



2019 WCRP CLIC Annual Report



About CliC

Who we are...

The Climate and Cryosphere Project (CliC) is one of the core projects of the WMO/ISC/IOC World Climate Research Programme (WCRP) (<http://www.wcrp-climate.org>) together with CLIVAR, GEWEX and SPARC. The core projects work closely with the WCRP Joint Planning Staff (JPS) and other working groups of WCRP. The projects organize their work through various focused initiatives, experiments, scientific advisory committees, and panels.

What we do...

The Climate and Cryosphere project encourages and promotes research into the cryosphere and its interactions with the global climate system. It highlights emerging issues, encourages communication between researchers with common interests in cryospheric and climate science, promotes international cooperation, and highlights the importance of this field to policy makers, funding agencies, and the general public. CliC also publishes scientific papers on the role of the cryosphere in the global climate system and recommends directions for future study.

How we work...

The CliC Scientific Steering Group (SSG) is composed of high calibre researchers and has the overall responsibility for planning and guiding the CliC science plan. SSG members are appointed by the WCRP Joint Scientific Committee (JSC), based on recommendations from the CliC SSG. Initial membership is for four years and, as a rule, two extensions of two years each may be recommended. The SSG usually meets once per year.

The CliC International Project Office (IPO) was hosted at the Norwegian Polar Institute in Tromsø, Norway until the end of 2018. Negotiations are currently being held for a new host. The IPO supports the SSG and the CliC community in coordinating and implementing the CliC science projects and tasks. Its functions of international communication and liaison make it the primary point of contact for those wishing to participate in, contribute to, or learn more about CliC activities.

CliC is fortunate to have a large number of leading cryosphere researchers working through regional and national programs, working groups, and expert panels.

Report prepared by Gwénaëlle Hamon with contributions from James Renwick, Fiamma Straneo, Miks Sparrow, Lars Smedsrud, Shin Sugiyama, Sophie Nowicki, David and Denise Holland, Gerhard Krinner, Chris Derksen, Regine Hock, Ben Marzeion, Alexandra Jahn, Dirk Notz, Christina Schaedel, Ted Schuur, Don Perovich, Marilyn Raphael, Julie Jones, Martin Vancoppenolle, Ed Hanna, Riccardo Farneti, Inga Smith, Amy Solomon, Ruth Mottram, Annette Rinke, John Cassano, Andrew Orr, Michael Karcher, Letizia Tedesco, Heiko Gozler, Ronald Buss de Souza, Robin Robertson, Franck. Kauker, and Richard Essery.

Cover picture: B. Marzeion

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Overview from the CliC and the Melting Ice & Global Consequences Grand Challenge Co-Chairs

2019 was another productive year for the CliC community and we are pleased to share this annual report highlighting some of our progress and achievements during the past year. The report also covers the outputs resulting from the WCRP Grand Challenge on “Melting Ice and Global Consequences.”

With an ambitious agenda but using limited resources, CliC had a busy year, including a series of workshops, covering all major components of the CliC Action plan.

The Grand Challenge “Melting Ice and Global Consequences” (GC) has been moving forward on its initial focus areas. CliC plays an important role in contributing to the GC’s goals by mobilizing the global cryosphere modelling community and supporting the sixth iteration of the WCRP Coupled Model Intercomparison Project (CMIP6). CliC is currently sponsoring model intercomparison projects covering snow, ice sheets, glaciers and sea ice (ESM-SnowMIP, ISMIP6, MISOMIP, GlacierMIP, SIMIP, ISMASS). These initiatives are the result of a strategy aimed at tightening the links between the cryospheric research and global modelling communities.

CliC SSG-members and projects leads played active roles in the Intergovernmental Panel on Climate Change (IPCC) 6th Assessment Report and Special Report on the Oceans and Cryosphere.

The co-chairs are happy to see the close cooperation between the CliC project office, and the WCRP joint planning staff.

The CliC Co-Chairs would like to thank Stephen Hudson, Shichang Kang, Hiroyuki Enomoto, Dario Trombotto who served on the CliC SSG from 2015/2016 to 2019. They would also like to wish a warm welcome to Jason Box, Hanne Christiansen, Camille Lique, Amy Lovecraft, Shin Sugiyama, and Tingjun Zhang, the six new members of the CliC SSG.



From left to right: J. Renwick and F. Straneo, CliC Co-Chairs; T. Naish, GC Chair

Scientific Steering Group (SSG) Members

Chairs

James Renwick, Victoria University of Wellington, New Zealand (1/2017-12/2020)
Fiamma Straneo, Scripps Institution of Oceanography, UCSD, USA (1/2018-12/2021)

Members

Lars H. Smedsrud, University of Bergen, Norway (1/2016-12/2021)
Helene Seroussi, NASA JPL, USA (1/2019-12/2022)
Martin Vancoppenolle, CNRS LOCEAN, France (1/2019-12/2022)

Outgoing Members

Hiroyuki Enomoto, National Institute of Polar Research (NIPR), Japan (1/2016-12/2019)
Shichang Kang, Chinese Academy of Sciences, China (1/2015-12/2019)
Stephen Hudson, Norwegian Polar Institute, Norway (1/2016-12/2019)
Dario Trombotto Liaudat, Centro Cientifici Tecnológico CONICET Mendoza, Argentina (1/2016-12/2019)

Incoming Members

Jason Box, Geological Survey of Denmark and Greenland (1/2020-12/2023)
Amy Lovecraft, University of Alaska Fairbanks, USA (1/2020-12/2023)
Tingjun Zhang, Lanzhou University, China (1/2020-12/2023)
Shin Sugiyama, Hokkaido University, Japan (1/2020-12/2023)
Hanne Christiansen, University Centre in Svalbard, Norway (1/2020-12/2023)
Camille Lique, IFREMER, France (1/2020-12/2023)



From left to right, 1st row: S. Sugiyama, J. Box, C. Lique; 2nd row: L. Smedsrud, H. Seroussi, M. Vancoppenolle; 3rd row: A. Lovecraft, T. Zhang, H. Christiansen

Support Team

International Project Office

Gwénaëlle Hamon, Executive Officer (2014–present) – WCRP Consultant

WCRP Joint Planning Staff

Mike Sparrow, WCRP Officer in Charge (CliC Liaison) (2015-present)

The International Project Office

Since 2019, the CliC project office has been in the process of being relocated to a new host institute. This process is still ongoing and in the meantime the CliC activities are coordinated by Gwenaelle Hamon, the Executive Officer, who was hired as a WCRP consultant to work closely with M. Sparrow, WCRP Officer in Charge.

CliC enjoyed another productive year in 2019 with workshops and related events taking place every month of the year. The project office facilitated 16 workshops throughout the year with total attendance in excess of 400 researchers and the participants coming from over 20 countries and organizations globally.

The CliC website and social media continue to expand rapidly in terms of content and viewership. Our social media feeds on Facebook and Twitter grew again in 2019 (with more than 2200 Likes on Facebook and more than 3200 Followers on Twitter) and we are regularly looking for opportunities to showcase the scientific outputs from our network on partner media channels. CliC also hosted more than 60 online project meetings on its GoToMeeting and GoToWebinar accounts.

Links with the other WCRP core project offices are important and in 2020, we started again to host online meetings to help coordinate our research more effectively and to manage our activities efficiently. CliC was also represented at the 2020 CLIVAR and GEWEX SSG meetings and at the 2020 WCRP Science Questions workshop in Hamburg.



From left to right: G. Hamon, M. Sparrow

Report Format

The remainder of this report presents the science highlights, publications, and future plans of the various activities and Modelling Intercomparison Projects (MIPs) in the CliC network. To help present the contributions of these activities we have divided the remainder of this report into the following sections:

- WCRP Grand Challenge on Melting Ice and Global Consequences
- Sea Ice
- Ice Sheets
- Regional Activities
- Inter-disciplinary Activities

Structure of CliC



Model Intercomparison Projects (MIPs)

- Earth System Model-Snow MIP (ESM- SnowMIP) (tightly linked to Land Surface, Snow and Soil Moisture MIP (LS3MIP))*/**
- Ice Sheet MIP for CMIP6 (ISMIP6)*/**
- Marine Ice Sheet-Ocean MIP (MISOMIP)*/**
- Diagnostic Sea Ice MIP (SIMIP)*/**
- GlacierMIP**

* Contributions to CMIP6, the 6th Phase of the Coupled Model Intercomparison Projects (MIP)

Activities

- Polar Climate Predictability Initiative (PCPI) (joint with SPARC)
- Southern Ocean Region Panel (joint with CLIVAR and SCAR)
- Northern Oceans Region Panel (joint with CLIVAR)
- BEPSII - Biogeochemical exchange processes at Sea Ice Interfaces (joint with SCOR and SOLAS)
- Antarctic Sea Ice Processes & Climate (ASPeCt) (joint with SCAR)
- Technical Committee on Sea Ice Observations
- Arctic Sea Ice Working Group
- Sea Ice & Climate Modelling Forum
- Ice Sheet Mass Balance and Sea Level (ISMASS) (joint with SCAR and IASC)
- Permafrost Carbon Network (part of the Study of Environmental Arctic Change (SEARCH) project)**
- Permafrost & Climate Modelling Forum
- Polar Coordinated Regional Downscaling Experiment (Polar CORDEX)
- Earth Observations and Arctic Science Needs (with ESA)
- Linkage Between Arctic Climate Change and Mid-Latitude Weather Extremes

* Part of the WCRP Grand Challenge – Melting Ice and Global Consequences, Lead: CliC, Chair: Tim Naish

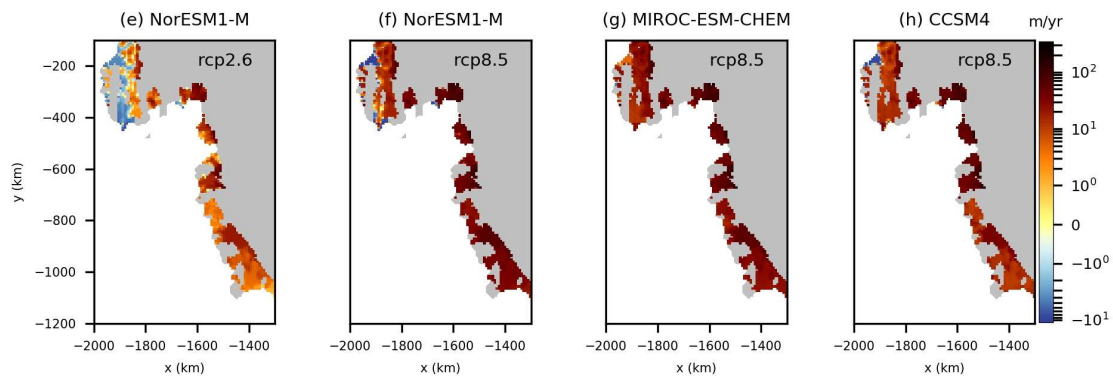
WCRP Grand Challenge - Melting Ice and Global Consequences

Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6)

Introduction

ISMIP6 has the objectives of improving projections of sea level contributed by the Greenland and Antarctic ice sheets, and increasing our understanding of the cryosphere in a changing climate. It maps into the 'Melting Ice and Global Consequences' and 'Regional Sea-level Change' Grand Challenges of the World Climate Research Programme. ISMIP6 is an endorsed activity within CMIP6.

Science Highlight



Example of sub-ice shelf basal melt in the Amundsen sea sector used to force ice sheet models with the parameterization developed for ISMIP6 by the ocean focus group, highlighting the impact of scenario and climate model.

Figure courtesy of N. Jourdain.

2019 Highlights

- Preparation of forcing dataset for ice sheet models and ice sheet model simulations targeting IPCC AR6.
- 13 modelling groups participated in Antarctica Projections, led by H. Seroussi
- 13 modeling groups participated in in Greenland Projections, led by H. Goelzer.
- Analysis of the ISMIP6 projections from Antarctica and Greenland, and ABUMIP model simulations
- One workshop: "Analysis of the ISMIP6 simulations" to explore preliminary projections and decide on additional experiments
- Presentations at EGU, AntClim21, IUGG, AGU and WCRP SL GC Meeting
- Creation of ISMIP6 special issue in Copernicus Journals, and 8 ISMIP6 related manuscripts submitted

2019 Publications

Seroussi, H., et al. 2019: initMIP-Antarctica: an ice sheet model initialization experiment of ISMIP6, The Cryosphere, [doi:10.5194/tc-13-1441-2019](https://doi.org/10.5194/tc-13-1441-2019).

Slater, D. et al. 2019: Estimating Greenland tidewater retreat driven by submarine melting, The Cryosphere, [doi:10.5194/tc-13-2489-2019](https://doi.org/10.5194/tc-13-2489-2019).

Future activities and developments

- Publications of the projections from standalone ice sheet models for Antarctica, Greenland, and ABUMIP results
- Publications on the coupled climate-ice sheet ISMIP6 simulations
- Large workshop and series of remote meetings to continue the planning for the evaluation of ISMIP6 simulations and implications for sea level projections, as well as planning for the next phase of ISMIP6.

Webpage: www.climate-cryosphere.org/activities/targeted/ismip6

Marine Ice Sheet Ocean Model Intercomparison Project (MISOMIP)

Introduction

Global sea-level rise is one of the most discussed potential consequences of global warming. The most uncertain aspect of such future sea-level change has to do with the marine based ice sheets, and particularly that of the West Antarctica Ice Sheet (WAIS). Despite its potential importance, current generation global climate models are unable to simulate sea-level change arising from glacier-ocean interaction.

Recently established is the RISE activity (Realistic Ice-sheet/ocean State Estimates), led out of the University of Tasmania, and with international participation. MISOMIP is supporting and endorsing this activity. Discussions have been held this past year with RISE and MISOMIP researchers to identify how these two efforts can best support one another. Going forward, RISE will provide valuable input data to assist in MISOMIP modeling activities.

See: <http://soos.aq/news/current-news/383-realistic-ice-shelf-ocean-state-estimates-riseinternational-collaboration-with-soos>

A meeting was held in October 2019 at Oxford University as a planning event for the International Thwaites Glacier Collaboration (ITGC, <https://thwaitesglacier.org/>). MISOMIP researchers who were in attendance held a sidebar meeting to discuss present MISOMIP experiments and planned future experiments. Additionally, many ITGC researchers are heading to Thwaites Glacier this austral spring in a coordinated effort to collect basic glacier-ocean data to better understand the behavior of that key outlet glacier. Field data will flow into the MISOMIP effort over the coming years.

Future activities and developments

One outcome of the third biennial meeting was the recognition of the need for a smaller, focused manuscript-writing workshop in which the results of the first major inter-comparison experiments could be brought together. Such a workshop, involving approximately one dozen of the participants who have carried out the specific experiments, is now being planned for Fall 2020.



Project-Start Goals Accomplished:

- Designing/testing the MISOMIP experiments (many groups have already run many of the experiments as part of designing them)
- Deliverable: Experiments defined in a peer-reviewed document: Dr. X. Asay-Davis (GMD) and D. M. Holland and D. Holland (EOS).

Mid-Project Goals Now Active:

- Comparison of MISOMIP results between models that have completed the experiments
- Coordinated idealized and regional realistic experiments (using agreed upon region to focus further experiments)
- Deliverable: Papers intercomparing results from MISOMIP

Project-End Goals Upcoming:

- Modeling goal: Provide a set of reference simulations and solutions for model development for future researchers and models

- Science goal: Focus regionally and on processes relating to coupling. Doing perturbations to explore uncertainties or processes.

2019 Publications

Asay-Davis, X., Adcroft, A., Dinniman, M., Galton-Fenzi, B., Gladstone, R., Goldberg, D., Gwyther, D., Hallberg, R., Hattermann, T., Holland, P., Jordan, J., Jourdain, N., Kushara, K., Marques, G., Nakayama, Y., Smith, R., Stern, A., and Zhou Q.: Melt rates in ocean models with ice-shelf cavities: results of the second Ice Shelf–Ocean Model Intercomparison Project (ISOMIP+). *Manuscript in prep.*, The Cryosphere, 2019.

Asay-Davis, X., R. Gladstone, and MISOMIP1 participants. Results from the first Marine IceSheet and Ocean Model Intercomparison Project. *Manuscript in prep.*, The Cryosphere, 2019.

Webpages:

<http://www.climate-cryosphere.org/activities/targeted/misomip> <http://nyuad.nyu.edu/cslc> Webpages

<http://www.climate-cryosphere.org/activities/targeted/misomip>

<http://nyuad.nyu.edu/cslc>

Earth System Model-Snow Model Intercomparison Project (ESM-SnowMIP)

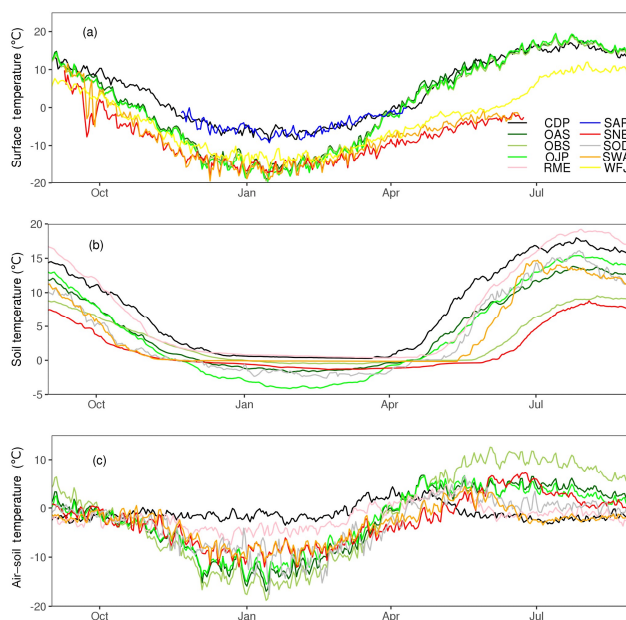
From the standpoint of CliC and the Cryosphere Grand Challenge, the main purpose of ESM-SnowMIP and LS3MIP, initially envisaged as a single CMIP6 project, is to pave the way for improved representation of snow in coupled climate models; in ESM-SnowMIP, improved snow modeling with more specialized dedicated model is an additional aim. To alleviate pressure on the CMIP6 groups, it was decided to carry out a restricted set of land surface only and coupled climate model runs within LS3MIP/CMIP6, while during that active CMIP6 production period ESM-SnowMIP concentrated on easy-to-manage site-scale runs.

LS3MIP led to the production of land-only and coupled simulations within CMIP6 which are currently being analyzed. Because of the specific design of the coupled LS3MIP simulations aiming at analyzing land-surface feedbacks in a warming world, these simulations necessarily have to be carried out after the basic scenario runs which they build on. As a consequence, only few of these simulations are available at the time of writing. The land-surface only LS3MIP simulations, designed as a land-surface equivalent of AMIP and OMIP, are currently being finalized.

After an initial ESM-SnowMIP overview paper showing some selected site-simulation results (Krinner et al., 2018), a paper by Ménard et al. (ESSD, 2019) described a new consistent data set for snow model driving and evaluation that was developed within ESM-SnowMIP. This consistent, harmonized and quality-controlled dataset, spanning a wide range of climate and snow regimes and open for future extensions (specifically to Arctic sites), will be a remaining legacy of ESM-SnowMIP. A comment by Ménard et al., currently submitted to BAMS, takes a more "philosophical" point of view, asking why, after 30 years of snow model intercomparisons, snow modeling has not seen the kind of spectacular progress seen in other fields such as numerical weather prediction. This paper will be followed by a more detailed paper analyzing the snow site simulations.

In April 2019, an ESM-SnowMIP meeting of opportunity was held during EGU in Vienna. At that point, it was suggested to move on with the production of global-scale land-only simulations designed to be complementary to the basic LS3MIP land-only simulations and to allow specific investigation of snow-related land-surface model parameterizations, and to solicit WGCM endorsement. However, initial analysis of the snow site simulations and of the LS3MIP land-only simulations suggests that snow model parameterizations still suffer of very basic drawbacks that do not necessarily require an additional battery of coordinated model experiments to be addressed properly.

The ESM-SnowMIP will be taking a step back in 2020 and carefully reconsider their initial plans of dedicated ESM-SnowMIP global snow simulations as a follow-up on the LS3MIP land-only experiments. In the framework of the WCRP Grand Challenges, this would also make sense because the plan for Grand Challenge project was always to be limited to a few years. The plan for 2020 is therefore to concentrate on the detailed analysis of the ESM-SnowMIP site-scale runs and of the snow-related aspects in the new LS3MIP land-only simulations, and to publish these results as a further legacy of ESM-SnowMIP.



From Ménard et al., *ESSD* 2019. Daily climatological surface and soil temperatures at the measurement sites collated for ESM-SnowMIP.

2019 Publications

Ménard, C. B., Essery, R., Barr, A., Bartlett, P., Derry, J., Dumont, M., Fierz, C., Kim, H., Kontu, A., Lejeune, Y., Marks, D., Niwano, M., Raleigh, M., Wang, L., and Wever, N.: Meteorological and evaluation datasets for snow modelling at 10 reference sites: description of in situ and bias-corrected reanalysis data, *Earth Syst. Sci. Data*, 11, 865–880, <https://doi.org/10.5194/essd-11-865-2019>, 2019.

Ménard, C.B., R. Essery, G. Arduini, P. Bartlett, A. Boone, Cl. Brutel-Vuilmet, E. Burke, J. Colin, M. Cuntz, Y. Dai, B. Decharme, E. Dutra, X. Fang, C. Fierz, Y. Gusev, S. Hagemann, V. Haverd, H. Kim, G. Krinner, M. Lafaysse, T. Marke, O. Nasonova, T. Nitta, M. Niwano, J. Pomeroy, G. Schädler, V. Semenov, T. Smirnova, U. Strasser, S. Swenson, D. Turkov, N. Wever, and H Yuan: Disentangling scientific from human errors in a snow model intercomparison. *Bull Am. Met. Soc.*, *submitted*.

Webpage: <http://www.climate-cryosphere.org/mips/esm-snowmip>

GlacierMIP – A model intercomparison of global-scale glacier models

Introduction

GlacierMIP is a model intercomparison project focusing on all glaciers in the world outside the ice sheets. It provides – for the first time – a framework for a coordinated intercomparison of global-scale glacier mass change models, to foster model improvements and reduce uncertainties in global glacier projections.

Science Highlight

Global glacier mass loss by 2100 relative to 2015 averaged over all glacier models’ multi-GCM means varies from $23\pm 7\%$ (RCP2.6) to $42\pm 11\%$ (RCP8.5) indicating that glaciers will remain important contributors to global sea-level change beyond 2100. Global and regional rates of mass loss show large inter-annual variations with maximum rates (multi-GCM means, RCP8.5) from three models exceeding 3 mm sea-level equivalent yr⁻¹ around 2080. Projections vary considerably between glacier regions, and also among the glacier models.

2019 Highlights

A paper was published in the Journal of Glaciology presenting the results of the model intercomparison of previously published glacier projections (Hock et al., 2019). Results directly fed into the IPCC Special Report on the “Ocean and Cryosphere in a Warming Climate (SROCC)” where a modified version of one of the figures of the paper was included. GlacierMIP results were also presented at several conferences in 2019. A GlacierMIP meeting was held at the IUGG meeting in Montreal, Canada in July 2019.

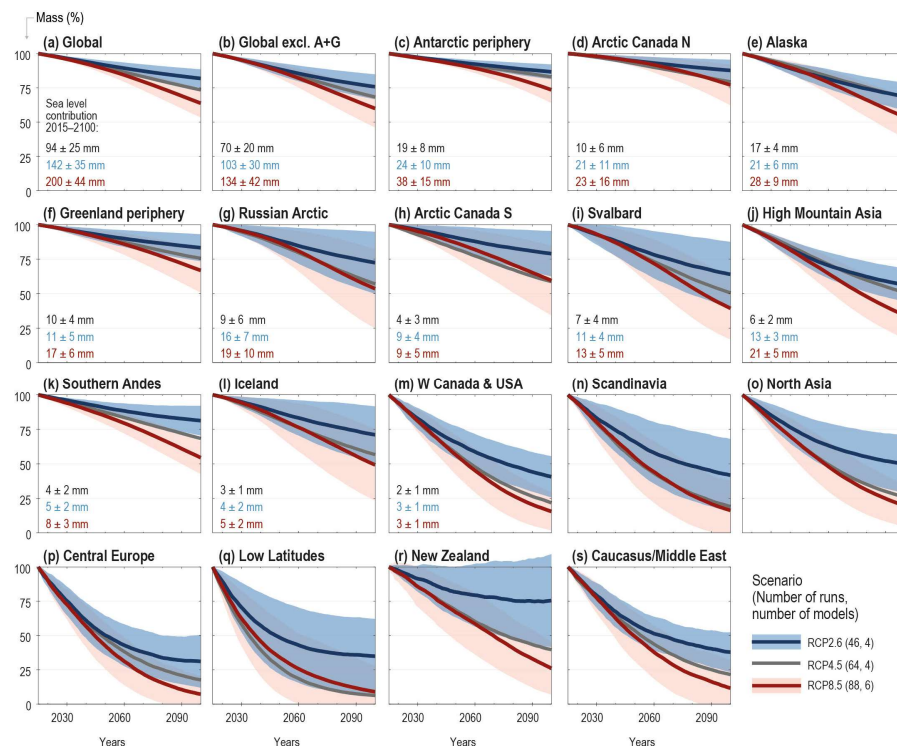


Figure from Hock et al, 2019

New glacier projections performed as part of GlacierMIP using standardized protocols have been submitted from eleven different glacier models and are currently analyzed.

Future activities and developments

Plans for a continuation of GlacierMIP are currently being developed

2019 Publications

Marzeion, B., R. Hock, B. Anderson, A. Bliss, N. Champollion, K. Fujita, M. Huss, W. Immerzeel, P. Kraaijenbrink, J-H. Malles, F. Maussion, Valentina Radic, D. R. Rounce, A. Sakai, S. Shannon, R. van de Wal, H. Zekollari, 2020. Partitioning the Uncertainty of Ensemble Projections of Global Glacier Mass Change. Earth's Future. *Submitted*

Hock, R., B. Marzeion, A. Bliss, R. Giesen, H. Hirabayashi, M. Huss, V. Radic and A. Slangen, 2019. GlacierMIP - A model intercomparison of global-scale glacier mass-balance models and projections. Journal of Glaciology, 65(251), 453-467. [doi:10.1017/jog.2019.22](https://doi.org/10.1017/jog.2019.22).

Webpage: <http://www.climate-cryosphere.org/mips/glaciermip>

Sea Ice and Climate Modeling Forum

Diagnostic Sea Ice Model Intercomparison Project (SIMIP)

Introduction

The CliC Sea Ice and Climate Modeling Forum contributes to a better understanding of the role of sea ice for the changing climate of our planet. To reach this aim, we coordinate large-scale model simulations and facilitate the exchange of modelers and observers through joint workshops.

Science Highlight

The Forum coordinated a community-wide effort to analyze the evolution of Arctic sea ice in CMIP6 model simulations. Based on this analysis, they have been able to show that the Arctic will likely become practically sea-ice free in summer before 2050 in all future emission scenarios.

2019 Highlights

Over the past year, the Forum primarily worked towards reaching the goals of our CMIP6 endorsed Sea Ice Model Intercomparison Project (SIMIP). Towards this aim, they organized a workshop on sea-ice modelling and analyses in connection with the IGS sea-ice workshop in Winnipeg on 18 August, which was joined by 24 participants.

Among others based on the results of this workshop, they coordinated the analyses and writing of a high-profile paper on Arctic sea ice in CMIP6 simulations, involving 30 scientists from the SIMIP community. The community-based approach was met with great enthusiasm and, in our view, resulted in a higher-quality paper than if the analyses had just been carried out by a small group of people.

Future activities and developments

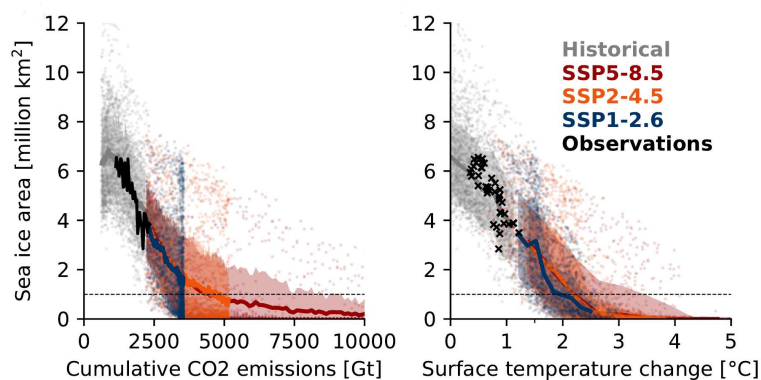
For 2020, the Forum expects a number of high-quality publications to arise from CMIP6-SIMIP. Three publications have been submitted in 2019, including a community paper. The further analyses of CMIP6 simulations will be guided through close interaction with the task teams that have formed within SIMIP over the past few years.

Publications submitted in 2019

Keen et al.: An inter-comparison of the mass budget of the Arctic sea ice in CMIP6 models, *The Cryosphere*, *under review*.

Roach et al: Antarctic sea ice in CMIP6, *Geophys. Res. Lett.*, *submitted*

SIMIP Community, Arctic sea ice in CMIP6, *Geophys. Res. Lett.*, *submitted*



September Arctic sea-ice evolution as a function of cumulative CO2 emissions and surface temperature change, modelled by CMIP6 models

Webpage: <http://www.climate-cryosphere.org/mips/simip>

Permafrost Carbon Network (PCN)

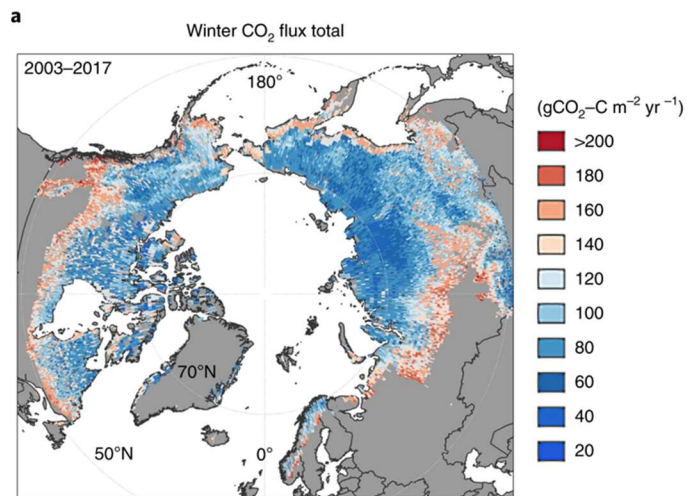
Introduction

The Permafrost Carbon Network facilitates synthesis of permafrost carbon science and communicates our current understanding to help society respond to a rapidly changing Arctic.

Science Highlights

2019 science highlights include:

- 1) a comment piece in Nature (Turetsky et al. 2019) showing that sudden collapse of thawing soils in the Arctic might double the warming from greenhouse gases released from tundra;
- 2) a synthesis of winter carbon dioxide emissions published in Nature Climate Change (Natali et al. 2019). The study provides a baseline for winter carbon dioxide emissions from northern terrestrial regions and shows that winter emissions can offset carbon gains during the growing season.



Average annual winter (October–April) CO₂ emissions estimated for the permafrost region for the baseline years 2003–2017 (Natali et al. 2019)

2019 Activities

The Permafrost Carbon Network hosted its 8th Annual Meeting in Washington, DC in December 2018 for 120 scientists. Members of the steering committee of the Permafrost Carbon Network participated and contributed to the Arctic Futures 2050 conference held in Washington, DC, in September of 2019.

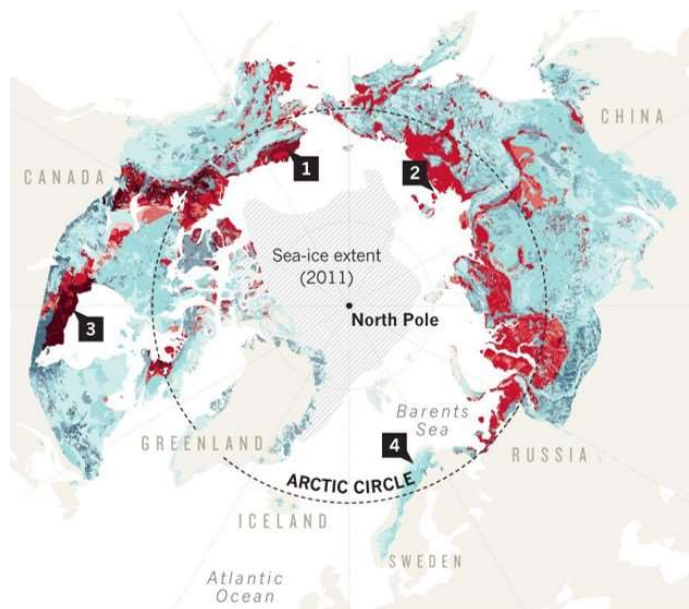
2019 Synthesis Publications

Natali SM, Watts JD, Rogers BM et al. 2019 Large loss of CO₂ in winter observed across the northern permafrost region, Nature Clim. Change, 1–6, [doi:10.1038/s41558-019-0592-8](https://doi.org/10.1038/s41558-019-0592-8), 2019.
Turetsky MR, Abbott BW, Jones MC, et al. 2019 Permafrost collapse is accelerating carbon release Nature 569 32. [doi:10.1038/d41586-019-01313-4](https://doi.org/10.1038/d41586-019-01313-4)

Future activities and developments

The Permafrost Carbon Network will meet for its 10th Annual Meeting in San Francisco, CA, December 2020. Synthesis leads and co-leads will present updates on synthesis activities and smaller breakout discussions in the afternoon will focus on individual syntheses as well as new emerging topics.

Website: www.permafrostcarbon.org



Rapid thawing (red colors) and gradual thawing (blue colors) in the northern permafrost zone (Turetsky et al. 2019)

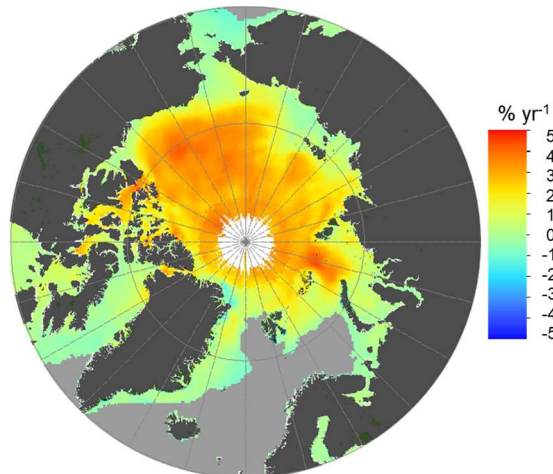
Sea Ice

Arctic Sea Ice Working Group (ASIWG)

Introduction

The goals of the Climate and Cryosphere Arctic Sea Ice Working Group are: i) Develop, standardize, and implement measurement protocols for Arctic sea ice in coastal, seasonal, and perennial ice zones; ii) Integrate surface-based observations with remote sensing and modeling efforts; and iii) Foster connections between international groups involved in sea ice observations, modeling, and remote sensing. The ASIWG has organized workshops, participated in programs, and produced documents addressing these goals.

Science Highlight



Estimated trends in solar heat input to the ocean through the ice and into leads. Results a synthesis of reanalysis products, satellite data, field results, and radiative transfer modeling.

2019 Highlights

ASIWG members are participating in the planning and execution of the sea ice portion of the MOSAic field campaign (Multidisciplinary drifting observatory for the Study of Arctic Climate). ASIWG members contributed to the Sea Ice Section of the Arctic Report Card and to the Sea Ice Prediction Network; and organized special sea ice sessions at the 2019 Fall Meeting of the American Geophysical Union; and the International Glaciological Society Symposium on Sea Ice. Ship based sea ice observations were made on science and tourist cruises using the ASSIST software package. Ice Watch fully transitioned to MET Norway. Coordination was facilitated between these activities.

2019 Publications

Richter-Menge, and others. 2019. The Arctic (in "State of the Climate in 2018"). Bull. Amer. Meteor. Soc. 100.
Gerland, S., D. Barber, W. Meier, C. J. Mundy, M. Holland, S. Kern, Z. Li, C. Michel, D. K. Perovich, and T. Tamura (2019), Essential gaps and uncertainties in the understanding of the roles and functions of Arctic sea ice, Environmental Research Letters, 14, doi.org/10.1088/1748-9326/ab09b3.



MOSAic field training in Utqiaġvik standardizing measurement protocols.

Future activities and developments

ASIWG will continue ongoing efforts with MOSAic, the Arctic Report Card, the Sea Ice Prediction Network, ASSIST software, and citizen scientist outreach. We are currently working on a transition plan for ASIWG leadership.

Webpage: <http://www.climate-cryosphere.org/activities/arctic-sea-ice-working-group>

Biogeochemical Exchange Processes at Sea Ice Interfaces (BEPSII)

Introduction

BEPSII is an open network for international knowledge exchange related to Biogeochemical Exchanges Processes at sea ice Interface. BEPSII aims to quantify the role of sea ice in polar ecosystem services – from biodiversity impacts to climate change – and communicate these globally-relevant issues. BEPSII is supported by the Surface Ocean Lower Atmosphere Study (SOLAS) and CliC as a long-lived activity, and received endorsement from SCAR in 2016 as well as workshop support from IASC.

BEPSII currently includes five Work Packages:

- (i) the SCOR working group ECV-ICE (methodologies);
- (ii) technology & data collation;
- (iii) modelling & observational process studies;
- (iv) synthesis;
- (v) outreach.

2019 Activities

In 2019 BEPSII completed a number of activities including the publication of science papers and the organization of workshops, such as:

- a 3-day workshop on Inter-comparison of 1D sea-ice biogeochemical models, May 15-17, 2019, in Paris (8 scientists participated);
- 3-day workshop in conjunction with the International Glaciological Society's Sea ice Symposium, August 16-18, 2019, in Winnipeg, in August;
- a synthesis paper: The future of Arctic sea-ice biogeochemistry and ice-associated ecosystems by Delphine Lannuzel et al., submitted to Nature Climate Change;
- an ice optics inter-comparison experiment (Saroma Lake, Hokkaido, Japan, Feb'19; D. Nomura et al.);
- a new eddy-covariance technique for CO₂ fluxes over sea ice (Butterworth & Else, AMT 2019);
- a revised sea ice phase composition diagram (M. Vancoppenolle et al., JGR'19) (see below);
- some progress on 1D sea ice biogeochemistry model intercomparison (L. Tedesco et al.);
- the hiring of 2 Early Career Scientists (Odile Crabeck, Giulia Castellani).

Future activities and developments

(a) For 2020, BEPSII plans to:

- o conduct gas intercomparison experiments (Roland von Glasow ice chamber, University of East Anglia)
- o continue the model intercomparisons;
- o host an online meeting;
- o prepare the Early Career Researchers field school;
- o conduct the analysis for the Antarctic Sea ice systems;
- o prepare a journal article on sea-ice ecosystem services.

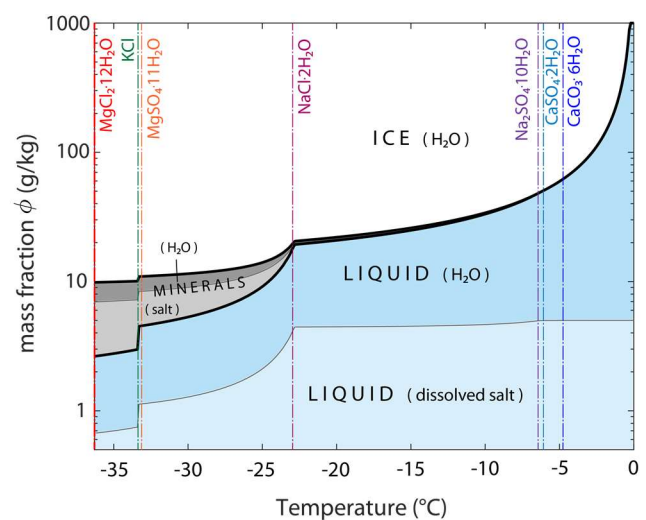
(b) On the longer term, BEPSII will:

- o produce an Ecosystem Services synthesis paper
- o hold the BEPSII Field School (Cambridge Bay, Canada, Spring 2021)
- o organize the BEPSII cruise.

Webpages:

BEPSII: <https://sites.google.com/site/bepsiiwg140/home>

ECV-ICE: <https://sites.google.com/view/ecv-ice/>



Revised sea ice phase composition diagram
(M. Vancoppenolle et al., JGR'19)

Antarctic Sea Ice Processes and Climate (ASPeCt)

Introduction

ASPeCt is an expert group on multi-disciplinary Antarctic sea ice zone research with the key objective of improving our understanding of the Antarctic sea ice zone and its response to climate change. This understanding is to be achieved through focused field programs, systematic monitoring of the ice cover, analysis of remote sensing and numerical modelling.

2019 Science Highlight

The South African programme undertook two cruises into the Antarctic sea-ice zone. ASPeCt underway data were collected, in situ measurements taken of the sea ice and autonomous instruments deployed on the sea ice. The Australian AFIN project completed a successful field campaign at Casey Station (East Antarctica), which coincided with the final deployment of NASA's Operation IceBridge [OIB] – with a coincident target area. The field project focused on collecting in situ measurements on sea ice and the glacial ice sheet for the validation of ICESat-2 data.

2019 Activities

ASPeCt sponsored one of the sea ice sessions at the IGS Sea Ice Symposium: 'Snow on sea ice: Processes and effects on sea-ice thickness.' ASPeCt also held a side-meeting before the IGS Symposium to discuss progress on ASPeCt's goals since the meeting in Davos (2018) and planned for the SCAR 2020 meeting in Hobart. CliC provided funds to support the attendance of three ECRs plus the ASPeCt Chair. ASPeCt's efforts to increase participation in its sea ice observation programme as its contribution to YOPP was very successful over the 2018-2019 season. Eight voyages have reported back to have collected ASPeCt data. These data will be quality controlled before being added to the ASPeCt database and YOPP archives.

2019 Publications (led by Southern Ocean Observing System and contributed to by ASPeCt)

Newman L., Heil P., Trebilco R., Katsumata K., Constable A., van Wijk E., Assmann K., Beja J., Bricher P., Colemans R., Costa D., Diggs S., Farneti R., Fawcett S., Gille ST, Hendry K.R, Henley S., Hofmann E., Maksym T., Mazloff M., Meijers A., Meredith M.M, Moreau S., Ozsor B., Robertson R., Schloss I., Schofield O., Shi J.X, Sikes E., Smith I.J, Swart S., Wahlin A., Williams G., Williams M.JM, Herraiz-Borreguero L., Kern S., Liesers J., Massom R.A, Melbourne-Thomas J., Miloslavich P., Spreen G. (2019) Delivering Sustained, Coordinated, and Integrated Observations of the Southern Ocean for Global Impact. *Front. Mar. Sci.*, 08 August 2019 | <https://doi.org/10.3389/fmars.2019.00433>

Sebastian Swart, Sarah T. Gille, Bruno Delille, Simon Josey, Matthew Mazloff, Louise Newman, Andrew Thompson, Tim Thomson, Brian Ward, Marcell D. du Plessis, Elizabeth C. Kent, James Girton, Luke Gregor, Petra Heil, Patrick Hyder Luciano Ponzi Pezzi, Ronald Buss de Souza, Veronica Tamsitt, Robert A. Weller and Christopher J. Zappa. Constraining Southern Ocean Air-Sea-Ice Fluxes Through Enhanced Observations *Front. Mar. Sci.*, 31 July 2019 | <https://doi.org/10.3389/fmars.2019.00421>

Future activities and developments

ASPeCt has begun a process of visualization of its current database in order to increase the accessibility of the data and to publicize its existence – expected completion date of the initial phase is April, 2020. ASPeCt plans to continue quality control of new data input into its database. ASPeCt has continued to actively enlist cruises going into the ice zone in order to increase contributions to the ship sea ice observation database. ASPeCt is using DUE SOUTH to access information on upcoming cruises. This is successful because more PIs are entering their upcoming cruise information in to the DUE SOUTH database. ASPeCt is continuing the development of the ASPeCt ship-based observation system and database for sea ice measurements taken by remote vessels (airborne and under ice), ship-based instruments and surface-based instruments and sampling.

Website: <http://aspect.antarctica.gov.au/>

Ice Sheets

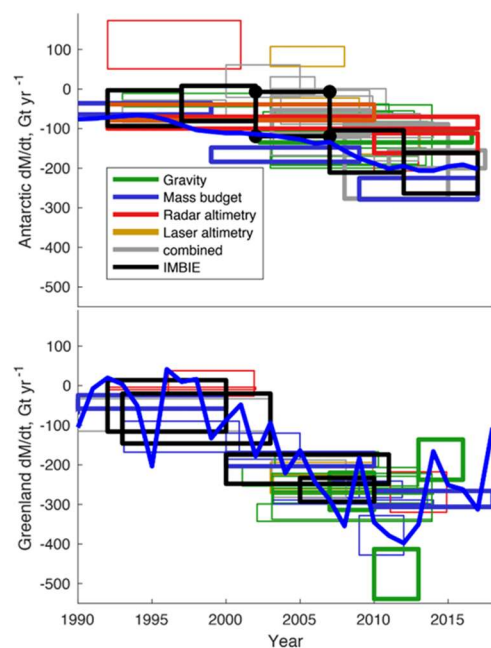
Ice Sheet Mass Balance and Sea Level (ISMASS)

2019 Science Highlight I

Hanna, E, F Pattyn, F Navarro, V Favier, H Goelzer, MR van den Broeke, M Vizcaino, PL Whitehouse, C Ritz, K Bulthuis, B Smith (2020) Mass balance of the ice sheets and glaciers—progress since AR5 and challenges. Earth-Science Reviews, 102976

<https://doi.org/10.1016/j.earscirev.2019.102976>

This article is the outcome of the ISMASS workshop held in Davos in June 2018. Title: “Update on mass balance of Greenland and Antarctica (linkages between data and models)”.



Mass rates for the Antarctic (top) and Greenland (bottom) ice sheets derived from published studies. The horizontal extent of each rectangle indicates the period that each estimate spans, while the height indicates the error estimate. Studies published between 2011 and 2017 are shown within the lines, studies published in 2018 and early 2019 with heavier lines. The colour of the lines indicates the type of estimate used, and any estimate that is based explicitly on more than one technique is treated as a ‘combined’ estimate. The IMBIE (Shepherd et al., 2012 for Greenland, Shepherd et al., 2018 for Antarctica) estimates are shown in black. Rectangles are over plotted with annual mass balance estimates from Rignot et al. (2019) for Antarctica and Mouginit et al. (2019) for Greenland, to indicate inter-annual variability.

2019 Science Highlight II

ISMASS is dedicated to both Arctic and Antarctic and is supported by SCAR, CliC, and IASC. The following information does not directly concern Antarctica but Greenland. However, the tools are common for both ice sheets. ISMASS promoted an intercomparison project (SMBMIP, also in the framework of ISMIP6) which is being led by Dr. Xavier Fettweis (University of Liege, Belgium) and is evaluating regional climate model (RCM), positive degree day (PDD) and global climate model (GCM) estimates of surface mass balance (SMB) for the Greenland Ice Sheet, with the goal of forcing ice sheet models with reconciled information from SMB models. The first results were presented at AGU in December 2018, and an updated analysis/synthesis was submitted as a journal paper in advance of the IPCC AR6 submission deadline (31 December 2019).

2019 Science Highlight III

Pattyn, F., C. Ritz, E. Hanna, X. Asay-Davis, R. DeConto, G. Durand, L. Favier, X. Fettweis, H. Goelzer, N.R. Gollidge, P. Kuipers Munneke, J.T.M. Lenaerts, S. Nowicki, A.J. Payne, A. Robinson, H. Seroussi, L.D. Trusel, M. van den Broeke (2018) The Greenland and Antarctic ice sheets under 1.5°C global warming. *Nature Climate Change* 8, 1053-1061. <https://www.nature.com/articles/s41558-018-0305-8>

This article is a review paper on the contribution of Greenland and Antarctic ice sheets to future sea level under a 1.5°C warmer climate (in line with the Paris Agreement). The study concludes it is important to limit global warming by 2100 to 1.5°C to maximise the chance of avoiding so-called tipping points that would dramatically accelerate mass loss. It is the direct outcome of the workshop organised by ISMASS in Brussels from 11-13 January 2017.

Future activities for 2020

Frank Pattyn and Guðfinna Aðalgeirsdóttir (representing ISMASS) will co-host a CliC-sponsored (with SCAR and IASC) session on Ice sheet mass balance and sea-level: ISMASS/ISMIP6”, initially planned for Spring 2020.

The session explores improvements in understanding and quantification of past, present and future ice sheet and sea-level changes. While the focus is on present and future (multi-centennial) Greenland and Antarctic ice sheets, paleo-studies are encouraged if they shed light on above topics.

Regional Activities

SCAR/IASC/CLiC Southern Ocean Region Panel (SORP)

Panel overview

The SORP is co-sponsored by WCRP's core projects CLIVAR and CLiC, and the Scientific Committee on Antarctic Research (SCAR). The SORP serves as a forum for the discussion and communication of scientific advances in the understanding of climate variability and change in the Southern Ocean. It advises CLIVAR, CLiC, and SCAR on progress, achievements, new opportunities and impediments in internationally-coordinated Southern Ocean research.

During 2019 highlights of SORP activities were: (i) SORP co-organized a session at the IGS Sea Ice Symposium; (ii) members of the panel participated at the OceanObs'19 Conference; (iii) the SORP co-chairs are co-authors on the CLIVAR-led OceanObs'19 conference whitepaper; and (iv) eight current, immediate-past, and ex-officio panel members are co-authors of the OceanObs'19 conference whitepaper related to Southern Ocean observations.

Achievements for 2019

SORP, together with NORP, co-organized a session at the IGS Sea Ice Symposium in 19-23 August, 2019 at Winnipeg, Canada. The session mixed Arctic and Antarctic modeling and observational research and it was a great success in terms of talks and posters.

Extensive participation in international research coordination and collaboration has occurred with several relevant programmes, including the Southern Ocean Observing System (SOOS), the Ocean Observations Panel for Climate (OOPC), Antarctic Sea-ice Processes and Climate (ASPeCt, which is co-sponsored by CLiC and SCAR) and the Year of Polar Prediction Southern Hemisphere (YOPP-SH).

The panel has four new members (Katy Altieri, Ronald Souza, Michiyo Yamamoto-Kawai, and Neil Swart) and an ex-officio representative of SOOS (Matt Mazloff).

National reports were obtained from 11 countries for 2018 so far, which allowed SORP to see opportunities for further cooperation in the Southern Ocean. All national reports can be downloaded from the SORP website (<http://www.clivar.org/clivar-panels/southern/national-representatives>).

Besides having an early career scientist among its panel members (F. Massonnet), early career scientists have been recruited for some of the National Representative roles. These roles are separate to full panel membership, and provide capacity building by involving more early career scientists in SORP activities than is possible with the strict fourteen member panel membership. F. Massonnet is due to rotate off SORP at the end of 2019, so SORP plans to recruit a new early career researcher to the main panel to replace him. SORP members are also active in other activities while representing SORP. e.g., Sandra Barreira was invited as a lecturer at the ninth ODC (UNESCO/IOC Regional Training and Research Center on Ocean Dynamics and Climate) training course on climate dynamics and air-sea interactions in June 2019.

Plans for 2020 and beyond

For 2020, SORP will recruit three new panel members to replace Heimbach, Klepikov and Massonnet. SORP will encourage early-career scientists' applications to replace one or more panel members. Targeted nominations will be considered in order to maintain and expand the skills acquired and focus on the panel needs, following CLIVAR policies and considering geographical and gender balance.

Articles published in 2019 as part of panel activities

Newmann, L., P. Heil, R. Trebilco, K. Katsumata, A. J. Constable, E. van Wijk, K. Assmann, J. Beja, P. Bricher, R. Coleman, D. Costa, S. Diggs, R. Farneti, S. Fawcett, S. T. Gille, K. R. Hendry, S. F. Henley, E. Hofmann, T. Maksym, M. Mazloff, A. J. Meijers, M. P. Meredith, S. Moreau, B. Ozsoy, R. Robertson, I. R. Schloss, O. Schofield, J. Shi, E. L. Sikes, I. J. Smith, S. Swart, A. Wahlin, G. Williams, M. J. Williams, L. Herraiz-Borreguero, S. Kern, J. Lieser, R. Massom, J. Melbourne-Thomas, P. Miloslavich, G. Spreen (2019), Delivering sustained,

coordinated and integrated observations of the Southern Ocean for global impact. Proceedings of OceanObs'19, Frontiers in Marine Science. [doi:10.3389/fmars.2019.00433](https://doi.org/10.3389/fmars.2019.00433)

Stammer, D., A. Bracco, L. Beal, N. Bindoff, P. Braconnot, W. Cai, D. Chen, G. Danabasoglu, B. Dewitte, R. Farneti, K. Takahashi Guevara, B. Fox Kemper, J. Fyfe, S. Griffies, S. Jayne, R. Mathew Koll, A. Lazar, M. Lengaigne, X. Lin, S. Marsland, P. Monteiro, W. Robinson, R. Rykaczewski, S. Speich, I. J. Smith, A. Solomon, J. Vialard (2019), Ocean climate observing requirements in support of climate research and climate information. Proceedings of OceanObs'19, Frontiers in Marine Science. [doi:10.3389/fmars.2019.00444](https://doi.org/10.3389/fmars.2019.00444)

Website: <http://www.clivar.org/clivar-panels/southern>

CLIVAR /CliC Northern Oceans Region Panel (NORP)

Panel overview

NORP serves as an international forum for coordinating and strategizing activities on the role of the Arctic Ocean in the context of the global climate system from a coupled perspective. NORP facilitates progress in the development of tools and methods to monitor and assess climate variability and change, and evaluate climate predictability of the ocean-atmosphere-ice system in the Arctic and Subarctic Ocean. NORP coordinates efforts to enhance the ability to monitor the coupled system, understand the driving mechanisms of the system change from a coupled process perspective, and predict the evolution of the emerging New Arctic climate. NORP plays a central role in coordinating, monitoring, and evaluating the progress of such activities during and beyond the Year of Polar Prediction.

NORP co-chair Fyfe stepped down at the beginning of 2019 and Ruth Mottram replaced him as the new co-chair.

Achievements for 2019

- Contributions to OceanObs19 white paper on “Ocean climate observing requirements in support of Climate Research and Climate Information”.
- Co-organizing for pre-AGU Workshop on Freshwater Fluxes from the Greenland Ice Sheet.
- Co-convening sessions for 2019 IGS Sea Ice Symposium on “Sea ice, ocean and climate connections in the Northern Oceans and the Southern Oceans”.
- Co-convening 2019 AGU Annual Meeting sessions on “Sea Ice–Ocean–Atmosphere Interactions in the “New” Arctic and Southern Oceans” and “Extratropical and High-latitude Storms, Teleconnections, Extreme Events, and the Rapidly Changing Polar Climate”.
- Co-convening 2019 EGU Annual Meeting session on “Changes in the Arctic Ocean, sea ice and subarctic seas systems: Observations, Models and Perspectives”.
- Presentations on NORP activities at US CLIVAR Summit, IASC Annual Meeting, FAMOS Annual Meeting, CLIVAR SSG, and CliC Annual report-out.
- Monthly telecons with reports of international Arctic collaborations and campaigns, updates on scientific studies, planning for future activities.
- Planning for NORP Bootcamp Summer School tentatively to be held in Helgoland, Germany in Summer 2021.
- Planning for GOOS/GCOS workshop on heat and freshwater transport and storage in models and observations initially planned to be held in Exeter, UK in April-May 2020.

Plans for 2020 and beyond

- 2nd NORP Panel Meeting
- AGU 2020 sessions on “Sea Ice–Ocean–Atmosphere Interactions in the “New” Arctic and Southern Oceans” and “Extratropical and High-latitude Storms, Teleconnections, Extreme Events, and the Rapidly Changing Polar Climate”.
- Plan NORP 2021 Summer School in coordination with NORP MOSAiC activities to:
 - learn/improve big data management skills; from writing the algorithm to visualizing the results;
 - get an Earth system perspective by working with students from a different topic;
 - improve critical skills: know why models are not perfect and how to detect biases;
 - provide an introduction to current MIPs and SSPs.
- Write white paper on sea-ice ocean metrics for lower-latitude-Arctic interactions for CMIP diagnostics.
- Work with national representatives to secure support for Arctic ocean-sea ice state estimates.
- Advance studies on Greenland ice sheet – ocean interactions: Advocate for inclusion in CMIP7 and Sea level call in Horizon2020.

- Coordinate archiving/mirroring of past/future campaign/in-situ data for assimilation and analysis: Coordinate with CLIVAR Global Synthesis and Observations Panel.
- Continue monthly telecons.

Articles published in 2019 as part of panel activities

Stammer D, Bracco A, AchutaRao K, Beal L, Bindoff NL, Braconnot P, Cai W, Chen D, Collins M, Danabasoglu G, Dewitte B, Farneti R, Fox-Kemper B, Fyfe J, Griffies SM, Jayne SR, Lazar A, Lengaigne M, Lin X, Marsland S, Minobe S, Monteiro PMS, Robinson W, Roxy MK, Rykaczewski RR, Speich S, Smith IJ, Solomon A, Storto A, Takahashi K, Toniazzo T and Vialard J (2019) Ocean Climate Observing Requirements in Support of Climate Research and Climate Information. *Front. Mar. Sci.* 6:444. [doi: 10.3389/fmars.2019.00444](https://doi.org/10.3389/fmars.2019.00444)

Website: <http://www.clivar.org/clivar-panels/northern>

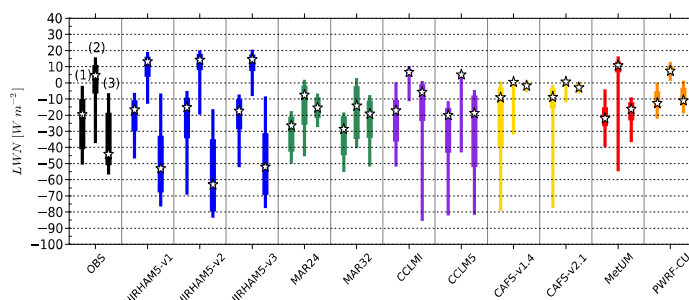
Polar CORDEX

Introduction

Polar CORDEX focuses on both Arctic and Antarctic RCM simulations.

Science Highlight

Swings in surface net longwave radiation (LWN) are consistent with advection of warm, moist air trapping a low, liquid-bearing cloud layer, followed by a drying and subsequent low-cloud dissipation. The simulations also reveal distinct transitions between the three periods, although to various degrees. Critical to the processes driving the surface energy balance is that most models did not transition to large LWN deficits, reflective of clear or intermittently cloudy skies, during the post-event period as indicated in the observations.



Observed and modeled percentile ranges of LWN for 3 one-week periods pre, during, post warm, moist advective event during ACSE2014 campaign.

2019 Highlights

The annual Polar CORDEX meeting scientific presentations focused on following key topics:

- (i) Surface mass balance of Greenland and Antarctic ice sheets - changes and key drivers. According model inter-comparisons have been accomplished. Simulated recent and future climate change over the Antarctic Peninsula region were presented.
- (ii) Coupled modeling, its challenges and benefits. For the Arctic, results from atmosphere-ocean models with respect to cyclones and their feedbacks, and improved model physics have been presented. The intra-annual prediction of Arctic sea ice is a promising new capability. For Antarctica, efforts towards coupling the atmosphere with ocean and ice sheet components have been presented.
- (iii) Model evaluation. Studies over Greenland and near Svalbard were presented. For the Arctic Ocean, a multi-model intercomparison with the ACSE2014 campaign data has been accomplished. Arctic and Antarctic sea-ice lead data sets have been compiled.
- (iv) Challenges of high-resolution downscaling: Impacts of sea-ice forcing, different physics, resolution, uncertainty assessment, methods to select CMIP6 models.

2019 Publication

Sedlar et al., 2020: Confronting Arctic troposphere, clouds and surface energy budget representations in regional climate models with observations, JGR Atmospheres, <https://doi.org/10.1029/2019JD031783>

Future activities and developments

Coordinated high-resolution simulations for MOSAiC. Contribution to IPCC AR6 Regional Atlas.

Webpage: www.climate-cryosphere.org/activities/targeted/polar-cordex

Inter-disciplinary Activities

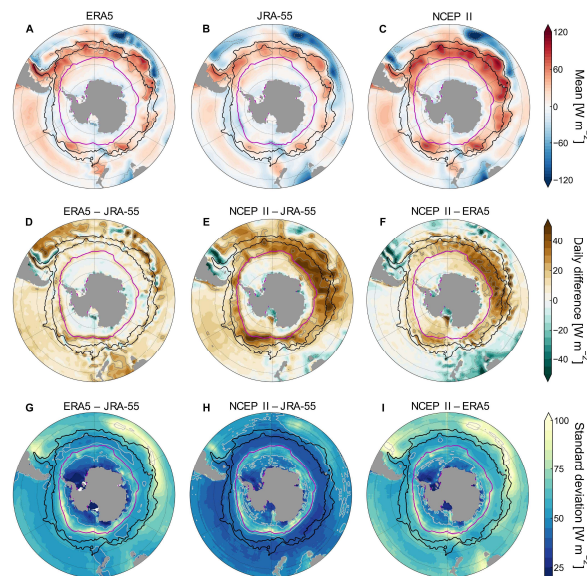
Polar Climate Predictability Initiative (PCPI)

Introduction

PCPI aims to advance understanding of the sources of polar climate predictability on timescales ranging from seasonal to multi-decadal. PCPI is concerned with the success of modelling and observing the changes seen in the Arctic and the Antarctic. PCPI works jointly with the Polar Prediction Project of the WWRP on mutual interests, though our focus is at the longer timescales.

Science Highlight

Reanalysis air-sea heat fluxes differ substantially between different products, both in their means and in their variability. These differences highlight the lingering uncertainties in air-sea exchange that may impede climate predictability, particularly at high latitudes, where the ocean is able to take up significant quantities of heat and CO₂. An expanded flux observing system, with more in situ measurement sites and strategic use of satellite observations, could increase our understanding of the physics driving air-sea exchanges and improve our data records (Swart et al 2019).



(A–C) The 10-year (2008–2017) mean net heat flux ($W m^{-2}$) for three reanalysis products: ERA5, JRA-55 and NCEP-II. (D–F) The 10-year mean difference in daily net heat flux (in $W m^{-2}$) between the products. (G–I) Standard deviation of the daily differences (in $W m^{-2}$) shown in panel (D–F). Positive (negative) values denote a heat flux into (out of) the ocean.

2019 Highlights

PCPI participated in the AntClim21 workshop ‘CMIP6 21st Century projections and predictions for Antarctica and the Southern Ocean’, British Antarctic Survey, June 2019. The aim of this workshop was to help ensure that the Antarctic and Southern Ocean climate science communities make a significant contribution to the IPCC AR6, an aim which fits well with that of PCPI. A PCPI meeting was held at the 27th IUGG General Assembly, in July 2019, to discuss ideas for future PCPI activities and development.

Future activities and developments

PCPI discussed reorganization of the structure of the initiatives to better reflect the current membership, and to align with the progress of scientific ideas around Polar Climate Predictability since the original structure was developed. In 2020 PCPI will continue this reorganization and plan for activities (workshops, etc.) to advance the goals of the new structure. This will be done through online meetings and science meetings of opportunity.

Webpage: <http://www.climate-cryosphere.org/wcrp/pcpi/background>

2019 CliC Meetings & Workshops

15th Session of the CliC SSG available, December 14-15, 2019, San Francisco, USA

The CliC SSG met on December 14-15, 2019, at the Hyatt Centric Fisherman's Wharf Hotel in San Francisco, in conjunction with the AGU Fall Meeting, and funded by WCRP. Thirty-three participants (25 in person; 8 remotely) working in thirteen different countries attended the meeting. The meeting was co-chaired by CliC Co-Chairs James Renwick and Fiamma Straneo and WCRP Officer In Charge Mike Sparrow. The meeting participants discussed the ongoing CliC activities, interactions with other organizations and the future of CliC.



CliC SSG 15 report available at: http://www.climate-cryosphere.org/media/com_hwdmediashare/files/c9/27/82/7e4e6e7a9cb488e19766afd3f8ce464b.pdf

9th Annual Meeting of the Permafrost Carbon Network, December 8, 2019, San Francisco, USA

--From the Permafrost Carbon Network Newsletter

The 9th Annual Meeting of the Permafrost Carbon Network, held the day prior to AGU 2019 in San Francisco, was so far the largest all scientist meeting with 130 participants. In the morning, the synthesis leads and co-leads gave short presentations about ongoing and new synthesis activities. A number of new exciting ideas for syntheses were proposed (e.g. fire and permafrost, isotopes in permafrost, and mercury release with permafrost thaw) and many ongoing syntheses are nearing completion. Stay tuned for updates. The afternoon was split into 1) a general breakout discussion round in which each group compared possible outcomes of permafrost ecosystems considering different cumulative permafrost carbon emission scenarios. 2) the second breakout round focused on individual synthesis topics that had been introduced in the morning.

Polar Coordinated Regional Downscaling Experiment (CORDEX) Annual meeting, October 7-9, 2019, Copenhagen, Denmark

--Contributed by Annette Rinke, John Cassano, and Andrew Orr

The annual Polar CORDEX meeting took place at the Danish Meteorological Institute (DMI) in Copenhagen on October 7-9, 2019. About 30 participants actively participated. The meeting was opened by a keynote on the role of regional climate modeling in the IPCC and we discussed the actual regional climate projection contributions to the upcoming AR6 report. For this, the status of both the Arctic and Antarctic CORDEX community was summarized - what has been done so far, common projects and papers. The scientific presentations were focussed on following key topics:
(i) Surface mass balance of Greenland and Antarctic ice



sheets. Their changes and key drivers were discussed based on different models, and model intercomparisons have been accomplished. Simulated recent and future climate change over the Antarctic Peninsula region were also presented.

(ii) Coupled modeling and its challenges and benefits. For the Arctic, results from atmosphere-ocean models with respect to cyclones and their feedbacks, and improved model physics and model optimization have been presented. The intra-annual prediction of Arctic sea ice is a promising new capability. For Antarctica, efforts towards coupling of the atmosphere with ocean and ice sheet have been presented.

(iii) Model evaluation. Studies over Greenland and near Svalbard were presented. For the Arctic Ocean, the comparison with the ACSE2014 campaign data includes a multi-model intercomparison. Arctic and Antarctic sea-ice lead data sets have been compiled.

(iv) Challenges of high resolution downscaling. Impacts of sea-ice forcing, different physics and resolution, uncertainty assessment and methods to select CMIP6 models have been discussed. The status of the upcoming high resolution Arctic regional reanalysis CARRA has been presented.

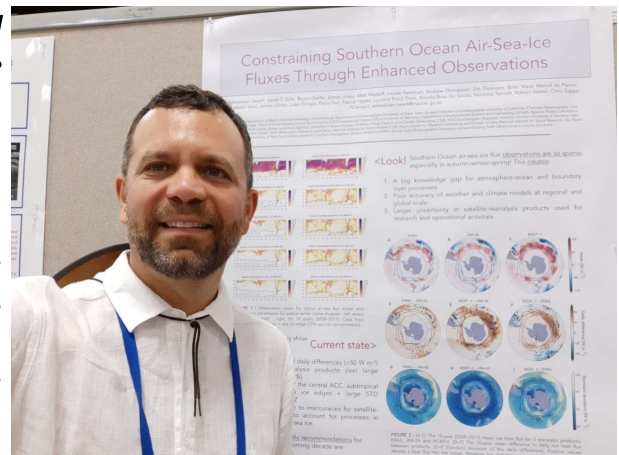
Finally, potential future developments of Polar CORDEX were discussed. This includes the contribution of Arctic CORDEX to MOSAiC and YOPPsiteMIP.

CliC representation at OceanObs'19, September 16-20, 2019, HI, USA

CliC funded two representatives from the CLIVAR/CliC/SCAR Southern Ocean Region Panel, Robin Robertson and Ronald Buss de Souza, to participate in the OceanObs'19 Conference in Hawaii in September. They share their experience below.

Ronald Buss de Souza, Center for Weather Forecast and Climate Studies (CPTEC), National Institute for Space Research (INPE), Brazil:

'OceanObs'19 was a great forum to meet, interact and make plans for future collaborations with colleagues from all around the globe. I was particularly interested in learning more about how my international partners are collaborating in order to expand their observational efforts in the fields of marine meteorology and air-sea interaction. When at the conference, as well as attending the conference sessions, I had the privilege of presenting a poster authored by Dr. Sebastiaan Swart and collaborators



resuming the Southern Ocean Observing System, Air-Sea Fluxes Task Group's more recent efforts. The paper, entitled "Constraining Southern Ocean Air-Sea-Ice Fluxes Through Enhanced Observations" (Front. Mar. Sci. 6:421, [doi: 10.3389/fmars.2019.00421](https://doi.org/10.3389/fmars.2019.00421)), suggests that we should build up a Southern Ocean observing system to produce air-sea-ice flux data aiming to provide continuous measurements and diminish uncertainties in our flux estimates.'

Robin Robertson, Xiamen University, Malaysia:

'Generally, my research is focused on wind and tidal mixing and I have done lots of research in the Antarctic. At OceanObs19, there was very little on turbulence or mixing at the meeting. Prof. Rob Pinkel wrote a white paper, but turbulence was deemed to be not mature enough to be included. I publicly objected to this. Additionally, the Antarctic and Southern Ocean were included in the Polar session and lost out to the Arctic, understandable as it is the Year of Polar Prediction (YOPP), which seems to be Arctic focused. We should address this in the next OceanObs meeting in 10 (or 5) years in Qingdao by having one or more breakout sessions on the Southern Ocean AND the Antarctic.'

Despite this, I had an extremely productive meeting. Probably the most applicable development for the general Southern Ocean and Antarctic community was the priority to fill in the gaps in the existing data coverage. They mentioned the ocean east of Africa, but the Southern Ocean and the Antarctic are big gaps, especially spatially in the coastal regions and/or ice covered areas and temporally during spring and winter. And there was significant information about the UN Decade of Ocean Science for Sustainable Development and the ocean research being carried out in China. I found the breakout sessions more productive than the plenaries and panel discussions, which tended to be a bit vague. There is a lot of movement on data availability and end user engagement. Integrating with the modelers was a priority, which as a modeler who does observations was of great encouragement to me. So despite the first paragraph, I had a very productive meeting in many different aspects: saw new instruments and vehicles for instrument deployment, talked to Jules Hummon about ADCP processing, attended several Early Career Functions as a mentor, had several discussions about future collaborations, etc.'

CliC Co-sponsor of the International Glaciological Society's Sea ice Symposium, August 19-23, 2019, Winnipeg, Canada

CliC co-sponsored the IGS Sea Ice Symposium held in Winnipeg in August and provided funding for 3 workshops organized in conjunction with the Symposium (see below). The IGS co-hosts a sea ice symposium every 5 years. The Centre for Earth Observation Science (University of Manitoba) hosted the first IGS event held in Canada. The symposium included oral and poster sessions, and provided a friendly and intellectually stimulating environment to facilitate face-to-face interactions and networking. Sea ice plays a critically important yet highly dynamic role in global climate, polar marine ecosystems, globalization, and Indigenous cultures. The theme of this event focused on the implications that changes to sea icescapes and freshwater-marine coupling particularly involving ice sheets, glaciers, ice shelves, sea ice loss and continental runoff have on climate systems within and beyond polar regions, environmental and ecological integrity, and socioeconomic development at the regional to global scales.

Biogeochemical Exchange Processes at the Sea Ice Interfaces (BEPSII) Meeting in conjunction with the International Glaciological Society's Sea ice Symposium, August 16-18, 2019, Winnipeg, Canada

--Contributed by Martin Vancoppenolle

BEPSII is an open network for international knowledge exchange related to sea ice biogeochemistry.

The 2019 BEPSII (Biogeochemical Exchange Processes at the Sea Ice Interfaces) meeting took place this year in Winnipeg, on the side of the IGS sea ice symposium, from August 16 to 18. The workshop spanned three days, split into activities related to each of the five BEPSII's task groups, including (i) the SCOR working group ECV-ICE focused on methodologies, (ii) technology & data collation, (iii) modelling & observational process studies, (iv) synthesis and (v) outreach. Highlights of this year include inter-comparison field & lab experiments in Japan and UK focused on ice optics and gases; the development of a new eddy-covariance technique to measure CO₂ fluxes over sea ice (Butterworth and Else, Atmos Meas. Tech. 2019); finalization of a synthesis paper dedicated to outline the impacts of upcoming sea ice changes on biogeochemistry and ecosystems; discussions around a possible sea ice ecosystem services synthesis; and progresses around two model inter-comparison exercises.



Perspectives for BEPSII were also discussed. Key items included plans for an upcoming field school (possibly scheduled for 2021 in Cambridge Bay, Canada), plans for a specific BEPSII cruise, the involvement of early-career scientists, and revision of our 5-year plan.

Antarctic Sea-ice Processes and Climate (ASPeCt) Meeting in conjunction with the International Glaciological Society's Sea ice Symposium, August 18, 2019, Winnipeg, Canada

--Contributed by Marilyn Raphael

The ASPeCt expert group held a three-hour side-meeting at the International Glaciological Society's Sea ice Symposium in Winnipeg, Manitoba in August 2019. A representative subset of the group (20 -25 members) attended the meeting including several Early Career scientists whose attendance was supported by CliC.



The meeting began with updates and news including the outcome of ASPeCt's YOPP effort, the Japanese Antarctic Program and the Polarstern Weddell Sea expedition this year. These were excellent examples of the progress of ASPeCt-related science. A proposal for a drifting project of Polarstern in the northwestern Weddell Sea as a repeat but updated ISPOL (Ice Station POLarstern) 2004 observations.

The updates were followed by some extensive discussion on optimizing ASPeCt's web presence (website, Twitter), updating the ASPeCt database and encouraging scientific use of the data as well as encouraging use of the Due South planning tool.

The rest of the meeting focused on three main topics: 1. ASPeCt's planned workshop in 2020 – The workshop's theme, timing and duration were discussed. Coordination with other groups with shared interests, e.g BEPSII and SOOS was also discussed. 2. Identifying critical Antarctic sea ice areas for targeted observations in the next 5 – 8 years 3. ASPeCt's science objectives for the next 5 – 10 years. Proposed ideas include development of a protocol on snow measurements on (Antarctic) sea ice, autonomous observations of sea ice and snow and a focus on modelling. These three topics were discussed extensively and the main points of the discussion have since been distributed to the larger group. It is anticipated that with further online discussion, the details of the workshop will soon be finalized and decisions on identifying sea ice areas for targeted observations as well as ASPeCt's science objectives will be taken at the workshop.

Sea Ice Modeling Intercomparison Project (SIMIP) Meeting in conjunction with the International Glaciological Society's Sea ice Symposium, August 18, 2019, Winnipeg, Canada

--Contributed by Alexandra Jahn and Dirk Notz

A successful and very lively and informative half-day SIMIP workshop was held before the IGS Sea Ice Symposium in Winnipeg. The workshop was live-streamed, and 24 people attended in person and 5 online, with 2 of the remote participants presenting at the workshop. Five of the in-person participants received partial travel support from CliC to attend the workshop.



The workshop was designed as a mix of short research presentations and updates from targeted analysis groups established at the last SIMIP workshop and discussions. We started with a welcome and an update on SIMIP by the SIMIP chairs, Alexandra Jahn and Dirk Notz, including the sea ice CMIP6 data currently available on the CMIP6 archives and the deadline for paper submissions and acceptance for inclusion in the next IPCC report (December 31st 2019 and September 30th 2020, respectively).

Dirk Notz then updated everyone on the plans for a SIMIP community paper, which has the goal to summarize the overall sea ice state in CMIP6 and the change to CMIP5, authored by the SIMIP community. It has the goal to establish how sea ice loss is represented in CMIP6, so that individual scientists can focus on the more interesting in-depth and process-based analysis. This update was followed by discussions on the SIMIP paper, in terms of what kind of analysis should be included. This was followed by 4 short presentations on new CMIP5/CMIP6 results, which were well received and represented some of the first CMIP6 sea ice analysis shared.

The activity leads from the targeted analysis efforts established at the 2017 SIMIP workshop then were invited to present updates on progress and plans under their activities. We had 10 groups provide updates, either in person or by sending slides or written updates, and all had very interesting results and plans to share, which sparked many discussions.

After a short break, we then heard short presentations on new observational data sets that can be used for climate model evaluation, in particular focused on ice thickness datasets. This was followed by a discussion to revise the SIMIP community paper, to solicit further feedback after all the updates and some of the new CMIP6 results were shared. The workshop was followed by a no-host lunch at a local place, attended by 12 participants, providing an opportunity to continue conversations.

Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6) Meeting in conjunction with the 27th International Union of Geodesy and Geophysics General Assembly, July 14, 2019, Montreal, Canada

--Contributed by Sophie Nowicki

The Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6) held a workshop on July 14th 2019 in Montreal, Canada, in conjunction with the International Union of Geodesy and Geophysics (IUGG) General Assembly. The workshop's goal was to review and finalize the experimental framework for projections of the Greenland and Antarctic ice sheet's contribution to sea level change. The focus was on experiments with ice sheet models that are driven offline from output from CMIP5 climate models, as well as simulations from CMIP6 coupled ice-sheet climate models. The meeting was attended by 25 participants with expertise in ice sheet modeling, climate modeling, polar ocean and polar atmosphere. The meeting was organized by the ISMIP6 steering committee, with travel support from WCRP CliC.



As ISMIP6 reaches its final stage, topics that were presented and discussed include: A review of the ISMIP6 effort and what we are learned from our first set of experiments of ice sheet model initialization (initMIP efforts). A review of the CMIP5 climate model selections, and how changes in the atmosphere and ocean characteristics translate into atmospheric and oceanic forcing for standalone ice sheet models. Initial submissions to the suite of core ISMIP6 projections for the Greenland and Antarctic ice sheets were presented and guided the discussion the next suite of experiments (targeted) for standalone ice sheet models. Simulations from CMIP6 coupled ice sheet-climate models (CESM and UKESM) were also presented. The next phase of ISMIP6 was discussed, which included topics such as how to include simulation with CMIP6 climate models as these become available, as well as publication strategy.

Glacier Modelling Intercomparison Project (GlacierMIP) Meeting in conjunction with the 27th International Union of Geodesy and Geophysics General Assembly, July 13, 2019, Montreal, Canada

--Contributed by Ben Marzeion

Eight participants attended the GlacierMIP meeting in person and one remotely. Ben Marzeion, GlacierMIP Co-chair, presented a first glimpse at the GlacierMIP2 results: the ensemble is large (~200 individual runs from 10 different glacier models) and coordination was generally successful (i.e., good coverage of the prioritized CMIP5 runs). Some seemingly unrealistic results of individual glacier models were taken up with the individual groups. Some results were subsequently updated/corrected/questions clarified.



For IPCC AR6, experiments additional to these already collected will be very useful. In particular, everybody who can do so was asked to provide additional runs based on the CMIP6 ensemble. Since this ensemble is

small, but constantly growing, a decision on which ensemble member to prioritize needs to be taken later. For this purpose, a telecom is envisioned in fall 2019. The results of these runs do not have to be included in the submission of the GlacierMIP2-paper, but can be accepted by IPCC as an update. To address issues of response time scale (which may become a focus of glaciers in AR6), equilibrium experiments (of probably a smaller ensemble of glacier models) will be helpful.

There is strong agreement that GlacierMIP was a successful endeavor so far and should be prolonged if possible. The foci of a second phase should include

- equilibrium experiments at different climate states
- reconstructions of glacier change
- detection & attribution experiment
- sensitivity analyses of model physics
- separation of parameter and climate (forcing) uncertainty

A group was tasked with preparing a proposal for prolongation of GlacierMIP within this year.

Polar Climate Predictability Initiative Meeting in conjunction with the 27th International Union of Geodesy and Geophysics General Assembly, July 11, 2019, Montreal, Canada

--Contributed by Julie Jones

This meeting was the second of two held this year to allow new PCPI members to meet face to face with long-term members. In this case new member Alex Jahn met with Julie Jones and Gareth Marshall. The meeting of subsets of its members at scientific meetings is part of the strategy employed by PCPI to supplement online meetings. We had a productive meeting discussing ideas for future PCPI activities and development. This meeting built on the first one held in Cambridge in June 2019.

CliC provided the PCPI with funds to support the attendance of Alex (an ECR) which enabled her participation in the IAMAS symposium at the IUGG, where she co-convoked a session (Past and Future Changes in Polar Climate System and their Global Linkages), and presented in the session 'Atmosphere-Ocean-Sea Ice Interactions: Local Processes and Global Implications'. Julie (who also received CliC support) and Gareth also presented, and all three benefited from attending many PCPI relevant sessions/presentations.

PCPI participation in the AntClim21workshop 'CMIP6 21st Century projections and predictions for Antarctica and the Southern Ocean', June 26-28, 2019, British Antarctic Survey, Cambridge, UK

--Contributed by Julie Jones

The aim of this workshop was to help ensure that the Antarctic and Southern Ocean climate science communities make a significant contribution to the IPCC 6th Assessment Report (AR6), an aim which fits well with that of PCPI. CliC funded the attendance of four PCPI members at this workshop: Lettie Roach and Marisol Osman (both ECRs and new members of PCPI), and Marilyn Raphael and Julie Jones. PCPI member Gareth Marshall also attended the workshop. Marilyn presented results from her work on Antarctic sea ice representation in a CMIP6 model, Marisol on 'Revision of the contribution of external forcings to the Southern Annular Mode trend, and Lettie on 'The influence of nonlinear physical

AntClim21 workshop on CMIP6 21st century projections and predictions



Aurora Conference Theatre
British Antarctic Survey, Cambridge

19th June 2019



processes on the seasonal cycle of Antarctic sea ice'. Marisol also chaired the introduction to the poster presentations.

The meeting was also an opportunity for the new and established PCPI members to meet in person, and they had a productive meeting to develop ideas for future PCPI activities.

9th International Workshop on Sea Ice Modelling, Data Assimilation and Verification, June 17-19, 2019, Bremen, Germany

--Contributed by Frank Kauker

A joint workshop of the International Ice Charting Working Group (IICWG), the Year of Polar Prediction (YOPP – the flagship activity of the Polar Prediction Project by the World Weather Research Programme (WWRP)), GODAE Oceanview (GOV) and the Coordination & Support Action KEPLER by the European Commission was organized on June 17-19, 2019 hosted by the Alfred Wegener Institute at “Haus der Wissenschaften” in Bremen, Germany.



The workshop builds on a series of successful workshops organized by the IICWG Data Assimilation Working Group to advance international capabilities for automated sea ice analysis and prediction on time scales from hours to a season. The focus of the workshop is to discuss cross-cutting issues in sea ice modelling and data assimilation and how deficiencies of current systems can be more efficiently diagnosed and addressed.

General topics considered appropriate for this workshop include (i) sea ice data assimilation (methods and results), (ii) sea ice observations and uncertainties, (iii) sea ice model parametrizations and coupling to ocean and atmosphere models, (iv) verification approaches for sea ice analyses and forecasts, (v) automated prediction systems. The workshop, as the precursors of the last years, was organized around presentations with ample time for discussion (30min) and a poster session. Altogether 65 people participated in the work shop and listened to 37 talks and looked at 20 posters. As in the years before the oral presentations and posters stimulated intensive discussions in the audience. One participant working on seasonal sea ice predictions summarized the workshop: “This workshop is a platform to discuss all ingredients necessary for my work from in-situ and remotely sensed observations to modelling development and advancement in data assimilation techniques”.

ClIC sponsored the workshop through granting travel support. The next work shop in this series, the 10th, is scheduled for autumn 2020.

BEPSII Workshop on Inter-comparison of 1D sea-ice biogeochemical models, May 15-17, 2019, Paris, France

--BEPSII is a ClIC/SCAR/SOLAS/IASC activity

--Contributed by Letizia Tedesco

The BEPSII WS was held at LOCEAN, Paris on 15-17 of May 2019 and aimed to finalize BEPSII Task 3.3, i.e. the inter-comparison of 1-D sea-ice biogeochemical models. During the morning of the first day of the WS, every modelling group gave their updates on their modelling configurations and interests in the inter-comparison. Available time-series to serve the inter-comparison were once again discussed: the Resolute time series (Canadian Arctic, Mortenson et al., 2017, Elementa) and the N-ICE refrozen lead time-series (Svalbard area, Duarte et al., 2016, JGR) and model results already achieved were presented by each group. Issues (scientific and technical)



and scientific goals were discussed and plenty of hands-on session led everyone to finalize most of the runs by the end of the workshop. The WS closed Day 3 afternoon by setting a new roadmap (first, skype call in June 2019), defining a table of content for a collaborative paper (to be submitted for the special issue of Annals of Glaciology for the IGS on Sea Ice) and setting a tentative timeline to write the draft (November and December 2019) and present the work at the IGS Symposium on Sea Ice in August 2019 in Winnipeg, Canada.

CliC co-sponsor of the ESA Living Planet Symposium 2019, May 13-17, 2019, Milan, Italy

--From the LPS19 website

The event, held every three years, took place on 13–17 May 2019 at the MiCo Milano Congressi in Milan, Italy. The Symposium was organised with the support of the Italian Space Agency. CliC was one of the many co-sponsors of the event. Attracting thousands of scientists and data users, ESA's Living Planet Symposia are amongst the biggest Earth observation conferences in the world. The event did not only see scientists present their latest findings on Earth's environment and climate derived from satellite data, but also focused on Earth observation's role in building a sustainable future and a resilient society. Participants were also able to explore how emerging technologies are revolutionising the use of Earth observation, creating new opportunities for public and private sector interactions, and how business and the economy can benefit from this new epoch.



40th Session of the WCRP Joint Scientific Committee (JSC), May 6-10, 2019, Geneva, Switzerland

--From the June 2019 WCRP Newsletter

The 40th Session of the WCRP JSC brought together over 80 attendees, including the WCRP JSC, the chairs and leaders of the WCRP Core Projects and activities, international project office directors and staff, WCRP Joint Planning Staff, WCRP sponsor representatives, and selected partners and guests.

One of the main tasks of the Session was to seek community input into the implementation of the WCRP Strategic Plan, following on from the Implementation and Transition Meeting (see article above). In addition, a number of strategic issues were discussed, such as the future of the Coupled Model Intercomparison Project (CMIP), WCRP regional activities, the future of the CCI/WCRP/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI) and the fast-emerging topics of machine learning and data mining. This was followed by two days of updates from WCRP Core Projects and activities and briefings from a number of WCRP's key partners.

On Wednesday 8 May, the World Meteorological Organization and WCRP jointly organized a Public Science Lecture, which included a lecture by Professor Thomas Stocker on "The Climate of Tomorrow: Building the Knowledge for Earth Stewardship" and panel discussions.

On the last day, the JSC elected from among its members three Officers who will be tasked with supporting the Chair and Vice-Chair in their duties. The elected officers are Pascale Braconnot, Jens Hesselbjerg Christensen, and James (Jim) Hurrell. Congratulations to each of you and thank you for your commitment to WCRP.

CliC Co-Chair James Renwick, Melting Ice and Global Consequences Grand Challenge Chair Tim Naish, and CliC Executive Officer Gwenaelle Hamon participated in the meeting.



WCRP Implementation and Transition Meeting, May 4-5, 2019, Geneva, Switzerland

--From the June 2019 WCRP Newsletter

This first meeting of the WCRP Community to discuss the implementation of the WCRP Strategic Plan 2019–2028 was attended by representatives drawn from across the WCRP community. Participants were tasked with developing and agreeing on the process of production of a WCRP Implementation Plan and the transition to a new structure of operating within WCRP. Outcomes of the meeting were reported to the subsequent JSC Session (see above). CliC Co-Chair James Renwick and Melting Ice and Global Consequences Grand Challenge Chair Tim Naish participated in the meeting.



Arctic Subarctic Ocean Flux (ASOF) study meeting, April 24-26, 2019, Copenhagen, Denmark

--Contributed by Michael Karcher

The yearly Arctic Subarctic Ocean Flux (ASOF) study meeting on 24 -26 April 2019, co-sponsored by CliC, was hosted at the Danish Meteorological Institute (DMI) in Copenhagen, jointly with the H2020 project 'Blue-Action' which is coordinated at DMI. The focus topics for this year's meeting were:

1. Representativeness of ocean observations: A recurring issue in the analysis and interpretation of observational data, as well in the use of these data for model validation and data assimilation, is how their representativeness in space and time are dealt with. This issue is of particular relevance for in-situ data such as oceanic measurements from profiling devices or time series data from mooring locations. We particularly welcomed submissions dealing with questions related to representativeness and uncertainties in observations, what these mean for the observational analysis as well as the usefulness of the data in modelling, and ways forward in resolving those issues in particular in regions of sparse data coverage.



2. Flux calculations: We had fostered a discussion the problems related to the usefulness/ambiguity of heat- and freshwater flux calculations across single gateways. Can we agree on a way forward?

We had 45 participants joining the meeting, with 34 presentations. In addition to presentations and discussion on the two focus topics we had numerous contributions on core ASOF topics, such as reports on the current status of the gateway moorings, new insights into the dynamics of ocean circulation and exchange between the basins, as well as Ocean-Sea Ice interaction. We gratefully acknowledge the travel support for three early career scientists by CliC, Stefanie Semper from the University of Bergen, Norway, Myriel Horn from the Alfred Wegener Institute for Polar Research, Germany, and Marylou Athanase from

L'OCEAN at the Université Sorbonne, France. In addition, thanks to the 'Blue Action' project, two experts on data representativeness in the context of data assimilation and ocean climatologies could be invited, An Nguyen from the University of Texas Austin, USA, and Viktor Gouretsky from the Institute for Atmospheric Physics, Beijing, China.

ESM-SnowMIP Meeting at EGU2019, April 11, 2019, Vienna, Austria

--Contributed by Richard Essery

A meeting to discuss ESM-SnowMIP was held on April 11 during EGU 2019, with 20 people in attendance. Richard Essery, Gerhard Krinner and Hyungjun Kim presented progress and plans.

Simulations for 10 reference sites have been submitted by 27 models and 2 ensembles driven with in situ data, and 22 models driven by bias-corrected global data.

An overview paper has been published. A paper documenting the reference site driving and evaluation data is in review, and the data are freely available. Work is now in progress to interpret the results for non-forested sites led by Cécile Ménard, for forested sites led by Paul Bartlett, and for large-scale forcing at reference sites led by Richard Essery.

Global coupled simulations for CMIP6 and global uncoupled simulations for LS3MIP are now underway in major modelling centres. Because of the high demands of these simulations, the requests for additional constrained ESM-SnowMIP simulations will be delayed until they are complete. It has been decided that the SnowMIP-rmLC prescribed snow experiment should be performed in coupled land-atmosphere configurations to avoid extreme hydrological impacts on circulation in coupled land-atmosphere-ocean models.

Additional site simulations can be performed at much lower cost by a wider range of models. A decision will be made whether to prioritise constrained simulations (prescribed constant snow albedo, prescribed neutral exchange coefficient, no soil insulation) or additional reference sites (to include more challenging ice sheet, tundra and prairie locations) in the next round of experiments.

ISMIP6 workshop at EGU2019, April 10, 2019, Vienna, Austria

--Contributed by Heiko Goelzer

The Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6) brings together a consortium of international ice sheet models and coupled ice sheet-climate models to fully explore the sea level rise contribution from the Greenland and Antarctic ice sheets. In this workshop we discuss first results from projections with standalone ice sheet models and coupled climate-ice sheet models.

Participants: Helene Seroussi, Heiko Goelzer, and Ayako Abe Ouchi from the ISMIP6 Scientific Steering Committee, ~25 modellers and other interested people.

Helene Seroussi opened with a short, general introduction on ISMIP6 to include people that were not familiar with the project. Then Heiko Goelzer presented some preliminary results from his Greenland model for all the models/scenarios currently available as a teaser for expected results. Afterwards was plenty of time to address general and specific questions from the audience and present modellers. The most

important points discussed were:

- Some modellers asked for more and more regular updates, e.g. when new data becomes available and when files on the ftp change. The contacts identified per expression of interest should be included in regular updates on what is going on. The estimation is that at this moment more emails to those people is better than less.
- In turn, a lack of clarity on who is doing what at the moment was identified. Demand for more communication in both directions is therefore an important conclusion of this meeting.
- Versioning and full transparency when files change/move on the ftp was seen as a crucial aspect for the tight schedule everybody is operating with now.
- An estimate in the room of how many groups will try to submit results by the 1 June deadline was ~10 for Greenland and ~8 for Antarctica.
- It was often expressed that the deadline was very sharp and it seems that it may not be observed by many groups. It was made clear that it is possible to soften the deadline, but the goal is still to aim for it.
- Some questions came about the initial state vs 2014 starting point/ mini historical that could be resolved.

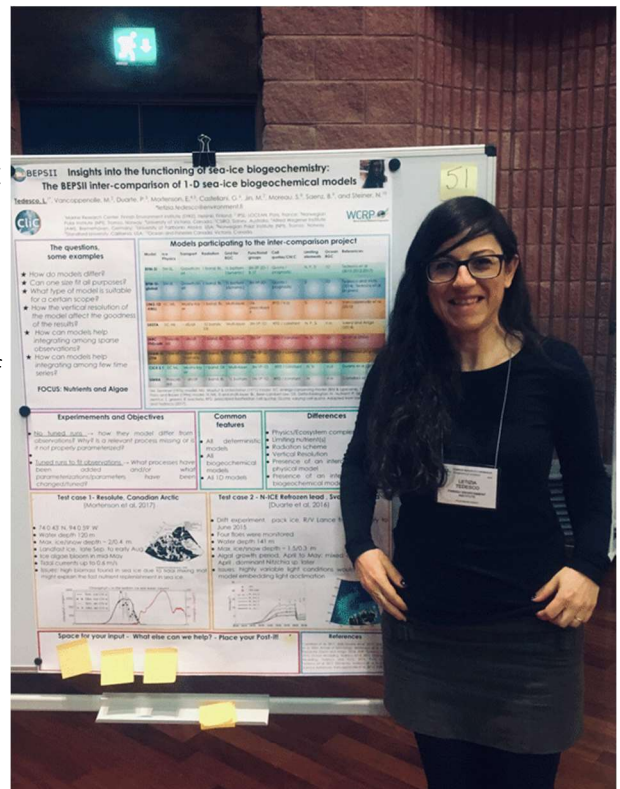
The overall impression was that people are happy to contribute and have taken on the challenge to getting their models ready. It seems that only a few groups are relying on the initMIP state, while the rest try to re-initialise.

BEPSII Meeting and Poster, at the GRC on Polar Marine Science, March 18-23, 2019, Barga, Italy

--Contributed by Letizia Tedesco

During the GRC on Polar Marine Science that was held at Il Ciocco Resort (Barga, Italy) on 18-23 of March, BEPSII SC members Letizia Tedesco and Klaus Meiners organized an open and informal BEPSII get-together for new and old members. About 15-20 people met over lunch on Wednesday on a sunny Tuscan terrace and continued discussing during a nice walk down the medieval village of Barga, where some of them also stopped in a cafe before returning back uphill to the conference site. The lunch and walk together gave the possibility to several people to meet for the first time, to get to know better what BEPSII is and does and to initialize new discussions and collaborations.

During the GRC also BEPSII representative Letizia Tedesco presented on Wednesday afternoon the BEPSII Intercomparison of 1D sea-ice biogeochemical models, one of the many BEPSII tasks. Besides supporting Letizia's participation to the GRC, CliC supports the intercomparison experiment by having funded an initial international workshop that was held at (SYKE) Helsinki in November 2017, and by co-founding the final international workshop that will be held in 15-17 of May at LOCEAN (Paris).



8th Session of the WCRP Data Advisory Council (WDAC-8), March 18-21, 2019, Marrakesh, Morocco

--From the WCRP website

The 8th session of the WCRP Data Advisory Council (WDAC) was hosted at the Es Saadi Marrakesh Resort, Marrakesh, Morocco on 18-21 March 2019, in conjunction with the GCOS-WCRP Joint Panels and the CEOS/CGMS WG Climate the same week.

The Council reviewed progress on important activities such as, but not limited to, data infrastructures, climate data set assessment, fluxes, reanalysis, impact of observations, and seek updates on observational and data requirements from WCRP core projects, modeling activities and sister programs. The session also considered major upcoming meetings, wider observations and data strategic questions, and linkages to climate services and associated key players in the context of the new WCRP Strategic Plan. CliC SSG member Hiroyuki Enomoto represented CliC at the meeting.





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