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Processes relevant for a range of projections of Greenland surface mass balance change using the CMIP3 multi-model output

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Future sea level change due to Greenland surface mass balance change is evaluated using the CMIP3 archive of multi-GCM output. Three scenarios, SRES A1B, A2, and B1, are considered. Surface melting rate change is calculated as a function of summer surface air temperature which is obtained by adding observed temperature on fine resolution grids ($0.05° \times 0.02°$) and model-simulated temperature change. Accumulation rate is calculated by simply interpolating model-simulated snowfall rate change on the same fine resolution grid. In all scenarios, surface melting rate dominates over snowfall rate in determining both sign and spread of the net rate change. The A1B scenario shows the largest intermodal spread. In the A1B scenario, 59% of the intermodel spread in surface melting rate change from 2000 to 2100 is accounted for by the global and annual mean temperature change. Processes relevant for the rest 41% of the variance are investigated. Based on composite and multivariate analyses, we found that larger summer surface temperature increase responsible for larger surface melting rate increase is accompanied by ocean warming and reduced sea ice cover near Greenland. Models with relatively larger warming and reduction of sea ice cover during the 21st century actually exhibit relatively larger sea ice cover among models under the present-day conditions. It implies that a representation of current Arctic sea ice cover is important for the evaluation of ice albedo feedback and even sea level change by the continental ice sheet.