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GRANTISM: An Excel model for Greenland and Antarctic ice-sheet response to climate changes

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Over the last decades, the response of large ice sheets on Earth, such as the Greenland and Antarctic ice sheets, to changes in climate has been successfully simulated with large-scale numerical ice-sheet models. Since these models are highly sophisticated, they are only applicable on the scientific level as they demand a large amount of computing on powerful computers. Based on similar physics, a computationally fast flowline model of the Greenland and Antarctic ice sheet is presented here, primarily designed for educational purposes. Using a novel numerical technique, i.e. an over-implicit scheme, the model runs fast and behaves in a similar way to changes in background temperature forcing as major ice-sheet models do. A series of experiments is presented for temperature perturbations ranging from -15K (glacial conditions) to +25K (extreme warm conditions). A user-friendly interface and the implementation within a common spreadsheet program (Excel) make the model suitable for the classroom.