

GRENE Arctic Climate Change Research Project in Final Phase

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Recently, due to abrupt retreat in summer sea ice area associated with global warming, rapid warming in surface air temperature, reduction of glaciers, melting permafrost and many other changes, the Arctic becomes the hot topic not only just of a scientific aspect, but also of the society. We have started a Japanese initiative **Arctic Climate Change Research Project** within the framework of the GRENE (Green Network of Excellence) Program funded by the Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT), in 2011. This Project targeted understanding and forecasting *Rapid Change of the Arctic Climate System* a Four strategic research targets are set:

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.

As the network of universities and institutions in Japan, this 5-year Project involves more than 300 scientists from 35 institutions and universities. National Institute of Polar Research (NIPR) works as the core institute and Japan Agency for Marine-Earth Science and Technology (JAMSTEC) joins as the supporting institute. There are 7 bottom up research projects on atmosphere, terrestrial ecosystem, cryosphere, marine ecology and fishery, sea ice and Northern sea route and modeling as follows:

- (1) Improvement of coupled general circulation models based on validations of Arctic climate reproducibility and on mechanism analyses of Arctic climate change and variability,
- (2) Change in the terrestrial ecosystems of the pan-Arctic and effects on climate,
- (3) Atmospheric studies on Arctic change and its global impacts,
- (4) The role of Arctic cryosphere in global change,
- (5) Studies on greenhouse gas cycles in the Arctic and their responses to climate change,
- (6) Ecosystem studies on the Arctic Ocean declining sea ice,
- (7) Projection of sea ice distribution and Arctic sea routes.

The Project will realize multi-disciplinary study of Arctic region and connect to the projection of future Arctic and global climatic change by modeling.

4 years have already passed since the beginning of the project in 2011. During that time, pan Arctic observation has been carried out in many locations, such as Svalbard, Russian Siberia, Alaska, Canada, Greenland and the Arctic Ocean. In particular, Cloud Radar in high precision was established at Ny-Alesund, Svalbard, and intensive atmospheric observations were carried out. In addition, the Arctic Ocean cruises by *Mirai* and other icebreakers were conducted and also mooring buoy observations were carried out. The retrieved data were accumulated in the Arctic Data Archive (ADS) and served with interfaces for analysis. In addition, modeling study has been promoted using from fundamental physical model to general circulation model. Through these observations and research, new research results are originated.

Now is the time to finalize. Research outputs on each issue are being born out and the creation of new scientific outcomes resulted for strategic research targets are required. In order to produce *answers* to the strategic research targets, research outcomes are examined and discussed with support of the project coordinator. As a result of the implementation of the project, clear messages to the community and society, *what could be concluded as a whole*, are requested, with the central axis of Arctic warming amplification. This review process will also become evolutionary issues to proceed to the next step (the next Arctic Research Projects).

Keywords: Arctic, sea ice, climate change, warming amplification, global warming