Solar Cycle Variations in Mesospheric Carbon Monoxide

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As an extension of Lee et al. (2013), solar cycle variation of carbon monoxide (CO) is analyzed with MLS observation, which covers more than thirteen years (2004-2017) including maximum of Solar Cycle 24. Being produced primarily by the carbon dioxide (CO_2) photolysis in the lower thermosphere, the variations of the mesospheric CO concentration are largely driven by the solar cycle modulated ultraviolet (UV) variation. This solar signal extends down to the lower altitudes by the dynamical descent in the winter polar vortex, showing a time lag that is consistent with the average descent velocity. To characterize a global distribution of the solar impact, MLS CO is correlated with the SORCE measured total solar irradiance (TSI) and UV. As high as 0.8 in most of the polar mesosphere, the linear correlation coefficients between CO and UV/TSI are more robust than those found in the previous work. The photochemical contribution explains most (68%) of the total variance of CO while the dynamical contribution accounts for 21% of the total variance at upper mesosphere. The photochemistry driven CO anomaly is further transported to the tropics, extending the solar impact to the summer hemisphere by the meridional residual circulation. The solar cycle signal in CO is further examined with the WACCM experiment by implementing two different modeled Spectral Solar Irradiances (SSIs): SRPM 2012 and NRLSSI. The model simulations underestimate the mean CO amount and solar cycle variations of CO, by a factor of 3, compared to those obtained from MLS observation. Different inputs of the solar spectrum have small impacts on CO variation.