

Annual Report for the year 2022

Activity/ Initiative: BEPSII (Biogeochemical Exchange Processes at Sea-Ice Interfaces)

Compiled by: BEPSII Steering committee (see below)

Notes: Reporting Period is January - December 2022. Information will be used for reporting, fundraising, networking, strategic development, & outreach.

1. What can SOLAS do to further foster your project / initiative / activity?

Continue to support BEPSII through funding in support of annual meetings and ECR training: BEPSII moved to holding an in person meeting only every two years and an online meeting every other year. This allows to allocate BEPSII funds to the ECR exchange program (or a nother field school) every other year when there are no funds required for the BEPSII meeting. We would appreciate SOLAS' continued contribution to these activities.

2. Scientific highlights

This years BEPSII highlight were the final activities of task group 1/SCOR-WG ECV-Ice, the inter-comparison experiment for gas in sea ice, flux, and primary production in Cambridge Bay, Canada, at the Canadian High Arctic Research Station 9CHARS) in spring 2022. An international team of BEPSII researchers performed inter-comparison experiments on sea-ice biogeochemistry in the joint setting to better understand differences and communalities among methods and instruments. Evaluations are ongoing. The experiment was linked with the BEPSII field school at the same location in May 2022.

3. Activities/main accomplishments in 2022 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

- ECV-Ice inter-comparison experiment (see science highlights) and BEPSII Field school (see capacity building) , spring 2022 in Cambridge Bay
- The new SCOR working group Clce2Clouds connecting BEPSII and CATCH (the Cryosphere & Atmospheric Chemistry, cosponsored by SOLAS and IGAC) has started activities including: Producing a tutorial paper on ocean-ice-atmosphere interactions in the polar oceans and synthesis papers for each of: the sulfur cycle, primary aerosols, and the nitrogen cycle in sea-ice areas. Developing field recommendations for combined atmosphere-sea ice research.

- 2022 Meetings: Annual meeting, workshops, conferences, etc. Please include:
 - Due to the demands of the field school and Intercomparison experiment and the upcoming in-person event in March 2023, no BEPSII annual meeting was held in 2022
 - First in-person Clce2Clouds meeting was held in conjunction with the SOLAS open Science conference in Cape Town, South Africa, September 2023. An event report will be published in the upcoming SOLAS news letter.
 - BEPSII participated in a session on “Southern Ocean Ecosystems” in the CRYOSPHERE Pavilion at COP27 in Sharm-El-Sheikh Egypt, November 2022.

4. Publications generated by the activity in 2022 (Reports, ACCEPTED articles, models, datasets, products, website etc.)

1. Campbell, K., Matero, I., Bellas, C. *et al.* Monitoring a changing Arctic: Recent advancements in the study of sea ice microbial communities. *Ambio* 51, 318–332 (2022). <https://doi.org/10.1007/s13280-021-01658-z>

Lebrun, M., Vancoppenolle, M., Madec, G., Babin, M., Becu, G., Lourenço, A., et al. (2023). Light under Arctic sea ice in observations and Earth System Models. *Journal of Geophysical Research: Oceans*, 128, e2021JC018161. <https://doi.org/10.1029/2021JC018161>

Chamberlain, EJ, et al. 2022. Impacts of sea ice melting procedures on measurements of microbial community structure. *Elem Sci Anth*, 10: 1. DOI: <https://doi.org/10.1525/elementa.2022.00017>

M. Corckill, S. Moreau, J. Janssens, A. D. Fraser, P. Heil, J.-L. Tison, E. Cougnon, C. Genovese, N. Kimura, K. M. Meiners, P. Wongpan, D. Lannuzel. Physical and biogeochemical properties of rotten East Antarctic summer sea ice. Submitted to *Journal of Geophysical Research: Oceans*, 128, e2022JC018875. <https://doi.org/10.1029/2022JC018875>

J. Gutt, S. Arndt, D. K. A. Barnes, H. Bornemann, T. Brey, O. Eisen, H. Flores, H. Griffiths, C. Haas, S. Hain, T. Hattermann, C. Held, M. Hoppema, E. Isla, M. Janout, C. Le Bohec, H. Link, F. C. Mark, S. Moreau, H.-O. Pörtner, F. Schaafsma, K. Teschke, S. Tippenhauer, S. Trimborn, A. Van de Putte, I. van Opzeeland, M. Wege, D. Zitterbart, and D. Piepenburg. A framework to observe, understand, and project ecosystem response to environmental change in the East Antarctic Southern Ocean. *Biogeosciences*

A. Lowther; C. von Quillfeldt; P. Assmy; L. De Steur; S. Descamps; D. Divine; S. Elvevold; M. Forwick; A. Fransson; A. Fraser; S. Gerland; M. Granskog; I. Hallanger; T. Hattermann; M. Itkin; H. Hop; K. Husum; K. M. Kovacs; C. Lydersen; K. Matsuoka; A. Miettinen; G. Moholdt; S. Moreau; P. I. Myhre; L. Orme; O. Pavlova; A. H. Solberg Tandberg. 2022. A review of the scientific knowledge of the seascape off Dronning Maud Land, Antarctica. *Polar Biology* <https://doi.org/10.1007/s00300-022-03059-8>

Nomura, D., Ikawa, H., Kawaguchi, Y., Kanna, N., Kawakami, T., Nosaka, Y., Umezawa, S., Tozawa, M., Horikawa, T., Sahashi, R., Noshiro, T., Kaba, I., Ozaki, M., Kondo, F., Ono, K., Yabe, I. S., Son, E. Y., Toyoda, T., Kameyama, S., Wang, C., Obata, H., Ooki, A., Ueno, H., Kasai, A. (2022). Atmosphere–sea ice–ocean interaction study in Saroma-ko Lagoon, Hokkaido, Japan 2021. *Bulletin of Glaciological Research*, 40, 1–17, doi: 10.5331/bgr.21R02.

Else, B. G. T., Cranch, A., Sims, R. P., Jones, S., Dalman, L. A., Mundy, C. J., Segal, R. A., Scharien, R. K., Guha, T. (2022). Variability in sea ice carbonate chemistry: A case study comparing the importance of ikaite precipitation, bottom ice algae, and currents across an invisible polynya. *The Cryosphere*, 16, 3685–3701, 2022 <https://doi.org/10.5194/tc-16-3685-2022>.

5. Describe your capacity building efforts for early career scientists and scientists from developing countries.

BEPSII emphasises the inclusion of Early Career Scientists in BEPSII research projects and encourages ECR leadership and training. Examples:

- 1) The BEPSII SSC includes 2 ECS (2 year assignments). Currently: Eeva Eronen-Rasimus (Finland) and Pat Wongpang (Australia).
- 2) BEPSII field school (May 2022, CHARS, Cambridge Bay, Canada, see below)
- 3) Frontiers of Young Minds - Science journal for kids: Antarctica and the Southern Ocean Collection (24 articles coming soon, coordinator P. Wongpang)

- **BEPSII Field school (<https://sites.google.com/site/bepsiiwg140/blog/bepsi-sea-ice-school-2022>)**

Some FACTS about the school

Place: CHARS Station, Cambridge Bay, Nunavut, Canada, *Time:* 14-23 May 2022,

Format: lectures, field work, lab work, poster sessions, group presentations

Topics covered: sea-ice physics, optics, gas exchange, algae and primary production, nutrients, and modelling.

Some NUMBERS from the school

Students: 31; *Lecturers:* 9; *Countries:* 13; *Funds raised:* about 40,000 EUR; *Blog articles:* 3; *Educational videos made:* 6; *Podcasts created:* 11; *Birthdays celebrated:* 2!

6. Describe how geographical, gender, and career balance is ensured.

In 2022, members of the BEPSII Steering committee represented 10 countries spread across both hemispheres, with a 50/50 women/men balance. 2 new early career researchers have joined the steering committee in 2022 as a means to ensure succession planning and integrate ideas from the next generation of polar leaders. Through their position in the SSC, we hope to engage them in the scientific foci of BEPSII and stimulate them to take-up leadership roles.

By demonstrating a diverse leadership team, the BEPSII community aims to express inclusiveness and openness to the global research community. Inclusion of researchers in developing countries who have an interest in polar/sea-ice research is problematic, which is at least partly due to the

fact that relatively few developing countries have a strong polar research interest. Researchers from South Africa are well embedded in BEPSII, and through the new SCOR working group Clce2Clouds, scientists from India and Chile are involved.

7. Does your leadership rotate and if so, how?

BEPSII does not have a strict rotation policy. So far, the BEPSII SSC has been fairly consistent with people leaving, being replaced by active BEPSII researchers who have been taking on leading roles within task groups. ECR assignments are for two years and are selected by evaluation of applications to the SCC following a public call. In 2022 two new ECR members joined the team.

2022 Members of the steering committee: Nadja Steiner (Canada, co-chair) , Jacqueline Stefels (The Netherlands, co-chair), Lisa Miller (Canada), Martin Vancoppenolle (France), Bruno Delille (Belgium), Klaus Meiners (Australia), Delphine Lannuzel (Australia), Sebastien Moreau (Norway), Letizia Tedesco (Finland)

New ECR members: Eeva Eronen-Rasimus (Finland), Pat Wongpan (Australia)

ECVice/Task group 1 chairs: Francois Fripiat (Germany), Daiki Nomura (Japan), Brent Else (Canada)

8. Goals, priorities and plans for future activities/events

1. **Position Analysis on Antarctic sea-ice and ecosystems** (to be finalized at March meeting)
2. **Polar Oceans and Sea Ice in a Changing Climate** - SOLAS paper (to be submitted at end of Feb 2023)
3. **Sea ice Ecosystems, chapter** in Comprehensive Cryospheric Science and Environmental Change, Elsevier (to be submitted in June 2023)
4. **Policy brief for the Antarctic** highlighting the position analysis and the Antarctic component of the sea-ice ecosystem services paper (Steiner et al 2021).
5. **Ice Algae Model Intercomparison Project (IAMIP2)** (Info: IAMIP2 website and Hayashida et al. 2021, GMD) – model runs, analysis and discussions among participants in progress
6. SCOR working group Clce2Clouds connecting BEPSII and CATCH (the Cryosphere & Atmospheric Chemistry, cosponsored by SOLAS and IGAC). Producing a tutorial paper on ocean-ice-atmosphere interactions in the polar oceans and synthesis papers for each of: the sulfur cycle, primary aerosols, and the nitrogen cycle in sea-ice areas. Developing field recommendations for combined atmosphere-sea ice research.
7. Manuscript on Antarctic fast-ice nutrient data compilation has been submitted (Henley et al.), and accompanying data product is being prepared for release.
8. Manuscript on sea-ice DIC & TA data compilation to be submitted in 2023
 - *Next BEPSII meeting: March 12-14, 2023 (Hybrid), Scripps Institute of Oceanography, La Jolla, California, following the GRC in Polar Marine Sciences.*
 - *BEPSII co-sponsored session at EGU, April 2022, Vienna*
 - *BEPSII co-sponsored session at the IGS sea-ice symposium in Bremen, June 2023*

9. Please provide one or more photos illustrating your research activities.

Attach the photo(s) to your email; use the free space below to add a short description of the photo(s) and the picture credit. The IPO will use the provided photos to illustrate the SOLAS website and to promote SOLAS related research.

Both pictures are from the ECVIce intercomparison experiment (photo credits Daiki Nomura) and show under-ice covariance measurement set up and sea-ice sampling for primary production

10. Comments

BEPSII greatly appreciates the continued support from SOLAS!