Ice Cores are small, Antarctica is large
Using radar to extrapolate ice-cores and using ice-cores to understand radar

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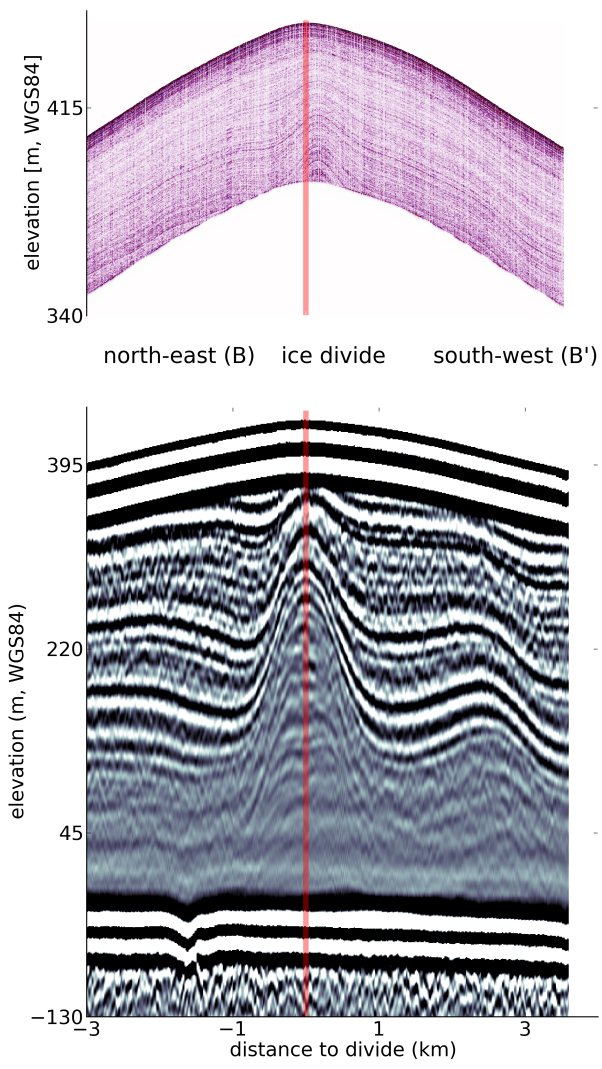

Context: Ice-coring in Antarctica is a powerful tool for understanding the climate history. However, because ice cores are point-measurements it is unclear how representative the results are. This is particularly true when ice cores are situated in a complex topography where the surface mass balance is variable. Ground-penetrating radar can overcome this limitation because it visualizes the internal ice stratigraphy (see image). When the internal layers are successfully linked to an ice core this can be used to spatially extrapolate the ice-core measurements. Such an approach has manifold applications in glaciology (e.g. mapping the surface mass balance, linking the depth-age scales of different ice cores for synchronization,...), but at the same time, it requires a detailed understanding of the radar signal reflection mechanisms. At ULB, three ice cores have been retrieved on an ice rise (a local ice island surrounded by a floating ice shelf). Two ice cores are located in the ice-rise's flanks, one at the dome. The goal is to link the three ice cores with radar. Will we find the same age in all cores (i.e. did the ice-core scientists do their job well?), will we find the same reflection mechanism in all cores (i.e. did the radar-guys do a good job)?

Approach: We will analyse radar data which have been collected in Antarctica over the last years. Different frequencies visualize the internal layering along the entire ice column. The focus will be on the shallow layering (< 40 m depth). Ice-core data will be used for the traveltime -to-depth conversion. Sophisticated algorithms (keyword: deconvolution, forward-modelling) will be investigated to identify prominent radar reflectors which can be compared to the ice-core data.

Applied methods: Basic radar processing will be done in Matlab. More sophisticated algorithms will be applied using advanced seismic/radar processing software (SeismicUnix). Potentially we will go into using a full forward-model to identify radar reflection mechanisms.

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 GPS data. These are geophysical techniques which are also widely applied outside glaciology (e.g. Construction business, Archeology, …). The results will be integrated using Geographic Information System which is equally useful inside our 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.