TIR-Based Volcanic SO_2 Science Products for Terra, Aqua, and Suomi NPP

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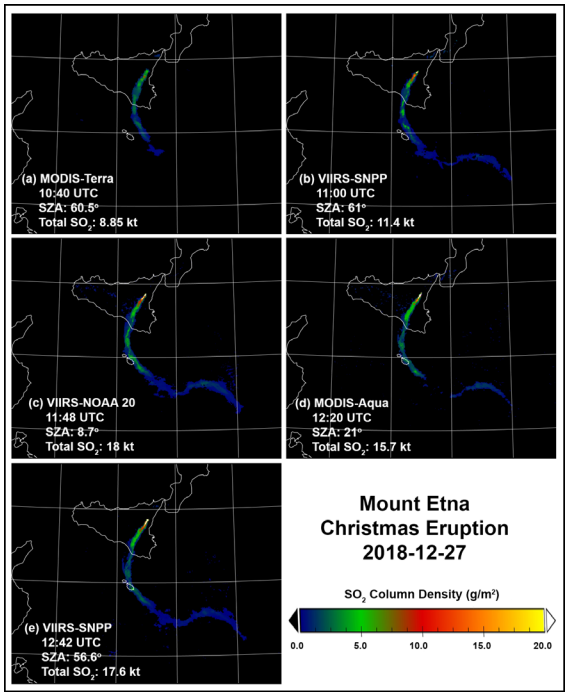
Chronology of SO_2 maps derived from MODIS-Terra, MODIS-Aqua, VIIRS-SNPP, and VIIRS-N20 data acquired over Mount Etna on 27 December 2018. The average time step between these daytime observations is 36 minutes



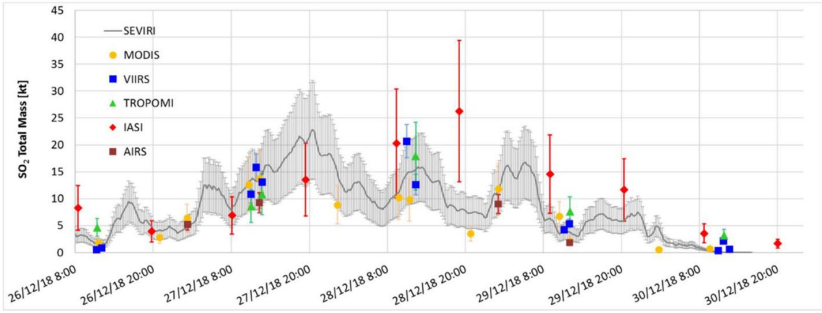


Figure 7. SO_2 total masses computed from the images collected by the different satellite instruments in the latitude–longitude grid 34–38N, 14–18E.

Corradini et al. (2021), The Etna December 2018 Eruption, Remote Sensing, 13, 2225, DOI: 10.3390/rs1311225

Objectives

- Develop an automated system for the detection and mapping of volcanic SO_2 plumes based on multispectral TIR image data from MODIS and VIIRS
- Validate data products through comparison with field measurements and complimentary satellite data products (e.g., SEVIRI, IASI, TROPOMI) provided by Italian National Institute of Geophysics and Volcanology (INGV)
- Apply system to analysis of MODIS and VIIRS data records for the long-lived (29 Aug 2014 – 27 Feb 2015) eruption of Bardarbunga Volcano, Iceland
- Prepare and submit documents (User Guide) for future generation of MODIS- and VIIRS-based products at A-SIPS

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Status and Updates:

- BT-based procedures for cloud and plume detection without radiative transfer modeling (see right-hand panel)
- Limit RT Processing to Regions of Interest (ROI) identified by cloud and plume detection masks
- Accelerate RT processing time through reuse of model spectra for upwelling and path radiance; SO_2 estimates based on re-calculation of transmission spectra

Needed Products:

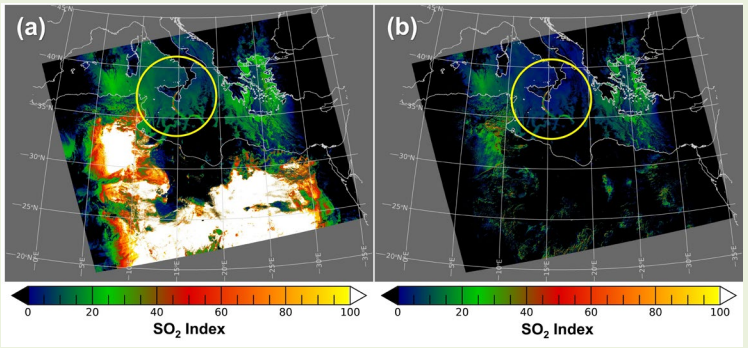
- L1 radiance data from MODIS-Terra, MODIS-Aqua, VIIRS-SNPP, and VIIRS-N20
- Digital Topography data base
- Emissivity data base (CAMEL, ASTER GED, MODIS MOD21, VIIRS VNP21)
- Atmospheric profiles (GEOS-5 FP-IT, radiosonde, AIRS, MODIS, NCEP, MERRA-2)

Known Issues:

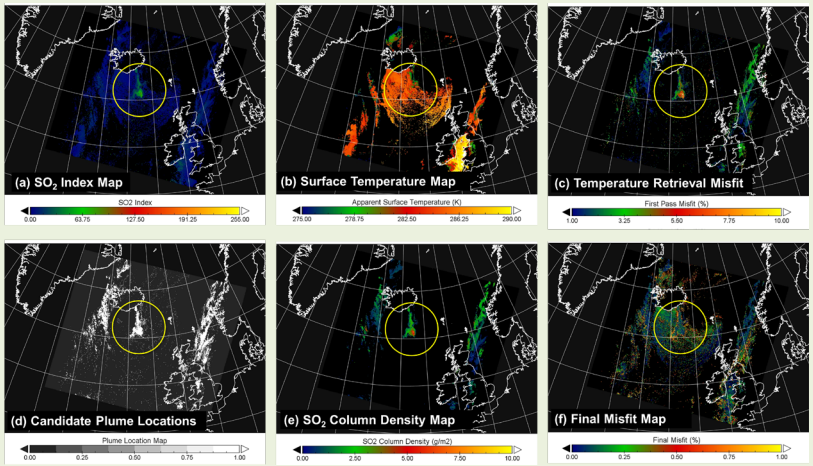
- Guidelines for computation and media storage resources available at A-SIPS
- RT Model issues, access to external data servers

Recent Publications:

- In preparation



(a) Surface emissivity (e.g., quartz sand) can mimic SO_2 Absorption. (b) Emissivity correction (based on CAMEL) minimizes false plume detections.



Product Workflow: Cloud and Plume Detection Procedures generate focus radiative transfer (RT) based processing. (a) SO_2 Index Limits RT to ~20% of pixels, (e) SO_2 estimation limited to ~7% of pixels