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Has Natural Variability Masked the Expected Increase in Antarctic Surface Mass Balance with Global Warming?

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One of the expected and rather paradoxical consequences of anthropogenic global warming is an increase in Antarctic surface mass balance (or net snow accumulation), as robustly simulated by both global and regional climate models. This surface mass balance (SMB) increase occurs because the higher moisture content of a warmer atmosphere leads to increases in precipitation, with this precipitation falling in the form of snow over Antarctica. Despite these robust model projections, however, observations indicate that there has been no significant change in Antarctic SMB during the past several decades. Here, we show that this apparent discrepancy between models and observations can be explained by the fact that the anthropogenic climate change signal is still relatively small compared to the noise associated with natural climate variability. Using an ensemble of 35 global coupled climate models to separate signal and noise, we find that the forced SMB increase due to global warming in recent decades is unlikely to be detectable in a statistical sense as a result of large natural SMB variability on interannual-to-multidecadal timescales. However, our analysis reveals that if the world continues to follow the present trajectory of greenhouse gas emissions, the anthropogenic impact on Antarctic SMB will emerge from natural variability by the middle of the current century. With this, SMB increases over Antarctica will begin to mitigate global sea-level rise, partially offsetting the effects of dynamic ice loss.