



## **Upper air relaxation in regional climate model improves resolved interannual variability of the surface mass balance of Antarctica**

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The surface mass balance (SMB) determines the variability of the mass balance of the Antarctic Ice sheet on sub-decadal timescales. Since continent-wide SMB cannot be measured, it must be modeled and regional climate models (RCMs) generally outperform global reanalyses in the representation of total mass flux and the spatial distribution of SMB. However, if RCMs are only forced with reanalysis on their lateral boundaries, the representation of the interannual variability of SMB deteriorates significantly.

In this study we show how to improve the resolved interannual variability in RCM modeled SMB. For this purpose we use annual SMB observations in the Thwaites drainage basin in Antarctica derived from airborne radar reflections and the RCM RACMO2. RACMO2, driven by ERA-Interim, better represents the mean spatial SMB pattern in this basin than ERA-Interim. However, without relaxation in the interior, RACMO2 poorly resolves the observed interannual SMB variability. If we gently relax the temperature and wind field in the upper atmosphere in RACMO2 to ERA-Interim, RACMO2 gets the best of both. Upper air relaxation little changes the mean SMB and spatial pattern compared to the original RACMO2 output, but allows RACMO2 to resolve the observed interannual SMB as good as ERA-Interim.