BELARUS

On December 18th, 2005 Belarus ratified the Montreal, Copenhagen and Beijing amendments to the Montreal Protocol thereby fully joining the countries-participants of the Protocol. In 2005-2006 customs regulations were changed towards more restrictions on ozone depleting substances importation. Analysis department has been recently created within the National ozone monitoring research and education center (NOMREC) as a part of National Environmental Monitoring System (NEMS) database.

OBSERVATIONAL ACTIVITIES

In accordance with the decisions of the Seventh Meeting of the Conference of the Parties to the Vienna Convention Belarus continues to design instrumentation as well as develop monitoring, calibration procedures and archiving of stratospheric/ tropospheric ozone, aerosols, and surface UV radiation data.

Column measurements of ozone

Total ozone measurements have been made at the Minsk ozone station (Minsk, 27.469E, 53.833N) by a UV spectrometer-ozonometer PION.

Total ozone values have been assessed employing the “direct-sun” procedure. There have been 80 to 120 series each containing 7 measurements during a daily session under clear sky. Signals have been taken at 13 working wavelengths of the spectrometer-ozonometer PION covering a range of 295 – 320 nm. The final calculations are based upon technique elaborated in the National ozone monitoring centre. The procedure hasn’t been applied under bad weather conditions (overcast, rain, heavy snowfall).

The total ozone amount is also retrieved by intensity ratios of pairs of wavelengths measured by a spectroradiometer PION-UV.

Total aerosol measurements

Monitoring of the general optical thickness (GOT) and optical aerosol thickness (OAT) of the atmosphere in a spectral range of 295 - 320 nm has been started at the Minsk ozone station since 2004. GOT and AOT are measured applying a “direct-sun” method by the UV spectrometer-ozonometer PION within TOA measurements session. To assume the overcast influence we use the signal of its tracking system with sensitivity maximum at 850 nm in addition to 13 working wavelengths of the spectrometer-ozonometer.

Total nitrogen oxide measurements

The measurements have been performed since 2007 at the Minsk ozone station. The nitrogen oxide column retrieval technique originally generated at the Obuchov’s Institute of Atmosphere Physics (Russia) has been employed.

Surface ozone monitoring

Measurements of surface ozone concentration have been started at the Minsk ozone station and Berezina National Park EMEP station employing DOAS instrument TRIO-1 to have passed recently a standard certification in the Belarus state institute of metrology. According to the results of the certification a range of ozone measured concentration is 0-200 ppb, the absolute error of measurements does not exceed ±1,45 ppb.

The results of monitoring of the surface ozone concentration at both stations for 2007 are demonstrated in Fig. 1

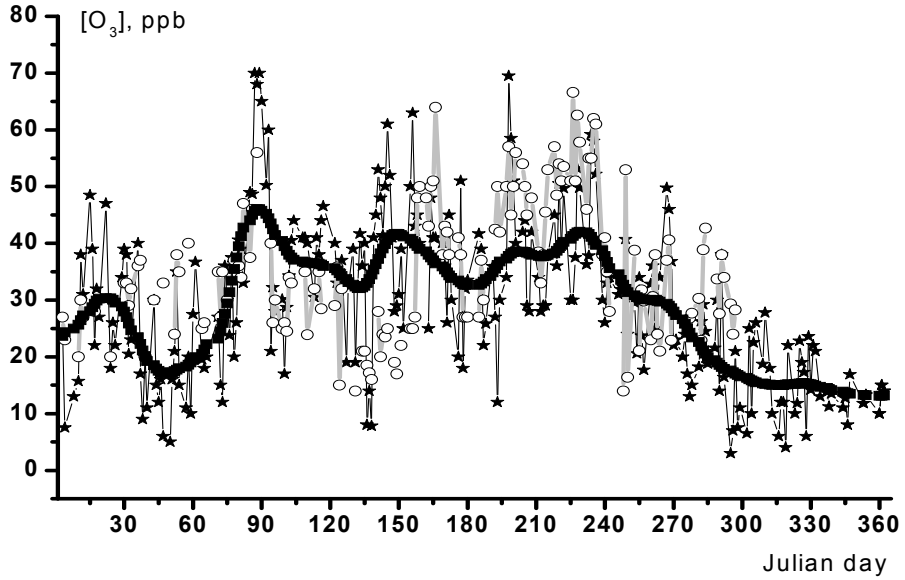

Figure 1: Concentration of surface ozone. Data received at the Minsk ozone station are marked with asterisks, those from Berezina National Park – with circles. Results of data smoothing with the averaging period for 15 days are brought.

Profile measurements of ozone and aerosols

The stratosphere monitoring was started by the Institute of Physics, National Academy of Sciences of Belarus (IP) in 80th.

IP station conducts two wavelength (355 and 532 nm) lidar measurements of stratospheric aerosol parameters.

Investigations of ozone concentration profiles in the stratosphere have been maintained since 2000 at a lidar station of the IP.

Fig. 2 demonstrates seasonal deviations of ozone concentration profiles in the stratosphere.

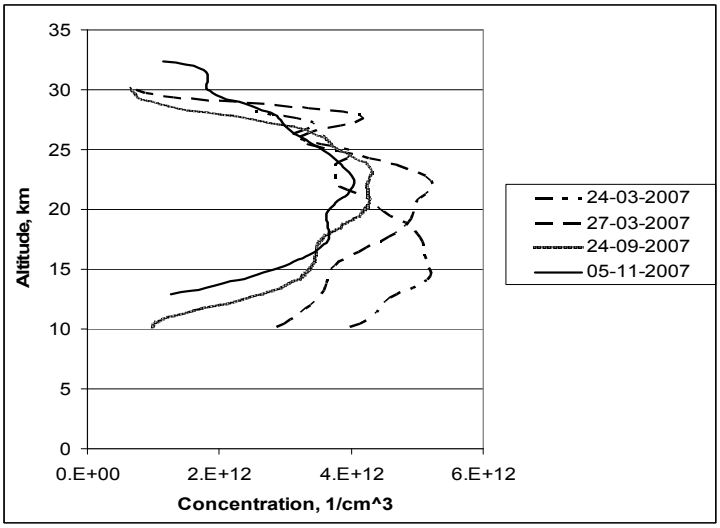

Figure 2: Altitude distributions of ozone concentration, Minsk, 2007.

The lidar system for sounding ozone in troposphere is being developed. A new type of a transmitter at the wavelength 281.7 nm on the base of solid-state stimulated Raman scattering converter is used in the lidar. A new lidar system provides measurements of ozone concentration in the layer of 1 – 10 km.

UV Radiation Measurements

Regular measurements of UV radiation level in a spectral interval of 285-450 nm have been maintained at the Minsk ozone station by a portable UV spectroradiometer PION-UV since September, 2001. The automatic device PION-UV (a double monochromator spectrometer with a resolution of 0.9 nm) registers up to hundred total/diffuse UV spectra per day.

To expand the ongoing activities a new UV-B monitoring site was set up in 2008 at the Naroch National Park (the North-Western part of Belarus). An automated double-channel narrow-band photometer is operated at the site.

Calibration Activity

The UV calibration of the spectroradiometer PION-UV was carried out with 300W tungsten band-lamp certified by the Russian National Standard Agency in a spectral range of 285-450 nm.

The M-124 instrument was recently calibrated against a WMO regional standard (Dobson N108 spectrophotometer) in St. Petersburg, Russia in 2007.

RESULTS FROM OBSERVATIONS AND ANALYSIS

Average annual value of total ozone amount (TOA) over territory of Belarus in 2006-2007 was close to climatically normal with deviations up to 8.5 per cent for monthly averaged values. "Mini-holes" were observed at a quite unusual period for Belarus – in February and even in July. The analysis of surface temperature and TOA shows that their values are correlated (for the summer period in Belarus, see Fig. 3). This correlation is assumed in the UV Index forecast technique. Moreover, the fact should be considered carefully that number of late spring and summer negative anomalies moving from Atlantic direction increased by 3 times during the period of 2001-2006 whereas the number of mini-holes coming from Arctic zone remains practically the same.

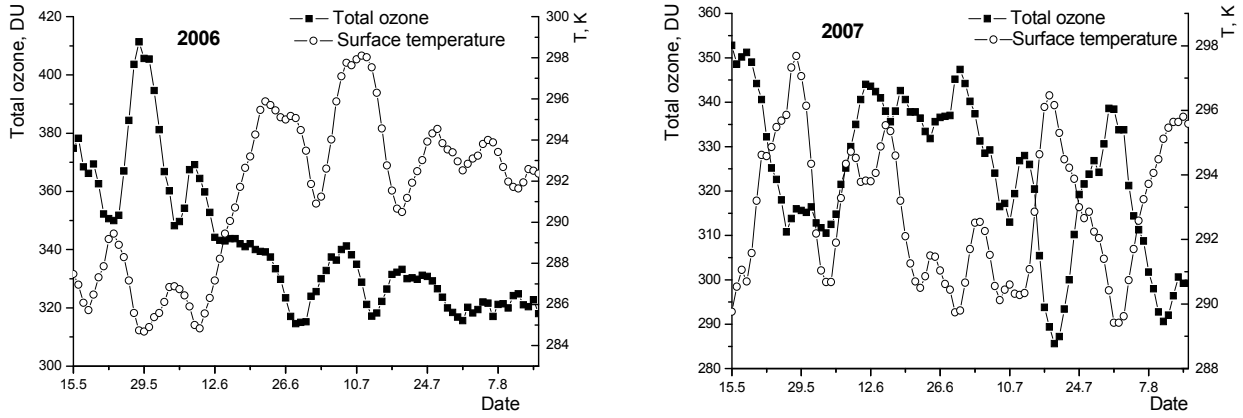

Figure 3: Daily values of surface temperature and total ozone (smoothed by 4 point moving average).

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THEORY AND MODELLING

Since the PION ozonometer operates 13 wavelengths being shorter than those at Brewer and Dobson devices we are advancing the technique of a measurement process as well as some accompanying procedures, particularly, aerosol optical thickness. Also, a self-calibration method

based on Langley technique modified to using statistical processing of results is being developed to define extraterrestrial constant and other instrument parameters.

DISSEMINATION OF RESULTS

The data being derived by the NOMREC along with the data collected at the Institute of Physics are submitted to and archived in the NEMS database. So far we are not able to send the accumulated data to the WOUDC because of a problem with their reevaluation. Nevertheless, certain measures are currently being undertaken towards resolving positively this problem.

Information to the public
Mapping and UV Index forecast generated specifically for different regions have been realized since 2006.

UV Index short-term forecast for all territory of the republic as well as a map (for clear sky and assuming predicted overcast) is submitted to the National news agency BelTA on a daily basis and published in republican newspapers "Zviazda" and "Obozrevatel".

These data are also available on the NOMREC site at http://ozone.bsu.by and on the official site of the Republican weather centre at http://www.pogoda.by. A corresponding program automatically updating site information has been originated by the NOMREC. Two brochures named “20 years of the Montreal Protocol” and ”UV radiation safe application” were specially published in 2007 for a national meeting of environmental specialists dedicated to the 20th anniversary of the Montreal Protocol.

PROJECTS AND COLLABORATION

The NOMREC is currently in charge of a few national projects related to total ozone amount, UV radiation and tropospheric ozone research. Those are as follows: ozone mini-holes dynamics and climate parameters, stratospheric and surface ozone interaction, evaluation of solar UV radiation long-term changes in Belarus (all in progress); designing of DOAS surface ozone instruments (along with the Lithuanian Institute of Physics).

Monitoring of atmosphere is maintained within the framework of lidar net in CIS countries CIS-LiNet and European lidar network EARLINET.

In 2006 certain activities were implemented towards modernization of a Russian ozonometer M-124 (addressing current technology and element base) by the NOMREC along with GGO atmosphere remote sounding research centre (St. Petersburg, Russia).

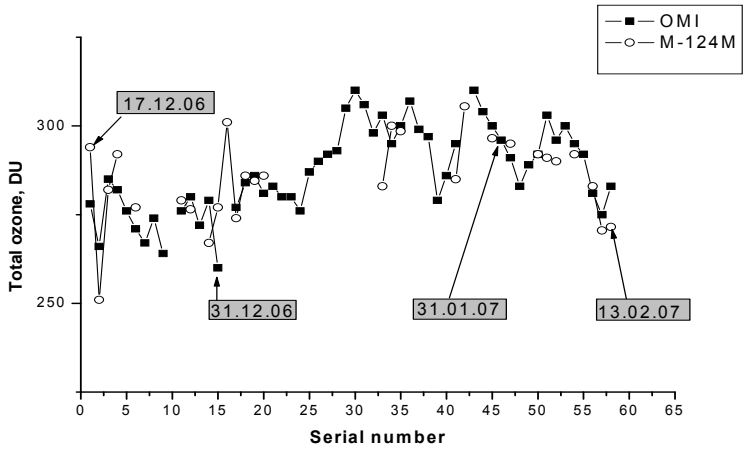

Figure 4: Total ozone data measured at Molodezhnaya Antarctic station.

Natural tests of the modernized M-124 model were performed during the seasonal Antarctic expedition (2006-2007). The model differs from the initial one by the combine interference-absorption filters and the solar-blind phototube.

Data analysis shows good conformation of the general trend of TOA variations to satellite data (see Figure 4).

FUTURE PLANS

Four more UV monitoring stations in different Belarus regions equipped with narrowband filter devices (NILU-UV type) will be brought into operation within next 3 years.

The instrument for zenith observation of total nitrogen dioxide is planned to be compared to the regional standard in Zvenigorod (Russia).

The lidar system for sounding ozone in troposphere shall be brought into operation regime at the IP lidar station. A complex technical project on PION and PION-UV modernization is adopted aiming at providing regular measurements of ozone and UV radiation in Antarctica. The GGO along with the NOMREC are intended to realize a project on maintaining the M-124 network beyond Russia Federation in terms of instrumentation repairing and modernization. As follows, in accordance with WMO Global Ozone Research and Monitoring Project Report No. 48 (Recommendations, point 11.2) we seek for financial and institutional support to keep this perspective attainable.

References

Chaikovsky, A.P., Ivanov, A.P., Balin, Yu.S., Elnikov, A.V., Tulinov, G.F., Plusnin, I.I., Bukin, O.A., and Chen, B.B. CIS-LiNet lidar network for monitoring aerosol and ozone: methodology and instrumentation // Atmos. Oceanic Opt. – 2005. - V. 18. - No. 12. – P. 958 – 964.

Bösenberg, J., Ansmann, A., Baldasano, J., Balis, D., Böckmann, C., Calpini, B., Chaikovsky, A., Flamant, P., Hagard, A., Mitev, V., Papayannis, A., Pelon, J., Resendes, D., Schneider, J., Spinelli, Trickle, T., Vaughan G.,Visconti G., Wiegner, M. EARLINET-A European aerosol research lidar network // Advances in Laser Remote sensing, Selected papers 20th Int. Laser Radar Conference (ILRC). Vichi, France, 10-14 July 2000. 2000. Pp. 155-158.

L.N. Turishev, Yu.I. Atrasheuski, V.N. Denisenko, V.L. Tavgin Spectroradiometer for the monitoring of surface ultraviolet solar radiation //J. of Applied. Spectroscopy, 2005, V.72, N.2, Pp. 264-270

L.M. Balatsko, A.N. Krasouski, A.M. Liudchik, and V.I. Pakatashkin. Measurement of the surface ozone concentration by absorption UV spectroscopy // J. of Applied Spectroscopy, 2005, V. 72, N 6, Pp. 833-836

L.M. Balatsko, V.S. Dyomin, A.N. Krasouski, A.M. Liudchik, and V.I. Pakatashkin. Multiwave technique for surface ozone concentration measurement by open-path optical measurer // J. of Applied Spectroscopy, 2008, V.75, N 2, Pp. 256-261

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