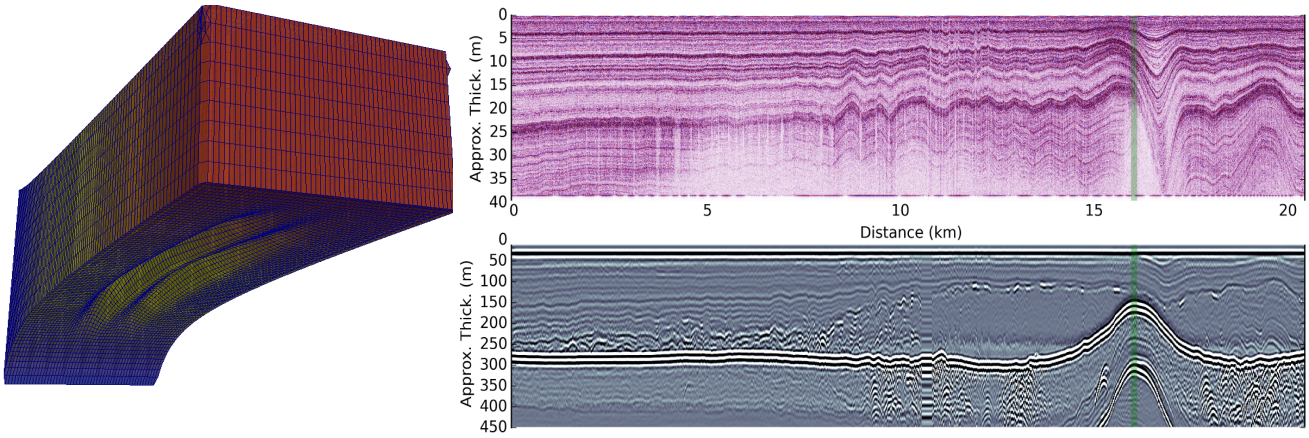
Master's Project: Ice-shelf channels in Antarctic ice shelves - Deriving the basal mass balance using geophysical techniques and ice-flow modeling



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Context: Almost three-quarters of the Antarctic ice-sheet boundary are in contact with the ocean where the majority of ice-mass loss occurs. Floating ice shelves extend from the continental ice seawards, providing an interface for melting and refreezing processes at the ice-shelf base. Ice-shelves regulate the continental ice flux through buttressing, and changes of the ice-shelves' buttressing strength feed back on the mass balance of the catchment areas upstream. A distinct feature of many ice shelves are longitudinal channels. They often start near the grounding-line and extend many tens of kilometers towards the ice-shelf front. Inside channels basal melting can be significantly enhanced, and channelized melting of this kind has potential to alter ice-shelf stability. However, the small-scale and transient nature of these channels hamper a reliable determination of the basal mass balance inside the channels without direct field evidence.

Approach: This project aims to determine the basal mass balance in a combined approach of using radar data and ice-flow modeling. The hypothesis is that the internal radar layers (a.k.a isochrones, see image above) hold a memory of the upstream melt history which can be used to quantify basal melting. In order to do so other mechanisms which also imprint on the layer geometry (e.g. increased surface mass balance, ice-dynamical deformation) must be adequately addressed.

Applied methods: The project will make use of a radar dataset which has been collected over the last three years on an Antarctic ice shelf. The data image the internal layering across a number of channels. Using widely-used geophysical processing techniques, the data will be analyzed to map characteristic patterns in internal layering of ice-shelf channels. These patterns will be compared with modeling results, using ice-flow models of varying complexity in an idealized geometry. The goal is to find the simplest ice-flow model which can adequately represent what is observed in the data. At this stage, the scene is set to use an inversion scheme for the quantification of the melt rates inside the channels. The latter is outside the scope of this Master's project but can serve as a promising starting point for a PhD Proposal.

Requirements: Prior experience in programming and some confidence in applying basic mathematical concepts. Experience (or the willingness to learn) to work in a Unix/Linux environment is highly appreciated.

Outlook: This project will teach you the handling of ground-penetrating radar and the integration of the results in a Geographic Information System. The modeling part is a very useful introduction for the general topic of using computers for solving complex systems of equations. All of these concepts are widely applied, also outside the world of academia. The topic is suited to trigger a follow-up PhD project if wished for.

Needless to say that this project will be a lot of fun.