Volcanic SO2 retrieved from GF-5 Environmental Trace Gas Monitoring Instrument

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Sulfur dioxide (SO2) from volcanic eruption and its long-distance transportation has a significant impact on global climate change and aviation safety. Satellite remote sensing technology provides an unprecedented advantage for continuous, large spatial and short-revisit monitoring for atmospheric SO2. GF-5 Environmental Trace Gas Monitoring Instrument (EMI) with high spatial resolution is the China's first instrument of hyper spectral measurements with wavelength range from 240 nm to 710 nm, and makes daily global observations of key atmospheric constituents, including ozone, nitrogen dioxide, sulfur dioxide.

EMI top-of-atmosphere (TOA) albedo

Based on the atmospheric radiation transfer model SCIATRAN, the clear sky albedo under typical atmospheric conditions is simulated by selecting the ocean area pixels with uniform surface types in the middle and low latitudes to evaluate the accuracy of the EMI top-of-atmosphere (TOA) albedo. Results show that, in the band range of 300-400nm, the EMI spectra of the sampling points in the ocean area are lower than the simulated spectra of SCIATRAN, and EMI and TROPOMI spectra show similar systematic biases.

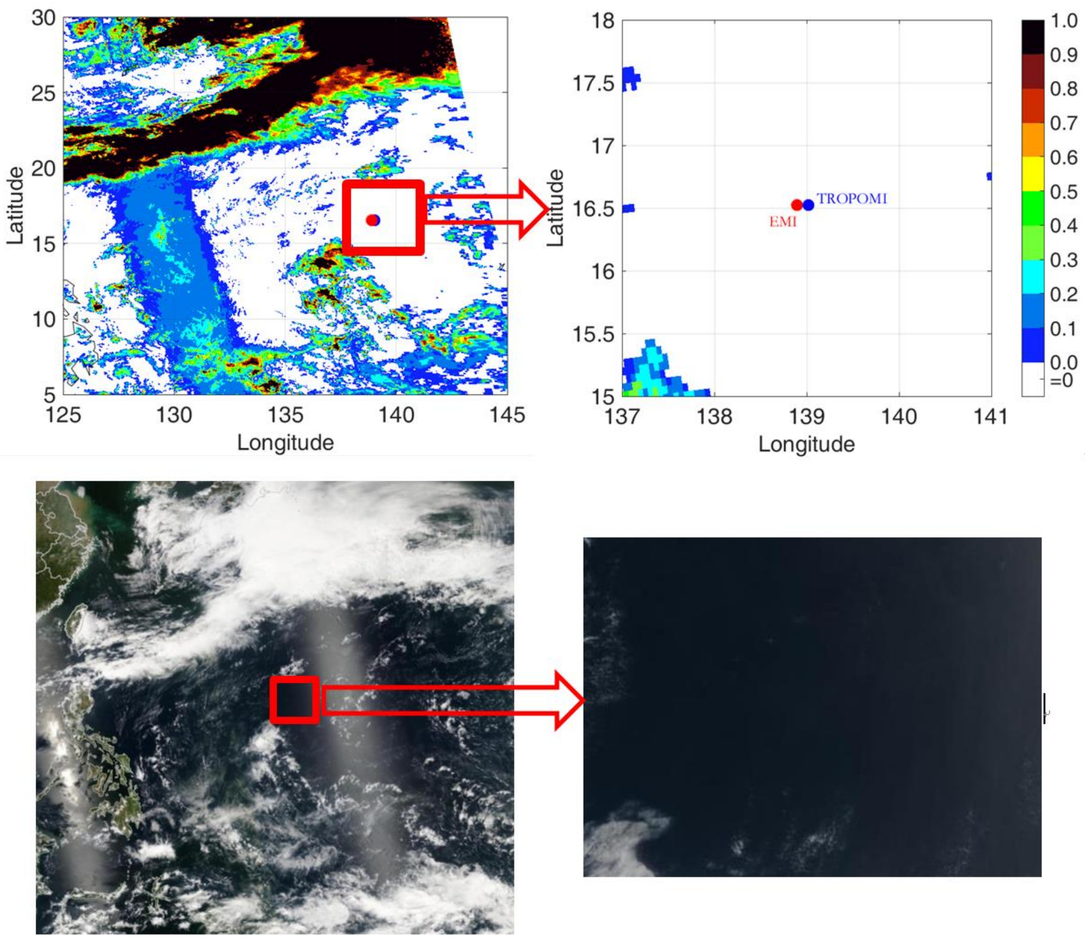


Figure 1. Selected sampling point in the ocean region based on TROPOMI cloud products and FY-3D true-color maps. (upper left) TROPOMI cloud distribution, in which red dot represent EMI pixel location and blue dot represent TROPOMI pixel location; (left below) FY-3D true color picture.

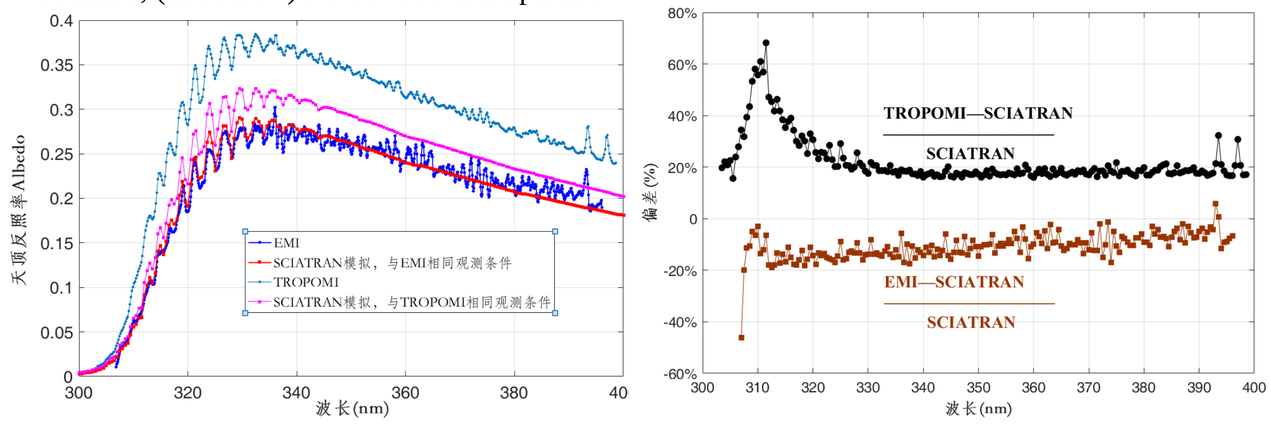


Fig. 2 Comparison of EMI and TROPOMI TOA albedo and SCIATRAN simulated spectra at sampling point 1.(1) EMI and TROPOMI TOA albedo and SCIATRAN simulated spectra in the band range of 300-400nm; (2) Deviation between the TOA albedo of EMI and TROPOMI and the simulated spectra of SCIATRAN.

Based on the GF-5 EMI L1 Radiance data and the DOAS algorithm, after 477nm O4 cloud screening, spectral calibration, slant column to vertical column conversion, the inversion results of total SO2 columns over volcanic eruption areas were obtained and compared with TROPOMI offline L2 SO2 products.

1. Cloud parameter inversion

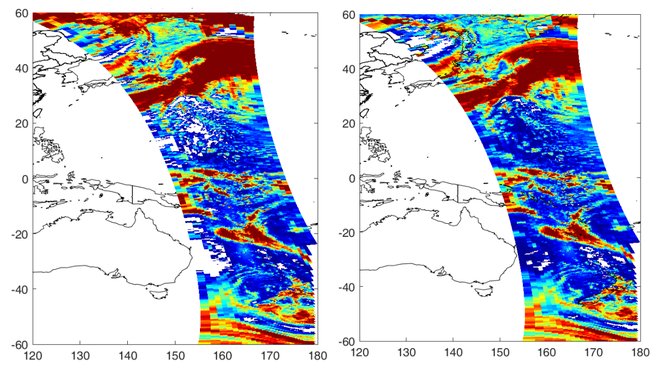
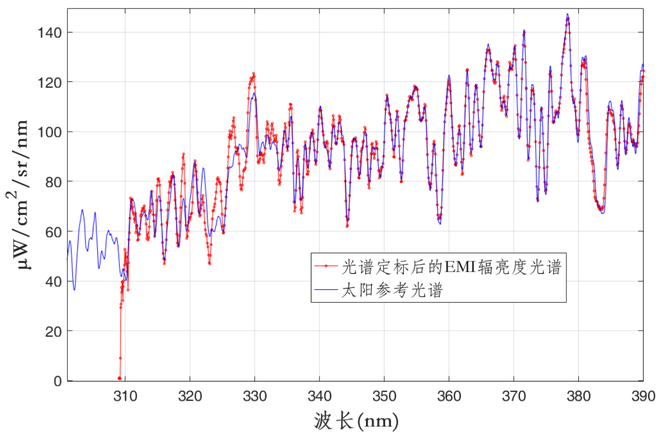
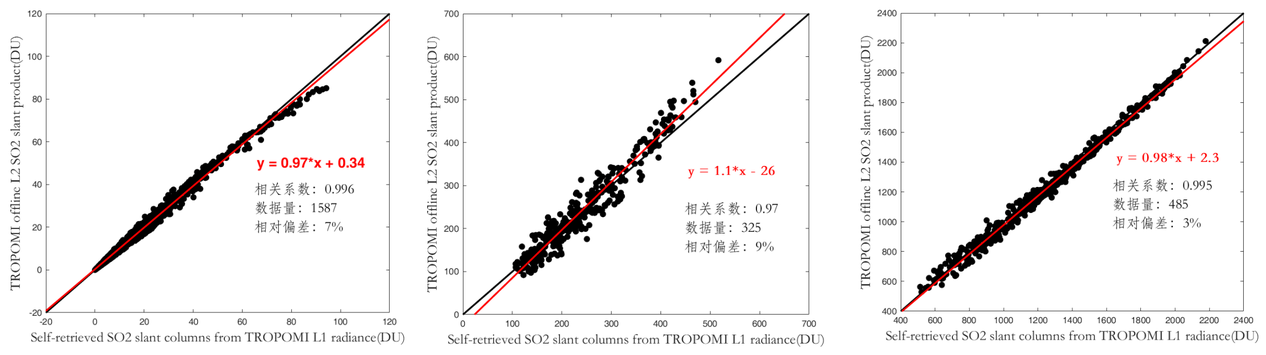


Fig. 3 Comparison of cloud fraction retrievals based on OMI L1B data and O2-O2 absorption feature inversion at 477nm band. (left) retrieved cloud cover result; (right) OMI L2 cloud product.

2.Spectral calibration



3. Slant columns retrieval



4. Vertical column and background correction

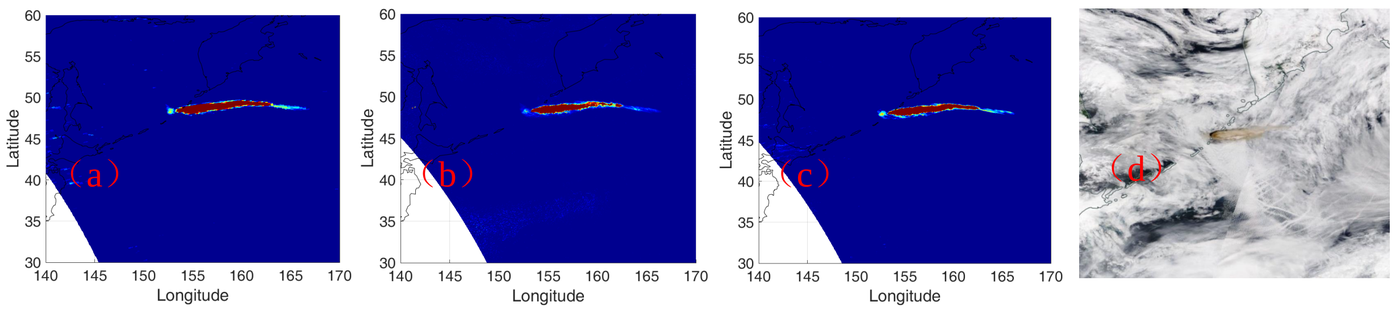


Fig. 6 Spatial distribution of volcanic SO2 in Kuril Islands monitored by satellite remote sensing, June 22, 2019.(a) GF-5 EMI SO2 inversion;(b) TROPOMI Offline L2 SO2 product, orbit 08749; (c) SO2 inversion based on the same TROPOMI L1B radiance data; (d) Terra/MODIS true colour image. The cloud cover pixel in the figure is filled with background values.

Selected reference:

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Conclusion :

GF-5/EMI can obtain the daily distribution of SO2 from volcanic eruption. The accuracy of GF-5/EMI SO2 columns can meet the needs of application of global volcano monitoring.。