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Global monsoonal systems during the last glacial-interglacial cycle

Monsoon is one of the most important components of the climate system and it strongly influences the economy, culture and rhythms of life of a large population on the Earth. Monsoon influences the climate not only in tropical and subtropical regions, but could also affect the climate at higher latitudes. Both observations and proxy reconstructions show that different regional monsoons (South and East Asian, Australian, North and South American, North and South African monsoons) could exhibit similar variations under a common forcing, but they also display significant differences related to the unique features of each monsoon system. High-resolution paleo-monsoon reconstructions with well dated chronology are indispensable for understanding the evolution of each monsoon system and the comparison between different monsoons.

This virtual special issue of *Quaternary Science Reviews* focuses on well-dated records of all regional monsoon systems as well as paleo-monsoon modelling during the last glacial-interglacial cycle (from ~150,000 years ago to the present). This special issue contains 14 papers focusing on monsoonal climate and hydrological changes in East Asia, India, Africa and Central America during the last glacial-interglacial cycles. They include reconstructions using various proxy records such as stalagmite, loess, lake sediments as well as climate model simulations. Changes on orbital and millennial timescales as well as abrupt changes are investigated.

The first paper by Duan et al. (2021) examines the timing and structure of the 8.2 kyr event as recorded in an 8.5–7.5 kyr speleothem record from Madagascar. The overall wet event shows a distinct two-stage structure, as previously shown elsewhere, with each stage showing two distinct wet peaks. The second paper by Li et al. (2022) presents a high-resolution $\delta^{18}O$ and $\delta^{13}C$ record from an annual-layered stalagmite from Rige Cave, southeastern Tibetan Plateau, spanning the time of the Younger Dryas (YD) to characterize the timing, structure, and internal variability of the YD response on the Tibetan Plateau. The authors find that centennial-scale monsoon events during the YD correlate with North Atlantic climate variations, triggered by the solar de Vries cycle (207-y). The paper by Jia et al. (2022) presents $\delta^{13}C$ and trace element records of a stalagmite from northwestern China over the last two millennia, suggesting that Northern Hemisphere temperatures, solar activity and hydroclimate changes in Northwest China are closely linked with each other.

The paper by Shi et al. (2022) analyzes millennial-scale variations in Indian monsoon intensity during the last deglaciation. Their record shows abrupt changes in sea surface temperatures, suggesting a strong low-latitude response to the northern high-latitude evolution of climate during the last deglacial epoch. A stalagmite record from Yangkou cave in southwest China, presented by Wu et al. (2023) provides a precise chronology of the Asian summer monsoon during Heinrich Stadial 4 (HS4). According to this record, the onset and termination of the HS4 was more gradual due to the influence of tropical oceans and the Southern Hemisphere. The paper by Wu et al. (2022) finds a weakened East Asian summer monsoon during the YD, suggesting a strong link with North Atlantic meltwater and Atlantic Meridional Overturning Circulation (AMOC) changes through an eastward wave train. In Jiang et al. (2023), an exceptionally-high-resolution (29.4 yr) loess record from the eastern Chinese Loess Plateau, the Hongtong section, is studied to investigate orbitally and galactic cosmic forced abrupt climate events during the last glacial period. The record shows two abrupt cooling-drying events at 48 and ~42 kyr BP, whereby the first event could have resulted from the extreme orbital configuration during the last glacial, whereas the second event is proposed to result from the change of the Earth's magnetic field which could cause a series of internal interactions in the regional climate system.

The paper by Ndiaye et al. (2022) provides a reconstruction of Holocene climate change in the Senegal, Northwest Africa, based on peat bog stable isotopes and charcoal abundances, suggesting a shift from natural to anthropogenic causes of savanna fires. The paper by Medina et al. (2023) uses high-resolution speleothem isotope records from northern Venezuela for mid to late Holocene, suggesting ice rafted debris (IRD) and North Atlantic Deep Water (NADW) forcing on Inter-Tropical Convergence Zone (ITCZ) rainfall between 6 and 5 kyr BP. Chase et al. (2022) provides an overview of regionally coherent climate variability in the southern African monsoonal region at the termination of the African Humid Period. The compilation of reconstructed climate records suggests a rapid phase change at ~5.5 kyr BP establishing a strong E-W dipole, linked to high and low latitude forcing driving land-sea pressure gradients.

Wang et al. (2022) presents a stalagmite record from Luoshui Cave, Central China over the past 23.5 kyr that coincides with tree ring $\delta^{18}O$ and lake level data, including four weak monsoon events since 7 kyr BP. Wavelet analysis reveals a distinct ~500 yr cycle in their record, suggesting that Asian summer monsoon was forced by solar activity and the North Atlantic Oscillation (NAO). Sun et al. (2022) presents a BrGDGTs-based 31–kyr record of past changes in temperature and hydrology from the North China Plain from fluvio-lacustrine sediments. The record shows a ~8–9 °C shift in temperature during the LGM-Holocene transition, associated with an increase in precipitation in monsoonal China.

Using simulations with the HadCM3 model, Lyu and Yin (2022) explore the spatio-temporal response of eastern Asian climate to insolation, CO_2 and ice sheets during Marine Isotope Stage 5 (MIS 5), suggesting that regional climate has different sensitivities to forcing, a study

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which contributes to the explanation of observed diversity in regions and between proxy records. Tian et al. (2022) present a magnetic susceptibility record, total organic carbon (TOC), redness and lightness from a loess section in the Menyuan basin in East Asia. The authors find that the East Asian monsoon region is divided into four sub-regions, where a transition of meridional tripole climate pattern occurred at ~260 kyr, with El Niño/Southern Oscillation (ENSO) as the dominant driver of this transition.

We believe that the papers in our virtual special issue on "Global monsoonal systems during the last glacial-interglacial cycle" provide a good overview of the current state of knowledge regarding research into palaeomonsoon.

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