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Reconstruction of East Asian Monsoon variability 6.5ka-present using organic and inorganic geochemical proxies in the Pearl River Estuary, China

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The East Asian Monsoon (EAM) is one of the most significant contributors, both environmentally and socioeconomically, to the densely-populated East Asia region in which over one third of the world's population reside. Additionally, the EAM is a key system in global atmospheric circulation. Thus, understanding past changes in the EAM is of pivotal importance for assessing the impact of future climate change. Previous EAM reconstructions have mainly focused on lake and cave records. However, these records record a small, regional-scale signal of paleoprecipitation and are thus susceptible to local responses and might not record continental-scale climate. Multiproxy studies from marginal marine systems such as estuaries and semi-enclosed seas have shown great potential to reconstruct past variability in the climate system, particularly aspects of the hydrological cycle and temperature, on a continental scale. The Pearl River was chosen for this study as it possesses a large (400,000km^2) drainage basin. The latitudinal orientation of the basin between the tropics and subtropics (22° to 26°N), its susceptibility to both summer (humid) and winter (dry) monsoon winds, and its location within the modern summer Inter-Tropical Convergence Zone (ITCZ) area make the basin very sensitive to variability in the EAM system. Here we present results for a suite of inorganic geochemical proxies for paleosalinity (such as foraminiferal oxygen isotope ratios, δ^{18}O) and organic geochemical proxies for fluvial sediment flux (such as the concentration ratio of terrestrial to marine biomarkers), testing both modern (spatial) and Holocene (temporal) variability. The anticipated spatial variability of inorganic and organic proxies is observed, with terrestrial signals dominating in the upper estuary but becoming weaker towards the open sea; however, some proxies appear to record this transition with greater fidelity than others, with the n-alcohol-based proxy being the strongest and sterol-based proxy the weakest. Correlation to water salinity was significant in all proxies (R^2=0.51 to 0.73) and fidelity was similar to those seen in the anticipated spatial distribution. Agreement among proxies in the temporal reconstruction is generally strong and show significant strengthening of the monsoon (as shown by an increase in terrigenous input) at 6.5ka, 4.5ka and 2.5ka, and weakening (as shown by a decrease in terrigenous input) at 5.5ka and 3.5ka, with little overall trend. This challenges aspects of previous reconstructions which show overall steady weakening in the monsoon during the latter part of the Holocene and agrees with aspects of a previous bulk sediment δ^{13}C-based proxy study on the Pearl Estuary.