Research Priority Team (RPT) 1: The Role of the Arctic in the Global System

Co-Chairs:

Xiangdong Zhang, North Carolina State University, USA
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Secretaries:

Greta Wells, University of Iceland, Iceland
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Research Theme 1: Improvement of and Integration Between Observations and Models

Co-Leads: Steve Arnold and Priscilla Mooney

Members: Ed Blockley, Markus Frey, Stefania Gilardoni, Mats Granskog, Joo-Hong Kim, Malte Müller, Giovanni Muscari, Michael Tjernström, Xin Yang, Xiangdong Zhang

Focal areas:

- Sustainability and enhancement of observations (in-situ and satellite observations);
- Improvement of sub-grid model processes (including vertical structures in the atmosphere, ocean, sea ice, and snow; super high model resolutions; different level of complexities of model physics);
- Assimilation of the observations leading to a better understanding of the coupled Arctic system, with special focus on winter processes.

Research Theme 2: Earth Systems Linkage and Feedbacks Between the Arctic and Lower Latitudes

Co-Lead: Marianne Tronstad Lund and Xiangdong Zhang

Members: Steve Arnold, Marius Årthun, Ed Blockley, Markus Frey, Stefania Gilardoni, Joo-Hong Kim, Seong-Joong Kim, Will Kochtitzky, Priscilla Mooney, Malte Müller, Kabir Rasouli, Armina Soleymani, Michael Tjernström, Claire Waelbroeck, Yutian Wu, Xin Yang, Masakazu Yoshimori

Focal areas:

- Interactions and feedbacks within the dynamic and chemical components and between them;
- Two-way linkage between the Arctic climate system components and between the Arctic and Global Systems (including sources, e.g., natural and anthropogenic, and sinks of greenhouse gasses and particles; transport in the atmosphere, ocean, and sea ice; AMOC; interactions between the atmosphere-ocean-sea ice-glacier/ice sheet; teleconnections; extreme events).

Research Theme 3: Attributions of Arctic Changes

Co-Lead: Masakazu Yoshimori and Hans Linderholm

Members: Marius Årthun, Margit Simon, Armina Soleymani, Tommaso Tesi, Yutian Wu, Xiangdong Zhang

Focal areas:

- Contributions from natural variability and anthropogenic forcings to Arctic system changes (including the atmosphere, ocean, sea ice, glacier/ice sheet, and biogeochemical components).

<u>Research Theme 4:</u> The Role of Arctic Terrestrial Systems in Global Change

Co-Leads: Kabir Rasouli and Hotaek Park

Members: Archana Daya, Hans Linderholm, Will Kochtitzky, Greta Wells

Focal areas:

- Permafrost, geohazards, hydrological cycle, land use changes, vegetation wildfires, land-terminating glaciers;
- Snow-vegetation interactions, snowmelt-fjord ecosystem interactions,
- Coastal erosion from the releasing carbon perspective with focus in the Arctic region

<u>Research Theme 5:</u> Socio-economic Implications and Consequences and Global Collaboration

Members: Céline Rodrigues, Elana W. Rowe, Erika Roesler

Focal areas:

- Consequences in the Arctic region/Arctic indigenous Peoples and globally (defining case studies: countries where socio-economic consequences are felt in the region and worldwide);
- Weather, sea ice, and climate services and co-production;
- Global collaboration to mitigate impacts in the Arctic and the rest of the globe.

Preliminarily Identified Grand Challenges:

- Coordinate, enhance, and exploit observations, including data assimilation methods, in the context of the Arctic warming and Arctic-global linkages (poleward heat and moisture/freshwater transport).
- Improve observations (satellite and in-situ) in coordination with other communities to reduce the biases in the simulations of vertical profiles of meteorological variables and atmospheric trace constituents.
- Improve the/our understanding of coupling processes between the atmosphere, sea ice, snow, ice sheet/glacier, and ocean, and fill out key gaps such as blowing snow or wildfire processes in regional and global models.
- Distinguish the roles/contributions of the natural variability and anthropogenic forcing in the Arctic climate changes and the linkage between the Arctic and global climate system (including the changes in SPV).
- Better understand anthropogenic forcings both locally and remotely and the relative roles of natural and anthropogenic gases and particles in the context of the coupled chemical and dynamical processes.
- Understand changes in Pacific and Atlantic poleward heat transport into the Arctic and subsequent heat release to the overlying sea ice and the atmosphere.

- Improve representation of the essential processes and exploit observational data to develop/implement super high resolution (km scale) Arctic regional model and coordinate the efforts with the global modeling community.
- Understand how changes in the hydrological cycle are influenced by competing processes between atmosphere, soil, and vegetation, then influencing the Arctic freshwater budget.
- Suggestion related to lack of ocean focus: Improve understanding of how a rapidly changing Arctic climate impacts on ocean circulation and water masses in the Arctic Ocean, and how these changes could impact large-scale ocean circulation (e.g., AMOC).
- Understand how carbon sources and sinks have changed and will change, in response to climate change, i.e., how permafrost thawing will affect the atmospheric CO2/CH4 and how greening will impact carbon sequestration.
- Suggestion related to observations and methodologies: Improve our physical understanding of the Arctic-global linkage using observations and novel methodologies such as machine learning.
- Understand the role of glacier mass balance in the climate system, how it is impacted by changes in the atmosphere and ocean and the magnitude of sea level rise to expect in the coming decades and centuries. What are the major uncertainties (i.e. glacier stability)?
- Include and increase open science and build tools to answer these questions that promote open collaboration.
- Understand the implications of Arctic climate and environmental change on carbon and biogeochemical climate feedback mechanisms.
- Evolution of Arctic physical hazards/CIDs and impact of Arctic change on remote extremes/hazards.
- Understand the environmental, climatic, societal, cultural and economic implications of Arctic economic development, as a consequence Arctic changes, at global scale (interdisciplinary approach needed).