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## Surface mass valance Variations of the Greenland ice sheet on decadal to centennial time scales

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The role of natural forcing in generating variability in the mass balance of the Greenland ice sheet (GrIS) is not clear. In particular, mass variations in the GrIS over the past several centuries are not well constrained. Until these natural climate variations are understood, it will be difficult to separate the role anthropogenic greenhouse gases have had on GrIS-induced sea level rise, and make predictions of GrIS changes in the future. In order to address these issues, we have performed a suite of global, atmosphere-ocean general circulation model simulations of the past millennium. These runs are long enough to establish the connection between Arctic climate conditions and surface mass balance changes over the Greenland ice sheet. We have created five historical simulations from years 850 to 2000 using the Community Climate System Model 3 and boundary conditions consistent with the Paleoclimate Modelling Intercomparison Project Phase 3. Over the preindustrial period, we examined how temperatures and precipitation over the GrIS varied with Arctic sea ice extent, NAO/NAM, Atlantic Meridional Overturning Circulation and its connection to the Atlantic Multi-decadal Oscillation, ENSO, volcanic aerosol loading, total solar irradiance changes, and anthropogenic greenhouse-gas concentrations. We also calculated surface mass balance time series for each simulation using a positive degree-day method. Thus, we will present an analysis of which variables are most important to temperature and precipitation in our simulations, and at which time scales. Next, we extended these simulations into the future using representative concentration pathways from the Coupled Model Intercomparison Project Phase 5. We will discuss whether these connections remain constant throughout the historical and future periods, or whether they change with increasing greenhouse gases. This should allow us to assess the role of natural and anthropogenic forcings on the GrIS surface mass balance in the past and into the future.