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Neogene aridification, precipitation $\delta^{18}O$, and trajectory analysis over Central Asia from paleoclimate simulations

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Central Asia is one of the largest arid regions in the world, however, multiple lakes have existed here since the Neogene. These lakes were able to sustain themselves despite the aridification trend in Asia through the Plio-Pleistocene. For example, long-term geological multiproxy records, including carbonate $\delta^{18}O$, from lake sediments of the Qaidam, Gaxun Nur, and Orog Nuur Basins indicate multiple changes in the hydrological cycle of the region with alternate phases of prevailing evaporation and precipitation. These changes are attributed either to Neogene global climate change or regional tectonic events. In this study, we use the isotope-equipped atmospheric general circulation model ECHAM5-wiso for modeling of Asia climate evolution and associated changes in precipitation $\delta^{18}O$ during key periods of the Neogene. High-resolution simulations (T159L31, ca. 0.8°x0.8° and 31 vertical levels, 6 hour output frequency) with Mid-Holocene, Pleistocene, Pliocene and Miocene boundary conditions allow us to estimate the contributions of global climate change into the hydrological budget over the Central Asia. We complement this work with a Lagrangian Trajectory analysis (wind back-trajectories) applied to the ECHAM5-wiso outputs to trace changes in the origin of precipitation-producing air masses. We show that in addition to precipitation amount variations associated with changes in large-scale atmosphere dynamics, considerable changes in moisture sources between the time slices considered contribute to the isotopic signature of precipitation within the Qaidam, Gaxun Nur, and Orog Nuur Basins. Finally, comparison of simulated $\delta^{18}O$ results to wind back-trajectory analysis suggests that local process, such as moisture recycling, exert an increasing control for more recent time periods.