

## **SLOVAKIA**

Atmospheric ozone and UV-B monitoring is mainly conducted by the Slovak Hydrometeorological Institute (SHMI). Research is mostly carried out by the Geophysical Institute of the Slovak Academy of Sciences (GISAS).

### **OBSERVATIONAL ACTIVITIES**

#### **Column measurements of ozone**

Total column 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. Poprad-Ganovce is Global Atmosphere Watch (GAW) regional station for total column ozone monitoring.

Ground level ozone is monitored at about 20 stations. Activities have been outlined in the Report of the Fifth Meeting of the Ozone Research Managers and will not be discussed in this report.

#### **Profile measurements**

Umkehr vertical ozone profiles are measured with the Brewer spectrophotometer by proper weather conditions in the morning.

#### **UV measurements**

##### ***Broadband measurements***

At present the Slovak UV-B network consists of five stations. Four of them are equipped with SOLAR Light 501 UV Biometers. Three stations belong to SHMI (Kosice, 48.70N, 21.27E, 230 m altitude, in operation since 1997, Bratislava 48.17N, 17.12E, 287 m altitude, since 1998, Poprad-Ganovce, since 1999) and one station situated in mountains belongs to GISAS (Skalnate Pleso, 49.20N, 20.23E, 1778 m altitude, since 2001). GISAS also measures the global ultraviolet radiation with Eppley UV-radiometer model TUVR for the wavelength range 290-385 nm located at Stara Lesna (49.15N, 20.29E, 808 m altitude, in operation since 2002).

##### ***Narrowband filter instruments***

No UV narrowband instruments are installed at SHMI and GISAS stations.

##### ***Spectroradiometers***

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. Poprad-Ganovce is GAW regional station for spectral UV-B monitoring.

##### **Calibration activities**

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 the instrument has taken part in two international comparisons and calibrations (Warsaw 2003, Hradec Kralove 2005).

The CAOM maintains the SL 501 UV Biometer designated as the national reference instrument. The instrument was compared with the Czech reference UV Biometer during the Brewer calibration campaign in Hradec Kralove in May 2005. In June all network UV Biometers in Slovakia were calibrated with the reference instrument.

UV-B data series from Bratislava (1997-2004) and Poprad-Ganovce (1999-2004) have been recalculated according to calibration results.

## RESULTS FROM OBSERVATIONS AND ANALYSIS

Figure 1 shows monthly means of total column ozone, UV-B dose and sunshine duration at Poprad-Ganovce. Small negative trend in total column ozone and positive trends in UV-B dose and sunshine duration have been observed during the period 1995-2004.

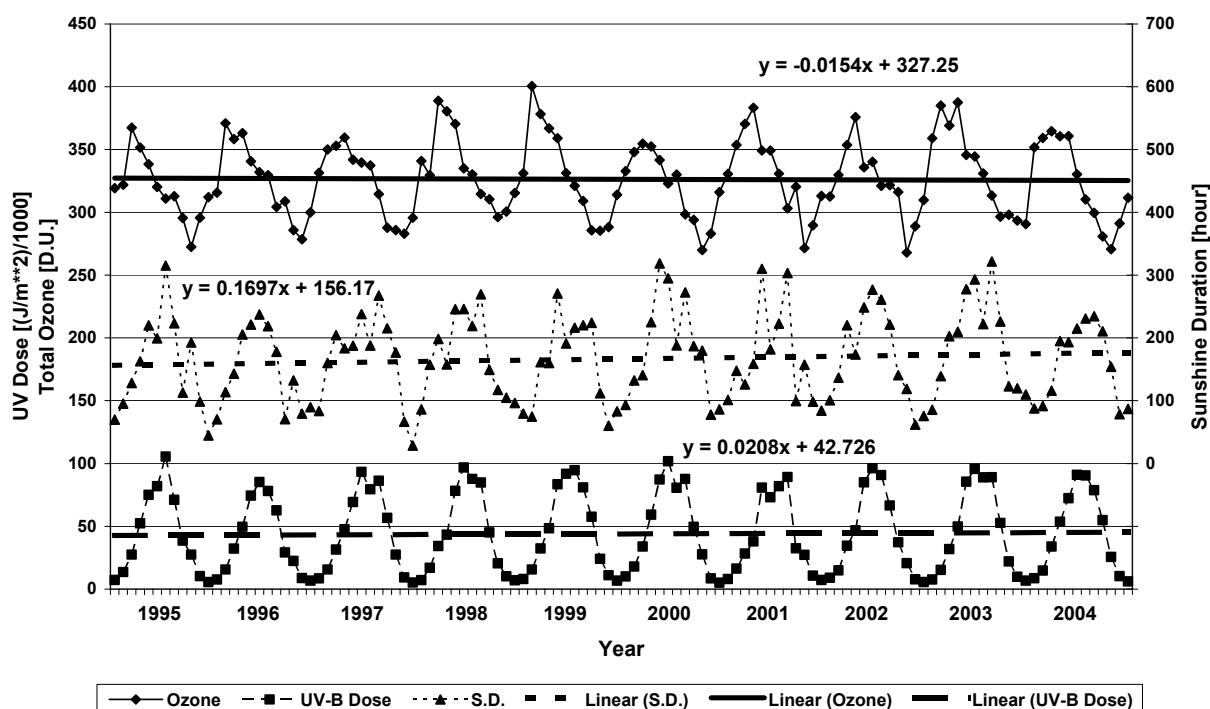


Fig. 1 Total Column Ozone, UV-B Dose and Sunshine Duration at Poprad-Ganovce 1995-2004

## THEORY, MODELLING AND OTHER RESEARCH

The effect of total ozone change on the biologically effective UV radiation has been studied using total ozone and spectral UV radiation measurements of the Brewer instrument and broadband UV-Biometer measurements at Poprad-Ganovce. The clear-sky morning UV-B irradiances (recalculated to mean Sun – Earth distance) were interpolated to fixed solar zenith angle (SZA). The obtained values of radiation amplification factor (RAF) were compared with that ones calculated from total ultraviolet visible radiation model (TUV model, Madronich, 1993). Good agreement between the RAF obtained from measurements and the RAF calculated by TUV model was achieved for large SZA 50° and 60°.

Atmospheric aerosol change effect on the biologically effective UV radiation was studied using aerosol optical depth (AOD) for radiation at wavelength 320.1 nm (AOD<sub>320</sub>). AOD<sub>320</sub> was calculated by Langley plot method from direct monochromatic solar irradiance observed by Brewer spectrophotometer during the period 1993-2002.

Sensitivity of the biologically effective radiation to the surface albedo change was determined using comparison between clear-sky UV-B irradiances observed under condition with continuous snow cover and without any snow cover at selected localities – Poprad-Ganovce (valley position), Stará Lesná (foothill of the High Tatras mountain) and Skalnaté Pleso (mountain conditions). UV-B data were recalculated to fixed total ozone content (300 DU) and to mean Sun – Earth distance.

Effect of altitude on the UV-B radiation has been investigated using comparison between UV Biometer data obtained at localities with significantly different altitude and relatively small horizontal distance.

Cloud effect on the UV-B radiation was studied using Brewer spectrophotometer measurements and cloud characteristics saved in Brewer commentary files.

A present research is oriented on determination of relations between solar UV-B radiation and meteorological and radiative proxies to model UV-B radiation in the past (COST-726 project).

## **DISSEMINATION OF RESULTS**

### **Data reporting**

The Brewer data are submitted to the World Ozone and Ultraviolet Data Centre (WOUDC) in Toronto every month. Total ozone and UV-spectral raw data are monthly submitted to Brewer Data Management System (BDMS) in Toronto to process and submit it to WOUDC. Since winter 1993 the station participate in WMO GAW Northern Hemisphere Ozone Mapping Experiment by daily submitting of total ozone data to Ozone Mapping Centres.

### **Information to the public**

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 provides regular total column ozone and UV Index (March-September) forecast. It is propagated by SHMI Web site.

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

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

### **Relevant scientific papers**

Please see references.

## **PROJECTS AND COLLABORATION**

SHMI participate in international ozone and UV projects mainly by regular submitting of the good quality ozone and UV-B data to the WOUDC.

At national level the task: "UV Biometer calibration methodology and UV-B observation series reconstruction" is solved at SHMI and the project: "Effect of atmospheric boundary layer on radiative fluxes and heat balance of Earth's surface" has been solved at GISAS.

Both projects are included into COST action 726: "Long term changes and climatology of UV radiation over Europe"

## **FUTURE PLANS**

Improvement of the UV Index forecast involving atmospheric aerosol effect on the UV-B irradiance variability. It needs precise measurements of aerosol optical depth in the UV range of the solar spectrum.

Determination of relations between UV-B radiation and meteorological (cloudiness, aerosol content, snow cover) and radiative (total solar radiation, sunshine duration) proxies to assess UV-B irradiance at different places in Slovakia at present and in the past

Participation in international calibration of broadband instruments planned for 2006 in frame of COST action 726.

Looking for a relevant partner to study some aspects of the damaging solar UV radiation impact on human health.

## **NEEDS AND RECOMMENDATIONS**

Regular international comparison of broadband UV radiometers is extremely needed to keep the homogeneous scale.

## **References**

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