surface ocean solas lower atmosphere study

solas event report

Report 41 I November 2025

Iron at the Air-sea Interface Workshop (joint with RUSTED 2025)

28-31 July 2025
Asheville, USA and Online

From 28th to 31st July, 2025, the [Iron at the Air-Sea Interface Workshop]() was held in Asheville, North Carolina (USA). The workshop was conducted in hybrid mode with asynchronous online discussion sessions held to facilitate participation from researchers all around the globe. Participants included researchers spanning career stages from graduate students to senior scientists, with strong representation from both atmospheric and marine science communities. Early-career scientists (from graduate students to 10 years post-PhD defence) represented nearly 50% of both the onsite and the virtual participant groups. Fifty-four participants (23 onsite and 31 online) attended the event, representing institutions from 13 different countries across North America, Europe, Australia, and Asia. More than one-third of participants were female researchers, continuing the workshop series' commitment to diversity and inclusion.

The workshop convened international experts in atmospheric-ocean interactions and biogeochemistry to explore cutting-edge knowledge about trace element cycling at the air-sea boundary. Trace elements such as iron (Fe), manganese (Mn), and zinc (Zn) serve as essential nutrients for marine phytoplankton, while others,

In this report

Attendees research profiles

Figure 1: Participants of the Iron at the Air-Sea Interface Workshop. Left to right - Front row: Dante Capone, Phoebe Scharle, Matthew Romm, Charlotte Kollman, Yuan Gao, Yingxi Shi, Yan Feng. Middle row: Daniel Ohnemus, Hope Elliott, Elisa Bergas Masso, Douglas Hamilton, Clifton Buck, Akinori Ito, Nicolas Cosentino, Zach Bunnell, Alexis Floback, Aditya Sonar. Back row: Nicholas Meskhidze, Tim Conway, Bill Landing, Eleanor Bates. Missing: Ashwini Kumar and Takamatsu Ito. Picture credit: Nicholas Meskhidze.

such as copper (Cu), can reach toxic levels at certain concentrations (Hamilton *et al.*, 2023). Elements like aluminum (Al) and titanium (Ti) function as indicators of atmospheric dust deposition into the ocean. Understanding shifts in trace element fluxes from the atmosphere to the ocean is critical for assessing ocean function and the overall health of marine ecosystems on a global scale.

This workshop continued the work initiated by earlier Iron at the Air-Sea Interface workshops held in Telluride (2018) and Asheville (2020). The inaugural 2018 workshop produced a forward-looking publication that provided concrete recommendations for future laboratory experiments, field observations, and modelling studies focused on iron biogeochemistry at the air-sea boundary (Meskhidze *et al.*, 2019). The second workshop in 2020 concentrated on identifying knowledge gaps and investigating emerging approaches for utilising remote sensing data to collect information about the atmosphere-ocean interface (see SOLAS Event Report Issue 20).

Workshop Themes

The 2025 edition of the workshop, initiated by members of the Scientific Committee on Oceanic Research (SCOR) Working Group 167 Reducing Uncertainty in Soluble aerosol Trace Element Deposition (RUSTED), was dedicated to identifying challenges and developing solutions to advance collaborations across atmosphere-ocean research domains. The goal was to better understand the biogeochemical and synergistic cycling of trace elements at the air-sea interface. The workshop was organised around five key themes identified as major challenges that prevent a better understanding of trace element cycling within the coupled atmosphere-ocean system:

1. **Ocean models and extreme atmospheric deposition events** - Evaluating how contemporary biogeochemical models

simulate large-scale aerosol deposition events, highlighting research opportunities to increase comprehension of iron (and other trace element) cycling and marine biogeochemical cycle sensitivity to atmospheric aerosol deposition events

2. **From lab to global: scaling up laboratory solubility measurements** - Connecting laboratory iron solubility measurements to global-scale biogeochemical processes
3. **The next-generation air-sea interface observations** - Identifying critical processes at the atmosphere-ocean interface that current satellite observations cannot capture, and exploring next-generation remote sensing capabilities to address these gaps
4. **Community model intercomparison project** - Developing standardised protocols for atmospheric nutrient deposition modelling
5. **Trace element research integration** - Developing community-wide approaches to trace element research that foster collaboration across disciplines and standardise methodologies for improved data comparability

Key recommendations from the workshop included a strengthening of global research efforts around the following aspects:

- **Mechanistic model development**: Focus on process understanding of trace element cycling and biological uptake across the air-sea interface to aid in the development of models and research into how biogeochemical cycles are changing
- **Standardisation of methods**: The community identified an urgent need for standardised approaches to measure soluble iron, including interlaboratory comparison studies and development of reference materials
- **Multi-platform observation systems**: Assessment of the potential for integration of satellite, ship-based, water column, and autonomous platform observations to capture and quantify atmospheric nutrient deposition processes across a wide range of spatiotemporal scales
- **Source attribution capabilities**: Further development of methods to aid in distinguishing between iron and other trace element sources, each with different temporal signatures and biogeochemical impacts

Community initiatives launched during the workshop aim at supporting future research to meet the identified research needs. For example, a new publicly available atmospheric trace element database was showcased, which provides free and centralised access to published atmospheric trace element data for enhanced global analysis and model development. As a legacy to the SCOR working group 167 activities, a large community Model Intercomparison Project (MIP) effort is being planned and international coordinators were identified for each of the MIP side projects. To advance this initiative, the MIP of Atmospheric Nutrient Deposition with RUSTED will be discussed at the Kyoto Coupled Model Intercomparison Project Phase 7 (CMIP7) workshop to be held in early 2026. The model intercomparison protocol was discussed during the workshop to help establish standardised procedures for needed atmospheric nutrient deposition simulations, including common forcing data and validation approaches.

Workshop participants agreed to produce a white paper synthesising key findings and proposing future research directions. To further disseminate workshop outcomes, a special session entitled "Advances in Understanding Natural Aerosols and Gases in the Earth System" is scheduled for the 2025 American Geophysical Union (AGU) Fall

Meeting, targeting the broader Earth system science community.

The workshop brought together researchers from GEOTRACES (An International Study of the Marine Biogeochemical Cycles of Trace Elements and Their Isotopes), SOLAS, NASA (National Aeronautics and Space Administration), DOE (Department of Energy), and other programs, reflecting the interdisciplinary nature of iron and trace element biogeochemistry research. Continuous effort is made to expand the community network and include experts from other disciplines. During this workshop, it was identified that experts from the social sciences and humanities were missing, preventing in-depth discussions of the initially planned discussion topic 6 on the impact of human activities on global trace element cycles.

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Event sponsors

- U.S. National Science Foundation (NSF) - Atmospheric Chemistry Program
- SCOR Working Group 167 RUSTED - Scientific Committee on Oceanic Research
- North Carolina State University - Logistics support

Dante Capone is a PhD candidate at Scripps Institution of Oceanography focusing on the impacts of wildfires on marine biogeochemistry in the California Current. Previously, he earned undergraduate degrees in marine biology and earth science at University of California, Santa Cruz and worked as a coastal oceanographic data analyst at the Bodega Marine Lab.

Extreme wildfire conditions shift coastal California phytoplankton community structure

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Extreme wildfires are increasing in frequency and intensity in the Western United States, yet observations of their impacts on marine ecosystems remain poorly documented (Abatzoglou & Williams, 2016). We investigated how the 2020 California Lightning Complex Fires influenced phytoplankton communities in Monterey Bay, a coastal region with extensive oceanographic monitoring and direct exposure to megafires. Multiple long-term datasets including satellite chlorophyll-a, shore station measurements, nutrient observations, aerosol records, and an eight-year Imaging FlowCytobot (IFCB) time series were used to test whether wildfire aerosols altered ocean biogeochemistry and plankton community structure.

Large positive anomalies in wildfire aerosols ($PM_{2.5}$, aerosol optical depth, and black carbon) were recorded in Monterey Bay following the CZU, SCU, and August Complex Fires. Back trajectory analyses indicated that local fires, particularly the CZU Fire, were the most likely source of aerosol deposition to the coastal ocean. In contrast to studies documenting anomalous blooms in the iron-limited open ocean, chlorophyll-a showed no significant increase during the fire period (Tang *et al.*, 2021). In situ fluorometer measurements, weekly water samples, and satellite products all remained within seasonal norms, and no significant cross-correlations with wildfire aerosols were detected.

In contrast, the IFCB revealed strong community-level responses (Figure 2). During the onset of the fires, the smallest phytoplankton size class (15-21 µm) increased in abundance, followed by peaks in intermediate size classes (22-69 µm). This was accompanied by a dramatic decline in the normalised abundance size spectrum slope, indicating a shift in size structure. Taxonomically, small centric diatoms bloomed nearly contemporaneously with peak wildfire aerosols, followed by chain-forming diatoms including *Asterionellopsis*, *Skeletonema*, *Hemiaulus, Leptocylindrus*, *Thalassionema*, and *Thalassiosira* (Figure 3). Cross-correlation analyses showed significant associations between these taxa and $PM_{2.5}$, with a modal lag of ~6 days. Probability density functions confirmed that abundances of these diatoms during August-September 2020 exceeded comparable windows and were the highest amongst all years of the IFCB record. Generalised additive models

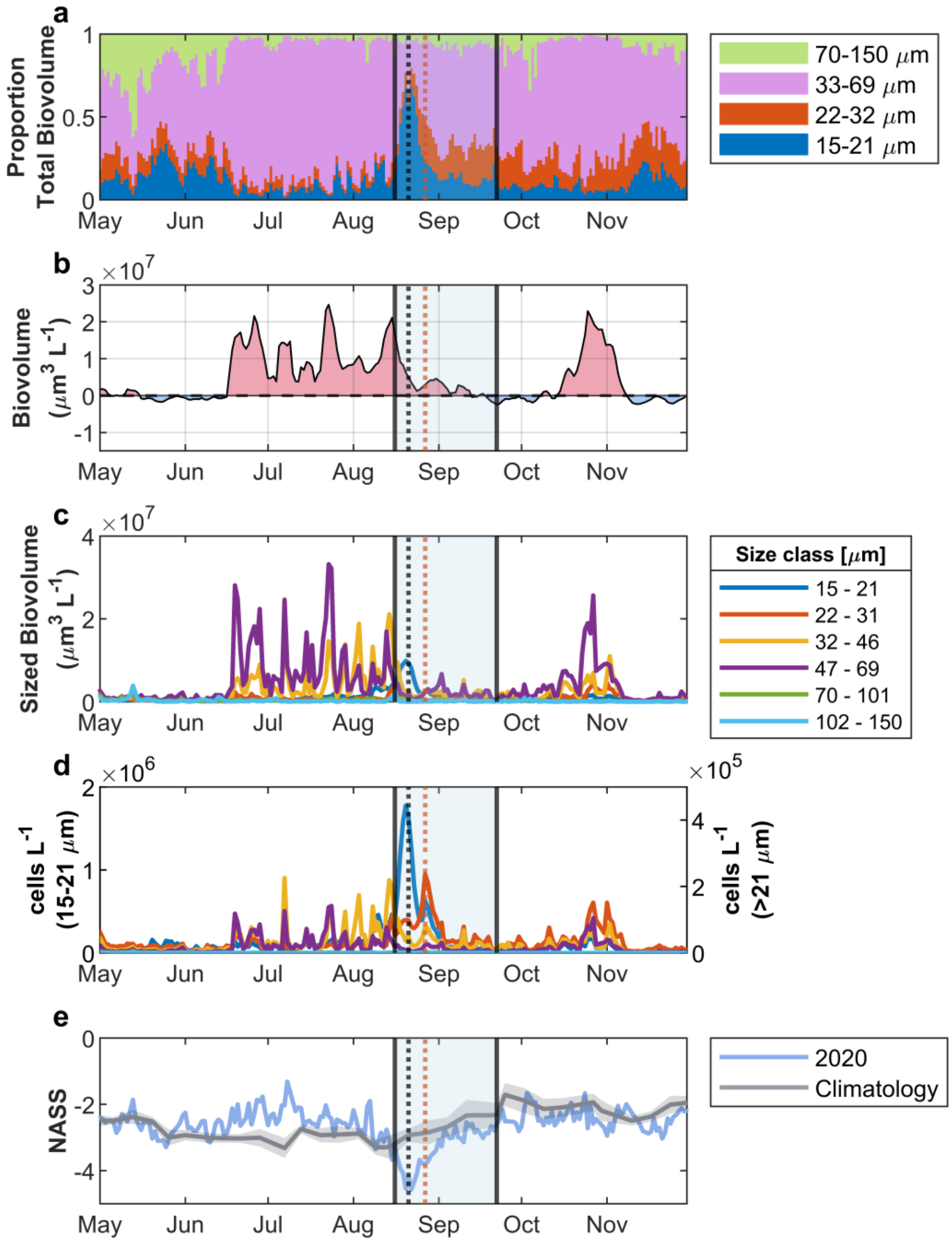

Figure 2: Imaging FlowCytobot (IFCB)-derived phytoplankton community morphometric time-series for May-October 2020. For all panels: the fire window (8/16-9/22/2020) is highlighted in light blue, the vertical dashed black lines correspond to peaks in the wildfire aerosols, and the vertical red dashed line is a 6-day lag following the peak in fire aerosols. a) Proportion of total community biovolume divided between 4 size classes, with the 4 largest size classes combined into 2 for visualisation. b) Community biovolume anomaly (μm^3 L^{-1}) computed as the difference between the observed total daily biovolume and the climatological weekly average. c) Total biovolume (μm^3 L^{-1}) summed for each of 6 logarithmically spaced bins between 15-150 µm. d) Total abundance (cells L^{-1}) summed for each of 6 logarithmically spaced bins between 15-150 µm with the smallest size class (15-22 µm) plotted on the left axis and the remaining size classes plotted on the right axis. e) The slope of the normalised abundance size spectrum (NASS; blue) and the weekly climatological mean is plotted in grey with standard error shaded.

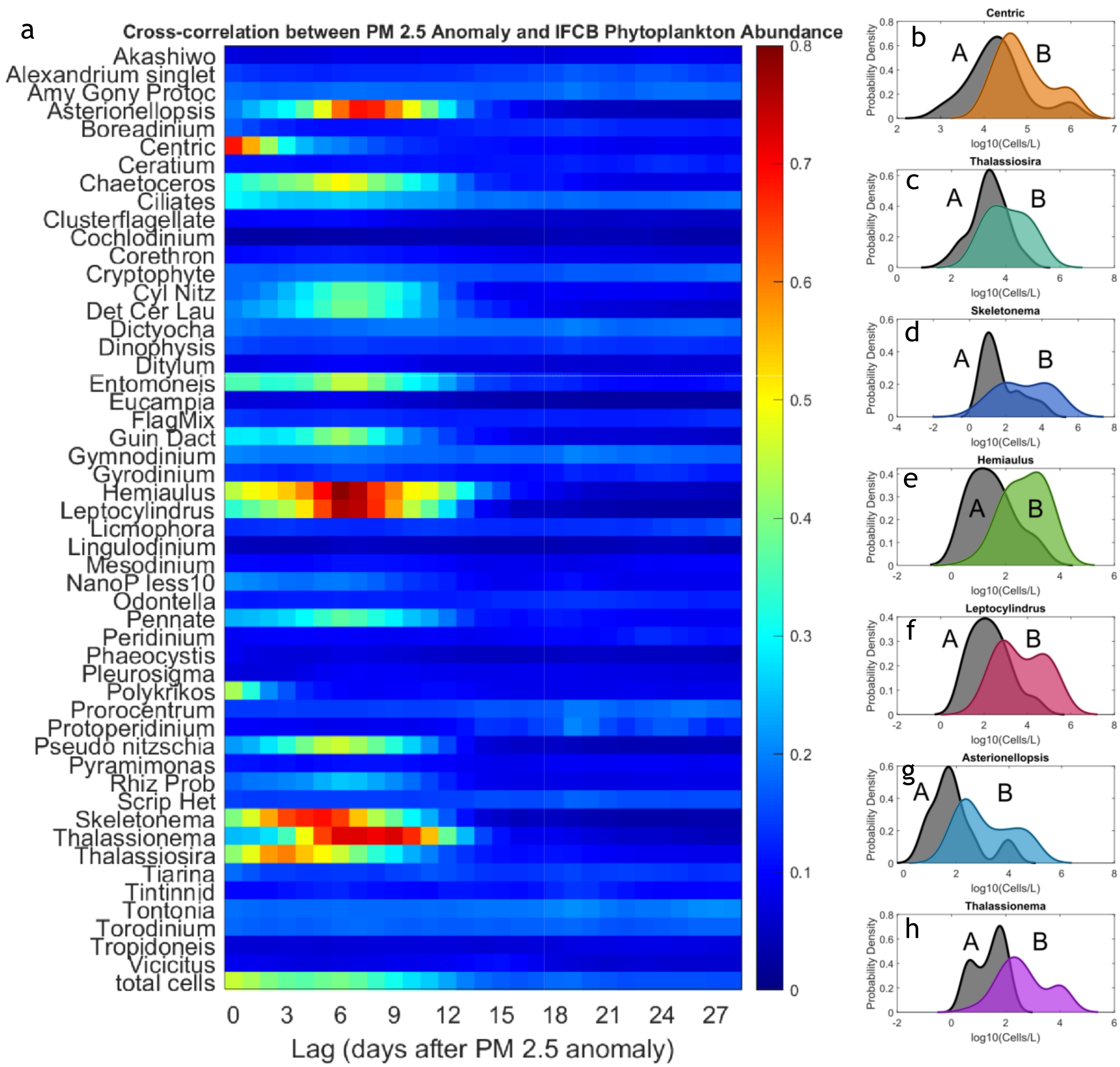

Figure 3: Taxon-specific cross correlation with wildfire aerosols and patterns of abundance during the 2020 wildfire period. a) Cross-correlation coefficients between Imaging FlowCytobot (IFCB) phytoplankton taxa and ground-based $PM_{2.5}$ observations at 0-15 day lags following the start of the wildfire aerosol anomaly. Taxa with significant correlations ($p_{adj}<0.05$) during the wildfire period are denoted with a "*". b-h) Probability density plots for 7 diatom taxa with strongest correlation coefficients showing the probability of abundance of plankton (Log_{10} cells L^{-1}) from the fire period for 2020 (color) compared with all other years (gray). Each 2020 Probability Density Function (PDF) is significantly different from the corresponding PDF in gray (Kolmogorov-Smirnov test, $p<0.05$).

identified $PM_{2.5}$ as a significant predictor of cell abundance across wildfire-associated diatom taxa, though its importance varied relative to physical drivers such as alongshore winds and upwelling. Comparisons with the broader IFCB time series revealed only two other occurrences of a similar assemblage (June 2018, April 2020), both with distinct environmental conditions and lower abundances.

Multiple interacting mechanisms likely explain the observed restructuring of phytoplankton communities. (1) Nutrient deposition from pyrogenic aerosols, particularly soluble iron or nitrogen, may have stimulated diatom growth (Hamilton *et al.*, 2020; Ito *et al.*, 2021). (2) Reductions in photosynthetically active radiation due to smoke shading could have favoured small cells less sensitive to light limitation (Finkel, 2001). (3) Altered grazing pressure may have played a role, as wildfire leachates have been shown to suppress microzooplankton feeding, releasing diatoms from top-down control (Baetge *et al.*, 2025). (4) Coincident physical drivers including stratification and anomalous wind conditions that both fuelled the fire's spread and structured coastal circulation may have set the stage for this unusual bloom.

These findings provide rare observational evidence that extreme wildfires can restructure coastal phytoplankton communities even without detectable changes in chlorophyll-a, building upon previous observations from coastal California (Kramer *et al.*, 2020). Sustained high-resolution monitoring and experiments that test the mechanisms identified here across different environments will be essential to understanding the ecosystem responses and carbon flows associated with increasing wildfires.

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Nicolás Cosentino is a geologist interested in the present-day and paleo mineral dust aerosol cycles, and in dust-climate interactions. He obtained his PhD at Cornell University (USA) and spent five years as a postdoc in Chile and Argentina, before taking a position as permanent researcher at Centro de Investigaciones del Mar y la Atmósfera (CIMA)-Instituto Franco-Argentino de Estudios sobre el Clima y sus Impactos (IFAECI) in Buenos Aires.

South American dust ocean fertilisation: Ironing out paleo-to-present observational challenges

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The magnitude of aerosol climate forcing represents one of the largest sources of uncertainty in representing current and future climate. Mineral dust is the most abundant atmospheric aerosol by mass, with this type of aerosol reducing atmospheric carbon dioxide (CO_2^{atm}) concentrations by fertilising iron (Fe)-limited oceans, which in turn enhances primary productivity. The resulting perturbation to the Earth's radiation budget is however highly uncertain, as the scientific understanding of this dust-climate interaction is very low (Kok *et al.*, 2023).

Southern South America (SSA) is the main dust supplier to the Southern Hemisphere's high-latitude oceans (e.g., Opazo *et al.*, 2025). In turn, these oceans dominate dust fertilisation-induced CO_2^{atm} drawdown, albeit with high uncertainty (e.g., Opazo *et al.*, 2025).

During the Last Glacial Maximum (LGM), CO_2^{atm} was 80-90 ppmv lower than during the pre-industrial (Figure 4). A significant fraction of this LGM reduction in CO_2^{atm} is estimated to be due to a stronger dust-induced forcing of the biological pump during dustier glacial periods. However, how much of the LGM reduction in CO_2^{atm} is due to dust ocean fertilisation is highly uncertain due to lack of data on: (1) size-resolved, paleo-dust deposition rate, particularly for under-sampled regions such as SSA (Cosentino *et al.*, 2024), and (2) the size-resolved soluble iron (SFe) content of paleo-SSA dust. As the LGM Patagonian ice sheet was 14-19 times more extensive than today (Figure 5), SSA dust was more glaciogenic and fine-grained during the LGM compared to today, due to enhanced glacial grinding. Also, in SSA glaciogenic dust was arguably enriched in SFe compared to non-glaciogenic dust (Simonella *et al.*, 2022), which is why better constraining glacial-interglacial changes in the indirect effect of dust on global climate through ocean fertilisation requires an understanding of the role of Patagonian glacial activity on the SFe content of SSA glacial dust sources.

Here we present project DustySAM, a project recently funded by the French Agence Nationale de la Recherche. DustySAM aims at constraining key parameters of the present-day and paleo dust cycles in SSA by combining observational and laboratory techniques (Figure 5). DustySAM aims to carry out: (1) a size-resolved aerosol monitoring program undertaken simultaneously at two sites, one located downwind of the other, that includes

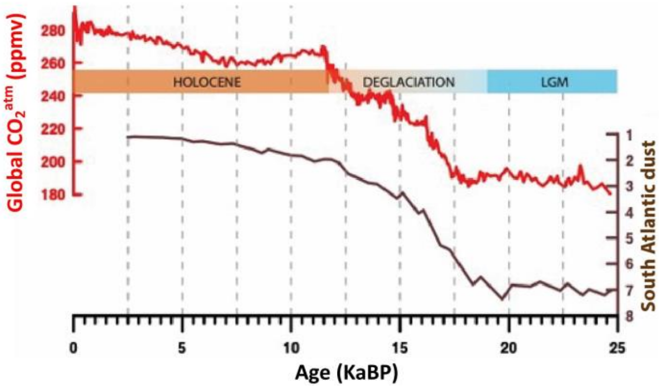

Figure 4: Global atmospheric carbon dioxide (CO_2^{atm}) from an Antarctic ice core, and dust deposition flux from a marine core in the South Atlantic (Lambert *et al.*, 2021). Note the inverted scale for dust deposition.

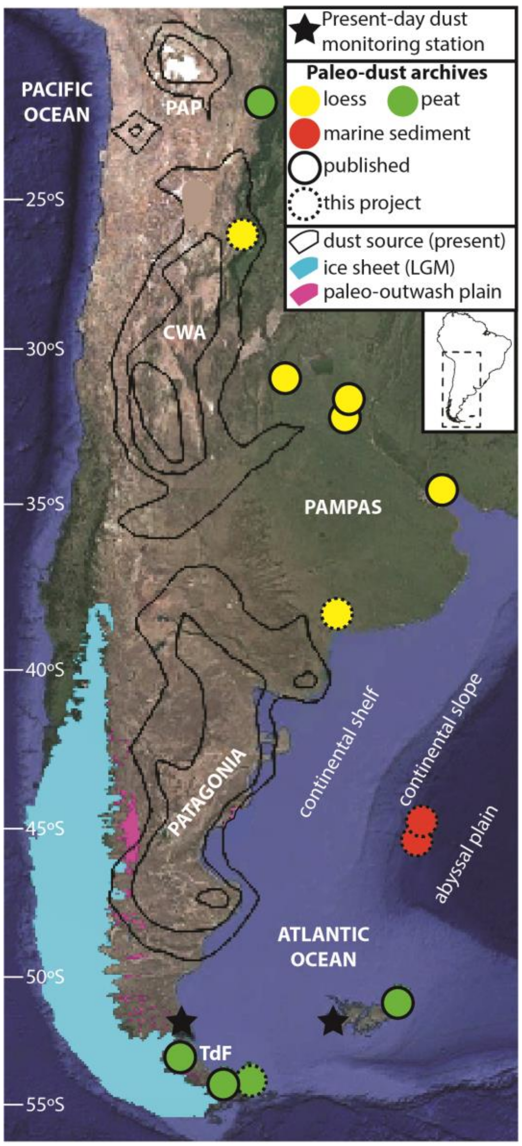

Figure 5: Published and projected sites to be studied as part of project DustySAM.

super-coarse (diameters between 10-62.5 µm) dust, as well as compositional studies to evaluate size-resolved mechanisms of Fe atmospheric processing, (2) a regional study of paleo-dust that combines different dust archive types both on land and offshore, and (3) the first ever estimations of source-inherited SFe in paleo-dust based on close-to-source dust archives.

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Anthropogenic contaminants at the air-sea interface, the example of micro and nanoplastics

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Plastic pollution has become an increasingly important issue that has now reached every compartment of the ocean, from surface to the deepest trenches (Lim 2021). A major factor in this pervasiveness is the fragmentation of plastic material into tiny micro and even nanoplastics (MNPs). These MNPs are now found in all ocean regions, including in aquatic organisms, but also in increasing quantity in the atmosphere, where inhalation is emerging as a significant human exposure pathway (Cox *et al.*, 2020). The widespread presence of MNPs in ocean and now atmospheric environments raises concerns regarding their potential impacts on ecosystems and even human health.

While atmospheric deposition of MNPs to the ocean is relatively small compared to riverine and coastal sources, it still plays an important role in shaping global MNP distribution. First, their specific source regions and atmospheric transport pathways lead to deposition in remote regions such as the Arctic that receive little MNPs from continental sources (Evangeliou *et al.*, 2022). Moreover, the predominantly fibrous nature of atmospheric MNPs may influence their distribution and interactions with biota (e.g. through ingestion by small organisms like zooplankton; Rodríguez-Torres *et al.*, 2024).

In a recent study combining ocean and atmospheric modelling of MNPs, Bucci *et al.* (2024) showed that accumulating MNPs at the surface ocean are emitted to the atmosphere through similar pathways to marine aerosols (bubble bursting). If atmospheric emissions do not constitute a significant sink of MNPs (emissions represent about 4.7 ppm of the global riverine inputs), they redistribute MNPs at the ocean surface (Figure 6). In particular, we observed net transport of atmospheric microplastics (MP) from the subtropical regions, which are major oceanic accumulation zones of MP, to the higher latitudes and even to the continents. Moreover, exploration of atmospheric concentrations of MNPs emitted from the ocean revealed that ocean MNPs may reach altitudes up to the troposphere, thus leading to potential impacts on cloud processes.

These findings underscore the need to include ocean-atmosphere MNP exchange in global models—not only to better understand ocean plastic pollution, but also to assess its broader impacts on atmospheric processes and potentially even climate systems.

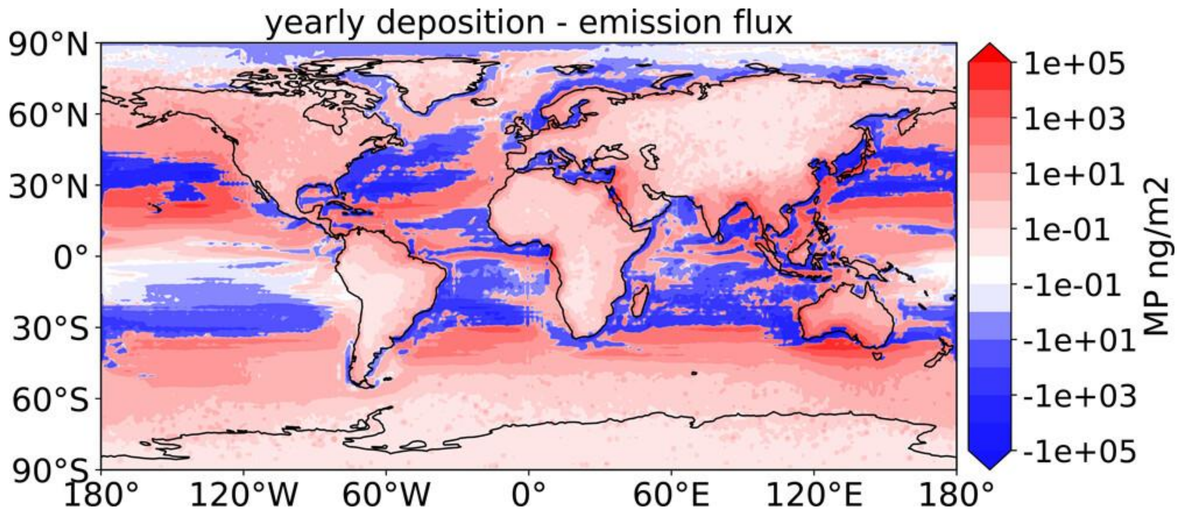

Figure 6: Yearly net flux of microplastics (MP) between the ocean surface and atmosphere. The red values represent regions with a net positive deposition flux and the blue values are the regions with emission fluxes higher than the deposition ones.

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Phoebe Scharle is a second year Ocean Sciences PhD student at the Rosenstiel School and the University of Miami. Phoebe focuses on nutrient deposition of Saharan dust into the tropical North Atlantic.

Continuous monitoring of iron in aerosol particles transported to Ragged Point in Barbados

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Ragged Point in Barbados has been in continuous operation since 1971, with the primary objective of understanding long range transport of Saharan dust to the Atlantic Ocean, Caribbean, and the Americas. Atmospheric deposition is a major source of iron to the world's oceans, with mineral dust as the dominant iron-containing aerosol. In February of 2025, the Gaston Lab installed an Xact 625i Ambient Metals monitor to the Ragged Point site. The Xact can measure the concentration of 36 elements using non-destructive X-Ray fluorescence. Fitted with dual $PM_{2.5}$ and PM_{10} inlets, the system can switch between the measurements of metals in fine and coarse aerosol particles every four hours. This process is fully automated, providing real time data that can be accessed remotely. Since its addition to the Ragged Point site, the Xact has been in continuous operation, providing 4-hour time resolution of 36 elements for over 6 months. In Figure 7, iron concentrations in aerosol particles in ng iron m^{-3} air spanning from February to August of 2025 are shown. Peaks in iron concentration up to 1500 ng m^{-3} can be shown in correspondence with summer dust events. Whereas lower iron concentrations can be noted in the winter, when dust transport is smaller in magnitude and includes contributions from biomass burning. Preliminary results demonstrate the importance of continuous monitoring of metals transported across the north Atlantic and will improve our understanding of seasonal metal deposition in this region. Data validation is still required to confirm seasonal trends.

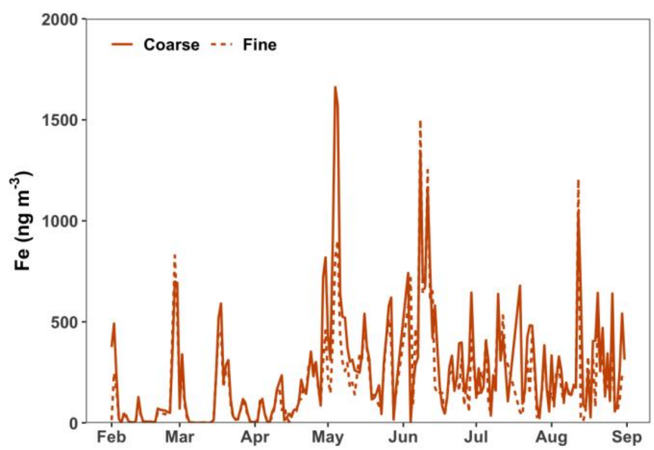

Figure 7: Iron concentrations (ng m^{-3}) in coarse and fine mode aerosols from February to August of 2025.

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Monitoring atmospheric aerosol variability on decadal time scales from satellite and how that variability may drive ocean ecosystem responses

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Understanding how atmospheric aerosols influence global ocean ecosystems and how that influence may change on a changing planet is one of the central challenges in Earth system science. The atmosphere and ocean operate on very different spatial and temporal scales. To connect these two spheres, the key lies in accurately estimating atmospheric deposition at scales spanning ocean basins. Without robust quantification of the deposition process, it remains difficult to establish direct cause-and-effect linkages between deposition and observed ocean biological responses. Because the Earth system is constantly changing, one way to introduce confidence in forward projections is to understand the changes to aerosol deposition as it has occurred over past decades, and because our interests are regional and global, satellite observations and global models are our best tools.

Previously, our work demonstrated that atmospheric dust can stimulate ocean ecosystems on a global scale (Westberry *et al.*, 2023). By examining dust events through MODIS (MODerate resolution Imaging Spectroradiometer) and GEOS (Goddard Earth Observing System) products, we documented consistent increases in plankton activity across a wide range of deposition magnitudes (Figure 8). Crucially, the biological response was not confined to iron-limited regions but extended across most tropical and subtropical basins. This finding suggested that aerosols act as a global driver of ecosystem health through nutrient delivery. Our findings underscore the potential to greatly advance the field by understanding current satellite and model deposition data, developing more accurate and robust deposition estimates, and extending beyond dust.

Significant challenges remain. Aerosol monitoring from space is complicated by the diversity of particle types and frequent cloud cover. Even when loading is captured, converting it to deposition introduces large uncertainties, particularly for wet versus dry processes. More critically, there is a lack of long-term daily surface monitoring of dust deposition beyond dry components. Such datasets are indispensable for validating satellite and model deposition products and for tracing deposition along transport trajectories. This gap in resources is one of the most important missing elements for advancing our understanding of aerosol–ocean biology interactions at global scales.

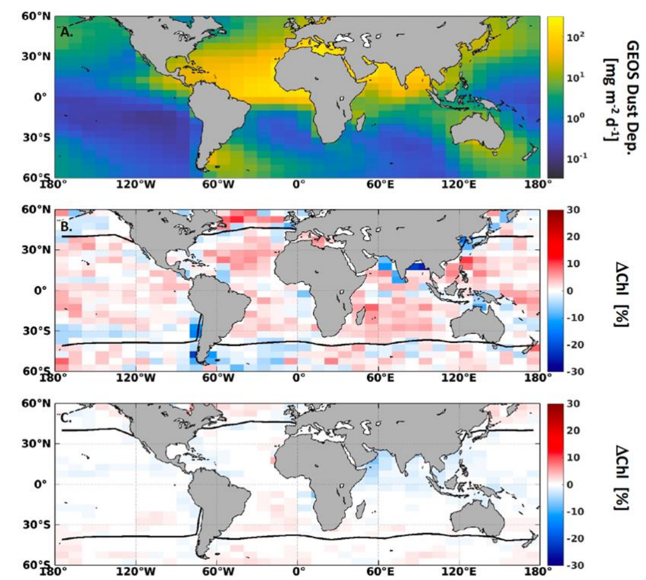

Figure 8: High dust deposition and subsequent ocean color response. (A) Average Goddard Earth Observing System (GEOS) dust deposition rate to the surface ocean (mg m^{-2} d^{-1}) during the top 10% of record (2003-2016). (B) Median relative change in chlorophyll concentration evaluated between 4-day period after top 10% of dust events (N=127) and 4-day period prior to the events (see Westberry *et al.*, 2023). (C) Median relative change in chlorophyll concentration evaluated similarly to (B), but for the 4-day periods prior to and following a randomly (bootstrap with replacement, N=1000) sampled 10% of the dust deposition time series at each location. Solid black contour in panels B and C shows the 15°C isotherm calculated from the average MODerate resolution Imaging Spectroradiometer (MODIS) sea surface temperature (SST) during 2003-2016. This boundary is used to demarcate the permanently stratified ocean (PSO) with annual average SST>15°C. Reproduced from Westberry *et al.*, 2023.

As a first step, our study has focused on evaluating model-based dust deposition using available ground-based and satellite products at temporal and spatial scales that can connect atmosphere and ocean. We compared Modern-Era Retrospective analysis for Research and Applications (MERRA-2) and GEOS models against ground-based and satellite derived dust optical depth (DOD) and deposition and surface dust concentration at Barbados to assess their performance. We found that MERRA-2 does well in reproducing DOD from MODIS and surface concentrations at daily scales but fails to capture deposition. In contrast, GEOS dust deposition showed the reasonable correlations, but not magnitudes, with satellite-derived monthly dust deposition products, making it a more reliable framework for indicating dust deposition events. These comparisons reveal substantial room for improving deposition datasets. In the absence of high-quality, long-term deposition records, model performance can only be inferred indirectly, highlighting the critical need for more comprehensive observational resources.

Our earlier analyses emphasised deposition events and subsequent ocean responses, but not monthly means or overall magnitudes. Yet the Earth system is not static; sources, transport, and pathways evolve over time. A critical dimension of this work is therefore understanding interannual variability of the dust events, rather than monthly means. By leveraging both satellite and ground-based data, we investigated how dust events vary across years and along transport pathways in the tropical and northern subtropical Atlantic. We found that dust source regions in North Africa showed strong year-to-year fluctuations and increasing trends along specific transport pathways across the subtropical Atlantic. For example, at Barbados, a key sink location where dust transported across the Atlantic is intercepted, the number of events and their deposition magnitude increased in the final three years of the 20-year record, particularly in June and July (Figure 9).

In summary, while significant progress has been made in demonstrating the global role of dust deposition in stimulating ocean ecosystems, the field now faces a clear bottleneck: the need for accurate, high temporal frequency deposition datasets. Our work highlights that understanding and better estimating deposition is the key that connects the atmosphere and ocean, bridging the gap between two systems with very different scales. Because the planet is changing and

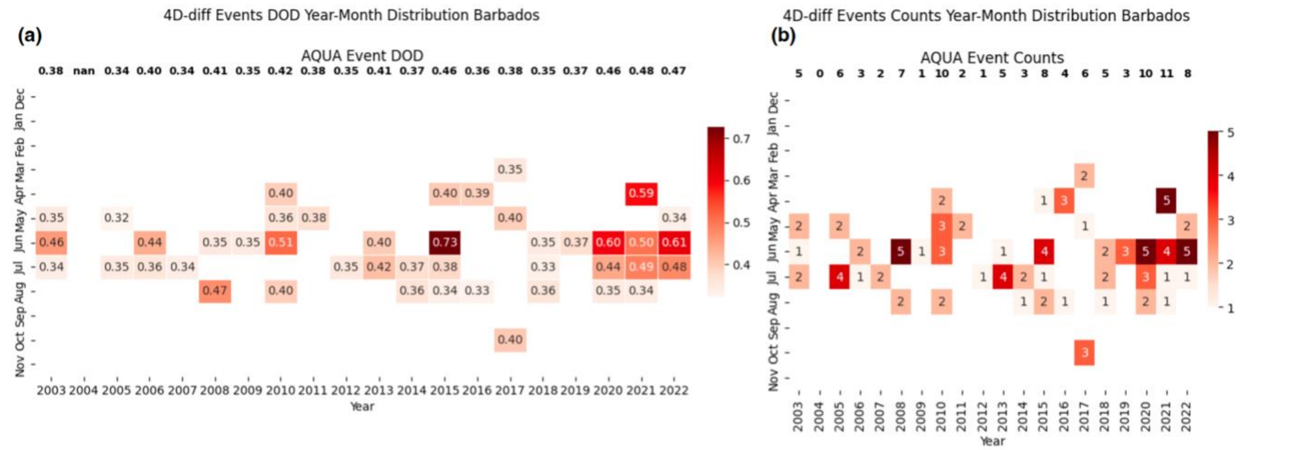

Figure 9: Heatmap analysis of MODerate resolution Imaging Spectroradiometer (MODIS) Aqua dust optical depth (DOD) at 1°×1° daily resolution from 2003-2022 for Barbados, a deposition site on the western side of the basin. a) The averaged DOD per top 3% dust event (defined as the DOD difference between four days after and four days before the event) by month and year. b) the corresponding number of top 3% dust events per month and year. For each year, the total number of events and the mean event DOD are annotated above the respective year column.

aerosol deposition events will change, we require a commitment to make high temporal resolution deposition measurements for the long term. We need this data for model validation and connection to satellite products such as DOD. Our findings highlight the opportunity to bridge a major gap between atmospheric and oceanographic communities by developing common approaches that translate atmospheric satellite and model deposition into forms that can be directly compared and used by the ocean community.

References

Westberry, T.K., Behrenfeld, M.J., Shi, Y.R., *et al.* (2023). Atmospheric nourishment of global ocean ecosystems. *Science*, 380(6644), 515-519. https://doi.org/10.1126/science.abq5252

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