Geophysical Research Abstracts
Vol. 13, EGU2011-10235, 2011
EGU General Assembly 2011

Estimating river discharge and identifying model errors during the UK summer 2007 flooding using remote sensing and data assimilation

Jeffrey Neal (1), Guy Schumann (1), Paul Bates (1), and David Mason (2)

(1) School of Geographical Sciences, University of Bristol, Bristol. BS8 1SS. United Kingdom., (2) Environmental Systems Science Centre, University of Reading, RG6 6AH. Reading, United Kingdom.

Remote sensing from space-borne platforms is often seen as an appealing method of monitoring components of the hydrological cycle, including river discharge, due to its spatial coverage. However, compared to gauging stations the data provided are sparse in time, include significantly more uncertainty and rarely observe the properties of greatest interest (e.g. discharge). Therefore, it can be advantageous to treat the observations within a data assimilation framework. This study assimilated water levels derived from a TerraSAR-X synthetic aperture radar image and digital aerial photography with simulations from a two dimensional hydraulic model to estimate discharge, inundation extent, depths and velocities at the confluence of the rivers Severn and Avon, UK. An ensemble Kalman filter was used to assimilate spot heights, namely water levels derived by intersecting shorelines from the imagery with a digital elevation model. Discharge was estimated from the ensemble of simulations using state augmentation and then compared with gauge data.

Assimilating the real data reduced the error between analyzed mean water levels and levels from three gauging stations to less than 0.3 m, which is less than typically found in post event water mark data from the field at these scales. Measurement bias was evident (levels were under predicted by $\sim$0.4 m), but the method still provided a means of improving estimates of discharge for high flows where gauge data are unavailable. Posterior estimates of discharge had standard deviations between 63.3 m3s-1 and 52.7 m3s-1, which were below 15% of the gauged flows along the reach. To help understand model errors, ensemble innovations (changes to the state variable made by the EnKF) were analysed across the spatial domain and comparisons with higher resolution (10m instead of 50m) benchmark simulations.

Quality control prior to assimilation, where measurements were rejected for being in areas of high topographic slope or close to tall vegetation and trees, was found to be essential as data from many regions of the image were unsuitable for assimilation. The study demonstrates the potential, but also the significant limitations of currently available imagery to reduce discharge uncertainty, calibrate inundation models and/or identify model errors in un-gauged or poorly gauged basins using a data assimilation framework.