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The 2017 field campaign to refine Oldest Ice candidate sites in the Little Dome C region: radar data acquisition

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The International Partnership for Ice Core Sciences (IPICS) has as a primary goal the recovery of deep ice cores that record the climate, environmental and atmospheric gas record for the last 1.5 million years. Glaciological modelling of parameters such as ice accumulation, surface temperature, ice depth, bedrock topography, ice flow and the geothermal heat flux have suggested a number of sites of interest across the East Antarctic ice sheet.

One area is close to Dome C, where the EPICA ice core project recovered an ice record spanning 800 kyrs. European Horizon 2020 funding for the 'Beyond EPICA – Oldest Ice' has enabled a three year programme of field research to refine selection amongst candidate sites for future deep drilling in a region about 40 km from the site of the EPICA deep ice core, in an area that has become known as 'Little Dome C'.

Fundamental to the selection a candidate deep drilling site is a detailed knowledge of local ice sheet thickness and basal topography. Early radar surveys of the East Antarctic plateau, recorded in BEDMAP2 (Fretwell et al, 2013), were refined by an airborne radar campaign (ICECAP) in January 2016, and a small area of 'high ground' in the basal topography in the Little Dome C region was identified as of potential interest for Oldest Ice. The region was further surveyed in the 2016/17 and 2017/18 austral summer field seasons using a ground based radar system, DELORES.

DELORES (DEep LOoking Radio Echo Sounder) developed by the British Antarctic Survey is a lightweight 3.5 MHz monopulse radar mounted on simple sledges, pulled behind a vehicle at around 15 km hr-1. The transmitter module fires into a dipole antenna orientated along track, while a receiver dipole antenna similarly orientated receives the radar returns from the bedrock, and from internal layers in the ice.

Over the two field seasons, approximately 2200 line km of radar data were recovered across an area about 18 km x 12 km, with spacing between lines initially 500 m, but refined to 250m or better where interesting areas were indicated by the data. Processing the data in the field within days of collection allowed us to build a detailed picture of the basal topography, and the depth of internal layers that could be dated by reference to the EPICA ice core chronology. The ice was generally around 2500 to 3000 m thick, with plateaus in the bedrock incised by deep valleys. In many of the deeper valleys, the signal indicated the presence of water, and occasionally what we initially interpret as a water table beneath a sediment. Working alongside an ice sheet modeller in the field (Ritz et al., EGU 2018) allowed us to refine local glaciological models of the age/depth relationship using the dated internal layers, and select during the field season the best site for future deep ice drilling.