

Workshop Report

**NORP-SORP-OMDP-ARP Workshop on Polar Heat:
Transports, Mechanisms and Global Linkages**
February 28th and March 1st, 2026, Glasgow, UK & Online

July, 2026
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Authorship notice

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1. Introduction

A two-day workshop on Polar Heat: Transports, Mechanisms and Global Linkages, was held on February 28th and March 1st, 2026 at the University of Glasgow (Glasgow, UK) and online. The workshop was jointly organized by four CLIVAR panels: the Atlantic Region Panel (ARP), the Ocean Model Development Panel (OMDP), the CLIVAR/CliC Northern Oceans Region Panel (NORP), and the CLIVAR/CliC/SCAR Southern Ocean Region Panel (SORP).

The workshop aimed to synthesize and advance understanding of polar ocean heat, its governing dynamics, and its far-reaching implications. It addressed three primary themes: (a) polar heat; (b) heat transports and large-scale circulation; and (c) local and regional processes in a warming global climate. A central objective was to unify the Arctic and the Southern Ocean.

The workshop brought together 75 in-person participants (Picture 1) from 15 countries, of whom 52% were Early Career Researchers (ECRs, defined as professionals within ten years of receiving their highest degree, including students), and the female:male ratio was 41:34. An additional 38 individuals from 19 countries participated online, 90% were ECRs, and the female:male ratio was 15:23. Attendees represented a range of observational and modeling expertise across both the Northern and Southern Oceans.

The workshop was well attended by CLIVAR members from all the organizing panels (Picture 2), noting the importance of having engaged members participating and supporting CLIVAR activities. Some of the workshop participants were also former members from the CLIVAR panels and the Scientific Steering Group.



Picture 1. Group picture of the workshop in-person participants.



Picture 2. Group picture of the CLIVAR members attending the workshop. From left to right: Joana Gonzalez (ICPO staff scientist), Yoshihiro Nakayama (SORP), Feili Li (ARP), Qiang Wang (NORP), Camille Lique (NORP), Yueng-Djern Lenn (NORP), Carolina Dufour (SORP), Céline Heuzé (OMDP), Torge Martin (OMDP), Lars Smedsrud (NORP), Stephanie Waterman (NORP), Benjamin Rabe (NORP Emeritus), Lu Zhou (SORP), Doroteaciro Iovino (OMDP), Chunxue Yang (GSOP), Leo Middleton (NORP), John Krasting (SORP), Paul Spence (OMD), Petteri Uotila (NORP) and Gustavo Marques (OMDP).

2. Workshop format

The workshop consisted of six keynote overview talks split over the two days during the morning session, and breakout sessions following the talks during the afternoons.

Keynote talks. The keynotes were scheduled pairing the speakers by themes. On the first day Dr. Igor Polyakov (University of Alaska Fairbanks) and Dr. David Ferreira (University of Reading) talked about global warming and polar heat: heat budgets, polar amplification and feedbacks; followed by Dr. Ed Doddridge (University of Tasmania, Australia), and Dr. Anna Wåhlin (University of Gothenburg), on local and regional processes: sea ice, ice shelves and vertical fluxes. On the second day Dr. Adele Morrison (Australian National University) and Dr. Lars H. Smedsrud (University of Bergen), addressed the heat transports and large-scale circulation, poleward overturning circulation, and Arctic/Antarctic contrasts. Each pair of keynotes was followed by a question period with some emphasis on understanding similarities and differences between the two polar regions. The keynotes over the morning sessions delivered key information on the state-of the art of the polar heat research

highlighting gaps, challenges and open questions that invigorated the afternoon discussions.



Picture 3. Snapshots of the keynote talks. Anna Wåhlin (top left), Ed Doddridge (top right), Adele Morrison (bottom left), and Lars Smedsrud (bottom right).

Breakout Rooms and plenary discussions. The workshop placed a strong emphasis on capacity building and the proactive planning of tangible outcomes beyond the event. To foster leadership development, each breakout room was co-chaired by a pair consisting of one senior researcher and one Early Career Researcher (ECR). This structure aimed to actively involve ECRs in the discussions while creating a more comfortable environment for them, as they were guided partly by their peers rather than exclusively by senior figures. The onsite participants were able to freely move around the breakout rooms according to their interests. Every breakout session was followed by a plenary session that allowed to share ideas that emerged during the group discussions and received feedback, and possibly to merge suggested efforts and activities.



Picture 4. Participants engaging into the discussions during the breakout rooms.

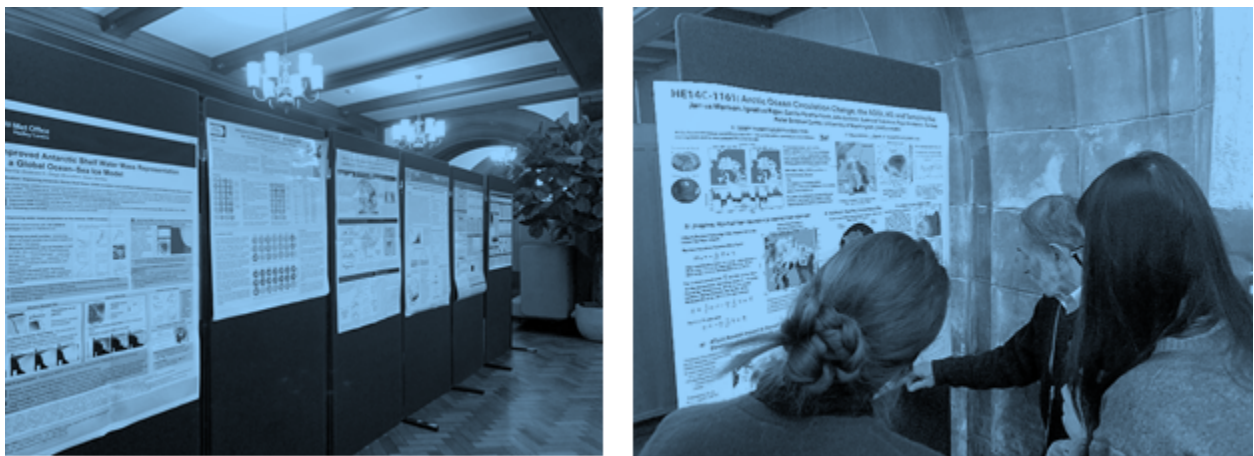


Picture 5. Top: Selection of sticky notes from discussions within the publication-oriented breakout, on topics of "Arctic-Antarctic Asymmetry in a Changing Climate: The Role of Ocean Heat Transport, Sea Ice, and the Atlantic Ocean", "Towards Eddy-Resolving Ocean Models: Confronting Process Understanding Across Scales with Observations", "Continental Shelf Oceanography in the Antarctic: Bathymetry, Cross-Shelf Exchange, and the Role of Boundary Currents in Deep Water Formation", "Ice, Ocean, and Atmosphere at High Latitudes: A Review of Ice Sheet–Ocean Interactions, Sub-Ice Shelf Circulation, and Their Implications for Sea Level Change" (from left to right). Bottom: Participants summarizing the brainstorming session.

On the first day, participants were divided into two breakout rooms to deepen discussions on the following themes: (1) global warming and polar heat, and (2) local and regional processes. On the second day, in addition to addressing the theme of heat transports and large-scale circulation, participants were invited to propose potential follow-up activities. They engaged in brainstorming and initial planning for these activities, culminating in three

simultaneous breakout rooms. Different techniques were used, including, for example, discussion in smaller groups within a breakout collecting ideas on post-it-notes (see Picture 5). Through these sessions, participants started developing concrete ideas and timelines, transcending the predefined themes, for: writing a review paper; organizing a workshops and hackathons on submesoscale processes and Observing System Simulation Experiments (OSSEs); and drafting proposals for the establishment of working groups and the pursuit of funding based on the brainstormed key priorities areas.

Poster session. A dedicated poster display space was available throughout the workshop, allowing participants to showcase their research and stimulate informal discussions during coffee and lunch breaks (Picture 6).



Picture 6. Poster display during the workshop at the One at the Square gallery.

Introduction to CLIVAR panels. As part of the agenda, and with the aim of promoting panel activities and encouraging future active participation, representatives from the four organizing panels delivered a brief five-minute introduction to their respective panel (Picture 7). These presentations covered the current membership, terms of reference, and ongoing activities, serving to inform participants and invite them to become involved in the panels' work. Specifically, the Ocean Model Development Panel was introduced by its co-chair, Doroteaciro Iovino; the Northern Oceans Region Panel by its co-chair, Petteri Uotila; the Southern Ocean Region Panel by its co-chair, Carolina Dufour; and the Atlantic Region Panel by its panel member, Feili Li. Through these concise yet informative contributions, participants gained valuable insight into the panels' scope and were encouraged to actively engage with the CLIVAR community. Both Northern and Southern Ocean Region panels are co-sponsored by Climate and Cryosphere (CliC) and the Southern panel is also co-sponsored by the Scientific Committee on Antarctic Research (SCAR).



Picture 7. Introductory presentations by CLIVAR panel representatives: Petteri Uotila (NORP Co-chair, top left), Carolina Dufour (SORP Co-chair, top right), Feili Li (ARP member, bottom left), and Doroteaciro Iovino (OMDP Co-chair, bottom right).

3. Participants feedback: Survey results and recommendations for future workshops

A post-workshop survey was conducted to collect anonymous feedback from the participants. The survey consisted of five sections designed to evaluate key components of the workshop and gather insights for improving future activities. The survey addressed the following areas: overall overview, workshop structure and flow (including time allocated to plenaries, discussions, and breakout rooms), the design of the breakout rooms, group dynamics and participation, and personal perspectives and ideas for improvement. A total of 40 responses were received: 33 from in-person participants and 7 from online participants. All the responses are in the Appendix F and G. More than half of the respondents identified themselves as early-career professionals (within ten years of completing their highest degree).

Overall, the participants' expectations regarding discussions, networking and concrete outcomes were met. The participants were highly satisfied with the keynotes quality and recommended longer time for discussion on the science. The networking spaces and discussion in smaller groups was also highlighted as a valuable aspect of the workshop. The online participants expected a more "hybrid" session where they felt also included in the onsite discussions.

This workshop format was challenging for the participants who joined after a 5-day conference, as it required a level of energy and focus that was hard to meet afterwards, they recommended to hold it before the conference and during weekdays. Opinions on the outcomes planning breakouts were mixed. The participants noted that good facilitation is key for an effective session, though experiences varied. Some suggestions made include sending instructions or more information prior to the workshop so the participants can prepare in advance and contribute to a more productive session. The size and number of parallel breakouts contributed to a less focussed session. Having a dedicated person to facilitate the online sessions was key and enhanced the experience of the online attendants.

For a better workshop structure, it's recommended to provide some background information at the beginning: an introduction of CLIVAR and its panels, and the overall objective of the workshop. A dedicated session or breakout for ECR's is recommended to provide spaces where they can discuss particular interests and capabilities. The participants expressed that clear communication previous the workshop on the format, instructions and goals would make the sessions more productive.

We thank all the participants for providing constructive feedback and suggestions for future activities, and we hope other panels can take these recommendations into account in the organizations of future activities.

4. Summary

The workshop managed to inform participants on state-of-the art in research related to polar heat across a broad range of settings. Comprehensive Keynotes talks, arranged along the three main themes (polar heat; heat transports and large-scale circulation; local and regional processes in a warming global climate.), covering both local, regional and global ocean-ice processes, prompted the setup of discussion breakout sessions that also covered

other, overarching topics, such as funding and outreach. The outcome of the workshop resulted in this report and will be summarized further in a report planned to be submitted for consideration to be published in the Bulletin of the American Meteorological Society. Several concrete activities were planned along definitive timelines to be pursued after the workshop, including two workshop-hackathon events, one review publication and community activity on science funding. The preparation of these activities will be ongoing through 2026 and 2027. This workshop stimulated further cooperation among diverse groups studying polar heat, contributing to a more unified understanding of both poles dynamics. Cross-panel activities were reinforced and initiated around this common theme, and it is anticipated that this workshop will serve as a preamble for additional products and initiatives aimed at advancing knowledge in the polar heat.

Acknowledgments

We would like to thank the World Meteorological Organization (WMO), World Climate Research Programme (WCRP) and its Core Project on Climate and Ocean, Variability, Predictability and Change (CLIVAR), and Bangor University for their support to this workshop. We also thank the staff of the University of Glasgow and Tapestry who contributed to the smooth development of this workshop. Views and opinions expressed are however those of the author(s) and organizing committee only and do not necessarily reflect those of the WCRP.

Appendix A: Agenda

Saturday February 28th, 2026

08:30 – 09:00	Registration
09:00 – 09:15	Welcome, Introduction / <i>Local logistics</i>
09:15 – 10:30	Keynotes on Topic A: Igor Polyakov & David Ferreira
10:30 – 11:00	<i>Tea/coffee break</i>
11:00 – 12:15	Keynotes on Topic C: Ed Doddridge & Anna Wåhlin
12:15 – 13:15	<i>Lunch</i>
13:15 – 13:40	Brief recap and organization into breakout groups
13:40 – 15:00	Breakouts groups
15:00 – 15:30	<i>Tea/coffee break</i>
15:30 – 16:30	Breakout groups
16:30 – 17:00	<i>Introduction to NORP-SORP-ARP-OMDP</i>
17:00 – 17:30	Plenary: reports on breakout groups, discussion and planning
18:00	<i>Optional dinner (self-funded) at Curlers Restaurant</i>

Sunday March 1st, 2026

09:00 – 09:15	Brief recap of Day 1
09:15 – 10:30	Keynotes on Topic B: Adele Morrison & Lars Smedsrud
10:30 – 11:00	<i>Tea/Coffee break</i>
11:00 – 12:00	3 Breakout groups
12:00 – 13:00	<i>Lunch</i>
13:00 – 14:00	3 Breakout groups
14:00 – 15:00	<i>Plenary – Reports on breakout groups, discussions of publication</i>
15:00 – 15:30	<i>Tea/Coffee break</i>
15:30 – 17:00	<i>Publication /planning, breakouts</i>
17:00 – 17:30	Plenary: wrap-up and tasks/timeline
17:30	End of the workshop

Topics: **A** Global warming and polar heat - Heat budgets, polar amplification and feedbacks, **B** Heat transports and large-scale circulation - poleward, overturning circulation, Arctic/Antarctic contrasts, **C** Local and regional processes - sea ice, ice shelves and vertical fluxes

Appendix B: Scientific Organizing Committee

Committee Lead Benjamin Rabe - Alfred Wegener Institute

Local host Yueng Djern Lenn - Bangor University

International CLIVAR Project Office Support Joana Gonzalez - Ocean University of China

Atlantic Region Panel

Ben Moat - National Centre of Oceanography

Feili Li - Xiamen University

CLIVAR/CliC Northern Oceans Region panel

Benjamin Rabe - Alfred Wegener Institute

Camille Lique - IFREMER

Hannah Zankowski - University of Wisconsin-Madison

Lars H. Smedsrud - University of Bergen

Leo Middleton - University of Gothenburg

Milena Veneziani - Los Alamos National Laboratory

Petteri Uotila - University of Helsinki

Stephanie Waterman - University of British Columbia

Yueng Djern Lenn - Bangor University

Xiangdong Zhang - North Carolina State University

Ocean Model Development Panel

Doroteaciro Iovino - Foundation Euro-Mediterranean Center on Climate Change

Manita Chouksey - Leibniz Institute for Baltic Sea Research Warnemünde

Paul Spence - University of Tasmania

Torge Martin - GEOMAR, Kiel

CLIVAR/CliC/SCAR Southern Ocean Region Panel

Alvaro Scardilli - Servicio de Hidrografía Naval

Carolina Dufour - IFREMER

John Krasting - NOAA - Geophysical Fluid Dynamics Laboratory

Lu Zhou - Utrecht University

Yoshihiro Nakayama - Dartmouth College

Appendix C: List of participants

In person participants

	Name	Affiliation
1	Adele Morrison	Australian National University
2	Alessandro Silvano	University of Southampton
3	Alice Marzocchi	National Oceanography Centre
4	Ana Barbosa Aguiar	Met Office
5	Andrew Thompson	California Institute of Technology
6	Andy Hogg	Australian National University
7	Anna Wåhlin	University of Gothenburg
8	Anna-Marie Strehl	University of Bergen & Bjerknes Centre
9	Anneke Vries	NIOZ Royal Netherlands Institute for Sea Research
10	Benjamin Rabe	Alfred Wegener Institute
11	Camille Lique	LOPS/Ifremer
12	Carolina Dufour	LOPS/Ifremer
13	Céline Heuzé	University of Gothenburg
14	Chiara-Marlen Hubner	Alfred Wegener Institute
15	Chuanshuai Fu	University of Alberta
16	Chunxue Yang	CNR-ISMAR
17	Claire Young	Australian National University
18	David Ferreira	University of Reading
19	Doroteaciro Iovino	Fondazione CMCC
20	Edward W Doddridge	University of Tasmania
21	Emma Boland	British Antarctic Survey
22	Feili Li	Xiamen University
23	Fousiya T. Shahulhmeed	CECI/CERFACS/CNRS
24	Frederike Benz	University of Delaware
25	Graeme MacGilchrist	University of St Andrews
26	Guðrið Eriksdóttir Johansen	Faroe Marine Research Institute
27	Gustavo Marques	NSF NCAR
28	Hannah Dawson	University of Tasmania

29 Helen Johnson	University of Oxford
30 Helen Phillips	University of Tasmania
31 Hugues Goosse	Université catholique de Louvain
32 Igor Polyakov	University of Alaska Fairbanks
33 James Morison	University of Washington
34 James Wyatt	University of Tasmania
35 Jed Lenetsky	University of Colorado - Boulder
36 Jennifer MacKinnon	Scripps Institution of Oceanography, UCSD
37 Jiechao Zhu	McGill University
38 Jiping Xie	Nansen Environmental and Remote Sensing Center
39 Joana Gonzalez	Ocean University of China, CLIVAR Project Office
40 John Krasting	NOAA-GFDL
41 Julia Neme	Australian National University
42 Kathryn Gunn	University of Southampton
43 Kiera Lowman	Princeton University
44 Krissy Anne Reeve	Alfred Wegener Institute
45 Lars H. Smedsrud	University of Bergen & Bjerknes Center
46 Leo Middleton	University of Gothenburg
47 Lise Dekoster	University of Liège
48 Lu Zhou	Utrecht University
49 Luolin Sun	Florida State University
50 Lynne Deborah Talley	Scripps Institution of Oceanography, UCSD
51 Madeleine Youngs	University of Maryland, College Park
52 Maren Elisabeth Richter	University of East Anglia
53 Margarita Markina	NCAR
54 Maurice Huguenin	GEOMAR Helmholtz Centre for Ocean Research Kiel
55 Maya Jakes	University of Southampton
56 Nathan Bindoff	IMAS, University of Tasmania
57 Ole Rieke	IMAS, University of Tasmania
58 Patrick Heimbach	University of Texas at Austin
59 Paul Spence	University of Tasmania
60 Petteri Uotila	University of Helsinki
61 Qiang Wang	Alfred Wegener Institute

62	Regiane Moura	National Institute for Space Research (INPE)
63	Ronald Buss de Souza	National Institute for Space Research (INPE)
64	Ruth Moorman	California Institute of Technology
65	Stephanie Waterman	The University of British Columbia
66	Stephen M Griffies	Princeton University
67	Svenja Ryan	Woods Hole Oceanographic Institution
68	Theo Spira	Alfred Wegener Institute
69	Tiago Dotto	National Oceanography Centre
70	Torge Martin	GEOMAR Helmholtz Centre for Ocean Research Kiel
71	Wilton Aguiar	Australian National University
72	Xiaoming Hu	Sun Yat-sen University
73	Yoshihiro Nakayama	Dartmouth College
74	Yueng Djern Lenn	Bangor University
75	Zhi Li	The University of New South Wales, Sydney, Australia

Online participants

	Name	Affiliation
1	Anant Dikshit	Indian Institute of Technology Roorkee
2	Andrea Mosso	Max Planck Institute for Meteorology
3	Ankit Bhadouriya	National Oceanography Centre
4	Anurag Chaudhary	Indian Institute of Tropical Meteorology
5	Brady Ferster	CNRS-CERFACS
6	Eresanya Emmanuel	Irish Climate Analysis Research Units (ICARUS)
7	Esraa Arafat	Port Said University
8	Francesco Cocetta	CMCC - Euro-Mediterranean Centre on Climate Change
9	Francisco Machín	Universidad de Las Palmas de Gran Canaria
10	Julia Selivanova	CMCC Foundation
11	Lettie Roach	Alfred Wegener Institute
12	Lorine Behr	Justus Liebig University Giessen
13	Lukrecia Stulic	University of Bologna
14	Lunyu Li	Fudan University

15	Marta Faulkner	Woods Hole Oceanographic Institution
16	Martina Zappunini	Alfred Wegener Institute
17	Md. Monjurul Hasan	Bangladesh Fisheries Research Institute
18	Md. Wahidul Alam	University of Chittagong
19	Michelle De Luna	University of California Los Angeles
20	Parvathi Vallivattathillam	National Oceanography Centre
21	Pedro Llanillo	Spanish Institute of Oceanography (IEO-CSIC)
22	Rajendran Shobha Ajin	University of Florence
23	Seung-Tae Yoon	Kyungpook National University
24	Shogo Urakawa	Meteorological Research Institute, Japan Meteorological Agency
25	Sofia Darmaraki	Cyprus Marine and Maritime Institute
26	Sofie Stomps	University Utrecht
27	Sougata Basak	University of Tasmania
28	Susanna Winkelbauer	University of Vienna
29	Svenja Frey	GEOMAR Helmholtz Center for Ocean Research Kiel
30	Tianyi Liu	Fudan University
31	Valentin Tembe Mwela	Red cross Higher Institute of Health Sciences of Bandundu
32	Vedant Vairagi	Bangor University
33	Wilson Fokou Kenfack	University of Abomey-Calavi
34	Xiangdong Zhang	North Carolina State University
35	Ying-Chih Fang	National Sun Yat-Sen University
36	Yu-Chiao Liang	National Sun Yat-Sen University
37	Yuhang Liu	University of Tasmania
38	Yuqing Wang	Fudan University

Appendix D: Acronyms

ARP	Atlantic Region Panel
CLIVAR	Climate and Ocean: Variability, Predictability and Change
GSOP	Global Synthesis and Observations Panel
ICPO	International CLIVAR Project Office

NORP	Northern Oceans Region Panel
OMDP	Ocean Model Development Panel
SORP	Southern Ocean Region Panel
WMO	World Meteorological Organization
WCRP	World Climate Research Programme

Appendix E. Survey

Section 1. Overall feedback

- Overall, how would you rate the workshop? (1- Poor to 5 – Excellent)
- Overall, Did the workshop meet your expectations, how/why? * Open question
- What was the most valuable part of the workshop for you? * Open question

- What was the least valuable or most frustrating part of the workshop for you? * Open question
- Holding a hybrid workshop incurs high costs for the organization and strongly impacts the activity budget (~20 % of total cost). Most of the participants who registered online (+70) were ECRs (waived, free of charge), but some of them did not join the online sessions in the end. How useful, valuable or enjoyable was the hybrid option for you /WHY? * Open question

Section 2. Structure and flow

How would you rate the balance between the 6 keynote presentations and the breakout discussion sessions?

- § Too many keynotes, not enough discussion,
- § A good balance
- § Not enough keynotes, too much discussion
- § Other

Thinking about the time allocated for each part of the day, the time for each keynote presentation felt:

- § Too long
- § About right
- § Too short
- § Other

The time for breakout discussions (on keynote topics) felt:

- § Too long
- § About right
- § Too short
- § N/A My group didn't get to this

The time for breakouts focused on planning tangible deliverables/timelines felt:

- § Too long
- § About right
- § Too short
- § N/A My group didn't get to this

If any of the time allocations felt "off," please explain why and suggest a better duration. (e.g., "We needed 15 more minutes for the deliverable planning because...") * Open question

Section 3. Breakout rooms

Thinking about the breakout rooms focused on discussing the keynote topics, How focused and productive were the discussions? * Scale: 1- Not productive to 5 - Very productive/focused

What contributed to or hindered the productivity of these discussions? (e.g., clear prompts, good facilitation, lack of focus, group dynamics) * Open question

Thinking about the breakouts focused on planning tangible deliverables and timelines, How clear was the goal of these sessions? * Scale: 1 - Very unclear to 5 - Very clear

Did your group succeed in creating a concrete deliverable or timeline?

- § Yes, we created a clear plan;
- § We started, but didn't finish
- § No, we struggled to get started/finish
- § N/A - Didn't attend

What would have made this planning session more effective? * Open question

Section 4: Group Dynamics & Participation

Thinking about the size of your breakout groups, the breakout rooms for discussions on Topics felt: *

- § Too small (lacked diverse perspectives)
- § Just right for good conversation
- § Too large (hard for everyone to participate)

The size of the deliverables planning groups felt:

- § Too small (not enough capacity to plan)
- § Just right for focused work
- § Too large (hard to coordinate and agree)
- § N/A (My group didn't do this)

In your opinion, what is the **ideal number of participants** for a productive breakout group focused on discussion? What about for planning? (e.g., "4-5 for discussion, 3-4 for planning")

Section 5: Your Perspective & Ideas for Improvement

If you were to redesign one part of this workshop to make it better, what would it be and why? * Open question

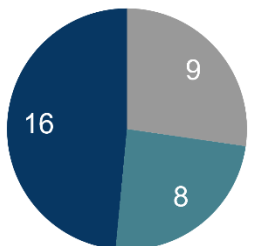
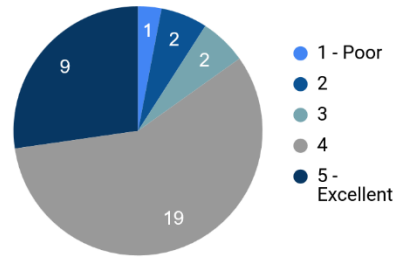
What is **one specific thing** we could change or add to improve the experience for future workshops? * Open question

Do you have any other comments, suggestions, or ideas for how we can improve the format, organization, or topics of our next workshop? * Open question

Online participants: Please let us know the specific sessions you are evaluating and which one you weren't able to attend * Open question

Extra: Any other comments

Appendix F. Survey results: Onsite participation

Question, Summary & All responses																					
Overview – 33 responses received																					
Career stage  • Senior • Mid career • Early career <table border="1"> <caption>Career stage distribution</caption> <thead> <tr> <th>Career stage</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>Senior</td> <td>16</td> </tr> <tr> <td>Mid career</td> <td>8</td> </tr> <tr> <td>Early career</td> <td>9</td> </tr> </tbody> </table>	Career stage	Count	Senior	16	Mid career	8	Early career	9	Overall, how would you rate the workshop?  1 - Poor 2 3 4 5 - Excellent <table border="1"> <caption>Workshop rating distribution</caption> <thead> <tr> <th>Rating</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>1 - Poor</td> <td>1</td> </tr> <tr> <td>2</td> <td>2</td> </tr> <tr> <td>3</td> <td>2</td> </tr> <tr> <td>4</td> <td>19</td> </tr> <tr> <td>5 - Excellent</td> <td>9</td> </tr> </tbody> </table>	Rating	Count	1 - Poor	1	2	2	3	2	4	19	5 - Excellent	9
Career stage	Count																				
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Rating	Count																				
1 - Poor	1																				
2	2																				
3	2																				
4	19																				
5 - Excellent	9																				
Overall, Did the workshop meet your expectations, how/why? Summary: <i>In general, the participants' expectations regarding discussions, networking and concrete outcomes were met. While the participants enjoyed the discussions from the keynote presentations, some of them did not understand the workshop's goal of outcome planning and would have appreciated more information or better advertising beforehand.</i> All responses: 1. Yes! It was great 2. The plenary/overview presentations were excellent and did a great job of summarizing a large body of work and highlighting key open questions. There was sufficient opportunity for discussions with colleagues. Overall, I was impressed by how the discussion sessions were moderated. 3. I wanted to write review papers but it seems that the latest "trend" is to organise hackathons. 4. I expected a mixture of lectures and breakout room discussion, which was what I expected. However, it was more ocean-focused (and there especially southern ocean) than I expected, I expected the atmosphere with its interaction to the ocean playing a greater																					

- role in the discussion. I missed a bit the 'big picture'.
5. The workshop brought a nice community of people working on the same topic which is what I expected.
 6. I thought day 1 was excellent. Day 2 the ideas raised in day 1 got diffused and the 3 breakouts were too many.
 7. I did not know exactly what to expect to be honest. It went very well I thought, and so went beyond my expectations. I enjoyed the discussions, especially the first day at the end of the talks and as well as during the breakout sessions.
 8. No. I expected to have discussions based on the presentations, with scientific ideas emerging organically from them. Instead, the numerous breakouts disrupted the discussions and focused on organizing future workshops rather than appreciating the people in-house at the time.
 9. It would have been nice to have more time for informal science discussions. The breakouts felt a bit forced as if the aim was to tick a box to say we had done something 'polar' related, rather than what is most useful. I'm not sure I'm convinced of the use of bringing together the Arctic and Antarctic communities, I think in most cases we could make faster, more efficient progress within our separate communities. With the exception of specific questions that cross over both, like improving basal melt parameterisations.
 10. I didn't know what to expect
 11. Sure
 12. Yes. Excellent quality of presentations, good networking opportunities and some concrete outcomes.
 13. Yes, the workshop was what I expected - it involved a lot of discussion, which I appreciated very much.
 14. It was a great opportunity to network and learn about things going on in the community
 15. Yes. I had wonderful conversations with people who share similar research interests and are truly passionate about their work
 16. The keynotes were excellent and it was nice to have a (smaller than OSM) group of people to chat to and discuss science and the venue and organisation was great. However, I didn't expect quite as much focus on producing output at the end of the workshop so I think that could have been better advertised as I was expecting a bit more science discussions and a bit less workshop/funding/organisation discussions.
 17. Yes
 18. The deliverables from this 2-day workshop are outstanding - I was amazed by how enthusiastic people are that literally everyone is engaged in discussion etc.
 19. No, it was a bit imbalanced in favour of producing outcomes rather than discussing the key science questions.
 20. Yes. I came in with the expectation of tangible outputs, which were achieved
 21. Yes, it exceeded my expectations in fact. I haven't attended a CLIVAR workshop before. It was really insightful and thought provoking. I learnt a lot about the subjects that was being discussed and i found the break out sessions really useful
 22. Yes, it was nice to see the keynote and what we still miss in the current polar heat knowledge

23. I believe it was above my expectations. The organisers managed to conduct a focused workshop that resulted in concrete plans.
24. I thought the workshop was really well structured. The plenaries were great, and I think it was well explained that the two poles are completely different in how heat is transported.
25. Yes
26. Yes
27. It did. I enjoyed the presentations and most of the discussions.
28. Yes, the workshop met my expectations. I particularly appreciated the amount of discussion and brainstorming time built into the programme. It created a very interactive and stimulating atmosphere that went well beyond standard presentations.
29. It was my first workshop!
30. Discussions and keynote talks were good and stimulating.
31. It was a good forum for dialogue and resulted in concrete plans for outcome (legacy: publications, workshops...)
32. I expected a weekend discussing scientific understanding of heat in the high latitudes. Instead, we seemed to spend most of the weekend forced to focus on planning the next workshop/activity.
33. Yes, the keynote talks were very good and the breakout sessions allowed time to learn from peers and think about possible ways to address gaps/challenges.

What was the most valuable part of the workshop for you?

Summary: *The participants were highly satisfied with the keynotes content quality but recommended longer time for discussion. The networking opportunities and discussion in smaller groups was also highlighted.*

All responses:

1. Discussions in session and during breaks
2. Plenary presentations and following questions/discussion.
3. Spending time with people in small groups
4. To meet other researchers
5. The keynotes and the networking around coffee and lunch breaks.
6. Hearing the key note talks, brainstorming breakout on day 1, talking to polar people in the breaks.
7. The meeting has generated new discussions and spun new collaborations. I expect this will lead into possibly a proposal, and certainly paper(s).
8. Good presentations and the Q&A surrounding the presentations. Alas, the Q&A was too short to be meaningful or to inform the

breakouts.

9. Taking to other scientists at morning / afternoon teas, lunches.
10. Keynotes
11. opportunity to talk to colleagues
12. Meeting the other participants with enough time to have real scientific connections
13. There was plenty of time for discussions around a relevant topic, which I think was great. I mostly profited from the science discussions (rather than the activity planning discussions)
14. Networking and discussing the community needs
15. Conversations with senior researchers and their thoughtful feedback reminded me that our work is meaningful. After all, research is a long journey, and progress isn't always immediately seen.
16. Keynote talks and talking to people in the breaks
17. connecting with others working on similar topics
18. Different but related challenges facing the Arctic/Subarctic and Southern Ocean communities.
19. Keynotes
20. Plenary talks paired with breakout discussions.
21. The keynote talks on the first day was really interesting to me personally and the break out sessions were really useful and interesting. I have never participated in this format of discussion and i could actually see and learn a lot from experts. This was really insightful and motivating at the same time. I saw how people pitch their ideas, how to negotiate and how to frame questions and how to approach it. That part was really insightful for me. I am sure breakout sessions are nothing new for many but it was for me and i am grateful for this opportunity. Thank you!
22. keynote and lots of nice discussion from the colleagues all around the world
23. Networking and concrete plans/outcomes.
24. I really enjoyed the breakout sessions, and I think it gives good insight (especially as an ECR) in how to plan workshops, summer schools, working groups etc.
25. keynote talks
26. The outcome to write a paper... with otehrs.
27. The unscheduled times: breaks, lunch, morning before the start.
28. The opportunity to meet and get to know a wide range of researchers working in this field. It was very valuable to learn about their current research interests and identify potential areas of overlap, which I hope will lead to future collaborations.
29. Networking/keynotes
30. Networking and initiating follow up processes.

31. breakout groups
32. Insightful talks and discussion with colleagues (during the short available time).
33. Extra time for networking and learning about the challenges and current status of polar ocean science.

What was the least valuable or most frustrating part of the workshop for you?

Summary: *The participants would appreciate more time for discussion on the keynote topics, and having more clear instructions/information on the breakout sessions prior to the workshop. The breakout session on planning tangible outcomes felt challenging after a long 5-day conference and the participants would have appreciated more information beforehand.*

All responses:

1. All was valuable
2. Discussions around planning future workshops as I am already committed to a few other workshops.
3. Disappointed by the outcomes; and I do not approve of activities organised over the week end in general
4. It felt to me more targeted to senior scientists rather than ECRs and I think I couldn't contribute much to the discussions and the outcome
5. The breakouts were a bit frustrating because of the difficulty in converging and the various levels of involvement of people during the discussions. Also, the time for questions after the keynotes was too short.
6. The final afternoon felt drawn out. The day 2 breakouts tried to work through too many topics. The facilitator in my group was a bit dismissive of some of the ideas raised.
7. Sunday afternoon was slow and it was clear that people were running out of steam, me included.
8. Too many breakouts that focused on outcomes rather than building networks, ideas, and concepts based on the many experts in the room.
9. Breakout discussion sessions.
10. The last breakout
11. the breakouts were very mixed, one was too structured (group A), one wasn't structured enough (working groups) so it feels like nothing was accomplished. I wanted to develop a long term working relationship with people and hoped to use this to develop momentum from more direct connection/collaboration.
12. By the end there was slightly too much time for the discussion sessions which started to get repetitive
13. The task/goal for the activity planning discussions wasn't entirely clear. It would have helped to formulate an outcome beforehand, such that the discussion leaders know where to lead the discussions.

14. I feel it ended without clear direction/goals for next steps for ECR's
15. Since I don't have much experience with topics like hackathons or summer schools, I sometimes find it hard to fully grasp the main direction of the discussion. I wonder whether workshops like this could be structured by experience level or target audience.
16. As a student, I think I was unable to contribute much to the discussions that focused on CLIVAR outputs (most of day 2). I would have preferred more discussion sessions about science-unknown questions etc that fed from the keynotes, rather than what felt a little like a strategic meeting, where my lack of experience meant it was difficult to engage.
17. nothing
18. It is challenging to discuss the Arctic/Subarctic changes and the Southern Ocean changes in parallel given their dynamical distinctions.
19. The Sunday breakouts.
20. Not enough time for discussion following the talks or during coffee breaks
21. I think everything in those 2 days were very valuable to me.
22. Not quite clear in terms of what we should do in the next step
23. The workshop could have been more productive if it was organised before a large conference. I think that after the conference, many people could have been tired.
24. I think I probably share the same issue as others in that there wasn't much time to just sit down and talk about science. I think just blotting out free time to break up into smaller groups and talk about science is incredibly undervalued. Allocating more time to this would allow for collaborations, data sharing etc.
25. no
26. The lack of agenda prior to the workshop
27. I found the heavily prescribed and focussed discussion made some of the sessions feel a bit forced.
28. I think the workshop could benefit from setting clearer overall goals or defined tasks at the outset, and then inviting participants to sign up for specific tasks or working groups during the workshop itself. This would help translate the excellent discussions into concrete collaborations more effectively.
29. Not your fault, but very tiring after 5 days of OSM
30. A bit of unknown what will happen next, and how things will shape up.
31. final plenary -- we should have set more details plans for reporting etc.
32. Precious little time for valuable, scientific discussion (except when I skipped the outcomes-oriented breakout sessions to chat with colleagues).
33. I was unable to stay until the end as train connections in the afternoon were longer so I preferred to leave during the morning

coffee break of the 2nd day.

Holding a hybrid workshop incurs high costs for the organization and strongly impacts the activity budget (~20 % of total cost). Most of the participants who registered online (+70) were ECRs (waived, free of charge), but some of them did not join the online sessions at the end.

All responses:

1. Better to have either online or in person
- 2.
3. It was absolutely useless to me. I joined in person and did not interact at all with the participants that were online.
4. I participated in person because I also joined OSM, but if it hadn't been in Europe, I would have joined online, because of the climate impact of flights. So I really appreciate hybrid meetings and workshops.
5. I was in person but from what I saw there was not much engagement from online participants.
6. I was on site so the hybrid part did not impact me at all. Since the workshop was oversubscribed, it was very nice that the organisers went to the trouble to allow people to join remotely.
7. N/A
8. I was in-person, and generally enjoy the in-person experience.
9. Not useful.
10. It was not influencing my output
- 11.
12. Not useful personally but feel it is good to offer equity of accessibility for all.
13. I participated onsite, and I wouldn't have participated as an online participant. I think it is much more valuable to meet in person. Particularly when the workshop is planned like this one, to take place immediately after a big conference, where many people are traveling there anyways.
14. I attended in person. But, I am a parent to young children, and so the option of participating online is invaluable for those many occasions when a parent can't participate in person (btw, mothers are more likely to leave academia after having children, whereas men are more likely to succeed in academia after entering parenthood). Perhaps an daily online sign in sheet and a participation certificate could encourage online participants to commit, along with a statement they have to sign at registration, stating that they intend to commit to attendance.
15. Since I attended in person, I am not in a position to evaluate the online experience. However, I noticed that there was limited

interaction between in-person and remote participants, and I did not personally engage with those attending online. The in-person environment felt more interactive and conducive to spontaneous exchanges, which were one of the most valuable aspects of the workshop for me.

16. N/A - I attended in person only

17.

18. Didn't really pay attention to online discussion etc. But frankly speaking, I would prefer in-person only event in the future.

19. For a small-ish workshop like this, I feel it is better value restricting to onsite participants. Virtual attendees get poor value for the investment and doing hybrid WELL is costly.

20. As an in person attendee, the hybrid option made little to no difference to my experience.

21. I attended in person and i would prefer to do that especially for the discussion part

22. I would prefer the on-site since we had more chances to discuss a lot of things

23.

24. I attended in person, so have no real opinion on the hybrid option.

25.

26. I never planned on attending virtually. Virtual meetings set in the UK are very hard to attend from Australia.

27. I understand the rationale for having a hybrid option, but it is hard to do well. Usually it ends up feeling like two separate events. I am not convinced it was worth the time and cost.

28.

29.

30.

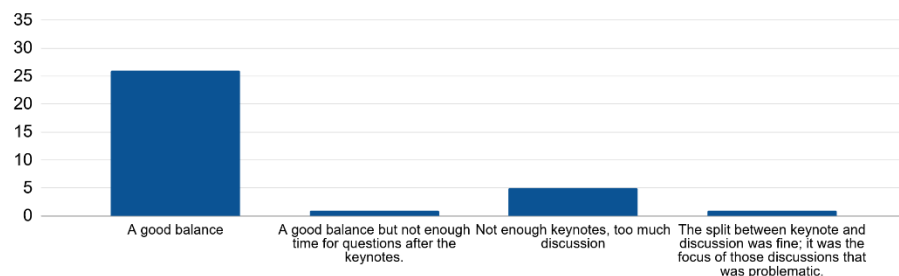
31. I think we should have assessed the hybrid (online) part better in the light of the breakout sessions, to see where it was feasible (e.g. was not feasible hybrid in the sub-breakouts that results in most sessions).

32.

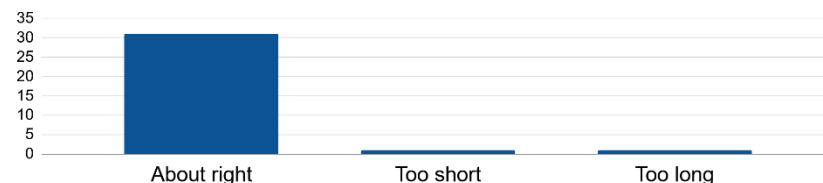
33. N/A

Structure and flow

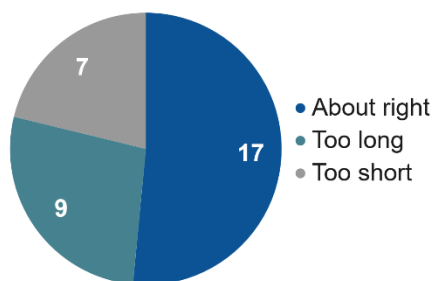
How would you rate the balance between the 6 keynote presentations and the breakout discussion sessions?



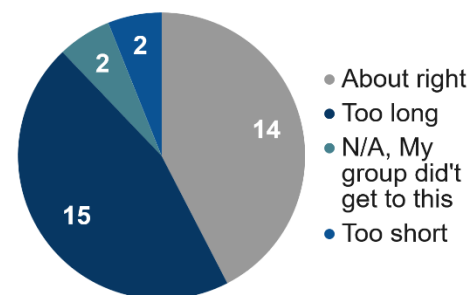
Thinking about the time allocated for each part of the day, the time for each keynote presentation felt:



The time for breakout discussions (on keynote topics) felt:



The time for breakouts focused on planning tangible deliverables/timelines felt:



If any of the time allocations felt "off," please explain why and suggest a better duration. (e.g., "We needed 15 more minutes for the deliverable planning because...")

Summary: The participants expressed the time allocated to the breakouts was too long and they would have preferred to use the time to hold discussions on the science rather than deliverables, especially after a long conference.

All responses:

1.

- 2.
- 3.
4. I think less time for the deliverables would have been sufficient
- 5.
6. The deliverable planning felt forced. There were too many topics to really drill down to the point of having a deliverable. My separate discussion with one or two people may grow more organically into something tangible that could then entrain other people.
7. Felt that the breakout sessions on Sunday worked less well. On Saturday, there was a lot of focus on the science questions, the Sunday sessions aimed more at tangible outcomes (which is harder to do, and was at the very end of a long week)
8. This workshop gathered numerous experts whose time was spent sitting in ill-conceived breakouts discussing review papers, future workshops, and hackathons. And yet there was little time to inform everyone of the cutting edge of the science that was part of the expertise in the room. and then organically leading to reviews, workshops, hackathons.

The limitations of funding and work effort necessitate realistic appraisals for one or two workshop/hackathons/reviews. Instead, there were many ideas posed that seemed little more than unrealistic wish lists of projects.

I was hoping to find a workshop with long presentations and associated discussions and Q&A among all participants, and only then to organically allow for breakouts, should that seem to be the optimal use of time.

So in summary, this workshop suffered from over-management and over-emphasis on outcomes, with little flexibility to respond to the ideas that could emerge from open and honest discussions informed by experts presenting plenary talks. "

- 9.
10. There was very little/no discussion on the keynotes (in the breakouts)
- 11.
- 12.
13. I would have preferred more time for science discussion. Some of the deliverable planning was difficult without having a clearly defined goal, and the groups were too large to go into the nitty-gritty details that were discussed in the end. I think it would have been good to define a group of deliverable leaders and the type of deliverable that should be developed further. But I think it would have been better to do the detailed planning in follow-up meetings online because people can then participate in several of the deliverables that were discussed at the same time.

Science discussions often lead to the development of great ideas and may result in a collaboration that acquires funding for a larger

project - so fostering these discussions in such a workshop seems very valuable and prioritizable to me."

14.

15. I don't have a clear view on the overall time allocation, since it naturally depends on how discussions evolve. That said, slightly shorter keynote sessions could potentially allow more time for interactive exchanges.

16. My group didn't talk much about science after the keynotes - it felt like we went straight to deliverables. So I would have preferred some more science talk first (maybe all of day 1 can be about science, day 2 after the keynotes more about deliverables)

17.

18.

19.

20.

21.

22.

23.

24.

25.

26. I didn't know what to expect prior to the meeting but I was very happy once there.

27. The focus on deliverables curtailed some of the interesting discussions in my group. I would have preferred a less planned discussion session.

28.

29.

30.

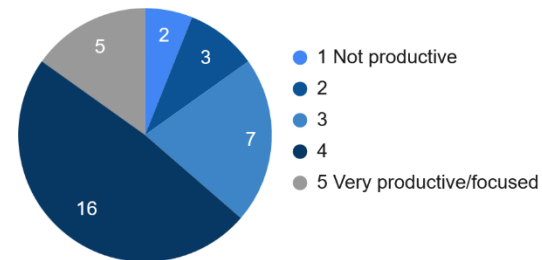
31.

32. You cannot designate specific amounts of time for discussing specific things. You need simply to create space for discussion, and creative things will emerge. Some degree of focus can be valuable, but there was far too much specific (and broadly uninteresting) direction in this workshop.

33.

Breakout sessions

Thinking about the breakout rooms focused on discussing the keynote topics, How focused and productive were the discussions?



What contributed to or hindered the productivity of these discussions? (e.g., clear prompts, good facilitation, lack of focus, group dynamics)

Summary: *The breakouts feedback depends on the dynamics of each group but overall effective facilitation and providing instructions or information previous the breakouts sessions is key for a more productive discussion. The size of the group was also mentioned, with smaller groups preferred.*

All responses:

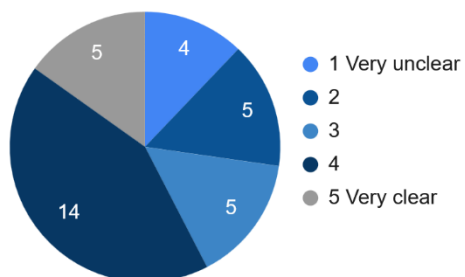
1. Good facilitation
2. Good group dynamics -- it would have been helpful to give everyone some time to write down their thoughts before jumping into discussion.

In general the KJ method (sticky notes) works better if ideas are posted before discussions begin.

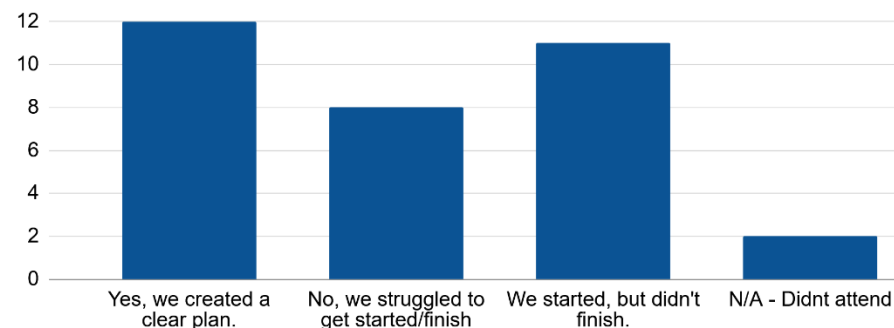
3. When it went off, it is because we naturally split in modelers vs observationalists, with each side thinking that they would be the saviour of the other.
4. maybe create a safe space for PhD students as their own breakout sessions?
5. There was good preparatory work from the breakout chairs.
6. The brainstorming part on day 1 was great
7. Good prompts from our 2 organizers gave some structure/direction to the discussion
8. Too many breakouts, and not enough time to listen to experts and pursue Q&As that led to emergent ideas and actions.
9. Lack of useful aims. Eg we were told a review paper on the Antarctic slope current could not be an outcome, because it needed to 'inclusive' and cover both poles. Even though covering both poles would be a less useful / impactful review paper.

10. Focus was on the planning/end result
11. too much boxing us in
12. Good facilitation and good group sizes with mixes of expertise and perspectives
13. It was good to collect general ideas first and then let the discussions evolve around these questions, to figure out what questions the community is urged to find answers to.
14. I think really there were too many people to have clear deliverables that everybody attending could be a part of.
15. The discussions were interesting, but I feel productivity was limited at times due to unclear leadership. It wasn't always obvious who was guiding the conversation or keeping it on track.
16. Prompts were more about deliverables than science, so we didn't really discuss the keynotes.
17. my discussions were all pretty good, good focus, good team dynamics
18. Clear objectives and good facilitation and group engagement.
19. Facilitation was good here.
20. required buy in, which can vary based on the group
21. Clear prompts from experts and group dynamics
22. some discussion are lack of focus and sometimes we only have time to discuss one topic
23. The group dynamics were good and we had good facilitators to organise the discussions. I liked the balance between senior and ECRs.
24. I think it was good that the groups felt very welcoming, no matter career stage. The direction from the chairs also was incredibly valuable in getting the ball rolling.
25. clear prompts
26. maybe the size of the groups, perhaps preparation of some breakout group leaders was "low". Were they last minute choices?
27. We often got distracted, but I actually really enjoyed the more free-ranging discussions. We used the keynotes as a prompt and built on that.
28. group dynamics
29. People being too tired
30. Good group dynamics and the lead.
31. Perhaps putting the breakout foci on the themes was not the best start -- but it led somewhere, in the end...
32. Group sizes were too large for constructive discussion. Even in these sessions, people had been asked to "be thinking about outcomes" which really gets in the way of interrogative discussion.
33. Good facilitation and prompts contributed to productive discussions

Thinking about the breakouts focused on planning tangible deliverables and timelines, How clear was the goal of these sessions?



Did your group succeed in creating a concrete deliverable or timeline?



What would have made this planning session more effective?

Summary: *Clear prompts and good facilitation, clearer expectations and background information before the workshop.*

1. More tables and power sockets
2. The possible range of activities were quite broad, so it was hard to focus in a small number of these in the time available.
3. It is a complex discussion that needs time over many months / years. I consider it a success that we initiated this conversation.
4. the chairs/champions interrupting discussions earlier when we get carried away?
5. Not sure as it is very hard to achieve.
6. better facilitation, focusing on 1 or 2 topics, a group more aligned with these 1 or 2 topics
7. Not sure
8. We created plans. But are they all realistic? I do not think so. Sorry, but I am cynical about over-management and over-tasking. It seemed like an unpleasant use of time.
9. Not sure.
10. ?
11. lack of focus, facilitators didn't summarize/condense as we needed.
12. Some prepared guidance on what tangible support is available for e.g. working groups, summer schools from the relevant CLIVAR panels and other orgs
13. defining the outcome and the available budget for execution of the deliverable would have helped - also communicating this to the ECR discussion leaders would have helped quite a lot.
14. Fewer people, smaller groups. There was this approach of getting everyone to write on post-its, and then going through it all, but

this took too long and therefore dominated how long we took to even reach discussion of deliverables. Perhaps there needs to be the collation of the post-it notes online prior to the workshop, that could evolve into clear goals before the workshop were to start, so that people can jump right in.

15. Make the bullet points clearer

16. Not sure - not experienced enough to really feel like I could help out. The activity I was most interested in wasn't discussed on day 2.

17. It was not clear what/how the CLIVAR groups would/could support us and what exactly they wanted as outcomes. Some things had a lot of momentum from the group but did not feel like it was what CLIVAR wanted to see. It would have been good if the introduction to the CLIVAR/SORP/NORP groups and what they do had come earlier. When people talked about the groups there were too many acronyms, most of the time I had no idea what these stood for or what their remit was.

18. Already very effective!

19. I guess I'm questioning the motivation for a session like this.

20. clearer facilitation on reaching tangible deliverables.

21. Break out sessions were not too short but could have been a bit longer.

22. clear topic and timeline and better coordination

23. N/A

24. I think that having a workshop to plan another workshop is a bit counterproductive. It would have been better in my opinion to focus less on a deliverable, and more on actual research output. I understand the need for deliverables from a funding perspective, but the opportunity to meet people and say 'hey we are doing similar cool stuff, we should link up' would also be invaluable.

25. identify action lead at early stage

26. Time is limited, and breakout groups and discussion is slow, so putting these things together takes time.

27. I don't know.

28. Setting clearer overall goals or defined tasks at the outset

29. na

30. More detailed planning beforehand.

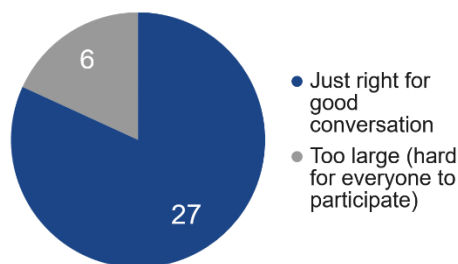
31. Better guidance to the breakout chairs, at least one more online meeting of the planning committee to that effect

32. Telling people ahead of time that they are coming to a planning session rather than a scientific workshop, though I expect that would put off many people.

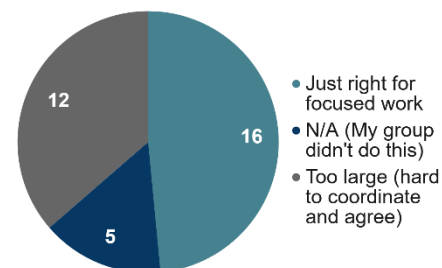
33. Informing participants of the goal of the breakouts ahead of the meeting, giving them more time to think?

Group Dynamics & Participation

Thinking about the size of your breakout groups, the breakout rooms for discussions on Topics felt:



The size of the deliverables planning groups felt:



In your opinion, what is the ideal number of participants for a productive breakout group focused on discussion? What about for planning? (e.g., "4-5 for discussion, 3-4 for planning")

1. 5-10
2. 6-8 discussion / 6-8 for planning
3. Fewer than 10 for each
4. 3-4 for discussion, 5-10 for planning
5. About 5-8 for both.
6. 6-8 for brain storming, 3-4 for planning
7. 4-5 for discussion is fine. Planning is much tougher (proposals across country lines is a nightmare, and bound to fail)
8. The whole group should be engaged in discussions that then led to the emergence of breakouts that were organic and not prescribed.
9. 10
10. 8-10 for both
11. 8-10 for discussion, less for planning
12. 6-10 for discussion. 3-7 for planning.
13. 5-6 for discussion, 3-4 for planning
14. 15
15. 4~5
16. 5-6 for discussion, 3-4 for planning, though there are also people who want to be vaguely involved but don't have the time or skills

yet who might want to sit in on planning sessions

17. 5-10 for both

18. 10ish for discussion, 4ish for planning

19. 5-10

20. 5-8 for discussion. 3-5 for planning

21. 6-8 people for discussion and 4 for planning

22. 4-5 for discussion and planning

23. 5-10 people, but with a balance of ECRs and seniors.

24. Maybe around 8 for discussion, planning should probably be capped at 6ish.

25. 8

26. ~10

27. 5-10 for discussion, 5-6 for planning

28. Around 4

29. 6-7

30. 6-7

31. given that it split into sub-breakouts, it was fine -- each subgroup should not have more than about 10 participants

32. 4-5 is best, but groups can work with 8-10, depending on the time given and nature of the conversation. There is literature on this.

33. 5-8 for discussion and same for planning; Note that I did not join the deliverables planning which is why I checked N/A

Your Perspective & Ideas for Improvement

If you were to redesign one part of this workshop to make it better, what would it be and why?

1. It was great

2. n/a

3. N/A

4. Split groups into PhDs/ECRS and seniors as their needs and capacities differ and to create a safe space

5. The breakouts because the structure and sequence made them a bit confusing.

6. Finish at 3pm on day 2. Only 2 breakouts on day 2 that are 1-1.5 hours long. The 20 minute second day 2 breakout didn't accomplish much.

7. N/A

8. Less breakouts; more presentations with long Q&As.

9. Separate Arctic and Antarctic communities

10. More clear when the topic was discussed
11. More clear organization of working groups
12. Longer breaks and longer breakouts
13. dedicate more time to science discussion
14. I would do the initial session online in advance to gather the themes and desired outputs. Then you already have established goals before starting, rather than spend most of the time establishing the goals
15. I have no idea.
16. I think I would the first day breakout sessions just about science and not deliverables, to get more ideas
17. introduce CLIVAR etc and the goal of the workshop at the start so everyone knows what the desired outcome is and what all the acronyms mean
18. Highlight the similarities/dissimilarities between Arctic/Subarctic vs. Southern Ocean
19. Having ECRs present short talks
20. I prefer questions directly after talks.
21. I really liked the format you had. I think the breakout session at the very end was a bit exhausting after a long day. it could have been shorter
22. reorganize the wrap-up discussion
23. N/A
24. Time to talk science, so perhaps take away a session from deliverables. or have it as another option.
25. better link the discussions on the first and second days
26. distribution of the agenda well in advance
27. I would reduce the focus on deliverables.
28. Setting clearer overall goals or defined tasks at the outset, and then inviting participants to sign up for specific tasks or working groups during the workshop.
29. -
30. More detailed planning beforehand
31. clearer procedure for breakouts (may still keep the general structure, but have clear methods laid out)
32. Breakout discussion time reallocated to general discussion.
33. Request that the participants should rotate between breakout sessions so that they get to exposure to different topics.

What is one specific thing we could change or add to improve the experience for future workshops?

Summary:

1. None
2. It would have been helpful to provide information about workshop deliverables prior to the start of the workshop. I appreciate that holding this immediately after Ocean Sciences made this challenging!
3. Do not have it AFTER the big conference. Everybody was clearly exhausted.
4. split groups for discussions into smaller groups and after career stage
5. Less push towards outcome but make sure discussions happen (a lot of things get actually decided during coffee/lunch breaks).
6. Focus less on deliverables and more about moving forward together on a topic.
7. N/A
8. Less breakouts; more presentations with long Q&As.
9. Have an idea of outcomes beforehand.
10. When all sit and eat in one room it is easier to include all....everyone has someone to talk to
11. no zoom
12. Nothing!
13. Have one science discussion for each set of key-note speakers
14. online preparation workshop and surveys to develop the themes and deliverable goals beforehand.
15. It could be helpful to start sessions with brief self-introductions, so everyone's role and experience level is clear. This would help structure the discussions and make them more productive.
16. Maybe a clearer outline from the start about what each of the breakout sessions are for
17. The volume of the speakers was very uneven. Some were too quiet because they were too far from the microphones. Ben was far too loud.
18. Clear agenda
19. Focus on science, not deliverables
20. Is there a better way to integrate online and in-person?
21. Opportunities for more interactions
22. for the summary about the follow-up action
23. N/A
24. Maybe an ECR focussed group, in which we can all actually meet each other and talk about our work a bit more. I helped some PhD meet other people who were a valuable resource, but having this as a more focused group could be helpful.
25. no
26. distribution of the agenda well in advance
27. Drop the hybrid aspect and focus on the in-person aspect. I know that limits access, but I think it's a compromise worth making.

28. Same with the last answer
29. -
30. Having a workshop during the work week.
31. at least one more planning telecon, including all breakout chairs
32. Focus on science. Outcomes/further work will emerge naturally.
33. Dinner - would have included this as part of the registration and opt for a less busy and quieter place.

Do you have any other comments, suggestions, or ideas for how we can improve the format, organization, or topics of our next workshop?

- 1.
2. The venue was spectacular! Thanks to all the organizers for their hard work and fun workshop.
3. Fewer cakes, more fruits :)
4. I missed a bit some general instructions at the beginning of the workshop, e.g. was there an awareness person? Maybe tell people not to group into closed circles but always leave room for other people to join conversations to make them feel welcome. Include ECR/PhD only groups as safe spaces or FLINTA only groups? Tell people who signed up for meat not to take food from the vegetarians/vegans until the end of the buffet such that everyone can eat something.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
14. Overall it was very enjoyable and I learned so much. It was clear that everybody enjoyed themselves and even shy people felt safe to speak out, which I think is a major achievement.
- 15.
- 16.
- 17.
- 18.

- 19.
- 20.
21. I attended the whole workshop in person and was really interesting and refreshing for me after the huge ocean sciences meeting. I think the number of participants were about right. I hoped to see many more people from the global south though.
- 22.
23. N/A
- 24.
- 25.
26. I enjoyed the keynote talks.
- 27.
28. One area that could be improved is the experience for online participants during the breakout sessions. It seemed quite difficult for them to be fully involved in those discussions, which is a shame since the breakout groups were one of the most productive parts of the workshop. It might be worth considering dedicated online facilitators or hybrid-friendly formats for the breakout sessions to ensure remote participants can contribute more effectively.
- 29.
- 30.
- 31.
32. I know that I am being incredibly negative in this form -- it is not a reflection of my gratitude for the work that went into putting this workshop on. However, I left the workshop feeling incredibly frustrated and let down. You managed to collect some of the best scientists in the world to address this topic, and then gave them no time to do it.
- 33.

Thanks for your feedback. We truly value it and will take it into account for our future activities. We hope you will continue to contribute to CLIVAR's activities and goals. -ICPO Any other comments:

- 1.
- 2.
3. I was positively surprised. Good job
4. Thank you for organizing the workshop and attaching it to the conference!
- 5.
6. Overall, I found the workshop excellent and appreciate the hard work of the organisers. The venue was awesome and the food was great. The number of people at the workshop felt just right. It was great to be able to have in-person conversations with people in this special field. Thank you for your efforts.

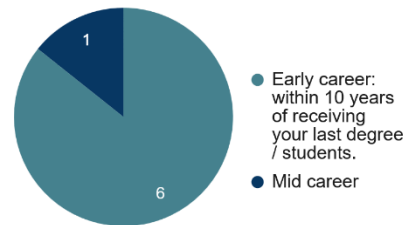
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
13. Thank you very much for organizing. It was a great workshop and I did take home quite a lot of new and inspiring thoughts.
14. Thank you!
15. See you~~
16. Thanks very much for organising the workshop, it was a nice opportunity to meet some more polar heat people after OSM.
- 17.
- 18.
- 19.
20. thank you for organising – it was one of my most productive components of the OSM week!
21. Thank you for this opportunity to be part of the workshop. I learnt a lot and met very good people and experts in my field. Keep up the good work
- 22.
- 23.
- 24.
- 25.
26. Glad to have went
- 27.
28. Thanks for the wonderful workshop! These are comments from ***** ** (****).
- 29.
- 30.
- 31.
- 32.
- 33.

Appendix G. Survey results: online participation

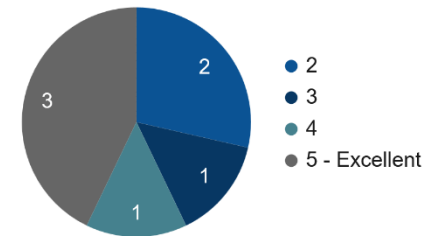
Question, Summary & All responses

Overview – 7 responses received

Career stage



Overall, how would you rate the workshop?



Overall, Did the workshop meet your expectations, how/why?

All responses

- Overall, the workshop exceeded my expectations in terms of scientific quality and the relevance of the topics discussed, particularly regarding advanced meteorological data analysis. The expertise of the speakers provided me with new perspectives for my own research on rainfall variability in Central Africa. However, my experience was partially limited by the remote format. While the hybrid option allowed me to access the knowledge, the lack of funding for on-site participation prevented me from fully engaging in the practical networking and collaborative discussions that are essential at this stage of my career. In the future, providing more travel grants for ECRs would ensure that the workshop's impact is as profound as its scientific content.
- It highly met my expectations. The lectures by the experts were amazing and were very inspiring for an early-career researcher like me. The idea of a breakout room for online participants and the designing of a review paper were excellent. Although online participation had its challenges, we felt like we were present there physically. Joanna and the complete team made that happen. Thanks to the whole team for making online participation so smooth.
- Yes regarding the speakers and the guidance of the workshop

- Great keynote talks. I really learn a lot.

What was the most valuable part of the workshop for you?

All responses:

- Quality of presentation
- The keynotes were extremely interesting.
- The talks
- Global warming and polar heat - Heat budgets, polar amplification and feedbacks
- As an online participant, the most valuable part for me is to engage in discussion and learn from experts in the field, especially Prof. Xiangdong Zhang during our online breakout session.
- Keynote talks
- Knowing insights given by the keynote speakers.

What was the least valuable or most frustrating part of the workshop for you?

All responses:

- None
- The workshop was not very effectively organised in a hybrid format, as online participants were not well integrated into the in-person event. Most of the programme consisted of breakout group discussions, and the few online participants were placed in separate breakout sessions which further limited opportunities for exchange. I understand that organising a fully hybrid workshop requires significant effort and is far from straightforward. However, it might have helped if the structure and intended format of the workshop had been communicated more clearly in advance, so participants could better understand what to expect and how they would be able to engage.
- Online participation was frustrating, as we couldn't really participate in the breakouts. Bummer, because it looked like very inspiring discussions!
- Link the Arctic and Antarctic – AMOC
- As an online participant, I think it could not have been better. I can say this is the best online experience I have had till now.
- Having to join a separate and unique online breakout group meant to be unable to attend the breakout group I was interested in. Moreover, the online breakout group was not formed because of common interests but because there was no other option offered to the 10-15 persons online, lacking also from the valuable input from the well-established senior scientists attending in

person. I think it would have been much better to have at least 3 options for the online people to join at least 3 different breakout rooms with the scientists in place.

- None

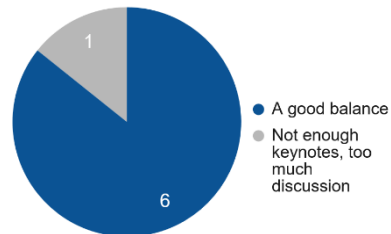
Holding a hybrid workshop incurs high costs for the organization and strongly impacts the activity budget (~20 % of total cost). Most of the participants who registered online (+70) were ECRs (waived, free of charge), but some of them did not join the online sessions at the end.

All responses:

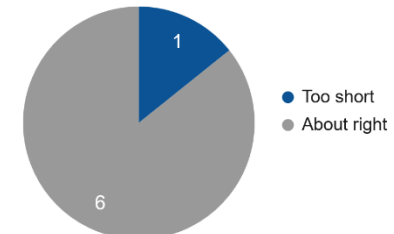
- Good
- Not extremely enjoyable, as an example the video quality was not very good and presenters were using a laser pointer which was not visible online making the talk more difficult to follow
- It felt quite frustrating (outside look in without TRULY participating). Next time maybe just in person or use the budget to allow for 1-2 low-income ECR to specifically join and then cover as much cost as possible to make it really accessible (fee + lodging costs, as that can be a hurdle).
- While the hybrid option was valuable as it allowed me to access the workshop's content despite the lack of personal or institutional funding, it is important to note that online participation cannot replace the impact of being there in person. In my view, the ideal approach for future sessions would be to reallocate part of these high technical costs toward travel grants for Early Career Researchers (ECRs). For researchers from regions like Central Africa, who often face significant financial barriers and have no external funding, fully-sponsored on-site participation is the only way to ensure real engagement, effective networking, and a lasting impact on our careers. While the hybrid mode is a good 'safety net,' the priority should remain on bringing ECRs to the venue to prevent the high attrition rate seen with online registrations
- It was the best online experience for me. Everything was really smooth. We really felt that we were there with others. Sorry to know that very few have joined online. I would really like to join physically if I get travel funding next time.
- The quality of the video and audio was quite good and this allowed me to follow the keynote talks online at ease. Regarding the online breakout room, it was a bit frustrating for me, see my previous comment.
- It provides an option for people who don't have budget to travel to Scotland. I really appreciate it.

Structure and flow

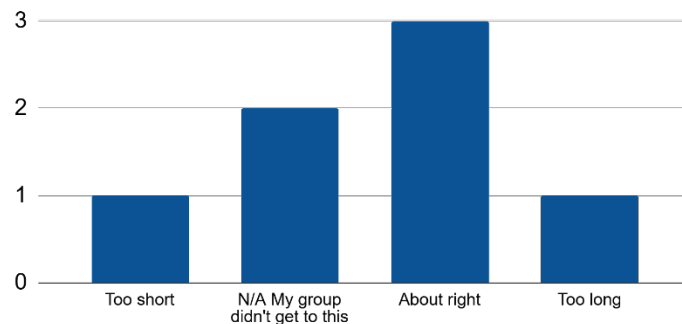
How would you rate the balance between the 6 keynote presentations and the breakout discussion sessions?



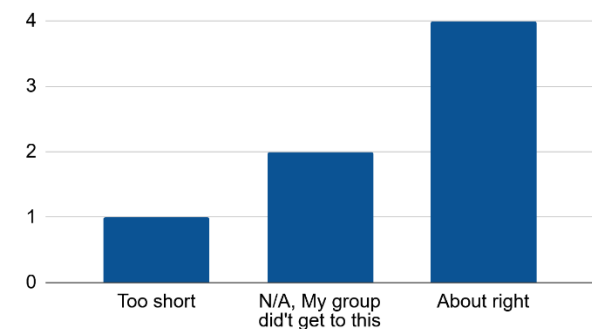
Thinking about the time allocated for each part of the day, the time for each keynote presentation felt:



The time for breakout discussions (on keynote topics) felt:



The time for breakouts focused on planning tangible deliverables/timelines felt:

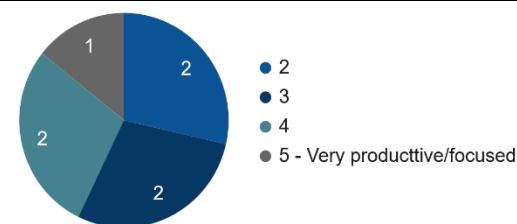


If any of the time allocations felt "off," please explain why and suggest a better duration. (e.g., "We needed 15 more minutes for the deliverable planning because...")

- 20 minutes is necessary.

Thinking about the breakout rooms focused on discussing

the keynote topics, How focused and productive were the discussions?



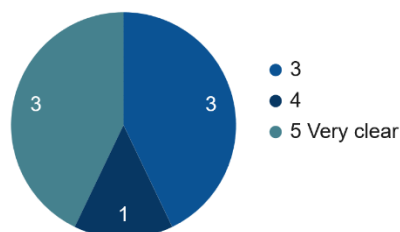
What contributed to or hindered the productivity of these discussions? (e.g., clear prompts, good facilitation, lack of focus, group dynamics)

All responses:

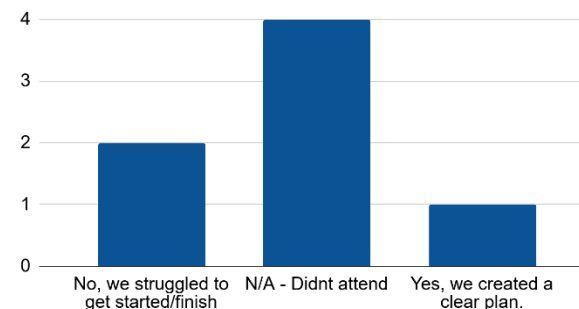
- Good
- Not applicable
- Not enough clear prompts and at times difficult group dynamics.
- Several factors contributed to the productivity of the discussions, notably the clear prompts and excellent facilitation that successfully integrated remote participants. However, my engagement was significantly hindered by major technical constraints, specifically the unstable internet connectivity in Cameroon. These recurring access difficulties, inherent to my local context, make the hybrid experience fragmented and challenging. This reinforces my belief that for an ECR in the Global South, fully-funded on-site participation remains the only way to ensure seamless integration into group dynamics and a true scientific impact, free from digital and infrastructural barriers.
- Due to fewer group members and the diversity of research expertise in our group, we had productive discussions on various aspects of polar science. Some of us were working on Oceanic, while others were more on the atmospheric side. So, overall, it was a good balance.
- The online breakout group was not formed because of common interests but because there was no other option offered to the 10-15 persons online, lacking also from the valuable input from the well-established senior scientists attending in person. Lack of focus.
- NA

Breakout sessions

Thinking about the breakouts focused on planning tangible deliverables and timelines, How clear was the goal of these sessions?



Did your group succeed in creating a concrete deliverable or timeline?



What would have made this planning session more effective?

All responses

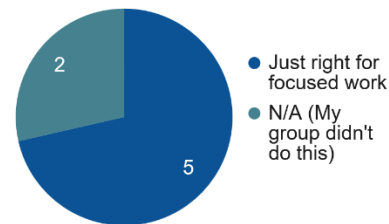
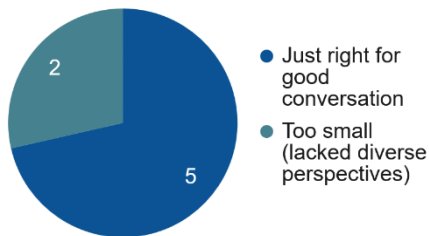
- Active participation
- Not applicable
- This planning session would have been significantly more effective if conducted in person for key participants. As a researcher based in Cameroon, chronic internet instability and power fluctuations often turn online participation into a technical struggle rather than a scientific contribution. To maximize effectiveness, allocating a dedicated budget for travel grants for Early Career Researchers (ECRs) would eliminate these digital barriers. This would ensure full immersion, seamless real-time interaction, and genuine inclusion in decision-making outcomes that the hybrid format cannot equitably provide given the current digital divide.
- As an online participant , it was best one could experience, We had clear and prompt instructions from Joanna during the workshop. I cannot comment for offline experience.
- I think it would have been much better to have at least 3 options for the online people to join at least 3 different breakout rooms with the scientists in place.
- NA

Group Dynamics & Participation

Thinking about the size of your breakout groups, the

The size of the deliverables planning groups felt:

breakout rooms for discussions on Topics felt:



In your opinion, what is the ideal number of participants for a productive breakout group focused on discussion? What about for planning? (e.g., "4-5 for discussion, 3-4 for planning")

All responses:

- 4
- 10 people in both cases
- -
- In my opinion, 4-5 participants for discussion is ideal to ensure a diversity of perspectives without losing focus. For planning, 3-4 participants is more effective, as it allows for a more agile coordination and clearer task distribution. However, in a hybrid setup involving participants from regions with unstable connectivity like Cameroon, keeping groups small (closer to the lower end of these ranges) is crucial. It ensures that if one participant loses their connection, the group can still function while easily integrating them back in when they return.
- I think 6-8 is best for discussion as well as planning. 6 is perfect.
- 10-25 / 10-25
- 5

Your Perspective & Ideas for Improvement

If you were to redesign one part of this workshop to make it better, what would it be and why?

- Interprétation of other language to increase number of participant.
- Not applicable
- Really think about if having the online participation is valuable for the online participants and how to solidly incorporate them into the workshop. If it can't be solved for next time, I would recommend not having the online option, as it can be a frustrating experience.
- If I were to redesign one part of the workshop, it would be the budget allocation strategy for inclusivity. Instead of investing heavily (20% of the total cost) in complex hybrid logistics that remain fragile for researchers in developing countries, I would prioritize funding full travel grants for Early Career Researchers (ECRs) from these regions. As a researcher based in Cameroon, I found that digital barriers (unstable internet, power fluctuations) significantly limit the impact of even the most well-organized online sessions. Redirecting the high costs of hybrid infrastructure toward physical participation would ensure genuine equity, high-quality networking, and a level of productivity that is simply not possible behind a screen in a digitally constrained environment.
- I cannot comment on the experiences of physically present participants. But online, it was best. So I would do the same if I had organized.
- I think it would have been much better to have at least 3 options for the online people to join at least 3 different breakout rooms with the scientists in place.
- N/A

What is one specific thing we could change or add to improve the experience for future workshops?

All responses:

- travel grant for country underrepresentation.
 - If having people online, I think the priority in the questions after talks should be given to them as they have less chances of discussion than people physically present
 - Guest list with shared research topics -> fast to find connections
- One specific addition to improve future workshops would be the establishment of 'Regional Participation Hubs.' If the budget cannot cover international travel for all, the organization could sponsor the gathering of researchers in regional academic centers (for example, a hub in Yaoundé for Central Africa) equipped with stable high-speed internet and reliable power. This would allow researchers in countries like Cameroon to overcome domestic infrastructural barriers while fostering a local physical group dynamic that can interact more effectively with the main venue. It represents a strategic compromise between individual hybrid participation and costly international travel, ensuring better engagement and inclusivity
- You might consider suggesting and facilitating funding opportunities and allowing sufficient time so that the person can do their

best to attend in person. Sometimes it's difficult for ECRs to secure funding. So the organization could help and guide the participant if they pass certain criteria.

- see my previous comment
- N/A

Do you have any other comments, suggestions, or ideas for how we can improve the format, organization, or topics of our next workshop?

All responses

- I mainly attended keynotes talks
- I am evaluating the "Hackathon Sandwich" sessions, specifically the OSSE framework and Observational Workflows. Due to time zone gaps and internet instability in Cameroon, I prioritized the Afternoon Discussions.

Scientific Feedback & Strategic Suggestions for Spring 2027:

Bridging Tropical-Polar Teleconnections: My research on intraseasonal oscillations (25-70 days) over Central Africa and the Congo Basin is directly relevant to your objectives. These tropical oscillations are key drivers of global energy transport. Integrating data from the Congo Basin into your WG1 (Air-Sea Heat Exchange) and WG3 (Advection) would provide a more holistic view of the uncertainties in heat transport toward the poles.

Regional Hubs for Global Science: To ensure that my expertise on African rainfall variability contributes to the 2027 Polar Hackathon, I suggest establishing a Regional Hub in Yaoundé. This would bypass the domestic connectivity issues I faced this time, allowing for seamless collaboration on GitHub and cloud-based (Google) resources.

Standardizing Underrepresented Regions: As you aim to standardize workflows, it is crucial to include datasets from the Congo Basin, which remains a "data-poor" region. Including this in the pre-selected observational datasets would significantly improve the "diverse range of perspectives" you are seeking.

A "Polar" hackathon that includes the "Tropical" drivers of heat transport will have a much higher scientific impact. I look forward to contributing my expertise on Central African climate variability to the OSSE framework development.

- I don't have any other comments.

- I attended Saturday and Sunday sessions and I joined the online breakout room which was mainly about Arctic amplification

Thanks for your feedback. We truly value it and will take it into account for our future activities. We hope you will continue to contribute to CLIVAR's activities and goals. -ICPO

Any other comments

- Travel grant for African participants on site.

Appendix G. Onsite participants group picture

