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Analyzing UVB narrowband solar irradiance. Comparison with erythemal and vitamin D production irradiances

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Ultraviolet (UV) radiation is capable of triggering several biological responses on human beings, in some cases positively such as the vitamin D synthesis, essential for good bone health but also harmful effects (e.g., erythema, skin cancer). During the last decades, the phototherapy from UV lamps has developed as a dermatological treatment for the healing of skin disorders such as the psoriasis, taking benefit of the positive properties of some UV wavebands. The most widespread in the dermatological community for the psoriasis healing is the UVB narrowband phototherapy based on the emission of radiation in the 309 $\pm$ 2nm range, avoiding the most erythematogenic wavelengths below 300 nm, common in the UVB broadband lamps. In some cases, the clinic of the disease allows the specialists to prescribe heliotherapy that uses sun exposures to treat diseases. Although this therapy has a great number of advantages, it is important to balance the likely benefits against the negative side-effects, as for example, the erythema as the most visible short-term damage or DNA damage as a possible long-term response.
Using solar spectral irradiances measured with a Bentham DMTc300 spectroradiometer at Barcelona (41.35° N, 2.16° E, 94.5 m a.s.l.) at different periods from 1999 to 2012, we have analysed the content of UVB narrowband irradiance in the surface solar UV irradiance. The narrowband irradiance was defined as the irradiance in the typical phototherapy range 309-313 nm. The measured spectra were weighted with the standardized vitamin D production and erythemal action spectra to derive the corresponding biologically effective irradiances. The ratio between UVB narrowband and erythemal irradiances was analysed according to several variables such as the total ozone content, the altitude, and the solar zenith angle (SZA). The results were compared with the ratios between vitamin D production and erythema as complementary information about the positive benefits of the solar radiation. Finally, using the minimum erythema dose as a limit for healthy exposure we have determined the dose in the narrowband range accounting to psoriasis healing.
The results show that the balance between narrowband irradiance content and erythema is larger as the SZA increases, up to SZA$\sim$65° when the behaviour is opposite and the ratio decreases. It represents that the best exposure is out of the period around the midday, avoiding the most harmful hours and lasting the exposure time and consequently, increasing the UVB dose beneficial for some skin disorder healing. Clouds, ozone thickness and aerosols can vary the exposure times and doses.