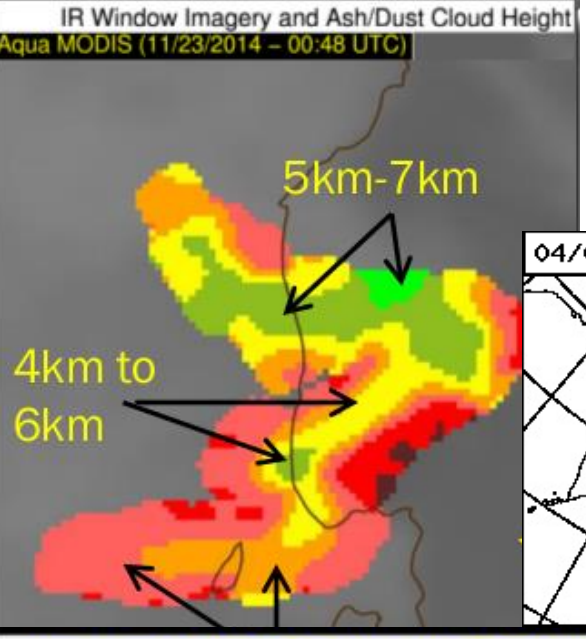
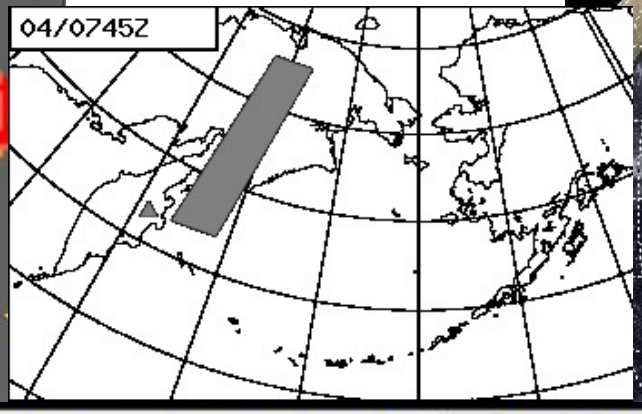
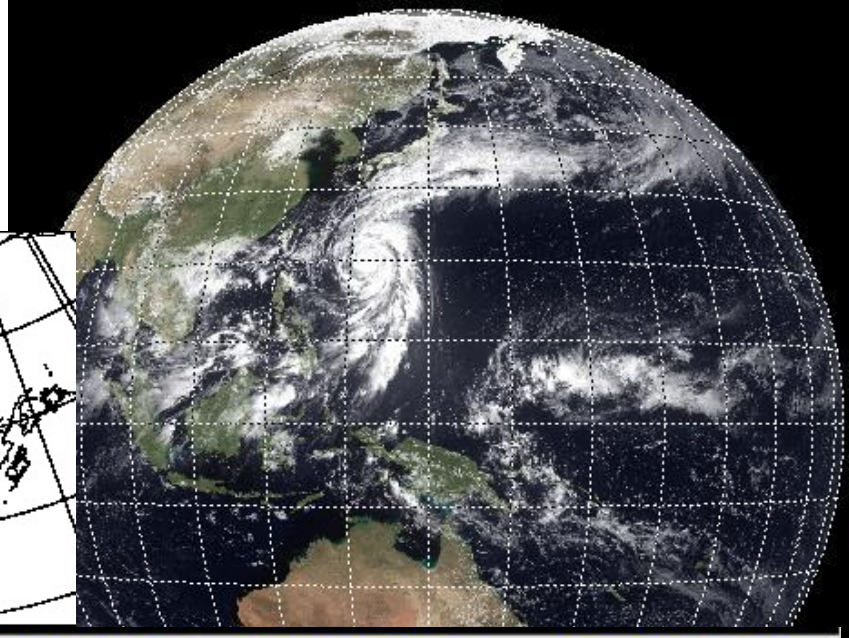
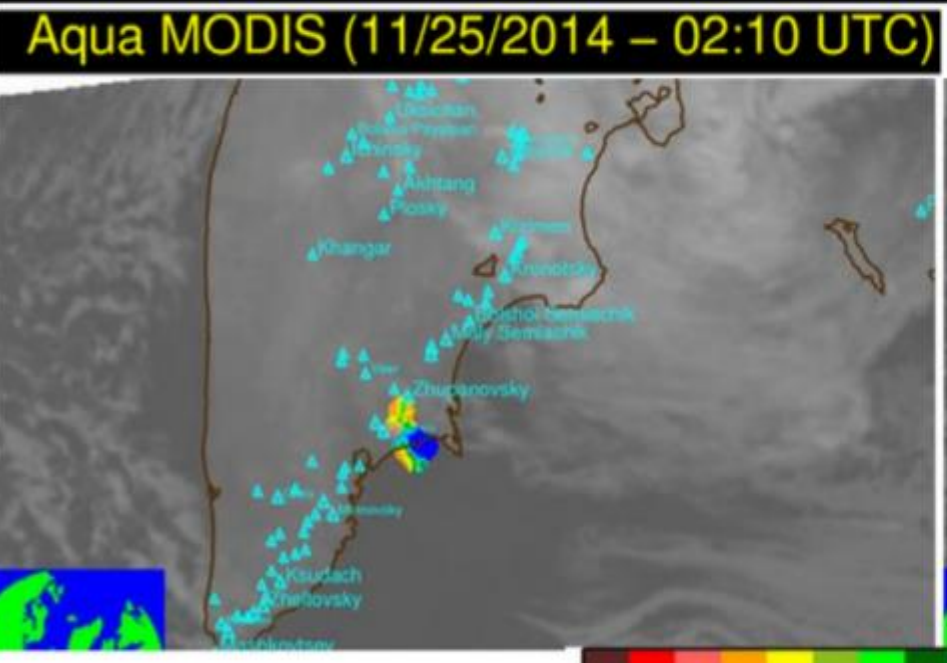
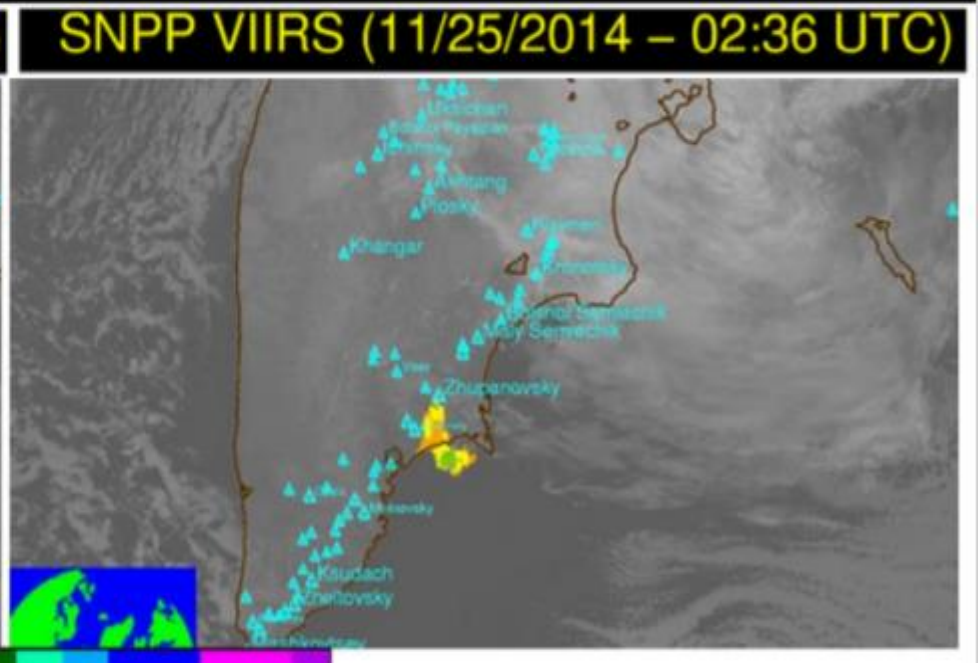

IR Window Imagery and Ash/Dust Cloud Height
Aqua MODIS (11/23/2014 – 00:48 UTC)
5km-7km
4km to
6km


04/07452




Aqua MODIS (11/25/2014 – 02:10 UTC)
Khangar
Zhupanovsky
Kaudach


SNPP VIIRS (11/25/2014 – 02:36 UTC)
Khangar
Zhupanovsky
Kaudach


0 2 4 6 8 10 12 14
Ash/Dust Height [km, ASL]

Conclusions

- New products on their way
- Novel ideas to use (e.g. tracking ash-cloud, trajectories, geo/leo combination
- New instruments already there (AHI,ABI)
- New instruments/capabilities coming, e.g. MTG IRS, Sentinel-4
- New technologies into operations; Lidar?

What are the most promising research tools to move into operations in satellite remote sensing?

Met Office

Current state of operational satellite-based volcanic cloud remote sensing:

- Imagery-based ash detection schemes
- Many groups performing geostationary and LEO imager-based retrievals:
  - Some very simple (with little or no inherent error analysis)
  - Others more sophisticated – errors for free
- Many are available to a wider audience via various channels
- (Hyper-spectral) sounder-based possibly less mature? – potentially more information (PSD, composition?) – less widely available (certainly on a NRT basis)
- Possibly less emphasis on UV/Vis?

Needs and challenges:

- Conveying uncertainty:
  - Reconciling different spectral regions, spectral resolutions, etc.
  - Reconcile differences between products using same or similar data
- Blended products?
- Operational users converge to specific schemes?
- Next generation of geo imagers
- Reliable automated alert system
- High latitudes in Winter for “weak” cases?

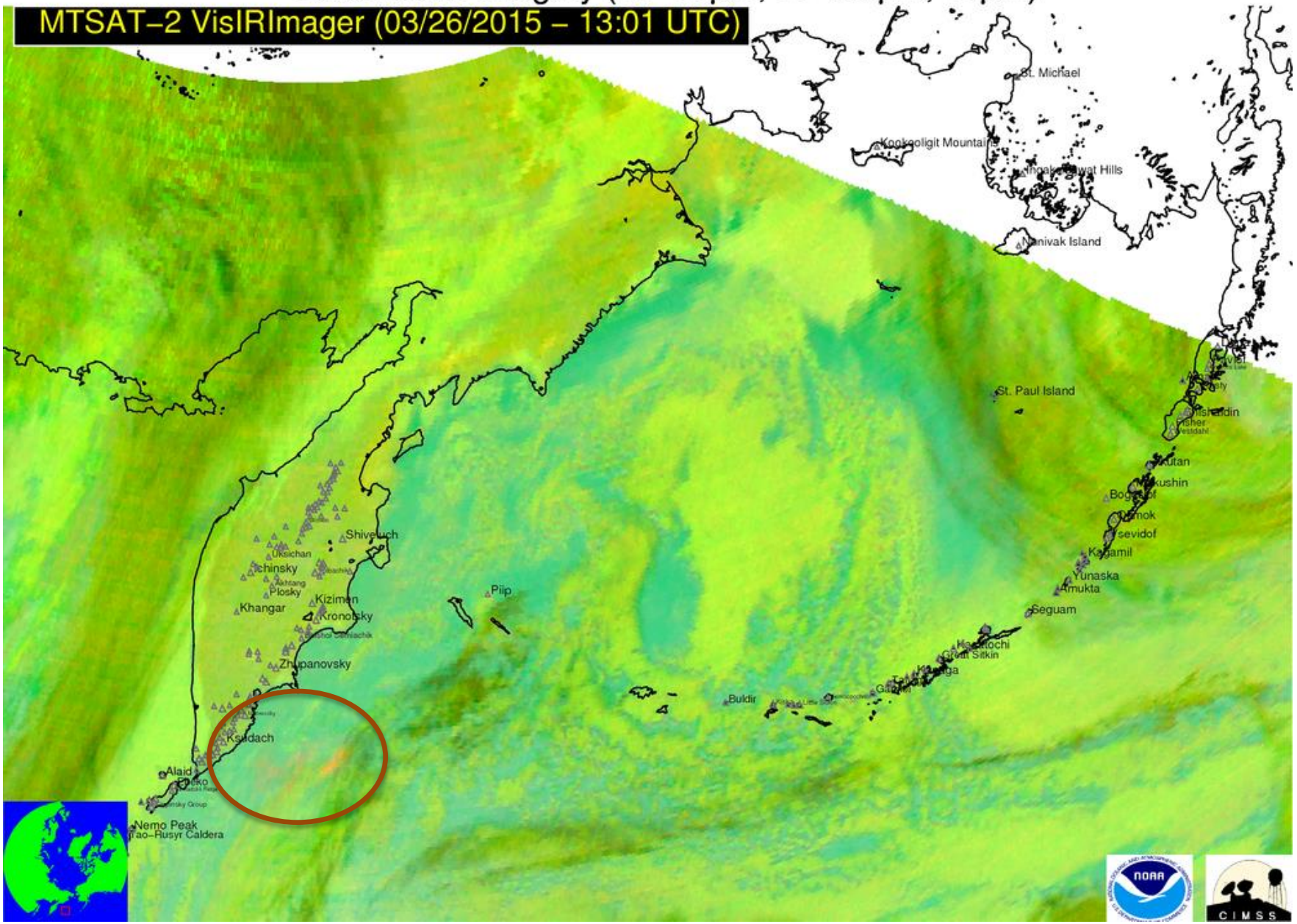
Satellite Remote Sensing

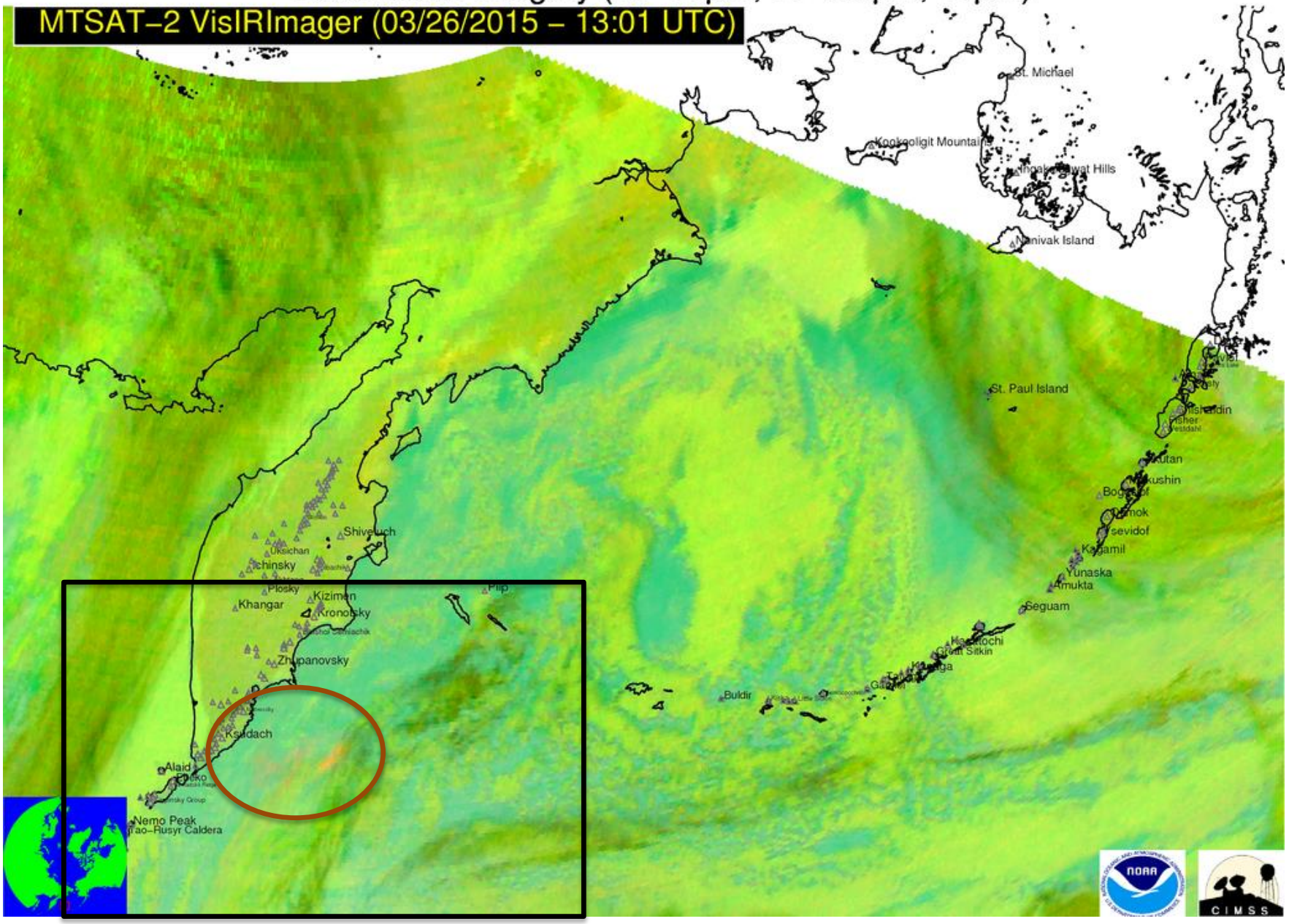
- **Promising Developments:** hyperspectral retrievals, cloud growth based eruption detection, alerting services, integration of satellite data and models
- **Challenges:** full utilization of the next generation of satellites, making products with fewer caveats
- **Ultimate Goal:** a multi-sensor “best” analysis that does not require users to be experts in measurement or retrieval theory, similar to a standard meteorological analysis

Wave length (μm)	Himawari-8/9			MTSAT-1R/2	
	Band number				
0.47	1	●	1		
0.51	2	●	1		
0.64	3	●	0.5	●	1
0.86	4	●	1		
1.6	5	●	2		
2.3	6	●	2		
3.9	7	●	2	●	4
6.2	8	●	2	●	4
6.9	9	●	2		
7.3	10	●	2		
8.6	11	●	2		
9.6	12	●	2		
10.4	13	●	2	●	4
11.2	14	●	2		
12.4	15	●	2	●	4
13.3	16	●	2	JMA	

Which "split-window" BTD should be used for ash tracking?

The AHI (and ABI) have 3 channels in the "split-window" region


False Color Imagery (12–11μm, 11–3.9μm, 11μm)
MTSAT–2 VisIRImager (03/26/2015 – 13:01 UTC)
St. Michael
Kookooligit Mountains
Nunivak Island
St. Paul Island
Shivelu
Uksichan
Plosky
Kiziman
Khangar
Kronotsky
Zhupanovsky
Ksudach
Alaid
Nemo Peak
Piip
Buldir
Seguam
Yunaska
Amukta
Kasatochi
Great Sitkin
NOAA
CIMSS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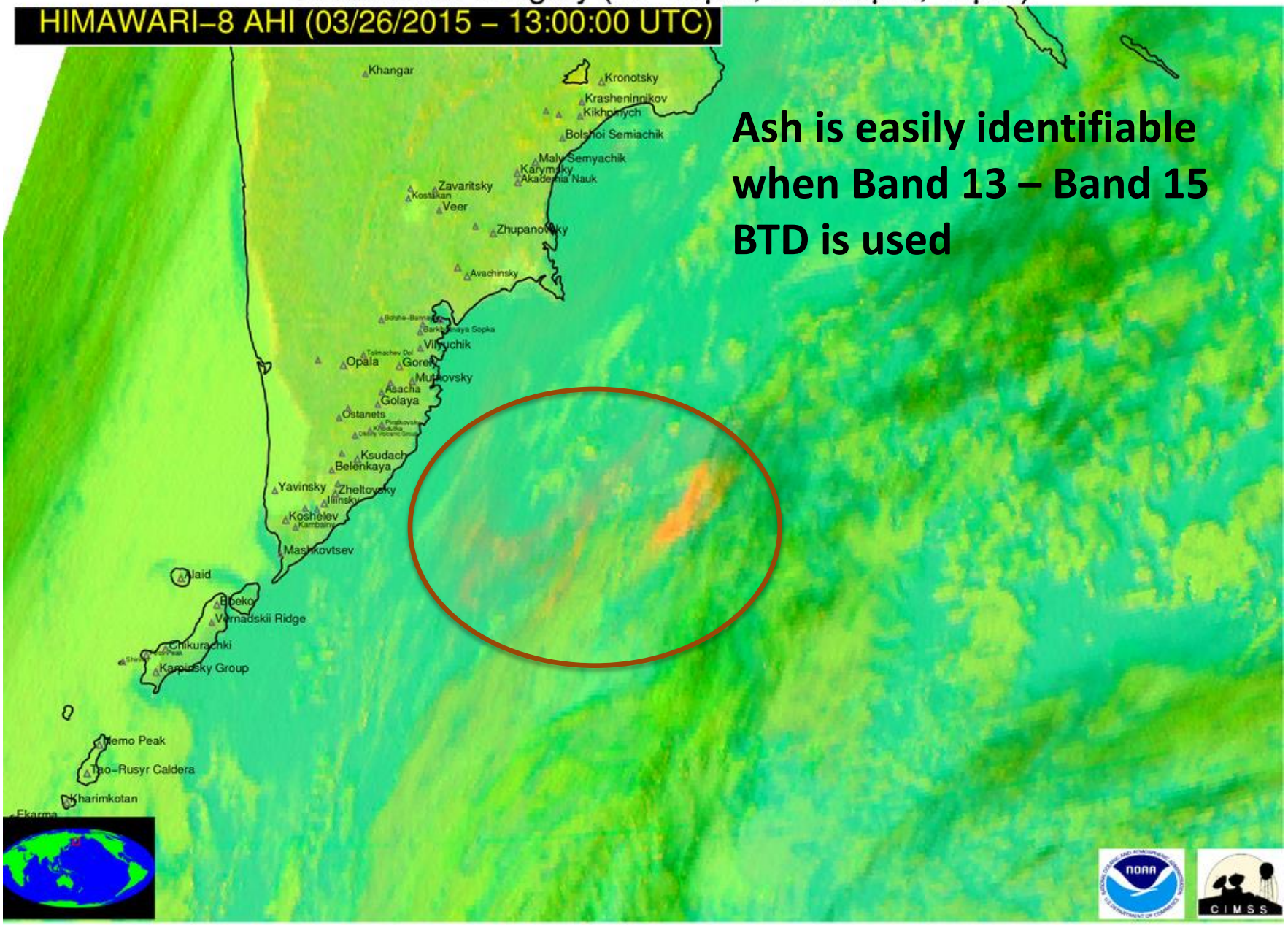
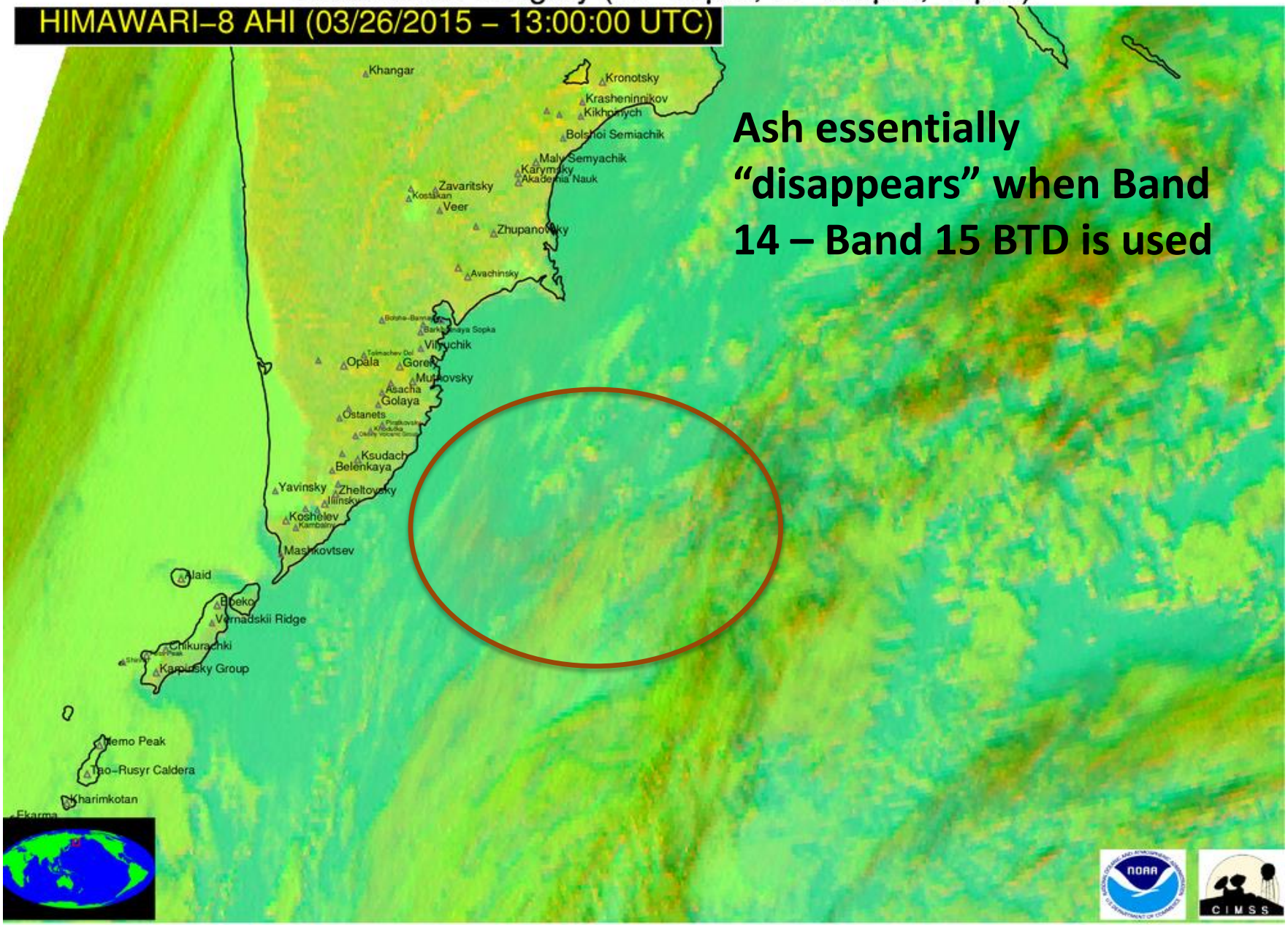
Kasatochi
Great Sitkin
NOAA
CIMSS


False Color Imagery (12–11μm, 11–3.9μm, 11μm)
HIMAWARI–8 AHI (03/26/2015 – 13:00:00 UTC)
Khangar
Kronotsky
Krasheninnikov
Kikhpinych
Bolshoi Semiachik
Maly Semyachik
Karymsky
Akademia Nauk
Zavaritsky
Kosa'kan
Veer
Zhupanovsky
Avachinsky
Opala
Gorely
Mutnovsky
Asacha
Golaya
Ostanets
Ksudach
Belenkaya
Yavinsky
Zheltovsky
Iliinsky
Koshelev
Kambalny
Mashkovtsev
Alaid
Bbeko
Vernadskii Ridge
Chikurachki
Karpinsky Group
Ushishir
Ebeko
Prevo Peak
Tao–Rusyr Caldera
Kharimkotan
Ekarma
Ash is easily identifiable when Band 13 – Band 15 BTD is used
NOAA
CIMSS


False Color Imagery (12–11μm, 11–3.9μm, 11μm)
HIMAWARI–8 AHI (03/26/2015 – 13:00:00 UTC)
Khangar
Kronotsky
Krasheninnikov
Kikhpinych
Bolshoi Semiachik
Mal. Semyachik
Karymsky
Akademia Nauk
Zavaritsky
Kosa'kan
Veer
Zhupanovsky
Avachinsky
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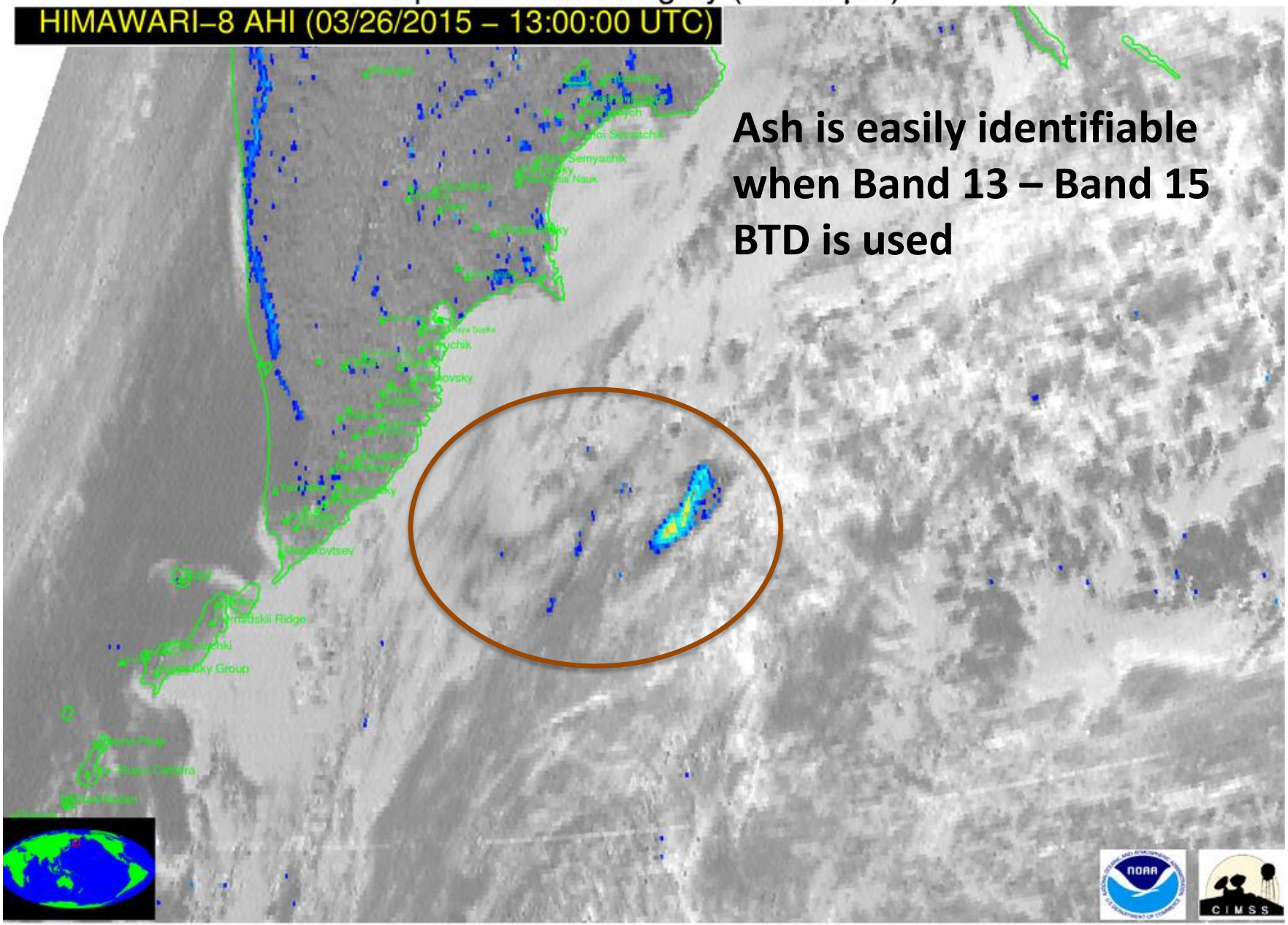
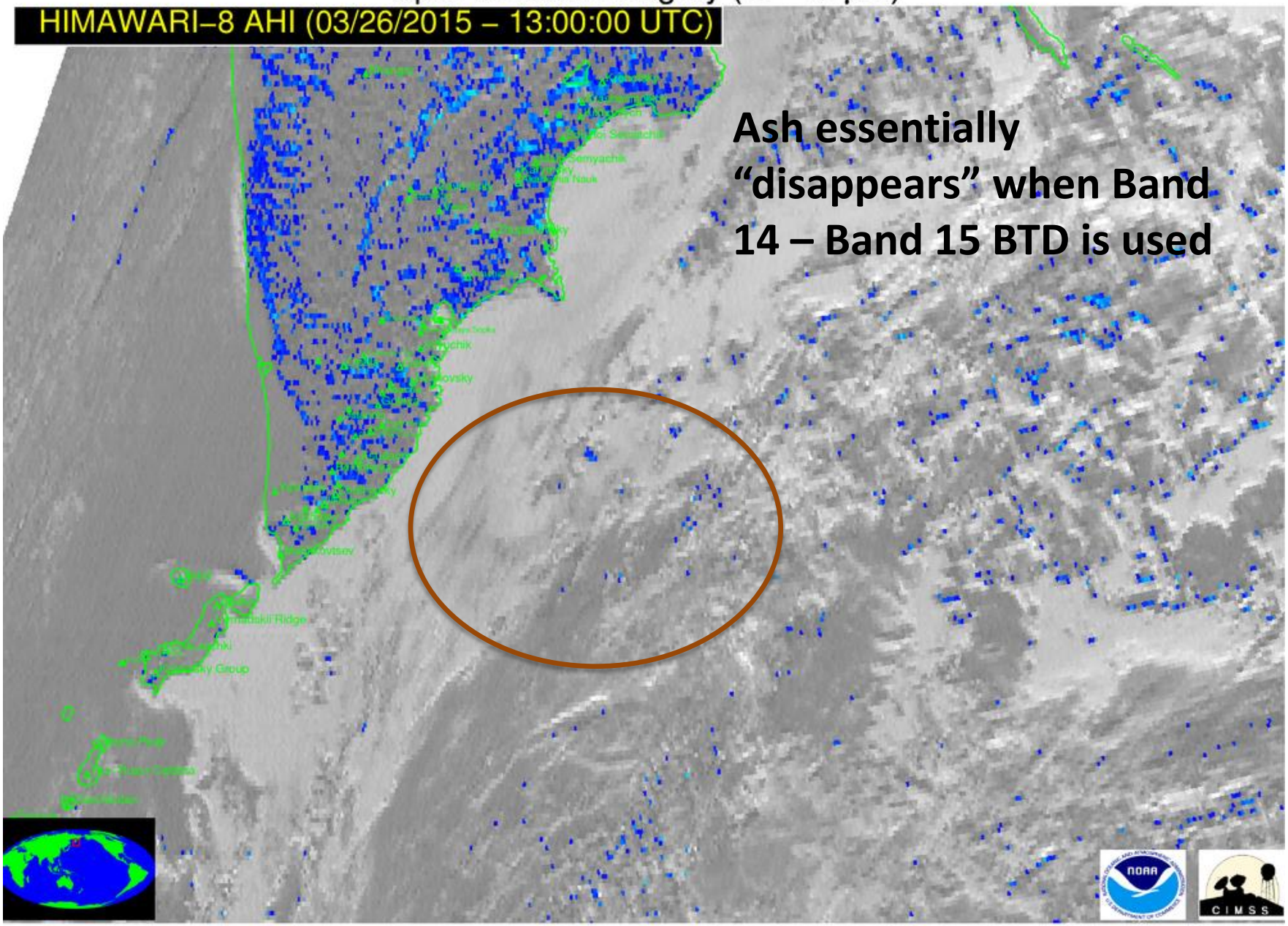
Belenkaya
Yavinsky
Zheltovsky
Iliinsky
Koshelev
Kambalny
Mashkovtsev
Alaid
Bbeko
Vernadskii Ridge
Chikurachki
Karpinsky Group
Nemo Peak
Tao–Rusyr Caldera
Kharimkotan
Ekarma
Ash essentially "disappears" when Band 14 – Band 15 BTD is used
NOAA
CIMSS


Split–Window Imagery (11–12 μm)
HIMAWARI–8 AHI (03/26/2015 – 13:00:00 UTC)
Ash is easily identifiable when Band 13 – Band 15 BTD is used
−6 −5 −4 −3 −2 −1 0 1 2 3 4 5
BTD[11–12 μm] [K]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Ash essentially "disappears" when Band 14 – Band 15 BTD is used
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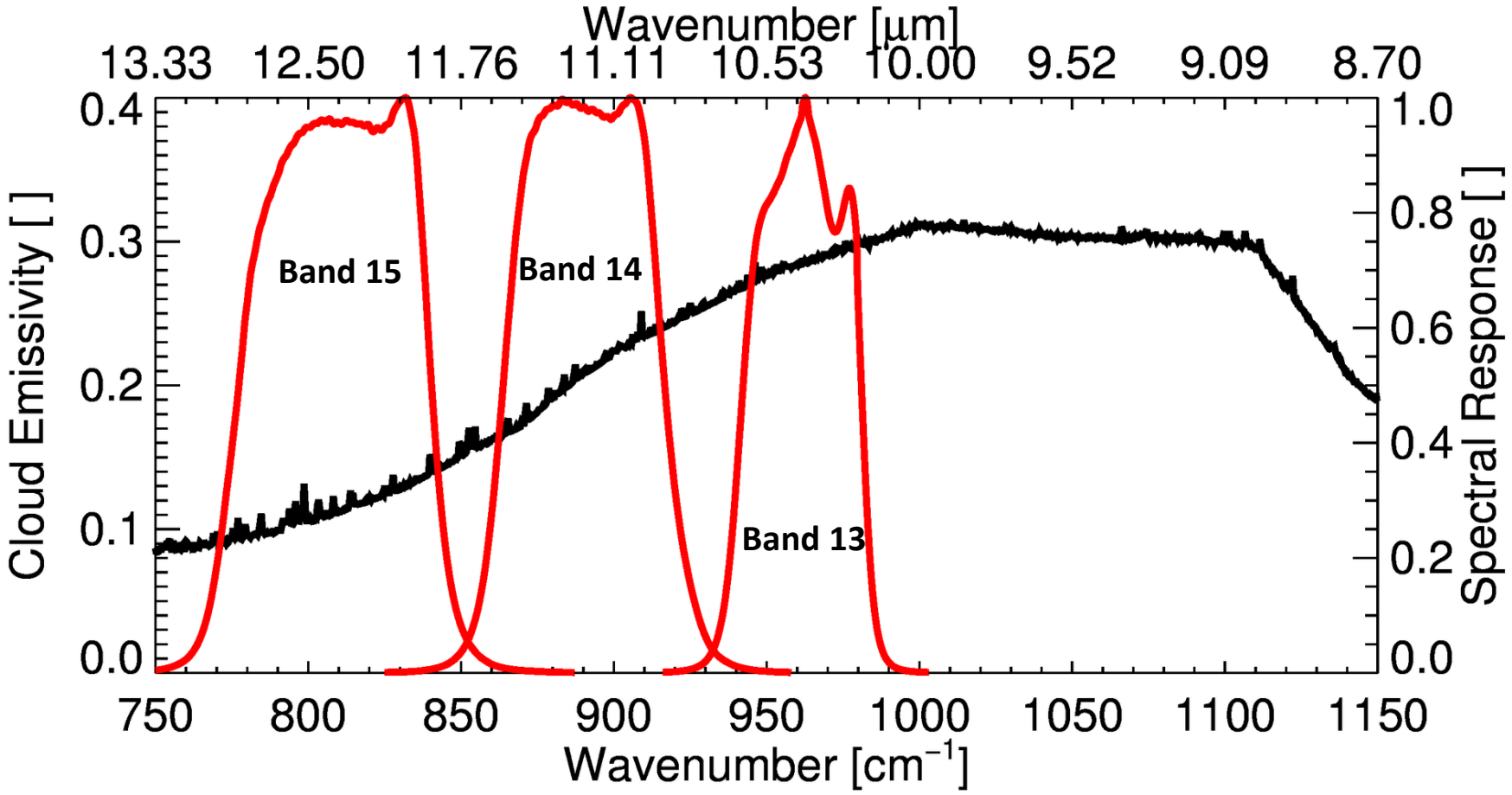
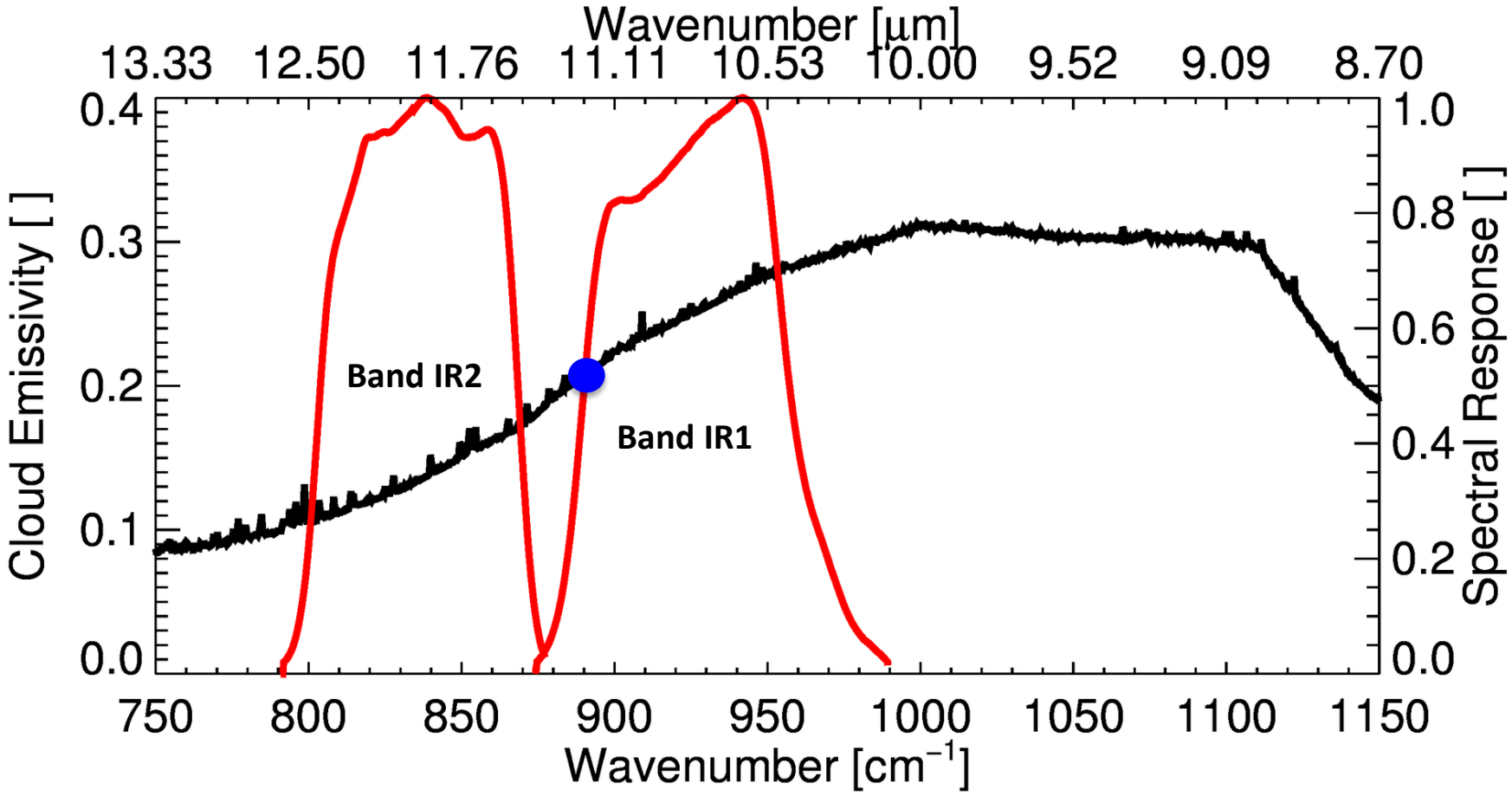
BTD[11–12 μm] [K]

Himawari-8 AHI



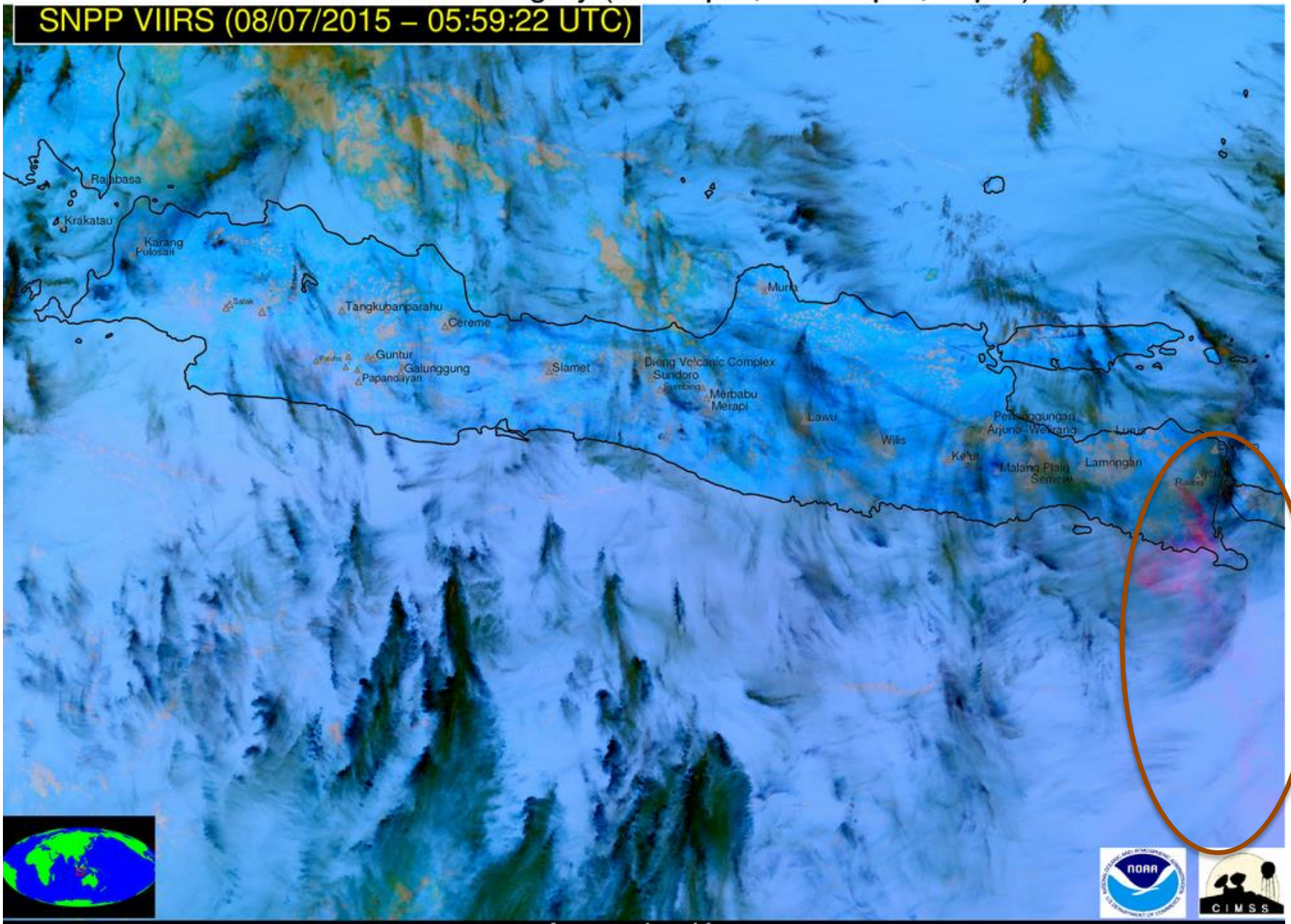
The emissivity of ash clouds decreases with increasing wavelength in the "split-window" region (the opposite is true for met clouds)

MTSAT-2



The emissivity of ash clouds decreases with increasing wavelength in the "split-window" region (the opposite is true for met clouds)

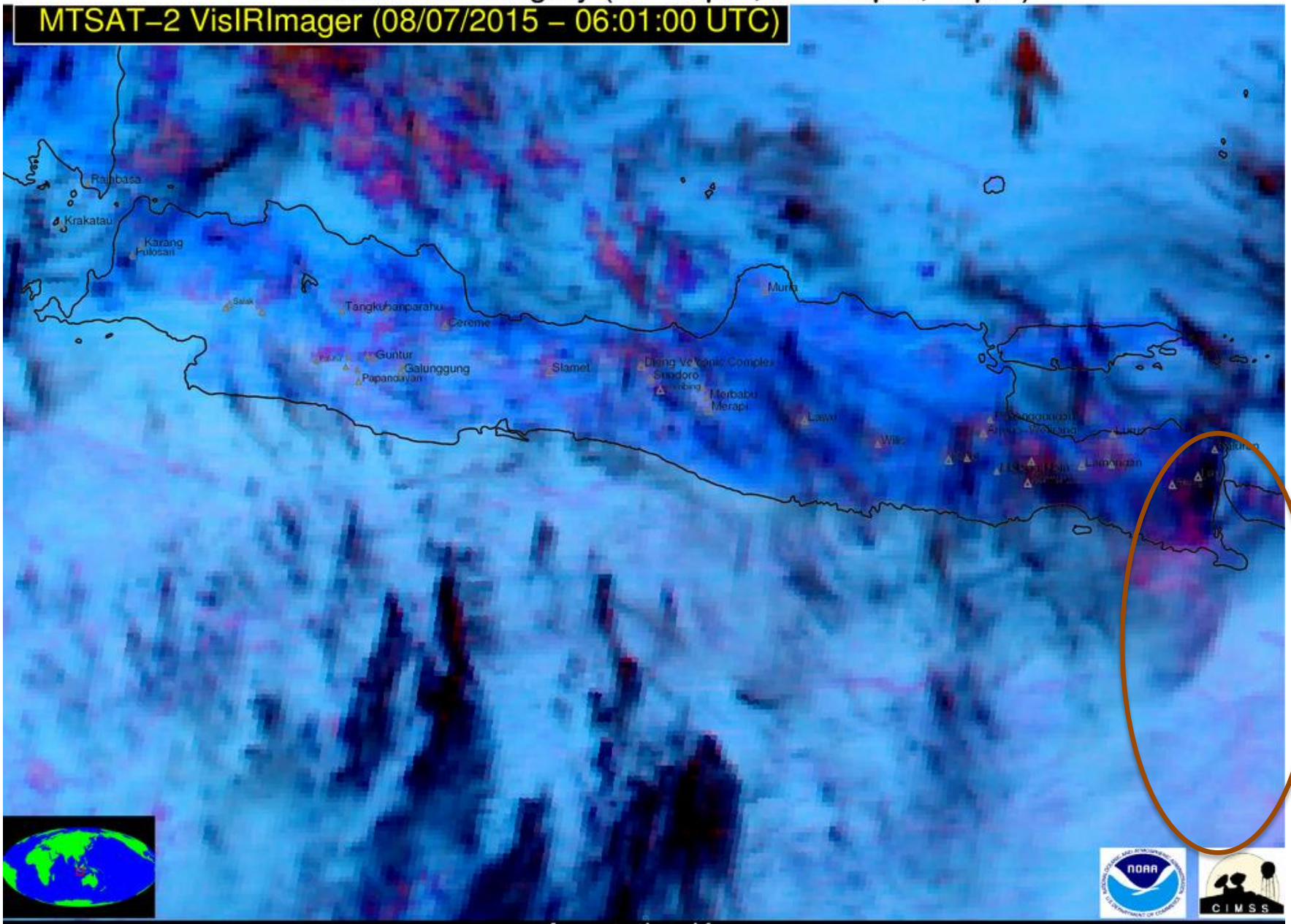
False Color Imagery (12–11μm, 11–8.5μm, 11μm)



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

Ash/Dust Cloud Volcanic Cb Thermal Anomaly

False Color Imagery (12–11μm, 11–3.9μm, 11μm)



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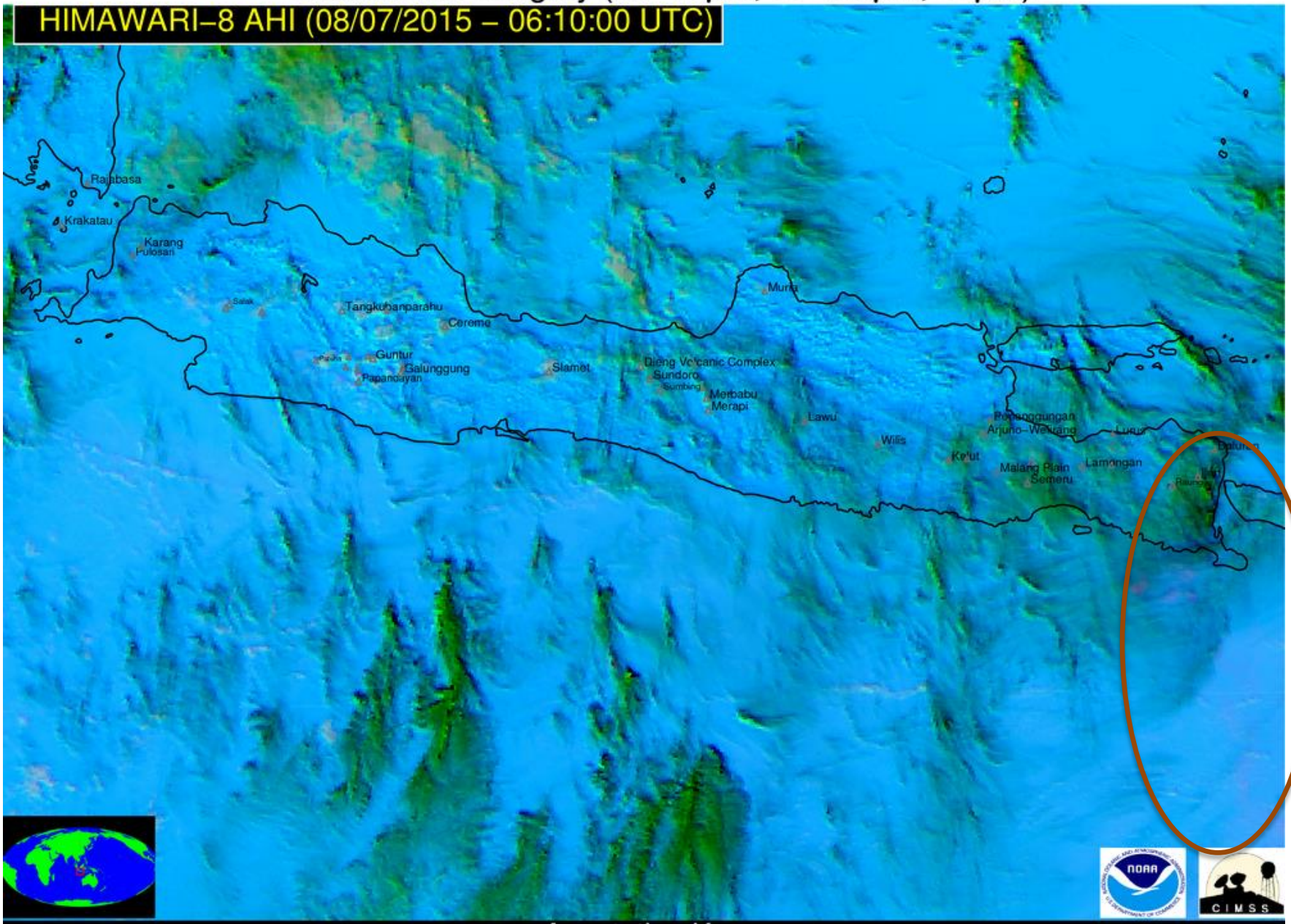

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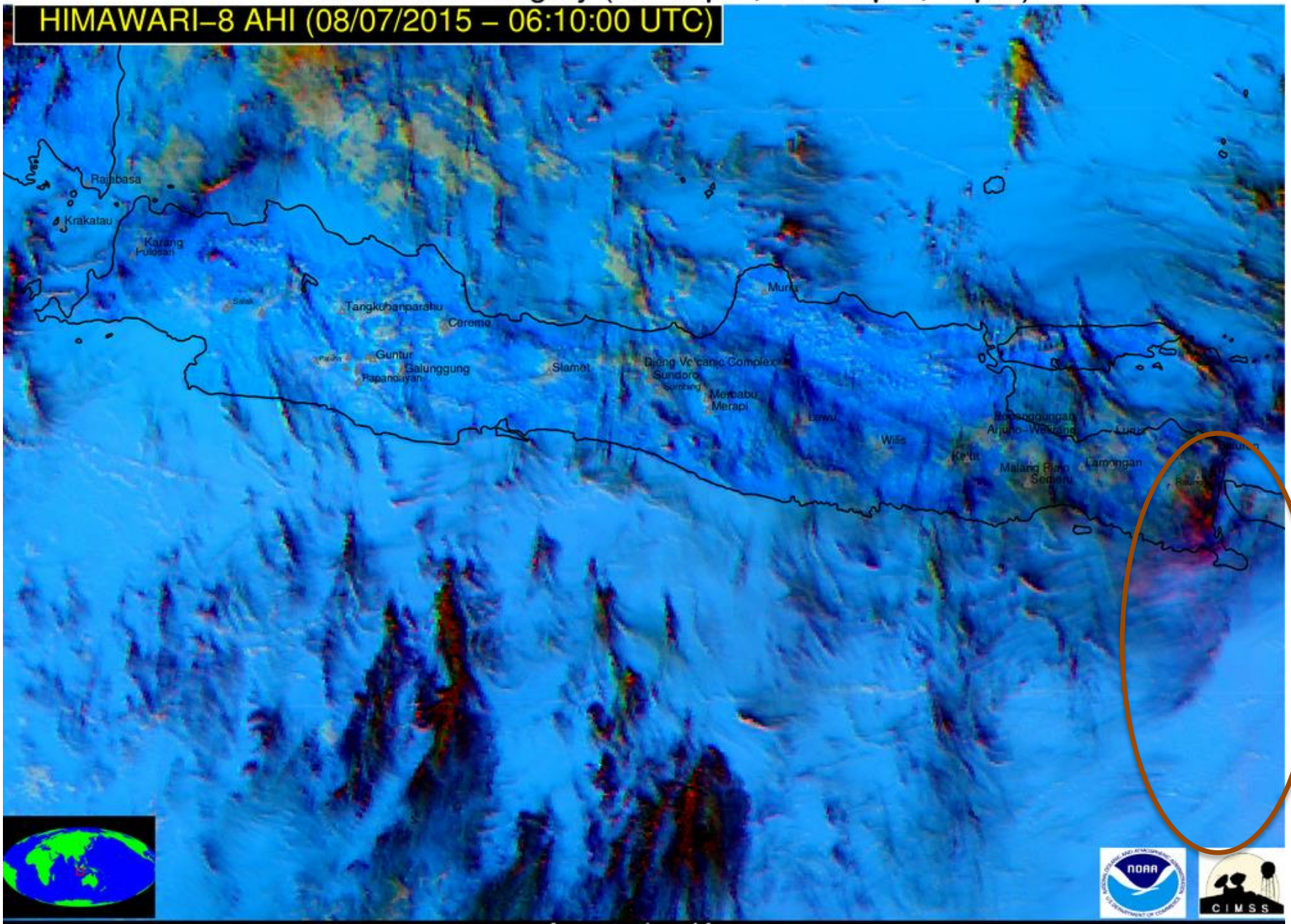

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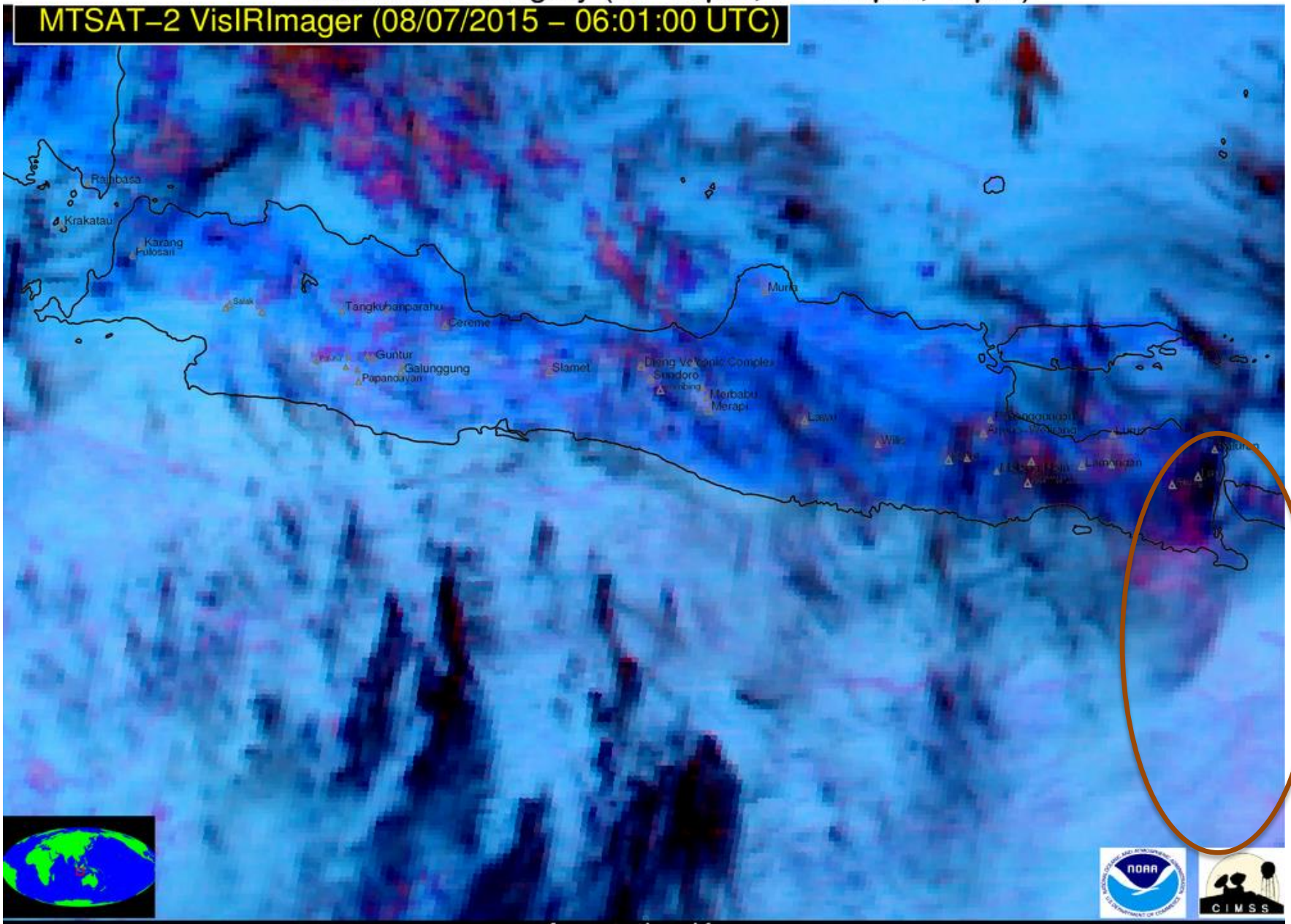

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