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Response Of The Atmospheric Chemistry And Dynamics To The Solar Irradiance Variability During 1975-2000 Simulated With CCM SOCOL

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We present the solar signal in the atmosphere extracted from the transient run of the Chemistry-Climate Model SOCOL covering 1975-2000. This model run has been driven by time evolving sea surface temperature and sea ice distributions, sulfate aerosol loading, spectral solar irradiance, greenhouse gases and ozone destroying substances. For the estimation of the atmospheric response to the solar irradiance variability we use multiple regression analysis to define the contribution of the imposed solar radiance changes to the time evolution of the simulated quantities and to estimate their sensitivity to the solar irradiance changes from the solar maximum to minimum cases. The analysis show that the solar irradiance variability during 1975-2000 plays an important role in the lower stratosphere/upper troposphere (UTLS) over the middle latitudes in the both hemispheres. The contribution of the solar irradiance to long term evolution of the ozone is about 10% in the lower stratosphere and mesosphere, however it could reach 20% over the northern high latitudes. The contribution of the solar irradiance to long term variability of the temperature exceeds 30% and could reach 80% near the tropopause in the Northern Hemisphere. It is also noticeable in the mesosphere (up to 20%) and in the surface air over the northern high latitudes (˜30%). The ozone response in the lower mesosphere and upper stratosphere to the solar irradiance changes is mostly positive (˜1-2%). Above 30 km the ozone response is well pronounced (˜5%) and occurs at 40 km over the middle latitudes. The ozone response is smaller ($<$2%) in the tropical middle stratosphere, while two additional maximums appear in the UTLS over the northern high and southern middle latitudes. In general, the response obtained from the transient simulation is closer to the observation data analysis than the results obtained from the steady-state experiment. Simulated solar

signal in the temperature resembles the results of the steady-state run by the location and magnitude of the warming spots. The differences appear to be substantial only in the UTLS region over the middle latitudes. They comprise in the additional warming with magnitude exceeding 0.6 K. These elevated temperatures presumably reflect an intensification of the polar vortices. The solar signal obtained for several other simulated quantities is also analyzed.