# Space-time transformation sky brightness at a horizontal position of the sun

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## ABSTRACT

This report discusses some simulation results of the angular distribution of brightness of the sky in the case of molecular scattering in the atmosphere for the benefit of the study of space-time changes of this distribution during the civil twilight.

**Keywords**: The brightness of the sky, twilight, atmosphere, molecular scattering of light.

In most of universally known works on the problem of modeling of the interaction of the optical solar radiation with atmospheric particles much attention is given to the field of radiation scattered in the atmosphere at various positions of the sun above the horizon. In [1,2] the basic mechanisms of the brightness of the atmosphere due to scattering of solar radiation on its particles were already considered with regard to geophysical factors, including the position of the sun at the horizon. On this basis, in the IAO SB RAS the AtModel software package was developed [3] by means of which the spatio-temporal variability of the atmosphere for the brightness of the twilight period was modeled. In the following figures on the right the calculated and presented in the form of Allsky images angular brightness distribution of the atmosphere, are shown and the left - the relative angular distribution of the rate of change of brightness for the red (R), green (G) and blue (B) ranges of the visible portion of the electromagnetic spectrum at different solar zenith angles. Below we presented diagrams of the brightness level of the calculated values, and its in the solar vertical for the three specified parts of the spectrum - R, G, B.

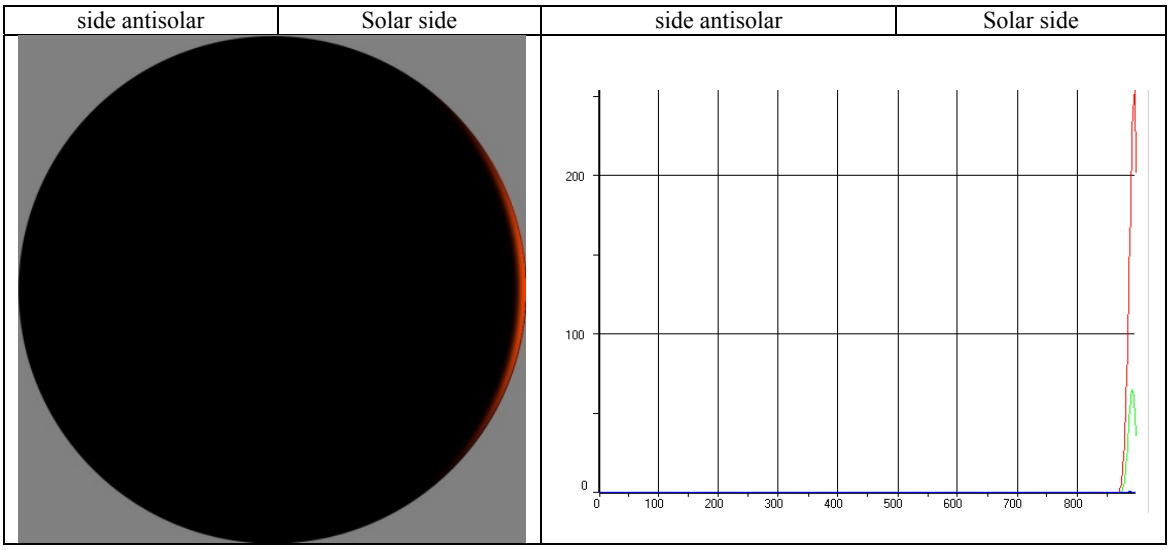


Fig. 1a) The angular distribution the level of rage sky.

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21st International Symposium on Atmospheric and Ocean Optics: Atmospheric Physics,
edited by G. G. Matvienko, O. A. Romanovskii, Proc. of SPIE Vol. 9680, 968017

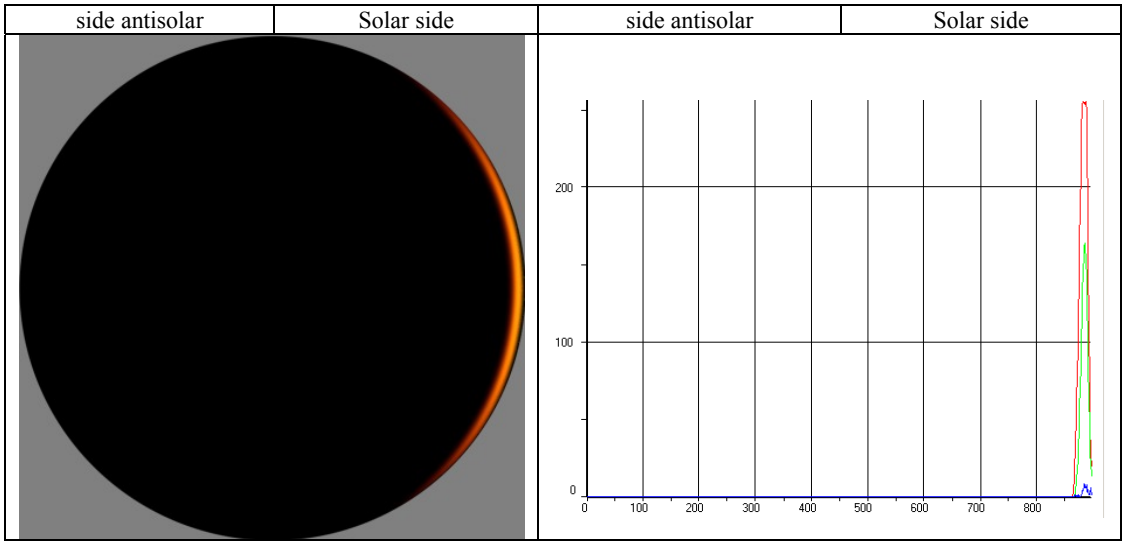


Fig. 1b) The angular distribution of time change of the brightness of the sky

*Fig. 1. (1a and 1b) The angular distribution of the sky brightness of heaven and its temporal variability (interval of 5 minutes) for molecular atmosphere at the zenith angle of the Sun 99 degrees.*

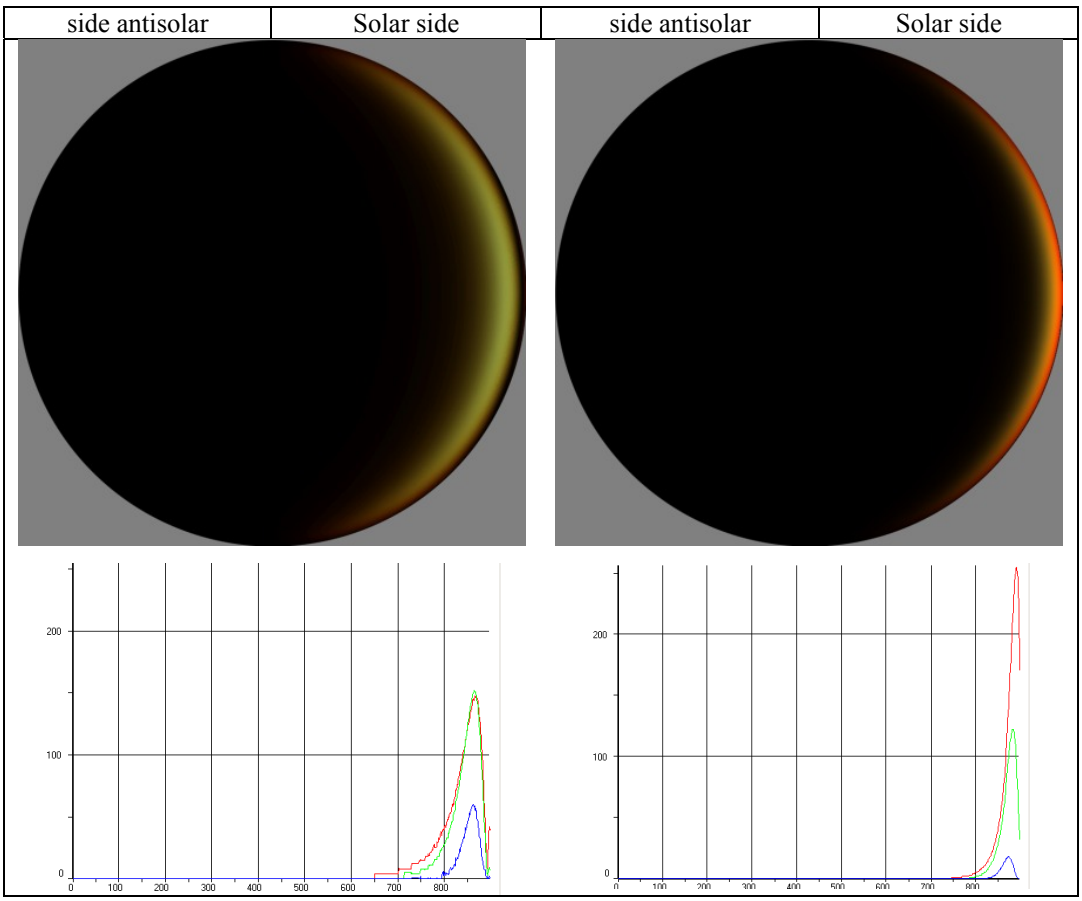


*Fig. 2. The angular distribution of the sky brightness and its temporal variability for molecular atmosphere at the zenith angle of the Sun 96 degrees.*

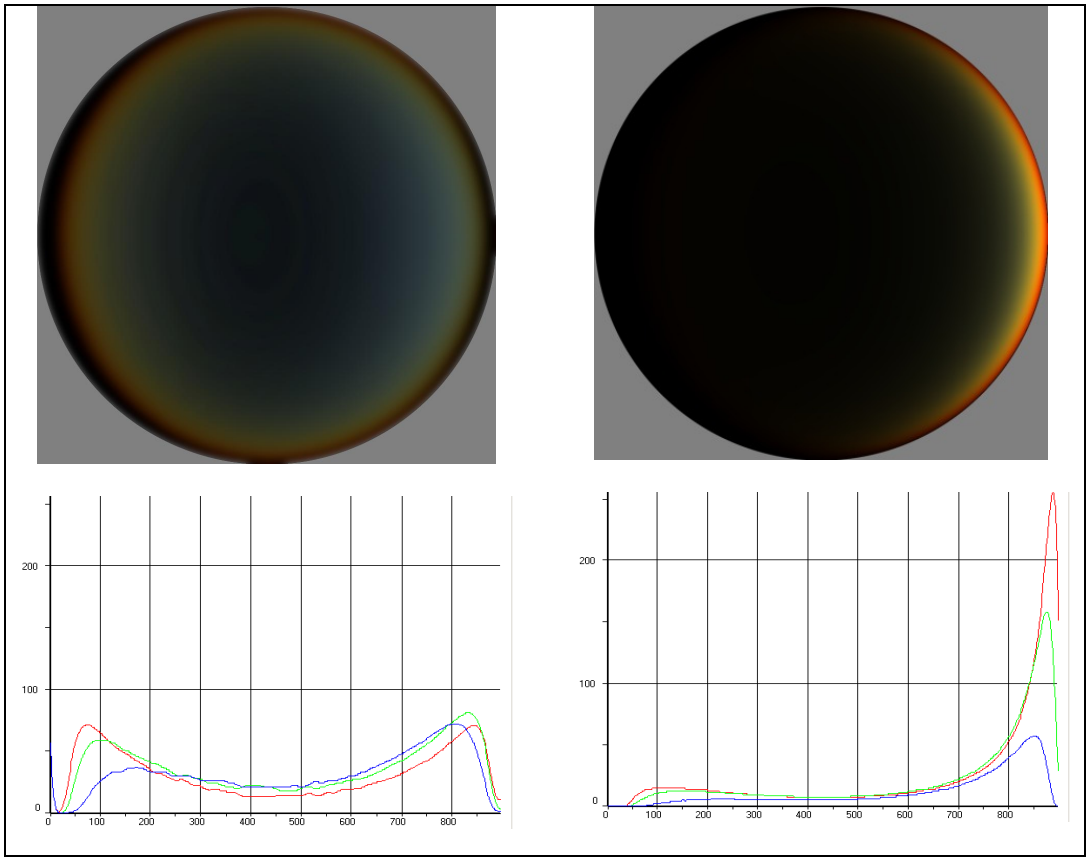


*Fig. 3. The angular distribution of the sky brightness and its temporal variability for molecular atmosphere at the zenith angle of the sun of 94.5 degrees.*

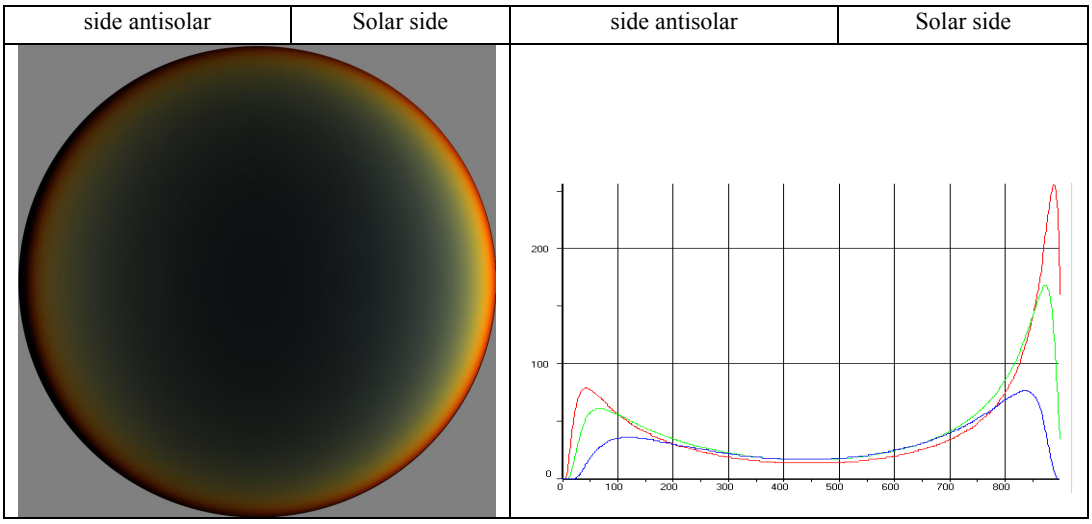


*Fig. 4a) The angular distribution the level of rage sky.*

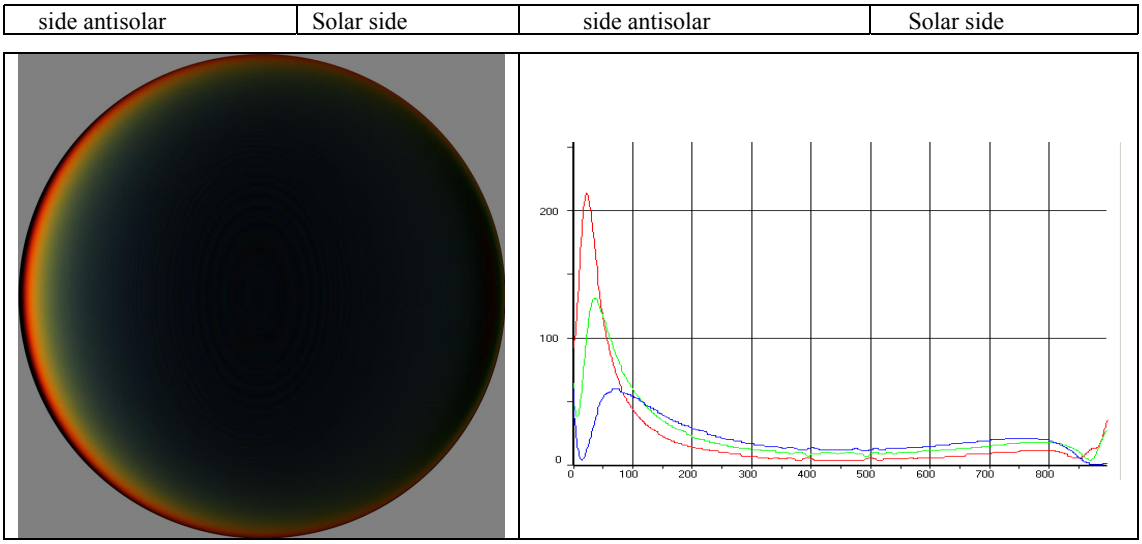


*Fig. 4b) The angular distribution of time change of the brightness of the sky*

*Fig. 4. (4a and 4b) The angular distribution of the sky brightness and its temporal variability for molecular atmosphere at the zenith angle of the sun of 91.5 degrees.*

Analysis of the simulation results shows that for large values of zenith angles (Fig. 1) the rate of change of brightness in the red spectral range is the highest and it is focused on the horizon in the plane of the solar vertical. By decreasing the solar zenith angle (Fig. 2) the rate of change of brightness decreases, but this is an expansion of the spectral range of brightness (added green and blue components of the spectrum). The maximum brightness value is still concentrated in the solar vertical, but the angular range of the sector of changes in the brightness is expanded compared with the previous figure. With a further reduction of the solar zenith angle (Fig. 3) there is a further decrease in the rate of brightness changes, but its change occurs across the sky and are more evenly distributed over the spectrum except near horizon zone where there is change in the dominance of the green range in the plane of the solar vertical in the direction of the sun and in the red part of the spectrum - in antisolar side. For values of zenith angles of the Sun close to the horizon (Fig. 4), there are the maximum changes in brightness in the red range of the spectrum antisolar side.

## REFERENCES

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