Enterprise-level architecture for interactive web-based 3D visualization of geo-referenced repositories

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web 3D CONSORTIUM

GraphiTech

AGENDA

Motivation 4

Objectives 5

Service Oriented Architecture (SOA) 6

3D Geographic Information System (GIS) 14

3D User Interface 17

- 3D Menu / Web Catalogue 17
- WMS / Feature modelling through WFS 22
- Web Processing Service 26

Conclusions 32

MOTIVATION & OBJECTIVES

- the increasing number of people and institutions sharing geographical information
- the problem of visualize large and complex geographic datasets
- the necessity of move from data to information, to awareness, to knowledge, turning a vast array of data into understandable pieces of intelligence
- the need of user-friendly interfaces, essential to achieve short training time, ease of use and fast response

- platform-independent implementation
- scalability
- interoperability
- the large number of open issues regarding interactivity
  - fault tolerance mechanisms
  - delayed-time transactions
  - data conformity

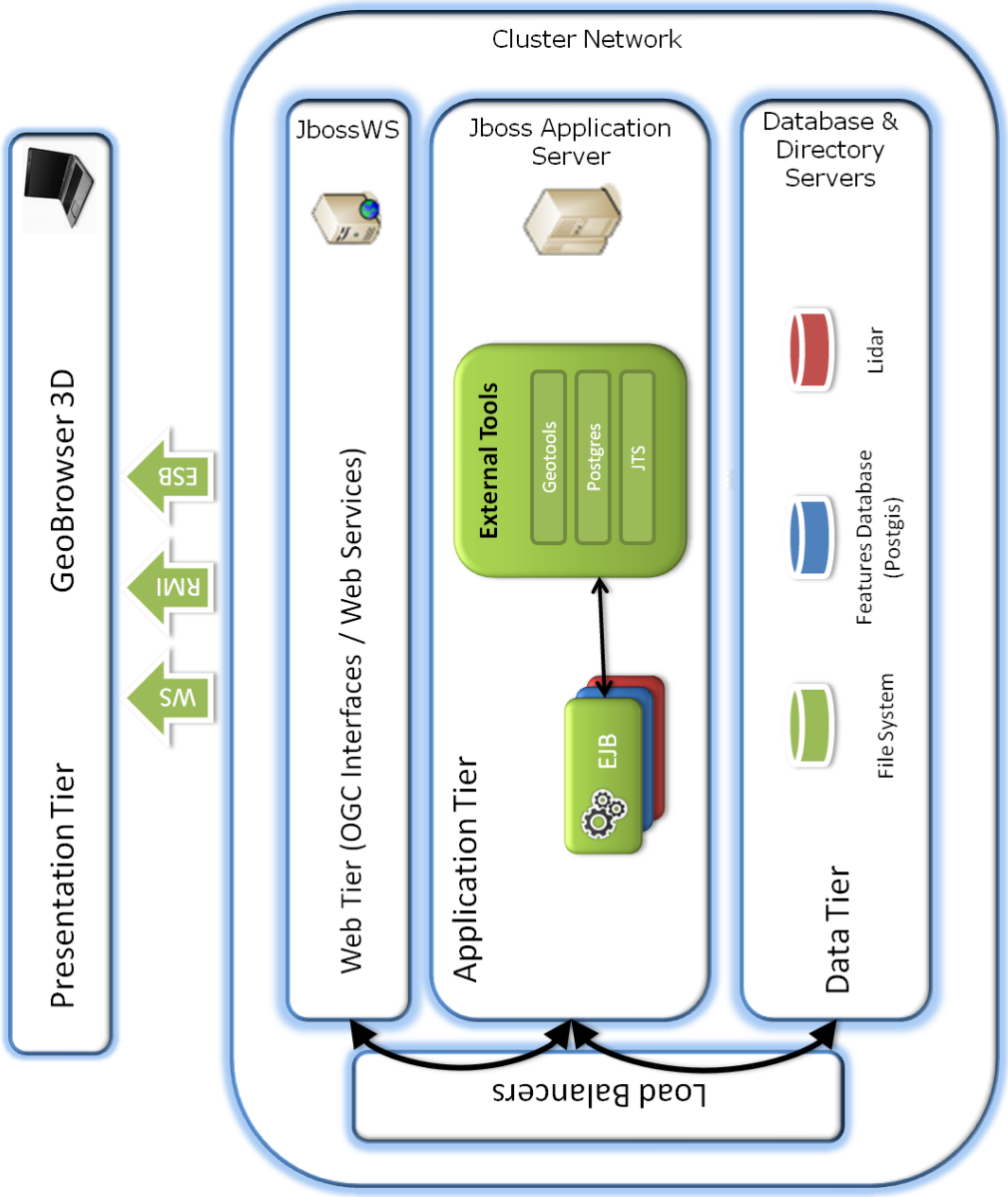
SERVICE ORIENTED ARCHITECTURE (SOA)

- Service-Oriented Architecture (SOA) solution consists in three main logical components:
  - consumers
  - SOA infrastructure
    - applications
    - service support
    - services
  - producers

- The logical component ”consumers” is composed by entities that makes use of offered services
- communicates with the SOA infrastructure through a transport protocol (e.g. HTTP).

- SOA infrastructure layer can be divided into three subcomponents:
  - Applications
  - Service Support
  - “Service” which is composed by entities that performs a specific task when invoked

- all the entities that offer a specific service or functionality then offered as service are classified as ”producers”
  - search engines
  - flat files
  - Geospatial One-Stop
  - etc.


Presentation Tier
GeoBrowser 3D
WS
RMI
ESB
Cluster Network
JbossWS
Web Tier (OGC Interfaces / Web Services)
Jboss Application Server
External Tools
Geotools
Postgres
JTS
EJB
Application Tier
Database & Directory Servers
Lidar
Features Database (Postgis)
File System
Data Tier
Load Balancers

- the processing load is distributed across different servers
- if any server node fails, the geo-processing application is still accessible via other cluster nodes
- clustering is crucial for scalable enterprise applications, as it becomes possible to improve performance by simply adding more nodes to the cluster

- delayed time transactions are supported through publisher/subscriber mechanisms
- when the operation is concluded, the server publish a message that is received by the client
- optionally, clients can access a page (the link is received when a operations is invoked) containing the status of the operation

3D GEOGRAPHIC INFORMATION SYSTEM (GIS)

WEB 3D APPLICATION

- The web 3D application presents a 3D environment:
  - developed using Java and JOGL
  - built over the World Wind APIs
  - exposed with Java Web Start technology
  - Using OSS libraries such as Geotools and JTS

WEB 3D APPLICATION

- the application has been engineered with the goal of delivering a web-based 3D and OGC compliant solution
- the application is capable to provide interoperable access to geographical information using OGC specifications such as GML, WMS, WFS, WPS and others
- Is extremely small

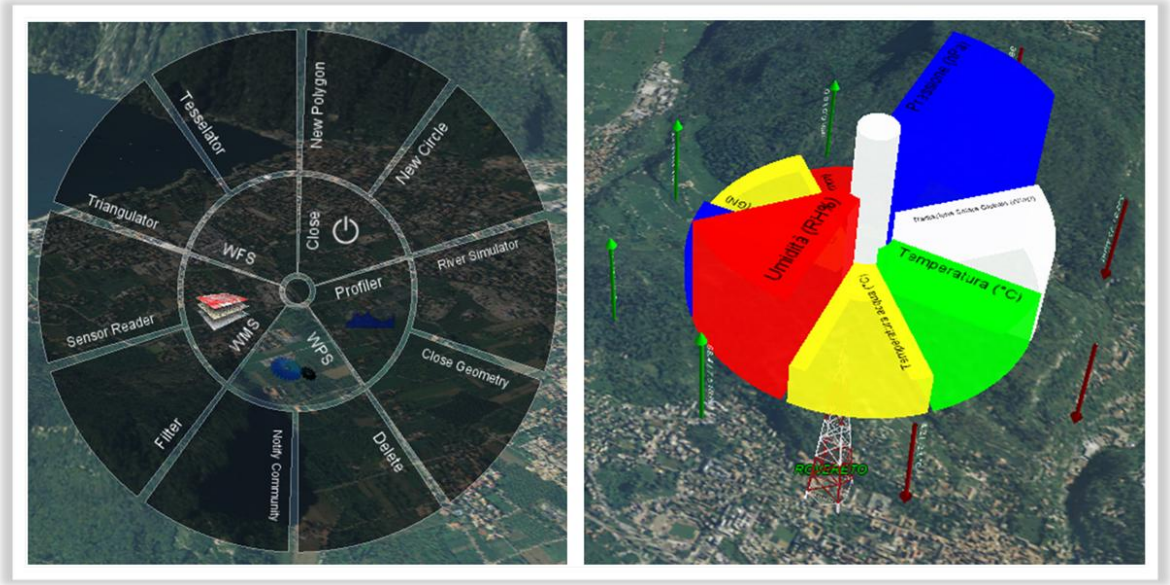
3D MENU / WEB CATALOG

WEB CATALOG

- search tasks can be a highly time-consuming (information may reside on a number of different distributed repositories)
- web catalogues are the best way to organize services and speed up searches

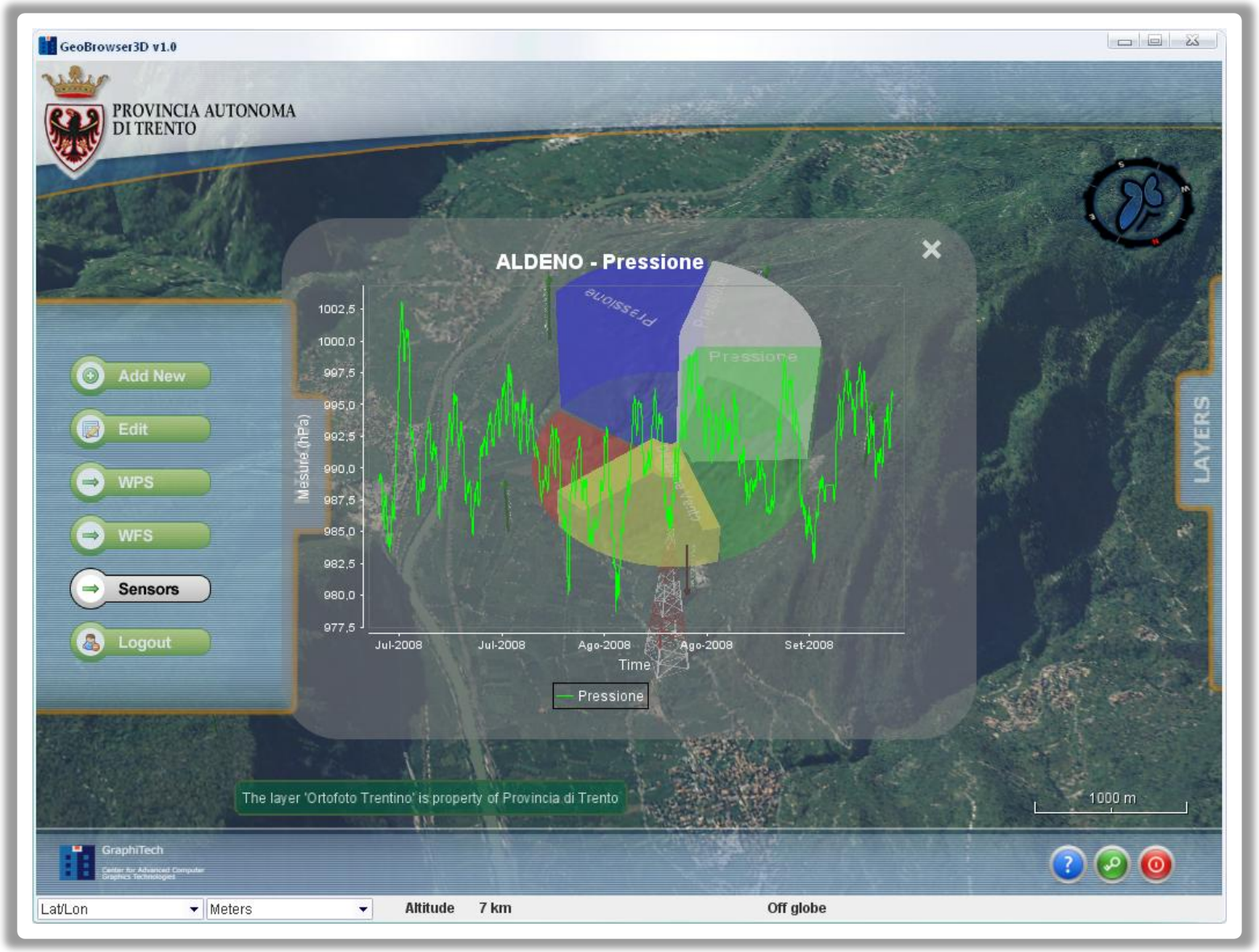
3D MENU

- populated with multiple catalogs
- possible to visualize data from multiple sources at same time
- keeps the previous state



- with the 3D pie, users can have:
  - an ante view of the last value in relation to the minimum and maximum value
  - the trend of the variation, indicated by an arrow
  - the concrete value for the trend
  - the last value displayed close-by to the arrow
- is shown in its geographical position

SENSORS

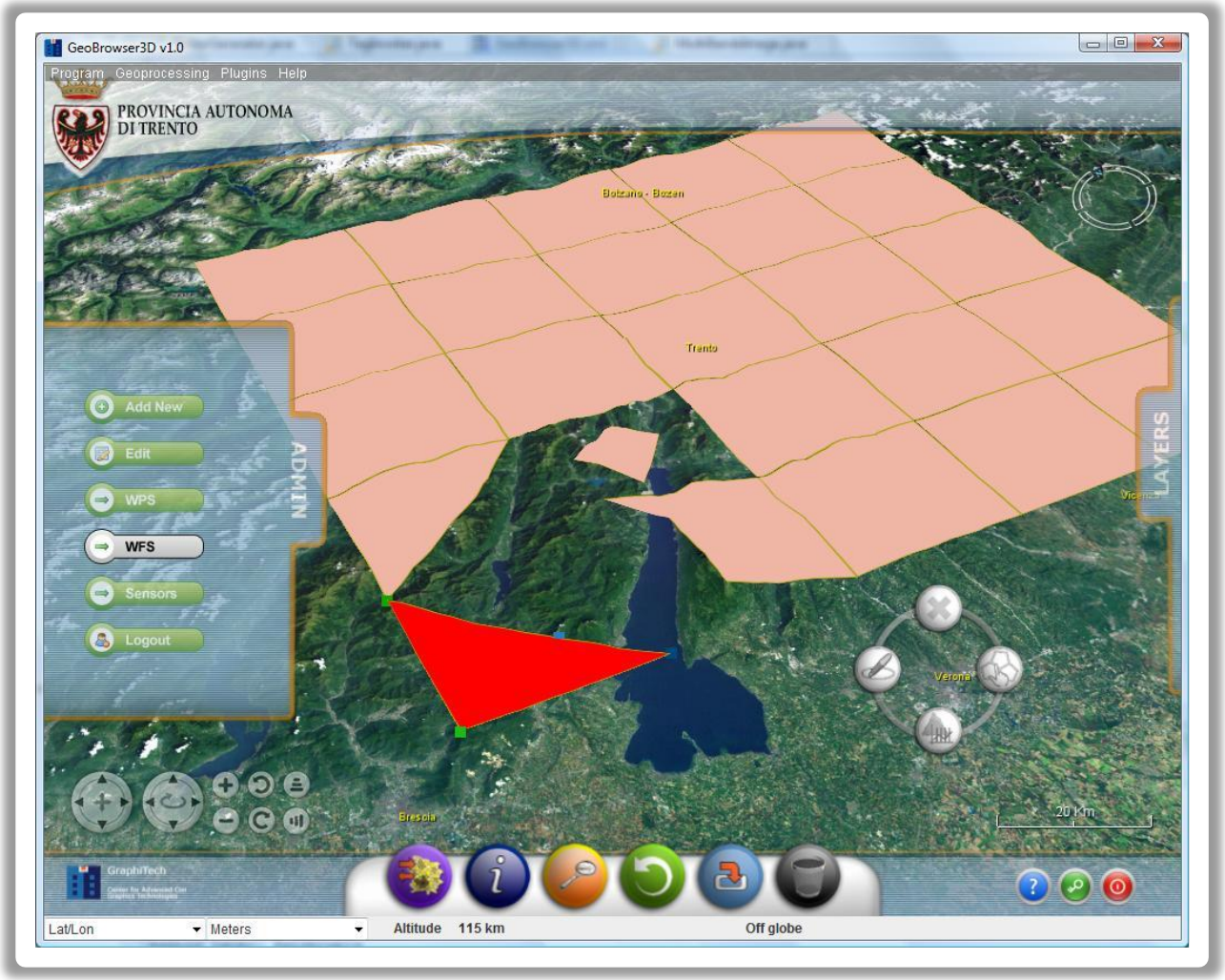

GeoBrowser3D v1.0
PROVINCIA AUTONOMA DI TRENTO
ALDENO - Pressione
Pressione
Mesure (hPa)
1002,5
1000,0
997,5
995,0
992,5
990,0
987,5
985,0
982,5
980,0
977,5
Jul-2008
Jul-2008
Ago-2008
Ago-2008
Set-2008
Time
Pressione
Add New
Edit
WPS
WFS
Sensors
Logout
LAYERS
The layer 'Ortofoto Trentino' is property of Provincia di Trento
1000 m
GraphiTech
Lat/Lon
Meters
Altitude 7 km
Off globe

ACCESS TO RASTER AND VECTOR DATASETS

- 2D maps can be navigated and visualized in 3D environments
- users can use any mapping service that support the WMS protocol
- Since we have direct access to pre-processed imagery, we increase the performance in the presentation stage, because large amounts of processed information can be displayed over one single image

- Through WFS-T the client can retrieve or operate on any feature (vector data like roads, borders) exposed with this protocol by any server
- the user can manipulate or create new geometries through simple mouse interactions or through a context menu
- Some strategies raster / vector are used in order to increase the application performance

WFS INTERFACE



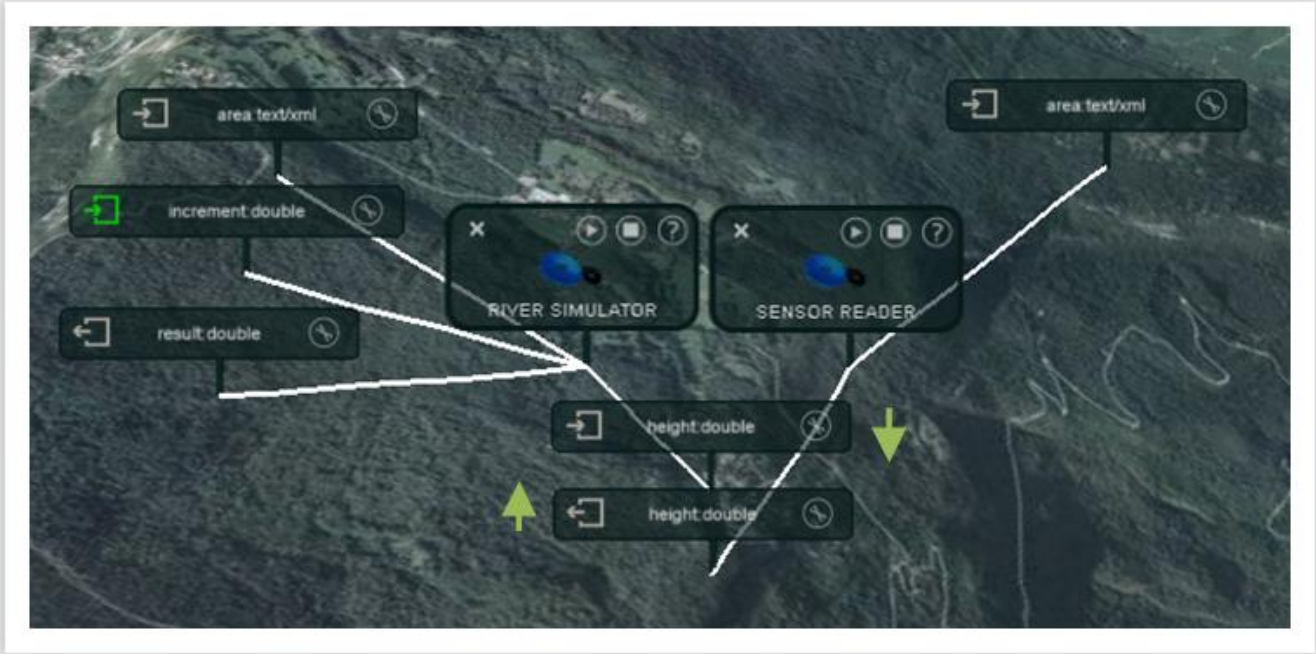
WEB PROCESSING SERVICE (WPS) INTERFACE

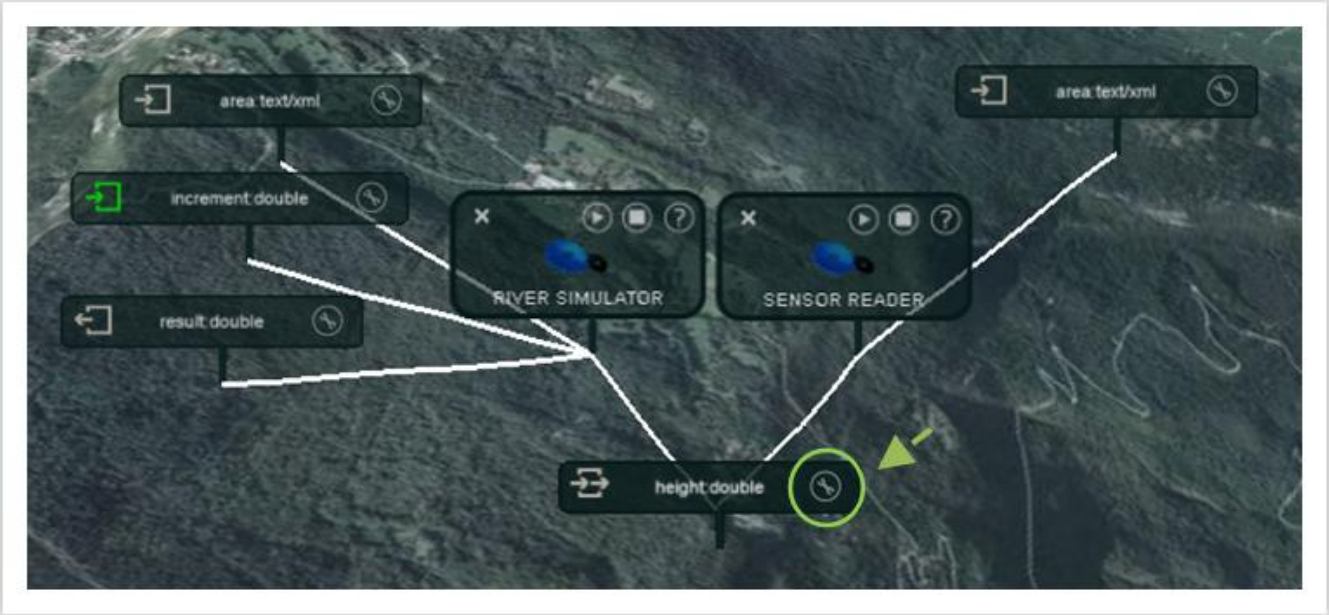
- to maximize readability the process, icons are rendered as billboards
- a process can be composed up to three distinct types of components:
  - the process controller itself
  - one or more input slots
  - one or more output slots.

- Every process operates as a black box that can receive input and transmit results to a further process via its output slots.
- Each input and output slots is automatically created through a process descriptor exposed by the WPS
- Since the algorithm processing takes place at the server level, it is executed in an asynchronous way

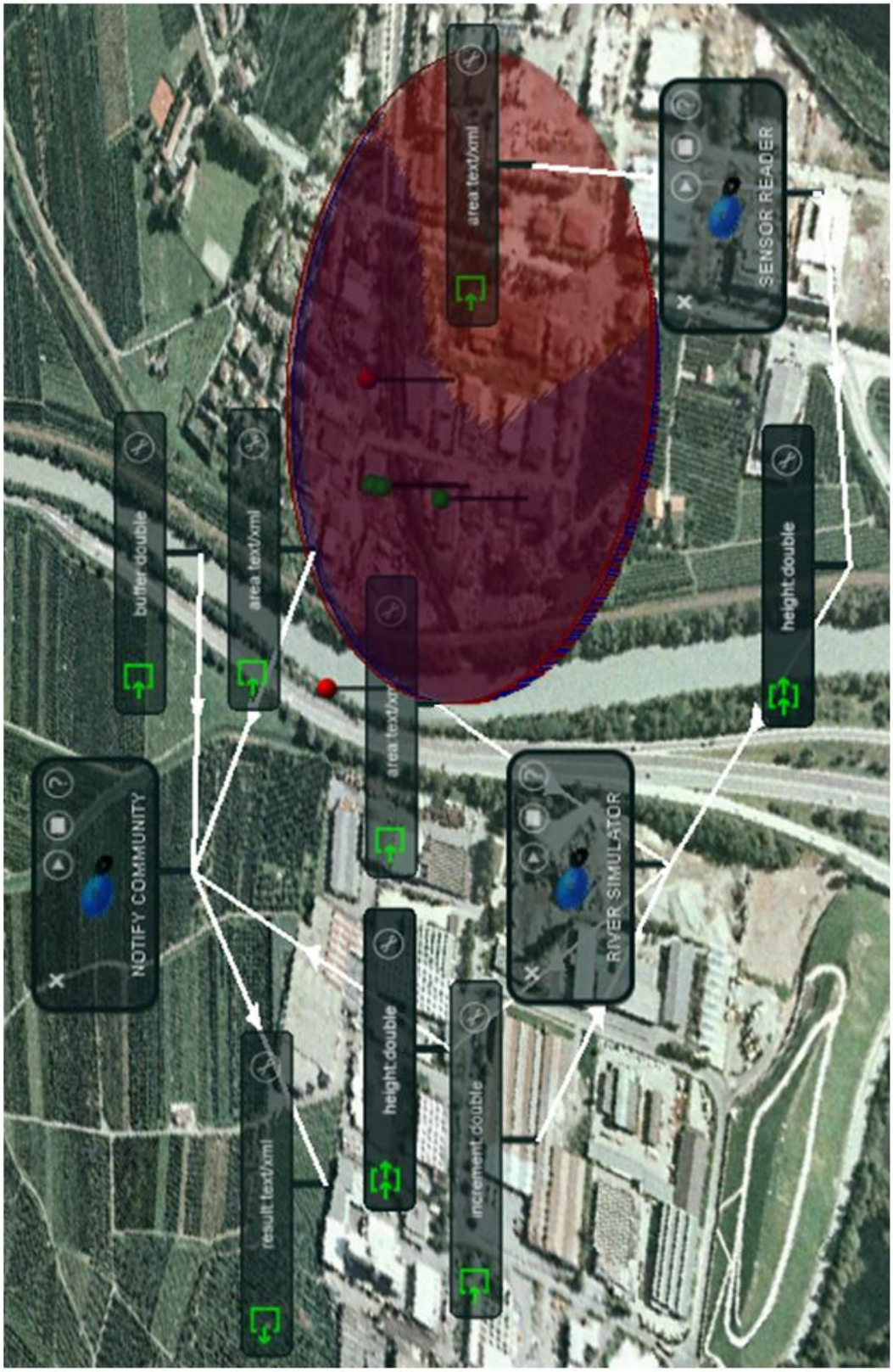
- Complex simulations can be created:
  - Using processes available through WPS
  - Making use of any combination / order (allowing creativity and freedom)
  - Using data/results existent in the 3D environment
  - In an asynchronous way
  - Processed in distributed environments

WPS – CONNECT PROCESSES





WPS EXAMPLE


NOTIFY COMMUNITY
result:text/xml
buffer:double
area:text/xml
height:double
area:text/xml
increment:double
RIVER SIMULATOR
area:text/xml
height:double
SENSOR READER

CONCLUSIONS

- Today interoperability is starting to become a reality thanks to several international harmonization efforts
- experiments showed that users have clearly indicated that this interface in general can be:
  - considered suitable and self descriptive for the given task
  - allow any decision maker that is not GIS expert to make use of it, with virtually no training

THE END

Thank you for your attention

Questions ?

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