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TEMPO Aerosol Retrieval Algorithm

Hai Zhang[1], Shobha Kondragunta[2], and Pubu Ciren[1]
[1]IMSG at NOAA, United States of America (hai.zhang@noaa.gov)
[2]NOAA/NESDIS, USA

TEMPO (Tropospheric Emissions: Monitoring Pollution) is a geostationary ultraviolet and visible spectrometer to monitor major air pollutants over north America. The instrument was launched in April 2023 and the L1b data were available since October 17, 2023. The sensor's coverage of the O_2B band (688nm) enables us to retrieve aerosol layer height (ALH). At National Oceanic and Atmospheric Administration (NOAA) in the United States, we developed an algorithm to retrieve aerosol optical depth, aerosol type, and aerosol layer height from the TEMPO data. Our approach involves the creation of a 0.05x0.05 degree database of surface reflectances for various bands, accounting for solar-satellite geometry. To retrieve AOD, AOD and surface reflectance are varied until a solution is found that gives a minimum residual between derived and prescribed spectral surface reflectance ratio between blue and red bands. The surface reflectances at the O_2B band are derived from retrievals of other bands using the surface reflectance ratio database. The ALH is determined by minimizing differences between the measured 688/670 bands' top-of-atmosphere (TOA) reflectance ratio and the calculated ratio.

The retrieval algorithm was tested using the August-September 2020 TROPOMI data as a proxy over CONUS region where heavy smoke was observed. The results show good AOD retrieval performance compared to ground-based Aerosol Robotic Network (AERONET) AOD: the retrieved AOD has a correlation of 0.68, a bias of 0.11 and RMSE of 0.37 with respect to AERONET AOD. Comparing to CALIOP ALH, the retrieved ALH has a correlation of 0.67, a bias of 0.91 km and an RMSE of 2.59 km. Preliminary AOD retrieval from TEMPO data also demonstrates favorable agreement with AOD from the ABI instrument onboard GOES-East.

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