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Stratospheric variability and tropospheric annular mode timescales.

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Climate models tend to exhibit much too persistent Southern Annular Mode (SAM) circulation anomalies in summer, compared to observations. Theoretical arguments suggest this bias may lead to an overly strong model response to anthropogenic forcing during this season, which is of interest since the largest observed changes in Southern Hemisphere high-latitude climate over the last few decades have occurred in summer, and are congruent with the SAM. The origin of this model bias is examined here in the case of the Canadian Middle Atmosphere Model, using a novel technique to quantify the influence of stratospheric variability on tropospheric annular-mode timescales. Part of the model bias is shown to be attributable to the too-late breakdown of the stratospheric polar vortex, which allows the tropospheric influence of stratospheric variability to extend into early summer. However the analysis also reveals an enhanced summertime persistence of the model's SAM that is unrelated to either stratospheric variability or the bias in model stratospheric climatology, and is thus of tropospheric origin. No such feature is evident in the Northern Hemisphere. The effect of stratospheric variability in lengthening tropospheric annular-mode timescales is evident in both hemispheres. While in the Southern Hemisphere the effect is restricted to late-spring/early-summer, in the Northern Hemisphere it can occur throughout the winter-spring season, with the seasonality varying on multi-decadal timescales.