An analysis of sensitivity of the inverse problem on retrieval of the altitude profiles of atomic oxygen and ozone from emission intensities of the molecular oxygen

Martyshenko Ksenia and Yankovsky Valentine

Atmospheric Physics Department of Saint Petersburg State University, Saint Petersburg, Russia

e-mail: ocsi18@mail.ru

The model YM2011 was used to develop algorithms for solving of inverse problems of retrieval of altitude profiles of $[O_3]$ and $[O(^3P)]$ from emission intensities of electronic-vibrational excited oxygen molecules O_2 ($b^1\Sigma_g$, v = 0-2) and O_2 ($a^1\Delta_g$, v = 0) in the mesosphere and the lower thermosphere of the Earth. An analysis of sensitivity of inverse problems was performed for variations of all model parameters (rate constants of chemical reactions and the parameters of the Earth's standard atmosphere). Based on the results of the analysis of sensitivity the author investigated the ozone and atomic oxygen altitude profiles retrieval accuracy taking into account uncertainty of all input parameters. Uncertainties of the profiles $[O_3]$ and $[O(^3P)]$ were also investigated using the numerical statistical experiment in which the rate constants of all reactions in the range of the standard errors of those parameters (the Monte Carlo simulations with the Latin hypercube sampling) varied. The uncertainties calculated concentrations of $[O_3]$, $[O(^3P)]$ and the excited oxygen molecules obtained during the numerical experiment do not exceed the values of errors calculated in the analysis of sensitivity.

As a result of solving the inverse problem, uncertainties of retrieval of altitude profiles of $[O_3]$ from $[O_2(b^1\Sigma^+_g$, v = 1] achieved 18±4%, and from $[O_2(a^1\Delta_g$, v = 0)] achieved 30 ± 6% at altitudes of z = 50-100 km were found. Also, uncertainties of retrieval of $[O(^3P)]$ from $[O_2(b^1\Sigma^+_g$, v = 2] achieved 17 ± 3% at altitudes of z = 90-120 km, and from $[O_2(b^1\Sigma^+_g$, v = 1)] achieved 29 ± 8% and from $[O_2(b^1\Sigma^+_g$, v = 0)] achieved 30 ±3% at z = 100-120 km were obtained.

Overall, it is shown that the maximum values of uncertainties of calculated concentrations of O_3, $O(^3P)$, $O_2(b^1\Sigma^+_g$, v = 0 , 1 and 2) , as above mentioned, don't exceed the error of the main reactions measured experimentally.

- POSTER -