

# Himawari-9 level-2 products validation

Based on health-check observation  
(1-12 December 2017)

- Atmospheric motion vector (AMV)
- Fundamental cloud products
- Clear sky radiance (CSR)
- High-resolution cloud analysis information (HCAI)

## Summary of validation

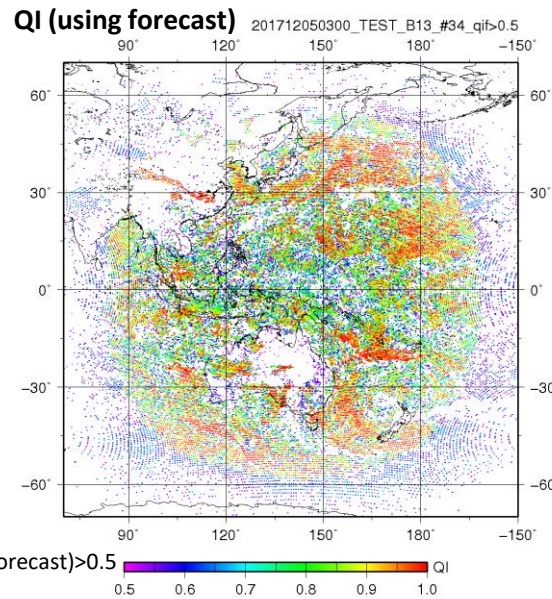
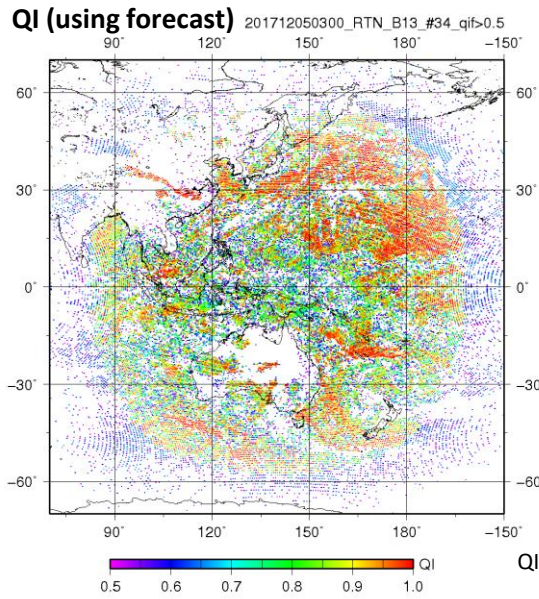
- ✓ Single-location QI and AMV height distribution (band 13)
  - There is no significant difference between the AMVs of Himawari-9 and Himawari-8.
- ✓ Time sequence of first guess (FG) departure (observation minus background (O-B) statistics) (band 13)
  - There is no significant difference between wind speed biases of Himawari-8 and Himawari-9 AMVs. The root mean square errors of vector difference (RMSVD) are almost identical.

# B13 AMV

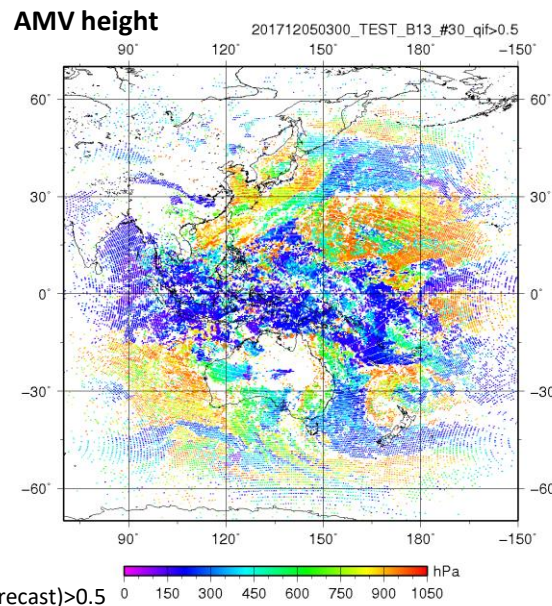
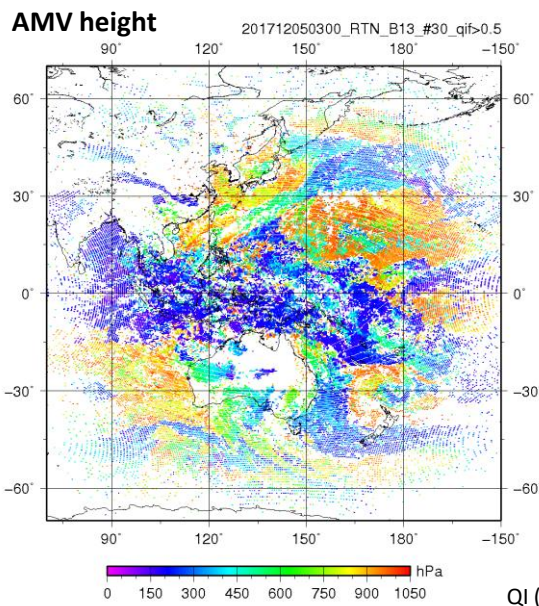
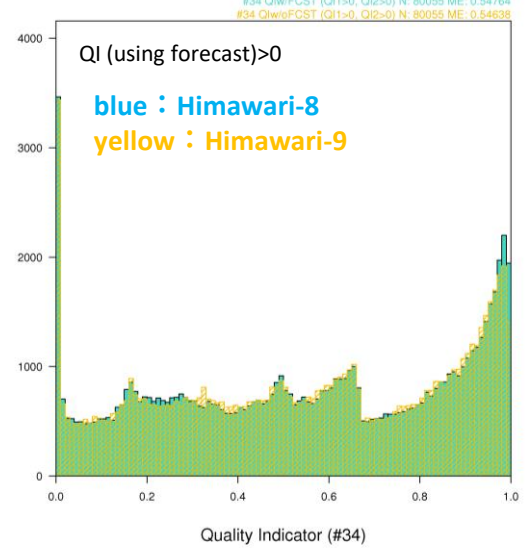
03:00 UTC 5<sup>th</sup> December 2017

## Himawari-8

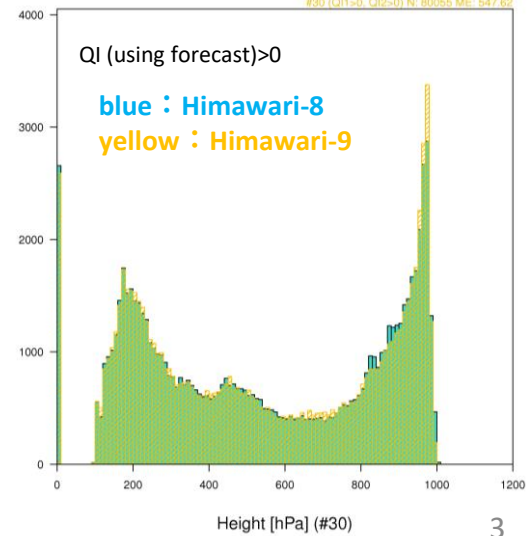
## Himawari-9



### Histogram of QI (using forecast)

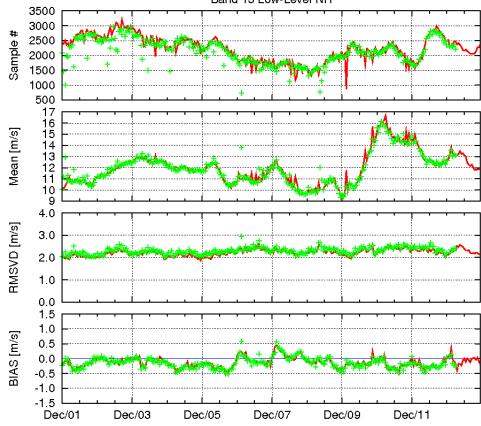


### Histogram of AMV height

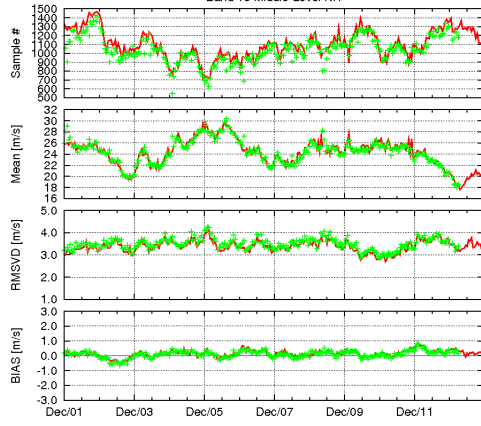


North hemisphere  
( > 20 N )

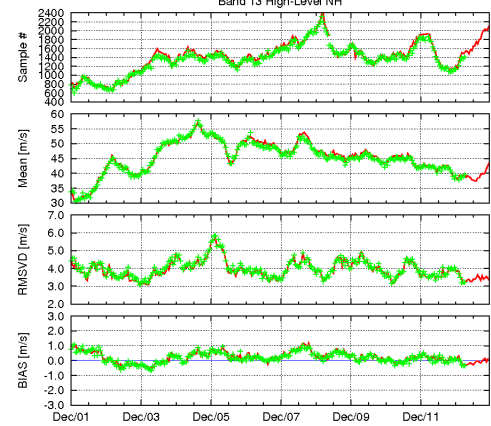
### Lower troposphere (>700hPa)



### Middle troposphere (400-700hPa)



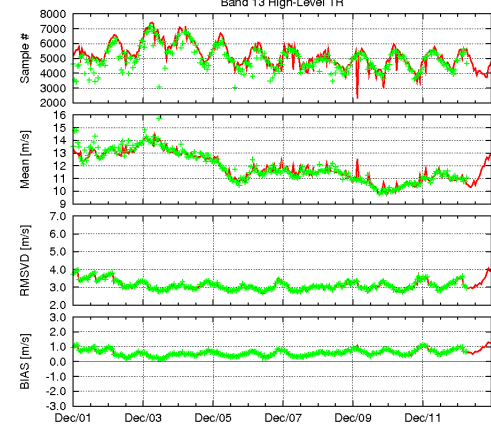
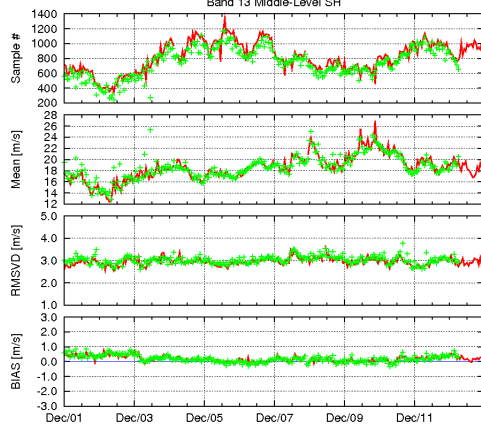
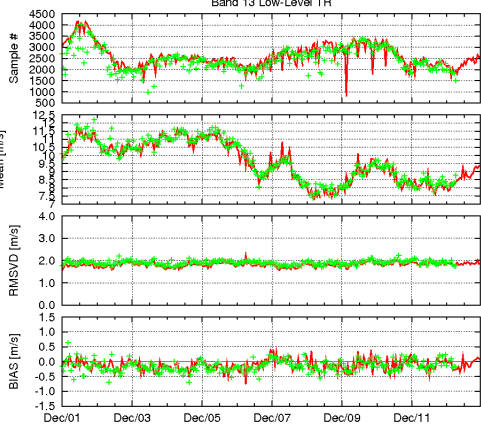
### Upper troposphere (<400hPa)



— Himawari-8  
+ Himawari-9

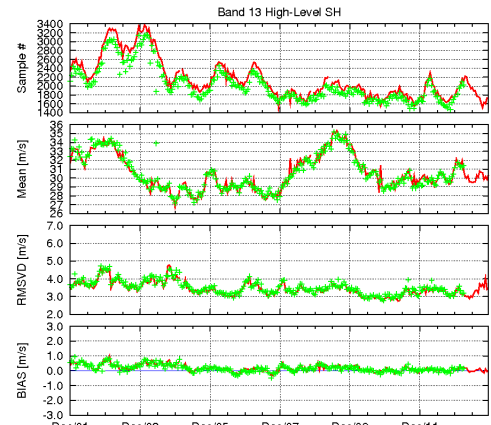
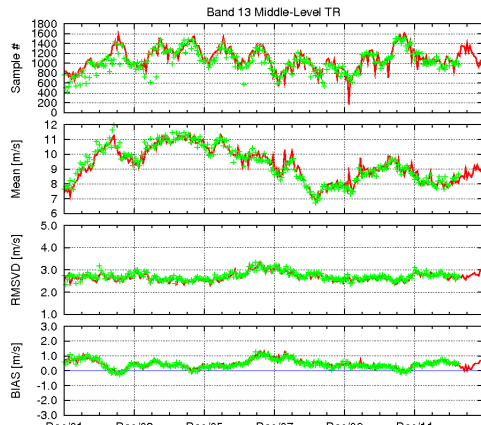
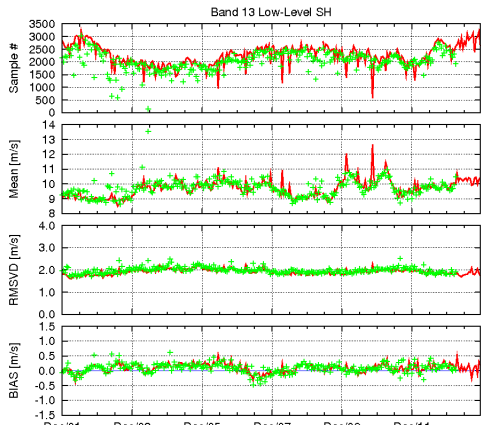
red :  
Himawari-8  
green :  
Himawari-9

Tropical zone  
( 20S - 20 N )



— Himawari-8  
+ Himawari-9

South hemisphere  
( > 20 S )



— Himawari-8  
+ Himawari-9

## Summary of validation

- Comparison with MODIS cloud products
  - The hit ratios of Himawari-9 cloud mask are almost identical to those of Himawari-8.
  - The mean error and standard deviation of Himawari-9 cloud top height are almost identical to those of Himawari-8.
- Analysis of Himawari-8 and Himawari-9 cloud top height correlation
  - As the computed coefficient of correlation between Himawari-8 and Himawari-9 cloud top height is significant, both are treated in the same manner.

# Fundamental cloud products

## Cloud Mask

- ✓ Cloud mask hit ratios were evaluated via comparison with the MODIS cloud mask product.
- ✓ The hit ratios of Himawari-9 cloud mask are almost identical to those of Himawari-8.

The Cloud mask hit ratios compared to those of MODIS.

	Satellite	Hit ratio	Cloudy hit ratio	Clear hit ratio
Whole day	Himawari-8	0.85	0.92	0.68
	Himawari-9	0.85	0.92	0.67
Daytime	Himawari-8	0.85	0.91	0.71
	Himawari-9	0.86	0.90	0.72
Night-time	Himawari-8	0.85	0.94	0.65
	Himawari-9	0.85	0.94	0.63

		MODIS Cloud Mask	
		Clear	cloudy
Himawari-8/9 Cloud Mask	clear	A	B
	cloudy	C	D

$$\text{Hit ratio} = (A + D) / (A + B + C + D)$$

$$\text{Cloudy hit ratio} = D / (C + D)$$

$$\text{Clear hit ratio} = A / (A + B)$$

# Fundamental cloud products

## Cloud top height

- ✓ The accuracies of cloud top height were evaluated by comparing with CALIPSO or MODIS cloud product.
- ✓ The cloud top height derived from Himawari-9 data is almost the same as that derived from Himawari-8 data.

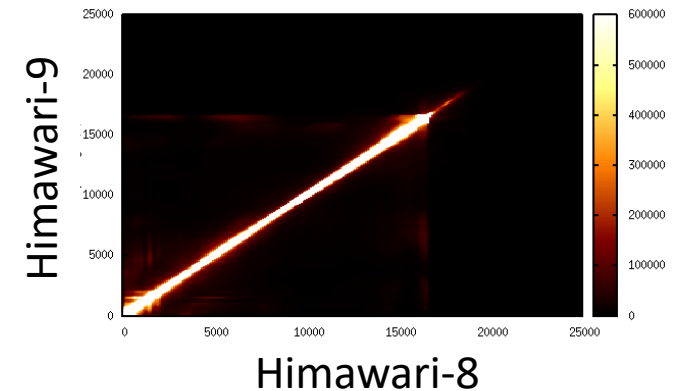
### cloud top height compared with CALIPSO

	Mean error (m)	Standard deviation (m)	Correlation coefficient
Himawari -8	-489.1	3430.4	0.79
Himawari -9	-484.2	3488.9	0.78

### cloud top height compared with MODIS

	Mean error (m)	Standard deviation (m)	Correlation coefficient
Himawari -8	979.1	3294.2	0.79
Himawari -9	1013.1	3328.0	0.79

### Correlation analysis of the cloud top heights derived from Himawari-8 and those from Himawari-9 data



Mean error (m)	26.1
Standard deviation (m)	1872.1
Correlation coefficient	0.95

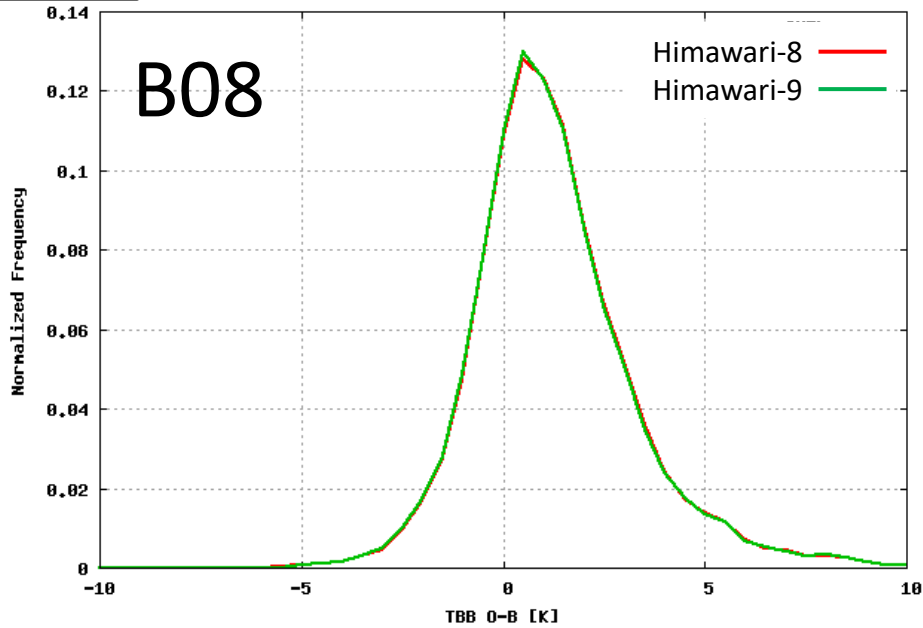
## Summary of validation

- Band 8 and 10 (the central wavelengths: 6.2 and 7.3  $\mu\text{m}$ , respectively)
  - Himawari-9 CSR values are almost identical to those of Himawari-8.
- Band 9 (the central wavelength: 6.7  $\mu\text{m}$ )
  - The distribution of observed minus background departures for Himawari-9 CSR values shows slightly higher temperatures than for Himawari-8.
  - The mean departure of Himawari-9 CSR values is slightly higher than for Himawari-8, while other statistical properties are almost identical.

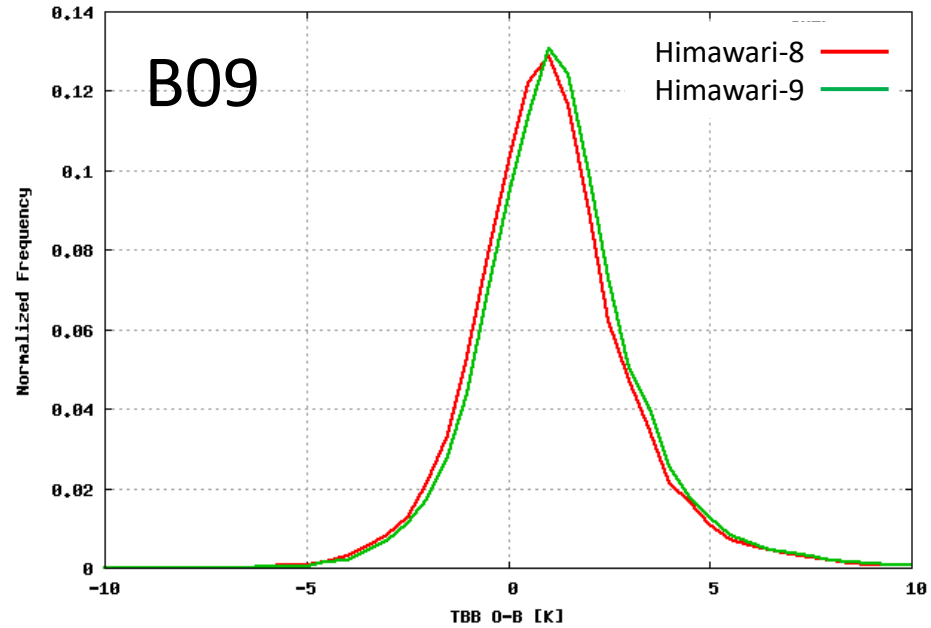


# CSR

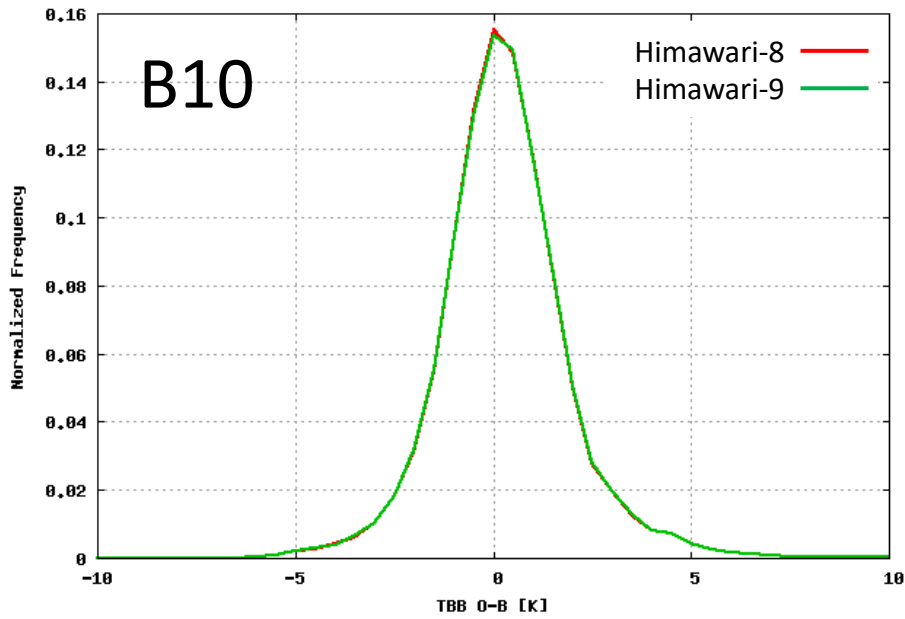
**B08 201712030300 GL**  
 CNTL N:48673 Mean:1.28 Sdev:2.00 Skew:0.89  
 TEST N:48317 Mean:1.26 Sdev:2.00 Skew:0.90



**B09 201712030300 GL**  
 CNTL N:45671 Mean:1.09 Sdev:1.95 Skew:0.65  
 TEST N:45254 Mean:1.28 Sdev:1.95 Skew:0.64



**B10 201712030300 GL**  
 CNTL N:37592 Mean:0.29 Sdev:1.63 Skew:0.61  
 TEST N:37190 Mean:0.30 Sdev:1.64 Skew:0.59

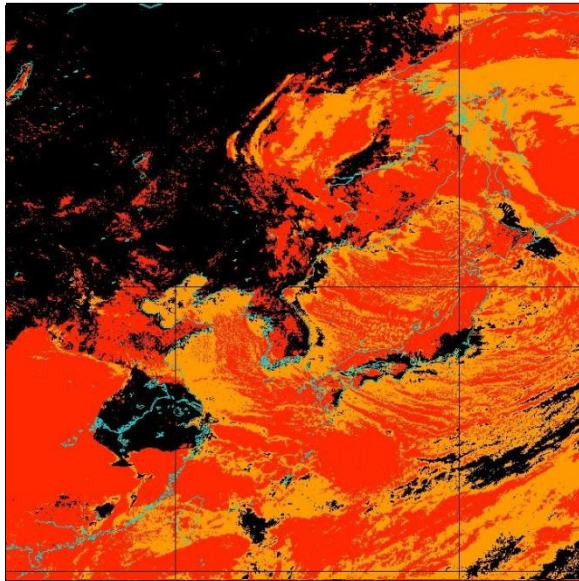


Band	Satellite	Number of data	Mean of first-guess departure (Kelvin)	Standard deviation of first-guess departure (Kelvin)
8	Himawari-8	48673	1.28	2.00
	Himawari-9	48317	1.26	2.00
9	Himawari-8	45671	1.09	1.95
	Himawari-9	45254	1.28	1.95
10	Himawari-8	37592	0.29	1.63
	Himawari-9	37190	0.30	1.64

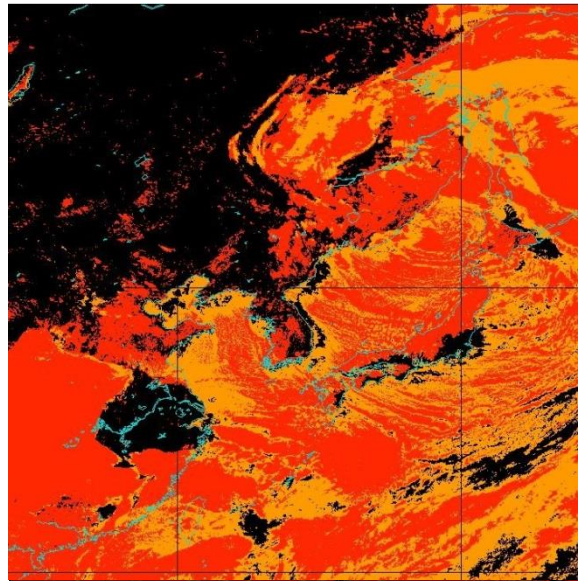
## Summary of validation

- All meteorological parameters derived from Himawari-9 data are almost identical to those of Himawari-8.
- The area of snow-covered land derived from Himawari-9 data tends to be smaller than that of Himawari-8, while the sea ice area is almost identical.
- Statistical analysis shows that cloud top height derived from Himawari-9 data is slightly lower than that of Himawari-8.

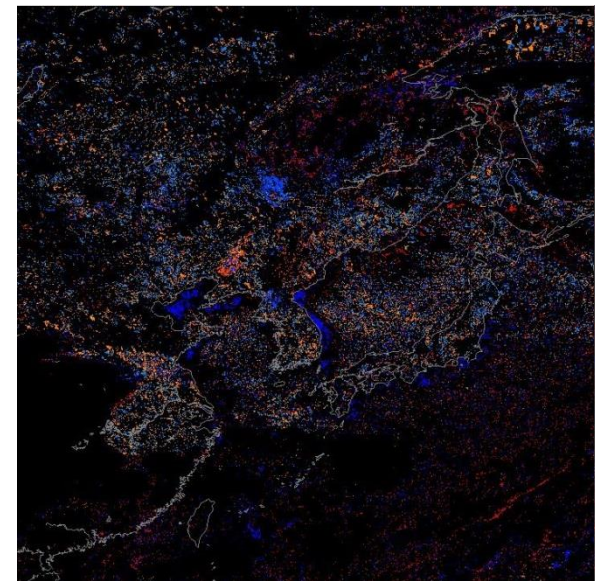
# Cloud Mask (Himawari-8 vs Himawari-9)



Himawari-8

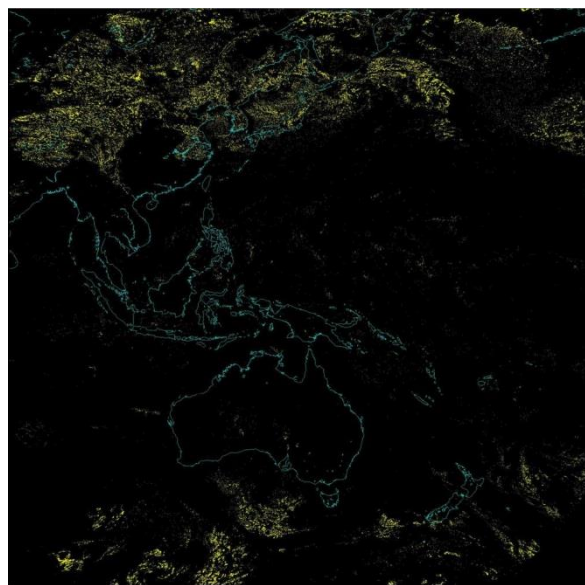


Himawari-9

Difference between  
Himawari-8 and -9

00:00 UTC on 12<sup>th</sup> December 2017

# Dust mask; presence or absence of dust (Himawari-8 vs Himawari-9)



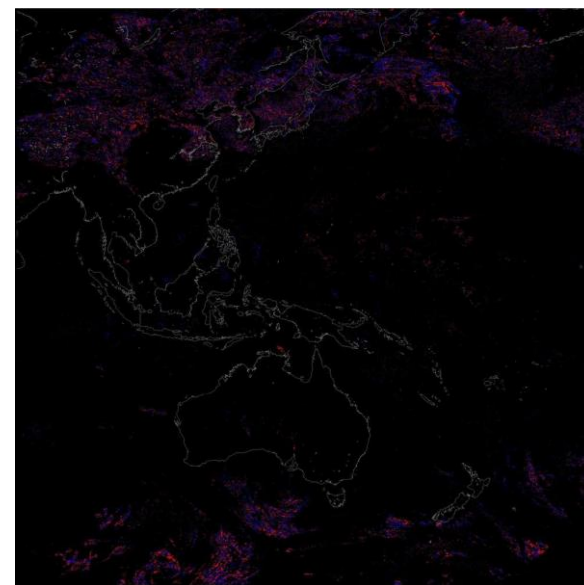
Himawari-8

No dust

Dust



Himawari-9

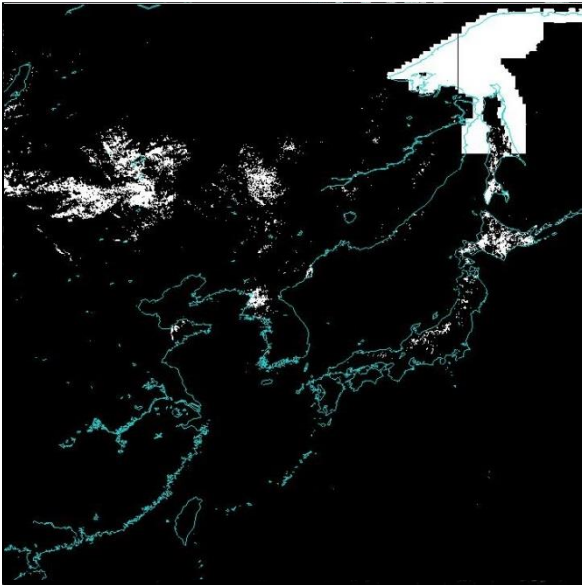


Difference  
between Himawari-8 and -9

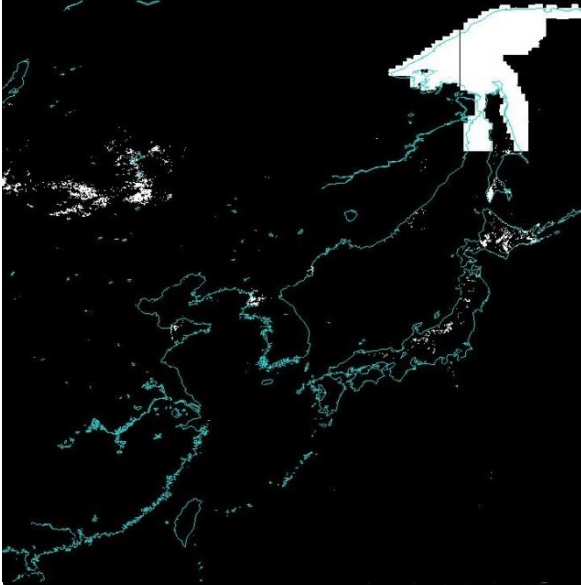


00:00 UTC on 12<sup>th</sup> December 2017

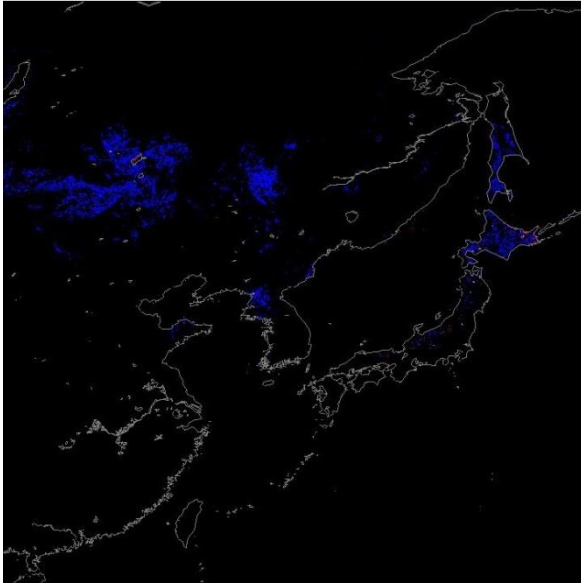
## Snow ice mask; presence or absence of snow/ice (Himawari-8 vs Himawari-9)



Himawari-8



Himawari-9

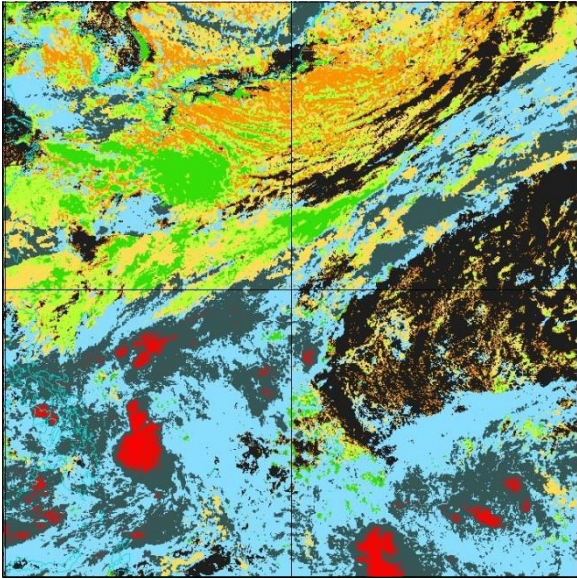


Difference between Himawari-8 and -9

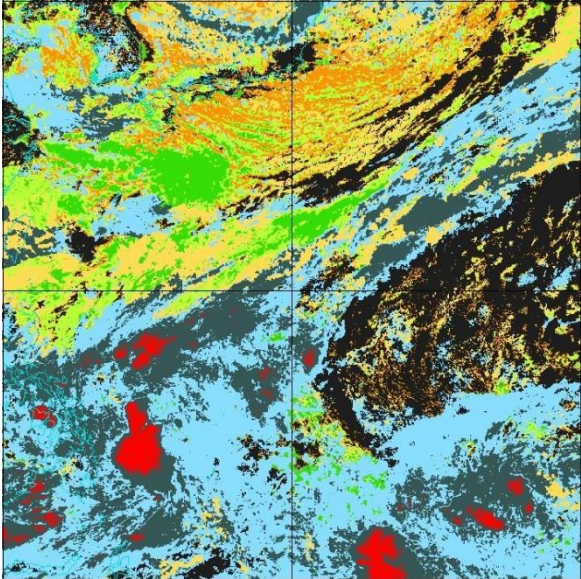


00:00 UTC on 12<sup>th</sup> December 2017

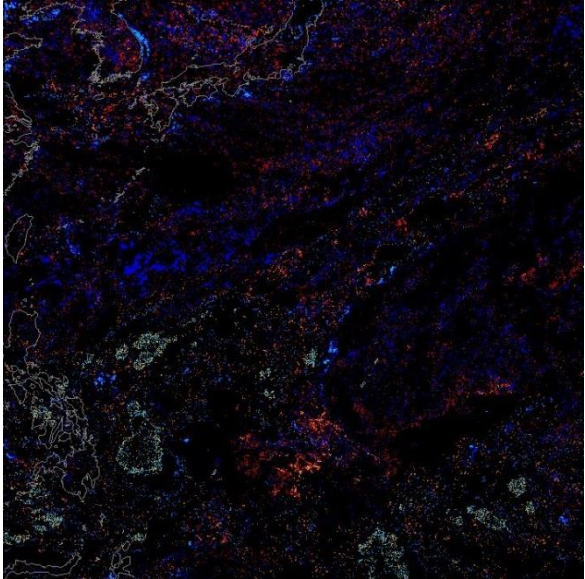
## Cloud type (Himawari-8 vs Himawari-9)



Himawari-8



Himawari-9



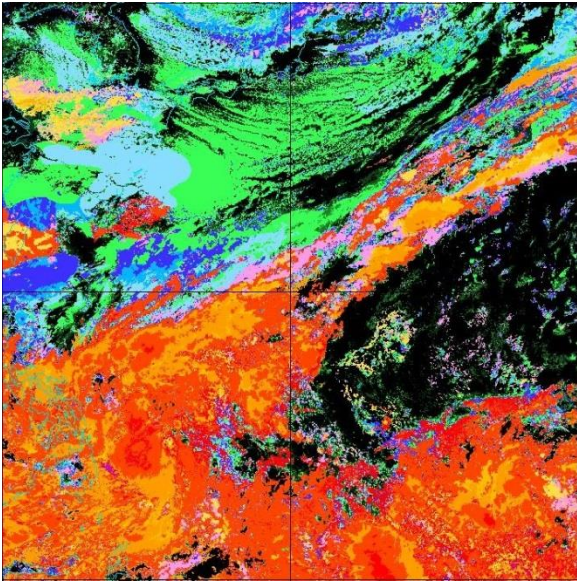
Difference  
between Himawari-8 and -9



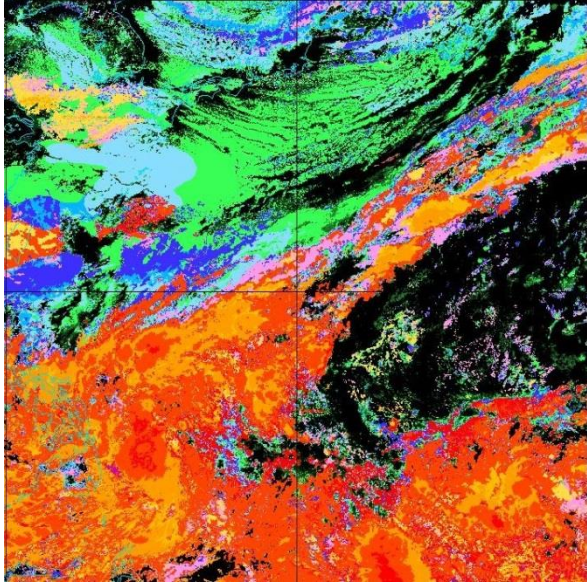
- Clr: clear
- Cb: cumulonimbus
- CH: cirrus
- CM: middle cloud
- Cu: cumulus
- Sc: stratocumulus
- St/Fg: stratus or fog
- Dense: dense cloud

00:00 UTC on 12<sup>th</sup> December 2017

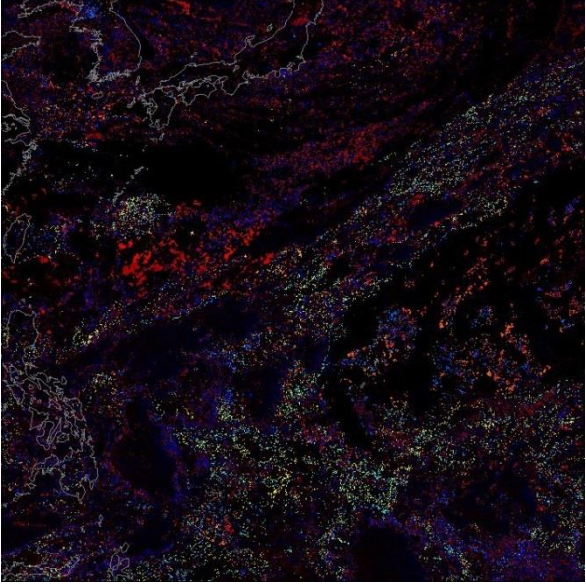
# Cloud top height (Himawari-8 vs Himawari-9)



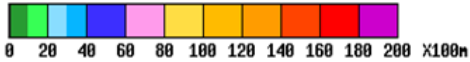
Himawari-8



Himawari-9



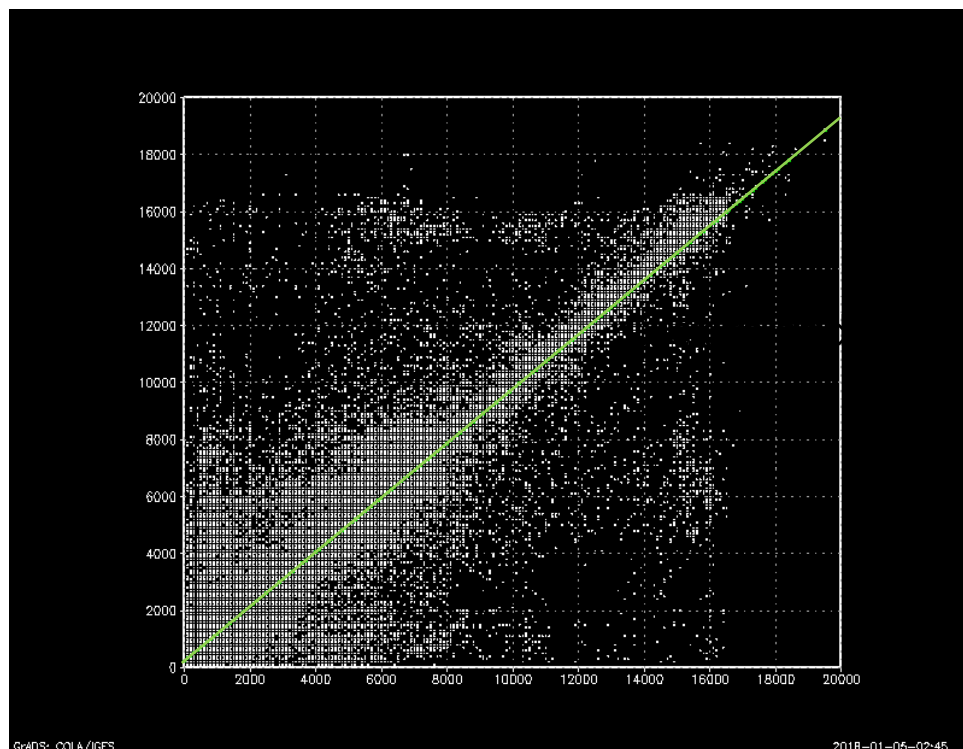
Difference  
between Himawari-8 and -9  
(H9 minus H8)



00:00 UTC on 12<sup>th</sup> December 2017

# Cloud top height distribution (Himawari-8 vs. Himawari-9)

Himawari-9 Cloud top height (m)



Himawari-8 cloud top height (m)

Correlation coefficient : 0.9491

$$H_{H9} = 0.9549 H_{H8} + 229.2$$

$H_{H8}$ : cloud top height derived  
from Himawari-8 data

$H_{H9}$ : cloud top height derived  
from Himawari-9 data