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The contribution of different factors to the evolution of the middle atmosphere state from 2004 to 2009

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The effects of the spectral solar irradiance (SSI) variations have been under consideration for a long time. The variability of the solar irradiance is the largest at the ultraviolet region of the solar spectrum. The radiation at these wavelengths penetrates into the middle atmosphere leading to a substantial response in this region. In particular, the variability of the irradiance at Herzberg continuum (200-242 nm) and Hartley band (200-300 nm) strongly influences the ozone concentration and temperature.

The recent measurements by SIM and SOLSTICE instruments onboard SORCE satellite show unprecedented behavior of the solar irradiance: the trend associated with 11-year solar activity cycle has different sign in the visible and UV regions and the changes in UV are several times higher than all recent estimates (e.g., Lean et. al., 2005).

To investigate the implications of these discrepancies for the ozone and temperature response we applied the 3D climate-chemistry model SOCOL forced by the different SSI datasets. The SSI input for the SOCOL model is the spectral solar irradiance from 121 to 750 nm. We used three different datasets: SSI reconstruction compiled by Lean et al. (2005) and two composites of SORCE data. . The first SORCE composite is based on SOLSTICE measurements up to 210 nm and SIM outwards (SIM dominated dataset) and the second one is based on SOLSTICE measurements up to 290 nm and SIM outwards (SOLSTICE dominated dataset).

We have simulated atmospheric response for period from May 2004 to February 2009. We have analyzed the hydroxyl, ozone and temperature responses using multiple regression analysis and found that it strongly depends on the applied SSI dataset. The data should be analyzed with a special care as both solar irradiance and chlorine family concentration have downtrend during the period of simulation. Both these factors strongly influence the ozone concentration so these two effects have to be separated. To investigate ozone response to the chlorine changes we have made additional model simulation where we removed the trend due to the solar activity cycle from all datasets. Based on the obtained in this run sensitivity of the ozone to the chlorine we can determine the sensitivity of the ozone changes to the SSI variability.