Meltwater discharge from Qaanaaq Glacier in the summer 2022

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Under the influence of air temperature rise in the Arctic, glacial meltwater discharge has been increasing in Greenland (e.g., Bamber et al., 2012). Unprecedented amount of discharge caused flooding, which resulted in damages of infrastructures in the coastal settlements in Greenland (Mikkelsen et al., 2012). For example, floods occurred in 2015 and 2016 at an outlet stream of Qaanaaq Glacier in northwestern Greenland destroyed a bridge and a road (Kondo et al., 2021). After the flood events, we began measurements of the stream discharge to investigate a link between recent climate change and the flooding. Based on the measurements from 2017 to 2019, we constructed a glacier runoff model and demonstrated that the floods were caused by intensive melt of the glacier in 2015, whereas by a heavy rain event in 2016. In the summer 2022, the discharge from Qaanaaq Glacier flooded again on 17 July and damaged the road connecting Qaanaaq Airport and the settlement of Qaanaaq (Fig. 1). This event highlights the need for further research in the region. To investigate the processes controlling the river discharge variations, we performed discharge and glacier melt measurements in the summer 2022.

Discharge from Qaanaaq Glacier was measured at 2.0 km from the glacier from 20 July to 26 August (Fig. 2). Water level of the stream was obtained every 10 minutes with a pressure sensor (HOBO U20-001-04) fixed within the water in the stream. Water current was measured 31 times every 0.5 m across the stream with an electromagnetic current meter (YOKOGAWA ES-7603) to compute the discharge by integrating the current over the cross-sectional area. The discharge measurements were repeated 31 times during the study period, so that observed water level variations were converted to discharge time series by using an empirical relationship between water level and discharge. Meteorological data was obtained from Qaanaaq Airport located at 16 m a.s.l. (Fig. 2). During the observation period, the discharge varied within a range from 0.21 to 2.72 $m^3 s^{-1}$ (Fig. 3). The lowest discharge was observed on 22 August when daily air temperature dropped to 3.9 °C (Fig. 3). On 17 July, the day of the flood event, air temperature increased to 11 ℃. This is the highest temperature during the summer 2022, suggesting the flood event was likely due to intensive glacier melt. Glacier runoff modelling is planned to investigate the processes drove the flood in 2022.

Figure 1. The food event on 17 July 2022.
The photograph was taken at the discharge measurement site indicated in Fig. 2.

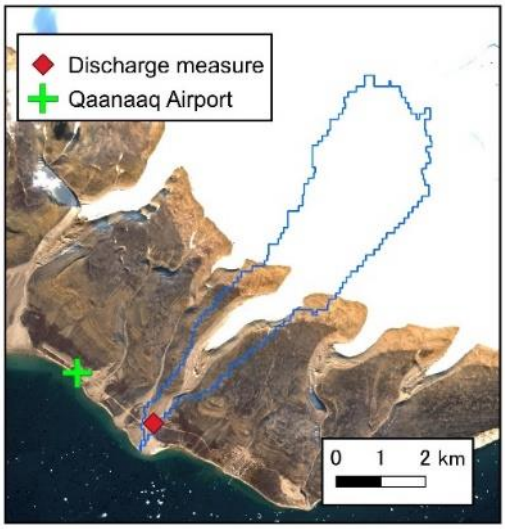

Figure 2. Sentinel-2 image of the study site (9 September 2022), showing the locations of the discharge measurement site(＋) and a weather station at Qaanaaq Airport (♦)

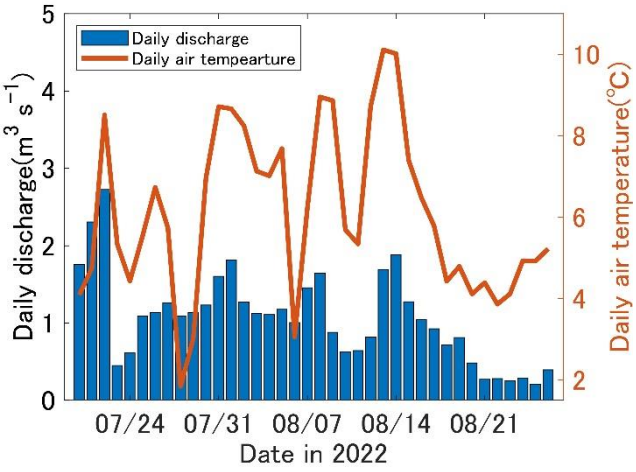

Figure 3. Daily discharge of the outlet stream of Qaanaaq Glacier (left) and daily mean temperature measured at Qaanaaq Airport (right) from 20 July to 26 August 2022

References

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