Project partners:

Integrating Open-Source Applications for Spatio-Temporal Data Management in the Environmental Sciences

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Outline

- Background
- Goals
- Data at CRTE - Henri Tudor
- Geospatial data infrastructure
- Meta data management system
- Examples
- Discussion
- Conclusions
- Next steps

Background

- An efficient water resource management is a compulsory component of sustainable development

- Management of water supplies and water cycle is reflected in European legislation:
  - Urban Waste Water Treatment directive
  - Drinking Water directive
  - Water Framework directive
  - Integrated Pollution Prevention and Control (IPPC) directive

Background

- In 2000: Water programme by NSF Luxembourg
  - better understanding of the natural water cycle and the evaluation of ways to protect natural water resources
- Development and implementation of new management concepts and technologies in a global and national environment
- Knowledge of different projects in interdisciplinary fields has to be linked and presented in a comprehensive way to public and stakeholders
- Idea of a centralised system to store relevant data

Project Goals

- Improve transfer of knowledge and results of research project in Luxembourg

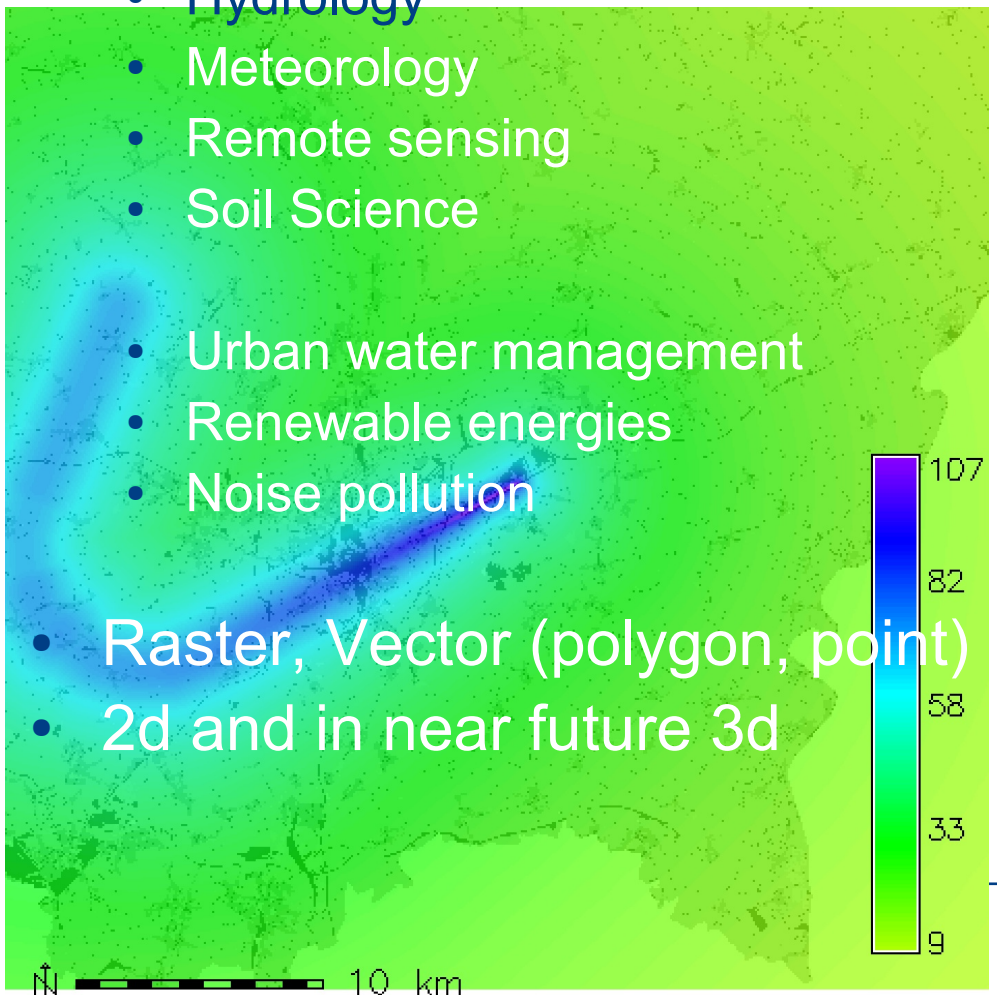
- Set up of a geospatial data infrastructure (GDI)
  - Make use of open-source to minimize costs and assure interoperability by using open standards
  - Provide a database driven system to make spatio-temporal data available to various users
  - Store spatio-temporal data and associated meta data
  - Data should be accessible with different clients according to the user needs to retrieve and/or further process data
  - Extend the geospatial database to all available environmental data for internal use at Henri Tudor

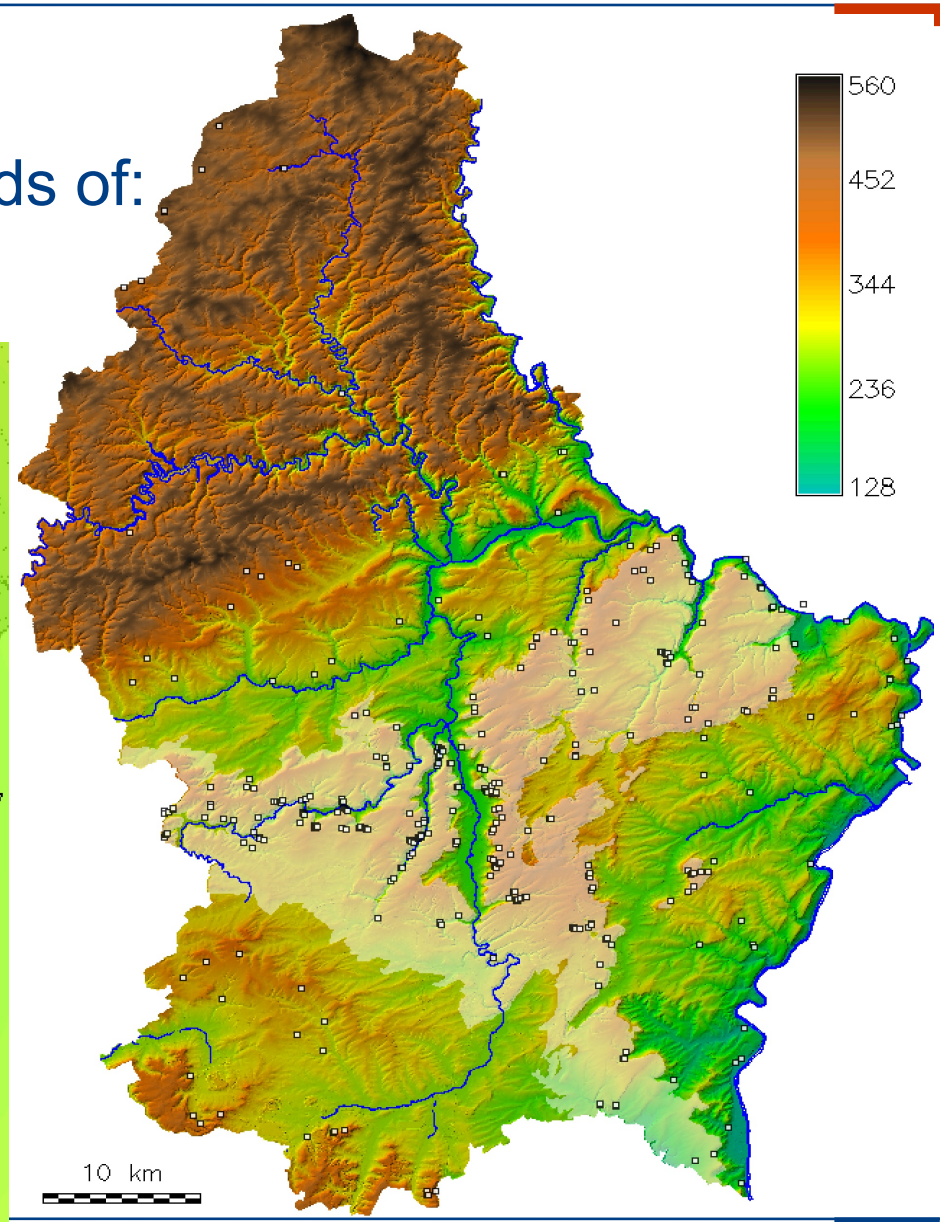
Data at CRTE Henri Tudor

- Spatio-temporal data in the fields of:
  - Geology
  - Hydrology
  - Meteorology
  - Remote sensing
  - Soil Science

  - Urban water management
  - Renewable energies
  - Noise pollution

- Raster, Vector (polygon, point)
- 2d and in near future 3d





Software chosen

- GDI based on following open-source software

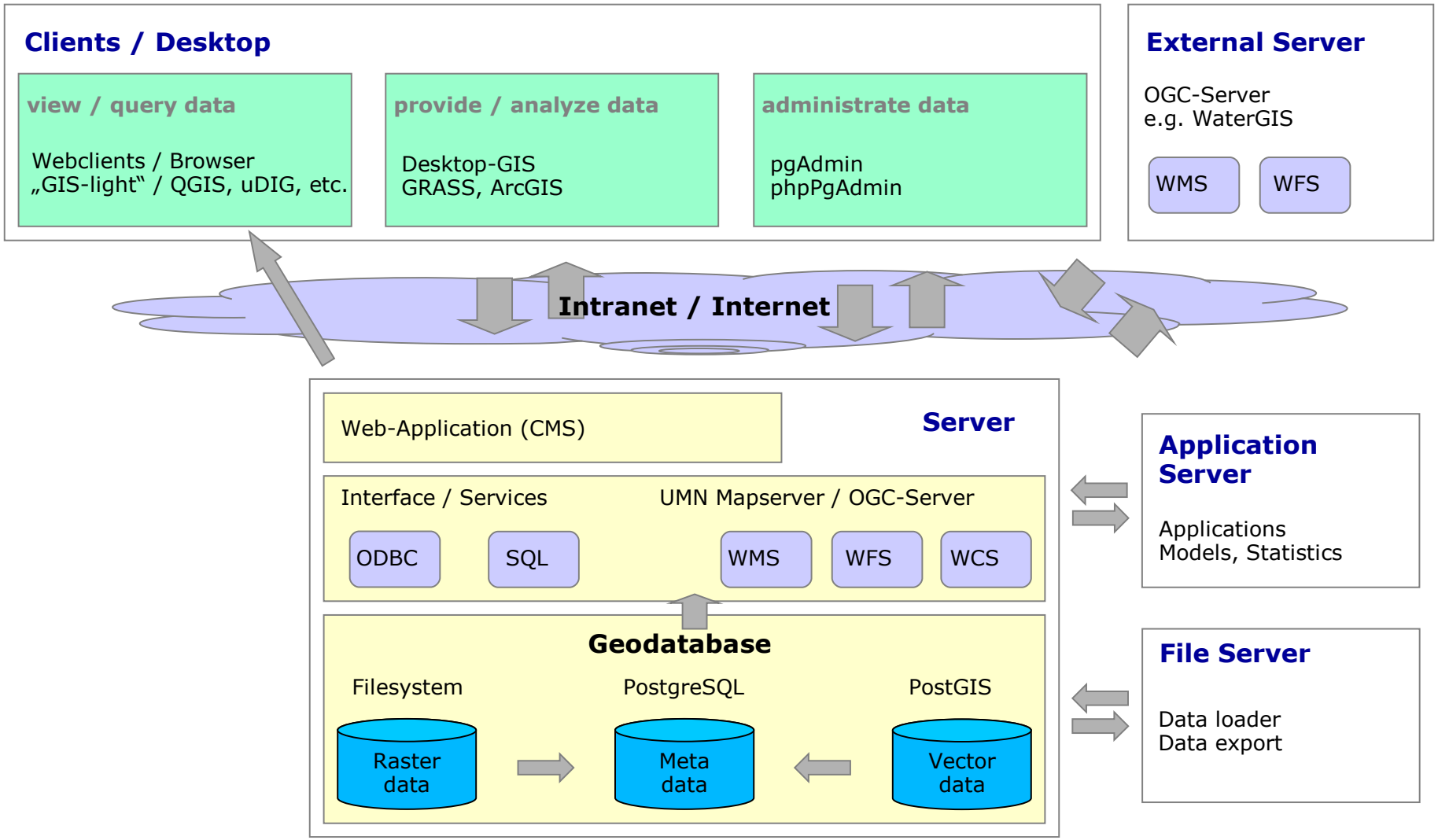
  Ubuntu Linux 7.04 Server

  PostgreSQL & PostGIS, Linux File system

  UMN Mapserver, GDAL/OGR

  GRASS GIS, QGIS, p.mapper, R

GDI Design


Clients / Desktop
view / query data
Webclients / Browser
„GIS-light" / QGIS, uDIG, etc.
provide / analyze data
Desktop-GIS
GRASS, ArcGIS
administrate data
pgAdmin
phpPgAdmin
External Server
OGC-Server
e.g. WaterGIS
WMS
WFS
Intranet / Internet
Server
Web-Application (CMS)
Interface / Services
UMN Mapserver / OGC-Server
ODBC
SQL
WMS
WFS
WCS
Geodatabase
Filesystem
PostgreSQL
PostGIS
Raster data
Meta data
Vector data
Application Server
Applications
Models, Statistics
File Server
Data loader
Data export

User access

- User interfaces to interact with the GDI
- Scalable and adoptable to the user's needs

Complexity of user interaction

Simple **data browsing** and **visualization**	WebGIS Client based on pmapper
Visualization, **advanced browsing/mining** of data and **simple analysis**	QGIS, UDIG, Spatial Commander etc.
Advanced queries and **analysis of data**, **generation** of **new data sets**	GRASS, ArcGIS
Administration of database system, **user setup** etc.	pgAdmin, phpPgAdmin

Access rights

GDI advantages

- No use of proprietary software
  - Platform independent
  - Various clients available for connection
  - Extendible system by adding new modules, plug-ins,...
- Use of standard software products
  - Ongoing development of all software components
  - Updates and upgrades easy to manage via package manager
  - Support of community
- Connectivity to external data services
  - Use of Web Services (WMS, WFS, WCS) of neighbouring countries is important for Luxembourg

Meta data management system

- Meta data
  - *„[..] provides information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data.”*

- A need for documented datasets to make best use of available data and information

Design - meta data management system

- Core elements of ISO19115 and additional individual fields for CRTE (~50 fields of information)
  - Dataset identification
  - Distribution information
  - Temporal resolution
  - Spatial scale and resolution
  - Error information
  - Other information (e.g. language, encoding, methodology)
  - Extendible to further information if required
- Automated meta data collection from
  - Vector data
  - Raster data

  Reduce completion time and typos of users
- Integration with p.mapper
- Export of meta data as xml based format

Meta data management system

- Cross-platform support of system
  - Ubuntu Linux, Apache 2
  - MS Windows, IIS 2003
  - PostgreSQL 8.x including PostGIS
- Client side
  - Javascript, CSS, HTML
  - Prototype 1.5.1 library for extended Javascript- and AJAX-Functions

Meta data management system

- Server side language
  - PHP5
  - ADOdb Data Abstraction Library for DB connection
  - Class upload 0.24 for file upload
  - TAR/GZIP/BZIP2/ZIP Archive Classes 2.1 for archive Shape export
- Server side execution of external programs
  - gdalinfo – GeoTIF raster meta data
  - PostgreSQL/PostGIS – meta information from vector data
  - pgsql2shp – dynamic shape export by extent

GDI in action – WebGIS Client

- Easy to use interface
- Presentation of basic map layers and advanced data
- Functions for searching, exporting and printing data sets
- Info button per layer which we use to link to meta data management system

INEAU WebGIS-Client powered by p.mapper3.1.0; MapServer and PHP/MapScript - Windows Internet Explorer

http://10.3.1.12/pmapper-dev/map.phtml?winsize=medium&language=en&config=

INEAU CRTE WebGIS Client v3.1

Link to current map

Search for

Tools

Scale 1: 140000

Bettendorf, Reisdorf, Beaufort, Ermsdorf, Berdorf, Medernach, Echternach, Waldbillig, Rosport, Consdorf, Heffingen, Bech, Fischbach, Junglinster

Springs

ID	567
Name	Herborn
Type	SCC
National ID	SCC-112-33
X Coordinate	96024.04
Y Coordinate	92787.13

Query Results - Windows Internet Explorer

http://10.3.1.12/pmapper-dev/info.phtml?PHPSESSID=30485afbea4614b05370623dad18a1cc

Springs

@	ID	Name	Type	National ID	X Coordinate	Y Coordinate
	652	SCC Hierzebierg	SCC	SCC-112-31	94425.46	91331.60
	567	Herborn	SCC	SCC-112-33	96024.04	92787.13
	582	Jacobsbierg	SCC	SCC-112-13	95053.00	91403.00
	560	Vollwaasser	SCC	SCC-112-04	94208.00	91422.00
	437	Wiesenquelle	PCC	PCC-112-12	95999.21	92117.21
	439	Willibrordus-Quelle	PCC	PCC-112-09	96118.04	92327.04
	312	SCC Geyershof	SCC	SCC-112-27	96074.00	92325.00
	342	Waldquelle	PCC	PCC-112-08	96137.04	92383.04
	259	Seitenquelle	SCC	SCC-112-11	95974.96	92233.04
	235	Wiederquelle	SCC	SCC-112-10	96021.21	92253.13
	24	Bech (Hitzebierg)	SCC	SCC-112-01	93546.82	91129.39

Zoom to Selected Features

Internet 100%

Apply on Layer Springs

Layers | Legend

- Gauging stations precipitation
- Gauging stations water level
- Channels, mill streams
- Heavy modified water bodies
- Mileage rivers
- Mileage streams
- Storagelake Sauer
- Rivers
- Streams
- **Land cover**
  - Land cover OBS (raster)
  - Land cover OBS (vector)
  - Land cover CORINE CLC2000 100m
  - Land cover CORINE CLC2000 250m
  - Land cover Steinsel plateau
  - Population density [inhab/km²]
- **Soils**
- **Solar Power**
- **Waste water**
- **WMS Belgium**
- **WMS France**
- **WMS Germany**
  - Arial views RLP
  - Flurgrenzen RLP
  - Gemarkungsgrenzen RLP
  - Geology 100k RLP
  - Topo Map 50k RLP
  - Topo Map 100k RLP
  - Topo Map 250k RLP
  - Topo map 500k RLP
- **WMS Satellite imagery**

Belgium, Germany, France, Luxembourg

X: 96034 Y: 92835

Done

Internet 100%

INEAU WebGIS-Client powered by p.mapper3.1.0; MapServer and PHP/MapScript - Windows Internet Explorer

http://10.3.1.12/pmapper-dev/map.phtml?winsize=medium&language=en&config=

INEAU CRTE WebGIS Client v3.1

Link to current map

Search for

Tools

Scale 1: 6660

Layers | Legend

- Springs
- SPATIALMONITOR
- **Hydrology**
  - Class of Risk
  - Floodplain 1993
  - Floodplain Alzette 1995
  - Floodplain Sure 1995
  - Gauging stations precipitation
  - Gauging stations water lev
  - Channels, mill streams
  - Heavy modified water bodies
  - Mileage rivers
  - Mileage streams
  - Storagelake Sauer
  - Rivers
  - Streams
- **Land cover**
  - Land cover OBS (raster)
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- **Solar Power**
- **Waste water**
- **WMS Belgium**
- **WMS France**
- **WMS Germany**
- **WMS Satellite imagery**

Metadata - Windows Internet Explorer

http://10.3.1.12/metadata/metadata_view.php

Metadata

print

Title	Kilometer mileage rivers
Brief abstract	Kilometer mileage of rivers
Keyword	Kilometer mileage, rivers, water body
Contact	CRP/CRTE, Christian Braun, 66, rue de Luxembourg, 4002 Esch-sur-Alzette, +352-545580-608
last modified	2007-09-13 10:27:00
status	
update intervall	asNeeded
language of dataset	en
methology description	derived of river network with linear referencing funtion of ArcGIS
general annotation	

export tables by actual extent: 76575.4131462 74222.30144550001,78535.4269888 75627.0955395

Export postgis2shape - Windows Internet Explorer

http://10.3.1.12/meta

Export postgis2shape

table: mileage_rivers

selected: --select-- / mileage_rivers

extent: 58916.244073 92983.2586757,70401.5248333 101215.06512

user: mapserver

password:

export

Belgium

Germany

France

X: 78655 Y: 74420

http://validator.w3.org/check?uri=referer

Meta data search

File Edit View History Bookmarks Tools Help

http://localhost/apache2-default/un

Google

SDI - INEAU | INEAU METADATA

Metadata | search metadata | list metadata entries | insert new metadata | edit contact data

Search metadata: landcover **Search**

Result: Records **1** to **1** from **1**

Title	Corine land cover 2000 (CLC2000) 100 m
Alternativ title	
Brief abstract	A comprehensive land cover database for the 25 EC Member States and other European countries, at an original scale of 1: 100 000, using 44 classes of the 3-level Corine nomenclature.
Abstract	One of the major tasks undertaken in the framework of the Corine programme has been the establishment of a computerised inventory on the land cover. The objectives of the land cover project are: - to provide those responsible for and interested in the European policy on the environment with quantitative data on land cover, consistent and comparable across Europe; - to prepare one comprehensive land cover database for the 25 EC Member States and other European countries, at an original scale of 1: 100 000, using 44 classes of the 3-level Corine nomenclature.
Purpose	**landcover** of europe
Keyword	CLC2000, Corine, geographic, **landcover**

Done

List meta data

INEAU METADATA - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/apache2-default/un

SDI - INEAU | INEAU METADATA

Metadata | search metadata | list metadata entries | insert new metadata | edit contact data

Metadata title	last modified	database		
Communities	2007-09-14 16:00:00	mygisdb (postgis)		
Rivers in Luxembourg	2007-09-14 16:07:00	mygisdb (postgis)		
FLUXALZETTE Measurement sites	2007-09-14 16:57:00	mygisdb (postgis)		
Kilometer mileage streams	2007-09-14 17:04:00	mygisdb (postgis)		
Kilometer mileage rivers	2007-09-14 17:05:00	mygisdb (postgis)		
Corine land cover 2000 (CLC2000) 100 m	2007-09-14 17:06:00	mygisdb (postgis)		

http://localhost/apache2-default/umn/metadata/metadata_main.php

Insert meta data – step 1

INEAU METADATA - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/apache2-default/umn/metadata/

SDI - INEAU | INEAU METADATA

Metadata | search metadata | list metadata entries | insert new metadata | edit contact data | list tables | list views

Step 1: Insert new metadata

* Title	Test ?
* Database or Filesystem	filesystem ?
	>> next step

-- please select --
filesystem
mygisdb

Done

Insert meta data - step 2

INEAU METADATA - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/apache2-default/umn/metadata/

SDI - INEAU | INEAU METADATA

Metadata | search metadata | list metadata entries | insert new metadata | edit contact data | list tables | list views

Step 2: Insert Metadata for data in a filesystem (raster)

Title:

Data path: /data/raster/dem

root

5mDEM.tif	84028.11 KB	2007-09-14 05:08:28	gdal
2mrelief.tif	96922.72 KB	2007-09-14 05:08:37	gdal
dem_5m_uint16.tif	93827.56 KB	2007-09-14 05:08:47	gdal
dem_5m_flt32.tfw	0.09 KB	2007-09-14 05:08:47	gdal
dem_5m_uint16.tfw	0.09 KB	2007-09-14 05:08:47	gdal
2mrelief.tfw	0.22 KB	2007-09-14 05:08:47	gdal
dem_5m_flt32.tif	388072.2 KB	2007-09-14 05:09:25	gdal
5mDEM.tfw	0.22 KB	2007-09-14 05:09:25	gdal

Insert meta data - step 2 - spatial info

File Edit View History Bookmarks Tools Help

http://localhost/apache2-default/umn/metadata/

SDI - INEAU | INEAU METADATA

Metadata | search metadata | list metadata entries | insert new metadata | edit contact data | list tables | list views

5mDEM.tif 84028.11 KB 2007-09-14 05:08:28 gdal

get gdalinfo

Gdalinfo

Driver: GTiff/GeoTIFF

Size is 15412, 16820

Coordinate System is `'

Origin = (38255.016143610002473,139981.335969120002119)

Pixel Size = (5.000002110000000,-5.000047720000000)

Image Structure Metadata:

COMPRESSION=DEFLATE

Corner Coordinates:

Upper Left (38255.016, 139981.336)

Lower Left (38255.016, 55880.533)

Upper Right (115315.049, 139981.336)

Lower Right (115315.049, 55880.533)

Center (76785.032, 97930.935)

Band 1 Block=15412x1 Type=Byte, ColorInterp=Red

Overviews: 7706x8410, 3853x4205, 1927x2103, 964x1052, 482x526, 241x263, 121x132

Band 2 Block=15412x1 Type=Byte, ColorInterp=Green

Overviews: 7706x8410, 3853x4205, 1927x2103, 964x1052, 482x526, 241x263, 121x132

Band 3 Block=15412x1 Type=Byte, ColorInterp=Blue

Overviews: 7706x8410, 3853x4205, 1927x2103, 964x1052, 482x526, 241x263, 121x132

query success

Insert meta data – step 2 - temporal info

INEAU METADATA - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/apache2-default/umn/metadata/

SDI - INEAU | INEAU METADATA

Metadata | search metadata | list metadata entries | insert new metadata | edit contact data | list tables | list views

Step 2: Insert Metadata for data in a geodatabase (vector)

Title: **Test**

>> next step (no calculation)

Calculate temporal resolution:

please select a table

selected table: **reseausure_n_heiderscheidergrund**

date >>calculate

from 2003-07-24 00:00:00 to 2006-07-23 23:55:00 Format (Date): YYYY-MM-DD ?

>> next step (send calculation)

Insert meta data – step 3

File Edit View History Bookmarks Tools Help

SDI - INEAU | INEAU METADATA

Metadata | search metadata | list metadata entries | insert new metadata | edit contact data | list tables | list views

Title: Corine land cover 2000 (CLC2000) 100 m

1. Metadata on metadata

* Points of contact	CRP/CRTE | Christian Braun ?	
* last modifing metadata	2007-09-14 17:06:00	new date/time: 2007-09-26 07:26 ?

2. Dataset identification

3. Distribution information

* Owner	European Environment Agency | NA ?
* Originator	European Environment Agency | NA ?
Processor	EIONET | NA ?
Distributor	-- please select -- ?
Type of constraint	restricted ?
Restriction	no commercial use ?

4. Spatial scale and resolution

5. Temporal resolution

6. Error information

7. Other dataset information

* **Database**	**mygisdb** ?
Link to mapserverclient	http://localhost/apache2-default/umn/pmapper-dev/map.phtml?dg=corine_100&me=2300 ?
Layername of client	corine_100 ?
linked Table(s) >edit	

Discussion

- Prototype of Geospatial Data Infrastructure is functional on all levels
- Data can be exported via Web client as CSV, GeoTIF and SHAPE
- Visualisation via WebGIS, GRASS and QGIS
- Direct data processing is limited for GRASS since GRASS does not integrate ideally with PostGIS and cannot process directly GeoTIF

  Import/Export is necessary:
  - Raster -> r.in.gdal, r.out.gdal
  - Vector -> v.in.ogr, v.out.ogr (,v.external)

Future steps

- Advanced analysis functions for WebGIS Client
  - Buffer, simple map queries,...
- Connection and integration of statistic tools
  - Connection of R and database to compute summary statistics, histograms, boxplots, time series statistics
  - Access from WebGIS client to spatio-temporal summary statistics and graphs implemented as R CGI-script
- Spatial Database
  - Improve handling of versioned spatio-temporal raster data sets
  - Better implementation of GRASS database structure
    - Raster data: direct or automated r/w access to GeoTiffs
    - Vector data: lock data sets edited by multiple users
- Improvements of meta data system
  - Exchange of meta data sets through XML im/export
  - User authentication

Thank you for your attention!

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