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Invited Session: GEOSS and Users: The Power of Interoperability

The Namibia Early Flood Warning System, A CEOS Pilot Project

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Over the past year few years, an international collaboration has developed a pilot project under the auspices of Committee on Earth Observation Satellite (CEOS) Disasters team. The overall team consists of civilian satellite agencies. For this pilot effort, the development team consists of NASA, Canadian Space Agency, Univ. of Maryland, Univ. of Colorado, Univ. of Oklahoma, Ukraine Space Research Institute and Joint Research Center(JRC) for European Commission. This development team collaborates with regional , national and international agencies to deliver end-to-end disaster coverage. In particular, the team in collaborating on this effort with the Namibia Department of Hydrology to begin in Namibia . However, the ultimate goal is to expand the functionality to provide early warning over the South Africa region.

The initial collaboration was initiated by United Nations Office of Outer Space Affairs and CEOS Working Group for Information Systems and Services (WGISS). The initial driver was to demonstrate international interoperability using various space agency sensors and models along with regional in-situ ground sensors. In 2010, the team created a preliminary semi-manual system to demonstrate moving and combining key data streams and delivering the data to the Namibia Department of Hydrology during their flood season which typically is January through April. In this pilot, a variety of moderate resolution and high resolution satellite flood imagery was rapidly delivered and used in conjunction with flood predictive models in Namibia. This was collected in conjunction with ground measurements and was used to examine how to create

a customized flood early warning system. During the first year, the team made use of SensorWeb technology to gather various sensor data which was used to monitor flood waves traveling down basins originating in Angola, but eventually flooding villages in Namibia. The team made use of standardized interfaces such as those articulated under the Open Cloud Consortium (OGC) Sensor Web Enablement (SWE) set of web services was good [1][2]. However, it was discovered that in order to make a system like this functional, there were many performance issues. Data sets were large and located in a variety of location behind firewalls and had to be accessed across open networks, so security was an issue. Furthermore, the network access acted as bottleneck to transfer map products to where they are needed. Finally, during disasters, many users and computer processes act in parallel and thus it was very easy to overload the single string of computers stitched together in a virtual system that was initially developed.

To address some of these performance issues, the team partnered with the Open Cloud Consortium (OCC) who supplied a Computation Cloud located at the University of Illinois at Chicago and some manpower to administer this Cloud. The Flood SensorWeb [3] system was interfaced to the Cloud to provide a high performance user interface and product development engine. Figure 1 shows the functional diagram of the Flood SensorWeb. Figure 2 shows some of the functionality of the Computation Cloud that was integrated. A significant portion of the original system was ported to the Cloud and during the past year, technical issues were resolved which included web access to the Cloud, security over the open Internet, beginning experiments on how to handle surge capacity by using the virtual machines in the cloud in parallel, using tiling techniques to render large data sets as layers on map, interfaces to allow user to customize the data processing/product chain and other performance enhancing techniques.

The conclusion reached from the effort and this presentation is that defining the interoperability standards in a small fraction of the work. For example, once open web service standards were defined, many users could not make use of the standards due to security restrictions. Furthermore, once an interoperable system is functional, then a surge of users can render a system unusable, especially in the disaster domain.

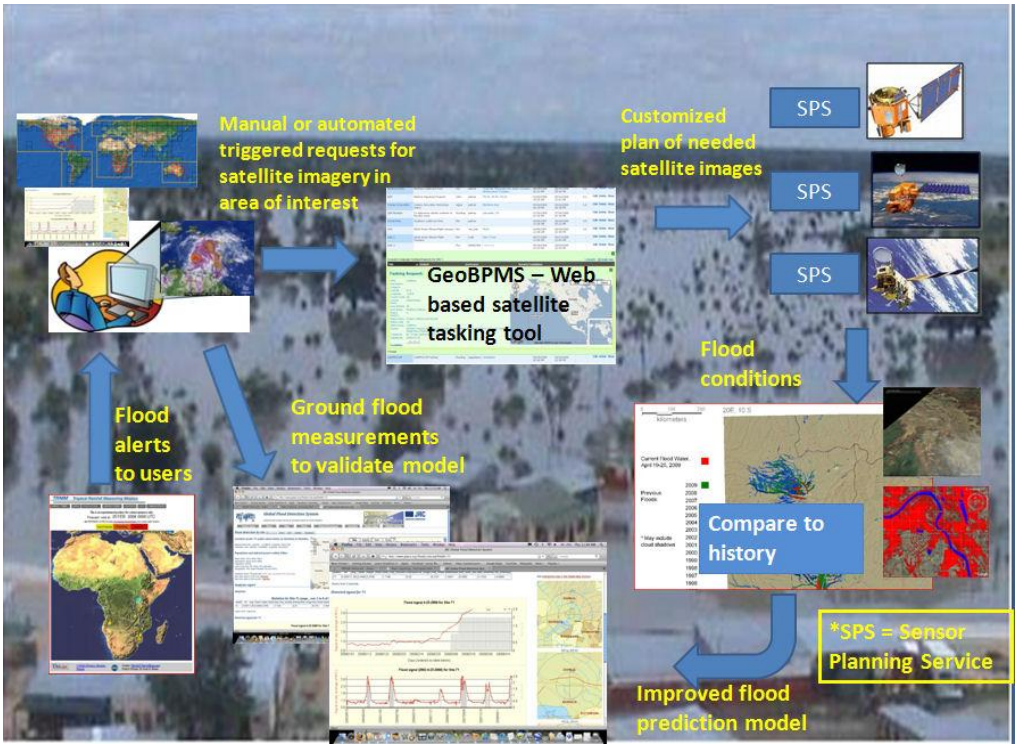

Figure 1 Flood SensorWeb functional diagram

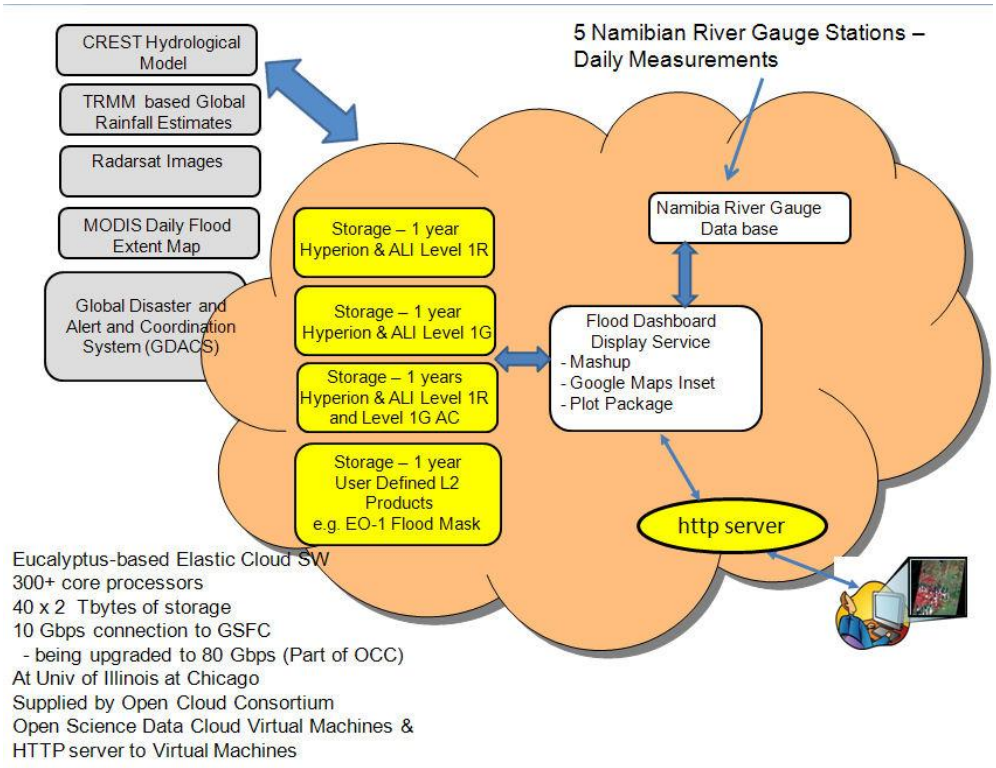

Figure 2 Computation Cloud functionality integrated with Flood SensorWeb

References:

[1] Frye, S., Mandl, D., “Overview of Namibian Flood/Disease SensorWeb Pilot Project”, IGARSS 2009, Cape Town, South Africa, July 12-17, 2009

[2] Mandl, D., “Matsu: An Elastic Cloud Connected to a SensorWeb for Disaster Response”, GSAW, Session 12F Working Group: Cloud Computing for Spacecraft Operations March 2, 2011 Los Angeles, CA

[3] Mandl, D., Rob Sohlberg, Chris Justice, Stephen Ungar, Troy Ames, Stuart Frye, Steve Chien, Pat Cappelaere, Daniel Tran, Linda Derezinski, Granville Paules, “A Space-based Sensor Web For Disaster Management”, IGARSS 2008, July 6, 2008, Boston, MA