surface ocean solas lower atmosphere study

Report for the year 2021 and future activities

SOLAS *Israel*
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First things first…Please tell us what the IPO may do to help you in your current and future SOLAS activities. ?

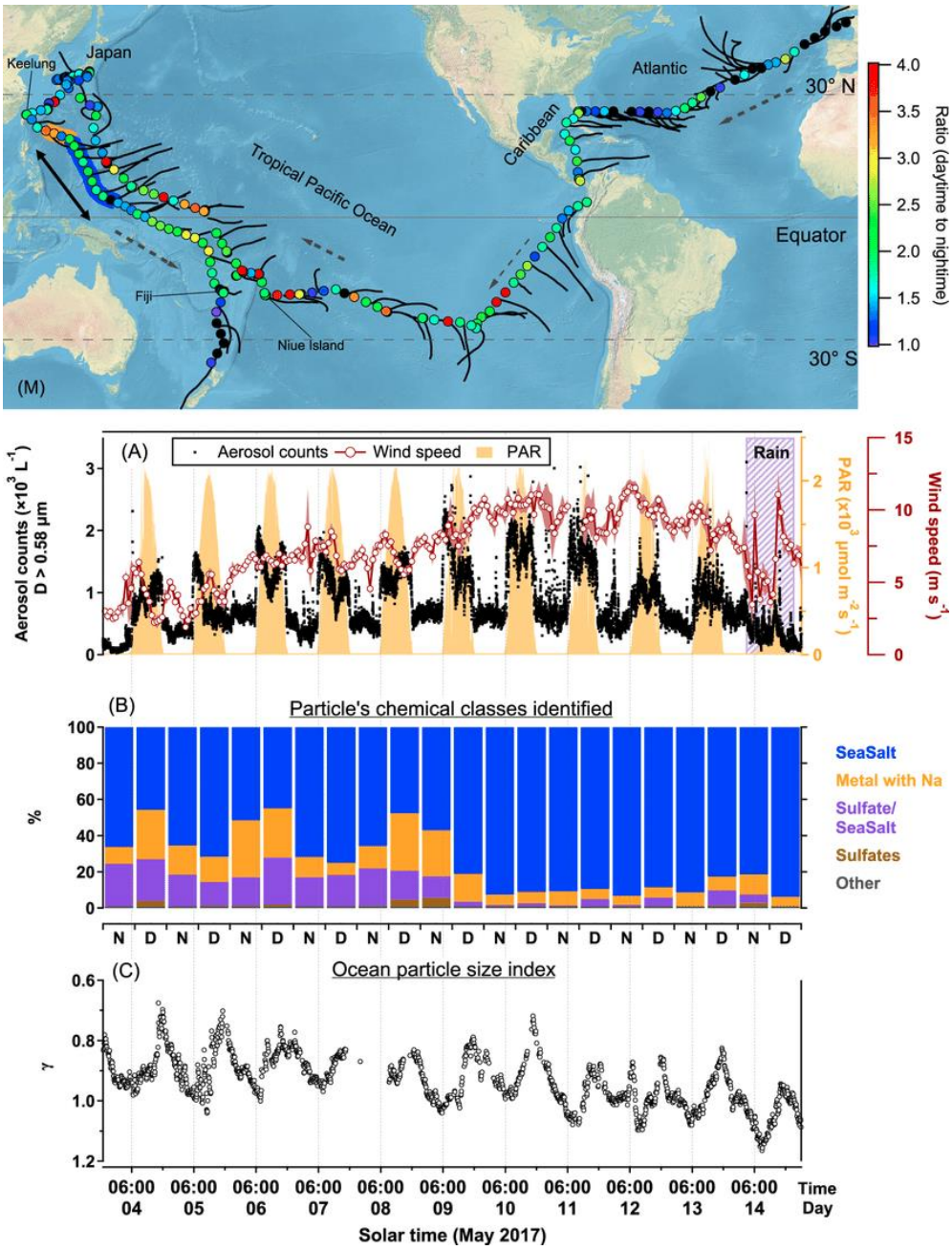
PART 1 - Activities from January 2021 to Jan/Feb 2022

1. Scientific highlight

Diel cycle of sea spray aerosol concentration

Sea spray aerosol (SSA) formation have a major role in the climate system, but measurements at a global-scale of this micro-scale process are highly challenging. This work describes measurements of high-resolution temporal patterns of SSA number concentration over the Atlantic Ocean, Caribbean Sea, and the Pacific Ocean covering over 42,000 km. The authors discovered a ubiquitous 24-hour rhythm to the SSA number concentration, with concentrations increasing after sunrise, remaining higher during the day, and returning to predawn values after sunset. Thepresence of dominating continental aerosol transport can mask the SSA cycle. The authors did not find significant links between the diel cycle of SSA number concentration and diel variations of surface winds, atmospheric physical properties, radiation, pollution, nor oceanic physical properties. However, the daily mean sea surface temperature positively correlated with the magnitude of the day-to-nighttime increase in SSA concentration. Parallel diel patterns in particle sizes were also detected in near-surface waters attributed to variations in the size of particles smaller than ~1 μm. These variations may point to microbial day-to-night modulation of bubble-bursting dynamics as a possible cause of the SSA cycle.

Citation: Flores, J.,M., G. Bourdin, A. B Kostinski, O. Altaratz, G. Dagan, F. Lombard, N. Haëntjens, E. Boss, M.B Sullivan, G. Gorsky, N. Lang-Yona, M. Trainic, S. Romac, C. R Voolstra, Y. Rudich, A. Vardi, I. Koren (2021). Diel cycle of sea spray aerosol concentration. *Nat com*. 12(1): 1-12



Twenty-four cycle of aerosol concentration and marine particle size index (M) Map of R/V Tara's route, with dotted arrows along the sailing direction and solid black lines along the 48-h back-trajectories. Filled circles on the route are colored by the value of the day-to-night concentration ratio. The data in panels (A) through (C) are from the orange and blue-shaded transect in the western Pacific between Keelung and Fiji (next to the double-ended arrow). The orange-shaded region represents anthropogenic polluted conditions, and the blue shaded refers to clean ones. A Main observation. Aerosol concentration per liter (optical diameter (Dop) > 0.58 µm, collected 30 m above sea surface), superimposed on the 24-h beat of incoming solar flux as represented by the photo-synthetically active radiation (PAR). Time series are punctuated by abrupt spikes at dawn and drops at dusk. The diel rhythm (away from land) is evident, ubiquitous, and persists on cloudy days. Pollution origin of this cycle is ruled out by the 48-h back-trajectories. B Aerosol composition determined by SEM-EDX for geometrical diameters (Dgeo) > 0.3 µm. N and D denote night and day, respectively. This is compelling evidence for the marine origin of the aerosols. The collection filters were replaced at about 08:00 09:30 and 20:00–21:30 (see Supplementary Table 1 in the SI for timing details). C Twenty-hour signal of marine particle size index γ (vertical axis inverted), where the mean particle size increases during the day and decreases during the night. Data collected at 0.5–3 m below the sea surface.

2. Activities/main accomplishments in 2021 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

Israeli scientists are involved in SOLAS-related activities in the adjacent Mediterranean and Red sea, as well as in other parts of the World Ocean. A major contribution to SOLAS research in the easternmost part of Mediterranean comes from a net of marine stations located off the Israeli coast. The net consists of DEEPLEV that was launched by Bar-Ilan University and the Israel Oceanographic and Limnological Research (IOLR), and THEMO that was launched by Texas A&M and the University of Haifa. DEEPLAV is a permanent marine research station ('mooring'), the first of its kind in this region, placed off the coast of Israel, 50 kilometers west of Haifa. Anchored to the seabed at a water depth of 1500 m, the station contains a large number of state-of-the-art measuring instruments, spread over a cable running from the seabed almost to the sea surface, enabling continuous study of the physical and ecological system in the eastern Mediterranean Sea. THEMO is an observatory comprising of two sensor arrays attached to 2.25m diameter surface buoys. THEMO includes an operational shallow mooring (125 m) in the coastal zone of the Levant Basin of the Mediterranean Sea, and a deep mooring (1500 m) located 50 km from the northern shores of Haifa after the continental shelf. The two moorings have mealtime RF communication capabilities, and the data is received at a shore station and is displayed at near-real time at the University of Haifa. The data from the marine stations is complemented by monthly interdisciplinary oceanographic cruises, which were carried out by researchers from different research institutes in Israel. In the Gulf of Aqaba, at the northern tip of the Red Sea, several SOLAS-related activities are performed by Inter-University Institute (IUI) researchers : (1) ongoing dust sampling time series, the first is a weekly resolved trap that has been deployed since 2006 and is operated by the National Monitoring Program, and the second is deployed for short time periods (~1-2 days) only during time of interest (e.g., dust storms) in order to obtain a more clear compositional fingerprint of the dust during different atmospheric settings; (2) Ongoing sediment trap mooring deployed at the north Gulf of Aqaba, a deep oligotrophic sea. This mooring has been deployed continuously since early 2014 and collects a coupled monthly and daily resolved samples. The samples are used, amongst other objectives, to identify the source to sink signal transfer of terrigenous particles (primarily atmospheric dust), and evaluate the connection between dust input, export production rates, and water column biogeochemical cycles; (3) Trace metal cycles and anthropogenic impacts in the Gulf of Aqaba. Trace metal concentrations and the Pb isotopic composition are measured monthly and sub-monthly in the dissolved phase of seawater profiles in the Gulf of Aqaba. The results are evaluated in the context of dust inputs and water column productivity and physical configuration.

3. List SOLAS-related publications published in 2021 (only PUBLISHED articles). If any, please also list weblinks to models, datasets, products, etc.

Flores, J.M. Guillaume Bourdin, Alexander B Kostinski, Orit Altaratz, Guy Dagan, Fabien Lombard, Nils Haëntjens, Emmanuel Boss, Matthew B Sullivan, Gabriel Gorsky, Naama Lang-Yona, Miri Trainic, Sarah Romac, Christian R Voolstra, Yinon Rudich, Assaf Vardi, Ilan Koren (2021). Diel cycle of sea spray aerosol concentration. *Nat com*. 12(1): 1-12.

Krupnik, N, D. Theodora Asis, N. Belkin, M. Rubin-Blum, Á. Israel, A. Paytan, D. Meiri, B. Herut, E. Rahav (2021). Dust-borne microbes affect Ulva ohnoi's growth and physiological state, FEMS Microbiology Ecology, 97, https://doi.org/10.1093/femsec/fiab020

Benaltabet T., E. Gutner-Hoch, A. Torfstein (2021). Heavy Metal, Rare Earth Element and Pb Isotope Dynamics in Mussels During a Depuration Experiment in the Gulf of Aqaba, Northern Red Sea, Frontiers in Marine Science 8, doi:10.3389/fmars.2021.669329

Rilov, G.m N. David, T. Guy-Haim, D. Golomb, S. Filin (2021). Sea level rise can severely reduce biodiversity and community net production on rocky shores, Science of The Total Environment 791, 148377

Silverman, J., C Price, M Asfur (2021), The Possible Effect of Seawater Total Alkalinity on Lightning Flash Intensity—An Experimental Approach, Geophysical Research Letters, doi.org/10.1029/2021GL093654.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2021? If yes, who? How did you engage?

PART 2 - Planned activities for 2022 and 2023

1. Planned major national and international field studies and collaborative laboratory and modelling studies (incl. all information possible, dates, locations, teams, work, etc.).

2. Events like conferences, workshops, meetings, summer schools, capacity building etc. (incl. all information possible).

3. Funded national and international projects/activities underway.

A coallboration between the Charney School of Marine Science at the University of Haifa and the GEOMAR center for ocean science has been, titled The Eastern Mediterranean Sea Centre- An Early-Warning Model-System for our Future Oceans: EMS Future Ocean REsearch (EMS FORE), has been launched in the frame a German-Israeli Helmholtz International Laboratory. The goals of EMS FORE target fundamental questions regarding the impacts of climate change and anthropogenic stressors on our oceans and specifically on the EMS. EMS FORE focuses on the complex oligotrophic EMS, and intends to draw a direct linkbetween anthropogenic pressures and changes in biogeochemical processes and ecosystem structure and function in this ocean region.

4. Plans / ideas for future national or international projects, programmes, proposals, etc. (please indicate the funding agencies and potential submission dates).

5. Engagements with other international projects, organisations, programmes, etc.

Comments