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Challenges for seasonal and ENSO analogues of tropical Pacific climate response to Termination 1

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The transitions from glacial to interglacial states (terminations) provide important tests of global climate sensitivity to evolving boundary conditions. The most recent termination (T1, c. 19-10 ka) was punctuated by a series of abrupt climate events that raise questions about the climate forcing mechanisms that operate at millennial timescales and that drive rapid climate changes. Specifically, evidence for dynamic tropical Pacific climate across T1 drives debate over whether modern analogues of seasonal Intertropical Convergence Zone (ITCZ) migration and/or El Niño-Southern Oscillation (ENSO)-like variability are appropriate, and how sensitive tropical Pacific climate may be to the dramatic events observed in the north Atlantic region. Here, we show results from high-resolution (average $\sim$66 yr) analyses of marine sediments from the Gulf of California (IMAGES site MD02-2515). We employ geochemical proxies to reconstruct sea-surface temperatures, biological production, wind strength and runoff in order to investigate changes to ocean and atmospheric circulation. We present evidence for southern-hemisphere forcing of sea-surface temperatures but a biological response to northern hemisphere events during T1. Using two organic geochemistry proxies (the UK37' and TEXH86 indices), we reveal different expressions of the deglacial sea-surface warming, and attribute the observed differences to changes in wind-driven upwelling intensity. Enhanced precipitation and runoff into the Gulf of California coincide with the Heinrich 1 and Younger Dryas stadials, reflecting an atmospheric response to the events originating in the North Atlantic. In contrast, these events are not reflected in the sea-surface temperature data. Fully-coupled climate model simulations for the glacial maximum and Heinrich events confirm the proxy data results: that neither the modern seasonal or inter-annual cycles are valid analogues for glacial or deglacial climates in the tropical Pacific.