GESAMP WORKING GROUP 38

THE ATMOSPHERIC INPUT OF CHEMICALS TO THE OCEANS

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

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During the past year GESAMP WG 38 has focused its attention on the following four areas: 1) Completion of a workshop in South Africa on the ocean management and policy implications of the air/sea exchange of nutrients and the development of paper(s) from that workshop; 2) Completion of a Summary for Policymakers for GESAMP Reports and Studies No. 109, "The Changing Acidity of the Global Atmosphere and Ocean and its Impact on Air/Sea Chemical Exchange"; 3) Began work on a GESAMP Reports and Studies document on the joint WG 38/40 workshop the atmospheric transport of microplastics to and from the ocean; 4) Organized a session on air/sea chemical exchange at the 2023 European Geosciences Union meeting. We also outline our plans for WG 38 activities for 2023-2024.

WG 38 Activities during 2022-2023

1. Successful completion of a workshop on air/sea exchange in South Africa

This meeting was originally scheduled to take place in 2020 but was delayed by Covid and finally took place in October 2022 at Gqeberha (formerly Port Elizabeth) in South Africa. The meeting was predominantly in person with a small number of participants joining virtually. In total there were 48 participants from 18 countries. We appreciate the support for this workshop from GESAMP, SOLAS, WMO, IMO, IOC, SCOR, the British High Commission Pretoria; Nelson Mandela University; and NMU's Institute for Coastal and Marine Research.

The core objectives of this expert group workshop were to investigate the causes of large-scale summer phytoplankton blooms which develop in some years south of Madagascar, and in particular if atmospheric transport of nutrients from southern Africa plays a role in stimulating these blooms. The southern Indian Ocean generally is a region where climate change is expected to lead to decreases in overall phytoplankton production potentially impacting fish harvests in an area where a large and vulnerable population is dependent on fishing for an important part of diet. These large summer phytoplankton blooms have the potential to alter ocean productivity and fishing activity, so understanding their causes, and the potential impact of climate change on these blooms, is an important scientific and policy challenge.

The meeting had two additional related objectives. The first was an element of regional capacity building, and to this end a group of early career scientists were given an introduction to the relevant biogeochemical atmospheric and ocean processes at both global and relevant regionals scales and the interactions between them. Following this these early career scientists joined the expert workshop as full participants to allow them to learn more about the processes by which a group of experts tackle a complex interdisciplinary issue such as understanding the drivers of these summer blooms south of Madagascar. The second additional element of the meeting was to engage with policy makers working on regional marine environmental management and fisheries to explore how the outcomes of the workshop could contribute to policy making. In particular the aim was to use the outcomes of the expert workshop as a case study of adaptive management, and specifically how policy makers and scientists can work together to develop policy responses in the face of inevitable scientific uncertainty.

We believe the meeting was able to successfully deliver on all its objectives. Further work is going on to try to better understand the drivers of the summer blooms which appear to be triggered by the interactions of several processes, which may include, but are not dominated, by atmospheric inputs. The results of the deliberations from the workshop are now being written up for publications in the scientific literature with at least two publications anticipated one focused on the environmental sciences aspects of the issues and one focused on the discussions of improving adaptive management.

2. **Completion of a Summary for Policymakers for GESAMP Reports and Studies No. 109, "The Changing Acidity of the Global Atmosphere and Ocean and its Impact on Air/Sea Chemical Exchange**

For the first time WG 38 has developed a Summary for Policymakers for one of its GESAMP Reports and Studies Documents. This brief 5-page report summarizes the scientific results in the original R&S 109 in two areas:

- The effect of changing ocean acidity on the emission of key climate-regulating gases from the ocean to the atmosphere; and
- The effects of changing acidity in the atmosphere on the deposition of key nutrients delivered to the ocean through the atmosphere and the resultant impacts of this on ocean biogeochemistry.

The report then summarizes some current implications for management and policy, including:

- providing a valuable aid in overall global or even regional approaches to marine management and climate policy formation and provide essential advice and guidance to bodies such as the IPCC;
- highlighting mid- to long-term concerns related to changes in productivity within the global ocean, which is of huge importance at the management and policy level. Falling productivity aligns with decreasing fish stocks and fisheries catches; and

- pointing out that productivity peaks and troughs may realign geographically with changes in ocean physics and chemistry creating new fisheries, which would clearly have geopolitical as well as socioeconomic implications to those countries affected.

3. **Began development of a GESAMP Reports and Studies document on the joint WG 38/40 workshop the atmospheric transport of microplastics to and from the ocean.**

After publication of the peer-reviewed paper in Nature, (Allen, D., et al., "Microplastics and nanoplastics in the marine-atmosphere environment", Nature Reviews, Earth and Environment, 3, 393-405), WGs 38 and 40 begam writing a more detailed report on this work for the GESAMP Reports and Studies series. At the present time we are attempting to get the permission from Nature to include that entire paper in the R&S document. We expect that R&S report to be completed and published later in 2023.

4. **Organized a session on air/sea chemical exchange at the 2023 European Geosciences Union meeting.**

For the tenth year in a row WG 38 organized a session on the atmospheric input of chemicals to the ocean for the 2023 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.

Plans for WG 38 for 2023-2024.

Working Group 38 has the following plans for the period 2023-2024:

- Completion of peer-reviewed papers from the 2022 workshop in South Africa on the ocean management and policy implications of the air/sea exchange of nutrients.

- Completion of 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.

- Discussion with the members of WG 38 about the next tasks that the working group will address. We do not expect there will be any completely new activities started in the upcoming 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)