CliC Overview for WDAC

Ben Galton-Fenzi (Australian Antarctic Division and , Antarctic Climate & Ecosystems Cooperative Research Centre)
Walt Meier (NASA Goddard Space Flight Centre)
Lawrence Hislop (CliC Director)

22 – 23 March 2017 ESRIN, Frascati, Italy

Organization – what is CliC?

Host agreement
1993 – 2003
2003 – 2018

= Climate and Cryosphere project

CliC structure

Scientific Steering Group (SSG)
Co-chairs:
Gerhard Krinner (until end of 2017)
Greg Flato (until end of 2016)
James Renwick (starting in 2017)

International Project Office
Director: Lawrence Hislop
Executive Officer: Gwénaëlle Hamon
Hosted by the Norwegian Polar Institute

WCRP Grand Challenge – Melting Ice and Global Consequences, Lead: CliC, Chair: Greg Flato

- **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)*
- **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)*

Limited Lifetime Targeted Activities

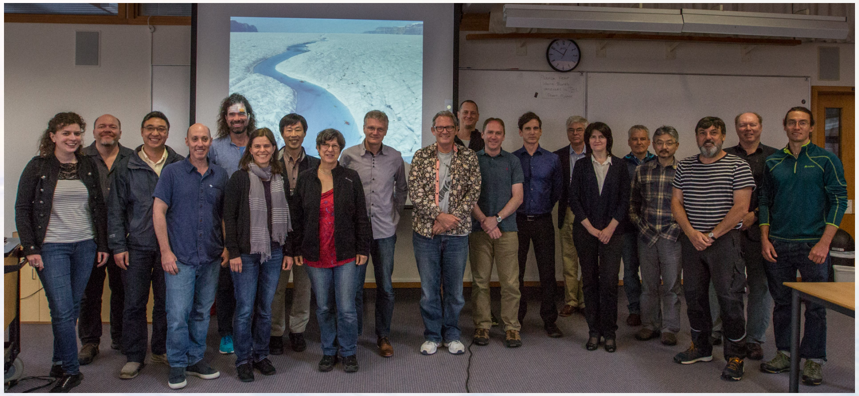
- **Polar Coordinated Regional Downscaling Experiment (Polar CORDEX)**
- **Arctic Freshwater Synthesis** *(completed)*
- **Southern Ocean Satellite Requirements** *(completed)*
- **Where Are They Now?** *(completed)*
- **Interactions Between High-latitude Cryosphere Elements**
- **Earth Observations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

Governance

Scientific Steering Group:

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)

SSG 13, Wellington 2017



IPO – Norway

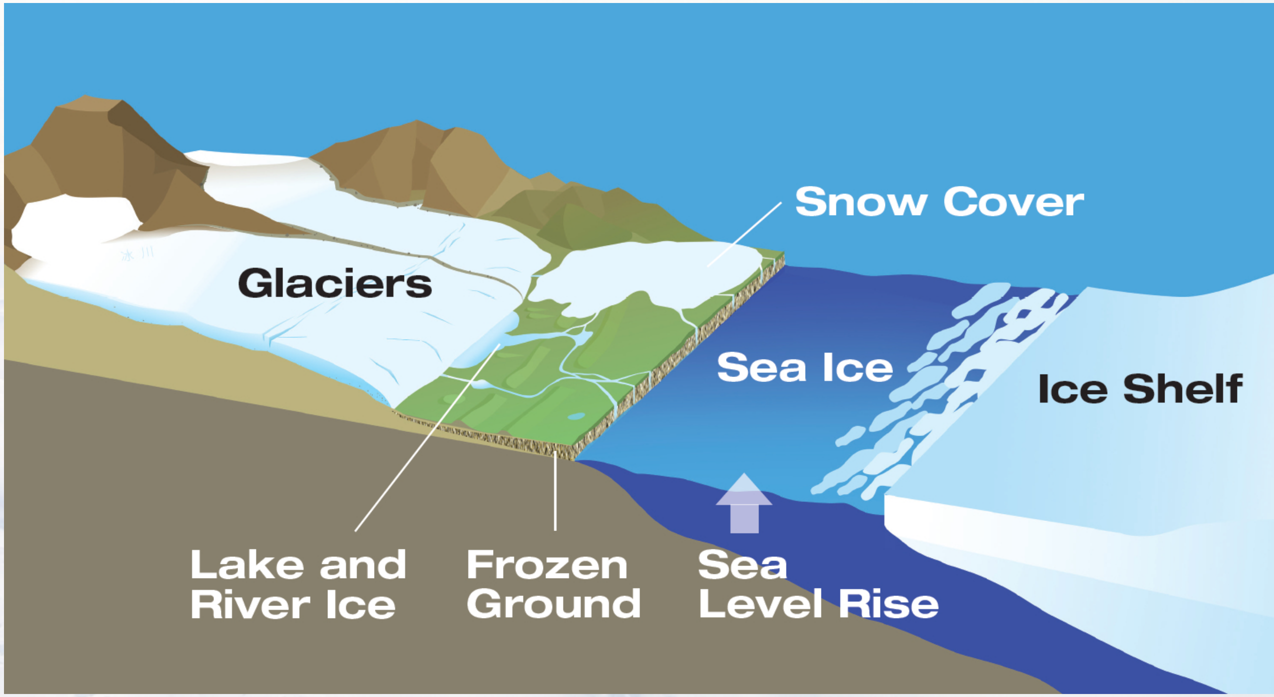
Lawrence Hislop
Gwen Hamon
Mike Sparrow (WCRP)

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

Domains…

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



How we work

CliC funding supports

- Workshops
- Meetings
- Papers
- Publications
- Videoconference
- ECS - Fellowships

Rising Coastal Seas on a Warming Earth
New York University Abu Dhabi Center for Global Sea-Level Change (NYUAD-CSLC)
Abu Dhabi, UAE
October 27 - 29, 2014
In Conjunction with: NYUAD Institute, NSF, NASA & CliC

First Row Seated L-R: J. Ahlkrona, D. Menemenlis, K. Kusahara, F. Pattyn, B. Galton-Fenzi, D. Holland, D. M. Holland, A. Jrrar, R. Gladston, G. Djoumna
Second Row L-R: J. Feldmann, M. Bentsen, R. Walker, X. Asay-Davis, J. Ridley, B. Parizek, I. Joughin, G. Durand, N. Jourdain, P. Mathiot, S. Nowicki, S. Price, R. Kumar
Third Row L-R: R. Timmermann, R. Hallberg, S. Goeller, E. Larour, S. Mernild, X. Wang, H-C Kim, W-S Lee, M. Dinniman, T. Hattermann

MISOMIP

ISMIP6

SnowMIP

Modelling work for CMIP6 and support for the Grand Challenge on Melting Ice & Global Consequences

- **ESM-SnowMIP** - Earth System Model-Snow Model Intercomparison Project
- **SIMIP** - Sea Ice Model Intercomparison Project
- **ISMIP6** - Ice Sheet Model Intercomparison Project
- **GlacierMIP** - Glacier Model Intercomparison Project
- **PCN** – Permafrost Carbon Network

All need access to best cryosphere observation data!

ISMIP6

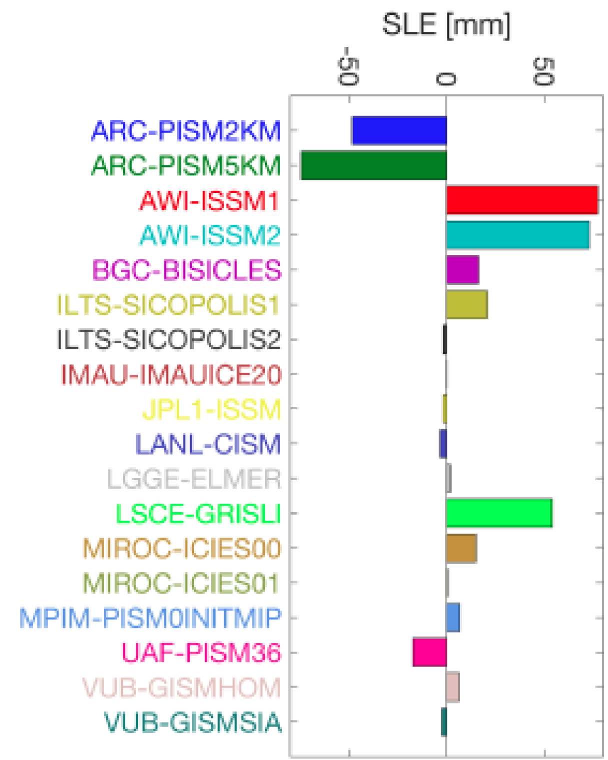
Highlights

- Finalized experiments and data protocols
- 13 modelling groups participated in initMIP-Greenland.
- Launch of initMIP-Antarctica.
- Three workshops (AGU): initMIP-Greenland at EGU, initMIP-Greenland and Antarctica at AGU, and ice-ocean interactions.

Future activities and developments

- Publication of the initMIP-Greenland results.
- Analysis of the initMIP-Antarctica model simulations.
- Workshops at EGU, and large workshop on evaluation of CMIP6 climate models to derive forcing for ice sheet models.

Science Highlight



Centennial sea level background trend in control experiments due to model drift or transient initialization from the initMIP-Greenland models, an effort that investigates uncertainty resulting from the initialization.

MISOMIP

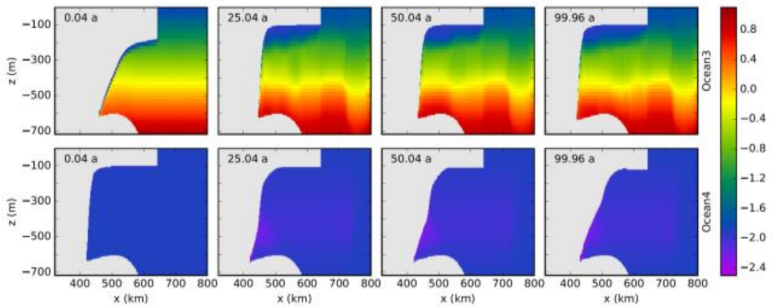
Highlights

- A second workshop brought together experts in the international modeling community to further discuss the advancement of state-of-the-art regional-scale glacier-ocean simulations.

Future activities and developments

- Side-bar MISOMIP meetings will be held at AGU, EGU,
- IGS and related meetings.
- Several publications analyzing MIP results are expected in 2017.
- Planning begun for the third MISOMIP meeting in spring 2018.

Science Highlight



Asay-Davis et al. (2016) describes three interrelated MIPs for marine ice-sheet models and ocean models with sub-ice-shelf cavities. The figure shows cross sections of ocean temperature (colored) and ice topography (gray) evolving in time in one of the MIPs experiments. The results from the first of the three MIPs were received in early October, and analysis has already begun. The results are expected to provide a basis for future model improvements.

ESM-SnowMIP

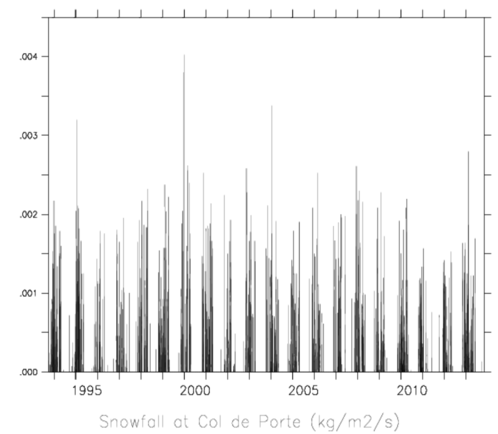
Highlights

- Simulation protocols finalized both for LS3MIP (see
- Meteorological forcing files on global and site scales produced.
- LS3MIP and ESM-SnowMIP are transitioning into production phases.
- ESM-SnowMIP held its official kickoff workshop in San Francisco in December 2016.

Future activities and developments

- CMIP6, and thus LS3MIP, enter production phase in 2017. First results of global land offline simulations from LS3MIP are expected towards the end of 2017. Similarly, ESM-SnowMIP site simulations will be carried out in 2017.

Science Highlight



Quality-controlled meteorological forcing to be used for site-scale snow simulations in ESM-SnowMIP (here: snowfall rates at Col de Porte, France)

GlacierMIP

Highlights

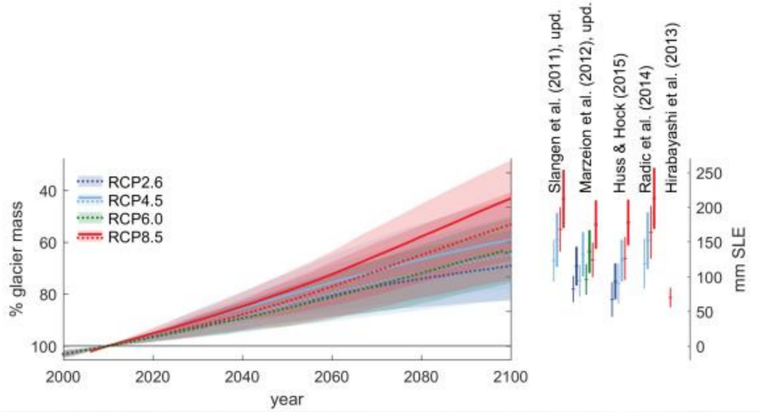
- A GlacierMIP meeting was held at AGU 2015. Work
- towards a joint peer-reviewed publication comparing
- recent global glacier projections is underway.

Future activities

- A GlacierMIP meeting held at the IGS/IACS/CliC conference in Wellington in February 2017.

Science Highlight

The data from six previous studies were submitted to GlacierMIP by the end of September 2015, and preliminary GlacierMIP comparisons have been presented at the AGU fall meeting in December 2015. Each study used 8-15 GCMs to force the projections. Results indicate that globally glaciers will lose between 15 and 55% of their current volume BY 2100 (multi-model mean of runs forced by 8-15 GCM and a variety of emission scenarios). This corresponds to 7 – 22 cm sea-level equivalent.



SIMIP

Highlights

- Finalizing diagnostic protocol for sea-ice related work within the upcomingCMIP6
- Protocols implemented into the most widely used sea-ice models LIM and CICE.

Future activities

- Host a workshop of modelers and observationalists to establish future cooperation
- Develop evaluation data sets for CMIP6 simulations.
- Coordinate analysis of sea-ice simulations focussed on the 1.5 °C global warming target of the Paris-agreement

Science Highlight

						include heat content of sea ice.	
2. Tendencies of sea-ice mass and area fraction (all negative for decreasing mass)							
sidconcth	tendency_of_sea_ice_area_fraction_due_to_thermodynamics	1	sea ice	1/s	sea-ice area fraction change from thermodynamics	Total change in sea-ice area fraction through thermodynamic processes	2
sidconcdyn	tendency_of_sea_ice_area_fraction_due_to_dynamics	1	sea ice	1/s	sea-ice area fraction change from dynamics	Total change in sea-ice area fraction through dynamics-related processes (advection, divergence…)	2
sidmassth	tendency_of_sea_ice_amount_due_to_thermodynamics	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change from thermodynamics	Total change in sea-ice mass from thermodynamic processes divided by grid-cell area	2
sidmassdyn	tendency_of_sea_ice_amount_due_to_dynamics	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change from dynamics	Total change in sea-ice mass through dynamics-related processes (advection,…) divided by grid-cell area	2
sidmassgrowthwat	tendency_of_sea_ice_amount_due_to_freezing_in_open_water	-1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through growth in supercooled open water (aka frazil)	The rate of change of sea ice mass due to sea ice formation in supercooled water (often through frazil formation) divided by grid-cell area. Together, sidmassgrowthwat and sidmassgrowthbot should give total ice growth	2
sidmassgrowthbot	tendency_of_sea_ice_amount_due_to_congelation_ice_accumulation	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through basal growth	The rate of change of sea ice mass due to vertical growth of existing sea ice at its base divided by grid-cell area.	2
sidmasssi	tendency_of_sea_ice_amount_due_to_snow_conversion	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through snow-to-ice conversion	The rate of change of sea ice mass due to transformation of snow to sea ice divided by grid-cell area	2
sidmassevapsubl	water_evaporation_flux	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through evaporation and sublimation	The rate of change of sea-ice mass change through evaporation and sublimation divided by grid-cell	2
sidmassmelttop	tendency_of_sea_ice_amount_due_to_surface_melting	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through surface melting	The rate of change of sea ice mass through melting at the ice surface divided by grid-cell area	2
sidmassmeltbot	tendency_of_sea_ice_amount_due_to_basal_melting	1	sea ice	kg m^{-2} s^{-1}	sea-ice mass change through bottom melting	The rate of change of sea ice mass through melting at the ice bottom divided by grid-cell area	2
sidmasslat	tendency_of_sea_ice_amount_due_to_lateral_melting	-1	sea ice	kg m^{-2} s^{-1}	Lateral sea ice melt rate	The rate of change of sea ice mass through lateral melting divided by grid-cell area (report 0 if not explicitly calculated thermodynamically)	2
sndmasssnf	snowfall_flux	1	sea ice	kg m^{-2} s^{-1}	snow mass change through snow fall	mass of solid precipitation falling onto sea ice divided by grid-cell area	2
sndmassmelt	surface_snow_melt_flux	1	sea ice	kg m^{-2} s^{-1}	snow mass change through melt	the rate of change of snow mass through melt divided by grid-cell area	2
sndmasssubl	surface_snow_sublimation_flux	-1	sea ice	kg m^{-2} s^{-1}	snow mass change through evaporation or sublimation	the rate of change of snow mass through sublimation and evaporation divided by grid-cell	2
sndmassdyn	tendency_of_snow_mass_due_to_sea_ice_dynamics	-1	sea ice	kg m^{-2} s^{-1}	snow mass change through advection by sea-ice dynamics	the rate of change of snow mass through advection with sea ice divided by grid-cell area	2
sndmasssi	tendency_of_snow_mass_due_to_snow_to_ice_conversion	-1	sea ice	kg m^{-2} s^{-1}	snow mass change through snow-to-ice conversion	the rate of change of snow mass due to transformation of snow to sea ice divided by grid-cell area	2
sndmasswindrif	tendency_of_snow_mass_due_to_drifting_snow	-1	sea ice	kg m^{-2} s^{-1}	snow mass change through wind drift of snow	the rate of change of snow mass through wind drift of snow divided by grid-cell area	2
3. Heat and freshwater fluxes (all only for sea-ice fraction of grid cell, downward always positive)							
sifllswdtop	surface_downwelling_shortwave_flux_in_air	1	sea ice	W m^{-2}	Downwelling shortwave flux over sea ice	the downwelling shortwave flux over sea ice (always positive by sign convention)	2
sifllswutop	surface_upwelling_shortwave_flux_in_air	1	sea ice	W m^{-2}	Upward shortwave flux over sea ice	the upward shortwave flux over sea ice (always negative)	2
sifllswdbot	bottom_downwelling_shortwave_flux_into_ocean	-1	sea ice	W m^{-2}	Downwelling shortwave flux under sea ice	the downwelling shortwave flux underneath sea ice (always positive)	2
siflllwdtop	surface_downwelling_longwave_flux_in_air	1	sea ice	W m^{-2}	Downwelling longwave flux over sea ice	the downwelling longwave flux over sea ice (always positive)	2
siflllwutop	surface_upwelling_longwave_flux_in_air	1	sea ice	W m^{-2}	Upward longwave flux over sea ice	the upward longwave flux over sea ice (always negative)	2
sifllsenstop	surface_upward_sensible_heat_flux	1	sea ice	W m^{-2}	Net sensible heat flux over sea ice	the net sensible heat flux over sea ice	2
sifllatstop	surface_upward_latent_heat_flux	1	sea ice	W m^{-2}	Net latent heat flux over sea ice	the net latent heat flux over sea ice	2
siflsensupbot	ice_ocean_heat_flux	-1	sea ice	W m^{-2}	Net sensible heat flux under sea ice	the net sensible heat flux under sea ice from the	2

Snippet of the newly established standard for sea-ice output from large scale model simulations. Full list available from www.climate-cryosphere.org/simip

PCN - Permafrost

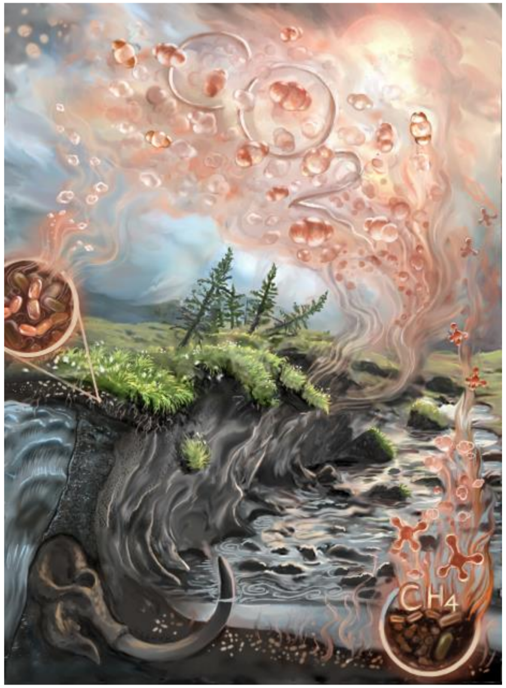
Highlights

- Multiple syntheses studies published
- June 2016, the PCN held its 6th network lead meeting in Potsdam, Germany. Synthesis leads gave short presentations and updated the group on synthesis progress.

Future activities and developments

- The 6th Annual Meeting of the PCN will be held in San
- Francisco, December 11 2016. Updates on syntheses will
- be given to the larger science community and new ideas
- will be discussed in afternoon break out groups.

Science Highlight



In thawing Arctic permafrost soils, carbon dioxide is produced by microbes in dry conditions, while both methane and carbon dioxide are produced by microbes in wet conditions. (Image courtesy Victor O. Leshyk)

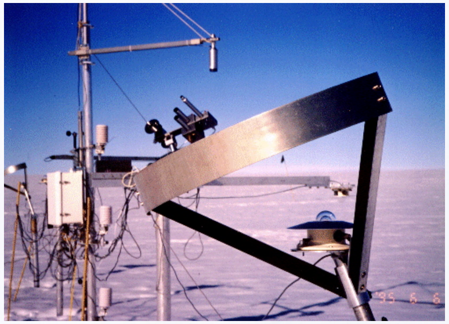
Ongoing needs

- Consolidation and standardisation of various crysopheric-related data streams
- Multi-national/institutional data portals, including management, of derived data products (e.g. from MIPs)
- Big data curation: new observational products and model outputs, in addition to CMIP6.
- How to best facilitate model evaluations with observations?

CliC Arctic Sea Ice Working Group (CASIWG)

Develop, standardize, and implement observation and measurement protocols including methods of visually observing sea ice on research ships across northern hemisphere ice covered waters.

Integrate surface-based observations with remote sensing and modelling efforts.



Establish and foster connections between international groups involved in sea ice observations, modelling, remote sensing, and data assimilation.

www.climate-cryosphere.org/activities/groups/arctic-sea-ice-working-group

CASIWG – 2017

- Working with the National Ice Center to develop solutions for near-real time transfer of data from ships to operational networks.
- ASSIST software / Ice Watch database now using shared libraries for defining ice observations and quality control.
- Conversion of ASSIST data to SIGRID-3, the WMO International Ice Chart Working Group (IICWG) standard format for presenting sea ice data, has been tested at the National Ice Center.
- 2016 cruises - 50 Let Pobedy, Nathanial Palmer, Sikuliaq

Antarctic Sea Ice Processes and Climate (ASPeCt)

2017

- Updated software and automatic cameras implemented to supplement ASPeCt visual observations and are being used for quality control and training of ice observers.

- Completed a manual for bridge based research quality sea ice observations

- Coordination of efforts between ASPeCt and the Arctic Ice Watch sea-ice observation programs (ASSIST). Observations recorded by ASSIST can now be archived in the ASPeCt data base.

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 observation methods, including satellite products.

CliC is on the GCW Steering Group

Global Cryosphere Watch

www.globalcryospherewatch.org

Thank you!

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