Educational Practices using Polar Sea Ice Data
for High School Science and Mathematics Classes

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Climate change education is essential for the next-generation of young students who will be directly affected and must cope with its threats in the future. For these students, it is important to have an experience processing and closely observing real-world climate data to promote a data-based discussion. As an example of the data-based climate change education, we conducted two different classroom practices using actual polar sea ice data for high school students. Polar sea ice data are suitable for this educational purpose, since Arctic sea ice shows the clearest global warming signal. In addition, all students can guess and discuss the ice melt/formation process based on their daily experiences.

The first educational practice was conducted in February 2018 at secondary school attached to the faculty of education of the university of Tokyo for 36 first-grade high school students in their two-hour mathematics class on data analysis. In this class, each student used a desktop computer to analyze the 5-day-interval Arctic and Antarctic sea ice extent data for 30 years (1979-2008). For most of the students, this was their first experience processing large data from the real world. They drew the sea ice extent graphs using Microsoft Excel and added regression lines (Figure 1). Then, they compared the change in sea ice extent in the Arctic where a clear downward trend can be confirmed with that in the Antarctic where the regression line shows a slight upward trend. This result was contrary to their expectations, as they expected that the sea ice extent both in the Arctic and Antarctic would decrease with global warming. Then, they had a free discussion about global warming, the Arctic and Antarctic climates, and the validity of the data analysis results.

The second educational practice was conducted in October 2022 at Tokyo metropolitan Tachikawa high school for 42 first-grade high school students in their two-hour science class on scientific inquiry activity. We aimed for students to motivate an active attitude toward observing scientific data. The satellite-derived Arctic sea ice concentration data (Figure 2) visualized and provided by the Arctic data archive system (ADS) (https://ads.nipr.ac.jp/vishop/#/monitor) of NPRI (National Institute of Polar Research) were used in this class. First, we explained how to access and operate the ADS homepage. Then, each student operated ADS with a laptop computer to repeatedly and closely observe the seasonal variation in the Arctic sea ice concentration field. To promote their close observation, we asked the students the following question "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 3 shows the whiteboards that list the answers received in the class. We can confirm that the students had noticed, shared, and learned a variety of characteristics of sea ice, ocean, and geography in the Arctic region.
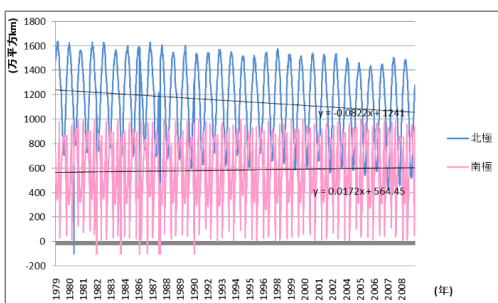

Figure 1. The Arctic and Antarctic sea ice extent graphs drawn in the first educational practice.
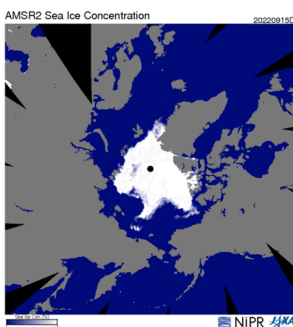

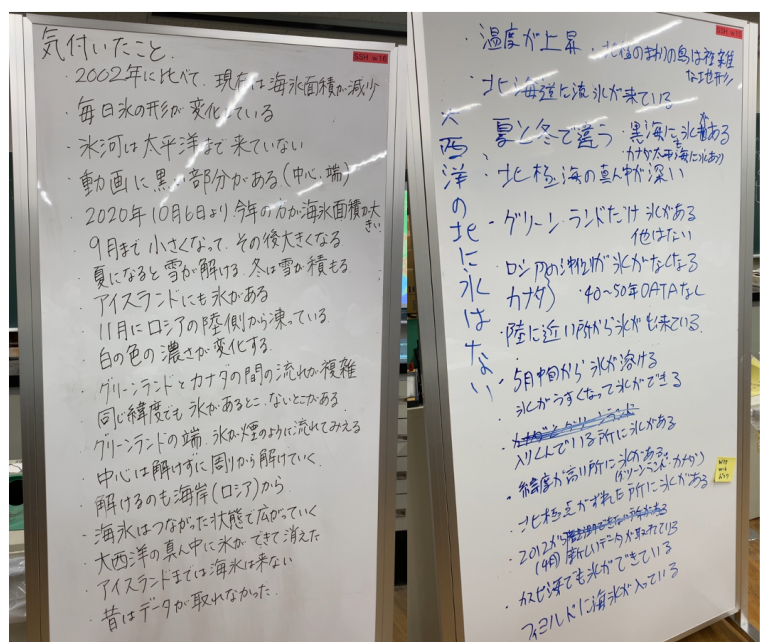Figure 2. The example of the ADS data used in the second educational practice

Figure 3. The whiteboards in the second educational practice that list what the students noticed from the ADS data.