

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

Integrated Science and Innovative Science (New multidisciplinary fields)



Title of Project : Effects of snow impurities and glacial microbes on abrupt warming in the Arctic

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Research Area : New multidisciplinary fields

Keyword : Polar environmental monitoring, Cryospheric change, Global warming

【Purpose and Background of the Research】

Many climate models cannot simulate recent abrupt snow/ice melting in the Arctic. One of the possible causes is albedo reduction due to light absorbing snow impurities such as black carbon (BC) and glacial microbes. To clarify that, we will conduct field campaigns in Greenland, where the abrupt melting is occurring, and continuous meteorological and snow observations in Japan. Based on those data, snow metamorphism and albedo process (SMAP) model and glacial microbe model (GMM) will be developed and incorporated into earth system model (ESM). We will simulate the recent and future climates, by which the quantitative contributions of BC and glacial microbes on the recent abrupt melting in the Arctic will be clarified. We will also reproduce the atmospheric aerosols and snow impurities after the Industrial Revolution from Greenland ice core. Furthermore, we will retrieve the temporal-spatial variations of snow physical parameters with satellite remote sensing.

【Research Methods】

- (1) Field campaigns for meteorological and radiation observations, snow pit work, and glacial microbial survey will be conducted from 2011 to 2013 in Greenland.
- (2) Continuous meteorological and snow observations will be performed at three sites in Japan from 2011 to 2015. Using those data including (1), SMAP model and GMM will be developed and validated.
- (3) Climate simulation and numerical sensitivity experiment with ESM, in which SMAP model and

GMM are incorporated, will be made for the present and future Arctic.

(4) Shallow ice core drilling will be conducted in Greenland to obtain the record of atmospheric aerosols, snow impurities, and glacial microbes after the Industrial Revolution.

(5) Long term and spatial variations of snow physical parameters and albedo in the Arctic will be retrieved with satellite remote sensing.

【Expected Research Achievements and Scientific Significance】

Snow pollution by BC in the Arctic is elucidated from in-situ and satellite measurements. Radiative forcing due to light absorbing snow impurities such as BC and glacial microbes are estimated with ESM, by which quantitative contributions of BC and glacial microbes on the recent abrupt snow/ice melting in the Arctic can be clarified. If the BC contribution to snow/ice melting cannot be ignored, these estimates could be scientific basis for the emission restriction.

【Publications Relevant to the Project】

Aoki, T., K. Kuchiki, M. Niwano, Y. Kodama, M. Hosaka, and T. Tanaka: Physically based snow albedo model for calculating broadband albedos and the solar heating profile in snowpack for general circulation models, *J. Geophys. Res.*, **116**, D11114, doi:10.1029/2010JD015507, (2011).

Takeuchi, N., and Li, Z.: Characteristics of surface dust on Ürümqi Glacier No. 1 in the Tien Shan Mountains, China. *Arctic, Antarctic, and Alpine Research*, **40**(4), 744-750, (2008).

【Term of Project】 FY2011-2015

【Budget Allocation】 165,400 Thousand Yen

【Homepage Address and Other Contact Information】

<http://www.mri-jma.go.jp/Dep/ph/ph3/ph3-e.html>

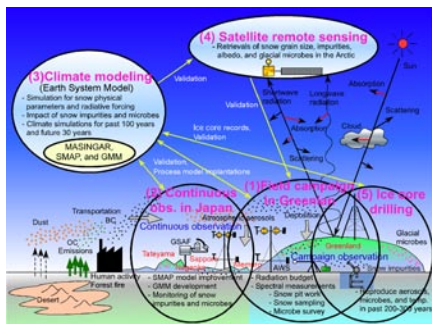


Fig. 1 Five research subjects in this study.