Short-term variability of erythemal UV radiation due to clouds

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In Switzerland, erythemal ultraviolet radiation (UV) is operationally measured at four locations under different climate regimes. The available data range back to the mid of the 1990ies and give information about UV radiation in the Swiss Alps and Lowlands. Because these time series are not sufficiently long for drawing conclusions about ground UV radiation temporal trends, and because of the spatial scarcity of the data we give an emphasis on UV reconstruction techniques. While other important effects on UV irradiance, such as ozone, surface reflectance, or solar elevation have been well studied in the past, the short-term variability of global UV radiation due to clouds is still difficult to quantify. In order to investigate the cloud-induced change of UV irradiance with respect to clear-sky conditions, a cloud modification factor (CMF) is introduced. This CMF is calculated by means of semiempirical relationships between UV and shortwave global radiation. After modeling clear-sky UV values, this CMF is used for estimating erythemal UV doses for all-sky conditions. Semi-empirical relationships between UV and global shortwave radiation are presented for the different locations in Switzerland where UV is measured. Their statistical characteristics are investigated as well as their dependences on various conditions such as season, ground reflectivity or cloud characteristics. These relationships between the ratio of all-sky to clear-sky UV and all-sky to clear-sky global shortwave radiation are linear and differ for almost overcast and partly cloudy skies. All-sky erythemal UV is derived and compared with measurements for independent time periods.