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Stratospheric variability and tropospheric annular mode timescales.

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The annular modes are the dominant modes of variability in the extra-tropical circulation of each hemisphere. In the troposphere they represent latitudinal migrations of the eddy driven mid-latitude jets. Many climate forcings such as ozone depletion and increasing greenhouse gas concentrations result in circulation changes that project strongly onto these modes. It is therefore important that the dynamics behind annular mode variability be understood and that such variability be captured correctly in climate models.

Observational evidence suggests that stratospheric variability enhances annular mode timescales, although it is difficult to prove this unambiguously as other factors, such as tropospheric jet structure, vary alongside stratospheric variability. Here, experiments with the Canadian Middle Atmosphere Model (CMAM) will be presented. A free running simulation is compared with a simulation in which the zonal mean circulation of the stratosphere is nudged toward the climatology of the free simulation. These two simulations have identical climatologies but one has zonal mean stratospheric variability and the other does not. This allows us to clearly demonstrate that stratospheric zonal-mean variability significantly enhances tropospheric annular mode persistence.

A common bias among climate models is that they tend to exhibit much too persistent Southern Annular Mode anomalies in the summer season. While some of this bias is attributable to stratospheric zonal-mean biases in late spring/early summer, these model experiments also reveal that, atleast for the case of CMAM, a significant proportion of this bias is internal to the troposphere. This potentially has important consequences for the ability of global climate models to simulate SH climate change in this season. Possible causes of this bias will be discussed.