

Solar Cycle Modulation of MLS Nighttime Ozone near the Secondary Ozone Maximum Layer

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Solar cycle variation of nighttime ozone near the secondary ozone maximum layer is analyzed with Aura Microwave Limb Sounder (MLS) observation, which covers most of the SORCE era (2004 – present). Being produced primarily from the recombination of molecular oxygen (O₂) with single oxygen (O) transported from the lower thermosphere, the variation of the mesospheric nighttime ozone concentration is modulated by the solar cycle driven UV changes. MLS measured nighttime ozone and Solar Radiation and Climate Experiment (SORCE) Solar-Stellar Irradiance Comparison Experiment (SOLSTICE) measured UV show positive in-phase correlations between mesospheric nighttime ozone and UV. The nighttime ozone correlations with temperature is not monotonously positive nor negative but depend on location and season. They are positively correlated with each other except the boreal winter in the NH high latitude region. Similarities in solar cycle variation between nighttime ozone and Carbon Monoxide (CO) in the upper mesosphere is originated from the in-phase solar cycle variation of oxygen (O) and its downward transport.

For this study, MLS nighttime ozone is re-defined by sub-setting MLS ozone product only when the solar zenith angle is greater than 90 degrees from both ascending orbit (10:30 AM local time) and descending orbit (10:30 PM local time). Even though MLS observation does not provide a full coverage of the secondary maximum ozone layer in the upper mesosphere and lower thermosphere, MLS ozone clearly shows solar cycle associated variations in the lower part of the maximum at 0.002 hPa. To confirm the ozone variation at this level, the variation of MLS radiance 25-channel spectral band at 235.71 GHz is also shown.