

SLOVAKIA

1. INTRODUCTION

Atmospheric ozone and UV-B monitoring and research is mostly carried out by the Slovak Hydrometeorological Institute (SHMI) and the Geophysical Institute of the Slovak Academy of Sciences (GISAS). Several other institutions perform special surface ozone measurements and carry out a research associated with adverse ozone effects on environment.

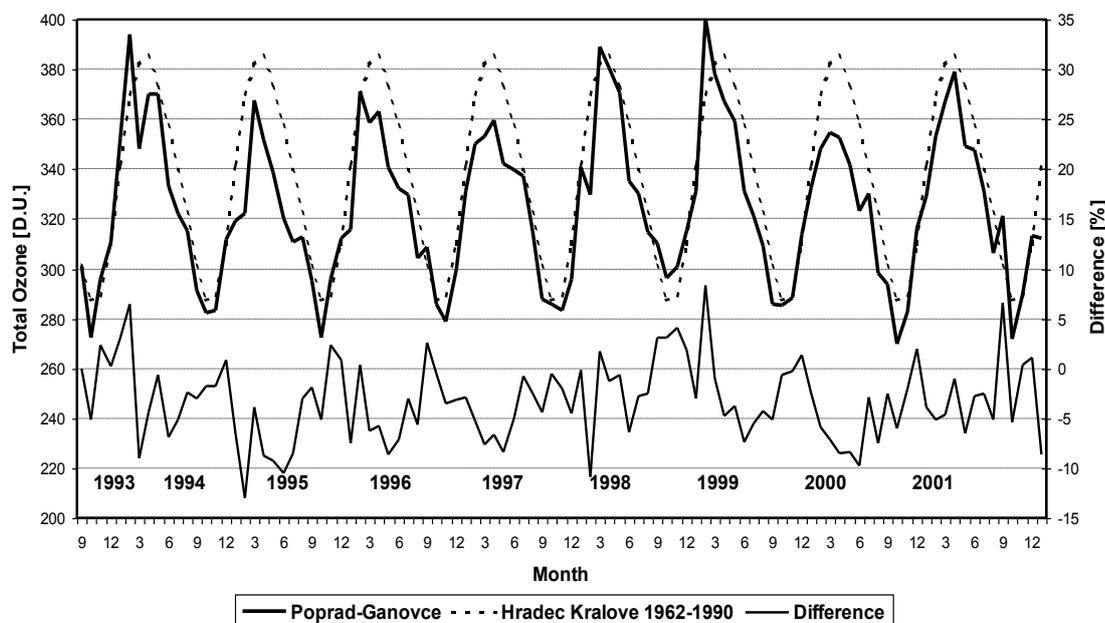
2. MONITORING AND MEASUREMENTS

Total Ozone

Total ozone measurements have been performed by the Centre of Aerology and Ozone Measurements (CAOM) of SHMI since August 1993. The Global Ozone Observing System (GOOS) station No. 331 is situated at Poprad-Ganovce (49.03N, 20.32E, 706 m altitude). The Brewer ozone spectrophotometer MKIV No.097 is used for routine measurements of total ozone and UV-B solar radiation. By proper weather conditions the mornings Umkehr vertical ozone profiles are taken.

The Brewer No.097 is regularly calibrated against World Travelling Standard Brewer No.017 every two years. Since the last Meeting of the Ozone Research Managers that instrument has taken part in two international inter-comparisons and calibrations (Poprad-Ganovce 1999, Budapest 2001). The Brewer data are stored in the ozone database of SHMI and daily averages are submitted to the World Ozone and Ultraviolet Data Centre (WOUDC) in Toronto every month. The raw Brewer data including Umkehr and UV-B data for period 1993-2001 were also submitted to the WOUDC in order to archive, process and check them by Brewer Data Management System (BDMS) of the Atmospheric Environment Service (AES) Canada. Since winter 1993 the station participate in WMO GAW Northern Hemisphere Ozone Mapping

Fig. 1 Total Ozone at Poprad-Ganovce Station Measured with Brewer #097 (September 1993 - January 2002)

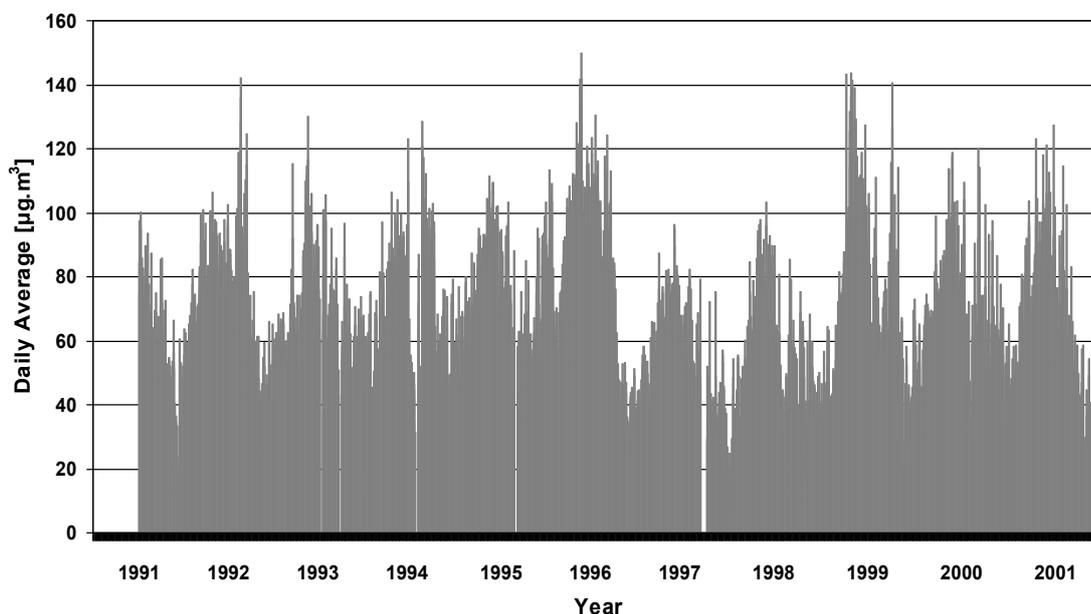


Experiment by daily submitting of total ozone data to Ozone Mapping Centre, Thessaloniki, Greece. The daily data are also submitted to WOUDC.

Ground Level Ozone

The measurement of ground level ozone concentrations in Slovakia started in 1991 within the monitoring network of the Slovak Hydrometeorological Institute. The number of monitoring stations has been gradually extended. At present the network consists of 18 stations. The stations Stara Lesna (49.15N, 20.29E, 808 m altitude, in operation since 1991), Starina (49.04N, 20.26E, 345 m altitude, in operation since 1994) and Chopok (48.94N, 19.59E, 2008 m altitude, in operation since 1994) are a part of the Environment Monitoring and Evaluation Programme (EMEP) network. Ozone analyzers of the Thermoenvironment (TEI) and the MLU companies have been used in most of the stations. In 1994, the secondary national ozone standard was installed in the Slovak Hydrometeorological Institute and regular audits by portable calibrator started to be carried out in the stations. The secondary standard of the SHMI is regularly compared with the primary ozone standard of the Czech Hydrometeorological Institute.

Fig. 2 Ground Level Ozone at EMEP station Stara Lesna 1991-2001



A project focused on protection of nature in the Tatras National Park (TANAP) is solved jointly by the TANAP office and the Polish Academy of Sciences (PAS). There are three other ground level ozone analyzers, operated upon principle of UV radiation absorption in Slovak part of the High Tatras. They are situated at 1100, 1778 and 2633 m altitudes and together with SHMI stations Stara Lesna and Poprad-Ganovce provide proper data for the vertical tropospheric ozone profile research. In period May-October about 25 passive Ogawa type sensors are exposed and two weekly evaluated in the High Tatras in a frame of that monitoring and research.

Monitoring and research of the tropospheric ozone vertical profile is also carried out at the Forest Research Institute (FRI). Three ML ozone analyzers are distributed at 480, 850 and 1360 m altitudes in Polana massif (central part of Slovakia).

Solar UV-B Radiation

Spectral measurements of the solar UV-B radiation (in the region 290-325 nm at 0.5 nm increments) have been performed with the Brewer spectrophotometer at Poprad-Ganovce since August 1993. Observations are scheduled at regular time intervals.

The other instruments are broadband ones. At present the SHMI UV-B network consists of three SOLAR Light 501 UV Biometers (Kosice, 48.70N, 21.27E, 230 m altitude, since 1997, Bratislava 48.17N, 17.12E, 287 m altitude, since 1998, Poprad-Ganovce, since 1999).

The CAOM maintains the 501 UV Biometer designed as the national reference instrument. That instrument was compared with the Czech reference UV Biometer during the Brewer calibration campaign in Budapest with very good result. Two network instruments were calibrated towards the reference one in autumn 2001. The third is planned to be calibrated in spring 2002.

Regular yearly comparison and calibration of all SHMI and GISAS UV network instruments against the reference one will start this year. A recalculation of UV data sets is planned to be done after each calibration.

GISAS measures the global ultraviolet radiation with Eppley UV-radiometer, model TUVR for the wavelength range 290-385 nm at Stara Lesna. This instrument was recalibrated at the Czech National Radiation Centre Hradec Kralove according to the laboratory standard NBS with quartz-halogen lamp EPI-1755 1000 W. In September 2001 YES UV Biometer was installed at Skalnaté Pleso (49.20N, 20.23E, 1778 m altitude). The instrument was calibrated towards the SHMI reference UV Biometer during the campaign at Poprad-Ganovce in autumn 2001.

Next 501 UV Biometer, bought already by GISAS will be installed at higher altitude in the High Tatras soon.

3. RESEARCH

Ozone and other Atmospheric Parameters Relations

As the upper-air and total ozone station is at the same place there are good conditions to investigate dependence of the total ozone on other atmospheric parameters at CAOM Poprad-Ganovce. The long term temperature course at selected levels was compared with total ozone. The negative total ozone trend significantly correlates with both positive temperature trend in the troposphere and negative temperature trend in the lower stratosphere. A precise investigation of the Poprad-Ganovce upper-air data 1961-2000 to use it for climate studies is about to finish.

Total Ozone and UV Index Forecast

In spring 2000 Slovak Hydrometeorological Institute started providing the UV Index forecast for the public using a regression model. Regional regression coefficients are calculated from 1993-1999 Poprad-Ganovce total ozone, DUV and upper-air data. The heights of standard pressure levels necessary for the total ozone prediction are forecasted by the numerical model ALADIN. The UV Index forecast and other information on total ozone and solar radiation are available on www.shmu.sk/ozon. The forecast is a result of collaboration between Slovak Hydrometeorological Institute and Slovak Academy of Sciences. The regression model is regularly checked and still improved.

Ground Level Ozone

Vertical gradient of the tropospheric ozone concentration has been studied at the FRI. International project focused on influence of the ground level ozone increase upon plants and animals is carried out by PAS and TANAP office in the High Tatras mountains. At SHMI ground level ozone trends, critical levels AOT40, AOT60 and other parameters of ambient air quality are evaluated and analyzed.

Annual Report on Ozone

The analyze of total ozone, surface ozone and solar UV radiation is regularly included in the annual publication: "Air Pollution in the Slovak Republic.

International Projects

SHMI participate in international ozone and UV projects mainly by regular submitting of the good quality ozone and UV-B data to the WOUDC. It is also prepared to take part in regional programs coordinated by WMO, EC and other relevant institutions.

4. APPLICATIONS

Public Information

The report on present state of ozone layer and intensity of solar damaging UV radiation (Erythema effect) for sunny day is sent to Slovak Press Agency twice a day. It is regularly utilized by television, broadcast and newspapers.

CAOM Poprad-Ganovce also has been preparing short report on the total ozone amount and recommended maximal sunburn time. This report is propagated by mobile telephone service. SHMI prepared regular total column ozone and UV Index (March-September) forecast. It is propagated by SHMI Web site.

Ministry of Environment and SHMI gradually equip big cities with electronic billboards. Both total and surface ozone data are included into presented information.

In 2001 Czech Hydrometeorological Institute licensed the modification and translation of the publication UV Index for the Public into Slovak language. The brochure was published in November 2001.

Public Warning

In association with the protection of human health and vegetation the set of ambient air quality standards for surface ozone concentrations according to the EU Directive 92/72 EEC has been adopted since 1996:

Ambient air quality standards	O ₃ concentration [$\mu\text{g}\cdot\text{m}^{-3}$]	Average within the time interval
for human health protection	110	8 h
for protection of vegetation	200/65	1 h / 24 h
for information to the public	180	1 h
for warning to the public	360	1 h
