

GESAMP WORKING GROUP 38

THE ATMOSPHERIC INPUT OF CHEMICALS TO THE OCEANS

Annual Report to WMO and GESAMP by the Co-Chairs of GESAMP Working Group 38

Robert Duce and Timothy Jickells

July 2022

During the past year GESAMP WG 38 has focused its attention on the following four areas: 1) Completion of a paper published in Nature resulting from the GESAMP WG 38 and WG 40 joint workshop on microplastics and nanoplastics in the marine-atmosphere environment; 2) Continuing development of a workshop in South Africa on the ocean management and policy implications of the air/sea exchange of nutrients; 3) Carrying out other WG activities; and 4) publishing results from the previous WG 38 workshops. We also outline our plans for WG 38 activities for 2022-2023.

WG 38 Activities during 2021-2022

1. Publication on the Atmospheric Transport of Microplastics to and from the Ocean

WG 38, in cooperation with GESAMP WG 40, carried out a virtual “**Workshop on the atmospheric transport of microplastics to and from the ocean**” on November 17-19, 2020. The Terms of Reference for this workshop were as follows:

- Identification of our current understanding and quantitative estimation of the major sources and types of atmospheric microplastics, their atmospheric transport paths, and their inputs to and emissions from the global ocean; and
- Development of guidelines on appropriate future atmospheric and marine sampling and measurement methods and strategies, to enable more accurate estimations of the above to be made.

Twenty-nine individuals from fourteen nations who have had experience with atmospheric and oceanic microplastics or with air/sea exchange of material participated in the three-day workshop. A detailed review paper resulting from the workshop was published by Nature Reviews – Earth Environment in May 2022, with lead authors Deonie and Steve Allen, who are among the leaders in the measurement of microplastics in the atmosphere/ocean system. The paper indicates that atmospheric transport may indeed be an important, and previously little considered, route by which microplastics reach the ocean. The sources of these atmospherically transported microplastics are both direct emissions and also the fragmentation, resuspension and redeposition (possibly many times) of plastics already released into the environment, meaning that emission control alone will not address this issue. Microplastics currently in the ocean may also be emitted into the atmosphere via air-sea exchange processes and transported

back to land. The paper goes on to propose a cost-effective global strategy to better quantify the role of atmospheric cycling of microplastics by building on existing sampling networks of the Global Atmosphere Watch (GAW) Programme of the World Meteorological Organization. We also expect to develop a report on this workshop for the GESAMP Reports and Studies series.

2. Continuing development of a workshop on the ocean management and policy implications of the air/sea exchange of chemicals

As described in the 2021 report of WG 38, plans have been developed, funds have been obtained from several UN agencies and from SOLAS, and individuals have been invited for a workshop that was originally to be held in October 2020 at Nelson Mandela University, Gqeberha (formerly Port Elizabeth), South Africa. This workshop is entitled **“Potential role of atmospheric deposition in driving ocean productivity in the Southwest Indian Ocean.”** Unfortunately, due to COVID-19, this in-person workshop was postponed until October 2021, and then postponed again to October 2022. Because a significant part of this workshop involves stakeholders/managers, students, and early career scientists, we do not believe that a virtual format would allow for the efficient engagement of these groups. Thus, we have continued to work toward an in-person/hybrid workshop in South Africa. We are optimistic that conditions will enable this workshop to be carried out in October 2022 in Gqeberha.

The workshop will include international and local scientists, managers, and policymakers, and it will evaluate the atmospheric inputs and impacts of nutrients from biomass burning and industrial emissions to the Madagascar Channel and the southwest Indian Ocean, with the following objectives:

- ◇ To evaluate the current knowledge of the atmospheric inputs into the southwest Indian Ocean and scientific evidence for the factors that control algal blooms in this region, including the potential role of atmospheric deposition, and the confidence in our understanding of these factors.
- ◇ To debate the associated potential impacts and management implications with a broader group of stakeholders/experts (including social scientists and economists).
- ◇ To present this information to decision-makers at the senior management and policy level for their response and advice on adaptive management steps.
- ◇ To identify the feasibility of institutionalizing such an adaptive/dynamic management process at the regional level and linking it into national management processes.
- ◇ In parallel with this process, to introduce young and emerging African scientists to the debate and the science involved and to build capacity for this dialogue within the region.

The algal blooms in this area of the Indian Ocean are particularly large, although the factors controlling them are not understood. Atmospheric inputs of different constituents may play an important role and needs to be scientifically evaluated. The marine resources of this region also

make an important contribution to the diet of many people living on land adjacent to this marine region. The challenge of the workshop will be to connect land management practices with the marine management practices understanding that one has serious implications for the other.

We have begun work on developing scientific questions and assembling relevant information for the workshop and this process will continue ahead of the workshop to try and ensure we all arrive in South Africa well prepared for the work to be done at the workshop. A Zoom call that included all invited scientists was held in late June to begin the development of the background material to be brought to the workshop.

As with the other WG38 activities, the aim is to develop and publish quickly in the open scientific literature the conclusions of the workshop. We appreciate very much the willingness of the supporting UN agencies and SOLAS to continue to support this workshop, even after two postponements due to Covid-19.

3. Other WG 38 Activities

For the ninth year in a row WG 38 organized a session on the atmospheric input of chemicals to the ocean for the 2022 European Geosciences Union meeting, held in Vienna, Austria in April – “Air-Sea Exchanges: Impacts on Biogeochemistry and Climate”. A number of oral and poster papers at this session were presented by a combination of WG 38 members and other scientists.

Tim Jickells, Robert Duce, Melanie Bergmann, and Peter Liss (three of whom are members of WG 38) organized and carried out a session at the American Geophysical Union Fall Meeting in December 2021 in New Orleans, LA entitled “Microplastics in the Atmosphere and Ocean”.

4. Publications of WG 38 in 2021 and 2022

Peer reviewed publications:

20. Baker, A.R., M. Kanakidou, A. Nenes, et al., 2021, “Changing atmospheric acidity as a modulator of nutrient deposition and ocean biogeochemistry”, Science Advances, **7**, eabd8800.

21. Allen, D., S. Allen, S. Abbasi, *et al.*, 2022, “Microplastics and nanoplastics in the marine-atmosphere environment”, *Nature Reviews - Earth Environment*, <https://doi.org/10.1038/s43017-022-00292-x>

GESAMP Reports and Studies:

WG 38, through WMO, published GESAMP Reports and Studies No. 109, The Changing Acidity of the Global Atmosphere and Ocean and its Impact on Air/Sea Chemical Exchange, 56pp, (2022).

Plans for WG 38 for 2022-2023.

Working Group 38 has the following plans for the period 2022-2023:

- Carrying out the workshop on the ocean management and policy implications of the air/sea exchange of chemicals at Gqeberha, South Africa in October 2022.
- Developing several peer reviewed papers resulting from the workshop in South Africa.
- Developing a GESAMP Reports and Studies document on the results from the WG 38/40 workshop on the atmospheric transport of microplastics to and from the ocean.

Except for the support confirmed earlier by several UN agencies for the work of WG 38 in South Africa, we do not expect to ask for any additional support this coming year.

Current Membership of GESAMP Working Group 38

Robert Duce, Co-chair (USA) (M)

Timothy Jickells, Co-chair (United Kingdom) (M)

Sajjad Abbasi, Iran (M) (early career)

Deonie Allen, New Zealand (F)

Katye Altieri, South Africa (F)

Alex Baker, United Kingdom (M)

Cecile Guieu, France (F)

Frances Hopkins, United Kingdom (F)

Akinori Ito, Japan (M)

Maria Kanakidou, Greece (F)

Daoji Li, China (M)

Peter Liss, United Kingdom (M)

Natalie Mahowald, USA (F)

Morgane Perron, Australia/France (F) (early career)

Mike Roberts, South Africa (M)

Monmohan Sarin, India (M)

(Sixteen members, 9 male, 7 female, 2 early career)