Indian Monsoon and westerlies during the Holocene - consequences for the oxygen minimum zone in the NE Arabian Sea

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The northeastern (NE) Arabian Sea is highly influenced by the strength and variability of the Indian Monsoon (IM) and the westerlies. They largely impact the biogeochemical environment and sedimentation processes in this region. At present, a pronounced oxygen minimum zone (OMZ) is situated at water depths between 100 and 1200 m. It is sustained by high productivity due to monsoonal upwelling in the western and wind-induced surface mixing in the NE Arabian Sea. Studies from the Arabian Sea show variations of the OMZ strength throughout the Holocene. While the influence of the southwest (SW) IM on the OMZ is well understood, the interaction and variability of the NE/SW IM and the westerlies are more complex in the NE Arabian Sea and dated paleoclimate records diverge from the western upwelling margin.

We present a Holocene high resolution sedimentary record from the upper OMZ (314 m depth) in the NE Arabian Sea. To better understand the interaction and variability of the IM and westerly realms on the OMZ, we use a multi-proxy approach based on mineralogical (grain size, major and trace elements) and biogeochemical (bulk, opal, $\delta^{15}N$) analyses. High productivity (low $CaCO_3$/Opal ratios, high $\delta^{15}N$ values) during the early Holocene suggests strong IM and increased humidity by the westerlies. Prevailing humid conditions but weaker winds are indicated between 6.5 and 8 ka BP and lowered the productivity in the NE Arabian Sea. The following productivity increase around 4.2 to 6.5 ka BP coincides with enhanced westerly winds and increasing OMZ volume/strength. The last 4 ka BP are characterised by aridification and stronger winds, higher productivity and strengthening of the OMZ in the NE Arabian Sea realm. Overall, the influence of the westerlies on the OMZ increased throughout the Holocene.