Sensor Observation Service and Web Processing Service @ Istituto scienze della Terra

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Content

• IST overview

• Current activities in SOS/WPS

• Protecting information

• Future works and final considerations
Current activities

IST OVERVIEW
SUPSI - Istituto scienze della Terra

- In the past we were the Cantonal Geological Office
- Moved to SUPSI (bachelor university)
- Scopes:
  - Applied research
  - Teaching
  - Scientific services
SUPSI - Istituto scienze della Terra

- 25 collaborators (researchers, PhD. students, technical staff, administration,...)
Field of activity

Natural Hazards and Environmental Resource Management

Land Planning

Hydrology

Hydrogeology

Geology

Geomatics
1. **Hazard zone:** DB maintenance, Web publishing, Hard printing
The Cantonal Mandate

2. Landslide monitoring: geodetic surveys, alarm systems, analysis reports, new technologies testing
3. Protection works inventory: development and service
4. Water protection: consultancy for protection areas, well exploitation
The Cantonal Mandate

5. Water quality: field survey and samples analysis, reporting

Lugano lake, P concentration

- 1976: start of restoration + sewage diversion
- 1986: P ban in textile detergents

NH4 - normato su limiti OPAc [mg/l]
- 0 - 0.2
- 0.2 - 1
- 1 - 1.5
- 1.5 - 2.5
- 2.5 - 20

10 km
The Cantonal Mandate

6. Early warning: lake Maggiore flooding
Early warning: data sources

DATA SOURCES

- **MeteoSwiss:**
  - forecast grid (36 hours)
  - 13 rain stations (10 min)
- **Lombardia (hourly):**
  - 6 rain stations
  - 2 water level stations
- **UFAM (10 min):**
  - 9 river discharge stations
- **ARPA Piemonte (hourly):**
  - 17 rain stations
  - 1 lake water level station
  - 2 river discharge stations
- **IST:**
  - 12 rain stations (tic)
  - 3 water level stations
Early warning: hydrological model
Early warning: warning dispatch
Early warning: SITGAP

- Cadastral data
- Elevation models
- National maps
- Sensible objects

Population housing

Emergency agencies

Level forecasts
Current researches and development

ISTSOS AND PYWPS
Why geo-services?

- IST scopes in using geo-services:
  - Interoperability with third parties
  - Better data accessibility and serving
  - Enhanced applications extendibility
  - Application management simplification

NO USEFUL!
istSOS: software development

http://istgeo.ist.supsi.ch/projects/istSOS

Entirely written in **Python** based on **Apache/mod_python**, **PostgreSQL/PostGIS** and **GDAL/ORG**
istSOS: design pattern

• istSOS has been implemented with a **factory method** as design pattern: this particular pattern allows the automatic instantiation of the required objects or functions depending on the request type.

  - [http://istgeo.ist.supsi.ch/isos?request=getCapabilities&section=serviceidentification%2Cserviceprovider%2Coperationsmetadata%2Ccontents&service=SOS&version=1.0.0](http://istgeo.ist.supsi.ch/isos?request=getCapabilities&section=serviceidentification%2Cserviceprovider%2Coperationsmetadata%2Ccontents&service=SOS&version=1.0.0)

  - [http://istgeo.ist.supsi.ch/isos?service=SOS&version=1.0.0&request=GetObservation&offering=temporary&procedure=P_BED,P_TRE&eventTime=2010-05-05T10:00:00+02:00/2010-05-06T12:20:00+02:00,2009-07-31T12:50:00+02:00&observedProperty=rainfall&responseFormat=text%2Fxml%3Bsubtype%3D%27sensorML%2F1.0.0'](http://istgeo.ist.supsi.ch/isos?service=SOS&version=1.0.0&request=GetObservation&offering=temporary&procedure=P_BED,P_TRE&eventTime=2010-05-05T10:00:00+02:00/2010-05-06T12:20:00+02:00,2009-07-31T12:50:00+02:00&observedProperty=rainfall&responseFormat=text%2Fxml%3Bsubtype%3D%27sensorML%2F1.0.0')
istSOS: factory pattern

1. SOS request
2. Filter
   - It converts SOS requests in python objects
3. Responder
   - It gathers required information or performs transactional operations
4. istSOS DB
5. Render
   - It converts information in SOS response format
6. Render
7. Render
8. SOS response
istSOS - database

- Fixed data model structure
SOS and WPS

• What do we need data for?:
  – **Data validation**: quality checks, data manipulation
  – **Anayles**: plotting, aggregation, interpolation, etc.
  – **Modeling**: data integration and preparation

• **But SOS does not provide these capabilities** so we need to use WPS to perform these operations -> **pyWPS is the interface to our applications**
Application 1: hydro portal

- WPS requests data to SOS for a given time and responds with a GML data layer (faster than OL parsing!)
Application 1: hydro portal

- WPS requests description for a given sensor to SOS and responds with an HTML information page (using XSLT!)
Application 1: hydro portal

- WPS requests observations to SOS for a given period and responds with plots and CSV data file
Application 2: Shallow landslide Hazard assessment in Vietnam

• In terms of frequency of disasters, Viet Nam is among the top 10 countries in the world.

• It’s high vulnerability to rainfall induced landslides, according to climate change scenarios, is predicted to increase in the next years.

• The Ha Gian province has been identified as one of the most vulnerable region to shallow landslide.
Application 2: Shallow landslide & Models

TRIGRS: landslide activation zones mapping

It combines models for infiltration of storm water, routing of runoff, and slope stability to calculate the effects of storms on the stability of slopes over large areas.

DFWALK: landslide runout assessment

It combines different approaches using physical motion description together with deterministic/stochastic approach for the debris expansion and an empirical method for sedimentation.
Application 2: Project aim

- Implementation of a complete framework for shallow landslide modeling for planning efficient countermeasures and in time disaster responses.
Application 2: WPS input data

- A storm is modeled as an arbitrary number of periods of different rainfall intensities.
  - Rainfall intensities values [m/s] for each period
  - Duration [s] of each period

wps.py "service=wps&request=getcapabilities"
wps.pyversion=1.0.0&service=Wps&request=Execute
&Identifier=get_hazard&datainputs=intensity=3e-7,9e-5;period=172800,43200"
Application 2: WPS output data
Application 3: Caribbean Water Monitor Project

“By mid-century, climate change is expected to reduce water resources in many small islands, e.g. in the Caribbean and Pacific, to the point where they become insufficient to meet demand during low-rainfall periods.”

Climate Change 2007: synthesis report (IPCC)

The Caribbean Water Monitor is an internet-based service for in water resources management, and offers a help for decision support for planning and managing water resources.
Application 3: Project aim

Statistical analysis of rainfall with the calculation of SPI index.

The SPI is an index based on the probability of the precipitation for any time scale and performs a complex analysis comparing the current rainfall to the average rainfall conditions of several months.

<table>
<thead>
<tr>
<th>Standard Precipitation Index (SPI)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+3.00 and above</td>
<td>Exceptionally wet</td>
</tr>
<tr>
<td>+2.00 to +2.99</td>
<td>Extremely wet</td>
</tr>
<tr>
<td>+1.25 to +1.99</td>
<td>Very wet</td>
</tr>
<tr>
<td>+0.75 to +1.24</td>
<td>Moderately wet</td>
</tr>
<tr>
<td>-0.74 to +0.74</td>
<td>Near normal</td>
</tr>
<tr>
<td>-1.24 to -0.75</td>
<td>Moderately dry</td>
</tr>
<tr>
<td>-1.99 to -1.25</td>
<td>Very dry</td>
</tr>
<tr>
<td>-2.99 to -2.00</td>
<td>Extremely dry</td>
</tr>
<tr>
<td>-3.00 and below</td>
<td>Exceptionally dry</td>
</tr>
</tbody>
</table>

SPI < 0 indicate deficit of rainfall
SPI > 0 surplus of rainfall

Barbados dataset consists of monthly measured rainfall [mm] for 16 distributed stations.
Application 3: WPS process

Specific WPS routines developed for:

- Rainfall data management
- SPI calculation and graphical representation
- SPI Spline-interpolation between stations using GRASS GIS
Application 3: WPS result
Securing sensible information

SECURING INFORMATION
GeoShield

Securing service for OGC services

Acts like a proxy that filter requests and responses based on user permission.

Currently implemented for WMS supporting filter parameter (geoserver)
GeoShield architecture

Consultation

Internet over HTTPS

Analysys

GeoShield
Institute of Earth Science
SUPSI

Applicazioni
WMS
WFS
SOS
WPS
GeoShield admin interface
Final considerations and future activities

CONCLUSIONS
SOS

• The maturity level of SOS is still **not fully satisfactory**:
  – Observation response is developer dependent (O&M too flexible)
  – Unique definition of observed properties is missing
  – Defined best practices are missing
2010-05-10T12:00, 0.6:
– does it refer to rainfall between 11:00 and 12:00 or to rainfall between 12:00 and 12:59:59?
– Is it upper boundary open or close? How to know this?
– Are data regular series or irregular?
– What is the quality level of the data?
– Etc.
SOS & WPS

• This ambiguity limits the usability of WPS to well known data provider and to defined applications!

We are loosing interoperability !!!!

Waiting for answers from SOS V2 !!!
Advantages

• Positive aspects:
  – One code for multi purpose (reuse!!)
  – Independence between data models & applications

MORE IMPORTANT:

– In the future We will not have to deal with tons of files formatted in thousand of way from tens of other institutes and processed by numerous scripts....
Near future works @ IST

• Finalizing the migration of data to SOS
• Developing python utilities for SOS processing
• Enhance istSOS with raster data support
• Developing high quality map printing service with WPS
• Extend Geoshield to SOS
• Porting of EWS for lake Maggiore flooding to OGC standard services
• Testing SOS and WPS interoperability in new projects (EU Interreg, etc.)
Thanks

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