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Comparison of ground-based UV irradiance measurements with satellite-derived values and 1-D- and 3-D-radiative transfer model calculations in mountainous terrain

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Since the discovery of anthropogenic ozone depletion more than 30 year ago, the scientific community has shown an increasing interest in UV-B radiation. Nowadays, ground-based high quality measurements of spectrally resolved UV-radiation are available. On the other hand, 1-D- and 3-D models have been developed, that describe the radiative transfer through the atmosphere physically very accurately. Another approach for determining the UV-irradiance at the surface of the earth is the use of satellite-based reflectance measurements as input for retrieval algorithms.

At the moment, the research focuses on the impact of clouds on UV-radiation, but the impact of mountains on UV-radiation, especially in combination with high surface albedo due to snowcover, is also very strong and detailed comparisons between measurements and modelling are lacking. Therefore, three measurement campaigns had been conducted in alpine areas of Austria (Innsbruck and Hoher Sonnblick). The goal was to investigate the impact of alpine terrain in combination with snowcover on spectral UV-irradiance and actinic flux. This contribution uses the ground-based UV-irradiance measurements to evaluate three different UV-irradiance calculation methods.

Results from three different calculation methods (satellite retrieval, 1-D- and 3-D radiative transfer model) for UV radiation in terms of UV-Index, erythemally weighted daily doses and spectrally resolved UV-Irradiance at 305, 310, 324 and 380nm are presented and compared with ground-based high quality measurements. The real case study is performed in very inhomogenous terrain under clear sky conditions. The values of the different methods are not only compared for the measurements sites, but additionally the impact of altitude is investigated. So far it seems, that 1-D simulations show the best agreement ($\pm$10%) with the measurements whereas the 3-D model simulations and satellite retrieved values differ much more. Satellite retrieved values significantly underestimate radiation at most stations. All three approaches show an increase of UV radiation with altitude. There are big uncertainties, since high surface albedo and obstraction of the horizon has a big impact and is difficult to take into account. The 3-D-model enables a more detailed study of the altitude effect. The separation of sun facing and sun averted slopes shows increasing UV radiation for sun facing and decreasing UV radiation for sun averted slopes with altitude.