Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04003, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04003
EGU General Assembly 2008

Adaptation of a catchment-based land surface model to the hydrogeological setting of the Somme River basin (France)

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The Somme River is a groundwater-fed stream located in North West France (catchment area = 5566 km^2). The main aquifer is the Chalk aquifer which contributes to 90% of the river discharge. The fast rise in the water table is considered to be responsible for the major flood that occurred in 2001 in the region of Abbeville, the main town before the outlet in the English Channel.

The CLSM (Catchment Land Surface Model) is a hydrometeorological model that has been used as part of a multi-model simulation project using 18 years of meteorological and streamflow data for the Somme River basin. CLSM relies on the concepts of the rainfall-runoff model TOPMODEL to account for the lateral distribution of soil moisture and its influence on runoff generation. Since TOPMODEL is conceived to represent baseflow from a shallow water table, CLSM has not been amenable to realistically simulate the Somme river catchment. Despite an extensive calibration exercise, we could not prevent the simulated high flows to be largely overestimated and the low flows to be underestimated, because groundwater storage was not sufficient on an annual to interannual timescale. To account for deep water storage, a linear reservoir was added to the model. We demonstrate that this very simple adaptation considerably improves the runoff calculation. The calibrated timescale of the storage-discharge relation is approximately two years. Nash efficiencies exceed 0.7 for several parameters sets, as peak flows are smoothed and low flows are sustained during dry periods. Moreover the modified CLSM simulates satisfactory flooded areas in 2001 as observed by

remote sensing. This parameterization is a contribution toward a better representation of water transfers in CLSM that enables to simulate groundwater-fed river discharge and associated floods.