World Climate Research Programme

45th Session of the WCRP Joint Scientific Committee (JSC)

27-30 May 2024

DEADLINE: 1 May

Instructions

Overarching content/goal: *To provide an update on progress made during the last year, as well as your future plans, and highlight any aspects that you want to bring to the attention of the JSC.*

- *The length of the report should be kept to around 4 pages if possible (appendices and links can of course be used).*
- *Include the topics indicated below.*
- *Work with the WCRP secretariat responsible for your activity, in the preparation of the report and/or presentation.*
- *Discuss any points you would like to raise with the JSC with your JSC liaison(s), keeping the WCRP Secretariat focal point informed.*

Report to the WCRP Joint Scientific Committee

Climate and Cryosphere

1. Highlights for Joint Scientific Committee *(including high-level publications, new achievements/products, and capacity building activities –* ***in particular anything you feel should go into a WCRP annual achievement report or brochure****)*

- *CliC supported 12 separate in-person/hybrid meetings and workshops for CliC co-sponsored activities at multiple international conferences and venues. This included support for early career travel to these events. Many high level research papers have come out in 2022-2024 as a result of these activity's meetings (see list of references at the end of this report).*
- *CliC administered grants to early career researchers for field work in crucial cryospheric systems to 1) investigate the effect of permafrost thaw in the Khentii Mountains of Mongolia on water availability 2) socio-economic factors affecting water storage and availability in the Chilean Andes, and 3) novel instrumentation development to improve satellite-based sea ice thickness estimates.*
- *CliC provided funds for a mini-documentary highlighting permafrost carbon science and synthesis work for the Permafrost Carbon Network, due out in Spring, 2024.*
- *CliC SSG held its first in-person meeting since 2019 at AGU, 2023.*
- *CliC IPO opened a new office with new staff in July, 2023.*
- *The CliC website is in the process of being revamped, and has been much improved: https://climate-cryosphere.org/.*
- *CliC Webinars by leading subject experts to the wider community were initiated, held approximately once a month in early 2024, and are archived here: https://climate-cryosphere.org/clic-webinars/*
- *A joint press release between the Arctic Sea Ice Working Group and Antarctic Sea Ice Properties & Climate groups for a call of action was published: https://www.wcrp-climate.org/news/wcrp-news/2031-polar-scientists-call-for-urgent-action-in-view-of-rapid-arctic-and-antarctic-change.*

- *ASIWG members have a leading role in writing the Arctic sea ice sections of the Bulletin of the American Society's State of the Climate Report (2023 in press) & the NOAA Arctic Report Card: https://arctic.noaa.gov/report-card/report-card-2023/sea-ice-2023/.*
- *ISMIP7 started a series of expert community workshops leading towards the forthcoming IPCC AR7 cycle.*
- *PolarCORDEX published Policy-relevant science highlights from the Antarctic CORDEX project in the World Meteorological Organisation Antarctic Treaty Paper, highlighting modelling insights about Antarctic Ice Sheet surface mass balance results and policy recommendations.*
- *Co-chair Edward Hanna contributed to a BBC Natural History Unit/INTERACT "Arctic Climate Magnification" video on the jet stream and Arctic/midlatitude climate linkages, that was published in October 2023 (from 7min25): https://www.youtube.com/watch?v=xCqofgFN7CA*
- *Review Article for Nature Reviews Earth & Environment based on a 2022 ISMASS workshop: Hanna, E. et al. Short- and long-term variability of the Antarctic and Greenland ice sheets. Nat Rev Earth Environ (2024). https://doi.org/10.1038/s43017-023-00509-7*
- *Arctic-midlatitude climate Linkages CliC/IASC workshop on the "Influence of the lower stratospheric polar vortex on cold-air outbreaks under climate warming" was held at University of Lincoln, UK, in September 2023 (led by E. Hanna and J. Overland), with an invited scientific paper being written up summarising the results.*

2. Planned science initiatives and major events *(over next 1- 5 years)*

- *Workshop immediately prior to EGU in April 2024 to kick off planning and scoping of Impacts of Changes in the Mountain Cryosphere working group (next 6-9 months) to bring together experts from different mountain regions to focus on societal impacts and hazards of elevation dependent warming, and to help develop recommendations or assessments for local risk management.*
- *CliC co-organized a session at EGU 2024 co-convened by A. Lovecraft: The diminishing cryosphere: transdisciplinary investigation of societal impacts to start scoping a working group*
- *CliC tentatively plans to hold an Open Science Conference in 2026 to mark the 30th anniversary of CliC. This would be a very significant international event that we aim to coordinate with other WCRP activities and some of our key external partners (e.g. APECS, IASC, SCAR), and to have a lasting legacy and benefit for the international research, educational and stakeholder communities with interest in climate and cryosphere matters, as well as helping to further promote CliC..*

3. Planned Products, high-level assessments or other key outputs/publications

- *CliC is in the process of putting together a Special Issue of Science focusing on the cryosphere, to be submitted in fall 2024. There will be 3 scientific papers assessing rapid and recent cryospheric changes in the Arctic, Antarctic, and Mountain Cryosphere respectively.*
- *In March 2024, CliC published its first newsletter since 2021 summarizing work from 2023 and communicating about events in 2024 and beyond.*
- *Working to collaborate with SCAR's AntClimNow to develop an Antarctic Climate Indicators assessment; CliC and AntClimNow have proposed a joint workshop held at the SCAR Open Science Conference in Pucón, Chile, 2024.*
- *CliC has recently been actively represented on ICARP IV and IPY/International Polar Decade planning groups/activities that are being led by IASC and others.*
- *CliC has a proposed workshop at the International Mountain Year in Innsbruck in Sept 2025 and is discussing a " Mountain cryosphere" annual report card.*
- *A. Lovecraft presented a poster with the intent of bridging geophysical modeling and community impacts "The Political Ecology of the Cryosphere: Theory and Praxis" that is the seed of a global author interdisciplinary scientific review paper to be published in 2025.*

4. Linkages with other Core Projects, Lighthouse Activities, Academy etc.

- *Planning for a joint activity comprising a summer school on polar climate and a workshop on sea ice role and variability in the climate system together with CLIVAR and ICTP in Trieste, Italy, in July 2024 is underway, with a NORP-SORP task team meeting fortnightly.*
- *SSG co-chair E. Hanna represented and presented on CliC at the SPARC July 2023 and GEWEX April 2024 SSG meetings.*
- *IPO Director, K. Alverson (remotely) represented CliC in the RiFS workshop "Robustness of Climate Information for Decisions" April 2024. CliC is seeking to partner with RiFs in future activities, perhaps focused on Mountain Cryosphere work.*
- *R. Bradley has been invited to serve on the Advisory Board for International Year of Glaciers' Preservation 2025*
- *R. DeConto has been invited to participate in the US Coast guard's Project Evergreen strategic foresight "Pinecone" workshop on Antarctica. This workshop, endorsed by the Vice Commandant of the U.S. Coast Guard, Admiral Steven Poulin, will be held on 13-14 May at The RAND Corporation offices in Pentagon City, VA*

5. Partnerships with entities outside of WCRP

- *Antarctica InSync was endorsed as an Ocean Decade Action and announced at the Polar Summit in Paris. SORP member Alexander Haumann is one of the Antarctica InSync coordinators, and has also joined the SOOS SSG.*
- *E. Hanna recently met the IASC leadership at ASSW2024 to discuss enhancing collaboration on matters of mutual interest; CliC is actively represented together with IASC in ICARP IV/IPY planning*
- *We closely coordinate several of our activities with APECS (representing cryosphere Early Career Researchers), and E. Hanna recently (March 2024) explored continued/potentially enhanced collaboration with the APECS Executive Director.*
- *We plan to consolidate partnership with MRI and ICIMOD (Himalayan mountain glacier changes and their impacts).*
- *We are cooperating with SCAR - holding our next SSG at their OSM, jointly running a workshop there on Antarctic Indicators.*
- *CliC co-sponsored the International Cryosphere Climate Initiative (ICCI) Cryosphere Pavilion at COP 28.*

***6. Suggestions, issues or challenges**, for example:*

- *For the Global Fellowship focus, potential areas of interest include: (1) the causes and impacts of extreme climate/cryosphere events; and (2) geoengineering, where the latter may or may not have a cryosphere focus.*
- *The turn around on the 2025 extra budget application process notified by WCRP was too tight for us to be able to take full advantage in terms of gathering and submitting requests. We would appreciate more advance notice of the 2026 budget.*
- *We are currently short of 3 SSG members (will be 5 by the end of 2024) due to the 2023 freeze by the JSC on recruiting new members whilst CliC is under review, and this limits what we can do/the division of labour, despite considerable work and efforts by the current SSG and IPO members.*

Key publications from CliC Activities

Sea Ice Model Intercomparison Project (SIMIP)

Rieke, O., Årthun, M., and Dörr, J. S.: Rapid sea ice changes in the future Barents Sea, The Cryosphere, 17, 1445–1456, https://doi.org/10.5194/tc-17- 1445-2023, 2023.

Southern Ocean Region Panel (SORP) and Northern Region Ocean Panel (NORP)

Rabe, B., T. Martin, A. Solomon, K. M. Assmann, L. C. Biddle, T. Haine, T. Hattermann, F. A. Haumann, A. Jahn, T. Karpouzoglou, G. Laukert, A. Naveira Garabato, E. Rosenblum, E. Sikes, L. Yin, and X. Zhang, 2023: Polar Fresh Water in a Changing Global Climate: Linking Arctic and Southern Ocean Processes. Bull. Amer. Meteor. Soc., 104, E970–E979, https://doi.org/10.1175/BAMS-D-23-0046.1., available at: https://journals.ametsoc.org/view/journals/bams/104/5/BAMS-D-23-0046.1.xml

Swart, N., T. Martin, R. Beadling, J.-J. Chen, C. Danek, M. H. England, R. Farneti, S. M. Griffies, T. Hatterman, J. Hauck, F. A. Haumann, A. Juling, Q. Li, J. Marshall, M. Muilwijk, A. G. Pauling, A. Purich, I. J. Smith and M. Thomas, 2023, The Southern Ocean Freshwater Input from Antarctica (SOFIA) Initiative: scientific objectives and experimental design, Geoscientific Model Development, 16, 7289–7309, https://doi.org/10.5194/gmd-16-7289-2023., available at: https://gmd.copernicus.org/articles/16/7289/2023/

Chen, J.-J., N. C. Swart, R. Beadling, X. Cheng, T. Hattermann, A. Jüling, Q. Li, J. Marshall, T. Martin, M. Muilwijk, A. G. Pauling, A. Purich, I. J. Smith, and M. Thomas (2023), Reduced Deep Convection and Bottom Water Formation Due to Antarctic Meltwater in a Multi-Model Ensemble, Geophysical Research Letters, 50, e2023GL106492. https://doi.org/10.1029/2023GL106492, available at: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2023GL106492.

CLIVAR, 2023: Final report on the NORP-SORP workshop on polar fresh water: Sources, Pathways and ImpaCts of frEsh water in northern and soUthern Polar oceans and seas (SPICE UP). CLIVAR Report 02/2023, 35 pp., https://doi.org/10.36071/clivar.rp.2.2023.

PolarCORDEX

Jozef et al. 2024, An Overview of the Vertical Structure of the Atmospheric Boundary Layer in the Central Arctic during MOSAiC, Atmos. Chem. Phys., 24, https://doi.org/10.5194/acp-24-1429-2024

Jozef et al. 2023, Thermodynamic and kinematic drivers of atmospheric boundary layer stability in the central Arctic during the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC). Atmos. Chem. Phys., 23, https://doi.org/10.5194/acp-23-13087-2023.

Kirbus et al. 2023, Surface impacts and associated mechanisms of a moisture intrusion into the Arctic observed in mid-April 2020 during MOSAiC, Front. Earth Sci., https://doi.org/10.3389/feart.2023.1147848

Svensson et al. 2023, Warm air intrusions reaching the MOSAiC expedition in April 2020—The YOPP targeted observing period (TOP). Elementa: Science of the Anthropocene, https://doi.org/10.1525/elementa.2023.00016

Akperov et al. 2023, Future projections of wind energy potentials in the Arctic for the 21st century under the RCP8.5 scenario from regional climate models (Arctic-CORDEX), Anthropocene, https://doi.org/10.1016/j.ancene.2023.100402

Orr 2023, CORDEX project, World Meteorological Organisation Antarctic Treaty Paper, https://www.ats.aq/devAS/Meetings/Documents/95

Orr et al. 2023, Characteristics of surface melt potential over Antarctic ice shelves based on regional atmospheric model simulations of summer air temperature extremes from 1979/80 to 2018/19, J. Clim., https://doi.org/10.1175/JCLI-D-22-0386.1

van Wessem et al. 2023, Variable temperature thresholds of melt pond formation on Antarctic ice shelves. Nature Climate Change, https://doi.org/10.1038/s41558-022-01577-1

Noël et al. 2023, Higher Antarctic ice sheet accumulation and surface melt rates revealed at 2 km resolution. Nature Communications, https://doi.org/10.1038/s41467-023-43584-6

van der Meer et al. 2023, Deep learning regional climate model emulators: A comparison of two downscaling training frameworks. J. Adv. Modeling Earth Systems, https://doi.org/10.1029/2022MS003593

Hansen et al. 2023, The importance of cloud phase when assessing surface melting in an offline coupled firn model over Ross Ice shelf, West Antarctica, The Cryosphere Discuss., https://doi.org/10.5194/tc-2023-145

Marine Ice Sheet and Ocean Model Intercomparison Project – phase 2 (MISOMIP2)

De Rydt, J., Jourdain, N. C., Nakayama, Y., van Caspel, M., Timmermann, R., Mathiot, P., Asay-Davis, X. S., Seroussi, H., Dutrieux, P., Galton-Fenzi, B., Holland, D., and Reese, R.: Experimental design for the marine ice sheet and ocean model intercomparison project – phase 2 (MISOMIP2), EGUsphere [preprint], https://doi.org/10.5194/egusphere-2024-95, 2024.

Ice Sheet Model Intercomparison Project (ISMIP6/7)

H. Seroussi, V. Verjans, S. Nowicki, A. Payne, H. Goelzer, W. Lipscomb, A. Abe Ouchi, C. Agosta, T. Albrecht, X. Asay-Davis, A. Barthel, R. Calov, R. Cullather, C. Dumas, B. Galton- Fenzi, R. Gladstone, N. Golledge, J. Gregory, R. Greve, T. Hatterman, M. Hoffman, A. Humbert, P. Huybrechts, N. Jourdain, T. Kleiner, E. Larour, G. Leguy, D. Lowry, C. Little, M. Morlighem, F. Pattyn, T. Pelle, S. Price, A. Quiquet, R. Reese, N. Schlegel, A. Shepherd, E. Simon, R. Smith, F. Straneo, S. Sun, L. Trusel, J. Van Breedam, P. Van Katwyk, R. van de Wal, R. Winkelmann, C. Zhao, T. Zhang, and T. Zwinger, 2023. Insights into the vulnerability of Antarctic glaciers from the ISMIP6 ice sheet model ensemble and associated uncertainty, 17, 5197-5217, The Cryosphere, https://doi.org/10.5194/tc-170-5197-2023

Ice Sheet Mass Balance and Sea Level (ISMASS)

Hanna, E. et al. Short- and long-term variability of the Antarctic and Greenland ice sheets. Nat Rev Earth Environ (2024). https://doi.org/10.1038/s43017-023-00509-7

Antarctic Sea ice Processes and Climate (AsPeCt)

Polona Itkin, Stefan Hendricks, Melinda Webster, Luisa von Albedyll, Stefanie Arndt, Dmitry Divine, Matthias Jaggi, Marc Oggier, Ian Raphael, Robert Ricker, Jan Rohde, Martin Schneebeli, Glen E. Liston; Sea ice and snow characteristics from year-long transects at the MOSAiC Central Observatory. Elementa: Science of the Anthropocene 5 January 2023; 11 (1): 00048. doi:https://doi.org/10.1525/elementa.2022.00048

Tian R. Tian, Alexander D. Fraser, Thomas Lavergne, Sonya L. Fiddes, Chen Zhao, Petra Heil. Linking timescale-dependent Antarctic sea ice kinematic observations to ice thickness. Remote Sensing of Environment, Volume 298, 2023, 113813, ISSN 0034-4257, https://doi.org/10.1016/j.rse.2023.113813

Permafrost Carbon Network (PCN)

Oehri, J, et al., Vegetation type is an important predictor of the arctic summer land surface energy budget. Nature Communications. 13 (1), 6379. https://doi.org/10.1038/s41467-022-34049-3

Ramage, JL., Kuhn M., Virkkala AM., Voigt C., Marushchak ME., Bastos A., Biasi C., Canadell JG., Ciais P., Lopez-Blanco E., Natali SM., Olefeldt D., Potter S., Poulter B., Rogers B., EAG Schuur et al. The net GHG balance and budget of the permafrost region (2000-2020) from ecosystem flux upscaling. 2023. ESS Open Archive 10.22541/essoar.169462008.85493456/v1, in revision

Hugelius G., Ramage JL., Burke EJ., Chatterjee A., Thomas SL., Aalto T., Bastos A., Biasi C., Josep CG., Chandra N., Chevallier F., Ciais P., Chane J., Feng L., Jones MW., Kleinen T., Kuhn M., Lauerwald R., Liu J., Lopez-Blanco E., Luijix IT., Marushchak ME., Natali SM., Niwa Y., Olefeldt D., Palmer P., Patra PK., Peters W., Potter S., Poulter B., Rogers B., Riley WJ., Saunois M., EAG Schuur et al. Two decades of permafrost region

CO2 , CH4 , and N2O budgets suggest a small net greenhouse gas source to the atmosphere. Global Biogeochemical Cycles, in revision

Maes, SL, et al.,2024. Environmental drivers of increased ecosystem respiration with warming in tundra. Nature, in press.

Strauss, J, M Fuchs, G Hugelius, F Miesner, I Nitze, S Opfergelt, E Schuur, C Treat, M Turetsky, Y Yang, and G Grosse. 2024. Organic matter storage and vulnerability in the permafrost domain. Encylopedia of Soils, in press.

Anna-Maria Virkkala, et al., 2024. An increasing Arctic-Boreal CO2 sink despite strong regional sources. Nature Climate Change, in review.

Craig R. See, et al., 2024. Decadal increases in carbon uptake offset by respiratory losses across northern permafrost ecosystems. Nature Climate Change, in press.

Treat, C., AM Virkkala, E Burke , L Bruhwiler, A Chatterjee , JB. Fisher, J Hashemi, F-J W. Parmentier, BM Rogers, S Westermann, JD Watts, E Blanc-Betes, M Fuchs, S Kruse, A Malhotra, K Miner, J Strauss, A Armstrong, HE Epstein, B Gay, M Goeckede , A Kalhori, D Kou, CE Miller, SM Natali, Y Oh, S Shakil, O Sonnentag, RK Varner, S Zolkos, EAG Schuur, and G Hugelius. 2024. Permafrost carbon: Progress on understanding stocks and fluxes across northern terrestrial ecosystems. Journal of Geophysical Research: Biogeosciences, 129, e2023JG007638. https://doi.org/10.1029/2023JG007638

Biogeochemical Exchange Processes at Sea-Ice Interfaces (BEPSII)

Sian F. Henley, S Cozzi, F Fripiat, et al., Macronutrient biogeochemistry in Antarctic land-fast sea ice: Insights from a circumpolar data compilation, (2023) Marine Chemistry, 257,104324, https://doi.org/10.1016/j.marchem.2023.104324.

SOLAS Review, Polar Ocean and Sea Ice in a changing climate, Willis, Lannuzel, Else et al(2023) Elementa Science of the Anthropocene 11 (1): 00056. https://doi.org/10.1525/elementa.2023.00056

Light Under Arctic Sea Ice in Observations and Earth System Models M. Lebrun, M. Vancoppenolle, G. Madec et al. (2023) JGR Oceans 128, https://doi.org/10.1029/2021JC018161