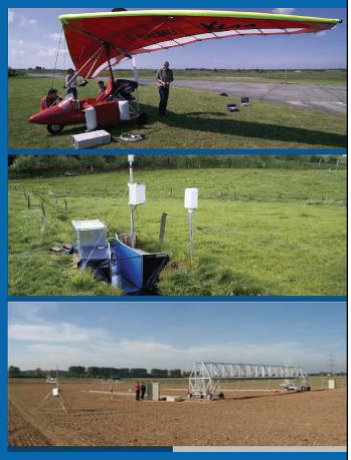
TEODOOR, a blueprint for distributed terrestrial observation data infrastructures



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4: Karlsruhe Institute of Technology, Garmisch-Partenkirchen, Germany
5: German Center for Environmental Health, BIOP, Oberschleißheim, Germany
6: GFZ German Research Centre for Geosciences, Centre for Geoinformation Technology, Potsdam

EGU General Assembly 2017, Vienna, Austria, 23 - 28 April 2017

HELMHOLTZ ASSOCIATION

The TERENO network

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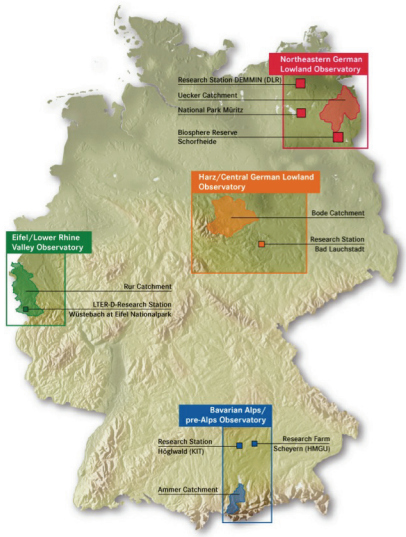
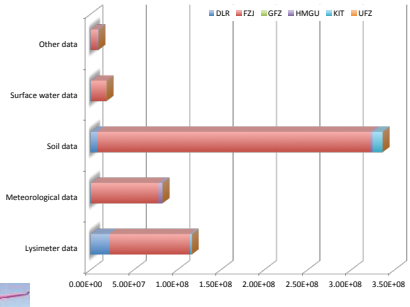
- Regional different effects of global climate change on terrestrial systems
- Global change affects all terrestrial compartments (water, soil, vegetation, atmosphere)
- Most existing observation networks focus on specific compartments and/or scientific questions
- TERENO:
  - Long-term observations (> 15 years) of hydrological and ecological parameters on different scales
  - Investigation of interaction between the different compartments
  - Bridging the gap between measurement, modelling and management
  - Currently 4 observatories, each operated by one individual Helmholtz Center
  - Project duration: 2008 until >2023



Institute for Bio- and Geosciences - Agrosphere (IBG-3)

Multi-scale and multi-compartment monitoring concept of TERENO

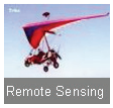
- 1065 stations
- 3 weather radar devices
- 129 lysimeters
- 400 file metadata sets




Geophysics


Groundwater monitoring


Modelling Platform


Remote Sensing


Wireless soil moisture sensor network


Lysimeters


Biodiversity monitoring

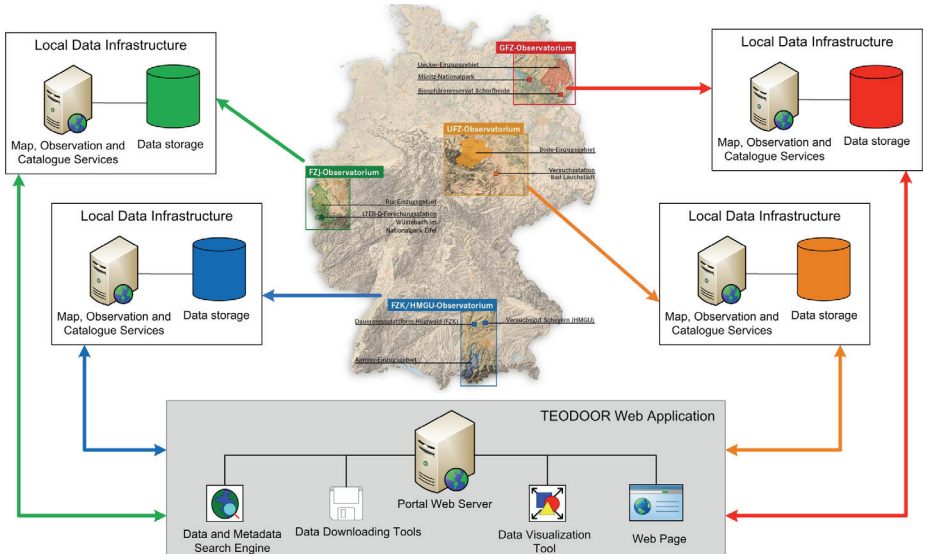

Mobile Mesocosms


Water quality monitoring


Eddy-Flux-Tower


Rainscanner

TEODOOR Distributed Spatial Data Infrastructure



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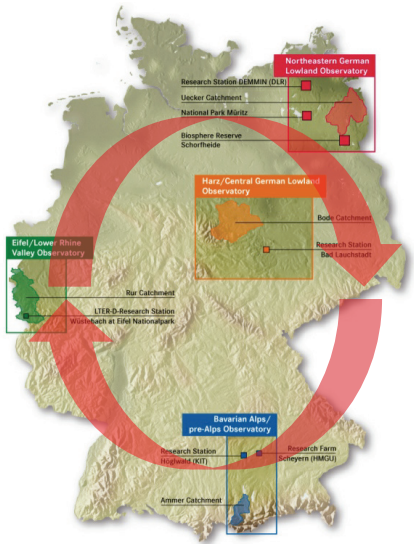
Interconnecting observatories

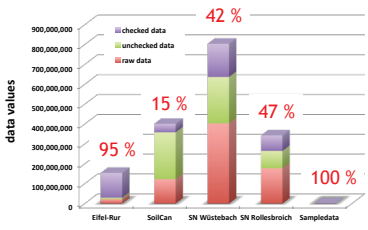
- Common data policy
  - Quality management
  - Time-limits for data delivery
  - Retention times for data publication
  - Accessibility of data
- Syntactical interoperability by consequent usage of standardized (OGC) web services and interfaces
- Semantical interoperability:
  - Common metadata profile
  - Common sensorML profiles
  - Common thesauri
  - Standardisation (parameters, units, ...)



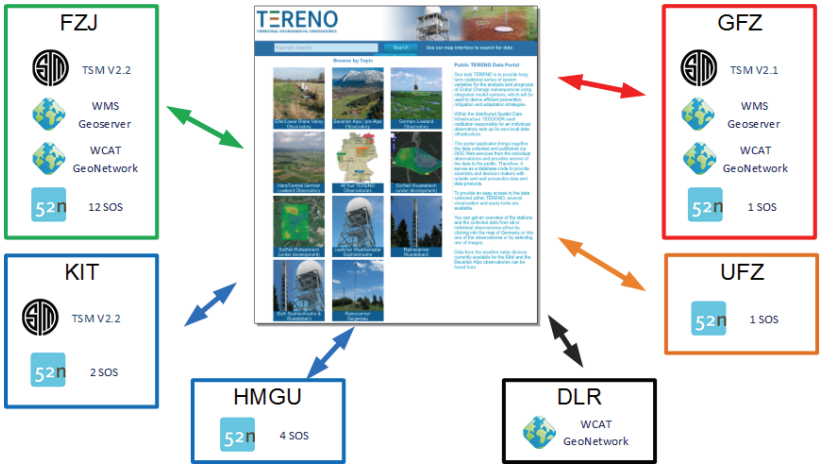
TERENO Quality management policy

Management System ISO 9001:2008
TÜVRheinland ZERTIFIZIERT
www.tuv.com ID 0010625691

- Establishing workflows for data collection, quality assessment and publication
- Nomination of responsible people
- Prohibition to circulate unevaluated data
  - **Technical inspection** (mandatory): Identification and tagging of obviously wrong data values
  - **Validity checks** (optional): Checking the continuity of time series and the definite conclusion that the observed data are representing the measured property
- Common system to assign
  - **Quality flags** (good, suspicious, bad data)
  - **Processing status** (unevaluated, quality checked,…)
- Automatic publication of quality assessed data



Data services connected to the DDP



TEODOOR: The TERENO Data Portal

http.//www.tereno.net

- Central portal for information exchange, data search and data access
- Querying the TERENO Metadata Catalogues
- Connected local data infrastructures from FZJ, DLR, GFZ, HMGU, KIT, UFZ
- Custom multi-condition queries
- Predefinded queries to data
- Free access to data from more than 900 sites

Client applications using standardized web services

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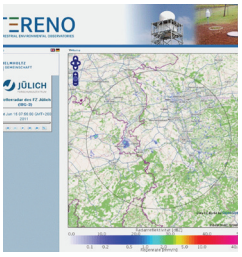
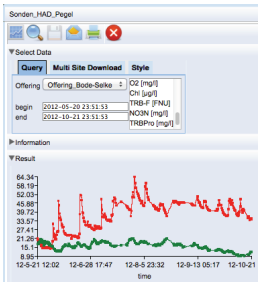
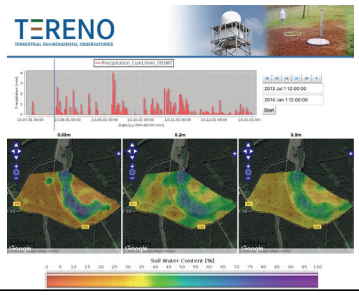


Animation of weather radar data using raster SOS

Visualization and download of time series data





Animation of automatically interpolated soil moisture data using raster SOS

Interconnecting infrastructures using OGC interfaces

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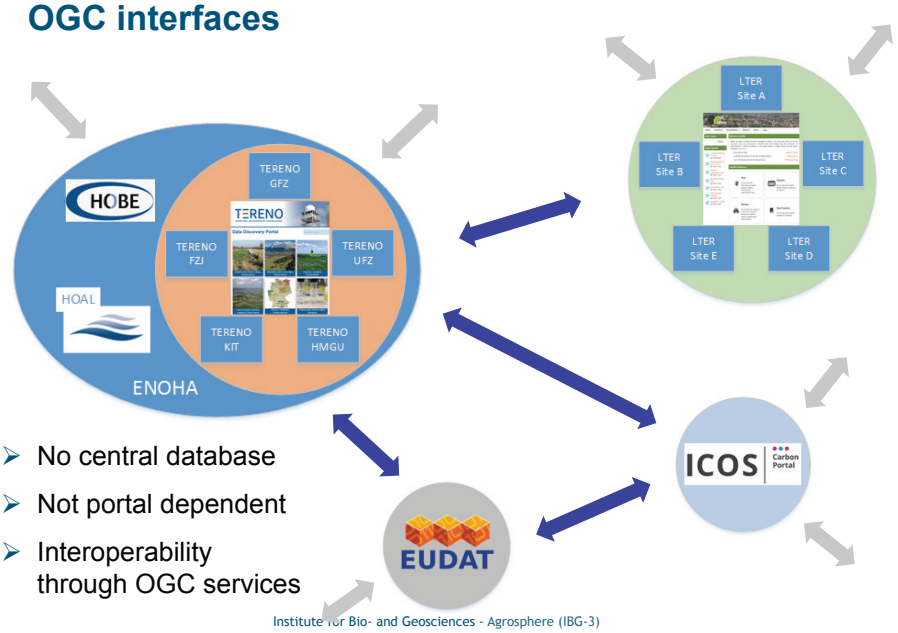

- No central database
- Not portal dependent
- Interoperability through OGC services

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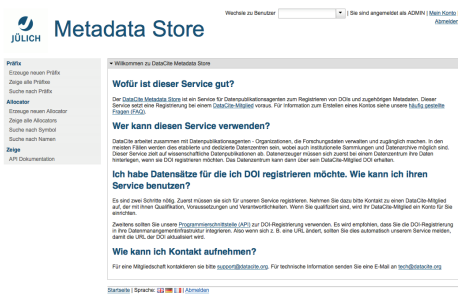
Naming issues

- Currently, naming of sites is ambiguous.
  - Different sites have identical names.
  - Sites are renamed.
  - Metadata that allow unique identification are often missing.
  - Institutions have their own naming protocols, no assurance that names are unique on a global scale.
- Access to information about observation sites
  - Need to ensure proper evaluation and facilitate interpretation of data.

DEOS - A Centralized Approach

provides a resolvable, persistent, interoperable link

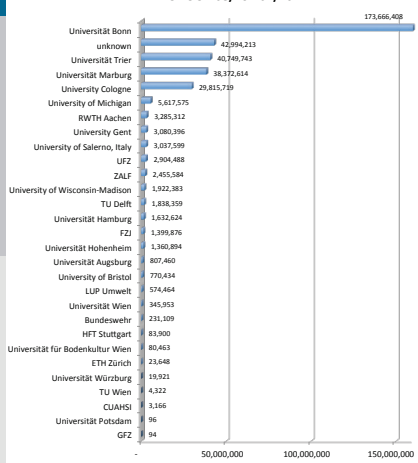
- resolvable – standard identifier syntax + network resolution mechanism (Handle System)
- persistent – through:
  - technical infrastructure (registry database, proxy support, etc.)
  - social infrastructure (obligations by Registration Agencies)
- interoperable - through a data model (semantic interoperability)

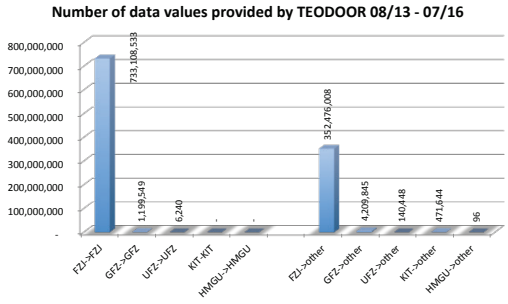


DEOS - A Centralized Approach

- Registration service currently hosted at FZJ: https://deos-id.org/deos/
- Structure: TERENO.ER012345
- Generated by DEOS or by users
- Does not replace personal or institutional names
- Building an inventory of observation facilities

TEODOOR download statistics





- Number of downloads: 3548
- Number of data series: 140,696
- Number of data values (est): 1,091,393,139
- Mean monthly dowloads: 25,000,000

Persistent data identifiers

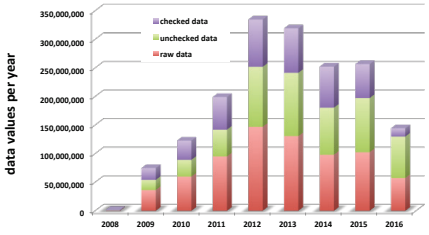
- Unique, digital identifier, allowing persistent citation of publications and data
  - Eases access to research data
  - Increases visibility of data
- Identifier refers to “landing page” containing:
  - Metadata (for station or data set)
  - Individual data sets
  - Licensing information (e.g. data policy)
- Landing page (and data, in general) hosted by issuing institution (here: GFZ)
- Internal agreement to be able to link to data from the TERENO portal
- Currently, 24 data sets/stations were identified through persistent identifiers (see https://search.datacite.org/works?query=TERENO)
- Drawbacks
  - File based approach
  - “Snapshot creation” of data from data bases required
  - Dynamical referencing to data in planning
  - Manual process
  - Hosting the same metadata on two systems in parallel (GFZ, TEODOOR)

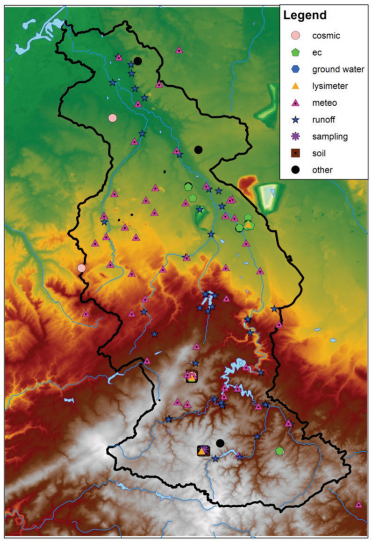
Examples

- Graswang
  - TERENO: „Graswang“ (http://tereno.imk-ifu.kit.edu/Graswang/)
  - ICOS: „DE-GWG“ (https://meta.icos-cp.eu/edit/stationentry/)
  - Fluxnet: „DW-GWG“ (https://fluxnet.ornl.gov/site/4147)
- Bad Lauchstädt
  - TERENO: „Lysimeterstation Bad Lauchstädt“ (multiple entries, e.g. http://teodoor.icg.kfa-juelich.de/ibg3searchportal2/dispatch?searchparams=freetext-lauch&metadata.detail.view.id=urn:ogc:object:feature:Sensor:UFZ:970)
  - LTER: „TERENO - Bad Lauchstaedt“ https://data.lter-europe.net/deims/site/lter_eu_de_019
- FZJ Climate Tower
  - TERENO: RU_K_001 (http://teodoor.icg.kfa-juelich.de/ibg3searchportal2/dispatch?searchparams=freetext-RU_K&metadata.detail.view.id=RU_K_001)
  - ICOS: JUE (https://meta.icos-cp.eu/ontologies/stationentry/AS/N2)

Local Infrastructure „Eifel-Rur“

- Static data (usually file based)
  - Descriptive data (reports)
  - Geodata
  - Other static data (statistics, …)
- Time series data
  - Runoff, water quality, soil, climate
    - *589 stations 10'-60', offline)*
  - Eddy-Covariance
    - *7 stations (20 Hz-10')*
  - Weather radar
    - *2 radar devices (5-10')*
  - Lysimeters (SoilCan)
    - *36 lysimeters (1'-15')*
  - Regular sampling campaign data





Time series Management System

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Developed based on open source software and open standards.