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DARKENING GREENLAND AND CRYOCONITE HOLE DYNAMICS

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Dark colored ice surface, which appeared on the Greenland Ice sheet in melting season, is one of possible factors to cause recent significant melting of the ice sheet. Since darker ice surface can absorb more solar radiation, the ice melts faster. Dark coloration of ice is usually due to impurities covering its surface, which consist of mineral particles, microbes, and organic matter. These impurities often aggregate and form small spherical granules (cryoconite granules), and usually deposited in small water-filled cylindrical pits formed on the ice surface, called cryoconite holes. Size of the holes can change with meteorological conditions. If they collapsed, impurities deposited at the bottom of holes spread out on the ice surface, and then darken the ice surface. Therefore, dynamics of cryoconite holes on ice surface is important to understand darkening process of glaciers. However, there are still only a few studies on the cryoconite hole dynamics.

We report continuous time-lapse observation of cryoconite holes in melting season on a Greenland glacier in order to understand relationship between their dynamics and meteorological conditions. Approximately 1 square meter of ice surface was captured every 1 hour with an interval camera at elevation of 700 m on Qaanaaq Glacier located in northwest Greenland. The observation revealed that holes temporally changed in their size, and collapsed twice during the observation. Comparison with meteorological data showed that the collapse of holes took place in the conditions of cloudy and windy, which corresponded to the dominance of latent or sensible heats rather than of radiation heat in the energy balance on the glacier surface. Results suggest that change of energy balance of glacier surface due to climate warming can cause the darkening ice surface of glaciers and the ice sheet.