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Late Cenozoic changes in moisture transport and precipitation over the Indian Ocean and Himalaya-Tibet from ECHAM5 palaeoclimate simulations

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Mega lakes in Central Asia have an important role in society as water reservoirs, yet the prediction of their response to ongoing climate change remains uncertain. In the Neogene, mega lakes were able to sustain themselves despite the Plio-Pleistocene aridification trend in Asia. The study of the underlying mechanism to this behavior will likely improve our prediction capabilities for similar, modern mega lakes. In collaboration with geoscientists working on lake sediments of Qaidam Basin, Gaxun Nur Basin and Orog Nuur Basin, we therefore investigate the causes of the persistence of mega lakes in dry climates and identify tipping points leading to their disappearance. Here, we present a first investigation into large scale climatic boundary conditions for regional moisture availability, specifically changes in moisture transport and precipitation, at different times in the Late Cenozoic using the atmospheric general circulation model ECHAM5. High-resolution palaeoclimate simulations (T159L31, ca. 0.8°x0.8° and 31 vertical levels, 6 hour output frequency) for the present-day (PD, control simulation), Mid-Holocene (MH, ca. 6.5 ka), Pleistocene (LGM, ca. 21 ka) and Pliocene (PLIO, ca 3 Ma) are complemented by calculations of vertically integrated moisture transport over the region to study the contribution of large scale climate to the hydrological budget over the regions formerly covered by mega lakes.

LGM meridional and zonal moisture transport over the Indian Ocean and India is less than during the PD, MH and PLIO, whereas MH and PLIO zonal moisture transport is similar to PD, and PLIO meridional moisture transport is enhanced in the Arabian Sea, the Bay of Bengal and eastern China. In the regions of the aforementioned basins north of the Tibetan Plateau, modelled MH precipitation and precipitation seasonality are similar to PD conditions, whereas the LGM simulation estimates lower (ca. 8 mm/a) and the PLIO simulation higher (ca. 5 mm/a) precipitation values than PD. Furthermore, precipitation seasonality is weakened in the LGM simulation, which estimates lower precipitation esp. in summer; PLIO precipitation seasonality is enhanced by higher precipitation values esp. in spring and summer.

The impact of the weakened and strengthened meridional moisture transports on the hydrological budget in the region covering the three basins will have to be investigated further with the aid of regional climate models, in which the hydrological cycle is better presented.