

Using GeoServer for spatio-temporal data management with examples for MetOc and remote sensing

Ing. Simone Giannecchini, GeoSolutions

Dott Riccardo Mari, LaMMA

Ing. Giampaolo Cimino, NATO STO CMRE



MOS14, Reading
19th November 2013

Outline

- Who we are
- The Building Blocks
- More on GeoServer
 - NetCDF
 - ImageMosaic PPlugin
 - OGC Services
- Real World Use-Cases

GeoSolutions

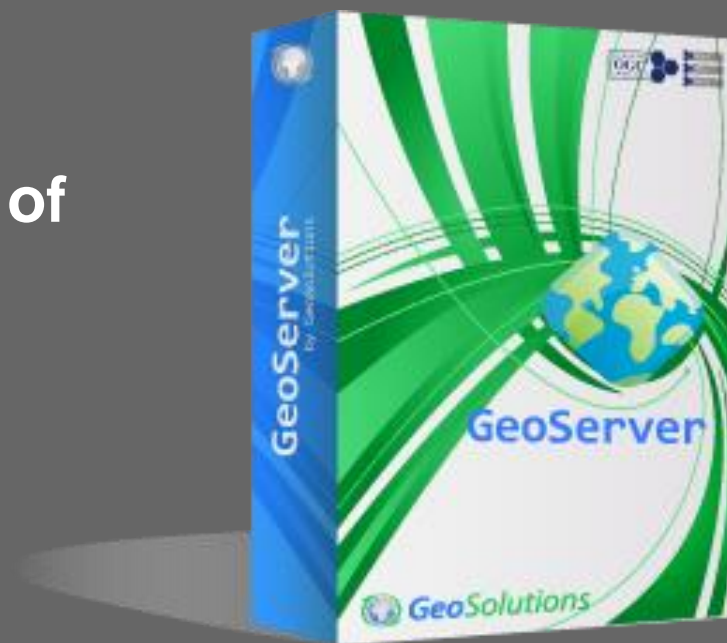
- Founded in Italy in late 2006
- Expertise
 - Image Processing, GeoSpatial Data Fusion
 - Java, Java Enterprise, C++, Python
 - JPEG2000, JPIP, Advanced 2D visualization
- Supporting/Developing FOSS4G projects
 - MapStore, GeoServer
 - GeoBatch, GeoNetwork
- <http://www.geo-solutions.it>



GeoServer

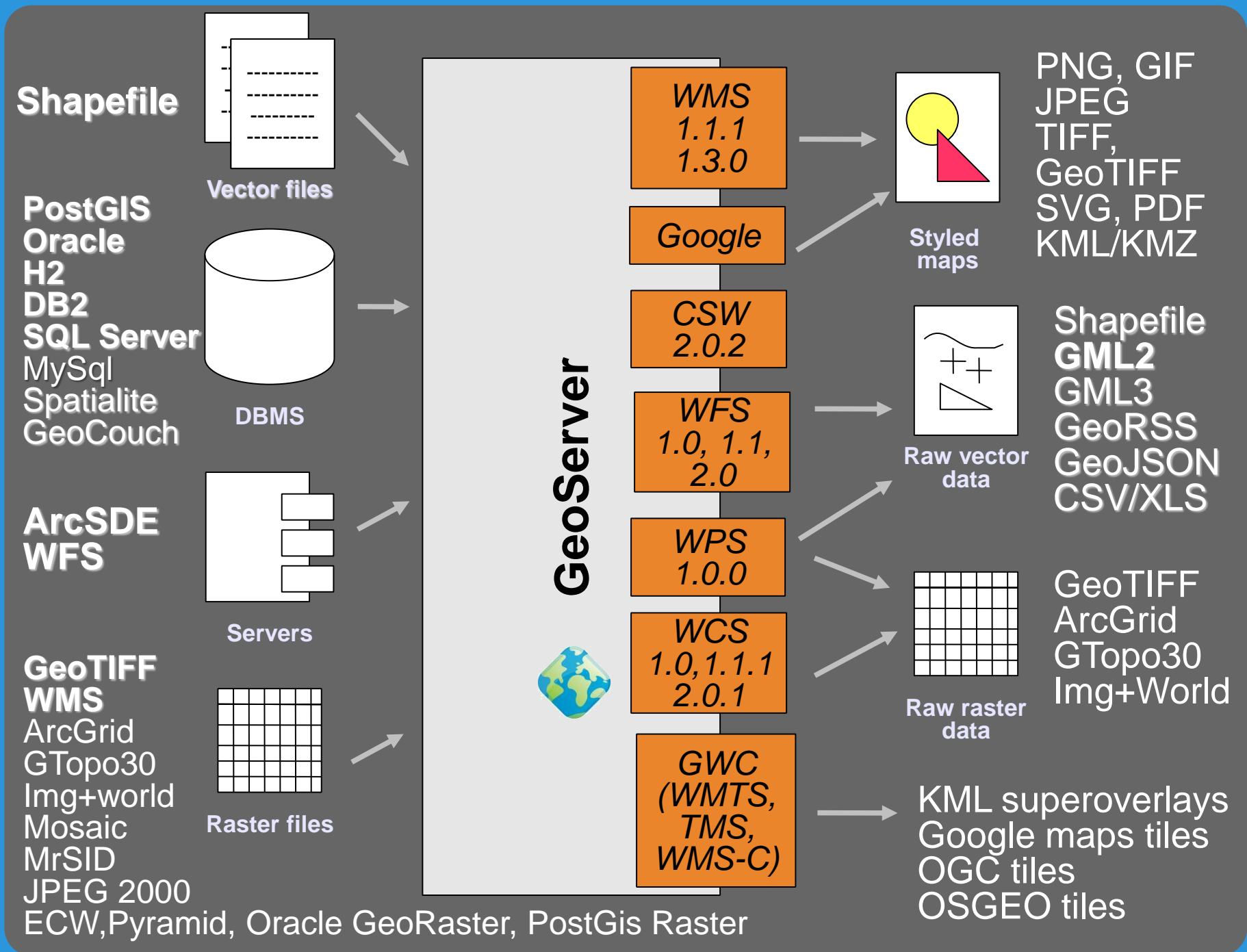


- **GeoSpatial enterprise gateway**
 - Java Enterprise
 - Management and Dissemination of raster and vector data
- **Standards compliant**
 - OGC WCS 1.0, 1.1.1 (RI), 2.0.1
 - OGC WFS 1.0, 1.1 (RI), 2.0
 - OGC WMS 1.1.1, 1.3
 - OGC WPS 1.0.0
 - OGC CSW 2.0.2
- **Google Earth/Maps support**
 - KML, GeoSearch, etc..





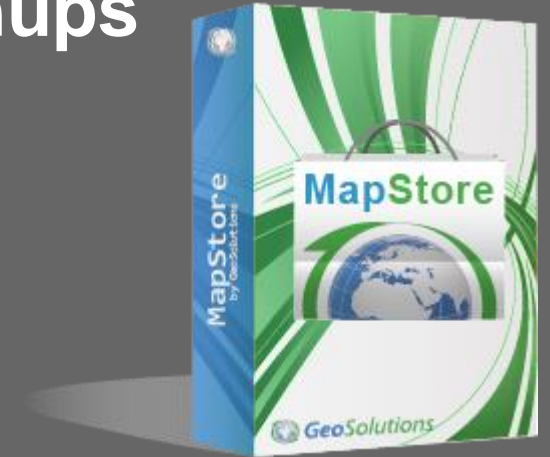
Formats and Protocols





MapStore

- Create and manage **maps** and **mashups**
- The **Map** is the key resource
 - Definition of data sources (e.g. WMS)
 - Definition and Layout of widgets
- **Main features**
 - Map Creation → you can create personal maps
 - Map Browsing → you can navigate existing maps
 - Map Sharing → you can share maps
 - Map Security → you can define access rights
- **Open source**
 - <https://github.com/geosolutions-it/mapstore>





Standards Supported

- We believe in standards, whether **internationally recognized**
 - WMS : 1.1.1, 1.3.0
 - WFS: 1.0.0, 1.1.0
 - WPS: 1.0.0
 - WMTS: 1.0.0
 - TMS: 1.0.0
 - CSW: 2.0.2
 - KML: XXX
- Or **de-facto**
 - GeoJSON
 - GeoRSS

Thanks OpenLayers 😊

GeoBatch

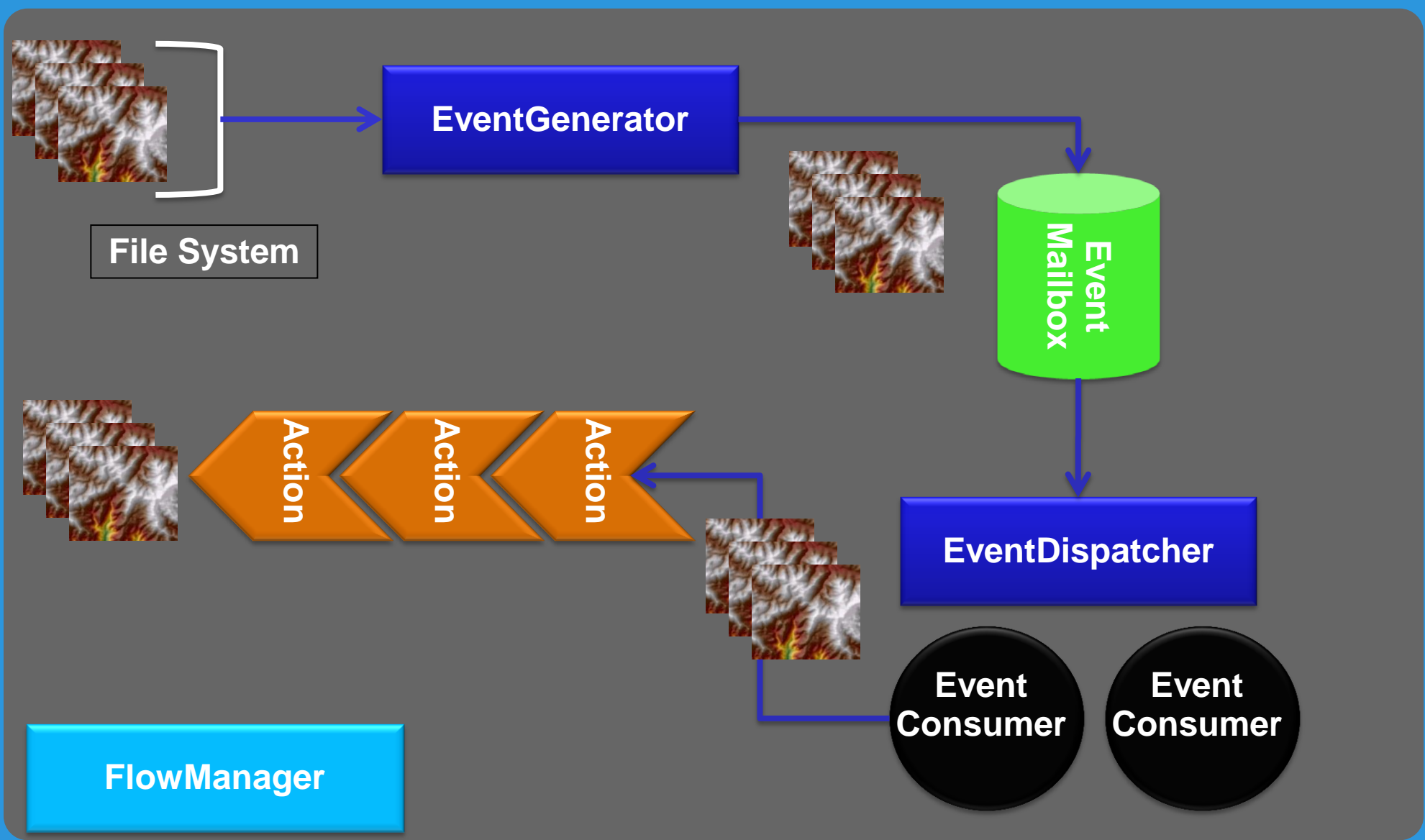
- **Geospatial batch ingestion/processing system**
 - *Event based* processing
 - *Time based* processing (periodic, one-off, based on Quartz)
- **Tools for automatic collection, processing and publication of data**
- **Open Source leverages on**
 - GeoTools
 - Apache FTP
 - Spring
 - XStream
 - Hibernate



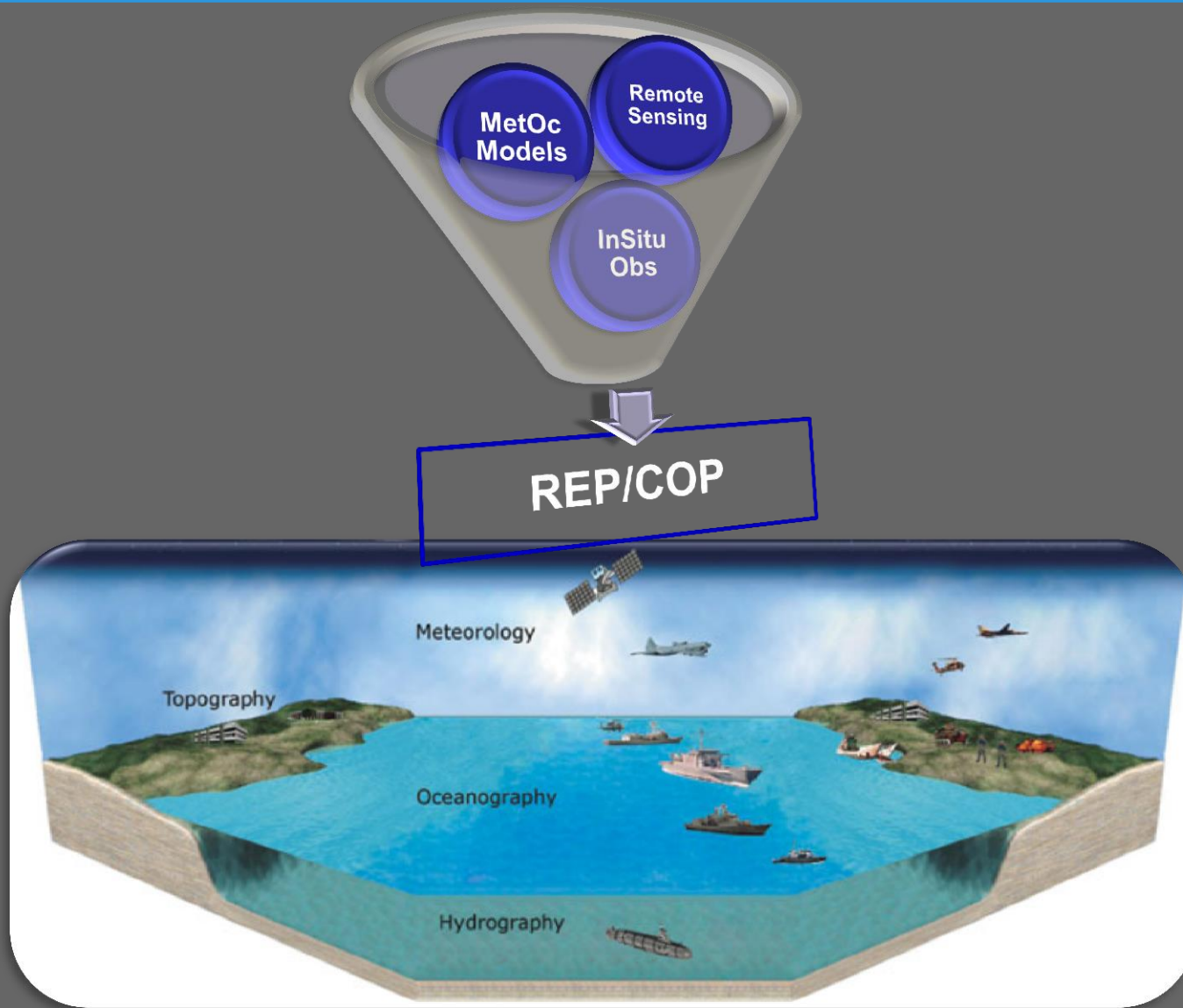
GeoBatch

- Code on [GitHub](#)
- Embedded FTP Server
- Automagically publish to
 - GeoServer
 - GeoWebCache (ongoing)
 - GeoNetwork
- User Interface
- REST Interface
- JMX Interface*
- JMS Connector*

GeoBatch Architecture



Reference Scenario/Domain



ImageMosaic – Part 1

ImageMosaic



- Terminology
- Granule/Tile
 - The individual raster element composing the mosaic
- (Granule) Index
 - The collection of metadata records describing the location, spatial coverage and other attributes of each single granule

fid [PK] integer	the_geom geometry	location character varying	ingestion timestamp without time zon
1	0103000020E610000001000000050000000000	NatColours_20130118T100000000Z.tif	2013-01-18 10:00:00
2	0103000020E610000001000000050000000000	NatColours_20130118T101500000Z.tif	2013-01-18 10:15:00
3	0103000020E610000001000000050000000000	NatColours_20130118T103000000Z.tif	2013-01-18 10:30:00
4	0103000020E610000001000000050000000000	NatColours_20130118T104500000Z.tif	2013-01-18 10:45:00

- Dimensions/Domains
 - The dimensions besides the spatial ones used to distinguish individual granules

ImageMosaic



- (Granule) Index
- Always present
- Drives the collection of granules for mosaicking
- Implemented by default using GeoTools Vector Sources
- Can be customized to support custom granule indexes (e.g. legacy catalog)
- Currently supported/tested DBMS
 - PostGis (JNDI)
 - Oracle (JNDI) *it's been a nightmare because to make it work!*
 - H2

ImageMosaic



- Dimensions/Domains
- Maps to alphanumeric attributes in the index
- TIME and ELEVATION receive special treatment for WMS and WCS
- Custom/Additional dimensions
 - Everything besides TIME & ELEVATION
 - Map to DIM_XXX in WMS
 - They can be dynamically discovered

ImageMosaic



• Custom/Additional dimensions

Custom dimension: FILEDATE

Enabled

Units

Unit Symbol

Presentation
 ▾

Custom dimension: UPDATED

Enabled

Units

Unit Symbol

Presentation
 ▾

```
<Layer queryable="1">
  <Name>geosolutions:NO2</Name>
  <Title>NO2</Title>
  <Abstract/>
  <KeywordList>...</KeywordList>
  <CRS>EPSG:4326</CRS>
  <CRS>CRS:84</CRS>
  <EX_GeographicBoundingBox>...</EX_GeographicBoundingBox>
  <BoundingBox CRS="CRS:84" minx="5.0" miny="45.0" maxx="14.875" maxy="50.9375"/>
  <BoundingBox CRS="EPSG:4326" minx="45.0" miny="5.0" maxx="50.9375" maxy="14.875"/>
  <Dimension name="time" default="current" units="ISO8601">
    2013-03-01T00:00:00.000Z,2013-03-01T01:00:00.000Z,2013-03-01T02:00:00.000Z,2013-03-01T03:00:00.000Z,2013-03-01T04:00:00.000Z,2013-03-01T05:00:00.000Z,2013-03-01T06:00:00.000Z,2013-03-01T07:00:00.000Z,2013-03-01T08:00:00.000Z,2013-03-01T09:00:00.000Z,2013-03-01T10:00:00.000Z,2013-03-01T11:00:00.000Z,2013-03-01T12:00:00.000Z,2013-03-01T13:00:00.000Z,2013-03-01T14:00:00.000Z,2013-03-01T15:00:00.000Z,2013-03-01T16:00:00.000Z,2013-03-01T17:00:00.000Z,2013-03-01T18:00:00.000Z,2013-03-01T19:00:00.000Z,2013-03-01T20:00:00.000Z,2013-03-01T21:00:00.000Z,2013-03-01T22:00:00.000Z,2013-03-01T23:00:00.000Z,2013-03-02T00:00:00.000Z,2013-03-02T01:00:00.000Z,2013-03-02T02:00:00.000Z,2013-03-02T03:00:00.000Z,2013-03-02T04:00:00.000Z,2013-03-02T05:00:00.000Z,2013-03-02T06:00:00.000Z,2013-03-02T07:00:00.000Z,2013-03-02T08:00:00.000Z,2013-03-02T09:00:00.000Z,2013-03-02T10:00:00.000Z,2013-03-02T11:00:00.000Z,2013-03-02T12:00:00.000Z,2013-03-02T13:00:00.000Z,2013-03-02T14:00:00.000Z,2013-03-02T15:00:00.000Z,2013-03-02T16:00:00.000Z,2013-03-02T17:00:00.000Z,2013-03-02T18:00:00.000Z,2013-03-02T19:00:00.000Z,2013-03-02T20:00:00.000Z,2013-03-02T21:00:00.000Z,2013-03-02T22:00:00.000Z,2013-03-02T23:00:00.000Z
  </Dimension>
  <Dimension name="elevation" default="10.0" units="EPSG:5030" unitSymbol="m">
    10.0,35.0,75.0,125.0,175.0,250.0,350.0,450.0,550.0,700.0,900.0,1250.0,1750.0,2500.0
  </Dimension>
  <Dimension name="UPDATED" default="2013-04-08T07:40:29.061Z" units="">2013-04-08T07:40:29.061Z,2013-04-08T08:18:41.597Z</Dimension>
  <Dimension name="FILEDATE" default="2013-03-01T00:00:00.000Z" units="">2013-03-01T00:00:00.000Z,2013-03-02T00:00:00.000Z</Dimension>
</Layer>
```


ImageMosaic



- Dimensions/Domains parsing
- indexer.properties file (*the old way*)

TimeAttribute=ingestion

ElevationAttribute=elevation

Schema=*the_geom:Polygon,location:String,ingestion:java.util.Date,elevation:Double

PropertyCollectors=TimestampFileNameExtractorSPI[time regex](ingestion),DoubleFileNameExtractorSPI[elevation regex](elevation)

ImageMosaic



- Dimensions/Domains parsing
- elevationregex.properties file (*the old way*)
regex=(?<=_)(\\d{4}\\.\\d{3})(?=_)
- elevationregex.properties file (*the old way*)
regex=[0-9]{8}T[0-9]{9}Z(\\?!\\.*[0-9]{8}T[0-9]{9}Z\\.*)
- Regex turn name parts into index attribute values!

ImageMosaic

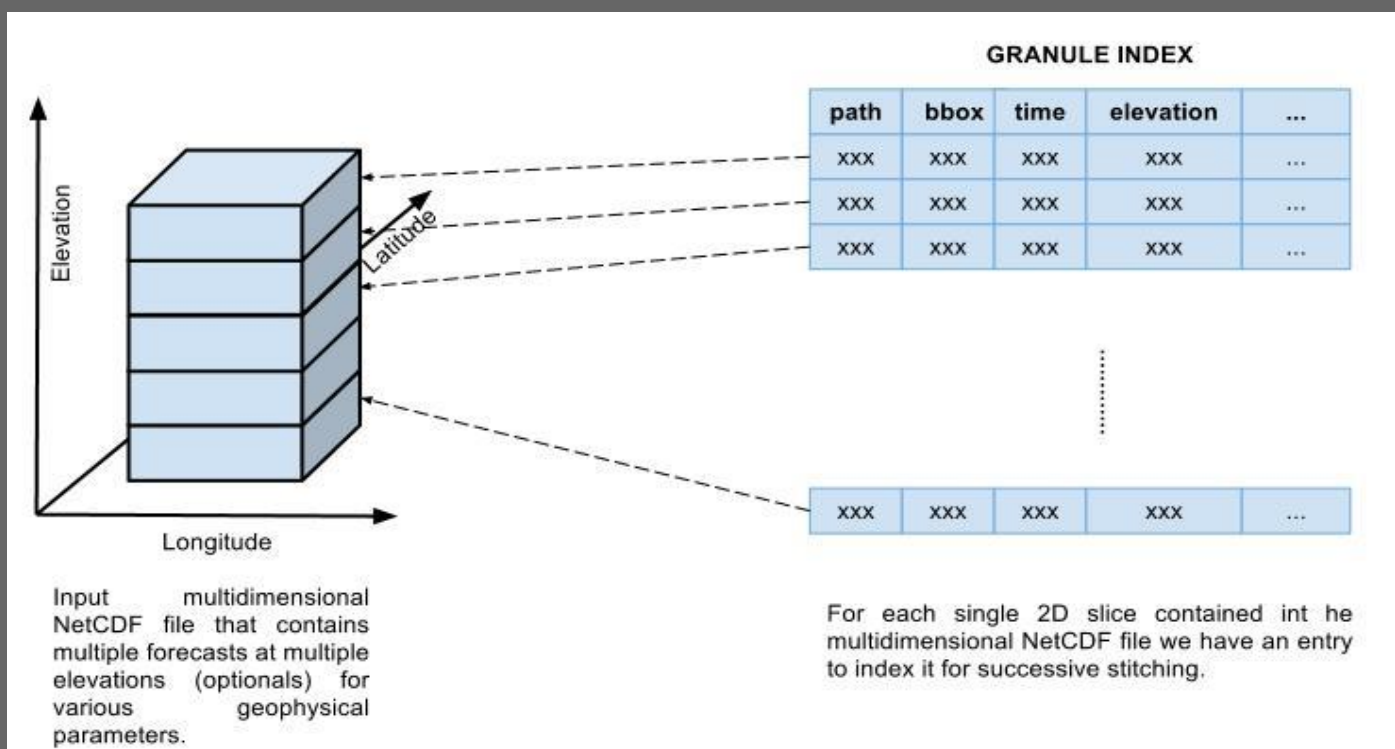


- Limitations/assumptions
- Granules must share the same Coordinate Reference System
- Granules must share the same ColorModel and SampleModel
 - We can stil merge RGB with Paletted RGB via colormap expansion
- 1 row in the index maps to 1 physical file

NetCDF

NetCDF Format Support

- **NetCDF support**
 - Support COARDS* conventions loosely
 - Expose NetCDF internal data as a set of 2D slices
 - Fast 2D (time, elevation) slice extraction



NetCDF Format Support

- Polyphemus Sample Dataset
- 1 File → Multiple Coverages!

The screenshot shows the NetCDF (4.3) Tools application window. The dataset path is `C:/data/MD-WORKSHOP/data/polyphemus_20130301.nc`. The interface includes tabs for FeatureTypes, THREDDS, Fmrc, GeoTiff, Units, NcML, and URLdump. Below these are sections for Viewer, Writer, NCDump, losp, and Coord Sys. A table displays the dataset's metadata:

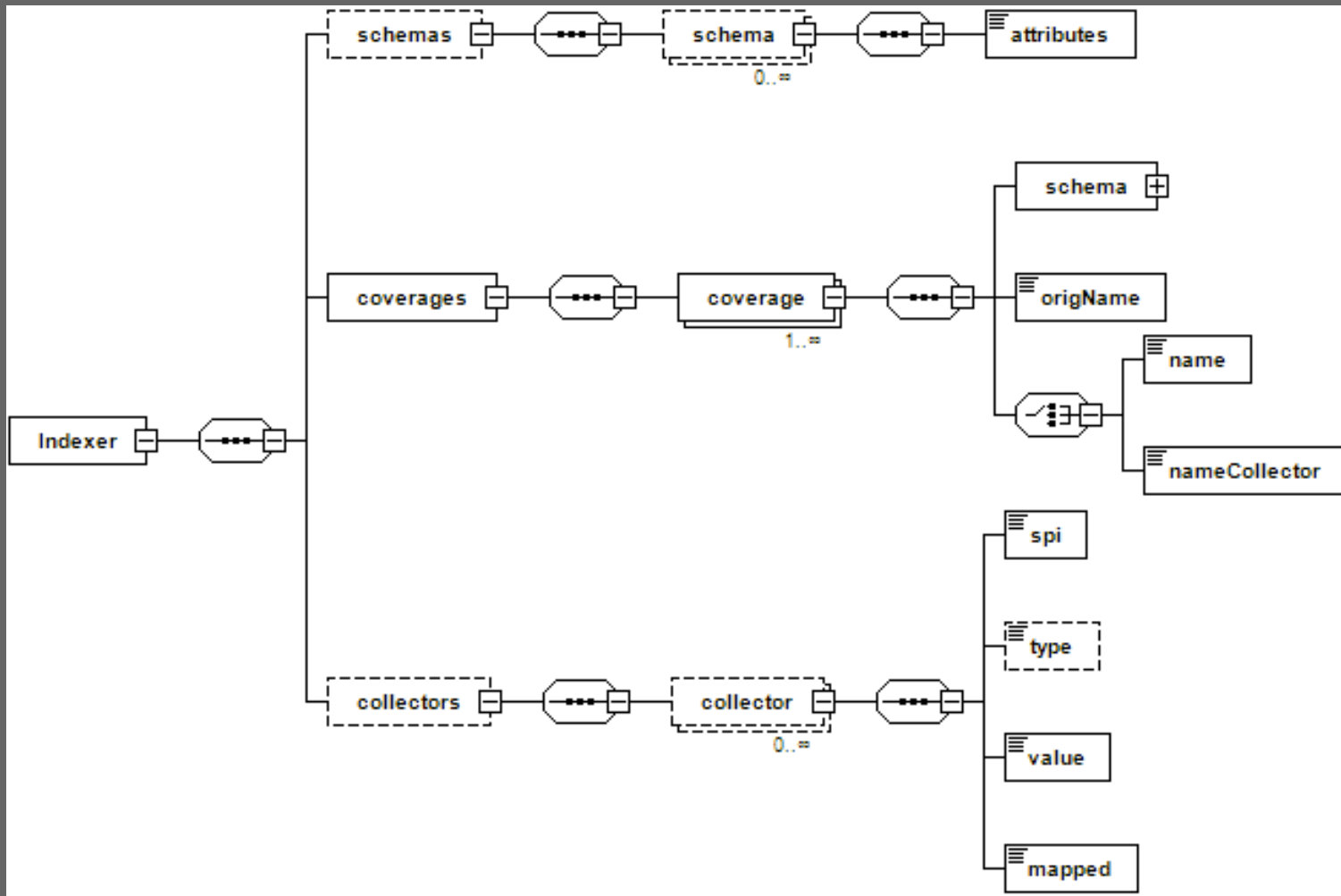
data...	description	dimensions	gr...	name	shape	units
float	Ozone conce...	time,z,lat,lon		O3	24,14,96...	
float	NO2 concent...	time,z,lat,lon		NO2	24,14,96...	
float	Meridional w...	time,z,lat,lon		V	24,14,96...	
float		time		time	24	hours since 2013-03-01 0:00:00
float	height	z		z	14	meters
float	latitudes	lat		lat	96	degrees_north
float	longitudes	lon		lon	80	degrees_east

The left sidebar shows a tree view of the dataset's structure, with folders for time, z, lat, lon, O3, NO2, V, time, z, lat, and lon. The 'time' folder is highlighted with a blue box, and the 'O3', 'NO2', 'V', 'time', 'z', 'lat', and 'lon' folders are highlighted with a red box.

NetCDF Format Support



- NetCDF Indexer



NetCDF Format Support



- NetCDF Indexer → drive the indexing

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
```

```
<Indexer>
```

```
<schemas>
```

```
<schema name="default" >
```

```
<attributes>the_geom:Polygon,imageindex:Integer,time:java.util.Date,elevation:Double</attributes>
```

```
</schema>
```

```
</schemas>
```

```
<coverages>
```

```
<coverage>
```

```
<name>O3</name>
```

```
<schema ref="default"></schema>
```

```
</coverage>
```

```
...
```

```
</coverages>
```

```
</Indexer>
```


NetCDF Format Support



- NetCDF Internal Index
- Speeds up 2D slice extraction
- H2 + binary file

```
20130103.METOPA.GOME2.03.PGL.idx  
20130103METOPAGOME203PGL.2.log.db  
20130103METOPAGOME203PGL.data.db  
20130103METOPAGOME203PGL.index.db  
20130103METOPAGOME203PGL.trace.db
```

- Index location is configurable via –
DNETCDF_DATA_DIR
 - Data in a non-writable location
 - Granule Index in a DBMS
 - Individual NetCDF Indexes on a separate directory

NetCDF Format Support

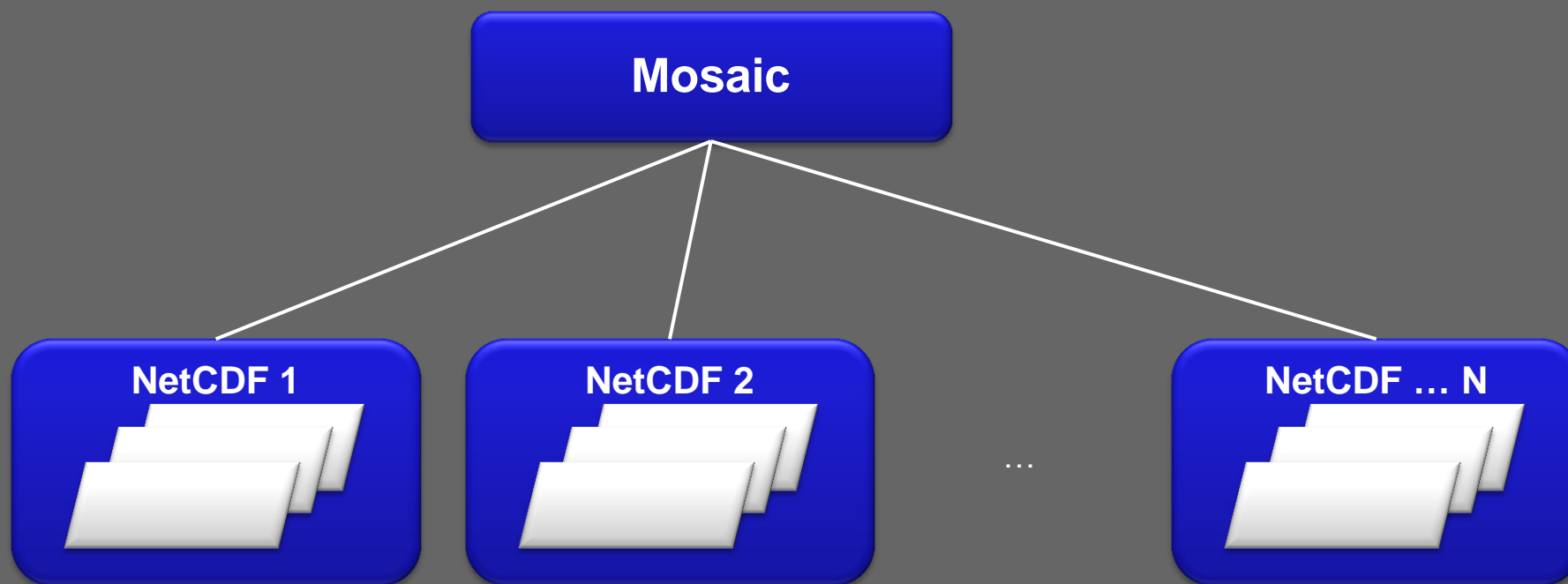


- Limitations/assumptions
- Only WGS84 is supported
- *Only NetCDF following COARDS convention are supported*
- ImageMosaic dimensions naming should be consistent with that of the underlying NetCDF reader
- NetCDF output is available only for StructuredGridCoverage2DReader implementors (ImageMosaic and NetCDF)

ImageMosaic – Part 2

ImageMosaic – Part 2

- ImageMosaic NetCDF integration
 - Allow the ImageMosaic to handle multiple NetCDF files
 - Expose NetCDF internal structure (times, elevations)
 - Make ImageMosaic handle slices of the NetCDF file as granules



ImageMosaic – Part 2



- New Indexer File (XML file)
- Definition of Dimensions/Domains
- Definition of table schema
- *Definition of Coverage*
- *Mapping of dimensions and table schema to Coverages*
- PropertyCollector definition
- Additional Indexing Parameters:
 - Path Behaviour
 - Indexing Directories
 - Aux File

ImageMosaic – Part 2



- New Indexer File (XML file)

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>
```

```
<Indexer>
```

```
  <domains>
```

```
    <domain name="time">
```

```
      <attributes><attribute>time</attribute></attributes>
```

```
    </domain>
```

```
    <domain name="elevation">
```

```
      <attributes><attribute>elevation</attribute></attributes>
```

```
    </domain>
```

```
    <domain name="fileDate">
```

```
      <attributes><attribute ref="fileDateCollector">fileDate</attribute></attributes>
```

```
    </domain>
```

```
    <domain name="updated">
```

```
      <attributes><attribute ref="updatedCollector">updated</attribute></attributes>
```

```
    </domain>
```

```
  </domains>
```

ImageMosaic – Part 2



- New Indexer File (XML file)

```
<schemas>
```

```
  <schema name="default" >
```

```
<attributes>the_geom:Polygon,location:String,imageindex:Integer,time:java.util.Date,elevation:Double,fileDate:java.util.Date,updated:java.util.Date</attributes>
```

```
  </schema>
```

```
</schemas>
```

```
<coverages>
```

```
  <coverage>
```

```
    <name>V</name>
```

```
    <schema ref="default"></schema>
```

```
    <domains>
```

```
      <domain ref="time" />
```

```
      <domain ref="elevation" />
```

```
      <domain ref="fileDate" />
```

```
      <domain ref="updated" />
```

```
    </domains>
```

```
  </coverage>
```

```
</coverages>
```

ImageMosaic – Part 2



- New Indexer File (XML file)

```
<collectors>
  <collector name="fileDateCollector">
    <value>[0-9]{8}</value>
    <spi>TimestampFileNameExtractorSPI</spi>
    <mapped>fileDate</mapped>
  </collector>
  <collector name="updatedCollector">
    <value>MODIFY_TIME</value>
    <spi>RuntimeExtractorSPI</spi>
    <mapped>updated</mapped>
  </collector>
</collectors>
<parameters>
  <parameter name="AbsolutePath" value="true" />
  <parameter name="AuxiliaryFile" value="polyphemus-test.xml" />
  <parameter name="IndexingDirectories"
value="D:/Training_2.4_multidim_Win64/source_data/polyphemus" />
</parameters>
```


ImageMosaic – Part 2



- Multiple Coverages per Mosaic

The screenshot shows the GeoServer web interface. The 'Layers' section is active, with the 'Add a new resource' button highlighted. A 'New Layer' dialog box is open, showing the 'Add layer from' dropdown menu set to 'geosolutions:polyphemus'. A second 'New Layer' dialog box is shown, displaying a list of resources from the 'polyphemus' store. The list includes three items: NO2, O3, and V, each with a 'Publish' button. The 'Publish' button for the NO2 resource is highlighted.

Layers
Manage the layers being published by GeoServer
[Add a new resource](#)
[Remove selected resources](#)

New Layer
Add a new layer
Add layer from **geosolutions:polyphemus**

New Layer
Add a new layer
Here is a list of resources contained in the store 'polyphemus'. Click on the layer you wish to configure

<< < 1 > >> Results 1 to 3 (out of 3 items) Search

Published	Layer name	Action
	NO2	Publish
	O3	Publish
	V	Publish

<< < 1 > >> Results 1 to 3 (out of 3 items)

ImageMosaic – Part 2



- Granule Index CRUD Operations via REST

- CREATE

```
curl -u admin:Geos -XPUT -H "Content-type:application/zip" --data-binary  
@http://localhost:8080/geoserver/rest/workspaces/geosolutions/coveragestores/  
emperature/file.imagemosaic
```

- READ index schema

```
curl -v -u admin:Geos -XGET  
"http://localhost:8080/geoserver/rest/workspaces/geosolutions/coveragestores/polyphemus  
/coverages/NO2/index.xml"
```

- READ WFS like with CQL filtering and paging

```
curl -v -u admin:Geos -XGET  
"http://localhost:8080/geoserver/rest/workspaces/geosolutions/coveragestores/p  
olyphemus/coverages/NO2/index/granules.xml?limit=1&filter=time='2013-03-  
03T00:00:00Z'"
```

ImageMosaic – Part 2



- Granule Index CRUD Operations via REST

- UPDATE

```
curl -v -u admin:Geos -XPOST -H "Content-type: text/plain" -d  
"/polyphemus_20130303.nc"  
"http://localhost:8080/geoserver/rest/workspaces/geosolutions/coveragestores/polyphemus/external.imagemosaic"
```

- DELETE WFS like with CQL filtering and paging or by ID

```
curl -v -u admin:geoserver -XDELETE  
"http://localhost:8080/geoserver/rest/workspaces/topp/coveragestores/polyphemus-  
v1/coverages/NO2/index/granules.xml?filter=location='polyphemus_20130301.nc'"
```

```
curl -v -u admin:geoserver -XGET  
"http://localhost:8080/geoserver/rest/workspaces/topp/coveragestores/polyphemus-  
v1/coverages/NO2/index/granules/NO2.2689.xml"
```

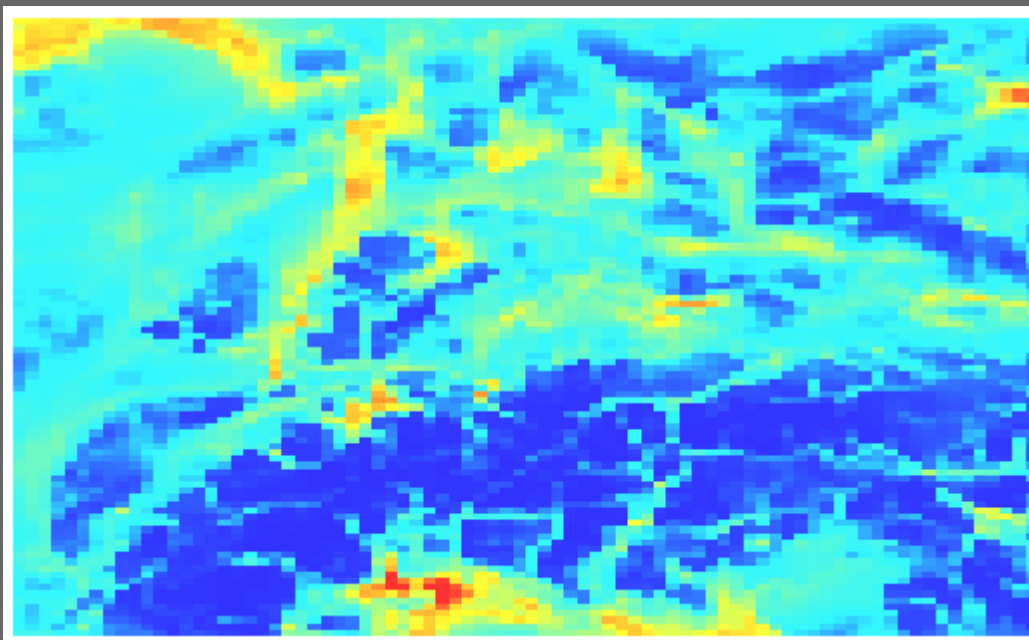
The Services

WMS



- TIME, ELEVATION & More

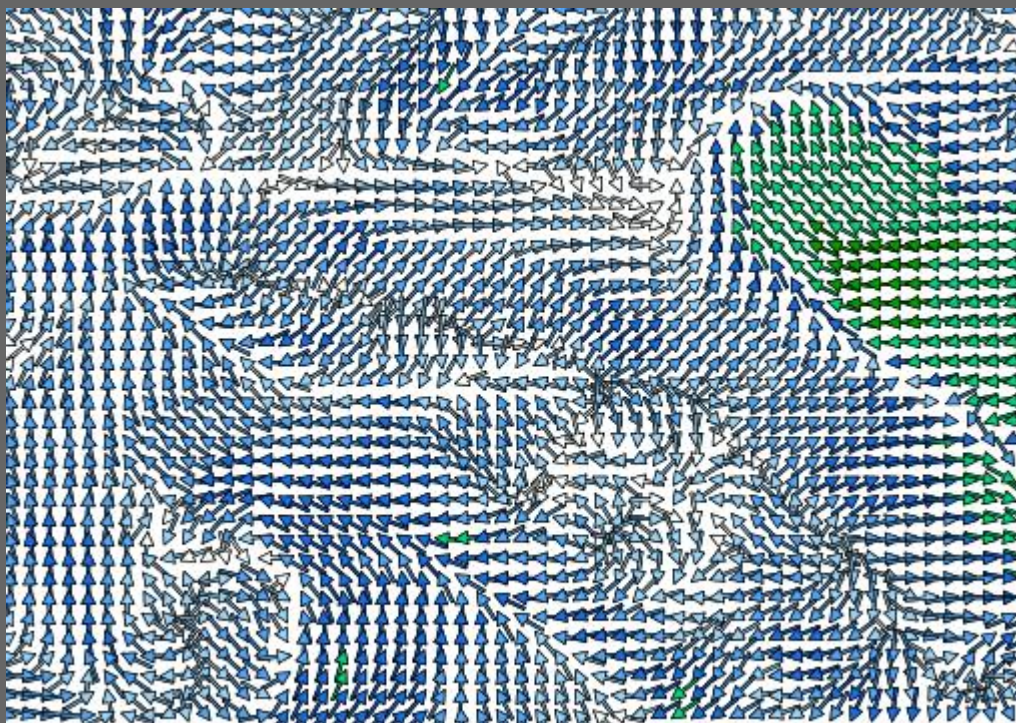
http://localhost:8080/geoserver/geosolutions/wms?...&time=2013-03-01T00:00:00.000Z&elevation=35.0&DIM_FILEDATE=2013-03-01T00:00:00.000Z&DIM_UPDATED=2013-04-08T08:18:41.597Z



WMS + WPS



- Rendering Transformations
- SLD Based transformations
- On-the-fly contouring
- On-the-fly polygonalization
- Wind Barbs

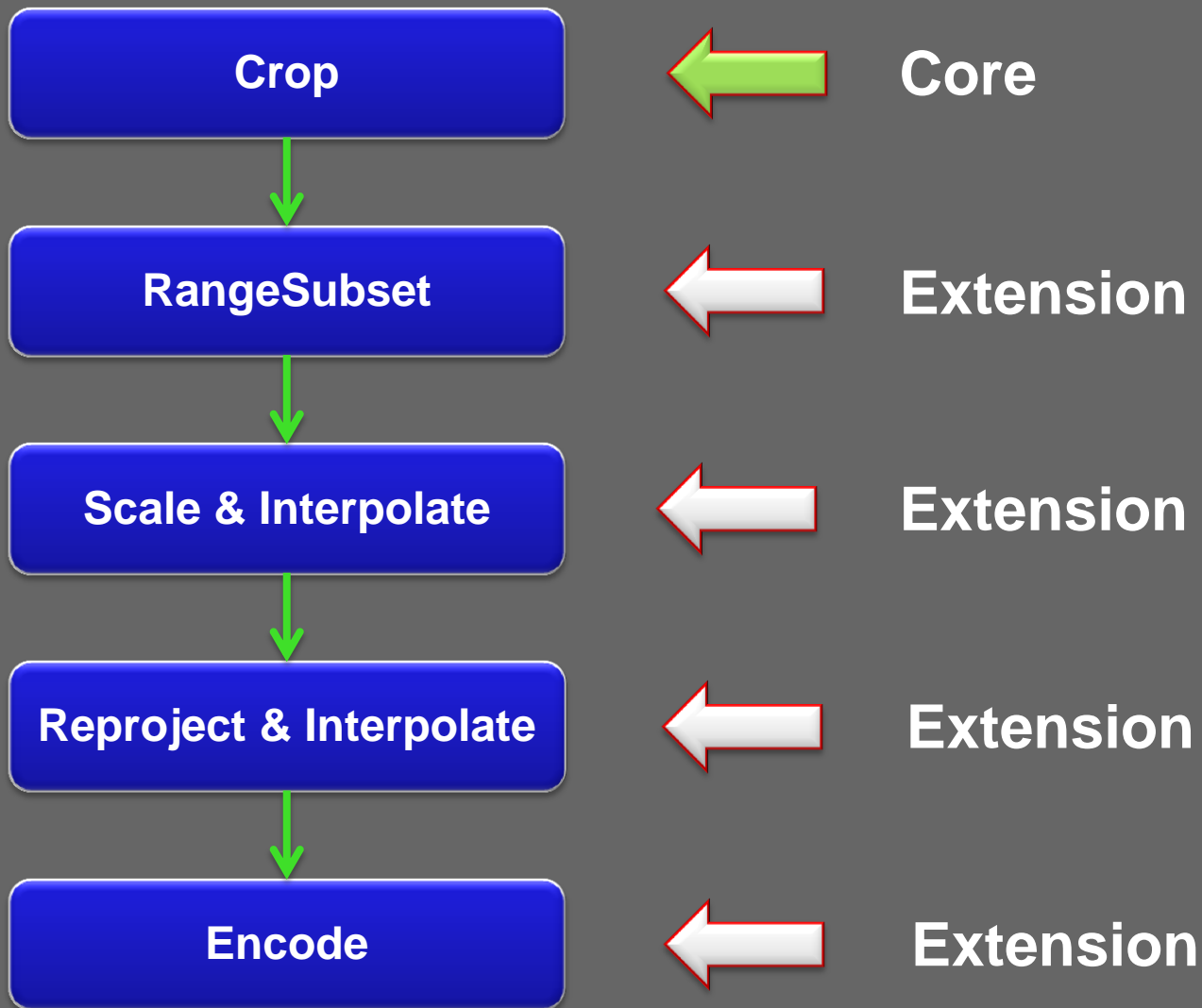


WCS 2.0

- **Build the basics**
 - Core service
 - KVP binding
 - XML binding
- **Implement the GetCoverage extensions**
 - CRS
 - Scaling
 - Interpolation
 - Range subsetting
 - GeoTiff
 - GML
 - NetCDF
- **Add the output format extensions**
 - GeoTIFF
 - GML Grid
 - NetCDF

WCS 2.0

- Processing Chain



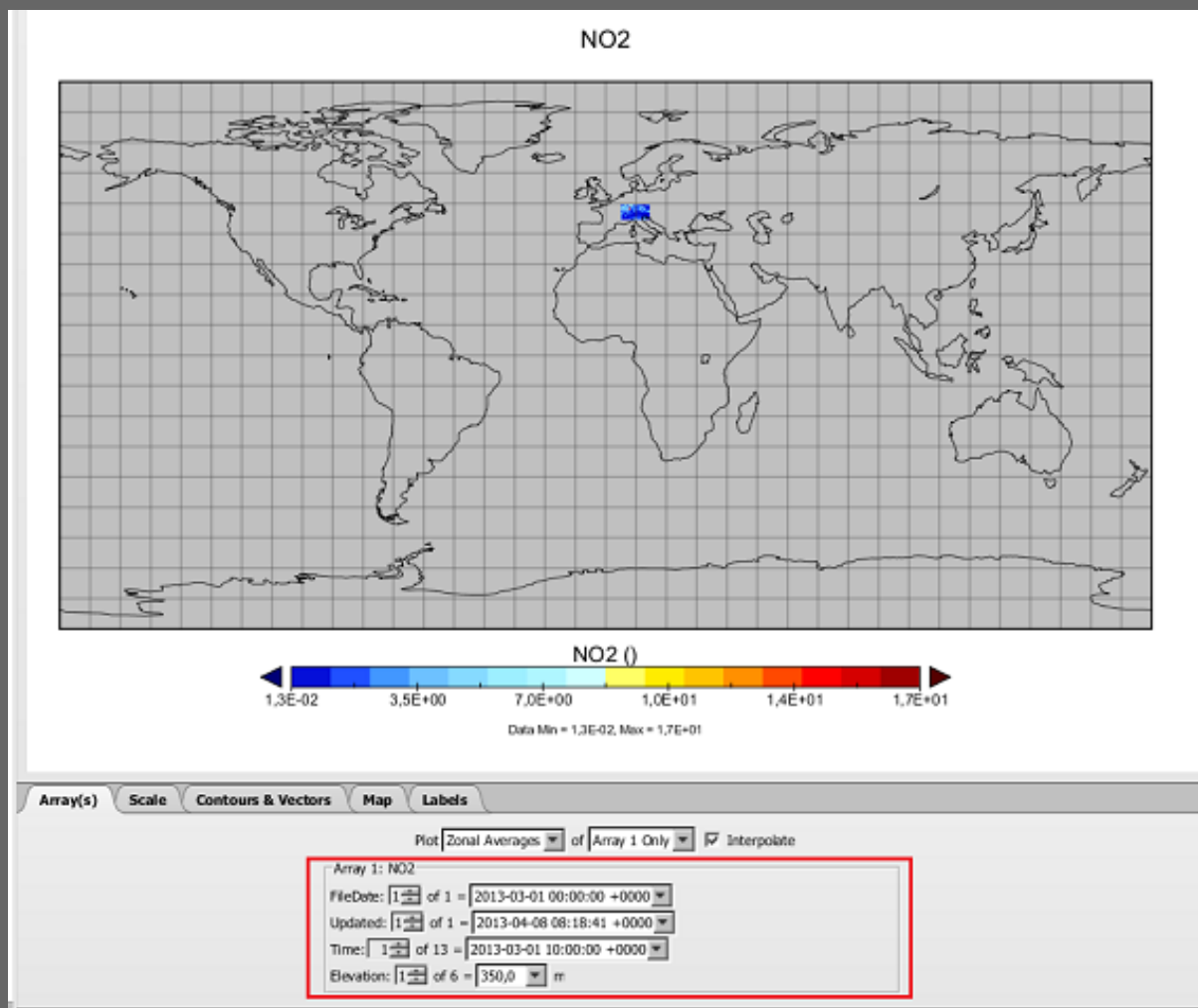
WCS 2.0

- NetCDF Output

```
http://localhost:8080/geoserver/wcs?request=GetCoverage&service=WCS&version=2.0.1&coverageId=geosolutions__NO2&Format=NetCDF&subset=http://www.opengis.net/def/axis/OGC/0/Long(5,20)&subset=http://www.opengis.net/def/axis/OGC/0/Lat(40,50)&subset=http://www.opengis.net/def/axis/OGC/0/elevation(300,1250)&subset=http://www.opengis.net/def/axis/OGC/0/time("2013-03-01T10:00:00.000Z","2013-03-01T22:00:00.000Z")
```

WCS 2.0

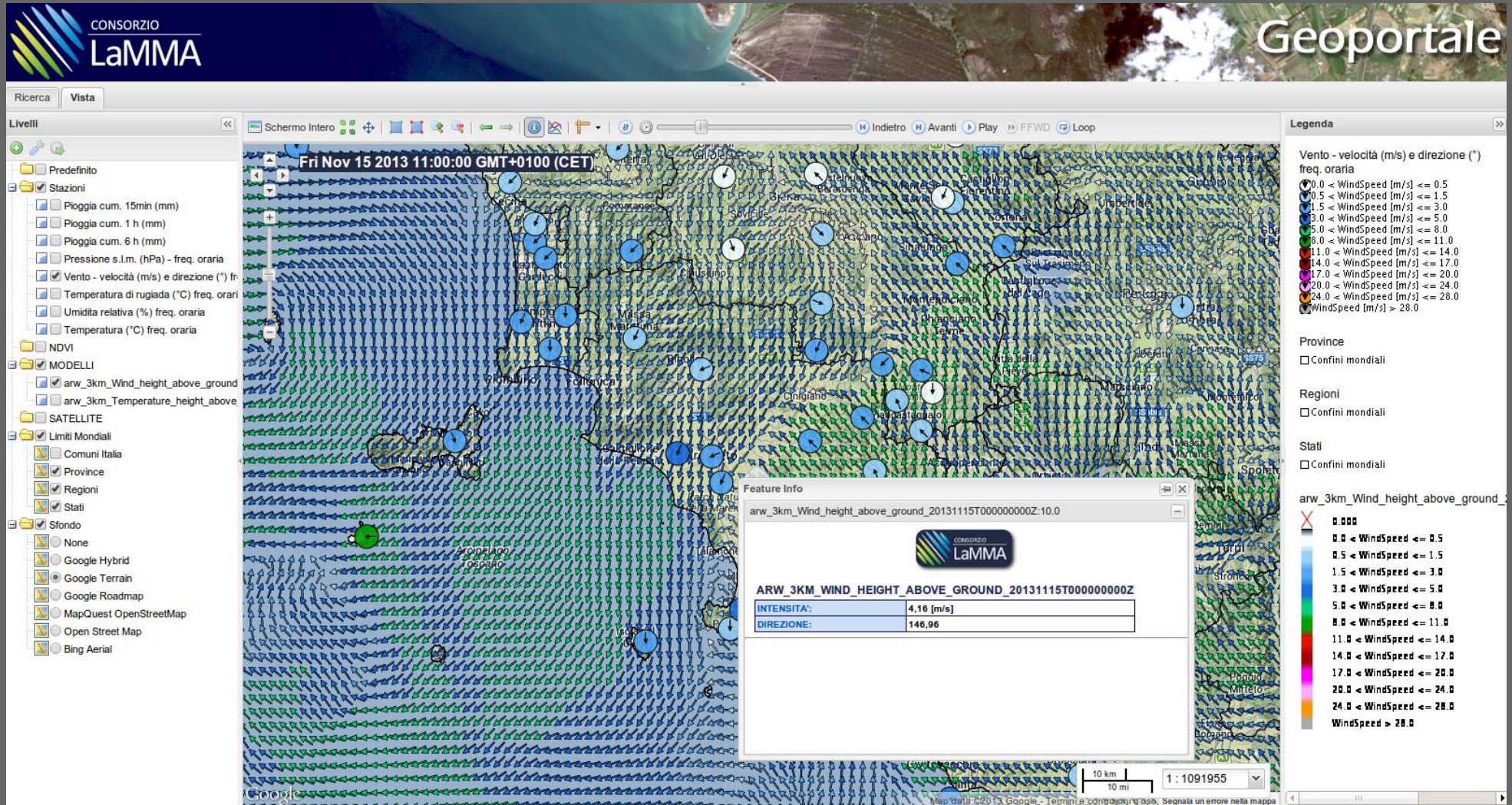
- NetCDF Output



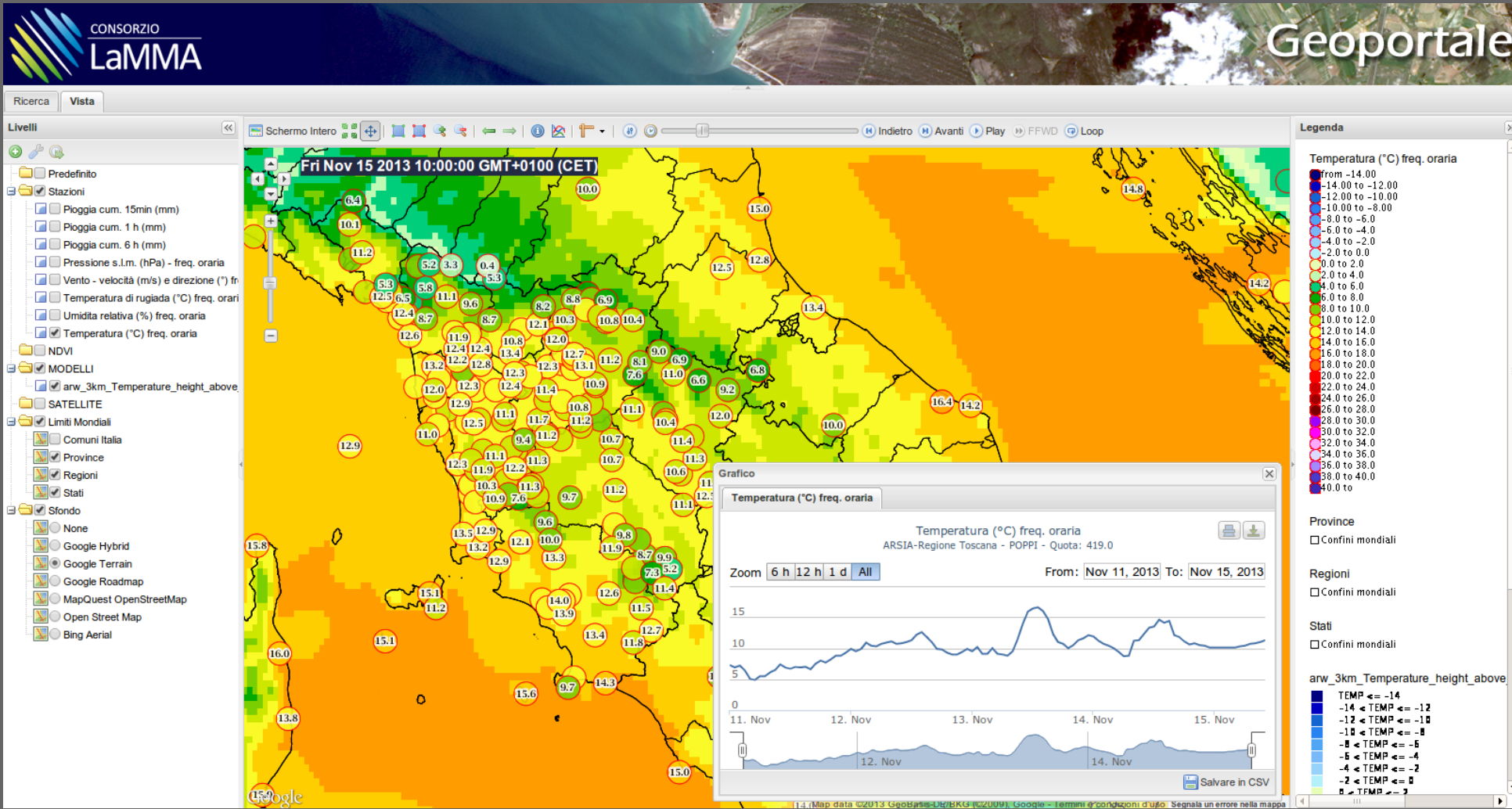
Use Cases



LaMMA GeoPortal



LaMMA GeoPortal



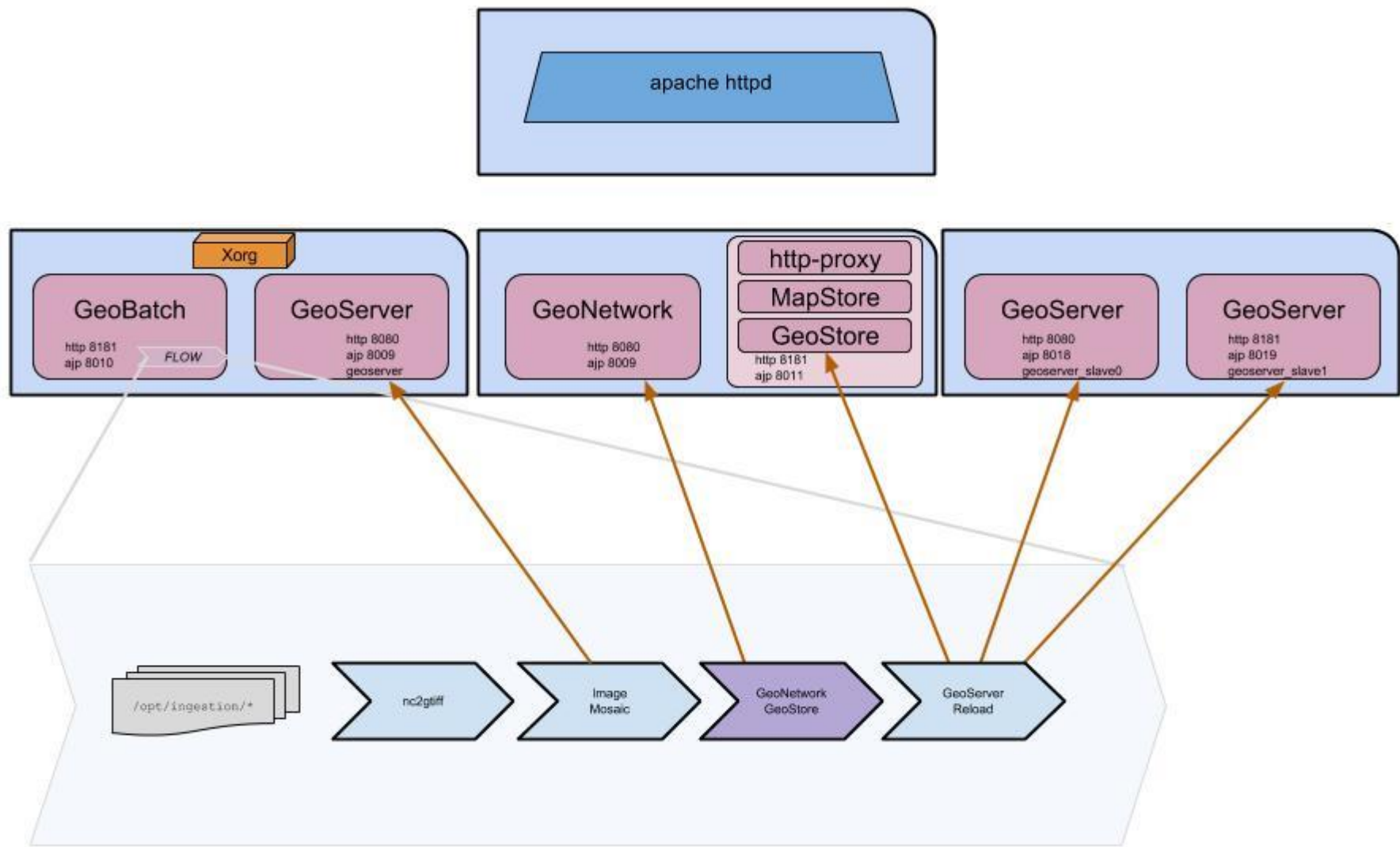
GeoBatch – LAMMA

- Ingestion and preprocessing of
 - 3 Meteorological model 2 times a day (00 & 12 UTC)
 - WRF-ARW @ 12km over MED with ECMWF initdata
 - WRF-ARW @ 12km over MED with GFS initdata
 - WRF-ARW @ 3km over Italy with ECMWF initdata
 - MeteoSat 2nd and 3rd generation data every 15 minutes
 - Radar data every 5 minutes
- Meteorological model
 - Acquire via FTP after each run
 - Transcode from Grib1 to a series of GeoTiff
 - Mosaic with support for time
 - Publish in GeoServer
 - Prepare metadata and register in GeoNetwork

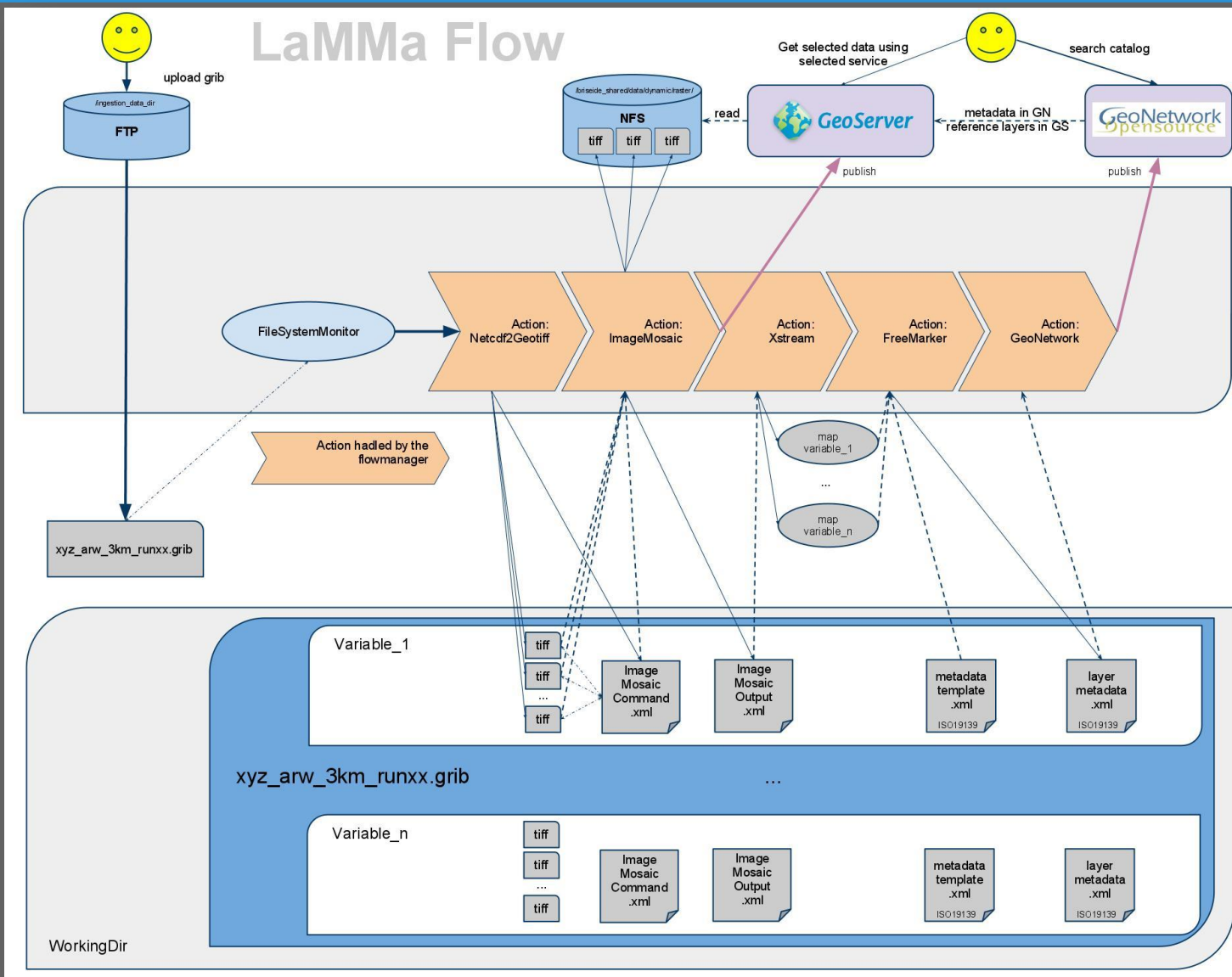
GeoBatch – LAMMA

- Operational Use
- Integrated Visualisation Tool for Obs and Models
- Data visual direct Query
- Everything in real-time!

GeoBatch – LAMMA



GeoBatch – LAMMA

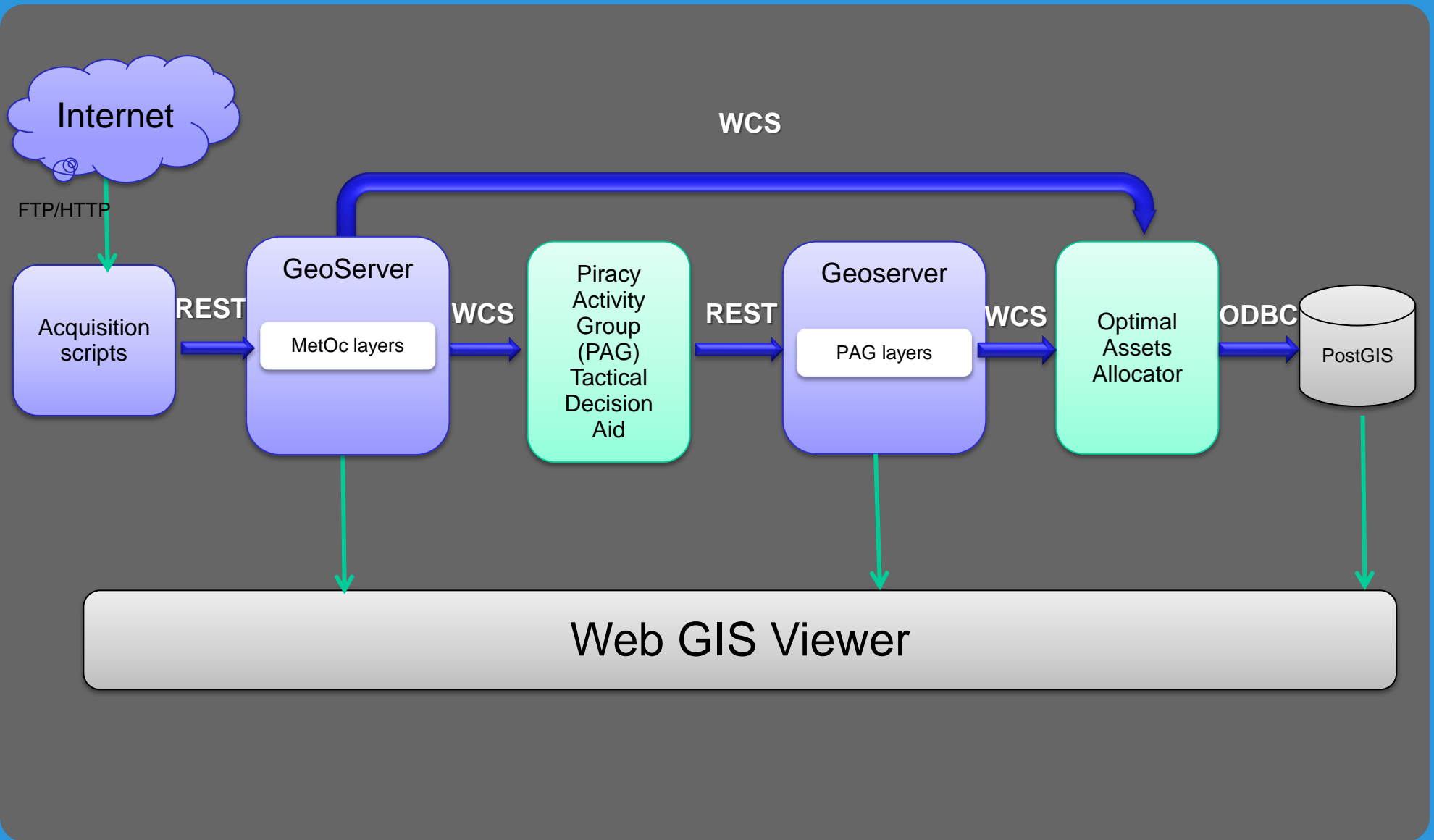


NATO STO CMRE EKOE DUOE (*)

- NATO STO CMRE employs Geoserver to store MetOc and Tactical Decision Aids layers
- All layers are rendered with OpenLayers in the CMRE Web GIS Viewer
- Layers have **Time Dimension** and an **extra custom dimension** to handle the model's "forecast time"
- **Data ingestions** and **dimensions definitions** are performed via Geoserver **REST** interface, scheduled on regular basis
- **Dynamic Colormap** is used to dynamically render Coverage layers: for each image the color map is generated between image min and max

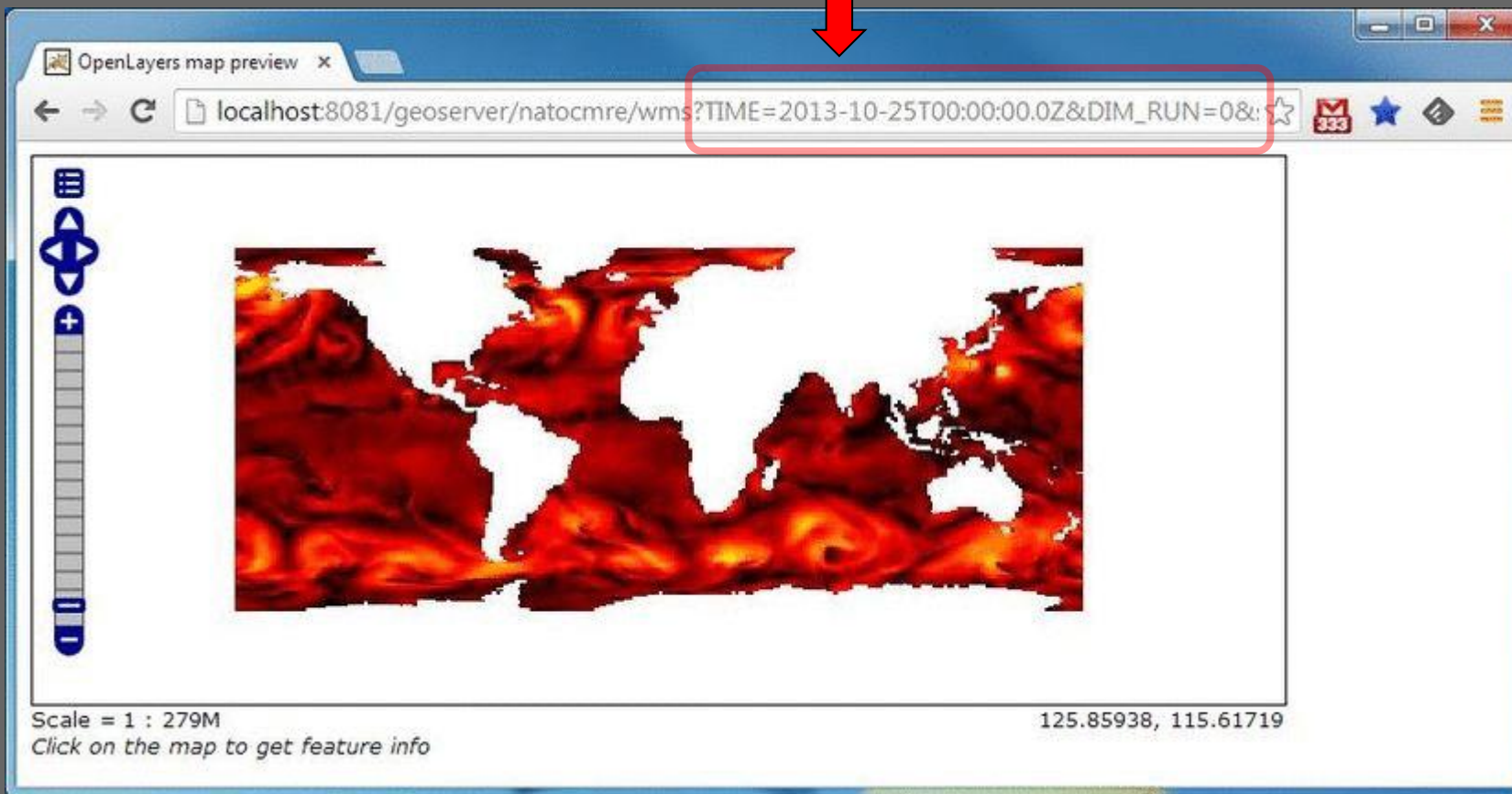
(*) Environmental Knowledge and Operational Effectiveness (EKOE) - Decisions in Uncertain Ocean Environments (DUOE)

NATO STO CMRE EKOE DUOE



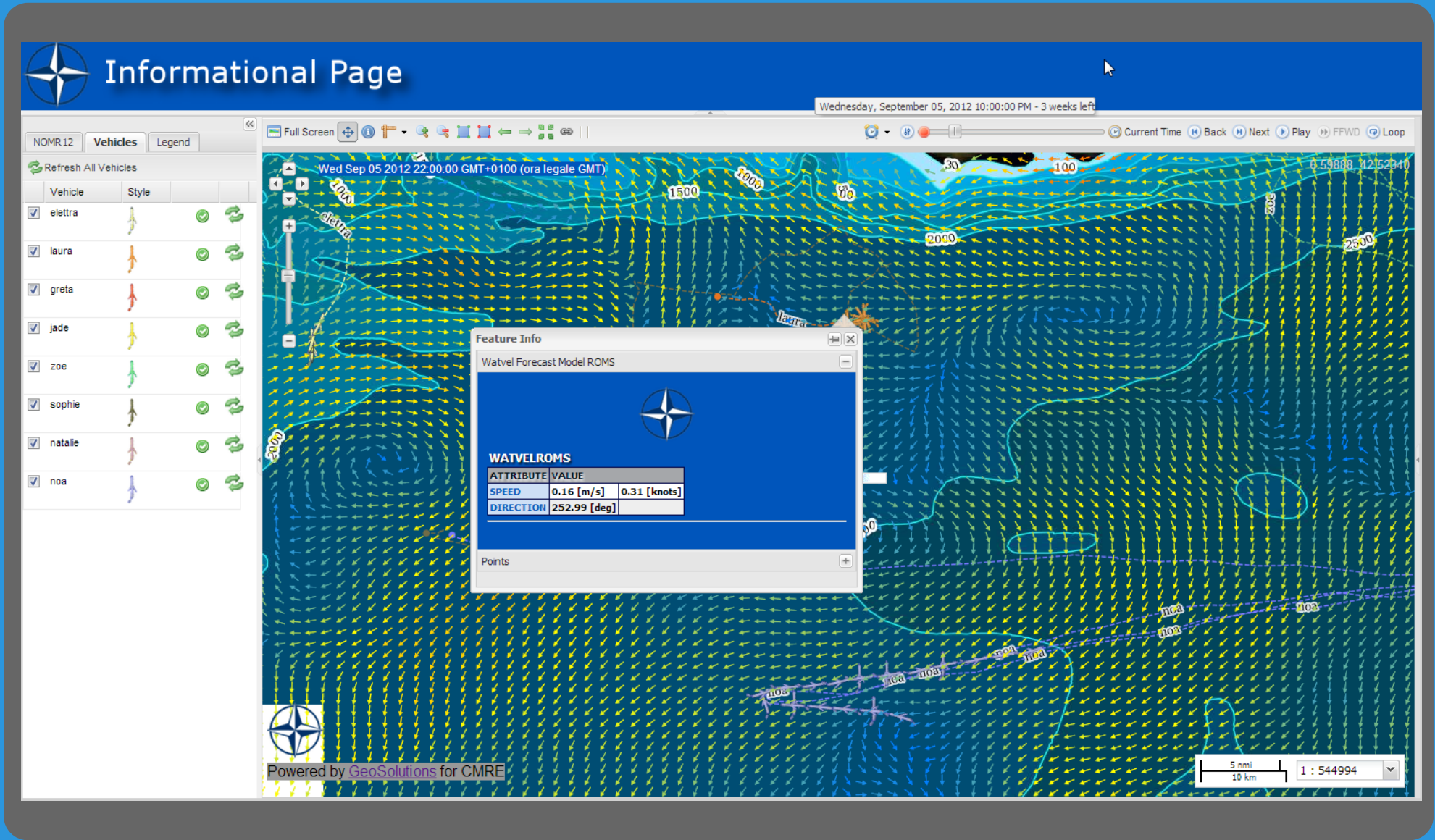
NATO STO CMRE EKOE DUOE

- NOAA WW3 Wind Speed, global coverage
- Time dimension and custom “Run” dimension (DIM_RUN)





NATO CMRE Gliders Portal



Use Case – NATO CMRE

- Gliders Observations (in-situ)
- ROMS Model (*sea surface currents*)
- NETTUNO Model (*sea surface currents*)
- *Everything in real-time!*

Use Case – FAO - GAEZ

Food and Agriculture Organization of the United Nations - for a world without hunger

GAEZ Global Agro-Ecological Zones

International Institute for Applied Systems Analysis
www.iiasa.ac.at

Register Login Feedback

Search enter search here...

Showing 1 - 6 of 6 results for "Crop production value (GK\$)"

Sort by

1. **Actual Yield and Production**
> Crop production value (GK\$)
>> Total crop production value

Crop : All Crops
Water Supply : Not Applicable
Input Level : Not Applicable
Time : 2000
Scenario : Not Applicable
CO2 Fertilization : Not Applicable

2. **Actual Yield and Production**
Crop : Cereals

3. **Actual Yield and Production**
> Crop production value (GK\$)
>> Total crop production value per hectare

Map Info
Crop : All Crops
Water Supply : Not Applicable
Input Level : Not Applicable
Time : 2000
Scenario : Not Applicable
CO2 Fertilization : Not Applicable
Variable : Yield

GK\$/ha

0 2000

Map Table Custom

Total crop production value per hectare
Actual Yield and Production
GK\$/ha: 2.50
Lat: 50.63, Lon: 4.41
Country: Belgium
Thermal Climates: Temperate, oceanic
Thermal Zones: Temperate, cool
Length of Growing Period: 240-268 days
Dominant Land Cover Pattern: Land cover associations
Dominant Soil: Podzols
Basins: Scheldt

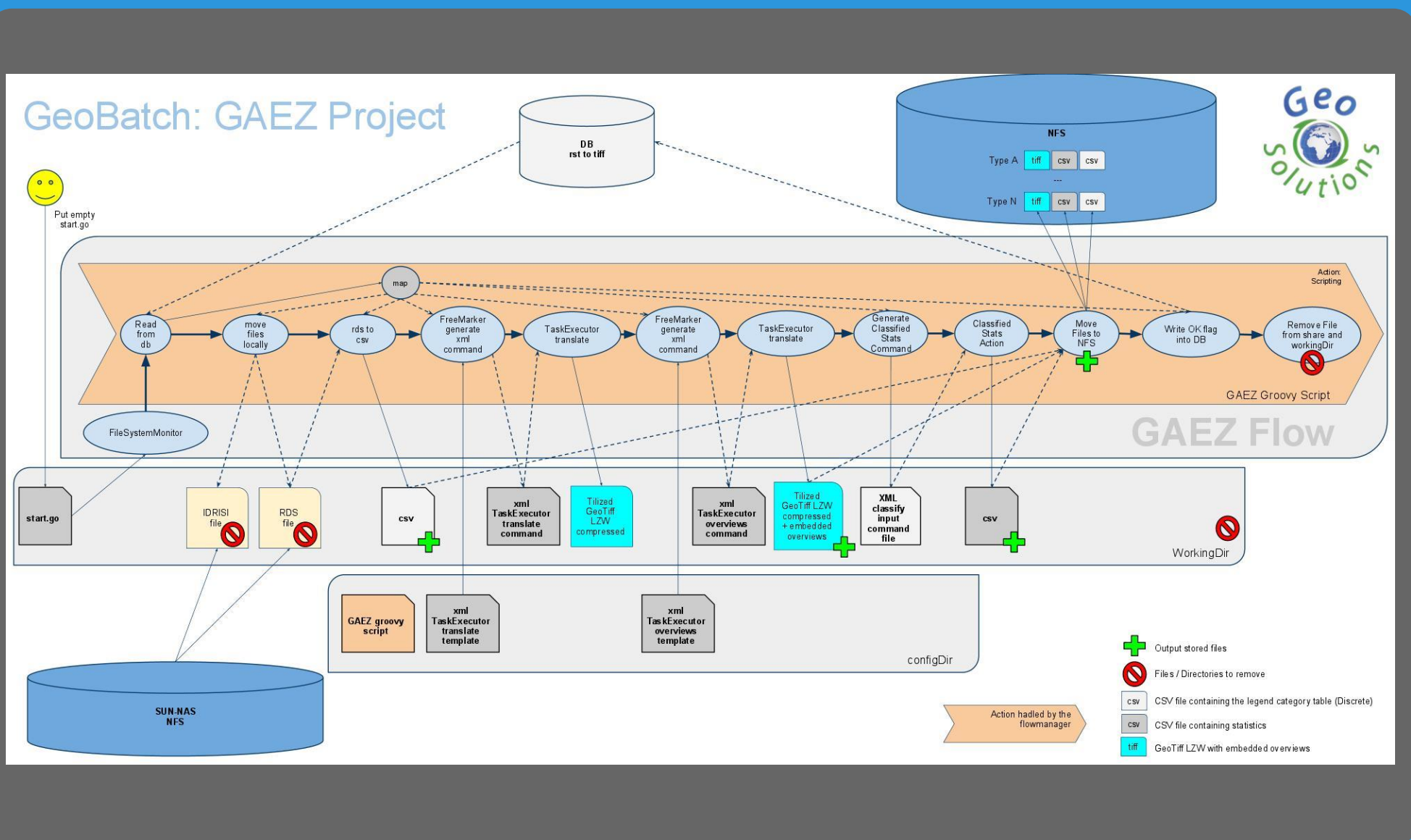
85.43, -52.47

1000 miles
2000 km

Use Case – FAO - GAEZ

- **Multidimensional Mosaic**
- **50 Years of data**
 - **Soil**
 - **Water**
 - **Land Cover**
 - **Protected Areas**
- **A few Mosaic Layer with dimensions rather than 100k layers**
- **Search Engine for on-the-fly filtering of Mosaic Layers**

GeoBatch – FAO Gaez Project



The End

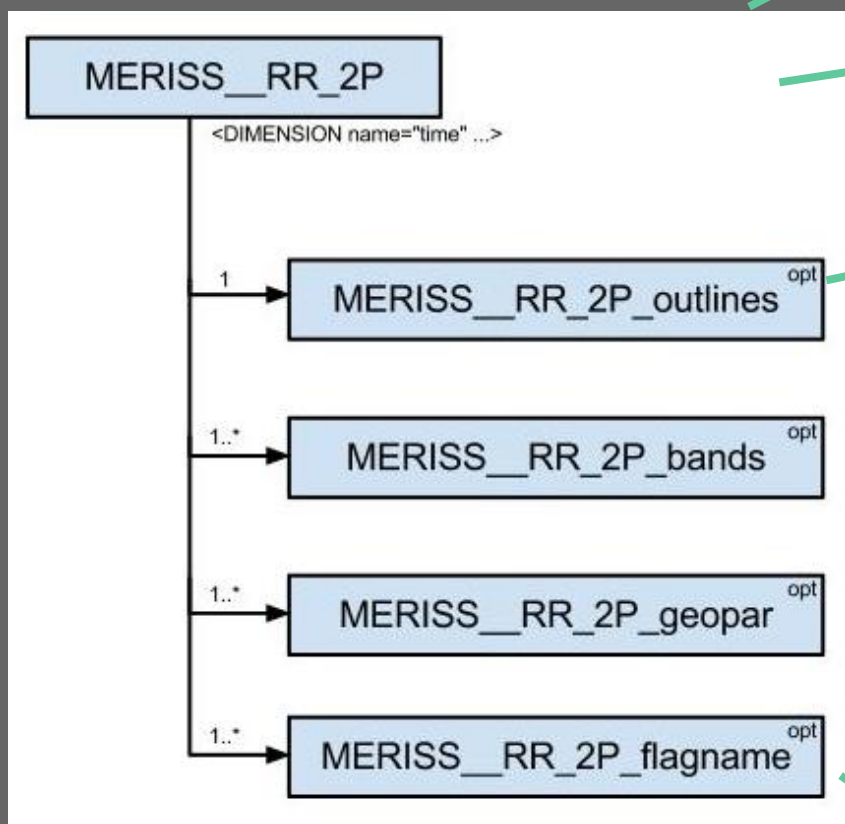


Thank You

simone.giannecchini@geo-solutions.it

WMS-EO

- How this fits in GeoServer's world
- [GSIP 84](#)



Wizard to configure EO layer groups

Extending LayerGroup concept

Support same style on both raster and vector data

Support custom dimensions

Alter map on the fly to support band combination

WMS-EO

- **WMS-EO Quirks**
 - **Root layer must respond with a specific layer rather than the composition of the children**
 - Kind of a *default* visualization for a certain Dataset
 - E.g. when I send a GetMap for the root layer I could get back the *browse image* default layer
 - **Same styles for both Raster as well as Vector data**
 - E.g. *yellow* can be use for both flags as well as outlines
 - **Peculiar behavior for Band layer (raw data)**
 - E.g. multiple bands at different wavelengths
 - Can request either 1 (grayscale image) or 3 (RGB image)
 - Different combinations are prohibited
 - **Peculiar Behavior for GetFeatureInfo**

WMS-EO

- **Extending the LayerGroup GeoServer concept**
 - Show the nested layers in the capabilities document
 - Allow the root of the group to be represented by a separate layer (the overview one)
 - The above is a set of API, GUI and REST config changes, so a GeoServer proposal is needed
- **Add the notion of custom dimensions in raster data**
 - Needed to support the “eoproduct_bands” layer
 - Modify the GeoServer API to support custom dimensions (was almost ready in this respect)
 - Modify the grid coverage readers API to allow new dimensions to be exposed
 - Allow “dynamic” dimensions to be exposed (dimensions that are configured by the user)
 - Adapt the GUI to allow new dimensions to be configured

WMS-EO

The screenshot shows the 'EO Layer Groups' management page in GeoServer. The page title is 'EO Layer Groups' and the subtitle is 'Define and manage Earth Observation layer groupings'. There are two main actions: 'Add new EO layer group' (indicated by a green plus icon) and 'Remove selected EO layer group(s)' (indicated by a red minus icon). Below these actions are two sets of navigation buttons (left, right, first, last) and the text 'Results 0 to 0 (out of 0 items)'. A table header for 'EO Layer Group' is visible, but no data is present. On the left sidebar, there are sections for 'About & Status' (Server Status, GeoServer Logs, Contact Information, About GeoServer) and 'Data' (Layer Preview, Workspaces, Stores, Layers, Layer Groups, EO Layer Groups, Styles).

The screenshot shows the 'New EO Layer Group' form in GeoServer. The page title is 'New EO Layer Group' and the subtitle is 'Add a new EO Layer Group'. The form has several fields: 'Name' (containing 'msg2'), 'Title' (containing 'msg2'), and 'Abstract' (a large text area). Below these is a 'Workspace' dropdown menu set to 'geosolutions'. There are sections for 'Bounds' (with input fields for Min X, Min Y, Max X, Max Y) and 'Coordinate Reference System' (with a 'Find...' button). A 'Generate Bounds' button is located below the CRS field. At the bottom, there are two options for adding layers: 'Add layers from a new image mosaic' and 'Add layers from an existing coverage store'. On the left sidebar, there are sections for 'About & Status', 'Data', 'Services' (WCS, WFS, WMS, WPS), 'Settings' (Global, JAI, Coverage Access), 'Tile Caching' (Tile Layers, Caching Defaults, Gridsets, Disk Quota), and 'Security' (Settings, Authentication, Passwords, Users, Groups, Roles, Data, Services).

The screenshot shows the 'Add coverages into EO layer group' page in GeoServer. The page title is 'Add coverages into EO layer group' and the subtitle is 'Select time based coverages from an existing store, and have GeoServer create the layers and add them to the layer group for you'. There is a 'Select source store' section. Below it, there is a 'Coverages to be added to layer group' section with navigation buttons and the text 'Results 0 to 0 (out of 0 items)'. A 'Search' button is located to the right. A table header for 'Coverage' and 'Layer type' is visible. One row is shown with 'MSG2_Channels' in the 'Coverage' column and a dropdown menu for 'Layer type' set to 'Geophysical parameter'. The dropdown menu options are: 'Geophysical parameter', 'Ignore layer', 'Browse image', 'Bands', 'Geophysical parameter', and 'Bitmask'. At the bottom, there are 'Add to Group' and 'Cancel' buttons.

WMS-EO

- geosolutions:wind2 wind2 OpenLayers KML
- geosolutions:MSG2_MSG2_Channels MSG2_MSG2_Channels OpenLayers KML
- geosolutions:MSG2_MSG2_Airmass MSG2_MSG2_Airmass OpenLayers KML
- geosolutions:MSG2_MSG2_FlagA MSG2_MSG2_FlagA OpenLayers KML
- geosolutions:MSG2_browse MSG2_MSG2_NatColours OpenLayers KML

geosolutions:MSG2

Workspace

Bounds

Min X	Min Y	Max X	Max Y
-22	-2	60	65

Coordinate Reference System
 EPSG:WGS 84...

Layers

- Add layers from a new image mosaic
- Add layers from an existing coverage store
- Select existing layer of type

Select a mosaic in the group and create a outlines layer from it:

Position	Source layer	Layer name in group	Type	Style	Remove
↓	geosolutions:MSG2_MSG2_Channels	MSG2_Channels	Geophysical parameter	raster	⊖
↑ ↓	geosolutions:MSG2_MSG2_Airmass	MSG2_Airmass	Geophysical parameter	raster	⊖
↑ ↓	geosolutions:MSG2_MSG2_FlagA	MSG2_FlagA	Bitmask	red	⊖
↑	geosolutions:MSG2_browse	browse	Browse image	raster	⊖

<< < | > >> Results 1 to 13 (out of 13 iter

Scale = 1 : 127M 50.39063, 38.57422
 Click on the map to get feature info

WMS-EO

```
</EX_GeographicBoundingBox>
<BoundingBox CRS="CRS:84" minx="-105.70013888888889" miny="-2.0" maxx="60.0" maxy="65.0"/>
▼<Layer queryable="1">
  <Name>geosolutions:MSG2</Name>
  <Title>geosolutions:MSG2</Title>
  <Abstract>Layer-Group type layer: geosolutions:MSG2</Abstract>
  <CRS>EPSG:4326</CRS>
  ▶<EX_GeographicBoundingBox>...</EX_GeographicBoundingBox>
  <BoundingBox CRS="EPSG:4326" minx="-2.0" miny="-22.0" maxx="65.0" maxy="60.0"/>
  ▶<Dimension name="time" default="current" units="ISO8601">...</Dimension>
  ▼<Layer queryable="1">
    <Name>geosolutions:MSG2_MSG2_Channels</Name>
    <Title>MSG2_MSG2_Channels</Title>
    <Abstract/>
    ▶<KeywordList>...</KeywordList>
    <CRS>EPSG:4326</CRS>
    <CRS>CRS:84</CRS>
    ▶<EX_GeographicBoundingBox>...</EX_GeographicBoundingBox>
    <BoundingBox CRS="CRS:84" minx="-22.0" miny="-2.0" maxx="60.0" maxy="65.0"/>
    <BoundingBox CRS="EPSG:4326" minx="-2.0" miny="-22.0" maxx="65.0" maxy="60.0"/>
    ▶<Dimension name="time" default="current" units="ISO8601">...</Dimension>
    <Dimension name="CHANNEL" default="01" units="">01,02,11</Dimension>
    ▶<Style>...</Style>
  </Layer>
  ▼<Layer queryable="1">
    <Name>geosolutions:MSG2_MSG2_Airmass</Name>
    <Title>MSG2_MSG2_Airmass</Title>
    <Abstract/>
    ▶<KeywordList>...</KeywordList>
    <CRS>EPSG:4326</CRS>
    <CRS>CRS:84</CRS>
    ▶<EX_GeographicBoundingBox>...</EX_GeographicBoundingBox>
    <BoundingBox CRS="CRS:84" minx="-22.0" miny="-2.0" maxx="60.0" maxy="65.0"/>
    <BoundingBox CRS="EPSG:4326" minx="-2.0" miny="-22.0" maxx="65.0" maxy="60.0"/>
    ▶<Dimension name="time" default="current" units="ISO8601">...</Dimension>
    ▶<Style>...</Style>
  </Layer>
  ▼<Layer queryable="1">
    <Name>geosolutions:MSG2_MSG2_FlagA</Name>
    <Title>MSG2_MSG2_FlagA</Title>
    <Abstract/>
    ▶<KeywordList>...</KeywordList>
    <CRS>EPSG:4326</CRS>
    <CRS>CRS:84</CRS>
    ▶<EX_GeographicBoundingBox>...</EX_GeographicBoundingBox>
    <BoundingBox CRS="CRS:84" minx="-22.0" miny="-2.0" maxx="60.0" maxy="65.0"/>
    <BoundingBox CRS="EPSG:4326" minx="-2.0" miny="-22.0" maxx="65.0" maxy="60.0"/>
    ▶<Dimension name="time" default="current" units="ISO8601">...</Dimension>
    ▶<Style>...</Style>
  </Layer>
</Layer>
```

WCS-EO

- **Build on top of a working WCS 2.0 with full extensions**
 - WCS 2.0
 - CRS extension
 - Range subsetting extension
 - Interpolation extension
 - Scaling extension
 - GeoTiff extension
 - NetCDF extension
- **Add support for the WCS-EO extras**
 - Listing coverage datasets in the capabilities documents (based on image mosaic contents, which will have to be marked as “exposed” so that we show their inner structure for EO)
 - Support describe coverage dataset
 - Support returning results for an entire dataset in GetCoverage

WCS-EO

- **Add support for downloading the original file in case of no subsetting/reprojection/scaling/format change**
 - Add support to GeoTools readers to signal they are returning us an original file
 - Use that information to download the original file directly
- **Add support for WCS EO metadata in readers**
 - Associate each file with EO metadata
 - Include such information in DescribeCoverage/DescribeEODataset