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SRTM-FM – A Hydrologically Conditioned SRTM Dataset for Flood Mapping: A Case Study over the Zambezi River Basin, Mozambique and Malawi

The Problem

Concerning natural disasters, flooding is the most common and widespread hazard worldwide. In 2011 one third of UNITAR's Operational Satellite Applications Programme (UNOSAT's) total emergency activations concerned rapid mapping services for flood events. Flood modelling can play a significant role in flood preparedness and in the development of Early Warning Systems (EWS). Moreover, building flood scenarios could support mitigation and disaster response planning, and timely identification of the areas that might be affected by floods could be strategic for emergency response. In this paper, we highlight a modelling approach focused on the exceptional flood event which affected in January and February 2015 the area of the Zambezi River Basin in Southern Malawi and Northern Mozambique along the Shire River.

The Science

River flow measurements and good quality digital terrain models play the most important role in flood modelling. In response to a need for good quality, high resolution Digital Elevation Models (DEMs) for flood mapping purposes, the US Geological Survey (USGS) and UNOSAT developed a GIS-based methodology for conditioning large DEMs based on a terrain calculation approach (ANUDEM) developed from the Australian National University (Hutchinson, 1989). The resulting global dataset called SRTM-FM (Arcorace M., 2014) is a hydrologically conditioned dataset, derived from the hole filled version (Jarvis et al., 2008) of NASA's Shuttle Radar Topography Mission data, for Flood inundation Mapping (hence SRTM-FM). The purpose of this dataset is to create a freely available, improved version of the existing hydrological data and maps based on SHuttle Elevation Derivatives at multiple Scales (HydroSHEDS) dataset for use in flood mapping. Version 1 of the SRTM-FM dataset is under production at UNOSAT's office at CERN, Geneva, Switzerland.

The Application to Policy and Practice

Figure 1 refers to the situation along the Shire River on the 7th of February: in blue is indicated the inundation extent derived from the SRTM-FM dataset with the USGS's "GIS Flood Tool" (GFT) model (Verdin J. et al., 2012), in red the probable standing flood waters extracted from Landsat-7 imagery (UNOSAT, 2015). Modelled inundation estimations have been obtained 5 days before the event using the forecasted streamflow value extracted from the "Global Flood Monitoring System" of the University of Maryland and confirmed by hydrological forecasts of CIMA Foundation. The good correlation between the simulated extent and the observed one demonstrates that, at this scale of analysis, flood modelling can be a very useful tool for decision makers, policy analysts and humanitarian actors in planning and prioritise adequate response activities as well as measures to reduce the vulnerability of communities living in flood-prone areas. Model results have been used internally by UNOSAT to guide and support the definition of Areas of Interest (AOIs) for the rapid acquisition of satellite imagery and have been provided to OCHA, UNDAC and UN Humanitarian Country Teams for monitoring flood situation in Mozambique and Malawi.

Did it make a Difference?

This case study highlights the operational relevance of this experimental modelling-based approach in supporting humanitarian actors during recent flood emergency in the Zambezi river basin. In particular, SRTM-FM dataset and modelling results, coupled with satellite based analysis, demonstrated to provide timely information about not only the extent but also the evolution of the flood event over an area lacking of field data.

UNOSAT's analysis has also supported both UN Humanitarian Country Teams and UNDAC team deployed in the field in gathering information on affected population over areas not directly covered during field assessments (UNDAC, 2015). So far, different studies and pilot projects have already been undertaken over the Zambezi river basin for Flood Early Warning System purposes (Mandl D. et al., 2012). UNOSAT is currently working, together with other partners, to upscale this methodological approach for setting up a global Flood Early Warning System as part of UNOSAT's Climate Service activities.

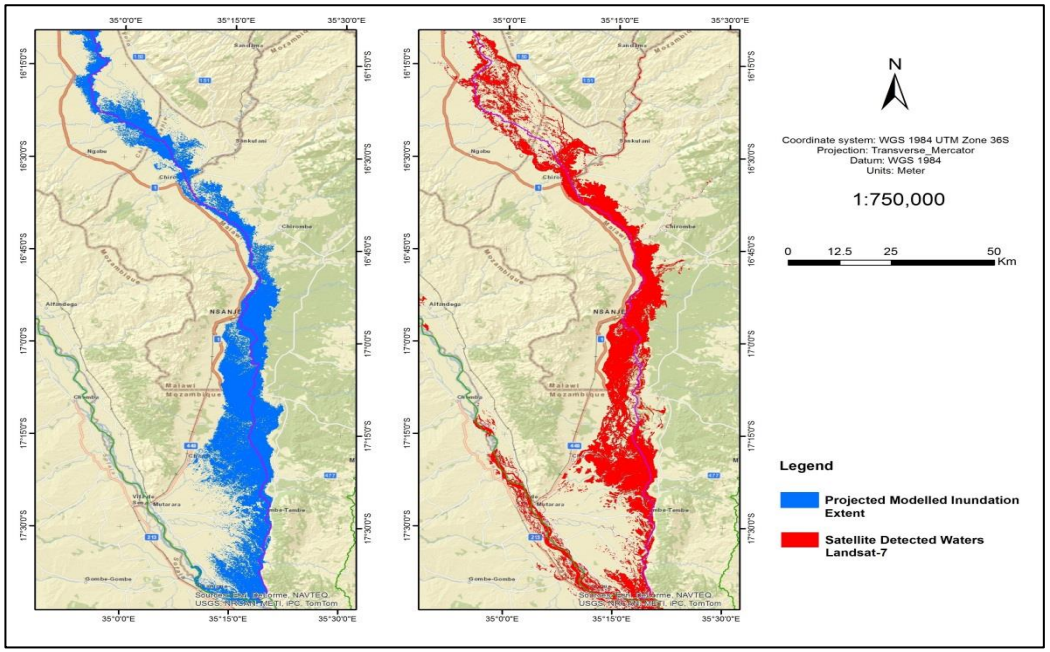

Figure 1. Left: projected inundation extent along the Shire River in Malawi and Mozambique made with the GFT model by using the SRTM-FM dataset as input data. Right: satellite-based analysis derived from Landsat-7 image acquired on the 7th of February 2015.

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