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# Measurements of the facial UV exposure using electronic two channel broadband devices

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The objective of our study was to measure the facial exposure of farmers during working time over a period of 6 months. This imposes high demands on the measuring devices like the ability to take mechanical stress, carrying comfort, temporal stability and appropriate accuracy of measurements.

The measuring devices are electronic small size broad band meters with two different sensors (Model X2000, Gigahertz-Optik, Germany). One sensor is sensitive mainly in the UVB and the other mainly in the UVA. By setting appropriate calibration factors the unified response curve becomes similar to the action spectrum of the human erythema. However the agreement is not perfect. Therefore correction factors must be applied to correspond to the changing solar spectrum. The changes are caused in first order by changes of the total ozone content and the changing path length of radiation through the atmosphere. In using radiative transfer model calculations and taking into account the action spectrum of the erythema and the spectral response of the sensors a correction matrix in dependence of solar height and total ozone content can be derived for each device. After calibrating the devices in the laboratory the calibration was controlled by outdoor measurements of solar radiation and by a comparison with measurements of another broadband device which is designed to measure the erythemally effective UV radiation (Model 501, Solar Light Inc., USA). This device is part of the Austrian UV network with standardised quality control procedures. The agreement between the devices was within ±5% during a day in April, where solar height varied between 5˚ and 50˚.

The twelve test persons carried the devices on the forehead during working time between April and October. Additionally they filled in a diary. The diary was written on a hourly base. It contains the weather condition, the kind of work, posture, clothing and shadowing from environment.

The erythemally weighted cumulative doses over the 6 months period differ very strongly within the test persons ranging from 8 $kJ/m^2$ to 75 $kJ/m^2$. Surprisingly we found only a weak correlation between these total doses and the number of working days. Further we found no correlation between the highest measured daily dose of each test person and the number of working days. The results show that facial exposure depends strongly on the work carried out. This is also supported by the fact that cumulative doses differ between wife and husband when working on the same field but doing different work. At the end of the study the calibration of the devices was re-controlled to exclude changes in the sensitivity of the sensors.

To sum up: our study has shown that appropriate devices are available to measure personal exposure even under rather hard working conditions. However it is imperative to control the properties of the devices independently from the manufacturer. The devices showed good agreement of measurements. Only under very cloudy conditions and low solar height, resulting in low irradiance, relative differences go up to 30% among the different instruments. However this has low impact on the measured daily dose. Correction procedures should be applied to take into account the differences between the spectral sensitivity of the devices and the action spectrum of the erythema. Diaries are very helpful in proving the reliability of measurements.