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Stability of the accumulation pattern around Dome C over the last glacial cycle

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The "Candidate A" region, just to the south of Dome C, is one of the climate community's targets for retrieving "old ice", aiming for an ice core bottom age of 1.5 million-years. The region lies along the divide that separates the Byrd and Totten glacier catchments, and thus its position could be sensitive to differential behavior of those two systems. In the winter of 15/16, the University of Texas at Austin Institute for Geophysics (UTIG) collected a detailed airborne radar survey known as OIA (Old Ice A) (Young et al., in review).

Seventeen internal radar reflections are mapped through this survey, encompassing both sides of the divide, spanning the last three glacial cycles, from 38 ka and 366 kyrs. Dates are obtained where the internal reflections intersect the EPICA Dome C ice core and the AICC20112 age-depth chronology can be transferred to each individual reflection. These internal reflections are easily traced in the OIA survey for several reasons: (1) Candidate A is a region of relatively stable ice, close to the ice divide, so very little horizontal flow has occurred and the radar reflections exhibit near-horizontal stratigraphy, (2) the gridded geometry of the survey design implies a high number of crossovers which allow regular checks on the accuracy of the reflection mapping, and supports the isochronal character of the reflections. Older airborne UTIG radar surveys in the region augment the dataset to provide constraints further away from the divide, and the same set of isochrones are traced throughout (previously published in Cavitte et al., 2016).

We use a 1D inverse model (Parrenin et al., in prep) to reconstruct the patterns of paleo-accumulation through time all the way back to the penultimate interglacial (127 kyr). To do this, we first fit the isochrones' geometries and ages to invert for the steady-state accumulation rate, the basal melting rate and the p exponent in the Lliboutry flow formulation. We then reconstruct paleo-accumulation rates between each pair of isochrones by fitting the isochrone geometries exactly. Each "layer" therefore provides a map of the paleo-accumulation rate pattern for the time interval represented by the layer.

We observe that the large-scale pattern of paleo-accumulation through the last 127 kyr has been consistent with today's: higher rates of accumulation to the NW of Dome C (i.e. nearer the coast) and lower rates with distance from the coast towards the SE. On smaller scales, we observe local accumulation highs, which correlate with local ice surface slope anomalies (usually reduced slopes) and remain stationary through time.

We suggest that the stationary character of the paleo accumulation patterns, both regionally and locally, point to a relative stability of the ice sheet's surface geometry all the way back to the penultimate interglacial. This would imply a stable dome position throughout, and perhaps a balanced grounding line influence from the Byrd and Totten catchments.