surface ocean solas lower atmosphere study

Report for the year 2018 and future activities

SOLAS *Israel*
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This report has two parts:

- Part 1: *reporting of activities in the period of January 2018 – Jan-Feb 2019*
- Part 2: *reporting on planned activities for 2019/2020 and 2021.*

The information provided will be used for reporting, fundraising, networking, strategic development and updating of the live web-based implementation plan. As much as possible, please indicate the specific SOLAS 2015-2025 Science Plan Themes addressed by each activity **or specify an overlap between Themes or Cross-Cutting Themes.**

1 Greenhouse gases and the oceans;
2 Air-sea interfaces and fluxes of mass and energy;
3 Atmospheric deposition and ocean biogeochemistry;
4 Interconnections between aerosols, clouds, and marine ecosystems;
5 Ocean biogeochemical control on atmospheric chemistry;
Integrated studies;
Environmental impacts of geoengineering;
Science and society**.**

IMPORTANT*: This report should reflect the efforts of the SOLAS community in the* ***entire country*** *you are representing (all universities, institutes, lab, units, groups, cities).*

PART 1 - Activities from January 2018 to Jan/Feb 2019
1. Scientific highlight
Atmospheric dust/aerosol deposition is an important source of external nutrients to the surface of the ocean. This study shows high resolution observational data gathered *in-situ* over a period of 4-years on bacterial and phytoplankton abundance and activity (i.e., primary production, bacterial production, N_2 fixation) during typical-background atmospheric conditions (median Al= 381 ng m^{-3}), and during intense dust storm events (median Al= 3844 ng m^{-3}) in the low nutrient low chlorophyll coastal waters of the southeastern Mediterranean Sea. Chlorophyll *a* (an estimate for phytoplankton biomass) and bacterial abundance show moderate changes in response to dust deposition/events (-10% and +20%, respectively), while rate measurements such as primary production, bacterial production and N_2 fixation rates were all significantly and positively affected (+25 to +40%; $p<0.05$) by deposition (see Fig. 1 for comparison between chlorophyll and primary production). The rapid changes in bacterial and/or phytoplankton rate parameters suggest that the released micro/macronutrients from atmospheric deposition are tunneled directly in metabolic processes and, to a lesser extent, for biomass accumulation. We further suggest that the intensity of the metabolic rate change following dust deposition is a function of the degree of oligotrophy, defined here by the initial (pre-deposition) concentrations of

Chlorophyll a. When ultra-oligotrophic conditions prevailed (usually during summertime, Chlorophyll a <0.07 µg L^{-1}, Figure 1A and see Uitz et al., 2010), stronger increases were recorded in primary production (maximum 100%), bacterial production (maximum 256%) or N_2 fixation (maximum 101%). This observation is strengthened by additional data from other studies across different marine provinces (not shown).

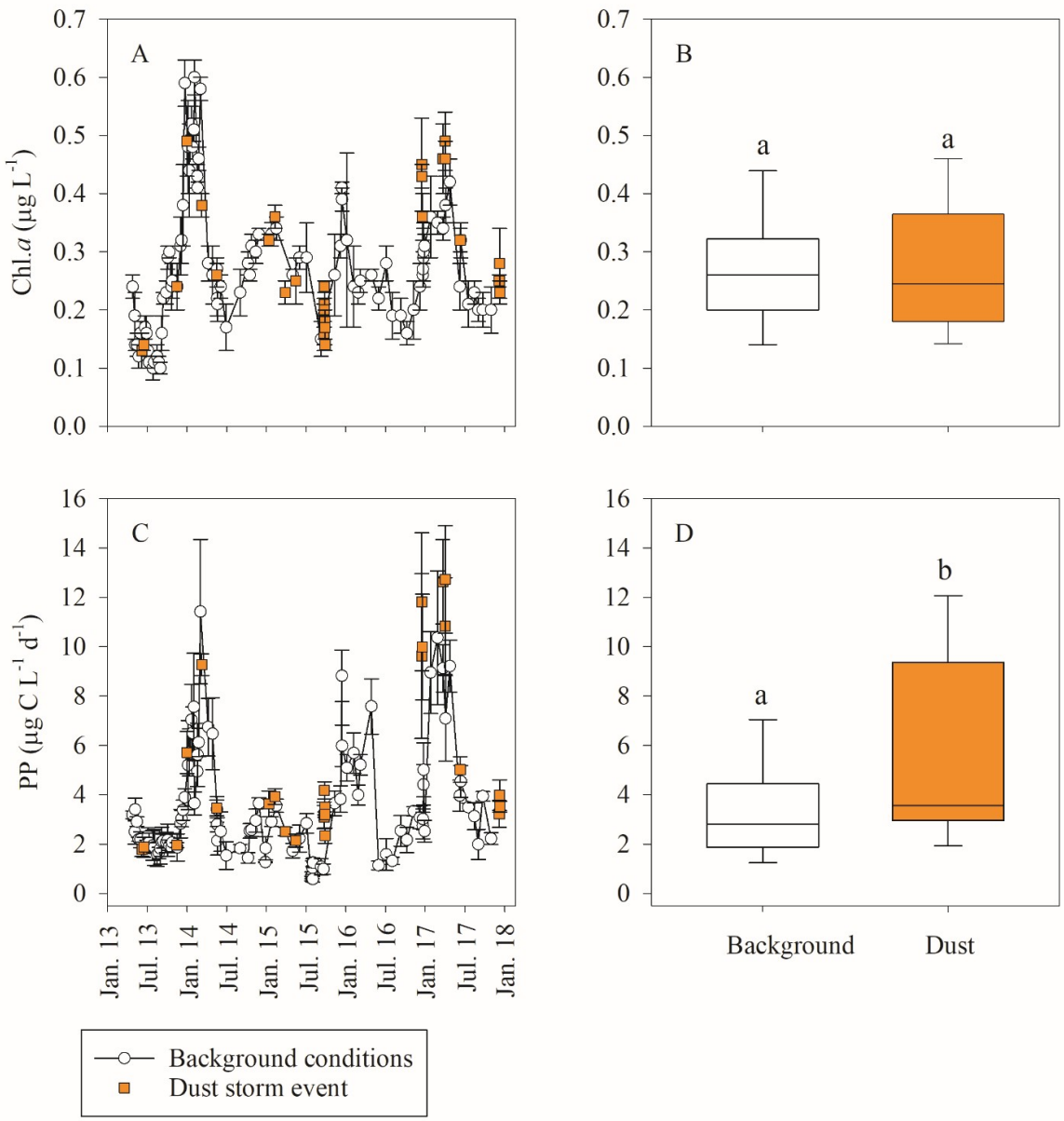

Figure 2 – Surface (1-2 m) chl.*a* (A,B) and PP (C,D) temporal variability (A,C) and distribution (B,D) at the coastal southeastern Mediterranean Sea between 2013-2017. Measurements were taken during 'typical' days (white, n=89) and during dust storms (orange, n=29). Box-Whisker plots shows the interquartile range (25th to 75th percentile) of the data set. The horizontal line within the box represent the median value. The letters above the box-plots represent significant differences (t-test, P <0.05) for mean values between the 'background' and 'dust' measurements.

Rahav, E., Belkin, N., Paytan, A and Herut, B. (2018). Phytoplankton and bacterial response to desert dust deposition in the coastal waters of the southeastern Mediterranean Sea; A four year in-situ survey. *Atmosphere*, 9:305.

2. Activities/main accomplishments in 2018 (projects, field campaigns, events, model and data intercomparisons, capacity building, international collaborations, contributions to int. assessments such as IPCC, interactions with policy makers or socio-economics circles, social sciences, and media).

sraeli 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, which is planned to be launched during the month of March, 2019. 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 are carried out by researchers from different research institutes in Israel.

In the Gulf of 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.

Researchers from the Weizmann Institute of Science (WIZ) have been running the ‘atmosphere component’ of the Tara PACIFIC expedition, which is a 2.5-year scientific expedition with continuous open-ocean sampling of the superficial layer’s biodiversity and surface ocean properties in the Atlantic and Pacific Oceans. The WIZ research team is continuously measuring aerosol size distribution and total concentration (for size ranges from 20 nm to 32 µm). The team also uses a filter system to measure the biological, chemical and morphological properties of marine aerosols at 27m ASL. The main goal of this research projectis to understand the spatial and temporal variability of the bio-physico-chemical properties of marine aerosols across the TARA route, examine the main variations between the aerosols in the Atlantic and Pacific Ocean, and explore the differences between the marine aerosols emitted in the oligotrophic parts of the ocean, with highly productive areas.

Top 5 publications in 2018 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

Torfstein A, SS Kienast (2018), No Correlation Between Atmospheric Dust and Surface Ocean Chlorophyll-a in the Oligotrophic Gulf of Aqaba, Northern Red Sea, J*ournal of Geophysical Research: Biogeosciences* 123 (2), 391-405.

Basu S., Y Shaked (2018), Mineral iron utilization by natural and cultured Trichodesmium and associated bacteria, *Limnology and Oceanography* 63 (6), 2307-2320.

Trainic M, Koren I, Sharoni S, Frada M, Segev L, Rudich Y, Vardi A: Infection Dynamics of a Bloom-Forming Alga and Its Virus Determine Airborne Coccolith Emission from Seawater, *iScience* 6, 327-335, 2018.

Dror T, Lehahn Y, Altaratz O, Koren I (2018), Temporal-Scale Analysis of Environmental Controls on Sea Spray Aerosol Production Over the South Pacific Gyre, *Geophysical Research Letters* 45 (16), 8637-8646.

Rahav, E., Belkin, N., Paytan, A and Herut, B. (2018). Phytoplankton and bacterial response to desert dust deposition in the coastal waters of the southeastern Mediterranean Sea; A four year in-situ survey. *Atmosphere*, 9:305.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2018? If yes, who? How did you engage?

PART 2 - Planned activities for 2019/2020 and 2021

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

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

Part of the annual meeting of the Israeli Association for Aquatic Sciences (IAAS) will be dedicated to discussion on-going and planned SOLAS activities. In addition, a course on “advanced topics in surface-ocean lower-atmosphere science”, which will be open to students from all academic institutes in Israel, is planned to be given at the University of Haifa.

3. Funded national and international projects / activities underway.

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

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

Comments