H2020 - Research and Innovation Action

APPLICATE

Advanced Prediction in Polar regions and beyond: Modelling, observing system design and LInkages associated with a Changing Arctic climaTE

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Deliverable No. 8.5

Report from US CLIVAR working group meeting including recommendations for adjustments to the WP3 part of the APPLICATE numerical experimentation plan

Submission of Deliverable

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EXECUTIVE SUMMARY

The US CLIVAR Working Group on Arctic Change and Possible Influence on Mid-Latitude Climate and Weather has been established to further the understanding of the coupling between Arctic variability and mid-latitude climate and weather. Its aims relate strongly with those of APPLICATE WP3, i.e., to advance our understanding of the mechanisms by which mid-latitude weather and climate cold respond to Arctic climate change.

The Working Group convened an international workshop at Georgetown University in Washington, DC, on 1-3 February 2017, to assemble experts across the fields of atmosphere, ocean, and cryosphere sciences to assess the rapidly evolving state of understanding and to identify consensus on knowledge and gaps in research, and to develop specific actions to accelerate progress within the research community.

APPLICATE coordinator Thomas Jung (AWI) and WP3-leader Doug Smith (MetOffice) participated in the workshop on behalf of the APPLICATE Consortium to strengthen the link with the working group and to gather recommendations for the WP3 numerical experimentation plan.

The workshop found that our understanding of Arctic amplification (AA) is incomplete, Arctic-midlatitude linkages aren't yet well understood, and observations and analysis are currently incomplete.

Recommendations for the modelling community included the creation of a modelling task force to coordinate MIP experiments drawing from the initial planning and discussions of the US CLIVAR Working Group and planned modelling element of the European Horizon 2020 projects (APPLICATE, Blue Action, and PRIMAVERA).

1. Introduction

The current dramatic retreat of Arctic sea ice has shown how the effects of climate change can be fast and with consequences in the near future. Open waters in the Arctic Ocean and the decrease in snow cover during the warm season have profound impacts on the energy balance of the region. Large heating anomalies in the Arctic basin may have effects at lower latitudes, especially across the Northern Hemisphere. These profound changes to the Arctic system have coincided with a period of frequent extreme weather events of across the NH mid-latitudes, including extreme heat and rainfall events and recent severe winters.

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The Working Group convened an international workshop at Georgetown University in Washington, DC, on 1-3 February 2017, to assemble experts across the fields of atmosphere, ocean, and cryosphere sciences to assess the rapidly evolving state of understanding and to identify consensus on knowledge and gaps in research, and to develop specific actions to accelerate progress within the research community. With more than 100 participants from 13 countries, the workshop was the largest and most comprehensive gathering of climate scientists to address the topic to date. Information on the meeting can be found on the meeting website at https://usclivar.org/meetings/2017-arctic-midlatitude-workshop.

APPLICATE coordinator Thomas Jung (AWI) and WP3-leader Doug Smith (MetOffice) participated in the workshop on behalf of the APPLICATE Consortium to strengthen the link with the working group and to gather recommendations for the WP3 numerical experimentation plan.

2. Objectives of the meeting and schedule

A number of previous US CLIVAR workshops have tried to frame the problem and lay the groundwork to improve our understanding of Arctic and mid-latitude linkages and accurate attribution of extreme weather events. Building on previous efforts, this three-day workshop has used the outcomes to guide synthesis efforts, coordinate on-going research to fill out key gaps and provide specific recommendations for accelerating scientific progress, with the aim to improve our understanding and predictability of 1) high- to mid-latitude climate variability on subseasonal-to-seasonal and on interannual-to-decadal timescales and 2) climate extremes.

The full agenda of the meeting is included in Annex 1. The programme included oral and poste presentations and discussion groups in three main sessions covering:

- Arctic Mid-Latitude Linkages - State of Knowledge
- Science Questions - What Happens in the Arctic Stays in the Arctic, or Not?
- Testing Ideas Using Modelling Studies of Arctic/Mid-latitude Linkages

The programme also included a public lecture and opportunities for networking.

3. Summary of findings

The full summary of findings by the meeting organisers is included as Annex 2.

The discussion around **Arctic rapid change – Emergence of new forcing (external and internal) for atmosphere circulation** showed that, although Arctic rapid change is clearly evident in the observations and is simulated and projected by the general circulation models (GCM), our understanding of Arctic amplification (AA) is incomplete, especially the different relative contributions of the various radiative, thermodynamic, and dynamic processes.

The discussion on **Arctic mid-latitude linkages – Focusing on seasonal and regional linkages and addressing sources of inconsistency and uncertainty among studies** revealed that it is likely that rapid Arctic change is contributing to changes in mid-latitude climate and weather as well as occurrence of extreme events, but how significant the contribution is and what mechanisms are responsible are less well understood.

The discussion on **Observations and analysis** highlighted the challenges for in situ observing systems in the Arctic and that current satellite observations do not provide data beyond the past 40 years. Finally the reliability of model- and data-assimilation technology-based reanalysis for evaluating variability and changes needs to be determined, in particular considering the lack of observations in the Arctic.

4. Recommendations to APPLICATE WP3

Recommendations emerged from the workshop to expand the observational datasets and analyses approaches of Arctic change and mid-latitude linkages with various objectives:

- to synthesize new Arctic observations to provide the best high-resolution estimate of the atmospheric state for better understanding sea ice and ocean surface processes;
- to create physically-based sea ice/ocean surface forcing data sets available to investigate Arctic-midlatitude linkages; to systematically employ proven and new metrics to identify forced signals of atmospheric circulation from natural variability;
- to analyse paleoclimate data and new observational datasets that span most of the past century, including reanalysis and sea ice; and to utilize new observational analysis methods (e.g., fluctuation dissipation analysis, causal effect networks) that extend beyond correlative relationships to establish causal links between forcing and response.

Specific recommendations for the international modelling community included:

- Using a hierarchy of models from conceptual or simple component or coupled models to complex atmospheric climate model (AGCM) or fully coupled Earth system models (CESM).
- Coordinated model intercomparison project (MIP) experiments, utilizing multiple models with each adhering to a common set of forcings, simulation protocols, and specified output parameters, will enable a more systematic evaluation of mechanisms and pathways linking Arctic and midlatitude climate and weather, as well as associated feedback processes.
- The creation of a modelling task force to design and coordinate MIP experiments. A multi-tiered set of MIP experiments is envisioned, drawing from the initial planning and discussions of the US CLIVAR Working Group and planned modelling element of the

European Horizon 2020 projects (APPLICATE, Blue Action, and PRIMAVERA). Tier one experiments would consist of atmospheric model (AMIP) simulations that can be conducted by different groups and made available to the community for analysis relatively quickly. Future tier two and tier three experiments using more complex (uncoupled and/or coupled) models and designed to address specific hypothesized mechanisms and pathways will be scoped by the Working Group and task team, as well as interested groups over the next year. This will result in a new CMIP6 "MIP" to study Arctic-midlatitude linkages.

5. References

Meeting website: https://usclivar.org/meetings/2017-arctic-midlatitude-workshop

6. Acronyms

AA	Arctic amplification
(A)GCM	(Atmospheric) General Circulation Model
CESM	Coupled Earth system models
MIP	Model Intercomparison Project
US CLIVAR	United States Climate Variability and Predictability Programme

7. Annexes

Annex 1	Meeting Agenda
Annex 2	Official summary of the meeting by the organising committee