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MELTWATER AND RAIN WATER DISCHARGE FROM GLACIER BASINS OF SPITSBERGEN AND ITS INFLUENCE ON ICE CLIFF DYNAMICS

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The process of calving from tidewater glaciers is driven by factors operating at both the glacier side and the sea-ward side of an ice cliff. Water supplied to the glacier drainage system influences the lubrication of its bed and hence basal sliding. Melt and rain water are the main sources of this supply. Climate warming causes an increase in frequency of extreme rainfall events in Spitsbergen. This study attempts to distinguish the importance of intense melt events and heavy rains for the dynamics of the frontal part of Hansbreen basing upon monitoring its ice cliff dynamics, data from meteorological stations and river discharge from the neighboring land-based glacier Werenskioldbreen. Two aspects of response of tidewater glacier terminus to high freshwater water supply are considered: (1) the intensification of glacier velocity caused by higher subglacial water pressure and (2) the increase in melting of the ice cliff in the vicinity of submarine turbulent outflow from a subglacial tunnel. Both are influencing the processes leading to calving. The recent enhance in calving of the subglacial discharge zone has caused the development of an embayement there. The record of river discharge from Werenskiold Glacier permitted to distinguish three types of discharge regimes: snow and ice melt driven discharge, rainfall driven discharge and a mixed one. A marked increase in liquid precipitation in Hornsund during summer seasons (June-September) has been noted in the period 1978-2012 with a significant increase of share for September. During the recent decade, the rainfall regime has been prevailing in the Werenskioldbreen proglacial river. In the first period of ablation season, snow and ice melting were the dominant sources of water going into the glacier drainage system, increasing subglacial water pressure and stimulating basal sliding. Subglacial channels would not have been developed enough at the time, after their winter closure. Subsequently, those channels became open. In the later part of the summer and in fall, ablation was lower. Heavy rainfalls were more frequent at the time when channelized drainage system dominated under the glacier. Thus, rainfall events had smaller impact on basal sliding and at the period when atmospheric supply was dominant the water was transferred faster towards the cliff giving higher discharges, as was visible in the record from the Werenskioldbreen river gauging station. One can expect more frequent intense rainfall events in fall and winter as an effect of climate warming. They will influence the disintegration of the ice cliff by forming a turbulent freshwater stream that will mix with warmer sea water and will cause more intensive melting locally. The creation of embayments with more intense calving over sublacial river outflows could lead to faster disintegration of the ice cliff. The described phenomena show climatic signals driving the ice cliff dynamics through changing the glacier drainage system and stimulating mass loss in the form of icebergs.

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