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Proposals on multi-channel methods for the simultaneous remote sensing of [$O(^3P)$], [O_3] and [CO_2] altitude profiles in the mesosphere and lower thermosphere in daytime

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Three small components of $O(^3P)$, O_3 and CO_2 in the daytime mesosphere and lower thermosphere (MLT) of the Earth are responsible for the thermal regime of the atmosphere. Among these components, only the altitude profile of ozone concentration can be measured by a direct method for absorbing radiation from the Sun or the stars in the UV range of the spectrum. However, this method is most often realized in the conditions of twilight, so cannot give an exhaustive presentation of the altitude profile of [O_3] throughout the daytime hours. Height profile of the atomic oxygen is usually restored on the assumption that it is looped with ozone. Despite the attractiveness of this approach, it cannot explain the altitude profile of atomic oxygen above 96-98 Km, where the ozone concentration decreases by catastrophic style. The CO_2 concentration in the MLT region is usually retrieved indirectly by solving complicated kinetic problem for the non- LTE radioactive transfer. The analogous difficulties of [O_3] retrieval from the observation of emission in 9.6 μm band are explained by the complexity of the vibrational kinetics of O_3 molecule. Retrieved values of both CO_2 and O_3 to some extent depend on a prior information about the $O(^3P)$ altitude profile. The problem can be solved by using individual proxy for each of the target component. Using a sensitivity study and uncertainty analysis of the contemporary model of O_3 and O_2 photolysis in the MLT, YM2011, we have tested three excited components; namely the electronic-vibrational excited molecules, $O_2(b1_g+, v=0, 1, 2)$, as [$O(^3P)$], [O_3] and [CO_2] proxies. We conclude that in the altitude range of 50-85 km, simultaneously independent retrievals of [O_3] and [CO_2] are possible (see figure 1); and in the range of 85-100 Km, the emissions in three channels from the $O_2(b1_g+, v=0, 1, 2)$ molecules make it possible to retrieve the [O_3], [CO_2] and [$O(^3P)$] simultaneously.

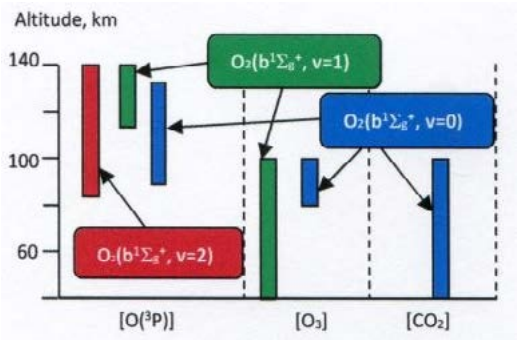

Figure 1: The types of proxy are recommended for retrieval of altitude profiles of the [$O(^3P)$], [O_3] and [CO_2] in the MLT region.

Biography

Valentine A Yankovsky is an Associate Professor of Atmospheric Physics at St. Petersburg State University. In 1986, he completed his PhD at St. Petersburg University. His main research fields are "The atmospheric photochemistry in the MLT region, the sensitivity and uncertainty study of complex photochemical systems and the retrieval of ozone and atomic oxygen in the MLT". He has published more than 25 papers in reputed journals.

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