Inter-comparison MTSAT-2 & Himawari-8

WMO Volcanic Ash Advisory Centre

Best Practice Workshop 2017

Tokyo Volcanic Ash Advisory Centre

Japan Meteorological Agency

Outline

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Tokyo Volcanic Ash Advisory Center
Japan Meteorological Agency

Introduction

- Himawari-8, a next generation meteorological satellite, was launched in 2014 and became operation in July 2015.

- Such new satellites contribute to improvement of VA analysis techniques and methods and enable VAACs to provide more accurate and timely information.

- On the other hand, volcanic ash which used to be NOT-discernible may become identifiable.

As part of efforts to develop discernible ash agreed techniques, inter-comparison of satellites are required

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Enhancement of Observation Functions

Spatial

MTSAT-1R/2
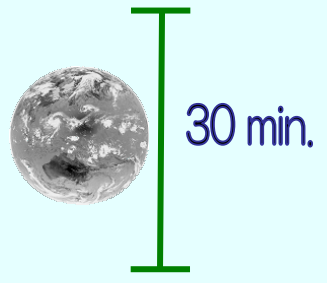VIS: 1km
IR: 4km

➡

Himawari-8/9
VIS: 0.5-1 km
IR: 2 km

Temporal

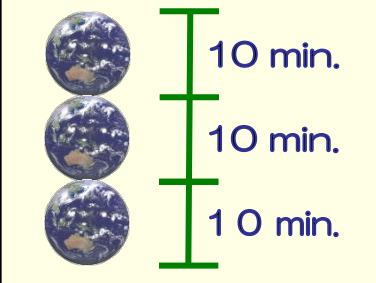Full disk: ten-minute intervals

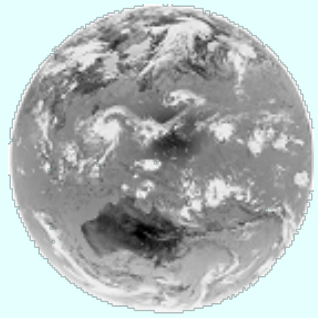**MTSAT-1R/2**

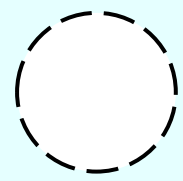30 min.

➡

Himawari-8/9

10 min.
10 min.
1 0 min.

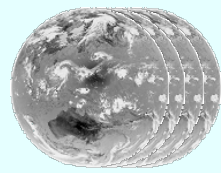* Himawari also provides regional observations every 2.5 minutes for specific areas.

Spectral
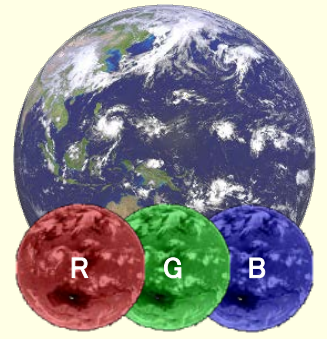
MTSAT-1R/2
VIS: 1
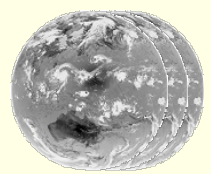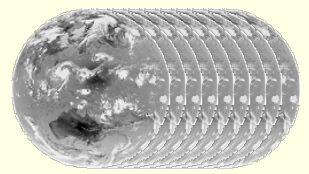
NIR: N/A

IR: 4

Total: 5

➡

Himawari-8/9
VIS: 3 (color)

R G B

NIR: 3

IR: 10

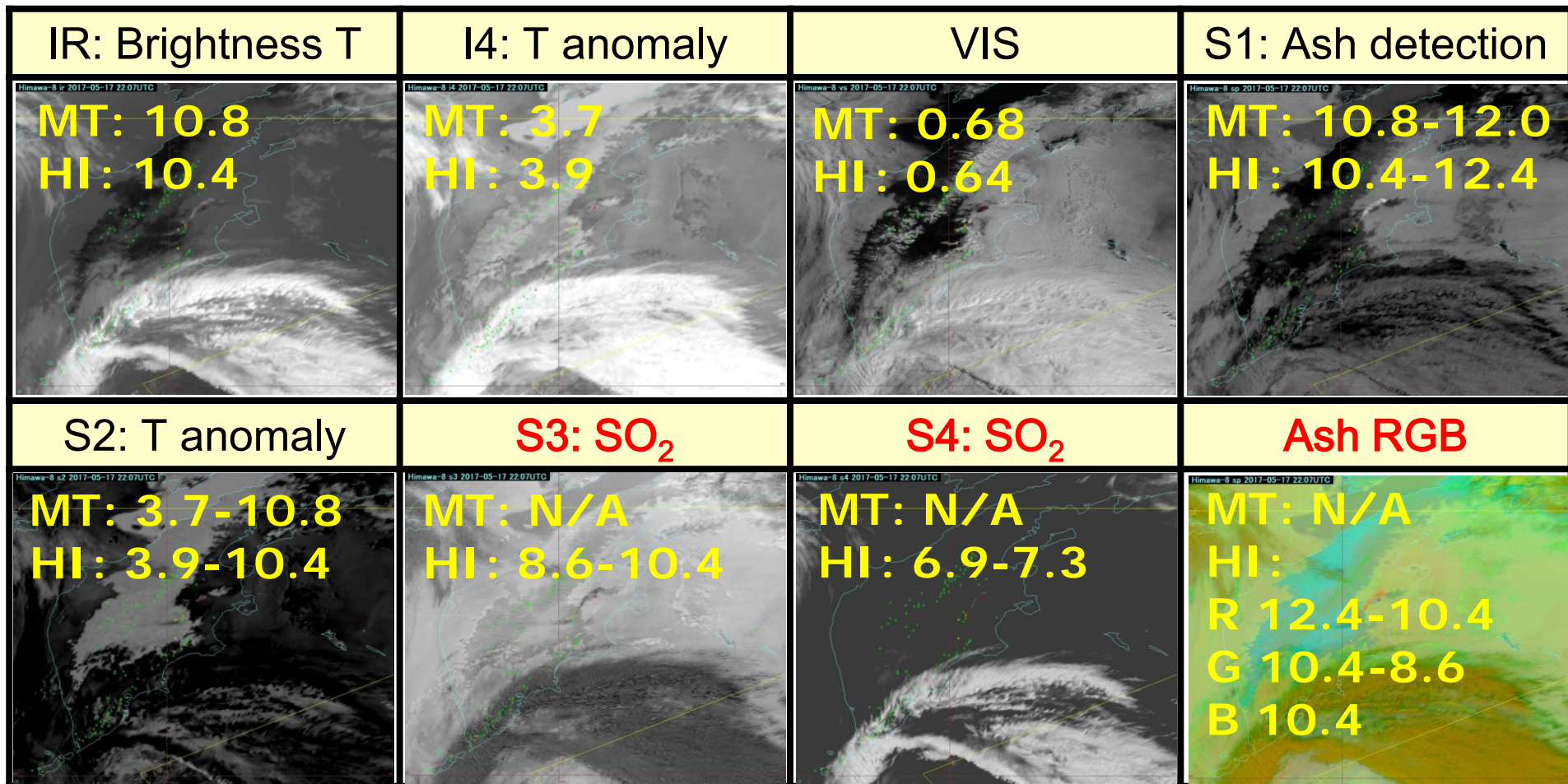Total 16

Examples of satellite imagery

Mainly eight types of imagery shown below are utilized for operational analysis in VAAC Tokyo (unit: μm).

IR: Brightness T	I4: T anomaly	VIS	S1: Ash detection
MT: 10.8 HI : 10.4	MT: 3.7 HI : 3.9	MT: 0.68 HI : 0.64	MT: 10.8-12.0 HI : 10.4-12.4

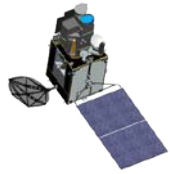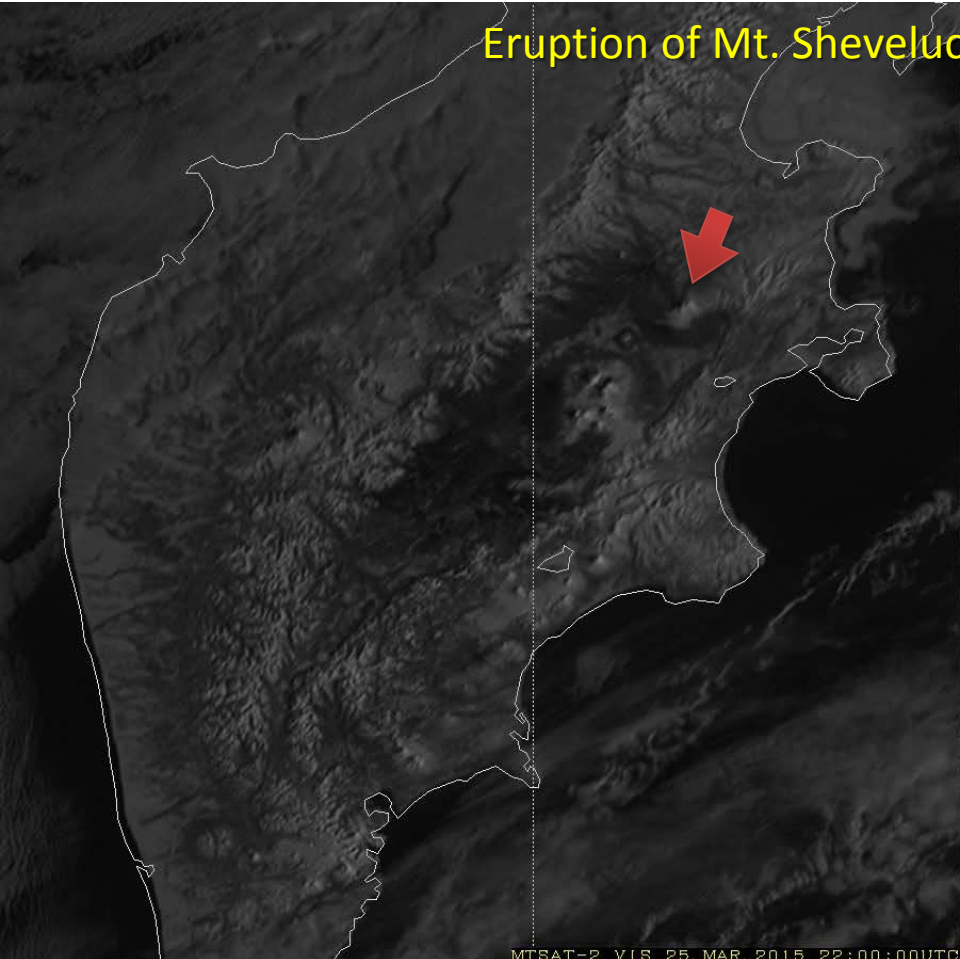| S2: T anomaly	S3: SO_2	S4: SO_2	Ash RGB
MT: 3.7-10.8 HI : 3.9-10.4	MT: N/A HI : 8.6-10.4	MT: N/A HI : 6.9-7.3	MT: N/A HI : R 12.4-10.4 G 10.4-8.6 B 10.4

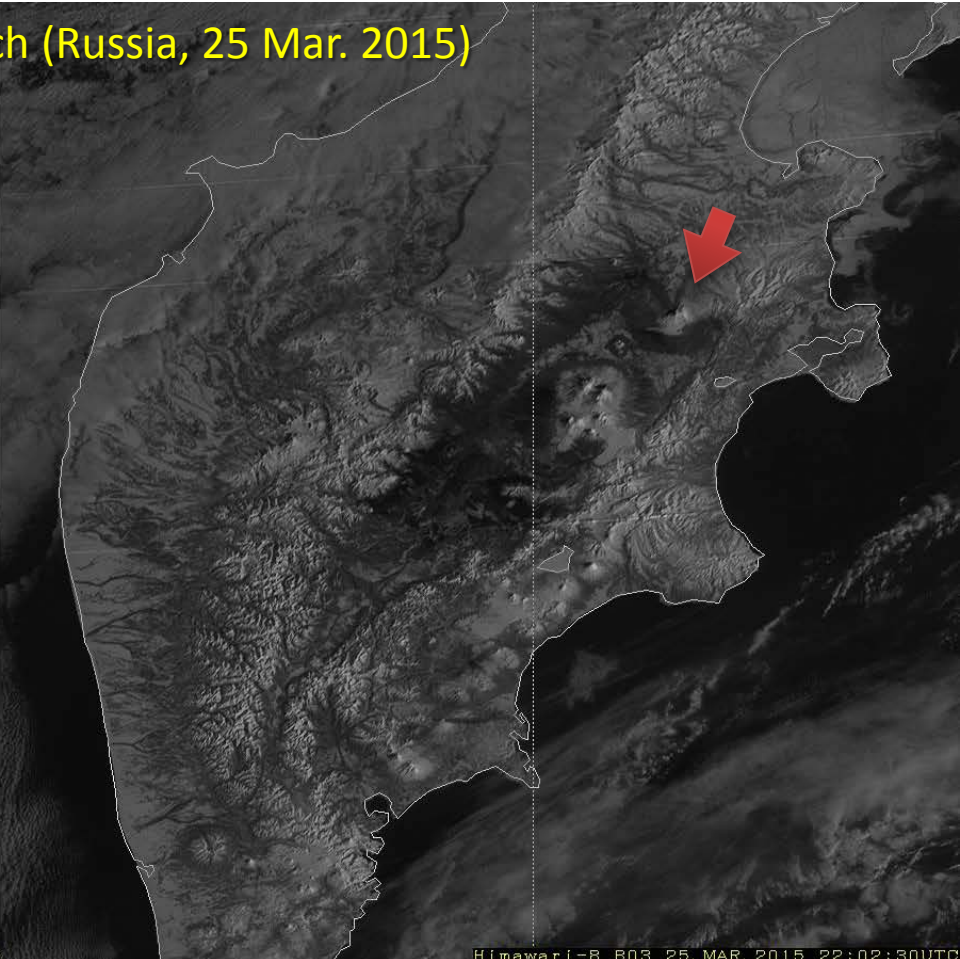# Comparison of appearance

MTSAT-2 VIS (0.68 μm) Every 30 min.

Himawari-8 B03 (0.64 μm) Every 2.5 min.

Eruption of Mt. Sheveluch (Russia, 25 Mar. 2015)

MTSAT-2 VIS 25.MAR.2015 22:00:00UTC

Himawari-8 B03 25.MAR.2015 22:02:30UTC

Method

[Period]
- From May 2015 to March 2016
- Choose nine cases

[Method]

For each case, five to six operational forecasters,
- Utilize operational procedures, but numbers of points (vertices) are not limited.
- Analyze imagery that are available for both satellites, including IR, S1, I4, VIS and S2.
- Determine VA areas every hour by using all imagery available until that time.

Cases

No.	Volcano	Period		Max. Height
		Start	End	
1	SAKURAJIMA	13/05/2015	14/05/2015	FL150
2	SAKURAJIMA	25/05/2015	26/05/2015	FL110
3	SHEVELUCH	12/03/2016		FL130
4	KARYMSKY	15/07/2015		FL090
5	KUCHINOERABUJIMA	29/05/2016		FL360
6	ZHUPANOVSKY	12/07/2015	13/07/2015	FL290
7	ZHUPANOVSKY	14/07/2015		FL140
8	SHEVELUCH	12/02/2016		FL150
9	RINJANI	05/11/2015		FL200

Analysis Tool (SATAID)

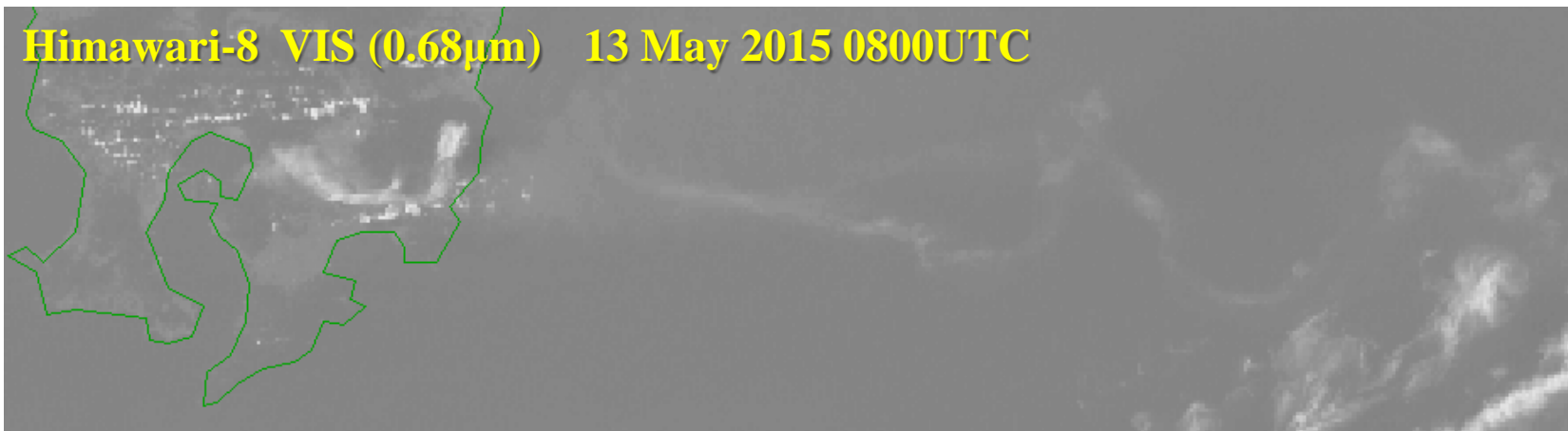Analysis on SATAID

Control animation

Select images

VA analysis

- Display several types of imagery in looping.
- Change gradation of imagery for monitoring and analysis.
- Draw VA polygons and calculate their ash top height and movement.

Adjust ⟹ Draw ⟹

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Case 1 Sakurajima

vertical: VA area (total)
horizontal: Time

Legend:
- HIMAWARI
- MTSAT
- Day Time
- Night Time

Little difference | Large difference | Longer detection

If there is only one analysis, values are shown in white as references
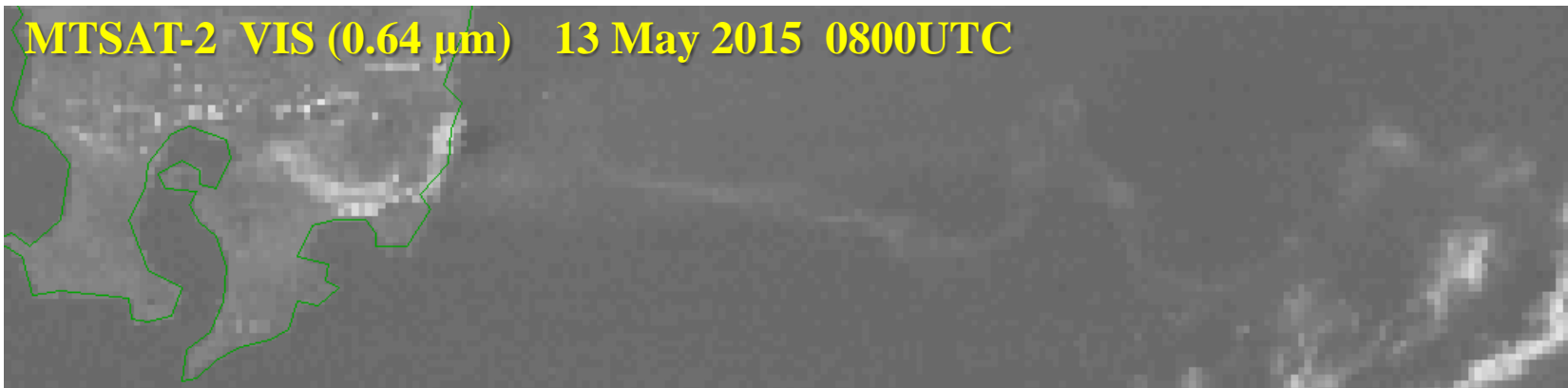
Tokyo VAAC

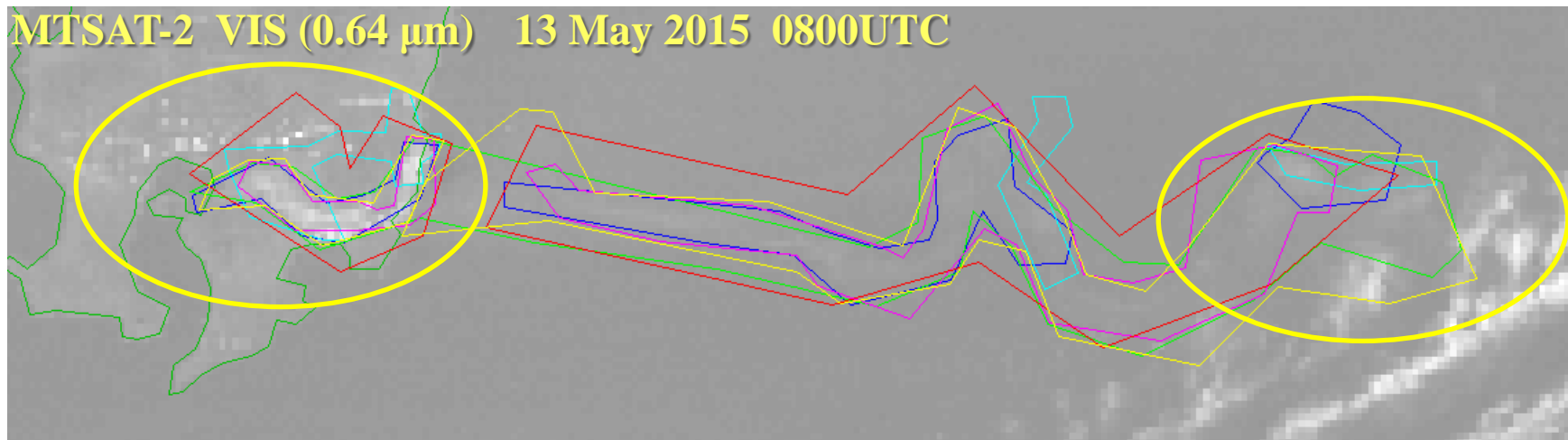# VIS imagery during daytime
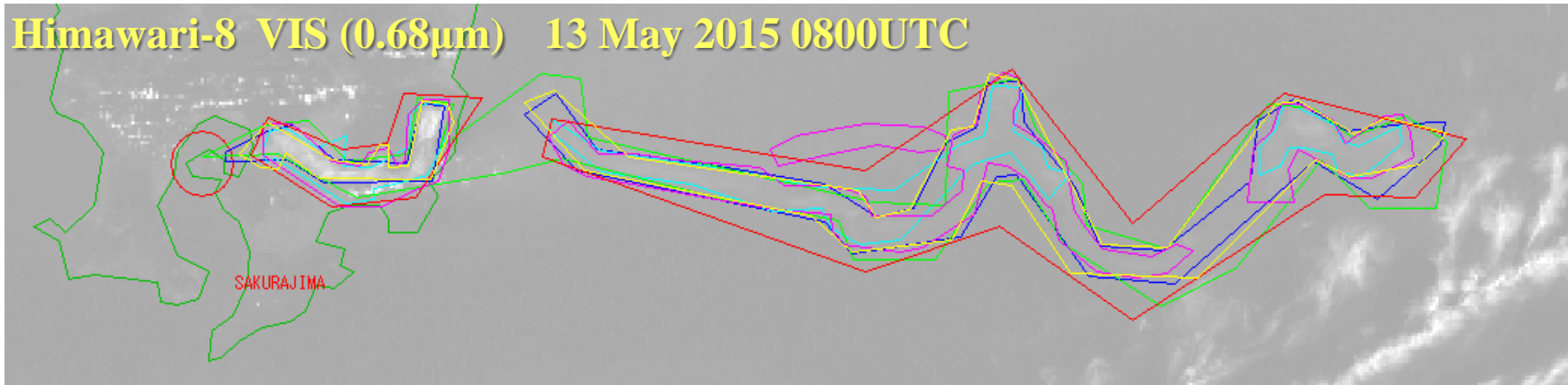
Himawari-8 VIS (0.68μm)   13 May 2015 0800UTC

MTSAT-2 VIS (0.64 μm)   13 May 2015 0800UTC
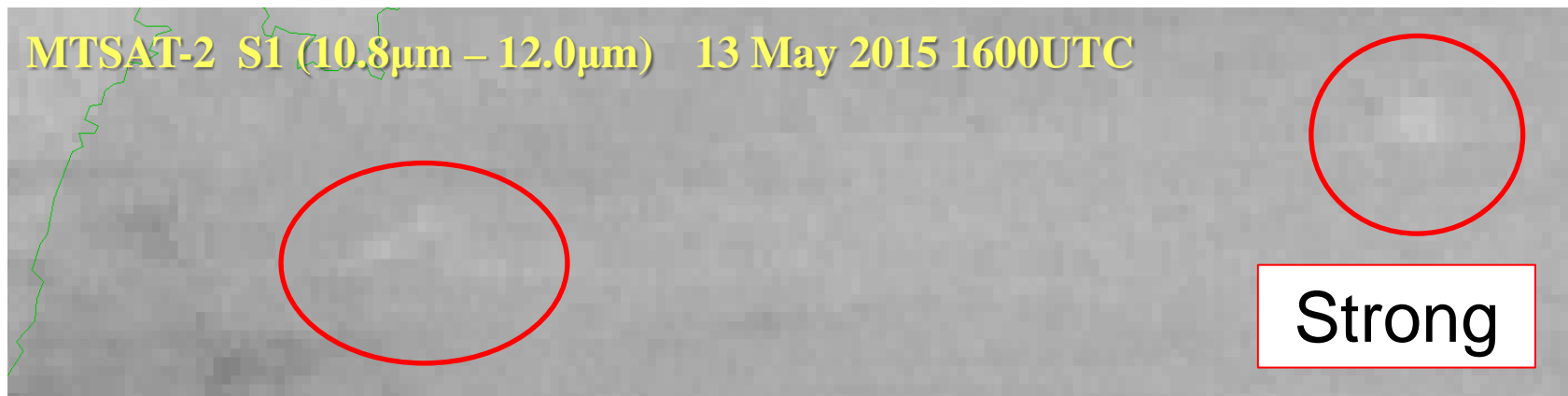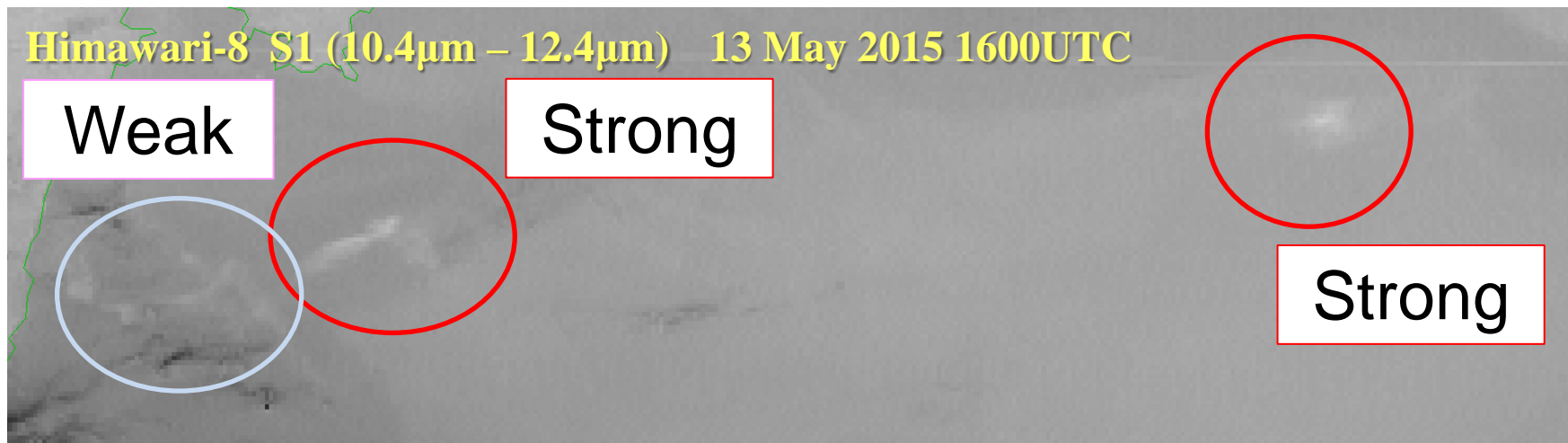
There is little difference on VIS images.
If the condition is good, an impact of high spatial resolution may
be saturated.

Analysis result

Himawari-8 VIS (0.68μm)   13 May 2015 0800UTC

SAKURAJIMA

MTSAT-2 VIS (0.64 μm)   13 May 2015 0800UTC

Himawari (above) provides more accurate results with less individual differences.

Polygons represent analysis results by forecasters

S1 Imagery during night time

Himawari-8 S1 (10.4μm – 12.4μm)   13 May 2015 1600UTC

Weak

Strong

Strong

MTSAT-2 S1 (10.8μm – 12.0μm)   13 May 2015 1600UTC

Strong

Not only by difference in resolutions, difference in sensors' characteristics also affect analysis results.

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Analysis result

Himawari-8 S1 (10.4μm – 12.4μm)   13 May 2015 1600UTC

Identifiable

MTSAT-2 S1 (10.8μm – 12.0μm)   13 May 2015 1600UTC

Not-identifiable
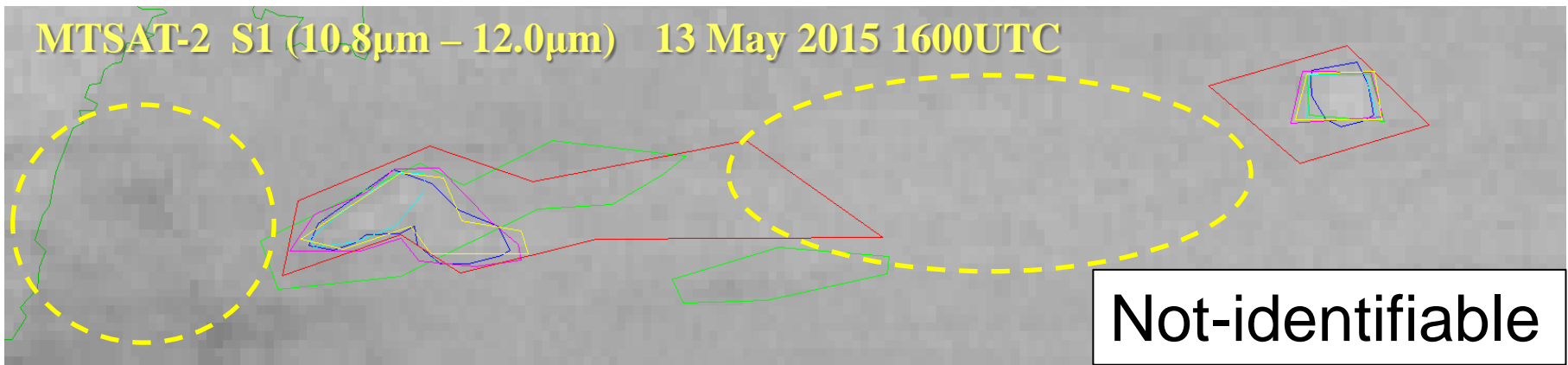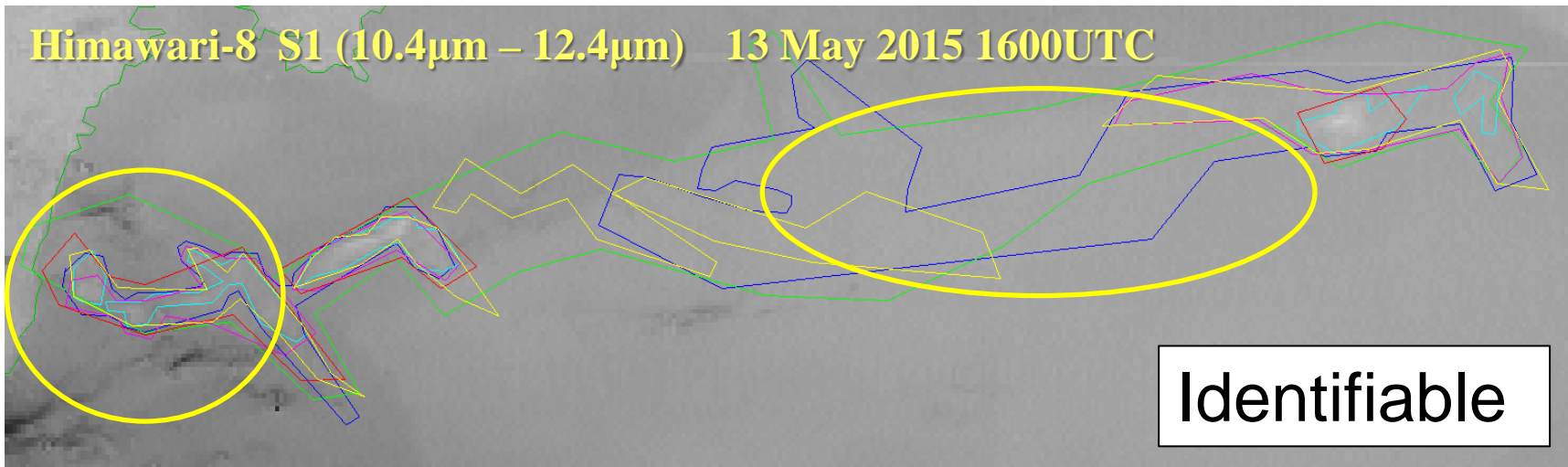
Larger area of VA is detectable on Himawari, while individual differences are quite large.

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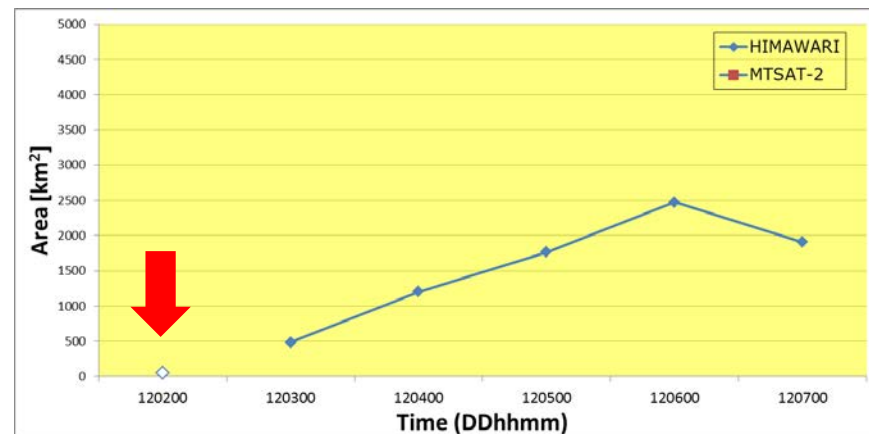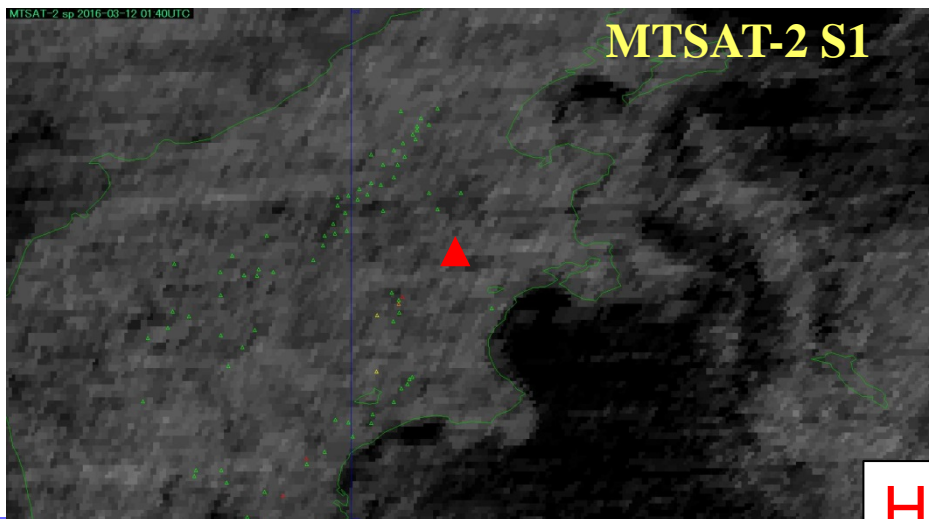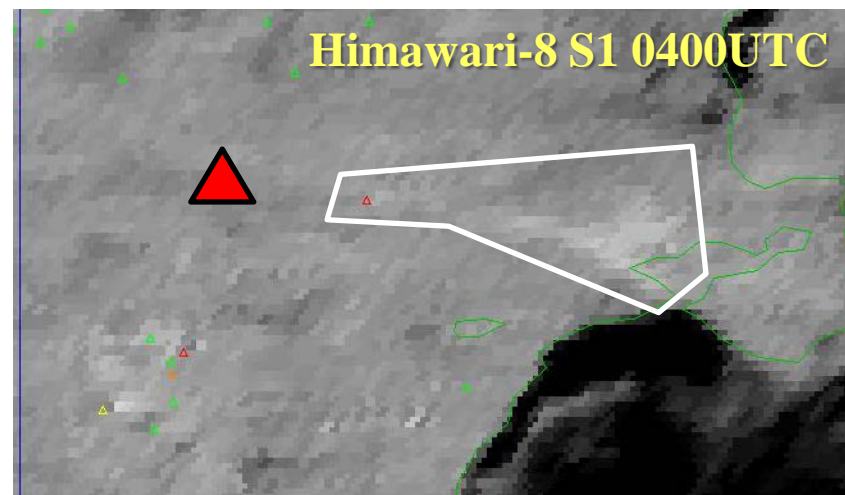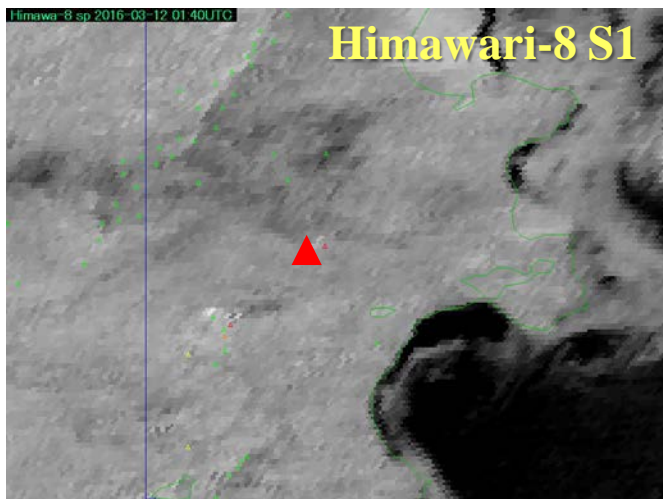Japan Meteorological Agency

Summary

1. VIS images provide similar appearance if the condition is good. However, if VA is covered MET clouds or is above the ground, analysis on Himawari is more accurate.

2. VA appearances on split images are quite different; it induces large differences in analysis results during night time.

3. VA on Himawari is detectable longer than VA on MTSAT-2.

Takeaways from other cases

Himawari-8 S1

Himawari-8 S1 0400UTC

MTSAT-2 S1

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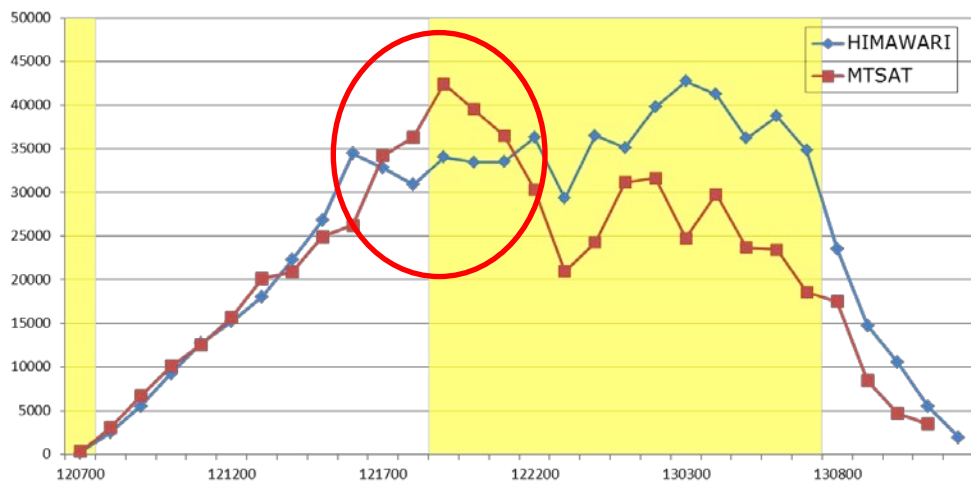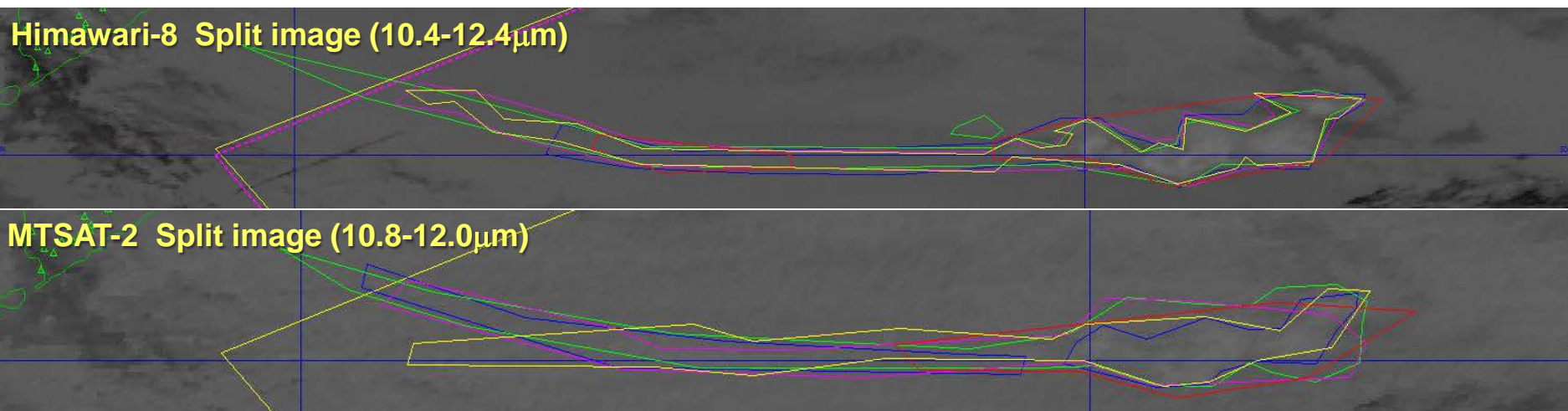Himawari detects small eruptions

Takeaways from other cases

Case 6: Zhupanovsky 12 July 2015 1900UTC

Himawari-8 Split image (10.4-12.4µm)

MTSAT-2 Split image (10.8-12.0µm)

MTSAT-2 analysis sometimes judges NOT-VA part as VA part

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Discussion – positive impacts

➢ Being able to detect small eruptions and volcanic ash from such eruptions that used to be missed.

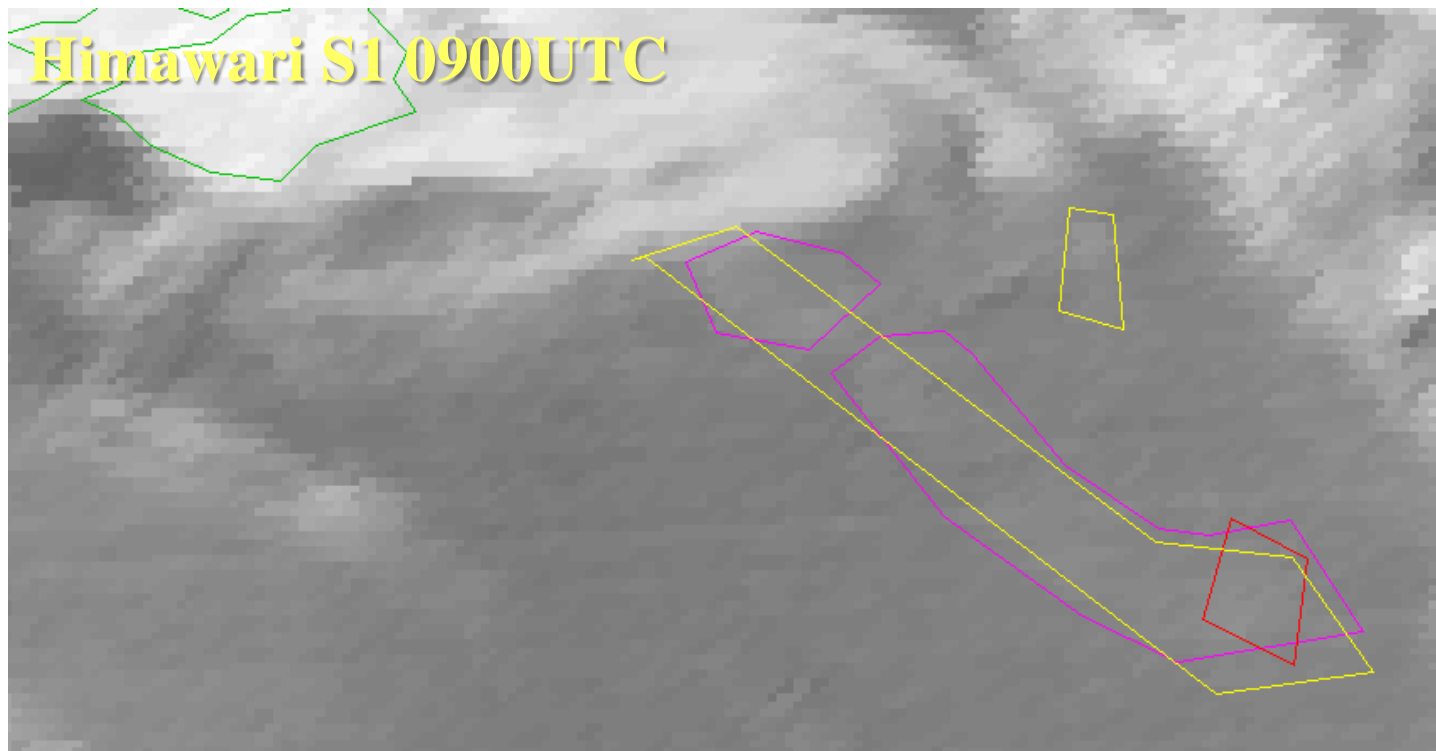➢ Being able to identify volcanic ash under bad conditions, such as VA is covered by met clouds.

New satellites contribute to reducing miss-detections and to providing more timely and accurate VAAs.

However …

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Takeaways from other cases

Himawari S1 0900UTC

Forecasters are able to detect very week signal on Himawari imagery; it induces large differences among forecasters, in particularly the last few hours before dissipation.

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Discussion – negative impacts

- ➢ Increase of operational work
  - ✓ Monitoring more satellite observations and new types of imagery and products.
  - ✓ Issuing more VAAs, in particularly for relatively small eruptions.

- ➢ Difficulty in keep consistency
  - ✓ Analysis in advanced satellite induces further individual differences within VAAC.
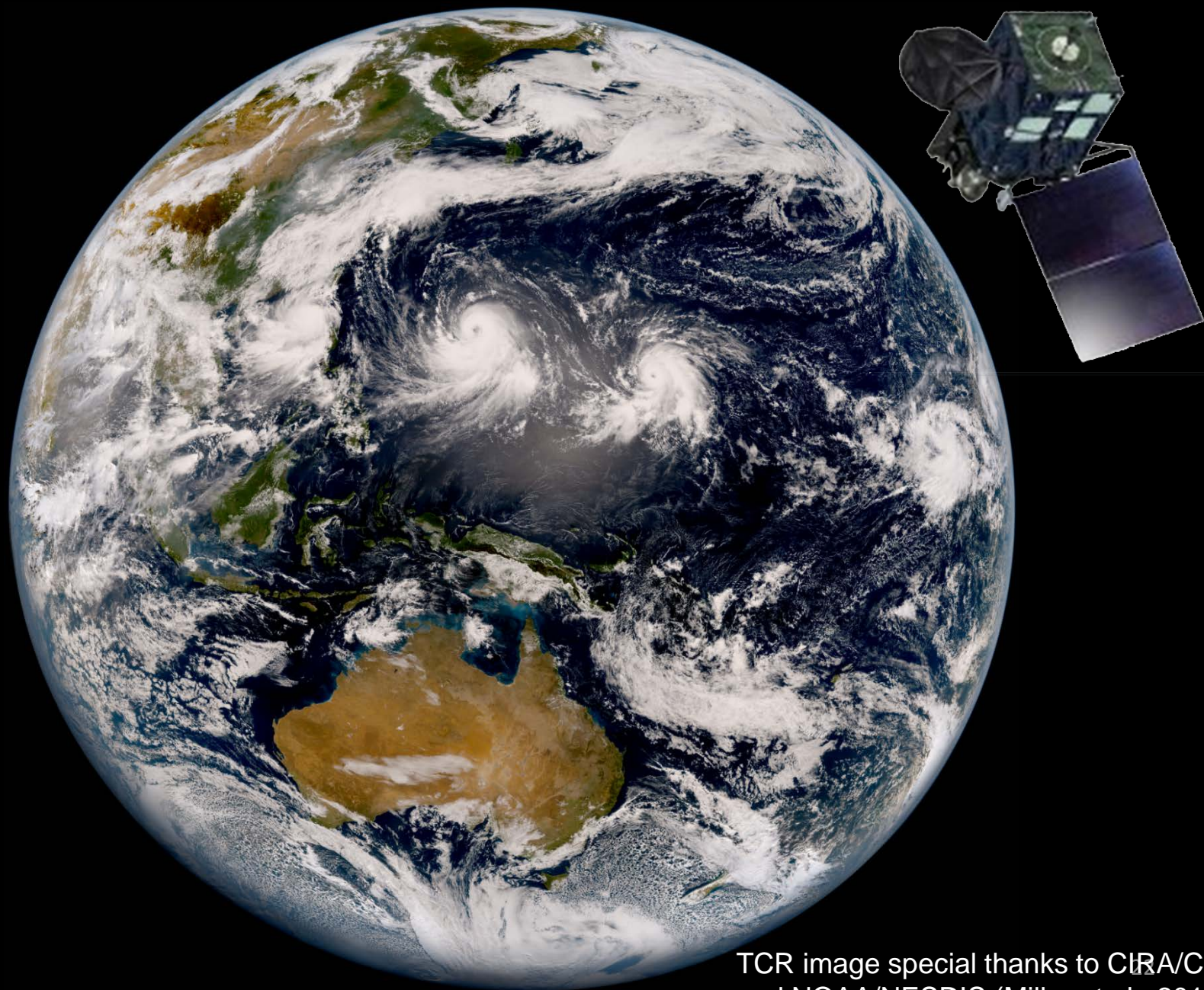 - ✓ Analysis in different satellites results in much larger differences among VAACs.

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Discussion – future works

- ➢ Satellite comparison
    - Old and new satellites (in VAAC)
    - New satellites (among VAACs)

- ➢ Analysis
    - Enhancement of analysis skills (in VAAC)
    - Development of agreed techniques for discernible VA detection (among VAACs)
    - Development of satellite products (beyond VAACs)

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Himawari-8 began operation at 02:00 UTC on 7th July 2015.