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The relationship between the Southern Hemisphere Annular Mode and Antarctic Peninsula summer temperatures: Analysis of a high-resolution model climatology

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The large regional summer warming on the east coast of the northern Antarctic Peninsula (AP), which has taken place since the mid-1960s, has been previously proposed to be caused by a trend in the Southern Hemisphere Annular Mode (SAM). We utilize a high-resolution regional atmospheric model climatology (14 km grid spacing) to study the mechanisms that determine the response of the near-surface temperature to an increase in the SAM (ΔT/ΔSAM). Month-to-month variations in near-surface temperature and surface pressure are well represented by the model. We found that north of $\sim$68°S, ΔT/ΔSAM is much larger on the eastern (lee) than on the western (windward) side of the barrier. This is due to enhanced westerly flow of relatively warm air over the barrier, which warms (and dries) further as it descends down the lee slope. The downward motion on the eastern side of the barrier causes a decrease in surface mass balance and cloud cover. South of $\sim$68°S, vertical deflection across the barrier is greatly reduced and the contrast in ΔT/ΔSAM between the east and west side of the barrier vanishes. In the north-eastern part of the AP, the modeled ΔT/ΔSAM distribution is similar to the distribution derived from satellite infrared radiometer data. The region of strongest modeled temperature sensitivity to the SAM is where ice shelf collapse has recently taken place and does not extend further south over the Larsen-C Ice Shelf.