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Basal melting and freezing beneath Antarctic ice shelves derived from glaciological modelling and remote sensing compared with results from oceanographic models

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To fully capture the sensitivity of the Antarctic ice sheet to changes in the ocean, coupled numerical models of ocean and marine ice sheets will be needed. If coupled models are to provide accurate predictions of the sea level contribution from the Antarctic ice sheet, they will need careful initialisation, so that the flow speed, rate of thickness change and surface mass balance of floating ice shelves are consistent with the basal mass balance, from melting or freezing, estimated from the oceanographic model. Any inconsistency would cause the forecast of ice thickness to suffer from spurious drift, and this in turn would affect the buttressing and flow of grounded ice in the interior of Antarctica. A sensible first step before proceeding with any coupled simulation is to compare maps of basal melt from the two different sources. Here, a new comprehensive map of basal melt/freeze for all Antarctic ice shelves is derived from a combination of remote sensing and glaciological modelling. In this approach, the viscosity of the floating ice shelves is selected using inverse methods to agree with satellite velocity measurements and the basal rate of melting or freezing is inferred using conservation of mass. Corrections are applied for surface mass balance and for satellite observations of ice shelf thickness change. We compare this map with estimates of basal melt/freeze from oceanographic models.