The 11-year Solar Cycle Signal in Global NO_2 Measurements from NDACC Stations

Shuhui Wang [1] *[shw@gps.caltech.edu], King-Fai Li* [2]*, Stanley P. Sanders* [3]*, and Yuk L. Yung* [4]

[1] *JIFRESSE, University of California, Los Angeles, CA, USA*
[2] *University of California, Riverside, CA, USA*
[3] *Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA*
[4] *California Institute of Technology, Pasadena, CA, USA*

The solar UV variability during 11-year solar cycles has impacts on many important atmospheric chemical species. Understanding and quantifying the variabilities due to the natural solar forcing is critical for an accurate prediction of future atmospheric changes in the context of continuing and complex anthropogenic forcings. In particular, the solar cycle induced variabilities in ozone and its controlling species NO_x (through catalytic reaction cycles involving NO and NO_2 in the lower part of the middle atmosphere) and HO_x (through reaction cycles involving OH and HO_2 in the upper part of the middle atmosphere) have been studied with various observations and model simulations. Puzzling questions or discrepancies between model and observations remain unresolved.

In the present work, we investigate the solar cycle signal in middle atmospheric NO_2 using the long-term data record from NDACC (Network for the Detection of Atmospheric Composition Change) stations. Most of the stations are located at higher altitude or away from urban areas. Local boundary layer pollution has little impact on the variability of NDACC NO_2 vertical columns. The dominant variabilities come from the seasonal cycle, QBO, solar cycle, and a possible long-term trend. We extract the 11-year solar cycle signal from these measurements. The global pattern of this signal is discussed. For those stations with NO_2 data record longer than 20 years, solar cycle signals in SC23 and SC24 are compared. The comparison with results from 3-D global model will also be discussed. The results from this study may have important implications for middle atmospheric ozone variabilities.