

An urban agglomeration effect on surface UV: Comparison of the Brewer measurements in Warsaw and at Belsk for the period 2013-2015

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The specific aerosols and cloud properties over large urban region could build the UV radiation island similar to the well known urban heat island. The present study focuses on the UV differences between Warsaw and Belsk, located in rural region at the distance of about 60 km in the south-west direction from the city. The ratio between the erythemal doses, from measurements with two well calibrated Brewer spectrophotometers (BS), No.207 (double monochromator) in Warsaw and No.64 (single monochromator) at Belsk, are calculated for clear-sky and all-sky conditions in the period between May 2013 and December 2015. For clear-sky conditions near-noon 3h doses were calculated (before solar noon) and for all-sky conditions midday 6h doses were calculated (3h before and 3h after the noon). Before the Warsaw-Belsk comparison campaign, BSs were operated simultaneously at Belsk in the period from October 2010 to April 2013 to assess uncertainty range of the ratio due to instrumental differences. The mean ratios (BS 64 / BS 207) at Belsk are $1.01 \pm (0.03)$ and $1.02 \pm (0.07)$ for the clear-sky and all-sky conditions, respectively. Whereas, for the Belsk-Warsaw comparison the ratio is $1.05 \pm (0.04)$ and $1.08 \pm (0.19)$, respectively. Radiative transfer model studies show that combined effects of more southern location of Belsk and the differences in total ozone (less than 1%) could induce 2% larger doses at Belsk. Statistical test for two means difference of large samples with unknown distribution shows that the distinction between the Warsaw-Belsk ratio and Belsk-Belsk ratio are statistically significant. Thus, the urban aerosols induce an additional near 5% attenuation of the clear-sky surface UV. It seems possible that the urban aerosols and heat island may generate specific cloud properties but in case of Warsaw this yields a few percent increase of the cloud attenuation. Thus, the Warsaw agglomeration influences only slightly incoming UV radiation.