

SCOR Annual Report

July 7, 2022

Highlights: Following the approval of Clce2Clouds (Coupling of ocean-ice-atmosphere processes: from sea-ice biogeochemistry to aerosols and Clouds), the community got to work quickly. To ensure a smooth spin-up despite the remaining pandemic-related travel restrictions, all members posted a short presentation of their research interests in Clce2Clouds for the group to watch. This allowed the group to take the first steps and efficiently move forward on the TORs. To address the development and refinement of conceptual models for key chemical compounds in the coupled ocean-ice-snow-atmosphere system, three sub-working group ((a) sulfur cycle, (b) nitrogen cycle and (c) primary aerosol) have been set up. The groups meet regularly online and are working toward drafting bi-polar and seasonal conceptual schematics on relevant processes. These schematics will inform the basis of conceptual models of known and constrained processes, and point toward knowledge gaps to inform future research. Approximately equal representations of atmospheric and ocean biogeochemical experts ensure that both sides of the ice/snow interfaces are represented adequately. Clce2Clouds held a day of sessions at the CATCH Open Science Workshop, and is looking forward to a first hybrid meeting connected to the SOLAS Open Science conference (Sept. 2022, South Africa). An open discussion session on differences in ocean-ice-snow-atmosphere processes in the Arctic and Antarctic is also planned for the SOLAS Open Science Conference.

1. Name of group

Clce2Clouds (Coupling of ocean-ice-atmosphere processes: from sea-ice biogeochemistry to aerosols and Clouds); Working Group #163

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

- Clce2Clouds was approved in October 2021 and a first planning meeting was held online in November 2021. This meeting focused on planning how to proceed given travel restrictions and the need to combine online & offline working flexibility
- Working group organization activities included set-up of working group communications through a Slack workspace, a Google Team Drive, and a working group website with support from IGAC (www.cice2clouds.org)
- The initial kick-off meeting held online in January 2022, before which all full and associate members recorded and posted a video to introduce themselves, their research and how this links to Clce2Clouds goals, TORs and deliverables. In this meeting, we:
 - Established 3 major sub-working groups on specific chemical/biological systems: (a) sulfur cycle, (b) nitrogen cycle and (c) primary aerosol, with several options for future sub-working groups that can be initiated (e.g., reactive halogens).
 - Identified a range of themes that link across the ocean/sea-ice interface and require education across disciplinary boundaries
- A first open community online meeting was held on the final day of the [CATCH Open Science Workshop](#) (May 9 -13, 2022), which included three tutorial-style introductory talks that are [posted freely online](#).
- Sub-working groups initiated during the January 2022 meeting are meeting online regularly, and are working offline using a Slack workspace and shared documents. Sub-working groups have met 4 - 5 times since our initial January 2022 full working group meeting.

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

- No peer-reviewed documents have been published so far
- Clce2Clouds website has been established: www.cice2clouds.org

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

(TOR1) To prioritize key coupled biological and chemical systems that drive atmospheric reactive trace gas, aerosol, and cloud properties in polar ocean environments. Synthesize expertise from ocean, sea-ice, snow, and atmospheric chemistry communities to provide a hierarchy of chemical species that reflect common overlapping science questions (Objective O1).

- *Progress toward TOR1:*
 - *Established sub-working groups on (a) sulfur cycle, (b) nitrogen cycle and (c) primary aerosol, which have each met online 4 - 5 times since January 2022. Sub-working groups work offline using Slack and shared documents, and are beginning to scope and outline initial publications outlining current knowledge and knowledge gaps and needs on each topic.*

(TOR2) To identify similarities and differences in controls on exchange processes between the Arctic and Antarctic O-SI-S-A systems. Compare and contrast common sea-ice and snow properties at both poles. Use this polar ocean comparison to describe how sea-ice properties control exchange processes, and constrain projections of future changes (Objective O2).

- *Progress toward TOR2:*
 - *Established sub-working groups on (a) sulfur cycle, (b) nitrogen cycle and (c) primary aerosol, which have each met online 4 - 5 times since January 2022. Sub-working groups work offline using Slack and shared documents, and are framing their discussions and publication scoping in the context of TOR2 Arctic-Antarctic comparison.*
 - *A discussion session proposal on differences in ocean-ice-snow-atmosphere processes has been submitted to the SOLAS Open Science Conference (Sept. 2022, South Africa)*

(TOR3) To develop a conceptual model of exchange processes in O-SI-S-A systems, focusing on key reactive trace gas and aerosol species prioritized in O1. Conceptual model evolution will be based on existing observational and numerical expertise, and will reflect the impact of heterogeneity in sea-ice environments at present and under future climate change scenarios (Objective O3).

- *Progress toward TOR3:*
 - *Each sub-working group ((a) sulfur cycle, (b) nitrogen cycle and (c) primary aerosol) are working toward drafting bi-polar and seasonal conceptual schematics on relevant processes. These schematics will inform the basis of conceptual models of known and constrained processes, and point toward knowledge gaps to inform future research.*

(TOR4) To develop interdisciplinary campaign planning recommendations to guide future studies and address model and measurement gaps. Building on the conceptual model (O3), we will identify future needs in observations and model parameterisations, and outline requirements for fully integrated, multidisciplinary and collaborative O-SI-S-A field, laboratory, and modeling research (Objective O4).

- *Progress toward TOR4:*
 - *Community open forum and discussion on joint campaign & experiment planning held at the [CATCH Open Science Workshop](https://www.piccaaso.org/), which initiated a collaboration between Clce2Clouds and PICCASSO (<https://www.piccaaso.org/>; Partnerships for Investigating the biogeoChemistry of the Atmosphere in Antarctica and the Southern Ocean) in drafting a white paper on the need for focused interdisciplinary studies of the ocean - sea-ice - snow - atmosphere interface in the Southern Ocean while this region remains the most pristine region of the globe.*

- *Established leadership for activities within this TOR, with offline communications via Slack.*

(TOR5) To facilitate community and capacity building opportunities for sustainable multidisciplinary science at the O-SI-S-A interface. Engage scientifically emerging countries and early career scientists in both observational and modeling communities (Objective O5).

- *Progress toward TOR5:*
 - *Initiated work toward Deliverable #3 (openly available introductory talks on fundamental topics in atmospheric chemistry and sea-ice biogeochemistry) at the CATCH Open Science Workshop in May 2022. The first three talks in this series focused on: (1) Algal Functional Groups and the Polar Sulfur Cycle, (2) What We Know About the Chemistry & Physics of Snow that is Relevant to Snow on Sea-ice, and (3) Aerosol as Cloud Nuclei for Cloud Formation in Polar Ocean Environments.*
 - *Planning for September 2022 Hybrid Clce2Clouds Workshop that will focus on initial scoping and writing of the tutorial-style review paper in Deliverable #3.*
 - *The working group members have been extended to include a new full member from Argentina and a new member with association to South Korea (as per recommendation from the Korean SCOR representative)*

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

- First Hybrid Clce2Clouds workshop prior to the SOLAS meeting in Cape Town, South Africa, and online (September 23 - 24, 2022).
Workshop Goals & Outcomes: To scope and begin collaborative writing for a *tutorial-style review paper* (TOR5, Deliverable #3), focused on fundamental concepts that link sea-ice biogeochemistry with atmospheric science and chemistry. This review paper will:
 - Be aimed at a broad and multidisciplinary scientific audience, including early career scientists
 - Outline what the atmospheric and sea-ice biogeochemistry communities need to know from each other to advance our knowledge of key processes at the ocean - sea-ice - snow - atmosphere (O-SI-S-A) interface
 - Be organized around key processes, such as brine transport, photo-oxidation in condensed phases, biological community development in sea-ice, air-sea fluxes in sea-ice environments, bubble bursting, wave breaking, snow lofting, atmospheric mixing, atmospheric oxidation, cloud processing, atmospheric deposition
- Completion of the above tutorial-style review paper (TOR5, Deliverable #3)
- Continued regular virtual meetings of sub-working groups, and drafting of initial synthesis article(s) (Deliverable #1, covering TORs 1-3)

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

So far progress has been good, despite the limitation to online meetings

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.