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Lake Chad (Africa): hydrological modelling and management options for inter-basin transfers.

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As in most of West and Central Africa, the rainfall regime over the Lake Chad basin has changed around 1970 from a humid to a dry period. Lake Chad being a closed lake, its surface area has changed according to the lower water inputs from the watershed. It is now divided into different individual seasonal or perennial lake basins: the northern and southern pools and the eastern archipelago separated by shallow sills. These hydrologic changes are the driving forces for the natural resources associated with the lake i.e. fisheries, recession cultivation on the draw down areas and green vegetation for livestock. Whereas the yearly cycle of the natural resources has become fairly predictable in the southern basin of the lake, vulnerability has much increased in the northern basin.

The hydrological model of the Lake developed recently has been here used for two main purposes :
- i) to reconstruct the past levels and areas when observed data are lacking and
- ii) to simulate the effects on the lake's level and extension of modifications of the water inputs, either by abstraction for irrigation purposes or addition from an inter basin transfer. The study period runs from 1973 to 2011 with a total surface area of the lake ranging between 1800 and 15 000 km2.

The reconstructed past levels are most valuable for the northern pool of the lake, for which only satellite derived inundated areas were available from 1986 to 2001. Simulations of managed modifications in the water inputs to the lake from inter-basin transfers indicated that an addition of 18.5 km3/y (590m3/s) would have been necessary to maintain the lake as a single body of water as it was before the occurrence of the present dry period. If a large draw down zone is considered as beneficial to the local populations, the management option is an annual discharge of the River Chari between 19 and 23 km3/year (600 and 730 m3/s) with a draw down zone area of 5,000 km2. This is about the average discharge observed during the period 1990-2009 (average 21.7 with standard deviation 5.4 km3/y). But the natural large variability between years has lead to the occurrence of some years of complete dryness in the northern pool, deleterious to the populations.