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Ice-sheet contributions to future sea-level change

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Accurate simulation of ice-sheet surface mass balance requires higher spatial resolution than is afforded by typical atmosphere ocean general circulation models (AOGCMs). A method has been developed for calculating mass balance changes by combining ice-sheet average time-series from AOGCM projections with information from high-resolution climate models and a 20-km ice-sheet mass-balance model. Antarctica contributes negatively to sea level on account of increased accumulation, while Greenland contributes positively because ablation increases more rapidly. In recent years, however, Antarctica has probably contributed positively to sea level, and Greenland's contribution has been increased, because of greater ice discharge into the sea. Current models and scientific understanding of the processes responsible are inadequate for making predictions with similar confidence to those of the surface mass balance, but we compare their possible magnitude for the 21st century. In the longer term, the Greenland ice sheet would probably be largely eliminated if climate change produces a negative surface mass balance, which is predicted to occur for a global warming exceeding 3.1 ± 0.8 K. The vulnerability of the Antarctic ice sheet is more likely through increased subsurface melting of the ice shelves or at the grounding line stimulating accelerated flow of inland ice.