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Understanding the new era linking the Arctic and midlatitude

Jun Inoue
National Institute of Polar Research, Japan

Abstract

In the Arctic, rainfall has been frequently observed in the last decade caused by the Arctic Amplification and warm and moist air intrusion from the midlatitudes by an atmospheric river. The Arctic climate tipping point should be understood from the viewpoint of the Arctic-midlatitudes linkage. One of the essential climate parameters is clouds in polar regions that regulate the sea/sea-ice surface radiation budget and freshwater supply into the ocean and sea ice through precipitation. The observing systems to monitor cloud systems have been available on RV Mirai. A shipboard Doppler radar succeeded in observing the Arctic cyclones near the marginal ice zone [1)]. The radio soundings from RV Mirai have been improving the skills for numerical weather predictions and sea-ice forecasts [2)], contributing to establishing the coordinated Arctic observing network in the framework of the WMO Polar Prediction Project – Year of Polar Prediction. Combining these instruments, the clouds and surface heat budgets represented in regional climate models were assessed under the Arctic CORDEX project [3)].

Recently, the application of new technologies to observe the clouds has been available. Cloud Particle Sensor (CPS) sonde counts the cloud particles with their size and phase [4)]. A lidar ceilometer can detect the clouds' phase and base height [5)]. Drone atmospheric profiling, including the number concentration of aerosols, has been used practically over a ship [6-8)]. Those new observing systems are vital to investigating the impact of emerging phenomena in the Arctic and beyond [9)]. For example, the long-range transport via atmospheric rivers from midlatitudes where forest fires have frequently occurred in North America and Eurasia would provide a large amount of moisture, heat, and aerosols, modifying the cloud-precipitation system over the Arctic Ocean. Emerging poleward shifts of typhoon track [10)] and abnormal stationary high-pressure systems over the midlatitudes [11)] may also influence ocean heat advection into the Pacific Arctic. Therefore, a new era at the point of no return in the Arctic climate should be carefully monitored to find unexpected feedback mechanisms connected to the events at mid-latitudes. Collaborating with land stations and ships in the Arctic countries, the new Japanese icebreaker has a crucial role in understanding the next stage of the Arctic states, contributing to filling a knowledge gap between the current and the never-experienced state in the near future.

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