The use of spatially distributed friction coefficients in a dynamic model of flood inundation.

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Abstract. Hydraulic models of overland flow allow river discharge to be related to flood inundation extent, and provide the capability to simulate flooding based on a scenario discharge. An important boundary condition for such models is surface friction. In particular, floodplain land cover causes friction which affects the movement of the flood wave. However, the selection of appropriate friction coefficients for hydraulic models is difficult and it is recognised that floodplain friction coefficients have considerable uncertainty and sensitivity associated with them. Specifically, there is a lack of information on friction in flood inundation models due to (i) a lack of data sources, (ii) the often coarse spatial resolution of data and (iii) the use of stationary models (e.g., use of average friction over whole catchment). Remote sensing can provide spatially distributed estimates of land cover, allowing a more informative and accurate representation of floodplain friction in flood inundation models. However, hard classification may not provide sufficiently detailed land cover data at the sub-pixel scale. For example, where SPOT HRV (spatial resolution of 20 m) or Landsat TM (spatial resolution of 30 m) imagery is used and the flood is only several hundred metres across, hard classification may be inappropriate. Therefore, in this paper, soft classification was used to estimate "soft" friction coefficients for each cell on the floodplain and the results of running the model with hard and soft classification were compared. In this paper, the 1998 'Easter' flood was simulated on a reach of the Nene river, Northamptonshire, England using a simple raster based flood inundation model. The Saint-Venant equations were applied within the channel, and flow on the floodplain was approximated using a simple continuity equation (flow rates were calculated based on the height of the water surface above the land, and the Manning friction coefficient). A digital elevation model with 10 m spacing was obtained from the Ordnance Survey and both hard maximum likelihood and soft k-means classification were applied to Landsat TM imagery to derive distributed friction coefficients. An input hydrograph was obtained from the Environment Agency to drive the model. Finally, validation was undertaken using an ERS-2 SAR image acquired close to the flood peak. The results obtained for both hard and soft classification were compared with those obtained assuming a single value for friction across the floodplain. Spatially distributed friction coefficients made a small difference to the predicted flood envelope, but the use of soft classification made little difference to the result. Future research will concentrate on the simulation of different, but equally probable realisations of spatially distributed friction coefficients to evaluate the effect of such spatial uncertainty on the resulting flood prediction.