Meltwater floods at Qaanaaq ice cap in northwestern Greenland investigated by using a surface mass balance model

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Melt increase in the Greenland ice sheet and peripheral ice caps give impact on coastal environment, but only a few studies have focused on its influence on the human activity in Greenland. Qaanaaq, a village in northwestern Greenland populated by 500 people, has been a base for field campaigns conducted by the GRENE and ArCS projects. On 21 July 2015 and 3 August 2016, streams flooded in the village, which resulted in destruction of a road between the village and Qaanaaq Airport. These floods were caused by increased runoff from Qaanaaq ice cap located several kilometers from the village. Similar floods were recorded in the past, but the one in 2016 caused unusually serious damage. Possibly, these floods are the results of recently changing climatic conditions in the Arctic region.
In this study, we investigated the floods in 2015 and 2016 by using a surface mass balance model NHM-SMAP (*Niwano et al.*, 2012, 2014). Model output at 5 km mesh grid points was downscaled to a 300 m grid, using the method proposed by *Noël et al.* (2016). This method considers the dependence of snow and ice melt rate on elevation. Digital elevation model and ice mask provided by Byrd Polar and Climate Research Center were used for this procedure (*Howat et al.*, 2014). We compared downscaled surface mass balance with the observational data acquired in 2012–2016. Then we estimated the amount of runoff from Qaanaaq ice cap.
Runoff from Qaanaaq ice cap was significantly larger than usual on 21 July 2015 and 2 August 2016, the day and the previous day of the flood in 2015 and 2016, respectively. The runoff computed for 21 July was the second greatest in 2015. Daily mean air temperature observed at Qaanaaq airport showed the highest in the year during the period from 21 to 23 July. In the upper part of the ice cap, the largest amount of melting in the year was calculated on the day of the flood. No significantly large melting was computed after the flood in 2015. Runoff on 2 August was the third largest in 2016, which corresponds to the largest amount of daily rainfall. From these results, rapid melting and strong rainfall were suggested as the causes of the floods in 2015 and 2016, respectively. This study showed that the floods occurred in the end of melt season.

References

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