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Calibration and spinup of an ice sheet model: application to the Antarctic ice sheet.

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Large scale ice sheet models were mainly developped to reconstruct past ice sheets on long time scales. These models are now also used for projections to evaluate their behaviour in the close future and estimate their contribution to sea level change. Short simulations in the future may require a different strategy for calibration and spinup than long paleo experiments. The difficulty of this exercise comes from two aspects: i) the present state is not fully known from observations (especially the 3D temperature field) ii) the parameters of the model need to be tuned.

The traditionnal method to do the spinup of an ice sheet model consists in starting with the present observed topography and an initial guess of the temperature field and let the model evolve long enough to reach a steady state (∼100 kyears). An improvement of this method is to take into account past changes of surface temperature and accumulation rates by forcing the ice sheet model with climatic records from ice cores. The advantage of this method is that all the fields are consistent between them with the set of parameters used. The major drawback is that the simulated topography for present time may differ substancially from the observed one. The topography discrepancies are usually corrected by tuning the various model parameters but this requires numerous simulations and each of them must run for at least 10 kyears.

We estimate that when the objective is to have a realistic starting state for future simulations (few kyears), it is not necessary to perform long thermomechanically coupled simulations. The most important criteria should be i) to have a good agreement between observed and simulated topography ii) to simulate a trend for present (change in thickness with time) that is small and preferably close to the observed one. iii) to simulate a present velocity field close to the observed one (where available). With these criteria in mind, we propose a set of successive procedures that associate balance velocities, uncoupled temperature calculation and basal drag calibration. Results are shown on the Antarctic ice sheet with the GRISLI model (SIA + SSA equations)