

On the Connection between Solar Spectral Irradiance, Planetary Wave Drag and the Zonal-Mean Circulation

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An ever-increasing body of evidence shows that changes in solar spectral irradiance (SSI) over the 11-year solar cycle (SC) can produce changes in stratospheric ozone. Changes in stratospheric ozone can in turn produce changes in planetary wave drag (PWD) via longitudinal variations in ozone heating, which was recently expounded upon in a paper by Nathan and Cordero (2007, JGR-Atmospheres). Because SSI-induced changes in PWD may have potentially far-reaching consequences for the global circulation, including the zonal-mean flow, the Brewer-Dobson circulation and stratosphere-troposphere communication, it is important to understand the connection between SSI and PWD. In this study we employ analytical and numerical models of the extratropical atmosphere to examine the connection between SSI and PWD. The models couple radiation, ozone and dynamics and provide in a relatively simple but self-consistent way the means to explicitly identify the pathways that connect changes in SSI to the wave-driven zonal-mean circulation. The sensitivity of the stratospheric circulation, particularly stratospheric sudden warmings, to changes in SSI associated with the SC is addressed.