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Validation of tropospheric ozone columns from SCIAMACHY: first results

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The limb-nadir-matching technique of the SCanning Imaging Absorption spectroMeter for Atmospheric ChartograpHY (SCIAMACHY) instrument on-board the ENVISAT satellite has been used to retrieve tropospheric ozone. This technique is a residual approach that involves the subtraction of the stratospheric ozone columns derived from the limb observations from the total ozone columns derived from the nadir observations. This approach to retrieving tropospheric ozone from one spectrometer helps to remove the uncertainties that may arise when comparing measurements made by different instruments probing slightly different air masses in different observation geometries. Tropospheric ozone has a significant adverse effect on the climate system, especially of the troposphere. It generally has great impact in the lower, middle and upper troposphere. In the lower troposphere, during summer, it is a major constituent of photochemical smog and excess of it are toxic to the ecosystem, animal and man. It is equally known as a major oxidant and also involved in the production of other oxidant such as hydroxyl (OH) radicals. In the middle and upper troposphere, ozone acts as a greenhouse gas. In this study we shall focus on the validation of the tropospheric ozone columns retrieved from SCIAMACHY limb-nadir observations. The retrieval of tropospheric ozone from SCIAMACHY involves the derivation of the stratospheric ozone columns, the total ozone columns and the tropopause height. The stratospheric ozone columns was derived by integrating the stratospheric ozone profiles from the tropopause, which was obtained from the re-analyses data of the European Centre for Medium-Range Weather Forecasts (ECMWF) in 1.5 ° x 1.5° x 91 levels based on both the thermal definition of tropopause using the WMO lapse-rate criterion as well as the potential vorticity definition of the tropopause. The total ozone columns were on the other hand retrieved using the Weighting Function DOAS algorithm (WFDOAS) at the spectral window of 326.6 – 334.5 nm. Equally of importance to this study is the tropospheric ozone columns derived from the ozonesondes by integrating the tropospheric ozone profiles from the bottom to the top of the troposphere, which was determined from the ozonesondes temperature profile measurements using the WMO lapse rate criterion definition of the thermal tropopause. The tropospheric ozone columns retrieved from SCIAMACHY compare well with some of the ozonesondes investigated at the tropics and midlatitude to an average of 1-3 DU but at the higher latitudes the comparison shows an average of 5 – 8 DU. The comparison on the global distribution plots with Tropospheric Emission Spectrometer (TES) and Ozone Monitoring Instrument/Microwave Limb Sounder (OMI/MLS) show similar pollution features in some regions of the globe.