Geophysical Research Abstracts, Vol. 7, 04307, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04307

1 Impact from regional to global scales of a sub-grid hydrology in the ISBA land surface model

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It is crucial to be able to simulate the discharges of large rivers, in order to validate the land surface water budget simulated in climate models, and to predict the response of these river discharges to a given climate anomaly (seasonal forecasts and/or climate scenarios). The land surface hydrology of the CNRM is based on the ISBA land surface model and on a river routing model, such as MODCOU at the regional scale or TRIP at the global scale, which allows us to convert the total runoff produced by ISBA into discharge. At the global scale, the river basin water budget is calculated on grid cells whose side measures typically from 50 to 300 km. With such a resolution, the quality of the hydrological simulations is very dependent on various processes occurring on unresolved spatial scales (distribution of topography, vegetation, precipitation and soil properties).

In order to take into account these sub-grid hydrological processes, a new parameterization within ISBA has been proposed and validated in off-line mode on the Rhône river basin using the high (8km) and low (1˚) resolution Rhône-AGGregation data sets. The comparison between the simulated and observed discharges shows a significant improvement of the simulation with the new version of ISBA. The validation at the global scale, where the meteorological forcing and the surface parameters remain uncertain in many regions of the globe, is more difficult. Nevertheless, the results also suggest a positive impact of the sub-grid hydrology on the simulated discharges over most of the largest world's river basin.