VOLCANIC ASH EDR

NOAA/NESDIS/STAR
608-263-9597; Mike.Pavolonis@noaa.gov
Mike Pavolonis (STAR)
Justin Sieglaff (UW-CIMSS)
Jason Brunner (UW-CIMSS)

Outline

- Cal/Val Team Members
- Algorithm Overview
- S-NPP/N-20 Product(s) Performance
- Major Risks/Issues and Mitigation
- Milestones and Deliverables
- Future Plans/Improvements
- Summary

Cal/Val Team Members

PI	Organization	Team Members	Roles and Responsibilities
Mike Pavolonis	NOAA/NESDIS/ STAR	Justin Sieglaff (UW-CIMSS), Jason Brunner (UW-CIMSS)	EDR algorithm development, refinement, validation, product review and delivery

Algorithm Overview

Instrument: VIIRS

Channels: 8.5 (M14), 11 (M15), and 12 µm (M16)

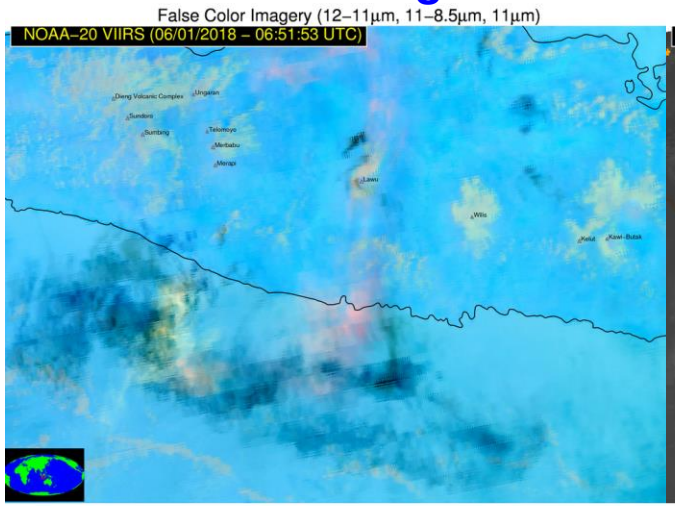
Ancillary data: GFS and OISST

Ash detection: differential absorption (Pavolonis 2010)

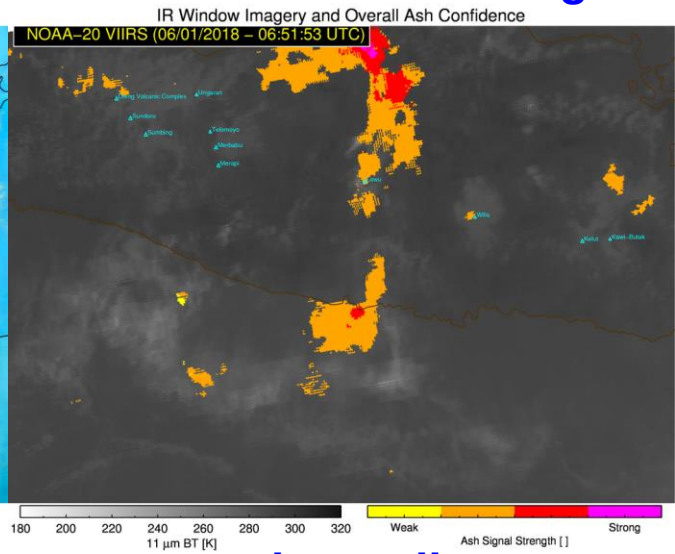
Ash properties: optimal estimation (Pavolonis et al., 2011)

Algorithm is the same as the baseline GOES-R algorithm except it does not utilize IR absorption channels

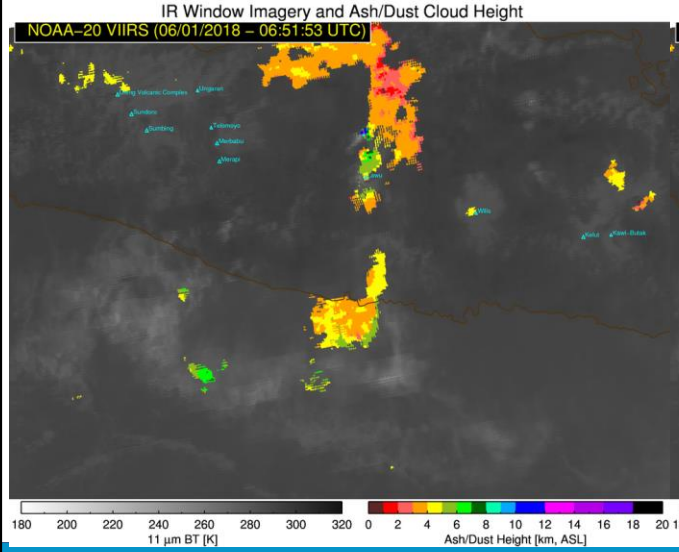
RGB Image



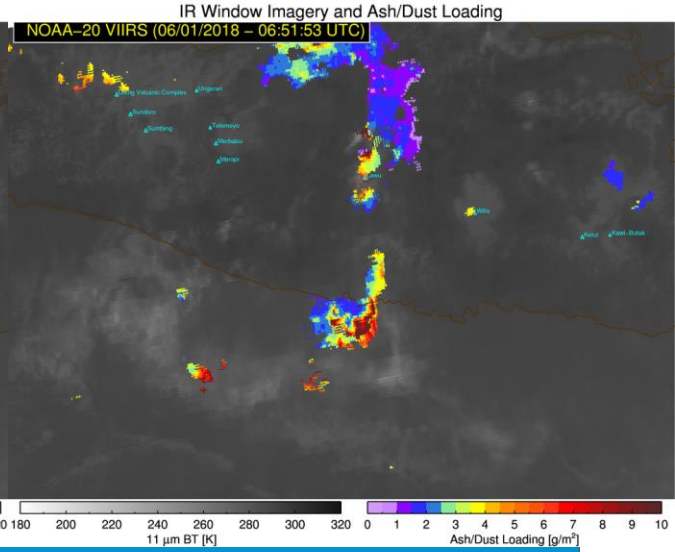
Ash Detection Flag



Ash Height



Ash Loading



S-NPP/N-20 Product(s) Overview

- Product(s) Performance Summary

Product	L1RDS APU Thresholds	S-NPP Performance	N-20 Performance
Ash Top Height	3 km	-1.9 km	~ 2 km (preliminary)
Ash Mass Loading	2 tons/km^2	1.1 tons/km^2	~1.5 tons/km^2

Wind correlation, comparisons to space-based lidar, and comparisons to other well characterized satellite products are the primary validation techniques

Major Risks/Issues and Mitigation

Risk/Issue	Description	Impact	Action/Mitigation
N20 Product Availability	NOAA-20 products are currently generated in the Integration and Testing string of NDE and are often unavailable (high impact on volcanic ash since this significantly reduces the number of validation opportunities).	High	Possible delay of provisional review until enough volcanic ash cases, sufficient for validation analysis, are collected
Underutilization of JPSS	The JPSS NDE algorithm only exploits a fraction of the JPSS capabilities. More sophisticated multi-sensor approaches have been, and continue to be, developed	Medium	A new PGRR initiative will develop, test, and evaluate a multi-sensor approach

Milestones and Deliverables

- FY19 Milestones/Deliverables

Task	Description	Deliverables	Scheduled Date
Development	Pursue algorithm enhancements	Cost benefit analysis	Sep 2019
Integration & Testing	Prepare for NOAA-21 and S-NPP and NOAA-20 updates	Updated algorithm code, NOAA-21 LUT	Sep 2019
Calibration & Validation	Comparison of volcanic ash products with validation data	Accuracy statistics	Sep 2019
Maintenance	Refine thresholds and LUTs for S-NPP and NOAA-20 as needed	Updated code and ATBD	Sep 2019
Long-term monitoring	Develop long-term monitoring tools	A tool for alerting when product anomalies are detected	Sep 2019

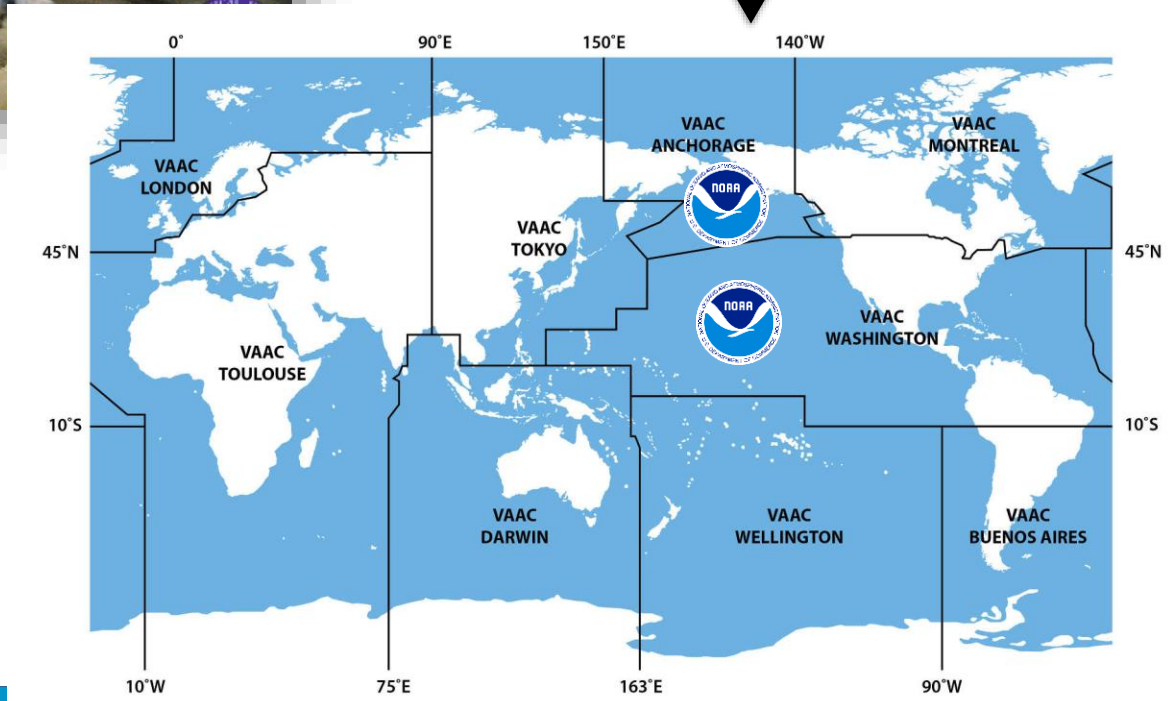
Future Plans/Improvements

- Volcanic ash products should be generated using a holistic approach that integrates all relevant components of the volcanic hazard problem, using all relevant measurements (JPSS and non-JPSS).

User Needs

Major Aviation Hazard

Operational Mandate



Key Operational Questions:

1). Has an eruption occurred?

2). Where is the ash/SO_2 now?

3). How much ash/SO_2 is present?

4). Where will the ash/SO_2 be in the future?

Volcanic Hazards Initiative

Core Research Team: Mike Pavolonis (PI, NOAA/STAR), Simon Carn (Michigan Tech), Alice Crawford (NOAA/ARL), Christoph Kern (USGS), Taryn Lopez (University of Alaska - Fairbanks), Dave Schneider (USGS), Ariel Stein (NOAA/ARL)

Core User Team: Jamie Kibler (NOAA – Washington VAAC), Christina Neal (USGS), Jeff Osiensky (NWS – Anchorage VAAC), Dave Schneider (USGS), Bill Ward (NWS PRH)

Key Operational Questions:

1). Has an eruption occurred?

- **Volcanic eruption alerts for ash and SO_2 emissions**

2). Where is the ash/SO_2 now?

- **Highly skilled automated volcanic ash and SO_2 detection and tracking**

3). How much ash/SO_2 is present?

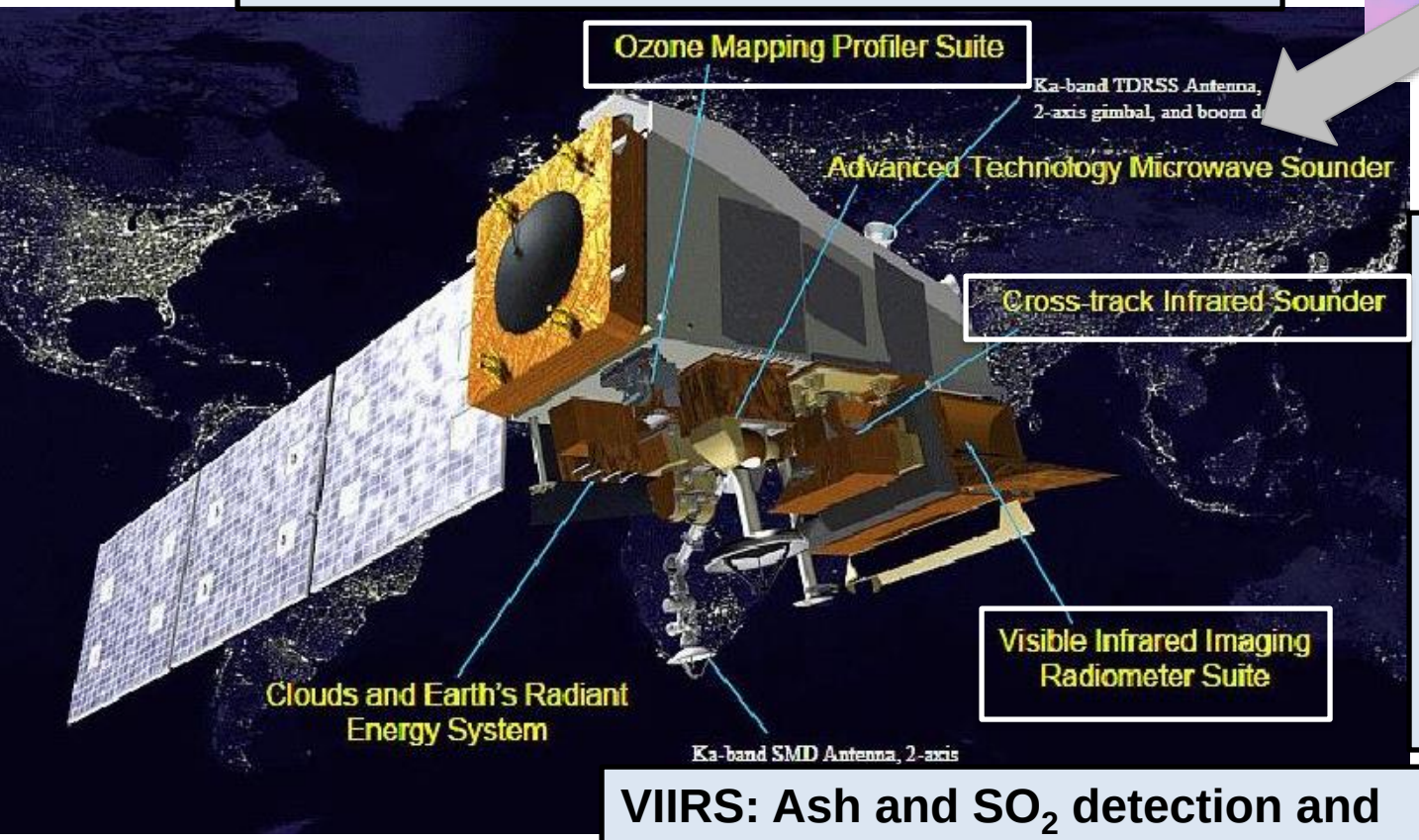
- **Retrievals of ash height, ash loading, ash effective radius, dominant mineral composition, SO_2 height, and SO_2 loading**

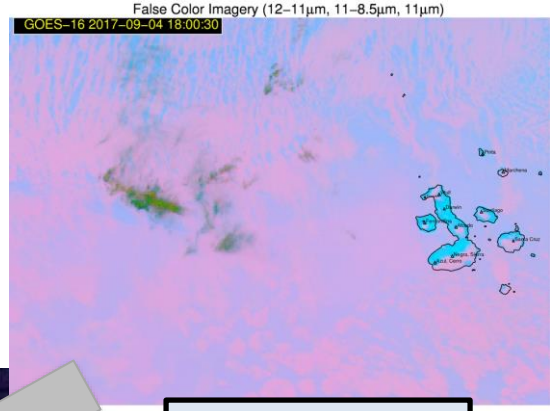
4). Where will the ash/SO_2 be in the future?

- **Integration of satellite products and HYSPLIT (dispersion model)**

Volcanic Hazards Initiative

OMPS: SO_2 detection and characterization, ash in optically thick clouds (SZA limited and course spatial resolution)





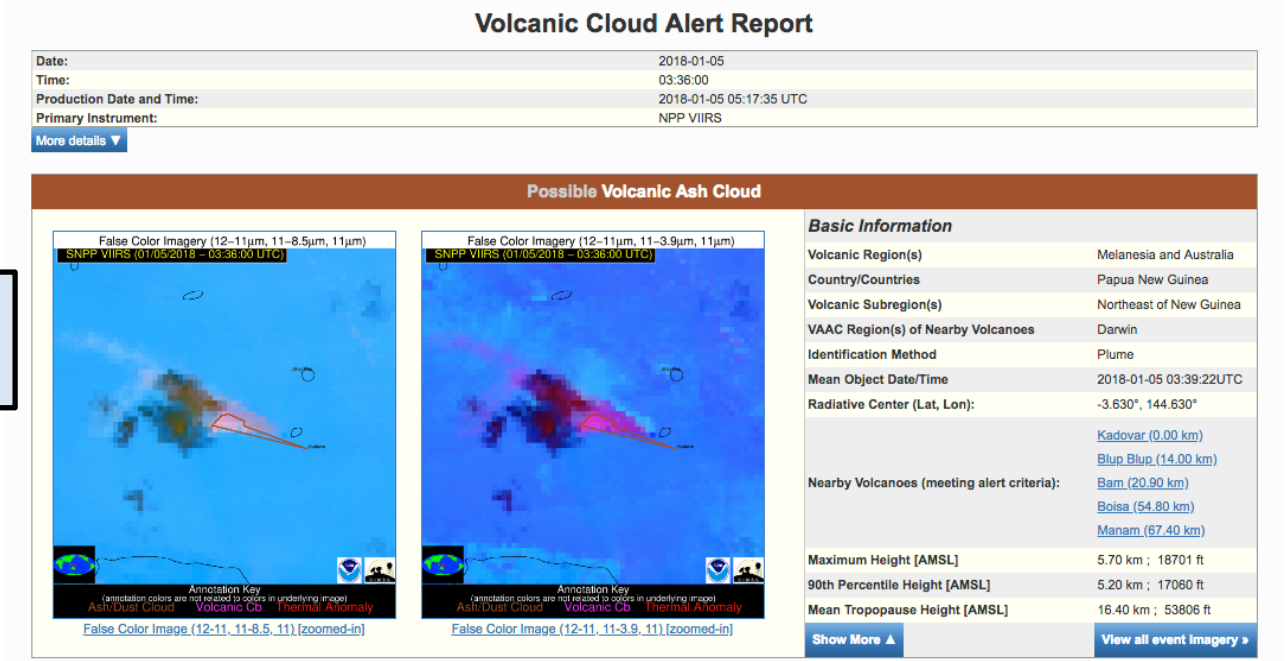
GEO

CrIS: Ash detection and characterization (including mineral composition), SO_2 detection and characterization (course spatial resolution)

VIIRS: Ash and SO_2 detection and characterization, source of imagery (limited accuracy for ash and SO_2 properties)

Volcanic Hazards Initiative

Eruption Alerting



Volcanic Cloud Alert Report

Date:	2018-01-05
Time:	03:36:00
Production Date and Time:	2018-01-05 05:17:35 UTC
Primary Instrument:	NPP VIIRS

More details ▼

Possible Volcanic Ash Cloud

False Color Image (12-11, 11-8.5, 11) [zoomed-in]

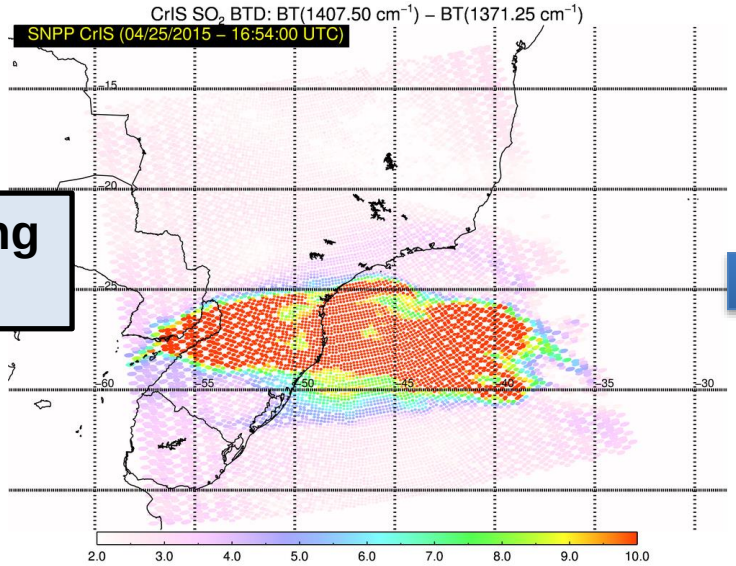
False Color Image (12-11, 11-3.9, 11) [zoomed-in]

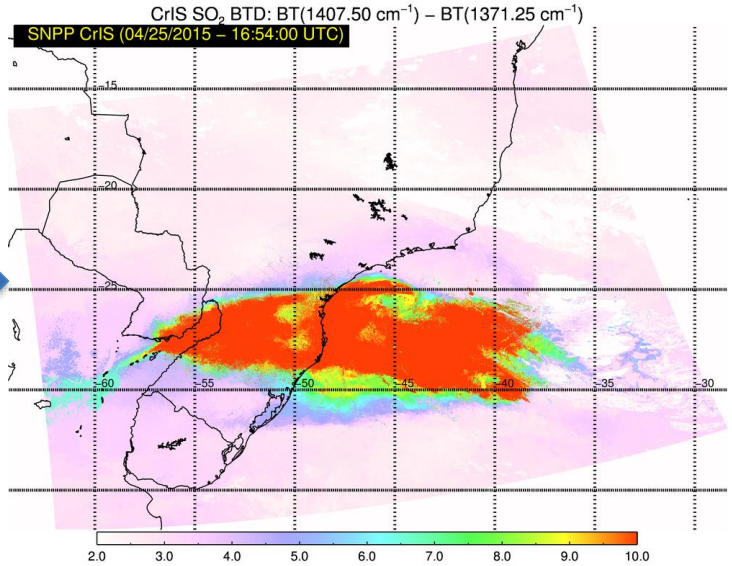
Basic Information

Volcanic Region(s)	Melanesia and Australia
Country/Countries	Papua New Guinea
Volcanic Subregion(s)	Northeast of New Guinea
VAAC Region(s) of Nearby Volcanoes	Darwin
Identification Method	Plume
Mean Object Date/Time	2018-01-05 03:39:22UTC
Radiative Center (Lat, Lon):	-3.630°, 144.630°
Nearby Volcanoes (meeting alert criteria):	Kadovar (0.00 km) Blup Blup (14.00 km) Bam (20.90 km) Boisa (54.80 km) Manam (67.40 km)
Maximum Height [AMSL]	5.70 km ; 18701 ft
90th Percentile Height [AMSL]	5.20 km ; 17060 ft
Mean Tropopause Height [AMSL]	16.40 km ; 53806 ft

Show More ▲ | View all event imagery »

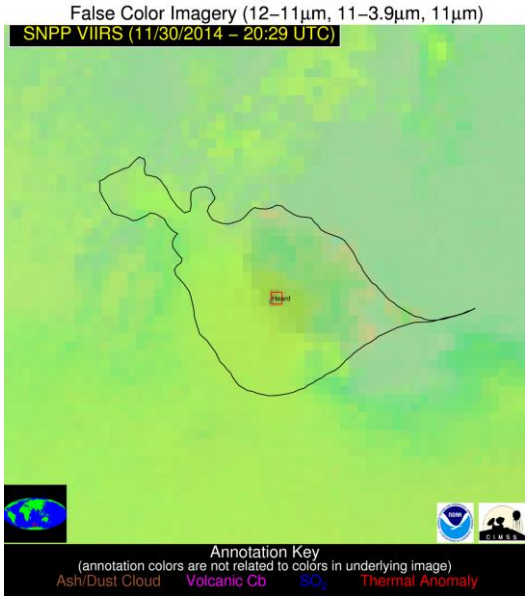
Downscaling of CrIS



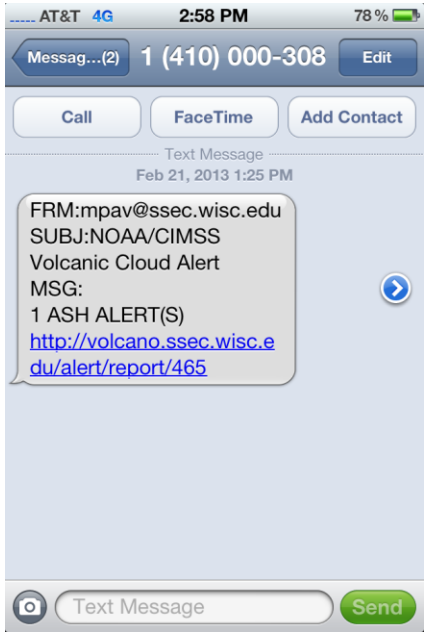


VOLcanic Cloud Analysis Toolkit (VOLCAT)

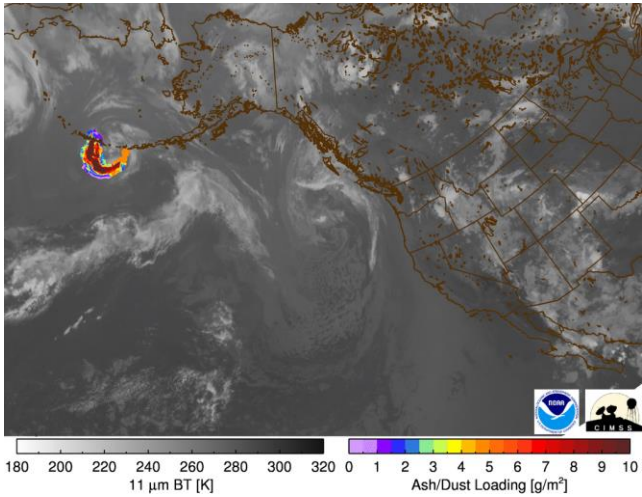
1). Unrest Alerts



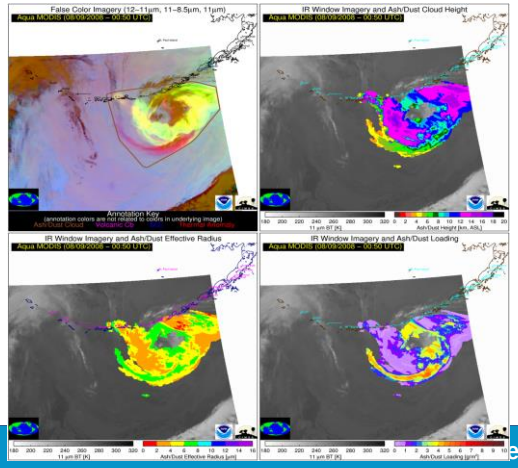
2). Eruption Alerts



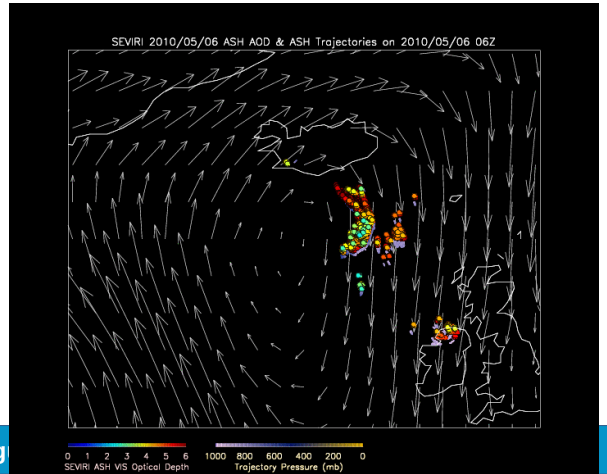
3). Volcanic Cloud Tracking



4). Volcanic Cloud Characterization



5). Dispersion Forecasting



User Feedback & Summary

- No two volcanic clouds are alike and non-volcanic features can mimic the spectral signature of ash and SO_2
- Thus, volcanic cloud detection and characterization is extremely challenging
- Present day satellite measurements (LEO and GEO combined) are capable of addressing the volcanic cloud problem, but only with highly sophisticated multi-sensor algorithms
- Users have found significantly greater value in the VOLCAT products
- The NDE products will continue to be validated and maintained while the integrated solution is developed