Drought monitoring and interoperability concept – the EuroGEOSS project

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Structure of presentation

• Introduction
• Background
• What is GEOSS?
• What is EuroGEOSS?
• Objectives of the project
• Interoperability concept
• Drought work package
• Drought Initial Operating Capacity
One of the most fundamental challenges facing humanity at the beginning of the 21st century is to respond effectively to the global changes that are increasing pressure on the environment and on human society.
Over the next decade the global scientific community must take on the challenge of delivering to society the knowledge and information necessary to assess the risks humanity is facing from global change and to understand how society can effectively mitigate dangerous changes and cope with the change that we cannot manage.
• The Global Earth Observation System of Systems (GEOSS) provides the indispensable framework to coordinate the earth observation efforts of the 86 GEO-members and 61 participating organisations.

• GEOSS promotes scientific connections and interactions between the observation systems that constitute the system of systems, and addresses some of the identified scientific challenges.

• GEOSS also promotes the introduction of innovative scientific techniques and technologies in the component observing systems.
European contributions to GEOSS

- European Commission plays a very active role in developing GEOSS:
  - Participating in and co-chairing GEOSS Committees and co-leading GEO Tasks.
  - Implementing important initiatives to collect and share environmental information for the benefit of the European and global society: INSPIRE Directive, the GMES and SEIS initiatives.
  - Funding R&D projects in FP6 and FP7 that develop the research base and provide resources contributing to GEOSS.
  - Reaching out to developing countries to provide a broad knowledge base.
The EuroGEOSS Project

- The concept of multidisciplinary interoperability and the need for it in managing societal issues is crucial to understanding the complex relations between environment and society and is therefore central to the addressing the challenges of sustainability research in EuroGEOSS project.
- The project addresses a specific call which is “The European Environment Earth Observation system supporting INSPIRE and compatible with GEOSS”.
- EuroGEOSS aims to demonstrate the added value to the scientific community and society of making existing earth observing systems and applications interoperable and used within the GEOSS and INSPIRE frameworks.
- Thematic communities addressed: Forest, Biodiversity, Drought.
The EuroGEOSS Project
Three **Interoperability** Development Phases

I. Enable thematic interoperability & connections local to global

II. Enable multi-disciplinary interoperability

III. Extend interoperability to other SBAs & systems
Objectives of the WP5 in EuroGEOSS project

The fundamental goal of the WP5 is to provide a unique access point to federate services provided by drought thematic area.

The project introduced:

• Access to new data
• Data cohesion at various levels (global, regional, national)
  – Enable existing drought monitoring systems to exchange complementary information, which is available on specific spatial scales only
  – Integration of continental to local information on droughts and enable end-users to up- and down scale existing information on drought situation, while keeping data, processing, responsibility and data ownership at the respective level
• Building capacities for interoperability arrangements in the future
General structure of drought monitoring system

Observing system
- Monitoring network
- Data quality control
- Data retrieval system
- Data analysis – converting data into information

Information System
- Web site
- Agro meteorological bulletins
- WMS
Interoperability arrangements

**International standards** defined by OGC (Open Geospatial Consortium) and commonly called in a whole as **OWS** (OGC Web Services)

- **WMS** – Web Map Service
  - Service used to display geospatial information in a raster format; it is mainly a view service

- **WCS** – Web Coverage Service
  - Service used to exchange/download geospatial information in a raster format

- **WFS** – Web Feature Service
  - Service used to exchange/download geospatial information in a vector format (mainly GML)

- **WPS** – Web Processing Service
  - Service used to provide standardized processing functions (e.g. buffer)

- **CSW** – Catalogue Service for the Web
  - Service used to query metadata catalogs of datasets and services

GML: Geography Markup Language
EuroGEOSS and Drought

At the moment there are two central access points for Drought within the EuroGEOSS framework, that are located between user and service providers on all levels:

- EuroGEOSS Drought Catalog
  
  [Link to EuroGEOSS Drought Catalog](http://eurogeoss.unizar.es/Search/Search.html)

- EDO (European Drought Observatory) MapViewer
  
Interoperability in Drought

EuroGEOSS Drought Catalogue

WMS, WCS, WFS, Files

Country / Region
Zoom
Europe
Data & Maps Continental Level

EDO MapViewer

Metadata

Drought info Provider

Data & Services Country / Regional Level

EDO Website

Metadata

Drought info Provider

Drought info Provider

Drought info Provider
Multi-discipline in EuroGEOSS
The EuroGOESS Metadata Catalog, developed by the University of Zaragoza (UniZar) was populated with spatial and non-spatial metadata from partner institutes within the project framework.

Metadata adjustments have been made to ensure ISO (19115, 19119, 19139) and INSPIRE compliance.

The catalogue functionalities were improved including a “Drought Vocabulary”, defined and implemented during the project.

The catalogue provides search, discovery and preview facilities of spatial and non-spatial metadata.
Express space and time constraints

Facilitate keyword expression (EO controlled vocabulary)
Refine Discovery

Select one or more collections (or datasets) and express stricter constraints
Off-line
Access (Common Access Environment)

Specify a common access environment (CRS, Spatial & Temporal resolution, domain subset, format)  
Select one or more datasets and access them

DMCSEE
Drought Management Centre for Southeastern Europe

Layer (coverage): SPI  
Time: 2011-10  
Format:  
CRS: EPSG:4283  
Coverage width: 380 pixels  
Coverage height: 180 pixels  
Bounding box: Min x: 10  Min y: 31.965  
Max x: 48.905  Max y: 50  
WCS Version: 1.0.0

Process Request  Resume
Generate graphs & timeseries
DMCSEE drought monitor

Menu bar
DMCSEE drought monitor

Web coverage service

Graph of temporal evolution of the SPI3 for the region of Gorenjska (Slovenia)
Uploading into the system

- **Upload**
- **Delete**

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<thead>
<tr>
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<th>Country</th>
<th>Variable</th>
<th>Date</th>
<th>Upload time</th>
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<td>Slovenia</td>
<td>TEMP</td>
<td>2003-06</td>
<td>2011-09-07 12:23:06</td>
</tr>
</tbody>
</table>

- **Map format**: Arc/Info ASCII Grid
- **Archive type**: zipped
- **File**: Browse...
- **E-mail (optional)**

Submit | Reset
Improvement of DMCSEE drought monitoring system

- EDO integrated drought monitoring system
- National drought monitoring systems
- DMCSEE drought monitor system
Main identified benefits

- knowledge about general methodological approach for integration of drought datasets on: national/regional/catchment area/local/ level
- networking activities
- participating in data sharing - accessing the other ones (gap assessment)
- infrastructure for enabling availability of data as quick as possible helps to understand drought hazard
- higher time resolution of drought information
- data are of great importance, but without services they are not really helpful

The importance of decision making in societal benefits areas is driven by at least two factors: (i) a new recognition that there are significant global impacts of decisions made at national levels and (ii) the complex and non-linear nature of environmental driving functions that make optimization of outcomes less intuitive (Borzacchiello and Cragila, 2011).
### Examples of data and services registered in EuroGEOSS (1)

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Service Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DMCSEE Time WMS (DMCSEE)</strong></td>
<td>WMS-T service delivering more indicators (SPI1, SPI3, SPI6, SPI12, WBA60) in a unique layer within EDO MapViewer (multi-parameter permanent layer).</td>
<td></td>
</tr>
<tr>
<td><strong>Slovenia Time WMS (DMCSEE)</strong></td>
<td>Like the previous WMS-T service, it is a multi-parameter permanent layer of EDO MapViewer, specialized for Slovenia.</td>
<td></td>
</tr>
<tr>
<td><strong>SIA-MARM (FGUA-OSE)</strong></td>
<td>WMS-T service delivering monthly drought report for Spain. It is a permanent layer of EDO MapViewer.</td>
<td></td>
</tr>
<tr>
<td><strong>Piezometers ADES (BRGM)</strong></td>
<td>WMS-T service of piezometric levels in aquifers in France. It is the permanent layer of EDO MapViewer with GetFeatureInfo request enabled.</td>
<td></td>
</tr>
<tr>
<td><strong>Indices de Sequia Regulado / No Regulado (CHE)</strong></td>
<td>WMS-T service of drought indexes for Ebro River Basin. CHE is at the moment the unique provider of permanent layers at local scale.</td>
<td></td>
</tr>
<tr>
<td><strong>EDO WMS Server and MapViewer (JRC)</strong></td>
<td>EDO is a WMS server and a WMS client at the same time. Improvements in WMS-T are planned for the next months.</td>
<td></td>
</tr>
</tbody>
</table>
### Examples of data and services registered in EuroGEOSS (2)

<table>
<thead>
<tr>
<th>Service</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DMCSEE WCS service</strong> (DMCSEE)</td>
<td>Available at <a href="http://www.dmcsee.org/en/wcs/">http://www.dmcsee.org/en/wcs/</a> to download raster maps of SPI 1, 3, 6, 12 and WBA-60</td>
</tr>
<tr>
<td><strong>Hydrogeological Data</strong> (CHE)</td>
<td>Provides hydrogeological data of the Ebro River Basin District in GML format</td>
</tr>
<tr>
<td><strong>CHE Gazetteer</strong> (CHE)</td>
<td>Search and retrieval of geographical names corresponding to WFD features, points of inventory (IPA) and other reference data of the Ebro River Basin</td>
</tr>
<tr>
<td><strong>eHabitat</strong> (JRC)</td>
<td>The model assesses likelihoods to find similar ecological conditions outside of protected areas and can be used to assess the impact of different climate change scenarios on protected ecosystems</td>
</tr>
<tr>
<td><strong>EuroGEOSS Broker</strong> (EuroGEOSS)</td>
<td>Is the catalogue of catalogues, because its goal is to search and retrieve metadata catalogues</td>
</tr>
</tbody>
</table>
Register your data in DMCSEE and EDO

a) **Drought Index (Resource) Preparation**: a few commonly agreed drought indices should be available at all levels; additional drought indices is up to the data provider since different partners have different data collections, expertise, and requirements.

b) **Index (Resource) Description**: all drought indices and services providing these data need to be documented with up-to-date metadata descriptions and uploaded to EuroGEOSS Metadata Catalogue.

c) **Service Publication in DMCSEE drought monitor and EDO MapViewer** of a subset of registered resources, by OWS. Implementation of additional services for data download and analysis can be discussed.

d) **Maintenance**: is very important to keep the service up-to-date.
New possibilities for drought research

• Intercompare drought indices obtained from different datasets and spatial resolutions in the same region in terms of how they quantify droughts in time and space

• Check, how the same drought index may differ as a function of the spatial resolution of the input datasets

• How reliable are datasets on different spatial resolution in terms of identifying drought episodes, quantifying their characteristics and monitor real time droughts?
New possibilities for drought research

Discovery of available data and services

- EuroGEOSS drought metadata catalogue
  - 1) Discovery of WMS services from EDO and DMCSEE
  - 2) Discovery of SPI maps from different data sources

Visualization of data

- European Drought Observatory
  - Drought Management Centre for South-Eastern Europe

Downloading the data

- EDO: obtaining SPI from a contact point
- DMCSEE: obtaining SPI maps from Web Coverage Service

Processing of data

- Comparison of drought indices from different data sources (statistical analysis)
- Searching and obtaining drought impact data, necessary for the analysis (damages, caused by drought in agricultural production, time series of crop yield)
- Interpolation of SPI from EDO to common grid in order to obtain maps for the comparison purposes

INITIAL OPERATING CAPACITY

- 1) Visual comparison of SPI from three different data sources on EDO portal
- 2) Visualization of SPI maps on WMS with time support (on EDO portal and DMCSEE drought monitor)
- 3) Time series graphs of SPI index (EDO portal) and regional statistics (DMCSEE drought monitor)

ADVANCED OPERATING CAPACITY

- 1) Low resolution SPI maps, based on GCC data
- 2) High resolution SPI maps, based on national precipitation dataset
- 3) Calculated SPI from selected meteorological stations in the South-Eastern Europe (including Slovenia)
General methods:

Three different precipitation datasets have been used to calculate the SPI in the Ebro basin and Slovenia.
General methods:

Accessing the data for the analysis:
Example of the SPI datasets from the EDO, GPCC and Slovenian datasets. The maps correspond to June 2003, in which strong drought conditions affected Slovenia (very low precipitation was recorded already on the beginning of the growing season, leading to drought stress for summer crops). High deviations can be seen on EDO maps.
Slovenia case study:
Comparison of drought indices from different datasets and spatial resolutions

Average 1-, 3-, 6- and 12-month SPI for Slovenia from EDO, GPCC and Slovenian datasets (1974-2010). The analysis of EDO datasets revealed inconsistencies in time series (especially on longer time scales).
Recommendations for optimum drought spatial datasets for multi-source applications: balancing data availability and user requirements

We must stress that using low spatial resolution meteorological information can be useful to quantify drought severity and to assess drought impacts.

The low resolution datasets analyzed in this study show that although they fail to detect the real spatial patterns of the specific drought episodes (especially above complex terrain), they reproduce quite well the general drought temporal variability, mainly at short time-scales. Moreover, they can also identify the main features of the drought changes, which are very important in the frame of the current climate change scenarios.

Low resolution datasets also provide reliable outputs in terms of knowing a variety of multi-source impacts

• the drought impacts and the drought vulnerability of a system are better identified using drought information at a high spatial resolution.
Recommendations for optimum drought spatial datasets for multi-source applications: balancing data availability and user requirements

Therefore, the main recommendation that may be inferred from the above analysis is that drought monitoring systems must provide drought information based on the available quality climatic information, independently of the spatial scale at which the data is available.

In addition, efforts must be conducted to improve the access to the available climatic information on higher spatial resolution at real time in Europe to have better monitoring systems that allow taking better decisions and more efficient drought preparedness and mitigation of the drought impacts.
Thank you for attention!

http://www.eurogeoss.eu/default.aspx