QOS2016-145-1, 2016
Quadrennial Ozone Symposium of the International Ozone Commission

Effects of changes in aerosols, total ozone and clouds on the short- and long-term variability of the spectral solar UV irradiance over Thessaloniki, Greece

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The depletion of stratospheric ozone over the mid and high latitudes of the northern hemisphere decelerated after the mid-90s as a result of the successful implementation of the Montreal protocol. Over high latitudes the change in the trends of stratospheric ozone is depicted in the trends of the solar UV-B irradiance that reaches the earth surface. Though, analysis of measurements over several mid-latitude stations reveals that UV-B irradiance increased importantly during the last two decades. In the present study, the short- and long-term variability of the spectral UV irradiance at 307.5, 324 and 350 nm are investigated using the quality-controlled dataset which has been recorded from two Brewer spectrophotometers at Thessaloniki, Greece (40.634° N, 22.956° E, 60 m altitude) during the period 1994 – 2014. The changes are presented for different solar zenith angles and discussed in association to changes in total ozone column (TOC), aerosol optical depth (AOD) and cloudiness observed in the same period. Positive changes in annual mean anomalies of UV irradiance, ranging from 2% to 6% per decade, have been detected both for clear- and all-sky conditions, which for clear skies are, in most cases, statistically significant at the 95% confidence limit. Further analysis reveals that for all the three wavelengths, both the clear-sky and the all-sky irradiance increase fast from 1994 until 2006 and remain relatively stable thereafter. The fact that the clear-sky changes are similar for all three wavelengths indicates that the long-term changes of the UV irradiance are mainly driven by changes in aerosols. Though, the short-term variability of the irradiance at 307.5 nm is anticorrelated with the short term variability of TOC. Changes in cloudiness were not found to have any significant impact in the long-term changes of the UV irradiance.