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Enhanced humidity in SW Iberia driven by the combination of insolation and ice-sheet forcing during MIS 13 interglacial

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Marine Isotope Stage (MIS) 13, ~500 ky ago, represents a Quaternary interglacial of primary interest due to the unexpected enhancement of monsoon systems under a cool climate characterised by low atmospheric CO₂ and larger ice volume than the present interglacial. Yet, key questions remain about its regional expression (intensity, climate variability, length) and underlying forcing factors. Here we examine the SW Iberian vegetation and terrestrial climate during MIS 13 directly compared with the sea surface temperatures using sediments from IODP Site U1385, and combine those terrestrial-marine profiles with climate-model experiments. We show for the first time that MIS 13 stands out for its large forest expansions with a reduced Mediterranean character alternating with muted forest contractions, indicating that this stage is marked by a cool-temperate climate regime with high levels of humidity. Results of our data-model approach reveal that the dominant effect of MIS 13 insolation forcing on the regional vegetation and precipitation regime in SW Iberia is amplified by the relatively large extent of the ice-sheets in high northern latitudes. In qualitative agreement with the pollen-based evidence, model results show that ice-sheet forcing triggers an increase in the SW Iberian tree fraction along with both intensified winter and summer rainfall. We propose that the interactions between ice-sheets and major atmospheric circulation systems may have resulted in the persistent influence of the mid-latitude cells over the SW Iberian region, which led to intensified moisture availability and reduced seasonality, and, in turn, to a pronounced expansion of the temperate forest.