

The R/V Mirai Arctic Ocean cruise in 2016 and its related GRENE/ArCS studies

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We conducted meteorological and hydrographic surveys including marine biogeochemical samplings in the northern Bering Sea and the Arctic Ocean on board the R/V Mirai from 22 August to 5 October 2016 under the Arctic Challenge for Sustainability (ArCS) Project. During the cruise, the following 10 studies were carried out.

Studies on board:

- Predictability study on weather and sea-ice forecasts linked with user engagement (NIPR)
- Ship-borne observations of trace gases/aerosols in the marine atmosphere (JAMSTEC)
- How plankton responses to multi stressors such as ocean warming and acidification? (JAMSTEC)
- Primary production and transportation of organic materials in the northern Bering and the southern Chukchi Seas (Hokkaido Univ.)
- Comparison of zooplankton with differences in net mesh-size, and standing stock and material flux role of Appendicularia (Hokkaido Univ.)
- Seasonal distribution of short-tailed shearwaters and their prey in the Bering and Chukchi Seas (Hokkaido Univ.)
- Smart float observation in the marginal ice zone (JAMSTEC)
- Elucidation of the variability of freshwater in the Arctic Ocean (Tokyo Univ. of marine science and technology)
- Mooring observations in the Barrow Canyon and southern Chukchi Sea (JAMSTEC)
- Observational study on the variability of physical and chemical environments in the Pacific Arctic Ocean (JAMSTEC)

Studies not on board:

- Ship-board observations of atmospheric greenhouse gases and related species in the Arctic ocean and the western North Pacific (NIES)

The planned activities in the northern Bering Sea and the Arctic Ocean are shown in Figure 1. The stations and cruise tracks were changed due to sea ice (Figure 2), weather and other conditions. However, we tried to complete the observations in some focused areas where physical, chemical, and biological processes are sustaining unique marine environment and ecosystem that might be influenced by the recent Arctic warming and sea ice reduction. For example, a biological hotspot off Pt. Hope is maintained by nutrient supplies from the Bering Sea in spring blooms and by nutrient regeneration at the bottom in fall blooms. A new instrument deployed during GRENE project off Pt. Hope indicated seasonal changes in zooplankton, and the changes might be associated with migration of sea birds. We have also reported aragonite undersaturation in the bottom water off Pt. Hope and anthropogenic CO₂ has significant impact on the duration of undersaturation in the bottom water. For further studies, we carried out detailed hydrographic surveys and a mooring deployment off Pt. Hope in this year. Another focused area is the Barrow Canyon, where we have deployed moorings to monitor the flux of warm water from the Pacific Ocean that may impact on the sea ice distribution in the Canada Basin. The water also plays an important role in the biogeochemical cycles, and therefore, we attached chemical and biological sensors to the mooring in this year. Shelf slopes are important to understand the shelf-basin interaction and its impact on ecosystem in response to meteorological conditions. Thus, some hydrographic sections were provided in the slope area. In the basin area, the sea ice has been decreasing drastically. We found that oceanographic and biological responses to the sea ice loss are quite different between the Alaskan and Siberian sides of the region. However, on the Siberian side, data are still lacking and many biogeochemical processes may remain unknown. Unfortunately, the planned experiments in the Siberia side were canceled due to a heavy sea ice condition (Figure 2). In the presentation, we will further show preliminary results obtained from the cruise in this year.

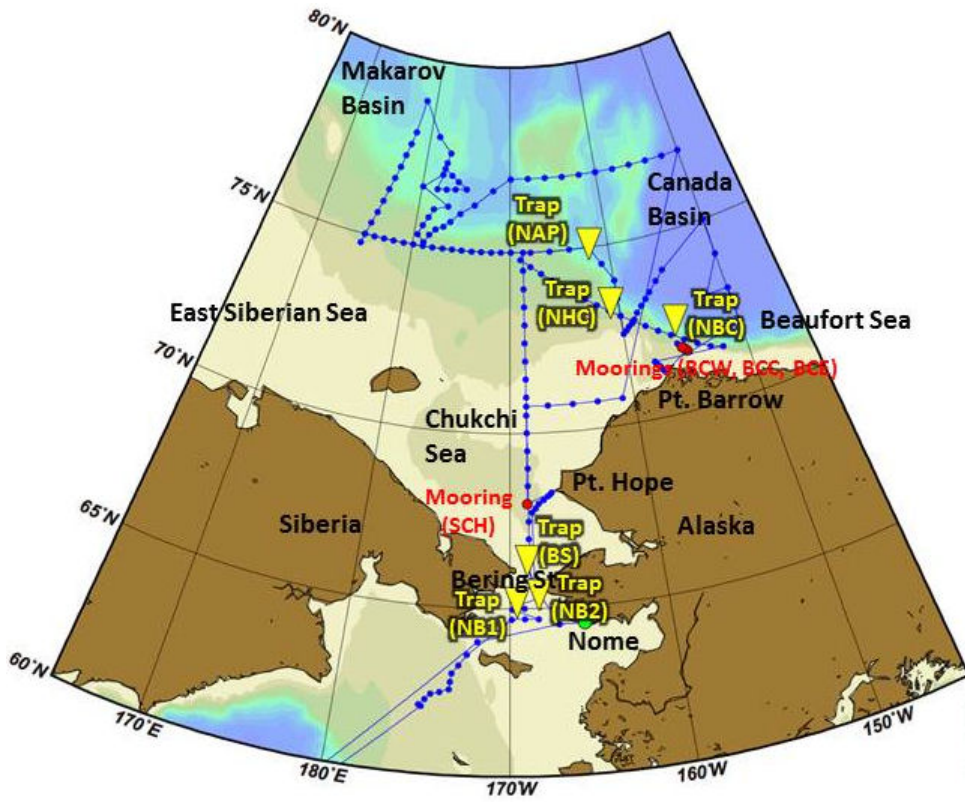


Figure 1. The geographical area of the intended work, the location of sampling stations, and the cruise tracks of survey lines in the northern Bering Sea and the Arctic Ocean. Planned points of stationary observations are represented by dots. Locations of moorings and sediment traps are represented by circles and triangles, respectively.

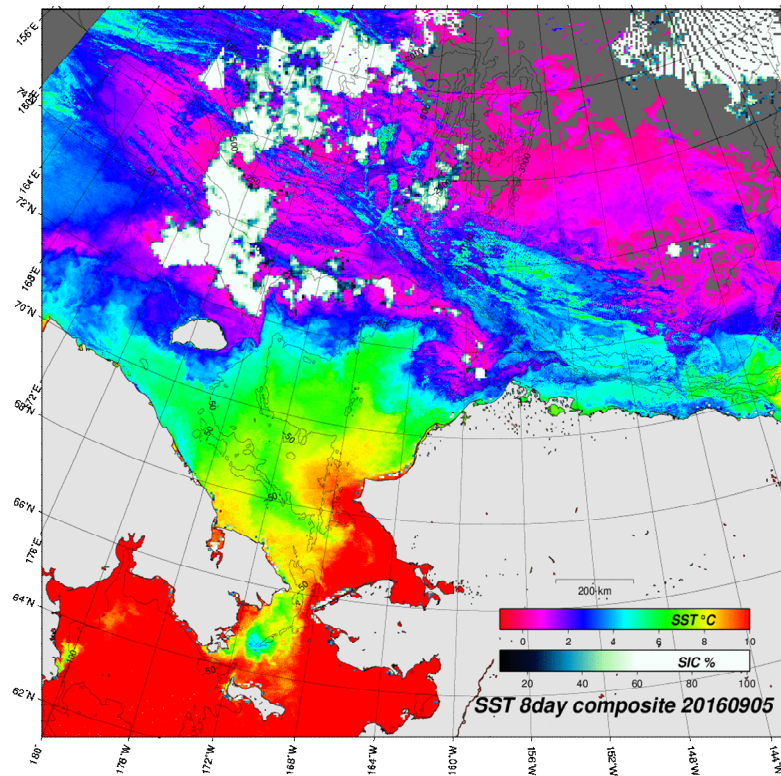


Figure 2. 8-day composite of Aqua-MODIS sea surface temperature and AMSR-2 daily sea ice concentration in our cruise region.