

2C.1 MEASUREMENTS OF UV-IRRADIATION ON INCLINED SURFACES FOR EXPOSURE ASSESSMENTS OF THE HUMAN BODY

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1. INTRODUCTION

In general measurements of UV-radiation are related to horizontal surfaces, as e.g. for the internationally standardized and applied UV-index (WMO, 1997). In order to get more relevant information in terms of UV-exposure of humans, eventually also for individual parts of the skin, there is a need for quantitative data of radiation fluxes in the directions of typically orientated surfaces of the human body (Webb et al., 1999; Schauburger, 1990). To measure these fluxes the new system "ASCARATIS" (Angle **SC**Anning **RA**diometer for determination of erythemally weighted irradiance on **T**itled **S**urfaces) was developed and built.

2. METHODS

ASCARATIS consists of two UV-radiometers measuring UV radiation in an erythemally weighted way. One is mounted horizontally, the other can be orientated to any direction by means of two computer controlled step motors. The movable radiometer is programmed to scan 27 positions - 12 positions with vertical orientation and steps of azimuth angle of 30°, 12 positions with an inclination of 45° also with azimuth steps of 30°, a position facing the zenith, a position facing the nadir and a position facing the sun. Both radiometers are mounted in a distance of about two meters and measure simultaneously (see Fig. 1). The data are stored on a PC which communicates once per day via modem with a server located at the Meteorological Institute.



Fig.1: Measuring system ASCARATIS at mountain Zugspitze

In total three ASCARATIS measuring units perform simultaneous measurements at different locations: mountain Zugspitze (2800 m.a.s.l.), Hohenpeissenberg (1000 m.a.s.l.), Munich center and periphery (500 m.a.s.l.) and Würzburg (200 m.a.s.l.). The locations were chosen to cover the whole range of altitudes in Bavaria and to be able to detect the effects of urban pollution on UV-radiation.

The routine measurements started in autumn 2000 on mountain Zugspitze and have been extended to the other locations since spring 2001.

3. RESULTS

The measurements of two clear sky days on mountain Zugspitze are shown in Figure 2 and 3. Figure 2 represents a winter day, 22.12.2000, and Figure 3 a summer day, 12.6.2000. The diurnal courses of the UV-index are shown for the directions facing the sun (27), zenith (25), nadir (26) as well as vertically orientated to North (1), East (4) and South (7). On 22.12.2000 at noon time (Fig. 2) the UV-index, measured directly to the sun and vertically orientated to South (195°), were almost double as high as to the horizontal surface. Also the values of the radiometer orientation vertically eastward were

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higher during the morning hours. It is important to mention that at this time of the year, close to winter solstice, the maximum of the UV-index is quite low (1.5).

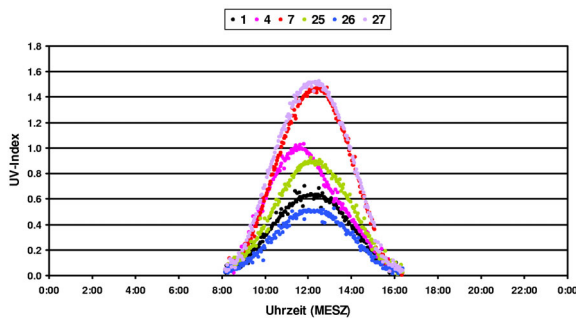


Fig. 2: Measured UV-Indices on 22.12.2000 at measuring site Zugspitze. The numbers from 1 to 27 are the numbers of the measuring.

Figure 3 shows the corresponding conditions on a day about one week before summer solstice (12.6.2001). The UV-Index at noontime is about 9. The difference of UV-index between the zenith measuring and directly to the sun are relatively smaller as in the winter scenario. In both scenarios the albedo of the ground due to snow cover was about 60%.

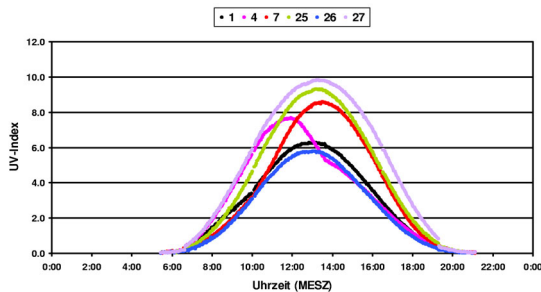


Fig.3: Measured UV-Indices on 12.6.2001 at measuring site Zugspitze. The Numbers from 1 to 27 are the Numbers of the measuring directions.

The parallel measurements with three ASCARATIS units will continue until September 2002. The data will be used for validation of a new extension of the radiation model STAR (System for Transfer of Atmospheric Radiation) developed at the Meteorological Institute in Munich (Ruggaber et al., 1994; Köpke et al., 1996), and for the creation of UV-exposure

maps of the human body (figure 4 shows an example).

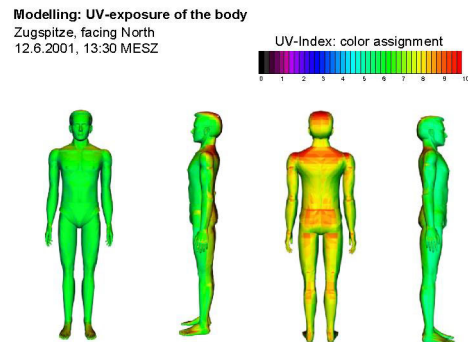


Fig. 4: Example of modeling of UV exposure based on ASCARATIS measurements.

4. ACKNOWLEDGEMENT

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More information on the study can be obtained at: <http://www.bayforuv.de/englisch/topindex.html>

5. LITERATURE

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