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Lake level change at the Last Glacial Maximum and implications for radiative forcing of the hydrologic cycle

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Climate models predict that the tropics will become wetter and subtropical deserts drier under future anthropogenic climate change, largely due to the thermodynamical effects of warmer tropospheric temperature. Since these physical processes should result in the opposite hydrologic outcome in a world with lower greenhouse gas concentrations and colder temperatures, it may be possible to test this result by comparing model simulations of the Last Glacial Maximum (LGM) to paleoclimate proxies of surface hydrology. Using monsoonal (tropical) and arid central (subtropical) Asia as a case study, we have compiled lake level information from proxy records for the LGM and compared these to output from four 21 ka simulations completed for the Paleoclimate Modeling Intercomparison Project, version 2 (PMIP2). Our review of proxy records indicates that lake levels were nearly all lower at LGM compared to present-day across both monsoonal and arid central Asia. This water-balance pattern is largely reproduced by all four models and results from decreased precipitation during the last glacial. An offline lake energy balance model forced with output from the PMIP2 models shows that lake evaporation also significantly decreased at LGM, but that in most areas the decrease in lake evaporation is overshadowed by decreased precipitation. A detailed atmospheric water budget analysis performed with LGM output from the Community Climate System Model version 3 (CCSM3) indicates that while the tropical drying supports future predictions based on thermodynamical considerations, the drying of the subtropical deserts reveals the additional role of atmospheric dynamics at the LGM. Preliminary results from PMIP3 simulations will also be discussed, as well as the potential for expanding this analysis to other regions.