Last glacial to Holocene sedimentation patterns and coccolithophore dynamics in the northwestern Bay of Bengal in response to South Asian monsoon strengthening

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In the modern northern Indian Ocean, biological productivity is intimately linked to near-surface, ocean–atmosphere dynamics forced by the South Asian monsoon (SAM). The interplay between monsoon winds and precipitation, ocean carbon cycle feedbacks, and climate forcing mechanisms in the oceanographically heterogeneous Bay of Bengal remains poorly understood. In the southern Bay of Bengal, seasonally reversing winds are the dominant control on mixing that brings nutrients into the mixed layer, thus stimulating productivity. However, in the northern Bay of Bengal, monsoon precipitation and runoff that peaks during the late summer–early autumn strongly influences upper water column structure, inducing strong stratification that may inhibit phytoplankton productivity.

Here, we present new high-resolution records of past biogenic sediment mass accumulation rates, coccolith assemblages, coccolith $CaCO_3$ export, and coccolith morphology that span the period from the Last Glacial Maximum to the Holocene (the last ~26 kyr). We examined samples from International Ocean Discovery Program (IODP) Site U1446 in the Mahanadi Basin (NW Bay of Bengal), a region strongly impacted by monsoon runoff. During the Last Glacial Maximum and the following deglaciation, we found that an increase in the relative abundance of upper photic zone coccolithophore species coincided with reduced stratification and runoff, which potentially increased nutrients as a result of a weaker SAM. In contrast, the lower photic zone species *Florisphaera profunda* displayed a higher relative abundance during the Holocene (up to 80%) due to strong salinity stratification that can be linked with increased precipitation and runoff that was the result of a stronger Indian Summer Monsoon (ISM). Throughout the study interval, and in particular under conditions of maximum stratification in the Holocene, *F. profunda* coccoliths dominated coccolith absolute abundances and mass accumulation rates, highlighting the importance of deep photic zone species in coccolith $CaCO_3$ and potentially organic C export into certain environments. Within the reticulofenestrid coccoliths, smaller morphotypes dominated during the strongly stratified Holocene, whereas larger reticulofenestrid coccoliths were more abundant during the glacial and deglaciation. Within the <3 μm reticulofenestrid coccolith group, mean coccolith mass decreased from the glacial to the Holocene, suggesting that more stratified and/or fresher conditions favored smaller and more lightly calcified morphotypes.