Geophysical Research Abstracts, Vol. 8, 04309, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04309

Model simulation of the global circulation in the middle atmosphere for January conditions

I.V. Mingalev, O.V. Mingalev and V.S. Mingalev

Polar Geophysical Institute (PGI), Russian Academy of Science, Fersman Str.14, Apatity, Ru-184209, Murmansk region, Russia (mingalev@pgi.kolasc.net.ru)

The mathematical model of the global neutral wind system of the middle atmosphere, developed earlier, is utilized to simulate global distributions of the horizontal and vertical wind for January conditions. Simulations enable to investigate how the horizontal nonuniformity of the atmospheric temperature affects the formation of the middle atmosphere circulation, in particular, the large-scale circumpolar vortices. The utilized model differs from existing global circulation models of the atmosphere, on principle. Firstly, the model does not include the pressure coordinate equations of atmospheric dynamic meteorology, in particular, the hydrostatic equation. Instead, the vertical component of the neutral wind velocity is obtained by means of a numerical solution of the appropriate momentum equation, with whatever simplifications of this equation being absent. Thus, three components of the neutral wind velocity are obtained by means of a numerical solution of the Navier-Stokes equation. Secondly, the model does not include the internal energy equation for the neutral gas. Instead, the global temperature field is assumed to be a given distribution. This peculiarity proceeds from complexity and uncertainty in various chemical-radiational heating and cooling rates, resulting in a discrepancy between the calculated and observed distributions of the atmospheric temperature. On the other hand, over the last years empirical models of the global atmospheric temperature field have been successfully developed. In the present study, we take the global temperature distribution from the NRLMSISE-00 empirical model and consider it to be an input parameter of our model. The simulation domain is the layer surrounding the Earth globally and stretching from the ground up to the altitude of 120 km at the equator. The Earth's surface is supposed to coincide approximately with an oblate spheroid whose radius at the equator is more than that at the pole. The finite-difference method is applied in the numerical model. The calcu-

lated parameters are determined on a 1^{O} grid in both longitude and latitude. The height step is non-uniform and does not exceed the value of 1 km. For the present study, the simulations were performed for winter period in the northern hemisphere (16 January) under moderate solar activity ($F_{10.7}$=101) and low geomagnetic activity (Kp=1). The variations of the atmospheric parameters with time were calculated until they become stationary. The steady-state distributions of the atmospheric parameters were obtained for inputs to model corresponding to 10.30 UT. The results of simulation have indicated that, at levels of the stratosphere and mesosphere, the circumpolar cyclone is formed in the northern hemisphere and the circumpolar anticyclone is formed in the southern hemisphere. These circumpolar vortices correspond to the global circulation of the middle atmosphere, obtained from observations.