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Early Holocene northward shift of the ITCZ and the Indian summer monsoon rains over Arabia: An alternative view

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Lake levels in basins in areas bordering northern Arabian Sea have been used to reconstruct regional paleohydrological patterns and to deduce paleoclimatology through lake-level statuses. For the early-middle Holocene, dramatic increases in regional rainfall have been proposed for Arabia. These rainfall changes are commonly thought to be associated with an intensified Indian summer monsoon and a large northward shift in the latitude of the boreal summer ITCZ over the Indian Ocean; this shift was proposed to reach latitudes as far north as the Levant. Currently, however, the Indian summer monsoon forces total summer drought not rains, in the Levant and neighboring deserts, including Arabia. The drought is due to large-scale air subsidence, which dries the region except in southernmost Arabia, where topography lifts air and produces orographic rain. This is assisted by increased upwelling that limits rainfall inland. These observations raise questions of how large the actual changes in paleohydrology were in the Arabian Peninsula, and what the real causes, if not the Indian summer monsoon, of these changes were. To address these questions we summarize paleohydrologic information from Arabia and specifically revisit the paleolake status of all lacustrine-like deposits and their basins in Arabia. From reinterpretation of these data and sedimentology and fauna, we conclude that these basins were occupied by shallow marsh environments, not lakes. Consequently, the paleohydrologic changes required to support restricted wetland versus lakes were much smaller. These conclusions are supported by the temporal and spatial distribution of other Holocene paleoclimate and paleoenvironment indicators such as pollen and speleothems. They indicate that (a) rainfall changes were very small in the heart of and northern Arabia, and (b) that these changes were only at the elevated edges of southwestern, southern, and southeastern Arabian Peninsula, where it rains at present, mainly due to orographic effects on precipitation in the presence of increased moisture supply. We propose that (a) latitudinal and slight inland impact expansion of the North African summer monsoon rains across the Red Sea, and (b) its uplifted air to southwestern Arabia highlands, rather than rains associated with intensification of Indian summer monsoon, increased rains in that region, producing the modest paleowetlands in downstream hyperarid basins.