Solar Cycle Spectral Irradiance Variation and Stratospheric Ozone

Richard S. Stolarski, Johns Hopkins University, Baltimore, MD; William H. Swartz, Johns Hopkins University Applied Physics Laboratory
Charles H. Jackman, NASA Goddard Space Flight Center, Greenbelt, MD; Eric L. Fleming, SSAI, Lanham, MD

☐ Solar cycle temperature change has equal (approximately) contributions from direct heating and from ozone change due to photolysis.

☐ Solar cycle ozone change is dominated by contribution due to photolysis (Chemistry Transport Models get it about right)

☐ Radiation shortward of 242 nm causes ozone to change in phase with solar cycle through ozone production by photolysis of O₂.

☐ Radiation longward of 242 nm causes ozone to change out of phase with solar cycle through the enhanced ozone loss from O atoms produced by photolysis of O₃.

☐ Expected solar signal in upper stratosphere depends on SSI variation with wavelength

☐ The studies on wavelength dependence of ozone change over a solar cycle is motivated by the remarkably different reconstruction of the 11-year solar UV variation put forward by Harder et al. (2009) based on 6 years of SORCE data compared to the previous reconstruction by Lean (2000) based on 30+ years of data from multiple satellite instruments.

Wavelength Dependence of Ozone Response as a Function of Altitude

- Below 242 nm
  - hv + O₃ produces odd oxygen and domanates

- Above 242 nm
  - hv + O₃ increases ozone loss
  - More O₂ produces odd oxygen and dominates

End result depends on relative amount of solar cycle variation above and below 242 nm

Acknowledgement: We thank J. W. Harder (University of Colorado/laboratory for Atmospheric and Space Physics) for providing the SORCE/SSM SSI time series data. Resources supporting this work were provided by the NASA High-End Computing (HEC) Program through the NASA Advanced Supercomputing (NAS) Division at the NASA Ames Research Center. This work was supported by NASA under grants NNX08AO66G, issued through the NASA/Goddard Space Flight Center, and NNX11AR19G, through the Living With a Star Targeted Research and Technology program.