Evaluation of Satellite Photobiological Effective Dose Products with a ground-based NILU-UV Radiometer: in preparation for TROPOMI/S5P.

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ABSTRACT

This study aims to assess and investigate the accuracy of ground-based and satellite-based models of three photobiological effective dose products: the erythemal UV, Vitamin-D and DNA damage. A suite of UV measuring instruments are operating at the Laboratory of Atmospheric Physics of the Aristotle University of Thessaloniki (LAP/AUTh) in Greece (40.63oE, 22.96oN). In particular, ground data provided by a Brewer UV double monochromator spectroradiometer (used as a reference for calibration), a NILU-UV multi-filter radiometer, and a YES UVB-1 pyranometer are used to produce the surface time series of photobiological effective dose products.

Novel methodologies are applied to the multi-filter data as well to the broadband derived measurements in order to obtain the three doses. In particular, a neural network is trained to simulate the Brewer-based photobiological effective dose products based on the NILU-UV solar measurements. The model is subjected to sensitivity analysis, is validated, and used to generate long coincident time series originated from the NILU-UV 5 irradiance measurements (nominal wavelengths: 305, 312, 320, 340 and 380 nm). For the UVB-1 derived measurements an empirical relationship was developed with appropriate correction factors applied in order to obtained the desired doses. Both retrieved datasets provide a time analysis of 1-minute estimations.

Then, satellite data are used to provide a comparison for the surface-based estimates. Specific, OMI/Aura surface UV irradiance data from 2004 to 2014 is used which includes the erythemally-weighted dose and erythemal dose rate at the overpass time and also at local solar noon. The same daily integrated sub-products provided by the SCIAMACHY/Envisat and GOME2/Metop-A joint UV product, are used for this purpose. Erythemal, Vitamin D and DNA damage daily doses are provide by the joint UV product also, and are compared with the daily doses derived from the NILU-UN and UVB-1 instruments. Time series analysis and correlation statistics of the comparisons provide a basis for a thorough assessment of model limitations as well as atmospheric, algorithm-related and/or technical factors responsible for sources of discrepancy among the retrievals.

Keywords: NILU-UV, Neural Network, Singular Spectrum Analysis, Erythemal UV, Vitamin-D Dose, DNA damage, Brewer, UVB, OMI, SCIAMACHY, GOME2

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