Aerosol profile retrieval algorithm development and validation for Sentinel-4

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In the ESA AEROPRO project we develop and validate an oxygen A-band aerosol profile retrieval concept for ESA's Sentinel-4 mission.

Sentinel-4

Sentinel-4 is an ESA mission (Ingmann, 2012) that is part of of the Global Monitoring for Environment and Security (GMES) space component. The primary mission objective is the observation of the diurnal cycle of the tropospheric composition in support of the operational air quality applications of the GMES Atmosphere Services. The Sentinel-4 instrument is an Ultra-violet Visible Near infrared spectrometer (S4/UVN) which is embarked on the geostationary Meteosat Third Generation-Sounder (MTG-S) platforms. Key features of the S4/UVN instrument are the spectral range from 305 nm to 500 nm with a spectral resolution of 0.5 nm, and from 750 nm to 775 nm with a spectral resolution of 0.12 nm. The instrument shall observe Europe with a revisit time of one hour. The spatial sampling distance varies across the geographic coverage area and takes a value of 8 km at a reference location at 45° N. The expected launch date of the first MTG-S platform is 2019, and the expected lifetime is 15 years (two S4/UVN instruments in sequence on two MTG-S platforms).

Aerosol Layer Height Retrieval

In the AEROPRO project measured oxygen A-band spectra (758–778 nm) from the Japanese GOSAT Fourier Transform Spectrometer (Kuze, 2009) are being used as proxy for the Sentinel-4 data. The spectral resolution of GOSAT is downgraded to 0.12 nm, which is the Sentinel-4 resolution. This also helps to improve the Signal-to-Noise ratio of GOSAT data. The AEROPRO O_2 A-band algorithm, with heritage from the Sentinel-5P/Tropomi (Veefkind, 2012) algorithm (Sanders, 2012), is based on optimal estimation and a forward model with full multiple scattering, using a simple aerosol microphysics model. The basic set of fit parameters comprises aerosol optical thickness, aerosol layer pressure and surface albedo. For vegetated land, we also fit fluorescence emission. Sensitivity studies show that aerosol cases for which the algorithm will be specifically suited include elevated, optically thick aerosols, such as volcanic ash plumes, desert dust and biomass burning aerosols. The retrieval is independent of the aerosol microphysics assumption.

Validation Approach

Since the altitude of aerosols is difficult to determine from space using passive sensors, validation of the AEROPRO algorithm is essential. During the ESA CarbonExp aircraft campaign, which took place over Greece and Turkey in August-September 2011, a GOSAT special pointed observation request was executed. This campaign offered a unique opportunity to validate the O_2 A-band aerosol profile retrievals from GOSAT, since the aircraft's actively sensed lidar data give the vertical structure of the atmosphere in an unambiguous way. Additional ground-based lidar data from the European Aerosol Research Lidar Network (Earlinet) and the Micropulse Lidar network (MPLnet) are used to validate the aerosol height retrievals from GOSAT for selected cases of strong aerosol events in between July 2010 and June 2012.

First results from the AEROPRO study will be shown.

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