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TEMPORAL AND SPATIAL VARIATIONS IN DARK ICE SURFACE ON GREENLAND ICE SHEET DERIVED FROM MODIS SATELLITE IMAGE

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Dark-colored ice surface appeared on the Greenland ice sheet every summer in recent years. It is likely to have a great impact on mass balance of the ice sheet because its low reflectance can enhance absorption of solar radiation to the ice surface and then accelerate the ice melting. However, there is still few studies focused on the temporal and spatial variations in extents of bare ice and dark ice areas on the entire ice sheet.

We report temporal and spatial variations in the bare ice and dark ice areas appeared in melting season on the Greenland ice sheet derived from MODIS satellite images from 2000 to 2013. The monthly mean of the bare ice area for July ranged from 121,750 km² to 348,475 km², which are corresponded to 5 and 16% of the entire ice sheet, respectively. The monthly mean of the dark ice area for July ranged from 12,675 km² to 47,250 km², which are 8 and 15% of the bare ice area of each year, respectively. Both the bare ice and dark ice areas tended to increase during the study period at a rate of 10,425 and 1,340 km² per year, respectively. Their spatial variations on the ice sheet showed that the expansion of the bare ice and dark ice areas have mostly occurred in the western side, particularly in the southwest side of the ice sheet. The temporal change of the dark ice area in the northwest side appears to synchronize with the change of the bare ice area, while the change in southwest side does not. The bare ice area in the southwest side had continuously expanded from 2010 to 2013 while the dark ice area had shrunk from 2010 to 2011, and then expanded again to 2013. This suggest that the change of the dark ice area is not simply controlled by snow melt on the ice, but probably controlled by changes in physical characteristics of the bare ice surface, such as expansion of impurities, ice roughness, and cryoconite holes.