

USER GUIDE AND DOCUMENTATION FOR

SatSuite
Satellite
&

SATVIEW

A data visualisation platform built exclusively for your convenience

Please refer to the latest version of this document on
[SatView](#)

DOCUMENT FIRST RELEASED ON: 22 OCTOBER 2020

DOCUMENT LAST UPDATED ON: 22 OCTOBER 2020

DOCUMENT CREATED BY: THAM YAP FUNG

DOCUMENT LAST EDITED BY: THAM YAP FUNG

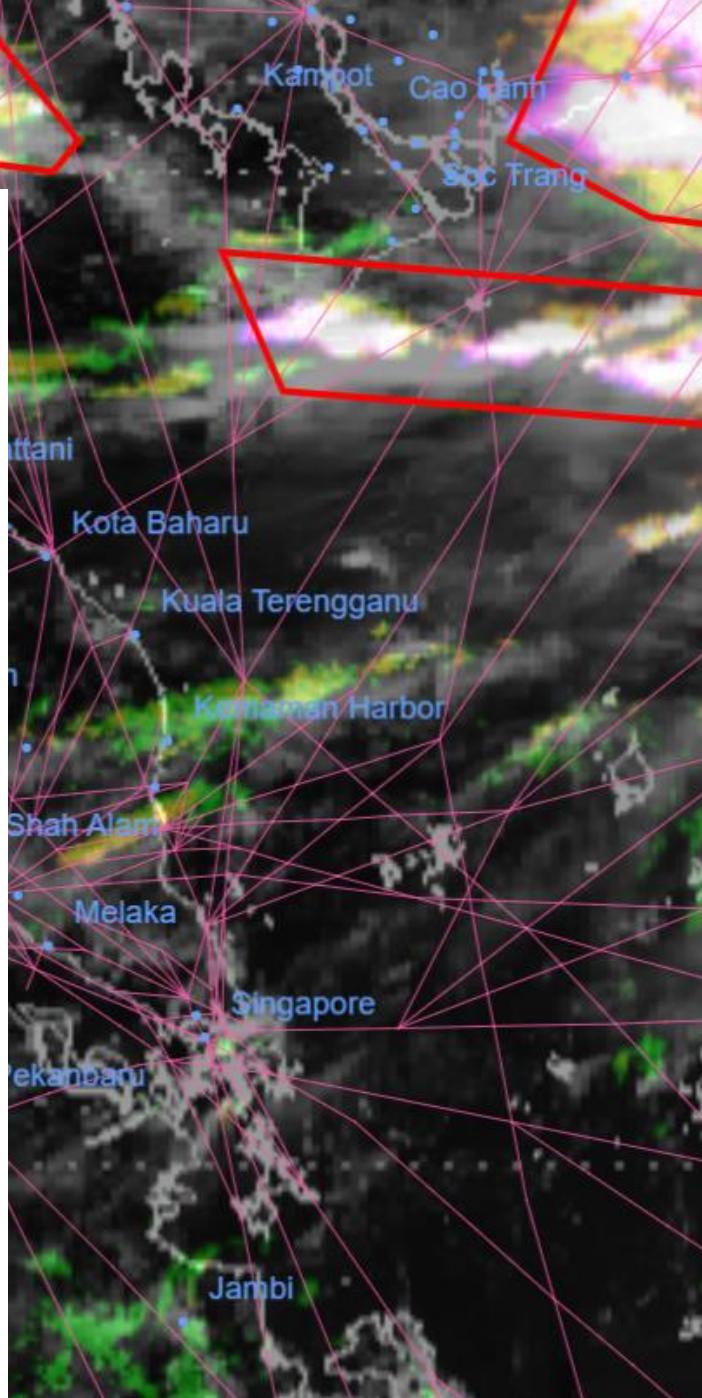


Table of Contents

Table of Contents	2
Background	4
SatSuite	4
SatView	4
SatSuite	5
SatTS.....	6
SatRGB.....	6
SatSC.....	7
SatSCN	8
Processing and Production Pipeline	9
Limitations.....	10
SatView	11
Versions.....	13
Data Refresh and Update.....	13
Data Layers	14
Himawari-8 Satellite.....	14
GeoKOMSAT-2A Satellite	15
FengYun-4A Satellite	15
Fire Hotspots.....	16
Hotspot Composite (FUSIUN)	16
Haze Tracking from Space (HATS).....	17
SatSuite for Thunderstorms	18
Weather RADAR.....	18
Lightning Detection System (LDS) Data.....	19

OPMET Data.....	19
OpenStreetMap	20
Other Static Layers	20
Interactive Display	21
Location and Measurement Tool.....	21
MutiView.....	22
Limitations.....	23
Acknowledgement.....	24
Table of Figures	25

Background

SatSuite

SatSuite is a product suite that provides diagnostic and prognostic information of thunderstorms for the region. Arising from the need for assessing thunderstorm forecast in the region where ground based observations are scarce, the first member of the suite was developed in July 2018 to identify thunderstorms using geostationary satellite data.

Subsequently, other products have been developed and were included in the suite in response to the rising demand and latest development in the regional and international aviation community.

SatView

SatView is a web-based, interactive data visualization platform that was first developed to address the operational limitations pertaining to regional weather watch with satellite data.

The first prototype version of SatView was developed in January 2020 to display satellite data and the aviation watch areas overlays. Since then, it has been constantly upgraded to include more data layers from other observation sources, and other features to improve the overall user experience.

Today, SatView displays meteorological data from the meteorological satellites, weather RADAR, lightning detection system, operational aeronautical meteorological (OPMET) data, fire hotspot data and other in-house developed products.

SatSuite



Figure 1 Logo of SatSuite

SatSuite is a collection of products for diagnostic assessment and prognostic prediction of thunderstorms with satellite data as the primary input.

Algorithms were developed and are used in combination of open source software packages and third party models to produce information on the cloud properties, thunderstorms, significant convection, and nowcast of the significant convection over the next few hours, automatically and objectively.

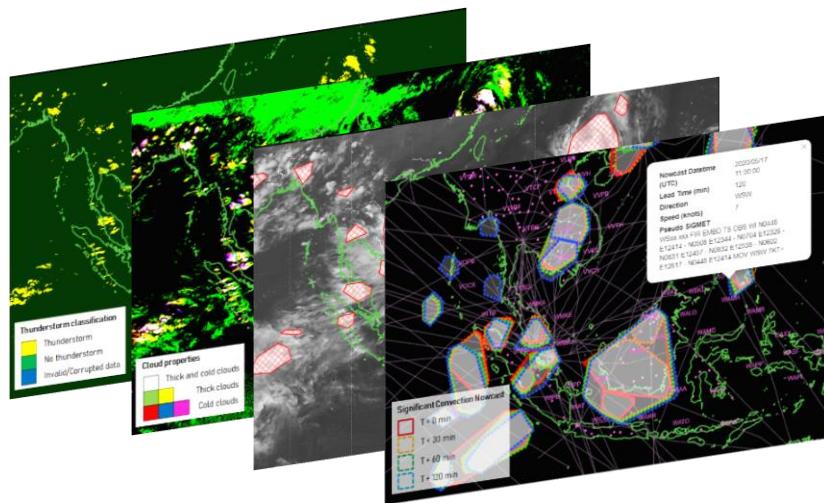


Figure 2 Products in SatSuite - SatTS, SatRGB, SatSC and SatSCN (left to right)

This section outlines the details of each of the member of the suite and summarizes the production pipeline of SatSuite.

SatTS

While a trained meteorologist is able to identify thunderstorm cells from a typical infrared or visible light satellite imageries, it is impractical to rely on human input for large data processing that requires thunderstorm observation as the input.

SatTS is a binary field thunderstorm observation product. It is developed to objectively and automatically identify thunderstorms based on the multi-channel brightness temperature data from the Advanced Himawari-8 Imager (AHI) of the Himawari-8 satellite.

The default colour representation of the product is given in the diagram that follows (yellow for thunderstorms, green for no thunderstorms, blue for invalid/corrupted satellite data).

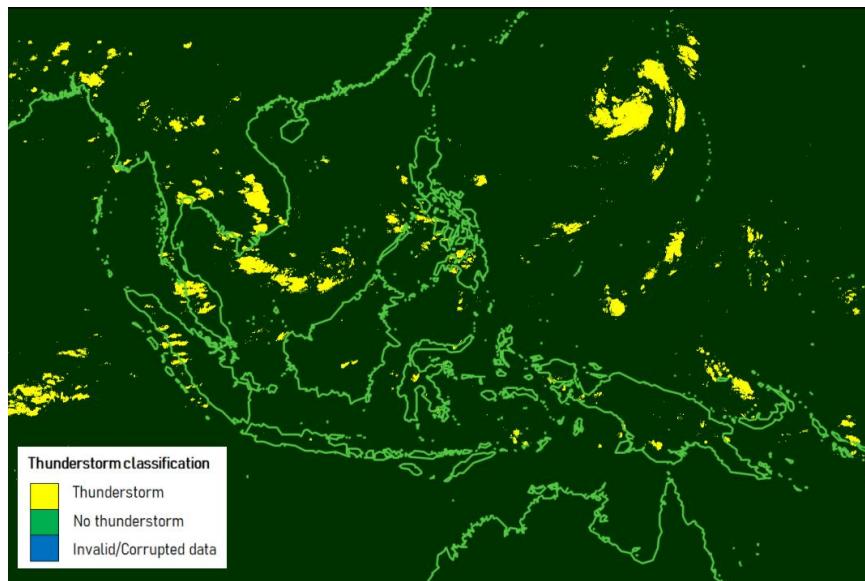


Figure 3 SatTS - satellite data-derived thunderstorm identification

SatRGB

SatRGB is a novel satellite RGB product that gives the properties (thickness and cloud top temperature) of thunderstorm clouds or clouds that could potentially be identified as thunderstorms.

Unlike the SatTS product which gives discrete binary identification of thunderstorms, SatRGB contains continuous information in more than a single dimension. This should provide the operational meteorologists more guidance in weather in the assessment of the developing convective clouds.

The default colour representation of SatRGB is given as below. Generally speaking, the white areas in SatRGB can be regarded as thunderstorms in SatTS.

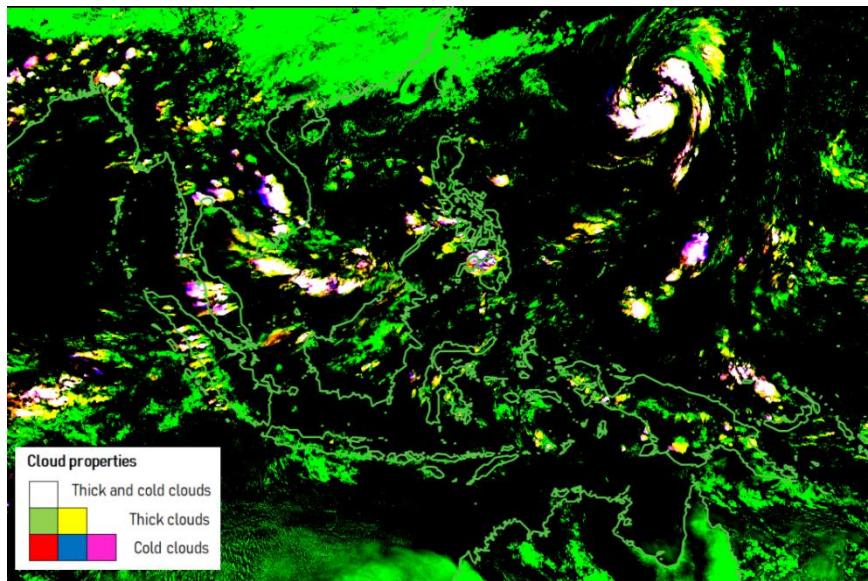


Figure 4 SatRGB – satellite-derived cloud properties of thunderstorms or potential thunderstorms

SatSC

SatSC is a higher-order product that classifies thunderstorms into polygons that represent significant convection that warrants SIGMET issuance. The classification is done automatically and in accordance to the ICAO Asia/Pacific Regional SIGMET Guide document. Thunderstorms that do not fulfil the criteria for SIGMET issuance will not be included in or shown as polygons.

On top of that, cloud top height information (the 95th percentile of the cloud top heights of the clouds in a polygon) is computed and included in each of the polygon. This is made available by incorporating the Himawari-8 Cloud Analysis Information (HCAI) product into the SatSuite production. Additionally, a pseudo SIGMET message is also automatically generated for each of the polygon generated.

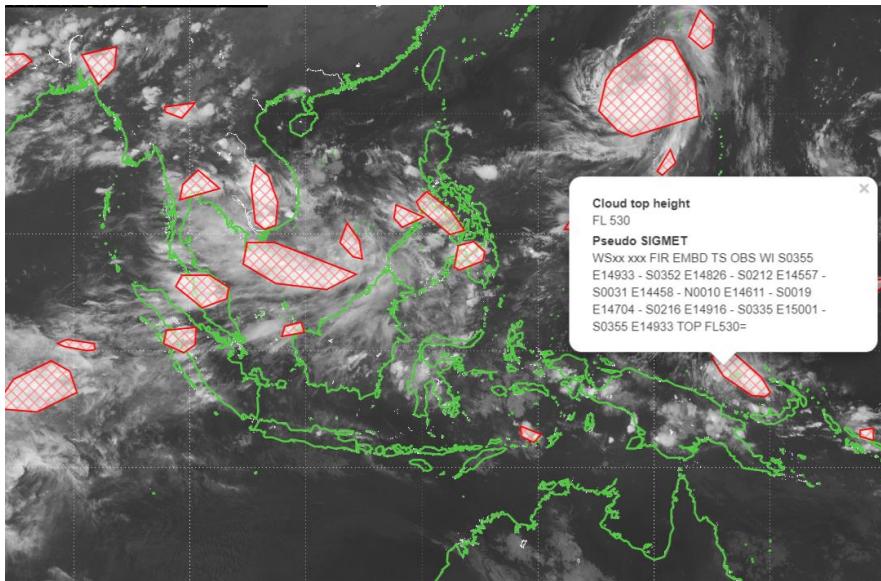


Figure 5 SatSC - Polygons of significant convection that warrants SIGMET issuance and the associated cloud top height

SatSCN

SatSCN is the thunderstorm nowcast output that is packaged into polygons of significant convection based on the guidelines provided in ICAO Asia/Pacific Regional SIGMET Guide document.

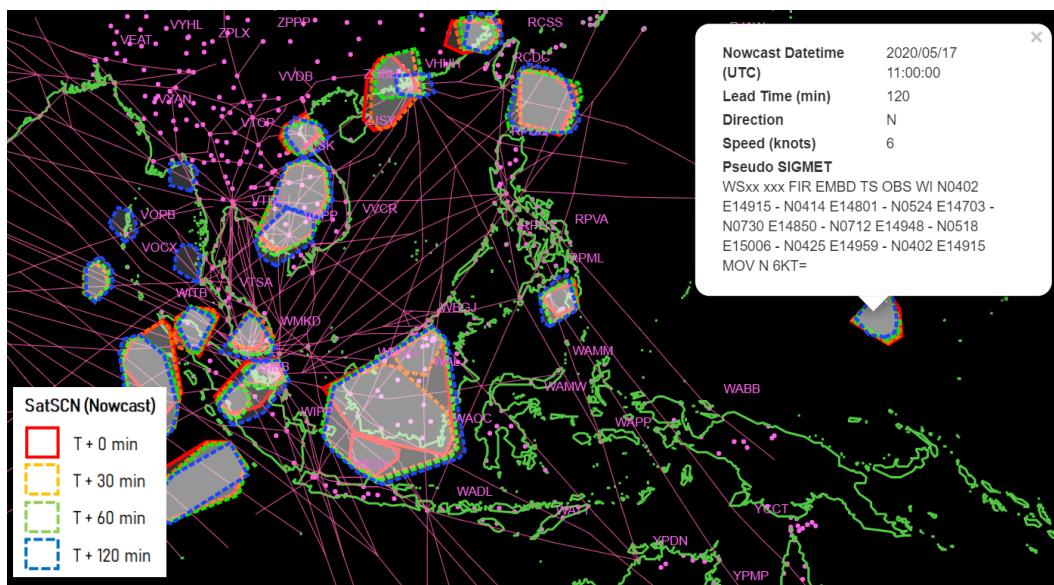


Figure 6 SatSCN - Nowcast of thunderstorms in significant convection polygons

Currently, the Thunderstorm Identification, Tracking, Analysis, Nowcasting (TITAN) system is being experimented using SatTS data as the input. The raw output of TITAN is post-processed to polygons of significant convection. The weighted average of

the speed and direction of movement of thunderstorms within a polygon is also calculated and made available.

Due to the limitations in server resources, this product is current in experimental phase. The product will be made available operationally once the real-time live data is made available on the server. More nowcasting algorithms will also be explored in future.

Processing and Production Pipeline

The processing for SatSuite production ingests the Himawari-8 Standard Data (HSD) and the Himawari-8 Cloud Analysis Information (HCAI) data files, which are updated and received every 10 minutes. To minimize data latency, the processing for is scheduled at every 2 minutes.

The processing is generally modular in its design to allow more flexibility. The production of some of the suite members can be enabled or disabled independently. The processing and production are to be continuously fine-tuned and modified as and when necessary. The production pipeline is summarized in the simplified schematics as follows.

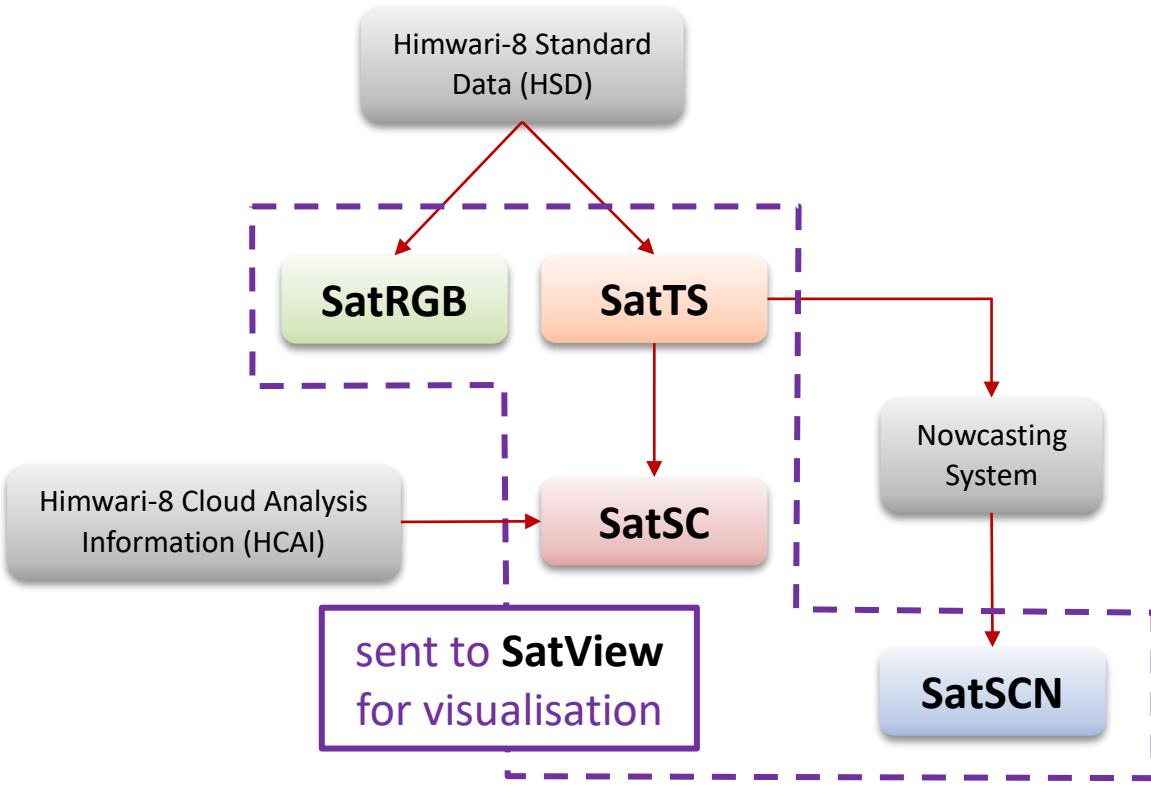


Figure 7 Simplified schematics of the processing and production of SatSuite

Limitations

Some of the known issues with SatSuite are the inherent issues of the satellite data, including the parallax error due to location of the satellite, and the latency in receiving the satellite input data. The production of SatSuite is also subjected to the availability and quality of input data, which is the Himwari-8's HSD data and the HCAI data.

It should be noted that there is no one single suite of products developed for weather watch and forecasting is not without its limitations. An informed user of SatSuite should always refer to multiple sources of information whenever possible in his/her assessment before coming to a decision.

SatView

SATVIEW

A data visualisation platform built exclusively for your convenience

Figure 8 Logo of SatView

SatView is a web-based, one-stop, interactive data visualization platform for operational weather watch and assessment. It was first developed with the objective to provide a convenient visualization tool to streamline operational processes and work flow of the operational meteorologists.

An overview of the user interface is given as follows.

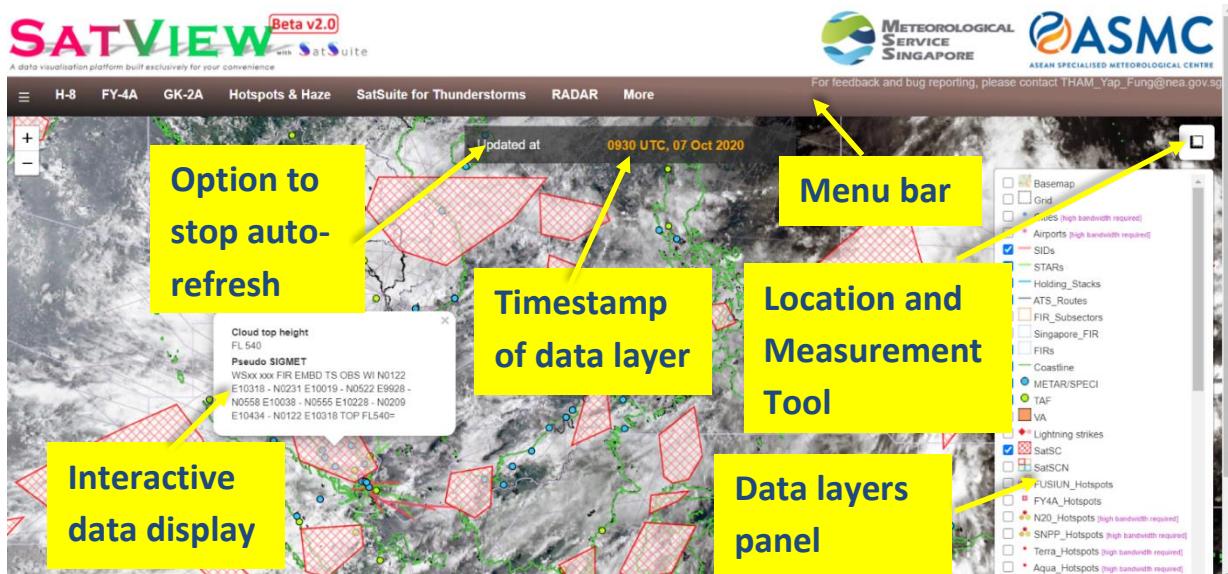


Figure 9 Overview of user interface of SatView

Prior to the release of SatView, the visualization application for satellite data is only available on a handful of local machines, and are not available at other MET offices. The user experience of the said application is also not ideal. It is often slow and requires

a long loading time and multiple steps to perform simple tasks such as viewing a satellite imagery animation.

With the objective to overcome the shortfall of the existing application, SatView is built with the following features

- **Accessible** – a web-based platform that can accessed from all machines at MET offices connected to the OPS network of MSS, provided that firewall access is enabled
- **Convenient** – loading, animating and zooming satellite imageries requires only one single click and a scroll
- **Smart** – it alerts the users with bright red colour or pop-out window if the data is not updated or when the users disable the auto-update function
- **Flexible** – new data layers can be added to the platform when necessary
- **Simple** – the interface is kept simple and clean to ensure there is no unnecessary features that affect the user experience

Versions

Since the release of the first beta version, there have been several rounds of upgrades and deployments of SatView. Currently, it is in its beta version 2.0. To adopt a more agile development approach, SatView is meant to be perpetual beta.

The summary of the previous versions and upcoming upgrades can be viewed on the “Versions” page under the drop-down list of the main menu.

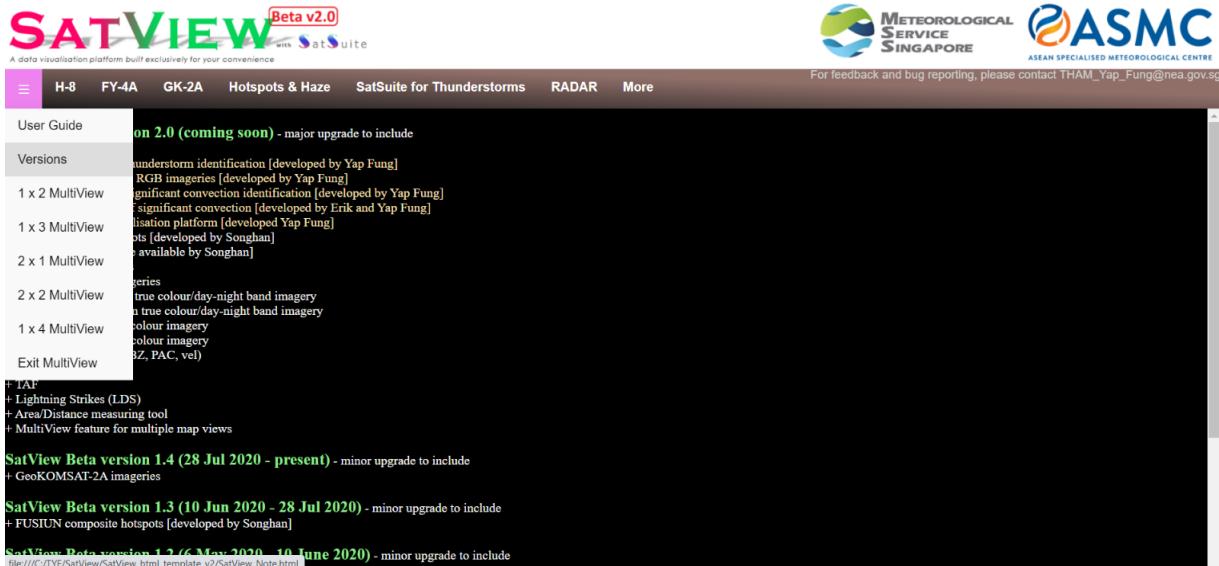


Figure 10 Summary page for all SatView versions

Data Refresh and Update

To reduce latency in data display, the maps on SatView are refreshed automatically every minute to reflect the latest available data, while the backend processing is scheduled at every 3 minutes. The actual data update rate of each data layer however depends on the observation sensor and data source itself.

The date and time of the data in display are shown on the time stamp on the top of the map panel. If the data shown is outdated, the timestamp box will turn red to alert the users. Users may also disable the default auto-refresh function by clicking on the ‘Updated at’ button, a pop-up alert will appear to warn the users that the data will no longer be refreshed.

As users may display more than one data layer on a map, it should be noted that the timestamp on SatView is of the data layer selected from the menu bar, but not for the ones selected on the side data layers panel.

Data Layers

Currently, close to 70 data layers are made available on SatView. The data layers can be broadly grouped into the following categories.

- Himawari-8 Satellite
- GeoKOMSAT-2A Satellite
- FengYun-4A Satellite
- Fire Hotspots
- Hotspot Composite (FUSIUN)
- Haze Tracking from Space (HATS)
- SatSuite for Thunderstorms
- Weather RADAR
- Lightning Detection System
- OPMET Data
- OpenStreetMap
- Other Static Layers

Himawari-8 Satellite

Single channel and RGB products of the Himawari-8 satellite for different domains and spatial resolutions are available. In general, the spatial resolution for the ‘Singapore’ domain is the highest while that of ‘Asia Pacific’ is the lowest.

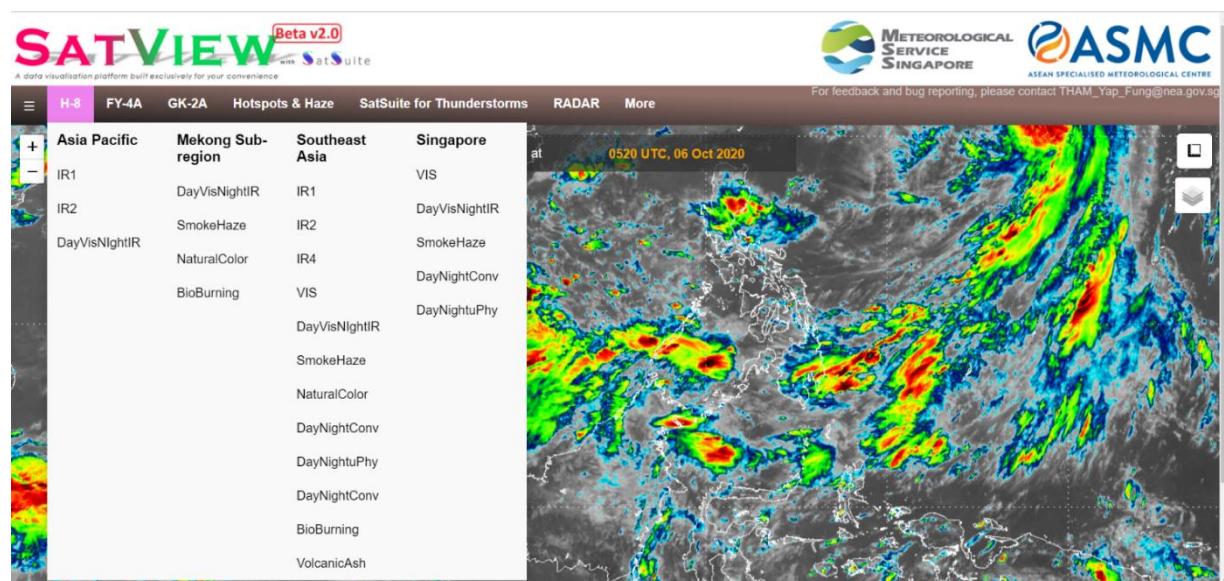


Figure 11 Himawari-8 products on SatView

GeoKOMSAT-2A Satellite

RGB products of GeoKOMSAT-2A (GK-2A) satellite over the Southeast Asian region are available.

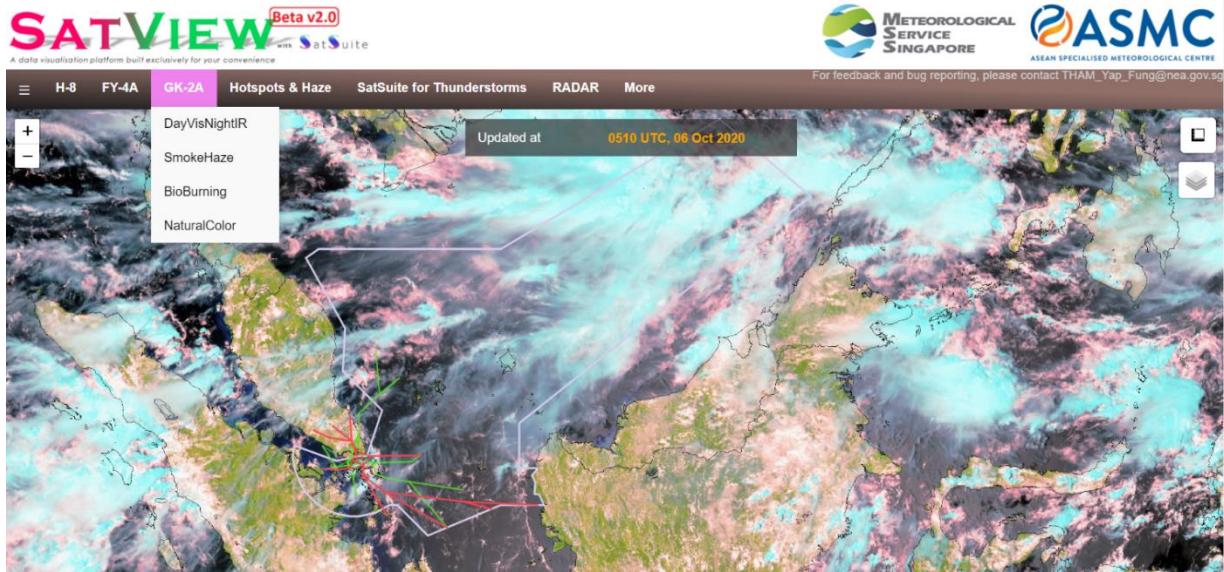


Figure 12 GeoKOMSAT-2A products on SatView

FengYun-4A Satellite

RGB products of Fengyun-4A (FY-4A) satellite over the Southeast Asian region are available. Do note that the update frequency of the FY-4A satellite data is irregular, ranging from a few minutes to almost an hour.

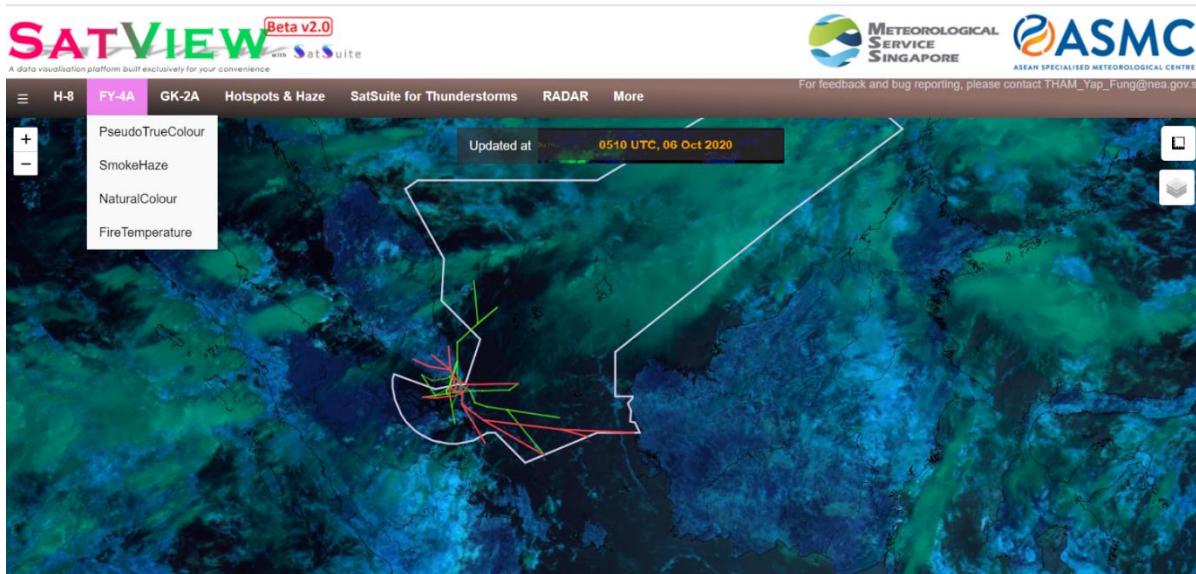


Figure 13 Fengyun-4A products on SatView

Fire Hotspots

Hotspot data from geostationary (Fengyun-4A) and polar orbiting (NOAA-20, Suomi NPP, Aqua and Terra) satellites are also available. The latest day/night pass images of NOAA-20 and Suomi NPP satellites, and the latest day pass of Aqua and Terra satellites can be viewed on SatView. As the image from a satellite may be merged from different passes of the same day, the timestamps of the images is on SatView is deliberately set to 0000 UTC.

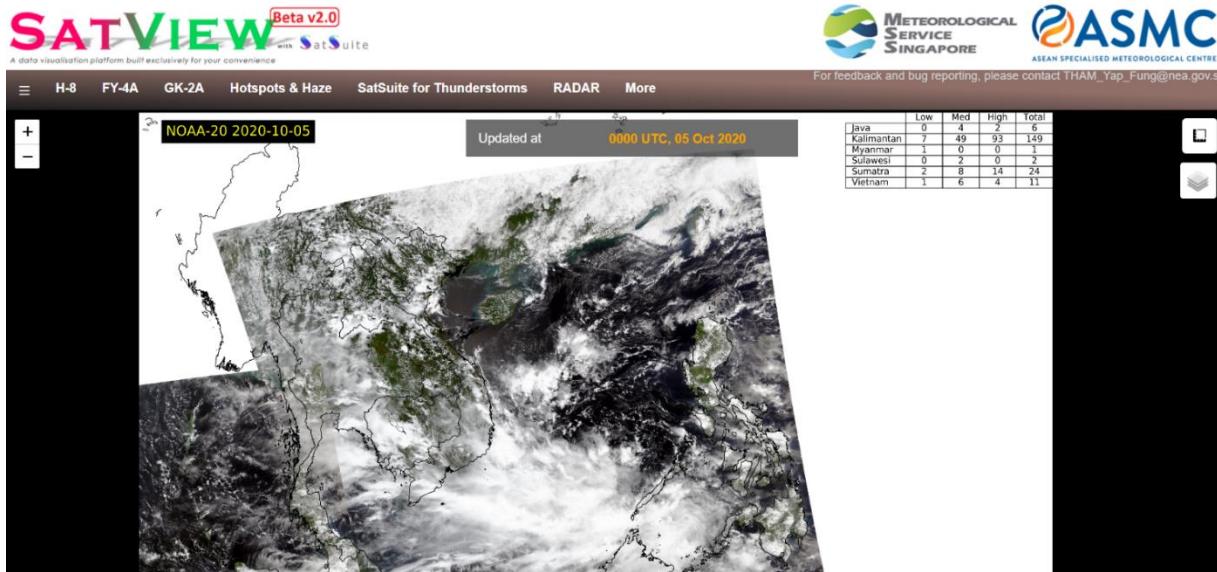


Figure 14 Hotspot data on SatView

Hotspot Composite (FUSIUN)

The in-house developed hotspot composite product (also known as FUSIUN) can be displayed on SatView. Grid boxes with high probability (≥ 0.6) of hotspots detected are outlined in red, while those with medium (≥ 0.4 but < 0.6) probability are outlined in orange. The actual probability of detection for each of the grid box can also be shown by clicking on the grid box itself.

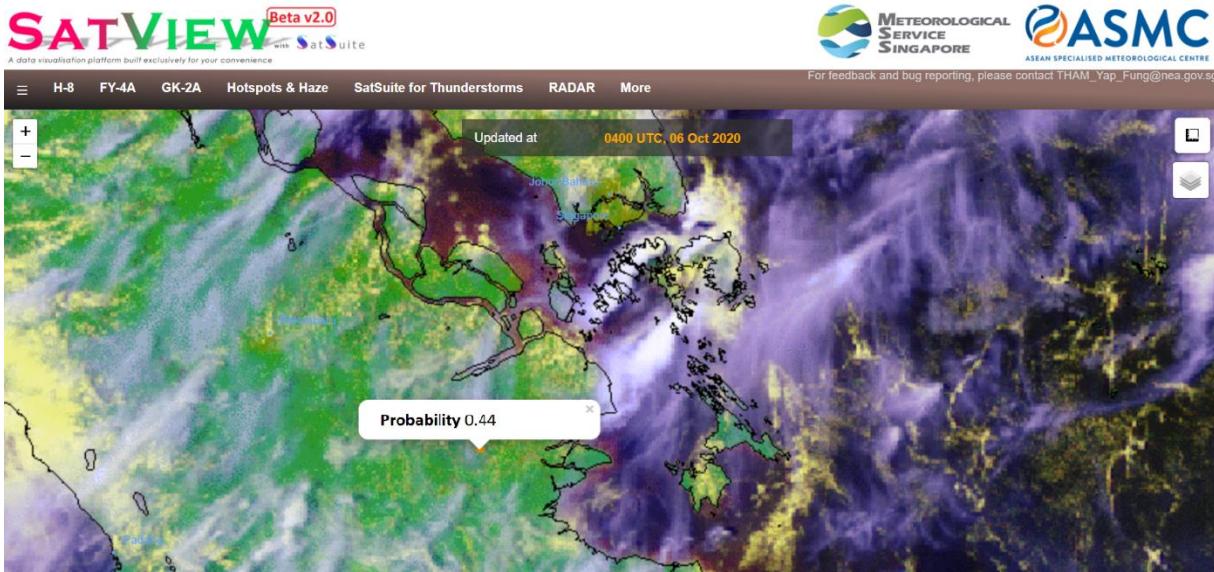


Figure 15 Hotspot Composite product on SatView

Haze Tracking from Space (HATS)

Temporal composites of smoke haze detected in the HATS product can be found on SatView. Currently, temporal composites from two different algorithms (i.e. thresholding and random forest model) are available and are known as ‘SmokeMask’ on SatView. The SmokeMask layer is the temperate aggregate of the all available hourly output from HATS in a day. A darker shade of brown-red colour denotes a longer period of haze detected.

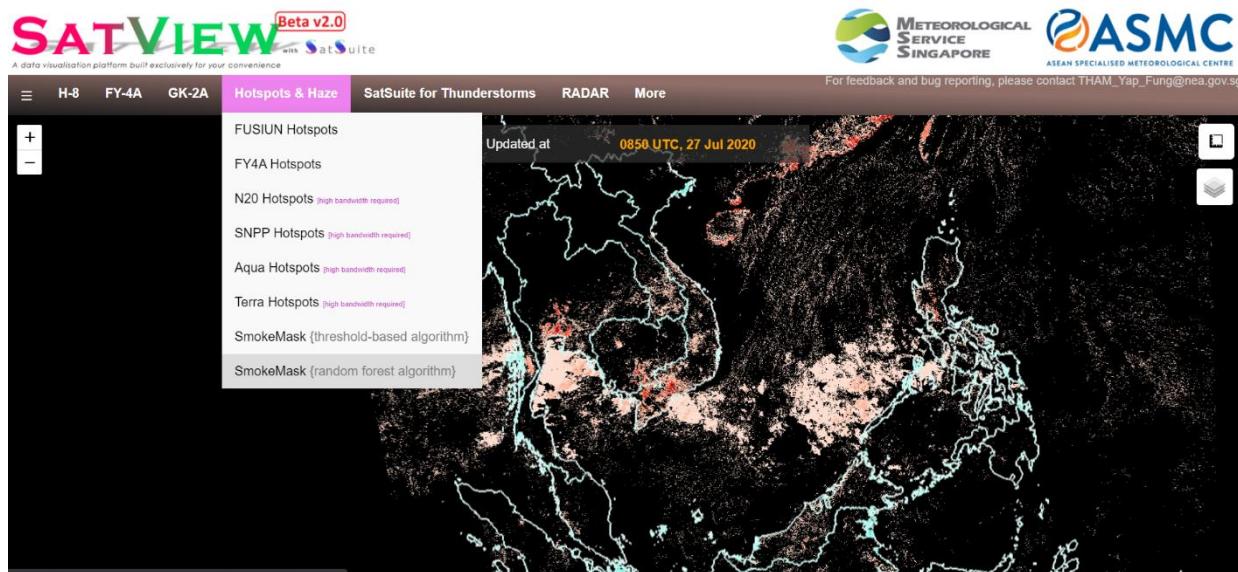


Figure 16 Haze Tracking from Space (HATS) product on SatView

SatSuite for Thunderstorms

SatSuite comprises products for observations and nowcast of thunderstorms. More details of this suite of products can be found in the earlier parts of this document.

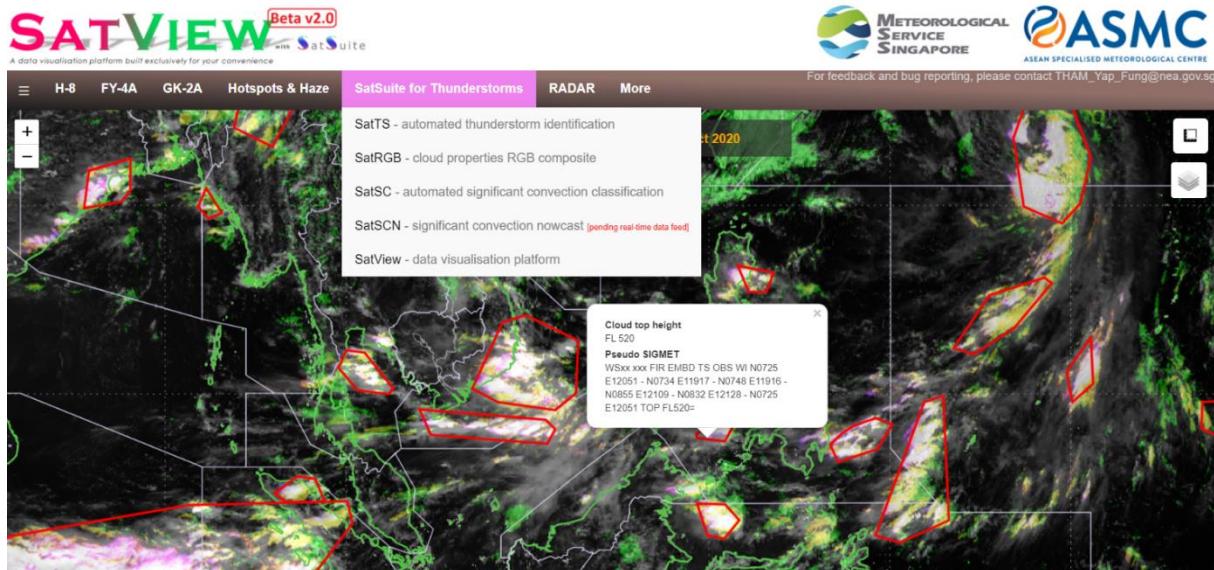


Figure 17 SatSuite on SatView

Weather RADAR

RADAR data such as rainfall rate, maximum reflectivity, maximum radial velocity and precipitation accumulation are available on SatView. Do note that there may be slightly longer data latency when viewing the RADAR data on SatView.

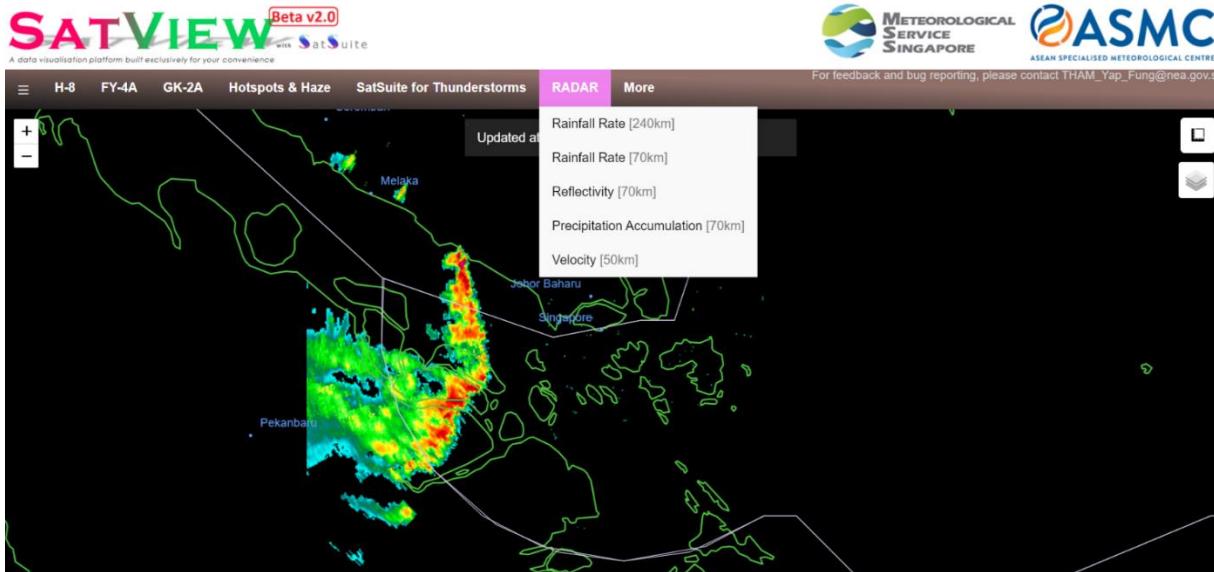


Figure 18 Weather RADAR data on SatView

Lightning Detection System (LDS) Data

Cloud-to-cloud and cloud-to-ground lightning detected over about the past 10 minutes are also available on SatView, but with slightly longer data latency. The details of each of the lightning strike detected can also be viewed by clicking it on the map.

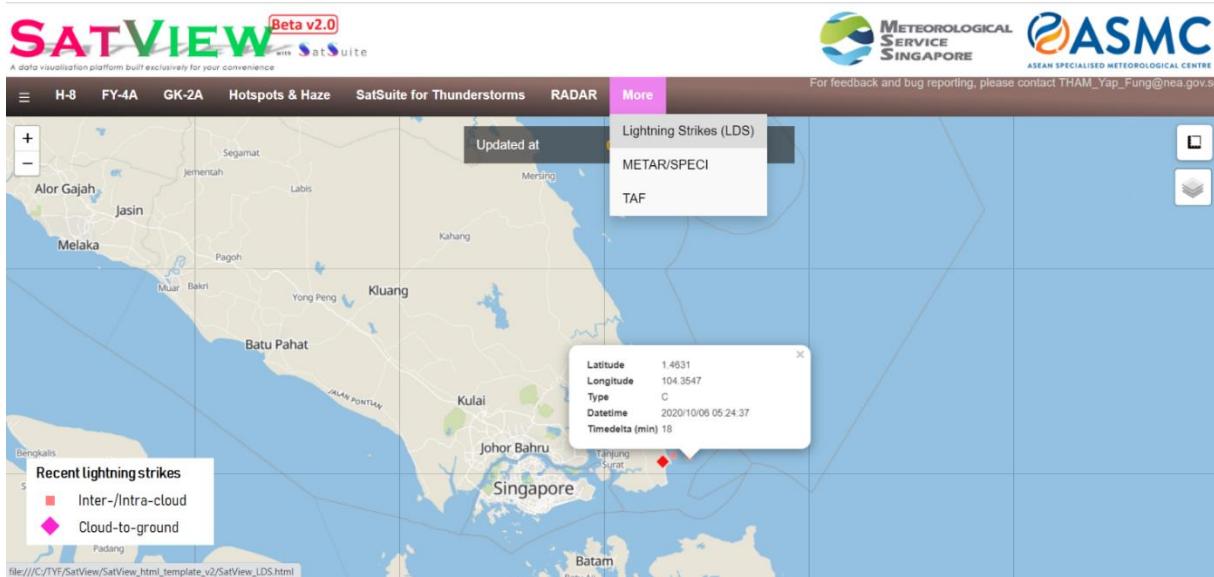


Figure 19 Lightning Detection System (LDS) data on SatView

OPMET Data

Operational aeronautical meteorological (OPMET) data such as METAR/SPECI and TAF at many aerodromes in the region are also available. The content of the report and forecast can be viewed by clicking on the aerodrome on the map.

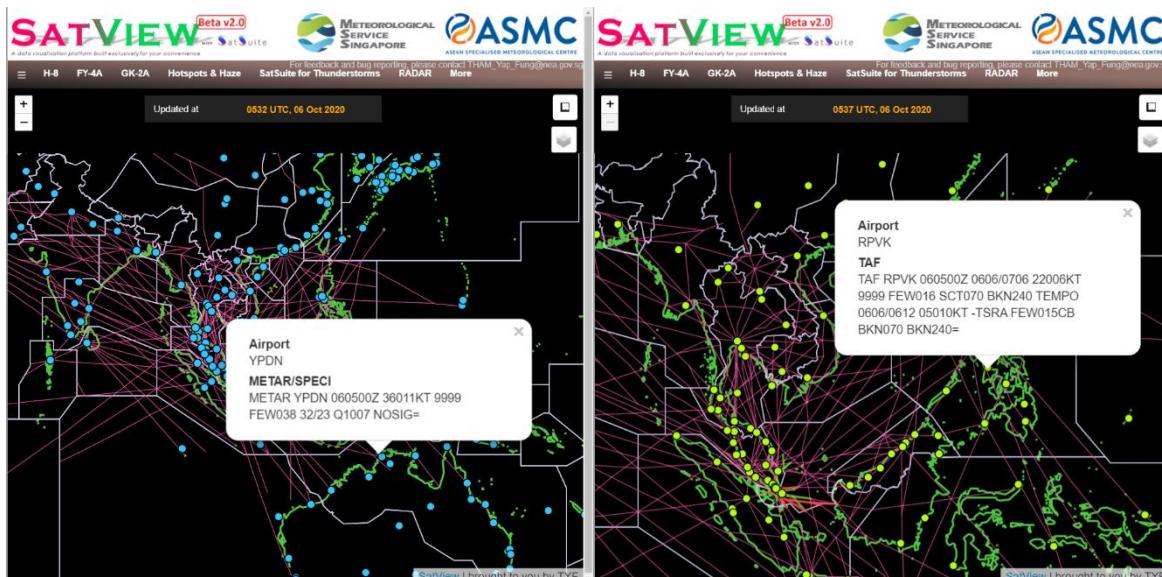


Figure 20 OPMET data on SatView

OpenStreetMap

OpenStreetMap (OSM) is a collaborative project to create a free editable map of the world. It is similar to Google Maps and are available on SatView.

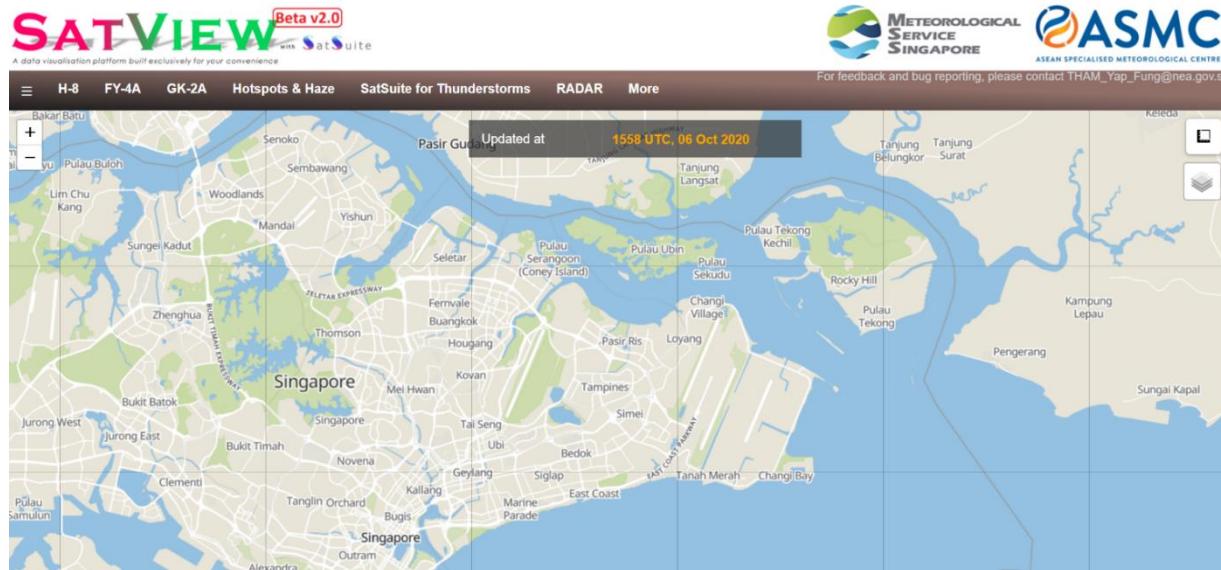


Figure 21 OpenStreetMap on SatView

Other Static Layers

There are also other static layers available on SatView, such as the air traffic service (ATS) routes for enroute aircraft operations, standard instrument departure routes (SIDs), standard arrival routes (STARs), flight information region (FIR) boundaries, peatland map, ASEAN provinces/states map, major cities, major aerodromes for civil aviation, and other critical watch areas.

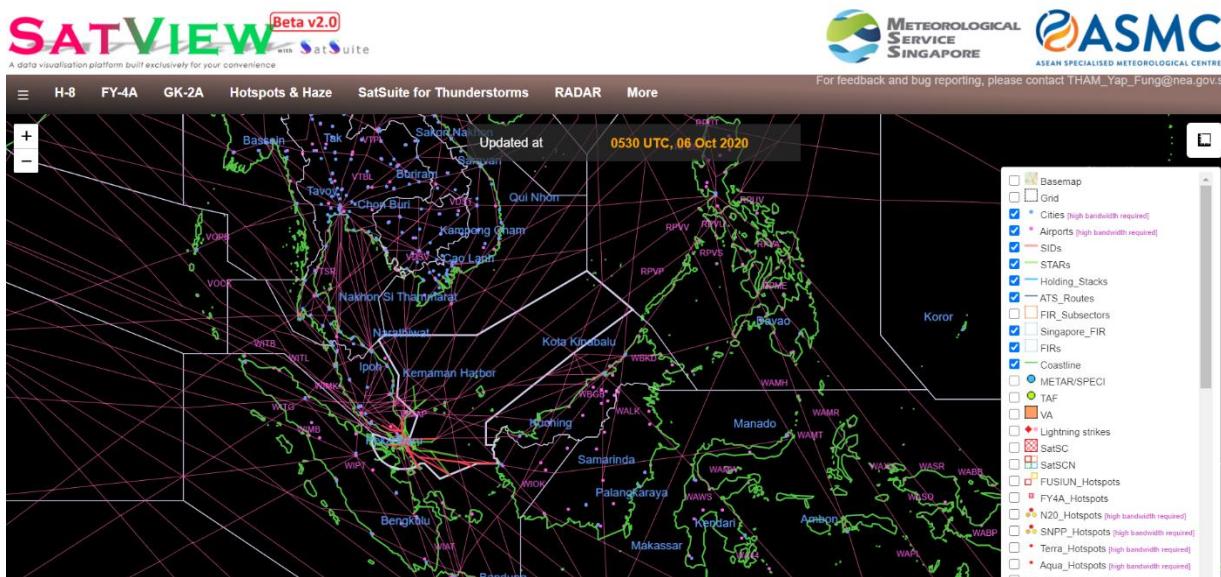


Figure 22 Other static layers and maps on SatView

Interactive Display

SatView provides a convenient way to view the details of the data layers in display. Users may simply click on the point or object, and details (e.g. the location and magnitude of a lightning strike, the probability of hotspot detection, the cloud top height of significant convection, the name of the city, the most recent METAR/SPECI of an aerodrome, etc.) will be shown accordingly.

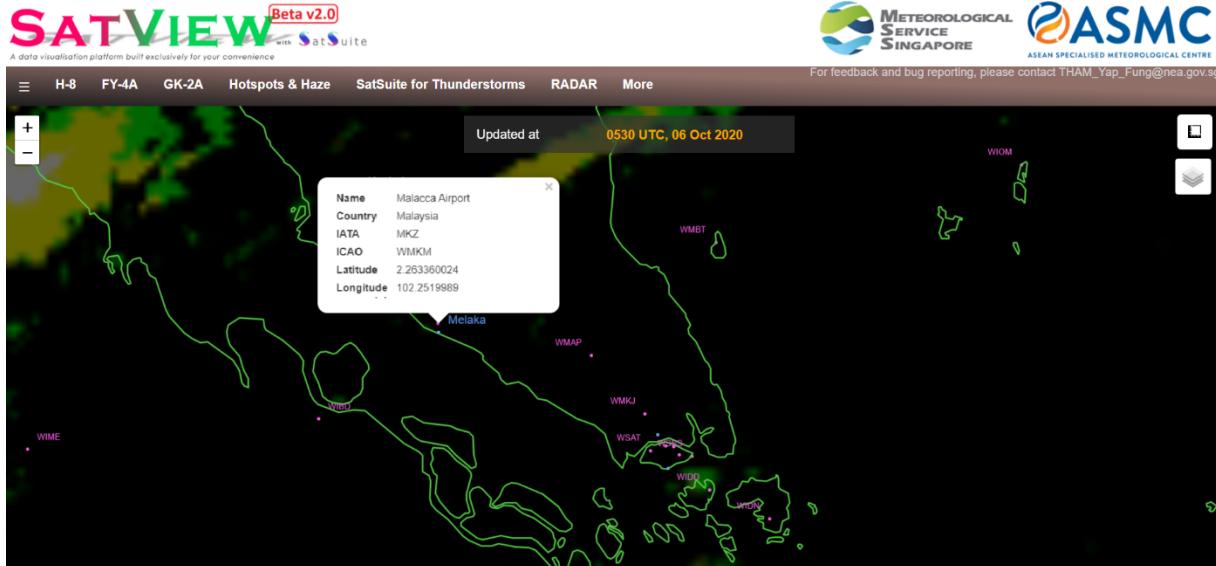


Figure 23 Interactive display on SatView

Location and Measurement Tool

More often than not, there is a need to know the location, distance and areal size of a weather phenomenon (e.g. latitude and longitude of a location, distance of a fire hotspot from Singapore, how far a Sumatra squall currently is from Singapore, size of a large convection system). The location and measurement tool is included in SatView for the purposes mentioned.

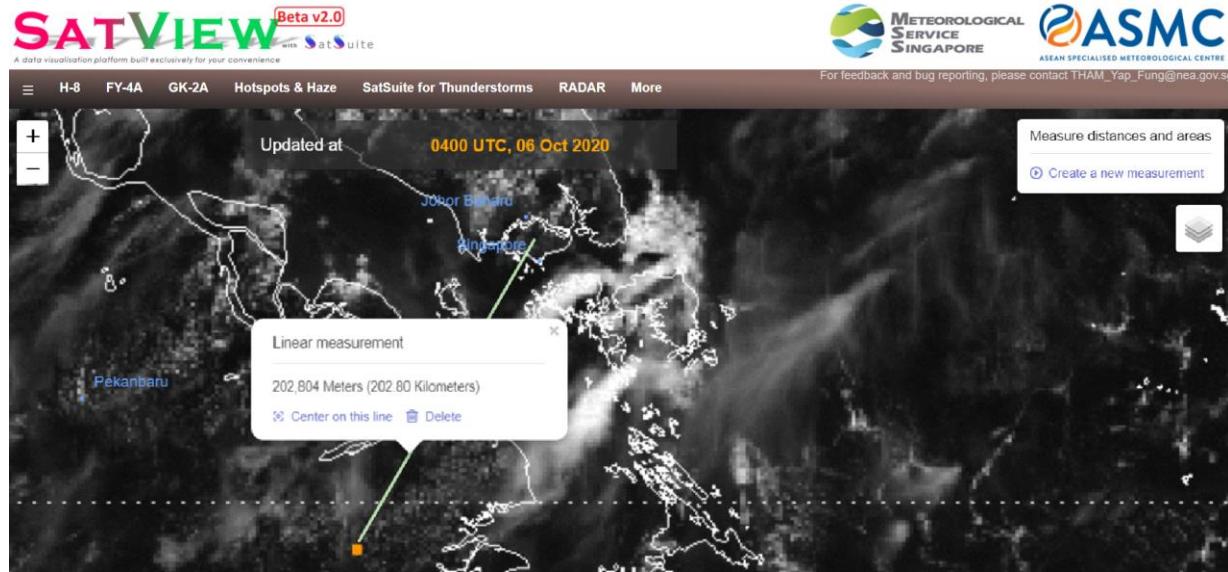


Figure 24 Location and measurement tool on SatView

MutiView

MutiView feature is added to SatView to allow the users to view multiple maps at one go without having to change or open multiple tabs. Users are free to choose set any configuration of map panels. This feature is available on the drop-down list of the main menu. To reset to a single map panel, simply click on ‘Exit MultiView’ or the SatView logo on the top. Please note that displaying multiple map panels in a single tab may drain more resources of your machine.

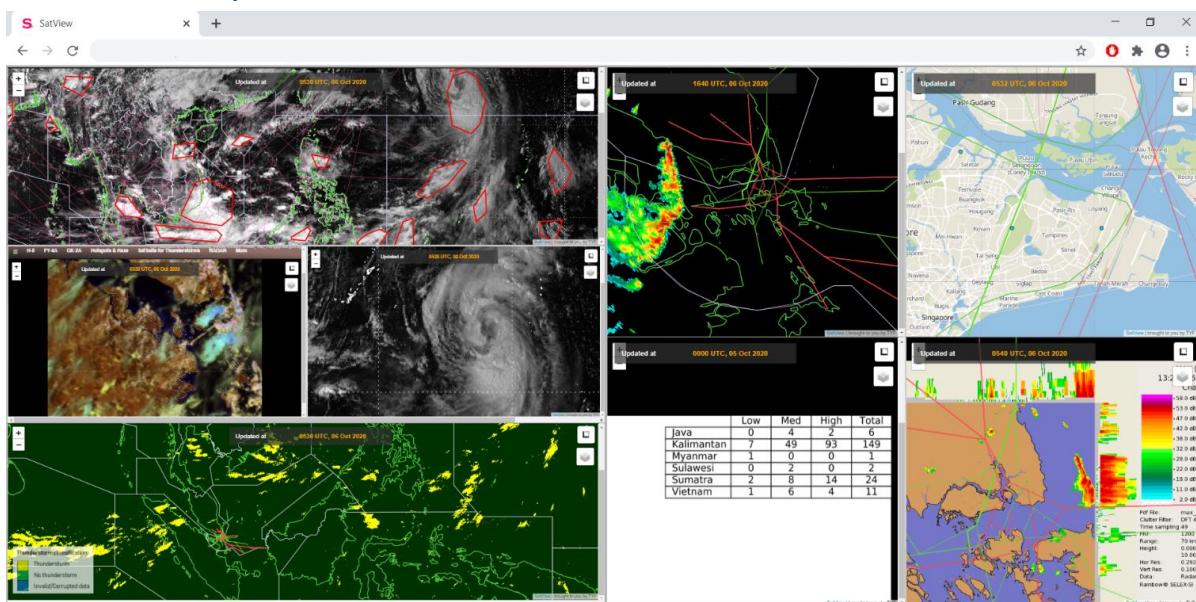


Figure 25 MultiView feature on SatView

Limitations

To reduce latency in data display, multi-thread processing is used to speed up the backend processing in producing the data layers. This however takes up a considerable amount of memory on the server. Hence, there is a limit of how frequent the backend processing can be scheduled.

On the frontend, depending on the capability of the machines used and network connection, some data layers may require a longer time to be loaded on the platform due to the large file size. There are annotations on the drop-down menu and data layers panel to inform the users of the large file size.

A known limitation of SatView is that it is designed to display only real-time data for operational weather watch and assessment, and is unable to show past and archived data.

For some data layers, there is longer latency in the data display on SatView as compared to their native visualisation software (e.g. LDS lightning data). Users should take note of this when using SatView.

While SatView is developed to provide a convenient, integrated visualisation platform for multiple data sources, it is not designed to replace other existing visualisation software applications for the respective data sources.

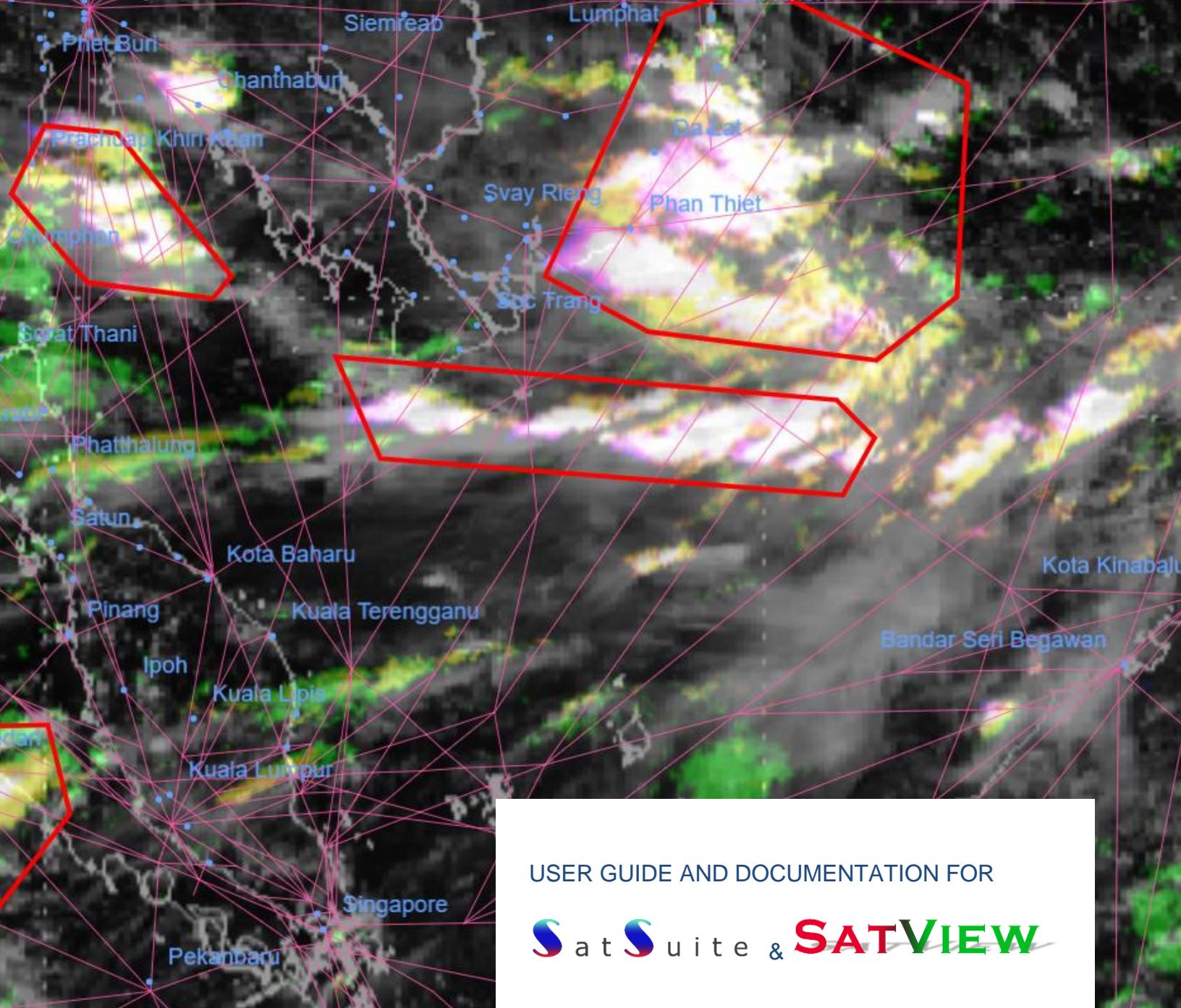
Acknowledgement

Credit is herewith given to other colleagues who have kindly contributed to the development of SatSuite and SatView, as in the following list, which by no means is exhaustive.

- **Wong Songhan** – made available satellite input data, enabled Web Map Service, and developed the hotspot composite (FUSIUN) product
- **Erik Becker** – installed, configured, and maintained nowcasting software applications for thunderstorm nowcasting in SatSuite
- **Efthymia Pavlidou** – developed the Haze Tracking from Space (HATS) products and made available the SmokeMask data on SatView
- **Ng Jin Zheng** – made available the FengYun-4A hotspot data
- **Operational Meteorologists** at the Central Forecast Office in Jan/Feb 2020 – provided feedback on the limitations in weather watch and forecasting with satellite data

Table of Figures

Figure 1 Logo of SatSuite.....	5
Figure 2 SatTS - satellite data-derived thunderstorm identification	6
Figure 3 SatRGB – satellite-derived cloud properties of thunderstorms or potential thunderstorms.....	7
Figure 4 SatSC - Polygons of significant convection that warrants SIGMET issuance and the associated cloud top height	8
Figure 5 SatSCN - Nowcast of thunderstorms in significant convection polygons	8
Figure 6 Simplified schematics of the processing and production of SatSuite.....	10
Figure 7 Logo of SatView.....	11
Figure 8 Overview of user interface of SatView.....	11
Figure 9 Summary page for all SatView versions	13
Figure 10 Himawari-8 products on SatView	14
Figure 11 GeoKOMSAT-2A products on SatView	15
Figure 12 Fengyun-4A products on SatView	15
Figure 13 Hotspot data on SatView.....	16
Figure 14 Hotspot Composite product on SatView	17
Figure 15 Haze Tracking from Space (HATS) product on SatView.....	17
Figure 16 SatSuite on SatView	18
Figure 17 Weather RADAR data on SatView.....	18
Figure 18 Lightning Detection System (LDS) data on SatView.....	19
Figure 19 OPEMET data on SatView	19
Figure 20 OpenStreetMap on SatView	20
Figure 21 Other static layers and maps on SatView.....	20
Figure 22 Interactive display on SatView	21
Figure 23 MultiView feature on SatView.....	22



USER GUIDE AND DOCUMENTATION FOR

SatSuite & SATVIEW

Please refer to the latest version of this document on
SatView

DOCUMENT FIRST RELEASED ON: 22 OCTOBER 2020

DOCUMENT LAST UPDATED ON: 22 OCTOBER 2020

DOCUMENT CREATED BY: THAM YAP FUNG

DOCUMENT LAST EDITED BY: THAM YAP FUNG