



**METEOROLOGICAL
SERVICE
SINGAPORE**

Singapore Country Report



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Top three hazards that can be monitored by satellite

Hazard 1: Severe Thunderstorms

- On average, Singapore experiences about 168 thunderstorms days a year
- Heavy rain and strong winds due to Sumatra squalls are the common weather hazards in Singapore
- Accurate and early warnings are necessary to help the users (public, agencies, specialised users) better manage the risk of weather hazards
- Face challenges in convective nowcasting, e.g radar unable to detect rapidly growing thunderstorm at initial stage
- Rapid-scan satellite imagery could provide hints of rapidly growing storm cells as compared to radar, potentially increase the lead time for weather warnings.



Strong winds by severe thunderstorms pose risk to the safety of pedestrian and impose damages to both the public and private assets [singapore](#)



Singapore Orchard Road – a major shopping district was submerged under flash floods due to intense downpour of severe thunderstorms in June 2010

Flash floods hit several areas in western Singapore



Flooding on the AYE. Photo by Sophina Smith.

One of the major express ways in Singapore paralysed by flash floods in Sep 2013

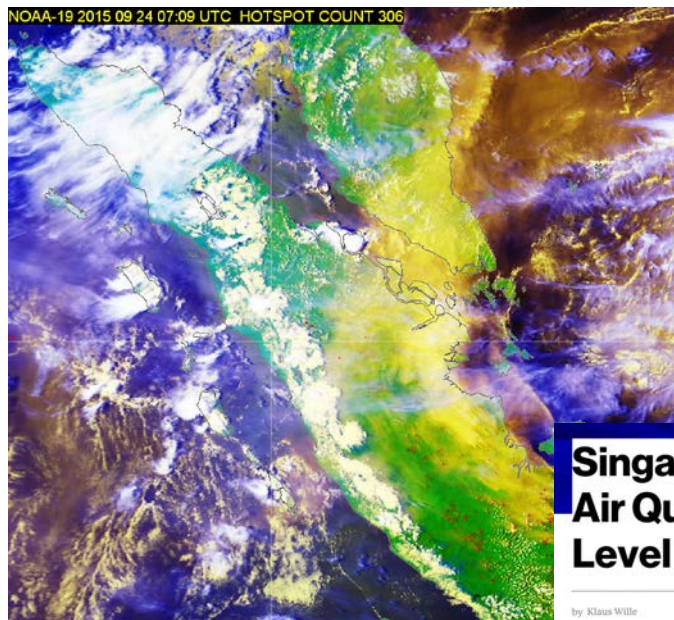
Top three hazards that can be monitored by satellite

Hazard 2: Smoke haze from land and forest fires

- Southeast Asia was hit by one of the worst smoke haze pollution in history due to land and forest fires in Sumatra and Kalimantan, Indonesia under the prevailing strong El Nino event
- Intermittent occurrences of smoke haze episodes affected Singapore between Sep and late Oct, with 24-hr Pollutant Standard Index (PSI) in the Unhealthy/Very Unhealthy levels on most days
- 24-hr PSI entered the Hazardous level on 25 September, forcing schools to be closed
- Significant disruption to economic and social activities during the haze episodes
- Satellite observation remains the **key component** in smoke haze monitoring and forecasting

- Lack of ground air quality stations on both land and sea areas
- Highly dynamic and fast-evolving nature of human-driven forest fires

Indonesia forest fires could become worst on record: Nasa



Singapore GDP will take hit from haze as countries issue travel warnings



Singapore Shuts Schools as Air Quality Hits Hazardous Level

by Klaus Wille
September 24, 2015 – 10:23 AM SGT | Updated on September 25, 2015 – 5:45 AM SGT



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A pedestrian wearing a face mask uses a smart device at Marina Bay as buildings in the central business district stand shrouded in smog in Singapore. Photographers: Nicky Loh/Bloomberg

Top three hazards that can be monitored by satellite

Hazard 3: Volcanic eruptions and volcanic ash

- Southeast Asia is one of the most active volcanic regions in the world
- Singapore Flight Information Region (FIR) is surrounded by a number of active volcanoes in close vicinity
- E.g Volcanic ash eruptions at Mt Raung caused intermittent disruptions to air travel between Singapore and Bali in Jul & Aug 2015
- Prolonged disruption to air travel could cause significant damage to Singapore's status as an international air hub

Singapore Airlines cancels Friday flights to Bali due to volcano ash cloud

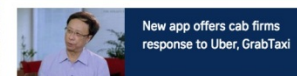


Ash and smoke from Mount Raung seen from the village of Sumber Arum, East Java province, on July 4. PHOTO: REUTERS

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Expectation of new series of satellites for hazard monitoring

Major hazard	Features of new generation GEO met. satellite
Hazard 1: Severe thunderstorms	Multi-spectral bands : Multi-spectral RGB techniques for better detection of severe storms, smoke haze and volcanic ash Rapid Scanning : Possibility to improve on convective weather nowcasting using satellite images; Better tracking of smoke haze and volcanic ash in the region
Hazard 2: Smoke haze from land and forest fires	High Spatial Resolution : To better distinguish subtle meteorological features to identify severe storms, dense smoke haze and volcanic ash plumes New Instrument :
Hazard 3: Volcanic eruptions and volcanic ash	Lightning mapper allows detection of lightning at distance beyond the limits of ground lightning detectors in Singapore, useful for severe convective weather hazards monitoring over the Flight Information Region in the South China Sea

Requirements to get benefits from the new gen of geostationary satellite

Major hazard	Requirements
Hazard 1: Severe thunderstorms	Easy-to-understand product: RGB color schemes and end products should aim to be as intuitive as possible
Hazard 2: Smoke haze from land and forest fires	Product algorithms: Interested in the detection of rapidly growing cumulus algorithm and the derivation of aerosol optical depth
Hazard 3: Volcanic eruptions and volcanic ash	Training in imagery analysis, basics of multi-spectral observation: Web-based case studies training for operational meteorologist, e.g ePort like training portal for Asian countries Training in product development: Interested to participate in product development/usage training of Himawari-8 related to convective weather and aerosol monitoring

Plans for Utilisation of New Generation Geostationary Meteorological Satellite

- Processing Himawari Cloud HSD Full disk , all 16 bands
 - HimawariCast as the backup system
- Baseline products based on GOES-R/MTSAT heritage algorithm:
 - **Fire hotspots detection**
 - **Aerosol optical depth**
 - Cloud Height/Phase
 - Atmospheric Motion Vectors
 - Sea Surface Temperature
 - Volcanic Ash Retrievals
- Development/implementation of operational multi-spectral products
 - Using basic EUMETSAT RGB suite
 - Explore more RGB products specifically for smoke haze and severe thunderstorms
- **Data assimilation** for high-resolution limited area models
 - Currently running three 1.5 km high res models – SINGV-UM (UKV-based), WRF-ECMWF, WRF-GFS
- Promote greater use of Himawari-8 satellite images for **outreach or public relations materials**
 - True color images are beautiful and easily understood by the public



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Thank You