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The influence of the spatial resolution of topographic input data on the accuracy of 3-D UV actinic flux and irradiance calculations

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The aim of this study was to investigate the influence of the spatial resolution of a digital elevation map (DEM) on the three-dimensional (3-D) radiative transfer performance for both spectral ultraviolet (UV) irradiance and actinic flux at 305 nm. Model simulations were performed for clear sky conditions and for two case studies in the area of Innsbruck and one case study in the area surrounding Sonnblick Observatory. We first found that the DEM resolution may change the altitude at some locations by up to 500 m and the obstruction of the horizon by 15%. The geographical distribution of UV irradiance and actinic flux shows that with larger pixel size, uncertainties in UV and actinic flux determination of up to 100% may occur. These large changes in incident irradiance and actinic flux with changing pixel size are strongly connected with shading effects. We investigated the effect of DEM pixel size on irradiance and actinic flux at six selected locations: an increase in irradiance with increasing DEM pixel size was found at two locations in the Sonnblick area and at one valley location in Innsbruck at high solar zenith angle. Actinic flux showed an increase in the Innsbruck area but a decrease in the Sonnblick area with increasing pixel size. Explanations for this difference probably lies in the larger shaded areas connected with a larger solar zenith angle in the two Innsbruck case studies compared to the Sonnblick case.