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Exploring the influence of frontal ablation on global glacier mass change projections

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Mountain glaciers across the world are contributing around one-third to the recent barystatic global mean sea-level rise, and relevant for regional hydrological changes. Although the majority of Earth's glaciers is land-terminating, roughly one-third of the glaciated area drains into an ocean or a lake. Due to the interrelation of surface and frontal mass budget, marine-terminating glaciers are subject to different dynamics than land-terminating ones, which are only forced by the atmosphere. This means that mass changes of marine-terminating glaciers cannot only be explained by changes in the atmospheric forcing. Thus, if ice-ocean interaction is not explicitly treated in a mass-balance model, calibration using, e.g., geodetic mass balances will lead to an overestimation of these glaciers' sensitivity to changes in atmospheric temperatures. However, most large-scale glacier models are not yet able to account for this process and frontal ablation remains an elusive feature of glacier dynamics, because direct observations are sparse. We explore this issue by implementing a simple frontal ablation parameterization in the Open Global Glacier Model (OGGM). One of the major changes this entails is the lowering of marine-terminating glaciers' sensitivities to atmospheric temperatures in the model's surface mass-balance calibration. We then use this model, forced with an ensemble of atmospheric temperature and precipitation projections from climate models taking part in the Climate Model Intercomparison Project's sixth phase (CMIP6), to project global glacier mass change until 2100. The main aim of this work is to investigate the influence of the frontal ablation parameterization on those projections. We find that introducing the parameterization of frontal ablation, but ignoring changes in ocean climate, reduces the spread between different emission scenarios in 2100.