Assimilation of surface velocities acquired between 1996 and 2010 to constrain the form of the basal friction law under Pine Island Glacier

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Résumé

In ice-sheet models, slip conditions at the base between the ice and the bed are parameterized by a friction law. The most common relation has two poorly constrained parameters, C and m. The basal slipperiness coefficient, C, depends on local unobserved quantities and is routinely inferred using inverse methods. While model results have shown that transient responses to external forcing are highly sensitive to the stress exponent m, no consensus value has emerged, with values commonly used ranging from 1 to infinity depending on the slip processes. By assimilation of Pine Island Glacier surface velocities acquired from 1996 to 2010, we show that observed accelerations are best reproduced with m =5. We conclude that basal motion, in much of the fast flowing region, is governed by plastic deformation of the underlying sediments. This implies that the glacier bed in this area can not deliver resistive stresses higher than today, making the drainage basin potentially more sensitive to dynamical perturbations than predicted with models using standard values m = 1 or 3.

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