Geophysical Research Abstracts
Vol. 21, EGU2019-13743, 2019
EGU General Assembly 2019

Simulating Greenland ice sheet stability under global warming

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The response of the Greenland ice sheet (GrIS) to climate change will play an important role in defining our long-term impact on the Earth system. Previous work has shown that the GrIS is subject to a tipping point in temperature that causes the ice sheet to lose stability in its present configuration and transition to a near ice-free state. However, this is a challenging system to study, given that it contains strongly non-linear feedbacks and as yet uncertain boundary conditions. For this reason, significant uncertainty remains in the estimation of the tipping point. Here we use the ice-sheet model Yelmo coupled to the regional climate model REMBO to simulate the stability of the GrIS under global warming. In contrast to previous work, this study includes a hybrid representation of ice dynamics and the implications of broader parametric uncertainty are explored. Quasi-equilibrium simulations are used to map the phase space of ice volume versus temperature, which reveal an abrupt transition from an ice-covered to essentially ice-free state. The mechanisms behind this abrupt transition are analyzed, and the results are compared to previous estimates.