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Comparison of solar UV irradiance and total ozone column observed at two contrasting Antarctic sites

K. Láska (1), B. Petkov (2), V. Vitale (2), C. Lanconelli (2), A. Lupi (2), M. Mazzola (2), and M. Budíková (3)

(1) Masaryk University, Faculty of Science, Department of Geography, Brno, Czech Republic (laska@sci.muni.cz), (2) Institute of Atmospheric Sciences and Climate of the Italian National Research Council, Bologna, Italy, (3) Department of Mathematics and Statistics, Faculty of Science, Masaryk University, Brno, Czech Republic

Understanding the distribution of solar ultraviolet (UV) irradiance observed in high latitudes of the Southern Hemisphere is important for variety of effects and feedbacks in the marine and terrestrial ecosystems. Seasonal increase of the UV irradiance caused by a decrease of the stratospheric ozone is a specific feature of solar radiation in Antarctica. Apart from ozone, the UV irradiance is strongly affected by various environmental factors such as cloudiness, ground reflectivity (albedo), and aerosol loadings. These environmental parameters present quite different temporal and spatial variability over the Antarctic costal and Plateau areas that induces corresponding distinctions in solar radiation and motivates the present study. The features of erythemally weighted (EW) irradiance and atmospheric ozone column observed during the spring-summer months of 2007–2011 at the Mendel (Antarctic Peninsula) and Concordia (interior Antarctic Plateau) stations were analysed and compared to each other. In addition, the differences in the transmittance characteristics of the atmosphere of both sites were quantified using a short-wave downwelling (SWD) solar irradiance measured at both sites. The EW and SWD spectral components were evaluated by the corresponding daily integrated values with taking into account the different environmental conditions and geo-locations of both stations. The results indicate that at Mendel station the surface solar irradiance is strongly affected by the changes in the cloud cover and albedo that cause a decrease in EW component between 20–35%, and from 0–50% in SWD component, which contributions are slightly lower than the seasonal SWD variations evaluated to be about 71%. On the contrary, the changes in the cloudiness at Concordia station produce only a 5% reduction of the solar irradiance, whilst the seasonal oscillations of 94% turn out to be the predominant mode. Our analysis leads to the conclusion that the variations in the ozone column cause an average decrease of about 46% in EW irradiance with respect to the value found in the case of minimum ozone content at each of the stations. The variation of ozone column over both stations is further presented in relation to the ozone depletion area and the instability of polar vortex for the selected days of November and December each year. In addition, the ratio between EW and SWD spectral components can be used to achieve a realistic assessment of the radiation amplification factor that quantifies the relationship between the atmospheric ozone and the surface UV irradiance.