

Annual SCOR Working Group Report for WG 161

1. Name of group

Respiration in the **Mesopelagic Ocean (ReMO)**: Reconciling ecological, biogeochemical and model estimates

2. Activities since previous report to SCOR (e.g., virtual or in-person meetings, email discussions, special sessions). Limit 1000 words

We received confirmation that WG 161 would be funded in November 2020, with the request to include a member from an African country in the group. Our proposal had only included 19 named members exactly because we hadn't yet identified a member from the African continent. So, our first activity was to recruit such a member. After several email discussions with African colleagues about the tasks and expertise involved in the WG, and then with Patricia Miloslavich, we were very pleased to welcome Raquel Flynn to the group. Raquel is a PhD student at the University of Cape Town working on oxygen and nitrogen cycling in the Benguela upwelling system.

Once the membership was confirmed, we created a Google site for use within the group and started to organize meetings. We held virtual co-chairs meetings on 18 December 2020 and 12 January 2021 and then the first virtual group meeting on 19 January 2021. During this first 2h meeting we introduced ourselves, recapped on the terms of reference for the WG and started to work on the first deliverable. The membership spans 21 time zones and so we decided that future virtual meetings should be held in duplicate at 08:00 UTC and 19:00 UTC on the last Thursday of every month. These meetings are recorded for anyone who cannot attend, they last for 2h and they each focus on a particular task or tasks and include progress updates from the co-leaders of each task. So far, we have had meetings on 25 February, 25 March, 29 April, 27 May, and 24 June 2021.

To advertise the work of the group, we gave a presentation to the [Jetzon](#) network of scientists who work in the mesopelagic zone, in November 2020, and wrote articles for the UK [Challenger](#) Society for Marine Science and the Canadian Ocean Sciences Newsletter. ReMO is one of several projects contributing to Jetzon, which in June 2021 became a UN Decade programme.

3. Documents published since previous report to SCOR (e.g., peer-reviewed journal articles, reports, Web pages) and should be limited to publications that resulted directly from WG activities and which acknowledge SCOR support

There are no peer-reviewed journal articles or reports arising from this WG yet. We have produced a Google Site to use within the WG – this includes all minutes and recordings from the meetings, editable WORD and EXCEL documents that we use to progress the tasks, information on membership and outputs. We haven't yet produced an external facing website but this is on our 'to do' list for this year.

4. Progress toward achieving group's terms of reference. List each term of reference separately and describe progress on each one. Limit 1000 words

Terms of reference (1-5) are detailed below, along with the relevant deliverables (D1-D11), the year-end by which they were planned to be completed (2021-2024) and a [statement on progress](#).

1. Identify, quantify and prioritise gaps in our knowledge, and prepare an action plan to reduce these gaps by reviewing available information on mesopelagic respiration

D1. An action plan to identify gaps in knowledge and propose ways to address those gaps (2021)

We have divided this task into three themes (biogeochemistry, ecology and modeling), with at least two WG members delegated to lead each theme. We are in the process of collating relevant references and synthesising published and our own unpublished data. We have had 3 brainstorming discussions to identify knowledge gaps and ways to address the gaps. The theme co-leads are drafting text for contributions, comments and discussion from all members at the monthly meetings. We envisage the plan will be complete by the end of 2021.

D2. A position paper, based on the plan, highlighting the importance of reliable estimates of mesopelagic respiration, and suggesting priority research questions (2021)

This will be largely based on D1, so will start once the action plan has progressed to draft 1.

D3. A model intercomparison / data sensitivity paper (2022)

A subgroup of the WG held an online discussion on the scope and structure of the model intercomparison and data sensitivity paper (29 March 2021). The paper will connect to the action plan and data compilation taking place within ReMO, and focus on carbon and respiration. One central question could be: "Can we explain respiration patterns (OUR) in the ocean?" (i.e., focusing on the large spatial scale). To answer this question we will analyse existing global biogeochemical model results (e.g., from FOCI-MOPS at GEOMAR), which include not only biogeochemical processes, but also an age tracer (ideal age, a synthetic tracer), to derive respiration rates either directly from model output, or diagnosed from AOU and age. Model analysis can be done globally, regionally or at specific sites, thereby providing the possibility to (i) compare directly to in situ observations or diagnosed respiration, (ii) guide spatial interpolation of local observations, and (iii) help to inform us on improved in situ sampling strategies. Model analysis is currently underway. We envisage the first draft will be available by the end of 2021.

2. Develop a global dataset of mesopelagic respiration estimates, derived from the range of ecological and biogeochemical techniques available, in order to create a resource for validation of biogeochemical models including Earth System Models used for climate projection

D4. A global dataset, linked to international marine data hubs, for use by modellers, launched at a Town Hall meeting at an international conference such as Ocean Sciences (2023)

We have consulted with national datacentres and produced a first draft of a template that could be used to collate data from the international community. Four volunteers have 'road tested' this template for different data combinations and provided comments on its structure. Draft two of the template is currently being developed and tested. We aim to have the template ready to distribute by the end of 2021 together with a glossary and instructions. We would encourage the community to

submit data during 2022 so that the dataset can be launched together with the data paper during 2023.

D5. A data paper in *Earth System Science Data* <https://www.earth-system-science-data.net/> (2023)
This will be progressed alongside D4.

3. Produce a new synthesis of open ocean mesopelagic respiration

D6. A synthesis paper on a model/observational case study, and presentations at appropriate international conferences (2024)

4. Produce a best practice manual of techniques and approaches to determine mesopelagic respiration, and make recommendations as to which is the most appropriate method or combination of methods for a particular application, including best practice on how to reconcile approaches across time and space scales

D7. A best practice manual for ecological and biogeochemical methods used to derive mesopelagic respiration (2023)

We have a draft structure of this manual, with co-leads identified for the different sections. We have had two discussion sessions on the structure and the document is editable on the Google site.

D8. A method inter-comparison paper and dataset (2024)

5. Build capacity, share knowledge and transfer technical skills, particularly to scientists in developing nations

D9. A training course on model and observational approaches to derive mesopelagic respiration for early career and experienced researchers, particularly aimed at scientists from developing nations (2023)

D10. Online training materials such as lectures and practical demonstrations of analytical techniques, budgeting exercises and modelling approaches (2024)

D11. A manuscript for children on mesopelagic microbial respiration in *Frontiers for Young Minds* <https://kids.frontiersin.org/> (2024)

We plan to initiate a mentoring scheme, whereby each ReMO member is paired with and subsequently mentors an early career scientist from a developing nation. We have discussed this at one meeting so far and have designated co-leads. The next step is to define what would be involved, draft an advert for mentees and advertise through early career researcher networks.

5. WG activities planned for the coming year. Limit 500 words

The action plan (D1) and position paper (D2) are on schedule to be submitted at the end of 2021. During 2022 we will complete and submit the model sensitivity paper (D3), progress the data compilation (D4), the data comparison paper (D5) and the methods manual (D7). We will also plan the training course (D9), progress the synthesis paper (D8) and paper for school children (D11) and launch the mentoring scheme.

6. Is the group having difficulties expected in achieving terms of reference or meeting original time schedule? If so, why, and what is being done to address the difficulties Limit 200 words

Due to COVID-19, we haven't had the opportunity to meet face to face. The dual meetings and Google site have enabled us to progress with the science tasks, but the interactions between members living in different time zones and the usual networking possible at face to face meetings has been limited. We would therefore aim to have a face to face meeting during 2022. We are currently discussing where to hold this - potentially for 2 days immediately before a relevant conference e.g. Ocean Sciences in Hawaii, EGU in Vienna or the Gordon Research Conference on Marine Biogeochemistry in Spain. This will also aid in the planning and preparation required for the training course.

7. Any special comments or requests to SCOR. Limit 100 words.

Additional information can be submitted and will be included in the background book for the SCOR meeting at the discretion of the SCOR Executive Committee Reporter for the WG and the SCOR Secretariat.