



Thermal Infrared (TIR) Remote Sensing of Volcanic Plumes: An Introduction (?)

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Jet Propulsion Laboratory
California Institute of Technology

TIR Remote Sensing of Volcanic Plumes



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California Institute of Technology

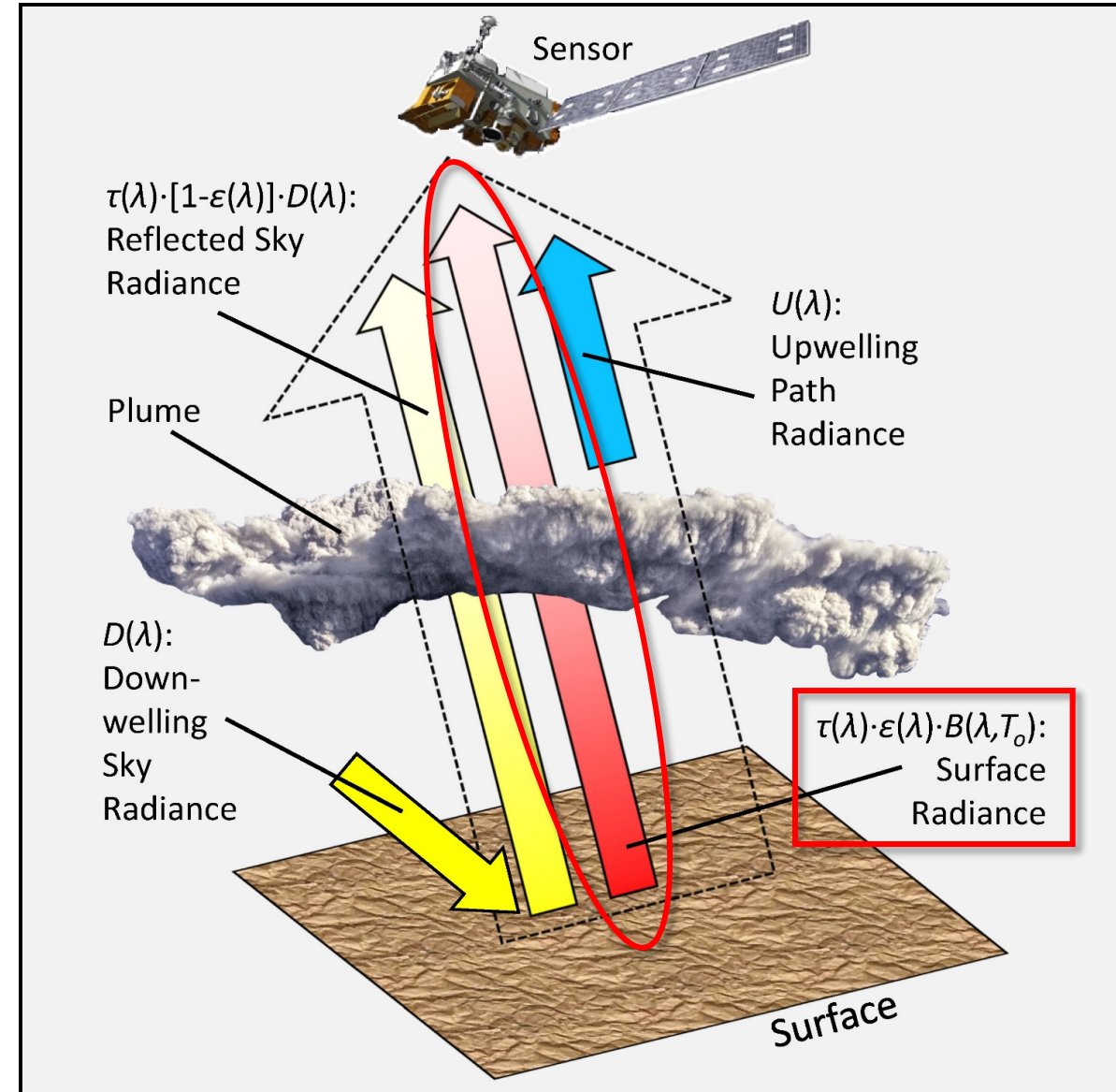
Detect plumes through transmission $[\tau(\lambda)]$:
the attenuation of surface radiance $[\varepsilon(\lambda) \cdot B(\lambda, T_o)]$
passing through the plume enroute to the sensor

$$L(\lambda, T_o) = \{\varepsilon(\lambda) B(\lambda, T_o) + [1 - \varepsilon(\lambda)] D(\lambda)\} \tau(\lambda) + U(\lambda)$$

The observed radiance $[L(\lambda, T_o)]$; outlined arrow] includes
the surface radiance (red arrow), reflected downwelling
sky radiance $[D(\lambda)]$, yellow arrow], and upwelling path
radiance $[U(\lambda)]$, blue arrow]

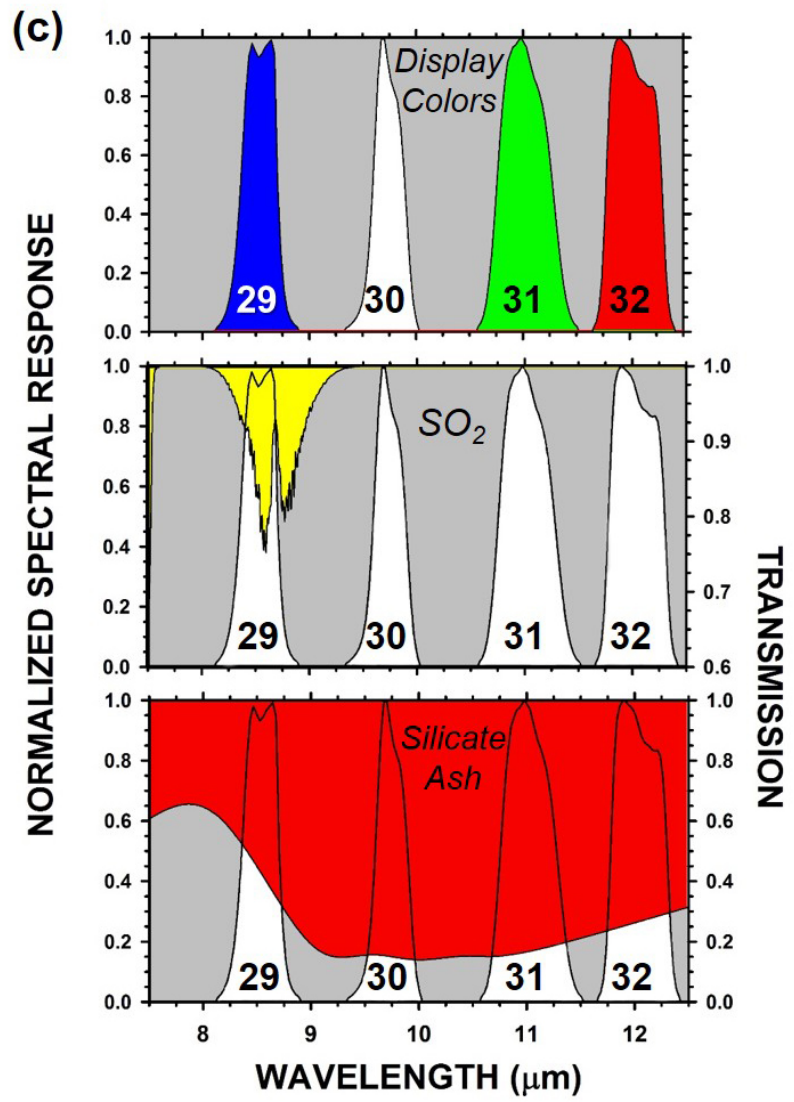
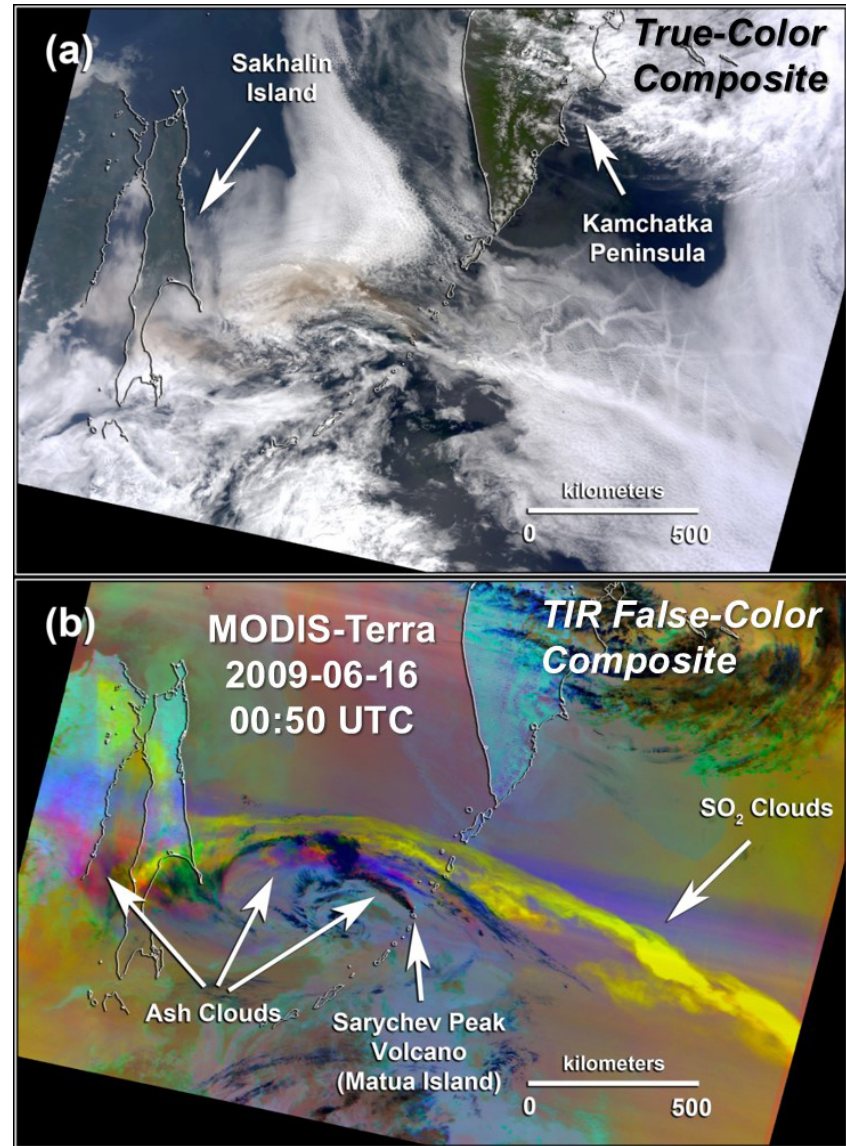
Reconstruct Observed Radiance:

- 1) Transmission, sky radiance, and path radiance are estimated through radiative transfer (RT) modeling, cached, and re-used
- 2) Surface emissivity $[\varepsilon(\lambda)]$ available from lab spectra, product archives, or calculated within scene
- 3) Surface temperature $[T_o]$ estimated from radiance observations



Plume Spectroscopy: Sarychev Peak Volcano

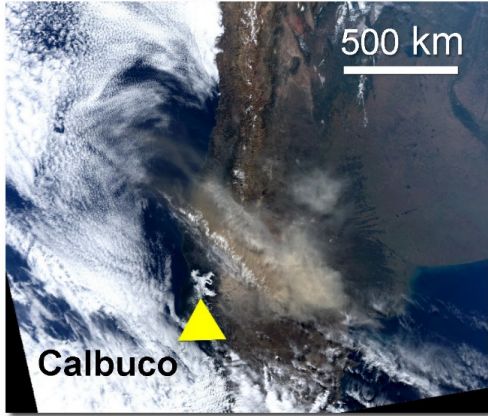
- a) MODIS-Terra True-color composite. Volcanic plumes and meteorological clouds have similar appearance at visible wavelengths
- b) False-color composite of TIR data from Channels 32, 31, and 29, displayed in red, green, and blue. SO₂ plumes appear yellow, while the display colors of ash plumes range between red and magenta
- c) Transmission spectra of SO₂ (middle) and silicate ash (bottom), superimposed on the spectral response of MODIS Channels 29, 30, 31, and 32



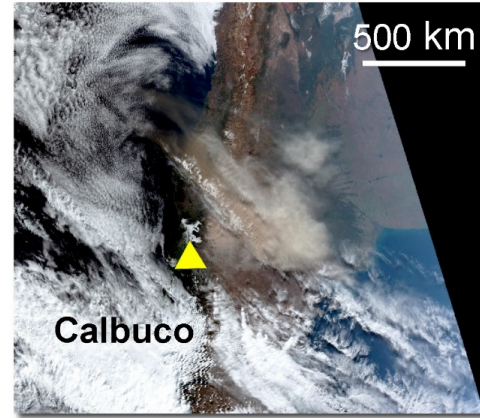
Plume Spectroscopy: Calbuco Volcano (Chile)

2015-04-23, 18:35 UTC (Aqua) / 19:12 UTC (SNPP)

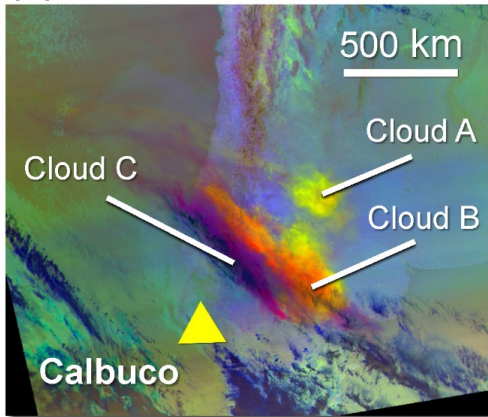
(a) MODIS RGB



(b) VMAE RGB

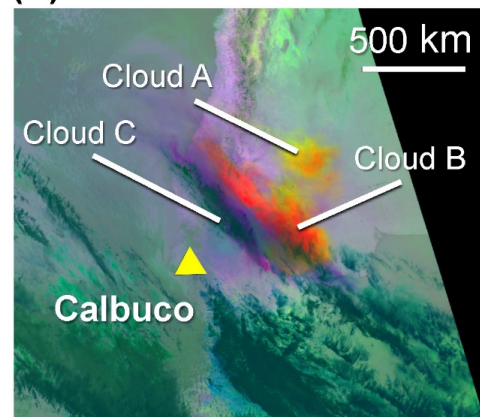


(c) MODIS TIR



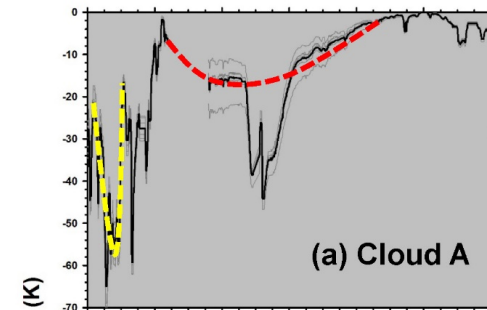
18:36 UTC

(d) VMAE TIR

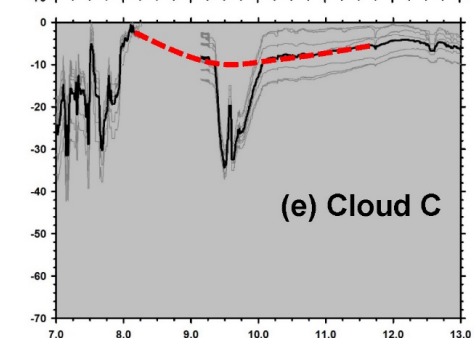
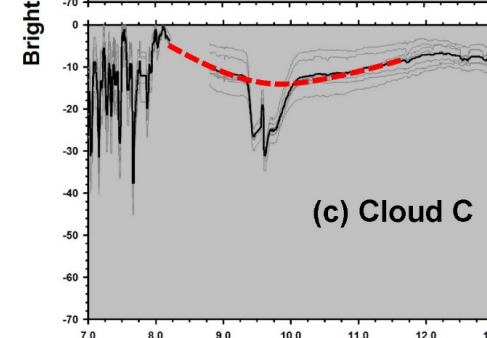
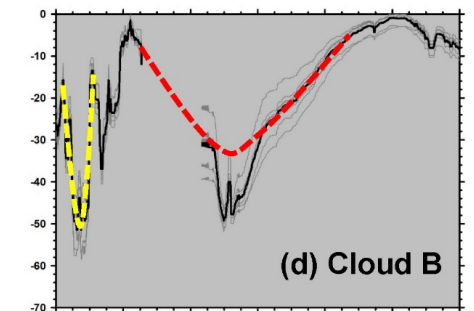
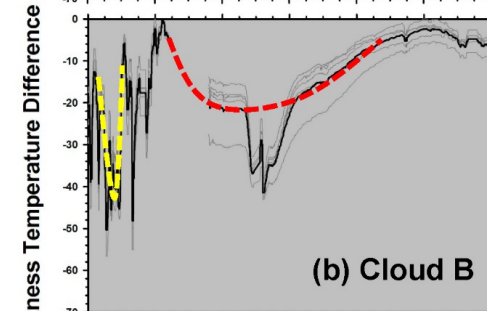
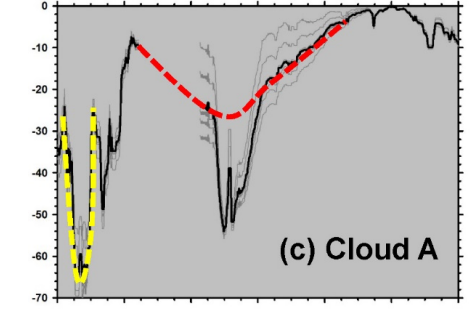


19:12 UTC

AIRS Spectra: 18:36 UTC



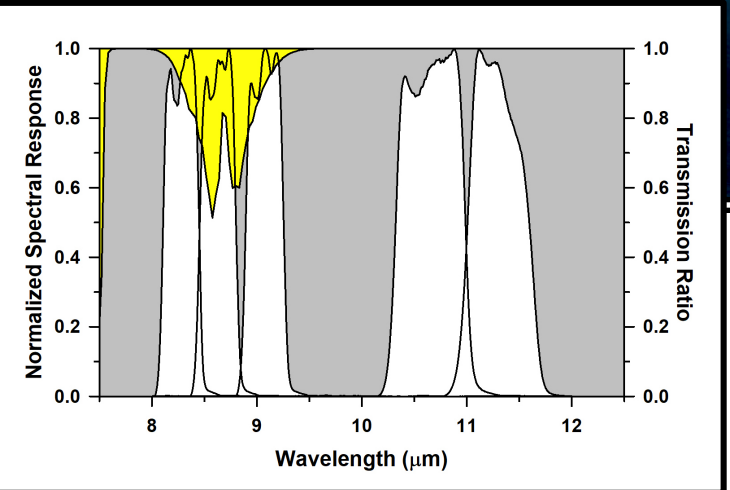
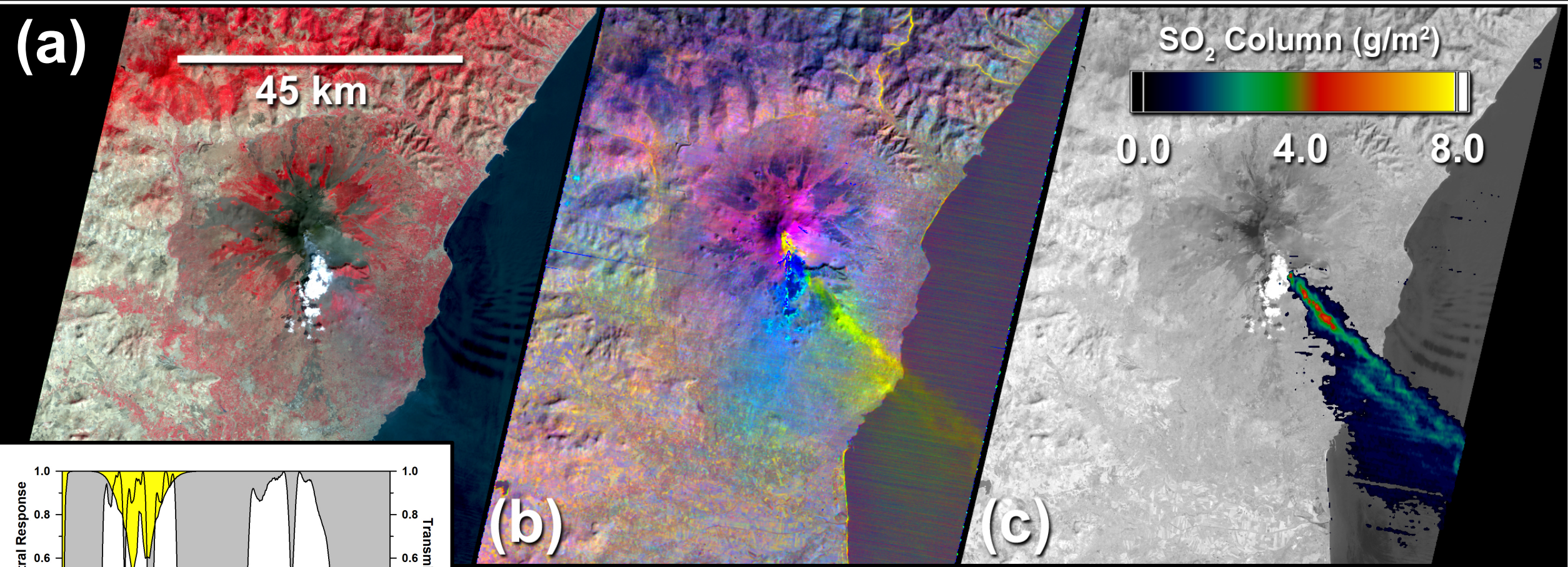
CrIS Spectra: 19:12 UTC



Wavelength (μm)

Wavelength (μm)

Advanced Spaceborne Thermal Emission and Reflectance Radiometer (ASTER)

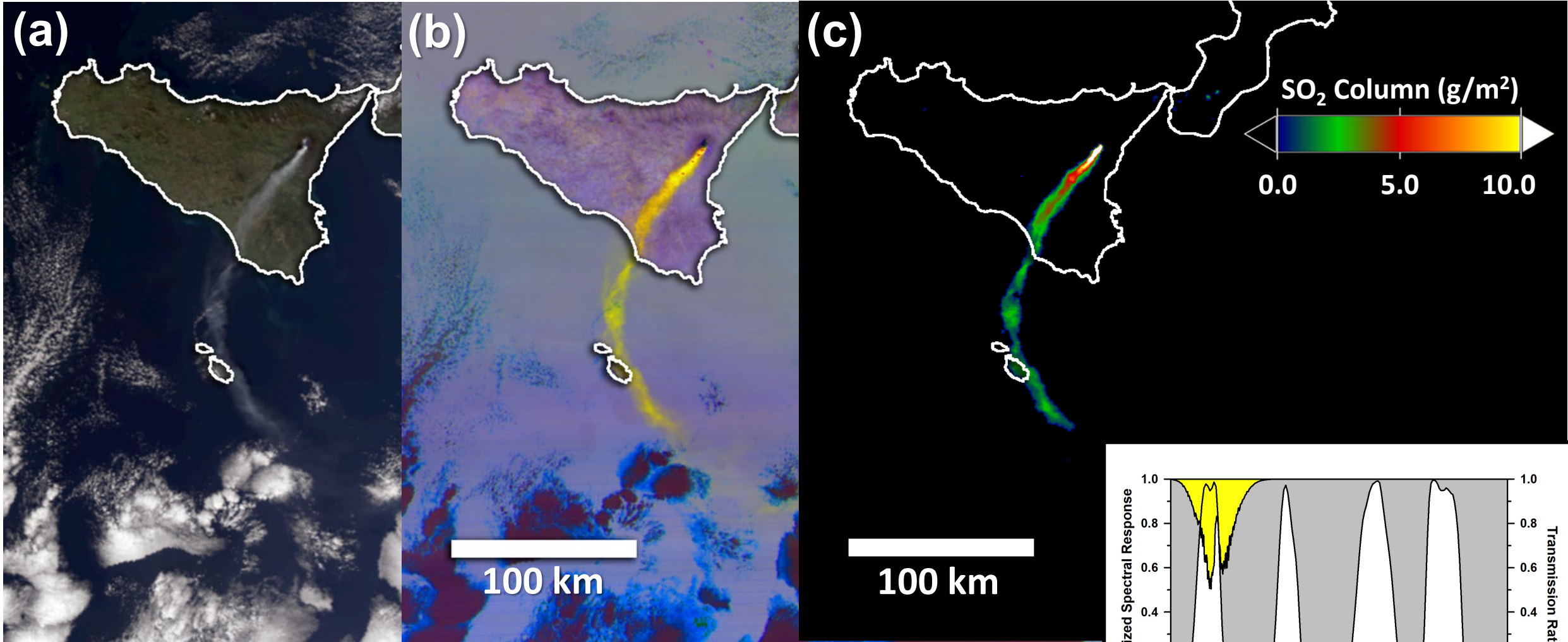


Mount Etna, 2011-07-29, 10:01 UTC

(a) VNIR Composite, (b) TIR Composite,
(c) SO₂ Column Density Map

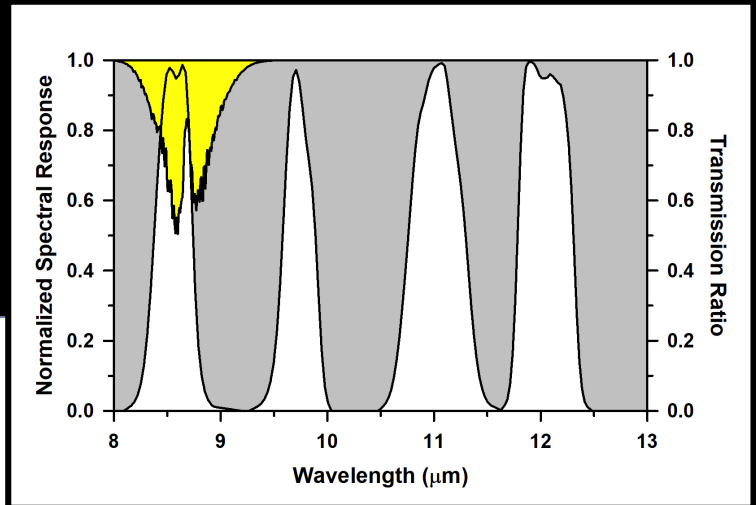
90 m IFOV,
830 X 700

Moderate-Resolution Imaging Spectrometer (MODIS): 1 km IFOV, 1354 X 2030

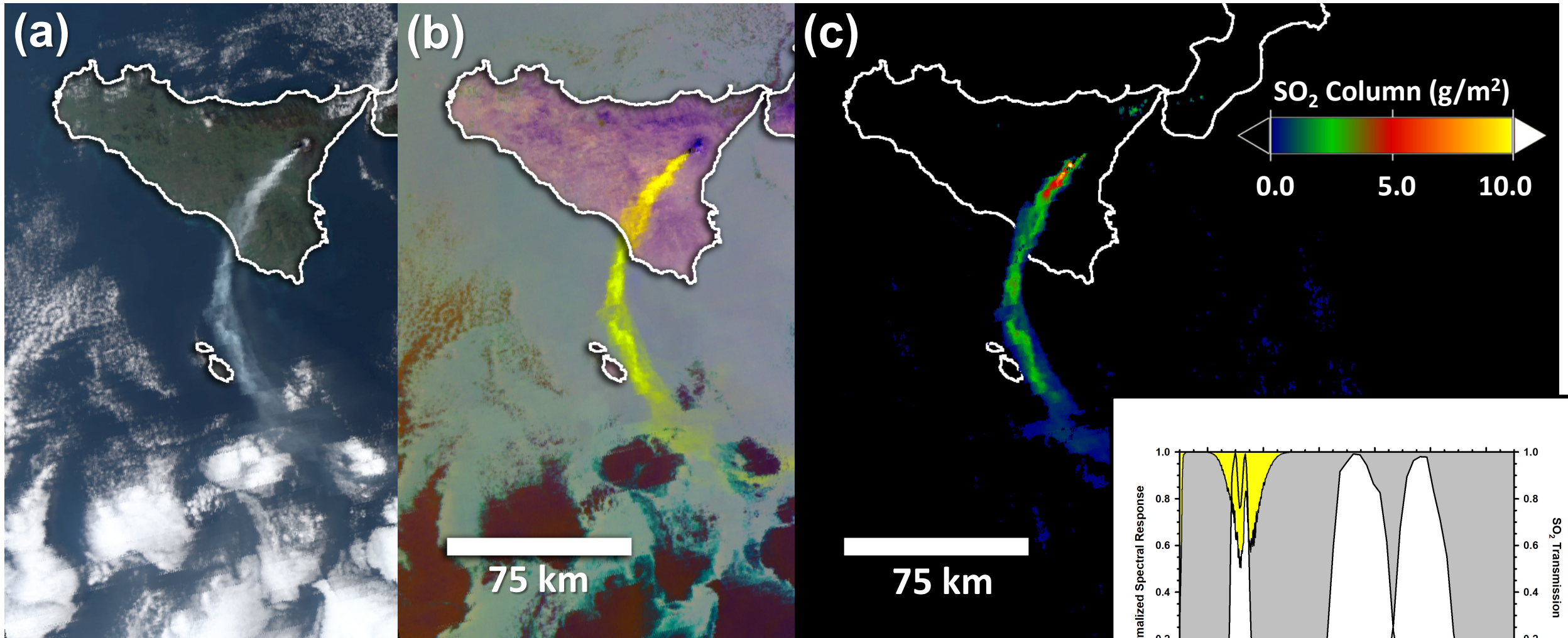


Mount Etna, 2018-12-27, 12:20 UTC

(a) RGB Composite, (b) TIR Composite, (c) SO₂ Column Density Map

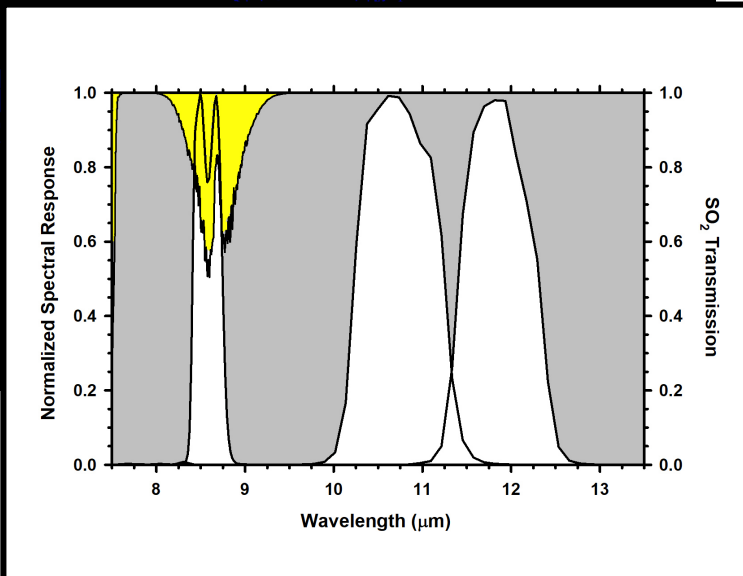


Visible Infrared Imaging Radiometer Suite (VIIRS): 750 m IFOV, 3200 X 3232



Mount Etna, 2018-12-27, 11:00 UTC

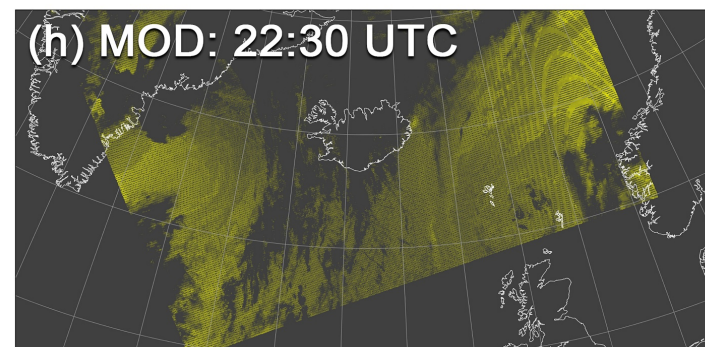
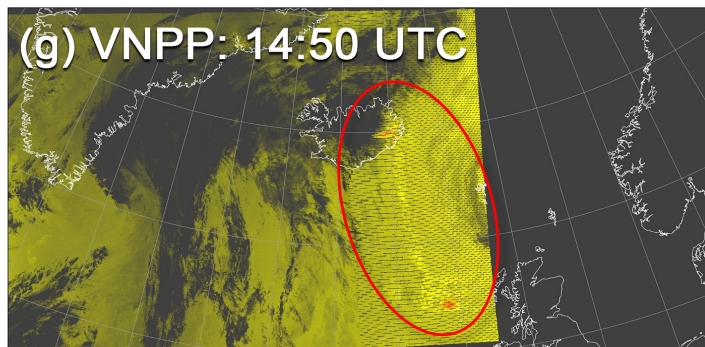
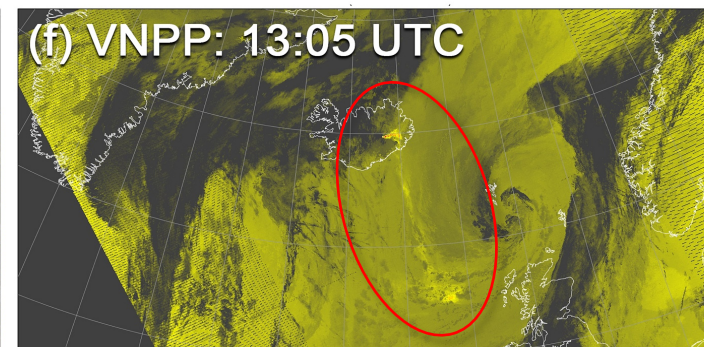
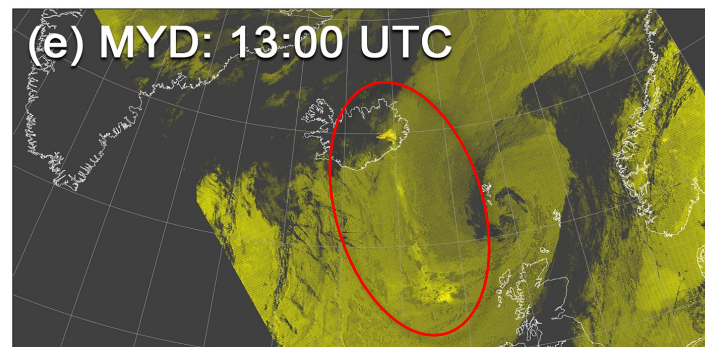
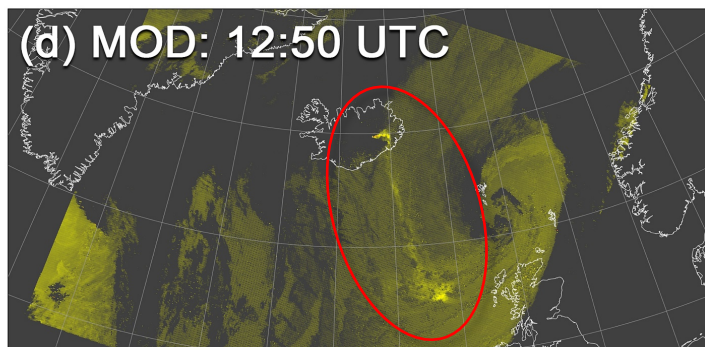
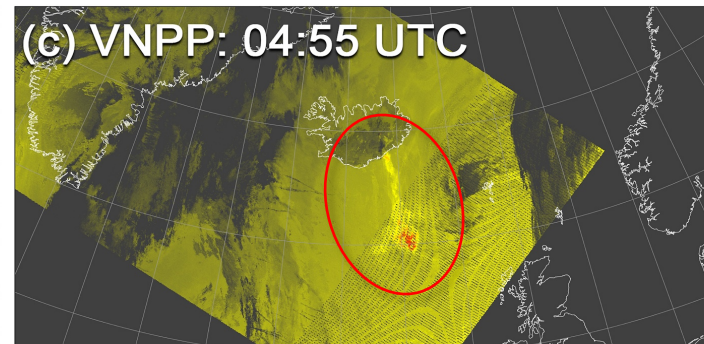
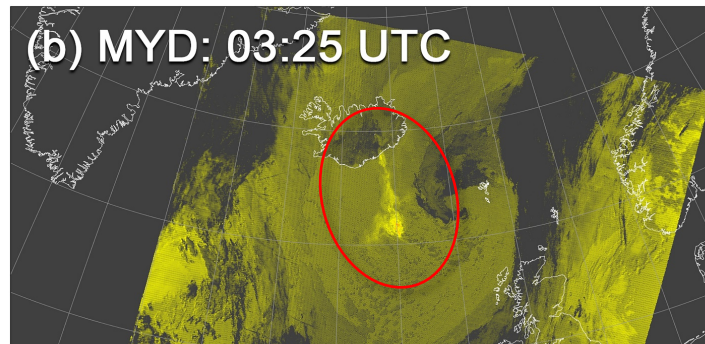
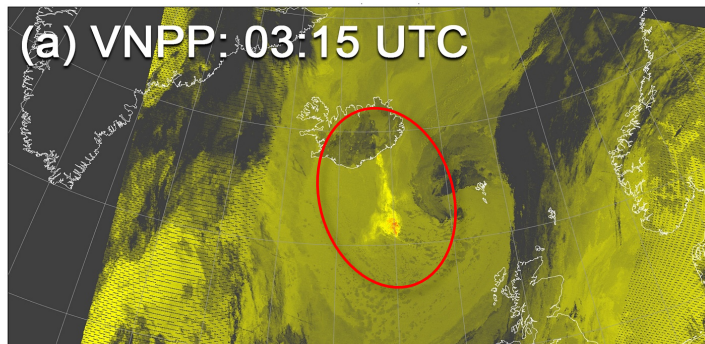
(a) RGB Composite, (b) TIR Composite, (c) SO₂ Column Density Map



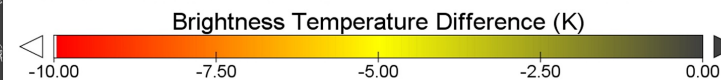
TIR Constellation: 1 Descending + 3 Ascending Orbits



Jet Propulsion Laboratory
California Institute of Technology



**Bardarbunga Eruption
5 September 2014**



Geostationary Instruments



Jet Propulsion Laboratory
California Institute of Technology

Spinning Enhanced Visible and Infrared Imager (SEVIRI)

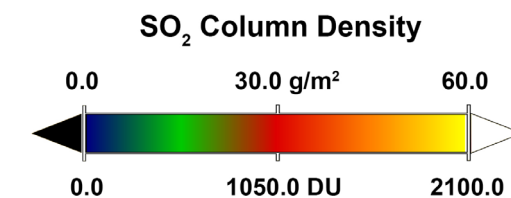
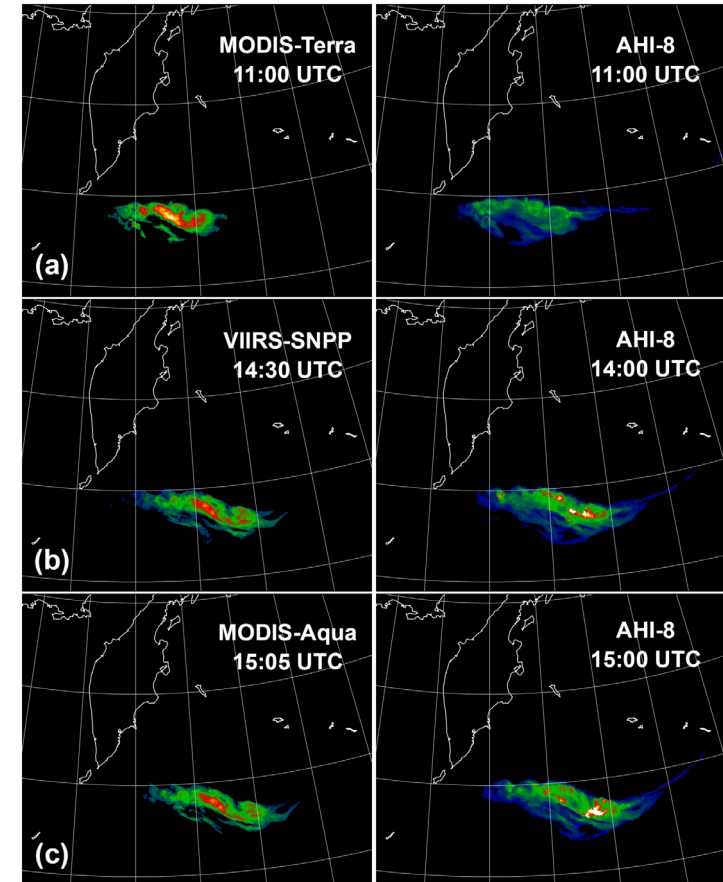
<https://www.eumetsat.int/seviri>

Advanced Baseline Imager (ABI)

<https://www.goes-r.gov/spacesegment/abi.html>

Advanced Himawari Imager (AHI)

https://www.data.jma.go.jp/mscweb/en/himawari89/space_segment/spsg_ahi.html



AHI processing
courtesy A. Prata

<https://search.earthdata.nasa.gov/search>



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The screenshot displays the EarthData Search web application. At the top, the NASA EarthData logo is on the left, and navigation links for 'Find a DAAC', 'Feedback', and 'Earthdata Login' are on the right. Below the header is a search bar with the text 'Search for collections or topics'. On the left side, a sidebar titled 'Filter Collections' is open, showing various filter categories: Categories, Features (with sub-options like 'Available from AWS Cloud', 'Customizable', 'Map Imagery', and 'Near Real Time'), Keywords, Platforms, Instruments, Organizations, Projects, Processing Levels, Data Format, Tiling System, and Horizontal Data Resolution. The main area of the page is a satellite-style world map. The map is centered on the Atlantic Ocean, showing the Americas on the left and Europe, Africa, and Asia on the right. Country names are labeled across the map, including Brazil, Argentina, Bolivia, Paraguay, Algeria, Libya, Egypt, Saudi Arabia, Iraq, Iran, Turkey, Italy, Spain, France, Morocco, Mali, Niger, Chad, Sudan, Nigeria, Cameroon, Central African Republic, South Sudan, Ethiopia, Somalia, Kenya, Tanzania, D.R.C., Republic of Congo, Angola, Zambia, Zimbabwe, Mozambique, Namibia, Botswana, South Africa, India, Pakistan, Afghanistan, Uzbekistan, Turkmenistan, Kazakhstan, Mongolia, China, Thailand, Myanmar, and Malaysia. The map includes a scale bar in the top right corner (1000 km / 500 mi) and a vertical toolbar on the right side with icons for home, zoom in, zoom out, full screen, and other map controls. The text 'NORTH ATLANTIC OCEAN' and 'SOUTH ATLANTIC OCEAN' are visible on the left side of the map, and 'INDIAN OCEAN' is visible at the bottom right.



LAADS DAAC About LAADS Find Data Data Discovery Quality Help Profile

1 PRODUCTS **2 TIME** **3 LOCATION** **4 FILES** **5 REVIEW & ORDER**

No products selected. No date selected. W: -180°, N: 90°, E: 180°, S: -90° No files selected. [reset](#)

All Sensors **All Searchable Collections** **All** Browse products

AERDB_D3_VIIRS_SNPP VIIRS/SNPP Deep Blue Level 3 daily aerosol data, 1x1 degree grid	i
AERDB_L2_VIIRS_SNPP VIIRS/SNPP Deep Blue Aerosol L2 6-Min Swath 6 km	i
AERDB_M3_VIIRS_SNPP VIIRS Deep Blue Level 3 monthly aerosol data, 1x1 degree grid	i
AERDT_L2_VIIRS_SNPP VIIRS/SNPP Dark Target Aerosol L2 6-Min Swath 6 km	i
CLDCR_L2_VIIRS_SNPP VIIRS/SNPP Cirrus Reflectance 6-min L2 Swath 750m	i
CLDMSK_L2_MODIS_Aqua Cloud Mask 5-Min Swath 1000 m (Aqua)	i
CLDMSK_L2_VIIRS_NOAA20 Cloud Mask 6-Min Swath 750 m (NOAA20)	i
CLDMSK_L2_VIIRS_SNPP Cloud Mask 6-Min Swath 750 m (SNPP)	i
CLDPROP_D3_MODIS_Aqua MODIS/Aqua Cloud Properties Level 3 daily, 1x1 degree grid	i
CLDPROP_D3_VIIRS_SNPP VIIRS/SNPP Cloud Properties Level 3 daily, 1x1 degree grid	i
CLDPROP_M3_MODIS_Aqua MODIS/Aqua Cloud Properties Level 3 monthly, 1x1 degree grid	i
CLDPROP_M3_VIIRS_SNPP	i

LAADS: Level-1 and Atmosphere Archive and Distribution System

Level-1 and Atmosphere Archive & Distribution System [Privacy Policy and Important Notices](#)



Home LAADS Archive

- Search by Product
- Online Archive
- Filename Search
- Image Viewer
- Load/Save Search
- Past Orders

Index of /archive/Science Domain/

- Download Selected
- See wget Download Command
- Download Help
- View as JSON
- View as CSV

Name	Last Modified	Size
.. Parent directory		
Atmosphere	2021-02-18 14:56	-
Land	2021-02-18 14:56	-
Level-0	2021-02-18 14:56	-
Level-1	2021-02-18 14:56	-

Land Processes (LP) DAAC

- ASTER
- MODIS and VIIRS Land Surface Products
- ECOSTRESS

On-Line Tools:
Application for Extracting and Exploring Analysis Ready Samples (AppEEARS)



The screenshot shows the AppEEARS web application interface. At the top, there is a navigation bar with the USGS logo, the AppEEARS title, and menu options for Extract, Explore, and Help. The main content area features a large heading "Welcome to AppEEARS!" followed by a sub-heading "Application for Extracting and Exploring Analysis Ready Samples (AppEEARS)". Below this, a paragraph describes the application's purpose: "The Application for Extracting and Exploring Analysis Ready Samples (AppEEARS) offers a simple and efficient way to access and transform geospatial data from a variety of federal data archives. AppEEARS enables users to subset geospatial datasets using spatial, temporal, and band/layer parameters. Two types of sample requests are available: point samples for geographic coordinates and area samples for spatial areas via vector polygons. Sample requests submitted to AppEEARS provide users not only with data values, but also associated quality data values. Interactive visualizations with summary statistics are provided for each sample within the application, which allow users to preview and interact with their samples before downloading their data. Get started with a sample request using the Extract option above, or visit the Help page to learn more."

At the bottom of the page, there are logos for the following organizations:

- NASA National Aeronautics and Space Administration
- USGS United States Geological Survey
- LPdaac Land Processes Distributed Active Archive Center
- NSIDC National Snow and Ice Data Center
- SEDAC Socioeconomic Data and
- ORNL DAAC DISTRIBUTED ACTIVE ARCHIVE CENTER FOR BIOGEOCHEMICAL DYNAMICS Oak Ridge National Laboratory



NASA WORLDVIEW

Layers Events Data

OVERLAYS

- Place Labels © OpenStreetMap contributors, Natural Earth
- Coastlines / Borders / Roads © OpenStreetMap contributors, Natural Earth
- Coastlines © OpenStreetMap contributors

BASE LAYERS

- Corrected Reflectance (True Color) NOAA-20 / VIIRS
- Corrected Reflectance (True Color) Suomi NPP / VIIRS
- Corrected Reflectance (True Color) Aqua / MODIS
- Corrected Reflectance (True Color) Terra / MODIS

+ Add Layers Start Comparison

1000 km 1000 mi

2021 FEB 18 1 DAY

JAN 2021 FEB 2021 DAY



The screenshot displays the NASA WorldView web application interface. A search overlay menu is open, showing various categories of data layers. The 'COMPARE MODE' section at the bottom left of the overlay is circled in yellow, with a '+ Add Layers' button. The background shows a satellite map of Earth with a comparison mode overlay and a timeline at the bottom.

Search Overlay Categories:

- Hazards And Disasters:** All, Absolute Dynamic Topography, Aerosol Index, Aerosol Optical Depth, Aerosol Albedo, Albedo, Amphibian Richness, ...
- Air Quality:** Aerosol Index, Aerosol Optical Depth, Carbon Monoxide, Corrected Reflectance, Dust, Fires and Thermal Anomalies, ...
- Ash Plumes:** Aerosol Index, Aerosol Optical Depth, Corrected Reflectance, Fires and Thermal Anomalies, Human Built-up And Settlement Extent, Land Surface Reflectance, ...
- Drought:** Corrected Reflectance, Dams, Drought Hazard, Human Built-up And Settlement Extent, Land Surface Reflectance, Land Surface Temperature, ...
- Dust Storms:** Aerosol Index, Aerosol Optical Depth, Dust, Corrected Reflectance, Human Built-up And Settlement Extent, Land Surface Reflectance, ...
- Fires:** Aerosol Index, Aerosol Optical Depth, Fires and Thermal Anomalies, Carbon Monoxide, Corrected Reflectance, Earth at Night, ...
- Floods:** Corrected Reflectance
- Severe Storms:** Corrected Reflectance
- Shipping:** Corrected Reflectance

COMPARE MODE: Swipe Opacity Spy

+ Add Layers Exit Comparison

Map Interface: You are now in comparison mode. X, 1000 km, 1000 mi, DAY

Timeline: 2021 FEB 18, 1 DAY, JAN 2021, FEB 2021, B, A



AIRS ATMOSPHERIC INFRARED SOUNDER

Home Sounding Science Mission Data Applications Multimedia Science Meetings

AIRS Rapid Response: Latest Sulfur Dioxide and Dust Detection

Detection Time: 2020/11/30, UTC 05:29:21

Region plotted represents one AIRS data granule.

SO2 DETECTION

AIRS Detection of Sulfur Dioxide 2020/11/30/05:29:21 UTC

weaker signal | -3.5 -4.0 -4.5 -5.0 -5.5 -6.0 -6.5 -7.0 -7.5 -8.0 -8.5 -9.0 -9.5 -10.0 | stronger signal
Brightness Temperature Difference, 1361.44 - 1433.06 cm⁻¹ (K)

About | KMZ | GeoTIFF

Center of Coverage Area

10.0 S, 122.0 E

VIEW AIRS, OMI, OMPs ON NASA WORLDVIEW

SO2 and Dust Detection Archive

VIEW

About the AIRS Products

The sulfur dioxide and dust browse products derived from AIRS observations can indicate the possibility of volcanic activity, but more detailed analysis is required to confirm the presence of volcanic clouds or estimate the composition and quantity of materials in the clouds.

[More about the products](#)

Get Email Alerts

Sign up to be notified of AIRS SO2 detections.

enter your email

Volcano Resources

- Global SO2 Monitoring (NASA)

Home Sounding Science Mission Data Applications Multimedia Science Meetings

About | KMZ | GeoTIFF

DUST DETECTION

AIRS Detection of Silicate Mineral Dust 2020/11/30/05:29:21 UTC

weaker signal | 400 420 440 460 480 500 | stronger signal
AIRS Dust Score

About | KMZ | GeoTIFF

CLOUDS

AIRS Cloud Detection 2020/11/30/05:29:21 UTC

Volcano Resources

- Global SO2 Monitoring (NASA)
- Volcanic Ash Advisory Center (NOAA/Washington D.C.)
- Volcanic Cloud Monitoring (NOAA/CIMSS)
- Support to Aviation Control Service (ESA)
- Volcanic Activity (Smithsonian)
- U.S. Volcanic Activity (USGS)

Helpful AIRS User Guide Selections

AIRS Level 2 Product User Guide
Provides a description of the AIRS SO2 Flag and Dust Flag along with quality indicators and caveats. See chapter 24, titled "LEVEL 2 PHYSICAL RETRIEVAL SURFCLASS, DUST FLAG, SO2 FLAG AND CLOUD PHASE FLAG".

[Product User Guide \(PDF\)](#)

AIRS Retrieval Channel Sets
Defines the SO2 Flag and Dust Flag tests plus important notes concerning contamination due to volcanic ash and dust. See section 2.12 SO2 Flag (L1B radiances) and Section 2.13 Dust Flag Determination (L1B radiances).

[Retrieval Channel Sets \(PDF\)](#)

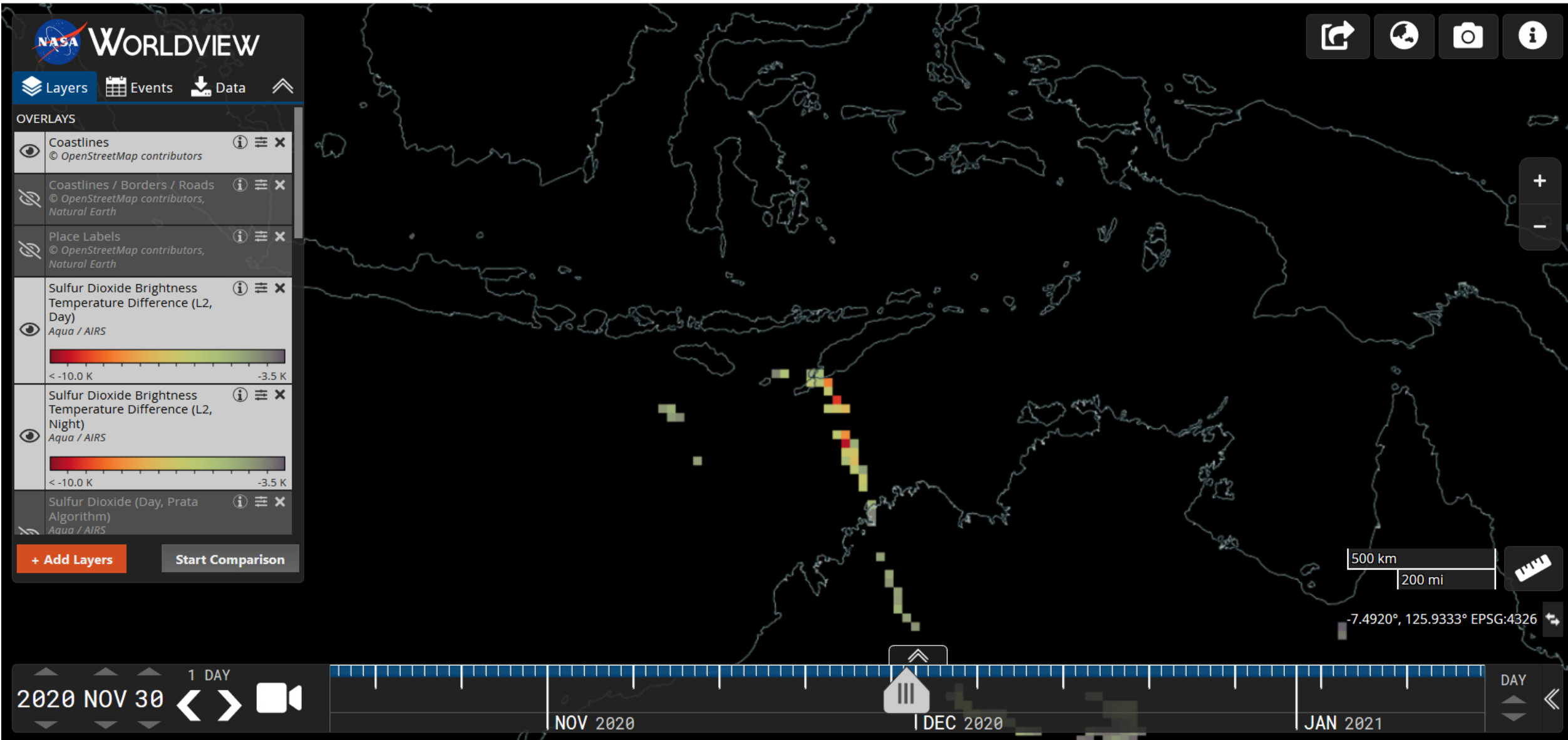
Get AIRS Data

- Near Real-time AIRS Products
- Standard Data Products

Ask AIRS

search

[Or browse all FAQ topics >](#)



<https://maps.disasters.nasa.gov/>



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Recent NASA Products for the 2018 Kilauea Eruption

[Home](#) [JAXA ALOS-2](#) [ASTER](#) [MODIS](#) [OMPS](#) [ESA Sentinel-1](#) [VIIRS](#) [GLISTIN-A](#)

NASA Disasters Program: Kilauea Eruption 2018

A collection of NASA's products used in response to the Kilauea Eruption on Hawaii's Big Island.

Click on the tabs at the top of the page to learn about the different ways NASA scientists use satellite data to study volcanic eruptions.

For more information about the NASA Disasters Program, click the following links:

[NASA Disasters Mapping Portal](#)

[NASA Disasters Program Website](#)

Image Source: [NASA Earth Observatory](#)

NASA Disasters Program





Recent NASA Products for the 2018 Kilauea Eruption

Home JAXA ALOS-2 ASTER MODIS OMPS ESA Sentinel-1 VIIRS GLISTIN-A

Information about products:

The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) is an imaging instrument onboard Terra, the flagship satellite of NASA's Earth Observing System (EOS) launched in December 1999. ASTER is a cooperative effort between NASA, Japan's Ministry of Economy, Trade and Industry (METI), and Japan Space Systems (J-spacesystems).

ASTER False Color and Hotspot Detection:
ASTER images produced from data acquired on the date in the image name. Visible-near infrared and thermal infrared multispectral bands show different aspects of the eruption.
Suggested Use:
The false color composite depicts vegetation in red, and old lava flows in black and gray. Superposed on the image in yellow, are hot spots detected on the thermal infrared bands. The easternmost hot spots are the newly-formed fissure and the lava flow spilling to the northwest. The middle spots are Pu'u O'o crater, and lava flows descending the slopes to the southeast. The westernmost area is the crater and lava lake on Kilauea's summit. The greenish area southwest of Pu'u O'o are ash deposits.
Resolution:
15 m for visible-near infrared

ASTER Sulfur Dioxide (SO₂) Plumes :
ASTER images produced from data acquired on the date in the image name. Visible-near infrared and thermal infrared multispectral bands show different aspects of the eruption.
Suggested Usage:
The massive sulfur dioxide plume from the new fissures is shown in yellow and yellow-green, extracted from ASTER's multiple thermal bands. A smaller, but thicker, SO₂ plume can be seen coming from Kilauea's summit. The prevailing trade winds blow the plumes to the southwest, out over the ocean. Thermal hot spots can be seen bright yellow pixels picking up volcano and fissures. Early lava flows from this event appear as red, while newer lava flows are a brighter blue.
Resolution:
90 m for thermal bands

ASTER Column Sulfur Dioxide (SO₂) 20180506:
ASTER image produced from data acquired on May 6, 2018 showing the column density of SO₂ due to eruptions along the Kilauea's East Rift Zone.
Suggested Usage:
The highest column SO₂ density can be found in the ash plume flowing towards the southwest from the eruptions from the fissures along Kilauea's East Rift Zone.

ASTER Brightness Temperature Difference (BTD) 20180506:
ASTER BTD is a proxy for SO₂ absorption. Higher concentrations of SO₂ result in larger (absolute) BTD values.
Suggested Usage:
SO₂ plume locations from May 6th can be seen near the Kilauea summit as well as near the fissures in Leilani Estates where there are large BTD values represented in brighter colors.
Resolution:
90 m at nadir

Satellite/Sensor:

NASA Disasters Program

ASTER

Find address or place

4mi -154.682, 19.482 Degrees

Esri, HERE, Garmin, USGS, NGA, EPA, USDA | NASA/METI/AIST/Japan Sp

All ASTER Products

Layers

- ASTER False Color and Hotspot Detection: 20180506
- ASTER Sulfur Dioxide (SO₂) plumes: 20180506
- ASTER Column Sulfur Dioxide (SO₂): 20180506
- ASTER Brightness Temperature Difference (BTD) 20180506
- ASTER False Color Composite: 20180515
- ASTER Sulfur Dioxide (SO₂) plumes: 20180522
- ASTER False Color Composite: 20180522

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Home JAXA ALOS-2 ASTER MODIS OMPS ESA Sentinel-1 VIIRS GLISTIN-A

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Resolution:
90 m for thermal bands

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ASTER image produced from data acquired on May 6, 2018 showing the column density of SO₂ due to eruptions along the Kilauea's East Rift Zone.
Suggested Usage:
The highest column SO₂ density can be found in the ash plume flowing towards the southwest from the eruptions from the fissures along Kilauea's East Rift Zone.

ASTER Brightness Temperature Difference (BTD) 20180506:
ASTER BTD is a proxy for SO₂ absorption. Higher concentrations of SO₂ result in larger (absolute) BTD values.
Suggested Usage:
SO₂ plume locations from May 6th can be seen near the Kilauea summit as well as near the fissures in Leilani Estates where there are large BTD values represented in brighter colors.
Resolution:
90 m at nadir

Satellite/Sensor:

NASA Disasters Program ASTER

Find address or place

Column Density (g/m²)

6.5 11.0 15.5 20.0

227.5 385.0 542.5 700.0

Column Density (DU)

4mi -154.671 19.533 Degrees

All ASTER Products

Layers

- ASTER False Color and Hotspot Detection: 20180506
- ASTER Sulfur Dioxide (SO₂) plumes: 20180506
- ASTER Column Sulfur Dioxide (SO₂): 20180506
- ASTER Brightness Temperature Difference (BTD): 20180506
- ASTER False Color Composite: 20180515
- ASTER Sulfur Dioxide (SO₂) plumes: 20180522
- ASTER False Color Composite: 20180522

<https://directreadout.sci.gsfc.nasa.gov/?id=dspContent&cid=159>



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What is Global View Live?

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> MyDRL Forum

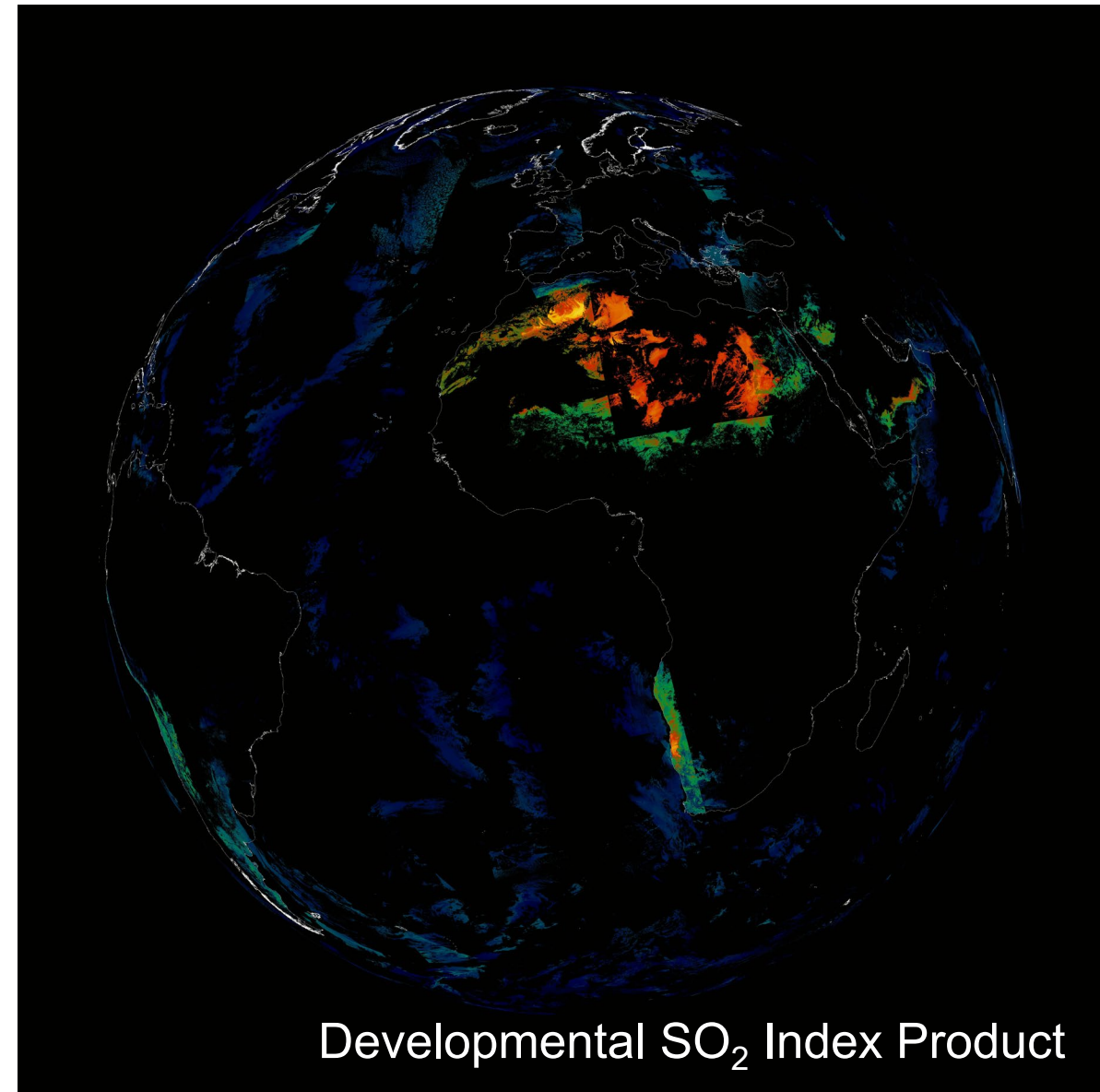
LATEST VIIRS OR MODIS IMAGE

RECENT DATA PRODUCTS

Select Sites...
DRL: CORRECTED REFLECTANCE
JPSS1 Instrument: VIIRS Product: TRUECOLOR

To view the KML files you need to download and install [Google Earth](#)

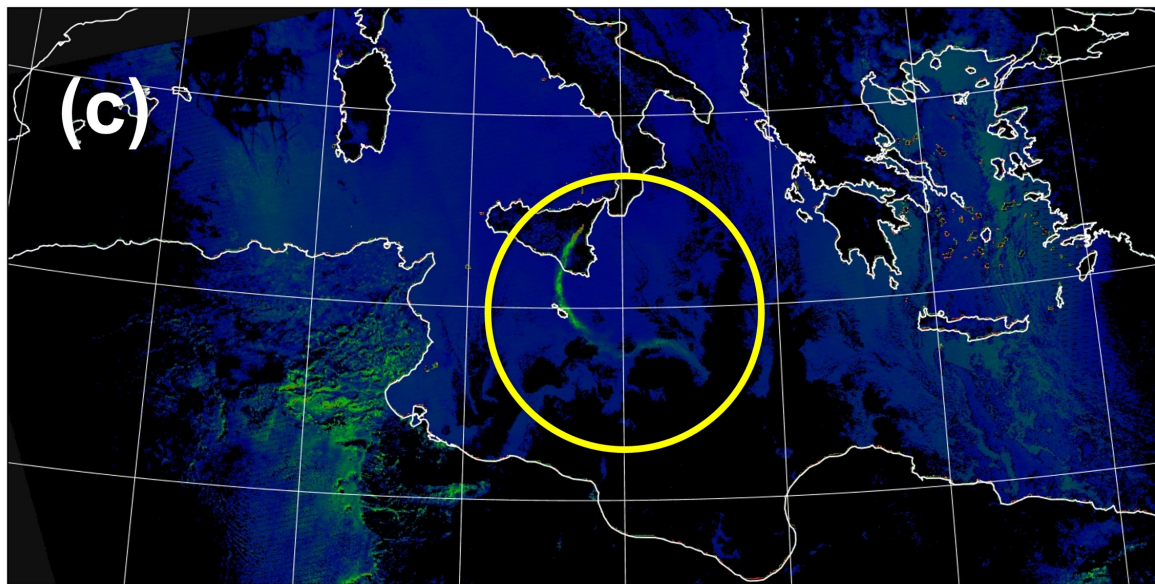
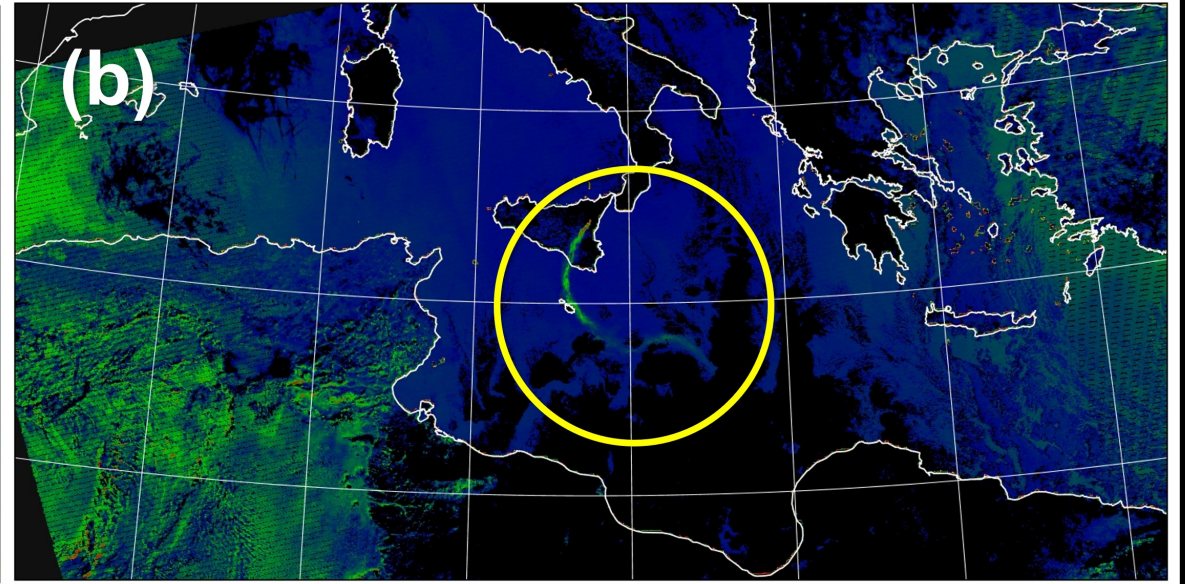
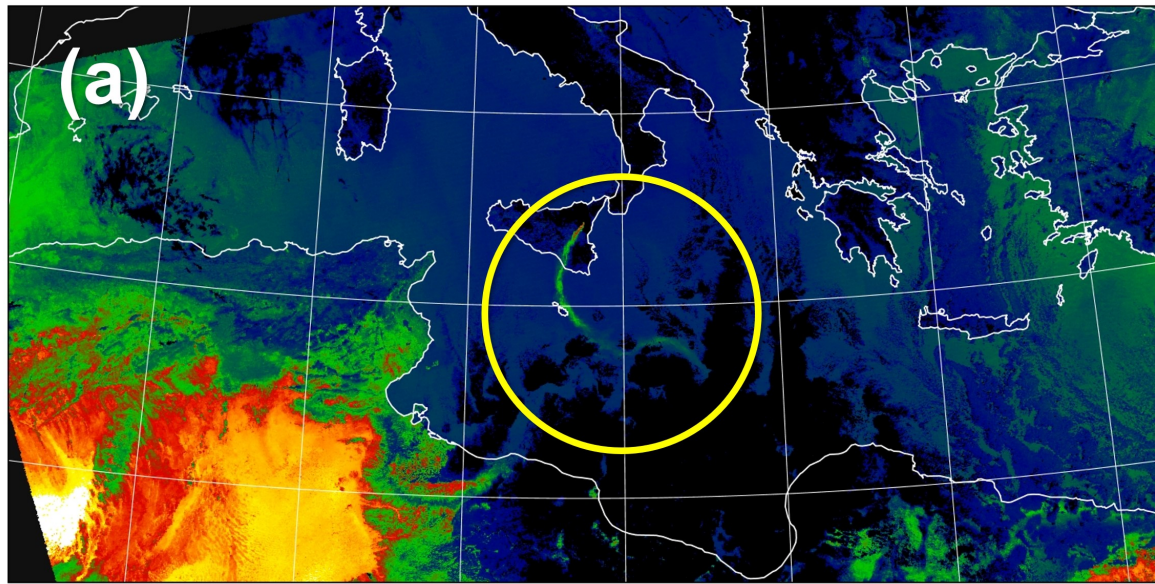
Feb 17 2021 18:51 Tiff Kml	Feb 17 2021 17:10 Tiff Kml	Feb 16 2021 19:11 Tiff Kml	Feb 16 2021 15:55 Tiff Kml
Feb 15 2021 19:30 Tiff Kml	Feb 15 2021 17:48 Tiff Kml	Feb 12 2021 18:44 Tiff Kml	Feb 12 2021 17:04 Tiff Kml
Feb 11 2021 19:07 Tiff Kml	Feb 10 2021 19:23 Tiff Kml	Feb 10 2021 17:41 Tiff Kml	Feb 10 2021 16:06 Tiff Kml
Feb 9 2021 19:44 Tiff Kml	Feb 9 2021 18:00 Tiff Kml	Feb 9 2021 16:23 Tiff Kml	Feb 7 2021 18:40 Tiff Kml



SO₂ Index: Corrections for Emissivity and Water Vapor Absorption



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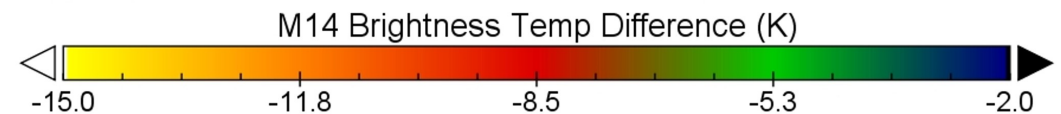


Mount Etna Christmas Eruption

27 December 2018

11:48 UTC

CAMEL Emissivity Correction

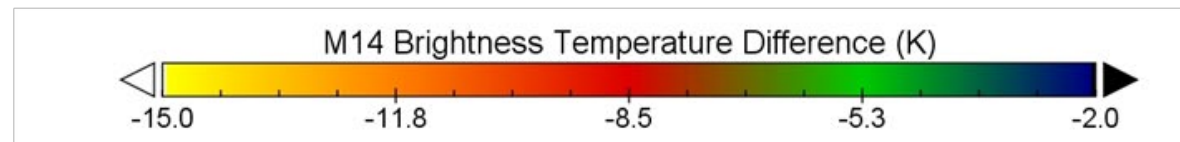
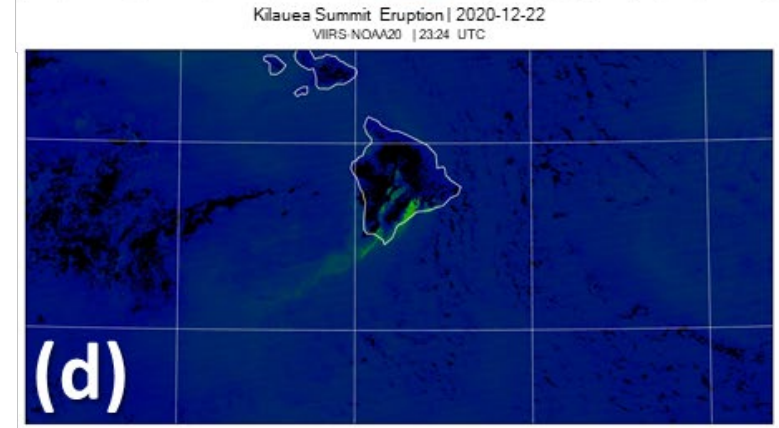
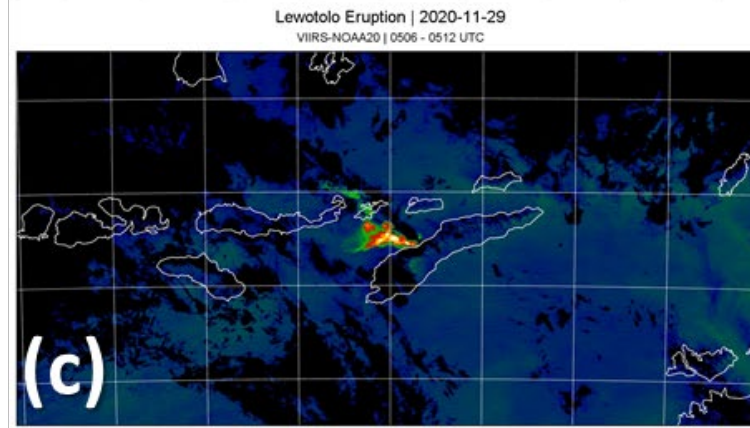
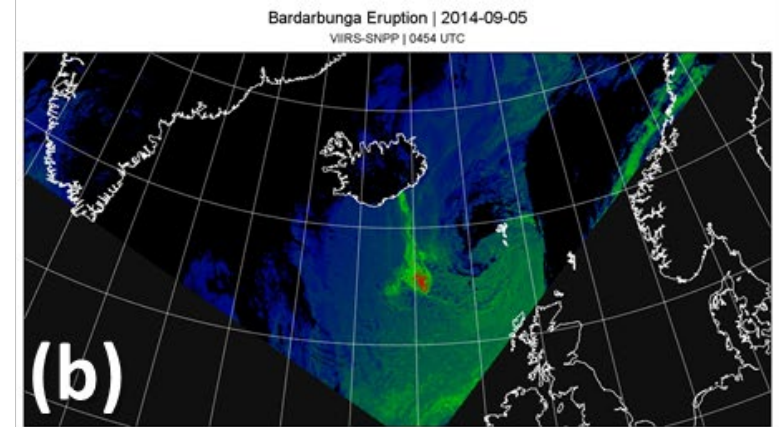
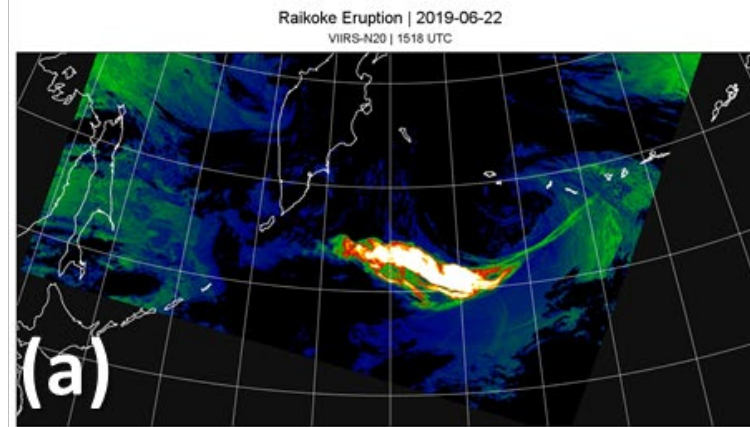


SO₂ Index: Sensitivity to Plume Height and Water Vapor Content Absorption



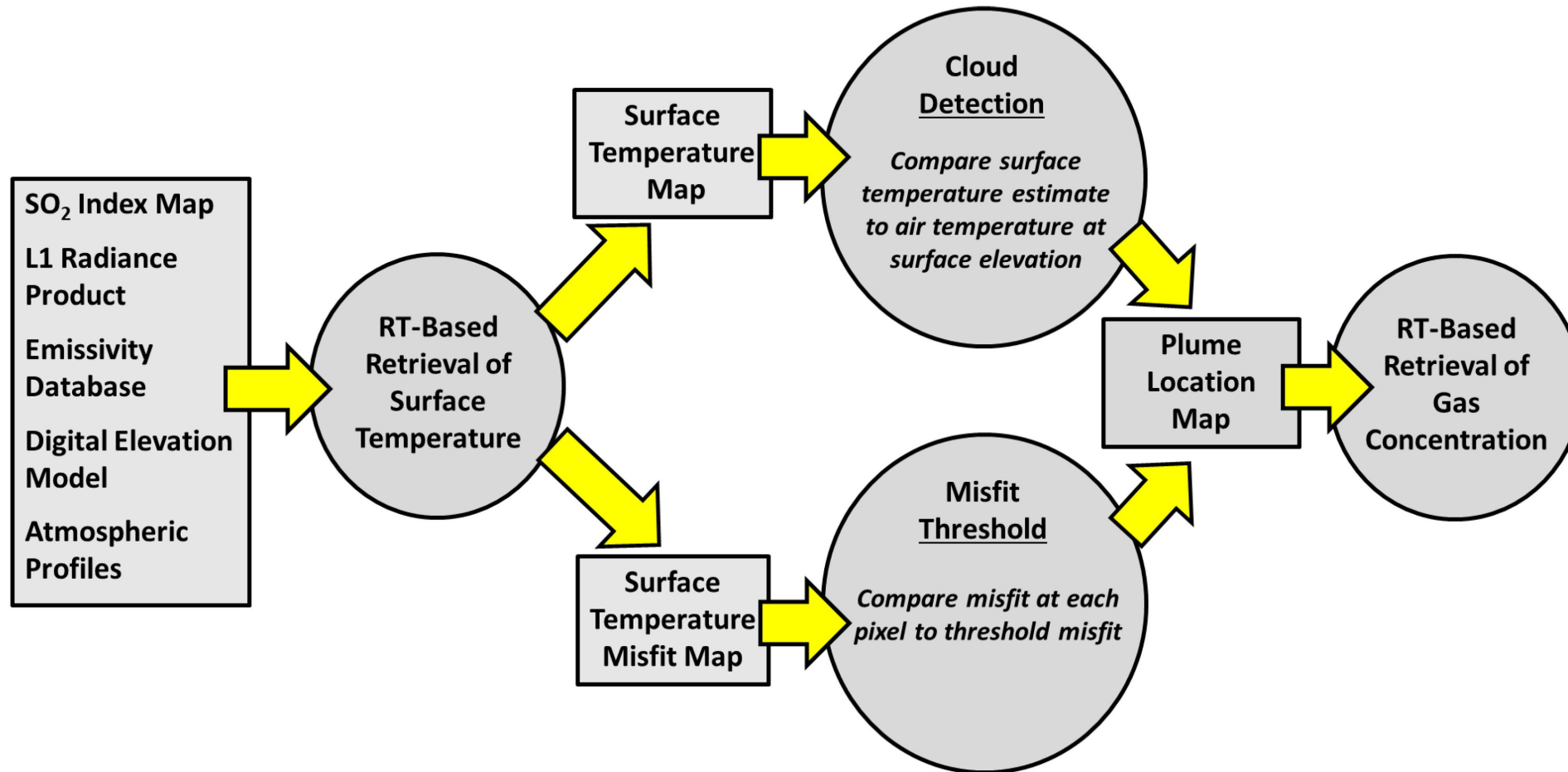
Plumes Were Detected in Four Test Cases

- (a) Raikoke: 22 June 2019
- (b) Bardarbunga: 5 September 2014
- (c) Lewotolok: 29 November 2020
- (d) Kilauea: 22 December 2020

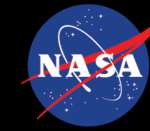


Volcano	Latitude	Plume Height (km)	Total Precipitable H ₂ O (mm)
(a) Raikoke	50° N	10 - 13	22.4
(b) Bardarbunga	62° N	5 - 6	12.6
(c) Lewotolo	9° S	5 - 6	42.9
(d) Kilauea	19° N	~ 2	30.3

Automated Plume Detection and Mapping: Processing Flow

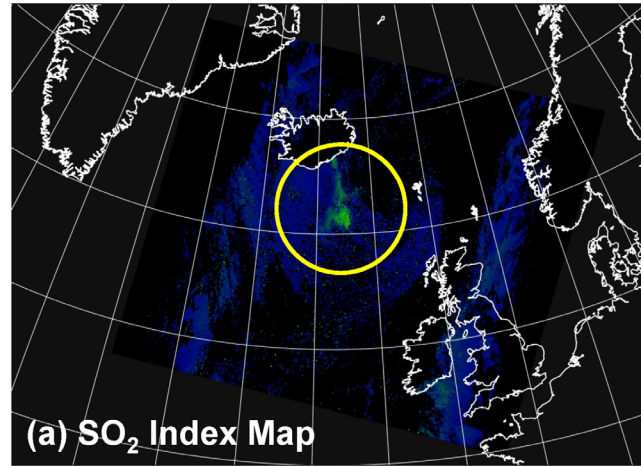


Automated Plume Detection and Mapping: Bardarbunga Volcano (Iceland) 2014-09-05

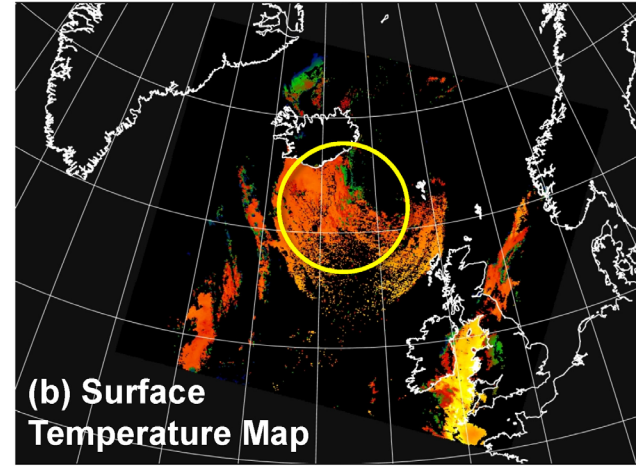


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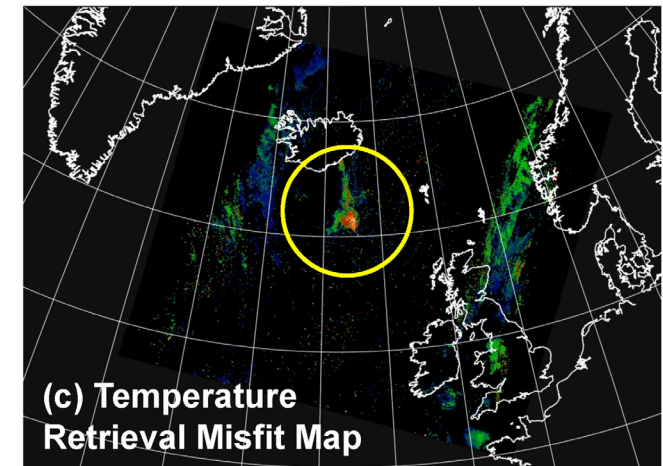
a) SO₂ Index: Limits the Surface Temperature Modeling to ~ 20% of Pixels



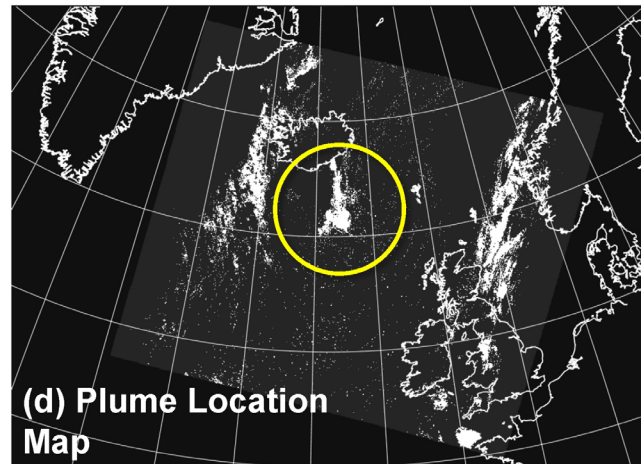
b) No Expression of Plume in Surface Temperature Map



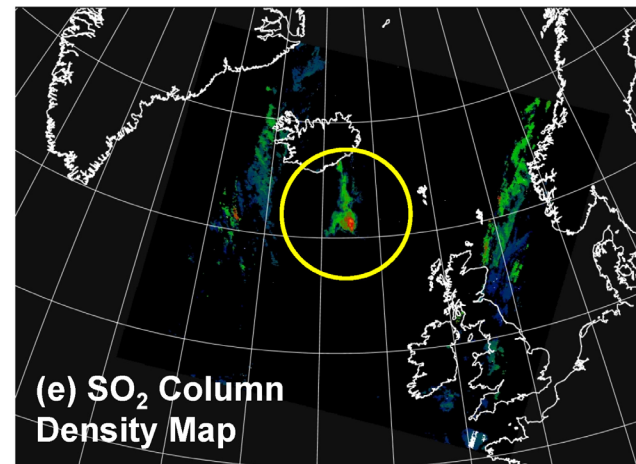
c) Temperature Misfit Map Shows Location of Plume



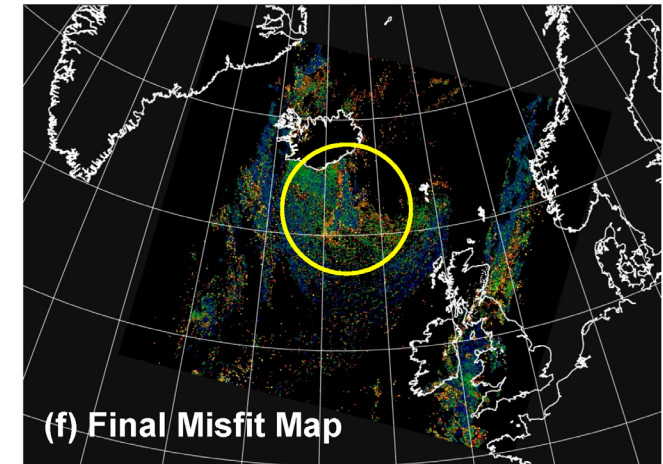
d) Plume Location Map Based on Cloud Detection and Temperature Misfit Combination



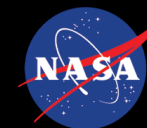
e) SO₂ Estimation Limited to ~7% of Total Pixels



f) No Expression of Plume in Final Misfit Map



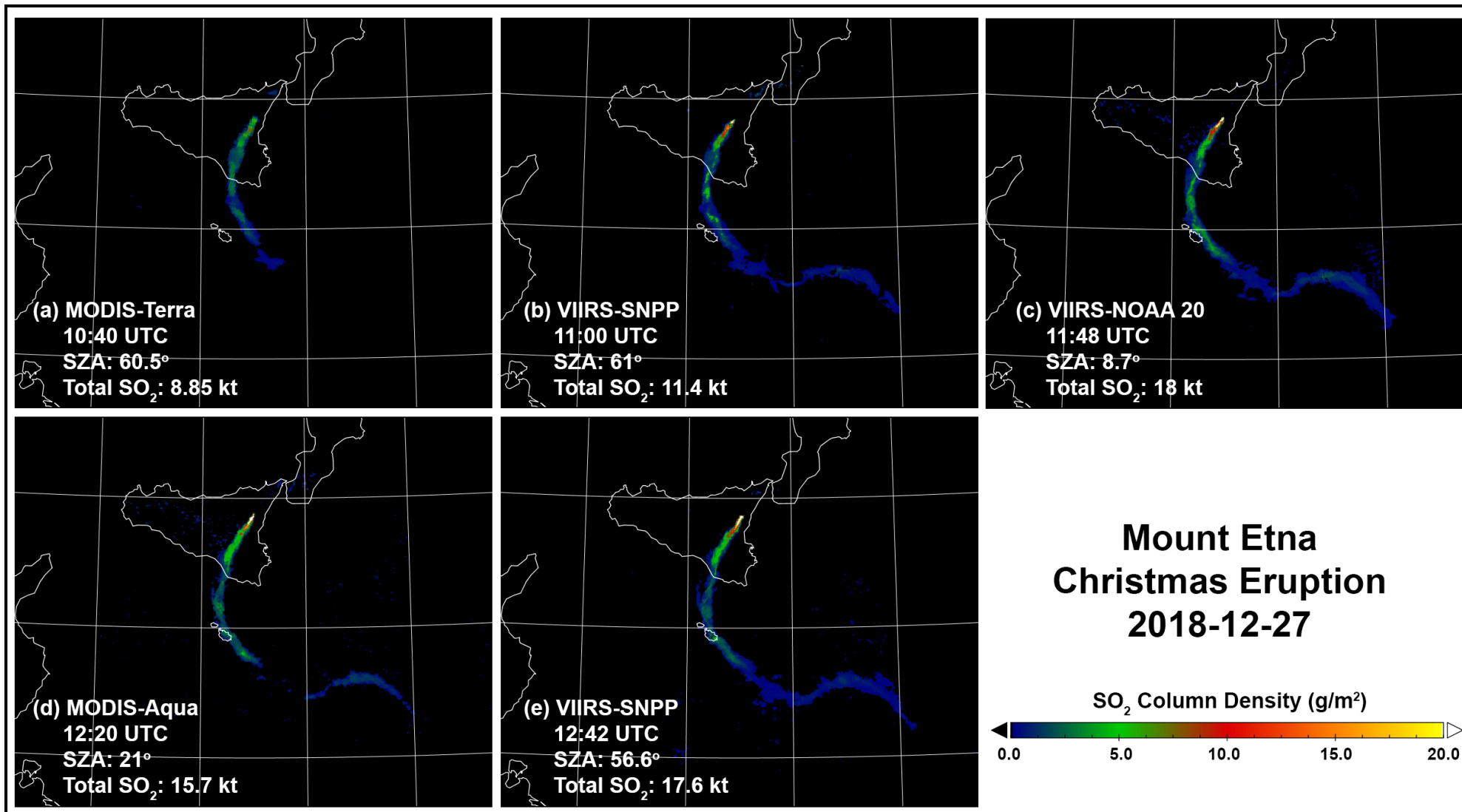
Calibration/Validation: Mt. Etna Example



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Five Daytime
Observations Within
Period of ~120 min
(average of 36 min
between observations)

Validate data products
through comparison
with field measure-
ments and compli-
mentary satellite data
products (including
SEVIRI, IASI, and
TROPOMI) provided
by Italian National
Institute of Geophysics
and Volcanology
(INGV)





Thanks for Your Attention!