Quantifying englacial decoupling in the Antarctic ice sheet and its significance on large-scale ice flow

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Project description: Ice penetrating radio-echo sounding data have recently revealed englacial structures interpreted by some as evidence for major levels of subglacial accretion of ice, increasing the local mass balance of some regions of both the Greenland and Antarctic ice sheets by up to 2-fold (Bell et al., 2011). This interpretation has received widespread scientific attention, such that other similar englacial structures have been referred to as evidence of significant basal freezing. Other hypotheses for at least some of the englacial features are possible, however. One is that they are ancient relic sections of cold-based ice, over which the ice sheet flows. This hypothesis will be tested in the PhD programme using three-dimensional numerical ice-flow modelling and recently-acquired geophysical data. The first step will be to quantify the 3-dimensional architecture of the englacial structures. A good target case study is available in West Antarctica, which will be central to the project, and others are also available in both East Antarctica and in Greenland for comparison. Next, a 3-dimensional ice flow model will be compiled, similar to that constructed recently to determine how englacial layers inform past rates of ice accumulation (Leysinger Vieli et al., 2011). The model will determine the conditions that make it possible for englacial shearing to occur and, from this, the hypothesis to be tested. It will also be used to test the hypothesis that the features are caused by accretion of ice. In both cased the time-dependent flow of ice, and build-up of the feature, will be modelled to ascertain the downstream influence on ice sheet flow.

Bell, R.E. et al. (2011). Widspread thickening of the East Antarctic Ice Sheet by freezing from the base. Science 331, 1592-1595.
Leysinger-Vieli, J.M.C., Hindmarsh, R.C.A., Siegert, M.J., Sun, B. (2011). Time-dependence of the spatial pattern of accumulation rate in East Antarctica deduced from isochronic radar layers using a 3D numerical ice-flow model. Journal of Geophysical Research. F02018, doi:10.1029/2010JF001785.