BRISEIDE: an interoperable 3D geobrowser supporting environmental analysis for emergency mitigation

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Large scale natural disasters such as landslides, earthquakes, forest fires or fresh floods, require adequate IT tools to help operators better plan resources and improve reaction to unexpected events by deploying the most appropriate response model and contingency plan.

To do so decision makers, civil protection operators, public administrators typically need to be capable of accessing, distributing and processing a wide range of information including, but not limited to, Earth Observation data, geographical information within GIS repositories, as well as live sensor data. Being able to access these resources from a unique 3D interactive environment, which act as a one-stop-shop, ensure essential improve to efficiency, thus reducing possibility of errors.

This work presents the results of the ongoing EU-funded project BRISEIDE - BRIdging SErvices, Information and Data for Europe (www.briseide.eu), which is being financed by ICT-PSP Programme. BRISEIDE specifically addresses civil protection scenarios by developing an interoperable Spatial Data Infrastructure (SDI), which provides not only interoperable access to data but also to processing functionalities. To do so BRISEIDE has developed a number of interoperable web-services which are not only able to deal with spatial features but with also temporal dimension. This way it becomes possible for the civil protection operators to perform spatio-temporal analysis which are essential to run comprehensive spatio-temporal queries of historical data and to perform simulations of scenarios of crisis.

Most relevantly, all the processing functionalities are made available through an interactive 3D client which allows real-time navigation within a virtual scene built through the use of Open Geospatial Consortium (OGC) compliant web services. The client, which is developed as ECLIPSE Rich Client Platform (RCP), allows user to access spatio-temporal information such as GIS and Earth Observation repositories through standards such as WMS or WCS extended to support time as dimension.

The possibility to retrieve or query datasets based on time properties is a fundamental requirement of the BRISEIDE framework. For this the fundamental step has been the definition of a data model which allows operating on spatial datasets which consider time as true dimension. With regard to this issue, it must be noted that the OGC standards WMS (Web Map Service) and WCS (Web Coverage Service), in their latest versions, formally support time as dimension. The requirement, set by the project, was to define a data/metadata model which considered time as a variable in a way which could be supported through an OGC-compliant requests. The aforementioned protocols support in fact the TemporalDomain element, which may or may not be referring to a spatialDomain element. In this specific case the TemporalDomain element describes the valid time constraints which can be associated to requests sent by the BRISEIDE 3D client to create the virtual scene (e.g. through GetMap or GetCoverage requests).

The data model developed by BRISEIDE, which is at the basis of the interactive 3D client developed, includes the TemporalDomain item. This may be structured either as a sequence of time instants (using Geography Markup Language – GML’s TimePosition) and/or time intervals (using timePeriod with beginPosition and endPosition, both of the GML TimePosition type). These time periods may refer to regular samples (indicated by the optional timeResolution element) or continuous reading (when timeResolution is absent).

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The 3D client can then represent raster spatio-temporal geographic information, through a complex structure based on a number of gridded datasets having the same domain and the same band layout. This is typically the case of remote sensing observations, imagery data or model runs/executions referring to time intervals. The 3D client can handle, in an interoperable manner, through WCS requests, time-dependent multi-dimensional raster data, such as Earth Observation data, whose models are represented by several 3D hypercubes for a predefined number of specific times, separated by a certain time period. Given a specific run time, a hypercube of data is in general multi-dimensional by itself. Its extent can span over Longitude, Latitude, Time (various forecasts time) and Elevation. The basic idea is that such a multidimensional object can be built by wrapping instances of the basic 2D implementation of the GridCoverage interface and associating to the proper value along the additional dimensions with respect to the canonical ones, Latitude and Longitude (or Easting and Northing).

Furthermore the BRISEIDE 3D client allows not only access but also processing of such multi-dimensional dataset. In fact the 3D client can connect to remote WPS (Web Processing Service) to create a list of available processing features. The operator can then create a complex simulation mechanism by visually dragging processing components within the 3D scene and by connecting them interactively to create complex processing chains. The client in fact performs a type check between input and output of each processing unit, allowing in practice visual programming, within the 3D scene, of complex processing steps (e.g. to identify moving features within a set of earth observations recorded at various intervals).

The services and the 3D client will become operational over the summer of 2011 for one year and will be tested, in real operational scenarios, in the following pilots:

- Landslide Risk (Italy)
- Geological Effects of Earthquakes (Italy).
- Monitoring of Hydrogeological Disturbances (Italy)
- Floods (Czech Republic)
- Sustainable Forest Management (Czech Republic)
- Emergency service planning (Spain)
- Environmental Quality Pilot (Portugal)
- Management of forest fires (Greece and Croatia)

Figure 1: an image of the 3D interactive clients accessing spatio temporal data