Geophysical Research Abstracts
Vol. 13, EGU2011-10762, 2011
EGU General Assembly 2011
© Author(s) 2011

Linking SAR-derived water level data to flood models: proof of concept

Laura Giustarini (1), Patrick Matgen (1,3), Renaud Hostache (1), Mara Montanari (1), Douglas Plaza (2), Valentijn R.N. Pauwels (2), Gabrielle J.M. De Lannoy (2), Laurent Pfister (1), Lucien Hoffmann (1), and Hubert H.G. Savenije (3)

(1) Centre de Recherche Public - Gabriel Lippmann, Département Environnement et Agro-biotechnologies, Belvaux, Luxembourg (giustari@lippmann.lu), (2) Laboratory of Hydrology and Water Management, Ghent University, Ghent, Belgium, (3) Water Resources Section, Faculty of Civil Engineering and Geosciences, Delft University of Technology, GA Delft, The Netherlands

Satellite-based active microwave sensors not only provide synoptic overviews of flooded areas, but also offer an effective way to estimate spatially distributed water levels. Synthetic Aperture Radar (SAR) is regarded as the most promising technology to monitor flood water from space. Since the launch of the ENVISAT mission in 2002 and more recently the successful launches of the high–resolution COSMO Skymed, TerraSAR-X and Radarsat-2 missions in 2007, considerable progress has been made in SAR-based flood delineation algorithms. These methods have been specifically developed for rapid, repeatable and reliable flood mapping. The retrieval of water level data by merging remote sensing-derived inundated areas with a digital elevation model adds value to remote sensing data for hydrological applications, enabling the monitoring of changes in water volume in ways that are not possible using hydrometric station data. If rapidly produced and processed, these data can be employed for updating hydraulic models in near real-time. Indeed, since space-borne sensors provide instantaneous snap-shots of an area, there is a need to combine remote sensing data sets with hydrologic-hydraulic prediction models to generate time-lapses of flooded surfaces. Sequential data assimilation methods can be used to integrate time-continuous model state forecasts (e.g. surface water storage) with remote sensing observations as they become available.

The usefulness of such approaches with real event data sets, provided by currently existing sensors, has yet to be demonstrated. In this case study, a Particle Filter-based assimilation scheme is used to integrate ERS-2 SAR and ENVISAT ASAR-derived water level data into a one dimensional (1D) hydraulic model of the Alzette River. Two variants of the Particle Filter are proposed with a global and local particle weighting procedure, respectively. The first option finds the best water stage line across all cross sections, while the second option finds the best solution at individual cross sections. The variant that is to be preferred depends on the level of confidence that is attributed to the observations or to the model, respectively. The results show that the Particle Filter (PF) can easily adapt to any kind of description of the observation uncertainty. In an operational context, where hydraulic models are updated on a regular basis, the proposed assimilation scheme leads to a reduction of forecast uncertainty. However, the performance of the assimilation depends on the skill of the hydraulic model and the quality of the observation data.

The objective of this paper is thus to examine the usefulness of currently available satellite data to update a hydraulic model in near real time, through a PF-based assimilation scheme. The specific objectives are: (1) to adapt the PF assimilation scheme in order to deal with non-Gaussian distributions of remote sensing derived water levels; (2) to deal with model structural errors and parameter uncertainties, proposing two variants of the PF; (3) to assess the usefulness of SAR data with respect to in situ hydrometric station data.