Transatlantic gradients in coccolithophore species fluxes: Influence of thermocline depth, Amazon water and Saharan dust

Catarina V. Guerreiro
University of Lisbon, MARE, Marine and Environmental Science Center, Campo Grande, 1749-016 Lisbon, Portugal; University of Bremen, Geosciences Department, 28359 Bremen, Germany; cataguerreiro@fc.ul.pt
Karl-Heinz Baumann
University of Bremen, Geosciences Department, as above; baumann@uni-bremen.de
Geert-Jan A. Brummer
NIOZ Royal Netherlands Institute for Sea Research, Department of Ocean Systems, Texel, The Netherlands; Utrecht University, Utrecht, The Netherlands; Vrije Universiteit Amsterdam, Department of Earth Sciences, Faculty of Science, 1081 HV Amsterdam, The Netherlands; geert-jan.brummer@nioz.nl
Gerhard Fischer
University of Bremen, Geosciences Department, as above; University of Bremen, MARUM – Center for Marine and Environmental Sciences, 28359 Bremen, Germany; Gerhard.fischer@uni-bremen.de
Laura F. Korte
NIOZ, as above; Utrecht University, as above; laura.korte@nioz.nl
Ute Merkel
University of Bremen, Geosciences Department, as above; University of Bremen, MARUM, as above; umerkel@marum.de
Carolina Sá
University of Lisbon, MARE, as above; University of Algarve, CIMA, Center for Marine and Environmental Research, 8005-139 Faro, Portugal; cgsa@fc.ul.pt
Henko de Stigter
NIOZ, as above; Utrecht University, as above; henko.de.stigter@nioz.nl
Jan-Berend W. Stuut
NIOZ, as above; Utrecht University, as above; Vrije Universiteit Amsterdam, as above; jan-berend.stuut@nioz.nl

Tropical oceans provide interesting perspectives as modern analogues for future ocean productivity, in the context of an increasingly warm, stratified and nutrient-depleted upper ocean. In order to obtain knowledge of the spatiotemporal variability of the phytoplankton communities thriving in these regions, we investigated one year of coccolithophore export fluxes and seasonal dynamics from a transatlantic transect of four sediment traps, moored between NW Africa and the Caribbean (at ~12ºN). The results show large ecological contrasts across the transatlantic array. Wind-forced, basin-scale variations in the thermocline/nutricline were clearly reflected in the distribution of distinct coccolith species fluxes. The surface-dwelling, opportunistic species *Emiliania huxleyi* and *Gephyrocapsa oceanica* decreased in abundance from east to west, while the deep-dwelling species *Florisphaera profunda* and *Gladiolithus flabellatus* increased in the same direction. Decreasing abundances of the surface-dwelling, opportunistic species *Emiliania huxleyi* and *Gephyrocapsa oceanica* from east to west, and the concurrent increase of the deep-dwelling species *Florisphaera profunda* and *Gladiolithus flabellatus* in the same direction, followed the geostrophic shoaling (deepening) of the thermocline/nutricline towards the eastern (western) tropical North Atlantic. We found that coccolith fluxes at the westernmost site (M4), closest to the Caribbean, at 49°W, were up to three to five times highe than at the other sites, including the highly-productive Cape Blanc upwelling region, and were primarily due to coccolith production in the poorly-illuminated lower photic zone. Finally, the pulsed flux maxima of opportunistic species, which were also observed in the western tropical North Atlantic, point to the occurrence of intermittent nutrient input. This is the result of sea-surface cooling and wind-forced vertical mixing that combines with dry dust deposition in the spring, and nutrient enrichment derived from Amazon River discharge that combines with wet dust deposition in the fall. Our findings: 1) provide relevant evidence to support the hypothesis that Saharan dust acts as a fertiliser for marine phytoplankton in the Atlantic Ocean; and 2) highlight the importance of coccolithophore production in the lower photic zone, with potential implications for the oceanic carbonate budget.