The 11-Year Solar Cycle Signature on Wave-Driven Dynamics in WACCM

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This study describes the 11-year solar cycle influences on gravity waves and the wave-driven circulation and using 51-year simulations of the Whole Atmospheric Community Climate Model (WACCM). Solar cycle influences are estimated by calculating the difference between perpetual solar maximum and minimum simulations. WACCM simulations show statistically significant responses of temperatures and winds in the Southern Hemisphere (SH) in high latitudes from winter to spring seasons. At solar maximum, the monthly-mean, zonal-mean temperature in the SH from July to October is cooler (-2 to -5 K) in the stratosphere and warmer (+3 to +6 K) in the mesosphere and the lower thermosphere (MLT). In solar maximum years, the SH polar vortex is more stable and its eastward speed is about 10 m s^{-1} greater than during solar minimum. The eastward changes in zonal winds propagate downward and poleward from July to October in the SH. Associated with these changes in the zonal winds, both vertical and meridional components of EP fluxes show negative responses to the solar cycle. Because of eastward changes in zonal winds, the propagation of eastward gravity wave activity to the MLT is reduced; this results in a net westward response of gravity wave drag to the 11-year solar cycle, peaking at ~10 m/s/day in the SH high-latitude MLT. The changes in gravity wave change the wave-induced residual circulation, and this contributes to a warming of ~3–6 K in the MLT region. Solar cycle influences on gravity wave variations obtained from SABER will also be presented.