Interhemispheric linkages of Australian and Asian monsoons on a warmer-than-modern Earth

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The large-scale Asian-Australian monsoon system consists of several regional subsystems that are dynamically linked through the annual migration of the Intertropical Convergence Zone across the equator, but exhibit distinct responses to external (local insolation) and internal (e.g., ice volume, greenhouse gas concentrations) forcings. Here we provide a long-term perspective of regional variability under different mean-state climate conditions. We focus on the 8 to 5 Ma period, which was characterized by warmer-than-modern climate conditions, but was also marked by distinct reversals in climate trends including transient cooling events exhibiting similarities to late Pleistocene Heinrich stadials. Extended sediment archives recovered by the Ocean Drilling Program (ODP) and the International Ocean Discovery Program (IODP) in the South China Sea, Bay of Bengal and off Northwest Australia allow direct comparison of Northern and Southern Hemisphere monsoonal subsystems on orbital timescales. High-resolution XRF-scanner derived estimates of terrigenous discharge, foraminiferal Mg/Ca derived mixed layer temperatures and stable isotopes reveal cooling and strengthening of the Northern Hemisphere winter monsoon starting at ~7 Ma. This intensification occurred synchronously with an increase in monsoonal seasonality in the Southern Hemisphere. In all regions, summer monsoonal precipitation intensified after ~5.5 Ma in tandem with globally rising sea surface temperatures. Our results suggest that changes in latitudinal temperature gradients, greenhouse gas concentrations and moisture budgets strongly influenced the long-term evolution of the Australian and Asian monsoons during the transition from a unipolar to a bipolar glaciated Earth.

Keywords: Asian-Australian Monsoon, late Miocene, International Ocean Discovery Program, Foraminiferal stable isotopes, Foraminiferal Mg/Ca, X-ray fluorescence scanner elemental data

