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Assessing the relationship between Saharan dust input and export of organic material in the deep eastern Mediterranean Sea using a one-year sediment-trap record

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Dust deposition can trigger phytoplankton growth in oligotrophic low nutrient low chlorophyl (LNLC) regions by providing essential nutrients to the surface ocean. As LNLC regions comprise 60% of the global ocean, dust fertilisation and potential subsequent increased downward carbon export could affect the strength of the biological carbon pump considerably. Additionally, ballasting effects of large dust particles could enhance downward carbon export even further, independent from fertilisation effects. However, compared to high nutrient low chlorophyl (HNLC) regions, the biogeochemical effect of dust deposition and its sensitivity to future climate change is less well understood for LNLC regions. For the LNLC Mediterranean Sea mesocosm experiments and satellite data suggest that some, but not all, dust events lead to increased primary production. However, the exact relationship between dust deposition, productivity and carbon export remains unresolved.

Here, we aim to identify and quantify the relationships between Saharan dust deposition (deposition mode, dust source), phytoplankton response (changes in community composition, phytoplankton vs heterotrophic bacterial growth) and carbon export in the eastern Mediterranean Sea by studying an exceptional high-resolution, 30-year sediment-trap time series of settling Saharan dust particles and phytoplankton remains (partly at 500m, 1500m, and 2500m water depth), combining sedimentological, biogeochemical, and remote sensing techniques. We here present a combined record of dust and organic matter fluxes for one full year of the time series (April 2017 to May 2018, 2200m water depth). Furthermore, the response of specific phytoplankton groups to dust input as well as the input of terrestrial plant material associated with desert dust is determined based on the presence and distribution of lipid biomarkers in the trap material.

Dust fluxes vary substantially over this one-year period, but peaks occur during spring 2017 and 2018, summer 2017, as well as some smaller, less pronounced peaks during autumn 2017. Some of these dust events indeed correspond to increased fluxes of lipid biomarkers, suggesting a relationship between dust input and enhanced sinking of organic material. However, due to the depth of trap deployment, the record does not allow to differentiate between the influence of dust

input as fertiliser or as ballasting effect. This will later be assessed by comparing biomarker records from sediment traps from different depths representing the surface and deep ocean. Nevertheless, the lipid biomarkers representing different phytoplankton groups (e.g., long-chain alkenones for coccolithophores, 23,24-dimethylcholesta-5,22E-dien-β-ol for diatoms, dinosterol for dinoflagellates, long-chain diols for eustigmatophytes) do not show a uniform response to dust input, indicating that the response of these phytoplankton groups depends on different conditions. Moreover, some dust events do not seem to trigger any phytoplankton response at all as they do not coincide with enhanced biomarker fluxes. This indicates that other factors such as dust source, deposition mode and/or trophic state of the surface ocean determine whether dust input triggers enhanced export of organic material or not. Differences in grain-size distribution and terrestrial plant content (indicated by terrestrial plant biomarkers) indeed suggest that the observed contrasting response might be due to differences in dust source and composition.