



# Rapid Hotspot Detection Using Himawari-8

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Indonesia

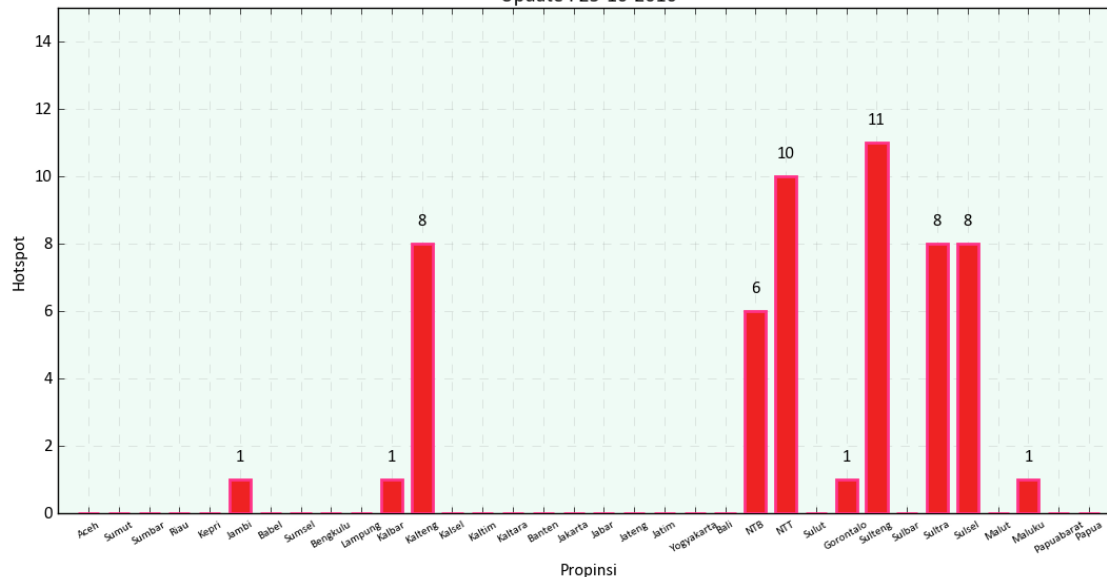


# Current Hotspot Information provided by BMKG

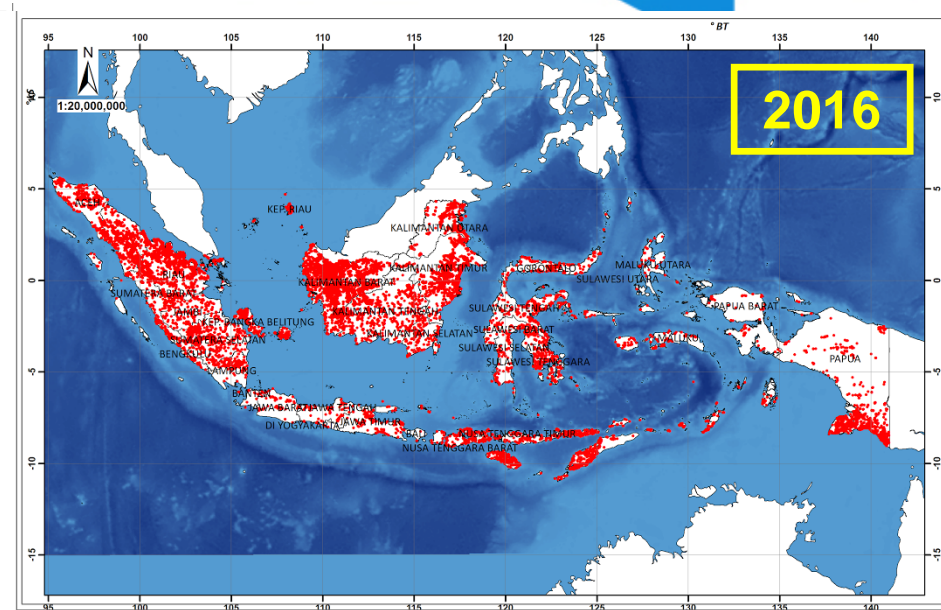
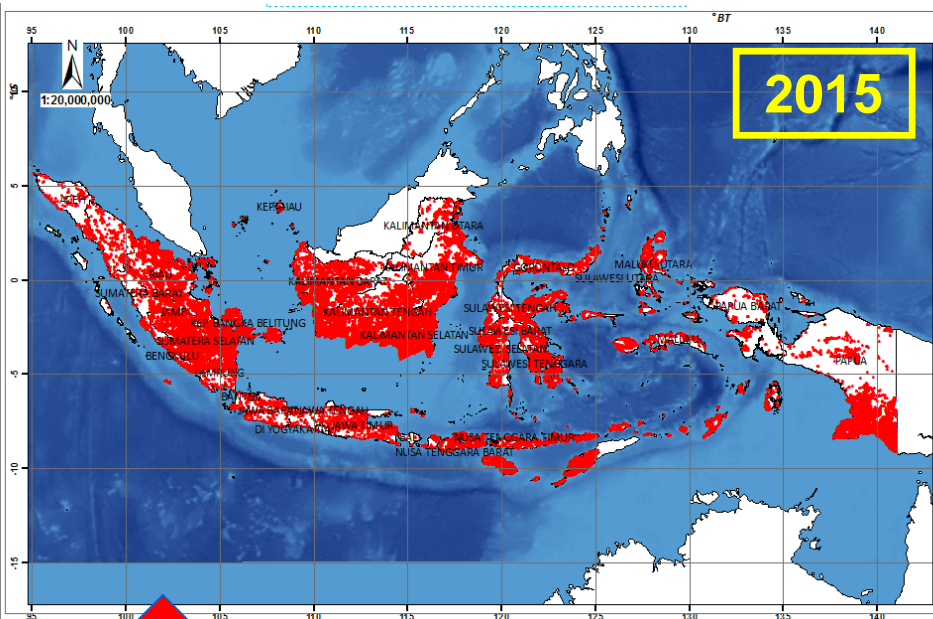
- Observation from MODIS sensor onboard NASA's Terra/Aqua satellites
- Data source : LAPAN (Indonesian Agency for Space and Aeronautics)



Jumlah Hotspot Per Propinsi 10 Hari Terakhir  
Tingkat Kepercayaan Tinggi (81-100%)  
Update : 25-10-2016

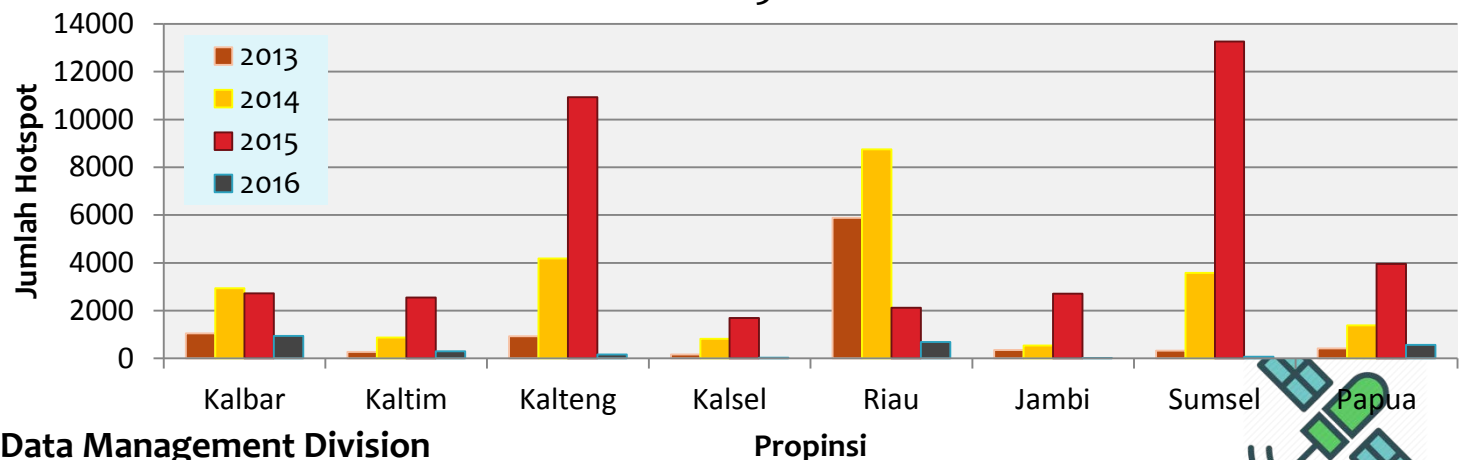


# Hotspot Occurrences for Year 2015 & 2016

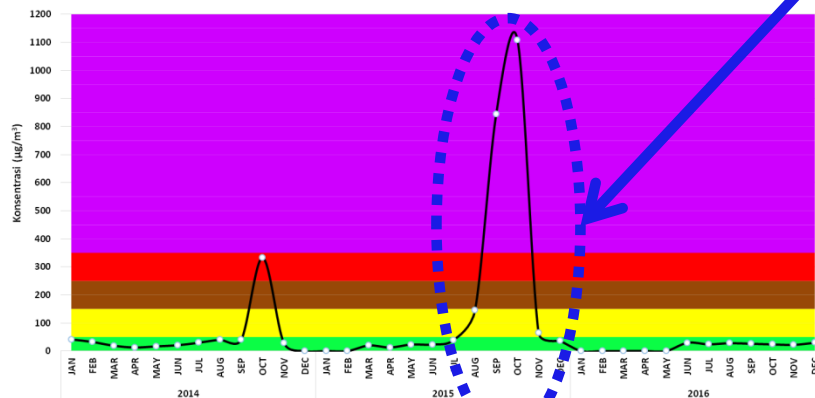
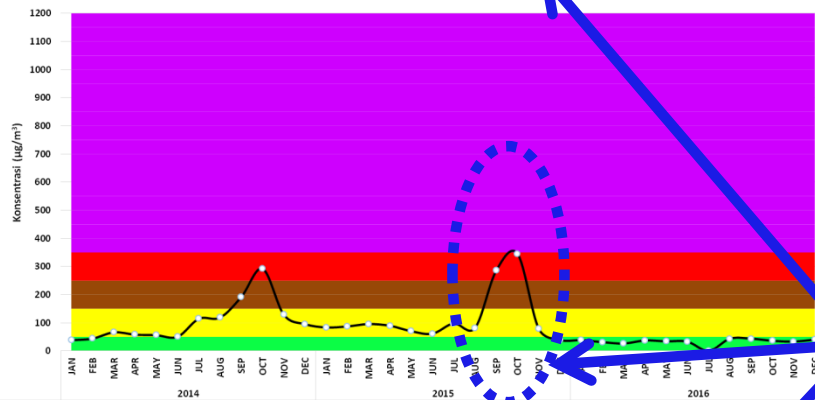
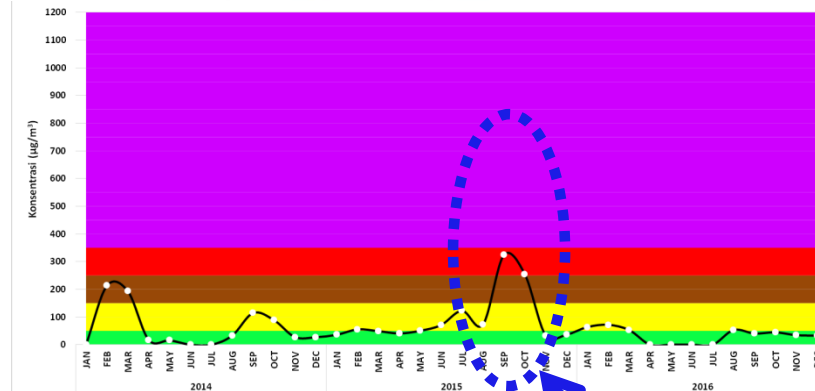


High confidence level (81-100%) MODIS Hotspot  
Year 2013-2016

**Estimated total economic loss due to 2015 massive wildfires: 221 Trillion IDR (22 billion USD) (BNPB, 2016)**



# PM10 Concentration at Pekanbaru, Palembang (Central and South Sumatra island), and Palangkaraya (Kalimantan island) 2014-2016



PEKANBARU  
(Riau province)

PALEMBANG  
(South Sumatra  
province)

SEP - OCT

PALANGKARAYA  
(Central  
Kalimantan)

## LEGEND :



**BERBAHAYA**  
**>350**

DANGEROUS



**SANGAT  
TIDAK SEHAT**  
**250-350**

VERY  
UNHEALTHY



**TIDAK  
SEHAT**  
**150-250**

UNHEALTHY



**SEDANG**  
**50-150**

MODERATE



**BAIK**  
**0-50**

GOOD



## Limitation detecting hotspot by MODIS (Terra/Aqua) :

- Low frequency of observation (4 times a day) makes less possibility to detecting hotspot
- Due to its polar orbiting unobserved area sometimes caused misleading in hotspot interpretation by emergency personnels the field

### Daytime :

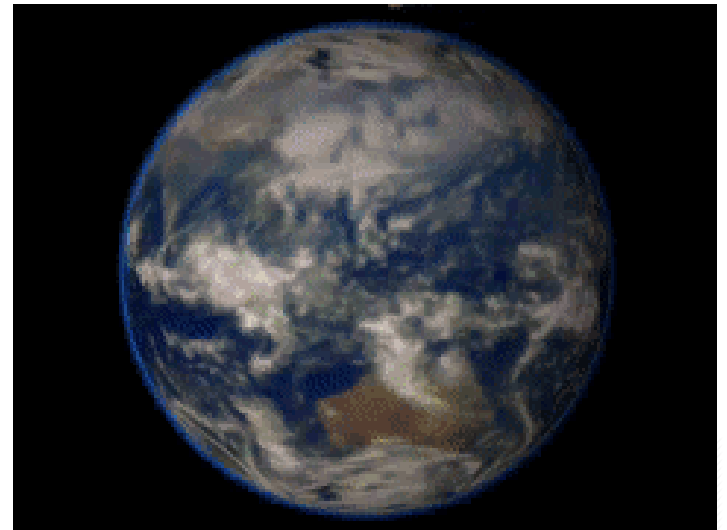
Terra/MODIS : 00:00 – 05:00 UTC  
(07:00 – 12:00 LST)

Aqua/MODIS : 03:00 – 08:00 UTC  
(10:00 – 15:00 LST)

### Nighttime:

Terra/MODIS : 12:00 – 17:00 UTC  
(19:00 – 24:00 LST)

Aqua/MODIS : 15:00 – 20:00 UTC  
(22:00 – 03:00 LST)

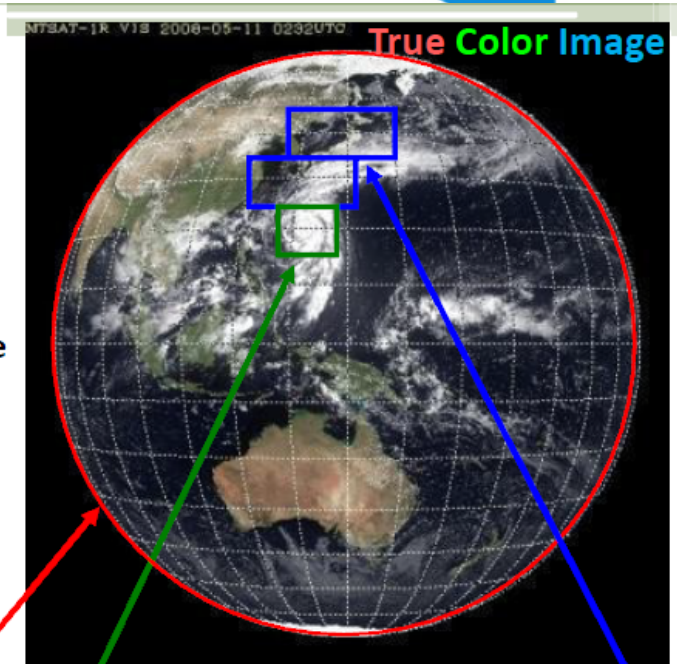




# Himawari-8

## Wavebands of the Advanced Himawari Imager (AHI)

Channel	Central Wavelength [μm]	Spatial Resolution	
1	0.43 – 0.48	1 km	RGB Composited True Color Image
2	0.50 – 0.52	1 km	
3	0.63 – 0.66	0.5 km	
4	0.85 – 0.87	1 km	
5	1.60 – 1.62	2 km	
6	2.25 – 2.27	2 km	
7	3.74 – 3.96	2 km	
8	6.06 – 6.43	2 km	Water Vapor
9	6.89 – 7.01	2 km	
10	7.26 – 7.43	2 km	
11	8.44 – 8.76	2 km	SO <sub>2</sub>
12	9.54 – 9.72	2 km	O <sub>3</sub>
13	10.3 – 10.6	2 km	Atmospheric Windows
14	11.1 – 11.3	2 km	
15	12.2 – 12.5	2 km	
16	13.2 – 13.4	2 km	CO <sub>2</sub>



**Full-Disk Observation**  
Interval: **10 minutes**

**Regional Observation (fixed): Japan**  
Interval: **2.5 minutes** (4 times in 10 minutes)  
Dimension: EW x NS: 2000 x 1000 km x 2

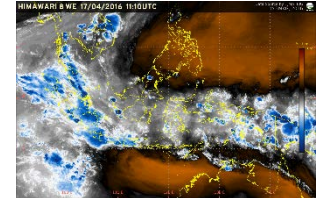
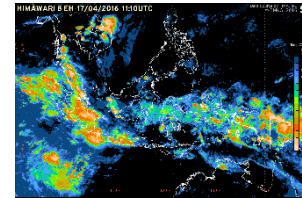
**Regional Observation (flexible): Typhoon, etc**  
Interval: **2.5 minutes** (4 times in 10 minutes)  
Dimension: EW x NS: 1000 x 1000 km



# Himawari Cloud



JMA Himawari Cloud Server



BMKG Himawari-8  
Data Processing  
Server

40mbps



- Download and convert HSD to SATAID format
- Product generation

BMKG Database  
Center



- User Request
- Archiving Data and Image
  - BZ2 Format (90 GB/day)
  - SATAID Format (40 Gb/day)



**Remote Sensing Data Management Division**  
Center for Public Weather Services - BMKG



# Algorithm

## Hotspot detection using Meteosat SEVIRI (Roberts and Wooster, 2008)

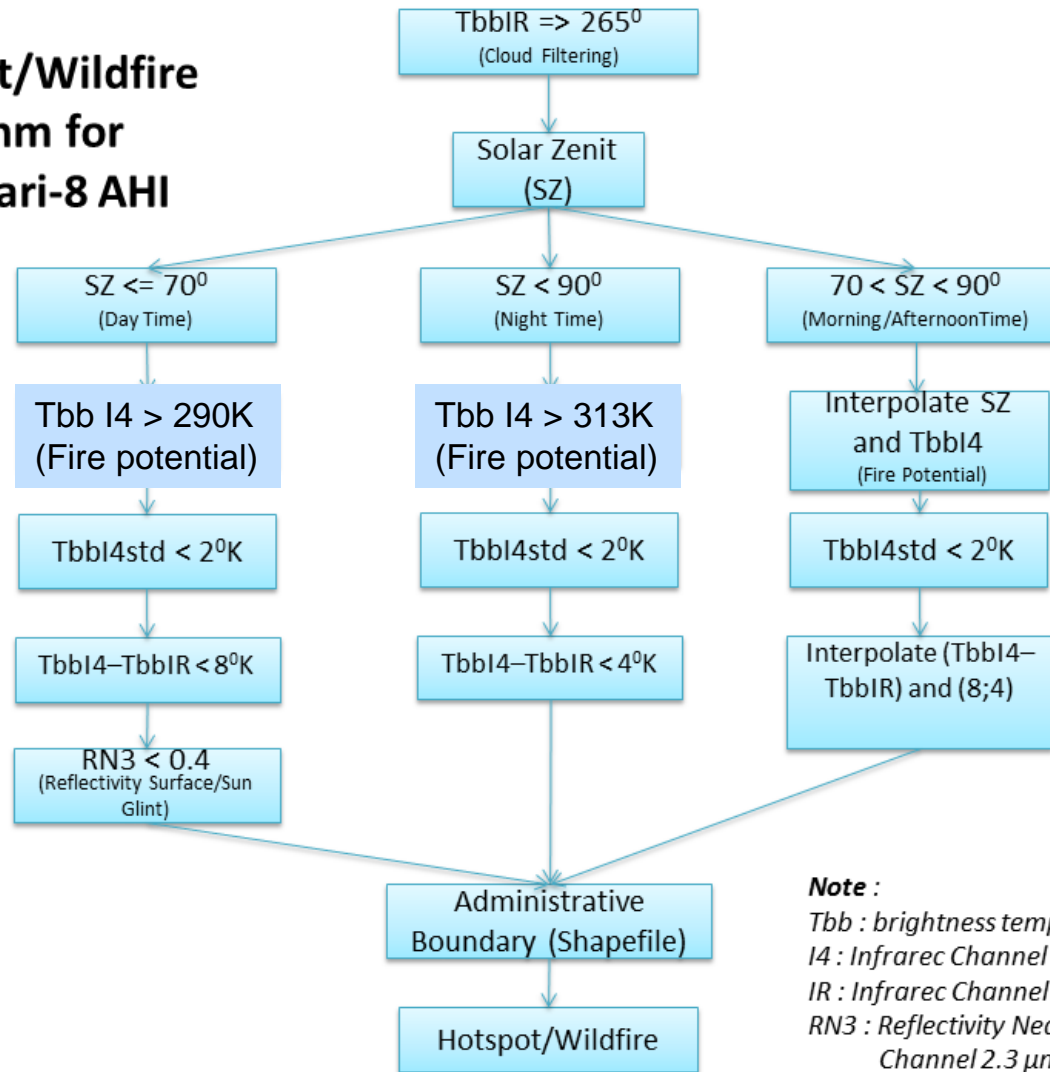
ALGORITHM STAGE	WAVEBANDS/PRODUCTS							
	3.9 $\mu\text{m}$ Brightness Temperature	1.6 $\mu\text{m}$ Spectral Radiance	3.9 – 10.8 $\mu\text{m}$ BT Difference	3.9/0.6 $\mu\text{m}$ Radiance Ratio	3.9/10.8 $\mu\text{m}$ Radiance Ratio	Fire pixel Confidence	Sunlint Angle	Solar Zenith Angle Criteria
Stage 1: PFP test (day)	310.5 to 280 K	-	1.75 to 1.3 K	-	-	-	> 5°	0° to 90°
Stage 1: PFP test (night)	283 K	-	1 K	-	-	-	-	>90°
Stage 2: Sunlint Test	-	-	-	> 0.7 (cloud pixels within 15x15 background window)	< 0.018	-	-	0° to 90°
Stage 2: Sunlint Test	-	-	-	> 0.4 (no cloud pixels within 15x15 background window)	-	-	-	0° to 90°
Stage 5: PPF 1	-	-	> 5 K	> 0.87	-	> 0.2	-	< 70°
Stage 5: PPF 2	-	$\geq 0.04$	> 3 K	-	-	> 0.2	-	> 90°
Stage 5: PPF 3	-	-	> 5 K	> 1.0	-	> 0.1	-	>65° and < 90°
Stage 5: PPF 4	-	-	> 5 K	> 0.75	-	-	-	>65° and < 90°
Stage 5: PPF (swamp/desert only)	-	-	> 5 K	> 1.0	-	> 0.35	-	0° to 90°





# Algorithm

## Hotspot/Wildfire Algorithm for Himawari-8 AHI



**Note :**

*Tbb* : brightness temperature

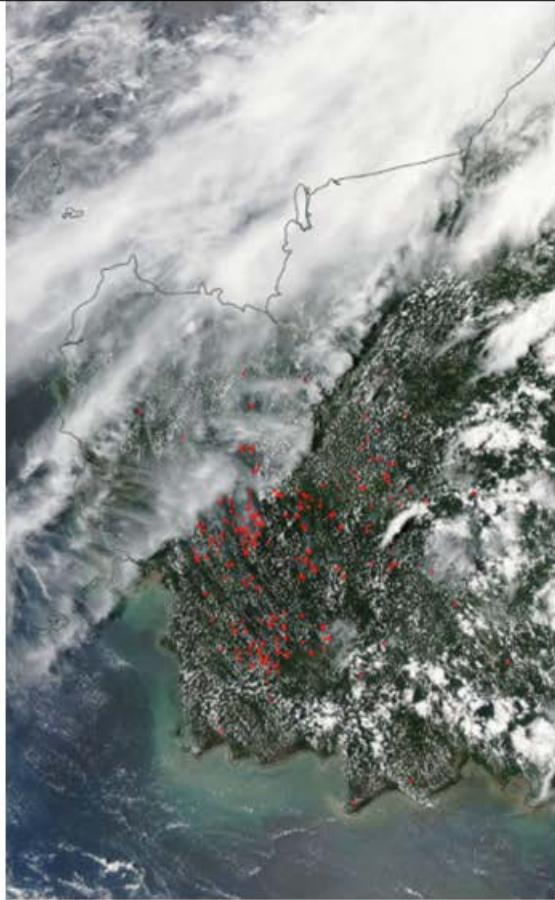
*I4* : Infrarec Channel 3.9 $\mu$ m

*IR* : Infrarec Channel 10.8 $\mu$ m

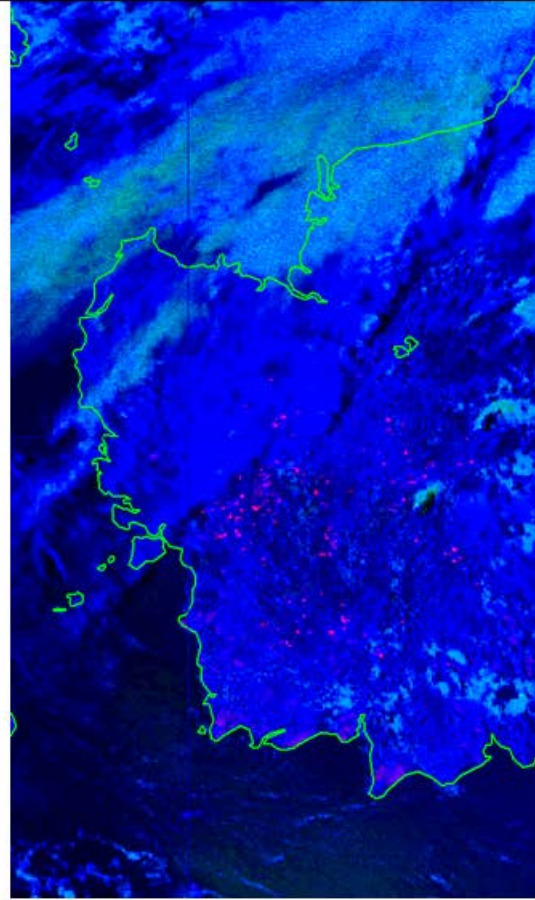
*RN3* : Reflectivity Near-Infrared  
Channel 2.3  $\mu$ m



Case study : 12 September 2016 12.50 LST



Aqua



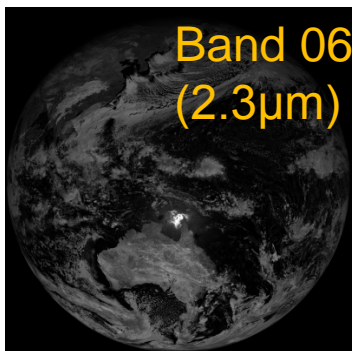
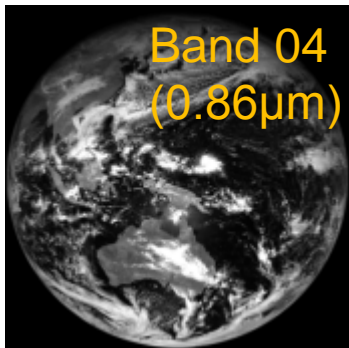
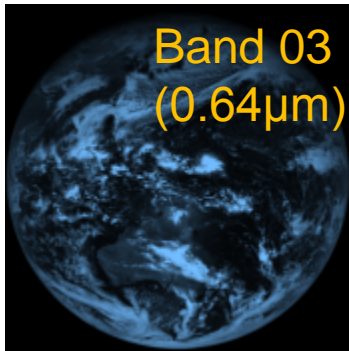
Himawari-RGB



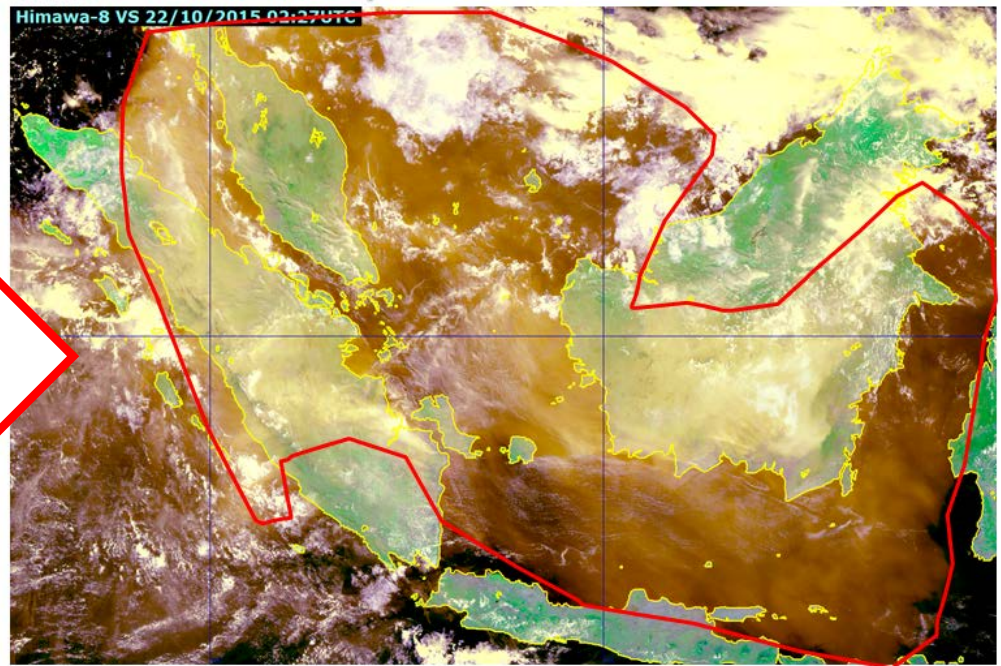
Filtering



# RGB Product



**R** = VS Gamma 1.8  
**G** = N1 Gamma 1  
**B** = N3 Gamma 3

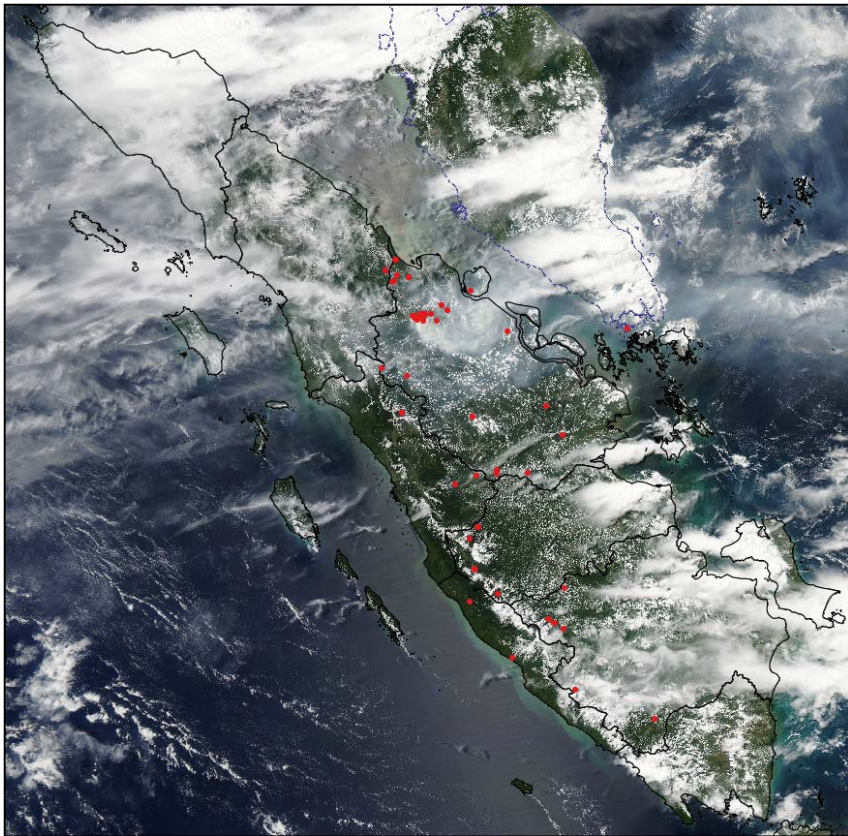


**Himawari-8 False Color (22 Oct 2015)**  
→ smoke/haze clearly depicted in this RGB combination

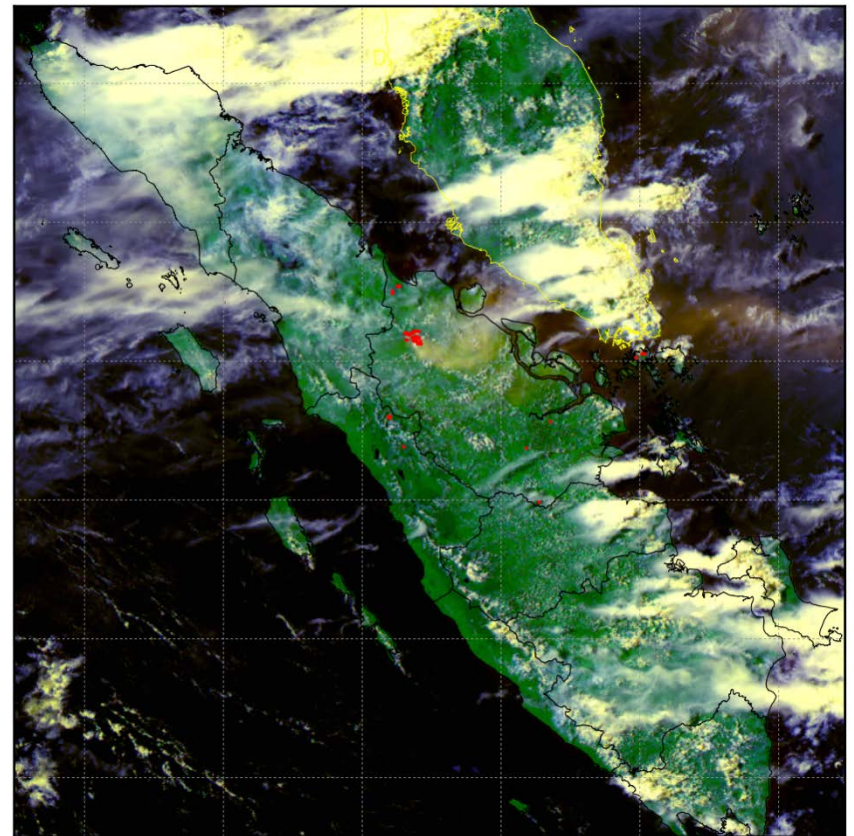




**Aqua(MODIS)**

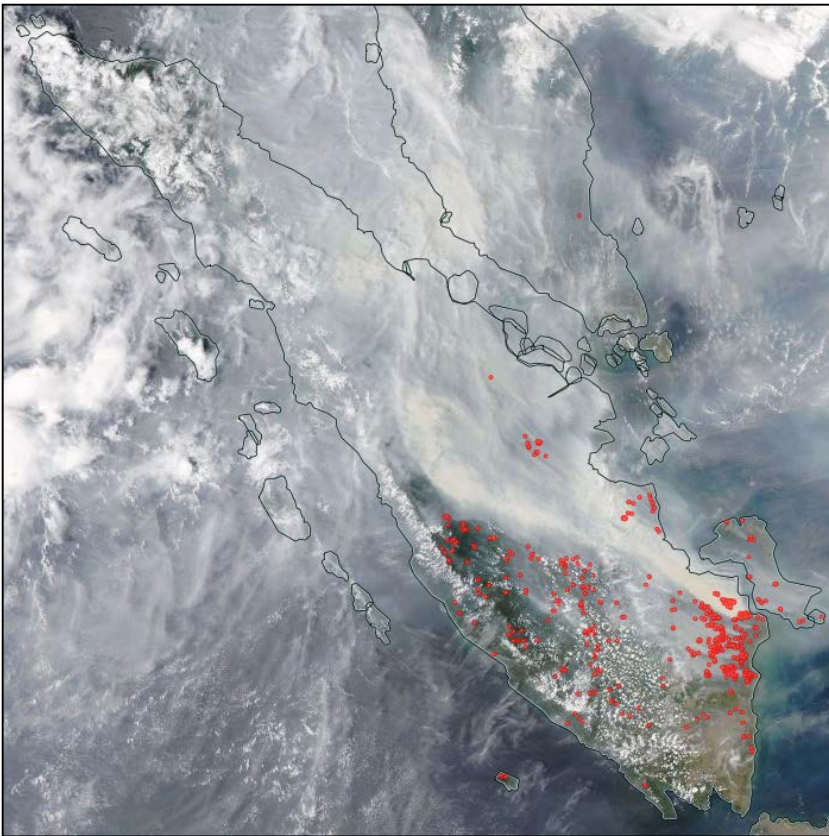


**Himawari-8**

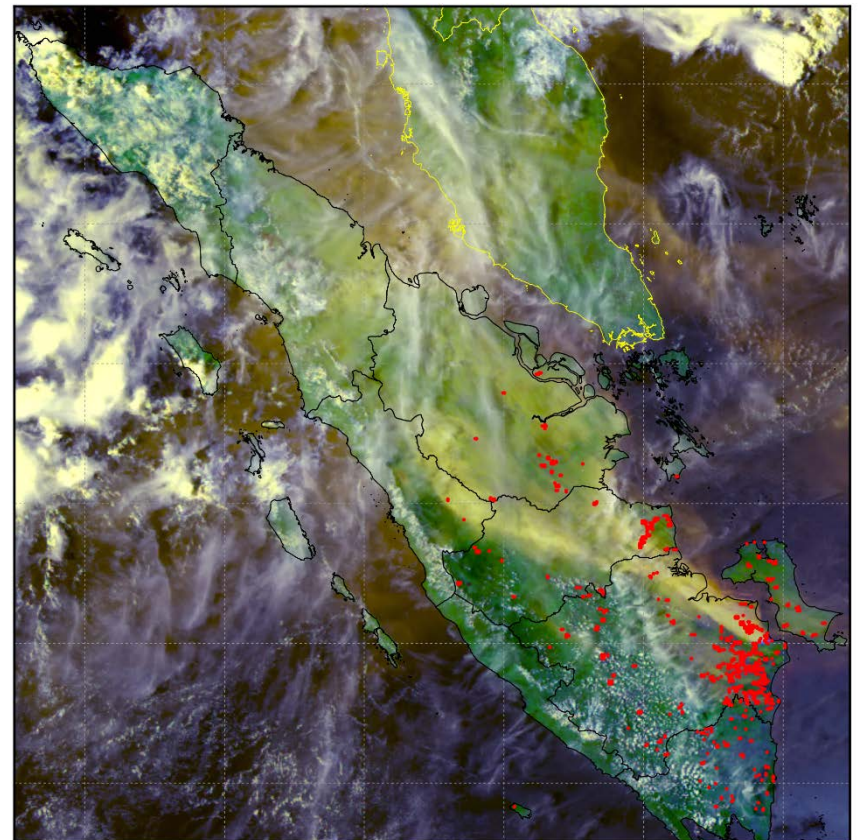




**Aqua(MODIS)**



**Himawari-8**

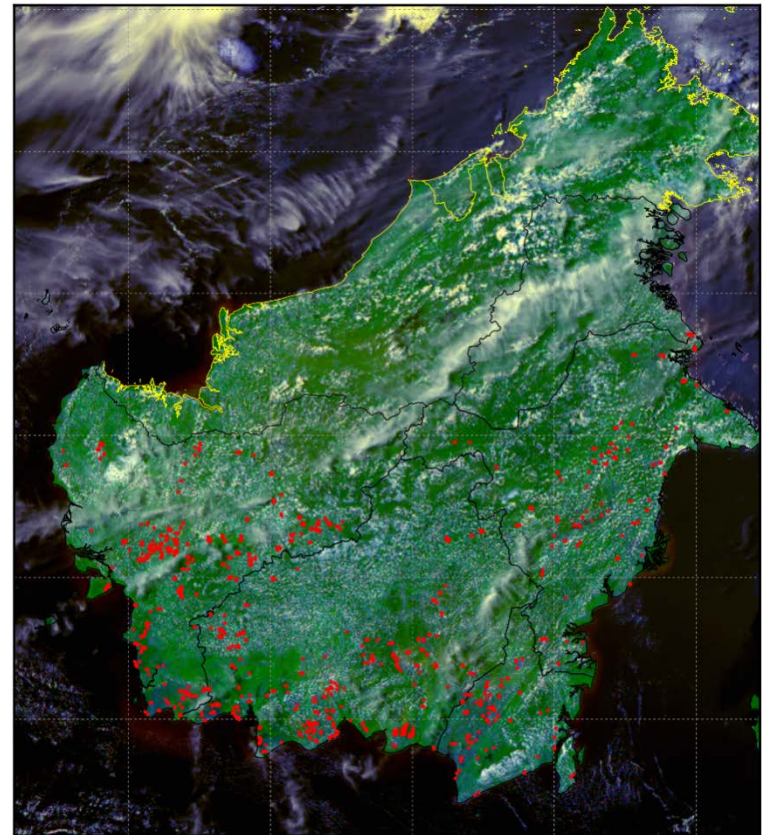




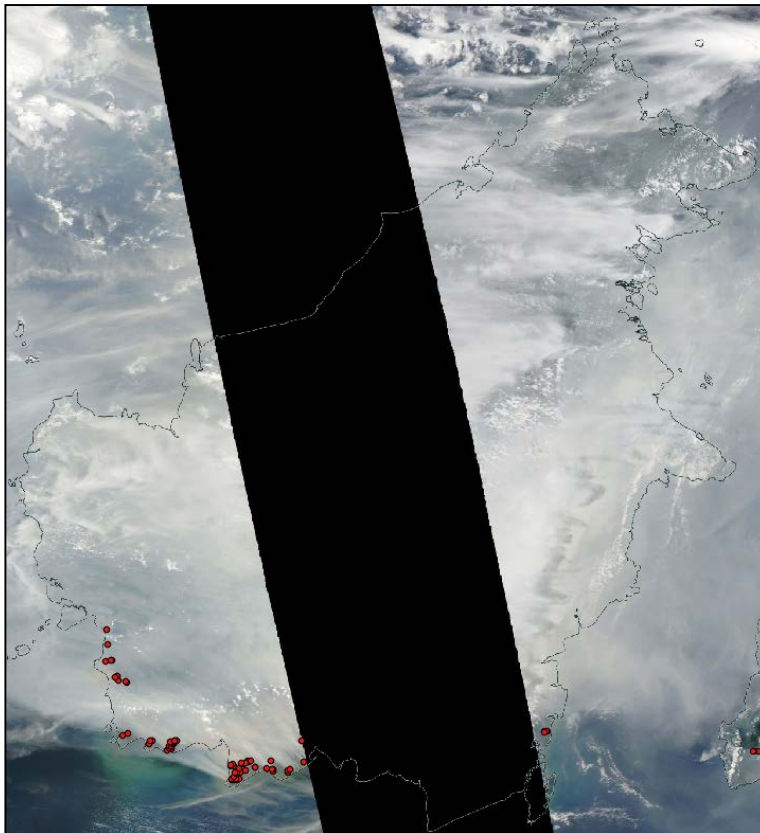
**Aqua(MODIS)**



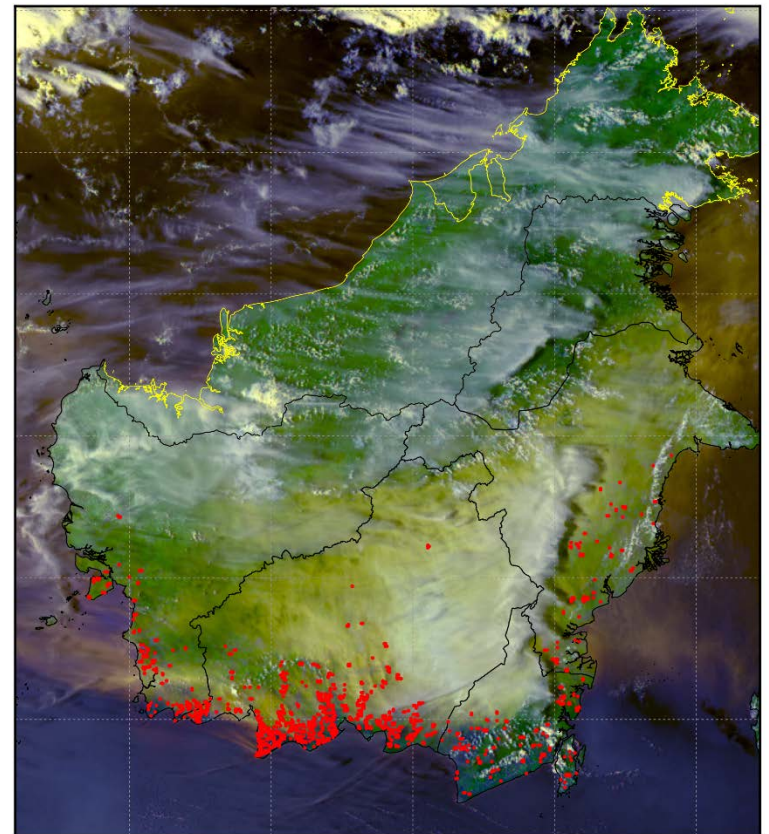
**Himawari-8**



## Aqua(MODIS)

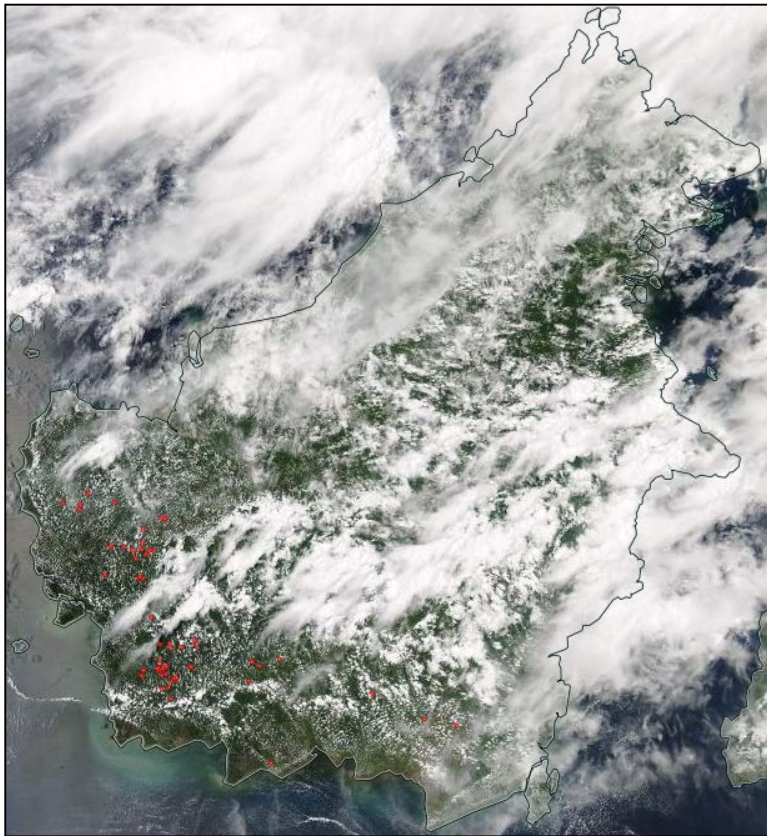


## Himawari-8

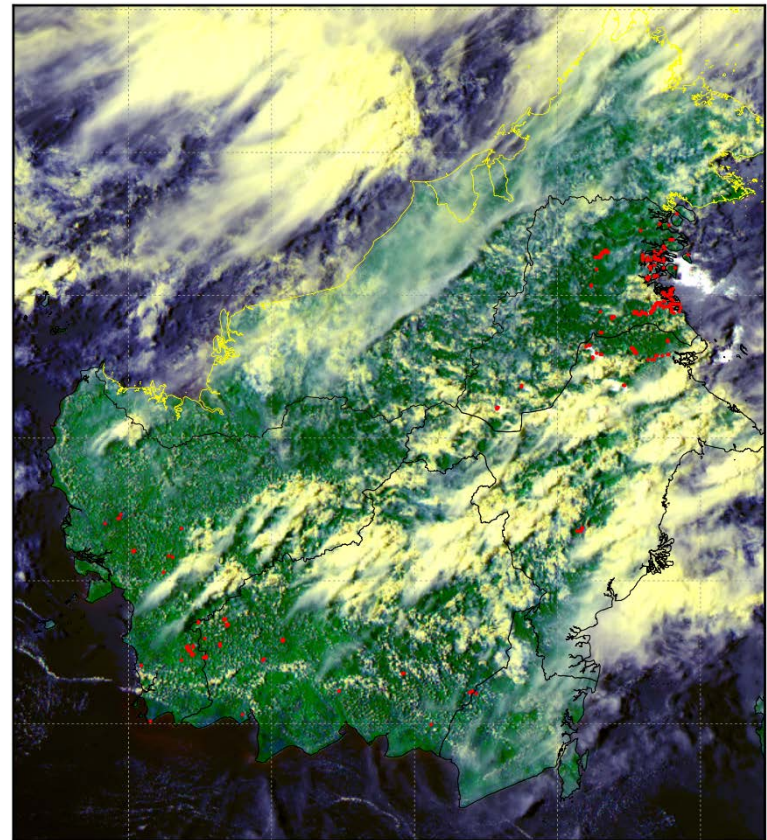




**Aqua(MODIS)**



**Himawari-8**





# Image True Color at daytime and Hotspot at daytime and night-time (Terra-Aqua-Suomi NPP)

## Masks fly off shop shelves as smoke shrouds Singapore

Melissa Lin  
The Straits Times

Singapore | Sat, August 27, 2016 | 04:39 pm



Many in the streets are seen wearing masks or covering their mouths and noses with cloth on Friday. (ST/Azmi Athni)

### Topics

Singapore haze  
forest-fires

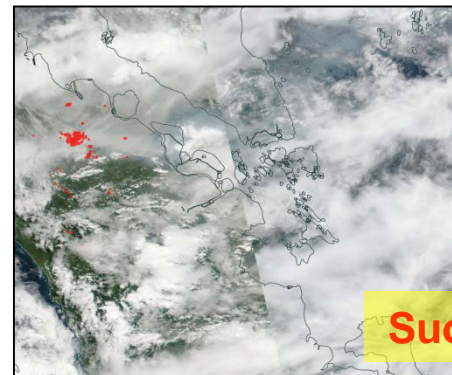
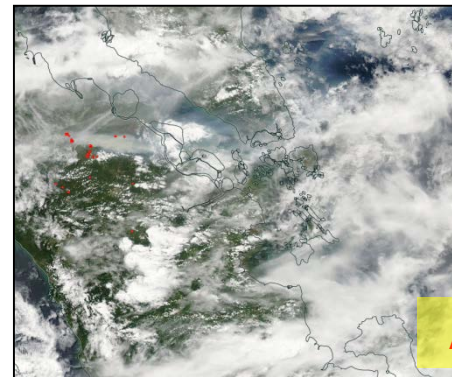
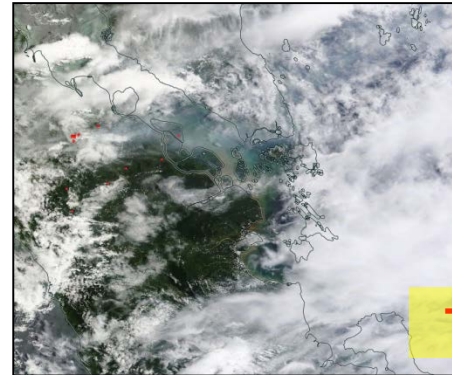
11

Grey skies and a familiar burning smell greeted Singaporeans on Friday morning as the haze made a return.

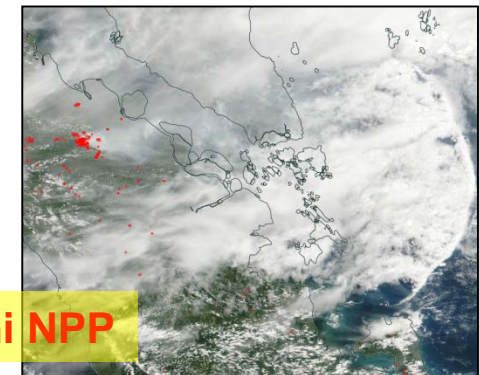
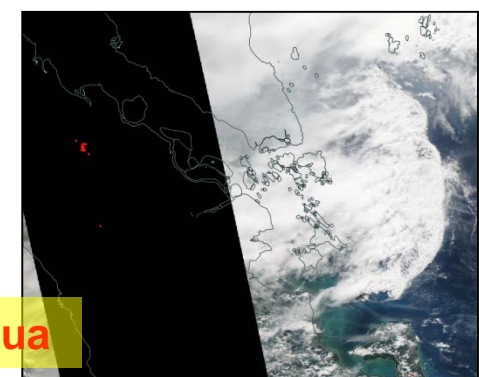
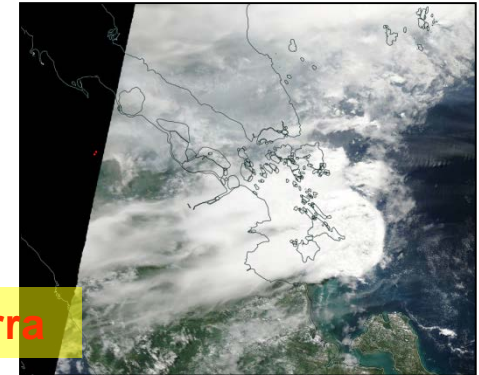
On the streets, people young and old were seen wearing face masks, while others held cloth over their mouths and noses. The sudden spike in demand for N95 masks on Friday caught retailers by surprise, with some shops running out of stock in the middle of the day.

<http://www.thejakartapost.com/seasia/2016/08/27/masks-fly-off-shop-shelves-as-smoke-shrouds-singapore.html>

26 Agt 2016



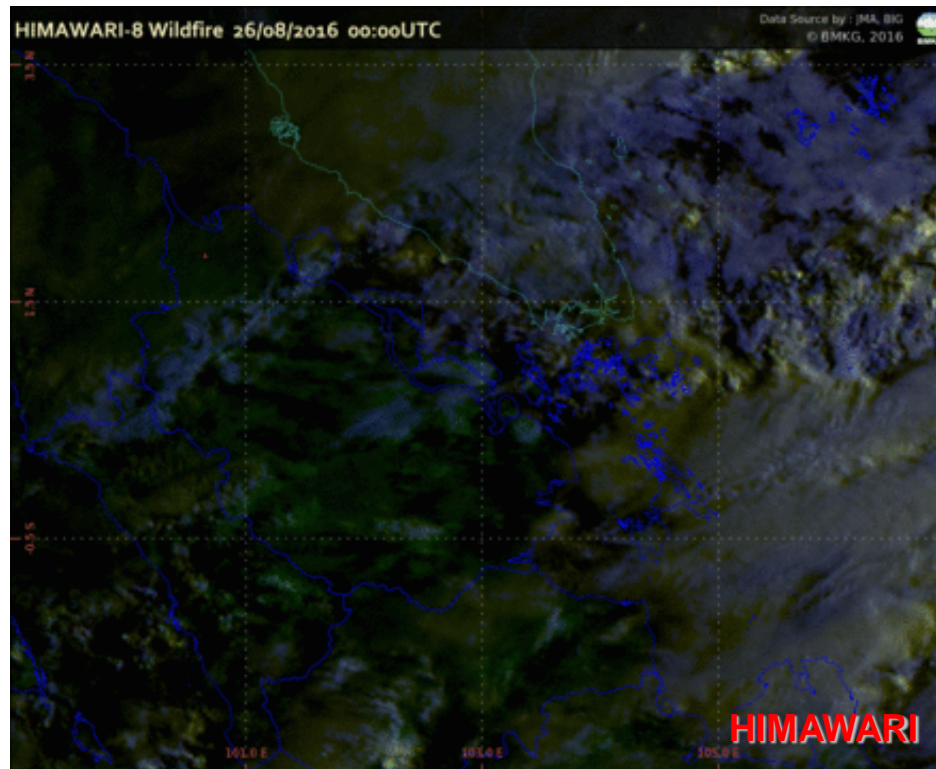
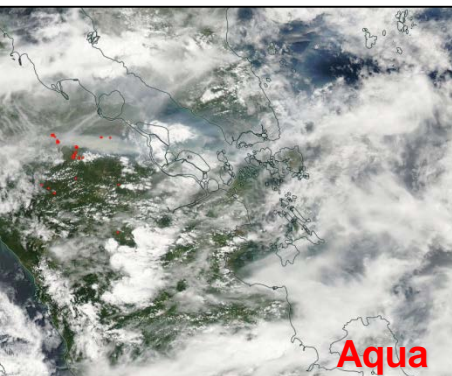
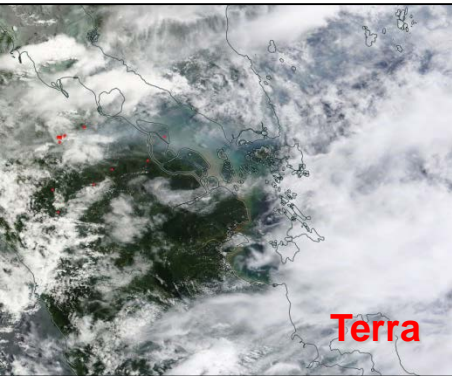
27 Agt 2016



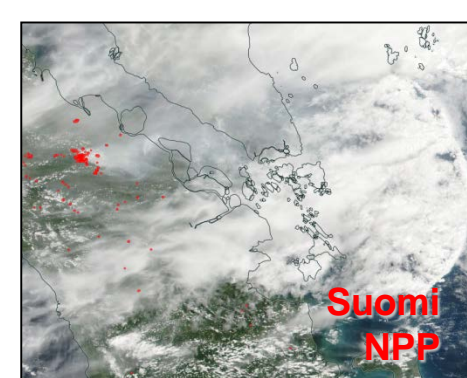
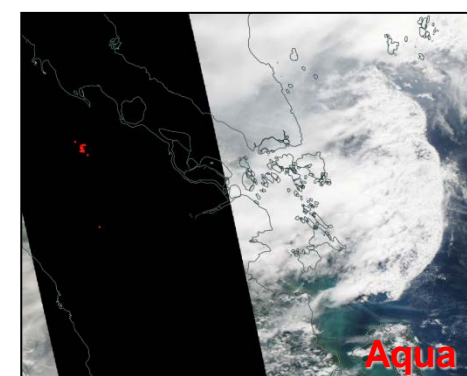
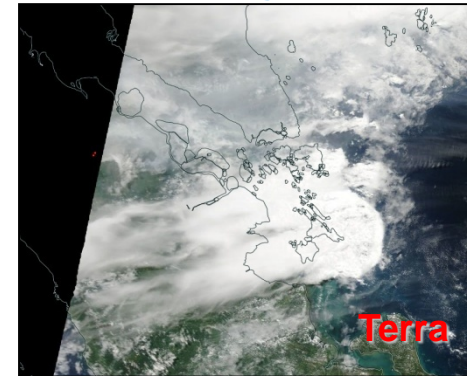


# HIMAWARI vs TERRA-AQUA-SUOMI NPP IMAGES (26-27 AUGUST 2016)

26 Aug 2016

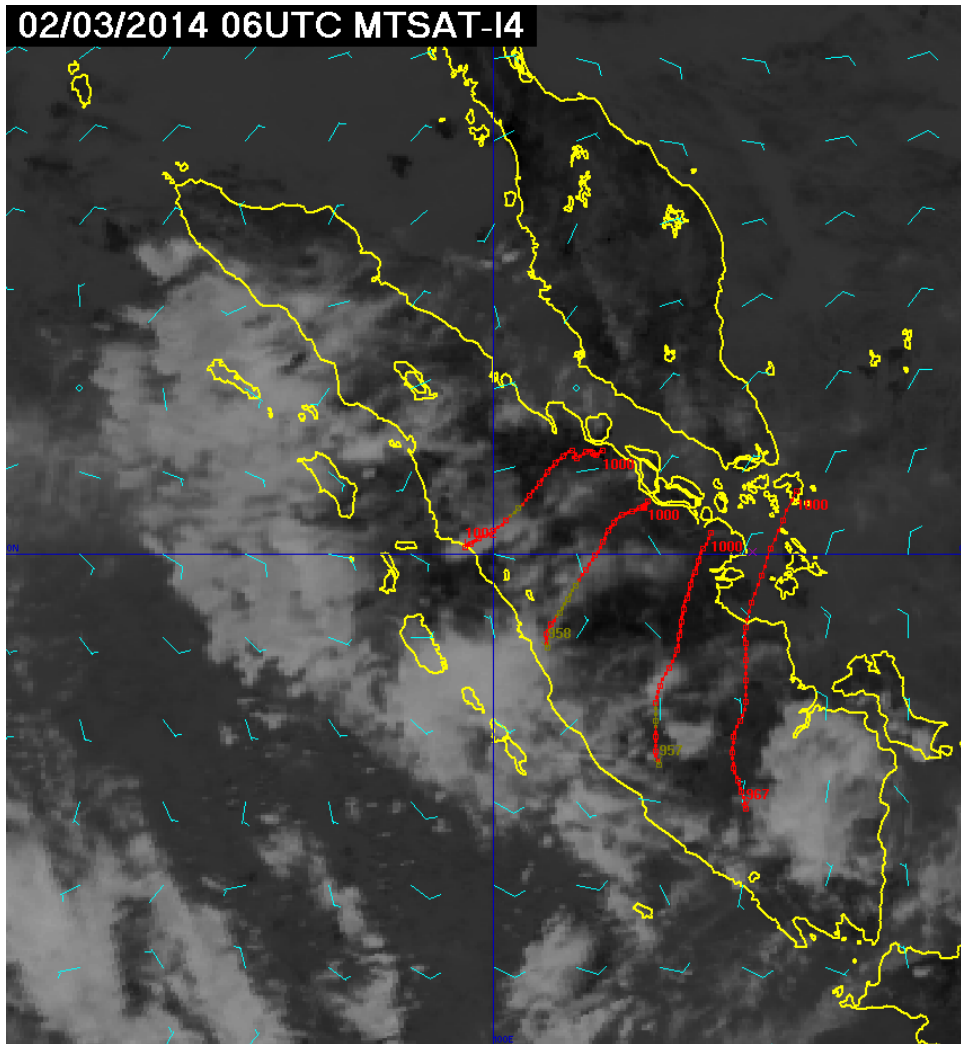


27 Aug 2016



a Management Division  
ather Services - BMKG

# Trajectory



## Sample of smoke Trajectory

### Riau - 2 March 2014

→ produced based on cloud trajectory movement and has been used to identify tendency of smoke/haze movements.

→ there is still challenges in haze dispersion modeling to complement satellite-based hotspot information for various concerned stakeholders and general public



# Challenges

- False alarm is still challenging in hotspot detection algorithm using Himawari-8 data in BMKG. Development of the algorithm should be improved to remove false alarm due to sun glint. River and lake boundary data could be a reference to eliminate sun reflection.
- Studying the relationship between infrared brightness from Himawari-8 bands and fire temperature on the ground as reference to make confidence level of hotspot detection.
- Haze dispersion model to improve services for relevant stakeholders is urgently needed.
- Improving computational resources is one of the solutions to shorten information dissemination time.







**Thank you for your attention...**

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