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The mechanisms of orbital and suborbital-scale productivity variations in the Eastern Equatorial Pacific

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The Eastern Equatorial Pacific (EEP) is known to exhibit high seasonal, interannual (ENSO-like) and longer-term climatic variability with possible worldwide consequences, however, the origin of the suborbital-scale changes in the region is still enigmatic. The centennial to millennial scale variations in the foraminiferal-based MAT-derived SST, productivity index (FP index estimated as the total faunal portion of the three productivity-related planktic foraminiferal species) and coccolithophore-based quantitative productivity record are investigated over MIS 3 and three glacial-interglacial terminations in the IMAGES Core MD02-2529 off Costa Rica (8°12.5' N, 84° 07.5' W, w.d. 1619 m). The stratigraphic framework over three climatic cycles is based on the benthic d 18O record performed on C. wuellerstorfi, and on the published time-scale for last 90 ka (Leduc et al. 2007). The results of the study provide new insight on the mechanisms of productivity variations in the EEP. FP index and total planktic foraminiferal abundance increase concurrently with the previously established salinity raise (Leduc et al.2007) at six H-events (from H-6 to H-1) and at the Younger Dryas relative to the adjacent values. SST record does not show any consistent positive or negative correlation with H-events. The longer-lasting events of enhanced FP index values associate with all three terminations, whereas SST and the total portion of foraminiferal oligotrophic species increase by the end of terminations. The recurrent increase in bioproductivity during H-events may be interpreted in terms of intensified nutrients supply at the core site. At present, bioproductivity at site MD02-2529 is influenced by the seasonal cycle and associated shifts of the Costa Rica Dome and by propagation of eddies and filaments from the nearby coastal upwellings in the Panama Bight and Gulf of Papagayo with the Ekman drift. As these seasonal upwellings are known to be driven by coastal wind jets associated with the northeast trade winds, they might be intensified during the H-events. The strengthening of the northeast trade winds and coastal jets could also affect the migrations of the Costa Rica Dome. The strengthening of the northeast trade winds in turn is in line with southward ITCZ shifts during the H-events suggested by several authors. Enhanced productivity may also result from a shallowing of pycnocline due to reduced moisture supply from the Caribbean and corresponding increase in sea- surface salinity at H-events at site MD02-2529 demonstrated by Leduc and co-authors (2008). Thus, changes in surface water salinity and bioproductivity in the EEP seem to reflect mainly the atmospheric teleconnections with the high northern latitudes during several intervals of the AMOC slowdown. On the other hand, the intervals of enhanced foraminiferal abundance and FP index corresponds to the intervals of maximum PP values estimated from coccolithophore assemblages over terminations which call on the shallow pycnocline and to more persistent La Nina-like conditions. The spectral analysis demonstrates the significant precessional control of both coccolithophore and foraminiferal-based productivity records. The productivity shifts at terminations are also coeval with the intervals of depleted carbon isotope values measured on subsurface planktic foraminifera in the EEP. As the shifts in carbon isotopes were previously interpreted by several authors in terms of nutrients advection from the Southern Ocean to the EEP at thermocline level the concurrent increase in bioproductivity may result from this oceanic teleconnection between the two regions associated with the reorganization of the THC over terminations. Hence, unlike the short-term productivity increase at H-events the longer-lasting shifts over terminations may imply different mechanisms including the orbital (mainly precessional) control, ENSO-like variability and oceanic teleconnections.