



## Evolution of Holocene Asian-African summer monsoon response to orbital forcing and the relationship with tropical Atlantic ITCZ and sea surface temperatures

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The response of the evolution of Holocene Asian-African summer monsoon precipitation to orbital forcing and the relationship with tropical Atlantic ITCZ (Inter-tropical Convergence Zone) as well as sea surface temperatures are studied with the Kiel Climate Model (KCM), a coupled atmosphere-ocean-sea ice general circulation model. The transient simulation for the period of Holocene from 9.5 ka BP (thousands of years before present day, ka BP) to present (0 ka BP) tests the response of climate change in Asian-African summer monsoon areas to changes in orbital parameters in terms of eccentricity, obliquity and precession. The empirical orthogonal function (EOF) analysis of KCM's orbital forcing induced evolution of summer precipitation shows different temporal-spatial patterns in summer precipitation over the Asian-African summer monsoon influenced areas during the Holocene. The statistical correlation analysis indicates a closely relationship between Asian-African summer monsoon precipitation and the lower level (850 hPa) zonal winds over (0-15N, 30W-30E) as well as the tropical Atlantic ITCZ, the latter showing a continuously southward shifting of its position with a gradually weakened intensity during the Holocene, which probably resulted from the gradually increased south-north gradient of sea surface temperature (SST) over the tropical Atlantic that weakened the cross-equatorial flow from southern to northern Hemisphere from 9.5 ka BP to 0 ka BP.