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Comparing ECMWF UV processor and aerosol scheme with ground-based measurements

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The ECMWF (European Centre for Medium-Range Weather Forecasts) system offers an alternative approach to provide global UV data products which can support environmental assessments of UV radiation, biological and photochemical impact studies, and to contribute to the global climatology of UV radiation. The ECMWF shortwave radiative transfer scheme has been extended to cover UV wavelengths with a choice of 0.2, 1, or 5 nm spectral resolution. The ECMWF model includes the effect of aerosols as a part of its radiation transfer calculations. During the first steps of the development of the UV processor, an aerosol climatology was used. In the latest version, however, prognostic aerosols have been coupled with the UV processor which, as a result, provides information about the global UV radiation and can be an alternative to satellite observations.
The aim of this study is to evaluate the ECMWF UV/aerosol optical depth (AOD) model against ground-based measurements. This was done by comparing the model data with measurements from EUVDB (European UV Database), NSF (National Science Foundation) and AERONET (Aerosol Robotic Network). The ECMWF shortwave radiative transfer scheme provides the UV radiation at the surface for wavelengths between 280 and 400nm. However, for this analysis, the wavelength ranges 290-320 (UVB) and 320-340 (UVA) were used. AOD is diagnosed for the 4 shortwave wavelengths (340nm, 380nm, 440nm, 500nm). Of these, the wavelengths 340nm and 500nm are included in the validation of AOD against AERONET measurements. Altogether, 7 UV and 10 AOD sites were included in the comparison in order to validate the ECMWF UV processor.
The ECMWF validation results show a good correlation between modelled and measured AOD values at 340nm and 500nm in biomass burning areas with the correlation coefficients (CC) between 0.83 and 0.89 The correlations are rather good in dust dominated sites (CC between 0.68 and 0.77) while the urban areas seems to have the lowest correlation. In all the UV validation sites, the model-measurement ratio decreased with increasing solar zenith angle (SZA), due to the two-stream approximation effect. This effect is larger for UVB than for UVA wavelengths, which could also be seen in most of the sites. In spite of this systematic difference under conditions of low Sun, the UV validation results overall show a fairly good agreement between UV processor and ground-based UV intensities, with CC > 0.9 for the summer period and CC > 0.85 for the winter.