Geophysical Research Abstracts
Vol. 14, EGU2012-2653, 2012
EGU General Assembly 2012

Influence of rainfall spatial variability on hydrological modelling: a simulation approach

I. Emmanuel (1), H. Andrieu (1,2), E. Leblois (3), and N. Janey (4)

(1) Ifsttar, Nantes, France (isabelle.emmanuel@ifsttar.fr), (2) IRSTV, Nantes, France , (3) IRSTEA, Lyon, France , (4) LIFC, Besançon, France

The link between rainfall space-time variability and hydrological modelling at a catchment outlet remains an open research issue in hydrology and it puts the following question: is it relevant to consider the spatial distribution of rainfall in hydrological modelling? Radar images provide a detailed knowledge on rainfall spatial variability which was not available with rain gauge networks. Thus, different case studies, linked to different approaches, have been carried out in order to determine the interest of radar images for flood runoff modelling. However, the results of such analyses are sometimes contradictory and highlight the difficulty to evaluate the contribution of radar data to hydrological modelling since rainfall measurement errors and modelling errors can not be distinguished from the influence of rainfall variability. In order to overcome errors on rainfall data, to control the rainfall variability and the hydrological behaviour of catchments, we suggest proceeding by simulation. In this way, we have developed a simulation chain composed of a rainfall simulator (based on the turning-band method), a catchment simulator (using the Diffusion-Limited Aggregation method) and a distributed hydrological model (composed of a production function and a transfer function which is based on the Hayami model).

This chain was used to evaluate for which type of rainfall and for which characteristics of catchments it is worth considering rainfall input with a high spatial resolution for hydrological modelling. Different scenarios of catchments and of rainfall types were considered. The influence of the size, the shape, the production function and the response time of catchments was analysed. The influence of the temporal variability of rainfall fields was studied by considering high life span rainfall fields characterized by different speeds. Rainfall fields of different spatial extent were also used to evaluate the influence of the spatial variability. Finally, different directions of rainfall fields were evaluated. For each configuration of rainfall, 100 rainfall fields were simulated at a spatial resolution of 250 m x 250 m and at a temporal resolution of 5 min. The evaluation of the usefulness of a detailed knowledge of rainfall was performed by considering two spatial rainfall resolutions (the simulated pixel size (250 m x 250 m) and the rainfall average over the catchment) and by comparing the associated hydrograms.

Results showed that a spatially detailed knowledge of rainfall was particularly important if the dimensionless ratio "speed of the rainfall field on celerity along the flow path" was small, if the rainfall field direction was perpendicular to the catchment flow direction, if the production function was of Horton or SCS type and if the rainfall fields generate contrasts on the catchment during a long enough time. At last, in order to verify that simulation results are close to reality, all results will have to be confronted to those obtained on real catchments with some real rainfall measurements.