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Effects of orbital-scale ITCZ fluctuations on the mid Cretaceous tropical Atlantic region

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Shifts of the Inter Tropic Convergence Zone (ITCZ) on Milankovitch time scales have profound effects on the climate-ocean system of tropical regions. Changes in wind systems, regional hydrology and continental runoff linked to past fluctuations of the ITCZ are well known to have triggered a complex chain of forcing and feedback mechanisms between the regional biosphere and geosphere. In our study we explore these relationships for the mid-Cretaceous super-greenhouse. We present proxy records from two regions of the Coniacian tropical Atlantic, ODP Site 959 (West Africa off Ivory Coast) and ODP Site 1261 (Northern South America off Suriname) and compare them with results of GENESIS Atmospheric General Circulation modeling. Our data suggest that bioproductivity in the eastern tropical Atlantic mainly followed a precession controlled cyclic pattern which was closely linked to changes in nutrient and freshwater supply via continental runoff from the African continent. Different from that bioproductivity in the western tropical Atlantic shows a strong obliquity and eccentricity cycle pattern. We propose that these differences in the west were mainly caused by fluctuations in wind-driven upwelling off northern South America with a constant and high supply of nutrients from the continent maintaining the ocean redox system anoxic without interruption. Bioproductivity from wind-driven upwelling in the west would have pushed the water column into repetitive sulfidic conditions (euxinia), as confirmed by geochemical evidence. Overall bioproductivity east and west of the tropical Atlantic was high supporting deposition of extensive black shale deposits. The observed differences in depositional patterns on both sides of the Coniacian tropical Atlantic support that (orbital-driven) fluctuations of the ITCZ were mainly responsible, with strong contrasts in regional moisture distribution over Africa and South America and local strengthening of the trade wind system causing upwelling off tropical South America.