Geophysical Research Abstracts,
Vol. 10, EGU2008-A-01673, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-01673
EGU General Assembly 2008


# Calibration of uncertain river flood inundation models using remotely sensed water levels.

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A traditional method of validating the performance of a river flood model is to compare the flood extent predicted by the model with that observed using synthetic aperture radar. The accuracy of SAR-derived flood extents may be reduced by a number of factors, in particular by the misclassification as flooded of un-flooded areas of low backscatter adjacent to the flood. Recently, airborne scanning laser altimetry has been used in conjunction with SAR data to constrain the observed flood waterline heights to vary smoothly along the reach (as occurs in practice), which reduces this type of misclassification. The increased accuracy of waterline heights that results raises the possibility of using a model validation performance measure based on waterline elevations rather than the more usual one using areal pattern-matching to assess the degree to which the two extents overlap.

This paper considers the advantages that can accrue from using a performance measure based on waterline elevations rather than one based on areal patterns of wet and dry pixels. The two measures were compared for their ability to estimate flood inundation uncertainty maps from a set of model runs carried out to span the acceptable model parameter range in a GLUE-based analysis. A 1 in 5-year flood on the Thames in 1992 was used as a test event. As is typical for UK floods, only a single SAR image of observed flood extent was available for model calibration. A simple implementation of a two-dimensional flood model (LISFLOOD-FP) was used to generate model flood extents for comparison with that observed.

The performance measure based on height differences of corresponding points along the observed and modelled waterlines was found to be significantly more sensitive to the channel friction parameter than the measure based on areal patterns of flood extent. The former was able to restrict the parameter range of acceptable model runs and hence reduce the number of runs necessary to generate an inundation uncertainty map. A result of this was that there was less uncertainty in the final flood risk map. The uncertainty analysis included the effects of uncertainties in the observed flood extent as well as in model parameters. The technique allows for the decomposition of the reach into sections, with different effective channel friction parameters used in different sections, which in this case resulted in lower r.m.s. height differences between observed and modelled waterlines than those achieved by runs using a single friction parameter for the whole reach. The increased sensitivity of the height-based measure may lead to an increased onus being placed on the model developer in the production of a valid model.