Reconstruction of ice streams in polar ice sheets

Abstract: The increased flow of ice from the polar ice sheets into the oceans is one of the main factors that causes global sea-level rise. In the Antarctic and Greenland ice sheets, ice flows under its own weight towards the margins. The ice sheets currently lose mass, as more ice is lost by melting and flow into the oceans than is added by precipitation. Ice in ice sheets is a ductile material, i.e. it can flow as a thick viscous fluid. The flow of ice in ice streams is not evenly distributed. Ice streams are zones where the flow is distinctly faster than in the surrounding ice. The North-East Greenland Ice Stream (NEGIS) is a spectacular example with a length of over 500 km and flow velocities 5-10x faster than in its surroundings. Ice streams such as NEGIS account for a significant part of all the ice discharge into the oceans. Yet, it remains unclear how and why ice streams form and how they may react to changing conditions, such as global climate change. The full-Stokes code Underworld is applied in this study for 3D modeling of the power-law and transversely isotropic (mechanical anisotropy due to crystallographic preferred orientation) ice flow, thus reconstructing ice streams in polar ice sheets and also the formation of the shear margin and englacial stratigraphic folding. Enhanced computing power will allow us to achieve larger models and with a higher resolution. This project will improve our understanding of the flow behavior of ice sheets, especially how ice streams form and behave now, in the past, and in the future, and indicating sea-level rise.