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VALIDATING MODELS OF THE WEST ANTARCTIC ICE SHEET

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The West Antarctic Ice Sheet (WAIS) is a dynamic system with interactions between ice streams, basal water, ice shelves and their neighbouring oceans. The present generation of continental scale ice sheet models do not include a full representation of this system. Basal hydrology and grounding-line evolution are two factors are crucial in the evolution of the WAIS; therefore if they are not included in models of the WAIS, the validity of modelling attempts is brought into question, especially in the case of response to future climate change.

The aim of this research is to test a present generation thermo-mechanical ice flow model against observed data and to incorporate a model of basal hydrology. Initial results show that the concave slopes typical of the Siple Coast ice streams are not reproduced by the most basic flow model (excluding basal sliding). Including a simple relation to represent basal sliding (proportional to the basal shear stress where there is basal melting) does not produce a more realistic velocity distribution. Low driving stresses (hence low basal shear stresses) and high sliding velocities in the Siple Coast ice streams suggest this relation is not an appropriate model to use. The model proposed and tested here relates basal sliding to water depth (greater water depth, lower basal friction). Using a constant basal water drainage factor (therefore basal water is a function of basal melt), concave ice slopes and more distinct ice streams result. Present day calculations of the basal melt rate suggest that basal freeze-on is occurring beneath the Siple Coast Ice Streams. Therefore, a model incorporating dynamic basal water flow is also investigated, the water flow being forced by the pressure potential. Using the present day ice configuration, the basal water is concentrated into distinct areas beneath the ice streams and their tributaries. Once this model is incorporated into the ice flow model, a feedback process can occur, where fast flowing ice streams can develop, fed by basal meltwater from tributaries.