

## Evaluation of Satellite Total Ozone Observations with a ground-based NILU-UV Radiometer: in preparation for TROPOMI/S5P.

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### ABSTRACT

A novel approach to retrieve total ozone at high temporal frequency from surface irradiance measurements performed with a NILU-UV multi-filter radiometer is presented. A neural network model utilizes time series of 1-minute NILU-UV irradiances at central wavelengths of 302, 312, 320, 340 and 376 nm along with collocated solar zenith angles calculated at Thessaloniki, Greece (40.63E, 22.96N) and the day of the year and its sinusoidal components as temporal variables. The target value (outputs) of the model during its training are a decade of coincident Brewer total ozone measurements (TOCs). The agreement between the NN estimates and Brewer derived TOC for the training data is denoted by the high correlation statistics ( $R^2 = 0.94$ , RMSE = 8.21 D.U. and bias = -0.15 D.U.).

After the training session, the model is fed with unseen real (noisy) inputs to estimate TOCs for the decade 2005-2014. Satellite total ozone from the GOME/ERS-2, SCIAMACHY/Envisat, OMI/Aura, and GOME2/MetopA GODFIT\_v3 Ozone-CCI ESA algorithm are used to provide a comparison at each overpass time for TOC estimates produced by the neural network model from NILU-UV irradiances. The NILU TOC estimates agree with the satellite TOC retrievals with coefficients of determination found to be in the range  $0.88 \leq R^2 \leq 0.90$  for all sky and  $0.95 \leq R^2 \leq 0.96$  for clear sky conditions. For the cloud free circumstances, the mean fractional differences (satellite-ground/ground TOCs %) were found equal to  $-0.67\% \pm 2.15\%$ ,  $-1.44\% \pm 2.25\%$ ,  $-2.09\% \pm 2.06\%$  and  $-0.85\% \pm 2.19\%$  for GOME, SCIAMACHY, OMI and GOME2 respectively. Furthermore, the high Pearson correlation coefficients ( $0.94 < R < 0.98$ ) is evidence of the linearity between the satellite algorithm retrievals of TOC and

ground-based estimates, while biases of less than 5 D.U. prove that systematic errors are low. This methodology provides a new approach to the ongoing assessment of the quality and consistency of ground and space-based measurements of total ozone columns and can be used as a benchmark for the new satellite instrument generation.

**Keywords:** Ozone; NILU; Brewer; Neural Network; OMI; SCHIAMACHY; GOME; GOME2.

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