

Climate and Cryosphere Project (CliC) of the World Climate Research Programme (WCRP)

Understanding the changing cryosphere and its climate connections

Lawrence Hislop
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Tromsø, Norway
Twitter: @CliC_WCRP
Facebook: Climate and Cryosphere



www.climate-cryosphere.org

Presentation Outline

- Governance + Strategy
- CliC 2017 activities (Grand Challenge)
- CliC + WMO Polar initiatives
- Plans for 2018



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Host



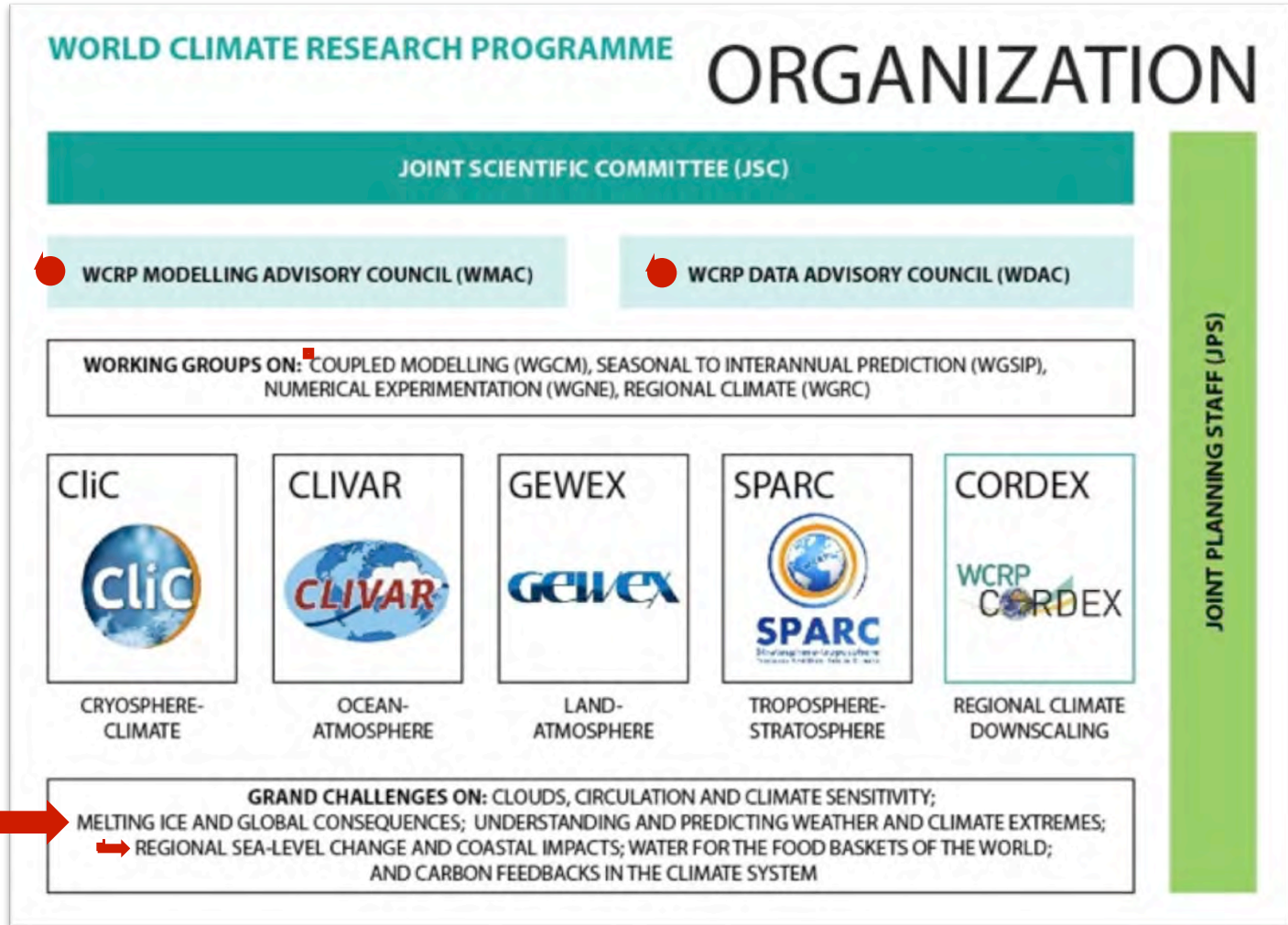
2003 - 2018

Sponsor



= Climate and Cryosphere project

WCRP Today



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What we do

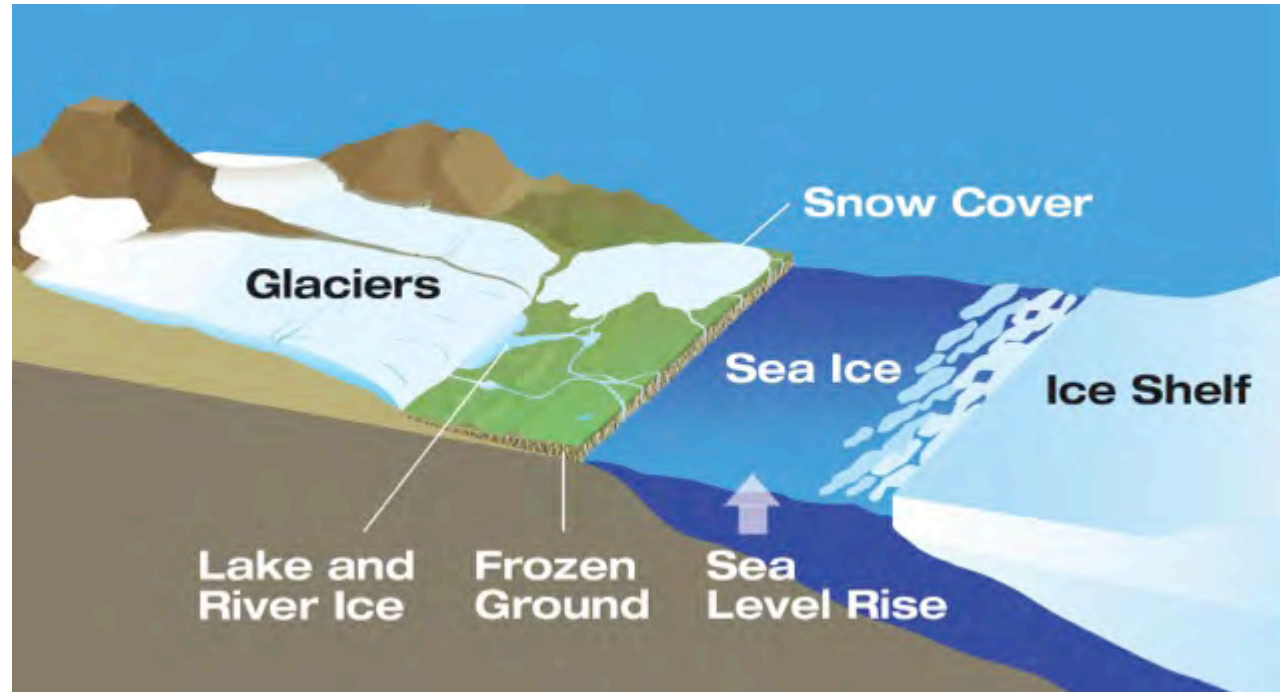
- Improve understanding of the **cryosphere** and its interactions with the **global climate system**
- Improve the ability to make quantitative **predictions and projections** of the cryosphere in a changing climate
- Link **observation and modelling** communities



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Domains

- Sea Ice
- Ice Sheets
- Glaciers
- Permafrost
- Snow cover
- Freshwater



Governance

Scientific Steering Group (12):

James Renwick (Co-Chair, New Zealand)

Gerhard Krinner (Co-Chair, France)

Hiroyuki Enomoto (Japan)

Stephen Hudson (Norway)

Alexandra Jahn (USA)

Margareta Johansson (Sweden)

Shichang Kang (China)

Rob Massom (Australia)

Sebastian Mernild (Chile)

Tatiana V. Pavlova (Russia)

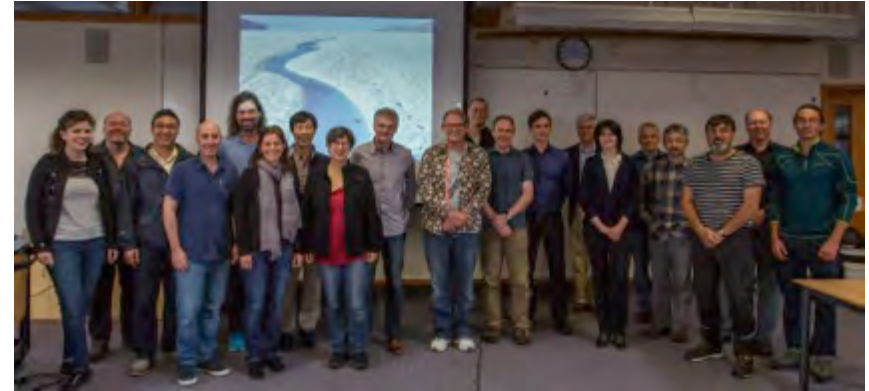
Lars H. Smedsrud (Norway)

Dario Trombotto Liaudat (Argentina)



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SSG 13, Wellington 2017



SSG 12, Copenhagen 2016



Next SSG: Polar18 (June)

Governance

International Project Office – Norway

Lawrence Hislop

Gwen Hamon



WCRP JPS Liaison Mike Sparrow, CliC Co-Chairs Gerhard Krinner, Greg Flato (former), James Renwick (new), CliC Executive Officer Gwénaëlle Hamon, and CliC Director Lawrence Hislop at the WCRP JSC Meeting in Geneva, April 2016

Incoming co-chair 2018

Fiamma Straneo



Physical Oceanography. Work has focused on the North Atlantic and Arctic high latitudes, Greenland, ice sheet - ocean interactions.

- Woods Hole Oceanographic Institution
- Scripps Institution of Oceanography



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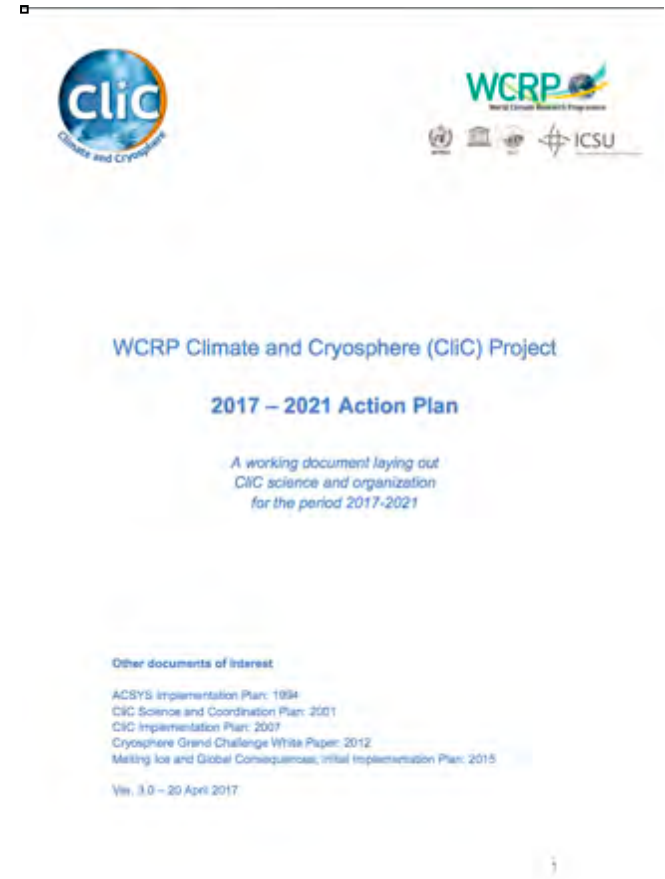
CliC Action Plan

Four General Science Themes

- **Observing** the Cryosphere
- Physical **Processes** and Dynamical Understanding
- **Modelling** the Cryosphere
- Global and Regional **Prediction** and Predictability



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15 pages 😊

Observing the Cryosphere

Key questions

- What are the magnitudes, patterns and rates of change in terrestrial cryosphere regimes on seasonal-to-century time-scales? **What are the associated changes in the water cycle and carbon cycles?**
- What are the present mean states, natural variability, and recent trends in sea-ice mass, seasonality of coverage and other characteristics in both hemispheres? What remote and in-situ techniques are best used to determine sea ice volume?
- How did and do mountain glaciers and permafrost react to recent and ongoing climate change? How far are they out of balance today?
- How, why and where do the major ice sheets vary over time scales from years to millennia? What is the magnitude of current trends in ice sheet mass?
- How much carbon is available in frozen ground and in frozen marine sediments?
- How can the climate modeling community use the available cryospheric observations over a wide range of time and space scales?



CliC Projects

Scientific Steering Group (SSG)

Co-chairs:

Gerhard Krinner (2014-2017)

James Renwick (2017-2019)

International Project Office

Director: Lawrence Hislop

Executive Officer: Gwénaëlle Hamon

Hosted by the Norwegian Polar Institute

Modelling - WCRP Grand Challenge

- 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
- Permafrost Carbon Network (part of the Study of Environmental Arctic Change (SEARCH) project)

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

Groups, Panels, and Fora

- Polar Climate Predictability Initiative (PCPI) (joint with SPARC)
- Southern Ocean Region Panel (joint with CLIVAR and SCAR)
- 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 & Climate Modelling Forum

Limited Lifetime Targeted Activities

- Polar Coordinated Regional Downscaling Experiment (Polar CORDEX)
- Arctic Freshwater Synthesis
- Southern Ocean Satellite Requirements
- Where Are They Now?
- Interactions Between High-latitude Cryosphere Elements
- Earth Observations and Arctic Science Needs (with ESA)
- Linkage Between Arctic Climate Change and Mid-Latitude Weather Extremes

Melting Ice and Global Consequences



How will melting ice respond to, and feedback on, the climate response to increasing greenhouse gases, and what will the impacts be?

The focus is on the profound global consequences of cryosphere melting. The most pressing of these involve:

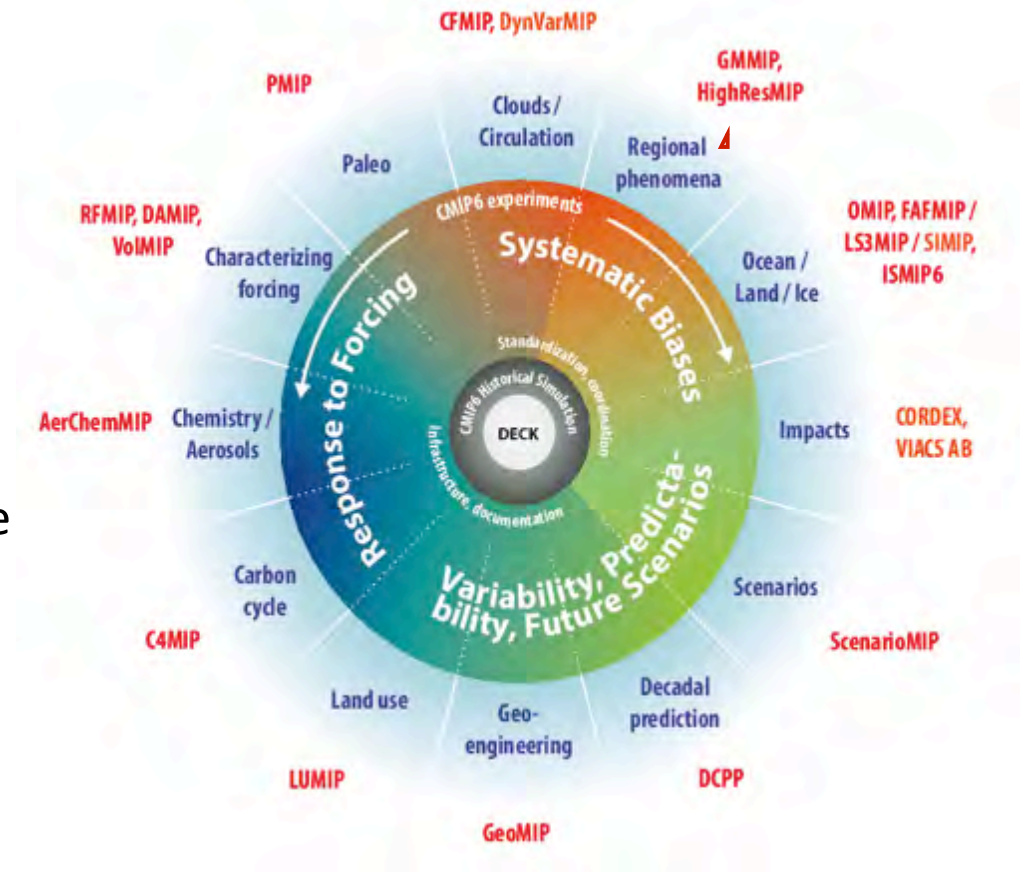
- Permafrost and the global carbon cycle
- Ice sheets, glaciers and rising sea level
- Sea ice and snow interacting with a changing climate



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Modelling - CMIP6

- How does the Earth system respond to forcing?
- What are the origins and consequences of systematic model biases?
- How can we assess future climate changes given internal climate variability, predictability, and uncertainties in scenarios?



Modelling (CMIP6)

- ESM-SnowMIP - Earth System Model-Snow Model Intercomparison Project (part of LS3MIP)
- SIMIP - Sea Ice Model Intercomparison Project
- ISMIP6 - Ice Sheet Model Intercomparison Project
- GlacierMIP - Glacier Model Intercomparison Project

*Permafrost Carbon Network (PCN)



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

- ESM-SnowMIP is an extension to LS3MIP focusing on the evaluation of the representation of snow in global and dedicated process models.
- Consists of site-scale simulations designed at evaluating the quality of the models at small scales.
- Site simulations will be analysed in detail during the next year, with good reasons to expect rapid publication of the main results.

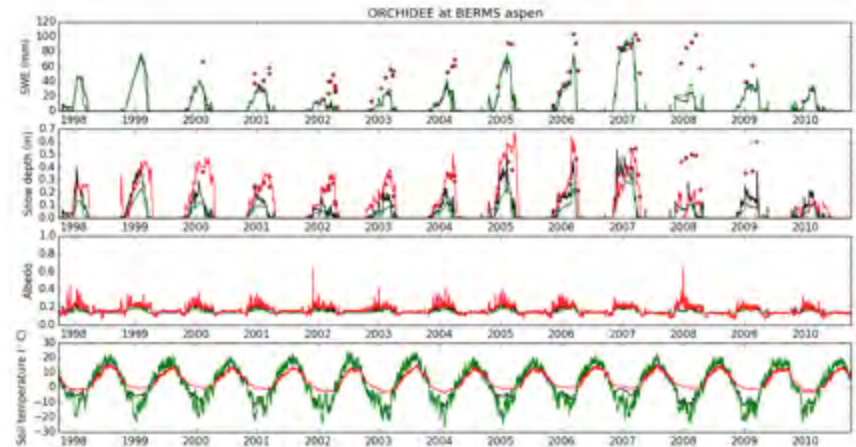


Figure 1. A preliminary evaluation of recently obtained model output at some selected snow sites immediately allowed to identify unrealistic model features, here underestimated winter soil temperatures in one version of the ORCHIDEE land surface model.

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GlacierMIP

A model intercomparison of global-scale glacier models

- Focused on all glaciers in the world outside the ice sheets.
- Provides a framework for a coordinated intercomparison of global-scale glacier mass change models.
- Fosters model improvements and reduce uncertainties in global glacier projections
- Workshop in Wellington, Feb 2017

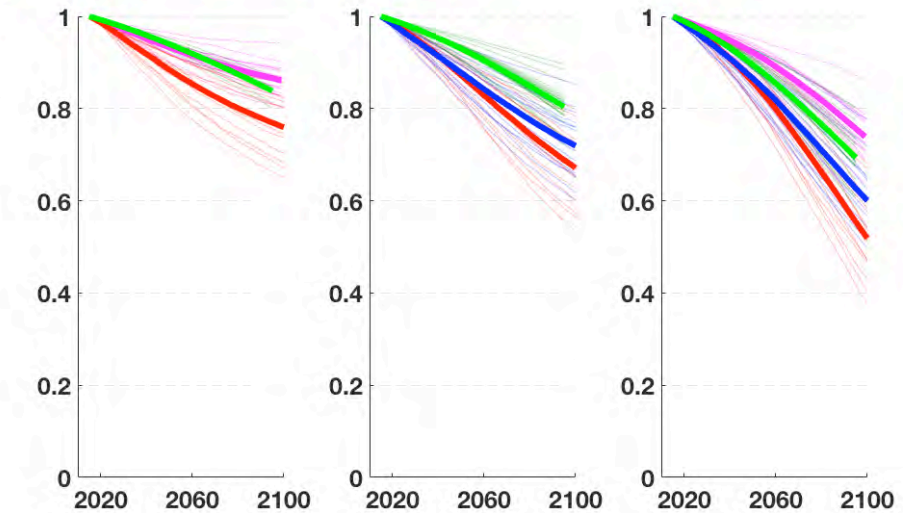


Figure 1: Normalized volume evolution of all glaciers outside the ice sheets for three emission scenarios (left: RCP2.6, middle: RCP4.5, right: RCP8.5) and six different glacier models (colors). Thick lines show multi-GCM means and thin lines individual GCM runs (unpublished).

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Permafrost Carbon Network (PCN)

- The Permafrost Carbon Network and Permafrost Action Team are part of the Study of Environmental Arctic Change (SEARCH).
- Synthesize existing research about permafrost carbon and climate in a format that can be assimilated by biospheric and climate models
- Highlight how the degradation of permafrost will affect both the Arctic and the globe.
- 2017 - Three topical science briefs developed (knowledge pyramid).

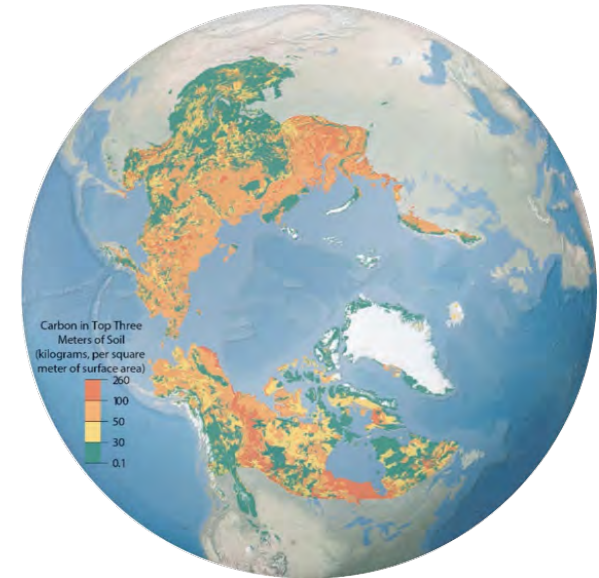
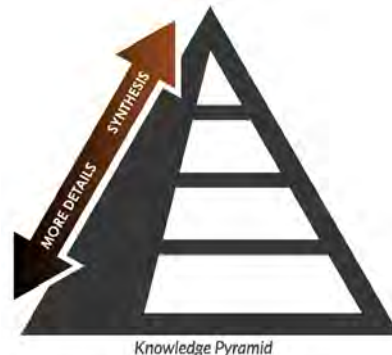


Figure: Carbon in the upper 3m of northern permafrost zone soils

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Christina Schädel – Network Coordinator, Northern Arizona University, USA christina.schaedel@nau.edu
www.permafrostcarbon.org

SIMIP – Sea Ice

Goal 1: to better understand sea ice in a changing climate

Goal 2: Define a list of variables to understand the evolution of sea ice in any experiment using the sea ice model as part of CMIP6.



Three guiding questions:

1. Why do model simulations differ from each other?
2. Why do model simulations differ from the observational record?
3. What can we do to reduce these differences to obtain a better understanding of sea ice in the climate system and achieve more realistic projections in both hemispheres.

*This is a diagnostic MIP. No dedicated experiments planned.

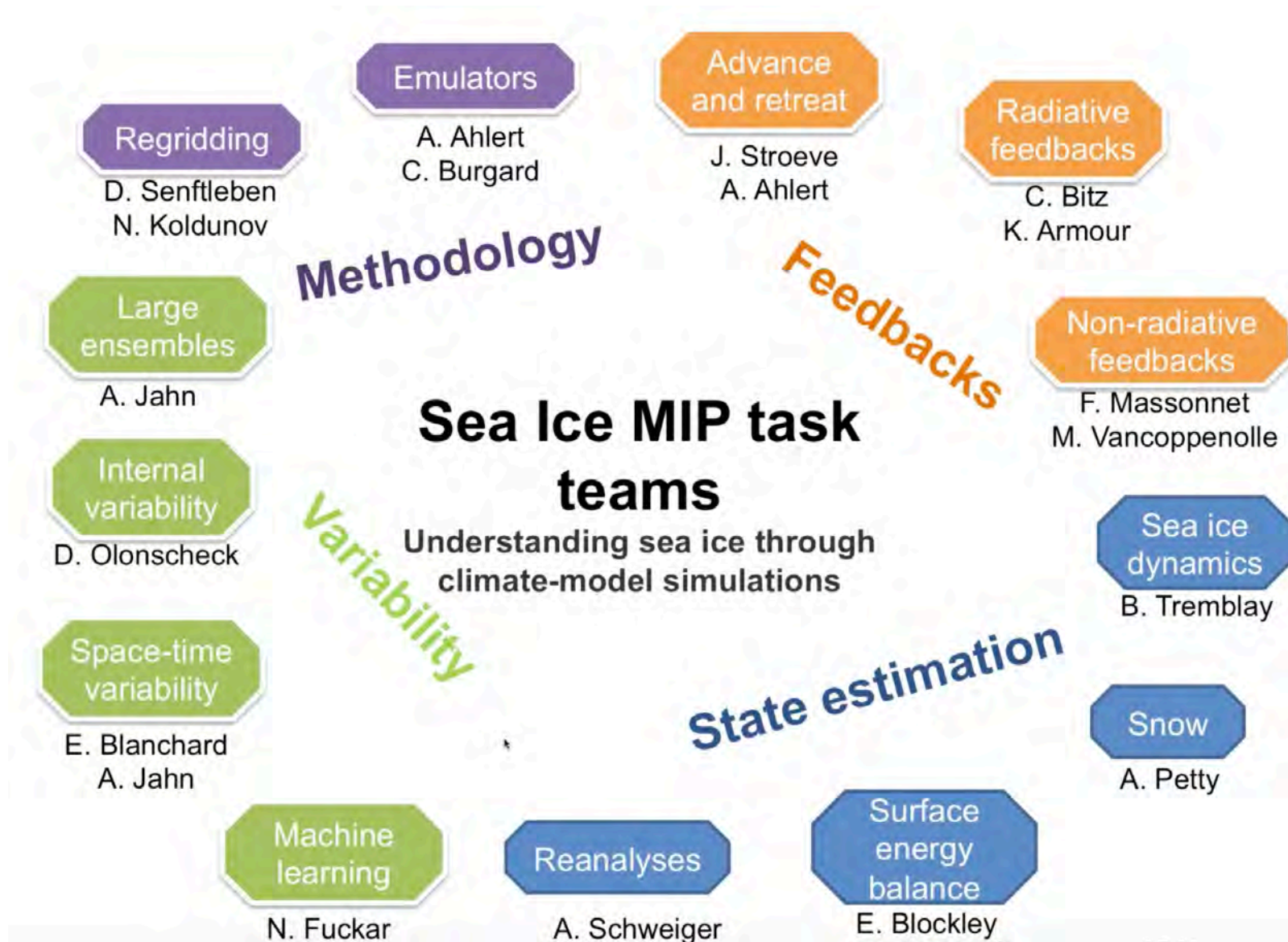
www.climate-cryosphere.org/simip

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SIMIP – Task Teams (13)



CMIP6 Publications

Geosci. Model Dev., 9, 4521–4545, 2016
www.geosci-model-dev.net/9/4521/2016/
doi:10.5194/gmd-9-4521-2016
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Model Development
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Ice Sheet Model Intercomparison Project (ISMIP6) contribution to CMIP6

Sophie M. J. Nowicki¹, Anthony Payne², Eric Larour³, Helene Seroussi³, Heiko Goelzer^{4,5}, William Lipscomb⁶, Jonathan Gregory^{7,8}, Ayako Abe-Ouchi^{9,10}, and Andrew Shepherd¹¹

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¹⁰Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan

¹¹School of Earth and Environment, University of Leeds, Leeds, LS2 9JT, UK

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Received: 29 April 2016 – Published in Geosci. Model Dev. Discuss.: 26 May 2016

Revised: 30 September 2016 – Accepted: 2 December 2016 – Published: 21 December 2016

Geosci. Model Dev., 9, 3427–3446, 2016
www.geosci-model-dev.net/9/3427/2016/
doi:10.5194/gmd-9-3427-2016
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The CMIP6 Sea-Ice Model Intercomparison Project (SIMIP): understanding sea ice through climate-model simulations

Dirk Notz¹, Alexandra Jahn², Marika Holland³, Elizabeth Hunke⁴, François Massonnet^{5,6}, Julienne Stroeve^{7,8}, Bruno Tremblay⁹, and Martin Vancoppenolle¹⁰

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CliC Arctic Sea Ice Working Group (CASIWG)

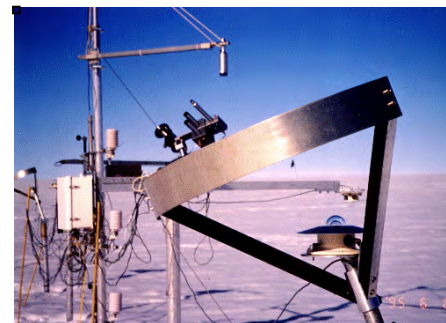
Goals:

1. Develop, standardize, and implement observation and measurement protocols for Arctic sea ice
2. Integrate surface-based observations with remote sensing and modelling efforts.

Deliverables 2017:

Conversion of ASSIST software / data to SIGRID-3, the JCOMM (WMO-IOC) International Ice Chart Working Group (IICWG) standard format for presenting sea ice data.

ASSIST Deployed on cruises - 50 Let Pobedy, RV Lance, Nathaniel Palmer + others.



Panels / Groups

CLIVAR/CliC/SCAR Southern Ocean Region Panel (SORP)

- Assess climate variability, climate change and climate predictability of the ocean-atmosphere-ice system in the Southern Ocean.
- Standardization, distribution and archiving of Southern Ocean observations.
- Span observations, models, experiments, and process studies.



12th session - June 2017, Boulder, CO, US

CLIVAR/CliC Northern Oceans Regional Panel (NORP)

- Provide a forum for communication and coordination across targeted national and international activities.
- Identify opportunities and coordinated strategies to implement these methods, spanning observations, models, and process studies.
- Examine linkages between Arctic and mid-latitude weather and climate.

2017 Highlights

17 workshops

- 430+ participants
- 25+ countries


5 Conference presentations

- CliC presentations
- ASSW, EGU, AGU+

GoToMeeting

80+ online project meetings

Social Media

 Facebook – 1700 likes

 Twitter – 2300 followers



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Upcoming CliC Events

 9 October 2017 - 11 October 2017
[Workshop on improved satellite retrievals of sea-ice concentration and sea-ice thickness for climate applications](#)

 18 October 2017 - 20 October 2017
[2017 Polar CORDEX meeting](#)


 1 November 2017 - 3 November 2017
[8th International Workshop on Sea Ice Modelling, Data Assimilation and Verification](#)

 8 November 2017
[Glaciological research in Svalbard – Liestøl Symposium](#)

 27 November 2017 - 29 November 2017
[BEPSII Workshop](#)

 10 December 2017
[GlacierMIP meeting at AGU Fall Meeting](#)

 11 December 2017 - 15 December 2017
[ISMIP6 meeting at AGU Fall Meeting \(date TBD\)](#)

 17 April 2018 - 27 April 2018
[Polar Prediction School 2018](#)

2017 Cryosphere Symposium

- Feb 2017, New Zealand
- 300+ participants
- Plenaries, workshops, side events
- CliC SSG Annual meeting
- 2 CliC workshops



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IGS **IACS** **cliC**
Climate and Cryosphere

International Symposium on
The Cryosphere in a Changing Climate

The Cryosphere in a Changing Climate
IGS IACS CliC

Wellington, New Zealand, 12-17 February 2017

Sponsored by:

- International Glaciological Society
- International Association of Cryospheric Sciences (IACS), an association of the International Union of Geodesy and Geophysics (IUGG)
- World Climate Research Programme Climate and Cryosphere (CliC) project

Co-sponsored by:

- National Institute for Water and Atmospheric Research (NIWA)
- University of Otago
- New Zealand Antarctic Research Institute (NZARI)
- Victoria University of Wellington
- GNS Science

IUGG
UGGI
International Union of Geodesy and Geophysics

WCRP
World Climate Research Programme

SECOND CIRCULAR
August 2016
<http://www.igsoc.org/symposia/>

ICSU

Other WMO initiatives

World Weather Research Programme - WWRP

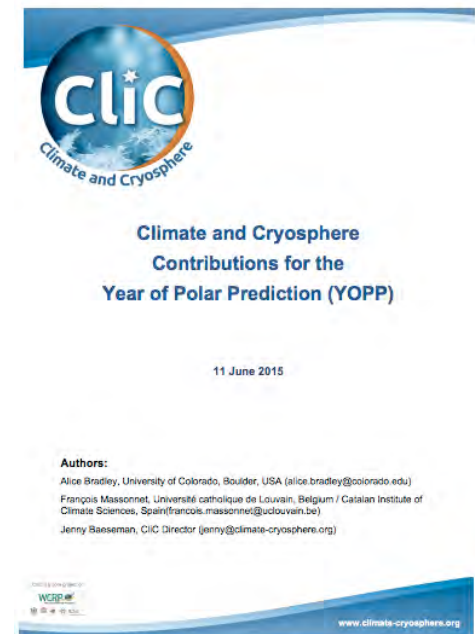


*MISSION: “ To enable a significant improvement in environmental prediction capabilities for the polar regions and beyond, by coordinating a **period of intensive observing, modelling, prediction**, verification, user-engagement and education activities.”*

CliC contribution:

Intensive observation period 2017-2019.
CliC’s ASIWG and ASPeCt to help improve coverage and temporal frequency of observations.

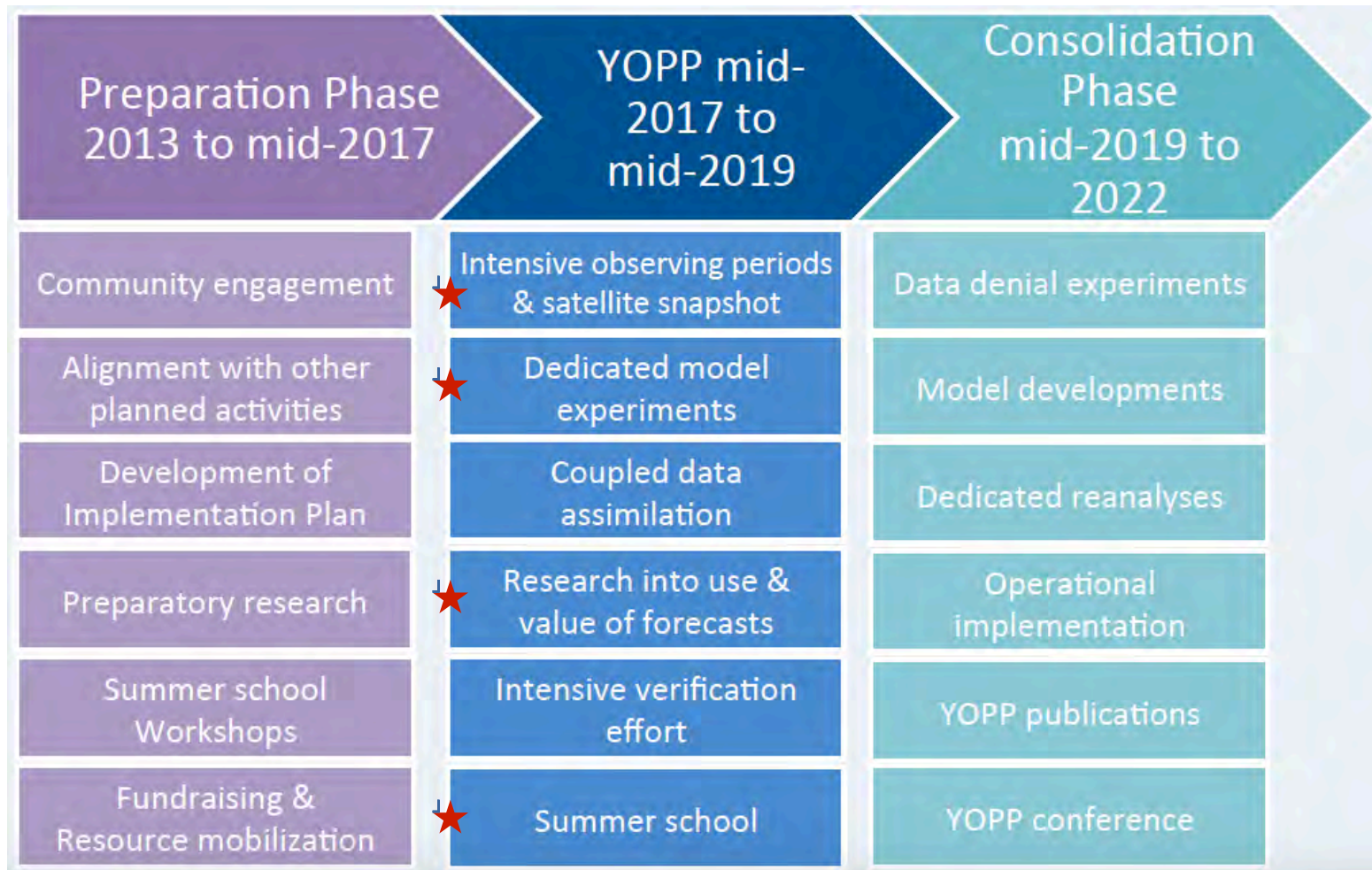
CliC fellowship for two ECS, produced report detailing YOPP opportunities.



www.polarprediction.net

Other WMO initiatives

World Weather Research Programme - WWRP



www.polarprediction.net

Global Cryosphere Watch - WMO

GCW is an international mechanism for supporting all key cryospheric *in-situ* and remote sensing observations.

Contributes to WMO's space-based capabilities database (with the **Polar Space Task Group**).

Engaging in, and supporting, intercomparison of products, particularly satellite products.

CliC - Data standards / best practices (CASIWG, ASPECT)

CliC is on the GCW Steering Committee
Common interest in e.g. sea ice activities



www.globalcryospherewatch.org

2018 Plans

IGS Cryosphere and Biosphere Symposium

- Sponsors: IGS, CliC
- Location: Kyoto, Japan
- Date: March 14-19
- Focus: Cryosphere and Biosphere linkages (PCN, BEPSII)
- Events: Project presentations



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2018 Plans

- Sponsors: IASC and SCAR
- Location: Davos, Switzerland
- Date: June 15-26
- Focus: Polar
- Events: 4 sessions, project workshops, side events, CliC SSG.



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Thank you



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