JMA Contribution to SWFDDP in RA-V

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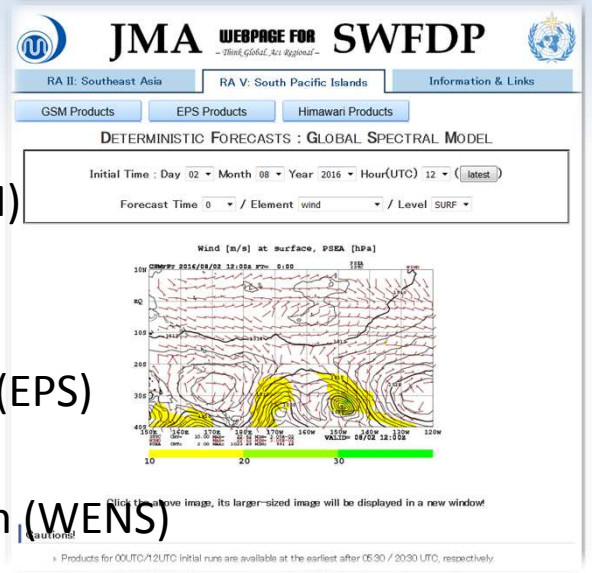
Meeting of the Regional Subproject Management Team (RSMT) of the Severe Weather Forecasting and Disaster risk reduction Demonstration Project (SWFDDP) for the South Pacific Islands, 27-28 August 2018

JMA's NWP products and services for regional subprojects of SWFDP

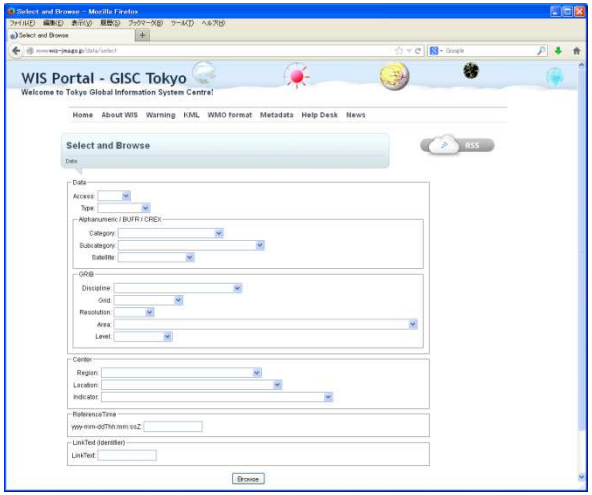
Japan Meteorological Agency

JMA's NWP Products for SWFDP

- **Map products**
  - ✓ via the JMA website for SWFDP, w/o passwd
    https://www.wis-jma.go.jp/swfdp/
    - Deterministic forecasts by Global Spectral Model (GSM)
      - parameterization schemes upgraded (2017)
      - fcst hours extended (2018)
    - Probabilistic forecasts by Ensemble Prediction System (EPS)
      - new system GEPS introduced (2017)
    - Wave Probabilistic forecasts by Wave Ensemble System (WENS)
      - newly released to SWFDP (2017)
    - Satellite (Himawari) images and products



- **GRIB2 format grid data**
  - ✓ via the GISC Tokyo website, partly w/ passwd
    https://www.wis-jma.go.jp/data/select
    - GSM forecast grid data
      - 0.25 (surf) and 0.5 (1000-10 hPa) deg. resolutions
    - Global Wave Model (GWM) forecast grid data
      - 0.5 deg. resolution



Global Spectral Model (GSM)

Objectives	Deterministic short- and medium-range forecasts
Horizontal res.	TL959 (0.1875 deg)
Vertical levels / Top	100 levels / 0.01 hPa
Forecast hours (Initial time)	84 –> 132 hours (00, 06, 18 UTC) (June 2018) 264 hours (12 UTC)
Initial condition	Global Analysis by 4D-Var

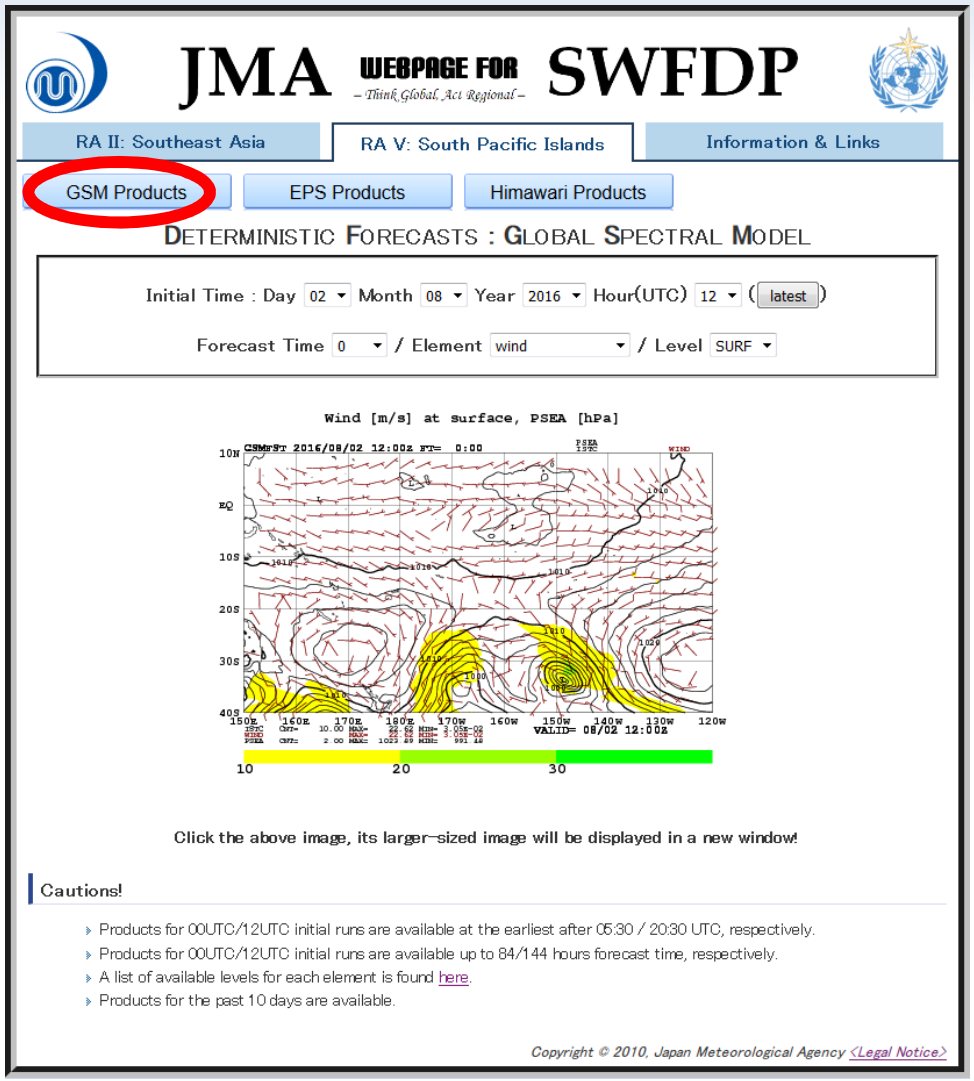
Changes since August 2016

May 2017: upgrading parameterization schemes of land/sea surfaces, deep convection, cloud and radiation

Jun. 2018: updating super computer system (10-times faster computation than previous system)

https://www.jma.go.jp/jma/en/Activities/nwp.html

GSM Products (deterministic forecasts)



Forecast intervals:

- 6-hourly up to 72 hours,
  12-hourly up to 144 hours

Map products:

- accumulated precipitation,
  min & max temperature,
  sea level pressure, relative humidity (surface)
- wind, temperature, humidity, geopotential height
  (surf., 925, 850, 700, 500, 300, 200 hPa)
- vorticity (500, 300 hPa)
- vertical velocity (850, 700, 300 hPa)
- 1000-500 hPa thickness,
  precipitable water, K index

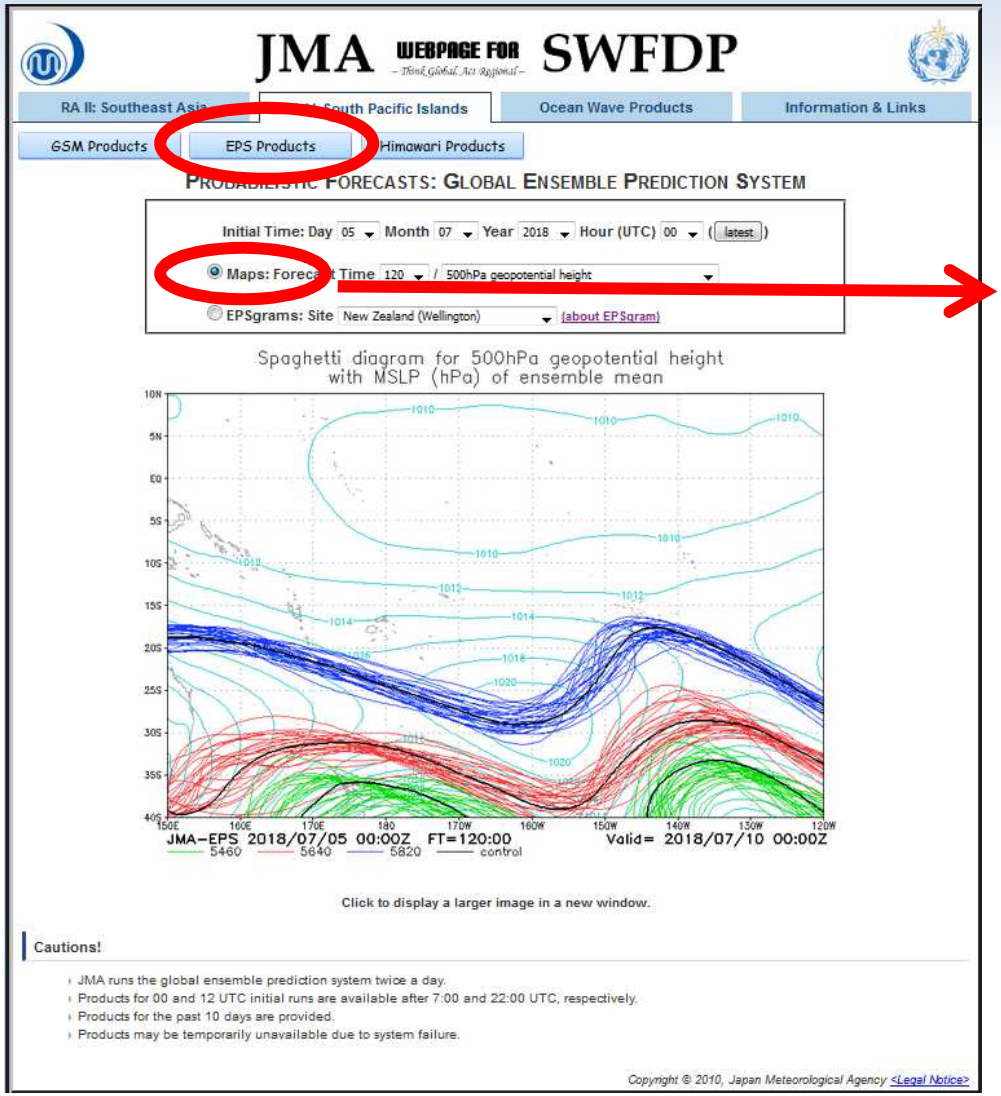
Global Ensemble Prediction System (GEPS)

Objectives	Probabilistic medium-range forecasts
Horizontal resolution	TL479 (0.375 deg)
Vertical levels / Top	60 –> 100 / 0.1 –> 0.01 hPa (Jan. 2017)
Forecast hours (Initial time)	264 hours (00, 12 UTC)
Ensemble members	27 members
Initial condition	Global Analysis w/ ensemble perturbations (SV –> SV + LETKF) (Jan. 2017)

Changes since August 2016

Jan. 2017: GEPS was introduced as a unified model in place of the typhoon, one-week, and one-month ensemble systems increasing number of vertical levels and introducing a Local Ensemble Transform Kalman Filter (LETKF) as a new initial perturbation production method

EPS Products (probabilistic forecasts) (1)



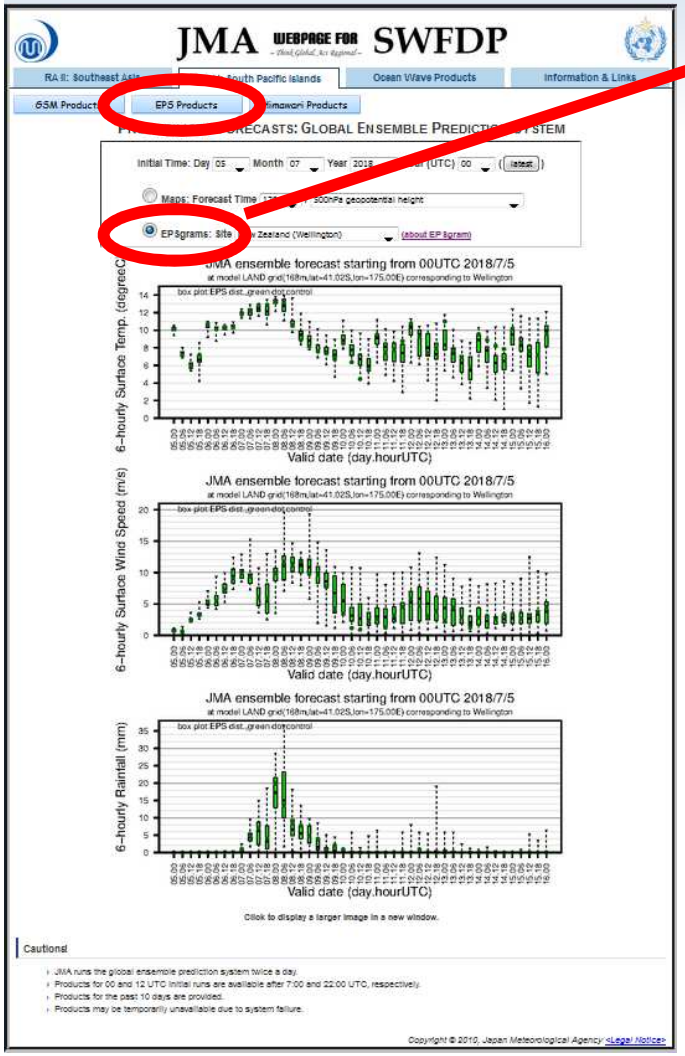
Forecast intervals:

- 6-hourly up to 144 hours

Map products:

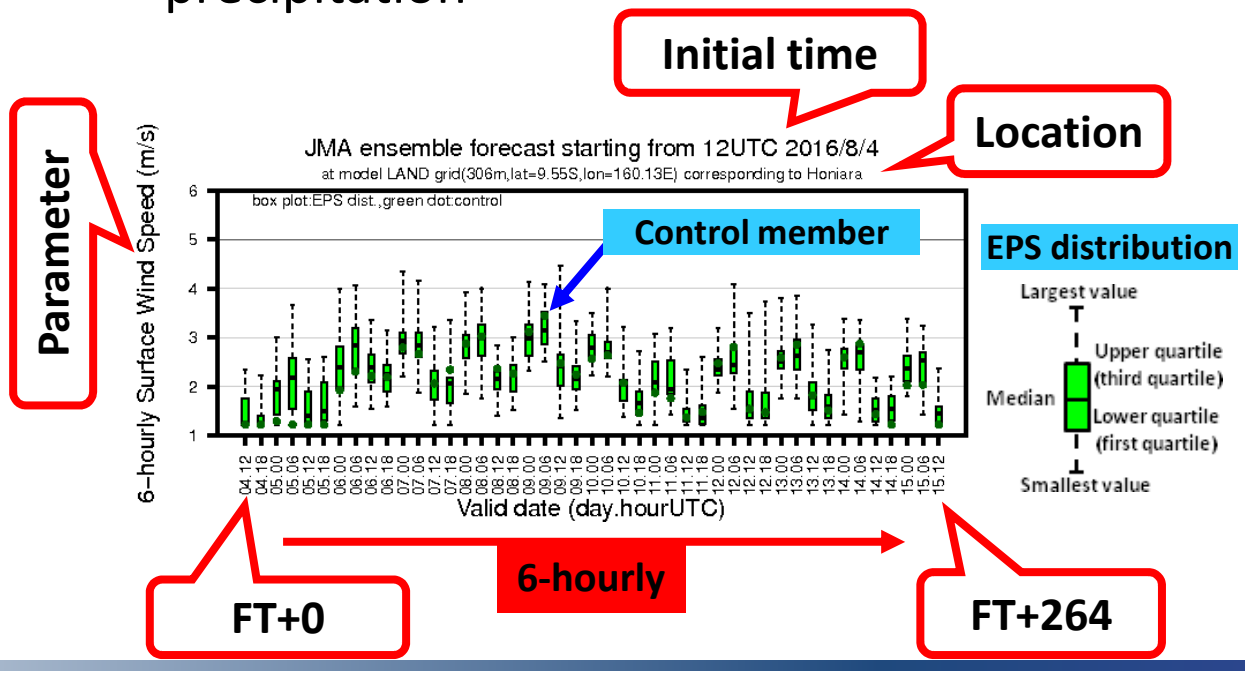
- **Spaghetti diagrams**
  - uncertainty in forecast (500 hPa)
- **Probability maps for precipitation**
  - 6-hour accumulated rain
    > 25, 50, 100 mm
  - 24-hour accumulated rain
    > 50, 100 mm
- **Probability maps for wind**
  - surface wind speeds
    > 20, 30 kt

EPS Products (probabilistic forecasts) (2)



EPS meteograms (EPSgram)

- probabilistic of ensemble forecasts at given locations (21 sites in RA-V)
- temporal evolution of ensemble forecast distributions
- surface temperature, wind speed, precipitation



New! Wave Ensemble Products

- JMA started to operate the Wave Ensemble System (WENS) in June 2016, in addition to the Global Wave Model (GWM).
- WENS products have been available for SWFDP since 27 Sep. 2017.
- GWM's new wave components (windsea and swell) will be provided.

Outline of JMA wave models

	Wave Ensemble System (WENS)	Global Wave Model (GWM)
model	MRI-III (Third generation wave model)	
region	Global over 75S – 75N	
grids	289 x 113	720 x 301
resolution	1.25 x 1.25 deg.	0.5 x 0.5 deg.
wave spectrum	900 components, 25 in frequency, 36 in direction	
forcing	GEPS (40 km, 27 mem)	GSM (20 km)
forecast time	264 hrs (12UTC)	264 hrs (12UTC) 132 hrs (00,06,18)

Products for SWFDP

Wave Ensemble Map Products

- Ensemble mean, 3rd quantile, maximum wave heights
- Probability of wave height over 2,3,4,5,6m
- Ensemble spread
- Wave period*
- EPS meteograms (EPSgram) at stations

GRIB format data of GWM

- Significant wave height, period, direction
- Windsea height, period, direction*
- Swell height, period, direction (two swell)*

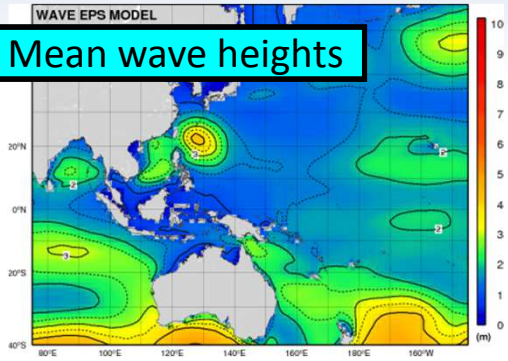
* Planned

New! Wave Ensemble Products

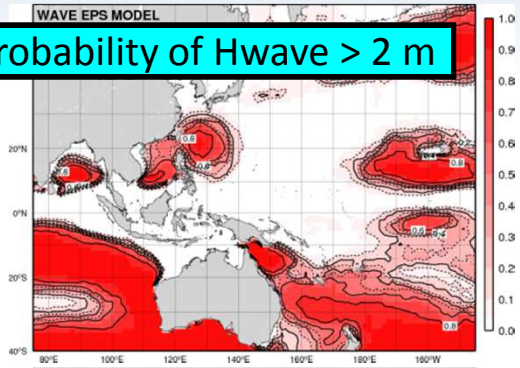
Example: 144-hour forecasts from 12 UTC on 1 June 2018

Map Products

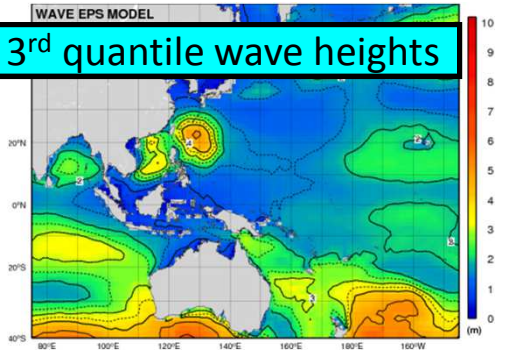
Mean wave heights



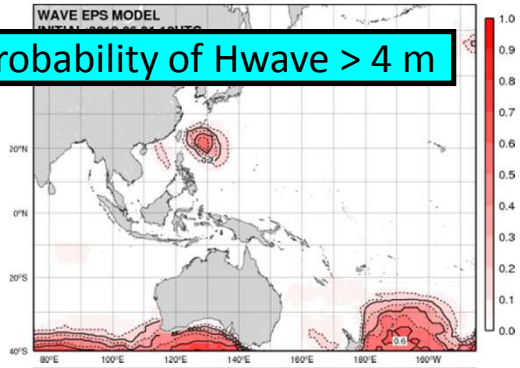
Probability of Hwave > 2 m



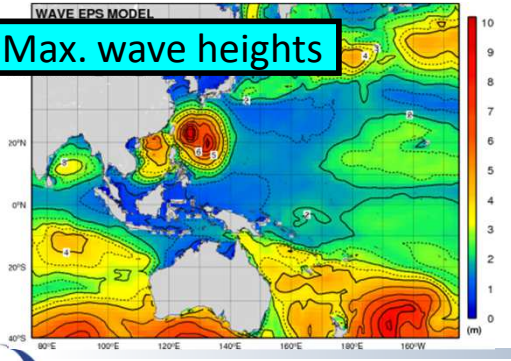
3rd quantile wave heights



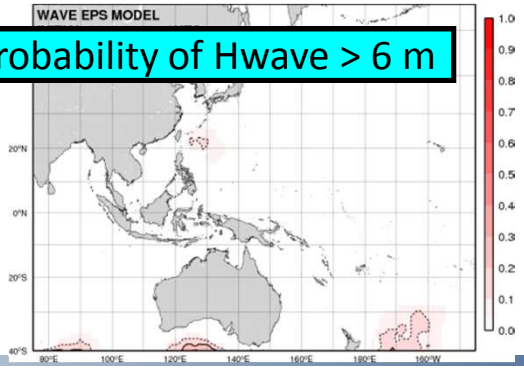
Probability of Hwave > 4 m



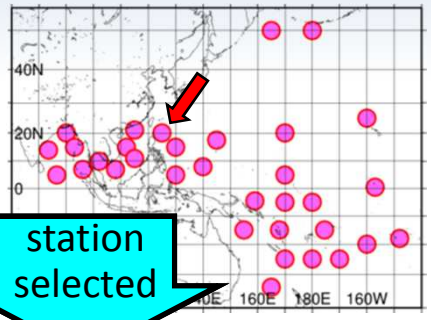
Max. wave heights



Probability of Hwave > 6 m

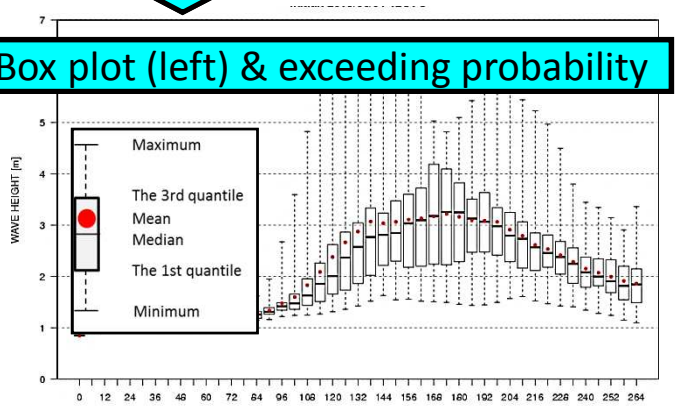


EPSgrams at stations

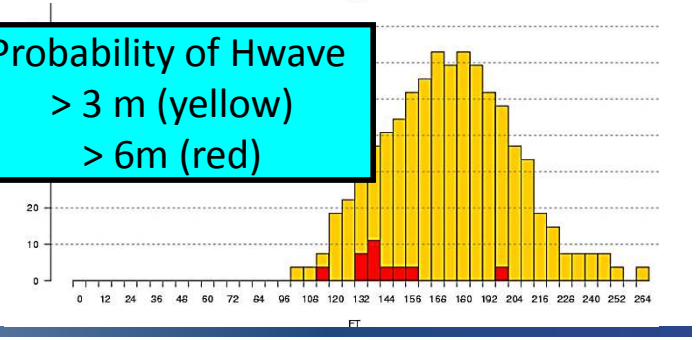


station selected

Box plot (left) & exceeding probability



Probability of Hwave
> 3 m (yellow)
> 6m (red)



JMA's Himawari Satellite Program in Support of SWFDDP

Japan Meteorological Agency

Meeting of the Regional Subproject Management Team
of the Severe Weather Forecasting and Disaster risk reduction Demonstration Project (SWFDDP)
for the South Pacific Islands, 27-28 July 2018 New Caledonia, France

1. Himawari-8/9 Overview

JMA's Geostationary Satellites

GMS (Geostationary Meteorological Satellite)

GMS (Himawari)

Launched in 1977

GMS-2 (Himawari-2)

1981

GMS-3 (Himawari-3)

1984

GMS-4 (Himawari-4)

1989

GMS-5 (Himawari-5)

1995

(GOES-9)

Back-up operation of GMS-5 with GOES-9 by NOAA/NESDIS from May 22, 2003 to June 28, 2005

MTSAT (Multi-functional Transport SATellite) Himawari

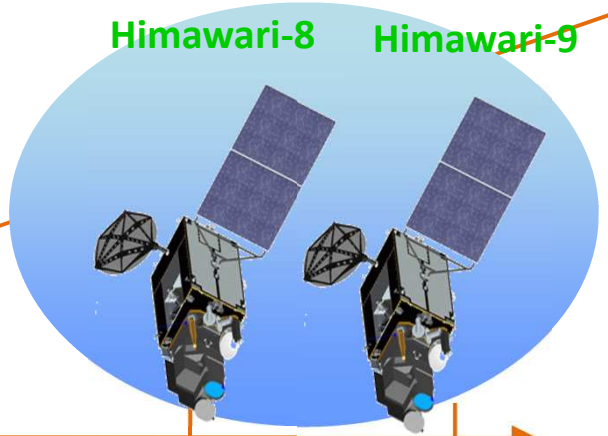
MTSAT-1R (Himawari-6)

Launched in 2005

MTSAT-2 (Himawari-7)

2006

Himawari-8 **Himawari-9**



2014 2016

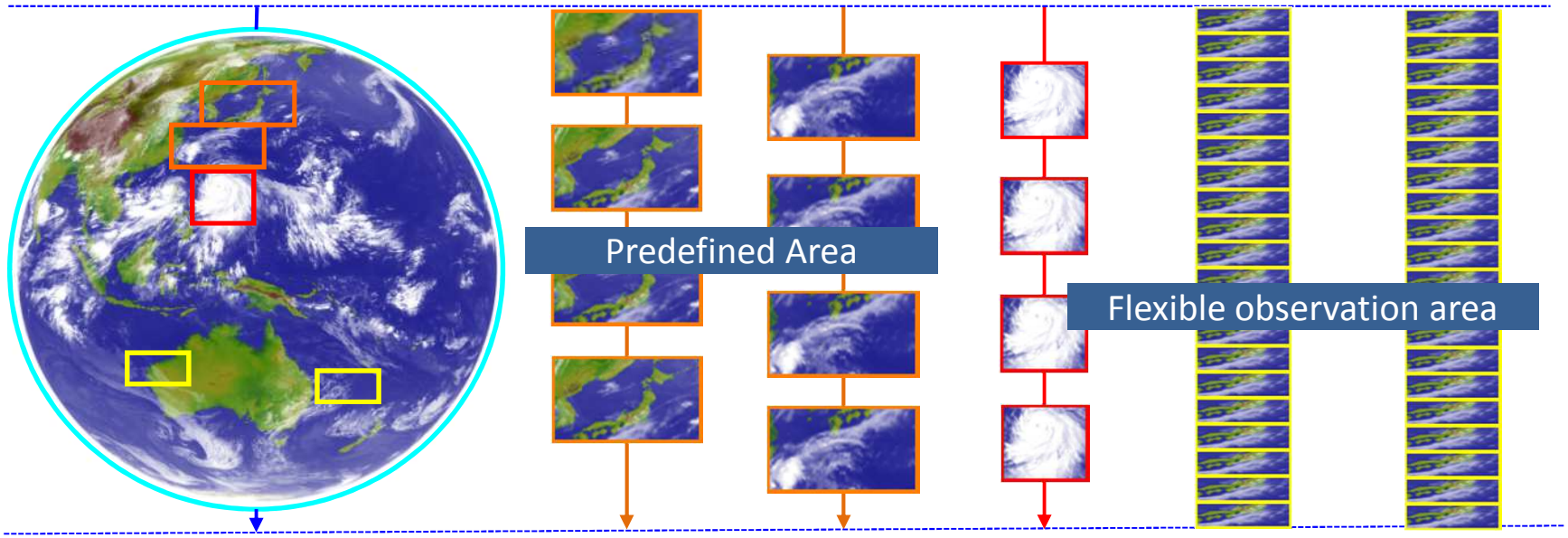
Satellite	Observation period
GMS	1978 – 1981
GMS-2	1981 – 1984
GMS-3	1984 – 1989
GMS-4	1989 – 1995
GMS-5	1995 – 2003
GOES-9	2003 – 2005
MTSAT-1R	2005 – 2010
MTSAT-2	2010 – 2015
Himawari-8	2015 – 2022
Himawari-9	2022 – 2029

Advanced Himawari Imager (AHI) on Himawari-8/9

Band		Spatial Resolution	Central Wavelength	Physical Properties
1	Visible	1 km	0.47 μm	vegetation, aerosol
2			0.51 μm	vegetation, aerosol
3		0.5 km	0.64 μm	Vegetation, low cloud, fog
4	Near Infrared	1 km	0.86 μm	vegetation, aerosol
5		2 km	1.6 μm	cloud phase
6			2.3 μm	particle size
7	Infrared	2 km	3.9 μm	low cloud, fog, forest fire
8			6.2 μm	mid- and upper-level moisture
9			6.9 μm	mid-level moisture
10			7.3 μm	mid- and lower-level moisture
11			8.6 μm	cloud phase, SO_2
12			9.6 μm	Ozone content
13			10.4 μm	cloud imagery, information of cloud top
14			11.2 μm	cloud imagery, sea surface temperature
15			12.4 μm	cloud imagery, sea surface temperature
16			13.3 μm	cloud top height

Each of Himawari series satellites carries a new generation imager, the Advanced Himawari Imager (AHI) with 16 spectral bands.

AHI Full Disk / Regional Observations



Full Disk Observation every 10 min.

Region 1	Region 2	Region 3	Region 4	Region 5
2000 x 1000 km (NE Japan)	2000 x 1000 km (SW Japan)	1000 x 1000 km (Target Area)	1000 x 500 km (Landmark Area)	1000 x 500 km (Landmark Area)
Every **2.5 min.**	Every **2.5 min.**	Every **2.5 min.**	Every **30 sec.**	Every **30 sec.**

Himawari-8/9 AHI is capable of frequent and flexible observation;

- ✓ Full-Disk images of the earth every 10 minutes
- ✓ Regional images with shorter intervals
- ✓ Region 3 used HimawariRequest Service since January 2018

New! HimawariRequest Service

from January 2018

- Target Area observation (Region 3)
  - 2.5 minutes interval images of a 1,000 km x 1,000 km area
  - Observing area changeable
- Primary use of Region 3
  - Observation of active volcanoes in the domain of the Tokyo Volcanic Ash Advisory Center (VAAC)
  - Observation to encompass typhoons within the responsibility area of RSMC Tokyo - Typhoon Center.
- JMA launched **HimawariRequest service** in January 2018
  - Inviting NMHSs to use the Target Area observation (Region3) by requesting to observe a particular observation target
  - In collaboration with the Australian Bureau of Meteorology (AuBoM)
- Observation data requested are provided
  - via the Internet cloud service HimawariCloud
  - Imagery pictures are also available on JMA's website http://www.data.jma.go.jp/mscweb/data/himawari/sat_tgb.php

New!

HimawariRequest: Request Webtool

Select Latitude ,Longitude , TIME, Event type & Purpose

Nation (Organization) : Japan (JMA)
Name : Akiyoshi ANDOU

Event Type : Tropical Cyclone (Others) : Others (to be specified)

Purpose : Disaster Risk Reduction (Others) : Others (to be specified)

Observation area :

⇑ ↑ S 8.5 ↓ ⇓ ≪ < E 158.2 > ≫

START TIME : As soon as possible

Duration : 24 hours

HimawariRequest Form

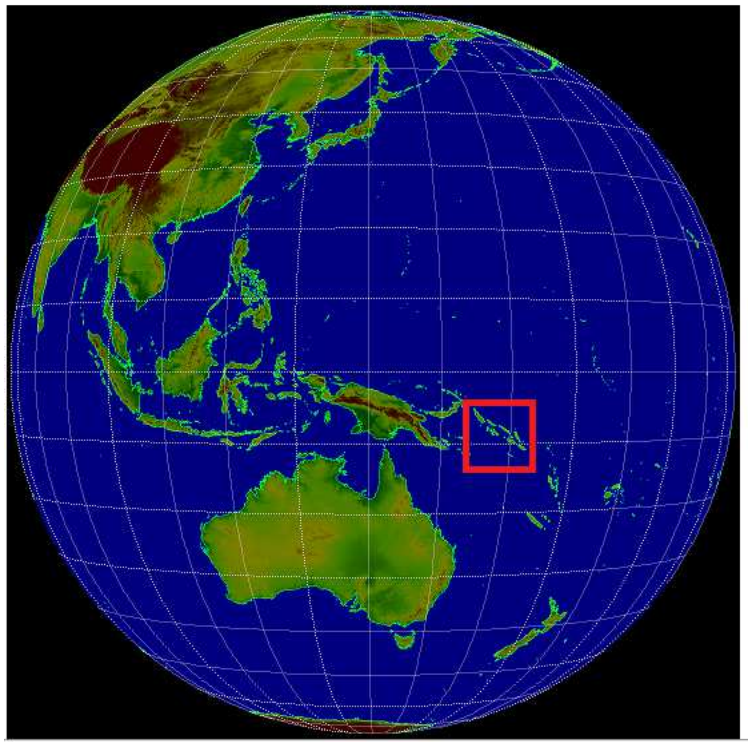
Nation (Organization) : Japan (JMA)
Personal Name: Akiyoshi ANDOU

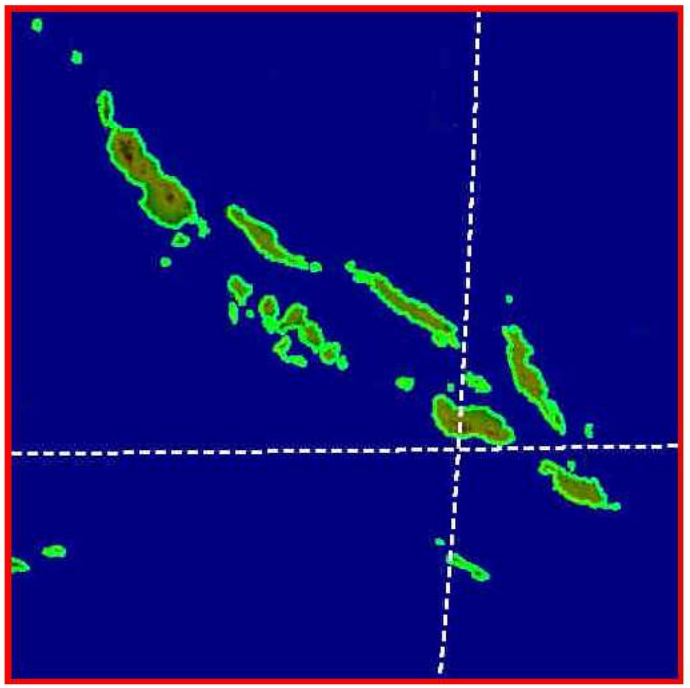
Event Type : Tropical Cyclone
Purpose : Disaster Risk Reduction

Latitude & Longitude : (-8.5,158.2)

Start Time [UTC] : As soon as possible
End Time [UTC]:2018/06/23 12:00
Duration : 24hours

: Send HimawariRequest e-mail (to metsat@met.kishou.go.jp)





New!

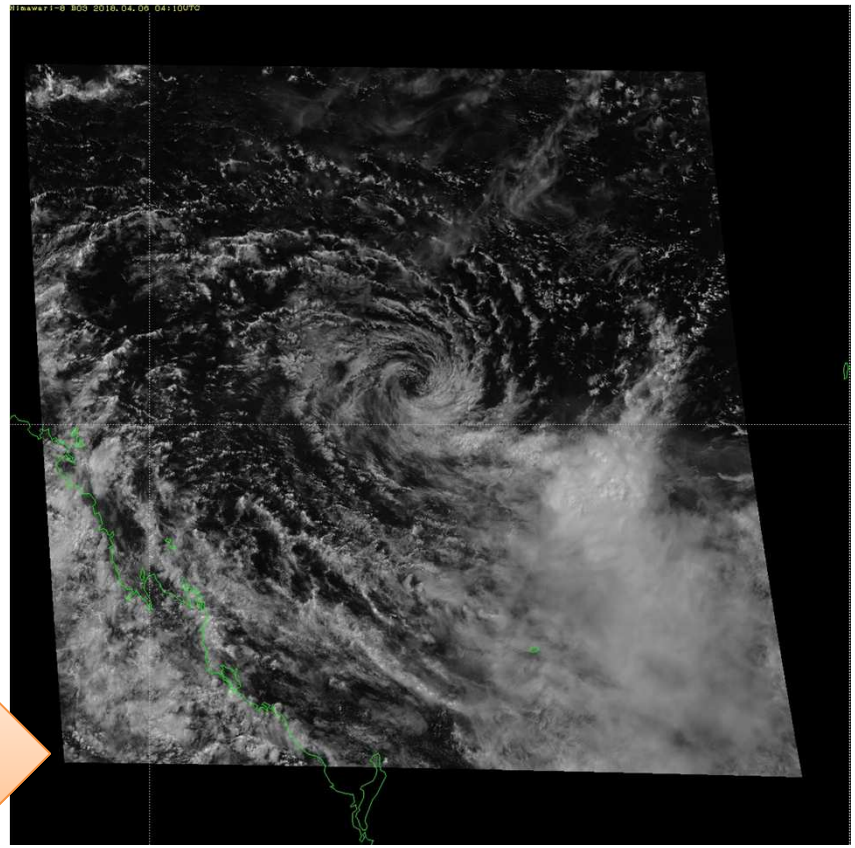
HimawariRequest: Current Status (As of 5 July 2018)

- **9 NMHSs are ready to request**

  (RA II) Hong Kong, Nepal, Thai, Russia

  (RA V) Australia, Fiji, Malaysia, New Zealand, Solomon Islands

- **3 NMHSs are in preparation**
  - Samoa, Myanmar, Bangladesh

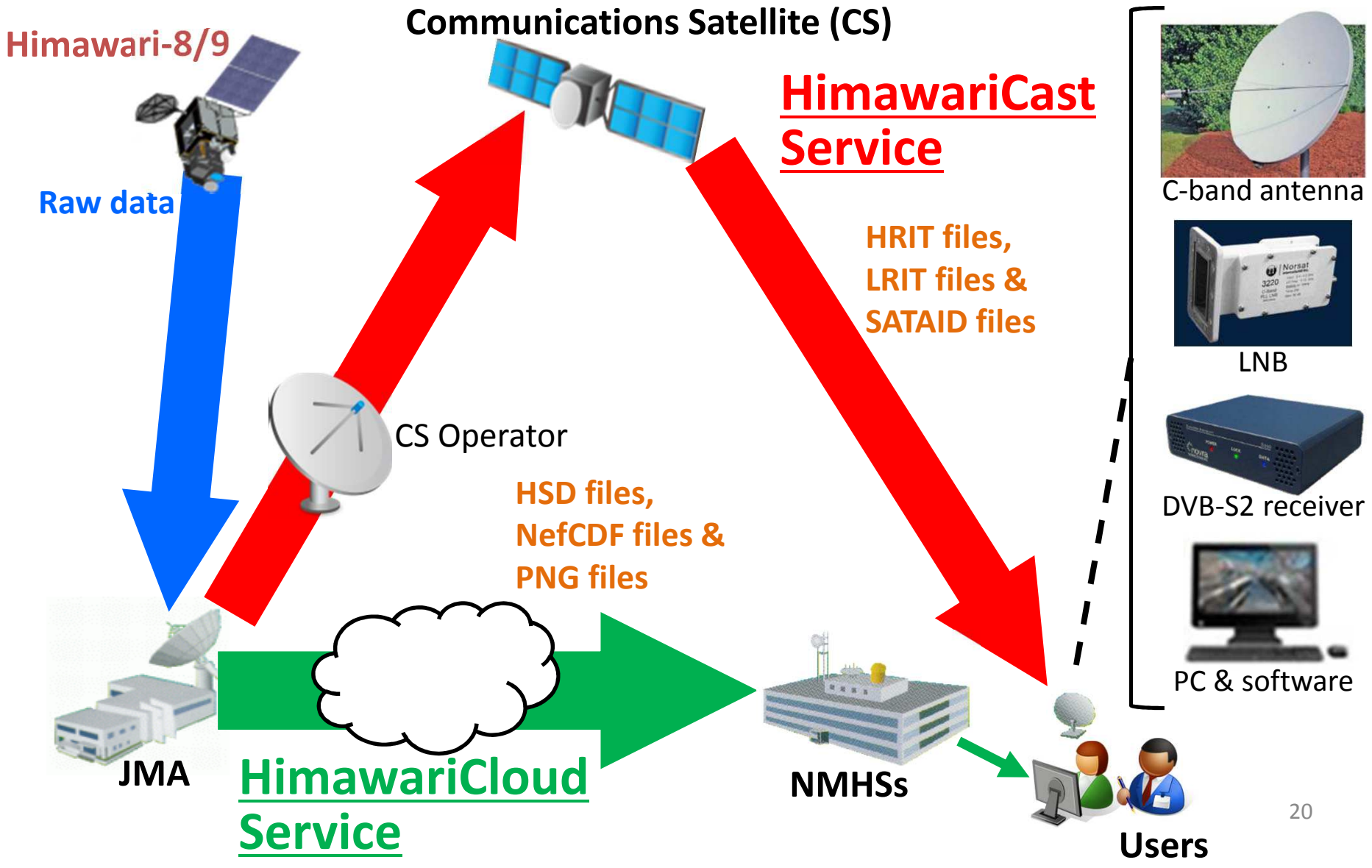


Test imagery requested by AuBoM around Tropical Storm "IRIS"
(04:00 UTC – 05:00 UTC on 6 April 2018)

HimawariRequest service is expected to support disaster risk reduction activities in the Asia and Oceania regions

2. Himawari Data/Product Distribution/Dissemination

HimawariCast/Cloud Services



NMHS users of Himawari

HimawariCast Receiving Systems

Already installed **32**

HimawariCloud accounts

21 users

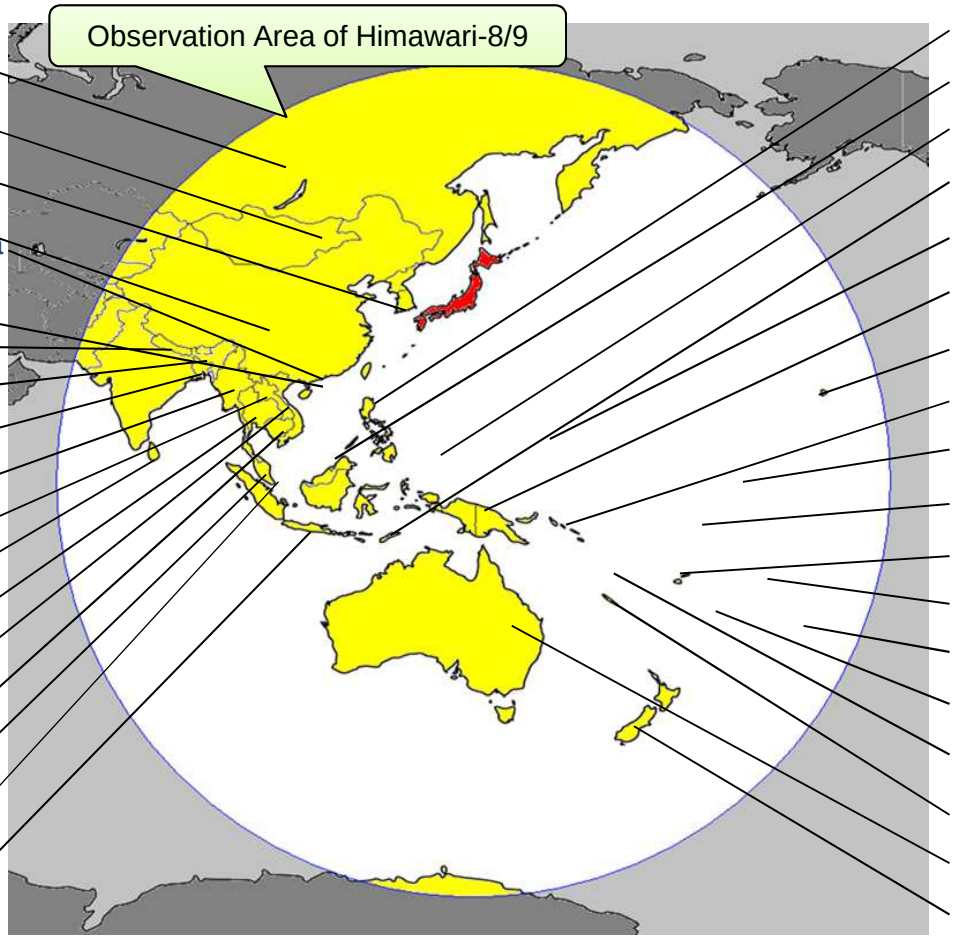
(In addition to these, NOAA/NESDIS and EUMETSAT have accounts.)

Web service covers

42 areas

(including Timor-Leste and Cook Islands)

- Russia
- Mongolia
- Korea
- China
- Hong Kong, China
- Macau
- Nepal
- Bhutan
- Bangladesh
- Myanmar
- Laos
- Sri Lanka
- Thailand
- Vietnam
- Cambodia
- Malaysia
- Singapore
- Indonesia

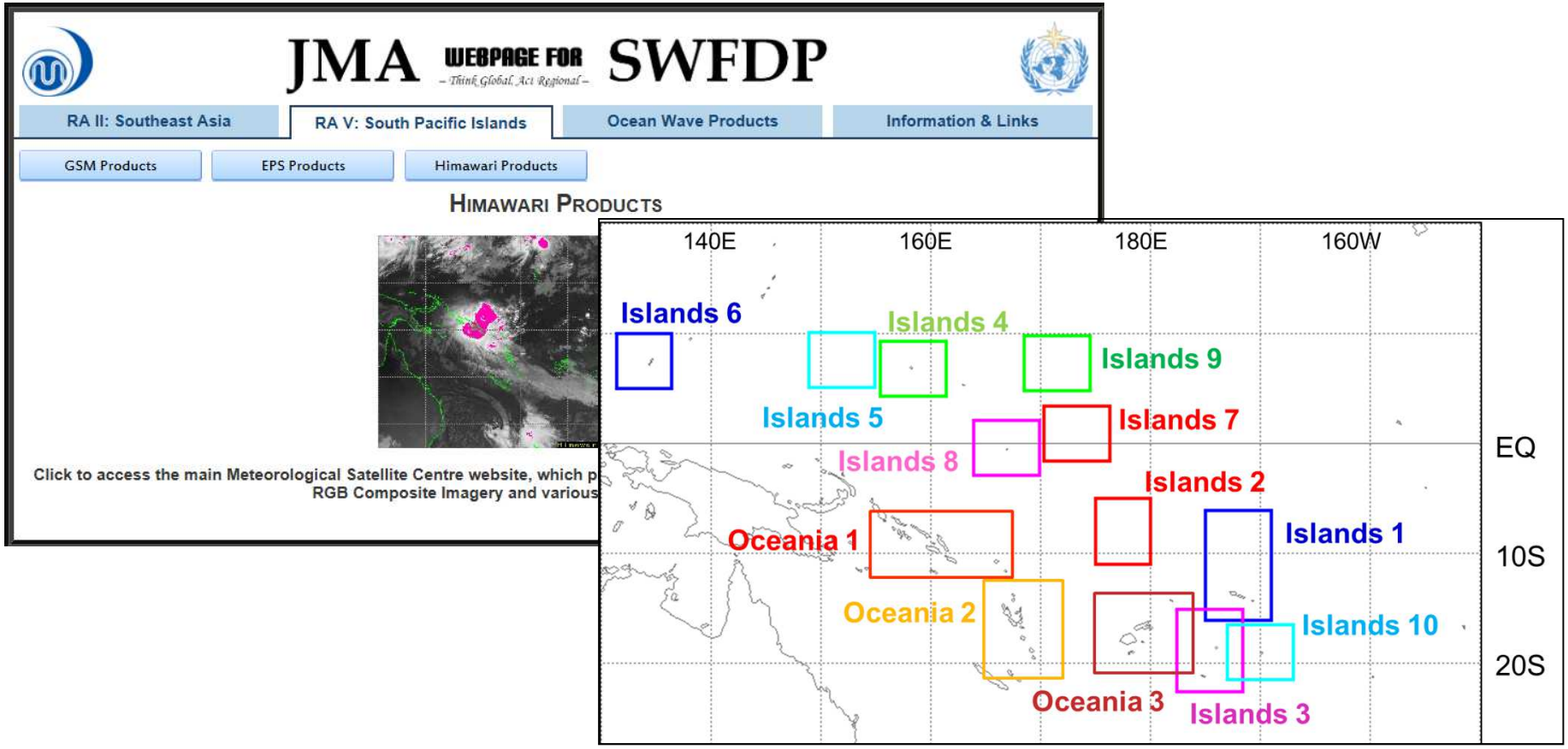


- Philippines
- Brunei
- Palau
- Timor-Leste
- Micronesia
- Papua New Guinea
- Hawaii (USA)
- Solomon Islands
- Kiribati
- Tuvalu
- Fiji
- Samoa
- Cook Islands
- Tonga
- Vanuatu
- New Caledonia (Fr.)
- Australia
- New Zealand

(As of May 2018)

JMA Webpage for SWFDDP

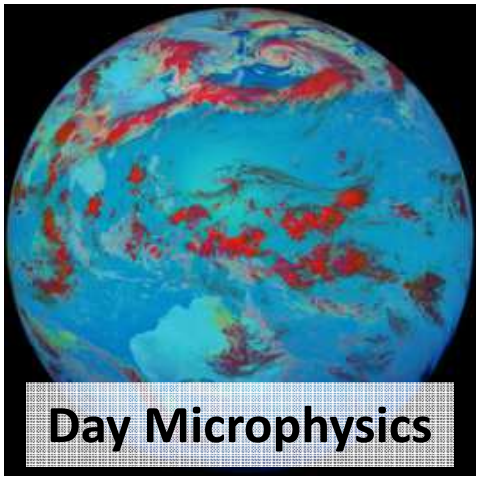
https://www.wis-jma.go.jp/swfdp/ra5_swfddp_spi.html

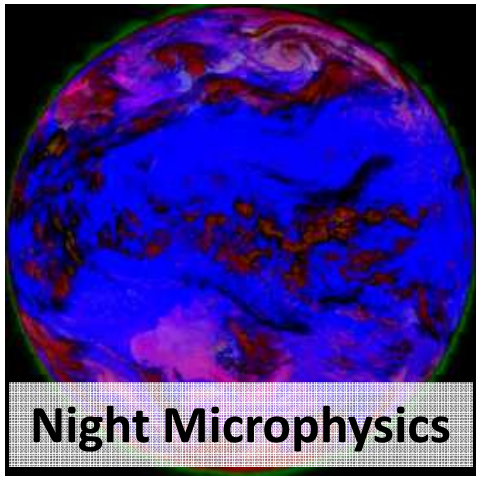


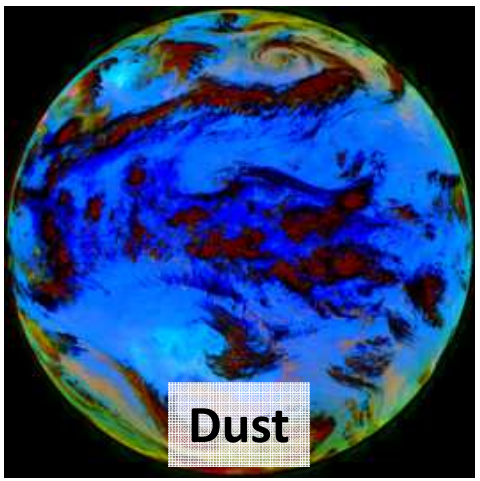
https://www.data.jma.go.jp/mscweb/data/himawari/

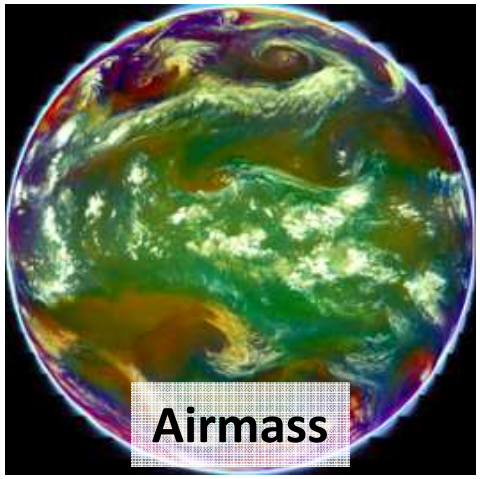
- JMA provides High-Resolution Real-time JPEG Himawari imagery in **40 regions** on the website.

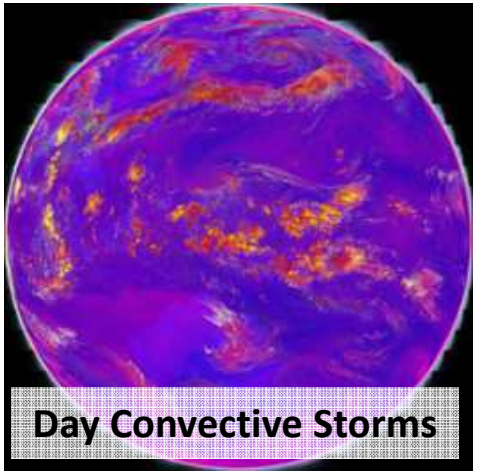
RGB composite products

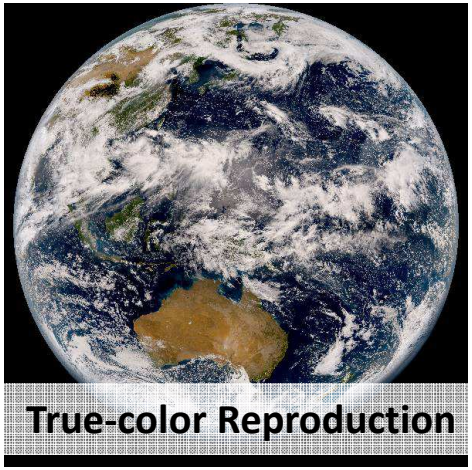








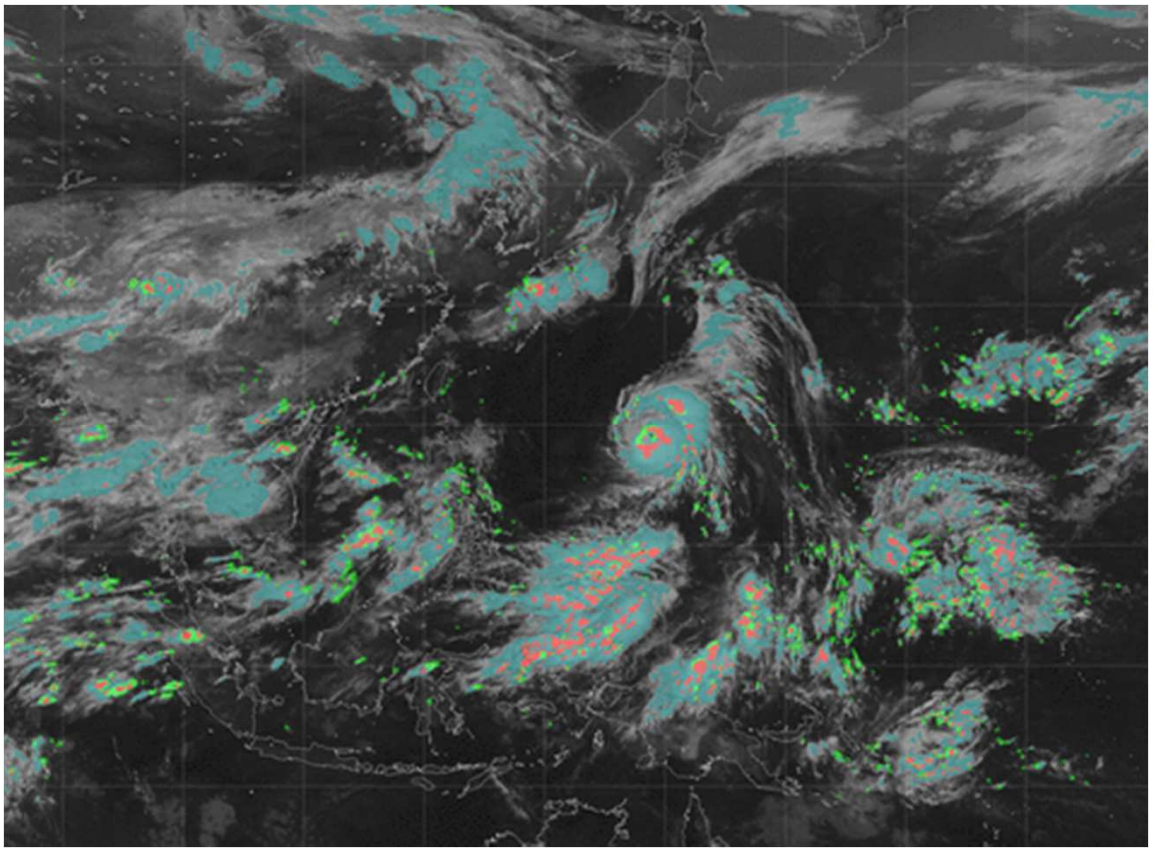


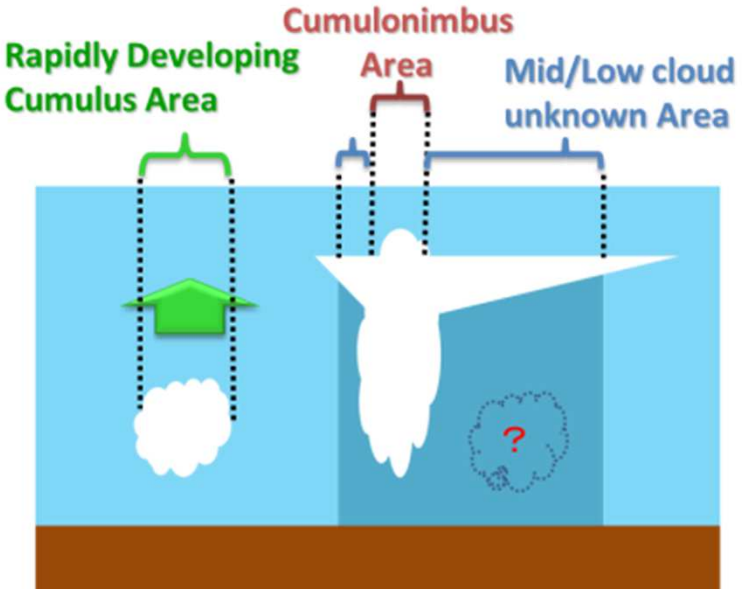


User's Guide:
https://www.data.jma.go.jp/mscweb/en/VRL/VLab_RGB/RGBimage.html

(Planned) RDCA product

- Rapidly Developing Cumulus Areas (RDCA) developed by JMA
- Analyzing 10-min interval cloud images to detect areas of either
  - ✓ **Rapidly developing cumulus**, **Cumulonimbus** or
  - ✓ **Unknown of mid/low level cloud** due to dense upper level clouds

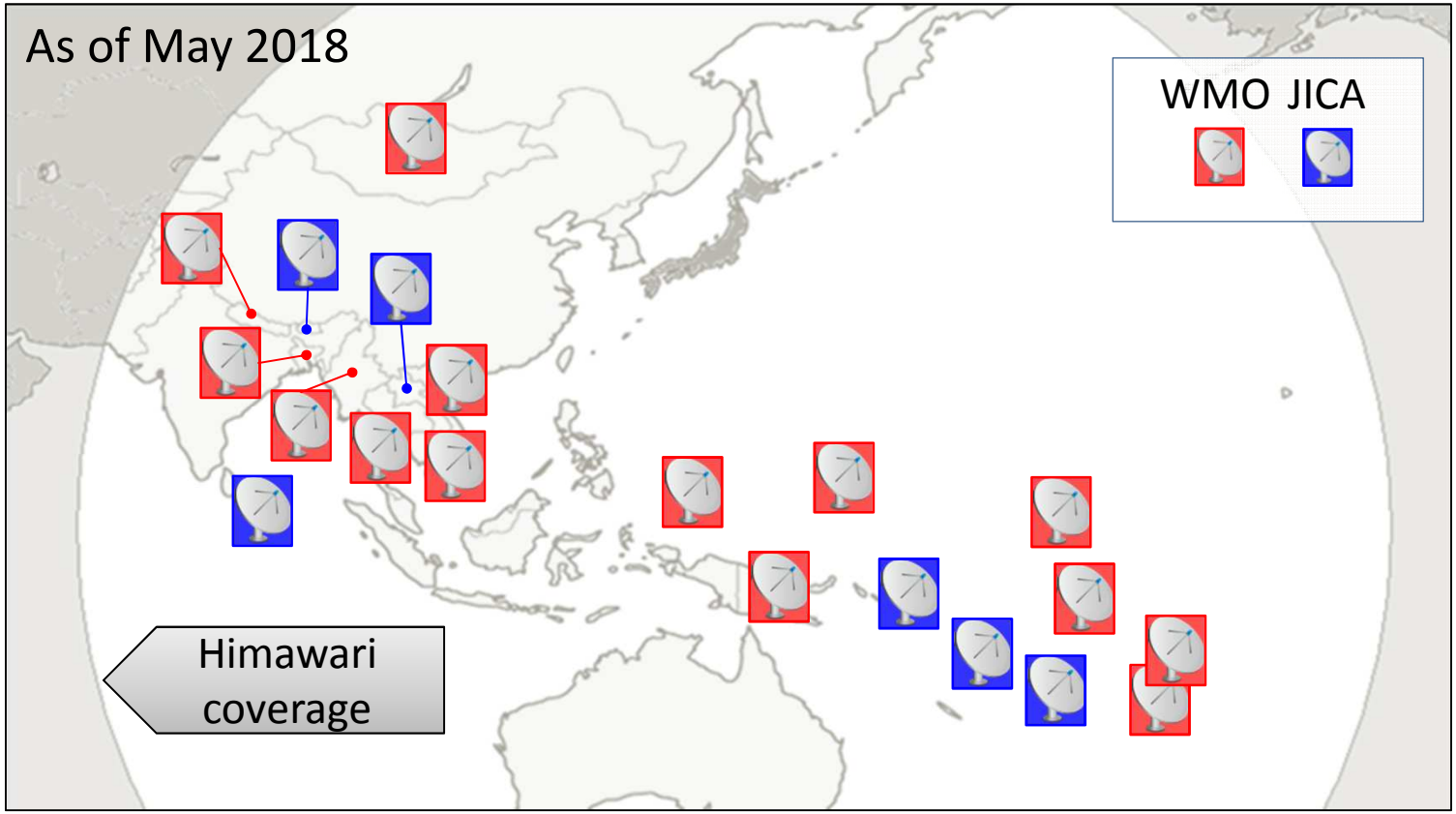




3. User support activities

Collaboration with WMO for HimawariCast Receiving System Installation

- **HimawariCast** system ensures reception of Himawari imagery data as back up or alternative means of Internet reception
- HimawariCast receiving systems have been installed to **20 NMHSs** in RA II and RA V through the WMO/JMA project and the JICA's projects.



Seminars for NMHSs

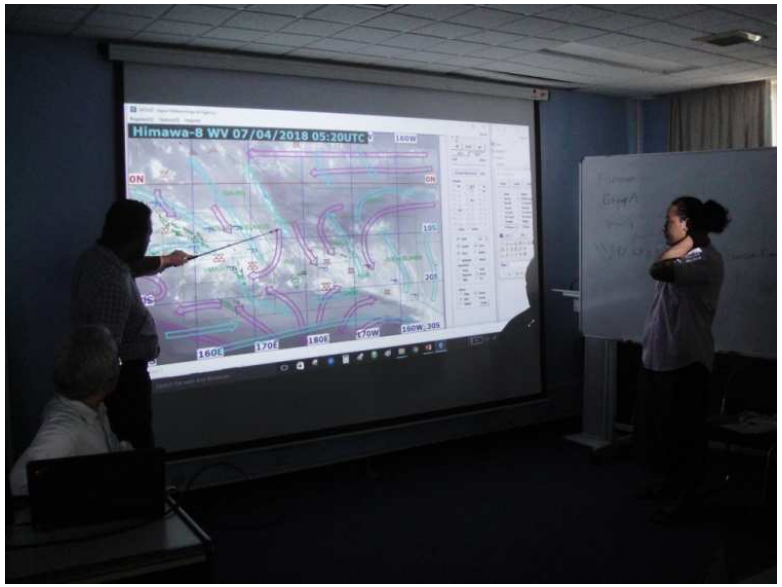
- JMA has organized training seminars at NMHSs in Asia-Oceania region for their better use of Himawari data.
- Training seminars include lectures/exercises on:
  - ✓Basics of satellite imagery analysis,
  - ✓Utilization of Himawari-8's 16 bands imagery, and
  - ✓Analysis using the JMA's SATAID software.
- Feedbacks from NMHSs have greatly helped JMA to improve its services.

Nov 2015	Thailand
Nov 2015	Cambodia
Dec 2015	Vietnam
Dec 2015	Myanmar
Dec 2015	Malaysia
Dec 2015	Bangladesh
Jan 2016	Tuvalu
Feb 2016	Philippines
Apr 2016	Micronesia
Apr 2016	Palau
June 2016	Bhutan
Sep 2016	Fiji/Pacific Islands
Sep 2016	Vanuatu
Nov 2016	Mongolia
Nov 2016	Papua New Guinea
Dec 2016	Solomon Islands
Jan 2017	Tonga
Jan 2017	Kiribati
Mar 2017	Nepal
Aug 2017	Samoa
Aug 2017	Sri Lanka
May 2018	Fiji/Pacific Islands

22 seminars!

JMA's Himawari-8/9 training event in collaboration with FMS in May 2018

- JMA dispatched its experts to Fiji Meteorological Service (FMS) to support the Third Country Training on effective utilization of Himawari data in 21-26 May 2018.
- 14 forecasters attended from 10 Oceania countries:
  - ✓ Cook Islands, Kiribati, Fiji, Nauru, Niue, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu
- A lot of time was spent on repeated exercises on satellite image analysis and forecast scenario creation so as to increase practical skills



Training event in Fiji

Summary

- Himawari-8/9
  - ✓ Carrying advanced observing functions
  - ✓ Covering Asia-Oceania region including the South Pacific Islands
  - ✓ Data is disseminated via HimawariCast and HimawariCloud
- Products for severe weather monitoring
  - ✓ Hi-Res. real-time JPEG images via Webpages of SWFDP and SWFDDP
  - ✓ RGB composite products available
- HimawariRequest invites NMHSs to request targeting observation by Himawari-8/9
- JMA has organized training seminars at NMHSs in Asia-Oceania region for better use of Himawari data.
  - ✓ More than 20 times since Nov. 2015