Development of an Enhanced AC-SAF OClO Retrieval Algorithm for Sentinel-5/Metop-SGA

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Understanding stratospheric ozone depletion and recovery is crucial for atmospheric science. Ozone shields Earth from harmful UV radiation and influences atmospheric chemistry and global climate. Ozone depletion rates are driven by chlorine, bromine, nitrogen, and hydrogen oxides, with polar regions being particularly affected due to low temperatures that enhance chlorine activation.

Chlorine dioxide (OClO) serves as a critical indicator of chlorine activation, a precursor to ozone destruction, although it does not directly participate in ozone depletion. The ClO-BrO catalytic cycle is central to ozone destruction, contributing to the formation of the polar ozone hole. OClO is predominantly observed in the polar vortex during winter and spring, yet current models often underestimate its abundance under specific conditions, emphasizing the need for more accurate measurements and modeling.

OClO columns are retrieved using the Differential Optical Absorption Spectroscopy (DOAS) method, a highly sensitive technique applied in both ground-based and satellite observations. Satellite missions such as SCIAMACHY, GOME-2, OMI, and TROPOMI have facilitated the development of OClO retrieval algorithms. Despite advancements, retrieval challenges persist, including spectral interferences with other atmospheric species.

Within the framework of the EUMETSAT Satellite Application Facility on Atmospheric Composition Monitoring (AC SAF), a state-of-the-art operational prototype for retrieving total OClO columns is being developed for the Sentinel-5 (S5) instrument onboard Metop-SGA. This represents the first fully operational global OClO product and establishing a new cornerstone for global monitoring of stratospheric chlorine activation. The algorithm has been developed and tested using Sentinel-5P/TROPOMI data to ensure full transferability to the S5 operational processing chain. This work presents an optimized OClO retrieval based on systematic refinement of DOAS parameters, including the spectral fitting window, polynomial degree, and treatment of interfering absorbers, with specific attention to mitigating instrument-related artifacts in polar conditions. The total OClO results derived from S5P datasets with preliminary validation against ground-based measurements are presented, and the expected performance of the future S5 OClO product is discussed.