surface ocean **solas** lower atmosphere study

Report for the year 2018 and future activities

SOLAS *'Turkey'*
*compiled by: 'Nazlı OLGUN KIYAK'**

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.

***IMPORTANT**: May we remind you that this report should reflect the efforts of the SOLAS community in the **entire country** you are representing (all universities, institutes, lab, units, groups, cities)!*

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PART 1 - Activities from January 2018 to Jan/Feb 2019

1. Scientific highlight

- **Scientific Highlight 1: Atmospheric water-soluble organic nitrogen (WSON) in the eastern Mediterranean: origin and ramifications regarding marine productivity.**

  Related to **SOLAS Theme 3**: Atmospheric Deposition and Ocean Biogeochemistry

  ***Citation:** Nehir, M and Koçak, M., 2018, Atmospheric water-soluble organic nitrogen (WSON) in the eastern Mediterranean: origin and ramifications regarding marine productivity, Atmospheric Chemistry and Physics, 18, 3603-3618,*

Aerosol and rain sampling in two size fractions was carried out at a rural site located on the coast of the eastern Mediterranean, Erdemli, Turkey. A total of 674 aerosol samples in two size fractions (337 coarse, 337 fine) and 23 rain samples were collected between March 2014 and April 2015. Samples were analyzed for NO_3^-, NH_4^+ and ancillary water-soluble ions using ion chromatography and water-soluble total nitrogen (WSTN) by applying a high-temperature combustion method. The mean aerosol water-soluble organic nitrogen (WSON) was 23.8 ± 16.3 nmol N m^{-3}, reaching a maximum of 79 nmol N m^{-3}, with about 66 % being associated with coarse particles. The volume weighted mean (VWM) concentration of WSON in rain was 21.5 µmol N L^{-1}. The WSON contributed 37 and 29 % to the WSTN in aerosol and rainwater, respectively. Aerosol WSON concentrations exhibited large temporal variation, mainly due to meteorology and the origin of air mass flow. The highest mean aerosol WSON concentration was observed in the summer and was attributed to the absence of rain and resuspension of cultivated soil in the region. The mean concentration of WSON during dust events (38.2 ± 17.5 nmol N m^{-3}) was 1.3 times higher than that of non-dust events (29.4 ± 13.9 nmol N m^{-3}). Source apportionment analysis demonstrated that WSON was originated from agricultural activities (43 %), secondary aerosol (20 %), nitrate (22 %), crustal material (10 %) and sea salt (5 %). The dry and wet depositions of WSON were equivalent and amounted to 36 % of the total atmospheric WSTN flux.

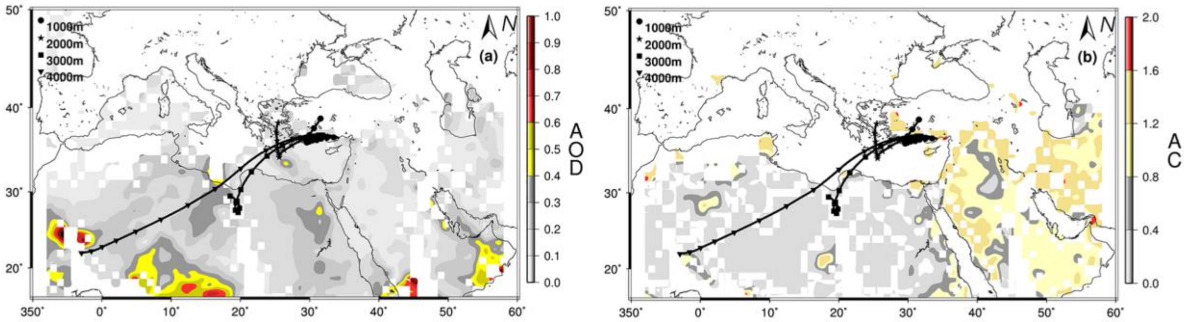

Figure 1: Three-day back trajectories showing the transport of air masses 1000 m (black circle), 2000 m (black star), 3000 m (black square) and 4000 m (black triangle) on 20 January 2015 for Erdemli. The aerosol optical depth (AOD, a) and Ångström component (AC, b) from MODIS (Moderate Resolution Imaging Spectroradiometer) distribution are also demonstrated with a color bar from grey to dark red.

Arithmetic mean concentrations together with corresponding standard deviations for water-soluble nitrogen species and nssCa 2+ in aerosol samples according to categorized air mass sectors (at 1 km) are presented in Table 5. WSON concentrations for the Middle East, north Africa and Turkey were comparable and arithmetic mean values were, respectively, 33, 36 and 32 nmol m^{-3}. Correspondingly, mean WSON concentrations for eastern Europe, western Europe and the Mediterranean Sea were 26, 26 and 22 nmol m^{-3} being at least 1.2 times lower than those observed for the Middle East, north Africa and Turkey (Mann–Whitney U test, $p < 0.05$). Coarse-mode contributions of WSON for air flow from the Middle East (61 %), north Africa (58 %) and Turkey (63 %) ranged from 58 to 63 %.

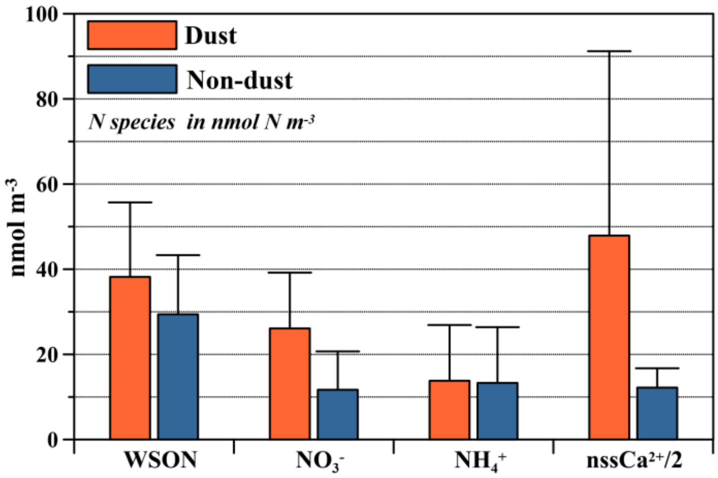

Figure 2: Arithmetic means together with corresponding standard deviations of WSON, NO_3^-, NH_4^+ and $nssCa^{2+}$ for dust and non-dust events at the Erdemli site. Orange and blue bars denote arithmetic means for dust and non-dust, respectively. The black vertical line shows standard deviation.

Lower coarse- mode contributions were observed when air flow originated from eastern Europe (49 %), western Europe (48 %) and the Mediterranean Sea (27 %). The highest NO_3^- concentrations were associated with airflow from north Africa and Turkey, with a value of 18 and 15 nmol N m^{-3}, respectively, and there was a statistically significant difference compared to the remaining air mass sectors ($p > 0.05$). The mean concentrations of NO_3^- for air masses derived from north Africa and Turkey were at least 1.3 times larger than those calculated for the Middle East, eastern Europe, western Europe and Mediterranean Sea air sectors ($p > 0.05$). NH_4^+ had the highest concentration under the influence of airflow derived from Turkey. For this airflow, detected concentration was 1.5–2.4 times greater than that calculated for other air mass sectors. In this study, water-soluble organic nitrogen in aerosol and rain samples obtained over the eastern Mediterranean has been investigated. From this investigation the following summary may be made.

1. Of the nitrogen species, aerosol WSON (23.8 ± 16.3 nmol N m $^{-3}$) exhibited the highest arithmetic mean, followed by ammonium (23.3 ± 14.4 nmol N m −3) and then nitrate (17.9 ± 15.7 nmol N m^{-3}). Aerosol WSON was mainly associated with coarse particles (66 %). The WSTN was equally influenced by WSON and NH+4, each contributing 37 and 35 %, respectively, whereas the contribution to WSTN of NO_3^- was 28 %. In rainwater, the VWM concentrations of water-soluble nitrogen species were comparable. WSON and NO −3 accounted for 29 and 32 % of the WSTN, whilst NH_4^+ elucidated 39 % of the WSTN.

2. Aerosol WSON concentrations exhibited large variation from one day to another day. Generally, lower concentrations were observed during rainy days. Higher concentrations of aerosol WSON were associated with different airflow. The three highest concentrations were related to (i) mineral dust transport from Sahara and Middle Eastern deserts, (ii) north/north-westerly airflow from Turkey's largest cultivated plain, Konya, and (iii) mid-range pollution transport from the Turkish coast.

3. Influence of mineral dust transport on aerosol WSON concentrations was assessed. The crustally derived $nssCa^{2+}$ and anthropogenic NO – 3 for dust events had arithmetic means of 95.8 nmol m $^{-3}$ and 26.1 nmol N m $^{-3}$, which were almost 4 and 2 times higher than those of observed for non-dust events. The arithmetic mean of WSON (38.2 nmol m^{-3}) for dust events was 1.3 times higher compared to that observed for non-dust events (29.4 nmol m^{-3}).

4. Source apportionment suggested that aerosol WSON was mainly originated from anthropogenic sources, including agricultural (43 %), secondary aerosols (20 %) and nitrate (22 %); whereas the two natural sources, crustal material (10 %) and sea salts (5 %), contributed 15 % to the WSON.

5. The total atmospheric deposition of water-soluble nitrogen (57.8 mmol N m $^{-2}$ yr $^{-1}$) was mainly via wet deposition (36.7 mmol N m $^{-2}$ yr^{-1}). In contrast, the atmospheric fluxes of WSON and NO−3were equally influenced by the dry and wet deposition modes. On average, WSON accounted for 36 % of the total atmospheric deposition of WSTN. From the beginning of the 2000s to 2015, the atmospheric deposition of the dissolved inorganic nitrogen declined about 45 %; as a consequence, there is a need to understand how the DIN flux changed.

- **Scientific Highlight 2: To which extent organic matter at the ocean surface affect properties of marine boundary layer aerosols?**
  Related SOLAS **Theme-2**: Air-sea interface and fluxes of mass and energy

N. OLGUN KIYAK attended the SOLAS/ESA meeting '*HARNESSING REMOTE SENSING TO ADDRESS CRITICAL SCIENCE QUESTIONS IN THE OCEAN-ATMOSPHERE INTERFACE'* on 12-15 June 2016 in Frascati, Italy. The scientific highlight indicated below is the outcome of '**Organic Matter'** working group leaded by Dr. Yoav LeHahn and the manuscript is still in preparation.

Sea spray aerosols (SSA), which are emitted from the ocean to the atmosphere through wind-driven processes, originate in an aquatic environment that contains varying amounts of organic matter (OM). The presence of OM may have a strong impact on SSA population, both through enrichment of the emitted particles and through altering the efficiency of the aerosol production process. Observed properties of organic marine aerosols is the contribution of marine hydrogels which are emitted during the sea spray production process. Orellana et al. (2011), have shown that marine gels may have an important effect on the chemical and physical properties of the atmosphere, by providing an important source of cloud condensation nuclei during the pristine arctic summer. Although it is well acknowledged that OM has an important effect of the properties of sea spray aerosols, fundamental questions on the nature of this effect are still open. Importantly, there is an ongoing debate on the dependency of sea spray aerosols on localized (in space and in time) events of enhanced biological activity, and on the efficiency of using chlorophyll-a (Chl, a measure to phytoplankton biomass) data as a proxy for OM enrichment. The manuscript will focus on the use of remote sensing tools to understand the impact of organic matter in the physico-chemical properties of marine boundary layer.

Citation: Manuscript in preparation (author list is not available yet).

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, etc.)

Submitted Project: 'Assessment of spatial and temporal changes in the Marmara Sea marine primary productivity by using satellite data and sediment bio-geochemistry' submitted to The Scientific and Technological Research Council of Turkey (TUBITAK), Coordinator: N. **OLGUN KIYAK**

Related to SOLAS **Theme 3**: Atmospheric deposition and ocean biogeochemistry

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

Nehir, M and Koçak, M., 2018, Atmospheric water-soluble organic nitrogen (WSON) in the eastern Mediterranean: origin and ramifications regarding marine productivity, Atmospheric Chemistry and Physics, 18, 3603-3618. (SOLAS Theme 3).

Yücel N., 2018, Spatio-temporal variability of the size-fractionated primary production and chlorophyll in the Levantine Basin, northeastern Mediterranean), Oceanologia, 60, 288-304. (SOLAS Theme 3)

Lambert, E., Nummelin, A. Pemberton P., **Ilıcak M**, 2018, Tracing the river imprint of river runoff variability on Arctic water mass transformation, Journal of Geophysical Research: Oceans, 124, 302-319. (SOLAS Theme 2).

Froese R., Winker H., Coro H., **Demirel N**, Athanassios C.T, Dimarchopolou D., Scarcella G., QuassM., Matz-Lück N., 2018, Status and rebuilding of European Fisheries, Marine Policy, 93, 159-170. (SOLAS Theme 4)

Dursun F., Ünlü S. and Yurdun T., Determination of Domoic Acid in Plankton Net samples from Golden Horn Estuary, Turkey, Using HPLC with Flouresence Detection, 2018, Bulletin of Environmental Contamination and Toxicology, 100, 457-462. (SOLAS Theme 3).

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?

Turkish SOLAS Representative Nazlı OLGUN KIYAK, is going to attend the SOLAS Open Science Conference on in Sapporo Japan 21-25 April 2019. Travel and hotel costs are covered by SCOR.

PART 2 - Planned activities from 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.)

Surface seawater sampling is planned for the Marmara Sea for chlorophyll-a measurements. Sampling interval is planned to be twice a year, in collaboration with MAREM (Marmara Environmental Monitoring Project). Chlorophyll-a measurements will be conducted with the context of the submitted project 'The Assessment of spatial and temporal changes in the Marmara Sea marine primary productivity by using satellite data and sediment bio-geochemistry'.

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

A 1-day workshop was planned in the Istanbul Technical University for the project Assessment of spatial and temporal changes in the Marmara Sea marine primary productivity by using satellite data and sediment bio-geochemistry' submitted to The Scientific and Technological Research Council of Turkey (TUBITAK).

3. Funded national and international projects / activities underway (if possible please list in order of importance and indicate to which part(s) of the SOLAS 2015-2025 Science Plan and Organisation (downloadable from the SOLAS website) the activity topics relate – including the core themes and the cross cutting ones)

Investigation of marine microbial reactions by using novel approaches including genetics, biogeochemistry and modelling, Project Coordinator: **B. Salihoğlu**, Middle East Technical University Institute of Marine Sciences, Project duration:2016-2018.

Development of Integrated Modelling System for the Marmara Sea, **B. Salihoğlu,** International Project**.**

4. Plans / ideas for future projects, programmes, proposals national or international etc. (please precise to which funding agencies and a timing for submission is any)

Submitted Project to The Scientific and Technological Research Council of Turkey (TUBITAK 3501).

'Assessment of spatial and temporal changes in the Marmara Sea marine primary productivity by using satellite data and sediment bio-geochemistry', Coordinator**: N. OLGUN KIYAK**

Related to SOLAS **Theme 3**: Atmospheric deposition and ocean biogeochemistry

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

Comments