Arctic education using sea ice data from ADS (Arctic Data archive System)

Yoshihiro Niwa[1], Akiko Mohri[2] and Hironori Yabuki[1]
[1] *International Polar and Earth Environmental Research Center, National Institute of Polar Research*
[2] *Arctic Environment Research Center, National Institute of Polar Research*

・Introduction

The decrease in Arctic sea ice extent is one of the most apparent manifestations of global warming. The summer sea ice extent in the Arctic Ocean has decreased by half over the past 40 years and is projected to almost disappear by the middle of the 21st century. In Japan, since students learn about global warming repeatedly through elementary, junior high, and high schools, the reduction of Arctic sea ice is featured in many science, social studies, and geography textbooks.

In current school education, there is a need for inquiry-based activities using real-world data. Additionally, students learning global warming need to develop the ability to discuss and consider its issues based on scientific data. As an example of such educational practices, we conducted high-school classes using satellite-observed Arctic sea ice data to help students understand the influence of global warming on the Arctic environment and the physical processes of sea ice formation and melting.

・Class practices

The classes were conducted for first- and second-year high school students in two public high schools, one in Tokyo and the other in Saitama prefecture, in October 2022 and February 2023, respectively. Both schools are super science high schools (SSH) designated by Japan's Ministry of Education, Culture, Sports, Science and Technology. To access Arctic sea ice data, we utilized ADS (Arctic Data Archive System) managed by the National Institute of Polar Research, available at https://ads.nipr.ac.jp/. ADS provides the image data of Arctic sea ice distribution every day from 1979 to the present (Fig.1).

In the classes, we began by explaining the significance of the Arctic ocean in climate change and its observational methods. Following that, students individually operated ADS using a tablet or a laptop PC to observe the decrease in Arctic sea ice extent over the years. They then attempted to predict the year when the summer sea ice extent would almost disappear.

Subsequently, to discuss the formation and melting processes of Arctic sea ice in more detail, students created an animation of seasonal sea ice variation using ADS. We then posed the following questions to students to encourage a close observation and discussion of the animation data. "What do you notice from the data? Please answer one thing for each person. Anything is OK, but answer different thing from what the others have answered." Figure 2 displays the classroom board listing the various answers from the students. It shows that the students discovered many things from the data. For example, one student noticed that Arctic sea ice is formed along the shallow Russian coastal region, while another noticed that the Arctic sea ice is transported along the eastern coast of Greenland to enter the warm Atlantic Ocean, where it is ultimately melted.

After the above discussion, we conducted a simple cup experiment (Fig. 3) to demonstrate the contrast between the ocean density structure in the Arctic Ocean where sea ice formation takes place and that in the Greenland, Iceland, and Norwegian seas where deep convection occurs. Through these interactive activities, students were able to learn various aspects of sea ice formation and melting processes, along with the fundamental principles of ocean physics.

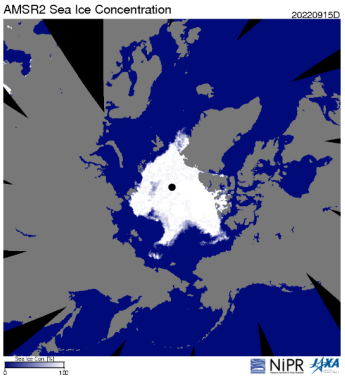

Fig.1 An example of image data of Arctic sea ice distribution provided by ADS

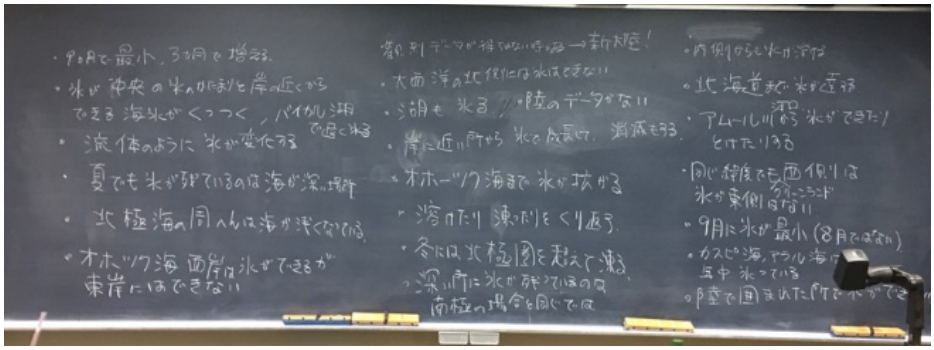

Fig.2 The classroom board showing what high-school students noticed from ADS data

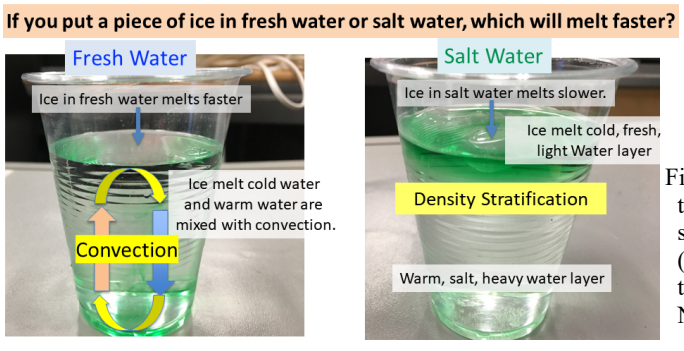

Fig.3 The experiment to demonstrate the contrast between ocean density structure in the Arctic ocean (salt water case) and that in the Greenland, Iceland, and Norwegian Seas (fresh water case).