surface ocean solas lower atmosphere study

Report for the year 2017 and future activities

SOLAS *Israel*
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This report has two parts:

***- Part 1:** reporting of activities in the period of January 2017 – Jan-Feb 2018*
***- Part 2:** reporting on planned activities for 2018/2019 and 2020.*

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 2017 to Jan/Feb 2018
1. Scientific highlight
Airborne microbes contribute to N2 fixation in surface water of the Northern Red Sea Desert dust storms are frequent in the Northern Red Sea (NRS) region, providing nutrients and trace-metals that may stimulate dinitrogen (N2) fixation. Dust also carries a high diversity of airborne microbes (bacteria, archaea), including diazotrophs, that may remain viable during transport. Here we evaluate the impact of atmospheric deposition and its associated airborne diazotrophs on N2 fixation in the surface water of the low-nutrients NRS, using mesocosm bioassay experiments. We compared the chemical (nutritional) and sole airborne microbial impact of aerosol additions on N2 fixation using 'live-dust' (release nutrients/trace-metals and viable airborne microorganisms) and 'UV-killed dust' (release only chemicals). Airborne diazotrophy accounted for about one-third of the measured N2 fixation (0.35±0.06 nmol N L-1 d-1 and 0.29±0.06 nmol N L-1 d-1, for 'February 2017' and 'May 2017', 'live-dust' additions, respectively, Figure 1). Two nifH sequences related to cluster III diazotrophs were amplified from the dust samples, consistent with the N2 fixation measurement results. We postulate that the deposition of viable airborne diazotrophs may enhance N2 fixation, especially in marine provinces subjected to high aerosol loads, and that the relative contribution of airborne N2 fixation may increase in the future with the predicted increase in dust deposition.

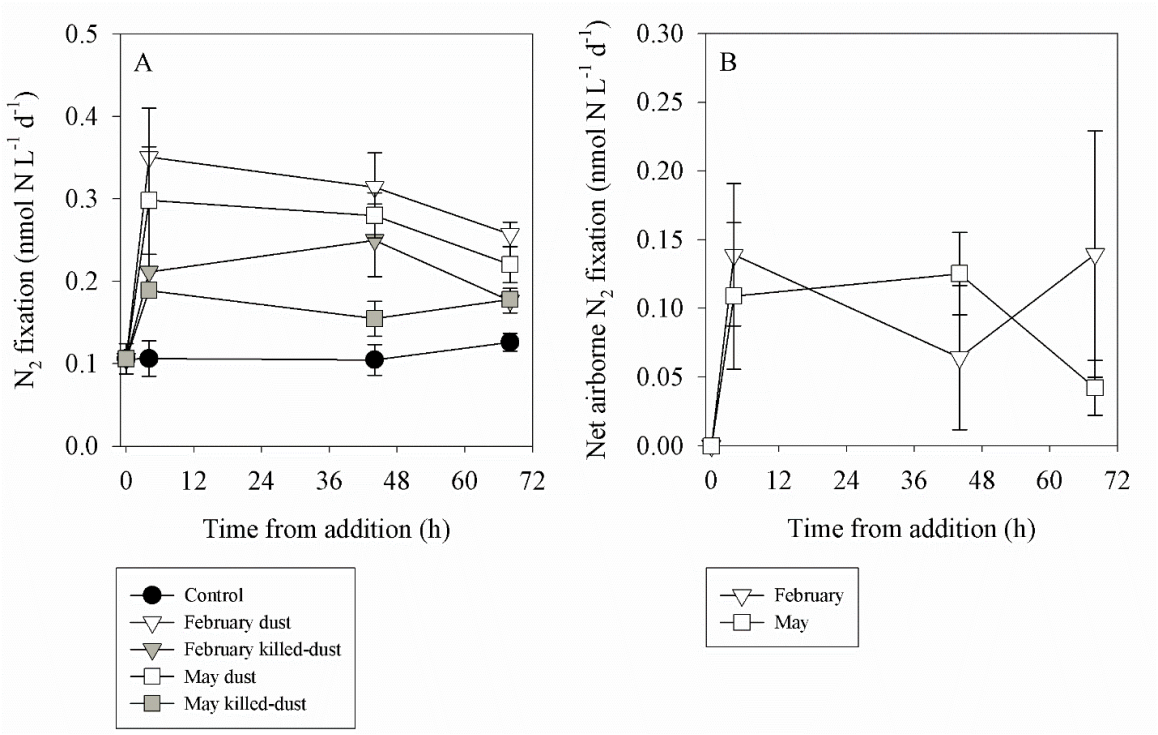

Figure: Temporal changes in volumetric N2 fixation rates (A) and the net airborne diazotrophic activity (B) following dust additions (~0.8 mg L-1) to surface seawater of the Northern Red Sea during July 2017. The following treatments were performed: dust collected in February 2017 (white triangle), UV-killed February 2017 dust (gray triangle), dust collected in May 2017 (white square), UV-killed May 2017 dust (gray square) and unamended controls (black circle). Data shown is the averages of 3 replicate mesocosms per treatment and their corresponding standard deviation. Note the different Y-axis. The net airborne diazotrophic contribution was calculated by subtracting the 'killed-dust' rates from the rates measured in the 'dust' treatments.

Citation: Rahav E., Paytan A., Mescioglu E., Galletti Y., Rosenfeld S., Raveh O., Santinelli C., Ho T.-Y. and Herut B., *Geophysical Reserach Letters*, under revision.

2. Activities/main accomplishments in 2017 (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).

Israeli scientists are involved in SOLAS-related activities in the adjacent Mediterranean and Red sea, and in 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 in a few months periods. 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) are currently 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.

3. Top 5 publications in 2017 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

*T*orfstein A., Teutsch N., Tirosh O., Shaked Y., Rivlin T., Zipori A., Stein M., Lazar B. and Erel Y. (2017), Chemical characterization of atmospheric dust from a weekly time series in the north Red Sea between 2006-2010. *Geochimica et Cosmochimica Acta 211,* 373-393.

Amitai Y., Gildor H. (2017), Can precipitation over Israel be predicted from Eastern Mediterranean heat content?, *International Journal of Climatology* 37 (5), 2492-2501

Zarubin M, Lindemann Y, Genin A. (2017), The dispersion-confinement mechanism: phytoplankton dynamics and the spring bloom in a deeply-mixing subtropical sea. *Progress in Oceanography* 155:13–27.

Lehahn Y., I. Koren, S. Sharoni, F. d'Ovidio, A. Vardi and E. Boss (2017), Dispersion/dilution enhances phytoplankton blooms in nutrient-limited waters, *Nature Communication* 8, 14868, doi: 10.1038/ncomms14868.

Tsagaraki T.M., Herut B., Rahav E., Berman Frank I., Tsiola A. , Tsapakis M., Giannakourou A., Gogou A., Panagiotopoulos C., Violaki K., Psarra S., Lagaria A., Christou E.D , Papageorgiou N., Zervoudaki S., Puelles M.L, Nikolioudakis N., Meador T.B , T. Tanaka T.B , Pedrotti M.L, Krom M.D, Pitta P. (2017), Atmospheric Deposition Effects on Plankton Communities in the Eastern Mediterranean: A Mesocosm Experimental Approach, *Frontiers in Marine Science*.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2017? If yes, who? How did you engage?

PART 2 - Planned activities for 2018/2019 and 2020

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

Most of the SOLAS-related activities described above are part of on going projects that are planned to be continued in the coming years. In 2018 several interdisciplinary air-sea mesocosm experiments are planned. This includes participation in a mesocosm experiment in the fjords of Bergen, Norway, that will allow high-resolution sampling for host-virus dynamics of an induced algal bloom. The bloom will be closely monitored at all scales, from single cell genomics to metabolic imprint and its impact on air-sea dynamics.

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 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