AOGS 2005
©2005 Asia Oceania Geosciences Society, Singapore

CHEMICAL AND DYNAMICAL RESPONSE OF THE MIDDLE ATMOSPHERE TO STRONG SOLAR PROTON EVENTS OF 23rd SOLAR CYCLE: 3D MODEL RUNS

A. Krivolutsky, A. Klyuchnikova , T. Vyushkova, G. Zakharov, A. Kuminov

Laboratory of Atmospheric Chemistry and Dynamics, Central Aerological Observatory (CAO), Pervomayskaya 3, 141700 Dolgoprudny, Moscow Region, RUSSIA
alkriv@netclub.ru/Fax: +7-095-5763327

3D middle atmosphere general circulation model, and chemical global transport model have been used to calculate the response of ozone (and other species), wind and temperature regime after two strongest solar proton events (SPEs) of 23rd solar cycle. These events occurred in July 2000 and October 2003. It was assumed in photochemical scheme that each pair of ions created at high latitude middle atmosphere by solar energetic protons born approximately one molecular of NO and two molecular of OH, which disturb photochemical system in the stratosphere and mesosphere. Ionization rates caused by SPE has been calculated using high time-resolution satellite measurements of solar proton fluxes from the board of satellite GOES-10. Calculated ionization rates showed that the maximum of ionization placed in the mesosphere and conserved about 1-2 days after the beginning of SPEs. 3D photochemical calculations showed that ozone was strongly reduced in the mesosphere region (about 60-70 % with minus), but corresponding "tail" of disturbances existed more than 10 days after SPEs due to the enhancement of long-lived NO_x . The results of numerical photochemical simulations of ozone depletion after SPEs has been introduced into three-dimensional model of general circulation of the middle atmosphere, and showed that such ozone depletion leads to the disturbances in atmospheric temperature and wind regimes. Some difference in dynamical and temperature response between north and south polar region have been revealed in model simulations. So, solar energetic particles, which reach the Earth's atmosphere at high latitudes and produce additional oxygen, nitrogen and hydrogen chemical compounds after solar proton events, change the regime of temperature and general circulation of the atmosphere. Such SPE-induced changes propagate to the lower latitudes in accordance with calculations and we must take it into account looking for mechanisms of global change and climate variability.
This work was supported by Russian Science Foundation (grant No 03-05-64675).