Geophysical Research Abstracts, Vol. 7, 06717, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06717

Sensitivity of hydrological model to land surface model outputs: application to lake Chad basin, Central Africa.

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Lake Chad is a large shallow endoreic lake, located in the semiarid Sahelian belt of Africa. Most of its input water (90%) is provided by the Chari-Logone river, coming from the humid southern part of the basin. Formerly of about 24000 km^2 in the 1950-60s, its surface area experienced a rapid shrinkage in the early 1970s in response to decreasing Chari-Logone inputs to the lake, from about 40 km^3/year to about 20 km^3/year. Since then, Lake Chad area lies between 2000 to 15000 km^2 depending on years and season and is often split into different basins (Lemoalle, 2004). This evolution appears to be mainly due the climate variability (long-term Sahelian droughts, with peaks in the early 1970s and 1980s). An other possible cause is an increase in irrigation taken off from the main affluent, the Chari River.

A model of Lake Chad water level has been applied to the recent years. The model structure, as described in Coe and Foley (2001), is based on i) a Land Surface Model (LSM), ii) an hydrological routing algorithm, HYDRA, forced by LSM outputs, runoff and drainage. In order to evaluate the sensitivity of the simulated lake inflow, we used two LSMs for the 1980-1990 period: IBIS from University of Madison, and ORCHIDEE developed in LMD-CNRS, Paris (Ngo-Duc et al., 2005). As an hypothesis, irrigation uptake volumes were set at 10 km^3/year for this period.

A first analysis of global runoff at the basin scale showed that IBIS output exceeds ORCHIDEE simulation results by about 25%. Moreover, irrigation appeared necessary to improve the simulation of the Chari discharge. A sensitivity analysis on drainage and irrigation indicated that the influence of these terms strongly depends on the LSM and leads to two extreme situations: the best IBIS results are obtained taking into account

irrigation and drainage while the Nash index resulting from ORCHIDEE scenario is higher with no irrigation nor drainage.

In conclusion, the sensitivity analysis on lake Chad basin models showed that various scenarios give comparable results in terms of Chari discharges. This involves i) the need to get more reliable information on real irrigation volumes, and ii) a deeper analysis of LSM outputs for a longer period.

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