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Greenland Ice Sheet surface runoff projections to AD2500 using degree-day model

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The Greenland ice sheet (GrIS) surface melt-water runoff dominates recent ice mass loss under global warming. We present runoff simulations during 1950-2500 over GrIS under RCP (Representative Concentration Pathways) 4.5, RCP8.5 and their extensions scenarios using three modified degree-day models, forced with five CMIP5 (Coupled Model Intercomparison Project) Earth System Models (CanESM2, BNU-ESM, HadGEM2-ES, MIROC-ESM and MIROC-ESM-CHEM). The degree-day factors are tuned at two sites on Greenland to best match the results by surface energy and mass balance model SEMIC. The modeled SMB over Greenland by modified degree-day models agree well with SEMIC in 21th century, then is applied to do projections for the 2100-2500 period. We also consider equilibrium line altitude evolution, surface topography changes and runoff-elevation feedback in the post-2100 simulations. The ensemble mean projected GrIS runoff is equivalent to sea-level rise of 7 cm (RCP4.5) and 10 cm (RCP8.5) by the end of the 21st century relative to the period 1950-2005, and 25cm (RCP4.5) and 121cm (RCP8.5) by 2500. Runoff-elevation feedback increases extra runoff of 7% (RCP4.5, RCP8.5) by 2100 and 23% (RCP4.5) and 22% (RCP8.5) by 2500. Sensitivity experiments show that 150% and 200% snowfall in post-2100 period would lead to 10% and 20% runoff increase under RCP4.5, 5% and 10% for RCP8.5, respectively.