Comparison of three methods for retrieving [O(^{3}P)] altitude profile from emissions of O$_2$ Atmospheric bands

Ekaterina Vorobeva and Valentine Yankovsky

Saint-Petersburg State University, Saint-Petersburg, Russian Federation (st062133@student.spbu.ru)

The study presents a comparison of three methods for retrieving [O(^{3}P)] altitude profile from emissions of O$_2$(b$^1\Sigma_g^+$, v' = 0 – 2 → X$^3\Sigma_g^-$, v") bands in the near IR spectral range of 629 – 997 nm. Based on balance equations of the forward problems, we obtained analytical expressions linking [O(^{3}P)] to the volume emission rate for the corresponding transition in the framework of the YM2011 model [1]. The uncertainties of the retrieved values of [O(^{3}P)] were estimated by the Monte Carlo simulation taking into account the errors of all model parameters [2]. Based on these uncertainties, it is possible to draw conclusions about the ranges of application of the suggested methods. Our results show that the retrieval of [O(^{3}P)] altitude profile by using the emissions from O$_2$(b$^1\Sigma_g^+$, v' = 1) can be applied only above 110 km with the relative uncertainty of 17 – 20%. As for retrieval of [O(^{3}P)] altitude profile by using the emissions from O$_2$(b$^1\Sigma_g^+$, v' = 2) and O$_2$(b$^1\Sigma_g^+$, v' = 0), these methods can be applied in a wide altitude range of 90 – 140 km and 95 – 140 km, respectively. The relative uncertainty of these methods amounts 15 – 20% and 20 – 25%, respectively. This study was supported by the Russian Fund for Basic Research (grant RFBR No.17-05-00532).

1.Yankovsky V. A., Martyshenko K. V., Manuilova R. O., Feofilov A. G. Oxygen dayglow emissions as proxies for atomic oxygen and ozone in the mesosphere and lower thermosphere. Journal of Molecular Spectroscopy, 327, 209-231 doi:10.1016/j.jms.2016. (2016).

2. Vorobeva E., Yankovsky V., and Schayer V. Estimation of uncertainties of the results of [O(^{3}P)], [O$_3$] and [CO$_2$] retrievals in the mesosphere according to the YM2011 model by two approaches: sensitivity study and Monte Carlo method. EGU2018-17950.