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Innovative Visualization Techniques applied to a Flood Scenario

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The large and ever-increasing amounts of multi-dimensional, time-varying and geospatial digital information from multiple sources represent a major challenge for today's analysts. We present a set of visualization techniques that can be used for the interactive analysis of geo-referenced and time sampled data sets, providing an integrated mechanism and that aids the user to collaboratively explore, present and communicate visually complex and dynamic data.

Here we present these concepts in the context of a 4 hour flood scenario from Lisbon in 2010, with data that includes measures of water column (flood height) every 10 minutes at a 4.5 m x 4.5 m resolution, topography, building damage, building information, and online base maps. Techniques we use include web-based linked views, multiple charts, map layers and storytelling. We explain two of these in more detail that are not currently in common use for visualization of data: storytelling and web-based linked views.

Visual storytelling is a method for providing a guided but interactive process of visualizing data, allowing more engaging data exploration through interactive web-enabled visualizations. Within storytelling, a snapshot mechanism helps the author of a story to highlight data views of particular interest and subsequently share or guide others within the data analysis process. This allows a particular person to select relevant attributes for a snapshot, such as highlighted regions for comparisons, time step, class values for colour legend, etc. and provide a snapshot of the current application state, which can then be provided as a hyperlink and recreated by someone else. Since data can be embedded within this snapshot, it is possible to interactively visualize and manipulate it. The second technique, web-based linked views, includes multiple windows which interactively respond to the user selections, so that when selecting an object and changing it one window, it will automatically update in all the other windows. These concepts can be part of a collaborative platform, where multiple people share and work together on the data, via online access, which also allows its remote usage from a mobile platform. Storytelling augments analysis and decision-making capabilities allowing to assimilate complex situations and reach informed decisions, in addition to helping the public visualize information.

In our visualization scenario, developed in the context of the VA-4D project for the European Space Agency (see http://www.ca3-uninova.org/project_va4d), we make use of the GAV (GeoAnalytics Visualization) framework, a web-oriented visual analytics application based on multiple interactive views. The final visualization that we produce includes multiple interactive views, including a dynamic multi-layer map surrounded by other visualizations such as bar charts, time graphs and scatter plots. The map provides flood and building information, on top of a base city map (street maps and/or satellite imagery provided by online map services such as Google Maps, Bing Maps etc.). Damage over time for selected buildings, damage for all buildings at a chosen time period, correlation between damage and water depth can be analysed in the other views. This interactive web-based visualization that incorporates the ideas of storytelling, web-based linked views, and other visualization techniques, for a 4 hour flood event in Lisbon in 2010, can be found online at http://www.ncomva.se/flash/projects/esa/flooding/.