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Spatial differences in the Holocene precipitation change in the Asian monsoon region - a model data comparison

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At mid-Holocene (6000 years before present), the cyclic variations in the Earth's orbital configuration led to an increase in incoming solar radiation by approx. 5% in the northern hemisphere during summer. As monsoon circulations are primarily induced by the seasonal and latitudinal differences in incoming solar radiation, this insolation forcing is supposed to result in an intensification of the Asian summer monsoon and an increase in precipitation due to an enhancement of the land-sea thermal contrast. This precipitation increase is often stated to reflect the annual precipitation signal. However, climate reconstructions as indicator of annual precipitation changes do not show an overall increased precipitation in the Asian monsoon region during mid-Holocene (Wang et al. 2010) and suggest differences in the response of the Indian and East Asian monsoon system to the insolation forcing (e.g. Maher and Hu, 2006).
In this study, we compare results of high-resolution global climate model simulations with a standardised set of moisture-reconstructions for the Asian monsoon domain at mid-Holocene. Using the climate model results, we investigate the role of seasonal precipitation changes in the annual signal and assess the atmospheric mechanisms leading to the reconstructed differences in the moisture patterns of the Indian and East Asian monsoon region.
According to the model, the strengthening of the summer monsoon system can only explain the increased annual precipitation in most parts of the Indian monsoon region during mid-Holocene. In contrast, the East Asian monsoon region is also affected by a decreased spring precipitation at mid-Holocene that locally compensates or even overcompensates the monsoon enhancement. This means, the simulated annual precipitation signal in the East Asian monsoon region depends on the balance of decreased pre-monsoon and increased monsoon precipitation. Our results point out the complex response of the Asian monsoon circulation to insolation changes and highlight the importance of including the pre-monsoon season in climate studies of the Asian monsoon system.

References:

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