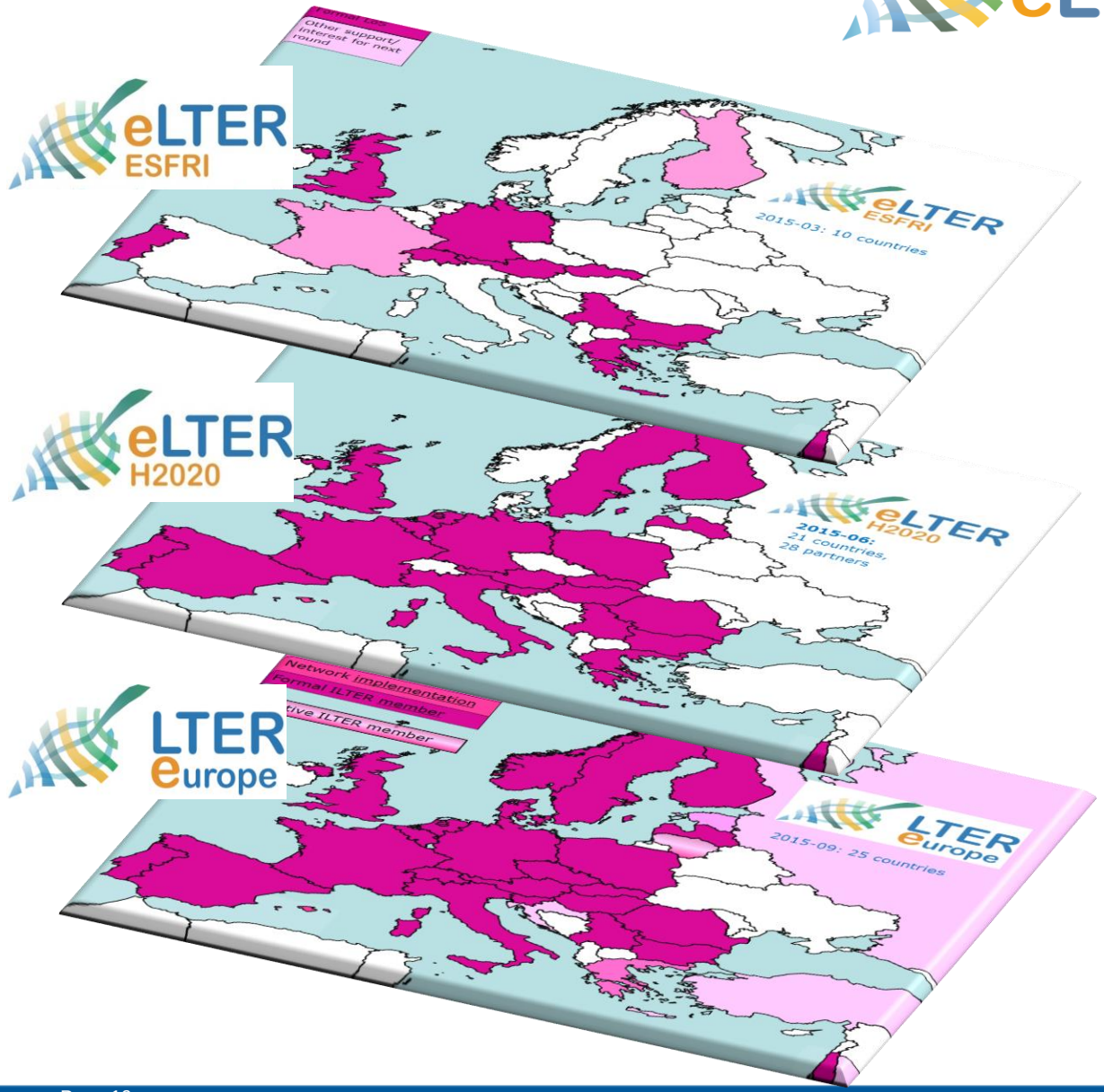


TERENO Data Portal




Scientific Challenges
Interdisciplinarity
Process Studies
Consistent Measurements
Multiscale
Continental Framework of ***STANDARDIZED*** long-term monitoring, observation

eLTER ESFRI Emerging Project



eLTER ESFRI emerging project

11 initiating countries

45/80/**130** eLTER **Sites** (MS, RS)

5/10/**30** eLTSER **Platforms**

eLTER H2020 Project 2015-2019

21 LTER countries,

28 partners

162 data providing sites

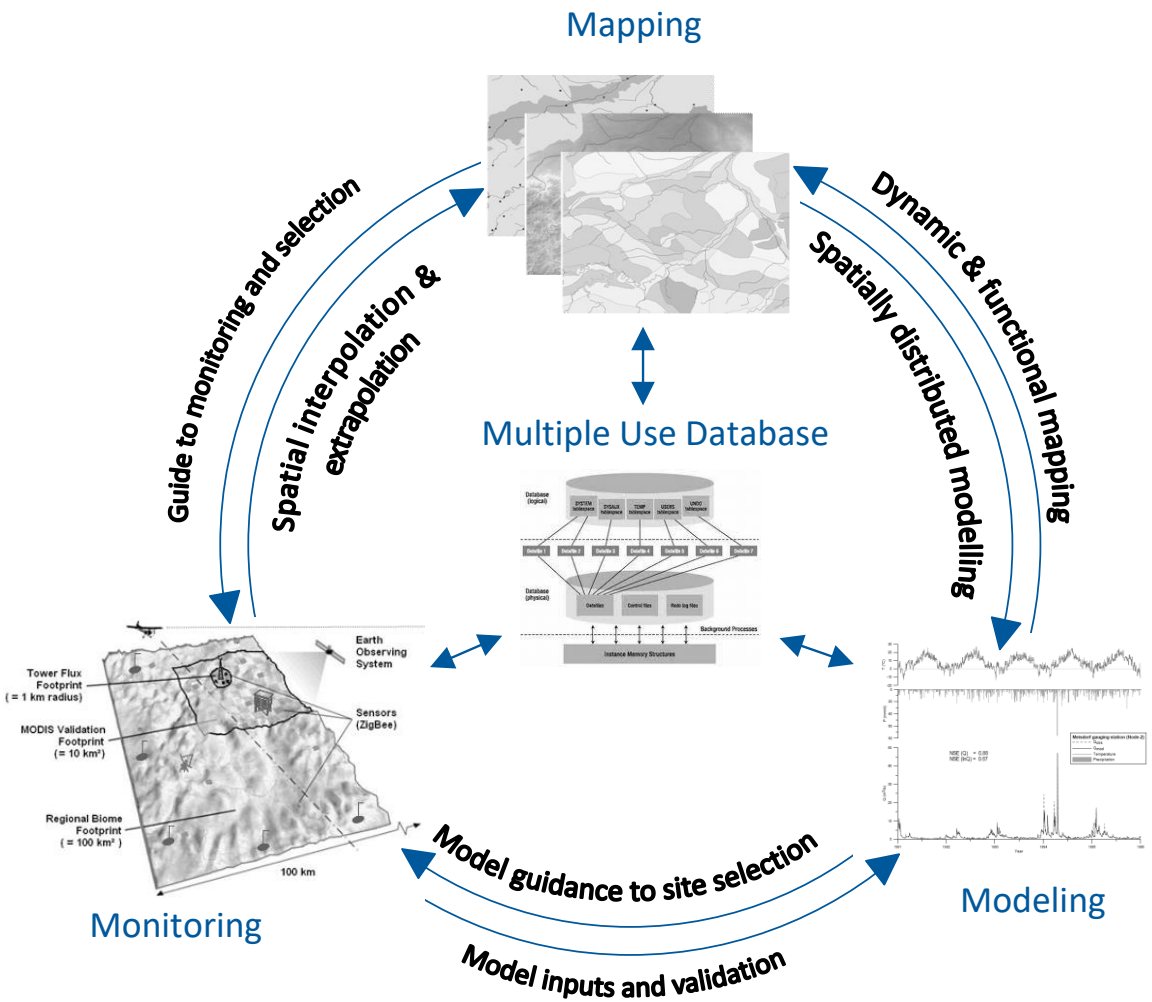
Network of formal national networks

25 countries

400 LTER Sites

35 LTSER Platforms

4M Approach
Monitoring-Mapping-Modeling-Multiple Use Database



Integrative loop of mapping, monitoring, modeling, and data mining as an integrated and evolutionary approach to adress the complexity and dynamics of the terrestrial system across scales (modified and extended 3M approach from Lin, 2010,)

Zusatz