

Complex basal conditions and their influence on ice flow at the onset of the Northeast Greenland Ice Stream

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Abstract

The ice stream geometry and large ice surface velocities at the onset region of the Northeast Greenland Ice Stream (NEGIS) are not yet well reproduced in ice sheet models and are thus, a large source of uncertainty in present ice sheet projections. A major gap remains the quantification of basal sliding and a parameterization of basal conditions. In this study, we assess the basal conditions of the onset region of the NEGIS in a systematic analysis of airborne ultra-wideband radar data. We evaluate basal roughness and basal return echoes in the context of the current ice stream geometry and ice surface velocity. We observe a change in basal roughness from a smooth to a rougher bed where the ice stream widens, and a distinct roughness anisotropy in the upstream survey region indicating a preferred orientation of subglacial structures. In addition, in this region we find a clear increase of the bed return power towards the centre of the ice stream, potentially indicating an increased water content at the base. At the downstream part, we observe an increased bed return power throughout the entire width of the ice stream and outside its margins. Together with basal water routing pathways, this hints to two different zones in this part of NEGIS: the upstream part collecting water, reducing basal traction, and in the downstream part the distribution of basal water underneath and beyond the shear margins. Our findings support the hypothesis that the NEGIS is strongly controlled by the subglacial water system in its onset region.