Evidence of a possible turning point in solar UV-B over Canada, Europe and Japan

C.S. Zerefos[1,2,4], K. Tourpali[3], K. Eleftheratos[1,4], S. Kazadzis[5], C. Meleti[3], U. Feister[6], T. Koskela[7], A. Heikkilä[7]

[1] Biomedical Research Foundation of the Academy of Athens, Athens, Greece

[2] Navarino Environmental Observatory (N.E.O.), Greece

[3] Department of Physics, University of Thessaloniki, Greece

[4] Faculty of Geology and Geoenvironment, University of Athens, Greece

[5] Institute for Environmental Research and Sustainable Development, National Observatory of Athens, Greece

[6] Meteorological Observatory Lindenberg, German Meteorological Service, Germany

[7] Climate Change Unit, Finnish Meteorological Institute, Helsinki, Finland

Correspondence to: Christos S. Zerefos (zerefos@geol.uoa.gr)

Abstract

This study examines the long term variability of UV solar irradiances at 305nm and 325nm over selected sites in Canada, Europe and Japan. Site selection was restricted to the availability of the most complete UV spectroradiometric datasets during the period 1990–2011. The analysis includes the long-term variability of total ozone, aerosol optical depth and cloud fraction at the sites studied. The results, based on observations and modeling, suggest that over Canada, Europe and Japan the period under study can be divided into three sub-periods of scientific merit: The first period (1991–1994) is the period perturbed by the Pinatubo volcanic eruption, during which excess volcanic aerosol has enhanced the "conventional" amplification factor of UV-B at ground level by an additional factor that depends on solar elevation. The increase of the UV-B amplification factor is the result of enhanced scattering processes caused by the injection of huge amounts of volcanic aerosols during the perturbed period. The second period (1995–2006) is characterized by a 0.14% yr^{-1} increase in total ozone and an increasing trend in spectral irradiance by 0.94% yr^{-1} at 305nm and 0.88% yr^{-1} at 325nm. That paradox was caused by the significant decline of the aerosol optical depth by more than 1% yr^{-1} (the 'brightening' effect) and the absence of any statistically significant trend in the cloud fraction. The third period (2007–2011) shows statistically significant evidence of a slowdown or even a turning point in the previously reported upward UV-B trends over Canada, Europe and Japan.