



FOSS4G 2010 *Barcelona*

ENVIMODEL

scientific workflow and geoprocessing for climate change



FBK-MPBA

**Predictive Models for Biomedicine
and Environment**

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Presentation Roadmap

ENVIRO

Concept and architecture

EnviDB

The spatial temporal database

EnviMapper

To map vulnerability to climate change

EnviModel

A framework to integrate and share data, analysis tools and models

Outlook

Results summary and future tasks

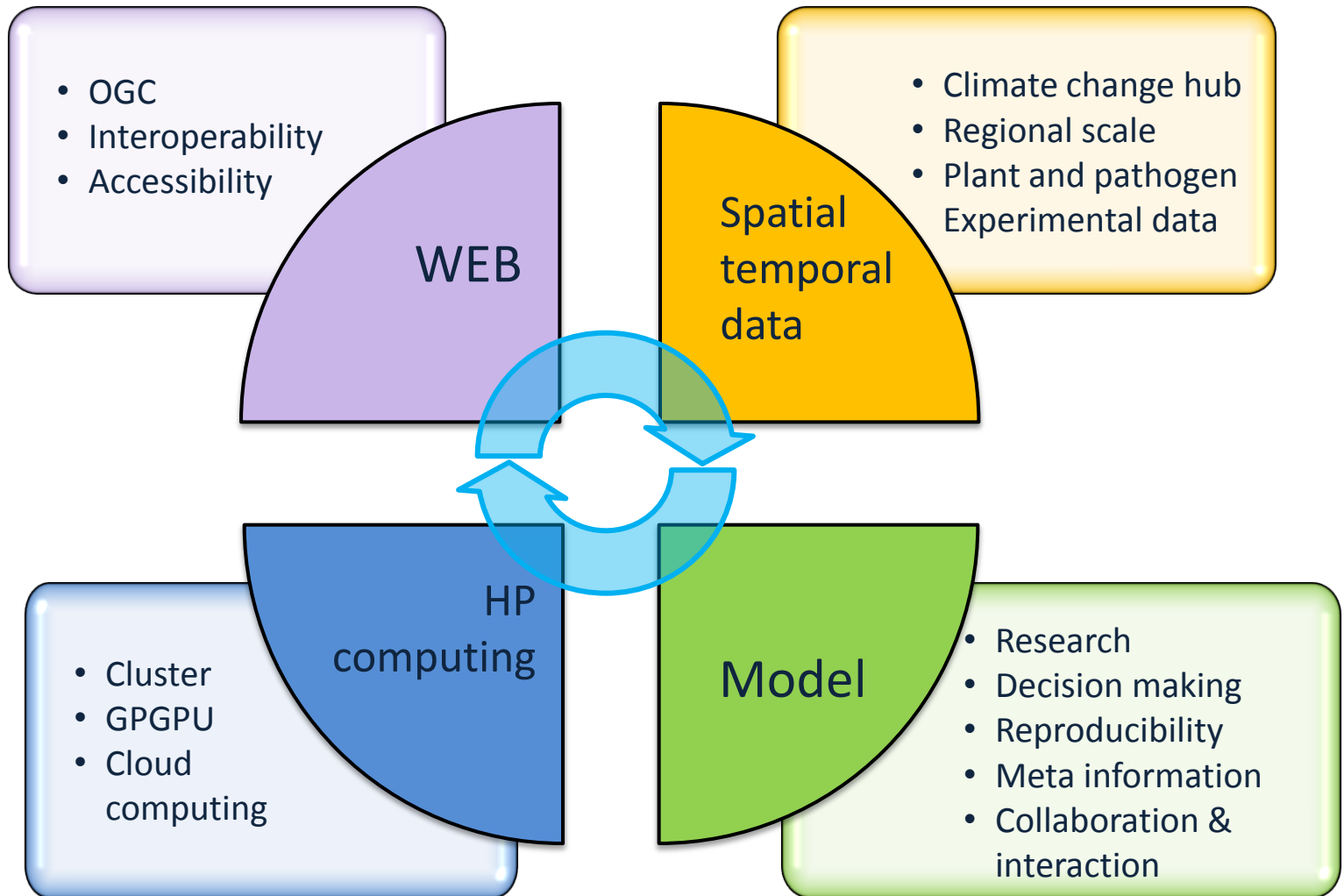
Demo

A quick tour (Sept 2010)

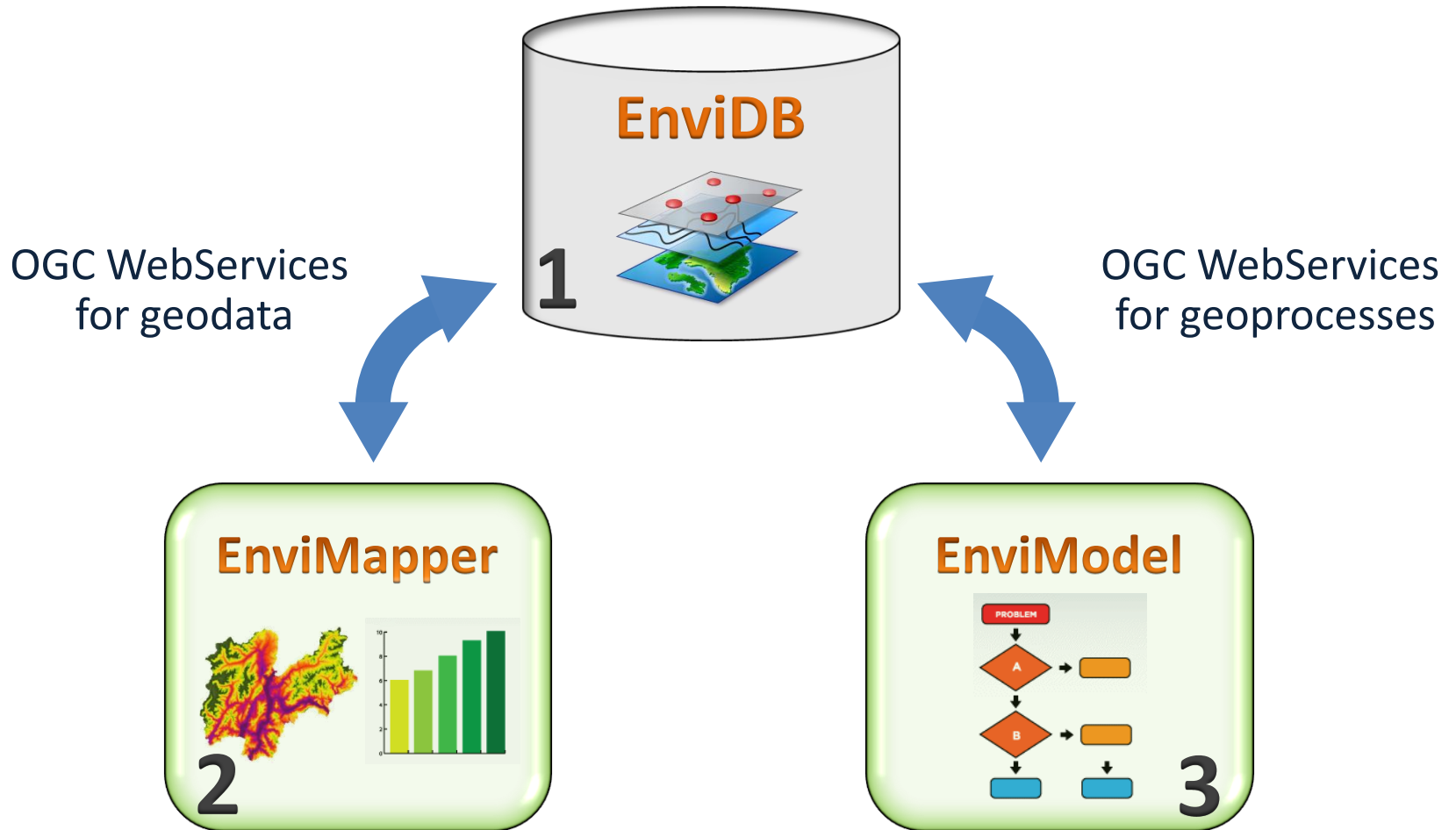
ENVIRO concept

- New-generation WebGIS that interfaces **agricultural plant-pathogen research models** with rich catalogues of **geographical resources** and **experimental data**
- Both viable for research and decision-making, with a strong support of **reproducibility**
- Structure: hub platform for **climate change** and **environmental risk studies**

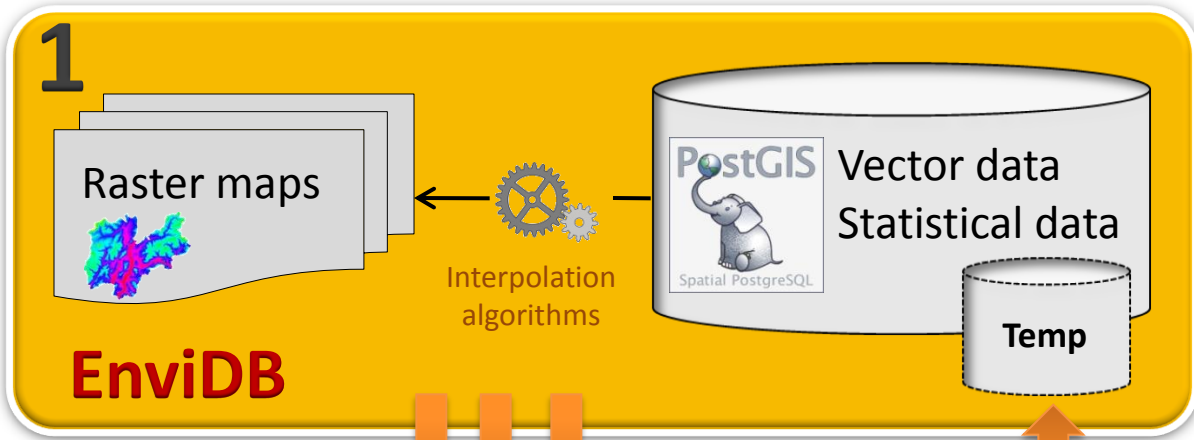
ENVIRO concept



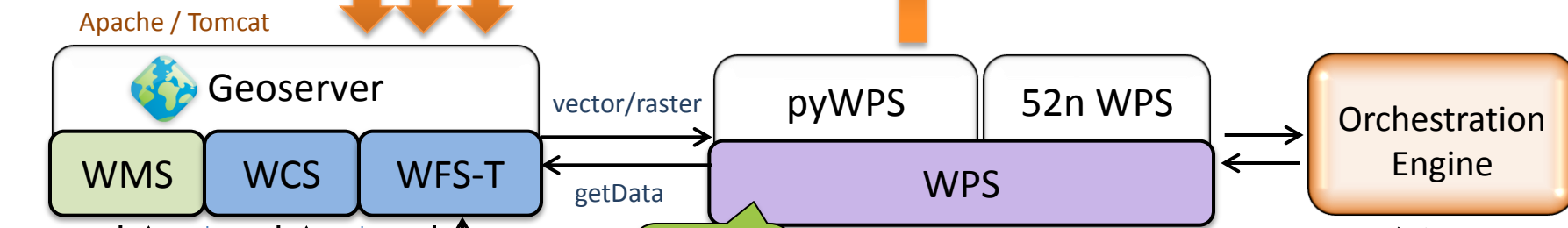
ENVIRO essentials



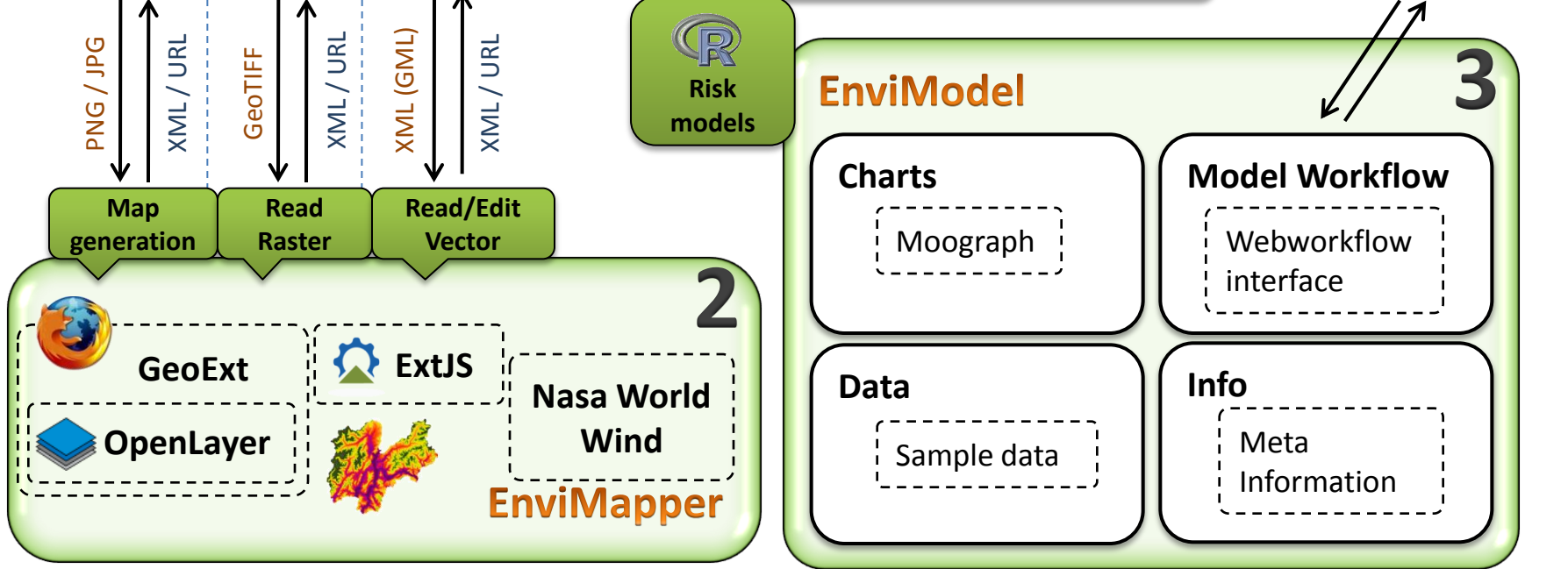
ST-DataBase



Application server



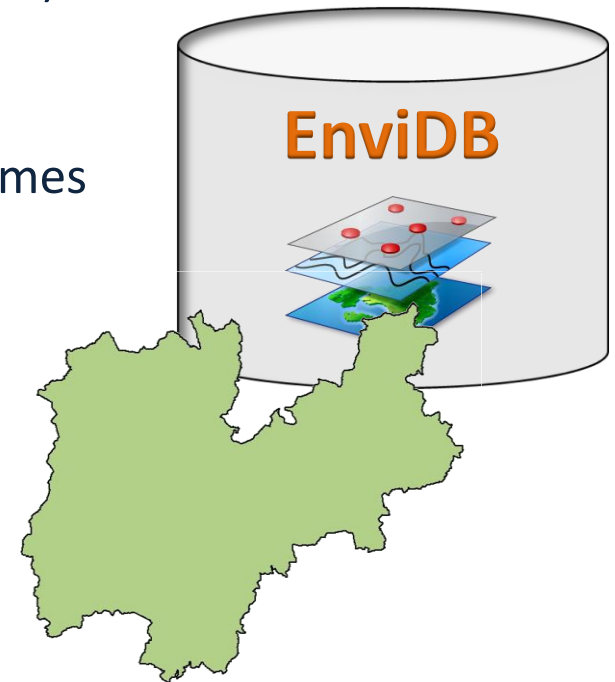
User Interface



1. EnviDB

More than 1,5 TB spatial temporal data

- Meteotrentino 600 GB, future climate projections 300 GB
- **Context map**
 - Aerial photo, hillshade, Open Street Map (OSM)
- **Static spatial data**
 - Cadastral vineyards, municipalities, places names
- **Variable spatial data**
 - Climate data, plants and pathogens models



Data (year 2)

Agricultural data

– Cadastral vineyards: “potenziale viticolo”

Catasto

1.621.280 parcels

**Potenziale
viticolo**

Catasto Viticolo

46.781 parcels

- Number of tree stumps
- Irrigation
- Cultivation form
- Plan spacing
- Variety
-

Catasto viticolo



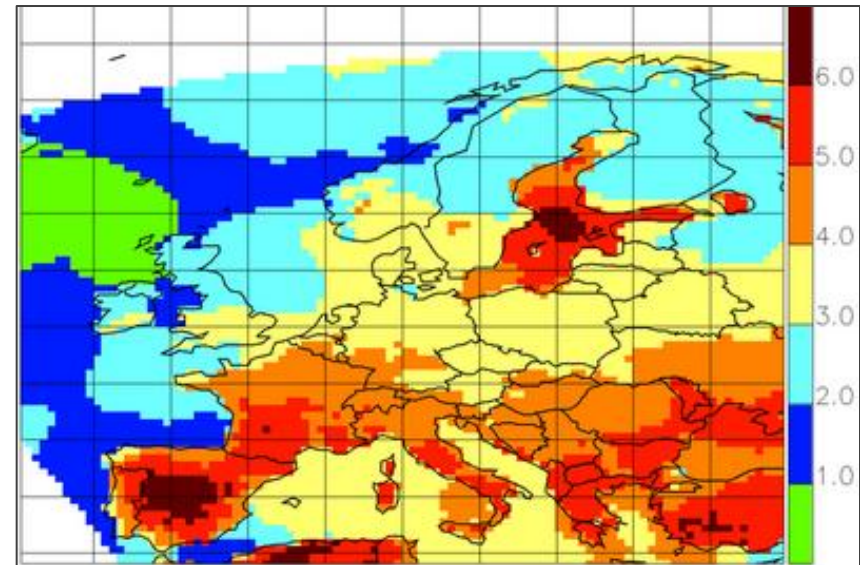
ENVIROCHANGE

ENVIROCHANGE

Data/2

Climate data

- Continuous surface for T, P (daily and hourly) 2001-2008
- Prudence
 - 12km spatial resolution
 - Daily t min, t max, prec
 - control 1980-1990
 - Scenarios: **2071-2100**

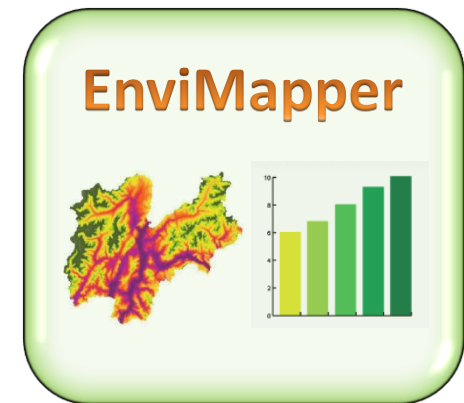


(Prudence project 2010, <http://prudence.dmi.dk/>)

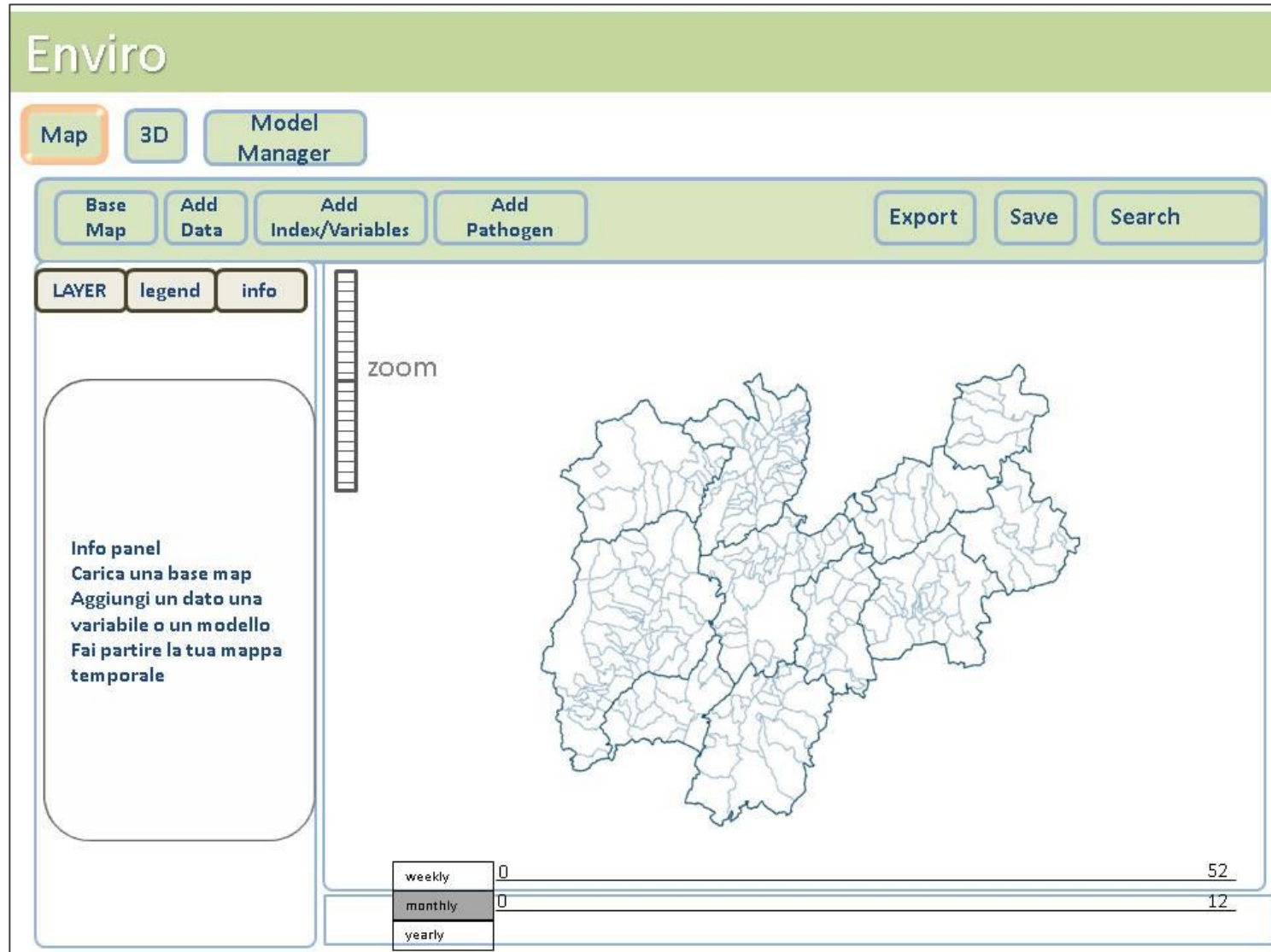
2.enviMapper

Map vulnerability to climate change at different aggregation scales (time, space)

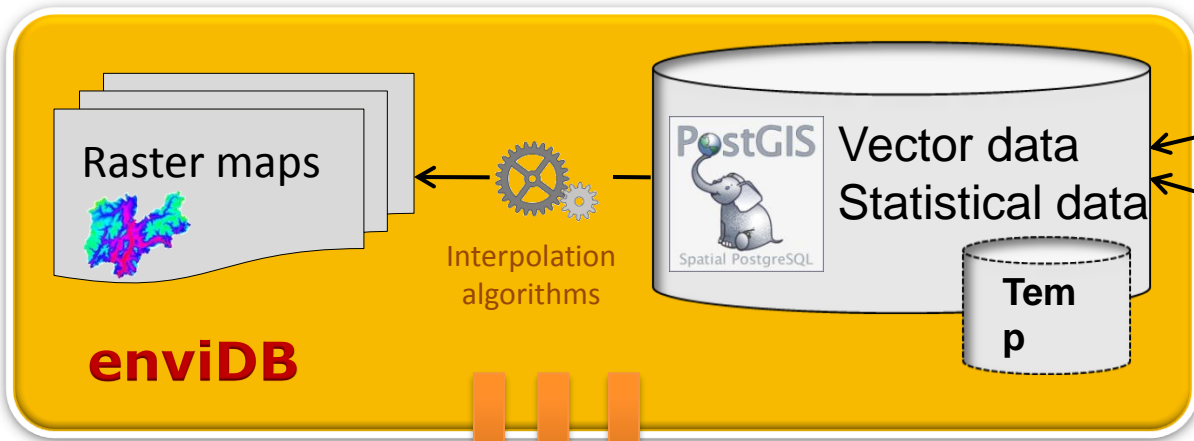
- **Map**: set of tools to interact with spatial temporal data
- **Time slider**: spatial data in multi temporal scale



enviMapper (mockup 2010)



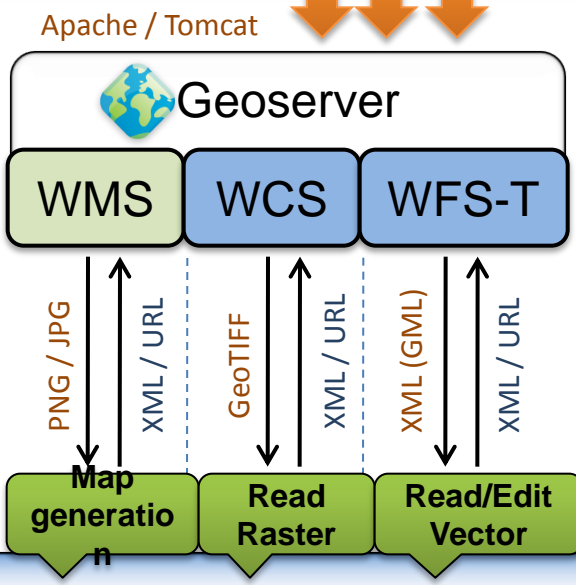
ST-DataBase



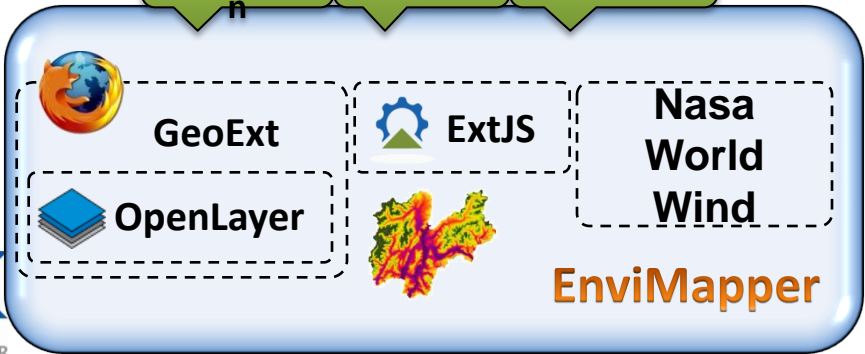
CC scenarios
 Ensambls (regional)
 WORLDCLIM (global)

SOS
 Real time observation

Application server



User Interface



Map

Base Map

Add a context map

Aerial photo, hillshade, Open Street Map OSM, etc.

Add Data

Add a static layer

Wine cadastral, pathogens sampling points, etc.

Add Variables

Add a variable in time

Climate, plant, pathogen, bio index etc.

Info panel

To inform user on layer properties

Layer list, legend, layer metadata

Save map

Save a map to load again or to share

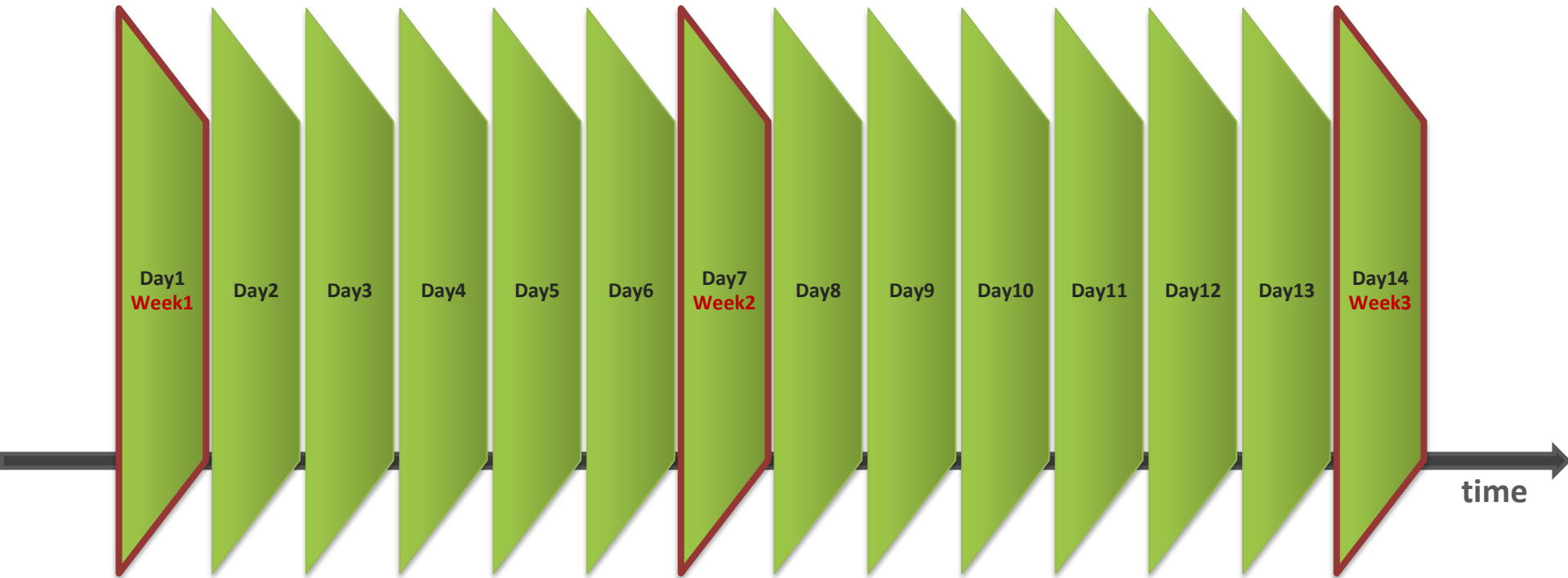
Export map

Export a map different formats

Time Slider

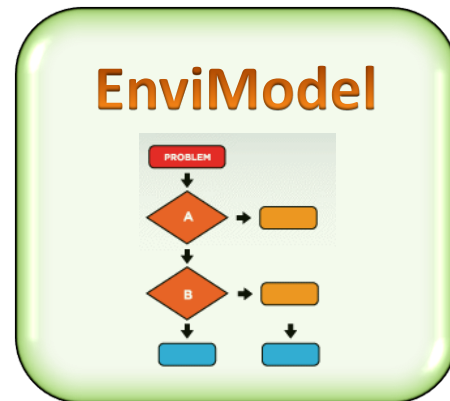
Tool to animate maps in time

- Hourly, daily, weekly, monthly, yearly



3.enviModel

- **Framework** to integrate and share data, analysis tools and models for plant and pathogen behavior and their interaction
 - Collaboration, interaction, reproducibility, **Web application**
- **Scientific workflows**
- **Metadata**

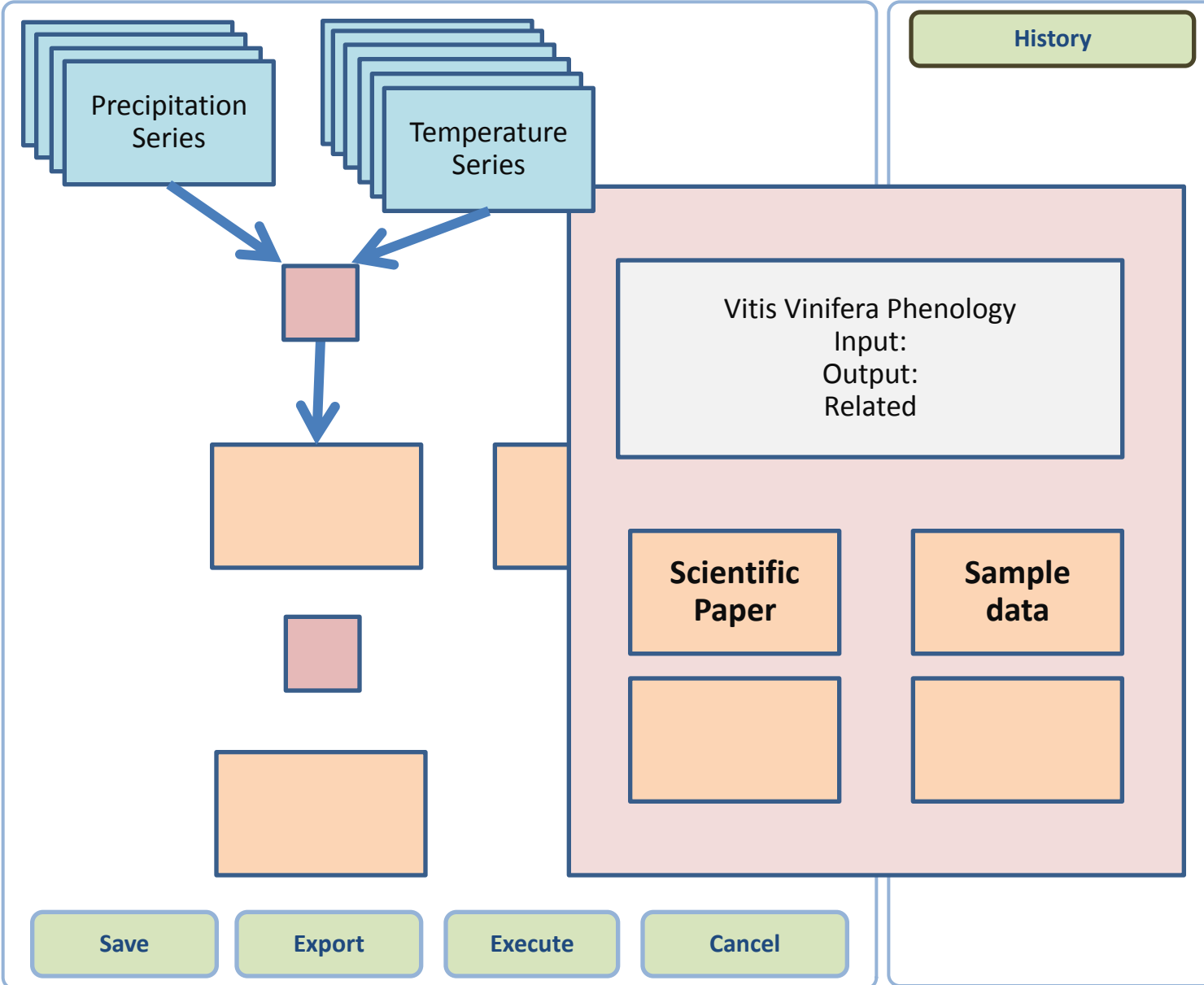


EnviModel

Bounding box
Projection
Resolution

Data

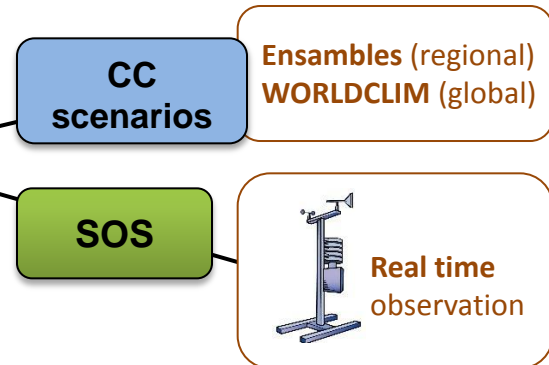
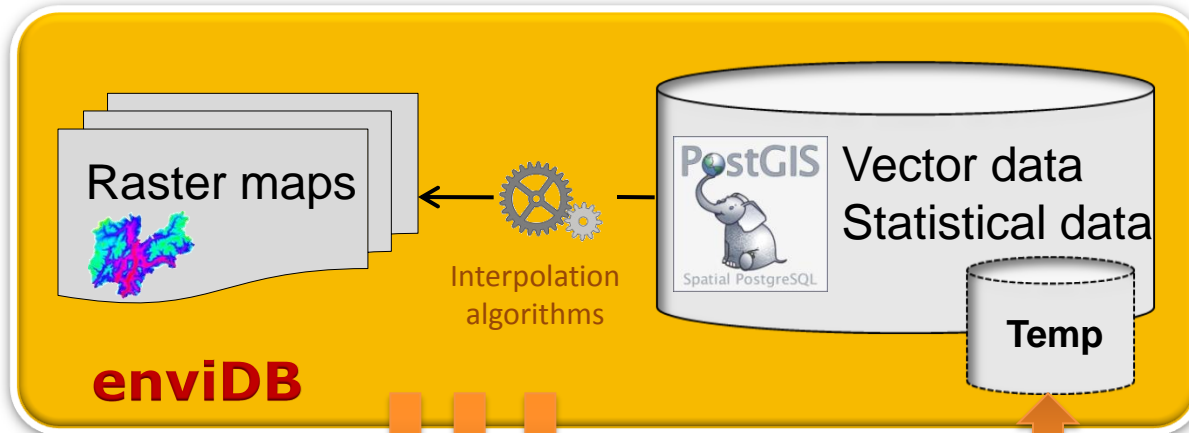
- Geoprocesses
- Vitis Vinifera
 - Phenology
 - Chardonnay
 - Pinot Noir
 - Malus communis
 - Phenology
 - General tools
 - Save result
 - Overlay



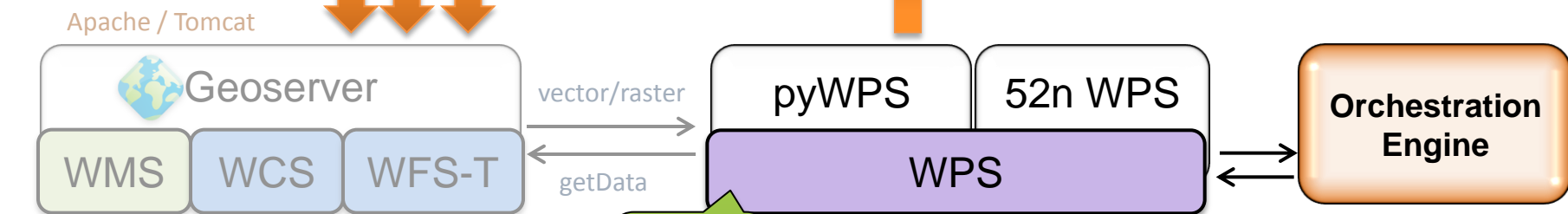
Main features

- **Web Geoprocessing engine**
 - WPS technology
- **Web interface for scientific workflows**
 - Galaxy tested as an ENVIRO component
 - JSPlumb + ExtJS
- **Orchestration engine**
 - Galaxy
 - Kepler and Hydrant actual testing phase (Pratt, 2010)
- **Tools for metadata**

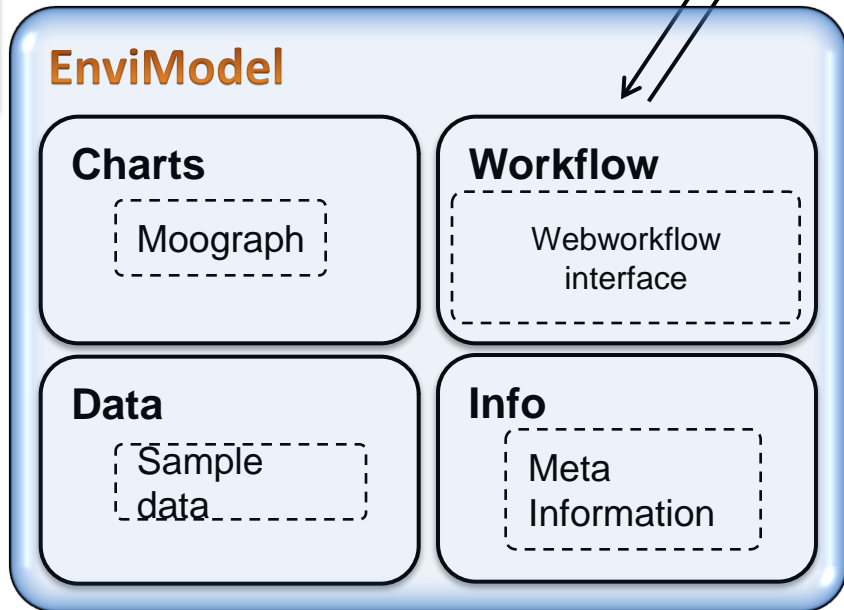
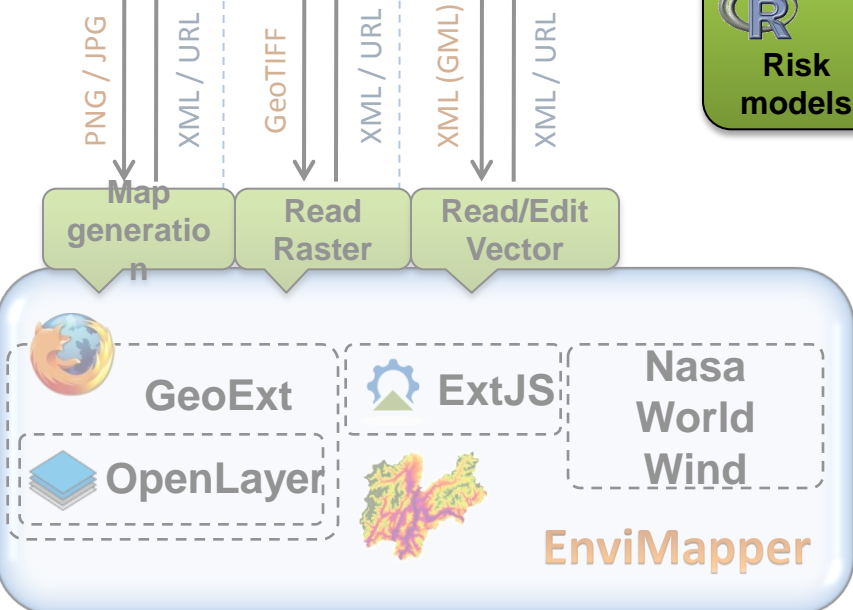
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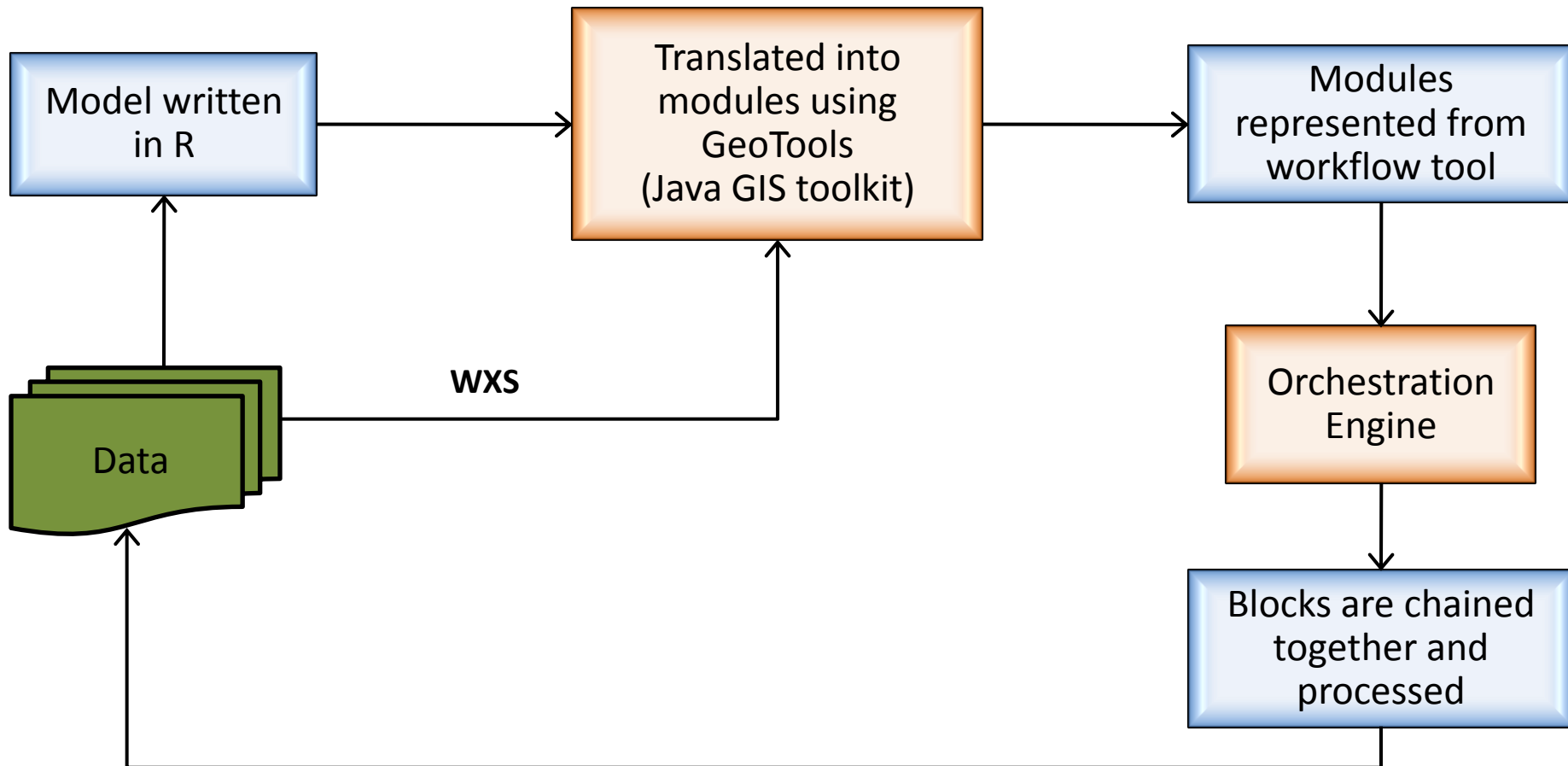
Application server



User Interface



From Model to WPS & Workflows



WPS

March 2010 ENVIROCHANGE Workshop

“WPS and scientific computing for climate change: informal day”

52north, pyWPS, Zoo Project and applications

- 52north implemented for testing using Geotools
 - GeoTIFF via WCS (Web Coverage Service)
 - Output loaded in Geoserver via REST plugin
 - Models implemented

1. *Lobesia Grape*

2. *Powdery Mildew Grape*

3. *Phenology Chardonnay*

4. *Botrytis Cinerea Grape*

5. *Huglin Index*

6. *Downy Mildew Index in development*

7. *Mary Blight in development*

- Web scientific workflow editor for Bioinformatics
 - Written mainly in Python
- Model interactions
 - Create, Edit, Execute, Share, Model metadata

The screenshot displays the Galaxy web interface. The main area is a 'Workflow Canvas' titled 'WPS sum'. It contains three instances of the 'Sum of two geoTIFF' tool, connected in a sequence. Each tool has two input ports labeled 'First input GeoTIFF' and 'Second input GeoTIFF', and one output port labeled 'outputfile (tif)'. The workflow starts with two parallel tools on the left, whose outputs are combined into a single input for a third tool on the right. The right sidebar shows the 'Details' for the selected tool, including its name, host, port, and input/output parameters. The left sidebar lists various tool categories such as 'Get Data', 'Text Manipulation', and 'Statistics'.

Extending Galaxy for WPS

Pro

- Web workflow interface
- Easy to access and use
- Easy to implement new tools using different programming languages

Cons

- Monolithic, hard to integrate
- No API
- Built to use locally stored data

JS Plumb

- Web workflow editor provides a means to visually connect element using a Canvas element
 - **jQuery** or MooTools
 - Possible to integrate with ExtJS in the ENVIRO interface
 - OS extend the code and tailor it for ENVIRO

Orchestration engine

- Chaining processes: Orchestration engine interprets events submitted to a server and acts on them according to defined computer processes
 - Galaxy (Python)
 - Kepler (Java)



- Both hard to extend
- *52north bpel service (FOSS4G 2010)*

Kepler for Envirochange



Used as orchestration engine (Pratt, 2010)

- Extended to execute requests to WPS
- Created new Java classes that execute WPS request and parses xml outputs
- Servlet to interface with the workflow editor based on JSPlumb

Extending Kepler for WPS

Pro

- Easy to deploy new actors using Java programming language
- Lots of actors already deployed

Cons

- Not a web application
- Kepler Workflow actors quite complex

Conclusions

- WPS are the right technology to implement heavy scientific computing on geodata in a multidisciplinary project
- Galaxy represent the state of the art of web scientific workflow interface
- Geoinformation needs a web workflow interface easy to integrate
 - Rich API set
 - Interface to easy interaction with OGC services
 - Orchestration engine that allows the workflow output to be translated into WPS

DEMO

The end