【Grant-in-Aid for Scientific Research (S)】

Broad Section K

Title of Project : Construction of world's most reliable deposited-aerosol database on the Anthropocene (from 1850 to 2020)

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【Research Purpose and Background】

According to a 2013 IPCC report, anthropogenic contribution factors to global warming are mainly greenhouse gases (warming) and aerosols (cooling). Among these factors, the aerosol-cloud interactions are the least understood scientifically. Thus, enhanced understanding of aerosol-cloud interactions is vital to more precisely evaluating the future prospects of global warming.

One promising approach to evaluating aerosol-cloud interactions is to follow the aphorism, "Discover new things by studying the past." Understanding the past relationships among aerosol concentrations, aerosol-cloud interactions and temperature fluctuations will lead to better forecasts of temperature change.

Aerosols from the past are preserved in snow and ice (cryosphere) through their solid precipitation. A highland in the Greenland ice sheet is an ideal area to evaluate past anthropogenic aerosol trends. In this study, we will drill into the Southeastern Greenland Dome, where aerosols have been extremely well preserved, to obtain a 250-meter-long ice core. Then, we will construct the most reliable database for aerosol concentrations and compositions during the Anthropocene (from 1850 to 2020).

【Research Method】

In our previous project (a study supported by MEXT/JSPS Kakenhi Grant Number 26257201), we obtained a 90-meter-long ice core from the Southeastern Greenland Dome (figure 1), and reconstructed changes in aerosol concentrations and compositions over the most recent 60 years. We found that nitrate aerosols are well-preserved at this site compared to other Greenland sites. In the present research project, we plan to drill a 250-meter-long ice core at the same site in 2020. We will analyze aerosol concentrations of sulfate, nitrate, ammonium, sea salt, dust, black carbon and organic matters, which are often studied for use in aerosol transportation models. Based on the analyzed data, we will construct the world's most reliable deposited-aerosol database on the Anthropocene (from 1850 to 2020). We will apply unique methods that can measure composition and isotopes of aerosol to better understand the mechanisms of aerosol fluctuations and aerosol-cloud interactions.

Figure 1: Ice core drilling at the Southeastern Greenland Dome.

【Expected Research Achievements and Scientific Significance】

The most reliable deposited-aerosol database on the Anthropocene (from 1850 to 2020) will be opened and published for climate model researchers and used as a scenario builder in IPCC reports. By tapping information contained in the database, researchers can provide more reliable forecasts of temperature change. Improved understanding of mechanisms involving aerosol fluctuations and aerosol-cloud interactions is expected to reduce uncertainty in predictions of future climate change.

【Publications Relevant to the Project】

Furukawa et al., Journal of Geophysical Research: Atmospheres, 122, 10,873–10,887, 2017, https://doi.org/10.1002/2017JD026716
Iizuka et al., Journal of Geophysical Research: Atmospheres, 123, 1, 574–589, 2018, https://doi.org/10.1002/2017JD026733

【Project term】 FY2018-2022

【Budget allocation】 147,000 Thousand yen

【Homepage Address and Other Contact Information】

SE-Dome ice core database
https://eprints.lib.hokudai.ac.jp/dspace/handle/2115/67127