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Uncertainties of calculated erythemally effective UV radiation from restricted availability and uncertainties in measured total ozone

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In this study we have analysed the sensitivity of the erythemally effective radiation to uncertainties in measured total ozone content of the atmosphere (TOC). These uncertainties result from a restricted spatial resolution, a restricted temporal resolution or the restricted accuracy of measured TOC.

Daily operational total ozone measurements from different instruments made over several years were used. Measurements were gained space born by EPTOMS, ERS-2/GOME and TOVS and from the ground by Dobson and Brewer Spectrophotometers for the locations of Hradec Kralove (Czech Republic, 50˚N), Nairobi (Kenya, 1˚S) and Springbok (Rep. of South Africa, 30˚S).

The measurement uncertainties were analysed by an inter-comparison of modelled erythemally effective UV radiation when using different sources of TOC. The evaluation of the uncertainties due to temporal delays was done in using TOC values with different temporal shifts up to 15 days. The influence of spatial gaps in TOC measurements was estimated separately in longitude and latitude up to distances of 1000 km around the measuring sites. The effect of altitude is rather low and can be corrected satisfactory.

From this analysis, requirements on the spatial resolution, temporal resolution and measuring uncertainties of total ozone measurements to calculate the erythemally effective UV radiation with a pre-selected accuracy can be derived in dependence of location and season. As the measure of relevance we have chosen the monthly 95% percentile of absolute differences (p95) which is comparable to an error that occurs one time per month

The analysis of the measuring uncertainties shows that for the location at 50˚N one has to take into account an error (p95) of 0.7 UVI between April and September. At the equator the values are quite similar to those at 30˚S. Only in March and April p95 values of 1.8 UVI could occur when using TOVS. Otherwise the values are below 1.0 UVI. From these results we can summarise that on the global scale the UV Index values can be given by $\pm$1UVI.

A p95 of 1 UVI needs in most cases TOC values which are measured not longer than 3 days ago. Due to the smooth annual course of TOC in the equatorial region the temporal resolution is less important. The spatial resolution is also less critical there.

Latitudinal gaps in TOC have a slight higher influence to the accuracy of the erythemally effective irradiance then longitudinal ones. The p95 of 1 UVI is generally reached by gaps of 600 km to 700 km in latitude and 900 km to 1000 km in longitude.