

## BELARUS

A number of significant amendments to the Law of the Belarus Republic for Ozone Layer Protection, adopted in 2001, were introduced by the National Assembly of Belarus in October 2004. Ozone monitoring was determined as a part of National Environmental Monitoring System (NEMS). A plan for the development of the Atmosphere Ozone Monitoring subsystem up to 2010 has been prepared. Decision of Belarus Government N 949 dated the July, 14 2003 pronounced the Ministry of Education responsible for ozone monitoring in Belarus.

### OBSERVATIONAL ACTIVITIES

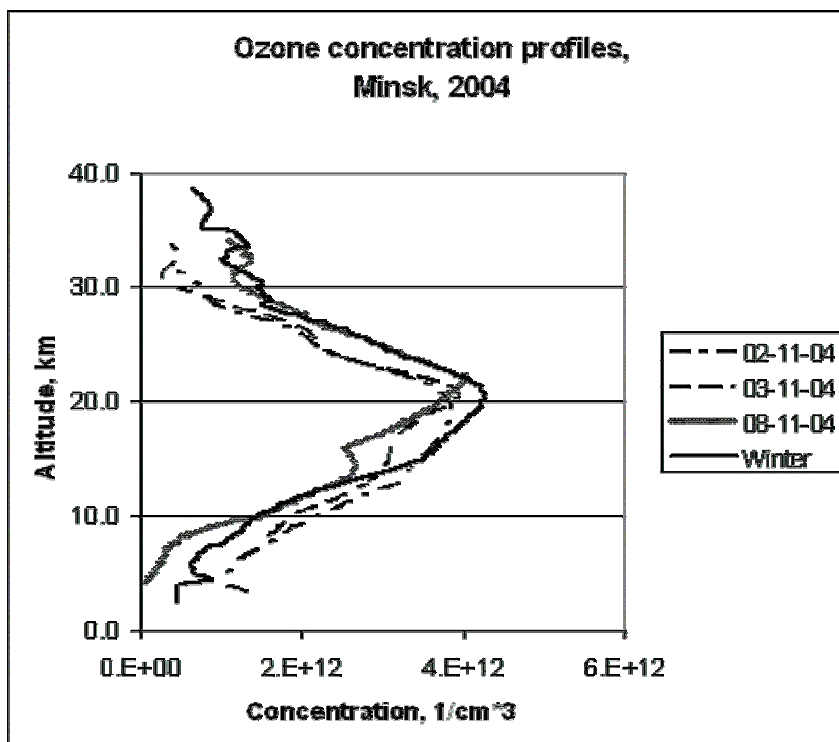
In accordance with decisions of the Sixth Meeting of the Conference of the Parties to the Vienna Convention, Belarus has continued to construct instruments and develop monitoring, calibration and archiving of stratospheric and tropospheric ozone, aerosols, and surface UV radiation data.

#### Column measurements of ozone

Total ozone measurements are carried out at an Ozonometric station (WOUDC identification N 354) located in Minsk at the National Ozone Monitoring Research & Education Center (NOMREC). The Station coordinates are (53.833N, 27.469E). The daily measurements are implemented with the ultraviolet multi-wavelength spectrometer-ozonometer PION. The total ozone amounts are also retrieved via intensity ratios of pairs of wavelengths using Stamnes tables from the observation of horizontal UV irradiance measured with spectroradiometer PION-UV. The both instruments constructed at the Belarus State University.

#### Profile measurements of ozone and aerosols

Profile monitoring of ozone concentrations and stratospheric aerosol executes by means of Dial lidar with working wavelength 308 and 355 nm up to 35-40 km. Routine measurements are carrying out three times per month on average at the Institute of Physics of National Academy of Sciences (IPNAS), Minsk (see Figure 1).



**Figure 1: Ozone concentration profiles during negative ozone anomalies in 2004, winter period.**  
**Solid line - Middle profile for winter period.**

## UV measurements

Regular measurements of irradiance in the spectral range 285-450 nm are carried out at the Ozonometric station (NOMREC, Minsk) with the portable UV spectroradiometer PION-UV since September 2001. The automated instrument PION-UV registers more than a hundred global/diffuse UV spectra per day. Simultaneously controlling programme calculates UV-index and daily doses of biological effects.

## Calibration activities

Spectrometer-ozonometer PION was inter-compared with a WMO regional standard (Dobson N 108 spectrometer) in St.-Petersburg (Russia, August 2001). NOMREC consistently develops and successfully introduces in practice a concept of self-calibration of the net ozonometers. This means carrying out all available calibration procedures mainly on the base of results of measurements and testing made during operation cycle of the instrument and excluding any laboratory testing and inter-comparisons. Now following procedures are available:

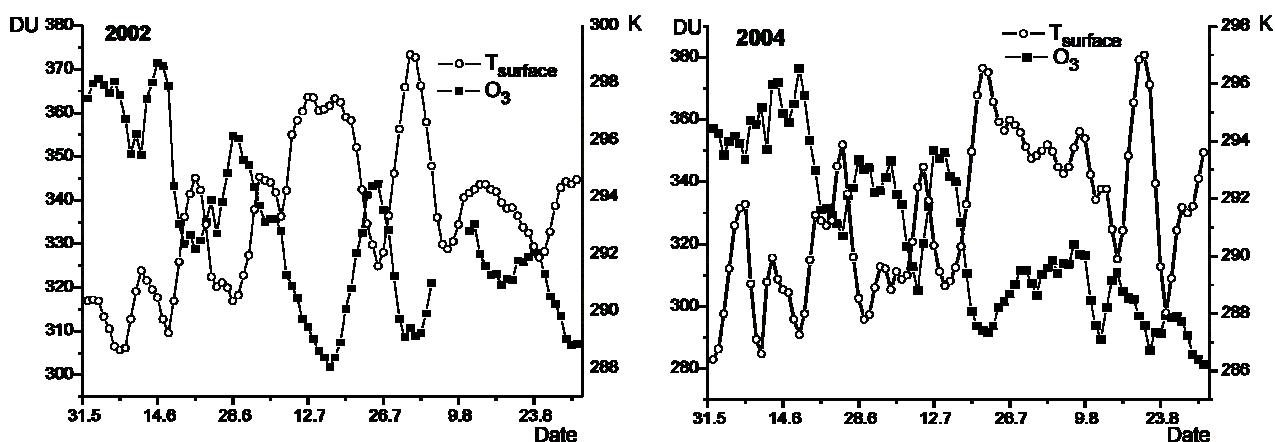
- testing and correction of the extraterrestrial parameters for total ozone calculation by analysis of the diurnal total ozone trends;
- testing and correction of the wavelength setting;
- Langley absolute calibration of the spectrometer.

Calibration testing of the current instrument's parameters is performed in NOMREC using special calibration bench with band-lamp certified by Russian National Standard Agency in spectral range 285 – 1200 nm.

## RESULTS FROM OBSERVATIONS AND ANALYSIS

The annual average total ozone value above Belarus in 2004 was lowest for all period of ground-based observations (1997-2004). In the second half of 2004 from middle of July till December the total ozone deficit above Belarus territory was about 5%. In the first half of 2005 the total ozone deficit above Belarus has increased up to 7 %. Occurrence of the «mini-hole» has been observed in unusual for Belarus period of time – beginning of September and the end of May.

The analysis of surface air temperature and total ozone data has shown that the daily total ozone and surface air temperature values are correlated (for summer in Belarus, see Figure 2). This interconnection has been taken into account in the UV index forecast technique.



**Figure 2: Daily values of surface air temperature and total ozone (smoothed by 4 point moving average).**

## **THEORY, MODELLING, AND OTHER RESEARCH**

An improved multi-wave variant of algorithm on vertical ozone profile retrieval from Umkehr measurements has been developed to update the ozonometer PION controlling programme.

A theoretical method to improve the technique of “direct-sun” Aerosol Optical Depth measuring in the UV spectral range has been proposed.

The Langley-procedure accuracy for “direct-sun” UV devices has been estimated and a method to avoid the clouds disturbance has been implemented.

Epidemic studies carried out in collaboration of NOMREC and Belarus Sanitary & Hygiene Research Institute (BSHRI) have demonstrated that the incidence of skin cancer in Belarus has been increasing rapidly over the last 10 years. Incidence of melanoma in 1993 was 3,0 per 100000 and increased to 4,56 in 2002, incidence basal cell carcinoma (BCC) increased from 19,96 to 35,57, and squamous cell carcinoma of skin (SCC) from 4,29 to 8,45.

## **DISSEMINATION OF RESULTS**

### **Data reporting**

The total ozone data are submitted to the World (Canada) and CIS (Russia) data centers. UV monitoring was carried out from September 2001 with the PION-UV spectroradiometer. But some calibration problems prevented us to put our surface UV spectra at WMO’s disposal. In 2005 year the spectroradiometer PION-UV was recalibrated using the new Russian National UV Source Standard. Now results obtained are recalculating and soon NOMREC will be ready to send data to WOUDC and other centers regularly (in real time mode if necessary).

### **Information to the public**

Short-term UV index forecast (both for cases of clear sky and with forecasted cloudiness taken into account) are daily submitted to Belarus Telegraph Agency and to national daily newspaper “Zvyazda” (about 50 000 numbers daily).

Also these values are presented at NOMREC Internet site <http://www.nomrec.bsu.by>.

## **PROJECTS AND COLLABORATION**

There are 6 federally funded national projects on ozone, UV radiation and tropospheric ozone. These projects are coordinated by NOMREC. Main topics are:

- Ozone mini-holes dynamics and climate parameters.
- Stratospheric and surface ozone interaction.
- DOAS instruments development.
- Stratospheric ozone and aerosols lidars.
- UV radiation level and human health.

Ozone and aerosols investigations are carried out in collaboration with Lidar Station of IPNAS. Lidar investigations of ozone layer are implemented in the frame of CIS-LiNet (lidar network in CIS countries) activity.

## **FUTURE PLANS**

Five new UV irradiance monitoring stations will be put into operation next 5 years.

New zenith observation instrument is developed for nitrogen dioxide total amount and profile retrieval in NDSC standard. It will be put into operation on NOMREC Ozonometric station aiming to be included into NDSC.

Developed theoretical models, software, and optical tool kit allow us to participate in international projects on validation of satellite spectral measurements and ozone/aerosol retrieval algorithms.

Planned activity on the atmospheric aerosol investigation includes theoretical modeling and realization of Sun-Aureole UV experiments aiming the aerosol micro-characteristics retrieval.

UV index mapping and differential forecast will be introduced in 2006.

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