Geophysical Research Abstracts, Vol. 8, 08793, 2006
SRef-ID: 1607-7962/gra/EGU06-A-08793

1 Reduction of equifinality in flood Modelling by integration of radar imagery

R. Hostache (1), C. Puech (1), P. Kosuth (1)

(1) Cemagref, UMR TETIS (Territoires, Environnement, Télédétection et Informations Spatiales), Montpellier, France (renaud.hostache@teledetection.fr)

Equifinality is a major issue in environmental modelling. Equifinality occurs when, for a given set of calibration scenarios, various sets of parameters provide almost identical numerical responses, without physical basis that could ensure their reliability when used for significantly different scenarios. This problem is of primary concern for the use of hydrological and hydrodynamic models in flood forecasting. Thus, the reduction of equifinality in such cases is a major challenge. Reduction of equifinality in flood modelling consists in building methodologies to filter out non-physical sets of parameters, allowing the decrease of the number of potentially relevant parameter sets. The most efficient technique to reduce equifinality is to use ancillary information to impose physical constraints on the model outputs. Remote sensing, that provides spatially distributed observations, although limited in time, is a relevant source of such ancillary information.

This paper presents an example of a two-steps equifinality reduction approach during a calibration process of a hydrodynamic 1D model, using satellite radar images as ancillary data. The study area concerns 25 km of the Mosel river between Thionville and Berg-sur-Moselle (France) for the flood event from 02/25 to 03/05/1997. Remote sensing datum is a RADARSAT satellite image acquired on 02/28/1997.

The first step of the approach consists in processing the remote sensing information, in order to delineate the extent of the flooded area at the time of the image acquisition: t time. The accuracy of the delineation of the water-body strongly depends on the spatial

resolution and the geo-referencing quality of the image. Radar images, unaffected by cloud cover, are more relevant than optical images for flood application. However, the detection of water bodies on radar images is biased by vertical objects, such as trees, roads, urban networks, buildings, etc. . . . Because these objects mask parts of the flooded area, flood extent edges delineated thanks to radar images are discontinuous. The use of external data, such as Land use, DEM, and ancillary databases, help in identifying and eliminating the masked parts of the flood extent. The remaining part of the flood extent provides the most relevant information of the image and is introduced as ancillary information into the calibration process.

The second step is the calibration process itself. The parameters to be optimised are two Manning friction coefficients, K1 for the minor bed and K2 for the major bed. A first calibration phase uses a Nash criterion based on the comparison between observed and simulated water levels in the downstream section. This calibration process is based on the GLUE method, which explores the whole sets of possible parameters for K1 and K2 within physical limits. A second calibration phase introduces the water extent observed at t time issued from remote sensing process as an additional constraint for calibration. It uses a new criterion based on the comparison between observed and simulated flood extents at t time.

The use of this new criterion reduces the number of possible sets of K1 and K2 and thus decreases the equifinality. Calibration results reveal low values of the major bed friction coefficient: K2. This appear to be physically coherent because this coefficient explains the whole friction phenomenon within the flood plain, including surface friction, meander friction and infrastructure friction, such as roads and railways.