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Investigation of Greenland Russell glacier with remote sensing observations and ice sheet/hydrodynamic simulations

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There is great interest in the mechanism and consequences of arctic ice sheet migration in the context of worldwide climate change. An in-depth investigation of glacial movement involving supra/under glacial hydrological channel activities is key to understanding the acceleration of Greenland's ice sheet changes and needs to be established as an integrated model. In terms of the glacial migration involving basal hydrology, we have conducted a case study over the Russell glacier in western Greenland. Remote sensed image analyses combined with a numerical model in its melt water outflow channels, such as the Akuliarusiarsuup Kuua and Qinnguata Kuussua rivers, and ice sheet simulations were performed. Employed technical approaches are summarized as follows: 1) Collecting 3D migration vectors combining differential interferometric SAR (D-InSAR) analysis, together with the in-house pixel tracking method employing optical flow and sub-pixel refinement with C band Sentinel-1 and L band ALOS PALSAR-2 images; 2) a 2D hydrodynamic simulation based on the channel bathymetry, which was driven from calibrated LANDSAT images together with along-track stereo DTM, and 3) an ice sheet model to extract the bedrock and basal characteristics of the glaciers. In addition, we tried Sentinel-1 InSAR time series to monitor ice sheet migrations over a certain time domain.
The results revealed the importance of hydrological channel morphology as a governing factor over migration speeds of glaciers. Specifically, the sub glacial processes and underlying morphology traced by remote sensing observation and the numerical model were correlated with the observed local migration speeds in terminus of the Russell glacier.
Those experiences naturally will lead to a more comprehensive understanding of the processes of artic glaciers. Thus, based on the output of this study, the proposed method will be extended to tackle the issues of ice sheet change occurring in the Greenland costal area.

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