Synthesis and Legacy of GRENE Arctic Climate Change Research Project

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Green Network of Excellence Program (GRENE) Arctic Climate Change Research Project “Rapid Change of the Arctic Climate System and its Global Influences” had been conducted from Fy 2011 to 2015, and was the first Japanese interdisciplinary and model-observation collaborating project, advanced by many participants under a system that encompasses nearly all of Japan. Four Strategic Research Targets were presented:

1. Understanding the mechanism of warming amplification in the Arctic,
2. Understanding the Arctic climate system for global climate and future change,
3. Evaluation of the impacts of Arctic change on weather and climate in Japan, marine ecosystems and fisheries,
4. Projection of sea ice distribution and Arctic sea routes.

In order to analyze these targets, seven bottom up Research themes were selected:

1. Modeling Theme,
2. Terrestrial Theme,
3. Atmosphere Theme,
4. Cryosphere Theme,
5. Greenhouse Gas Theme,
6. Marine Ecosystem Theme,
7. Sea Ice and Arctic Sea Routes Theme.

It was such a unique structure that bottom up research themes answer the top down strategic research targets.

In the project, field observations were conducted at pan-Arctic sites such as Svalbard, Russian Siberia, Northern Canada, Greenland and Arctic Ocean. A high precision Cloud Profiling Radar (95 GHz) was established at Ny-Ålesund, Svalbard and intensive atmospheric observation campaigns had been held. In the Arctic Ocean, research cruises by RV “Mirai” and other ice breakers were conducted and mooring buoys were deployed. Observational data were collected in the Arctic Data archive System (ADS) and opened to the public with interfaces for the analysis. Modeling studies were carried out using various types of the models from the principal physical models to the general circulation models.

Through these observation, analysis and modeling studies, plenty of outcomes have been produced, typically as:

Identification and quantitative evaluation of the feedback processes with the seasonal cycle that cause Arctic warming amplification,

Mid-latitude link of the Arctic warming and sea ice reduction through the troposphere-stratosphere interaction including the effect to extreme weather in Japan such as cold winter and heavy snow,

Projection of sea ice distribution and possibilities of Arctic sea routes,

Changes in terrestrial ecosystems and strengthening of atmospheric CO_2 sink,

Impacts of marine environment change including ocean acidification to the marine ecosystems and change in superior species,

Contributions of glacier and ice sheet collapse to the sea level rise.

However, still many issues remain unsettled such as cloud behaviors according to the warming, advancing polar prediction capabilities, improvement of understanding water cycles and methane

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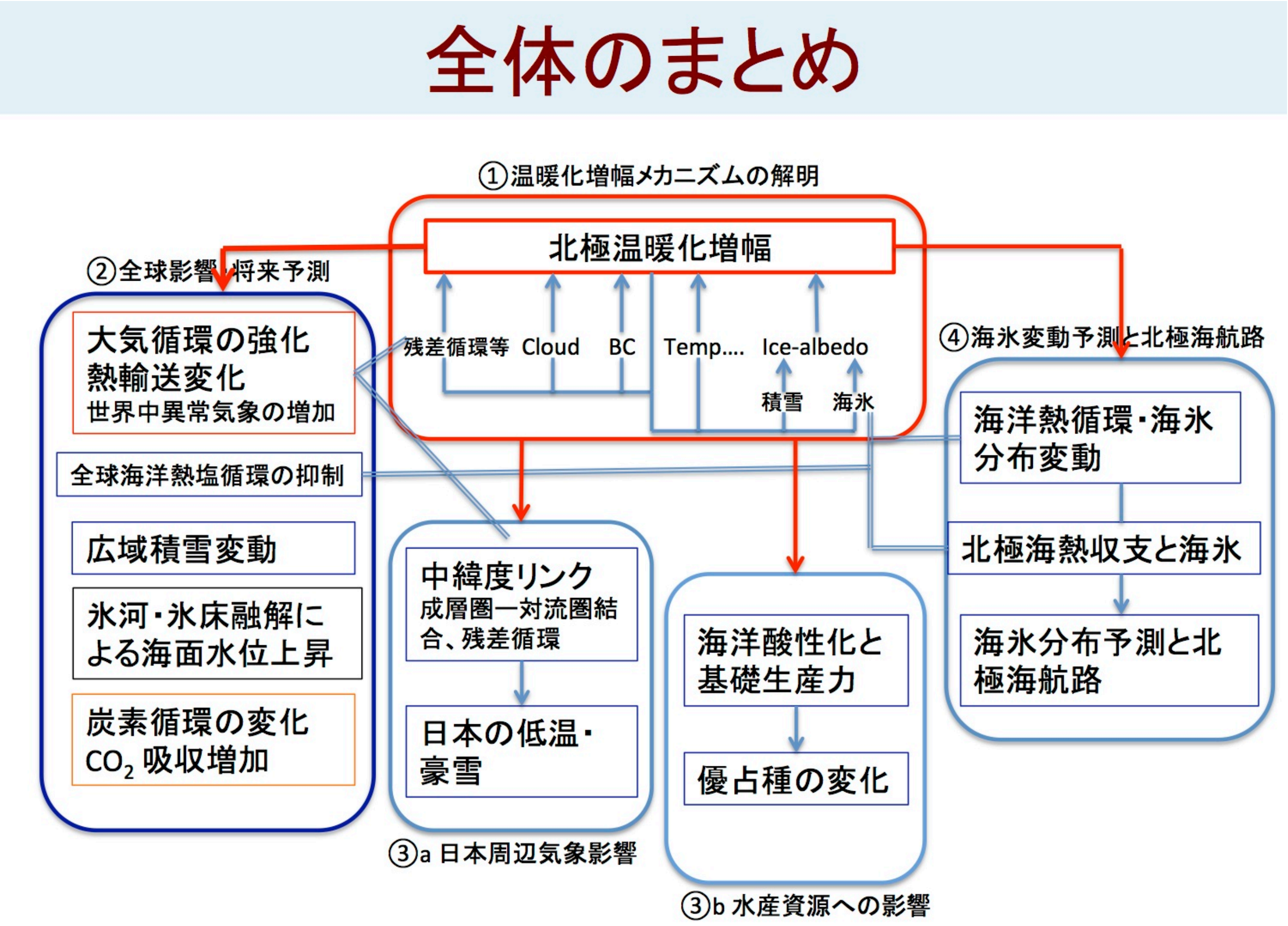
emission from permafrost and offshore region, and extensive future research activities are waited. It is greatly welcomed to further research programs using Cloud Profiling Radar as a basic infrastructure and interdisciplinary study circumstances cultivated during the project as a legacy of GRENE. Already ArCS (Arctic Challenge for Sustainability) has been started and study aimed at joining YOPP (Year of Polar Prediction; WMO/PPP) is planned, it is expected to proceed with much more new research studies on Arctic climate change.

Keywords: Arctic, sea ice, warming amplification, mid-latitude link, Arctic sea routes



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