ESTONIA

INTRODUCTION

In Estonia, atmospheric total ozone and UV radiation monitoring began in 1994. The monitoring is carried out at the Tartu-Tõravere Meteorological Station (58^o.16'N, 26^o.28'E, 70 m a.s.l.) and the research work by the Department of Atmospheric Physics of the Tartu Observatory, located at the same site. The studies of atmospheric aerosols and atmospheric transmittance are also performed at the Institute of Environmental Physics of the University of Tartu. The Tartu Observatory has participated in the European Community EDUCE research project and is also taking part in the COST 726 activities.

INSTRUMENTS AND MONITORING

The Tartu-Tõravere Meteorological Station is the successor of the Meteorological Observatory of the Univeristy of Tartu, operating regularly since 1865. The first attempts to measure solar radiation at this station were made in the 1930s. Since January 1950, regular measurements have been performed outside the town and from 1965 the station has been at the present site. In 1999, the station was included in the Baseline Surface Radiation Network (BSRN).

At present the operating UV sensors are:

- Erythemally weighted: Scintec UV-SET (since 1998)
- YES UVB-1 (since 2005)
- PMA2200 used for calibration transforms (since 2003)
- UV-B narrowband (306 nm) Kipp&Zonen CUVB1 (since 2002)
- UV-A broadband UVSB2 (since 2002)

Direct sun total ozone measurements are made using a MICROTOPS-II instrument.

At two other stations - Tallinn-Harku (59^o24'N, 24^o36'E, 39 m a.s.l.) and Tiirikoja, (58^o51'N, 26^o57'E, 32 m a.s.l.) the narrowband UV-B sensors are installed and the Pärnu station (58^o23'N, 24^o30'E, 5 m a. s. l.) has a broadband UV-A sensor.

Taking into account the previous experience of the exploitation the minispectrometers a minispectrometer AvaSpec-256 produced by *Avantes* company was obtained by the Tartu Observatory and is suited for the field measurements by adding necessary auxiliary equipment.

Additionally, a teflon diffuser was made and studied for cosine response. A quartz fiber of 4 m length and 100 µm diameter connects the diffuser to the spectrometer. An UFS-5 glass optical filter was installed between the diffuser and fiber to reduce the scattered light inside the spectrometer and to guarantee the reliable recording of signal in the whole measured spectral region. For reliable recording of noise signals, the optical interface is automatically covered by a shutter before and after each measurement cycle.

The control of the sensitivity for the uniform recording of spectra is realized through the change of integrating time at the interval 1 to 60 s. In this way a maximum value of the signal approximately 16,000 arbitrary units is realized in each spectrum. For reducing the noise level the spectrometer is installed in a refrigerator and kept at the temperature of + 7^oC. Radiometric response of the system was established using the NIST (National Institute of Standards and Technology) traceable quartz FEL lamp.

The measurement process is fully computer-aided through a Linux programme. The control computer of the spectrometer is connected to the observatory web. Using the server it is possible to access any spectrum in a user-friendly form. It is also possible to track the measurements using any computer of the local web (http://sputnik.aai.ee) and also to have access to the archive of spectra.

UV CLIMATOLOGY

The Estonian total ozone climatology, based on TOMS and other available data, was published in 2002.

The first results of the proxy-based reconstruction of the erythemally weighted UV doses back to 1967 were published in 2002. These results were for the period from vernal equinox to the autumnal equinox, constituting about 90 % of the yearly dose. The sunshine duration was used as a cloud influence related proxy.

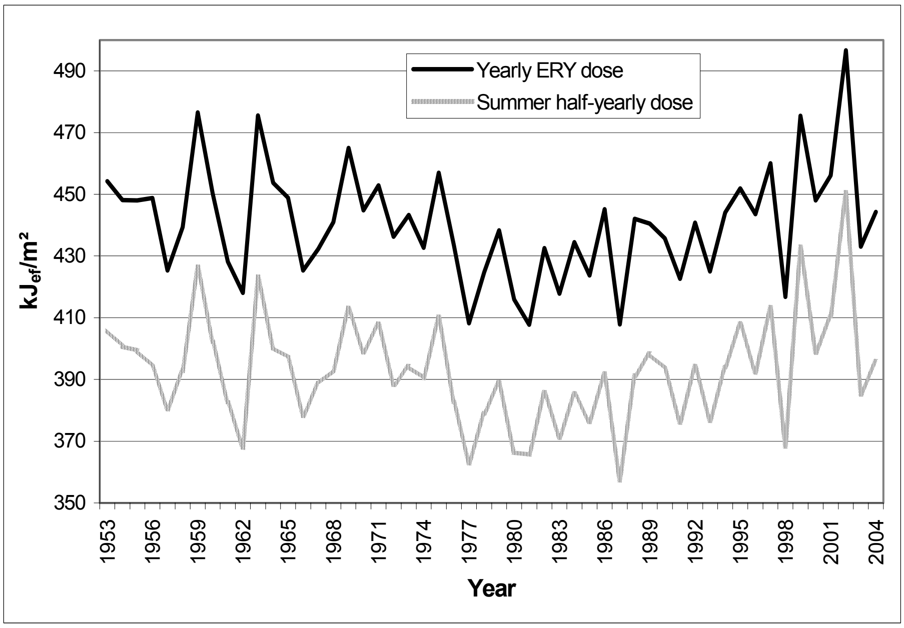

Figure 1: Reconstructed yearly and summer half-yearly erythemal doses at Tartu.

.

Recently, the reconstruction of the erythemally weighted daily doses has been recalculated using the daily relative sum of broadband direct irradiance and the daily relative sum of broadband global irradiance as the cloudiness influence related proxies. The first proxy was used in the cases of significant contribution of sunshine during a day and the second on almost overcast days. The correction for deviation of total ozone from its climatic value was calculated when data were available.

It was assumed that in sunshine conditions the sum of broadband direct irradiance accounts for the deviation of atmospheric turbidity from the average. In the cold period of the year, statistical relationships were derived separately for snow and snow-free conditions.

The biases between measured and reconstructed daily doses in 52-58 % of cases around the year were within ± 10 % and in 82-84 % of cases within ± 20 %. In the summer half-year, these amounts were 58-65 % and 85-92 %, respectively. In most years the results for longer intervals did not differ significantly in case of climatic ozone and therefore no corrections were made for the daily deviations before 1979. The yearly and summer half-yearly doses (constituting on average 89 % of the yearly dose) in 1979-2004 agreed within ± 2 %, except the post volcanic years and a year of extremely fine weather (2002). The largest deviation 3.5 % was met in 2002.

In Figure 1, the yearly and summer half-yearly reconstructed doses for 1953-2004 are presented. One can see that the interval 1976-1993 regularly manifests values lower than the average. The amplitude of deviations from the average in the summer half-year is within 92-111 %. The range of variation of all proxy quantities is larger. For the sum of global irradiance, it is 89.7-114.4 %. For the sum of direct irradiance, it is 74.4-132.2 %, and for the sunshine duration 79.8-132.9 %. The spring period constitutues on average 42.9 % and the summer period 46.2 % of the yearly dose. The darkest 102 (roughly 100) days of the winter from November 1 to February 10 when the noon solar elevation remains below 15°, make up on average only 2.7 % of the yearly erythemal dose.

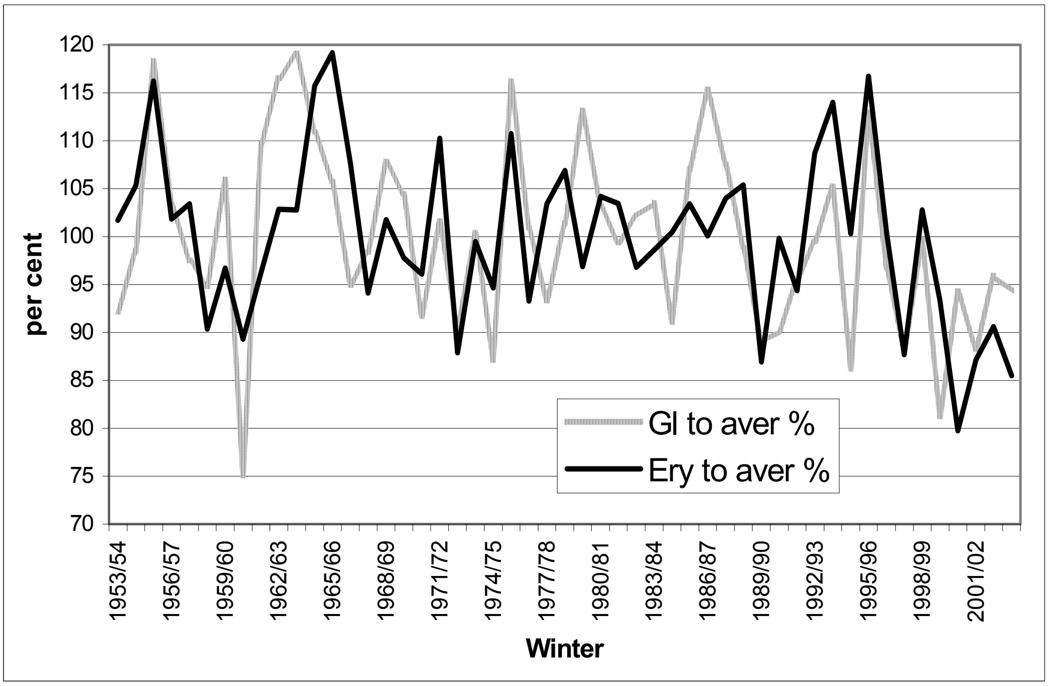

Figure 2: Reconstructed erythemal doses of 100 darkest days in winters 1953-2004.

The year-to-year variations of the erythemal dose as well as the sums of global broadband irradiance in the scale of percentage deviation from the average values are presented in Fig. 2. The variations of erythemal dose during that interval occurred in the range ± 20 %. The minimum values were met in cloudy winters with extended snow-free episodes. Since 2000, the midwinters have been darker than the average.

PUBLIC INFORMATION

In the summer period, when high UV levels occur, the Estonian Institute of Meteorology and Hydrology *warns people of the related risks using the radio, TV and other means of mass media.* Current value of the UV Index for each minute of a day is displayed on the Tartu Observatory *homepage* (http://www.sputnik.aai.ee)

The research results as well as the general ozone layer issues have also been introduced to the general public during the *public awareness campaigns* conducted in the frame of the UNEP funded Institutional Strengthening programme by the National Ozone Office (2001-2004). The presentations given by the specialists of the Tartu Observatory, the Estonian Institute of Meteorology and Hydrology and the Ozone Office in a special ozone tent lasted for approximately 40 minutes. Illustrative materials in Power Point as well as NASA images on the status of the ozone layer have been shown. During all events ozone leaflets, T-shirts and balloons were distributed among the participants and refrigerators were raffled. Although the campaigns primarily focused on raising public awareness, a positive side effect was that about 5 000 old refrigerators were collected during 3 years. For the future, the general public will continue to be informed of the UV levels and ozone issues. The Country ODS Phaseout Programme consisted of three additional projects: Recovery and Recycling (UNDP), Baltic Regional Halon Bank (UNDP) and Train the Trainers in Refrigeration (UNEP).The UN programmes gave strong momentum to ODS phaseout in Estonia and brought the country to new horizons. The results are clearly reflected in reduced usage of ozone depleting substances.

In Estonia, a biennial conference, Atmosphere*Human*UV-radiation, is also held regularly in each odd year. The results of current research are introduced and discussed.

Estonia has ratified the Vienna Convention, the Montreal Protocol and all its amendments and is following the decisions of the Parties. In addition, the EC legislation on ozone depleting substances, that goes in many areas beyond the requirements laid down in the Montreal Protocol, came in force on 1 May, 2004.

****