

ArCS II Cryosphere research–3 "Water and material circulations between snow-and-ice and atmosphere in seasonal sea ice regions and their impact on environment in the Arctic"

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Outline of the project

We introduce Cryosphere Research–3 "Water and material circulations between snow-and-ice and atmosphere in seasonal sea ice regions and their impact on environment in the Arctic", which has been launched under "Arctic Challenge for Sustainability II (ArCS II) in this presentation. This project aims to elucidate (1) regional processes of water circulation over seasonal sea ice in winter and its influence on the precipitation in the coastal region of Greenland, (2) influence of chemical substances emitted from seasonal sea ice region in winter on chemical environment and ice and cloud nucleation in atmosphere, (3) temporal changes of their processes on seasonal sea ice region on global warming by ice core analyses obtained from coastal area of Greenland Ice Sheet.

Background of the project

Hara et al. (2017) showed the cases of selective concentration of sea salt on the frost flower formed on new sea ice and emission of aerosol from the frost flower to the atmosphere and suggest the possible impact of the halogen compound in the aerosols on photoredox reaction in the atmosphere. We believe these processes should be considered in elaborated Chemical Transport Models in the Arctic atmosphere. Kurosaki et al. (2020) analyzed a coastal ice core of Greenland Ice Sheet (SIGMA-A), showed the correlation between the precipitation amount at the drilling site and the supplied amount of water vapor from nearby ocean surface, and indicate the importance of contribution of local water circulation to the precipitation at the coastal region of Greenland.

Observation plan in 2020/21 season

We will rent on a hut from a residence and establish an observation site in Siorapaluk village in northwestern Greenland in December 2020. In order to detect the changes of atmospheric conditions during the formations and the breakups of sea ice in front of Siorapaluk village, we will conduct meteorological monitoring (air temperature, relative humidity, air pressure, wind speed and direction, precipitation amount, and UV irradiation), continuous observation of water vapor concentration and water stable isotope ratio of water vapor, and aerosol sampling with a high-volume aerosol sampler. Aerosol will be collected by 4 step size classification on quartz filters with 2-weeks interval. The aerosol samples will be transported in frozen to Japan, and will be analyzed for compositions of sea salts, halogen species, organic compounds, trace metals and so on, and conducted formative ability test of ice nuclei for the aerosols. We will also conduct observations of frost flowers and aerosols on sea ice in February and March 2021 to elucidate processes of emission of aerosols from the surface of sea ice.

Observation plans 2021-2024

We will keep on the continuous observations at Siorapaluk until 2024. We will also conduct shallow ice core drilling at a coastal area of Greenland Ice Sheet near Siorapaluk and Arctic Canada in 2022 and 2023. The length of the ice cores will be approximately 100m, which can cover 100 years.

References

Hara et al., Frost flowers and sea-salt aerosols over seasonal sea-ice areas in northwestern Greenland during winter-spring, *Atmos. Chem. Phys.*, 17, 8577-8598, 2017.
Kurosaki et al., Reconstruction of sea ice concentration in northern Baffin Bay using deuterium excess in a coastal ice core from the northwestern Greenland Ice Sheet, *J. Geophys. Res.-Atmos.*, 125, e2019JD03166, 2020.