EGU21-13327
https://doi.org/10.5194/egusphere-egu21-13327
EGU General Assembly 2021

The role of an interactive Greenland Ice Sheet in abrupt 4xCO2 forcing experiments.

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We compare the response of a coupled atmosphere-ocean-Greenland Ice Sheet (GrIS) model forced with an abrupt quadrupling of CO_2 from greenhouse gas concentrations in 1970 with the response of the atmosphere-ocean model with a static GrIS . The model, UKESM1.ice.N96.ORCA1, consists of HadGEM GC3.1 coupled to the BISICLES ice sheet model with mean annual surface mass balance (SMB) passed to BISICLES and orography and cumulated iceberg flux passed back to the atmosphere and ocean, respectively, at the end of each year. The differences in the surface temperature and atmospheric fields between the two experiments are confined to Greenland, with no discernible global effects from the evolving orography. The volume of the GrIS decreases by 15 % in 330 years. The surface height decreases the most (over 800m in 330 years) in southwest GrIS due to surface melting enhanced by feedbacks between elevation, air temperature and albedo. The input of freshwater to the ocean from Greenland is enhanced due to increased meltwater runoff, but the flux from melting icebergs decays to zero as calving from glaciers declines. The resulting sea level rise is dominated by SMB, where the equivalent sea level rise is 1179 mm (5.0 mm/yr) for the static GrIS and 1120 mm (4.4 mm/yr) for the interactive ice sheet at 2300. There is less sea level rise in the interactive GrIS experiment, even though more mass is lost through surface melting, because the amount lost through iceberg calving decreases as the grounding line of marine-terminating glaciers retreat inland whereas calving in the static experiment is constant.