Accumulation rates from 38 ka and 161 ka radio-echo sounding horizons in East Antarctica

Introduction
The surface mass balance (SMB), used for the spin up of ice sheet models, has great influence on the models’ results. On the East Antarctic Ice Sheet (EAIS) the accumulation is (nearly) the only component of the SMB. Even though, the coverage with information on SMB is still sparse. Paleo-accumulation rates can be derived from ice cores or radio-echo sounding (RES) data, the latter having the advantage of spatial coverage. To retrieve accumulation rates from isochronous RES horizons, independent assessment of the horizons’ ages and the thinning of the original layer by flow divergence is necessary.

We use two RES horizons, that are dated at deep drill sites, and trace them continuously across great parts of the EAIS. To account for the ages and the thinning of the original layer by flow divergence is necessary.

Our result is a large scale spatial distribution of accumulation rates for two time intervals.

Method
• Accumulated mass above and between RES horizons, calculated with ice-core densities (see Fig. 2, middle panels).
• Gradient field of PISM velocities gives the horizontal divergence values, the negative sum of which equals the vertical divergence.
• Extraction of depth curves of the horizontal divergence values at every RES profile point, using bilinear interpolation.
• Numerical integration of divergence curves from surface to respective depths of horizons.
• Adding this to the respective accumulated mass of each horizon and division by ages gives the mean accumulation rates (Fig. 2, bottom panels, and Fig. 5).
• Calculation of stream lines, using PISM velocities, to assess the tenability of neglecting the particle paths (Fig. 4).
• Extracting spatial variation in present-day accumulation rate along stream lines (Fig. 3, bottom).

Results
In Fig. 3 (top panel) we compare our results for the DML profile with those of Huybrechts et al. (2009). They use a more complex model to additionally account for upstream deposition of snow and possible accumulation variations along the stream lines. There is a good fit of the large-scale pattern of our accumulation rates for both time intervals. This reassures us to use our method also for the DC-DA region.

Deviations occur mainly where the accumulation rates vary strongly on a small scale. In order to assess where our approach might be too simplistic, we calculate stream lines (Fig. 4) and the variation of accumulation rates along those stream lines (Fig. 3, bottom).

Figure 5 shows the spatial distribution of mean accumulation rates for the intervals of 0-38.2 ka and 38.2-161.1 ka in the DC-DA region and of 0-38.2 ka and 38.2-73.8 ka in the DML region. There is a general trend towards higher accumulation rates in the younger time interval compared to the older one, and towards lower accumulation rates further inland.