



Sources of Annular Mode Timescales

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Timescales derived from Annular Mode (AM) variability provide dynamical insight into stratosphere-troposphere coupling and are linked to the strength of AM responses to climate forcings. AM timescales reflect decorrelation times of geopotential height in the stratosphere and troposphere. But geopotential height involves a vertical integral via the hypsometric equation, and this makes ambiguous some aspects of the dependence of the timescales on vertical level. In this study, a method for decomposing AM variability into contributions from surface pressure and from temperature is presented that is based on a linearization of the hypsometric equation. The decomposition is then used to interpret stratosphere-troposphere coupling events and the seasonal variation of AM timescales in reanalysis products and in two versions of a general circulation model that have distinctly different stratospheric representation. Surface pressure variations best account for tropospheric AM variability and stratospheric temperature variations best account for stratospheric AM variability during coupling events, but AM timescales are not so readily separated. AM timescales involve strong coupling between the surface pressure and stratospheric temperature variations: the pressure-temperature cross correlation functions are small in magnitude but highly persistent and thus provide significant sources of AM persistence. These empirical results might serve as the basis for further theoretical analysis on the origins of zonal mean stratosphere-troposphere coupling.