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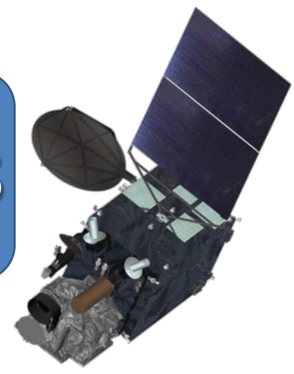
# An Introduction of Himawari-8 Cloud Products



Ryo YOSHIDA, Kouki MOURI and Hiroshi SUZUE
Meteorological Satellite Center, Japan Meteorological Agency

## 1. Introduction

The Himawari-8 is next-generation geostationary satellite of JMA, which began operation on 7 July 2015. The satellite carries the Advanced Himawari Imager (AHI), which is greatly improved than past ones in terms of the number of bands and temporal/spatial resolution.

The Meteorological Satellite Center (MSC) of JMA has developed the AHI Cloud Product (ACP) and the High-resolution Cloud Analysis Information (HCAI) and these product s have been operational since 7 July 2015. This poster introduces these two cloud products.

## 2. Overview of the ACP and HCAI

### 2. 1 General Description

The ACP is composed of cloud mask, cloud type, cloud phase and cloud top height. It is derived from the Himawari Standard Data (HSD) and Numerical Weather Prediction (NWP) data once an hour. The ACP is used for AHI L2 products developed by MSC.

The HCAI is derived from the ACP but it is resample into EQR coordinate. It is disseminated to foreign NMHSs via JDDS as well as internal use in JMA.

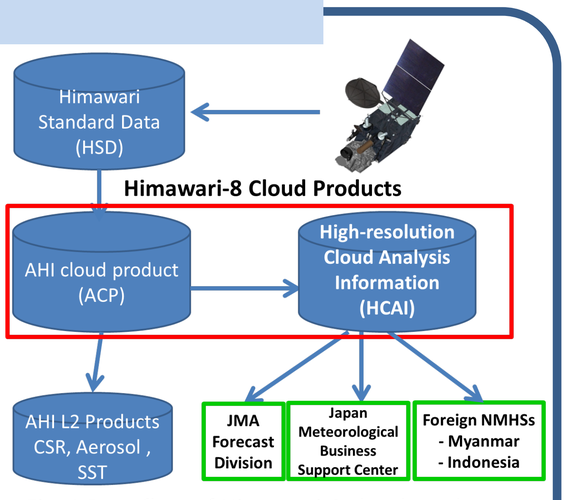



Fig. 1 Data flow of Himawari-8 cloud products

### 2. 2 AHI Cloud Product (ACP)

#### 2.2.1. Cloud Mask

The ACP cloud mask algorithm is based on that of NWC-SAF and NOAA/NESDIS. Most of cloud detection tests are threshold methods based on radiative transfer calculation using NWP data as atmospheric profile. The thresholds are modified by the offsets determined by comparison with MODIS cloud mask product.

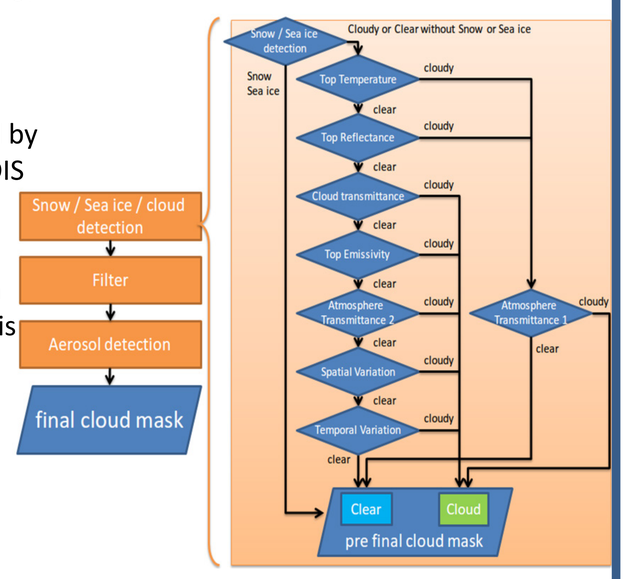



Fig. 2 Flow chart of the cloud mask algorithm

#### 2.2.2. Cloud Type and Phase

The cloud type and phase algorithm is based on the NWC-SAF threshold method. The cloud type is classified into Opaque, Semi-transparent and Fractional. Opaque and Semi-transparent are subdivided according to its top height. The cloud phase is 3-category cloud top phase (ice, water and mixed).

#### 2.2.3. Cloud Top Height

The cloud top height is determined by the following 3 methods developed by NWC-SAF. One of those methods is applied depending on the cloud type.

**-Intercept Method**

IRW/H2O Intercept Method(Schmetz et al., 1993)

**-Radiance ratioing Method**

Radiance Ratioing Technique(Menzel et al., 1982 )

**-Interpolation Method**

Observed radiance and vertical profile of black body radiance calculated RTTOV with NWP data are compared.

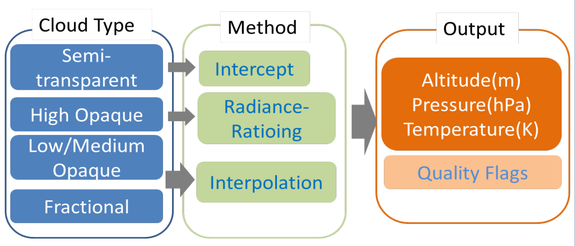



Fig. 3 Cloud top height determination scheme

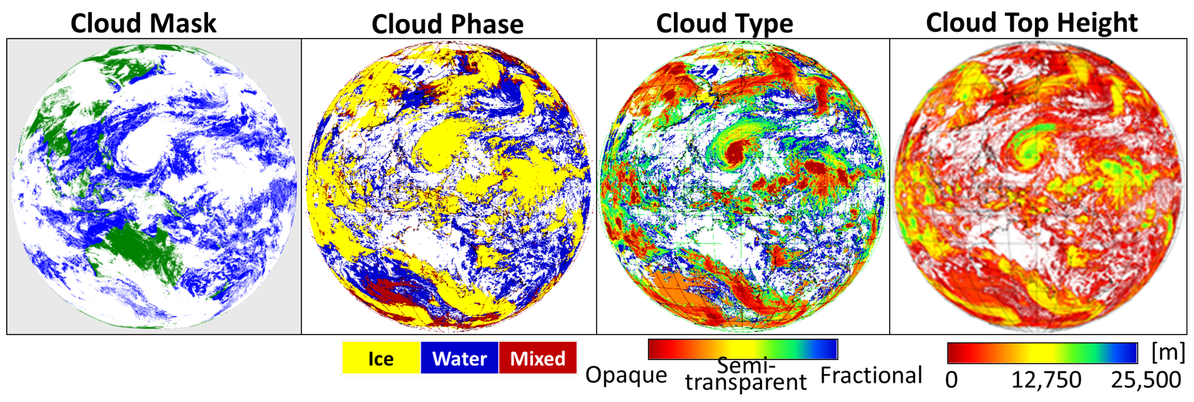



Fig. 4 Example of the AHI cloud product at 0200 UTC, 1 Apr. 2015

### 2. 3 AHI High-resolution Cloud Analysis Information (HCAI)

The HCAI is composed of cloud mask, cloud type, cloud top height, snow mask, aerosol mask and quality control information. Each element of the HCAI is the ACP resampled into EQR coordinate, but cloud type definition corresponds to the classification used in surface observation. The ice and the aerosol masks are accessory products of the ACP cloud mask. The HCAI is mainly intended to be used for cloud monitoring.

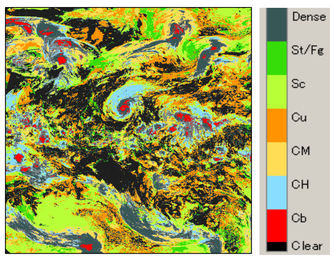



Fig. 5 Example of HCAI cloud type

### 2. 4 Specification Summary of the ACP and the HCAI

| | ACP | HCAI |
|---|---|---|
| Projection | Same as HSD (Normalized Geostationary Projection) | EQR projeciton (EQuiRectangular projection) |
| Spatial res. | Same as HSD of Infrared Bands (2km at Sub Satellite Point) | 0.02deg in both lat. and lon. |
| Temporal res. | Once an hour | |
| Coverage | 70deg.N - 70deg.S<br>70deg.E – 150deg.W | 60deg.N - 60deg.S<br>80deg.E - 160deg.W |

## 3. Evaluation of the ACP

### 3. 1 Cloud Mask and Phase

Hit rate of the cloud mask compared with the MODIS product (MYD35_L2, C6) was some 85 % during two weeks in Sep. 2015. Day-time hit rate was slightly greater than night-time one. Although false detections of cloud (cyan colored) had been found in tropical region, those were corrected by offset adjustment in Oct. 2015. Over looking of cloud (red colored) were less during day time. Since visible bands are available, cloudy pixels tend to be detected precisely in day time. Capture rate of the cloud phase toward the MODIS product (MYD06_L2, C6) is some 90% for ice and some 70% for water.(figures are not shown).

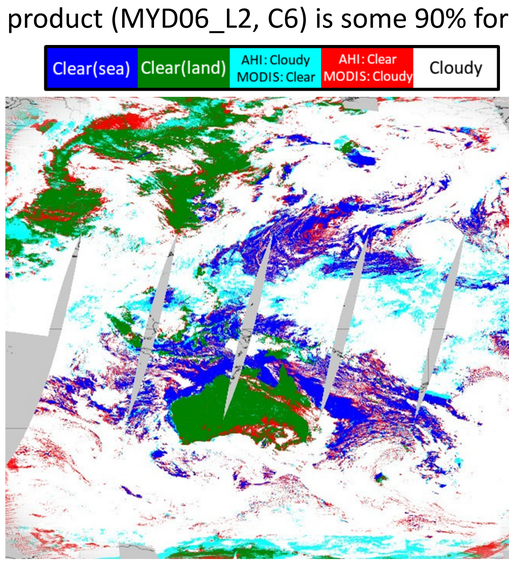



Fig. 6 Comparison between the cloud mask and the MODIS product on 2 Sep. 2015, (left) day time, (right) night time.

### 3. 2 Cloud Top Height

Bias errors of the cloud top height toward the MODIS product (MYD06_L2, C6) and the CALIPSO product (L2 1 km V3.30) were derived during 22 Aug. 2015 – 4 Sep. 2015. Those of low-level and middle-level cloud ( < 9000m) were under +2000m toward MODIS and some +1000m toward CALIPSO. On the other hand, for the high-level cloud (9000m <), bias errors were negative and those absolute values were greater, especially they reached -4000m toward CALIPSO. This great negative bias for the high-level cloud is now under investigation.

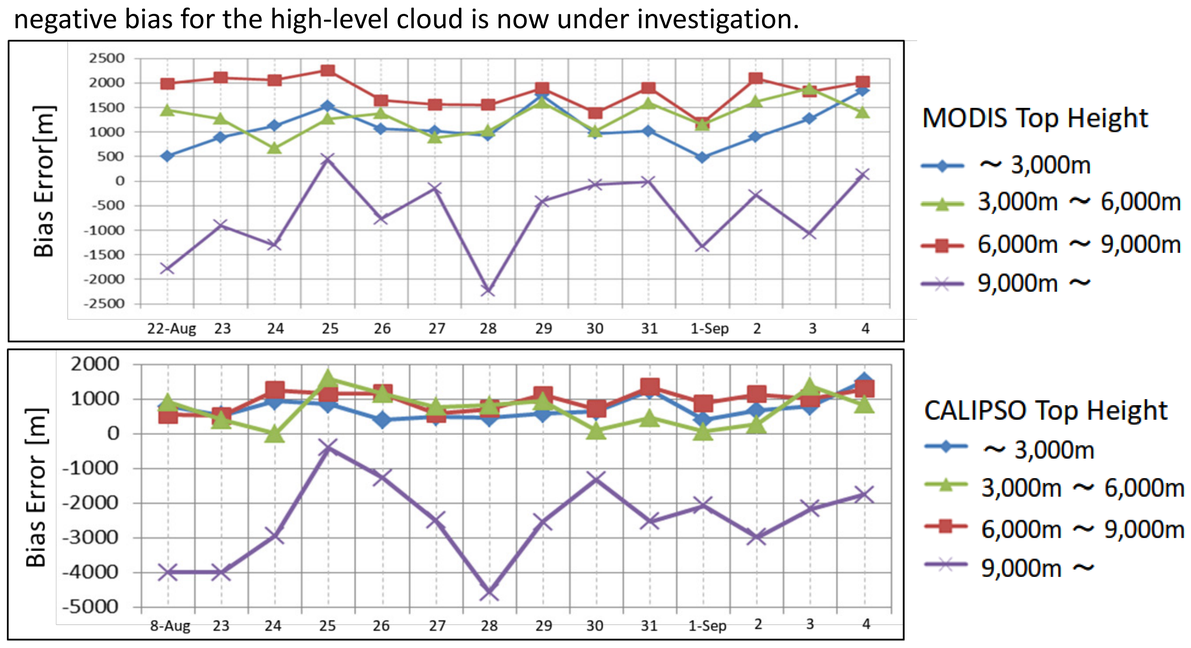



Fig. 7 Bias error of the cloud top height toward the MODIS (top) and toward the CALIPSO (bottom). Negative value means the ACP is lower than the MODIS or CALIPSO product.

## 4. Characteristics of the HCAI Cloud Type

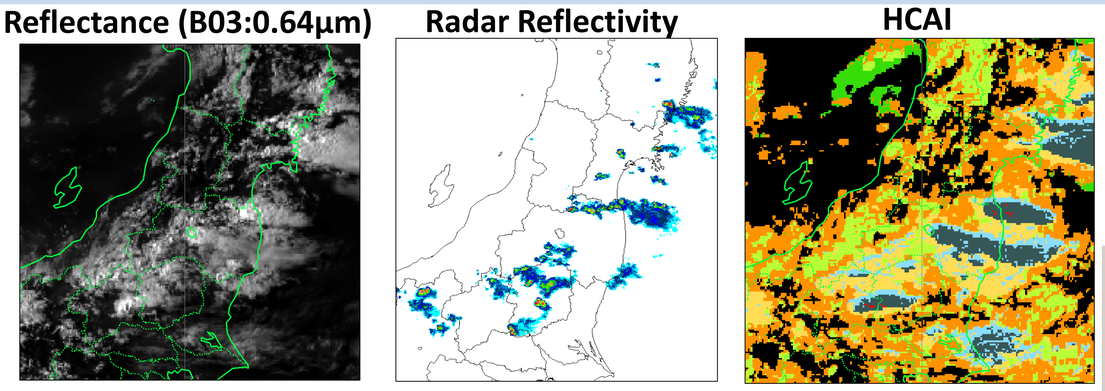



Fig. 8 Cloud type results at 0700UTC 15 June 2015

Scattered thunderstorms were occurred in Gunma, Fukushima and Miyagi Pref. due to atmospheric instability with upper cold air and surface temperature rise.

Since the HCAI spatial resolution (0.02 deg. in both lat. and lon.) is much higher than that of the legacy product (0.20 deg. and in lat. and 0.25 deg. in lon.), the HCAI is able to detect local cumulonimbus that was not captured by the legacy one.

## 5. Summary

- The ACP and the HCAI are operational cloud products from Himawari-8.
  > Cloud Mask, Phase, Type, Top Height and accessory products
- The ACP has been evaluated using the MODIS and the CALIPSO products.
  > Bias error in cloud top height for high-level cloud (under investigation)
- The HCAI captures more detailed cloud type pattern than the legacy product.