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Effects of time variation in the ice-sheet surface ice properties on the ice-layer thinning function

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The interpretation of climatic records preserved in ice-sheets requires an accurate knowledge of the absolute age of the ice layers, as well as the relation between thickness and the time interval represented by each layer, as a function of depth. This depth - age relation depends on the flow history experienced by ice since it was deposited at the ice-sheet surface. Usually, this dating relation is inferred from simplified ice flow models and leads to a smooth thinning function. In the case of a dome, the model is generally reduced to a one-dimensionnal flow model by assuming rotational symmetry of the flow around the dome.

Recent microstructure measurements of the EPICA Dome C core have shown that some layers have experienced a larger deformation than the adjacent layers. This could explain the difficulties encountered to match the EPICA Dome C and Dronning Maud Land time scales. These observations indicate that polar ice deformation exhibits spatial heterogeneities and consequently the expected layers thinning function should be less smooth than it is currently assumed.

Possible causes for these layer disturbances, and their implication in terms of dating, are studied with an higher order ice flow model which takes into account the strain-induced anisotropic behaviour of ice. The proposed method consists in following layers that present different initial material properties, in term of viscosity and/or initial fabric. The resulting thinning function for different initial material properties is discussed.