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## The perimeter feedback: a cornerstone of ice-sheet stability

**Jan Swierczek-Jereczek**<sup>1,2</sup>, Jorge Alvarez-Solas<sup>1,2</sup>, Alexander Robinson<sup>3</sup>, Lucía Gutiérrez-González<sup>1,2</sup>, and Marisa Montoya<sup>1,2</sup>

<sup>1</sup>Complutense University of Madrid, Physics, Earth Science and Astrophysics, Madrid, Spain (janswier@ucm.es)

<sup>2</sup>Geosciences Institute, CSIC-UCM, Madrid, Spain

<sup>3</sup>Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Potsdam, Germany

Ice sheets can undergo self-sustained retreat (or regrowth), with important impacts on sea-level, climate and consequently life on Earth. For instance, the collapse of the ice saddle between the Cordilleran and the Laurentide Ice Sheet during the last deglaciation has been suggested to contribute to the rapid sea-level rise that characterized Meltwater Pulse 1A, which led to significant changes in atmospheric circulation thereafter. Conversely, saddle mergers have been shown to drive self-sustained ice growth, potentially playing a key role in the large-scale inception of the Laurentide and British Isles Ice Sheet. In the present work, we simulate a similar behaviour for the Antarctic Ice Sheet, which additionally presents a larger hysteresis and more bifurcation points than previously simulated. We generalise the idea of saddle merger/collapse under the concept of perimeter feedback, which applies well beyond this specific case and refers to the fact that an ice sheet typically increases its mass balance when decreasing the ratio of perimeter to surface area. This is largely conditioned by the bedrock roughness and the coastline irregularity, and results from the interplay between thermo-mechanics, ice-ocean-atmosphere interactions and geometry. In particular, we show that the perimeter feedback plays a key role in the collapse of the West-Antarctic Ice Sheet simulated under global warming, as well as in abrupt regrowth of the East-Antarctic Subglacial Basins under global cooling. The analysis performed here does not introduce new physics but provides a key tool to better understand a ubiquitous mechanism underlying the instabilities simulated by ice-sheet models.