

Projecting the Long-Term Sea-Level Contribution from Antarctica

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The Antarctic Ice Sheet is by far the largest potential source of future sea-level change, storing approximately 58 m sea-level equivalent. Its past and future evolution is thus of primary importance for coastal communities, infrastructure and ecosystems worldwide. To this day, the complex dynamics of the ice sheet and its surrounding ice shelves is one of the key challenges for sea-level projections. Atmospheric and oceanic warming is expected to cause enhanced ice loss from Antarctica in the future, potentially sped up by positive feedback mechanisms such as the marine ice sheet instability and the melt elevation feedback.

Sea level will continue to rise well beyond 2100, even under strong mitigation scenarios. Due to the long lifetime of anthropogenic CO₂ in the atmosphere and the consequent slow decline in temperatures, greenhouse gas emissions within this century can induce a sea-level commitment of several meters for the next millennia. On these timescales, the Antarctic Ice Sheet might show critical threshold behavior in several basins which are preconditioned to become subject to the marine ice sheet instability. The West Antarctic Ice Sheet is projected to become unstable after 600 - 800 GtC of additional carbon emissions. Beyond this additional carbon release, the destabilization of ice basins in both West and East Antarctica leads to a threshold increase in global sea level. If carbon emissions result in global warming substantially beyond 2°C, millennial-scale rates of sea-level rise are likely to be dominated by ice loss from Antarctica.