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Recent temporal change of Greenland ice sheet surface temperature and reflectance derived from MODIS data

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Rapid Arctic climate changes are reported in recent decades. Greenland ice sheet holds approximately 10% of the fresh water on earth. If it melts all, sea level rises about 7.2meter. It is reported that mass of Greenland ice sheet is decreasing with temperature rising of climate change. However many climate models aren't able to simulate the recent melting of snow and ice in the Arctic including Greenland. One of the possible causes is albedo reduction of snow and ice surface by light absorbing snow impurities such as black carbon and dust and by glacial microorganisms. In addition, there are reports that the dark region darkened with glacial microorganisms has emerged in the southwestern part of Greenland (Wientjes and Oerleman., 2010). However there are few researches for effect of glacial microorganisms in wide area. So it is important to clarify the impact of glacial microorganisms in wide area.

The goal of this study is to clarify the effect of microorganism on Greenland ice sheet surface temperature change using satellite images and observation carried out in northwestern Greenland.

In this paper, we show the temporal change of monthly average ice sheet surface temperature derived from MODIS/Aqua July in recent years, from 2002 to 2010.

We use MODIS LST Product as ice sheet surface temperature. It estimates land surface temperature using Land Surface Temperature Algorithm based on split window method (Wan et al., 1996). We analyzed surface temperature on dark region (68.45N, 49W), downstream of dark region (68.45N, 50W) and upstream of dark region (68.45N, 48W).

Monthly average ice sheet surface temperature is falling in recent years around dark region. The rate of temperature change on downstream is -0.08 degree Celsius per year and the rate of temperature change on upstream is -0.07 degree Celsius per year. The rate of temperature change on dark region is -0.007 degree Celsius per year, it shows less change than the other area. It is considered that low surface reflectance advances solar radiation absorption caused by glacial microorganism. Cooling on the other area seems to be caused by appearance of low temperature ice body under the snow cover especially downstream of dark region. Low temperature ice body controls glacial microorganism growth. Cooling trend on downstream of dark region is caused by suppression of glacial microorganism.

In the future, in order to clarify the relationship between temperature change and glacial microorganism, we will develop product to determine the quantity of glacial microorganism by satellite images.

Keywords: Greenland, Surface temperature, Reflectance, Glacial microorganism