



## **East–west contrast of Northeast Asian summer precipitation during the Holocene**

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The East Asian summer monsoon (EASM) is a complex system that brings precipitation to East Asia showing considerable spatiotemporal variations. This study explored the zonal differences of summer precipitation in Northeast Asia at orbital timescales during the Holocene by comparing proxy records with simulation results. Model–proxy comparison revealed that the driest interval occurred during the late Holocene in western Northeast Asia and during the early and middle Holocene in eastern Northeast Asia. At orbital timescales, there was generally an east–west antiphasing of summer precipitation in Northeast Asia during the Holocene. Changes of summer precipitation in western Northeast Asia were mainly influenced by precession-driven EASM variability. On the one hand, a weaker EASM during the late Holocene weakened water vapour transport from the North Pacific Ocean to Northeast Asia, and on the other hand it induced anomalous downward motions in western Northeast Asia. Both these two factors were in favour of a reduction of summer precipitation in western Northeast Asia during the late Holocene. In contrast, anomalous downward motions were produced by the stronger EASM in eastern Northeast Asia, which overwhelmed the effect of enhanced water vapour transport, leading to a dry climate in this area from the early to middle Holocene. This study suggests that special care should be taken when discussing the meridional shift of the Holocene climatic optimum in the EASM region due to the existing zonal precipitation contrast.