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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A new parameterization of the UV irradiance altitude dependence for clear-sky conditions and its application in the on-line UV tool over Northern Eurasia" *by* N. Chubarova et al.

Anonymous Referee #2

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General comments:

The authors of the paper propose a parametrization of the altitude effect on three types of biologically effective UV irradiance. In such context this research thoroughly explores the amplification of the effective irradiances as a function of the altitude variation of molecular number density, of ozone and aerosol, and albedo. The implementation of the UV parametrization in the on-line UV tools can be of potential interest to the researchers involved in studies on the assessment of human UV exposures. The analysis is comprehensive and it will be acceptable for publication after taking into consideration

the issues underlined below.

Specific comments: Introduction L32:The predominant factors which interact with UV radiation determining its variability at the Earth' surface are mentioned, however UV radiation is also controlled by the variation in the cyclic Sun emittance: the 27-day cycle leads to variations less than 1% for λ >250nm , 6-8% in the band 245-250nm; the 11-year sunspot cycle determines small changes in irradiance and influences the shortest extra-terrestrial wavelengths. The above factors should be also included (Ref. S., Madronich. The atmosphere and UV-B radiation at ground level. [book auth.] A.R. Young (Eds.) L.O. Bjorn. Environmental UV Photobiology. New York : s.n., 1993, pp. 1-39.) L43: How the UV index is calculated should be better specified for readers not familiar with this parameter as well as its reference (COST-713. Action UVB Forecasting. European Communities. Brussels : s.n., 2000). L47-49: the photobiological quantities (erythemally –weighted irradiance, erythemal doses) should be defined. L46-47: the following references could be acknowledged: Siani, G.R. Casale, H. Diémoz , G. Agnesod, M.G. Kimlin, C.A. Lang and A. Colosimo, Personal UV exposure in high albedo alpine sites, Atmos. Chem. Phys., 2008, 8, 3749–60; Casale G. R., A. M. Siani, H. Diémoz, G. Agnesod, A.V. Parisi, A. Colosimo (2015) Extreme UV Index and Solar Exposures at Plateau Rosà (3500 m a.s.l) in Valle d'Aosta Region, Italy, Science of the Total Environment 512–513 (2015) 622–630; L65. The following reference should be also acknowledged: Seckmeyer, G., Mayer, B., Bernhard, G., Erb, R., Albold, A., Jager, H., Stockwell, W.R.: New maximum UV irradiance levels observed in Central Europe, Atmos. Environ., 31(18), 2971-2976, 1997. Materials L89: It is worth pointing up that biological action spectra, although helpful to understand the biological reaction, do not express direct information on the possible combined effects of different wavelengths. Additivity for wavelength contributions has been documented for the erythema action spectrum, but not for the vitamin D action spectrum (ref. M. Norval, L. Björn, F. R. de Gruijl, Is the action spectrum for the UV-induced production of pre-vitamin D3 in human skin correct?, Photochem. Photobiol. Sci., 2010, 9, 11–17). L91-98: The weighting function (action spectrum) is generally normalized to unity at

the wavelength of maximal sensitivity, in case of erythemal and Vitamin D action spectra are both normalized at 298 nm. Perhaps figures showing the discrepancy among the action spectra could better explain the wavelength-dependent effectiveness of UV radiation in causing the specific reactions. L137-144: More clarity is necessary in this part of the text mainly in “noon UV deficiency and UV deficiency category”. How is the vitamin D threshold determined? What are the values of “UV excess” In the context of biomedical radiation effects it should be highlighted that the skin orientation relative to the Sun and the geometry of the human body, could strongly modify the results limited to UV irradiance measurements on horizontal surface. In addition since the beneficial effect of UV radiation is related to the body area of exposed skin, the length of time to produce sufficient vitamin D decreases with the increase of the exposed body area for all phototypes (See for example McKenzie, R.L., J. B. Liley and L. O. Bjorn (2009) UV Radiation: Balancing Risks and Benefits. Photochem. Photobiol., 85, 88–98.). Yet, obesity and age should also be mentioned as influential factors in vitamin D production (see The Relationship between Ultraviolet Radiation Exposure and Vitamin D Status in Nutrients 2010, 2, 482-495; doi:10.3390/nu2050482). In this regard it would be reasonable at least to acknowledge the above issue, whether in the Introduction or in the Discussion. Results L214: The quadratic and linear terms of eqs 6-7-8 have very small coefficients with respect to the constant term. The authors should provide the physical meaning of these equations, for example: when h=0, does the RAF(erythema or vitamin D) account the diffuse component? The units of the coefficients in eqs should be specified. Numbers of the coefficients in Eqs 8 and 9 should be expressed in the same form L286: The authors should give more details about “ the coefficients have been re-affirmed using more statistics”. In discussion or in conclusions: the authors should point out that their analysis is based on irradiance and the question of how well the radiation received by the anatomical area is related to that incident on a horizontal surface should be discussed. To determine the individual levels of UV exposure, that is, the real biologically effective doses of sunlight, dosimeters which have a spectral response almost identical to that of the UV-induced photobiological effect, should be

mentioned.

Minor comments: web addresses could be in a web reference list. L143: “Ccurrently “ should be replaced by “Currently” Eq 11: the subscript “AOT-0” should be replaced by “AOT0”

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