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Combining models of ice flow and calving over Larsen B

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While there has been considerable work in recent years on the modeling of ice shelf behaviour, this has largely focused on issues such as grounding line migration, which can be handled by conventional glaciological flow models. These models largely ignore frontal processes, partly for historical reasons, and partly due to the difficulty of reconciling continuum-based flow models with the discrete nature of the calving process.

While past studies have proposed various ways to model the calving process numerically, these models tend to not consider the complexities of flow, focusing instead on individual calving events. Although this approach helps us to understand the calving process itself, it is less applicable to the broader questions of ice shelf dynamics, and to predictive modeling of ice shelf collapse.

Here, we present preliminary results from a numerical model where conventional ice flow dynamics are integrated with calving physics based on linear elastic fracture mechanics, as applied to modeling the pre-collapse behaviour of the Larsen B ice shelf. We hope to illustrate the pitfalls associated with this approach, as well as some of the possible benefits. We apply the model to Larsen B ice shelf with the intention of producing hindcasted model predictions of its collapse in 2002. Predictive physical modelling of ice shelf collapse constitutes an essential part of understanding future behaviour of the Antarctic ice sheet.