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Complex responses of regional climate on the northeastern Tibetan Plateau to Holocene large-scale climate forcing

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High-resolution paleoclimate records from southern and eastern China indicate the intensification of the SE Asian summer monsoon in the early Holocene and a continued weakening trend during the mid- and late Holocene, as predicted by precession-driven change in summer insolation (Kutzbach orbital monsoon hypothesis). Further inland in NW China and central Asia, however, it is poorly known how monsoon intensity has influenced regional climate, given potential influences from the mid-latitude westerlies and local topography. Here we analyze multiple sedimentary parameters from a freshwater lake (Hurleg Lake) in the Qaidam Basin on the NE Tibetan Plateau to track changes in effective moisture during the Holocene. The climate history derived from our lithology, pollen, carbonate isotope, mineral magnetics, grain size, and ostracode shell trace element data indicates a wet climate at 11.5-9.5 ka (1 ka = 1000 cal yr BP), a highly variable and drier climate from 9.5-4.2 ka (with a millennial-scale variability at 9.5-7.2 ka and a centennial-scale variability at 7.2-4.2 ka), and a stable and wet climate after 4.2 ka. Our record appears to be out of phase with that expected from monsoon history, including records from Qinghai Lake, just 300 km east of Hurleg Lake. This contrasting and spatially-complex pattern indicates the importance of the interactions between the subtropical monsoon, mid-latitude atmospheric circulation (westerlies), and local topography. In particular, the intense heating and uplifting of air over the Tibetan Plateau accompanied by dry subsiding air in the surrounding ar-

eas, including the Qaidam Basin, are a likely explanation for the out-of-phase, wet-dry relationship.