Effect of horizontal flow on the age field along the Dome C – Little Dome C flow line

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We present a 2.5D pseudo-steady state inverse model applied to the flow lines from Dome C to LDC and from Dome C to North Patch (an area ~10km NE of Dome C). The model is constrained by radar horizons dated from 10-476 ka using the EPICA Dome C (EDC) ice core. We interpolate and extrapolate the age-depth relationship using these horizons. The simplicity of our 2.5D numerical integration scheme results in an efficient computation time allowing us to use inverse methods to determine an average accumulation rate over the past 800 ka, a mechanical ice thickness and the thinning parameter which describes the shape of vertical velocity profile. The inverted mechanical ice thickness allows us to infer either the melt rate or the thickness of a layer of stagnant basal ice.

The model shows that the EDC-LDC flow line is dominated by melting on in the upstream sections, and further downstream, there is a thick layer of stagnant ice over the LDC mountainous bedrock relief. Our results show to what extent the Beyond EPICA - Oldest Ice drill site is affected by horizontal flow from upstream at the dome and the implications for the age-depth profile of the ice core currently being drilled. The deepest oldest ice at the drill site, comes from 10-15 km upstream. However, the differences between the model and observations cannot be fully explained by horizontal flow. We also show that North Patch is a promising potential oldest ice site but more high-resolution radar surveys would be required to constrain this. This model could be applied to other areas of Antarctica of Greenland such as the flow lines from Dome Fuji to EDML or at from Ridge B to lake Vostok or from GRIP to EGRIP.

This work is part of the network of DEEPICE PhD projects associated with the Beyond EPICA drilling project which aims to recover a continuous 1.5 million year old ice core from Little Dome C in Antarctica.