Geophysical Research Abstracts,
Vol. 11, EGU2009-2235, 2009
EGU General Assembly 2009

Detection of flood extent in urban areas using high resolution TerraSAR-X data

D. Mason (1), R. Speck (2), B. Devereux (3), G. Schumann (4), J. Neal (4), and P. Bates (4)

(1) University of Reading, Environmental Systems Science Centre, Reading, United Kingdom (dcm@mail.nerc-essc.ac.uk, +44-118-378-6413), (2) DLR Oberpfaffenhofen, Wessling, Germany, (3) Department of Geography, University of Cambridge, Cambridge, UK, (4) School of Geographical Sciences, University of Bristol, UK

Flooding is a major hazard in both rural and urban areas worldwide, but it is in urban areas that the impacts are most severe. An investigation of the ability of high resolution TerraSAR-X data to detect flooded regions in urban areas is described. An important application for this would be the calibration and validation of the flood extent predicted by an urban flood inundation model. To date, research on such models has been hampered by lack of suitable distributed validation data. The study uses a 3m resolution TerraSAR-X image of a 1-in-150 year flood near Tewkesbury, UK, in 2007, for which contemporaneous aerial photography exists for validation.

The DLR SETES SAR simulator was used in conjunction with airborne LiDAR data to estimate regions of the TerraSAR-X image in which water would not be visible due to radar shadow or layover caused by buildings and taller vegetation, and these regions were masked out in the flood detection process. A semi-automatic algorithm for the detection of floodwater was developed, based on a hybrid approach. Flooding in rural areas adjacent to the urban areas was detected using an active contour model (snake) region-growing algorithm seeded using the un-flooded river channel network, which was applied to the TerraSAR-X image fused with the LiDAR DTM to ensure the smooth variation of heights along the reach. A simpler region-growing approach was used in the urban areas, which was initialized using knowledge of the flood waterline in the rural areas. Seed pixels having low backscatter were identified in the urban areas using supervised classification based on training areas for water taken from the rural flood, and non-water taken from the higher urban areas. Seed pixels were required to have heights less than a spatially-varying height threshold determined from nearby rural waterline heights. Seed pixels were clustered into urban flood regions based on their close proximity, rather than requiring that all pixels in the region should have low backscatter. This approach was taken because it appeared that urban water backscatter values were corrupted in some pixels, perhaps due to contributions from side-lobes of strong reflectors nearby.

The TerraSAR-X urban flood extent was validated using the flood extent visible in the aerial photos. It turned out that 76% of the urban water pixels visible to TerraSAR-X were correctly detected, with an associated false positive rate of 25%. If all urban water pixels were considered, including those in shadow and layover regions, these figures fell to 58% and 19% respectively. These findings indicate that TerraSAR-X is capable of providing useful data for the calibration and validation of urban flood inundation models.