Long-term variation of UV radiation fluxes observed in Tomsk

M.V. Vinarskii, I.I. Ippolitov, and M.V. Kabanov

Institute of Optical Monitoring,
Siberian Branch of the Russian Academy of Sciences, Tomsk

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The long-term variation of UV fluxes is considered based on the results of ground-based measurements in Tomsk (from 1994 to 2001). It was found that the dynamics of UV fluxes is not connected with the dynamics of the total ozone content and cloudiness, but is caused by variation of atmospheric aerosol and solar activity.

Regular measurements of solar UV radiation fluxes have been conducted in Tomsk since 1994 with a filter UV spectrophotometer[1] in the spectral regions A (315–400 nm) and B (280–315 nm). The measurements of the UV radiation flux intensity at the surface level are accompanied by measurements of air temperature and humidity, as well as atmospheric pressure, and assessment of cloudiness and wind. The observation site locates at the geophysical station of the Institute of Optical Monitoring, SB RAS.

From processing of experimental observations for the period since September 1994 until March 2001, we have found deviations of the UV radiation flux intensity from the monthly mean values obtained from all observations (Fig. 1).

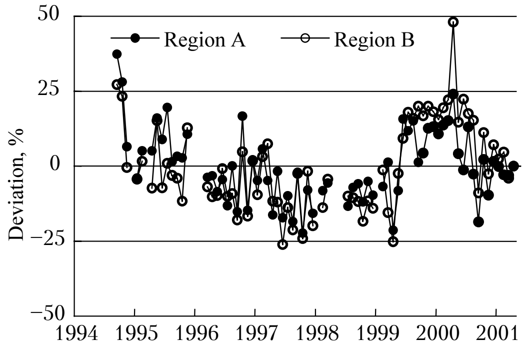

Fig. 1. Deviation of UV radiation intensity from monthly mean values.

It can be seen from Fig. 1 that a long-term tendency can hardly be found in the dynamics of the UV radiation intensity in both A and B region. Nevertheless, it is worth noting the decrease of the UV-A and UV-B radiation intensity in 1996–1999 and relatively high values of the observed fluxes in 1999–2000.

These deviations can be caused by a number of factors, namely, cloudiness dynamics in the considered observation period, dynamics of the total ozone content (TOC), variation of the aerosol optical depth, and solar activity. To assess the effect of these factors on the dynamics of the UV radiation fluxes, we studied the correlation of UV-A and UV-B radiation fluxes with the dynamics of cloudiness and TOC,[2] as well as with the Wolf number characterizing the solar activity. The values of the correlation coefficients are given in the Table.

Table. Coefficients of correlation between UV-A and UV-B radiation fluxes and total and lower cloudiness, TOC, and Wolf number *W*

Region	Total cloudiness	Lower cloudiness	TOC	*W*
A	0.09	0.02	−0.05	0.18
B	−0.13	−0.16	−0.39	0.49

For the considered period, we observed the increase of the total cloud amount and decrease of the lower cloud amount (Fig. 2), while no pronounced tendency was observed in TOC (Fig. 3). It can be seen from the tabulated correlation coefficients that the correlation of the UV radiation fluxes with cloudiness is insignificant in the region A, while a weak negative correlation is observed in the region B. The correlation between TOC and UV radiation is significant in the region B.

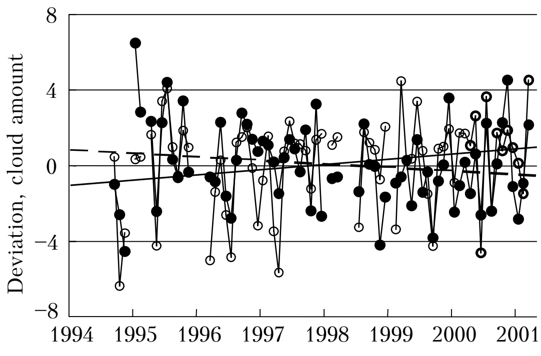

Fig. 2. Deviation of total (—o—) and lower (—□—) cloudiness from monthly mean values; trends of the total (XXX) and lower (X X X) cloudiness.

Since the correlation of UV radiation with cloudiness and TOC is different in the regions A and B and the observed deviations in the dynamics of UV radiation fluxes manifest themselves in both spectral regions with the high correlation coefficient of 0.81, we can conclude

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that the dynamics of cloudiness and TOC does not explain long-term variations in the UV radiation fluxes.

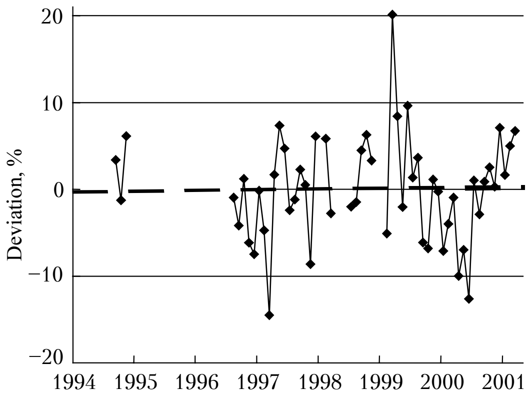

Fig. 3. TOC deviation from monthly mean values; TOC trend (X X X).

According to data from Ref. 3, the aerosol concentration over the Western Siberia in the many-year dynamics follows the 11-year cycle of solar activity with the two-year shift. After the maximum in 1994, we observe a permanent decrease of the aerosol concentration in the surface layer. Since the UV spectrophotometer records largely the scattered radiation,[1] the decrease of the number of scatterers can lead to a fall off of scattered UV radiation. However, this behavior of the aerosol number density does not explain the increase of the UV radiation flux in 1999–2000. It was just in this period that we observed the increase of solar activity (Fig. 4), which can cause intensification of the UV radiation flux. The strong correlation between the dynamics of UV radiation fluxes and the solar activity is also confirmed by rather high values of the correlation coefficient (0.18 in the region A and 0.49 in the region B).

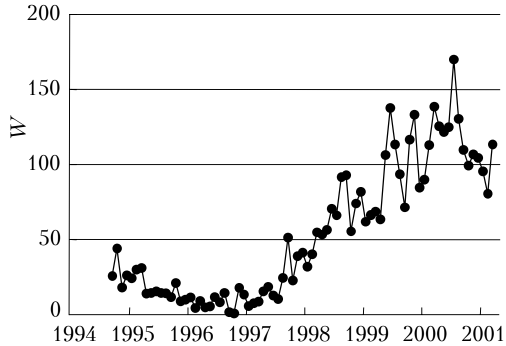

Fig. 4. Wolf number.

Thus, we can conclude that the dynamics of UV radiation fluxes for the considered period is not connected with the dynamics of TOC and cloudiness, but is caused by variations of the aerosol component of the atmosphere and of the solar activity.

References

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