The Mega-Lake Chad during the mid-Pliocene: occurrence and feedback on climate.

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In order to assess the quality of Pliocene Model Intercomparison Project (PlioMIP) simulations, several indicators can be used: in particular, terrestrial data through pollen analysis. Some authors documented the quality of mid-Pliocene climate simulations using paleovegetation simulated with BIOME4 (Salzmann et al., 2009; Kamae et al., 2012). Their results show AGCM outputs have better skills than AOGCM outputs for representing the shift to more humid vegetation in the present-day arid zone of the Chad basin, because of the alteration of Hadley/Walker circulation due to imposed sea surface temperature pattern (Kamae et al., 2011). However, none of these simulations are humid enough to reproduce tropical savanna and tropical forest/woodland in this area (Leroy and Dupont, 1994; Brunet et al., 1995; Zazzo et al., 2000).

Paleohydrology, and in particular the ocurrence of a Mega-Lake Chad, could help to resolve the model/data inconsistencies in vegetation. Sediment data in the Chad basin shows arid/humid variations between 7 and 3 Ma (Schuster, 2002), with at least 6 Mega-Lake episodes, one in particular around 3.3 to 3 Ma.

In order to investigate the sustainability of a Mega-Lake Chad under the simulated mid-Pliocene climate, we use a lake and river routing model, HYDRA/THMB (Coe, 2000). We use LMDZ4 atmospheric model outputs using an anomaly method to avoid model biases, as input in HYDRA. The simulated lake covers 240,000 km^2 but only reaches 294 meters asl, not the maximum water level of ca. 320-325 meters asl reached during the mid-Holocene (Schuster et al., 2003). We then present the feedback of the potential presence of a Mega-Lake on the climate of North Africa, giving lake area as an input in an AGCM including lake surfaces (Krinner et al., 2003). The simulated climate shows that the presence of an open-water surface in these regions reduces the surface temperature and modifies the hydrological cycle, as already shown by Krinner et al. (2012) for the mid- Holocene North African climate.

During the Quaternary, occurrence of Mega-Lake Chad is associated with favorable orbital conditions, as for mid-Holocene. Mid-Pliocene seems to be more humid than mid-Holocene in the Chad Basin, possibly involving longer Mega-Lake phases. Sensitivity studies to orbital parameters will allow us to discuss the humid/arid variations in the Chad basin.