

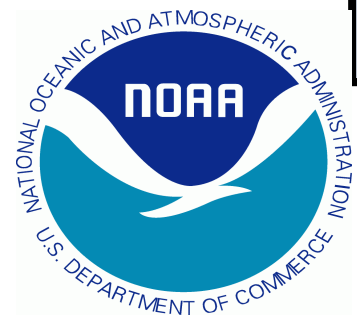


Marco Fulle - www.stromboli.net

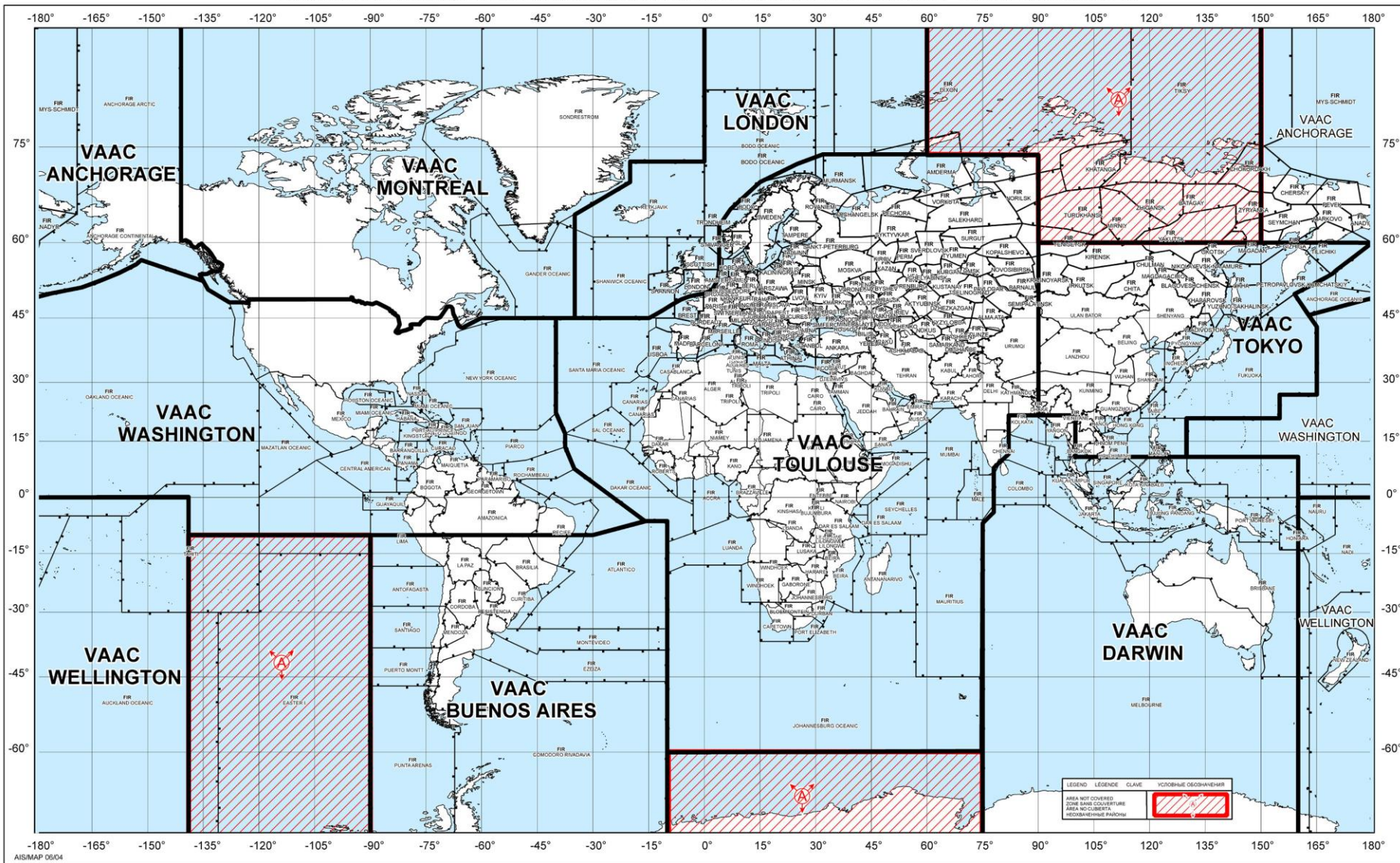
Development of a Space-based System for Quantitative Detection and Analysis of Volcanic Clouds

**Michael Pavolonis
(NOAA/NESDIS/STAR)**

**Justin Sieglaff and John Cintineo
(UW-CIMSS)**

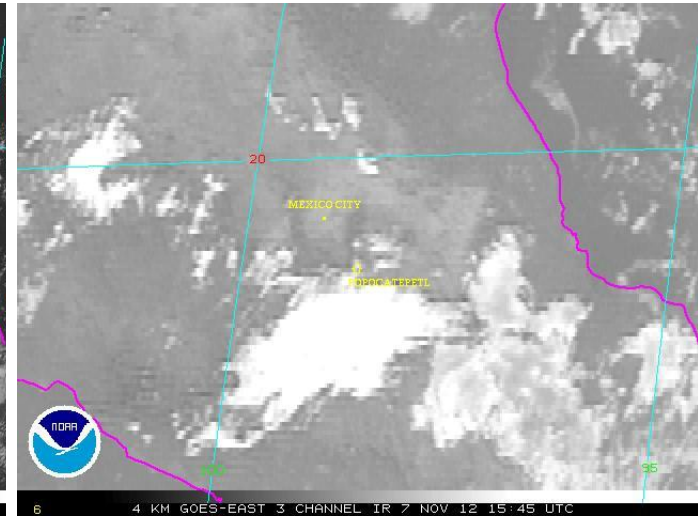
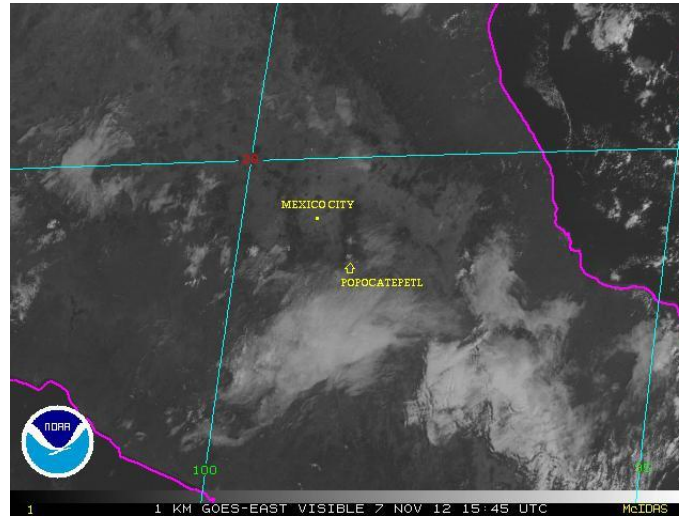


CURRENT STATUS OF ICAO VOLCANIC ASH ADVISORY CENTRES (VAAC) - AREAS OF RESPONSIBILITY
 SITUATION ACTUELLE DES CENTRES OACI D'AVIS DE CENDRES VOLCANIQUES (VAAC) - ZONES DE RESPONSABILITÉ
 ESTADO ACTUAL DE LOS CENTROS DE AVISOS DE CENIZAS VOLCÁNICAS (VAAC) DE LA OACI - ÁREAS DE RESPONSABILIDAD
 СУЩЕСТВУЮЩЕЕ РАСПРЕДЕЛЕНИЕ КОНСУЛЬТАТИВНЫХ ЦЕНТРОВ ИКАО ИО ВУЛКАНИЧЕСКОМУ ПЕПЛУ (VAAC) - РАЙОНЫ ОТВЕТСТВЕННОСТИ



Volcanic Ash Requirements

Heritage NOAA volcanic ash products are imagery based and qualitative



In preparation for GOES-R, the volcanic ash requirements were re-defined and are now quantitative (ash cloud height and mass loading)

| Product Measurement Precision | Vendor Allocated Ground Latency | Product Refresh Rate/Coverage Time (Mode 4) | Product Refresh Rate/Coverage Time (Mode 3) | Measurement Accuracy | Measurement Range | Mapping Accuracy | Horizontal Resolution | Vertical Resolution | Geographic Coverage (G, H, C, M) | User & Priority | Name |
|-------------------------------|---------------------------------|---|---|------------------------|-----------------------------|------------------|-----------------------|---------------------|----------------------------------|-----------------|------------------------------------|
| 2.5 tons/km ² | 430 sec | Full disk: 15 min | Full disk: 15 min | 2 tons/km ² | 0 - 50 tons/km ² | 1 km | 2 km | 3 km (top height) | Full Disk | GOES-R | Volcanic Ash: Detection and Height |

Summary of Products and Techniques

- End products: ash probability, ash top height, mass loading, effective particle radius, volcanic cloud alerts, cloud vertical growth rate anomalies, volcanic thermal anomalies
- Techniques: probabilistic cloud object based ash detection, optimal estimation retrieval of ash cloud properties (ash height, mass loading, and effective radius), multi-sensor cloud tracking to improve ash detection and cloud property retrieval
- Ash detection does not rely on robust “split-window” signature and is designed to emulate a skilled human analyst (good probability of detection, very low false alarm rate)
- Value added applications: plume medial axis transformation and polygon fitting



Channels Used in NOAA Algorithms

A temporal history of detected ash clouds is used to help ensure good consistency from image to image regardless of the sensor

| Sensor | Channels used |
|----------------|--|
| AVHRR | 0.65, 3.75, 11, and 12 μm |
| COMS | 0.65, 3.9, 6.7, 11, and 12 μm |
| FY2 | 0.65, 3.9, 6.7, 11, and 12 μm |
| GOES | 0.65, 3.9, 6.7 11, and 12 μm |
| GOES-R ABI | 0.65, 3.9, 6.7, 7.3, 8.5, 11, 12, and 13.3 μm |
| Himawari-8/9 | 0.65, 3.9, 6.7, 7.3, 8.5, 11, 12, and 13.3 μm |
| MODIS | 0.65, 3.75, 7.3, 8.5, 11, 12, and 13.3 μm |
| MTSAT | 0.65, 3.9, 6.7, 11, and 12 μm |
| SEVIRI and MTG | 0.65, 3.9, 6.2, 7.3, 8.5, 11, 12, and 13.3 μm |
| VIIRS | 0.65, 3.75, 8.5, 11, and 12 μm |

***The same software is used for all sensors.

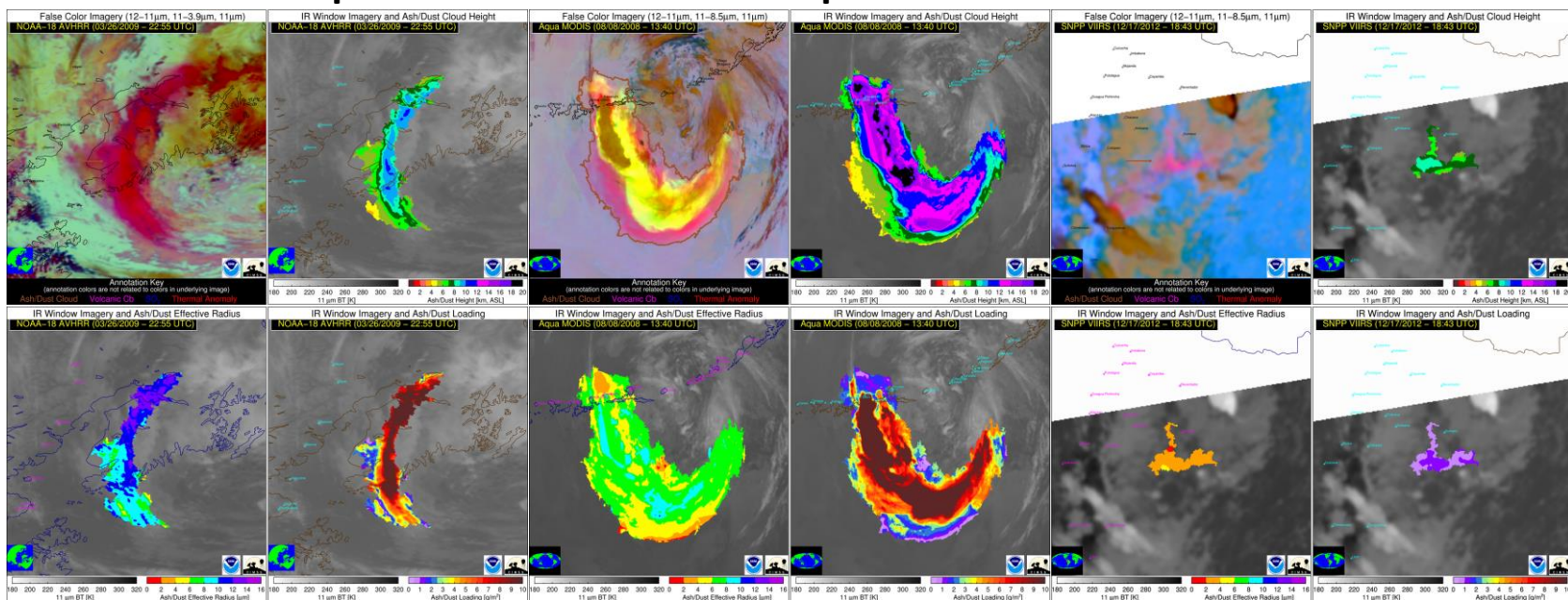
Making Full Use of the Space-based Observing System for Volcanic Cloud Monitoring

NOAA and MetOp AVHRR

Terra and Aqua MODIS

SNPP-VIIRS

LEO

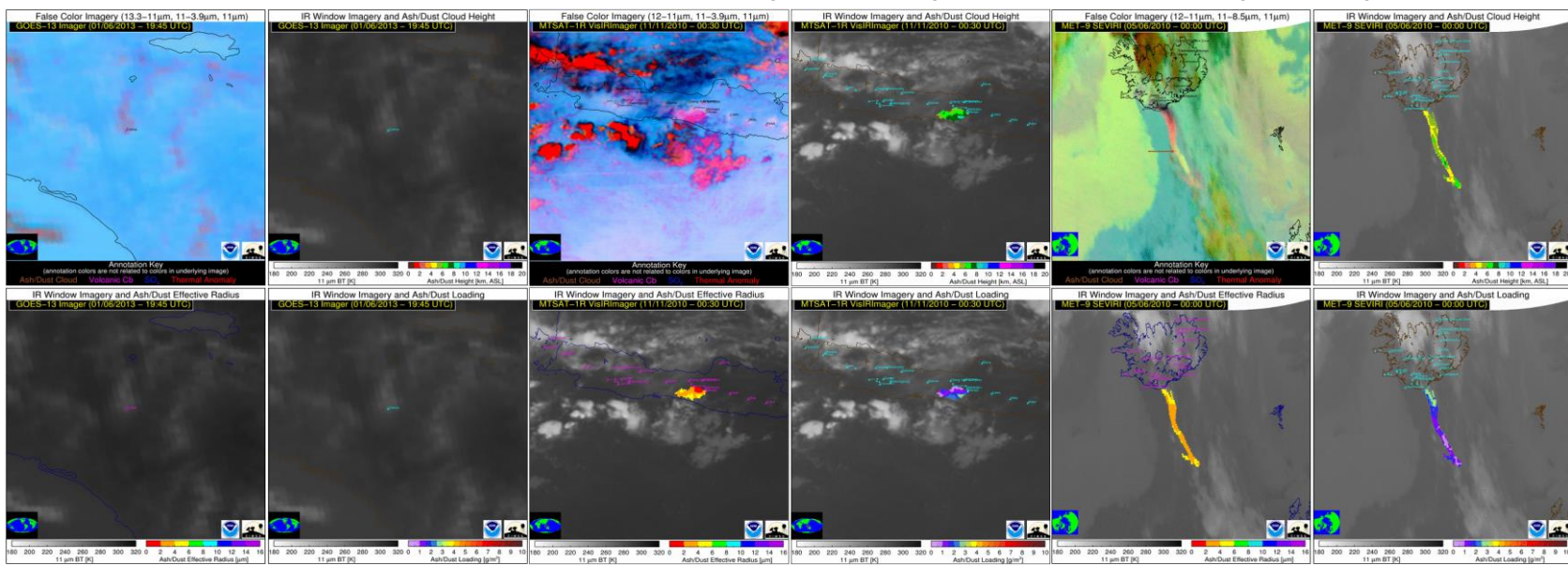


GOES-13-15

MTSAT-(1r and 2)

Met-(8,9,10) SEVIRI

GEO



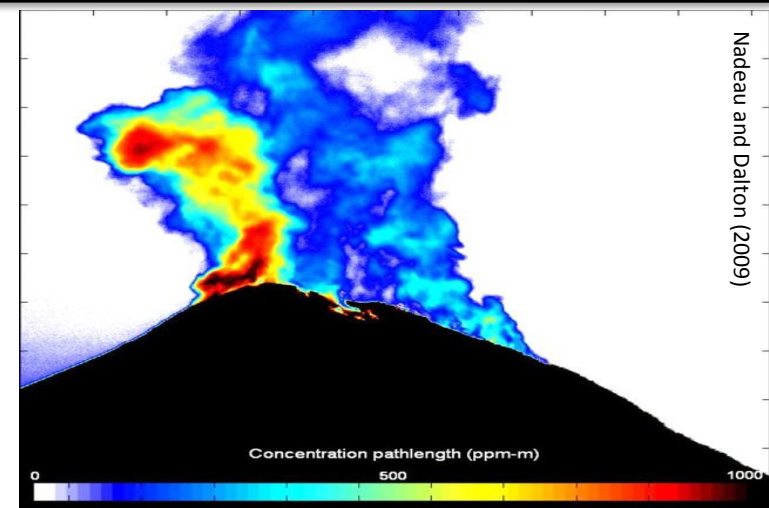
1). Ash dominated volcanic plumes – Semi-transparent clouds dominated by volcanic ash. Lightning is usually not present in these clouds.



2). Ice topped umbrella clouds – These clouds are mostly observed during a major eruption. A spectral based volcanic ash signal is usually initially absent because the ash is encased in ice and/or the cloud is opaque. Lightning is often present in these clouds.



3). SO₂ clouds – Sulfur dioxide clouds (SO₂ gas is invisible to the eye) that may or may not contain volcanic ash. Some eruptions produce large amounts of SO₂ and very little ash and vice-versa.



From: Mike Pavolonis NOAA Federal
Subject: **NOAA/CIMSS Volcanic Cloud Alert**
Date: April 19, 2014 7:07:12 PM CDT
To: Mike Pavolonis NOAA Federal

@*****VOLCANIC ALERTS*****

STARTING DATE/TIME OF IMAGE: 2014-04-19 23:31:59 [UT]
PRIMARY INSTRUMENT: MTSAT-2 Vis/IR_Imager
WMO SPACECRAFT ID: 172
LOCATION/ORBIT: GEO
L1 FILE: mtsat02_1_2014_109_2332.area.gz
VOLCANO DATABASE: /data/common//VOLCAT_DATA/alert
NUMBER OF ASH CLOUD ALERTS: 2
NUMBER OF VOLCANIC Cb ALERTS: 0
NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS: 0
NUMBER OF SO2 CLOUD ALERTS: 0

REPORT WITH IMAGES:

<http://volcano.ssec.wisc.edu/alert/report/13523>

POSSIBLE VOLCANIC ASH CLOUD FOUND

Alert Status: New Alert Object

Latitude of Radiative Center: -7.353 [degrees]

Longitude of Radiative Center: 109.551 [degrees]

Mean Viewing Angle: 42.09 [degrees]

Mean Solar Zenith Angle: 79.00 [degrees]

Nearby Volcanoes (meeting alert criteria):

Slamet(39.83 km)

Dieng Volc Complex(43.79 km)

Sundoro(48.99 km)

Sumbing(57.42 km)

Ungaran(88.39 km)

Cloud Object Probability: 100.00000 [%]

Median Probability of Object Pixels: 99.63298 [%]

Percent Unambiguous Pixels: 21.43983 [%]

Maximum Height [AMSL]: 10.2 [km] (33478.48 [ft])

90th Percentile Height [AMSL]: 9.9 [km] (32488.88 [ft])

Mean Tropopause Height [AMSL]: 16.5 [km] (54133.33 [ft])

Total Mass: .001098 [Tg]

Median Effective Particle Radius: 5.08 [um]

Total Area: 329.72 [km^2]

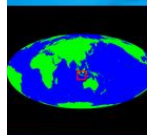
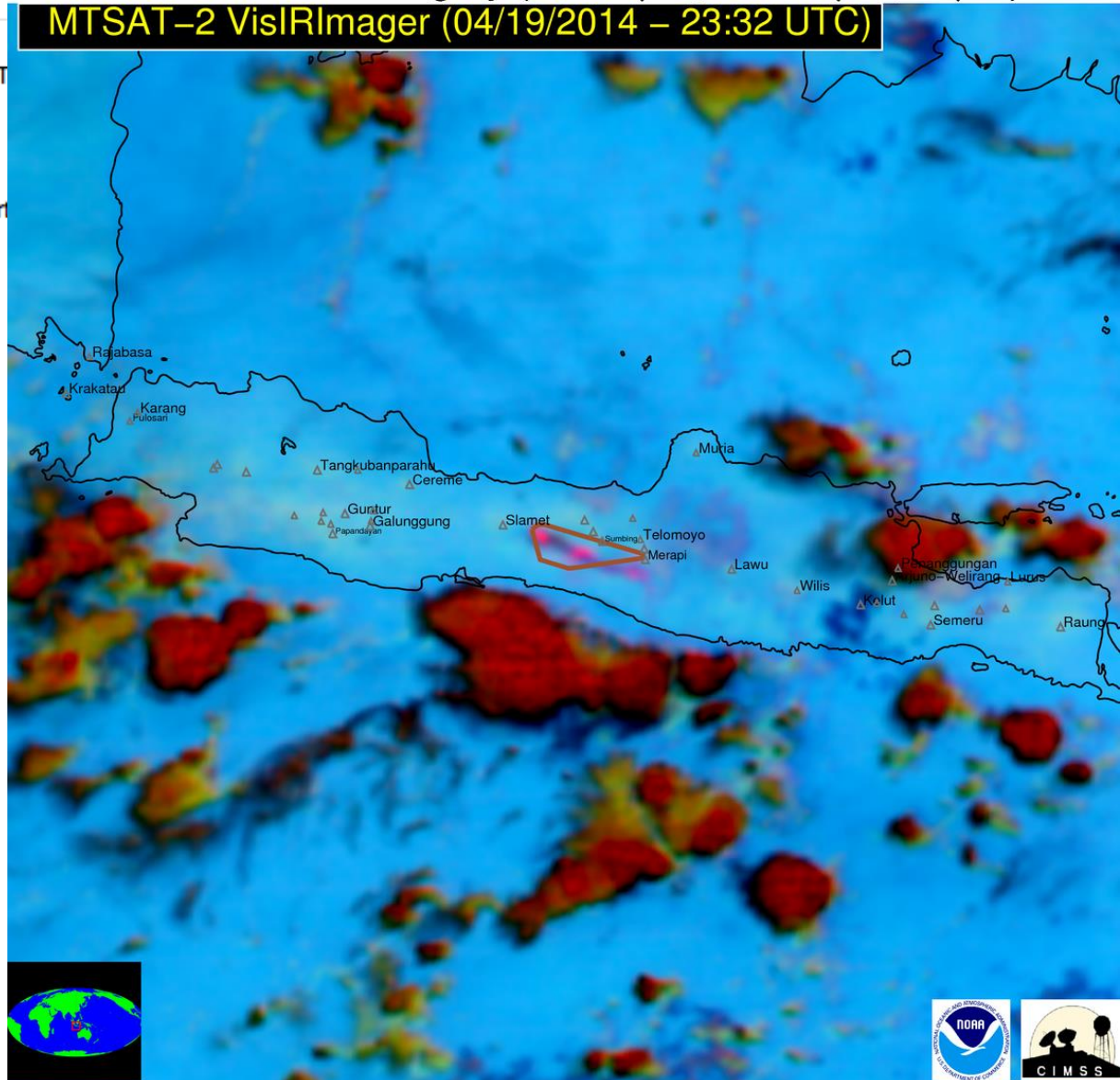
Geographic Regions of Nearby Volcanoes: Java

VAAC Regions of Nearby Volcanoes: Darwin

FIR Regions of Nearby Volcanoes: Unknown

False Color Imagery (12-11um, 11-3.9um, 11um)

MTSAT-2 VisIRImager (04/19/2014 - 23:32 UTC)



Annotation Key

(annotation colors are not related to colors in underlying image)

Ash/Dust Cloud

Volcanic Cb

SO₂

Thermal Anomaly



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NUMBER OF SO2 CLOUD ALERTS: 0

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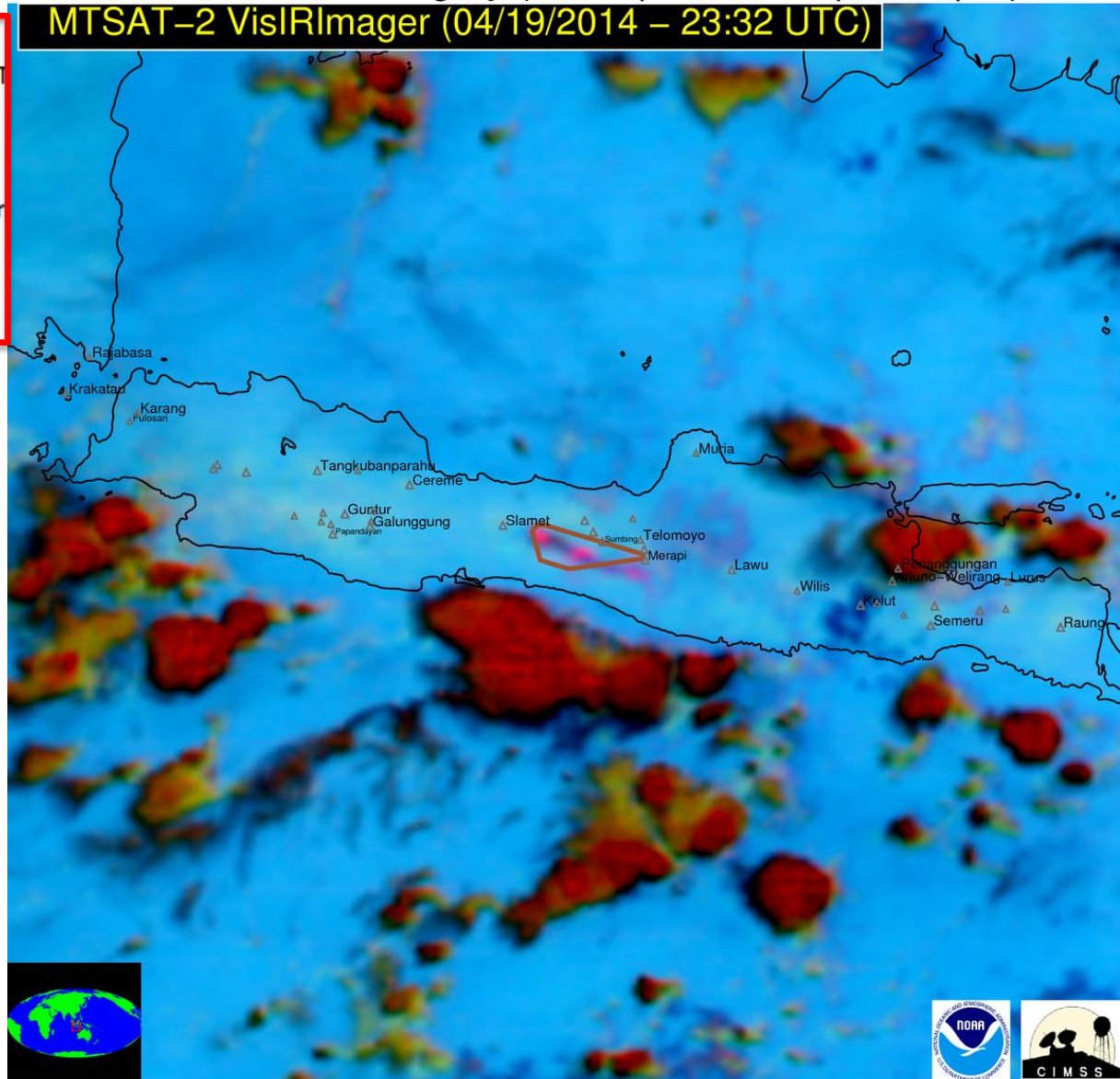
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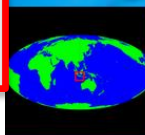
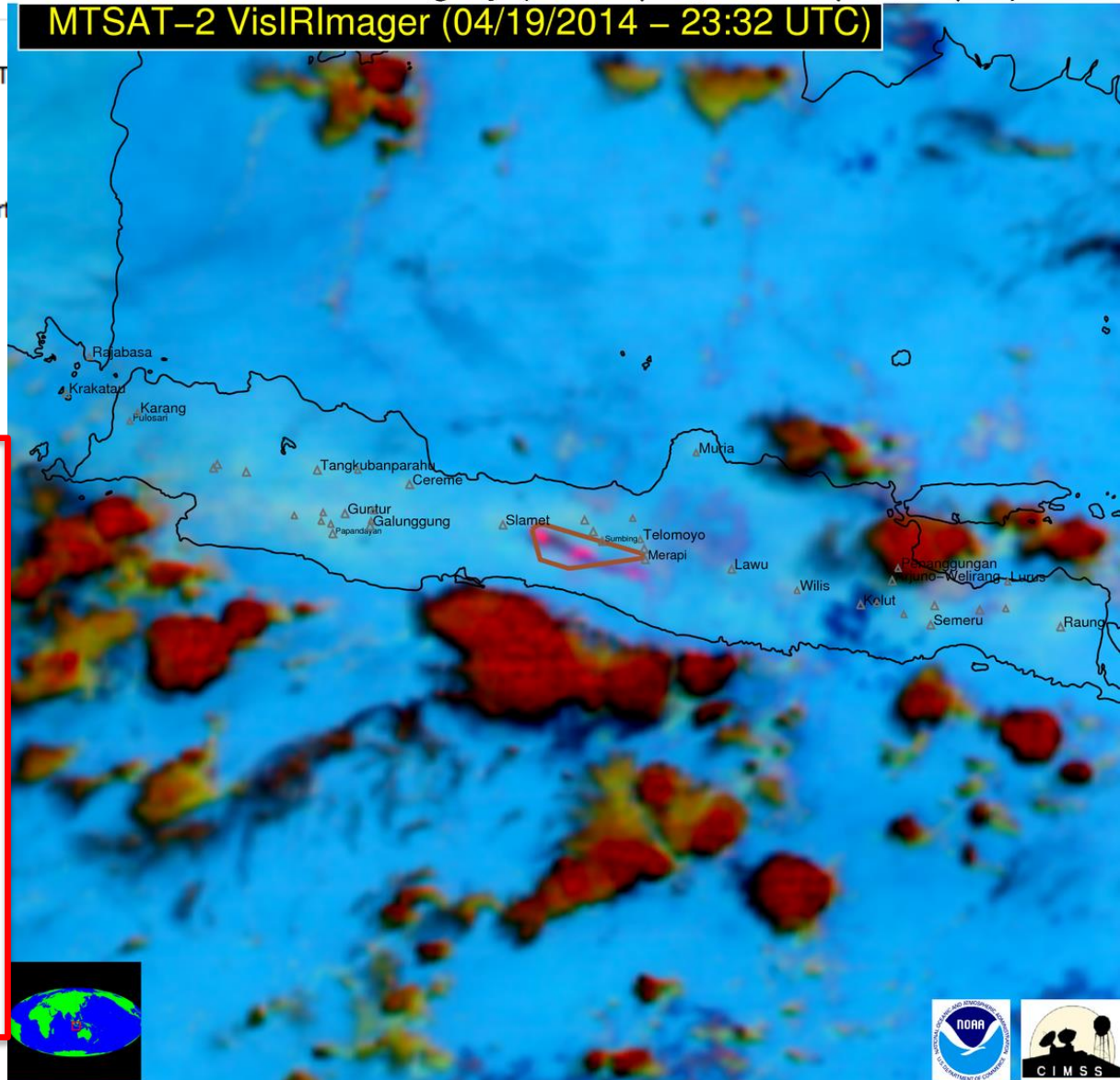
Geographic Regions of Nearby Volcanoes: Java

VAAC Regions of Nearby Volcanoes: Darwin

FIR Regions of Nearby Volcanoes: Unknown

False Color Imagery (12–11 μ m, 11–3.9 μ m, 11 μ m)

MTSAT-2 VisIRImager (04/19/2014 – 23:32 UTC)



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Volcanic Cb

SO₂

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L1 FILE: mtsat02_1_2014_109_2332.area.gz
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NUMBER OF SO2 CLOUD ALERTS: 0

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Total Area: 329.72 [km^2]

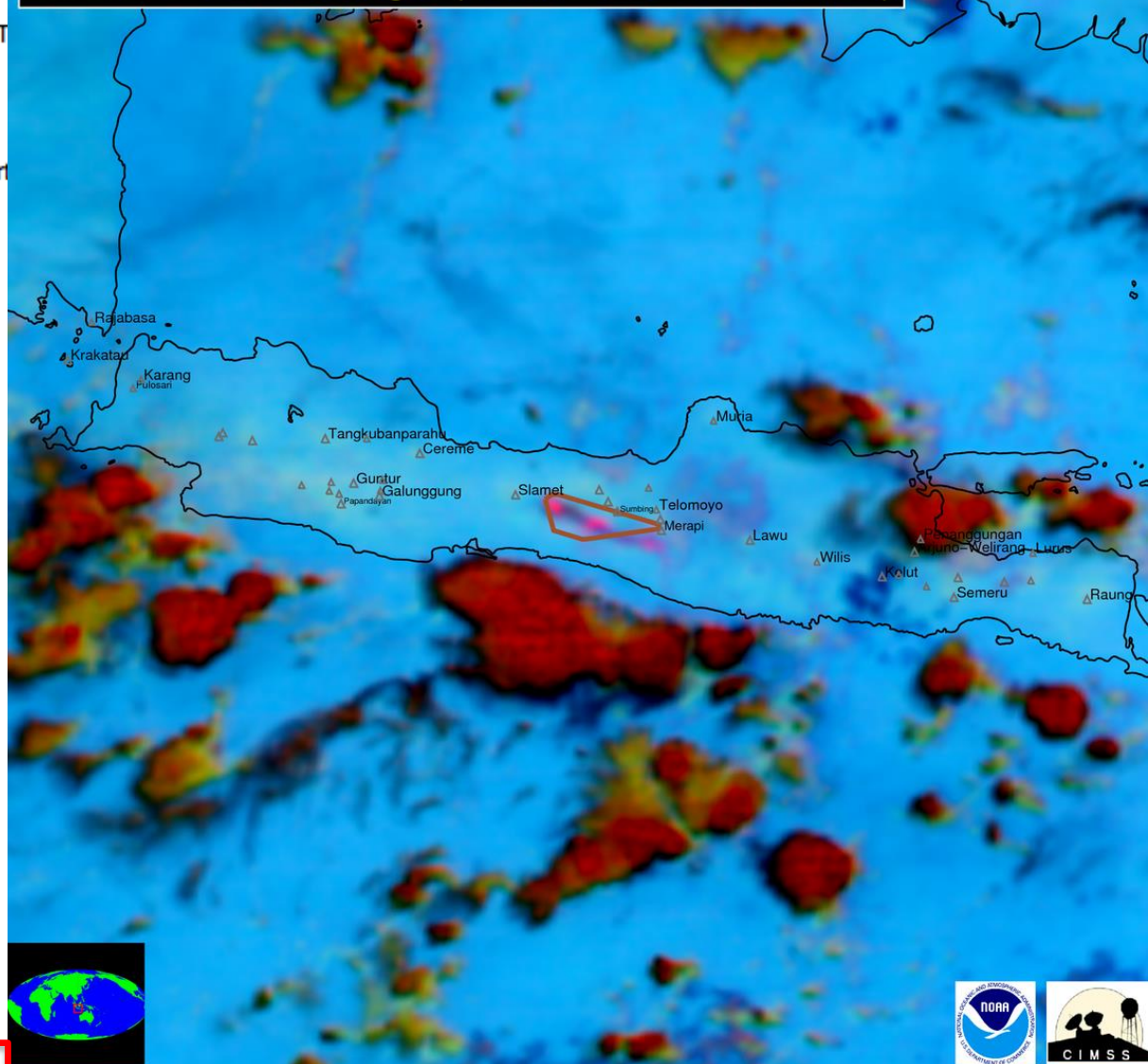
Geographic Regions of Nearby Volcanoes: Java

VAAC Regions of Nearby Volcanoes: Darwin

FIR Regions of Nearby Volcanoes: Unknown

False Color Imagery (12-11um, 11-3.9um, 11um)

MTSAT-2 VisIRImager (04/19/2014 - 23:32 UTC)



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Ash/Dust Cloud

Volcanic Cb

SO₂

Thermal Anomaly

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To: Mike Pavolonis NOAA Federal

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PRIMARY INSTRUMENT: MTSAT-2 Vis/IR_Imager
WMO SPACECRAFT ID: 172
LOCATION/ORBIT: GEO
L1 FILE: mtsat02_1_2014_109_2332.area.gz
VOLCANO DATABASE: /data/common/VOLCAT_DATA/alert
NUMBER OF ASH CLOUD ALERTS: 2
NUMBER OF VOLCANIC Cb ALERTS: 0
NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS: 0
NUMBER OF SO2 CLOUD ALERTS: 0

REPORT WITH IMAGES:

<http://volcano.ssec.wisc.edu/alert/report/13523>

POSSIBLE VOLCANIC ASH CLOUD FOUND

Alert Status: New Alert Object

Latitude of Radiative Center: -7.353 [degrees]

Longitude of Radiative Center: 109.551 [degrees]

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Mean Solar Zenith Angle: 79.00 [degrees]

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Sundoro(48.99 km)

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Percent Unambiguous Pixels: 21.43983 [%]

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90th Percentile Height [AMSL]: 9.9 [km] (32488.88 [ft])

Mean Tropopause Height [AMSL]: 16.5 [km] (54133.33 [ft])

Total Mass: .001098 [Tg]

Median Effective Particle Radius: 5.08 [um]

Total Area: 329.72 [km^2]

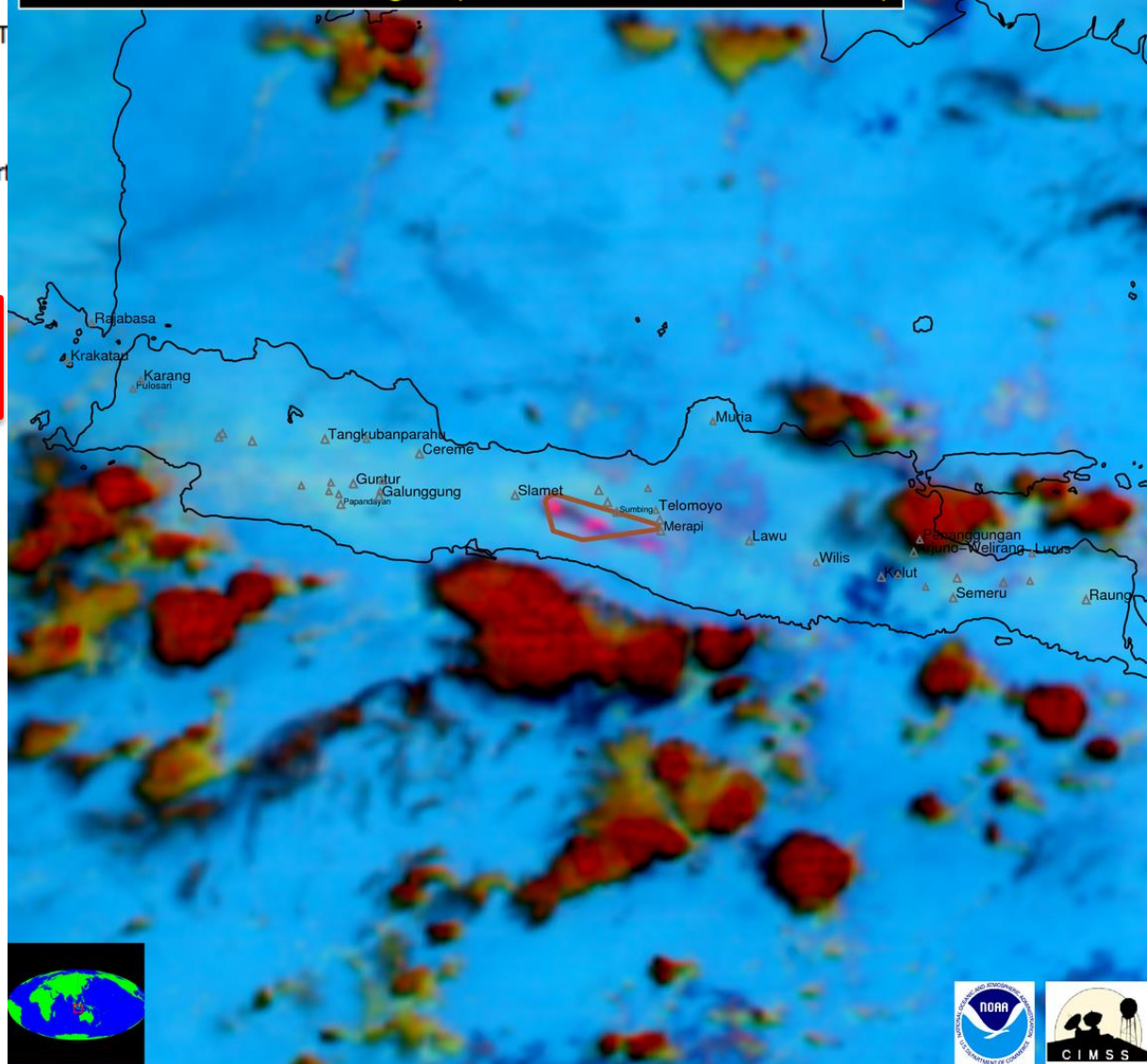
Geographic Regions of Nearby Volcanoes: Java

VAAC Regions of Nearby Volcanoes: Darwin

FIR Regions of Nearby Volcanoes: Unknown

False Color Imagery (12-11um, 11-3.9um, 11um)

MTSAT-2 VisIRImager (04/19/2014 - 23:32 UTC)



Annotation Key

(annotation colors are not related to colors in underlying image)

Ash/Dust Cloud

Volcanic Cb

SO₂

Thermal Anomaly

Volcanic Cloud Monitoring — NOAA/CIMSS

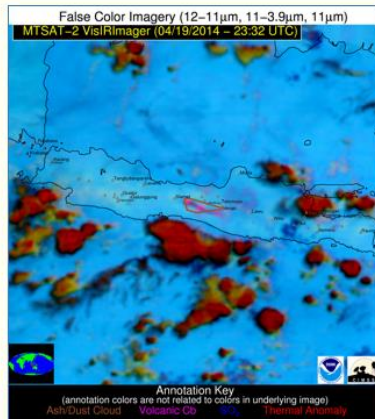
[Home](#)
[Satellite Imagery](#)
[Alerts](#)
[Admin](#)[Logout \(mpav@ssec.wisc.edu\)](#)

Volcanic Cloud Alert Report

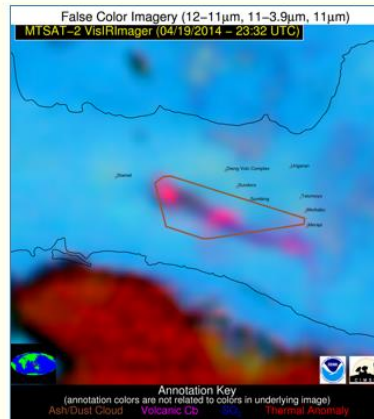
Date: 2014-04-19
 Time: 23:31:59
 Production Date And Time: 2014-04-20 00:05:49 UTC
 Primary Instrument: MTSAT-2 Vis/IR_Imager

[More details ▼](#)

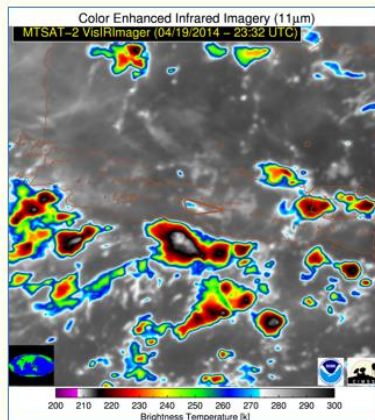
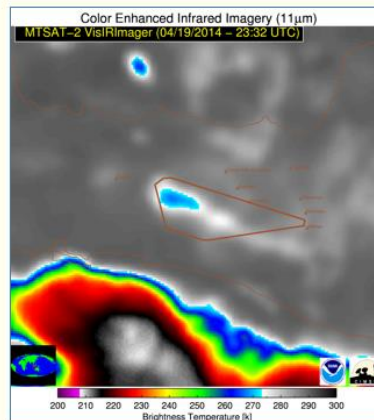
Possible Volcanic Ash Cloud

[View event imagery »](#)

False Color Image (12-11, 11-3.9, 11)



False Color Image (12-11, 11-3.9, 11) [zoomed-in]

Brightness Temperature (11 μ m)Brightness Temperature (11 μ m) [zoomed-in]

| | |
|--|--|
| Alert Status | New Alert Object |
| Radiative Center (Lat, Lon): | -7.353 °, 109.551 ° |
| Mean Viewing Angle | 42.09 ° |
| Mean Solar Zenith Angle | 79.00 ° |
| Nearby Volcanoes (meeting alert criteria): | Slamet (39.83 km) Dieng Volc Complex (43.79 km) Sundoro (48.99 km) Sumbing (57.42 km) Ungaran (88.39 km) |
| Cloud Object Probability | 100.00000 % |
| Median Probability Of Object Pixels | 99.63298 % |
| Percent Unambiguous Pixels | 21.43983 % |
| Maximum Height [amsl] | 10.20 km |
| 90th Percentile Height [amsl] | 9.90 km |
| Mean Tropopause Height [amsl] | 16.50 km |
| Total Mass | 0.001098 Tg |
| Median Effective Particle Radius | 5.08 μ m |
| Total Area | 329.72 km ² |
| Geographic Regions Of Nearby Volcanoes | Java |
| Vaac Regions Of Nearby Volcanoes | Darwin |
| Fir Regions Of Nearby Volcanoes | Unknown |

From: Mike Pavolonis NOAA Federal
Subject: **NOAA/CIMSS Volcanic Cloud Alert**
Date: June 2, 2014 12:48:38 PM CDT
To: Mike Pavolonis NOAA Federal

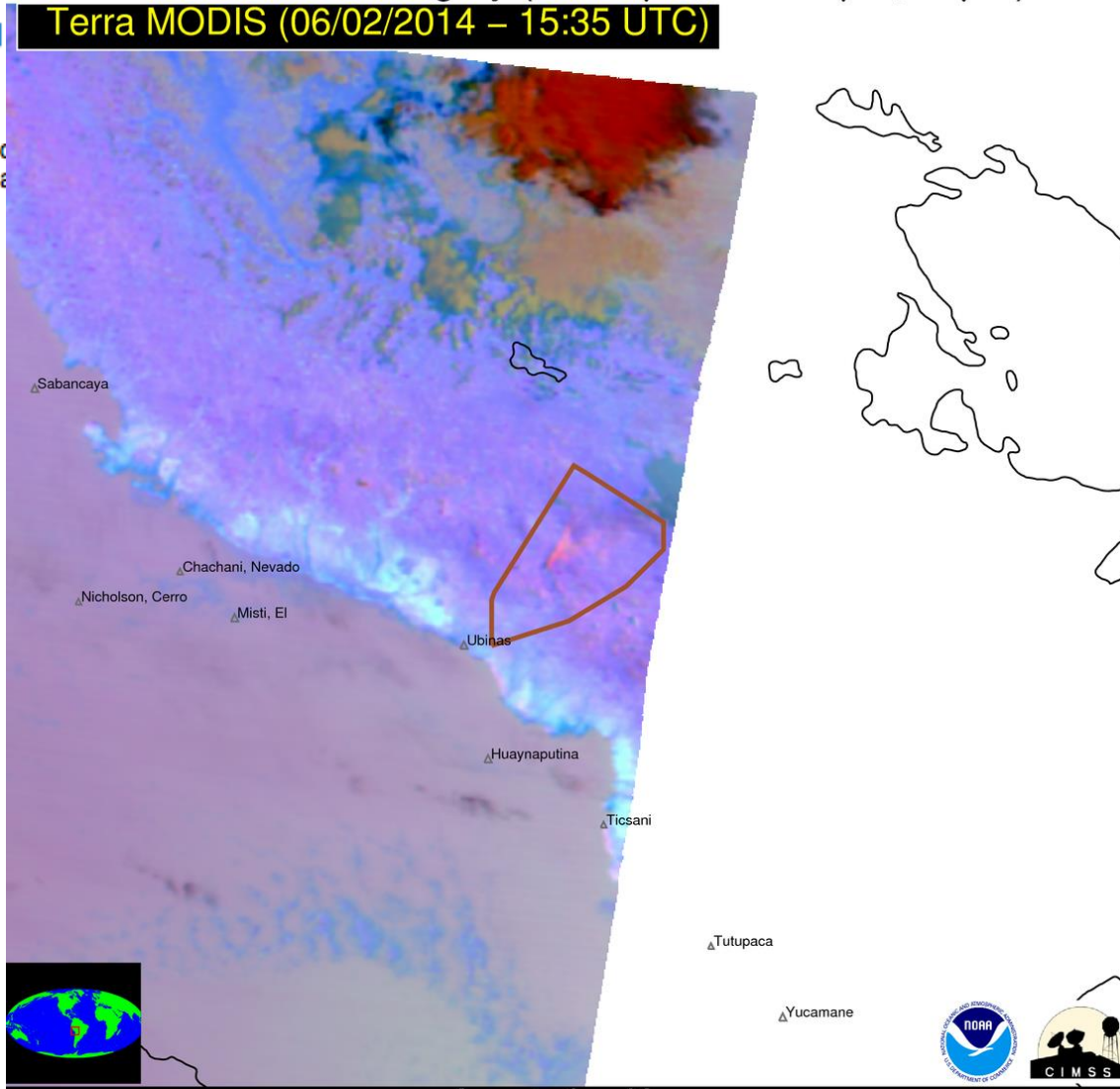
@*****VOLCANIC ALERTS*****
STARTING DATE/TIME OF IMAGE: 2014-06-02 15:35:00 [UTC]
PRODUCTION DATE/TIME OF ALERT: 2014-06-02 17:47:16 [UTC]
PRIMARY INSTRUMENT: Terra MODIS
WMO SPACECRAFT ID: 783
LOCATION/ORBIT: LEO
L1 FILE: MOD021KM.A2014153.1535.005.2014153163121.NRT.h0
VOLCANO DATABASE: /data/common/VOLCAT_DATA/alerts/Volca
NUMBER OF ASH CLOUD ALERTS: 1
NUMBER OF VOLCANIC Cb ALERTS: 0
NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS: 0
NUMBER OF SO2 CLOUD ALERTS: 0

REPORT WITH IMAGES:
<http://volcano-test.ssec.wisc.edu/alert/report/11821>

POSSIBLE VOLCANIC ASH CLOUD FOUND
Alert Status: New Alert Object
Latitude of Radiative Center: -16.174 [degrees]
Longitude of Radiative Center: -70.737 [degrees]
Mean Object Date/Time: 2014-06-02 15:35:00 [UTC]
Mean Viewing Angle: 56.48 [degrees]
Mean Solar Zenith Angle: 41.52 [degrees]
Nearby Volcanoes (meeting alert criteria):
 Ubinas(26.90 km)
 Huaynaputina(49.86 km)
Cloud Object Probability: 100.00000 [%]
Median Probability of Object Pixels: 98.77958 [%]
Percent Unambiguous Pixels: .05021 [%]
Maximum Height [AMSL]: 8.6 [km] (28362.17 [ft])
90th Percentile Height [AMSL]: 6.8 [km] (22184.90 [ft])
Mean Tropopause Height [AMSL]: 16.6 [km] (54325.78 [ft])
Total Mass: .001287 [Tg]
Median Effective Particle Radius: 2.64 [um]
Total Area: 1186.63 [km^2]

Geographic Regions of Nearby Volcanoes: Peru
VAAC Regions of Nearby Volcanoes: Buenos Aires
FIR Regions of Nearby Volcanoes: Unknown

False Color Imagery (12-11µm, 11-8.5µm, 11µm)
Terra MODIS (06/02/2014 – 15:35 UTC)



Annotation Key
(annotation colors are not related to colors in underlying image)
Ash/Dust Cloud Volcanic Cb SO₂ Thermal Anomaly

From: Mike Pavolonis NOAA Federal
Subject: **NOAA/CIMSS Volcanic Cloud Alert**
Date: June 3, 2014 10:02:47 PM CDT
To: Mike Pavolonis NOAA Federal

@*****VOLCANIC ALERTS*****

STARTING DATE/TIME OF IMAGE: 2014-06-03 22:45:00 [UTC]
PRODUCTION DATE/TIME OF ALERT: 2014-06-04 03:01:19 [UTC]
PRIMARY INSTRUMENT: Aqua MODIS
WMO SPACECRAFT ID: 784
LOCATION/ORBIT: LEO
L1 FILE: MYD021KM.A2014154.2245.005.2014155014054.NRT
VOLCANO DATABASE: /data/common/VOLCAT_DATA/alerts/V
NUMBER OF ASH CLOUD ALERTS: 1
NUMBER OF VOLCANIC Cb ALERTS: 0
NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS: 0
NUMBER OF SO2 CLOUD ALERTS: 0

REPORT WITH IMAGES:

<http://volcano-test.ssec.wisc.edu/alert/report/11945>

POSSIBLE VOLCANIC ASH CLOUD FOUND

Alert Status: New Alert Object

Latitude of Radiative Center: 55.373 [degrees]

Longitude of Radiative Center: -162.005 [degrees]

Mean Object Date/Time: 2014-06-03 22:45:00 [UTC]

Mean Viewing Angle: 54.07 [degrees]

Mean Solar Zenith Angle: 32.46 [degrees]

Nearby Volcanoes (meeting alert criteria):

Emmons Lake(5.90 km)

Pavlof(8.88 km)

Pavlof Sister(13.54 km)

Dutton(28.41 km)

Dana(58.12 km)

Cloud Object Probability: 100.00000 [%]

Median Probability of Object Pixels: .00000 [%]

Percent Unambiguous Pixels: .02882 [%]

Maximum Height [AMSL]: 8.3 [km] (27347.90 [ft])

90th Percentile Height [AMSL]: 6.2 [km] (20186.51 [ft])

Mean Tropopause Height [AMSL]: 11.8 [km] (38867.68 [ft])

Total Mass: .013838 [Tg]

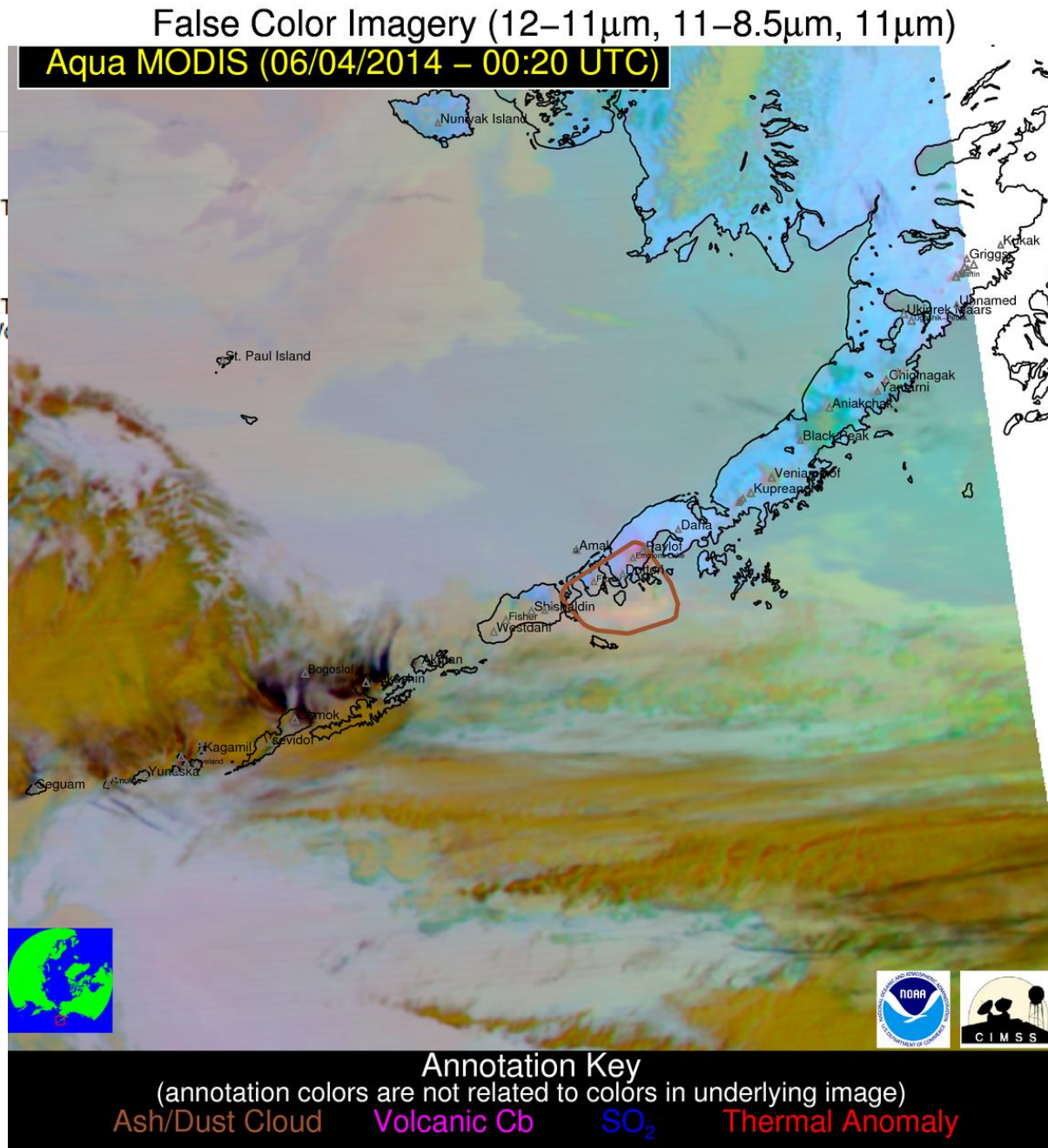
Median Effective Particle Radius: 4.05 [um]

Total Area: 12419.03 [km^2]

Geographic Regions of Nearby Volcanoes: Alaska Peninsula

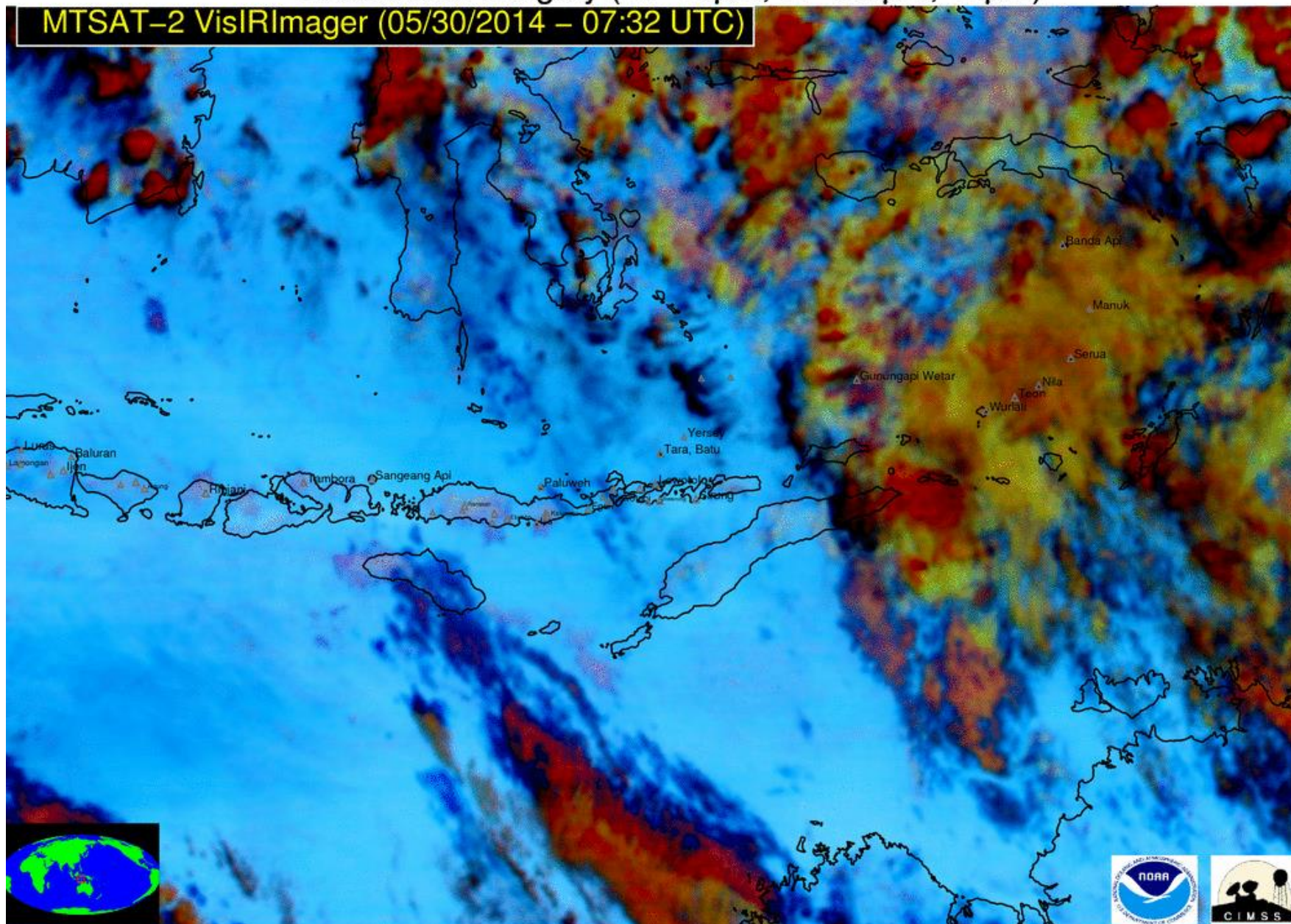
VAAC Regions of Nearby Volcanoes: Anchorage

FIR Regions of Nearby Volcanoes: Unknown



False Color Imagery (12–11 μ m, 11–3.9 μ m, 11 μ m)

MTSAT-2 VisIRImager (05/30/2014 – 07:32 UTC)



Annotation Key

(annotation colors are not related to colors in underlying image)

Ash/Dust Cloud

Volcanic Cb

SO₂

Thermal Anomaly

From: Mike Pavolonis NOAA Federal
Subject: NOAA/CIMSS Volcanic Cloud Alert
Date: May 30, 2014 6:08:15 AM CDT
To: Mike Pavolonis NOAA Federal

@*****VOLCANIC ALERTS*****

STARTING DATE/TIME OF IMAGE: 2014-05-30 10:32:00 [UTC]
PRIMARY INSTRUMENT: MTSAT-2 Vis/IR_Imager
WMO SPACECRAFT ID: 172
LOCATION/ORBIT: GEO
L1 FILE: mtsat02_1_2014_150_1032.area.gz
VOLCANO DATABASE: /data/common/VOLCAT_DATA/alerts/V
NUMBER OF ASH CLOUD ALERTS: 1
NUMBER OF VOLCANIC Cb ALERTS: 0
NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS: 0
NUMBER OF SO2 CLOUD ALERTS: 0

REPORT WITH IMAGES:

<http://volcano.ssec.wisc.edu/alert/report/14318>

POSSIBLE VOLCANIC ASH CLOUD FOUND

Alert Status: New Alert Object
Latitude of Radiative Center: -8.421 [degrees]
Longitude of Radiative Center: 119.678 [degrees]
Mean Viewing Angle: 31.21 [degrees]
Mean Solar Zenith Angle: 100.73 [degrees]
Nearby Volcanoes (meeting alert criteria):
 Sano, Wai(49.71 km)
 Sangeang Api(71.71 km)
 Poco Leok(93.32 km)
 Ranakah(94.86 km)
 Inielika(147.81 km)
Cloud Object Probability: 99.99957 [%]
Median Probability of Object Pixels: 92.45512 [%]
Percent Unambiguous Pixels: 12.30223 [%]
Maximum Height [AMSL]: 10.2 [km] (33355.06 [ft])
90th Percentile Height [AMSL]: 9.6 [km] (31600.68 [ft])
Mean Tropopause Height [AMSL]: 16.5 [km] (54080.38 [ft])
Total Mass: .004477 [Tg]
Median Effective Particle Radius: 5.74 [um]
Total Area: 1281.51 [km^2]

Geographic Regions of Nearby Volcanoes: Lesser Sunda Is
VAAC Regions of Nearby Volcanoes: Darwin
FIR Regions of Nearby Volcanoes: Unknown



From: Mike Pavolonis NOAA Federal
Subject: **NOAA/CIMSS Volcanic Cloud Alert**
Date: February 13, 2014 10:09:05 AM CST
To: Mike Pavolonis NOAA Federal

@*****VOLCANIC ALERTS*****

STARTING DATE/TIME OF IMAGE: 2014-02-13 15:32:00 [UTC]
PRIMARY INSTRUMENT: MTSAT-2 Vis/IR_Imager
WMO SPACECRAFT ID: 172
LOCATION/ORBIT: GEO
L1 FILE: mtsat02_1_2014_044_1532.area.gz
VOLCANO DATABASE: /data/common/VOLCAT_DATA/alerts
NUMBER OF ASH CLOUD ALERTS: 0
NUMBER OF VOLCANIC Cb ALERTS: 0
NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS: 1
NUMBER OF SO₂ CLOUD ALERTS: 0

REPORT WITH IMAGES:

<http://volcano.ssec.wisc.edu/alert/report/12211>

POSSIBLE VOLCANIC THERMAL ANOMALY FOUND

Alert Status: New Alert Object

Latitude of Radiative Center: -7.920 [degrees]

Longitude of Radiative Center: 112.268 [degrees]

Mean Viewing Angle: 39.18 [degrees]

Mean Solar Zenith Angle: 151.86 [degrees]

Nearby Volcanoes (meeting alert criteria):

Kelut(4.67 km)

Maximum 3.8 um Brightness Temperature: 310.37 [K]

Maximum 3.8 um Thermal Anomaly: 20.80 [K]

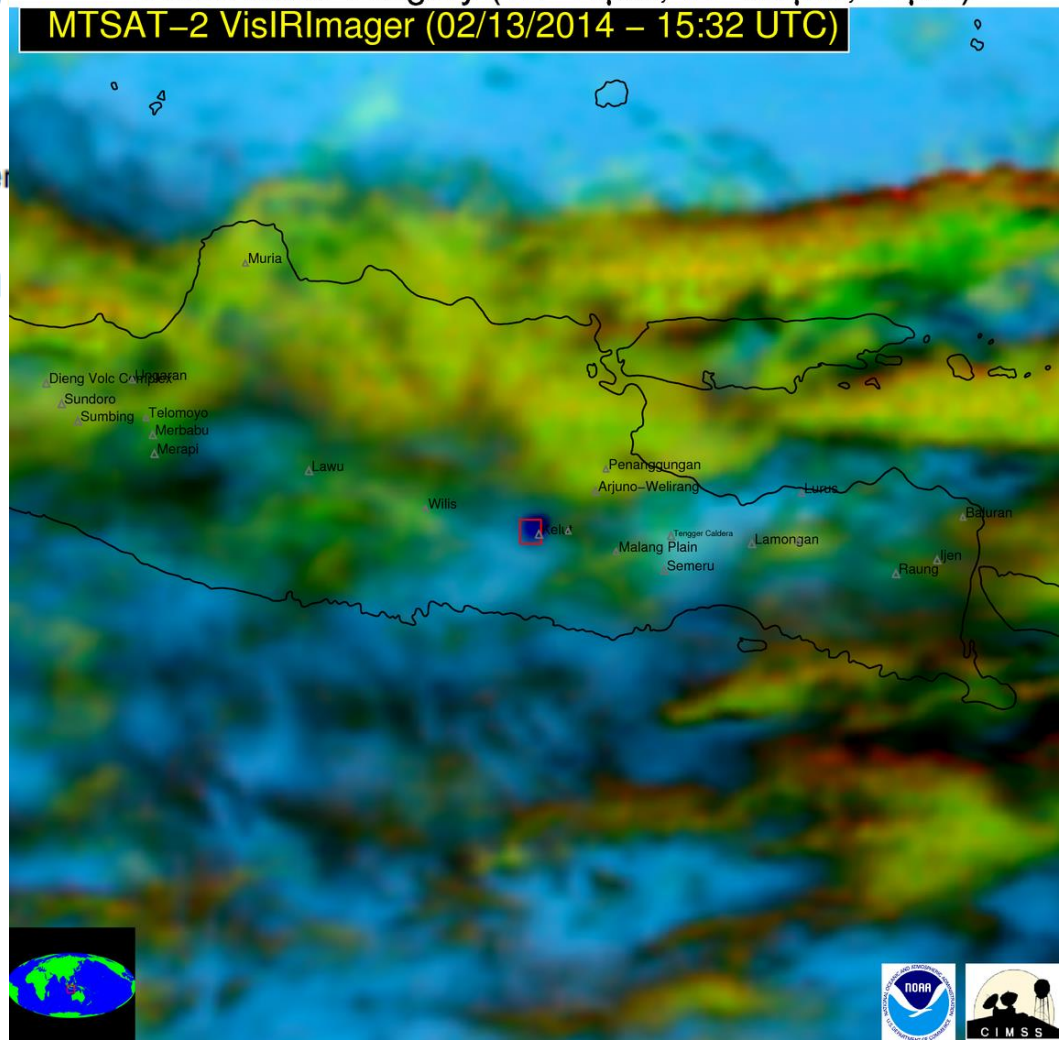
Total Area: 89.30 [km²]

Geographic Regions of Nearby Volcanoes: Java

VAAC Regions of Nearby Volcanoes: Darwin

FIR Regions of Nearby Volcanoes: Unknown

False Color Imagery (12–11μm, 11–3.9μm, 11μm)
MTSAT-2 VisIRImager (02/13/2014 – 15:32 UTC)



Annotation Key
(annotation colors are not related to colors in underlying image)
Ash/Dust Cloud Volcanic Cb SO₂ Thermal Anomaly

30 minutes later...

Erupsi Kelud
@hilmi_dzi | 00:30 am
Nglegok, Blitar



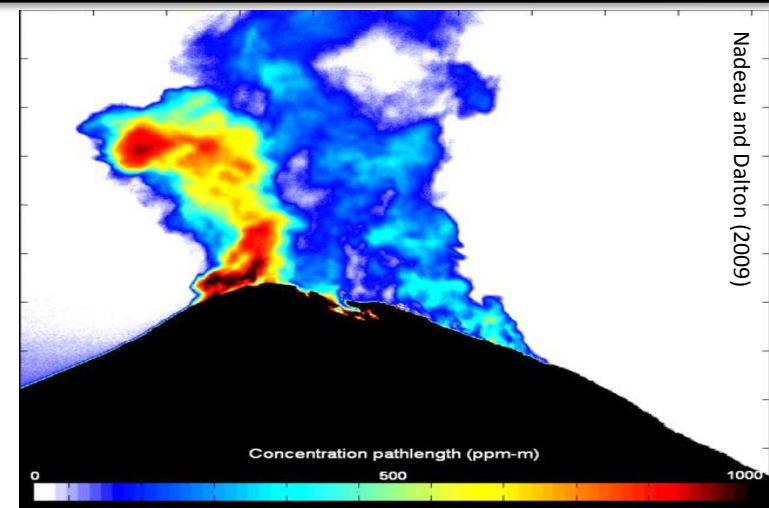
1). Ash dominated volcanic plumes – Semi-transparent clouds dominated by volcanic ash. Lightning is usually not present in these clouds.



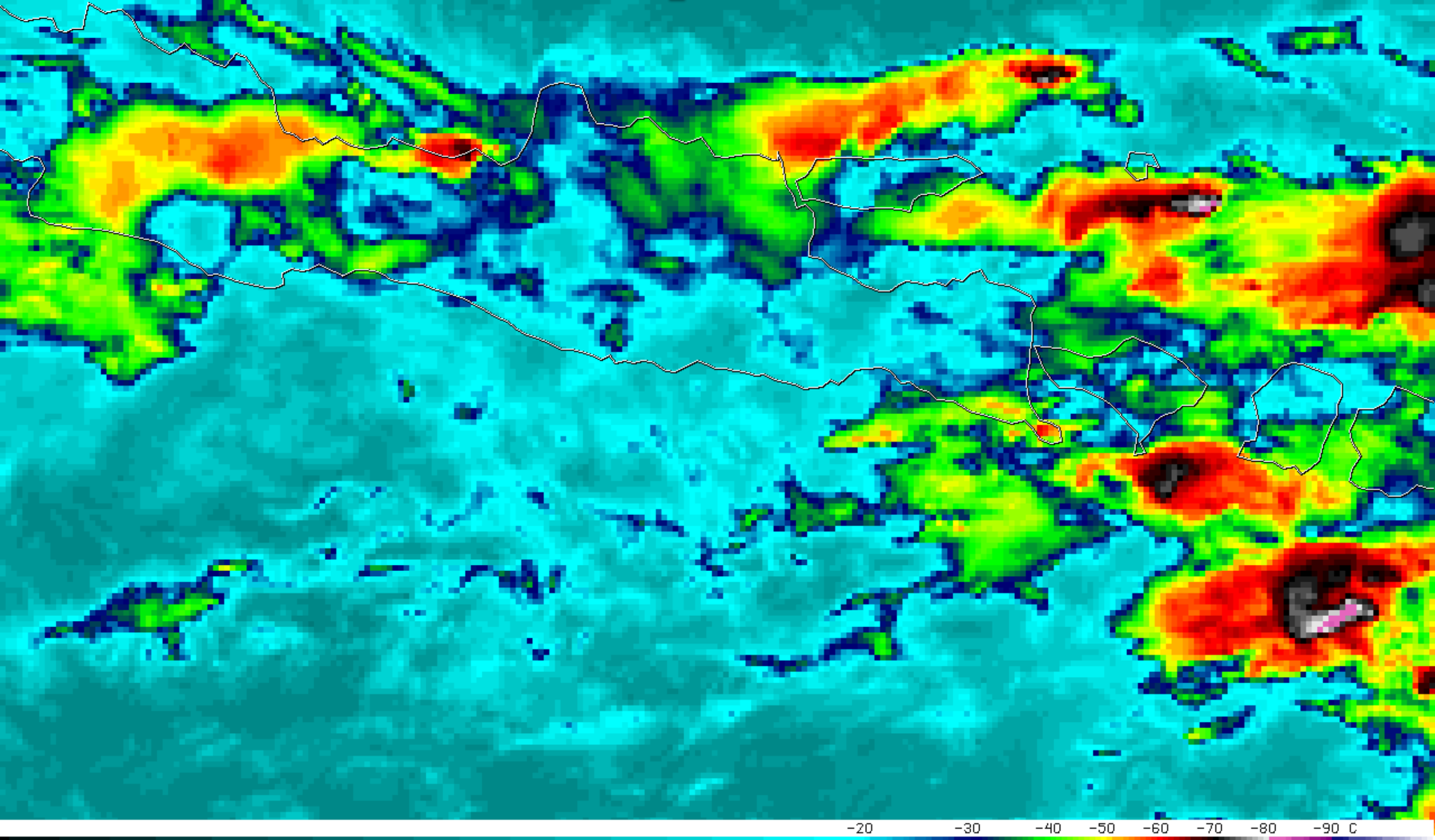
2). Ice topped umbrella clouds – These clouds are mostly observed during a major eruption. A spectral based volcanic ash signal is usually initially absent because the ash is encased in ice and/or the cloud is opaque. Lightning is often present in these clouds.



3). SO₂ clouds – Sulfur dioxide clouds (SO₂ gas is invisible to the eye) that may or may not contain volcanic ash. Some eruptions produce large amounts of SO₂ and very little ash and vice-versa.

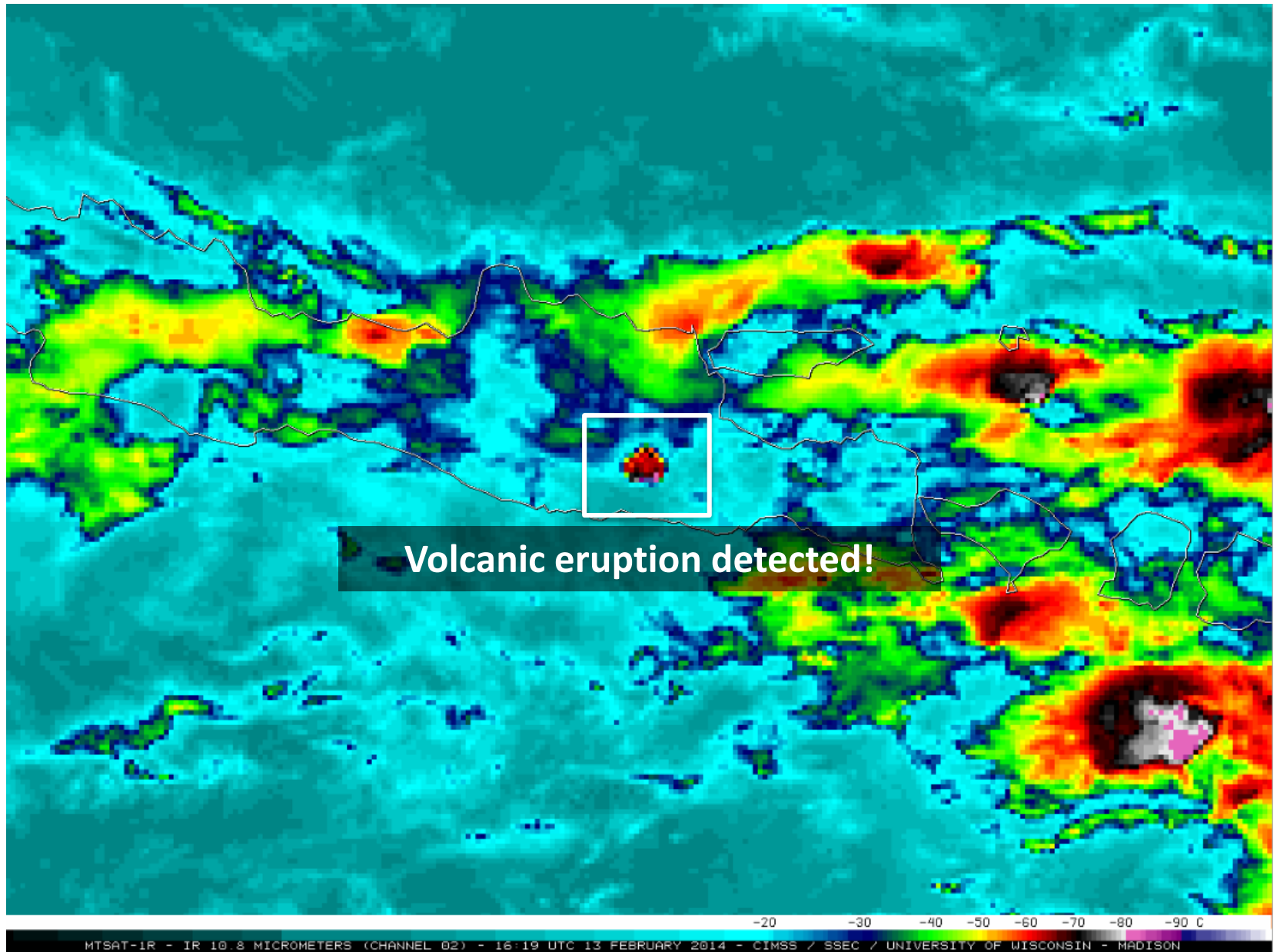


Weather or volcanic eruption?

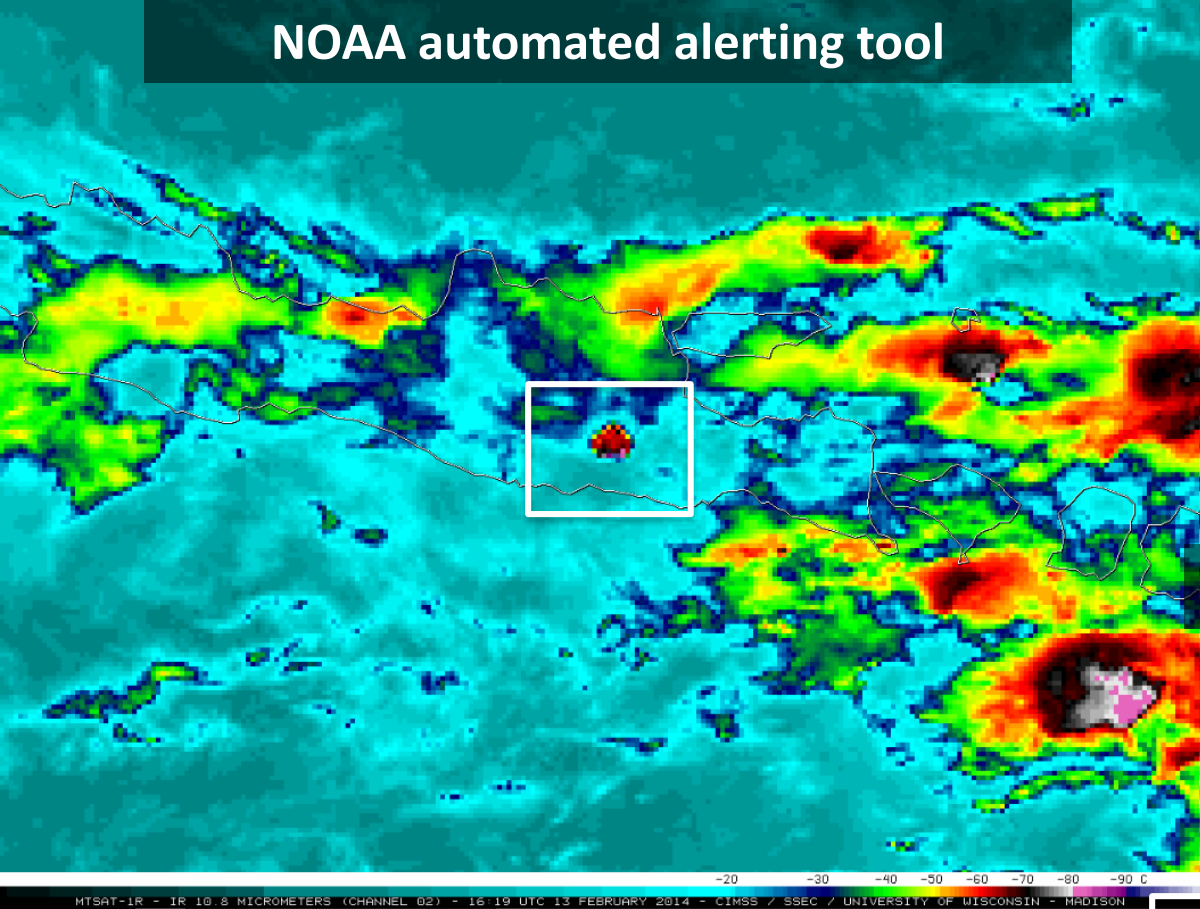


-20 -30 -40 -50 -60 -70 -80 -90 C

Automated system is able to detect Kelut eruption about 60 minutes sooner than standard tools

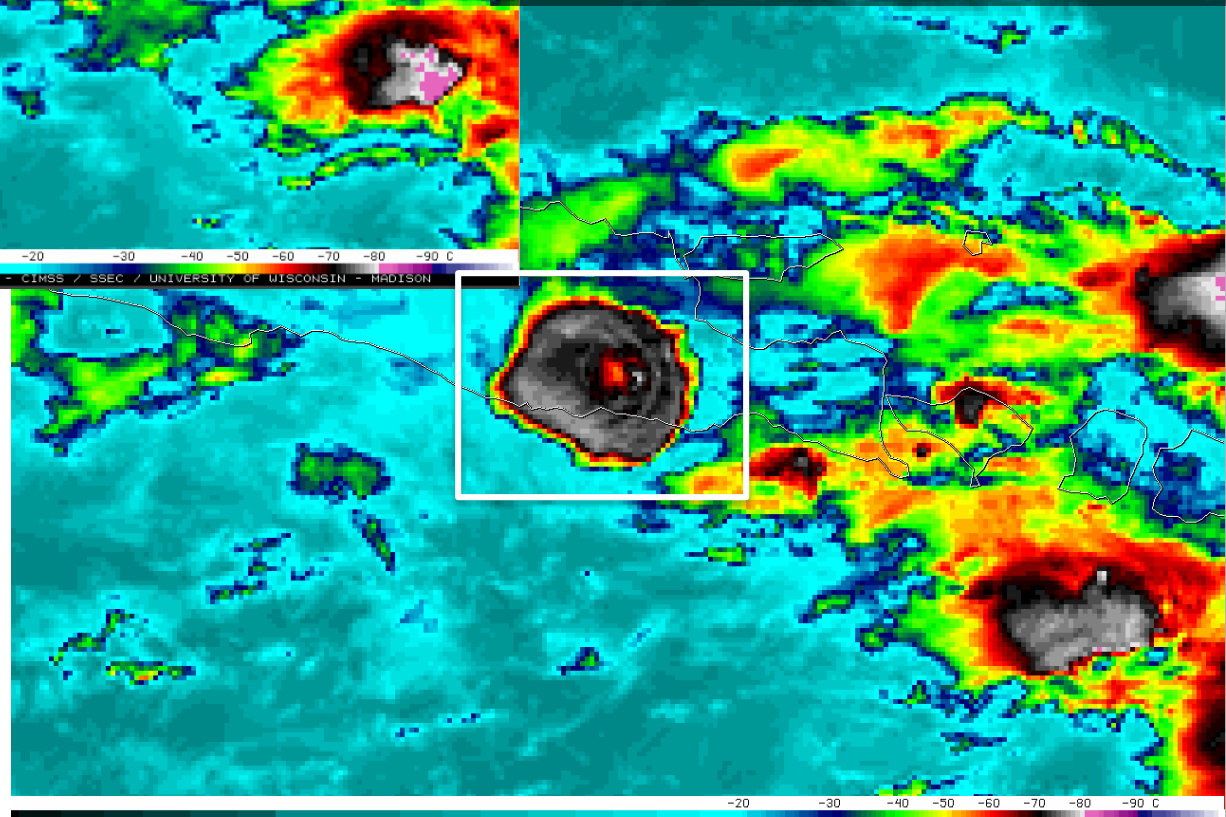


NOAA automated alerting tool



MTSAT-1R - IR 10.8 MICROMETERS (CHANNEL 02) - 16:19 UTC 13 FEBRUARY 2014 - CIMSS / SSEC / UNIVERSITY OF WISCONSIN - MADISON

Traditional tools (+ 1 hour)



-20 -30 -40 -50 -60 -70 -80 -90 C

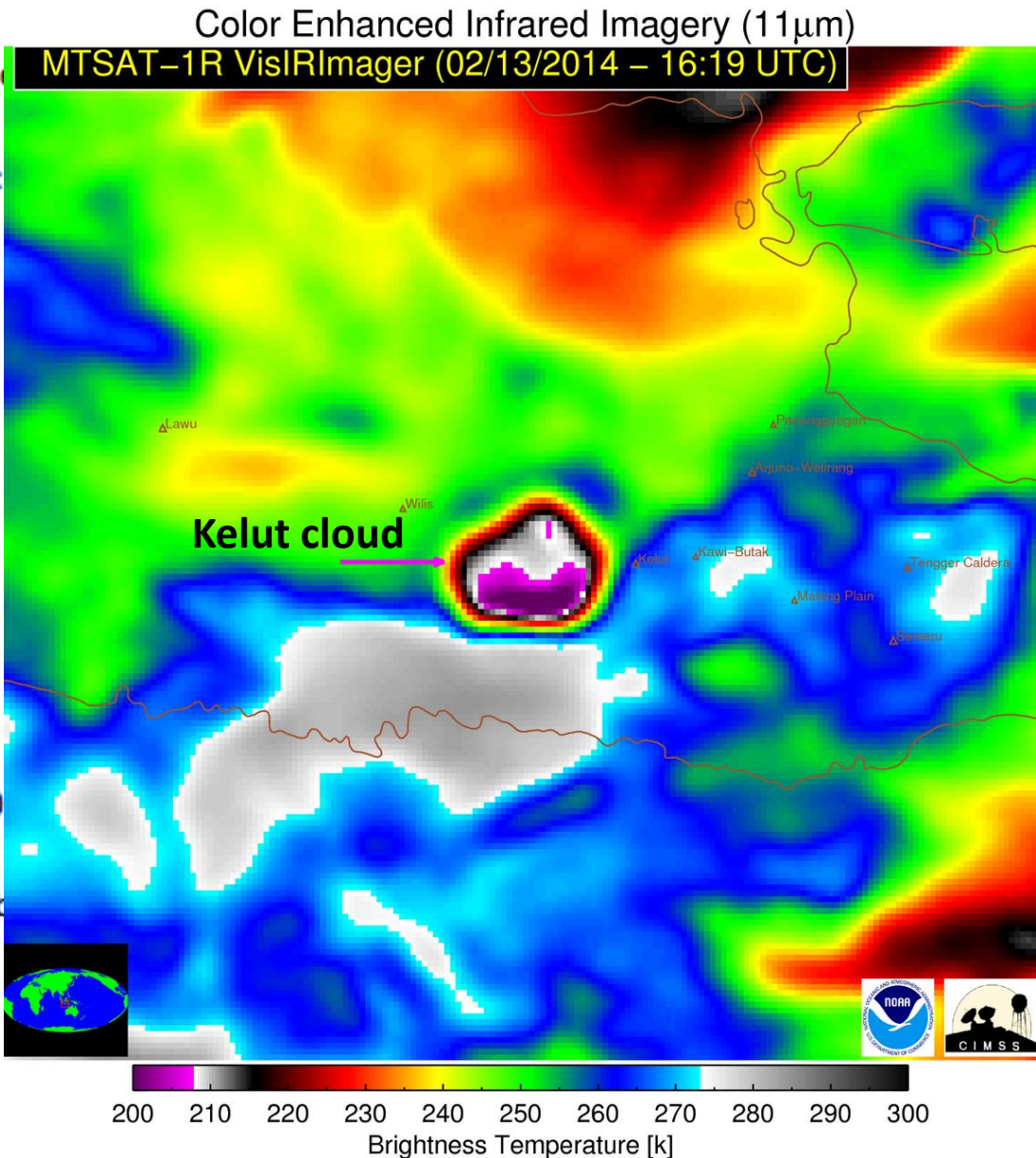
@*****VOLCANIC ALERTS*****
STARTING DATE/TIME OF IMAGE: 2014-02-13 16:19:00 [UTC]
PRODUCTION DATE/TIME OF ALERT: 2014-02-14 16:49:44 [UTC]
PRIMARY INSTRUMENT: MTSAT-1r Vis/IR_Imager
WMO SPACECRAFT ID: 171
LOCATION/ORBIT: GEO
L1 FILE: mtsat01_1_2014_044_1619.area.gz
VOLCANO DATABASE: /data/common/VOLCAT_DATA/al
NUMBER OF ASH CLOUD ALERTS: 0
NUMBER OF VOLCANIC Cb ALERTS: 1
NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS:
NUMBER OF SO2 CLOUD ALERTS: 0

REPORT WITH IMAGES:
<http://volcano.ssec.wisc.edu/alert/report/12238>

POSSIBLE VOLCANIC ERUPTION DETECTED
Alert Status: New Alert Object
Latitude of Radiative Center: -8.012 [degrees]
Longitude of Radiative Center: 112.265 [degrees]
Mean Viewing Angle: 33.92 [degrees]
Mean Solar Zenith Angle: 157.44 [degrees]
Nearby Volcanoes (meeting alert criteria):
 Kelut(9.99 km)
 Kawi-Butak(23.00 km)
Maximum Height [AMSL]: 21.2 [km] (69649.79 [ft])
90th Percentile Height [AMSL]: 19.2 [km] (62995.20 [ft])
Mean Tropopause Height [AMSL]: 16.4 [km] (53783.42 [ft])
Trend in IR Brightness Temperature: -53.16 [K]
Vertical Growth Rate Time Interval: 10 [minutes]
Vertical Growth Rate Anomaly: 24.75 [number of stddev at
Total Area: 1270.01 [km^2]

Geographic Regions of Nearby Volcanoes: Java
VAAC Regions of Nearby Volcanoes: Darwin
FIR Regions of Nearby Volcanoes: Unknown

Kelut eruption is detected in a timely manner



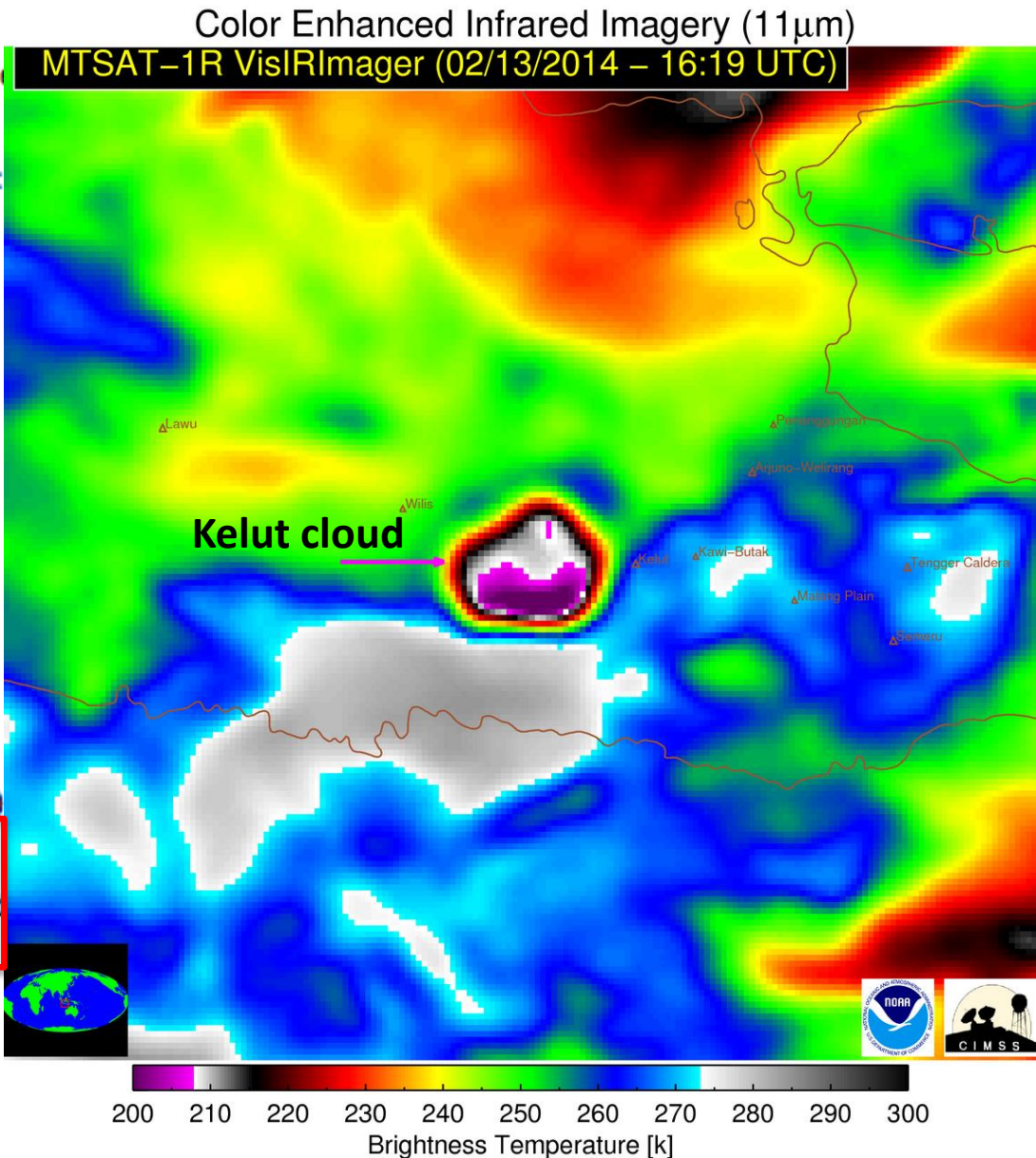
@*****VOLCANIC ALERTS*****
STARTING DATE/TIME OF IMAGE: 2014-02-13 16:19:00 [UTC]
PRODUCTION DATE/TIME OF ALERT: 2014-02-14 16:49:44 [UTC]
PRIMARY INSTRUMENT: MTSAT-1r Vis/IR_Imager
WMO SPACECRAFT ID: 171
LOCATION/ORBIT: GEO
L1 FILE: mtsat01_1_2014_044_1619.area.gz
VOLCANO DATABASE: /data/common/VOLCAT_DATA/al
NUMBER OF ASH CLOUD ALERTS: 0
NUMBER OF VOLCANIC Cb ALERTS: 1
NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS:
NUMBER OF SO2 CLOUD ALERTS: 0

REPORT WITH IMAGES:
<http://volcano.ssec.wisc.edu/alert/report/12238>

POSSIBLE VOLCANIC ERUPTION DETECTED
Alert Status: New Alert Object
Latitude of Radiative Center: -8.012 [degrees]
Longitude of Radiative Center: 112.265 [degrees]
Mean Viewing Angle: 33.92 [degrees]
Mean Solar Zenith Angle: 157.44 [degrees]
Nearby Volcanoes (meeting alert criteria):
Kelut(9.99 km)
Kawi-Butak(23.00 km)
Maximum Height [AMSL]: 21.2 [km] (69649.79 [ft])
90th Percentile Height [AMSL]: 19.2 [km] (62995.20 [ft])
Mean Tropopause Height [AMSL]: 16.4 [km] (53783.42 [ft])
Trend in IR Brightness Temperature: -53.16 [K]
Vertical Growth Rate Time Interval: 10 [minutes]
Vertical Growth Rate Anomaly: 24.75 [number of stddev ab
Total Area: 1270.01 [km^2]

Geographic Regions of Nearby Volcanoes: Java
VAAC Regions of Nearby Volcanoes: Darwin
FIR Regions of Nearby Volcanoes: Unknown

Kelut eruption is detected in a timely manner



The next generation of GEO satellites are very well suited for automated detection of volcanic eruption through cloud object growth rate analysis!

NUMBER OF ASH CLOUD ALERTS: 0
NUMBER OF VOLCANIC Cb ALERTS: 1
NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS: 0
NUMBER OF SO2 CLOUD ALERTS: 0

REPORT WITH IMAGES:

<http://volcano.ssec.wisc.edu/alert/report/12238>

POSSIBLE VOLCANIC ERUPTION DETECTED

Alert Status: New Alert Object

Latitude of Radiative Center: -8.012 [degrees]

Longitude of Radiative Center: 112.265 [degrees]

Mean Viewing Angle: 33.92 [degrees]

Mean Solar Zenith Angle: 157.44 [degrees]

Nearby Volcanoes (meeting alert criteria):

Kelut(9.99 km)

Kawi-Butak(23.00 km)

Maximum Height [AMSL]: 21.2 [km] (69649.79 [ft])

90th Percentile Height [AMSL]: 19.2 [km] (62995.20 [ft])

Mean Tropopause Height [AMSL]: 16.4 [km] (53783.42 [ft])

Trend in IR Brightness Temperature: -53.16 [K]

Vertical Growth Rate Time Interval: 10 [minutes]

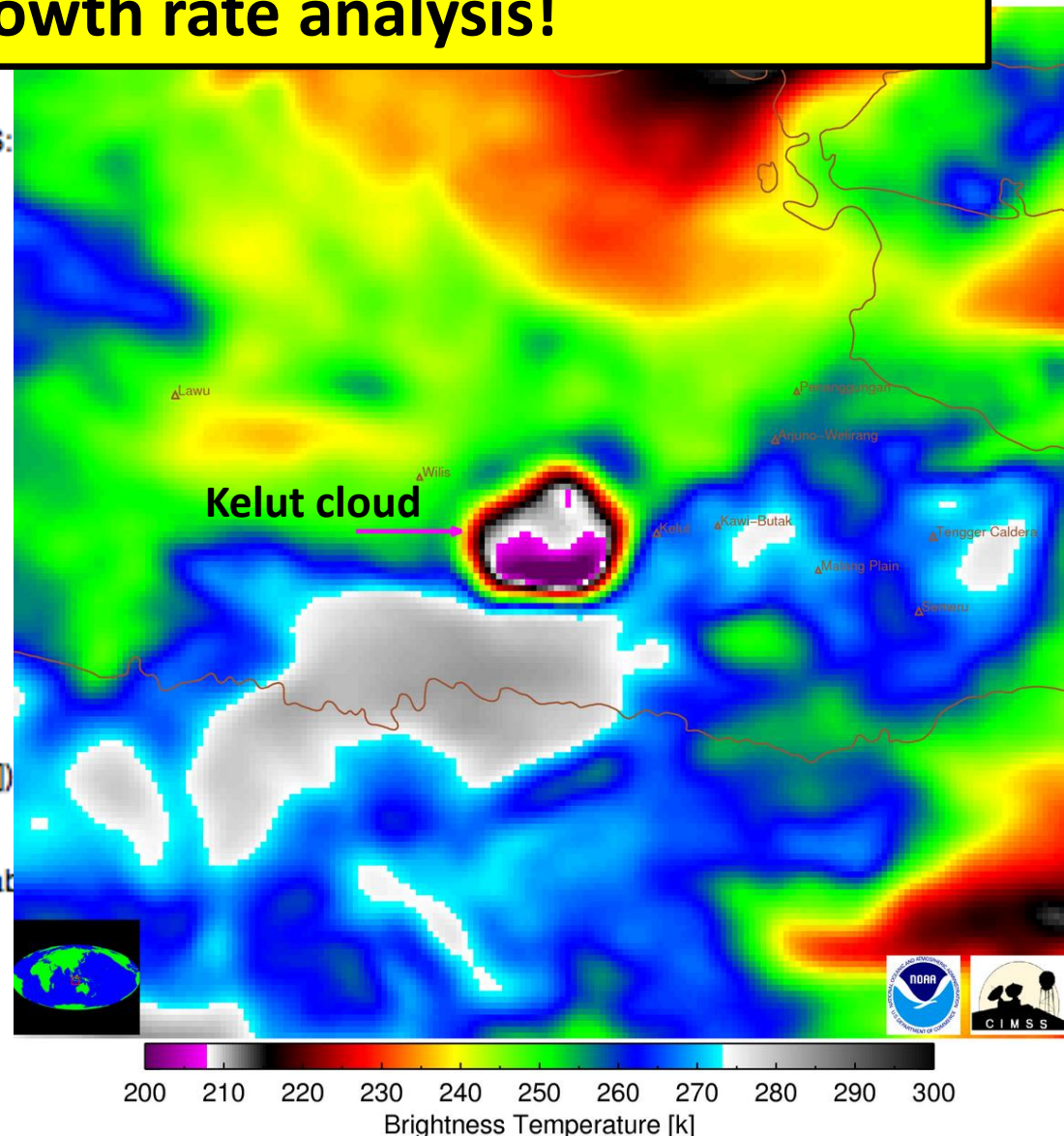
Vertical Growth Rate Anomaly: 24.75 [number of stddev ab

Total Area: 1270.01 [km^2]

Geographic Regions of Nearby Volcanoes: Java

VAAC Regions of Nearby Volcanoes: Darwin

FIR Regions of Nearby Volcanoes: Unknown



From: Mike Pavolonis NOAA Federal
Subject: NOAA/CIMSS Volcanic Cloud Alert
Date: April 4, 2014 6:38:49 PM CDT
To: Mike Pavolonis NOAA Federal

@*****VOLCANIC ALERTS*****

STARTING DATE/TIME OF IMAGE: 2014-04-04 23:15:00 [UTC]
PRIMARY INSTRUMENT: GOES-13 Imager
WMO SPACECRAFT ID: 257
LOCATION/ORBIT: GEO
L1 FILE: goes13_4_2014_094_2315.area.gz
VOLCANO DATABASE: /data/common/VOLCAT_DATA/alerts/Volca
NUMBER OF ASH CLOUD ALERTS: 0
NUMBER OF VOLCANIC Cb ALERTS: 1
NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS: 0
NUMBER OF SO2 CLOUD ALERTS: 0

REPORT WITH IMAGES:

<http://volcano.ssec.wisc.edu/alert/report/13264>

POSSIBLE VOLCANIC ERUPTION DETECTED

Alert Status: New Alert Object

Latitude of Radiative Center: -1.461 [degrees]

Longitude of Radiative Center: -78.443 [degrees]

Mean Viewing Angle: 4.45 [degrees]

Mean Solar Zenith Angle: 89.59 [degrees]

Nearby Volcanoes (meeting alert criteria):

Tungurahua(.62 km)

Maximum Height [AMSL]: 13.3 [km] (43739.11 [ft])

90th Percentile Height [AMSL]: 12.5 [km] (41012.50 [ft])

Mean Tropopause Height [AMSL]: 16.9 [km] (55536.23 [ft])

Trend in IR Brightness Temperature: -62.70 [K]

Vertical Growth Rate Time Interval: 30 [minutes]

Vertical Growth Rate Anomaly: 3.69 [number of stddev above mean]

Total Area: 92.78 [km^2]

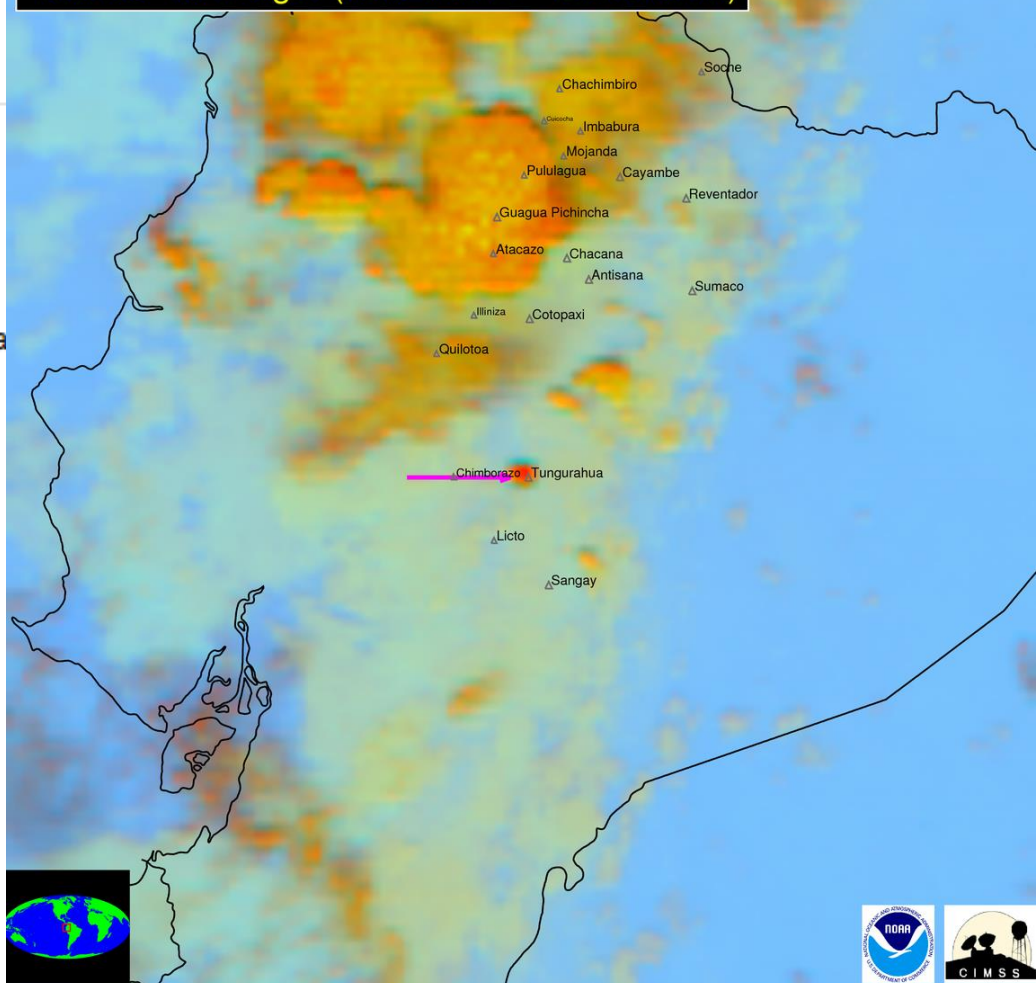
Geographic Regions of Nearby Volcanoes: Ecuador

VAAC Regions of Nearby Volcanoes: Washington

FIR Regions of Nearby Volcanoes: Unknown

False Color Imagery (13.3–11 μ m, 11–3.9 μ m, 11 μ m)

GOES-13 Imager (04/04/2014 – 23:15 UTC)



Annotation Key

(annotation colors are not related to colors in underlying image)

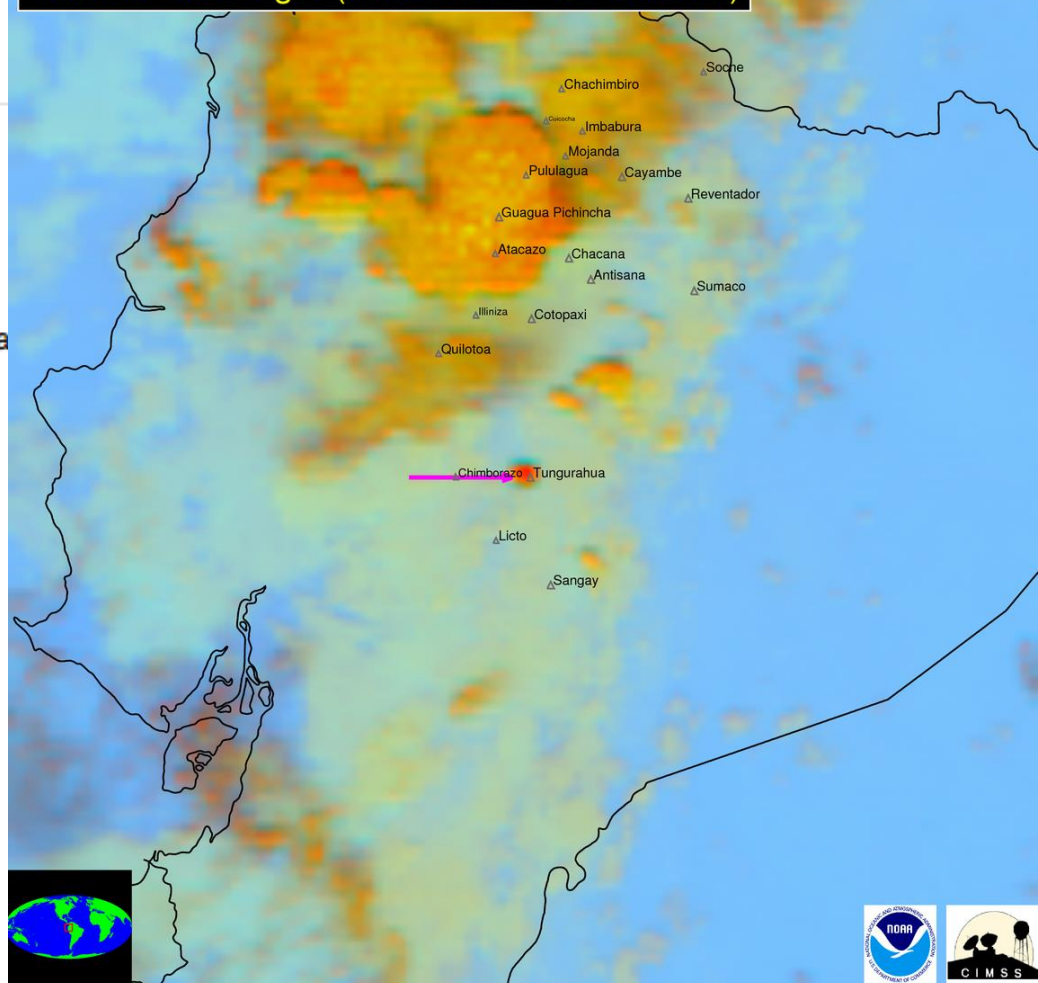
Ash/Dust Cloud Volcanic Cb SO₂ Thermal Anomaly



From: Mike Pavolonis NOAA Federal
Subject: NOAA/CIMSS Volcanic Cloud Alert
Date: April 4, 2014 6:38:49 PM CDT
To: Mike Pavolonis NOAA Federal

False Color Imagery (13.3–11 μ m, 11–3.9 μ m, 11 μ m)

GOES-13 Imager (04/04/2014 – 23:15 UTC)



@*****VOLCANIC ALERTS*****

STARTING DATE/TIME OF IMAGE: 2014-04-04 23:15:00 [UTC]

PRIMARY INSTRUMENT: GOES-13 Imager

WMO SPACECRAFT ID: 257

LOCATION/ORBIT: GEO

L1 FILE: goes13_4_2014_094_2315.area.gz

VOLCANO DATABASE: /data/common/VOLCAT_DATA/alerts/Volca

NUMBER OF ASH CLOUD ALERTS: 0

NUMBER OF VOLCANIC Cb ALERTS: 1

NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS: 0

NUMBER OF SO2 CLOUD ALERTS: 0

REPORT WITH IMAGES:

<http://volcano.ssec.wisc.edu/alert/report/13264>

POSSIBLE VOLCANIC ERUPTION DETECTED

Alert Status: New Alert Object

Latitude of Radiative Center: -1.461 [degrees]

Longitude of Radiative Center: -78.443 [degrees]

Mean Viewing Angle: 4.45 [degrees]

Mean Solar Zenith Angle: 89.59 [degrees]

Nearby Volcanoes (meeting alert criteria):

Tungurahua(.62 km)

Maximum Height [AMSL]: 13.3 [km] (43739.11 [ft])

90th Percentile Height [AMSL]: 12.5 [km] (41012.50 [ft])

Mean Tropopause Height [AMSL]: 16.9 [km] (55536.23 [ft])

Trend in IR Brightness Temperature: -62.70 [K]

Vertical Growth Rate Time Interval: 30 [minutes]

Vertical Growth Rate Anomaly: 3.69 [number of stddev above mean]

Total Area: 92.78 [km^2]

Annotation Key

(annotation colors are not related to colors in underlying image)
Ash/Dust Cloud Volcanic Cb SO₂ Thermal Anomaly

Geographic Regions of Nearby Volcanoes: Ecuador

VAAC Regions of Nearby Volcanoes: Washington

FIR Regions of Nearby Volcanoes: Unknown

Primary Limitations

- Volcanic ash must be the highest cloud layer
- The products will be degraded if L1 sensor data is degraded
- The ash cloud properties, and to a lesser extent, the ash detection results, will be more accurate if determined from a more advanced sensor (methods are being explored to address this issue)
- The selection criteria applied to cloud objects generally works well, but is still being refined
- Low level ash plumes that have a very similar temperature as the surface or warmer than the surface will often be missed by our ash detection algorithm at the present time



Alert subscription service will be opened to all VAACs and collaborators for beta testing this summer

CIMSS » Volcanic Cloud Monitoring » Alert Subscriptions

Volcanic Cloud Monitoring — NOAA/CIMSS

[Home](#)[Sector Imagery](#)[Alerts](#)[Subscriptions](#)[Tutorials](#)[Logout \(justins@ssec.wisc.edu\)](#)

Add Alert Subscription

Note: you may only subscribe to 5 subscriptions.

| | |
|------------------------|--|
| Send alerts to me via: | <input type="radio"/> SMS: <input type="text"/> |
| | <small>(Only alpha-numeric characters as well as spaces, dashes, plus signs and parentheses are allowed)</small> |
| | <input type="radio"/> Email: <input type="text"/> |

| Alert Type | Region | WMO Spacecraft | |
|----------------------|----------------------|----------------------|----------------------|
| | | Exclude List | Include List |
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |

Problems with website: [Webmaster contact form](#)



Alert subscription service will be opened to all VAACs and collaborators for beta testing this summer

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Add Alert Subscription

Note: each user may set up a maximum of 5 (combination of email and SMS) subscriptions.

Send alerts to me via:

☐ SMS:

(Only alpha-numeric characters as well as spaces, dashes, plus signs and parentheses are allowed)

☒ Email:

myemail@ssec.wisc.edu

Alert Type



Volcanic Ash Cloud
Volcanic Thermal Anomaly
Volcanic Cb

Geographical Coverage of Alerts



Click here to select a region

WMO Spacecraft (optional)

Exclude List

Include List

Click here to add list

Click here to add list

Submit

Problems with website: [Webmaster contact form](#)



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Volcanic Cloud Monitoring — NOAA/CIMSS

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Add Alert Subscription

Note: each user may set up a maximum of 5 (combination of email and SMS) subscriptions.

Send alerts to me via:

☐ SMS:

(Only alpha-numeric characters as well as spaces, dashes, plus signs and parentheses are allowed)

☒ Email:

myemail@ssec.wisc.edu

| Alert Type | | Geographical Coverage of Alerts | | WMO Spacecraft (optional) | |
|----------------------------------|---|--|--|---|---|
| <input type="button" value="+"/> | <input type="button" value="-"/> Volcanic Ash Cloud | <input type="radio"/> Volcanic Region | <input checked="" type="radio"/> VAAC Region | Exclude List | Include List |
| | | <input type="text" value="Select a region"/> | | <input type="text" value="Click here to add list"/> | <input type="text" value="Click here to add list"/> |
| | | Update | | | |
| | | <input type="button" value="Submit"/> | | | |

Problems with website: [Webmaster contact form](#)



Alert subscription service will be opened to all VAACs and collaborators for beta testing this summer

CIMSS » Volcanic Cloud Monitoring » Alert Subscriptions

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[Home](#)[Satellite Imagery](#)[Alerts](#)[Tutorials](#)[Links](#)[Logout \(justins@ssec.wisc.edu\)](#)

Add Alert Subscription

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Send alerts to me via:

☐ SMS:

(Only alpha-numeric characters as well as spaces, dashes, plus signs and parentheses are allowed)

☒ Email:

myemail@ssec.wisc.edu

| | | | |
|--|--|---|-----------------------------------|
| Alert Type | | WMO Spacecraft (optional) | |
| <div><div>+ -</div><div>Volcanic Ash Cloud</div></div> | | Exclude List | Include List |
| Geographical Coverage of Alerts | | <div>GOES-13 GOES-14 GOES-15 MODIS-Terra</div> <div>Update List</div> | <div>Click here to add list</div> |
| <div><input type="radio"/> Volcanic Region <input checked="" type="radio"/> VAAC Region</div> <div>Select a region</div> <div>Update</div> | | | |
| <div>Submit</div> | | | |

Problems with website: [Webmaster contact form](#)



Alert subscription service will be opened to all VAACs and collaborators for beta testing this summer

CIMSS » Volcanic Cloud Monitoring » Alert Subscriptions

Volcanic Cloud Monitoring — NOAA/CIMSS

[Home](#)[Satellite Imagery](#)[Alerts](#)[Tutorials](#)[Links](#)[Logout \(justins@ssec.wisc.edu\)](#)

Add Alert Subscription

Note: each user may set up a maximum of 5 (combination of email and SMS) subscriptions.

Send alerts to me via:

☐ SMS:

(Only alpha-numeric characters as well as spaces, dashes, plus signs and parentheses are allowed)

☒ Email:

myemail@ssec.wisc.edu

| Alert Type | | Geographical Coverage of Alerts | | WMO Spacecraft (optional) | |
|--|--------------------|---------------------------------------|--|--|------------------------|
| | | | | Exclude List | Include List |
| <div><div><div></div><div></div></div></div> | Volcanic Ash Cloud | <input type="radio"/> Volcanic Region | <input checked="" type="radio"/> VAAC Region | GOES-13 GOES-14 GOES-15 MODIS-Terra | Click here to add list |
| | | Select a region | | | |
| | | Update | | Update List | |
| <div>Submit</div> | | | | | |

Problems with website: [Webmaster contact form](#)



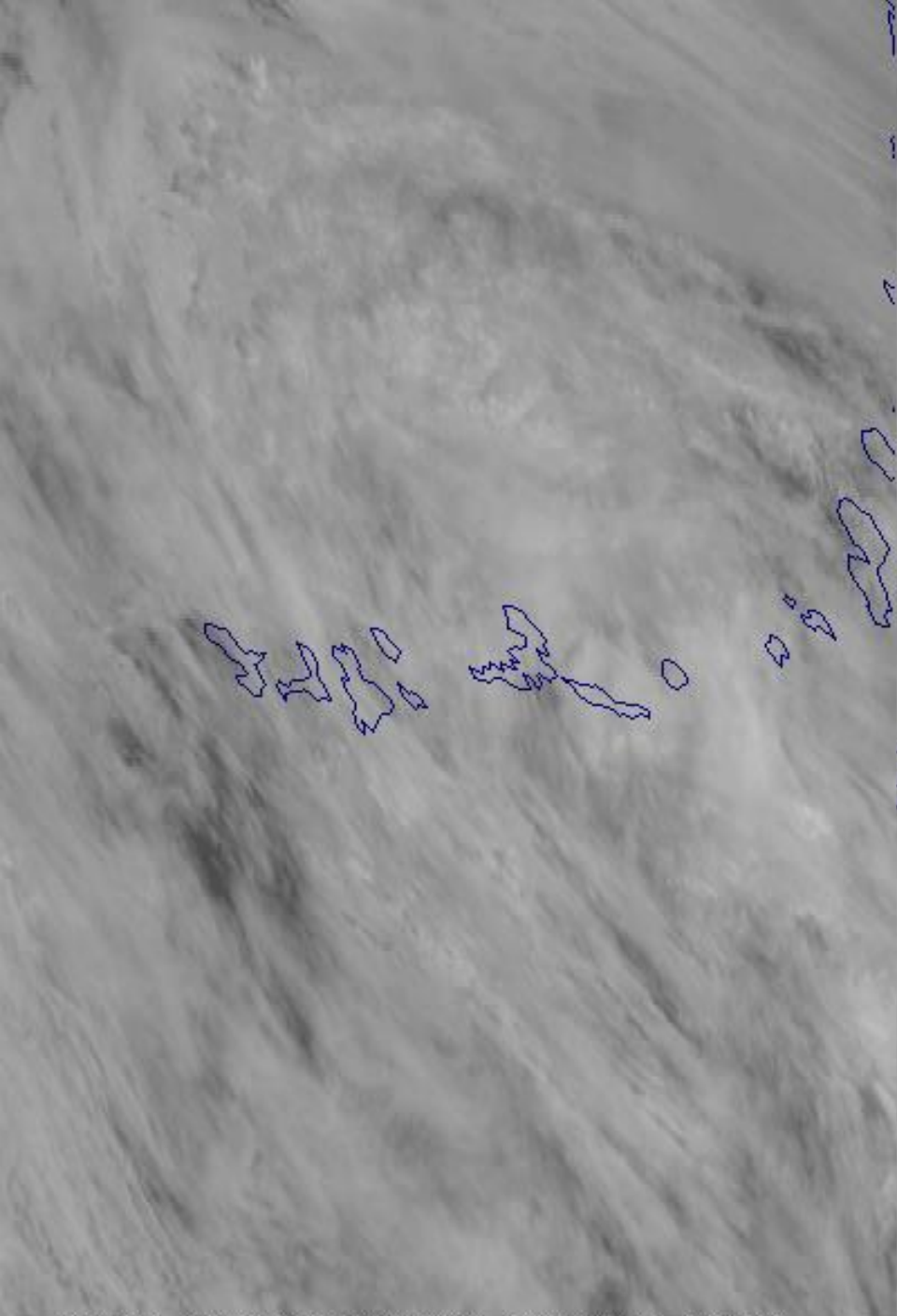


Marco Fulle - www.stromboli.net

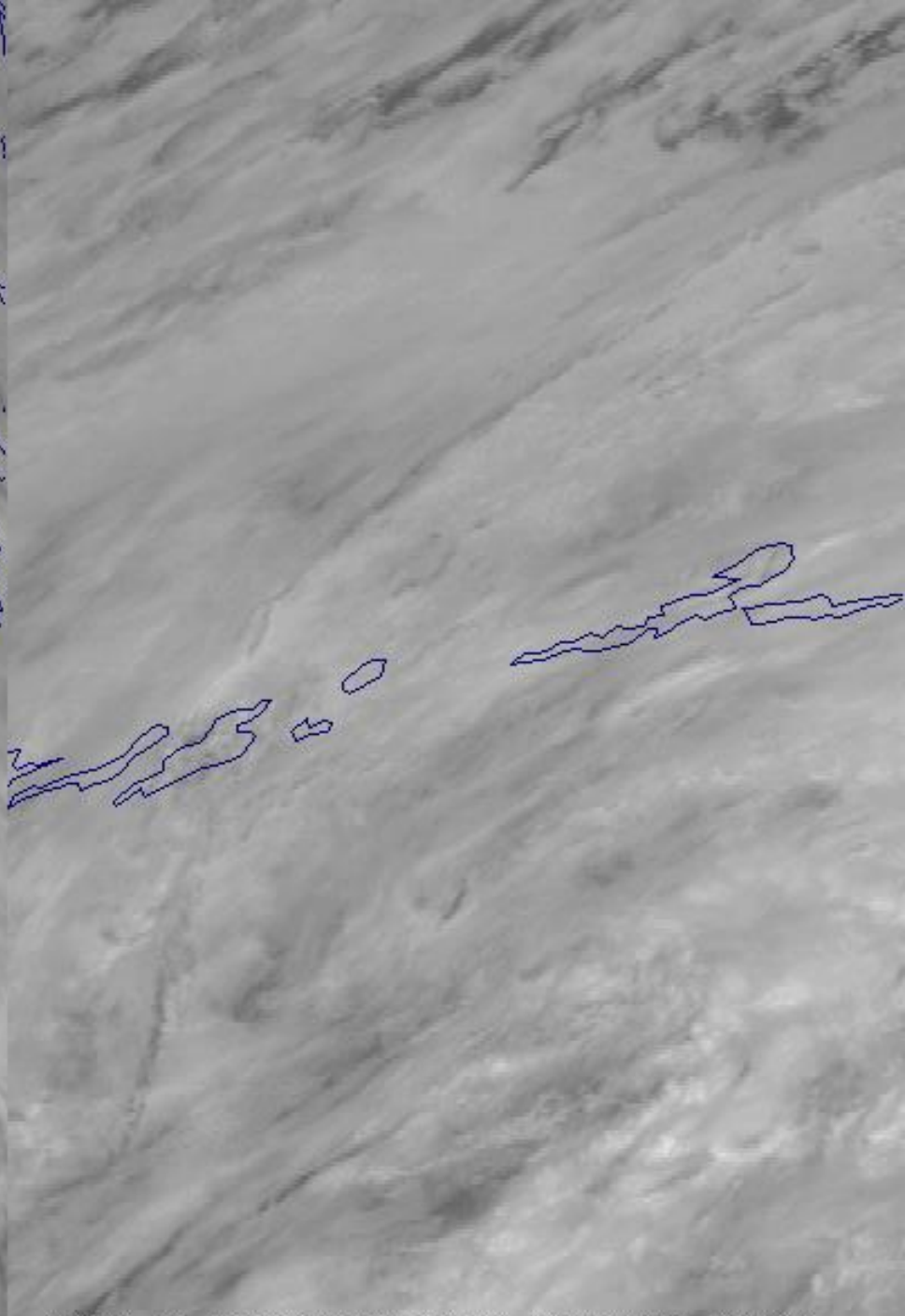


Analysis of 2008 Kasatochi eruption





MTSAT VIS 21:57UTC 07 AUG 2008 CIMSS



GOES-11 VIS 22:00UTC 07 AUG 2008 CIMSS

@*****VOLCANIC ALERTS*****

STARTING DATE/TIME OF IMAGE: 2008-08-08 04:45:59 [UTC]

PRIMARY INSTRUMENT: GOES-11 Imager

WMO SPACECRAFT ID: 255

LOCATION/ORBIT: GEO

L1 FILE: goes11_1_2008_221_0446.area.gz

VOLCANO DATABASE: /data/common/VOLCAT_DATA/alerts/V

NUMBER OF ASH CLOUD ALERTS: 0

NUMBER OF VOLCANIC Cb ALERTS: 1

NUMBER OF VOLCANIC THERMAL ANOMALY ALERTS: 0

NUMBER OF SO2 CLOUD ALERTS: 0

REPORT WITH IMAGES:

<http://volcano.ssec.wisc.edu/alert/report/10614>

POSSIBLE VOLCANIC ERUPTION DETECTED

Alert Status: New Alert Object

Latitude of Radiative Center: 52.161 [degrees]

Longitude of Radiative Center: -175.397 [degrees]

Mean Viewing Angle: 71.30 [degrees]

Mean Solar Zenith Angle: 67.53 [degrees]

Nearby Volcanoes (meeting alert criteria):

Kasatochi(7.84 km)

Koniuji(19.03 km)

Maximum Height [AMSL]: 13.7 [km] (45112.91 [ft])

90th Percentile Height [AMSL]: 13.2 [km] (43433.68 [ft])

Mean Tropopause Height [AMSL]: 10.6 [km] (34680.12 [ft])

Trend in IR Brightness Temperature: -44.67 [K]

Vertical Growth Rate Time Interval: 16 [minutes]

Vertical Growth Rate Anomaly: 13.99 [number of stddev above mean]

Total Area: 1045.84 [km^2]

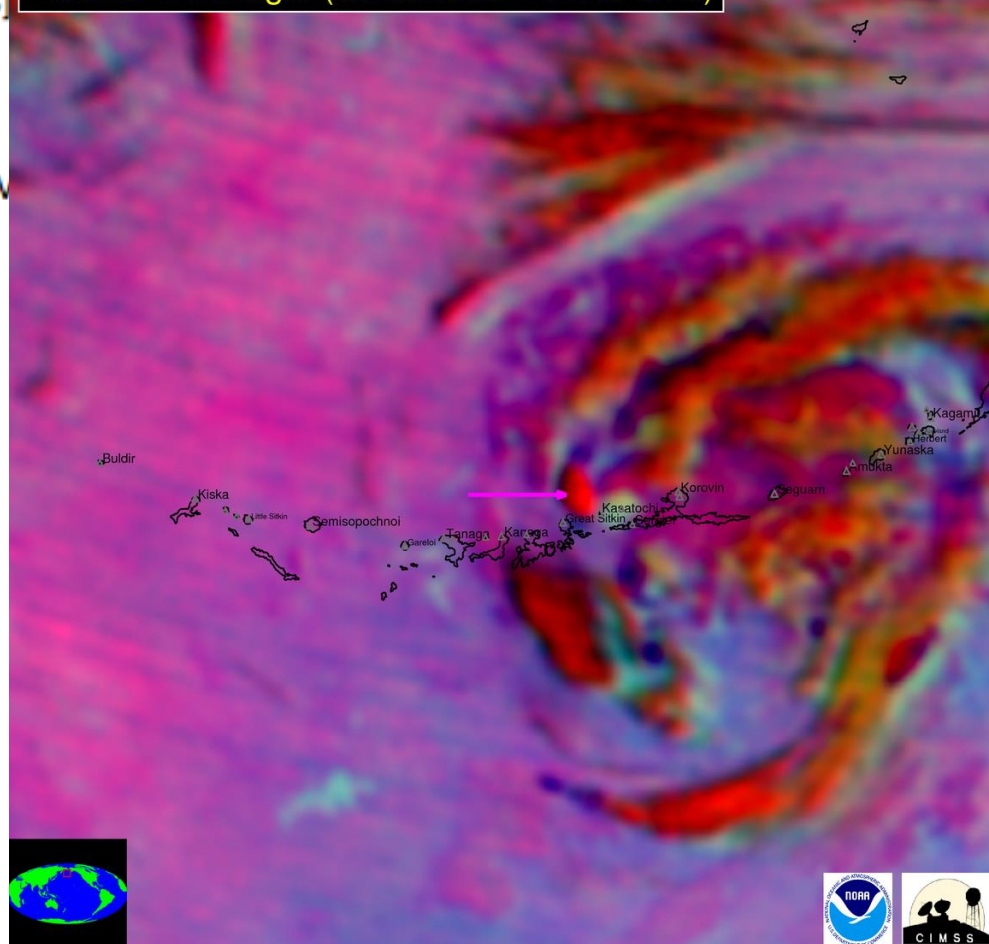
Geographic Regions of Nearby Volcanoes: Aleutian Is

VAAC Regions of Nearby Volcanoes: Anchorage

FIR Regions of Nearby Volcanoes: Unknown

False Color Imagery (12-11 μ m, 11-3.9 μ m, 11 μ m)

GOES-11 Imager (08/08/2008 - 04:46 UTC)



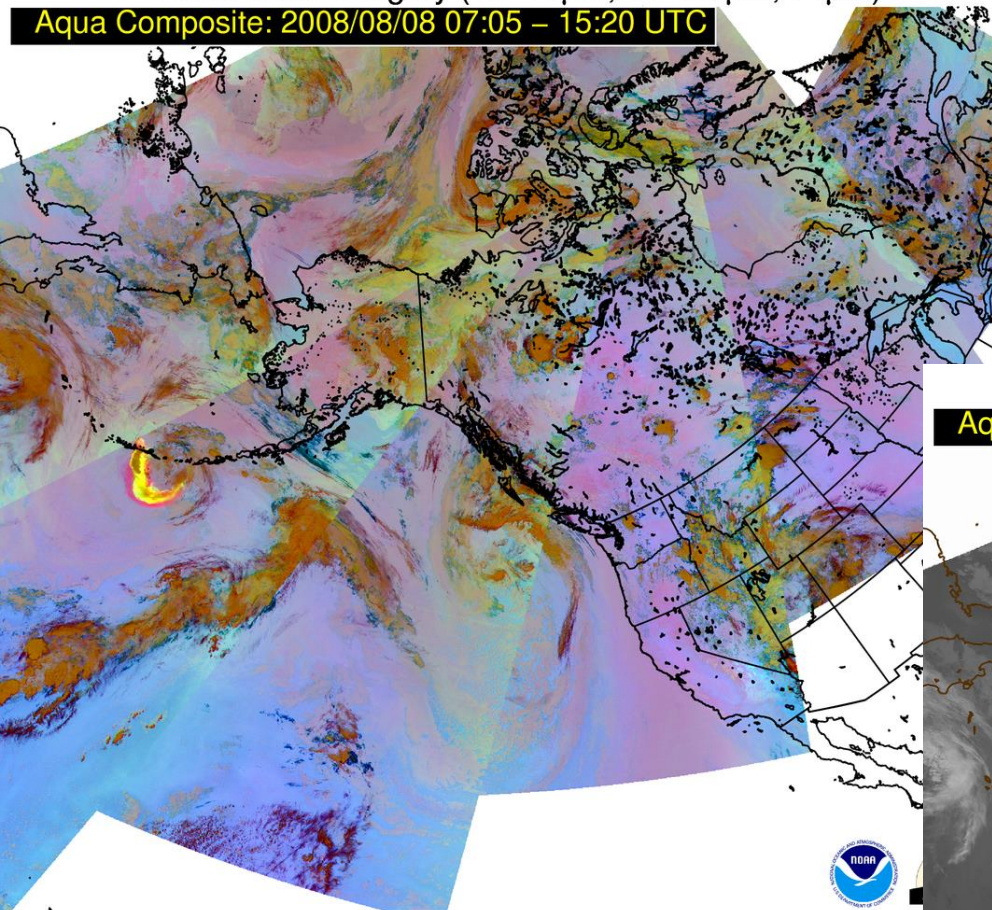
Annotation Key

(annotation colors are not related to colors in underlying image)

Ash/Dust Cloud Volcanic Cb SO₂ Thermal Anomaly

False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

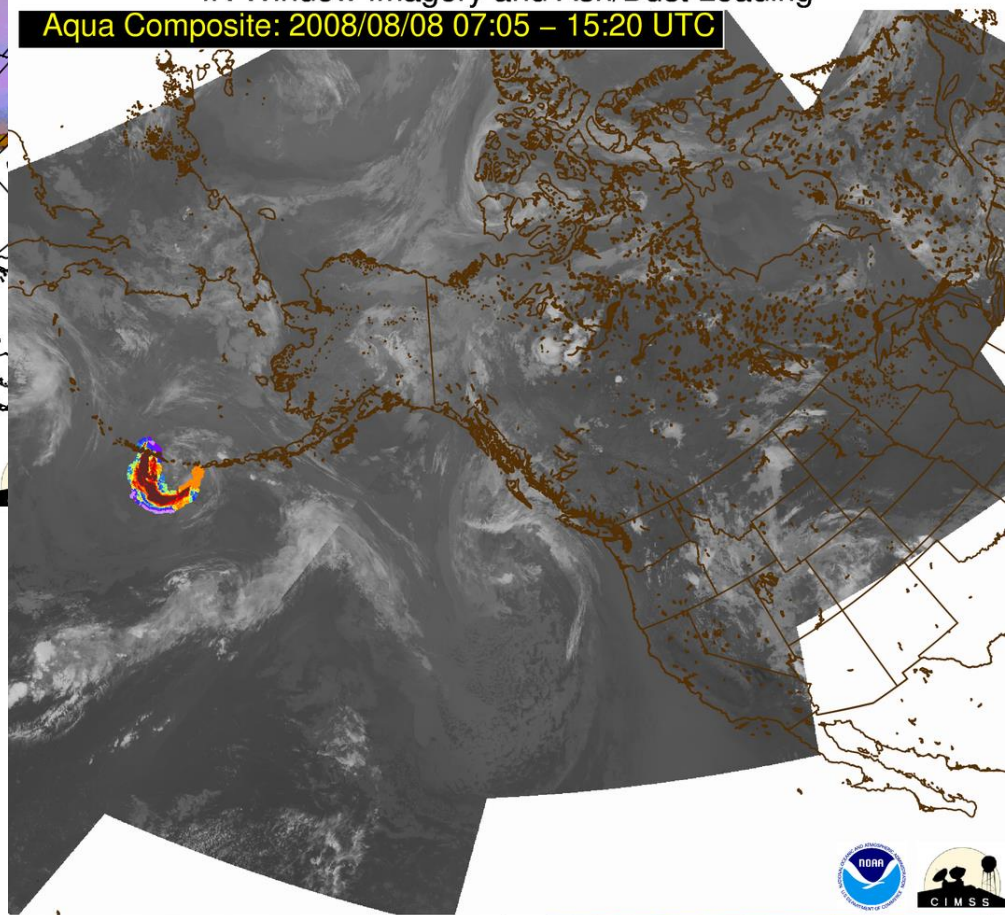
Aqua Composite: 2008/08/08 07:05 – 15:20 UTC



**Aqua MODIS descending node
August 8, 2008 (UTC)**

IR Window Imagery and Ash/Dust Loading

Aqua Composite: 2008/08/08 07:05 – 15:20 UTC



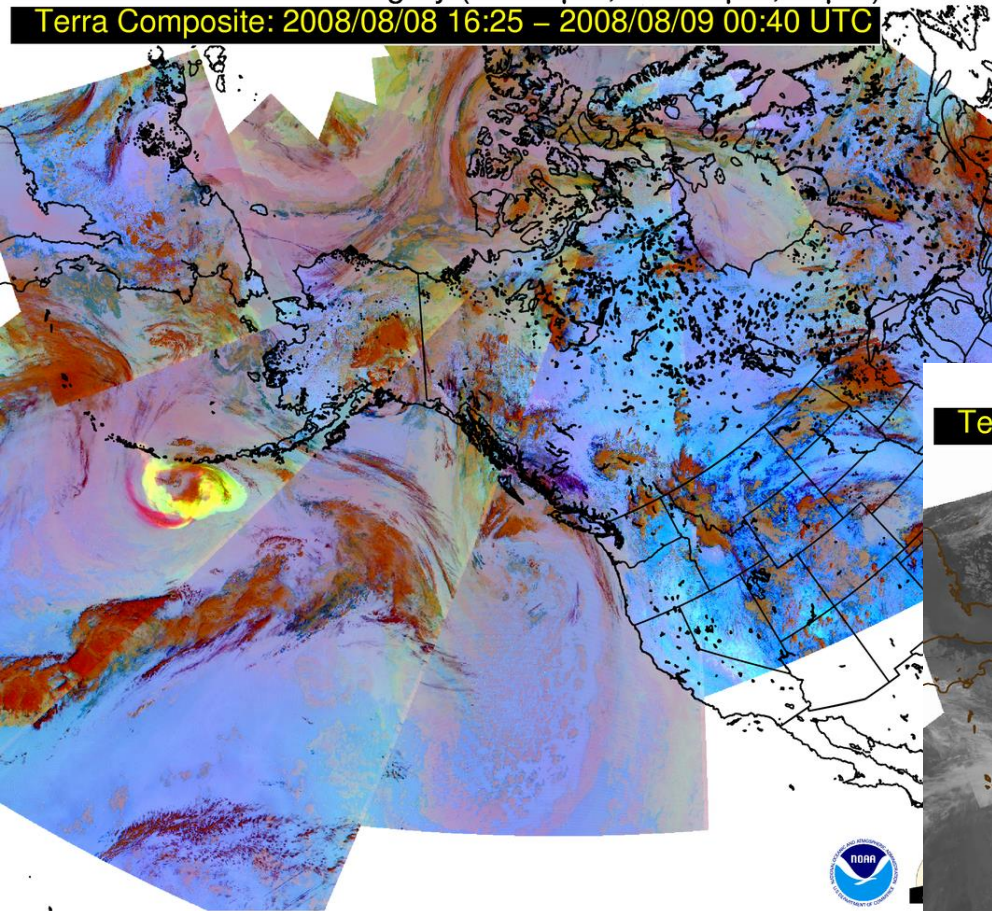
11 μ m BT [K]



Ash/Dust Loading [g/m²]

False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

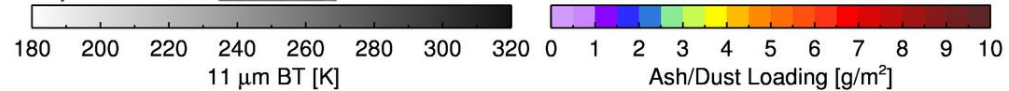
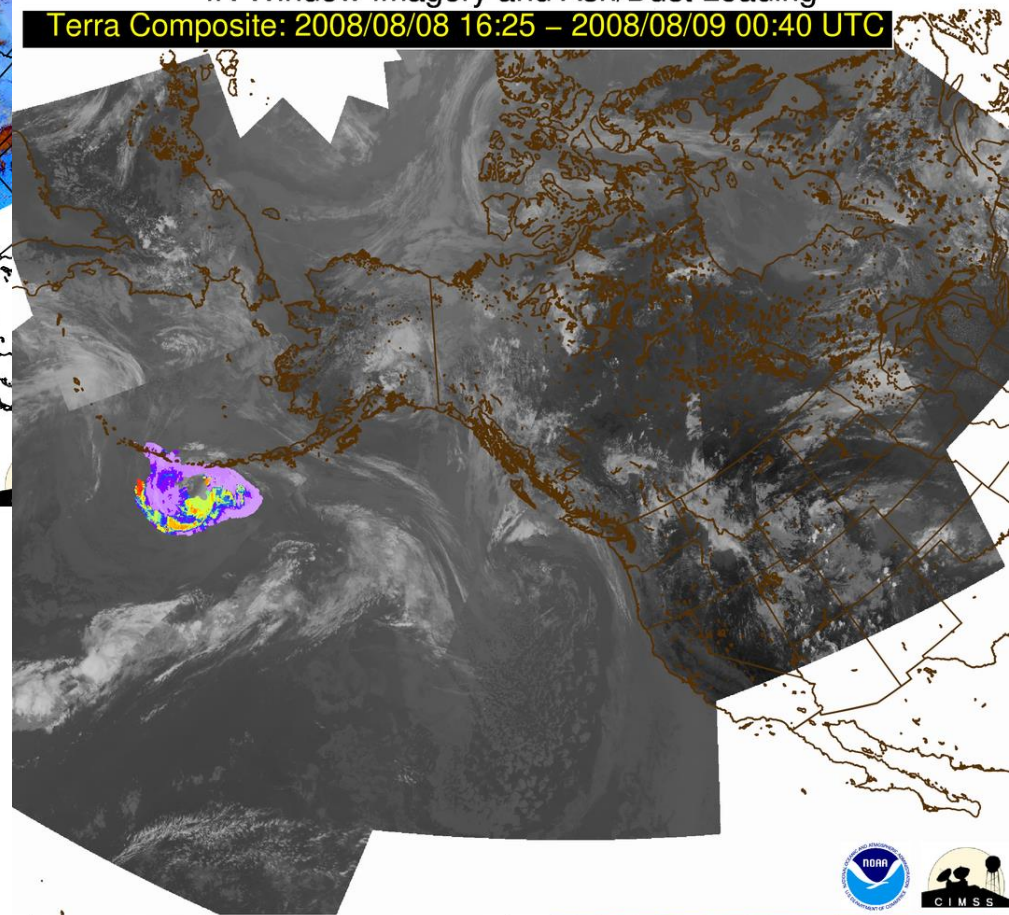
Terra Composite: 2008/08/08 16:25 – 2008/08/09 00:40 UTC



Terra MODIS descending node
August 9, 2008 (UTC)

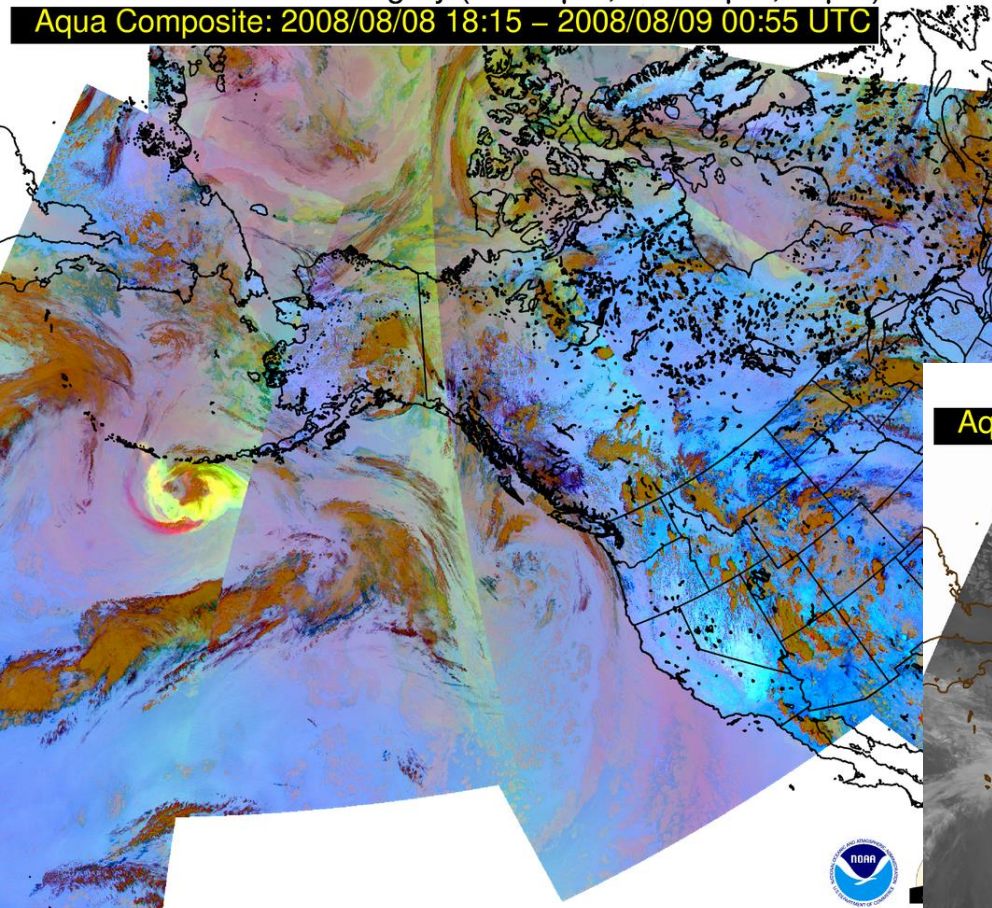
IR Window Imagery and Ash/Dust Loading

Terra Composite: 2008/08/08 16:25 – 2008/08/09 00:40 UTC



False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

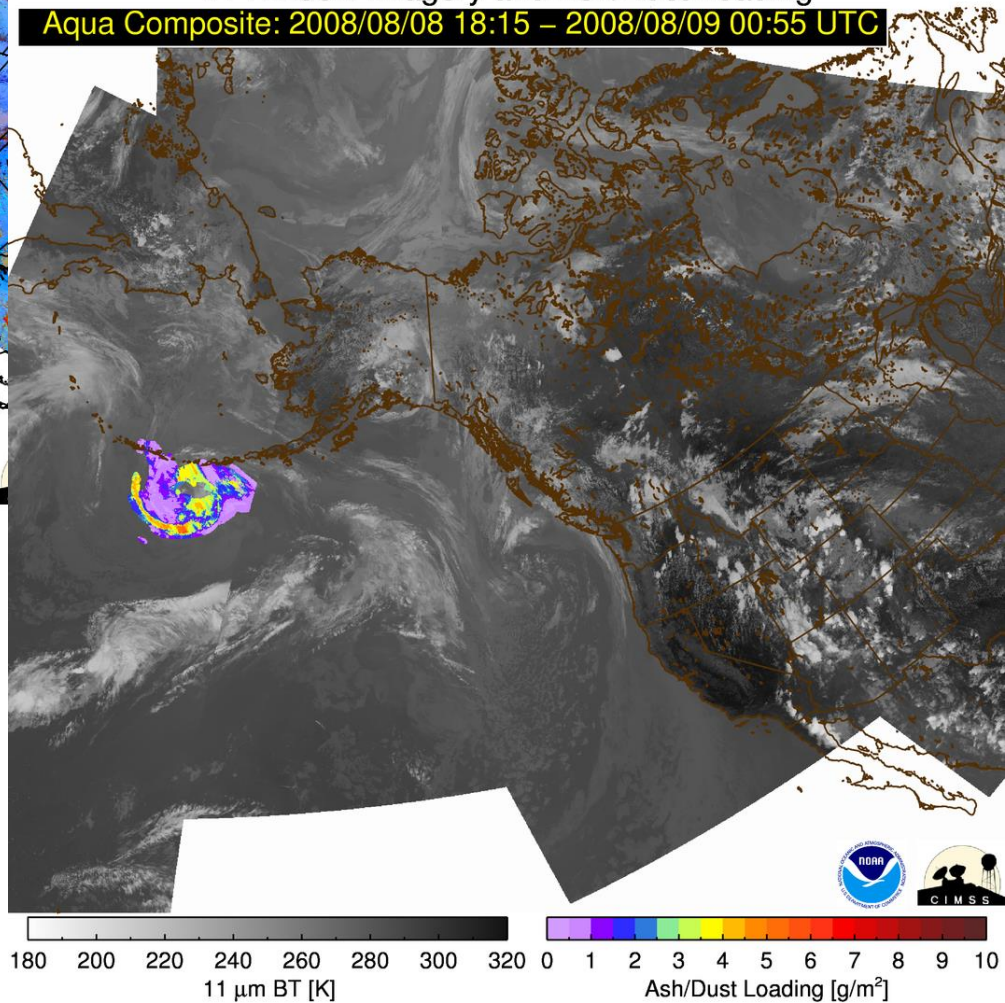
Aqua Composite: 2008/08/08 18:15 – 2008/08/09 00:55 UTC



Aqua MODIS ascending node
August 9, 2008 (UTC)

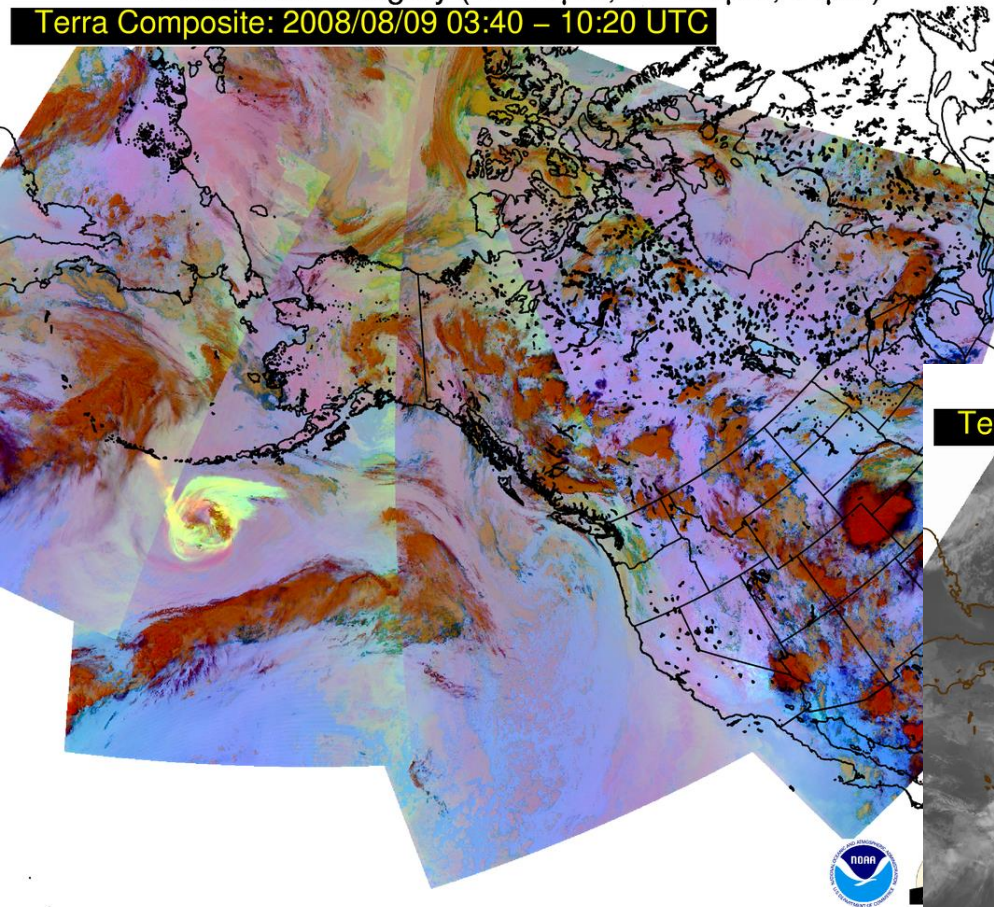
IR Window Imagery and Ash/Dust Loading

Aqua Composite: 2008/08/08 18:15 – 2008/08/09 00:55 UTC



False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

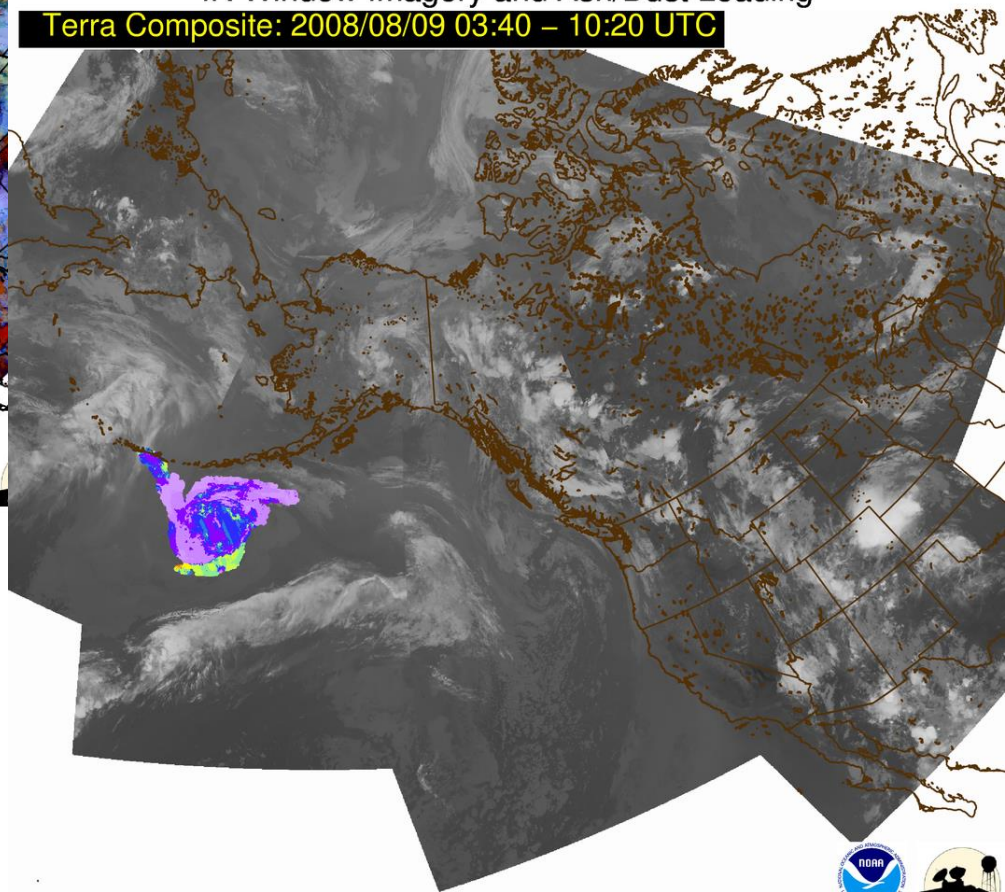
Terra Composite: 2008/08/09 03:40 – 10:20 UTC



Terra MODIS ascending node
August 9, 2008 (UTC)

IR Window Imagery and Ash/Dust Loading

Terra Composite: 2008/08/09 03:40 – 10:20 UTC



180 200 220 240 260 280 300 320
11 μ m BT [K]

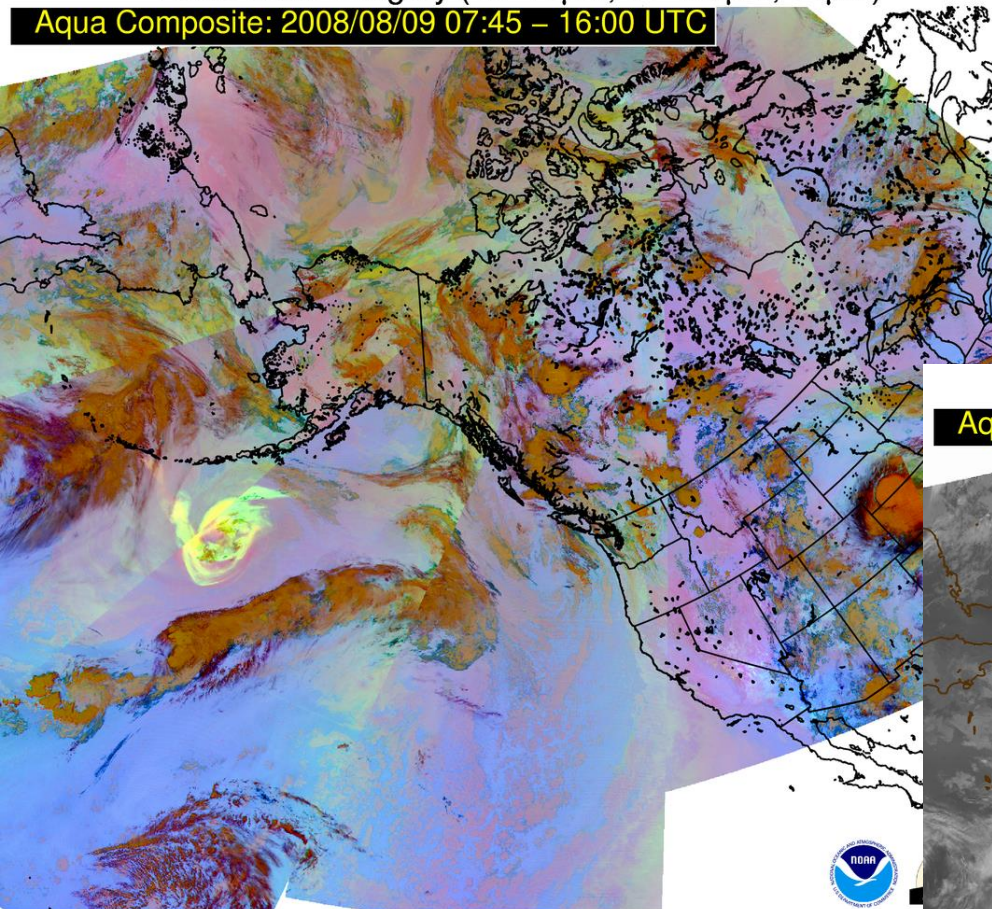


Ash/Dust Loading [g/m²]



False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

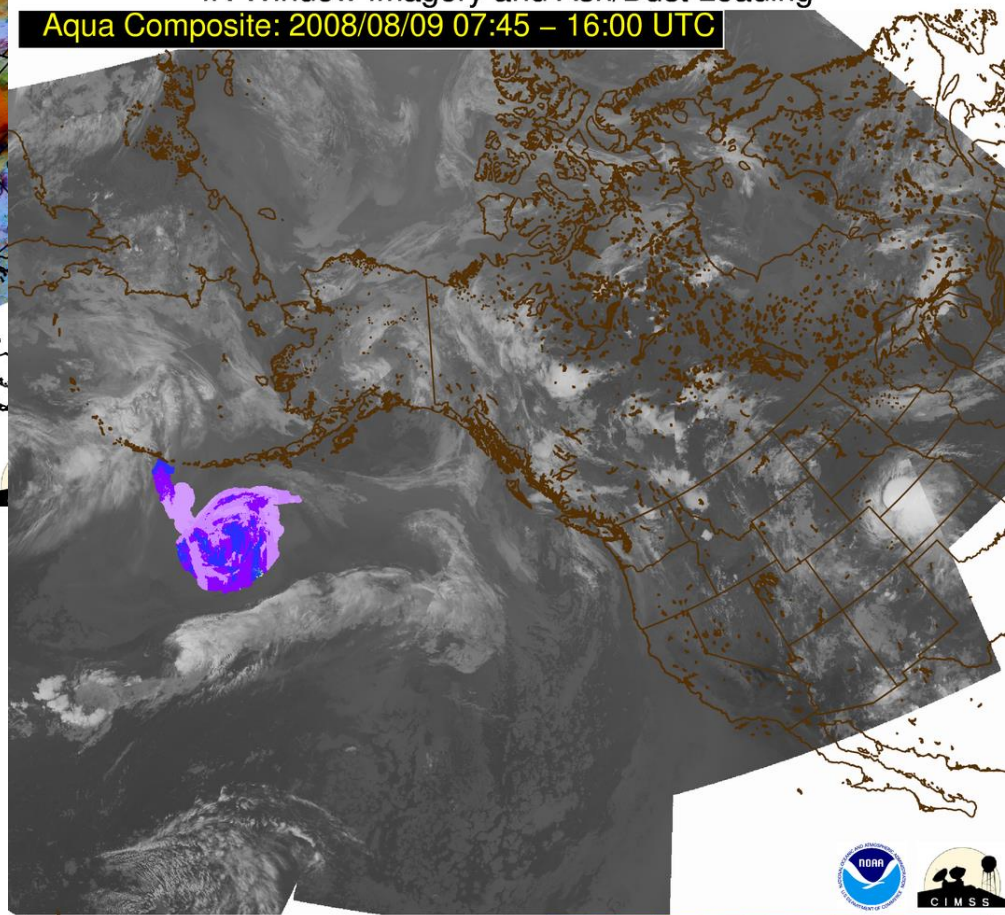
Aqua Composite: 2008/08/09 07:45 – 16:00 UTC



Aqua MODIS descending node
August 9, 2008 (UTC)

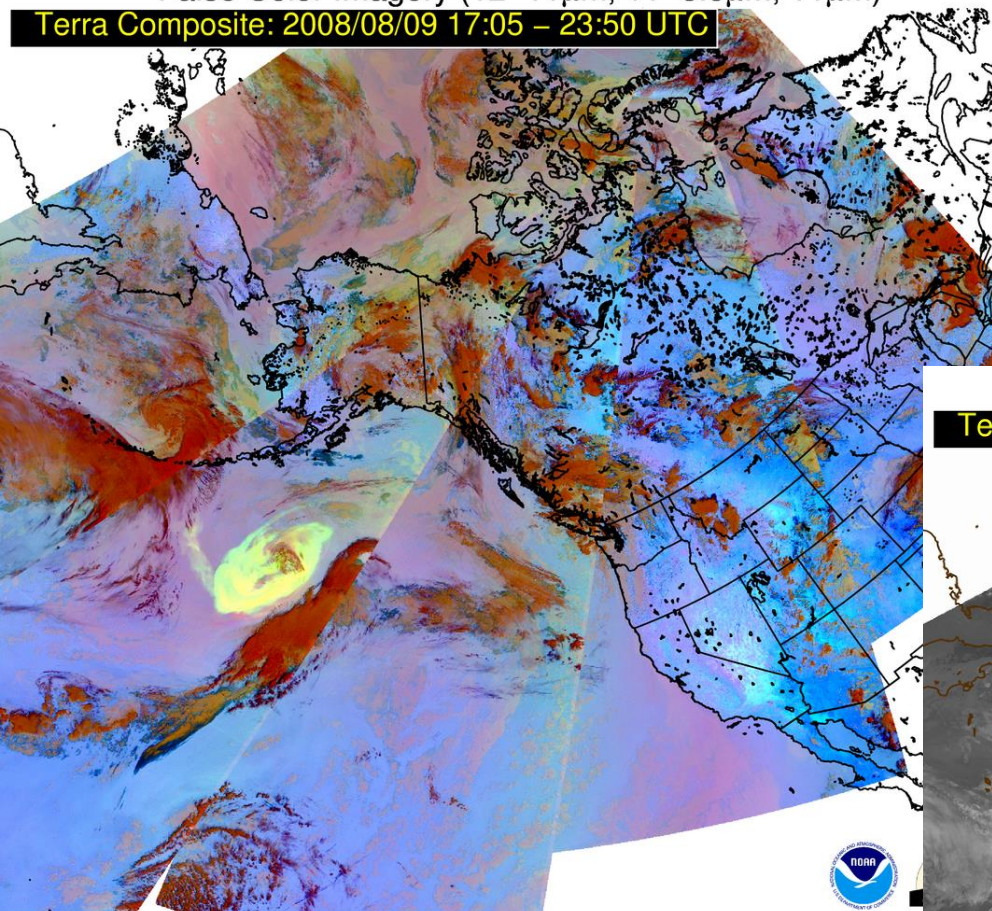
IR Window Imagery and Ash/Dust Loading

Aqua Composite: 2008/08/09 07:45 – 16:00 UTC



False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

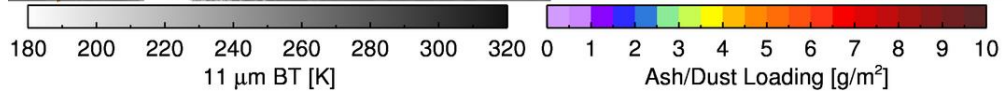
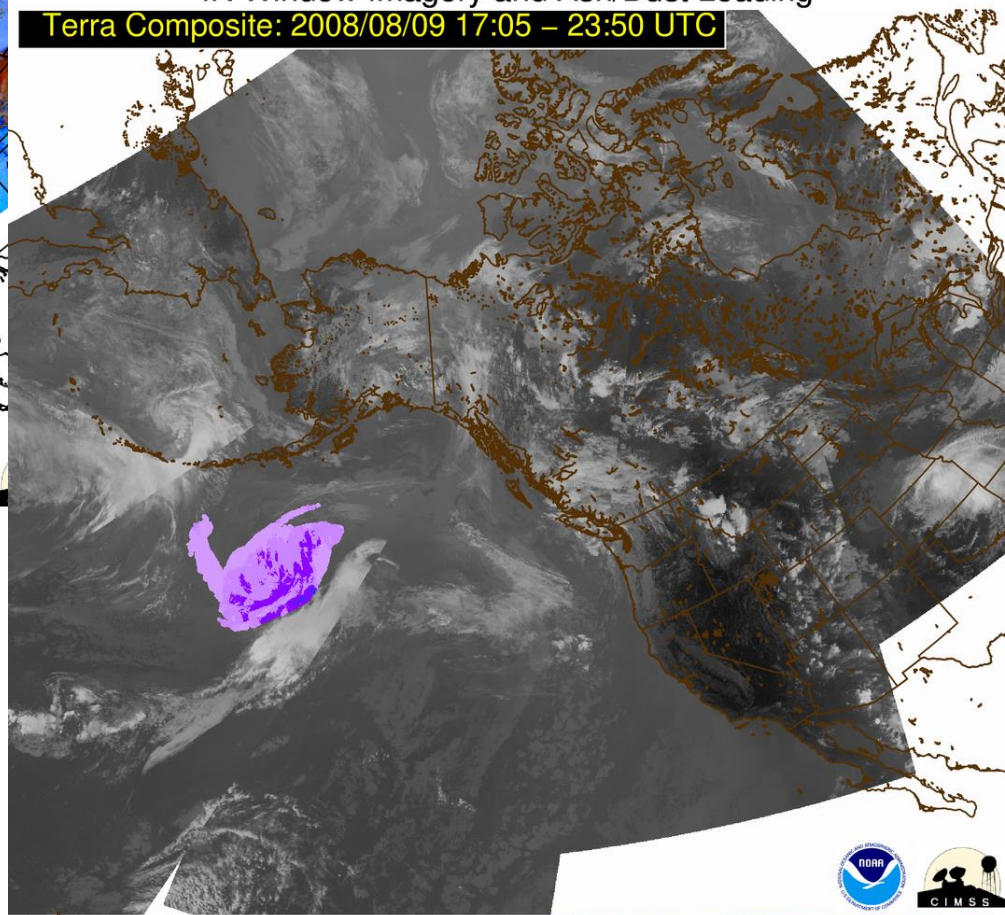
Terra Composite: 2008/08/09 17:05 – 23:50 UTC



Terra MODIS descending node
August 9, 2008 (UTC)

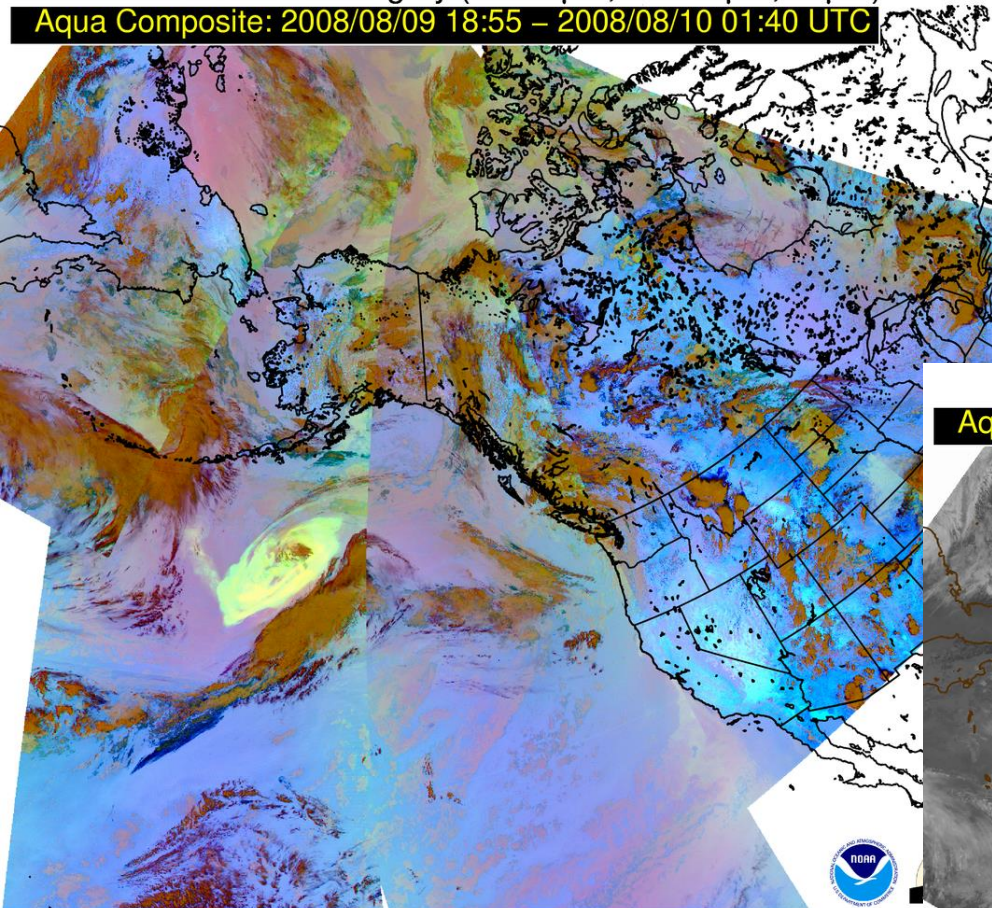
IR Window Imagery and Ash/Dust Loading

Terra Composite: 2008/08/09 17:05 – 23:50 UTC



False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

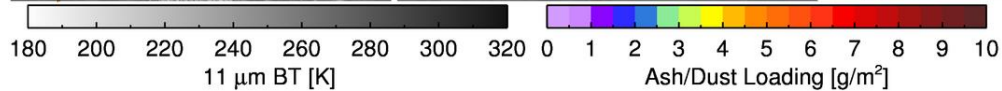
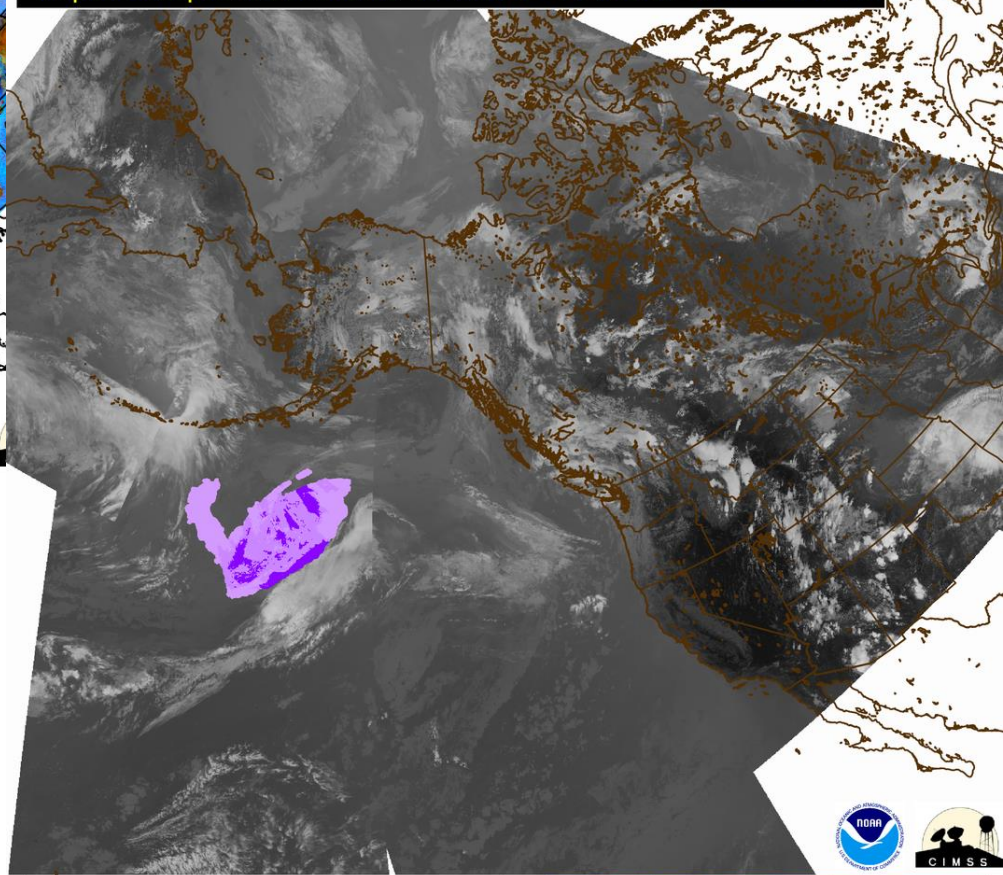
Aqua Composite: 2008/08/09 18:55 – 2008/08/10 01:40 UTC



**Aqua MODIS ascending node
August 10, 2008 (UTC)**

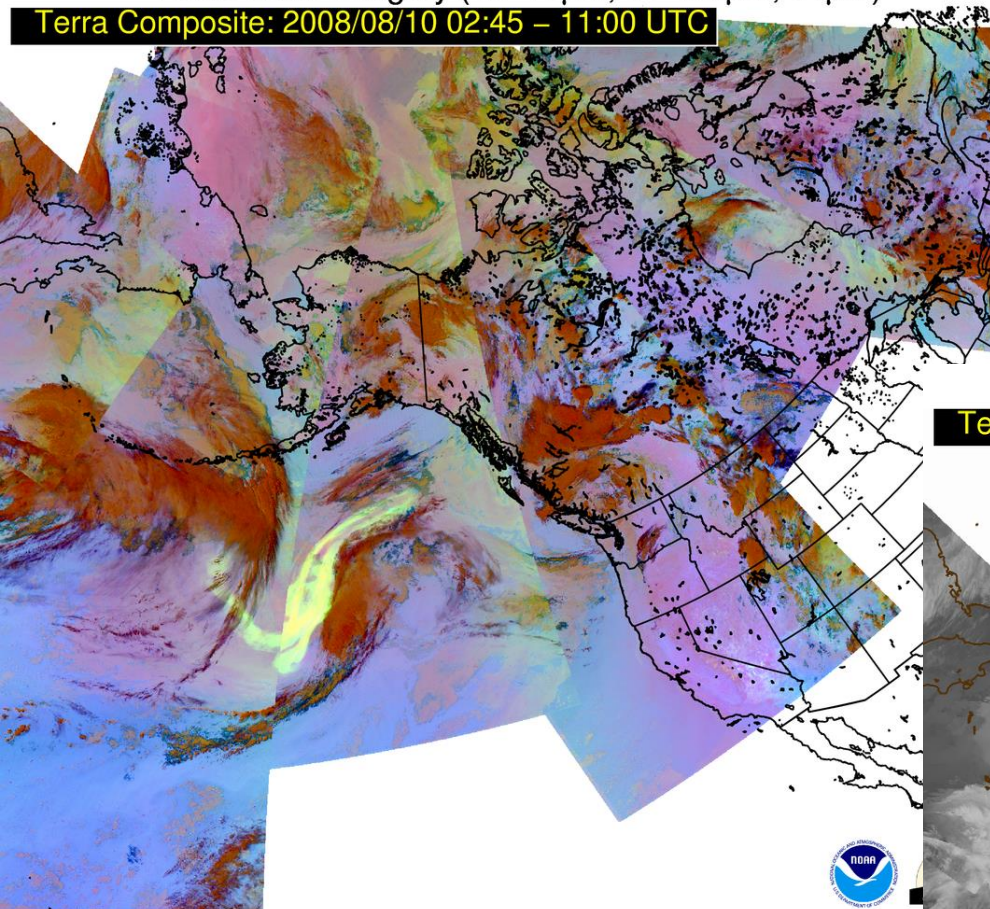
IR Window Imagery and Ash/Dust Loading

Aqua Composite: 2008/08/09 18:55 – 2008/08/10 01:40 UTC



False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

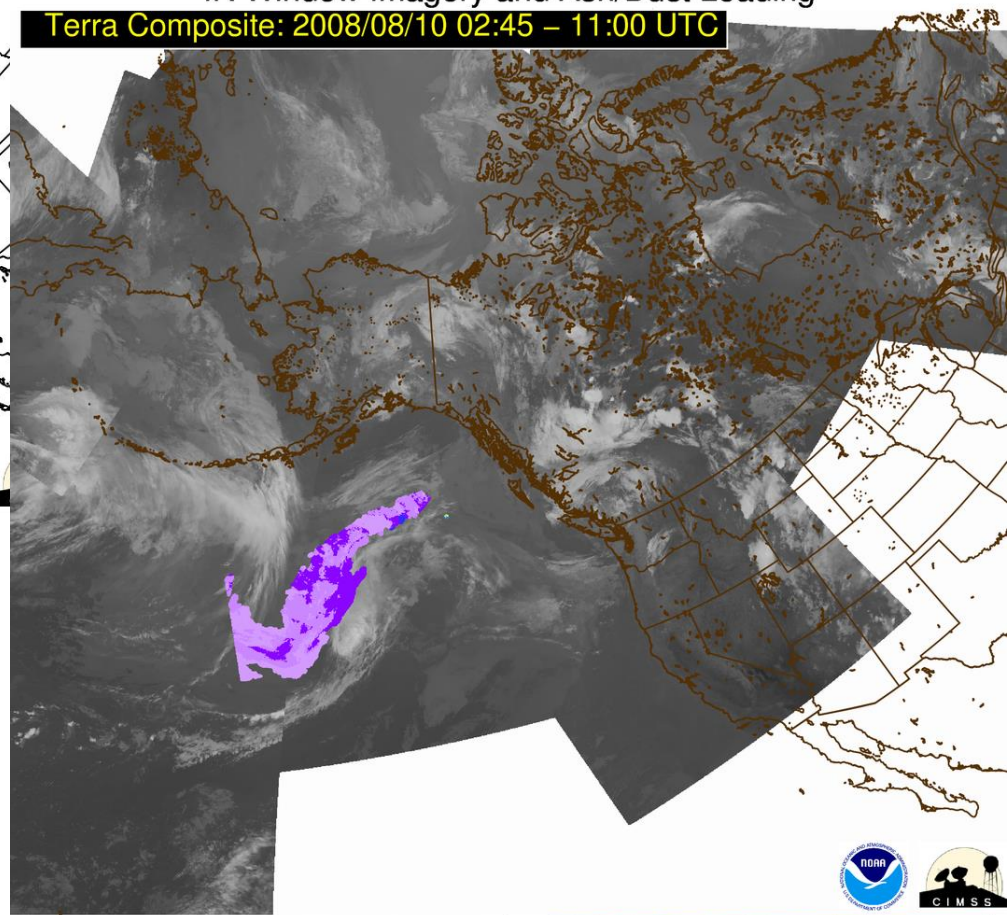
Terra Composite: 2008/08/10 02:45 – 11:00 UTC



Terra MODIS ascending node
August 10, 2008 (UTC)

IR Window Imagery and Ash/Dust Loading

Terra Composite: 2008/08/10 02:45 – 11:00 UTC



180 200 220 240 260 280 300 320

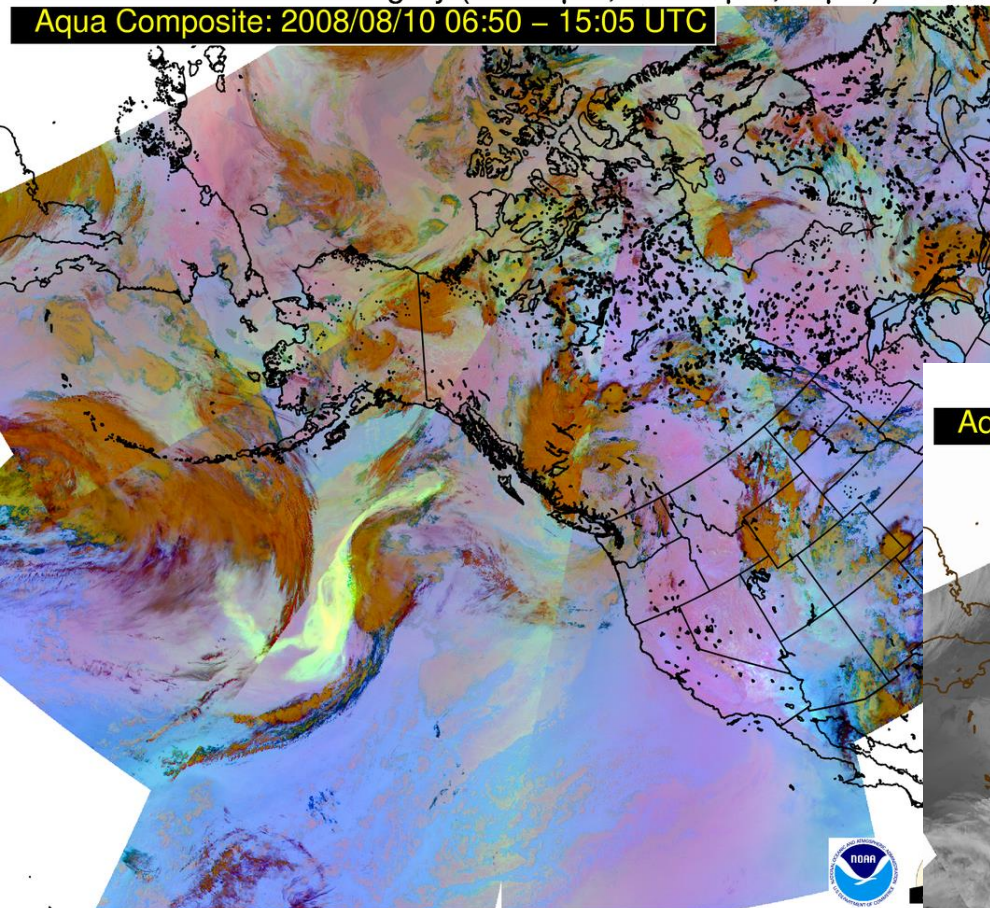
11 μ m BT [K]

0 1 2 3 4 5 6 7 8 9 10

Ash/Dust Loading [g/m²]

False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

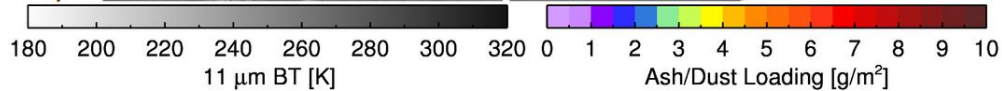
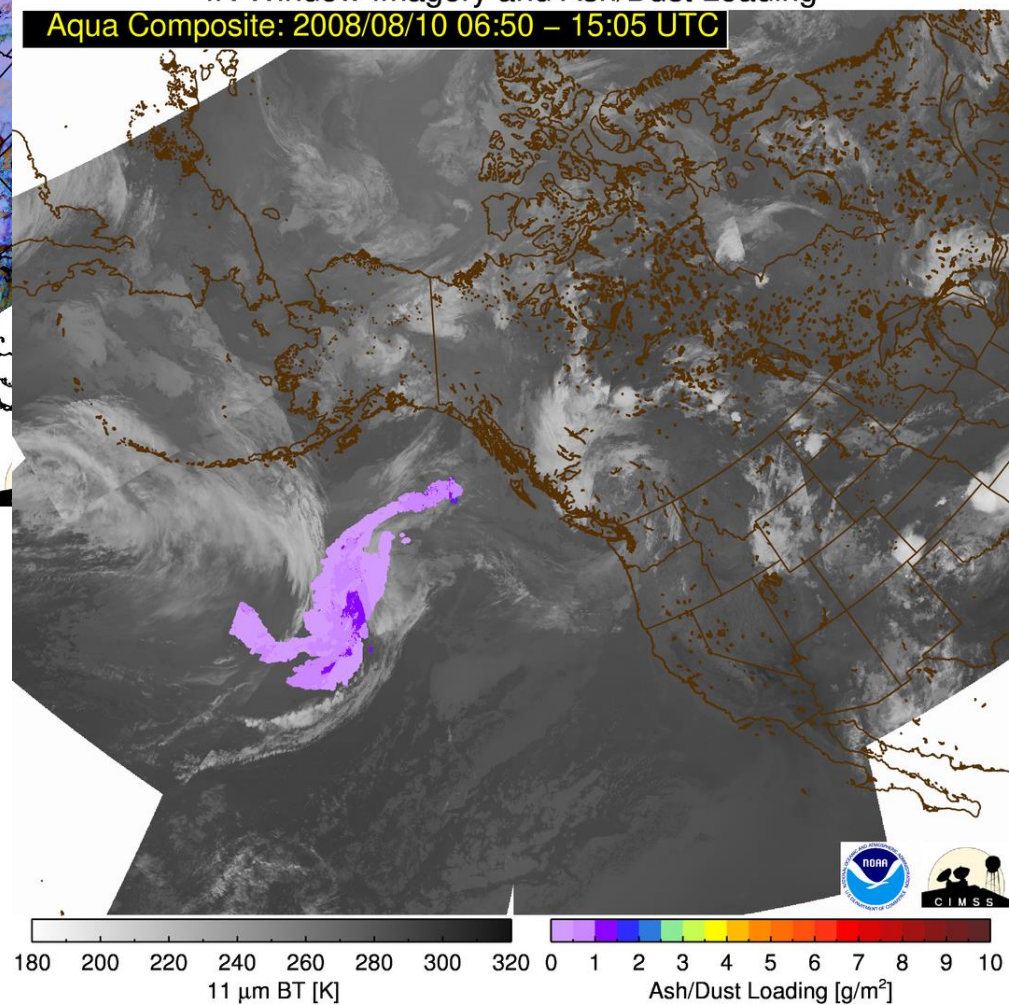
Aqua Composite: 2008/08/10 06:50 – 15:05 UTC



**Aqua MODIS descending node
August 10, 2008 (UTC)**

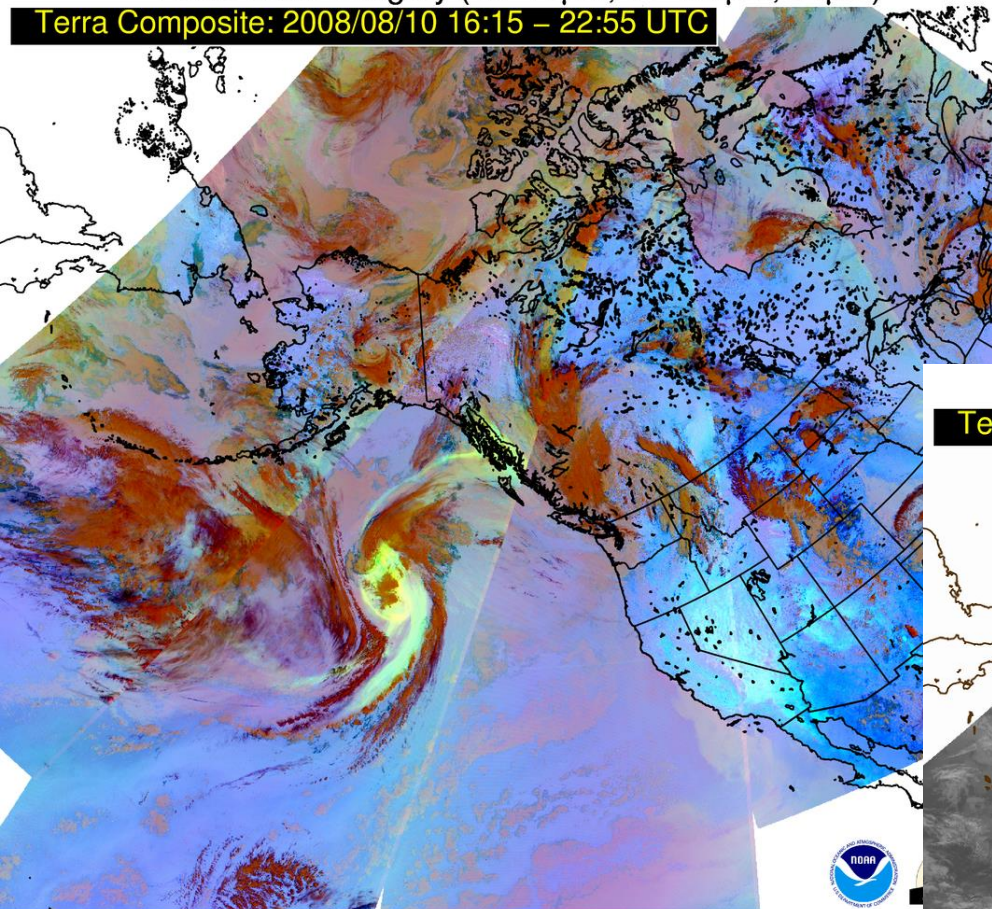
IR Window Imagery and Ash/Dust Loading

Aqua Composite: 2008/08/10 06:50 – 15:05 UTC



False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

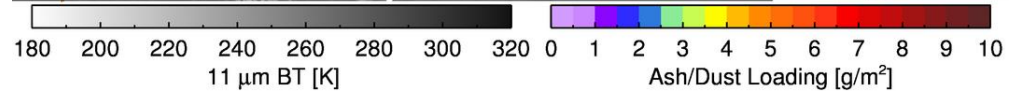
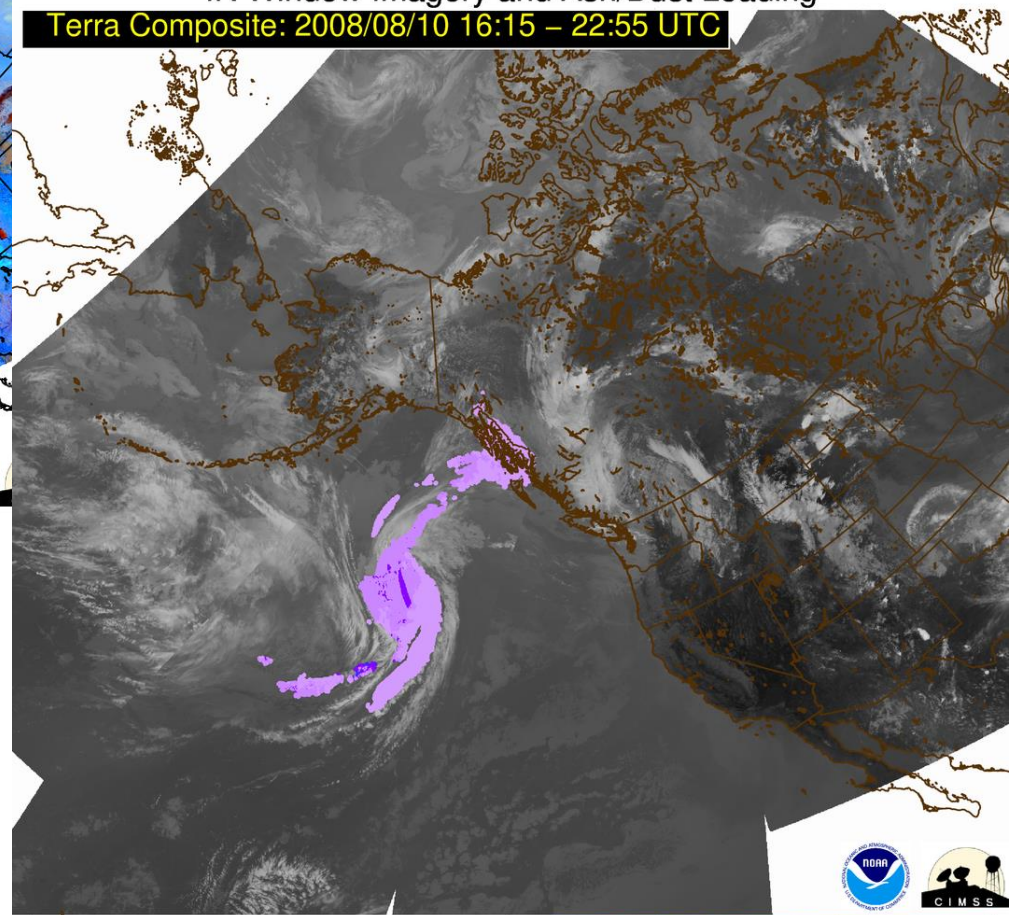
Terra Composite: 2008/08/10 16:15 – 22:55 UTC



**Terra MODIS descending node
August 10, 2008 (UTC)**

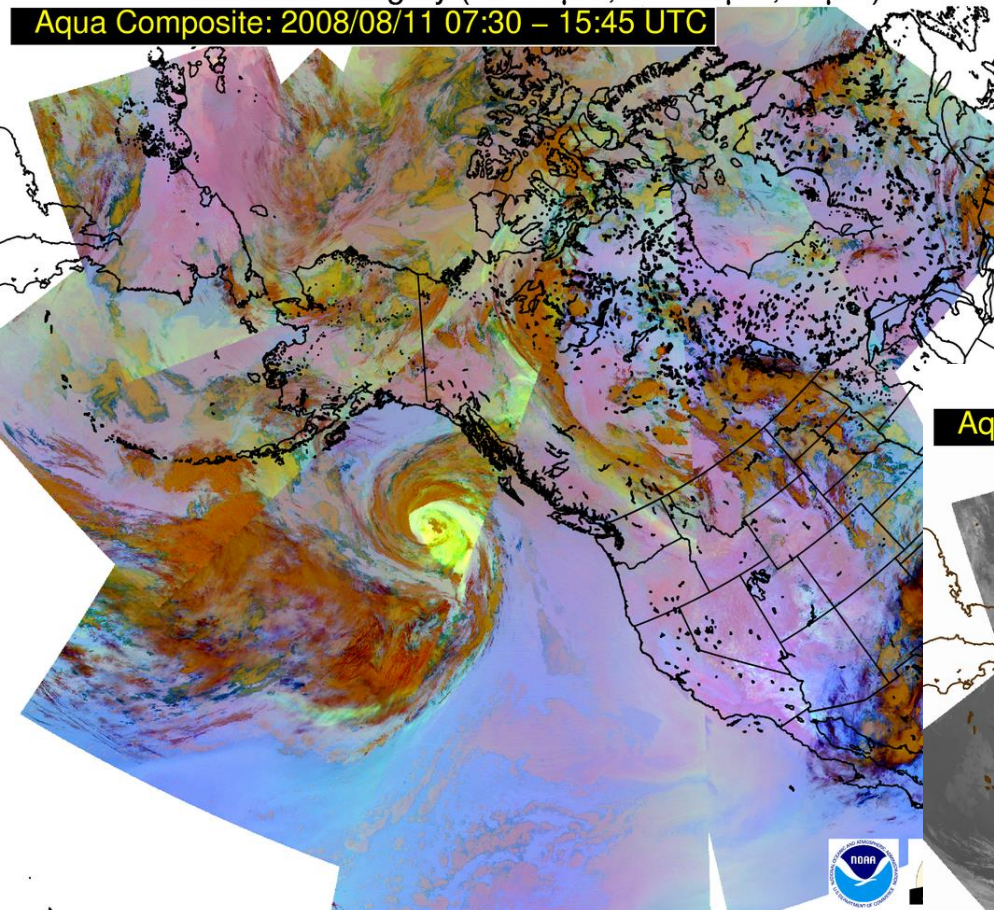
IR Window Imagery and Ash/Dust Loading

Terra Composite: 2008/08/10 16:15 – 22:55 UTC



False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

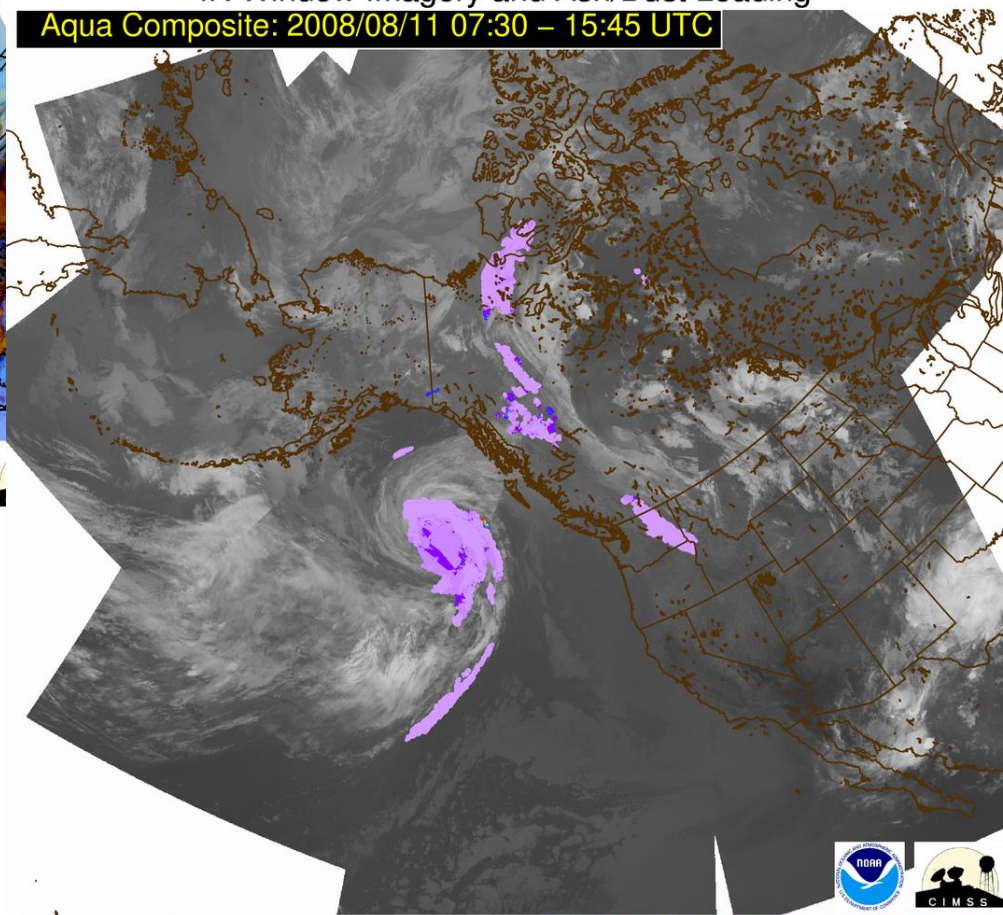
Aqua Composite: 2008/08/11 07:30 – 15:45 UTC



Aqua MODIS ascending node
August 11, 2008 (UTC)

IR Window Imagery and Ash/Dust Loading

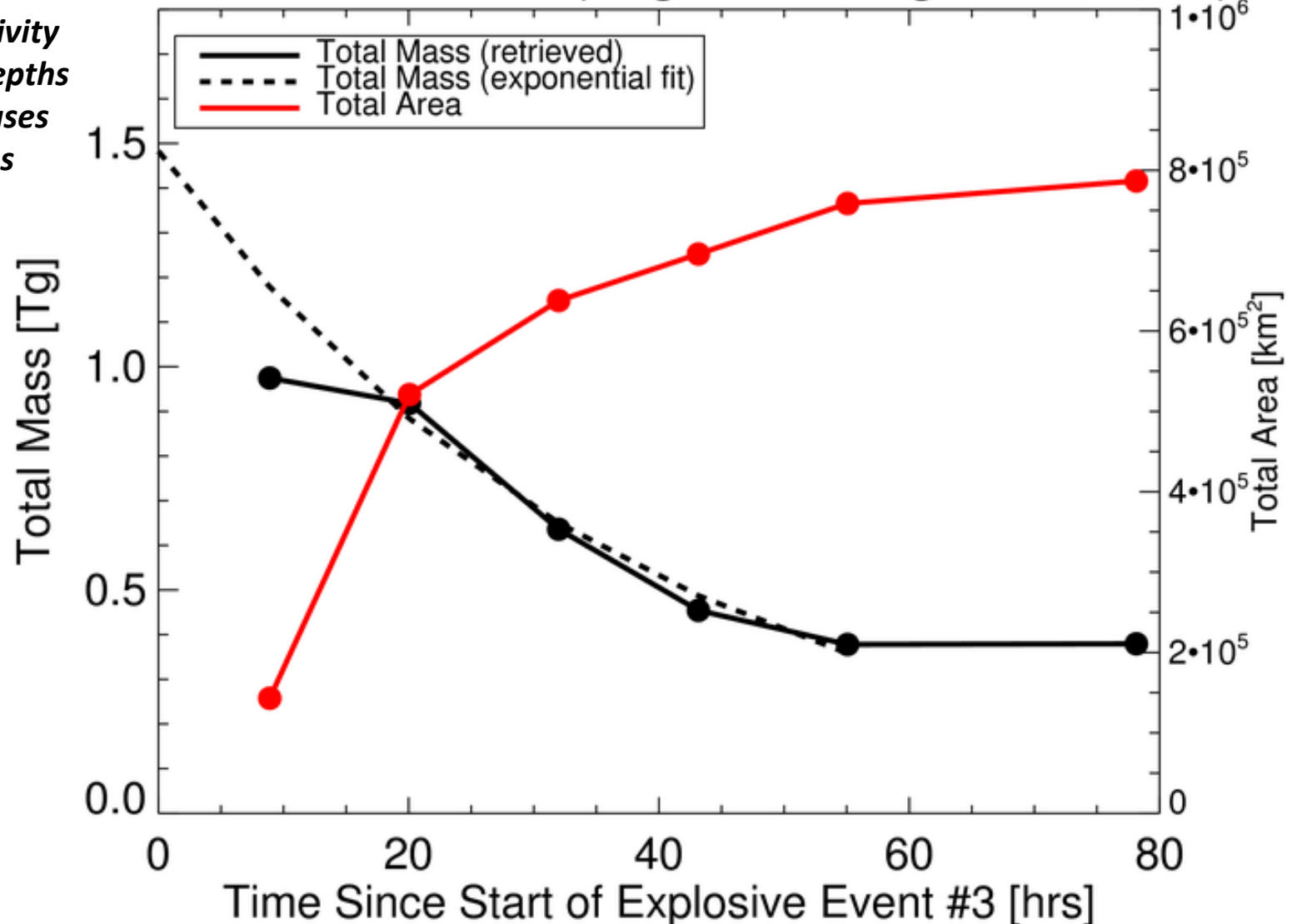
Aqua Composite: 2008/08/11 07:30 – 15:45 UTC



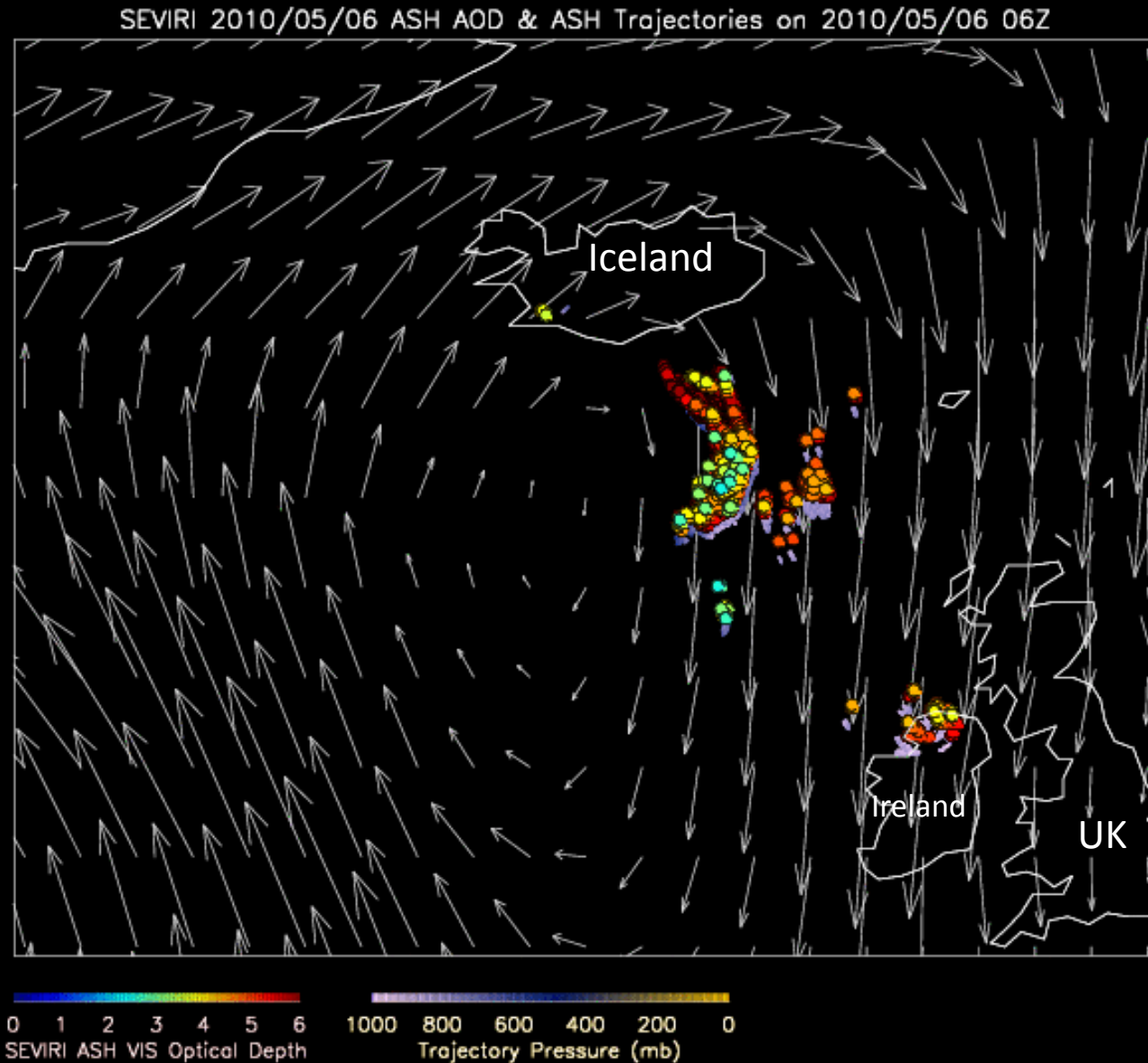
Total mass and area time series

Kasatochi Ash Cloud (August 8 – August 11, 2008)

The limited sensitivity to large optical depths in the IR likely causes the first total mass value to be underestimated



Improving ash cloud forecasts



Future Plans

- Transition of NOAA volcanic cloud system to NESDIS operations
- Alerting service from “experimental” system at the UW will be made available to VAAC’s this summer and additional users at a later time (SCOPE-Nowcasting, CEOS DRM activities, and Satellite Proving Ground activities)
- SCOPE-Nowcasting inter-comparison activity
- Several ongoing collaborations with modeling groups
- New GOES-R project with USGS to integrate additional satellite and non-satellite data sources (hyperspectral IR, lightning, infrasound, seismic, etc...)





Questions?



Marco Fulle - www.stromboli.net



Back-up slides

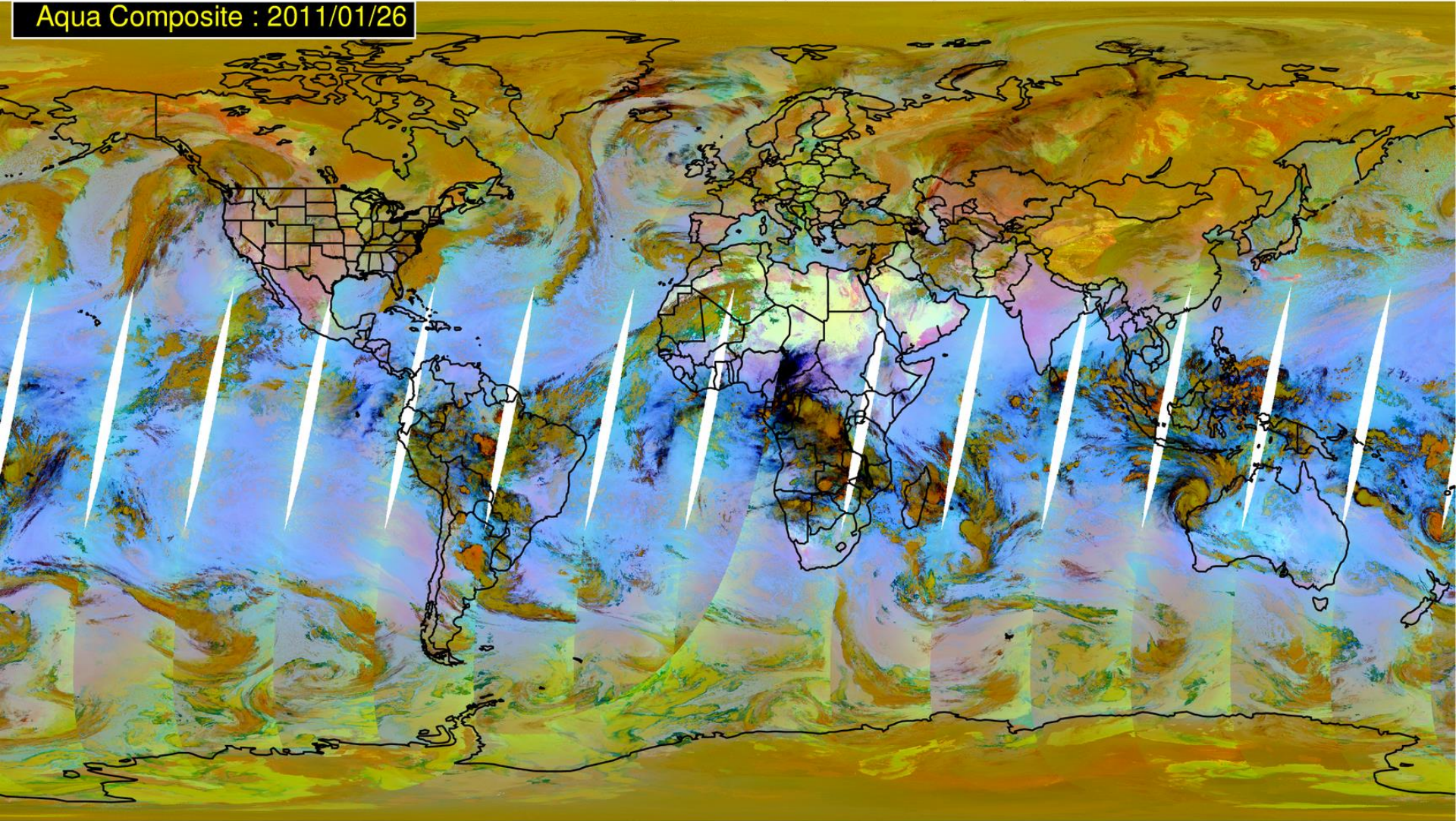


Rueters



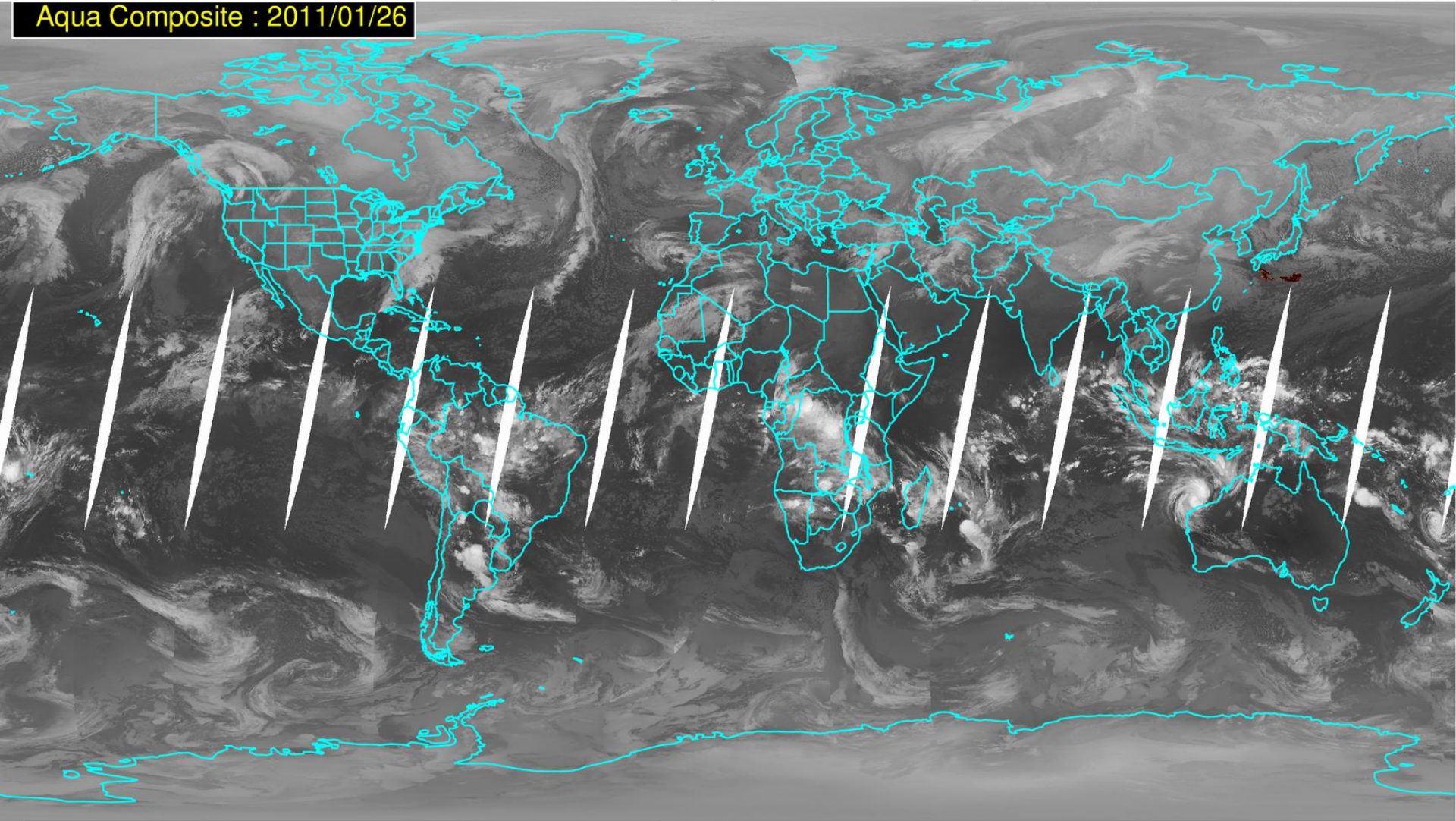
False Color Imagery (12–11 μ m, 11–8.5 μ m, 11 μ m)

Aqua Composite : 2011/01/26



IR Window Imagery and Ash Probability

Aqua Composite : 2011/01/26

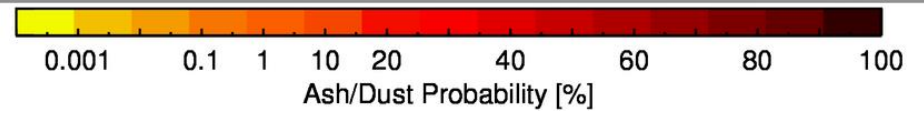
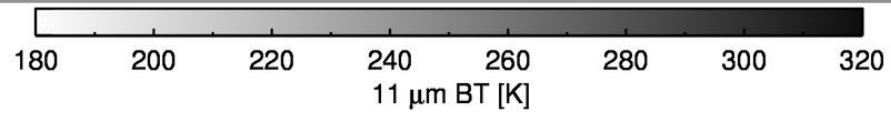
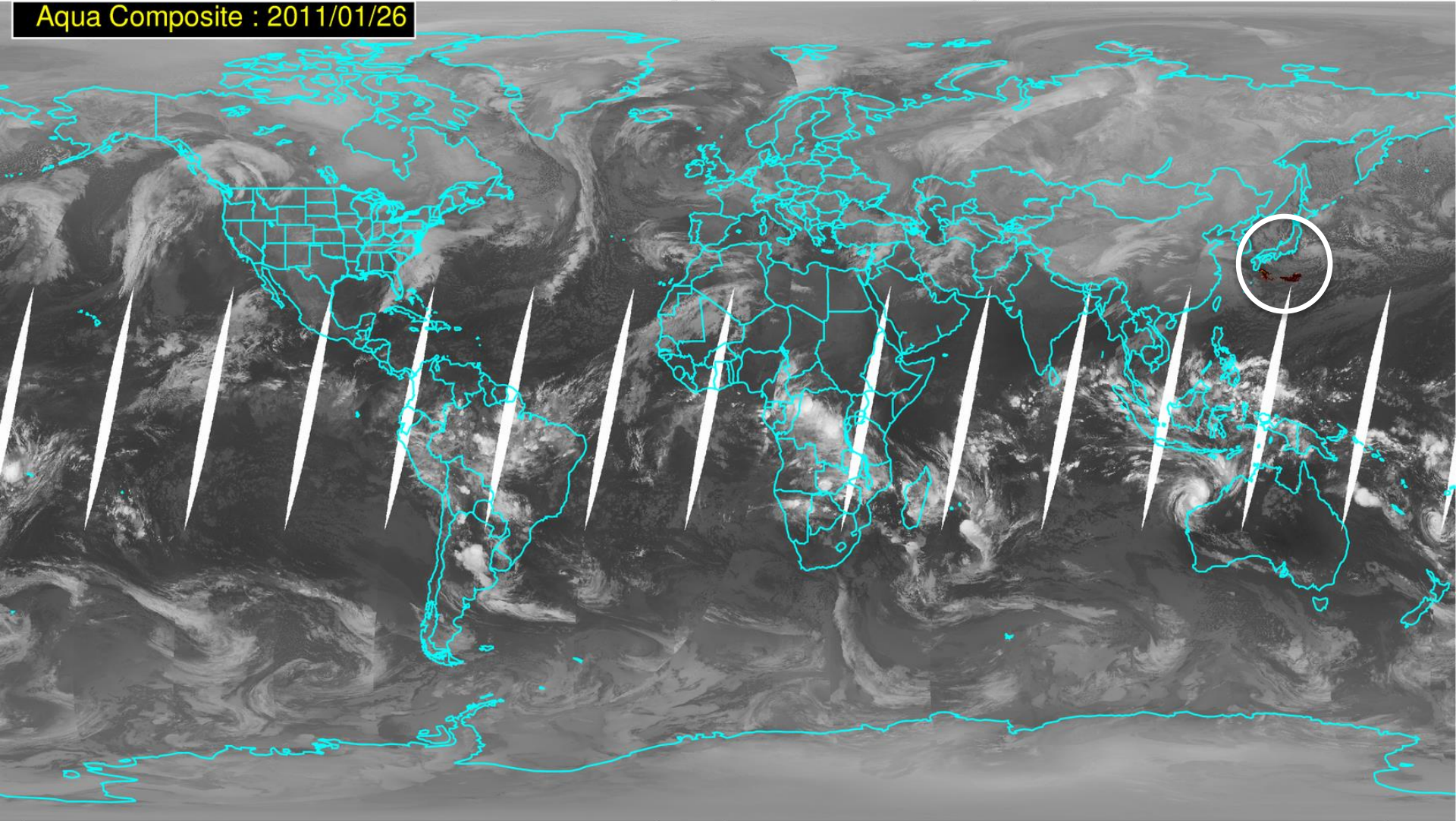


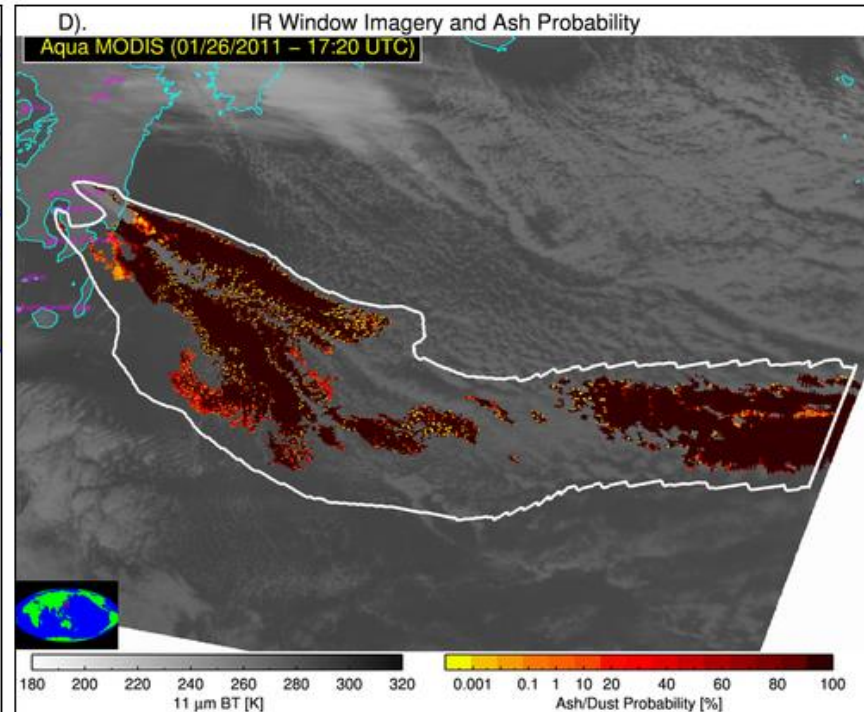
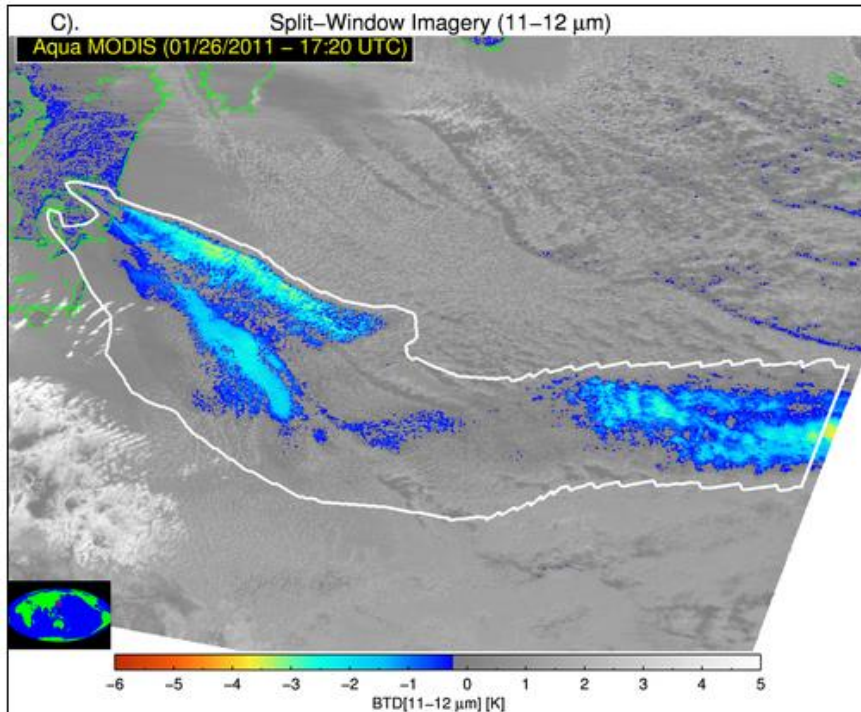
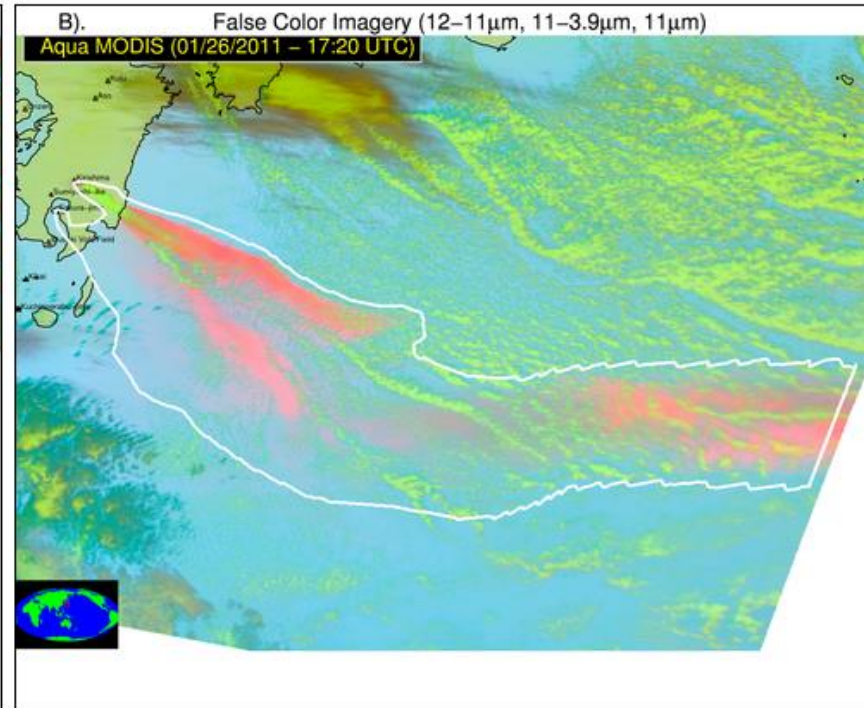
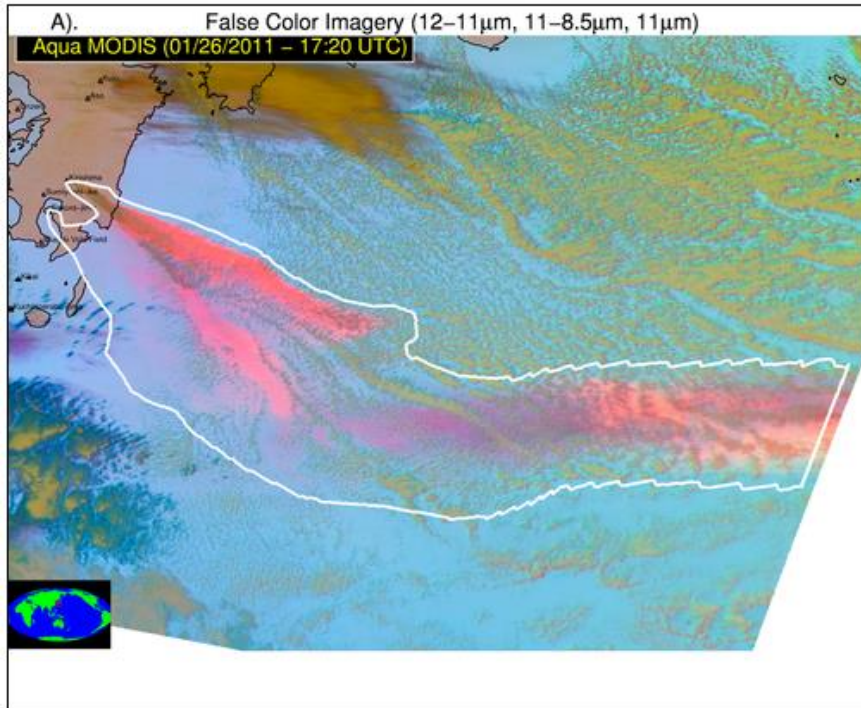
180 200 220 240 260 280 300 320
11 μm BT [K]

0.001 0.1 1 10 20 40 60 80 100
Ash/Dust Probability [%]

IR Window Imagery and Ash Probability

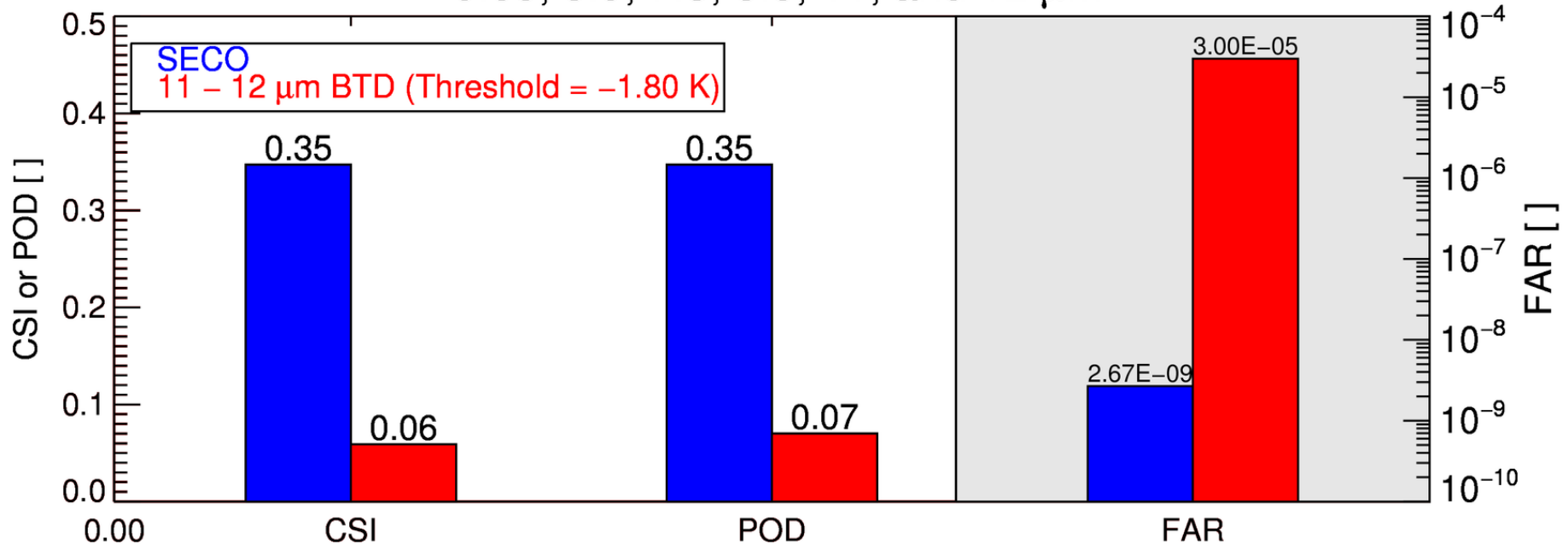
Aqua Composite : 2011/01/26





Global Performance

0.65, 3.9, 7.3, 8.5, 11, and 12 μm



The SECO method resulted in no false alarms other than in very close proximity to the manually analyzed ash cloud boundary, while the “split-window” method produced many more false alarms despite the incredibly conservative optimized threshold of -1.80 K.

Split-Window Imagery (11–12 μm)

Aqua Composite : 2011/01/26

