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Comparative Impact of Solar Insolation and the Indo-Pacific Warm Pool Temperature on the East Asia Summer Monsoon During the MIS-13 Interglacial

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Abstract

During Marine Isotope Stage (MIS)-13, an interglacial about 500 000 years ago, the East Asian summer monsoon (EASM) was suggested exceptionally strong by different proxies in China. However, MIS-13 is a weak interglacial in marine oxygen isotope records and has relatively low CO₂ and CH₄ concentrations compared to other interglacials of the last 800 000 years. In the meantime, the sea surface temperature (SST) reconstructions have shown that the warm pool was relatively warm during MIS-13. Based on climate modeling experiments, this study aims at investigating whether a warmer Indo-Pacific warm pool (IPWP) can explain the exceptionally strong EASM occurring during the relatively cool interglacial MIS-13. The relative contributions of insolation and of the IPWP SST as well as their synergism are quantified through experiments with the Hadley Centre atmosphere model, HadAM3, and using the factor separation technique. The SST of the IPWP has been increased based on geological reconstructions. Our results show that the pure impact of a strong summer insolation contributes to strengthen significantly the summer precipitation in northern China but only little in southern China. The pure impact of enhanced IPWP SST reduces, slightly, the summer precipitation in both northern and southern China. However, the synergism between insolation and enhanced IPWP SST contributes to a large increase of summer precipitation in southern China but to a slight decrease in northern China.

Therefore, the ultimate role of enhanced IPWP SST is to reinforce the impact of insolation in southern China but reduce its impact in northern China. We conclude that a warmer IPWP helps to explain the strong MIS-13 EASM precipitation in southern China as recorded in proxy data, but another explanation is needed for northern China.

Keywords: MIS-13 interglacial, Warm Pool SST, Insolation, East Asia Summer Monsoon

