Beneath the ice: geophysical observations at Rutford Ice Stream, West Antarctica

Tavi Murray[1], Andy M. Smith[2], Alessandro Foreri[1], H. Corr[2]

[1]Swansea University; [2]British Antarctic Survey

The fast flowing ice streams in West Antarctica control the rate at which snow accumulation is evacuated from the continent, and hence the ice sheet's impact on global sea levels. What happens beneath these ice streams affects both the way in which they flow and the landforms left behind when after retreat. In this talk we will present intriguing observations collected during the RABID project that reveal details of both the bed more than 2km beneath a fast flowing West Antarctic ice stream and of its contemporary dynamics. Seismic and radar observations allow mapping of the basal topography, and the differentiation of areas where the ice stream is sliding from areas where the sedimentary bed is deforming. Repeat observations show erosion at a rate of 1 m a^{-1}, followed by cessation of erosion and the formation of a drumlin from mobilized sediment over ~decade. Mapping radar reflectivity at the bed in radar data allows the identification of water features a few metres wide extending for about 5-10 km upstream in deforming bed areas, which we interpret as part of a linear hydrological system. In contrast, regions of the bed where sliding occurs coincide with high and variable reflectivity. The bed in sliding regions appears to be characterized by a distributed drainage scheme, possibly a cavity system. The results reveal that the bed consists of a patchwork of areas of sliding and deformation at the ice stream bed, each with its distinctive hydrological systems, and that basal conditions can change rapidly. We also report on over 2-years of GPS data collected in the same region. There is clear modulation of the ice stream's flow at ocean tidal frequencies from semi-diurnal to annual. Taken together the results suggest a sensitive and rapidly reorganising ice stream system, and suggest that it is unlikely that present models of ice dynamics simulate sufficient processes to predict future changes in the ice streams with any certainty.