Zvenigorod Airglow Data

The aim of our research is to understand better the atmosphere between 80 and 100 km as a transition region between the middle atmosphere and near space environment (so called the mesopause). A particular interest focuses on the processes that control thermal and dynamical regime of the mesopause. Observations of the night airglow spectrum at the near infrared, emitted from the mesopause, are the remote sensing a given atmospheric area. In Zvenigorod (56^o N, 37^o E) at the scientific station of A.M. Obukhov Institute for Atmospheric Physics, Russian Academy Sciences, we observe airglow spectra of two gas species of the mesopause, hydroxyl (band OH(6-2) at 834.5 nm) and molecular oxygen (O_2A(0-1) at 865 nm).

The emission of the hydroxyl airglow arises from the ozone-hydrogen reaction (Bates and Nicolet, 1950). The emitting hydroxyl layer has its volume emission rate peak near 87 km and a half-width of approximately 9 km (Baker and Stair, 1988).

The O_2A(0-1) emission band belongs to the Atmospheric system of the $O_2(b^1\Sigma)$ airglow, which is formed via the recombination of atomic oxygen at nighttime and additionally via the fluorescence and ozone photolysis at daytime (Khomich et al., 2008). The nighttime $O_2(b^1\Sigma)$ emitting layer is located in the lower thermosphere with the peak intensity at about 94 km and a half-width of approximately 10 km (Witt et al., 1979; Watanabe et al., 1981; Takano et al., 1990; Yee et al., 1997).

The spectral observations at Zvenigorod allow us to determine intensities of the given bands of the mesopause airglow and temperature of vibrationally-excited hydroxyl (OH*), which is defined as the rotational temperature from the Boltzman distribution of OH* molecules over the first three thermalized rotational states. A detailed description of the spectral device, observation conditions, procedure of the spectrum treatment, and determining the OH(6-2) and O_2A(0-1) intensities and OH* temperature is given in the paper by Pertsev and Perminov (2008).

Although the airglow observations at Zvenigorod are conducted since 1957, the present database is based only on airglow measurements since 2000, when digital registration instead of photofilm one was developed for spectral observational instrument. That allowed us to introduce the unified approach to the spectral treatment and the determination of airglow characteristics.

The present database includes the airglow emission intensities only for clear weather nights. All intensity values are reduced to zenith conditions. Data on the OH* temperature are given for both clear and semiclear nights. Since the night duration at 56° N is highly variable in the course of year (~14 h in December and ~1 h in June), we form data sets using the measurements obtained between 21 and 22 UT (around local midnight). Besides, these measurements are averaged over this time interval. As a result, the statistical error (the standard deviation of the mean value) is ±1 K for the temperature, and ±6.4 R and ±5.3 R for the intensity of the OH(6-2) и O_2A(0-1) bands, respectively.

The present airglow data were obtained by the following scientific team:

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The following reference should be cited when using the data of the present database:

● Pertsev, N., and V. Perminov (2008), Response of the mesopause airglow to solar activity inferred from measurements at Zvenigorod, Russia, *Ann. Geophys.*, 26, 1049–1056, doi:10.5194/angeo-26-1049-2008.

Data access

The data files are in ASCII text format. The data can be freely downloaded at the following web resource of the A.M. Obukhov Institute of Atmospheric Physics: http://ifaran.ru/lab/lfva/airglow_data_engl.html

Filename	Description	File table format
MT.txt	Midnight OH* temperature	Year-month-day, temperature (K*)
MAI.txt	Midnight OH(6-2) and $O_2A(0\text{-}1)$ band intensities**	Year-month-day, OH(6-2) intensity (R***), $O_2A(0\text{-}1)$ intensity (R)

*in units of kelvin (K)

** intensity values reduced to zenith

*** in units of rayleigh (R)

Last updated database: January 2019, Vladimir Perminov (v.perminov@rambler.ru) and Nikolay Pertsev (n.pertsev@bk.ru)