



Seminar on Proposed and Revised set of indicators
June 4-5, 2014 - Belgrade (Serbia)

The ORIENTGATE data platform

WP2, Action 2.4

Alessandra Nuzzo, Sandro Fiore, Giovanni Aloisio
Scientific Computing and Operations Division, CMCC



Data platform: goals and main tasks



*The data platform represents a single entry point to the data produced by the ORIENTGATE partners, both in terms of **climate simulations** and **impact indicator datasets**.*

Main tasks:

- *Task 1: Design of the data management platform*
- *Task 2: Setup of a virtual machine based environment*
- *Task 3: Data subsetting functionality and data compression*
- *Task 4: Deployment of the main data services*
- *Task 5: Enhanced configurations for the data services*
- *Task 6: Design and implementation of a dashboard based monitoring and browsing tool for the data platform*



Requirements and main activities of the data platform

General requirements

- *Heterogeneity of data*
- *Heterogeneity of the user requirements*
- *Heterogeneity of the software components (e.g. services)*
- *Integration and global view of the produced data*

Activities regarding the integrated platform

- *Design of the integrated platform*
- *Identification of the set of services that meet the project needs*
- *Test and validation activities*

Activities regarding the data storage

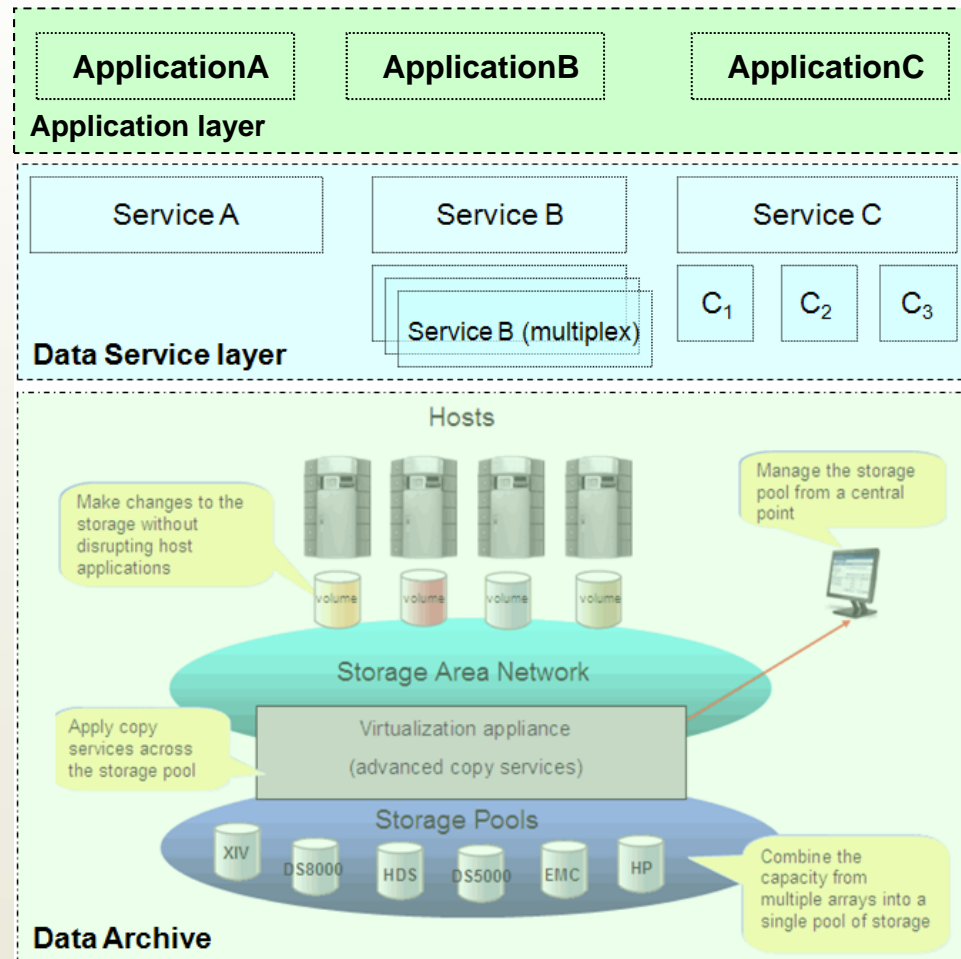
- *Definition of a directory structure*
- *Filename, datasetname encoding rules*
- *Preliminary tests and validation of the publication guidelines on some WP3, WP5 datasets.*



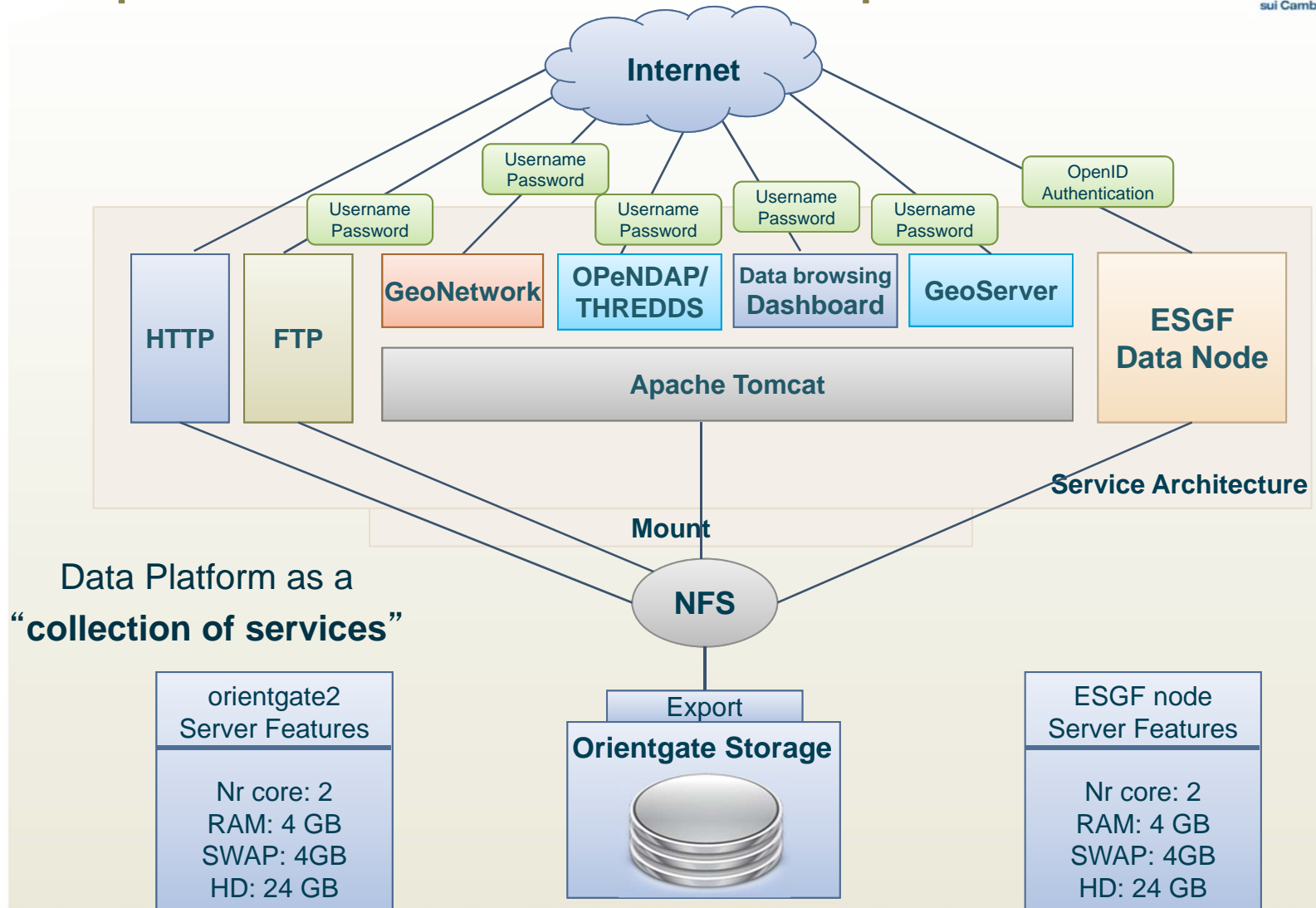
Design of ORIENTGATE data platform



Data Platform as a
“collection of services”



Implementation of ORIENTGATE data platform



Data Platform as a
“collection of services”



THREDDS (Thematic Realtime Environmental Distributed Data Services)



The THREDDS service aims at bridging the gap between data providers and data users. The goal is to simplify the discovery and use of scientific data and to allow scientific publications and educational materials to reference scientific data.

It's a web server providing features of metadata and data access using HTTP, OPeNDAP, WMS, NetCDF subset service.

The screenshot displays a web browser window with the URL `http://orientgate02.cmcc.it:8080/thredds/catalog/orientgate/drought_water_coasts/pilot_study3/CMCC_ERA40_COSMOCLM_italy-apulia_8km_1971-2000/wso/catalog.html`. The interface is divided into two main sections:

- Dataset Catalog:** A tree view on the left shows a directory structure under `CMCC_ERA40_COSMOCLM_italy-apulia_8km_1971-2000`. The `wso/` directory is expanded, listing various time-series datasets such as `z0.nc`, `v10m/`, `u10m/`, `lso/`, `tanow/`, `sa/`, `totprec/`, `lmin2m/`, `lmax2m/`, `sd2m/`, `l2m/`, `soiltyp.nc`, `runoffa/`, and `runoffb/`.
- Dataset Details:** The right pane shows details for the selected dataset `wso/wso_2000.nc`. It includes:
 - Initial TDS Installation:** THREDDS Data Server
 - Catalog URL:** `http://orientgate02.cmcc.it:8080/thredds/catalog/orientgate/drought_water_coasts/pilot_study3/CMCC_ERA40_COSMOCLM_italy-apulia_8km_1971-2000/wso/catalog.html`
 - Dataset:** `wso/wso_2000.nc`
 - Access:**
 - Data size: 64.21 Mbytes
 - Data type: GRID
 - ID: `orientgate_catalog/drought_water_coasts/pilot_study3/CMCC_ERA40_COSMOCLM_italy-apulia_8km_1971-2000/wso/wso_2000.nc`
 - Dates:**
 - 2013-11-11 11:48:07Z (modified)
 - Viewers:**
 - Integrated Data Viewer (IDV) (webstart)
 - NetCDF-Java ToolsUI (webstart)
 - Godiva2 (browser-based)

<http://orientgate02.cmcc.it:8080/thredds/catalog/orientgate/>



OPeNDAP (Open-source Project for a Network Data Access Protocol)



OPeNDAP is a framework designed to easily share scientific data on web, making accessible local data from remote connections.

The screenshot shows a web browser window titled "OPeNDAP Server Dataset Query Form" with the URL <http://test.opendap.org/opendap/data/nc/sst.mmmean.nc.gz.html>. The page contains the following sections:

- Action:** Buttons for "Get ASCII", "Get as NetCDF", "Binary (DAP) Object", and "Show Help".
- Data URL:** A text input field containing `http://test.opendap.org/opendap/data/nc/sst.mmmean.nc.gz`.
- Global Attributes:** A text area displaying metadata:


```
NC_GLOBAL.title: NOAA Extended Reconstructed SST V3
NC_GLOBAL.conventions: CF-1.0
NC_GLOBAL.history: created 09/2007 by CAS
NC_GLOBAL.comments: The extended reconstructed sea surface temperature
(ERSST)\012was constructed using the most recently available \012Comprehensive
```
- Variables:** Two variable selection sections.
 - sst:** Grid of Array of 16 bit Integers [time = 0..1856][lat = 0..88][lon = 0..179]. Includes fields for time, lat, lon, long_name (Monthly Means of Sea Surface Temperature), valid_range, actual_range, units (degC), and add_offset (0.000000000).
 - time_bnds:** Array of 64 bit Reals [time = 0..1856][nbnds = 0..1]. Includes fields for time, nbnds, and long_name (Time Boundaries).

Features

- Sharing of scientific data
- Remote access
- Different data formats
- Data subsetting

Activities

- Deploy, configuration and tuning on test VMs
- Test with compressed data
- Test on multiplexed configurations to increase throughput and fault tolerance
- First service available for test on a preliminary set of ORIENTGATE data
- Security added to protect data
- Logging enabled to keep track of accesses to the data/service.

<http://orientgate02.cmcc.it:8080/thredds/dodsC/orientgate/>



NetCDF Subset Service



Web service for subsetting CDM scientific dataset. The subsetting is specified using earth coordinates. The data arrays are subsetted but not resampled or reprojected, and preserve the resolution and accuracy of the original dataset.

Activities

- Several actions have been carried out to **install** the software and **test the robustness** as well as the **capabilities** provided by this service
- Specific settings have been setup on the **thredds** service to enable and perform some **tuning**

GeoQuery := (GeoBox, Variable, Date)

- CP = Convective precipitation
- LSM = Land-Sea mask, 1 all land, 0 all sea
- LSP = Stratiform precipitation (Large scale precipitation)
- SSR = Surface solar radiation
- SSRD = Surface solar radiation downwards
- STR = Surface thermal radiation
- STRD = Surface thermal radiation downwards
- TCC = Total cloud cover

Variable

GeoBox

Choose Spatial Subset:

Lat/lon subset Coordinate subset
Bounding Box (decimal degrees):
 north

 west east

 south
[reset to full extension](#)

Horizontal Stride:

Choose Time Subset:

Time range Single time
 Starting:
 Ending:
 Stride:
[reset to full extension](#)

Add 2D Lat/Lon to file (if needed for CF compliance)

Add Lat/Lon variables

Temporal extent



FTP and HTTP

Indice di ftp://orientgate01@ori...
 ftp://orientgate02.cmcc.it/circe/CMCC_MED/20c3m_sres1b/

Indice di ftp://orientgate01@orientgate02.cmcc.it/circe/CMCC_MED/20c3m_sres1b/

Vai alla cartella superiore

Nome	Dimensione	Ultima modifica
drwxr-xr-x 2 root root 73728 Jul 18 13:46 20c3m_sres1b/		
echam_cir13		
[root@orientgate2 CMCC_MED]# cd 20c3m_sres1b/		
[root@orientgate2 20c3m_sres1b]# ll		
total 8903262412		
-rwxr-xr-x 1 root root 4686033937 May 26 2009 echam_cir13_195001.01.gz		
-rwxr-xr-x 1 root root 4237368518 May 22 2009 echam_cir13_195002.01.gz		
-rwxr-xr-x 1 root root 4716925625 May 22 2009 echam_cir13_195003.01.gz		
-rwxr-xr-x 1 root root 4574794681 May 22 2009 echam_cir13_195004.01.gz		
-rwxr-xr-x 1 root root 4713602186 May 22 2009 echam_cir13_195005.01.gz		
-rwxr-xr-x 1 root root 4559152358 May 22 2009 echam_cir13_195006.01.gz		
-rwxr-xr-x 1 root root 4687833884 May 22 2009 echam_cir13_195007.01.gz		
-rwxr-xr-x 1 root root 4785656091 May 22 2009 echam_cir13_195008.01.gz		
-rwxr-xr-x 1 root root 4569706103 May 22 2009 echam_cir13_195009.01.gz		
-rwxr-xr-x 1 root root 4738704816 May 22 2009 echam_cir13_195010.01.gz		
-rwxr-xr-x 1 root root 4558513642 May 22 2009 echam_cir13_195011.01.gz		
-rwxr-xr-x 1 root root 4697050878 May 22 2009 echam_cir13_195012.01.gz		
-rwxr-xr-x 1 root root 4687190484 May 22 2009 echam_cir13_195101.01.gz		
-rwxr-xr-x 1 root root 4241875009 May 22 2009 echam_cir13_195102.01.gz		
-rwxr-xr-x 1 root root 4726165830 May 22 2009 echam_cir13_195103.01.gz		
-rwxr-xr-x 1 root root 4573236218 May 22 2009 echam_cir13_195104.01.gz		
-rwxr-xr-x 1 root root 4727427212 May 22 2009 echam_cir13_195105.01.gz		
-rwxr-xr-x 1 root root 4554278335 May 23 2009 echam_cir13_195106.01.gz		
-rwxr-xr-x 1 root root 4709310130 May 23 2009 echam_cir13_195107.01.gz		
-rwxr-xr-x 1 root root 4710601305 May 23 2009 echam_cir13_195108.01.gz		
-rwxr-xr-x 1 root root 4583247914 May 23 2009 echam_cir13_195109.01.gz		
-rwxr-xr-x 1 root root 4745203282 May 23 2009 echam_cir13_195110.01.gz		
-rwxr-xr-x 1 root root 4560511033 May 23 2009 echam_cir13_195111.01.gz		
-rwxr-xr-x 1 root root 4680495802 May 23 2009 echam_cir13_195112.01.gz		
-rwxr-xr-x 1 root root 4680125826 May 23 2009 echam_cir13_195201.01.gz		
-rwxr-xr-x 1 root root 4397875006 May 23 2009 echam_cir13_195202.01.gz		
-rwxr-xr-x 1 root root 4718112288 May 23 2009 echam_cir13_195203.01.gz		
-rwxr-xr-x 1 root root 4566393398 May 23 2009 echam_cir13_195204.01.gz		
-rwxr-xr-x 1 root root 4720115396 May 23 2009 echam_cir13_195205.01.gz		
-rwxr-xr-x 1 root root 4566143516 May 23 2009 echam_cir13_195206.01.gz		
-rwxr-xr-x 1 root root 4714942172 May 23 2009 echam_cir13_195207.01.gz		
-rwxr-xr-x 1 root root 4712297715 May 23 2009 echam_cir13_195208.01.gz		
-rwxr-xr-x 1 root root 4580270507 May 23 2009 echam_cir13_195209.01.gz		
-rwxr-xr-x 1 root root 4746445317 May 23 2009 echam_cir13_195210.01.gz		



GeoNetwork

Several testing activities are been carried out:

As ADMINISTRATOR:

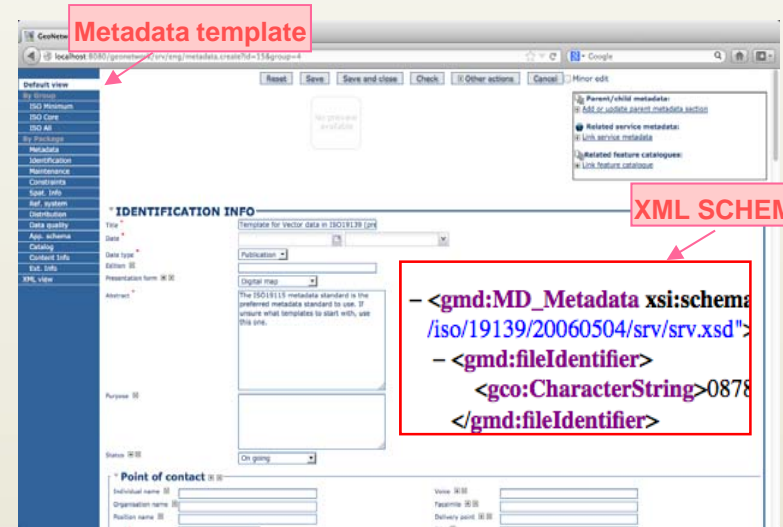
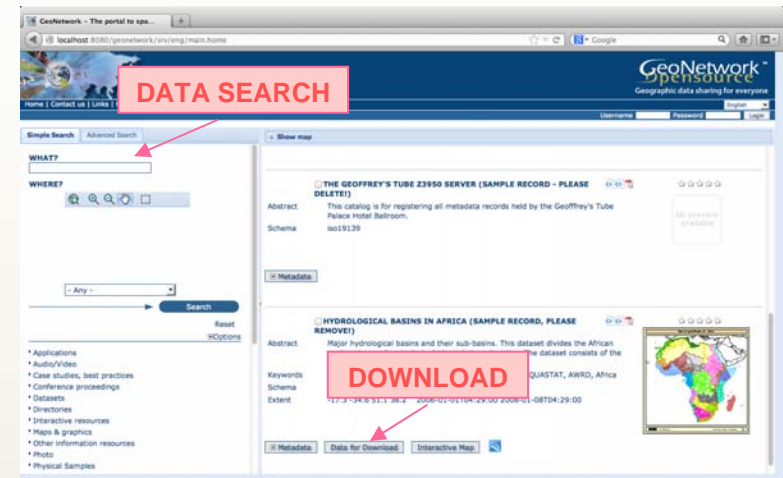
- Installation of the platform
- Users and Group management

As USER:

- Search&Discovery in multiple catalogs through a website
- Access to interactive maps
- Data download: depending on the privileges that have been set for each record, the dataset is available and downloadable
- Support for multiple metadata standards

As DATA PROVIDER:

- Metadata editing tool
- XML metadata import
- Set different sharing levels





GeoServer



GeoServer is an open-source software allowing users to share, process and edit geospatial data.

It allows data publication data from any major spatial data source using open standards, such as:

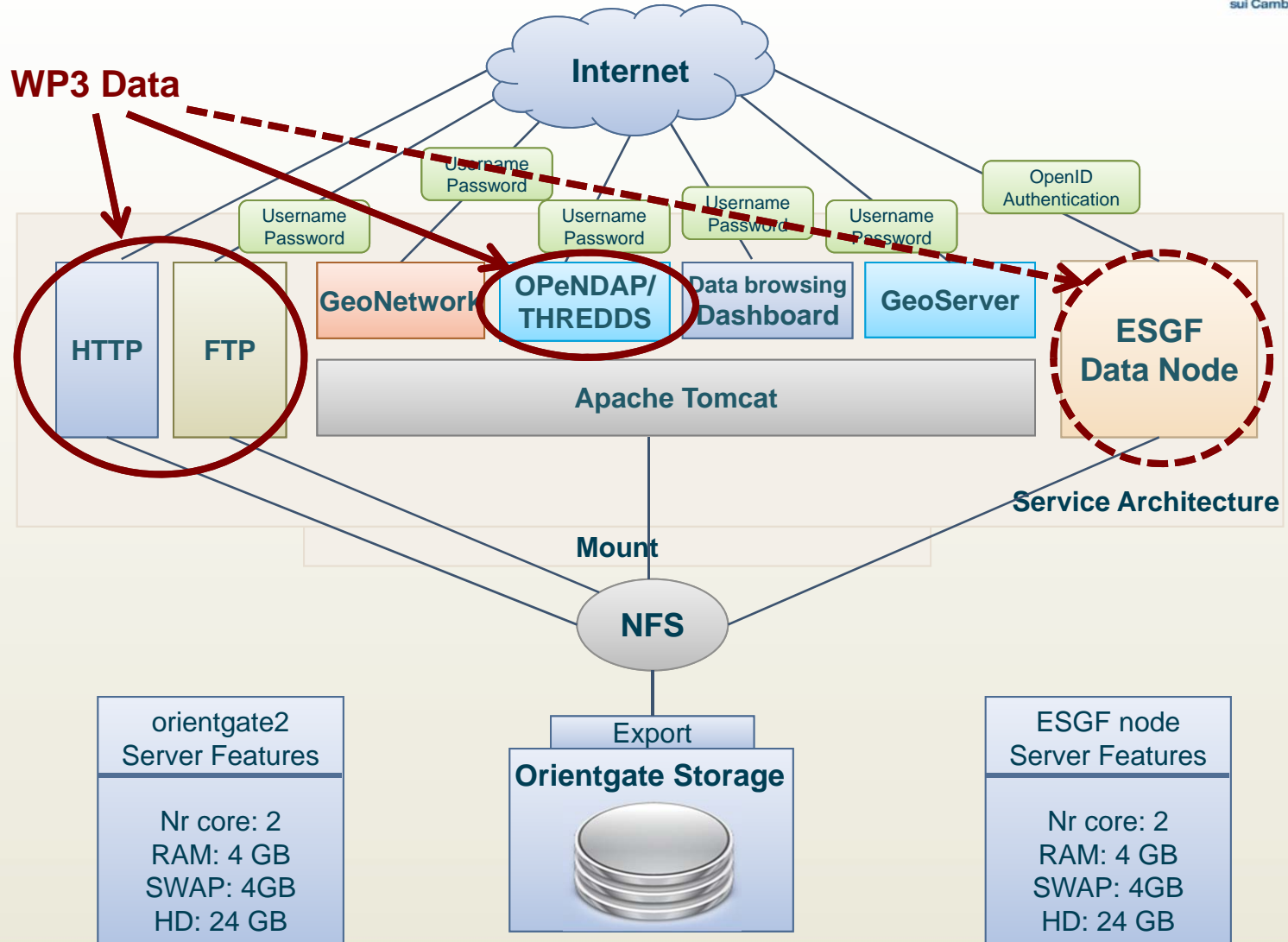
- Web Map Service (**WMS**) allows for requests of images generated from geographical data.
- Web Feature Service (**WFS**) supports requests of geographical feature data (vectors)
- Web Coverage Service (**WCS**) supports requests for coverage data (rasters)

These standards allow web clients to query and receive geographic information in the form of image, vector, or coverage data.

- GeoServer reads a variety of data formats, including:
 - Shapefile
 - GeoTIFF
 - GTOPO30
 - ECW, MrSID
 - JPEG2000
 - Post GIS
 - MySQL
 - DB2
 - ArcSDE
 - Oracle Spatial
- Output formats: KML, GML, Shapefile, GeoRSS, PDF, GeoJSON, JPEG, GIF, SVG, PNG and other more formats.
- Integrated OpenLayers client for previewing data layers.
- Efficient publishing of geospatial data to Google Earth, using KML language.



ORIENTGATE Data Platform – services for WP3 datasets



The example dataset:

- is produced by **Republic hydrometeorological Service of Serbia**;
- the **model** is **NMMB**;
- the **forcing** used during the experiment is **ERA40**;
- refers to the **Balkan** area;
- the **resolution** of the data is **8 km**;
- the **temporal subset** goes from 1971 to 2000.



Directory structure and datasetname encoding



The datasetname encoding will adhere to the following convention:

institutenam_ forcinginfo_ modelinginfo_ geographicalinfo_ resolution_ temporalsubset

where:

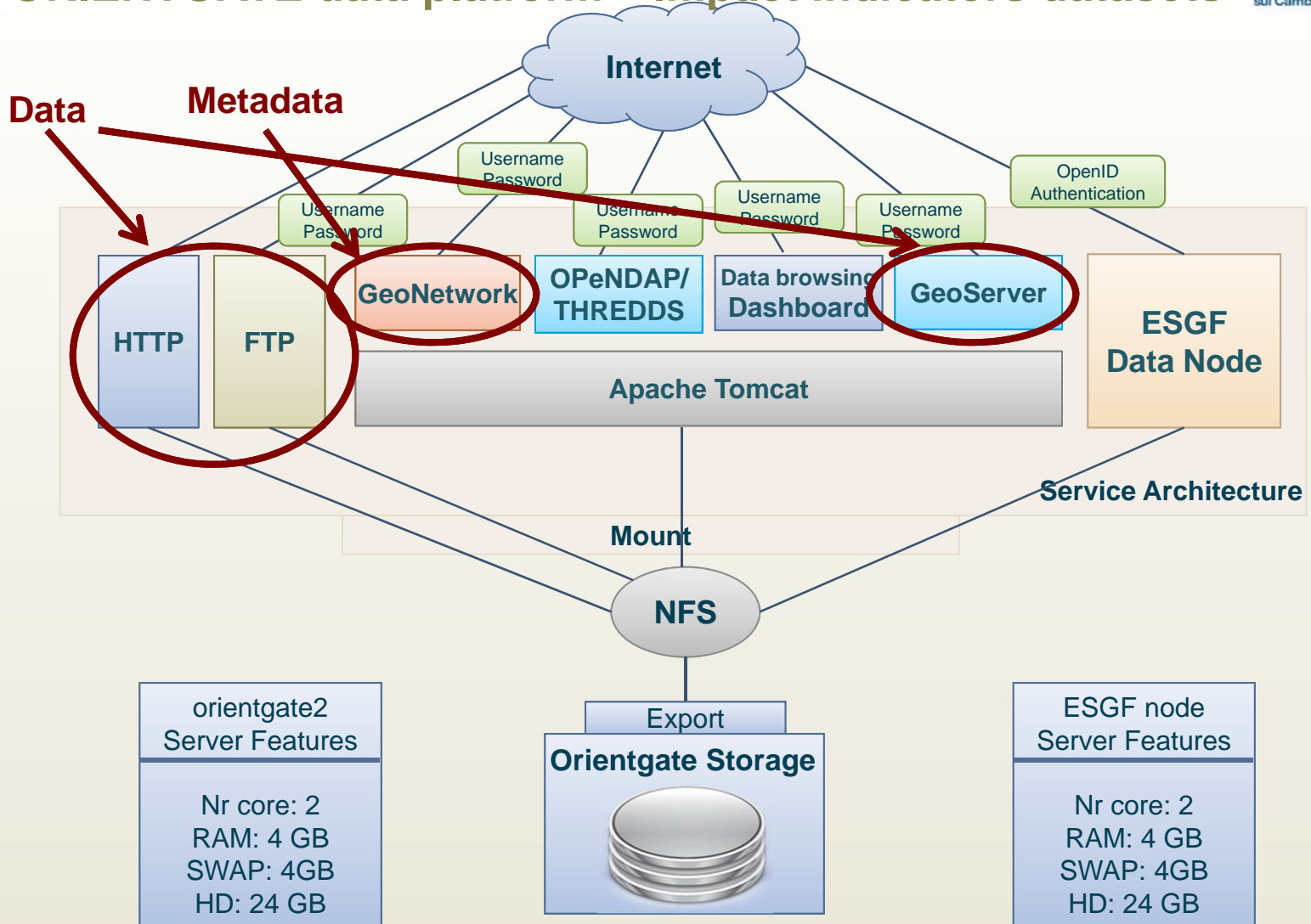
- ***institutenam*** represents the name of the institute producing the data
- ***forcinginfo*** indicates the forcing used during the experiment
- ***modelinginfo*** provides information about the used model and a possible scenario
- ***geographicalinfo*** indicates the geographic area
- ***resolution*** indicates the resolution of the produced data
- ***temporalsubset*** is the temporal period of the data

Example of dataset:

RHMSS_ERA40_NMMB_Balkan_8km_1971-2000



ORIENTGATE data platform – Impact indicators datasets





Publication of a WP5 dataset



The first WP5 dataset published/tested on the data platform:

- is produced by **Pilot Study 3**, within the **Thematic Centre 2**
- the **category_framework** of the indicator is “hazard_UN-DRR”
- refers to a **single indicator**.

The **identifier** of the indicator is SDI, the **time frequency** is 30 years, the **spatial resolution** is 350000 (meaning 1:350000 scale) and the **temporal subset** refers to the 1971-2000 period.

The **entire period** of the dataset ranges from 1971 to 2070.

The corresponding file is a shapefile.



Directory structure and datasetname encoding

- The **directory structure** is been already setup on the platform and with the information the data producers will provide we will put the data under the corresponding folder.
- The **datasetname encoding** adheres to the following convention:

<indicator_identifier>_<time_frequency>_<spatial_resolution>_<temporal_subset>

The datasetname will be composed by:

- an identifier of the indicator (**indicator_identifier**)
- the time frequency (**time_frequency**);
- the spatial resolution (**spatial_resolution**);
- a time interval (**temporal_subset**).

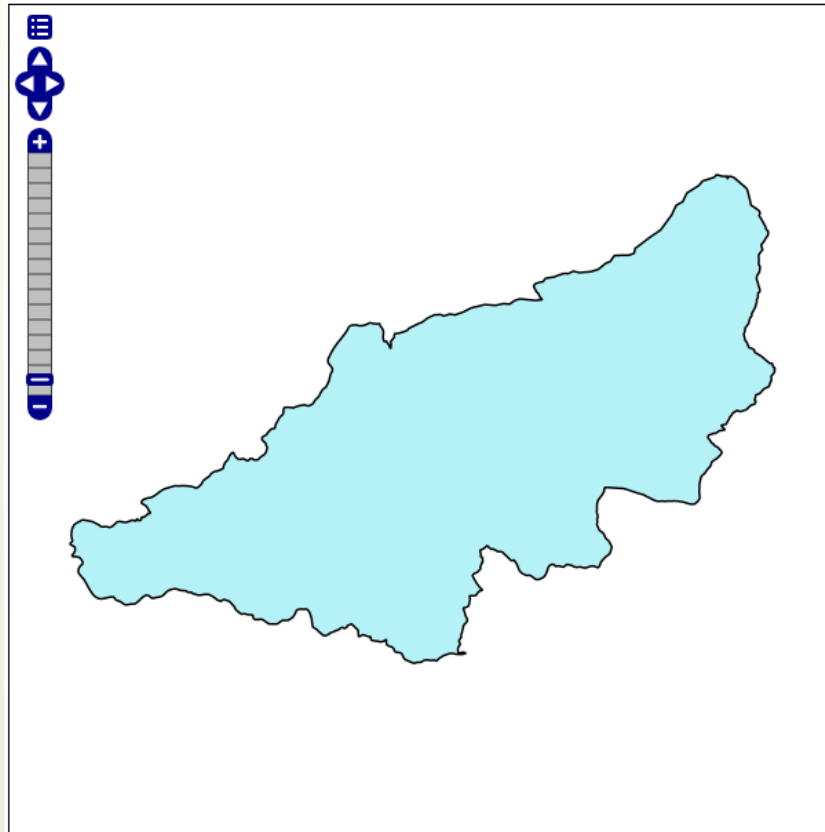
Example:

SDI_ 30y_ 350000_ 19712000

Visualization of a WP5 dataset (shapefile)

WMS version: 1.1.1 Tiling: Single tile Transition effect: None Antialias: Full Format: PNG 24bit Styles: Default Width/Height: Auto Auto

Filter: CQL  



Polygon Shapefile

Scale = 1 : 697K
 2609317.51089, 4551898.77290
SDI_30y_350000_19712000

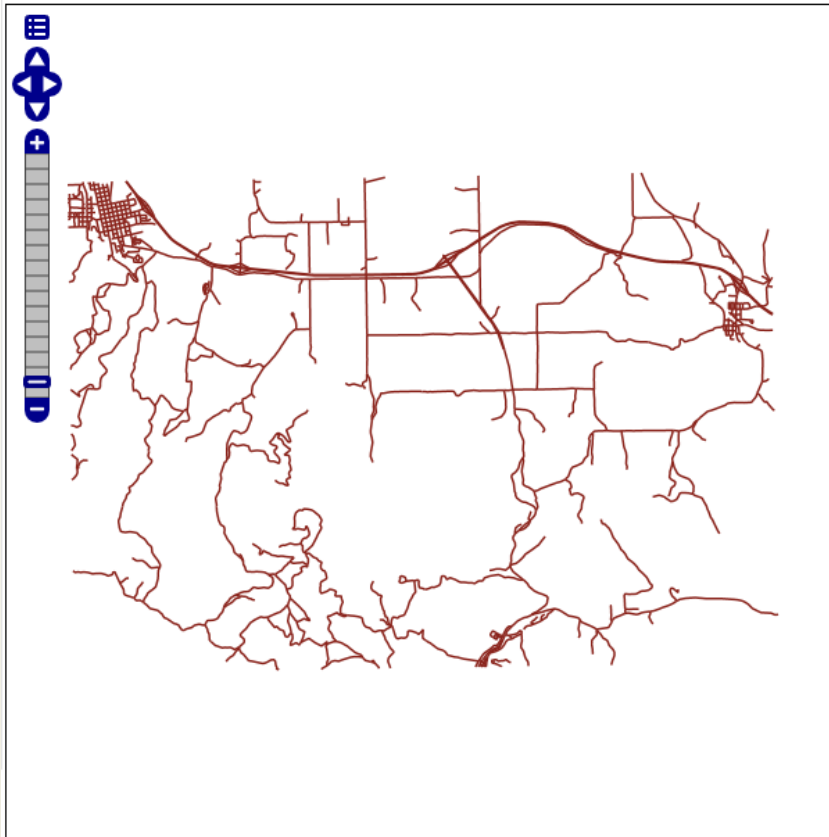
fid	NOME	SDI_1	SDI_2	SDI_3	SDI_4	SDI1_trend	SDI2_trend	SDI3_trend	SDI4_trend
SDI_30y_350000_19712000.1	Ofanto	-0.033	-0.01	-0.018	-0.017	-0.029	-0.058	-0.061	-0.063



Other examples (shapefile)

WMS version: 1.1.1 | Tiling: Single tile | Transition effect: None | Antialias: Full | Format: PNG 24bit | Styles: Default | Width/Height: Auto | Auto

Filter: CQL | [D] [X]



← **Polyline Shapefile**

Scale = 1 : 140K 604543.36466, 4920762.91425

roads

fid	cat	label
roads.532 5	unimproved road	
roads.555 4	light-duty road, improved surface	

Data from www.naturalearthdata.com

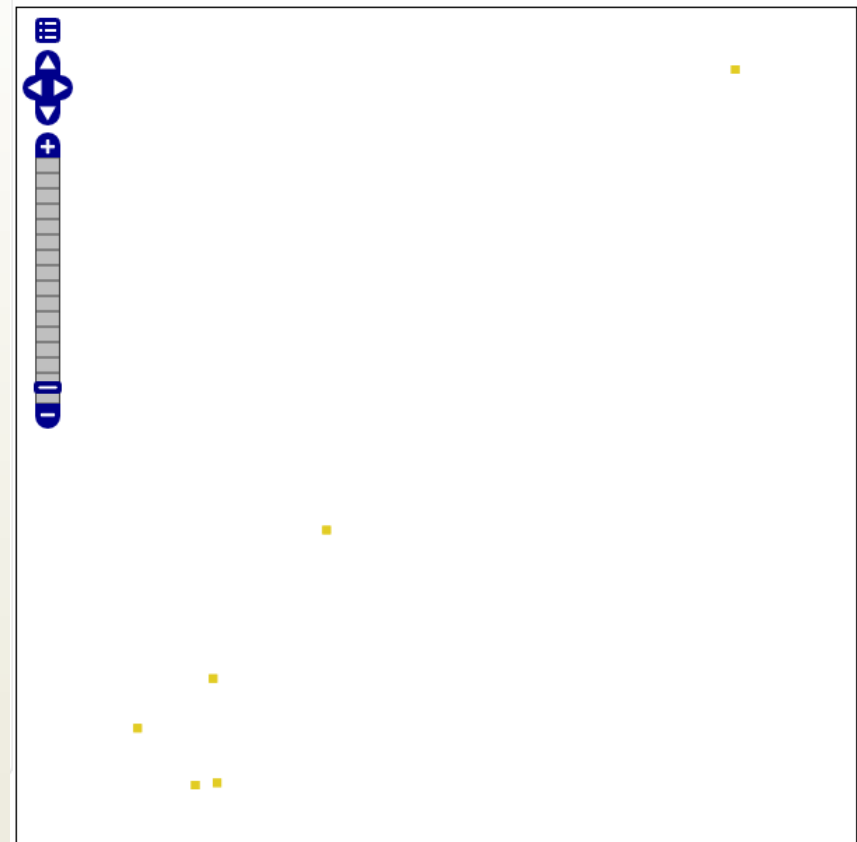




Other examples (shapefile)

WMS version: 1.1.1 Tiling: Single tile Transition effect: None Antialias: Full Format: PNG 24bit Styles: Default Width/Height: Auto Auto

Filter: CQL



← **Point Shapefile**

Scale = 1 : 10K -74.01045, 40.70759



poi

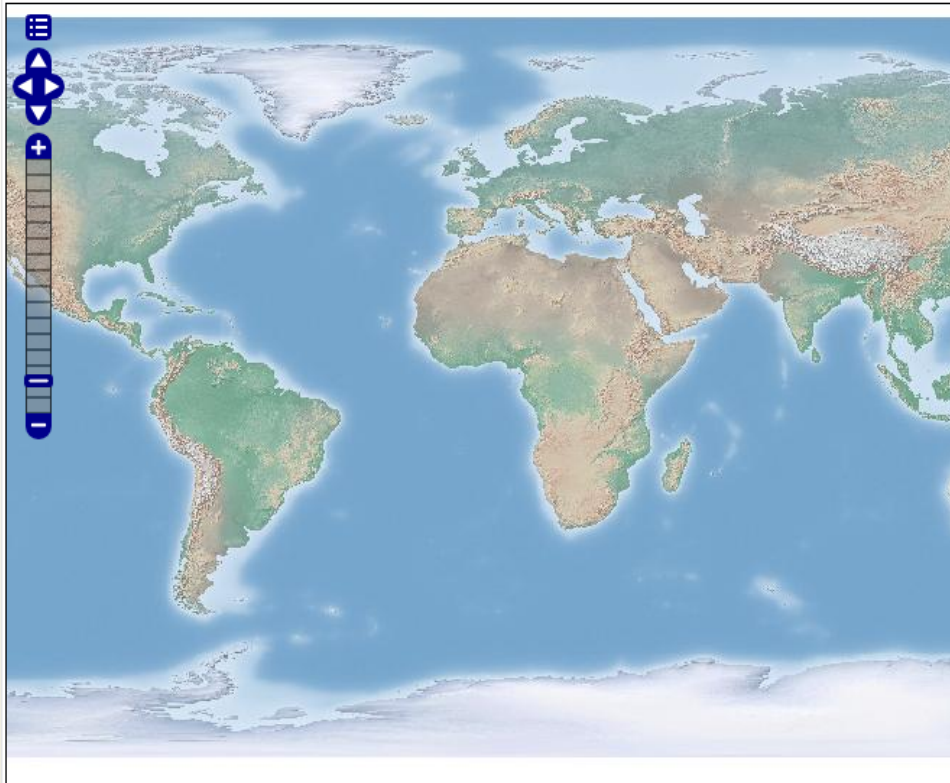
fid	NAME	THUMBNAIL	MAINPAGE
poi.1	museam	pics/22037827-Ti.jpg	pics/22037827-L.jpg

Data from www.naturalearthdata.com

Other examples (raster)

WMS version: 1.1.1 Tiling: Single tile Transition effect: None Antialias: Full Format: JPEG Styles: Default Width/Height: Auto Auto

Filter: CQL  



 Raster type (.tif)

Scale = 1 : 140M

-3.16406, 79.79297

HYP_50M_SR_W

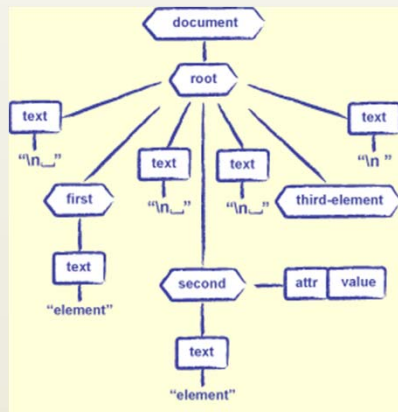
fid	RED_BAND	GREEN_BAND	BLUE_BAND	ALPHA_BAND
172.0	181.0	164.0	255.0	

Data from www.naturalearthdata.com



Not only data... the Metadata concept

- *Structured information about the data*
- *Metadata are “data (information) about data (raw data)”*
- *Metadata describe the content, the quality and other features of the data (e.g. origin of the data, citations, abstracts, scope, credits, state and point of contact).*
- *Helps to search and discovery data, to better organize and use them and enables interoperability*
- *The adoption of standards allows the interoperability and the possibility to interact with other project and share and compare results*



SCHEMA

```

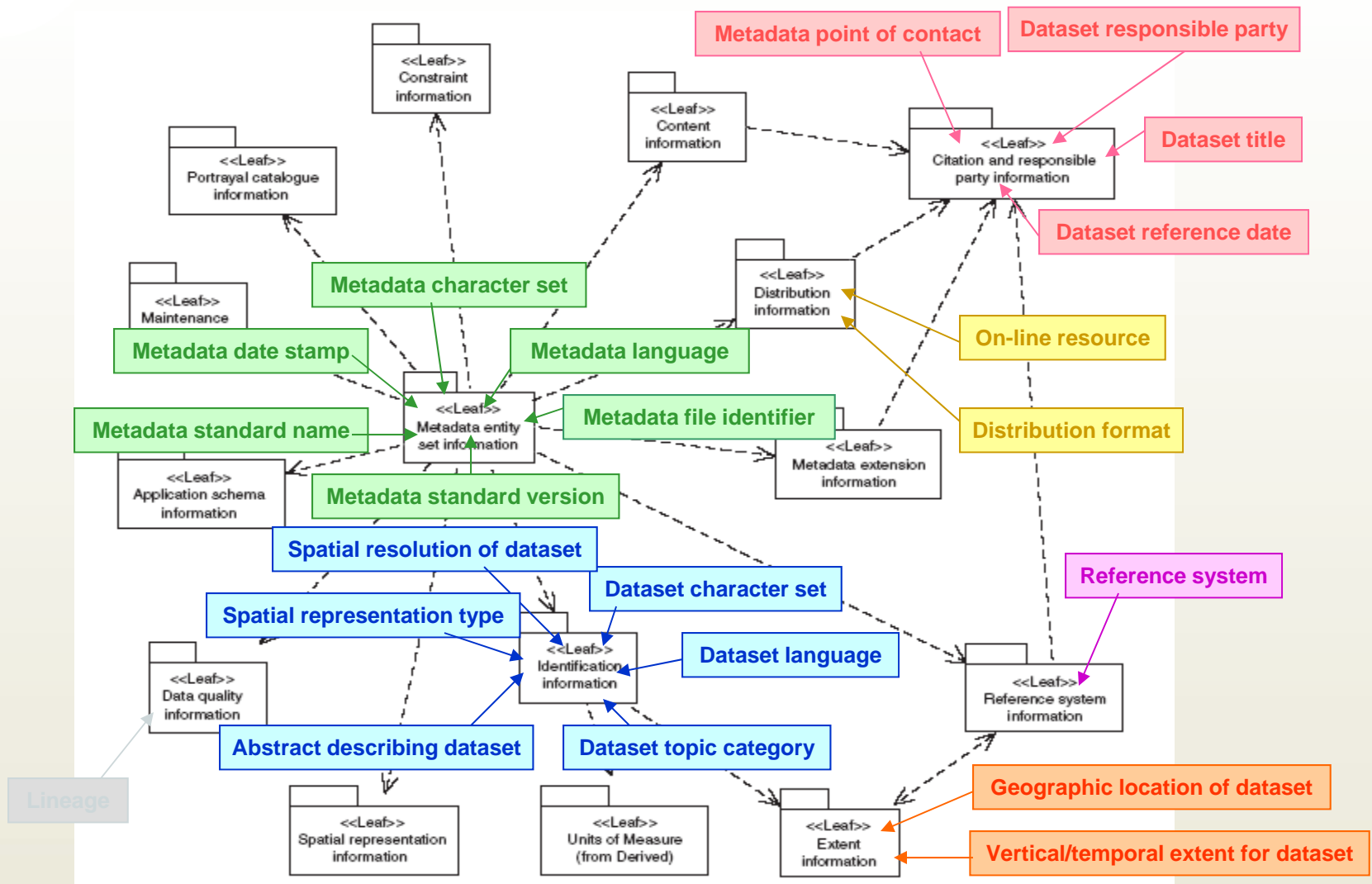
<METADATA>
  <AUTHOR>John Smith</AUTHOR>
  <DATE>11-06-2009</DATE>
  <DATA>
    <FILE>simulation.nc</FILE>
    <KEYWORD>ocean</KEYWORD>
  </DATA>
  ....
</METADATA>

```

XML Documents



ISO19115 Schema



Metadata for dataset related to impact indicators (1)

Geographic data sharing for everyone

Home | Contact us | Links | About | Help |

English

Username Password Login

Default view

By Group

- ISO Minimum
- ISO Core
- ISO All

By Package

- Metadata
- Identification
- Maintenance
- Constraints
- Spat. Info
- Ref. system
- Distribution
- Data quality
- App. schema
- Catalog
- Content Info
- Ext. Info
- XML view

ANNUAL TEMPERATURE CHANGE 2021-2050

Related service metadata:

- Annual temperature for 2021-2050

Identification info

Title	Annual Temperature Change 2021-2050		
Date	2012-03-21T14:10:48		
Date type	Revision: Date identifies when the resource was examined or re-examined and improved or amended		
Abstract	Projected changes in annual mean surface temperature (in K) under A1B scenario, multi-model ensemble mean for the time period 2021-2050 relative to 1961-1990 mean. Map presents changes using ensemble mean of several regional climate models (RCMs), run by different climate modelling communities in the frame of the EU FP6 Integrated Project ENSEMBLES (Contract number 505539). Data are presented as changes in relative terms (according to 1961-1990 period) in spatial resolution of approximately 25 km.		
Status	Completed: Production of the data has been completed		

Point of contact info

Individual name	Stéphane Isoard	Voice	33367284
Organisation name	European Environment Agency	Delivery point	Kongens Nytorv 6
Position name	Project manager - Climate change adaptation and economics	City	Copenhagen
Role	Point of contact: Party who can be contacted for acquiring knowledge about or acquisition of the resource	Administrative area	K
		Postal code	1050
		Country	Denmark
		Online resource	http://discomap.eea.europa.eu/ArcGIS/services/ClimateAdapt/Annual_Temperature_changes_2021_2050/MapServer/WMSServer

Geographical info

Topic category code: Climatology, meteorology, atmosphere

Geographic bounding box

West bound: -23.87500

North bound: 71.47500

East bound: 45.37785

Metadata for dataset related to impact indicators (2)

South bound
29.12312

Distribution Information

Transfer options	
Interactive Map	Annual Precipitation Change 2021-2050 (OGC-WMS Server: http://discomap.eea.europa.eu/ArcGIS/services/ClimateAdapt/Annual_Precipitation_changes_2021_2050/MapServer/WMSServer)
View in Google Earth	Annual Precipitation Change 2021-2050
OnLine resource	1 (LegendURL)

Distribution info

Reference System Information

Code	EPSG:4326
------	-----------

Reference system info

Reference System Information

Code	EPSG:3857
------	-----------

Data quality info

Hierarchy level	Dataset: Information applies to the dataset
-----------------	--

Data quality info

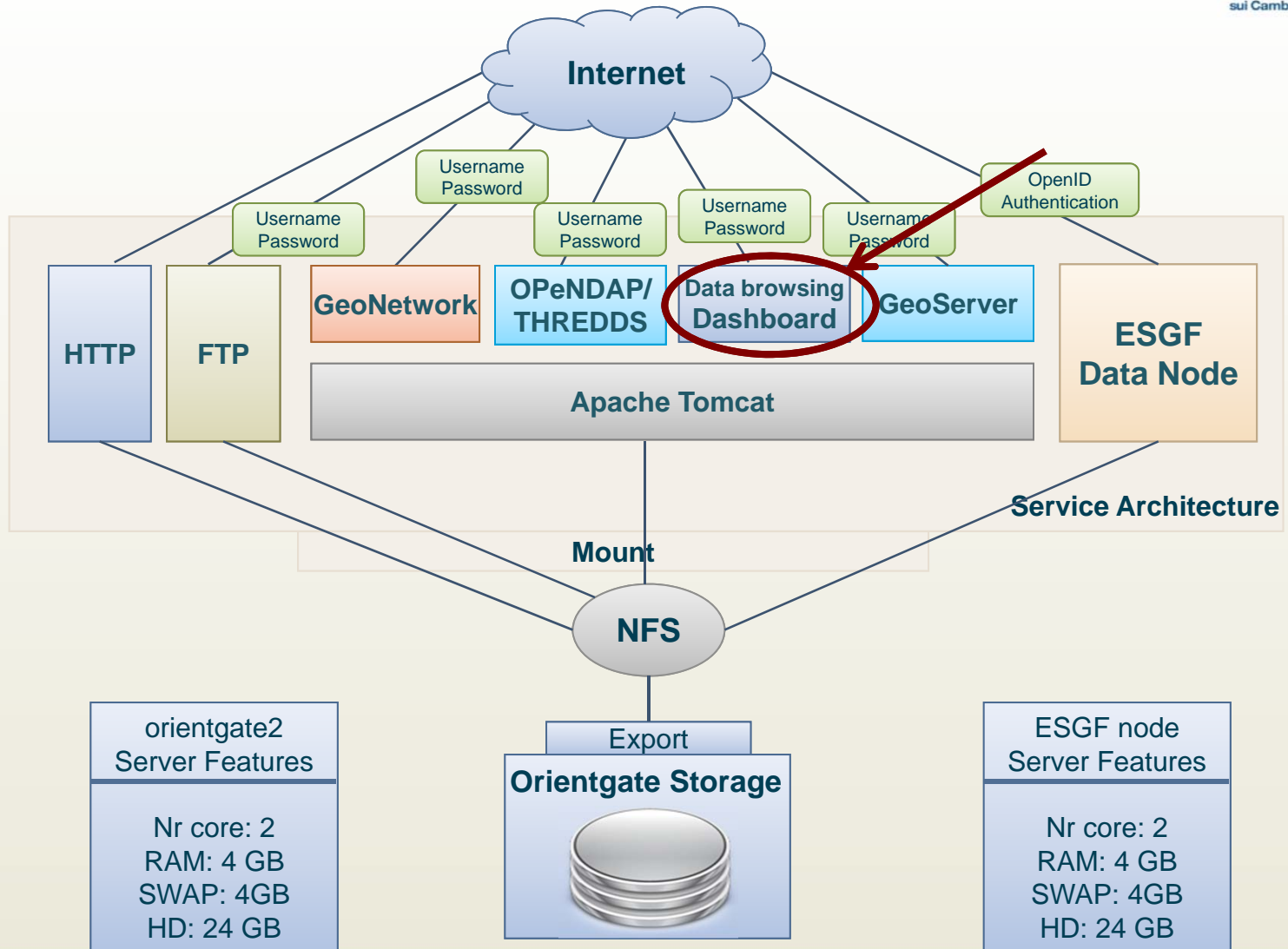
Metadata

File identifier	f921b4af568c49668dedf9942789292b8ba85415	
Metadata language	English	
Character set	UTF8: 8-bit variable size UCS Transfer Format, based on ISO/IEC 10646	
Hierarchy level	Dataset: Information applies to the dataset	
Date stamp	2012-11-14T10:46:43	
Metadata standard name	ISO 19115:2003/19139	
Metadata standard version	1.0	

Metadata info

Contact

Individual name	Stéphane Isoard	Voice	33367284
Organisation name	European Environment Agency	Facsimile	-
Position name	Project manager - Climate change adaptation and economics	Delivery point	Kongens Nytorv 6
Role	Point of contact: Party who can be contacted for acquiring knowledge about or acquisition of the resource	City	Copenhagen
		Administrative area	K
		Postal code	1050
		Country	Denmark
		OnLine resource	http://discomap.eea.europa.eu/ArcGIS/services/ClimateAdapt/Annual_Precipitation_changes_2021_2050/MapServer/WMSServer



ORIENTGATE data platform Interface

Service Registry

Data Browsers

FTP THREDDS GEONETWORK

Port: 21

Indice di ftp://orientgate02.cmcc.it/impacts/

Vai alla cartella superiore

Nome	Dimensione	Ultima modifica
adaptivecapacity_IPCC-AR4		11/10/13 00:00:00
exposure_IPCC-AR4		23/04/14 16:30:00
exposure_UN-DRR		30/04/14 08:53:00
hazard_UN-DRR		30/04/14 09:16:00
potentialimpact_IPCC-AR4		18/12/13 10:06:00
risk_UN-DRR		11/10/13 00:00:00
sensitivity_IPCC-AR4		11/10/13 00:00:00
vulnerability_IPCC-AR4		11/10/13 00:00:00
vulnerability_UN-DRR		18/12/13 10:08:00





The screenshot shows the GeoNetwork OpenSource web interface. At the top, there's a navigation bar with 'Home | Contact us | Links | About | Help |' and a language dropdown set to 'English'. Below this is a search section with 'Simple Search' and 'Advanced Search' tabs, and a 'Show map' button. The main content area is divided into two columns. The left column has a 'WHAT?' search input field and a 'WHERE?' section featuring a world map with navigation icons (zoom in, zoom out, pan, home, full screen) and a dropdown menu currently set to '- Any -'. A 'Search' button is at the bottom of this section. The right column contains the heading 'FIND INTERACTIVE MAPS, GIS DATASETS, SATELLITE IMAGERY AND RELATED APPLICATIONS' followed by 'GEONETWORK'S PURPOSE IS:' and a bulleted list of three points: 'To improve access to and integrated use of spatial data and information', 'To support decision making', and 'To promote multidisciplinary approaches to sustainable development'. Below the list, it states 'GeoNetwork opensource allows to easily share geographically referenced thematic information between different organizations. For more information please contact'.

GeoNetwork service



Dashboard gadget and integrated into the ORIENTGATE website

The screenshot displays the Orientgate website interface. At the top right, there is a search bar labeled "Enter keywords...". Below it, navigation links for "Thematic Centres" include "Forestry & Agriculture", "Drought, Water & Coasts", and "Urban Adaptation & Health". A main navigation menu contains "Home", "About", "Partnership", "Results", "Data" (highlighted), "Library", "News", and "Events".

The central area features a "Service Registry" section with "Data Browsers" for "FTP", "THREDDS", and "GEONETWORK". The "GEONETWORK" browser is active, showing a "Port: 8080" and a "GeoNetwork™ OpenSource" header with the tagline "Geographic data sharing for everyone". It includes a search bar, a "Show map" button, and a "WHAT?" section with a "WHERE?" map interface. The main content area is titled "FIND INTERACTIVE MAPS, GIS DATASETS, SATELLITE IMAGERY AND RELATED APPLICATIONS" and lists "GEONETWORK'S PURPOSE IS:" with three bullet points:

- To improve access to and integrated use of spatial data and information
- To support decision making
- To promote multidisciplinary approaches to sustainable development

 It also states: "GeoNetwork opensource allows to easily share geographically referenced thematic information between different organizations. For more information please contact". A "Featured map" section highlights a "PHYSIOGRAPHIC MAP OF NORTH AND CENTRAL EURASIA (SAMPLE RECORD, PLEASE REMOVE!)" with two map thumbnails.

The footer contains a "Contacts" link, the slogan "INTEGRATING CLIMATE KNOWLEDGE INTO PLANNING", and logos for "SOUTH EAST EUROPE" and the "EUROPEAN UNION".





Thank you!

Alessandra Nuzzo (alessandra.nuzzo@cmcc.it)

Sandro Fiore (sandro.fiore@unisalento.it)

Giovanni Aloisio (giovanni.aloisio@unisalento.it)