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Integration of Grid and Sensor Web for Flood Monitoring and Risk Assessment from Heterogeneous Data

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Over last decades we have witnessed the upward global trend in natural disaster occurrence. Hydrological and meteorological disasters such as floods are the main contributors to this pattern. In recent years flood management has shifted from protection against floods to managing the risks of floods (the European Flood risk directive). In order to enable operational flood monitoring and assessment of flood risk, it is required to provide an infrastructure with standardized interfaces and services. Grid and Sensor Web can meet these requirements.

In this paper we present a general approach to flood monitoring and risk assessment based on heterogeneous geospatial data acquired from multiple sources. To enable operational flood risk assessment integration of Grid and Sensor Web approaches is proposed [1]. Grid represents a distributed environment that integrates heterogeneous computing and storage resources administrated by multiple organizations. SensorWeb is an emerging paradigm for integrating heterogeneous satellite and in situ sensors and data systems into a common informational infrastructure that produces products on demand. The basic Sensor Web functionality includes sensor discovery, triggering events by observed or predicted conditions, remote data access and processing capabilities to generate and deliver data products. Sensor Web is governed by the set of standards, called Sensor Web Enablement (SWE), developed by the Open Geospatial Consortium (OGC). Different practical issues regarding integration of Sensor Web with Grids are discussed in the study. We show how the Sensor Web can benefit from using Grids and vice versa. For example, Sensor Web services such as SOS, SPS and SAS can benefit from the integration with the Grid platform like Globus Toolkit.

The proposed approach is implemented within the Sensor Web framework for flood monitoring and risk assessment, and a case-study of exploiting this framework, namely the Namibia SensorWeb Pilot Project, is described. The project was created as a testbed for evaluating and prototyping key technologies for rapid acquisition and distribution of data products for decision support systems to monitor floods and enable flood risk assessment. The system provides access to real-time products on rainfall estimates and flood potential forecast derived from the Tropical Rainfall Measuring Mission (TRMM) mission with lag time of 6 h, alerts from the Global Disaster Alert and Coordination System (GDACS) with lag time of 4 h, and the Coupled Routing and Excess STorage (CREST) model to generate alerts. These are alerts are used to trigger satellite observations. With deployed SPS service for NASA's EO-1 satellite it is possible to automatically task sensor with re-image capability of less 8 h. Therefore, with enabled computational and storage services provided by Grid and cloud infrastructure it was possible to generate flood maps within 24-48 h after trigger was alerted. To enable interoperability between system components and services OGC-compliant standards are utilized.

[1] Hluchy L., Kussul N., Shelestov A., Skakun S., Kravchenko O., Gripich Y., Kopp P., Lupian E., "The Data Fusion Grid Infrastructure: Project Objectives and Achievements," Computing and Informatics, 2010, vol. 29, no. 2, pp. 319-334.