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ALTIUS Primary Species Retrieval Algorithms in Solar Occultation Mode Validated using SAGE III-ISS Observations.

The Atmospheric Limb Tracker for the Investigation of the Upcoming Stratosphere (ALTIUS) is the European Space Agency's (ESA) future ozone mission, part of ESA's Earth Watch Programme. The mission is set to launch in 2027 from Kourou, aboard the Vega-C launcher.

ALTIUS is designed to perform measurements in various geometries to optimize global coverage. This includes observing limb-scattered solar light during the day, solar occultations at the terminator, and stellar, lunar, and planetary occultations during the night. The primary mission objective is to obtain high-resolution stratospheric ozone concentration profiles. Given its diverse measurement geometries, ALTIUS is considered a necessary successor to ESA's SCIAMACHY and GOMOS instruments, which were retired after the decommissioning of ENVISAT in 2012.

The ALTIUS payload, which will be mounted on a PROBA platform, comprises three imagers: UV (250-355 nm), VIS (440-675 nm), and NIR (600-1040 nm) channels. Each imager can independently capture images at desired wavelengths and acquisition times, allowing for optimal wavelength and acquisition time selection. This feature enhances vertical resolution, enabling the retrieval of vertical profiles of various chemical species, including but not limited to Ozone, NO_2, and aerosols.

The focus of this work is on simulating the ozone retrieval algorithm in the Solar Occultation configuration, using data from the Stratospheric Aerosol and Gas Experiment (SAGE-III) on board of the ISS. Since 2017, SAGE-III on ISS has been producing Solar Occultation measurements in the UV/VIS spectrum, providing spectral coverage from 280nm to 1040nm with a spectral resolution of ±1.2nm, and includes an additional 1550nm channel for aerosols and clouds.

Owing to its similar measurement geometry, large dataset, and theoretically high spectral resolution, SAGE-III serves as a valuable data source for simulating ALTIUS's Solar Occultation mode. The objective of this work is to adapt SAGE-III data to align with ALTIUS's Solar Occultation configuration by creating so-called "Altiusified stimuli." These stimuli are then used to validate ALTIUS's Level 2 algorithm and to verify the performance of its Ozone, NO_2, and Aerosol products by comparing the results against the corresponding SAGE-III Level 2 dataset.

During this work, several technical challenges were addressed that impacted the stimuli generation process, including but not limited to:

1. Gaps in spectral data within SAGE-III's Level 1 product,
2. Noise present in the Aerosol and NO_2 data of the SAGE-III Level 2 product,
3. The need to determine a best-fitting effective radius for the aerosol profiles.

As a result of these challenges, alternative measurement vectors need to be used in the L2 processing of this Altiusified data.

End-to-end simulations were conducted using our System Performance Simulator (SPS), which models the actual ALTIUS performance based on the most recent instrument characterizations available at the time of this study.

Topic

Upcoming Earth observation limb and occultation instruments

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