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Dissolved aluminium in the Gulf of Aqaba, northern Red Sea: On the short- and long- term effects of daily time scale dust storms, wet deposition and sediment resuspension

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Dissolved aluminium (Al) is a primary tracer for evaluating atmospheric deposition fluxes to the open ocean. However, the impact of daily time scale environmental perturbations such as dust storms, sediment resuspension and rainfall events on the oceanic water column is poorly constrained due to the typically low temporal resolution of sampling in open ocean settings. The Gulf of Aqaba (GoA), northern Red Sea, is a highly accessible deep oligotrophic water body featuring exceptionally high atmospheric dust deposition rates, delivered primarily during discrete dust storms.

Here, we report a highly resolved time series of vertical profiles of dissolved Al and silicate concentrations sampled during 2017 and 2018 in the GoA, with a particular focus on daily time scale dust storms, episodes of sediment resuspension and rain events. We evaluate the results in conjunction with high temporal resolution measurements of airborne aerosols and sediment trap based water column sinking particulate fluxes.

Dissolved Al concentrations range between 22 and 91 nmol kg^{-1} and are controlled in shallow waters by dissolution and scavenging processes induced by atmospheric inputs. At depth, Al inventories are mainly controlled by diatom remineralization and to a lesser extent (3-8%) by partial dissolution of resuspended sediments. Counter intuitively, mixed layer Al (Al_{ML}) inventories decrease with increasing aerosol loads, with dust storms promoting intense Al scavenging, abruptly driving down Al_{ML} by up to 14%. By contrast, wet deposition may enhance the soluble Al flux from mineral dust by a factor of 13. Post dust storm Al_{ML} change rates decline linearly with increasing theoretical dissolution rates following the Dry Deposition Curve. Accordingly, low particle density conditions driven by low magnitude dust storms and deep mixing depths will result in scavenging favoring conditions. In response to a sediment resuspension event, Al water column inventories decreased by 34% as dissolved Al was mainly scavenged onto resuspended sediments and only mildly (2-5%) incorporated into diatom frustules.

The *in-situ* rates and insights presented here may be incorporated into atmospheric deposition models to better quantify and understand the short- and long-term impacts of abrupt environmental events on water column chemical compositions.