ISARD-2025-polar004

Parametrization of mesopause heating due to IR radiation absorption by polar mesospheric louds

Arseniy V. Sokolov[1,2], Elena N. Savenkova[2], Andrey V. Koval[1], Karina V. Kravtsova[3,2], Nikolai M. Gavrilov[1]

[1] St Petersburg University
[2] Russian State Hydrometeorological University
[3] Arctic and Antarctic Research Institute

anigahuchi@yandex.ru

The article is devoted to the development of parameterization of upper atmosphere heating due to absorption of IR radiation fluxes by polar mesospheric clouds (PMC) crystals. The peculiarity of such parameterization is the consideration of thermophysical properties of ice and interaction of cloud particles with the environment. The parameterization uses data on the spatial and temporal distribution of ice crystals in the upper atmosphere of the summer hemisphere based on satellite solar occultation measurements by SOFIE spectrometer. This parameterization allows us to calculate the PMC contribution to the mesosphere-lower thermosphere (MLT) thermal balance. Test calculations were performed using the background SD/WACCM-X temperature distributions for different conditions including the maximum positive/negative temperature anomalies of the subpolar MLT at the end of May. The results obtained show that PMCs can make a significant contribution to the heat balance of the upper atmosphere comparable to the heating caused by the dissipation of gravity waves. In particular, it is shown that, if the mean temperature in the MLT region is higher than the climatic norm, the heating calculated in the parameterization depends on the water vapor content: with increasing water vapor content, the heating in May increases to 3 (K/day). With decreasing background temperature, the dependence on water vapor content weakens. At negative temperature anomalies in the MLT, the heating intensity can reach 4.5 (K/day), and the heating region extends to lower latitudes, up to 50°N. The parametrization can be used in global atmospheric circulation models to study the feedback chain providing cooling of the subpolar MLT above the PMC layer.