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Validation of Copernicus Height-resolved Ozone data Products from Sentinel-5P TROPOMI using global sonde and lidar networks (CHEOPS-5P)

Arno Keppens (1), Jean-Christopher Lambert (1), Daan Hubert (1), Tijl Verhoelst (1), José Granville (1), Gérard Ancellet (2), Dimitris Balis (3), Andy Delcloo (4), Valentin Duflot (5), Sophie Godin-Beekmann (2), Marilisa Koukouli (3), Thierry Leblanc (6), Trissevgeni Stavrakou (1), Wolfgang Steinbrecht (7), Réné Stübi (8), and Anne Thompson (9)

(1) Royal Belgian Institute for Space Aeronomy, Brussels, Belgium, (2) LATMOS/IPSL/CNRS/UVSQ/UPMC, Paris, France, (3) Aristotle University of Thessaloniki (AUTH), Greece, (4) Royal Meteorological Institute of Belgium (RMIB), Brussels, Belgium, (5) LACy, Université de la Réunion, Saint-Denis, France, (6) California Institute of Technology, Jet Propulsion Laboratory, Wrightwood, CA, USA, (7) Deutsche Wetterdienst (DWD), Hohenpeissenberg, Germany, (8) MeteoSwiss, Payerne, Switzerland, (9) NASA/GSFC, Greenbelt, MD, USA

Monitoring of and research on air quality, stratospheric ozone and climate change require global and long-term observation of the vertical distribution of atmospheric ozone, at ever-improving resolution and accuracy. Global tropospheric and stratospheric ozone profile measurement capabilities from space have therefore improved substantially over the last decades. Being a part of the space segment of the Copernicus Atmosphere and Climate Services that is currently under implementation, the upcoming Sentinel-5 Precursor (S5P) mission with its imaging spectrometer TROPOMI (Tropospheric Monitoring Instrument) is dedicated to the measurement of nadir atmospheric radiance and solar irradiance in the UV-VIS-NIR-SWIR spectral range. Ozone profile and tropospheric ozone column data will be retrieved from these measurements by use of several complementary retrieval methods. The geophysical validation of the enhanced height-resolved ozone data products, as well as support to the continuous evolution of the associated retrieval algorithms, is a key objective of the CHEOPS-5P project, a contributor to the ESA-led S5P Validation Team (S5PVT).

This work describes the principles and implementation of the CHEOPS-5P quality assessment (QA) and validation system. The QA/validation methodology relies on the analysis of S5P retrieval diagnostics and on comparisons of S5P data with reference ozone profile measurements. The latter are collected from ozonesonde, stratospheric lidar and tropospheric lidar stations performing network operation in the context of WMO's Global Atmosphere Watch, including the NDACC global and SHADOZ tropical networks. After adaptation of the Multi-TASTE versatile satellite validation environment currently operational in the context of ESA's CCI, EUMETSAT O_3M-SAF, and CEOS and SPARC initiatives, a list of S5P data Quality Indicators (QI) will be derived from complementary investigations: (1) data content and information content studies of the S5P data retrievals; (2) traceable preparation of the S5P data and correlative measurements in view of data comparisons (co-location studies, unit and representation conversions, handling of smoothing and sampling issues, independent estimate of tropopause altitude, (sub-)column integration...), with associated error propagation; (3) data comparisons leading to statistical estimates of the systematic bias and random difference between S5P and reference network data as a function of latitude, their cycles, their long-term evolution, and their dependences on influence quantities (e.g., clouds, solar zenith angle, and slant column density); (4) and finally the assessment of compliance with user requirements as formulated, e.g., by Copernicus Atmosphere and Climate services and by GCOS.