



## **The granular sea-ice model in spherical coordinates and its application to a global climate model**

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The granular sea-ice model (GRAN) from Tremblay and Mysak (1997) is converted from cartesian to spherical coordinates. In this conversion, the “metric” terms in the divergence of the deviatoric stress and in the strain rate are included. As an application, the GRAN is coupled to the global Earth System Climate Model from the University of Victoria. The sea-ice model is validated against standard data sets. The sea-ice volume and area exported through Fram Strait agree well with values obtained from in-situ and satellite derived estimates. The sea-ice velocity in the interior Arctic agrees well with buoy drift data. However, the model tends to underestimate the thickness distribution. The thermodynamic behaviour of the sea-ice model over a seasonal cycle at one location in the Beaufort Sea is validated against the Surface Heat Budget of the Arctic Ocean (SHEBA) data sets. The thermodynamic growth rate in the model is almost twice as large as the observed growth rate, and the melt rate is 25% lower than observed. The larger growth rate is due to the thinner ice to begin with and the absence of internal heat storage in the ice layer in the model. The lower summer melt, on the other hand, is due to the smaller than observed net ocean heat flux.