

Volcanic Ash Remote Sensing at NOAA/NESDIS and CIMSS

**Mike Pavolonis (NOAA/NESDIS/STAR)
Contributions from: Justin Sieglaff (CIMSS)
and
Andrew Parker (CIMSS)**



USGS Photo by D. Harlow, June 12, 1991



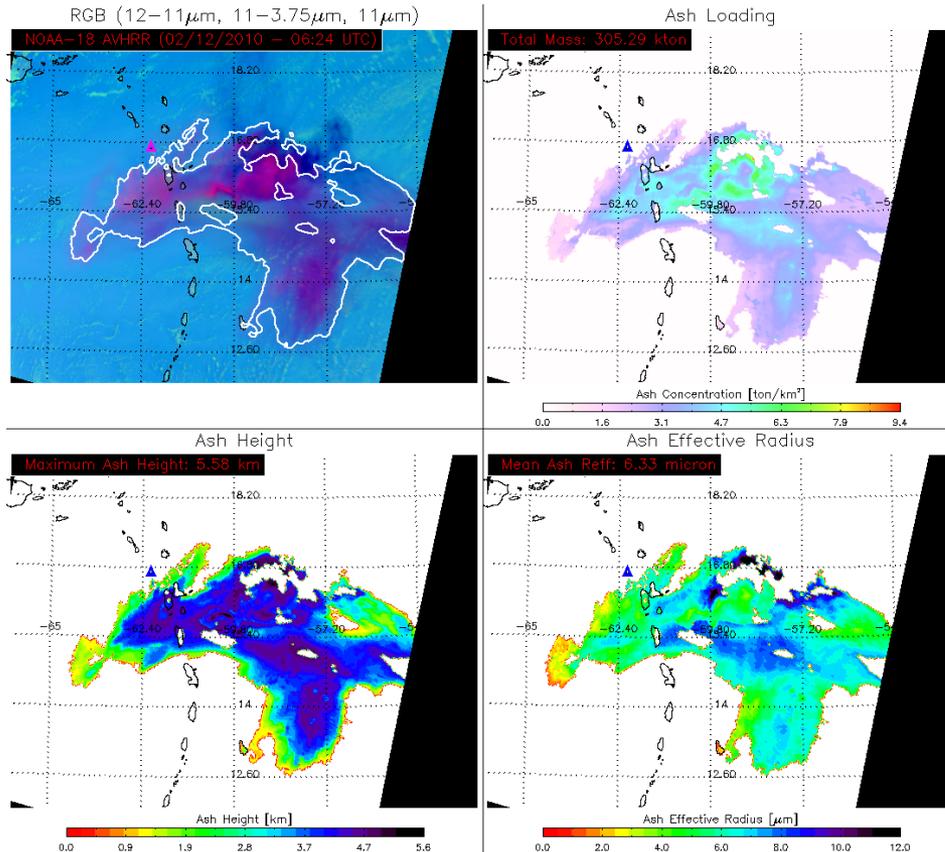
Ongoing Funded Projects

- **AVHRR Volcanic Ash** (funded by NOAA PSDI) - transition automated volcanic ash detection and ash retrieval for the AVHRR to NESDIS operations
- **GOES volcanic ash** (funded by NOAA GIMPAP) - develop automated volcanic ash detection and retrieval algorithms for the current GOES Imager series
- **GOES-R Volcanic Ash** (funded by NOAA GOES-R AWG) - develop, implement, and validate the operational GOES-R volcanic ash products (ash height and mass loading)
- **GOES-R SO₂** (funded by NOAA GOES-R AWG) - develop, implement, and validate the operational GOES-R SO₂ product

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- The AVHRR code is in the process of being transitioned to NESDIS operations.
- In addition, the code is being transitioned to the University of Alaska - Fairbanks. UAF will utilize the Gilmore Creek receiving station to provide the Anchorage VAAC with real-time AVHRR products.



Science Summary:

- An advanced cloud object based approach is used to detect volcanic ash clouds and an optimal estimation technique is used to retrieve the ash height, mass loading, and effective particle radius.
- An automated email alert is sent to the VAAC's when ash is detected.



Automated AVHRR Ash Warning System



- The warning criteria is fully user configurable.
- In addition to the text message, an automatically generated, pre-analyzed false color image along with product images are supplied to the user.

E-mail Warning

Product Quick-look

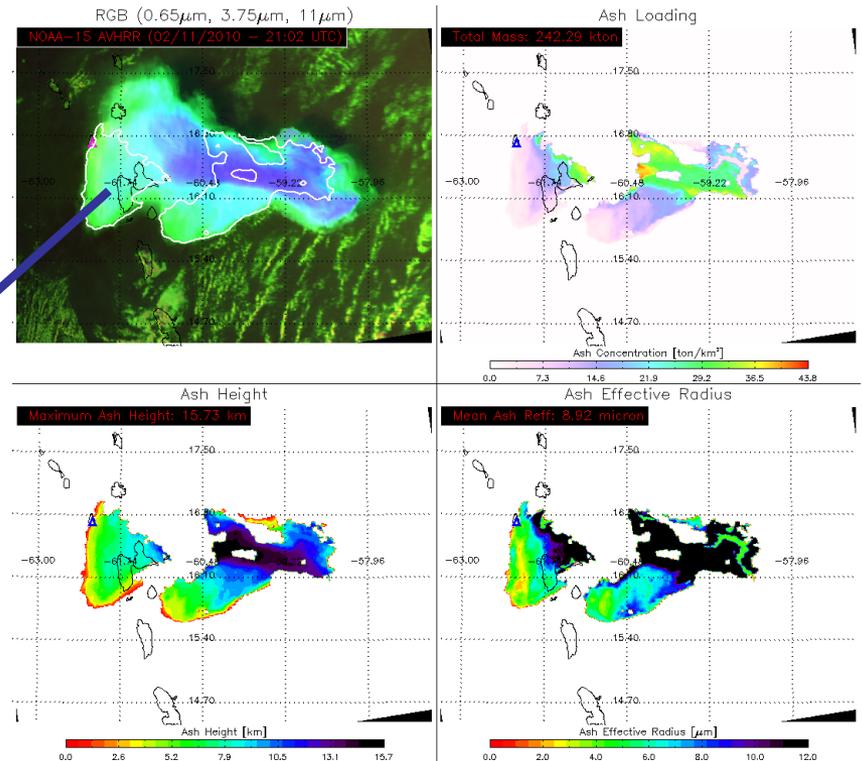
From	Subject	Date Received
Peter Webley	[volcanicclouds] Puff Automated Volcanic...	Today 3:53 PM
mpav@ssec.wisc.edu	VOLCANIC CLOUD ALERT	Today 3:54 PM
Mike Pavolonis	[volcanicclouds] AVHRR height and mass...	Today 4:18 PM
Mike Pavolonis	[volcanicclouds] AVHRR height and mass...	Today 4:19 PM

From: Mike Pavolonis
 Subject: **VOLCANIC CLOUD ALERT**
 Date: February 11, 2010 3:54:32 PM CST
 To: Mike Pavolonis

@*****GENERATING VOLCANIC CLOUD WARNINGS*****
 DATE: 02/11/2010
 TIME: 20:59 UTC
 SATELLITE: NOAA-15 AVHRR
 L1B FILENAME: NSS.HRPT.NK.D10042.S2059.E2112.B6109191.MI
 ORBIT NUMBER: 6109191
 NUMBER OF ASH CLOUD WARNINGS: 1
 NUMBER OF VOLCANIC Cb WARNINGS: 0
 NUMBER OF VOLCANIC HOT SPOT WARNINGS: 0

 VOLCANIC ASH CLOUD FOUND
 Radiative Center (Lat, Lon): 16.460, -61.113
 Mean Viewing Angle (degrees): 43.30
 Mean Solar Zenith Angle (degrees): 75.86
 Nearby Volcanoes:
 Soufriere Guadeloupe(75.04 km)
 Diablos, Morne aux(100.29 km)
 False Alarm Potential: 0 out of 35515
 Maximum Height: 12.4 km (40704.85 ft)
 Mean Tropopause Height: 18.6 km (61069.13 ft)
 Median Effective Radius: 5.54 micron
 Total Mass: 72.40 ktons
 Total Mass of Fine Ash: 1.16 ktons
 Total Area: 6896.00 km^2

Quantitative description of ash cloud needed to issue an accurate ash advisory



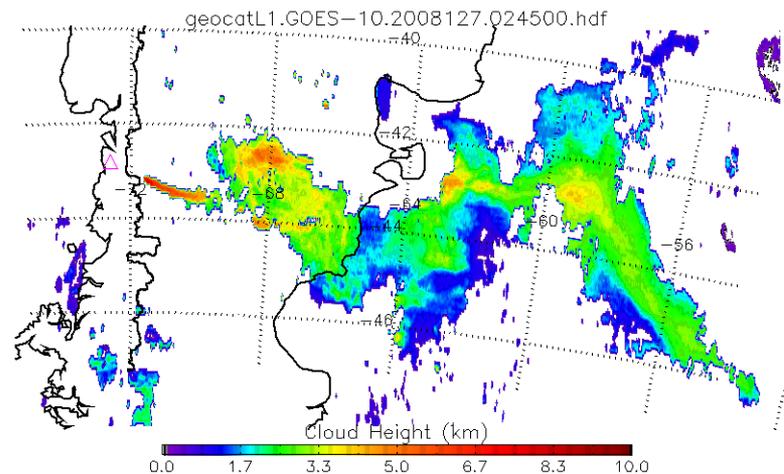
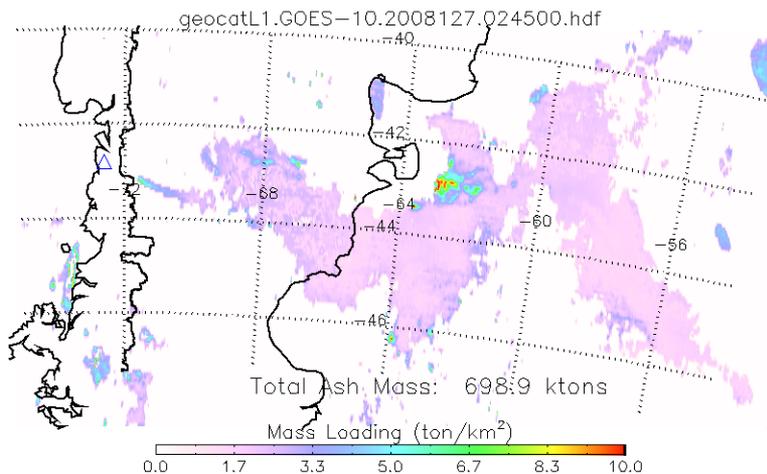
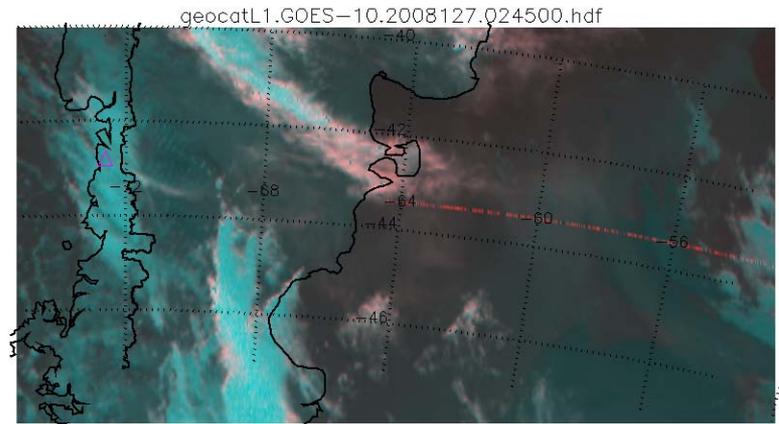
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Project Summary:

- The same automated alert and retrieval capabilities developed for the AVHRR are being developed for the current GOES Imager.
- After one more year of research funding, we will seek NOAA PSDI funding to transition the GOES capability to NESDIS operations.

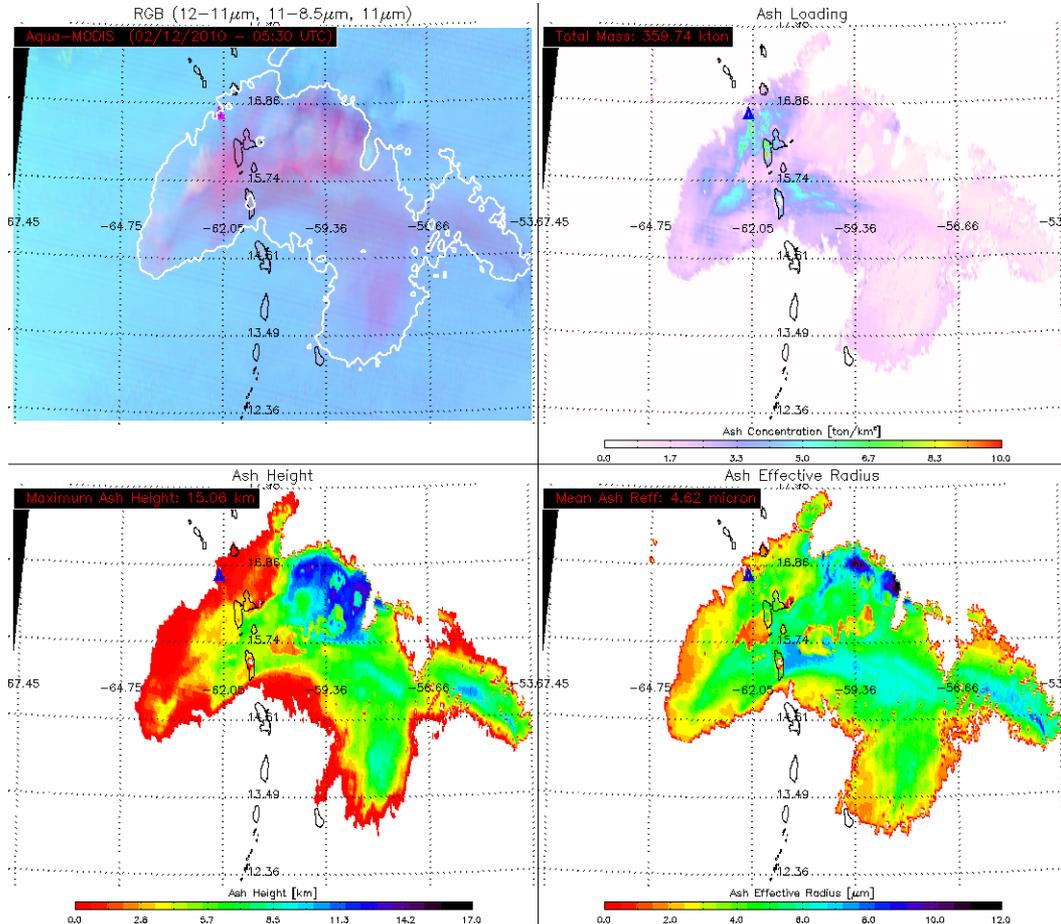
Chaiten (May 6, 2008)



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Soufriere Hills (2/12/2010)

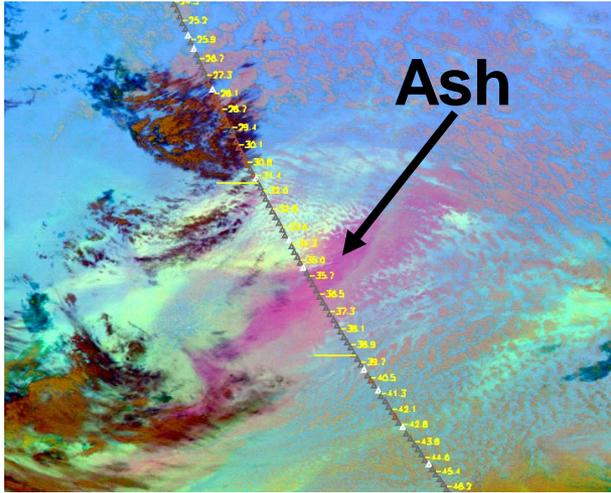


Project Status:

- The products are meeting the height and mass loading accuracy specifications (see next slide).
- The 100% Algorithm Theoretical Basis Document will be delivered in July.
- We plan on developing an automated email alert capability, although the email alert is not a GOES-R requirement.

Validation of GOES-R ash cloud height retrieval

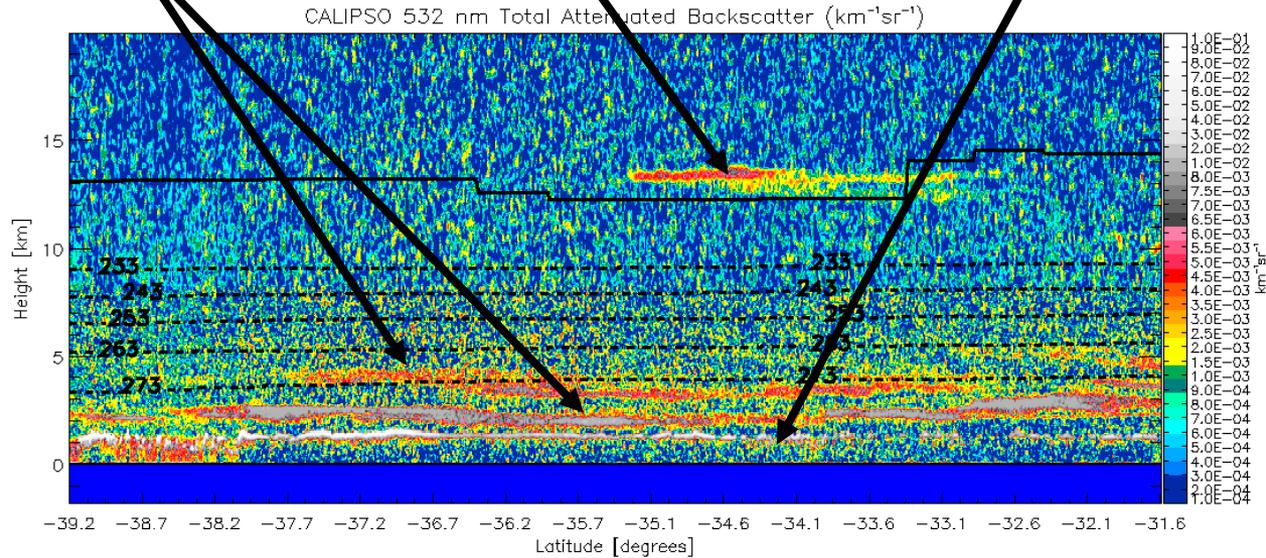
Chaiten Ash Cloud (05/05/2008, 1515 UTC)



Dual layer ash cloud

Thin cirrus

Liquid water cloud



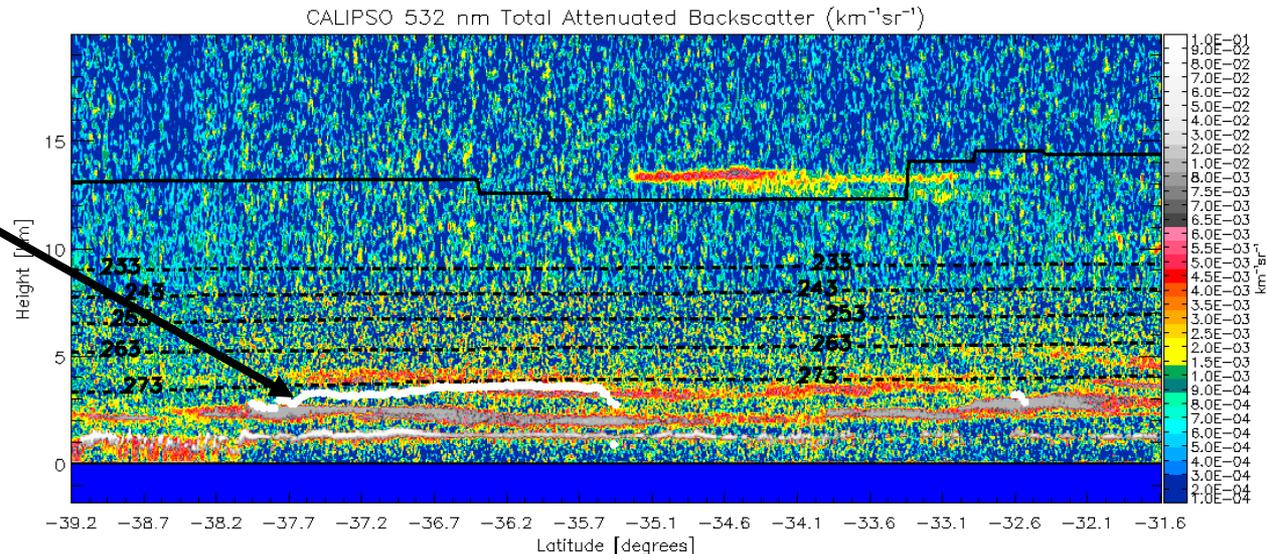
GOES-R Height Retrieval

Stats (highest ash layer)

N = 92

Bias = 0.6 km

Stddev = 0.5 km



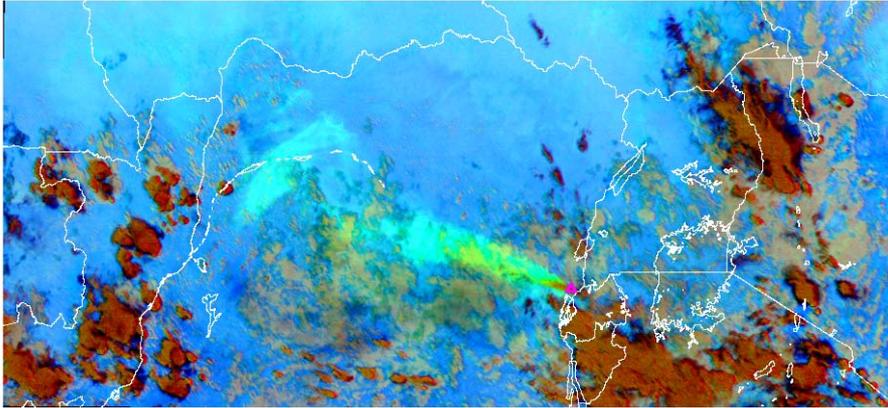
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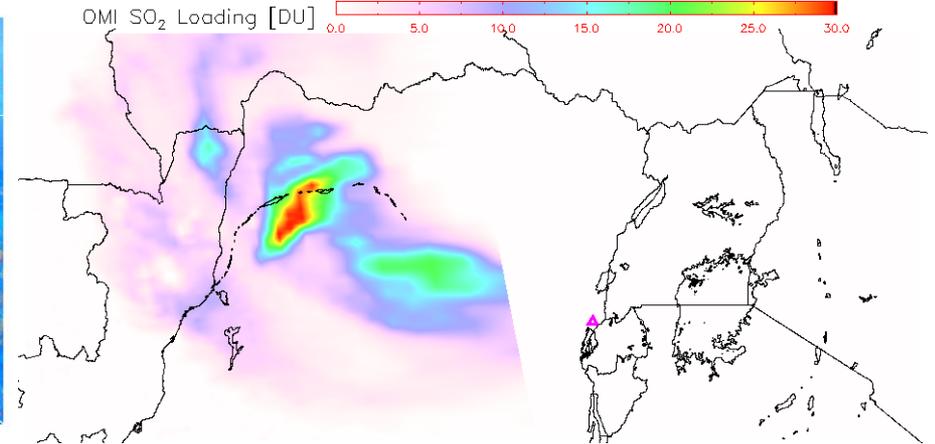
Validation of Nyamuragira (11/29/2006, 1245 UTC)

False Color

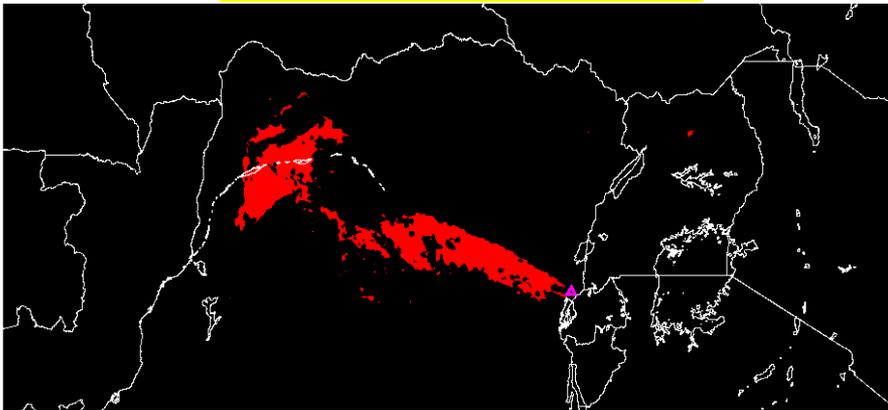
RGB(12–11 μm , 11–8.5 μm , 11 μm)



OMI (UV) SO₂



ABI SO₂



Project Status:

- The GOES-R SO₂ detection algorithm is close to meeting the 70% detection requirement (for loadings of 10 DU or greater).
- The 80% version of the Algorithm Theoretical Basis Document will be delivered in July.

Summary

- Automated volcanic ash email alerts for all sensors are needed to take full advantage of satellite data.
- These alerts can now be performed with operational quality accuracy and should be an operational requirement.
- Retrievals of ash height, mass loading, and effective particle radius are needed to validate and improve dispersion model forecasts (these retrievals should be an operational requirement for all volcanic ash relevant sensors).
- We have begun collaborating with modeling groups on assimilating satellite ash cloud retrievals.
- ***Our goal is an automated combined LEO/GEO global volcanic ash monitoring system that will be a reliable tool for volcanic ash forecasters and modelers.***
- ***Email questions to: Mike.Pavolonis@noaa.gov***