HOLOCENE CHANGES IN THE INTERTROPICAL CONVERGENCE ZONE OVER SOUTH AMERICA

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RESUMO: Modern rainfall over northeastern (NE) South America is highly sensitive to and strongly controlled by the position of the Intertropical Convergence Zone (ITCZ). The ITCZ is a tropical belt of maximum precipitation resulting from deep convection (i.e., rising limb of the Hadley circulation) over the oceans. Deep convection is associated with low-level convergence above the warm tropical oceans. The ITCZ controls precipitation over NE South America because the dominant tropical easterly winds (i.e., trade winds) bring Atlantic moisture onto the continent. Today, semi-arid northern NE Brazil receives ca. 50 % of its total annual precipitation during March-April, when the ITCZ and the associated equatorial precipitation reach its seasonal southernmost position over NE South America. Ample evidence from the Northern Hemisphere suggests a mid- to late Holocene southward migration of the ITCZ. One such shift would be expected to increase precipitation over semi-arid northern NE Brazil (Southern Hemisphere). However, the most expressive precipitation record from northern NE Brazil shows a drying trend throughout the Holocene. Here we address this apparent contradiction presenting a high temporal resolution reconstruction of precipitation over northern NE Brazil based on data from a marine sediment core, together with analyses of mid- and late Holocene simulations of a fully coupled climate model. More specifically, we reconstructed changes in rainfall through three independent approaches: (i) bulk sediment ln(Fe/Ca) and ln(Ti/Ca) values; (ii) mass accumulation rate of the siliciclastic fraction; and (iii) stable hydrogen isotopic composition of plant waxes. A mechanistic understanding of the reconstructed changes from our core and other NE South American ITCZ-related high temporal resolution records was attained by specific analyses of FGOALS-s2 climate model simulations. Our data show a decrease in precipitation over northern NE Brazil from the mid- to the late Holocene that is supported by the climate model. The model outputs further indicate a latitudinal contraction of the seasonal migration range of the ITCZ that, together with an intensification of the regional Walker circulation, were responsible for the mid- to late Holocene changes in precipitation over NE South America. Our results conciliate apparently conflicting precipitation records and climate mechanisms used to explain changes in precipitation over NE South America.

PALAVRAS-CHAVE: PRECIPITATION; INTERTROPICAL CONVERGENCE ZONE; HOLOCENE.

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