

Impact of Antarctic and Greenland Ice Sheet melting on sea level, regional climate, and future coastlines

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The Antarctic and Greenland ice sheets are expected to have significant long-term impacts on sea level, Earth's topography, and climate. Using the fast Earth system model CLIMBER-X, we perform transient simulations in which the Greenland, Antarctic, and combined Greenland–Antarctic ice sheets are linearly reduced from their present-day states to complete deglaciation (0m ice thickness). These idealized scenarios allow us to quantify the climatic and sea-level responses to varying degrees of ice sheet melt. We express our results in terms of the fraction of ice sheet mass lost and evaluate the individual and additive contributions of Greenland and Antarctica to global mean and regional sea level rise. Our simulations reveal pronounced changes in Earth's hypsometry and substantial regional climate shifts, particularly in the North Atlantic and Southern Ocean. Plausible future coastlines are shown. This study highlights the sensitivity of regional climate and ocean circulation patterns to ongoing cryospheric change, and provides a framework to assess the lasting impacts of ice sheet melt on the Earth system.