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Inferring the spatial ice rigidity distribution of Larsen B before its disintegration from an inverse control method and investigating the role of fracture

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The disintegration of 3250 square kilometers of Larsen B Ice Shelf in the Antarctic Peninsula within 5 weeks in 2002 provided the opportunity to establish a clear connection between the removal of ice shelves and the acceleration of their ice streams. Radar interferometry observations analyzed by *Rignot et al.* [2004] revealed that glaciers flowed up to eight times faster after the collapse of Larsen B, while *Scambos et al.* [2004] detected a lowering of ice stream surfaces by up to 38 m. The significance of these findings is heightened by the fact that neighboring ice streams with intact ice shelves remained largely unchanged.

In this work, we use satellite radar interferometric observations of Larsen B obtained in 2000, which provide a near-complete coverage of ice velocity, to infer the spatial distribution of ice rigidity (flow law parameter B) before the disintegration by an inverse control method. Of particular interest is how the presence of rifts affected the distribution of ice rigidity and ice shelf flow patterns compared to the case of a non-rifted ice shelf. We further employ these results to investigate factors that could have contributed to the observed 20% acceleration of ice shelf flow between 1996 and 2000 [*Rignot et al.*, 2004]. This work raises the prospect of using the inferred ice rheology patterns as proxy to predict whether other ice shelves are in the process of collapse, refining forward numerical modeling by the application of parameter B as a distribution rather than a single averaged value, and elucidating the role of fracture in ice shelf processes.

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