

기후 분과 [P-144]

Mitigating Antarctic ice loss requires negative emissions

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The Antarctic Ice Sheet (AIS) has the potential to substantially contribute to global mean sea level rise (SLR), with the most rapid changes occurring in West Antarctica. Since completely avoiding global warming is no longer an option, a critical question is whether climate mitigation efforts can stabilize the AIS mass balance and prevent long-term SLR. Here we evaluate the AIS evolution under different mitigation pathways—net-zero emissions (ZEC) and negative emissions (NEC)—emphasizing the necessity of active mitigation. In both cases, emissions initially follow the SSP5-8.5 scenario before declining. Under ZEC, Antarctic ice loss persists even after emissions cease, contributing ~2.2 m of SLR. In contrast, NEC, which reduces emissions below zero, limits Antarctic warming to <4 K relative to pre-2000 levels, and holds SLR to <1 m. This large difference arises not just from radiative forcing but from whether the AIS crosses critical thresholds. Idealized multi-millennial extensions for the NEC demonstrate that this distinction has profound implications for recovery: some regions of West Antarctica may recover within ~2,000 years, while others require much longer timescales. If negative emissions were applied later, the AIS would likely cross its safe-operating boundary, prolonging recovery to many millennia. These results, obtained with a realistic configuration, show that both the magnitude and the timing of negative emissions are decisive in determining the reversibility of AIS mass loss and prolonged SLR, underscoring the urgency of near-term climate action.

Keywords: Antarctic Ice Sheet (AIS), Climate Mitigation, Sea Level Rise