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Lake discharge beneath the East Antarctic ice-sheet reconstructed from numerical modelling of englacial layers

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Internal ice-sheet layering obtained from ice-penetrating radio echo sounding (RES) at Terre Adélie reveals a highly unusual structure. Isochronous internal layers are pulled downwards to the flat ice-sheet base between 300 to 700 m across a horizontal distance of 13 km. Above a depth of 1100 to 1300 m the englacial layers show no down-warping, suggesting that the transition took place around 9 to 11 ka when considering modern accumulation rates.

Recent observations of the dynamic behaviour of subglacial lakes may suggest a similar process such as a sudden lake discharge as a possible cause for this anomalous feature. A temporal change in basal melting or/and sliding-no sliding on its own or combined with a lake discharge might also explain it. In order to explore the cause for this anomaly, we use a numerical ice-flow model which computes ice-sheet isochronous layering in three dimensions, based on the shallow ice approximation (SIA). With this model we investigate the effect on englacial layer architecture from changes in basal conditions such as 1) basal sliding-no sliding transition, 2) enhanced basal melting and 3) a sudden subglacial lake discharge and combinations of the three.

We show that the englacial architecture along the RES transect from Terre Adélie can not be reproduced by only applying basal melting or sliding. However by adding a subglacial lake drainage event we produce structures comparable to the observed englacial architecture. The timing of this inferred event may suggest that it has been triggered by relatively small changes to the ice-sheet profile subsequent to the last glacial maximum.