Towards a Comprehensive Platform for Interdisciplinary Environmental Research
- experiences with sensor data management and visualisation – (Projects COGEAR, SwissExperiment and OSPER)
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Rationale: GIS Platform for Environmental Research
- COGEAR, SwissExperiment and OSPER projects
- Creating a Web-based GIS Platform for supporting interdisciplinary environmental research:
  - Organization of available research data from research partners for geographically identifying areas of interest
  - Portal for data sharing (among research partners)
  - Fast access to official topographic and geologic data
  - Visual data mining
  - Integration of (real-time) sensor measurements
  - User-friendly and straightforward user interface
  - Improved cooperation and exchange between research partners

GeoViTe GIS Platform for Environ. Research
- GIS Platform Components:
  - Databases (data structuring and management)
  - Services (visualization and download)
  - User Interface (Web-based)
- Three-tier Architecture:
  - The foundation is the data management!

Handling of Sensor Measurements in COGEAR
- COGEAR- a database-centric, distributed approach:
  - (automatic) sensor measurements import into spatially enabled database (PostgreSQL/PostGIS)
  - availability of spatial types (geometries), spatial indexes and spatial functions
  - Advantage: use of spatially enabled database means no additional effort to integrate with GIS
  - Disadvantage: high implementation effort for loading the sensor data into the database (different types of sensors, hardware dependent, etc…)

Handling of Sensor Measurements in SwissEx
- SwissEx:
  - Advantage: facilitates the deployment and programming of sensor networks
  - Disadvantage: no direct communication with GIS
Handling of Sensor Measurements

- SwissEx - a middleware-centric, distributed approach
- Global Sensor Networks (facilitates the deployment and programming of sensor networks) with GIS interoperability
- PostgreSQL backend is now supported for GSN
- GSN – GIS interoperability via GML

GSN speaks GML

- GML – Geographic Markup Language
- Standard for spatial data exchange and the bridge to GIS
- Rich set of geometries (e.g. Point, LineString, Polygon)
- GML export implemented in GSN with REQUEST_GML handler (REQUEST = 901)
- Translates sensor measurements into GIS attributes
  - Sensor position expressed with point geometry, e.g.:
    `<gml:Point><gml:coordinates>8.770053,47.591567</gml:coordinates></gml:Point>`
  - Straightforward implementation!

Example: SLF Wannengrat sensor integration

http://montblanc.slf.ch:22001/gsn?REQUEST=901

Sensor Integration in the GIS Platform Workflow
GIS Platform Prototypes

The GeoVIe GIS Platform for Environ. Research

Ultimate Goal Reached: Easy Data Sharing

Sensor Data Visualisation

Benefits of Sensor Integration with GIS

Fundamental Idea: Sensor Data is GIS Data!
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Visualisation with Cartographic Web Services

Cartographic Web Services (CartoWS) are means for producing maps dynamically from geographic information based on an open map representation.

The map representation formally describes all the steps necessary for creating the map content and enables a cartographic web service to render a corresponding map from source geodata.

CartoWS Specifications

- Enhancing (and compatible with) the OGC Web Map Service (WMS) specification
  - Produce maps based on the cartographic map representation
  - Map representations are shared and reused

With Enhanced Symbology Encoding (SE)

- Handle Polygon, Line, Point and Thematic Symbolization
- Change Request submitted to OGC (SE CR 07-105)
- Introduced with many examples in Iosifescu, I., 2011, Cartographic Web Services, PhD Thesis

Any Imaginable Pattern Definitions for Polygons

- Not Random Patterns, but Discretionary Complex

[after Eberle, 2009]
Any Imaginable Pattern Definitions for Lines

Any Imaginable Scalable Vector Point Symbols

References:


- Iosifescu, I., 2011. Cartographic Web Services, PhD Thesis, ETH Zurich, Switzerland

Outlook – SwissExperiment & OSPER

- Unified GIS platform linked with the ETH Geodata Portal (GeoVITe)
- Continuing development: with SwissExperiment & OSPER the future of environmental sciences is a widespread temporal and spatial monitoring
Swiss Experiment Platform (SwissEx)

- Enable new advances in science through:
  - sharing of resources
    - Common access point for experimental data and national network data.
    - Documentation and safe (but visible) storage of experimental data.
  - combination of diverse data sources.
    - Development of new technologies to enable low-power, rapidly deployable sensors.
  - Programme for public outreach on measurement technologies and climate.

SwissEx – Measurement technologies

- SensorScope: cheap, mobile, self-organising wireless networks
- X-Band Precipitation Radars (Single and Dual-Polarised)
- Long-distance wifi data links
- Low-power video disdrometer: Largest SPAD in the world. 150,000 fps.
- GPS Snow height and SWE measurements + tectonic movement and GPS tomography
- RFID stream-bed particle movement tracking device
- Contactless water quality monitoring

SwissEx – Documentation of experimental data

- 3-D Scanning Lidar

SwissEx – Usage

- EPFL Raman lidar

OSPER – Open Support Platform for Environmental Research

Aim: to prepare a sustainable platform for ETH domain researchers that provides added value over their standard workflow

- Further development of query functionality and standardised output (to align with international standards) in both database middleware and WebGIS systems.
OSPER

• Cloud enablement of storage and processing (in collaboration with SMSCG)

• Knowledgebase for environmental research (sensor deployment methods etc. + integration of ScienceWise)

• Documented, connected desktop tools for:
  – Common tasks performed by researchers
  – Spatial and temporal statistics incl. extreme value statistics