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Supplement of

Version 1 NOAA-20/OMPS Nadir Mapper total column SO_2 product: continuation of NASA long-term global data record

Can Li et al.

Correspondence to: Can Li (can.li@nasa.gov)

Description of version 1 NOAA-20/OMPS SO_2 product

Detailed description of the current version of our PCA-based N20/OMPS SO_2 product (product name: OMPS_N20_NMSO2_PCA_L2_Step1), including its file format in netCDF-4 and data fields, is given in the product readme file, available at https://disc.gsfc.nasa.gov/datasets/OMPS_N20_NMSO2_PCA_L2_Step1_1/summary (Li et al., 2023). A summary of the data fields that are of interest to most data users is given below.

SlantColumnDensitySO2: SO_2 slant column densities (SCDs) in molecules cm^{-2} derived using sun-normalized radiances between 310.5 and 340 nm.

SLER: simple Lambertian equivalent reflectivity (Ahmad et al. 2004) at the terrain pressure at three wavelengths, 342, 354, and 367 nm.

ColumnAmountSO2_PBL: SO_2 vertical column densities (VCDs) in Dobson Units estimated using SO_2 SCDs and a fixed AMF of 0.36 (see section 2.2). The AMF is calculated assuming that SO_2 is predominantly in the boundary layer, hence the name for the data field. The PBL SO_2 data can be used for studies on anthropogenic SO_2 pollution, but pixels with large SLER (for example > 0.2 at 342 nm) should be excluded to reduce the cloud effects that are unaccounted for in the AMF.

ColumnAmountSO2_TRL: SO_2 VCDs (DU) estimated assuming a lower troposphere (TRL) *a priori* SO_2 profile with a center mass altitude of 3 km. The TRL SO_2 data can be used for studies on volcanic degassing.

ColumnAmountSO2_TRM: SO_2 VCDs (DU) estimated assuming a middle troposphere (TRM) *a priori* SO_2 profile with a center mass altitude of 8 km. The TRM SO_2 data can be used for moderate volcanic eruptions.

ColumnAmountSO2_TRU: SO_2 VCDs (DU) estimated assuming an upper troposphere (TRU) *a priori* SO_2 profile with a center mass altitude of 13 km. The TRU SO_2 data can be used for studying explosive eruptions that inject SO_2 into the upper troposphere.

ColumnAmountSO2_STL: SO_2 VCDs (DU) estimated assuming a lower stratosphere (STL) *a priori* SO_2 profile with a center mass altitude of 18 km. The STL SO_2 data can be used for studies on explosive eruptions that directly inject SO_2 into the lower stratosphere.

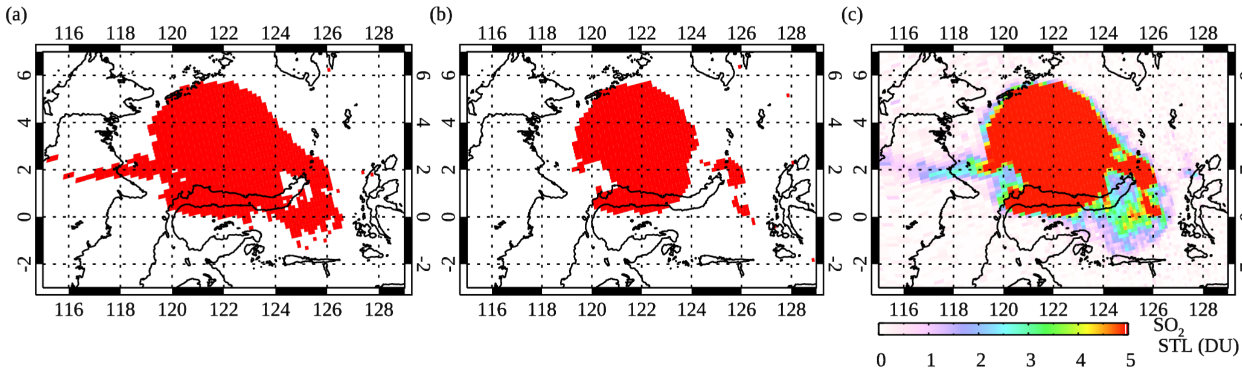

Figure S1. NOAA-20/OMPS pixels flagged for potential volcanic SO_2 signals from the Ruang volcanic plume on 30 April 2024 using (a) the new and (b) the old volcanic SO_2 screening scheme. (c) SO_2 vertical column densities (VCDs) retrieved assuming a plume height of 18 km.

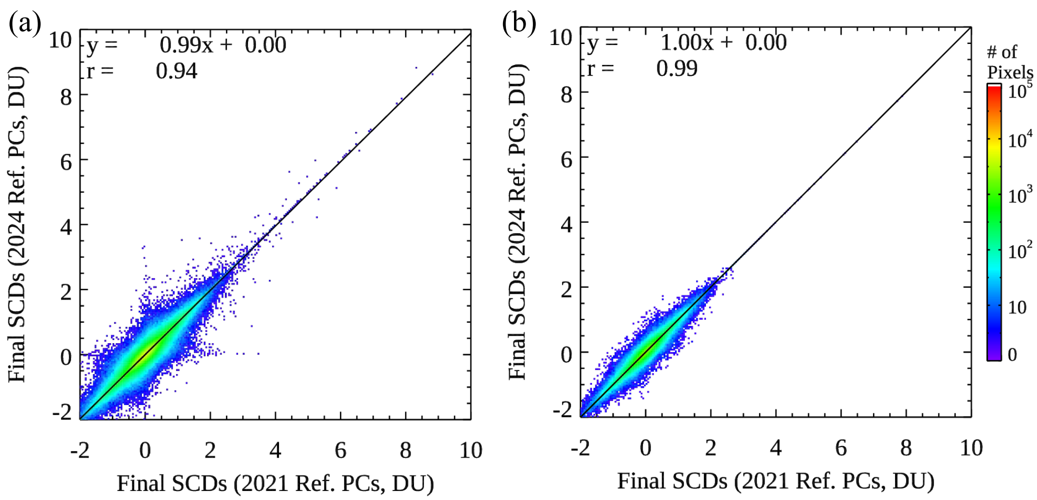

Figure S2. The density map comparing the final N20/OMPS SO_2 SCD retrievals using reference PCs from orbit 17460 on 1 April 2021 *vs.* those using reference PCs from orbit 33010 on 1 April 2024. (a) includes all orbits on 1 April 2023, whereas (b) includes orbits on the same day that are unaffected by SAA.

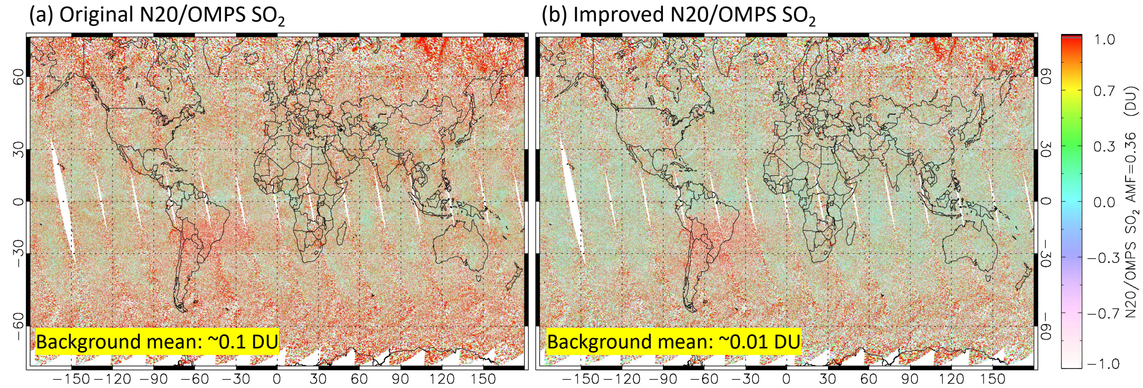

Figure S3. SO_2 vertical column densities (VCDs) for April 1, 2020, retrieved from N20/OMPS using (a) the same settings as in the SNPP/OMPS algorithm, and (b) the updated algorithm settings as described in section 2.2.2. A constant air mass factor (AMF) of 0.36 is applied to all pixels in both retrievals.

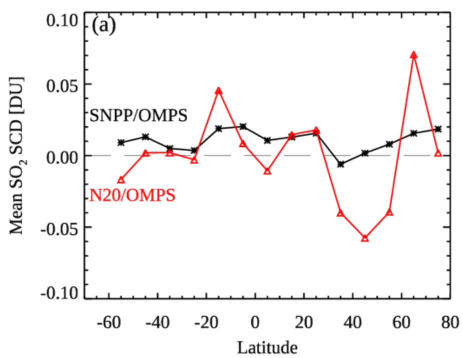

Figure S4. Same as Figure 2a but showing NOAA-20/OMPS retrievals conducted without grouping pixels in each row into different subsectors. As compared with retrievals that use subsectors, the mean SO_2 SCDs show greater latitudinal variations and exceed ±0.05 DU for multiple latitude bands.

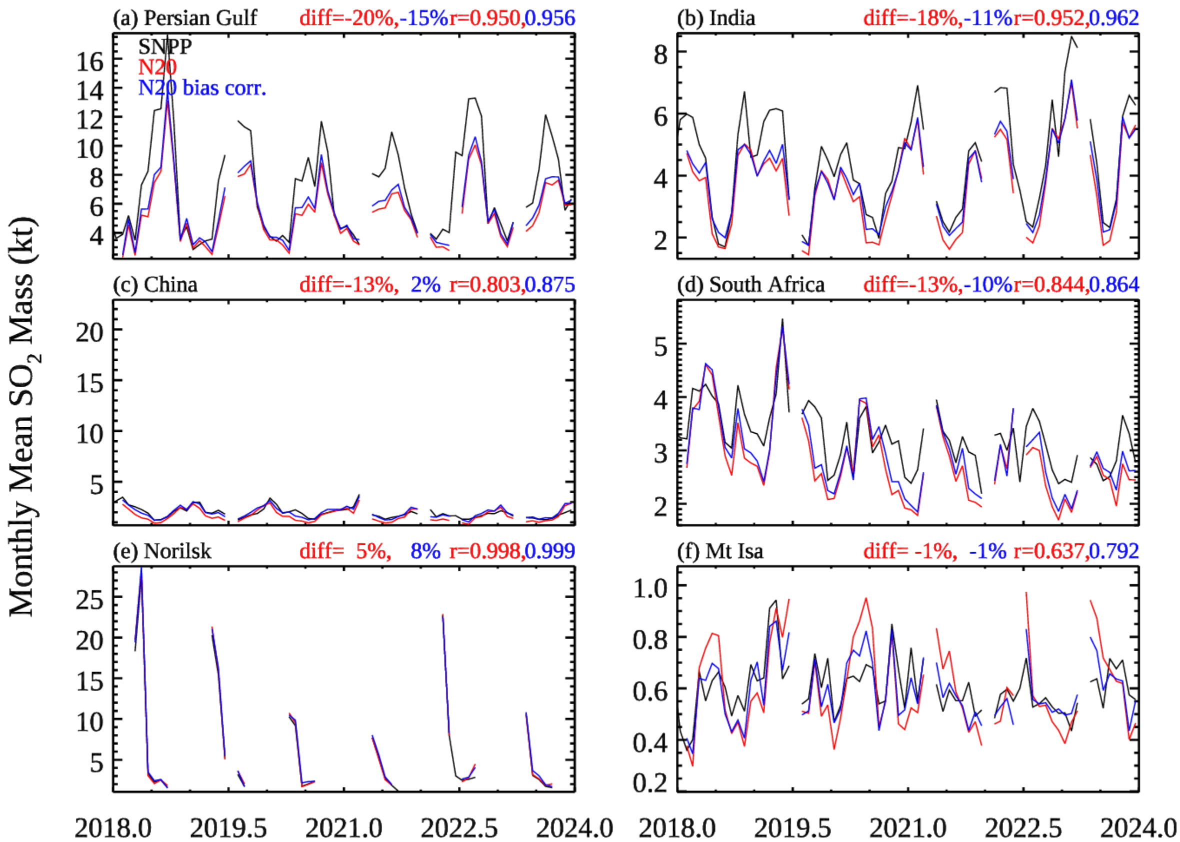

Figure S5. Same as Figure 6 but for the period of 2018-2023.

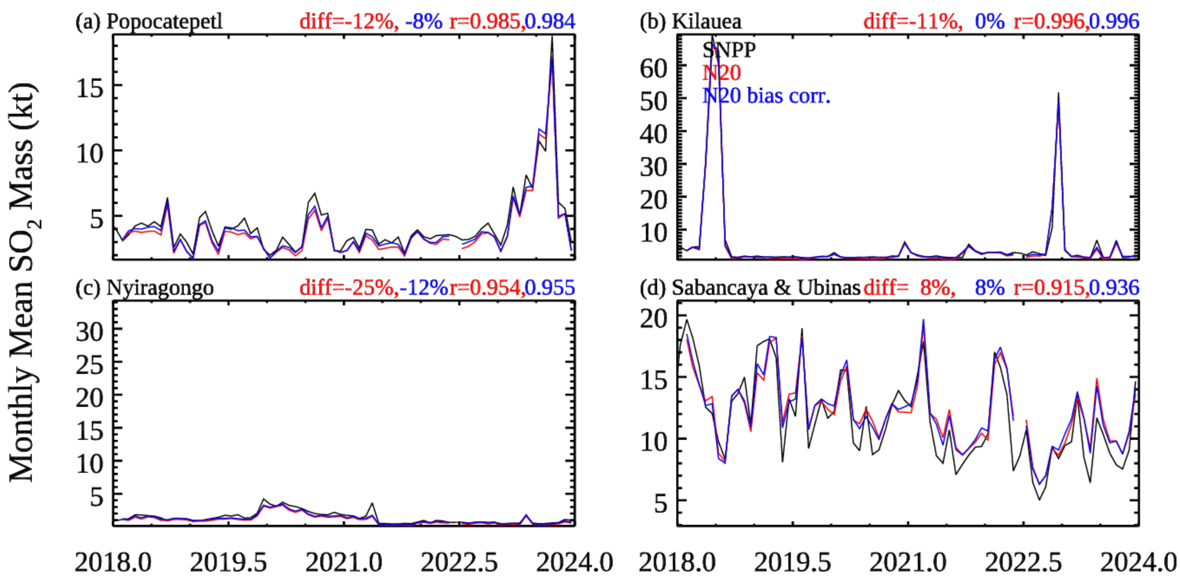

Figure S6. Same as Figure 7 but for the period of 2018-2023.

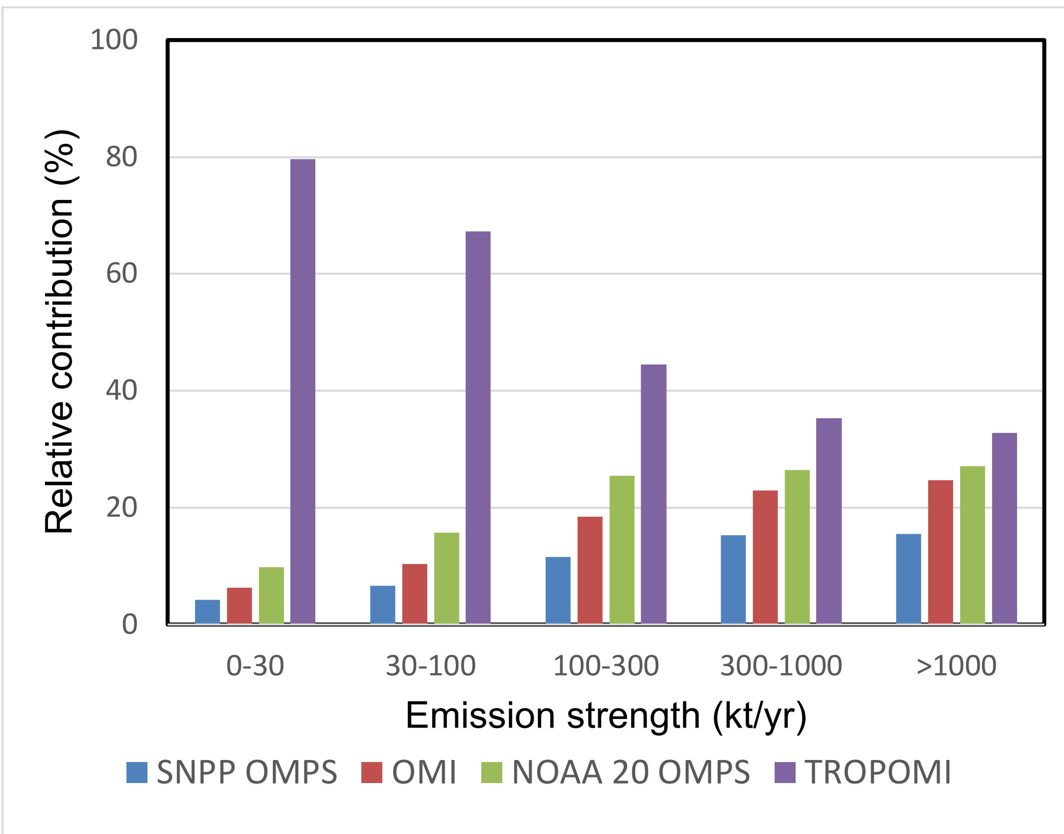

Figure S7. Relative contribution of individual satellite instruments to the weighted average for emission estimates depending on the emission strength for 2018-2023.