A trans-Atlantic study of African dust collected over the ocean

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Poster outline

1. Data collection
2. Potential source locations and sampling route
3. Satellite images giving insight into the pathway of major dust outbreaks during the first days of sampling
4. A representation of the amount of pollen, fungi spores and diatoms found in the dust samples

Background

Each year, about 180 megaton of dust is transported from the African continent westward across the Atlantic Ocean, of which 140 megaton is deposited on the ocean surface (Yu et al., 2015) resulting in stimulation of phytoplankton growth (Pabortsava et al., 2017). African dust emissions can therefore have a major influence on our global climate. Changes in these dust emissions are expected to occur with global climate change due to their high sensitivity to fluctuations in hydrology and land-use (Pausata et al., 2020). It is therefore important to understand the distribution of the most significant dust emissions, the source locations of these emissions and the source-to-sink variability of emitted dust.

Here, we present a set of dust samples that were collected over the Atlantic Ocean while sailing from the Canary Islands to Martinique onboard the clipper Stad Amsterdam in December 2023. This data set provides the unique opportunity to study downwind compositional changes of northwest African dust.

The aim of this study is to identify the main contributing source location(s) and major downwind trends of dust that is blown across the tropical North Atlantic Ocean during boreal winter. The techniques that will be applied are: counts of different functional groups (pollen, diatoms, fungi), fluxes, particle size and bulk chemical composition.

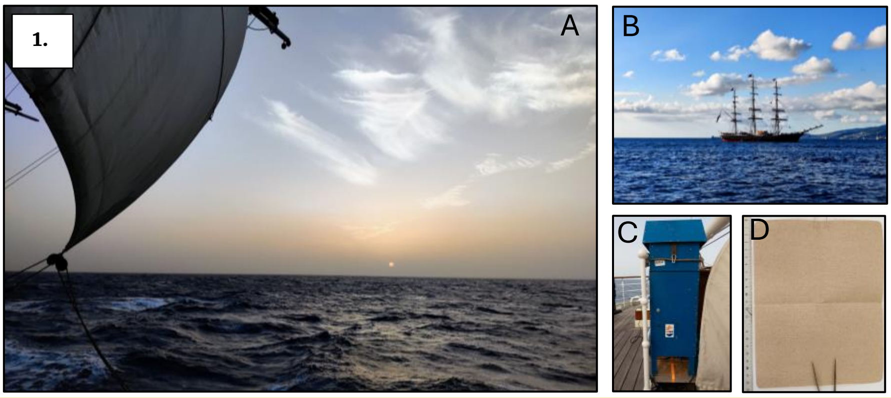
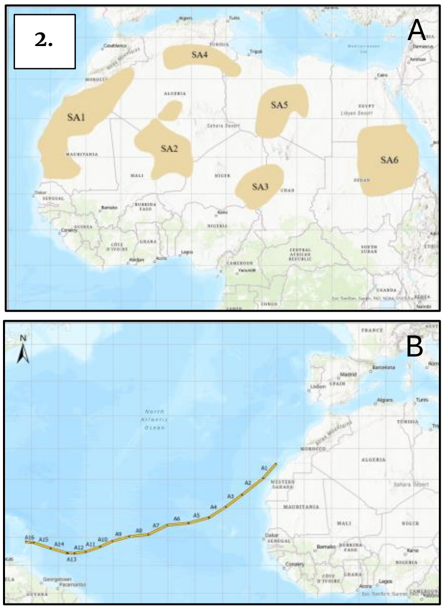


Figure 1 (A): An example of how dust reduces visibility over the North Atlantic Ocean (photo taken during sample A4); (B): clipper Stad Amsterdam in the harbour of Martinique; (C): NIOZ Dust sampler mounted on the deck of clipper Stad Amsterdam; (D): An example of a cellulose acetate filter after 24h collection time (~1,800 m³ of filtered air).



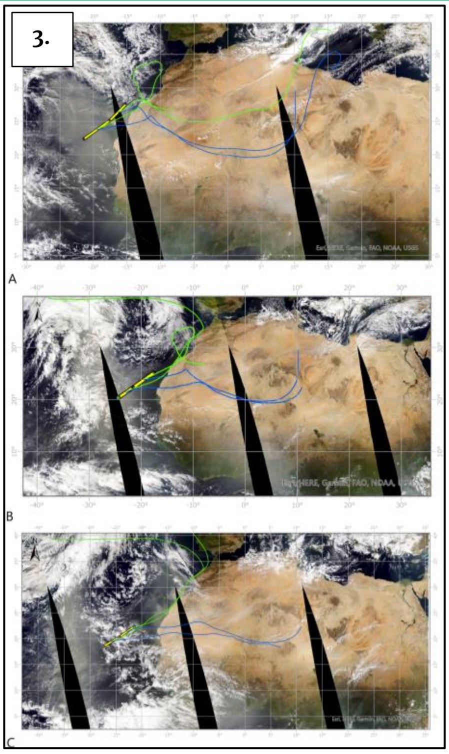


Figure 2 (above) (A): major potential dust sources (SA1 – SA6) (modified after Scheuvens et al., 2013); (B): Sampling numbers and route

Figure 3 (left): Three satellite images (EOSDIS) depicting pathway of major dust outbreaks including five-day back trajectories starting at 10 m altitude (green) and 500 m altitude (blue) at sampling location. (A): image from 14-12-2023; (B): image from 15-12-2023; (C): image from 16-12-2023

Figure 4 (right): An example of Aulacoseira, which make up the bulk of all the diatoms identified in the samples

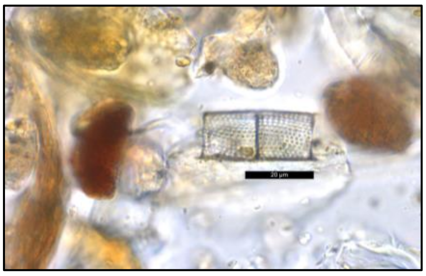
Initial results and outlook

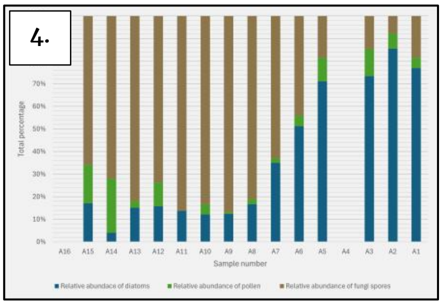
First results

- Satellite images (figure 3) and dominant activity of NE-tradewinds indicate a high probability for source locations SA1 and SA2
- Results from HYSPLIT model indicate a high probability for source locations SA1 and SA2
- High amount of diatoms present in dust samples (figures 4, 5 and 6) could be an indication for source location SA3 (former Mega-lake Chad), which is known for its high quantity of diatom skeletons (Bristow et al., 2009)

Next steps

- Quantify changes in grainsize and fluxes
- Quantify changes in bulk chemical composition through XRF analyses
- Identify the pollen and diatom content in the dust samples





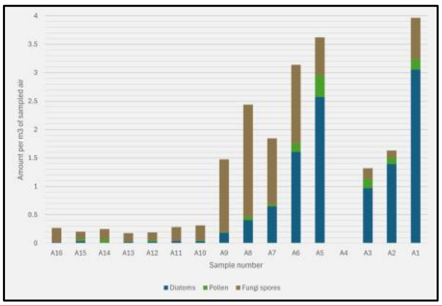


***Figure 5** (above left): Column chart depicting the relative abundance of diatoms, pollen and fungi spores found in the dust samples*
***Figure 6:** (above right) Column chart depicting the absolute abundance of diatoms, pollen and fungi spores found in the dust samples*

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