

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

*Understanding the changing cryosphere and its climate connections*

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Mike Sparrow, Gwenaelle Hamon

WDAC8  
20-21 March 2019  
Marrakesh, Morocco



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# Organization – what is CliC?

## Host

Tromsø  
2003 – 2018



## Sponsor

Geneva  
WMO / UNESCO-IOC / ISC



CliC will have a new host in 2019  
(awaiting funding confirmation).

Executive Officer hired as a  
consultant to ensure continuity.



= Climate and Cryosphere project

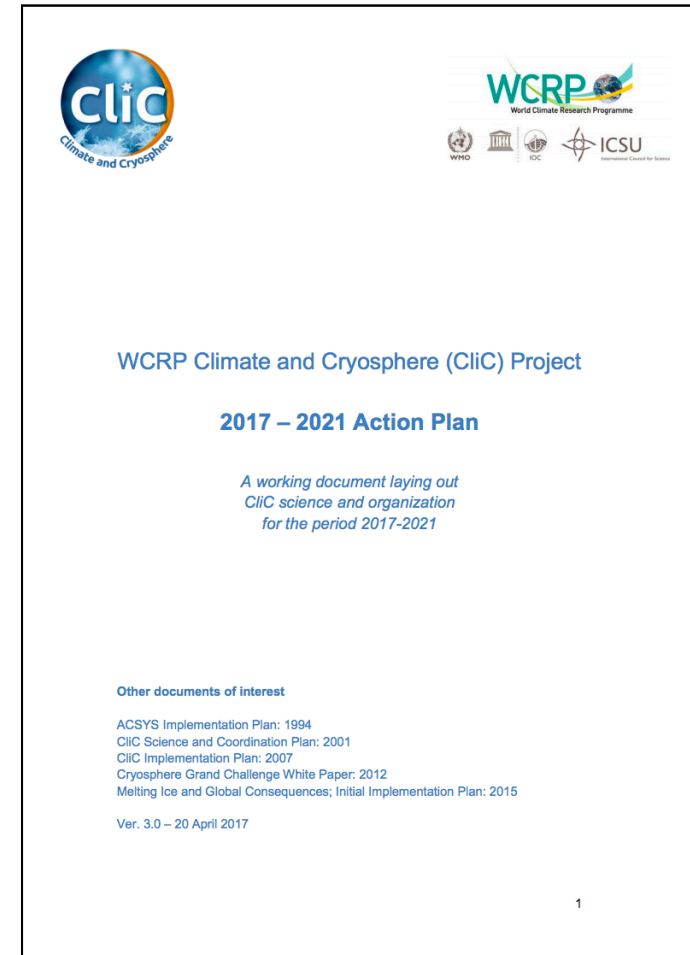
# cliC Science (Action) Plan

## 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

# CliC structure

## Scientific Steering Group (SSG)

Co-chairs:

James Renwick (2017-2020)

Fiamma Straneo (2018-2020)

## International Project Office

Executive Officer (consultant): Gwénaëlle Hamon

## WCRP Grand Challenge – Melting Ice and Global Consequences, Lead: CliC, Chair: Tim Naish

- 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*)
- 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 & Climate Modelling Forum

## Limited Lifetime Targeted Activities

- 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

# 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
- **MISOMIP** - Marine Ice Sheet-Ocean Model Intercomparison Project
- **GlacierMIP** - Glacier Model Intercomparison Project
- **PCN** – Permafrost Carbon Network

All need access to best cryosphere observation data!



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# ESM-SnowMIP and LS3MIP

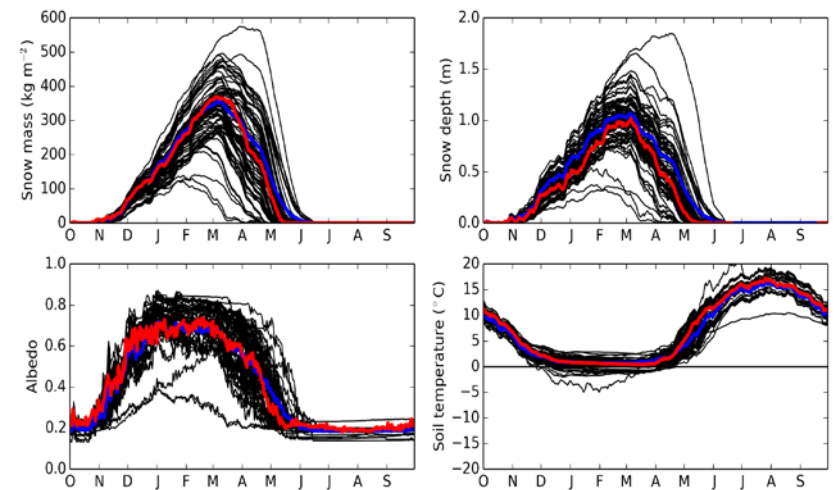
Earth System Model-Snow Model Intercomparison Project  
Land Surface, Snow and Soil Moisture Model Intercomparison Project

## 2018:

Focus on snow and its role in the global climate system. Site-scale simulations at snow measurement sites have been carried out within ESM-SnowMIP and are currently being published as part of an overview paper.

## 2019:

LS3MIP global simulations will be run as a part of the CMIP6 exercise, followed by ESM-SnowMIP runs in the following year. In parallel, a more detailed paper on ESM-SnowMIP site simulations, and a paper describing the site data for future model developments are planned.



*The multi-model mean (blue) simulates quite correctly the observed seasonal evolution of the snowpack, but the ensemble spread is substantial, pointing towards parameter or structural inaccuracies in individual models.*



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## SIMIP – Sea Ice

Goal 1: 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.

### 2018:

Further worked on preparing the scientific analyses

Based on the resulting data call, the upcoming CMIP6 simulations will provide unique insights into the evolution of the polar sea-ice cover.



### 2019:

Most CMIP6-SIMIP model results should be available. Close monitoring of the availability of the data and guide its analysis through the SIMIP sub groups.

High-profile papers based on SIMIP output will be submitted for inclusion into the IPCC AR6.



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# Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6)

## 2018:

15 modelling groups participated in initMIP-Antarctica

12 modeling groups participated in in ABUMIP

Analysis of the initMIP-Antarctica and ABUMIP model simulations

2 workshops: Developing process-based projections of the sheets' contribution to future sea level, and annual ISMIP6 PreAGU

Series of webinars in the Fall 2018 to present the experimental protocol

Presentations at EGU, Polar2018, AGU and WCRP SL GC Meeting

## 2019:

Publications of the initMIP-Antarctica and ABUMIP results

Preparation of forcing dataset for ice sheet models and ice sheet model simulations targeting IPCC AR6

Workshops at EGU, AGU and large workshop on evaluation of ISMIP6 simulations and implications for sea level projections.



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# Marine Ice Sheet-Ocean Model Intercomparison Project (MISOMIP)

## 2018:

Designing/testing the MISOMIP experiments

Deliverable: Experiments defined in a peer-reviewed document: Dr. X. Asay-Davis (GMD) and D. M. Holland and D. Holland (EOS).

Comparison of MISOMIP results between models that have completed the experiments

Coordinated idealized and regional realistic experiments

Deliverable: Papers intercomparing results from MISOMIP

## 2019:

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.



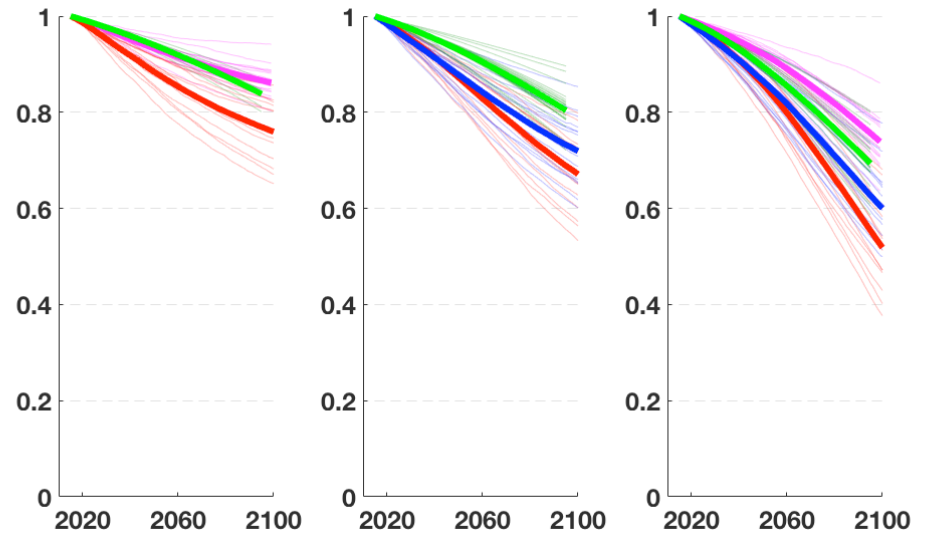
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# GlacierMIP

## 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
- Publication on Phase I of GlacierMIP being revised for Journal of Glaciology



*Figure: 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)

Facilitates synthesis of permafrost carbon science and communicates our current understanding to help society respond to a rapidly changing Arctic.

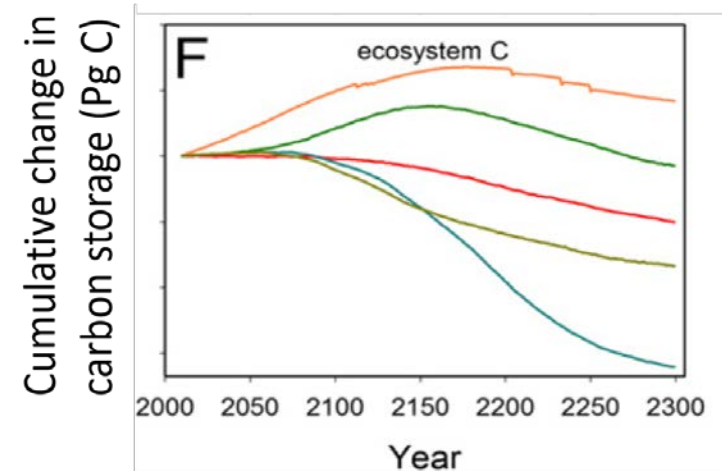
## 2018:

2 workshops in 2018 on 'Reconciling Historical and Contemporary Trends in Terrestrial Carbon Exchange of the Northern Permafrost-Zone' at the Arctic Data Center and National Center for Ecological Synthesis and Analysis in Santa Barbara, California, which brought together international experts on ecosystem dynamics to synthesize an observational time series of ecosystem-atmosphere carbon exchange from the 1990s to the present day.



## 2019:

9<sup>th</sup> PCN Annual Meeting at AGU Fall Meeting



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# Climate and Cryosphere Arctic Sea Ice Working Group (CASIWG)

## 2018:

Contribution to definition of observational protocols for sea ice measurements during the **MOSAiC** field campaign (Multidisciplinary drifting observatory for the Study of Arctic Climate).

Contribution to the Sea Ice Section of the **Arctic Report Card** and to the Sea Ice Prediction Network.

Ship based sea ice observations made on science and tourist cruises using the **ASSIST** software package.

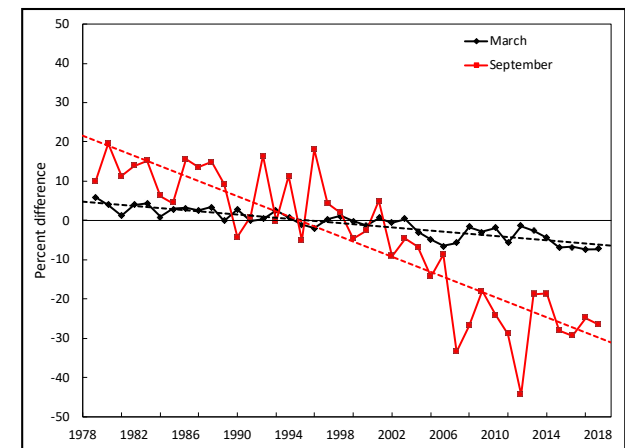
## 2019:

Continue ongoing efforts with MOSAIC, Arctic Report Card, the Sea Ice Prediction Network, ASSIST software, and citizen scientist outreach.

ASIWG meeting planned for August 2019 in conjunction with IGS Sea Ice Symposium.



Citizen scientists collecting melt pond data at the North Pole, 25 July 2018.



Time series of ice extent anomalies in March (month of maximum ice extent) and September (minimum). The anomaly for each year is the difference (in %) in ice extent relative to the mean values for the period 1981-2010. Least squares linear regressions are shown for March (2.7% per decade) and September (12.8% per decade).



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# Biogeochemical Exchange Processes at Sea Ice Interfaces (BEPSII)

## 2018:

Joint ECV-Ice - BEPSII Meeting at POLAR 2018

BEPSII session at POLAR2018

ECV-Ice intercalibration experiments on biomass, nutrients, PP (Hokkaido, March),  
gases (Norwich, fall).

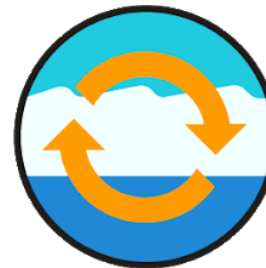
## 2019:

Currently designing future activities, such as:

Analysis on Arctic sea-ice biogeochemical response to climate change.

Expert contribution to ongoing discussions on the design of biogeochemistry and ecosystem components of MOSAiC.

Model intercomparisons (CMIP6, FAMOS, ...)



# BEPSII

BIOGEOCHEMICAL EXCHANGE PROCESSES  
AT SEA ICE INTERFACES



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# Antarctic Sea ice Processes and Climate (ASPeCt)

An expert group on multi-disciplinary Antarctic sea ice zone research within the SCAR Physical Sciences program.

## 2018:

ASPeCt's data acquisition strategy endorsed for inclusion in YOPP

Data collected by cruises into the ice zone in 2018-2019 will be contributed to the YOPP archives

ASPeCt session on Antarctic sea ice processes and ice shelves status at POLAR2018.

## 2019-20:

Session and meeting at 2019 IGS Sea Ice Symposium

Workshop at SCAR 2020.



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# 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



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[www.globalcryospherewatch.org](http://www.globalcryospherewatch.org)

# Regional activities

## **SCAR/IASC/CliC Southern Ocean Region Panel (SORP)**

SORP members at OceanObs'19 in Hawaii

SORP-14 held at SCAR 2020 in Hobart

## **CLIVAR /CliC Northern Oceans Region Panel (NORP)**

Advance studies on Greenland ice sheet – ocean interactions: Advocate for inclusion in CMIP7 and Sea level call in Horizon2020.

## **Polar CORDEX**

Arctic: Pre-MOSAiC model intercomparison study and preparation for MOSAiC modeling participation

Polar region: Contribution to the IPCC AR6 Regional Atlas for future projections



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# Ongoing needs

- Consolidation and standardisation of cryosphere-related data streams
- Multi-national/institutional data portals, including management, for 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?
- Improved process understanding, especially of linkages across components of the cryosphere



# 2018 Highlights

## 17 workshops

- 430+ participants
- 25+ countries


## 5 Conference presentations

- CliC presentations
- POLAR18, EGU, AGU+

## GoToMeeting

80+ online project meetings

## Social Media









 Facebook – ≈2000 likes

 Twitter – ≈3000 followers



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## Upcoming CliC Events

-  10 April 2019 10:45 am - 11:45 am  
ISMIP6 Workshop at EGU 2019
-  11 April 2019 10:45 am - 11:45 am  
ESM-SnowMIP Meeting at EGU2019
-  22 April 2019 - 26 April 2019  
Arctic Sub-arctic Ocean Fluxes (ASOF)
-  11 May 2019 - 15 May 2019  
MISOMIP Writing Workshop
-  13 May 2019 - 17 May 2019  
BEPSII Workshop
-  17 June 2019 - 19 June 2019  
9th International Workshop on Sea Ice Modelling, Data Assimilation and Verification
-  26 June 2019 - 28 June 2019  
Workshop on CMIP6 21st century projections and predictions for Antarctica and the Southern Ocean
-  8 July 2019 - 18 July 2019  
PCPI Meeting at the 27th IUGG General Assembly

# Coming in 2019...



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- ~18 CliC focussed workshops
  - Focussing on aims outlined in Action Plan
- Sponsor of major conferences:
  - ESA Living Planet Symposium, 13-17 May 2019, Milan, Italy
  - IGS Sea Ice Symposium, 18-23 August 2019, Winnipeg, Canada
- Sponsor of major school:
  - MOSAiC School, 15 September – 26 October 2019, onboard
- Input to other major conferences:
  - EGU General Assembly, 7-12 April 2019, Vienna, Austria
  - 27th IUGG General Assembly, 8-18 July 2019, Montreal, Canada
  - OceanObs'19, 16-20 September 2019, Hawaii, USA
  - AGU Fall Meeting, 9-13 December 2019, San Francisco, USA

# CliC Communications

## Web



## Facebook



## Newsletter



Ice and Climate Newsletter  
Volume 28, December 2017  
Science Features

### The Cryosphere and Atmospheric Chemistry (CATCH)

Co-Edited by Thorsten Berntz-Roth (Switzerland), Jennie Thomas (France), and Markus M. Frey (CATCH co-chair)

Leadership team: Kerri Pratt (USA), Ann Abbott (Canada), Daisuke Nomura (Japan), Tom Douglas (USA), Paul Shepson (USA), V. Faye McNeill (USA), Anna Jones (UK), Carl Amodeo (USA), Kise Kim (Korea), Megan Wilson (Canada), Jennifer Munty-Cavallaro (Spain), Maria Soria (USA), James Francis (UK), Manuel del Valle (Spain), Alberto del Valle (Spain), Cristina Facchini (Italy)

Earth's cold regions such as the Poles, the upper troposphere, and high mountain areas are an integral part of atmospheric chemistry. A new activity within the International Global Atmospheric Chemistry (IGAC) project co-sponsored by the Surface Ocean-Lower Atmosphere Study (SOLAS) focuses on natural processes specific to these cold regions.

Both IGAC and SOLAS provide networks to bring international scientists across disciplines together. IGAC focuses on enhancing fundamental research of atmospheric chemistry processes. SOLAS focuses on processes at the ocean-atmosphere interface. They are both a part of Future Earth and achieve their goals through sponsored activities. One recent activity is CATCH, the Cryosphere and Atmospheric Chemistry.

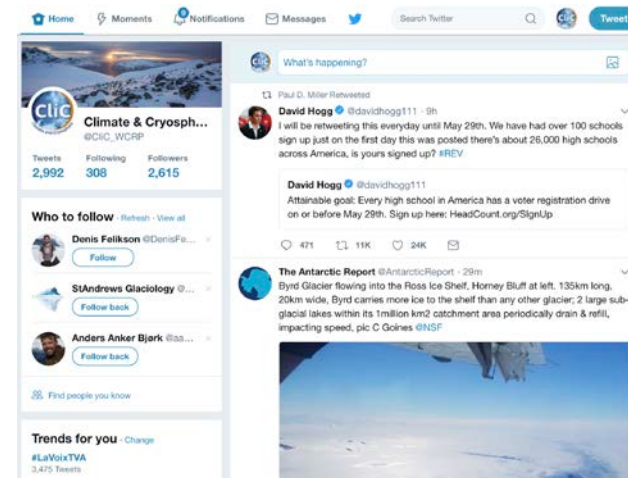
CATCH aims to build a scientific network to facilitate atmospheric chemistry research within the international community with a focus on the chemistry, biology, and physics of the natural environment in cold regions. CATCH held its first workshop in France in spring 2017. The two main objectives of the workshop were: 1) to foster future collaborative work by highlighting cross-disciplinary research questions and 2) to identify future research needs and opportunities.

The cold and high regions are currently undergoing significant changes with implications for regional and global climate, ecosystems, and society. CATCH science focuses on the following underlying natural chemical, biological and physical processes, and feedbacks:

- New aerosols are formed and processed in cold regions;
- How cold region aerosols impact cloud properties;
- Feedbacks between climate change and atmospheric chemistry that are determined by changes in the cryosphere;
- How the ice core record can be used to understand global environmental change.



## Twitter




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# Thank you



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