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Response of the Tropical Middle Atmosphere to the Solar Irradiance Variability During 28-Days Solar Rotation Cycle

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Chemistry-Climate Model SOCOL has been used to study the atmospheric response to the solar irradiance variability during the Sun rotation cycle. We have carried out an ensemble simulation comprising of nine 1-year long runs driven by the spectral solar irradiance prescribed on the daily basis using UARS SUSIM measurements for year 1992. We have analyzed the correlation of zonal and daily mean hydroxyl, ozone and temperature averaged over the tropics with solar irradiance. The correlation between the hydroxyl and solar irradiance is very robust and almost the same for all ensemble members. The correlation of the ozone with solar irradiance is found to be significant and robust in the mesosphere. For zero phase lag the response of the ozone is negative there reflecting enhancement of hydroxyl radical. The simulated ozone sensitivity in the mesosphere is in a reasonable agreement with observation data. In the stratosphere the ozone correlation with solar irradiance is stable, however for two ensemble members the correlation is weak. The ensemble mean sensitivity of the ozone in the stratosphere to the solar irradiance changes is in a perfect agreement with observation data, however, there is a substantial scatter of its magnitude for different ensemble members. The temperature correlation with solar irradiance is found to be not robust, probably because its variability strongly depends on non-linear dynamics and transport in the atmosphere. The correlation is found to be significant (>0.5) only for two ensemble members. The ensemble mean temperature sensitivity is in a reasonable agreement with observation data only above 50 km. In the stratosphere the maximum of the temperature sensitivity occurs ˜5 km lower than in the observations. The temperature sensitivity has substantial variability and depends on the year of the ensemble run. There are some years of the ensemble, which resembles the observation

data more closely than ensemble mean. Therefore, the model validation based on the temperature sensitivity to short-term solar irradiance variability should be taken with precautions. Successful simulation of the ozone response provides a solid basis for short-term nowcast of the ozone and some other species using prediction of the solar irradiance. In the paper we intend to show an example of such a prediction.