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Additional global warming commitment due to crossing critical thresholds within the Earth's cryosphere

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Several tipping elements are known to exist in the climate system (Lenton et al., 2008). Some of them might be at risk of transgressing into a qualitatively different state within the Paris range between 1.5°C to 2°C of global warming (Schellnhuber et al., 2016). Among these are crucial components of the cryosphere: the West Antarctic Ice Sheet, the Greenland Ice Sheet as well as the Arctic summer sea ice and mountain glaciers. Their disintegration could possibly lead to severe changes in the climate system itself, through positive feedbacks such as the ice albedo feedback which act back on temperature.

Here, we quantify the additional global warming commitment using the Earth-system model of intermediate complexity CLIMBER-2 (Pethoukov et al., 2000; Ganopolski et al., 2001). Furthermore, we separate the total model response into different tipping elements and into contributions from the different fast climate feedbacks including the albedo, water vapor, clouds and lapse rate feedbacks.