The 12th Asia-Oceania Meteorological Satellite Users' Conference

Pre-Operational Validation of AHI on Himawari-9 in Level 2 Products

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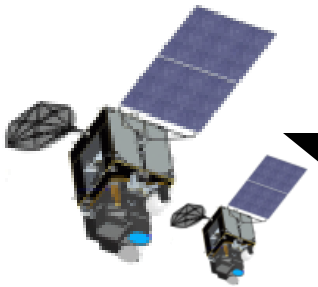


2014 Himawari-8

2016 Himawari-9

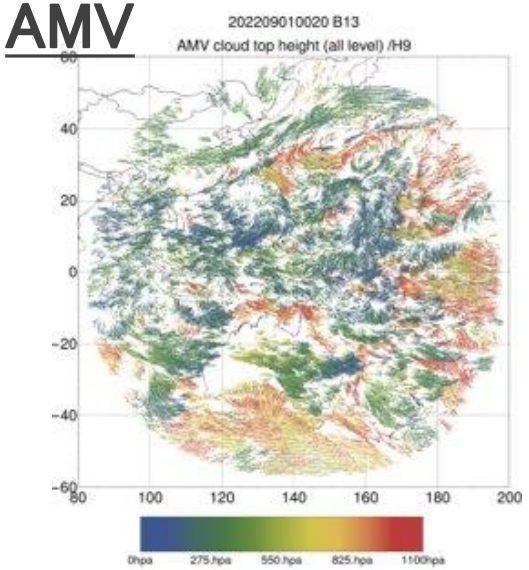
① Contents

- Himawari Level 2 Products
- Himawari-9/AHI Level 2 Products Validation
  - Atmospheric Motion Vector (AMV)
  - Fundamental Cloud Product (FCP)
  - Clear Sky Radiance (CSR)
  - High-resolution Cloud Analysis Information (HCAI)
- Summary

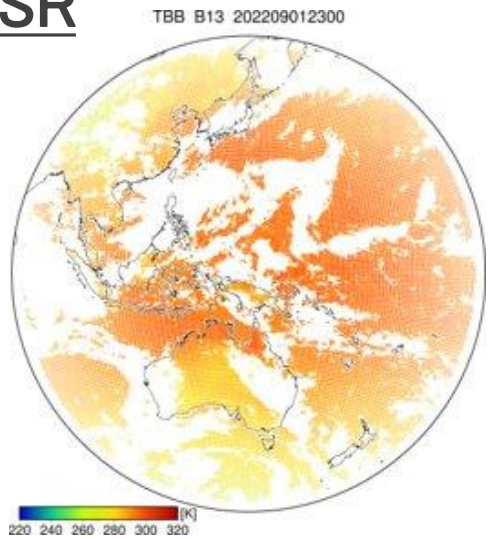
* In this presentation, Himawari-8 and -9 are referred to as H8 and H9, respectively.
** Please refer to the s41-03 presentation for the details of Himawari imager specifications.

② Himawari Level 2 Products

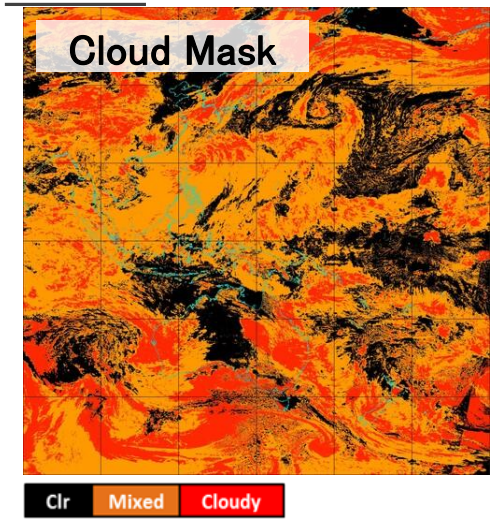
AMV

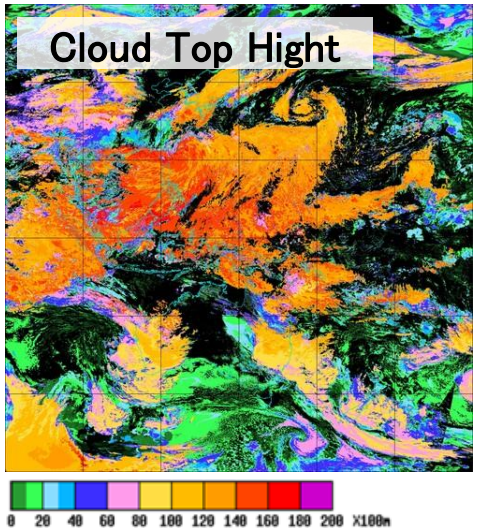


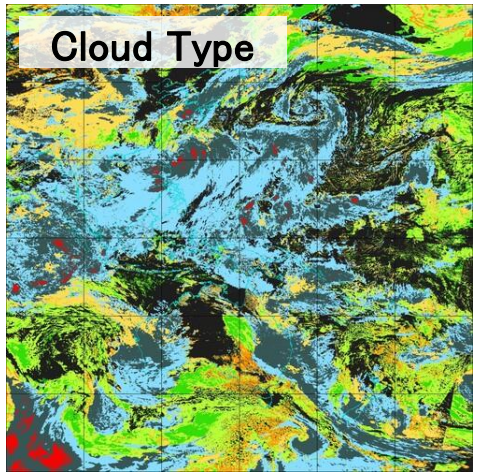
CSR



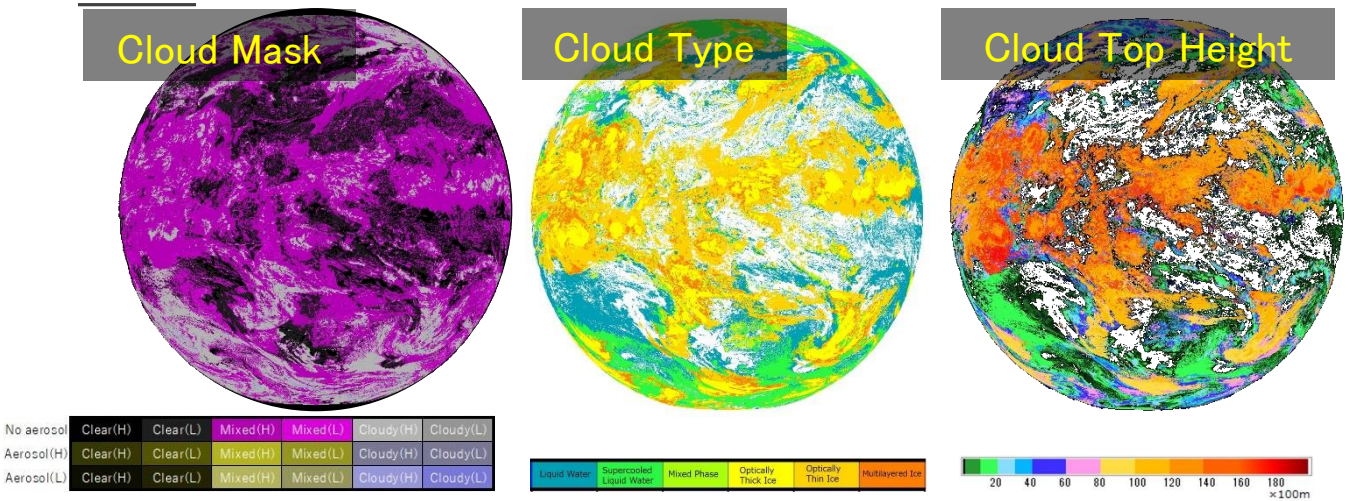
HCAI



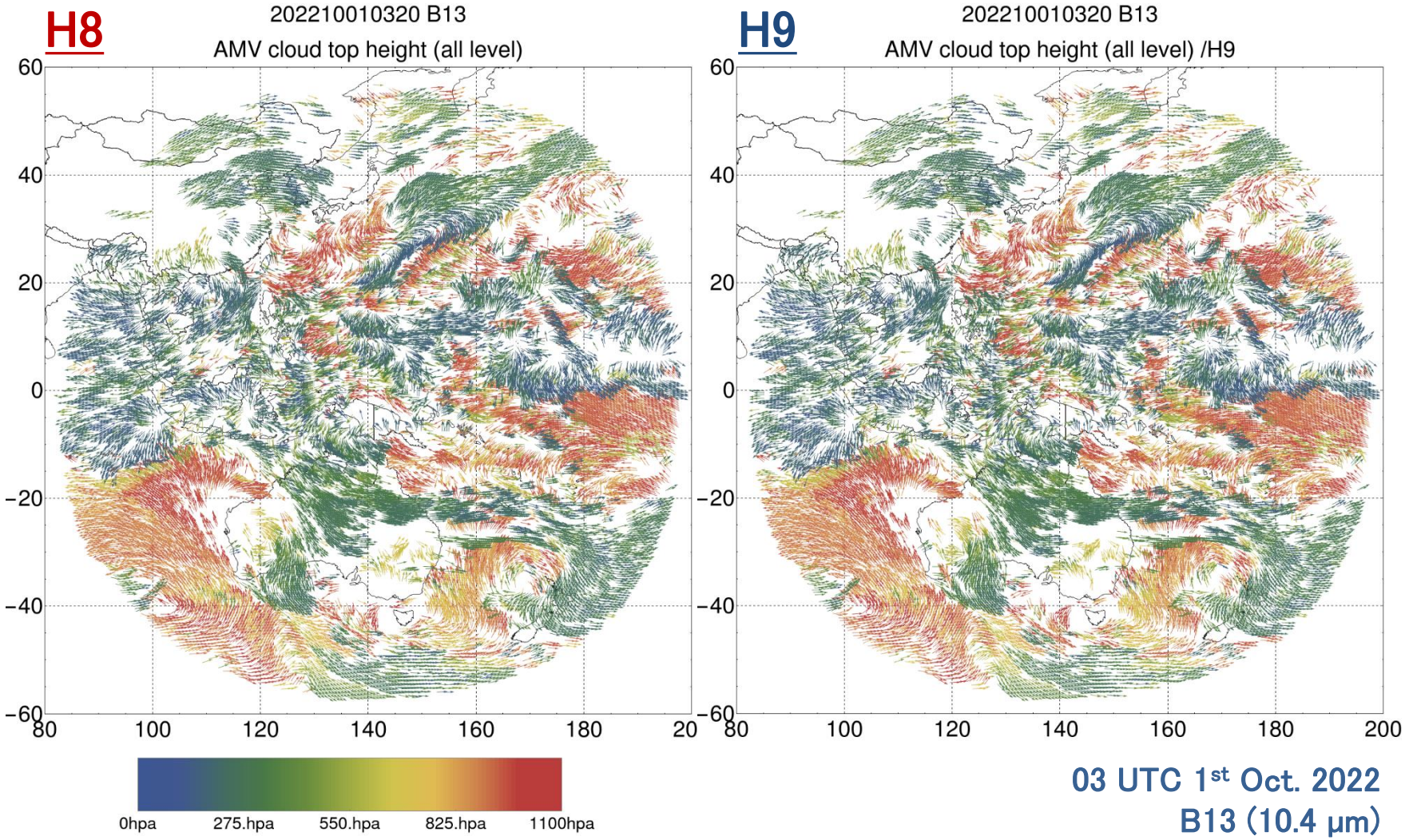




FCP



③ Atmospheric Motion Vector (AMV)



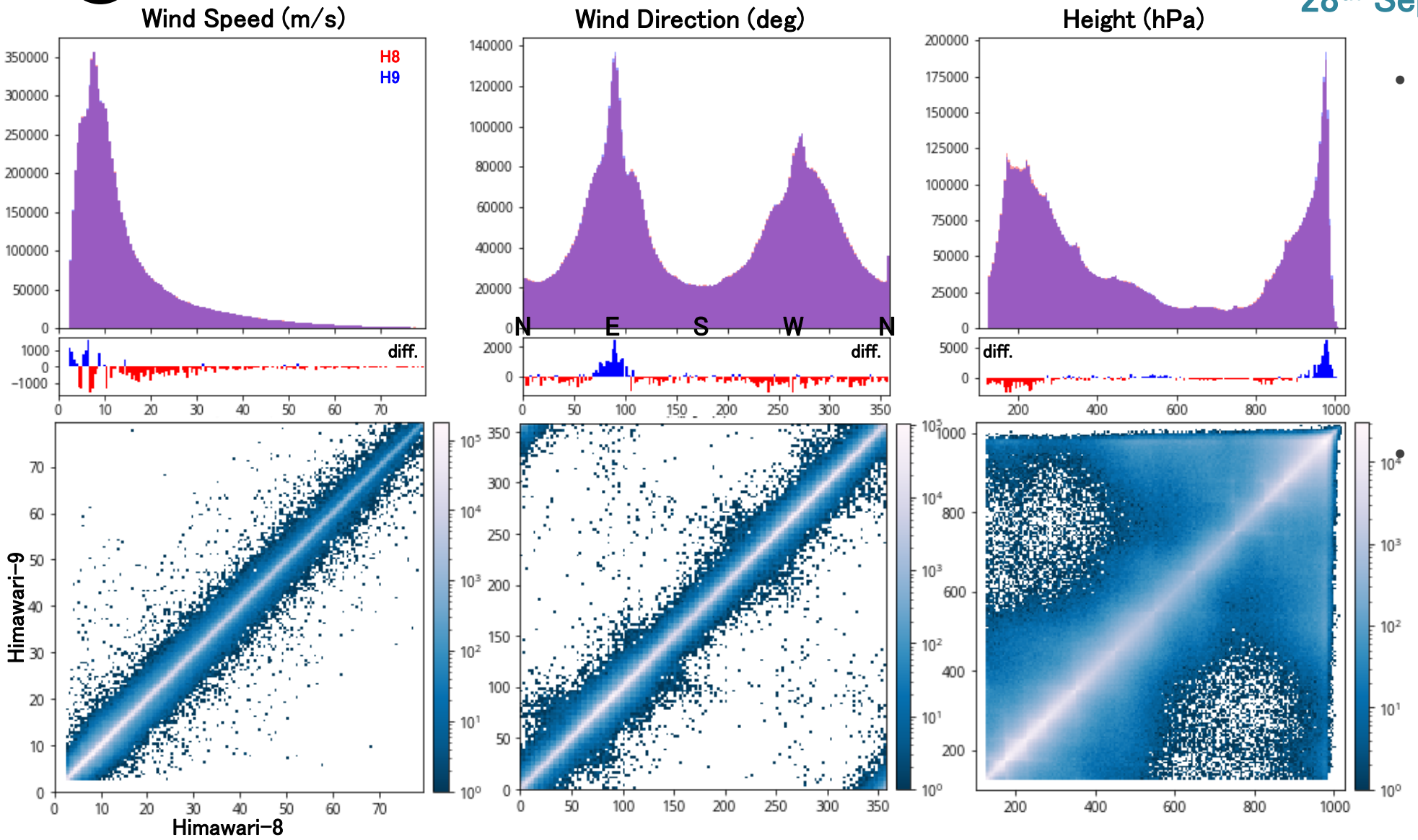
03 UTC 1st Oct. 2022
B13 (10.4 μm)

Atmospheric Motion Vectors (AMVs) are produced with cloud feature-tracking and cloud height estimation algorithm based on Himawari imagery and are used for numerical weather prediction.

- There is no significant difference in the spatial distribution.

④ Histograms

28th Sep. – 11th Oct. 2022

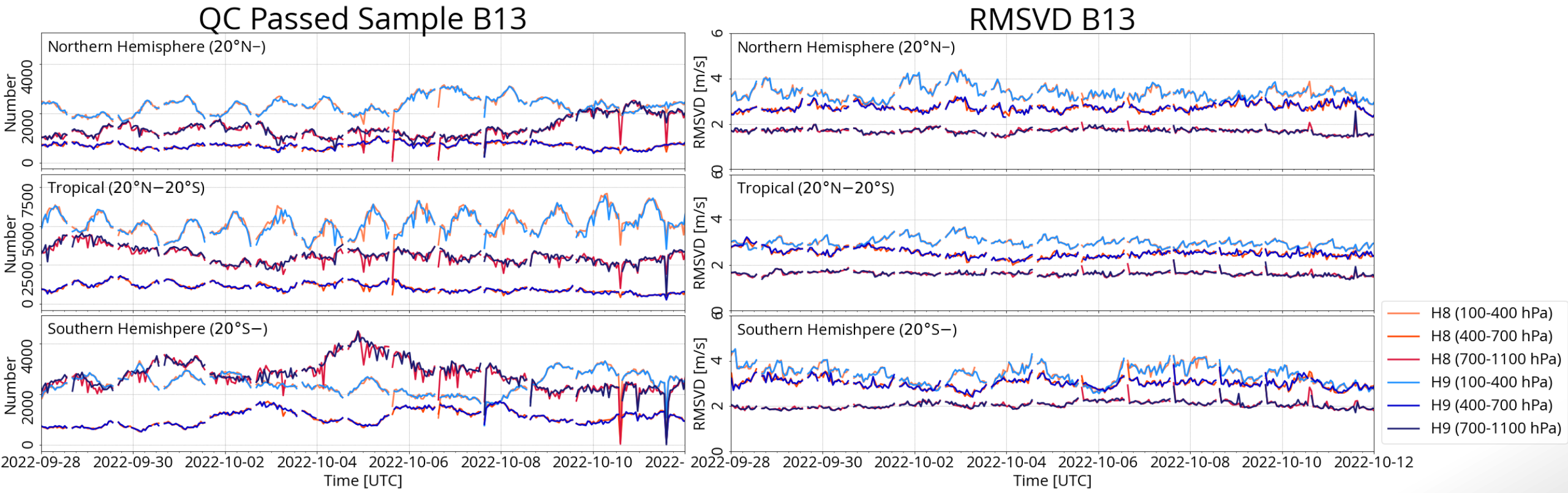


- The distribution of each elements in H9 AMV is almost identical to that of H8.
- Direct comparison of collocated data shows a strong correlation between H8 and H9 AMVs.

5 Time Series of Statistical Properties

AMV

- There is no region- or height-dependent difference between H8 and H9 AMVs through the validation period.
- The same results goes for the other bands.

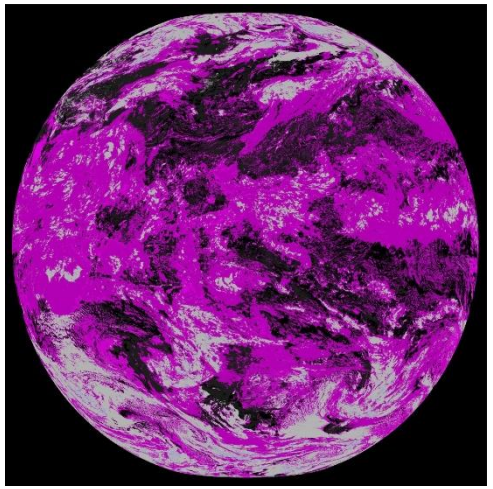


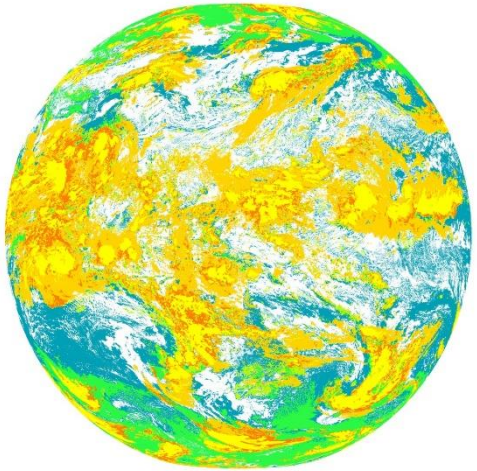
* Drops in sample size around 15 UTC are due to Sun avoidance

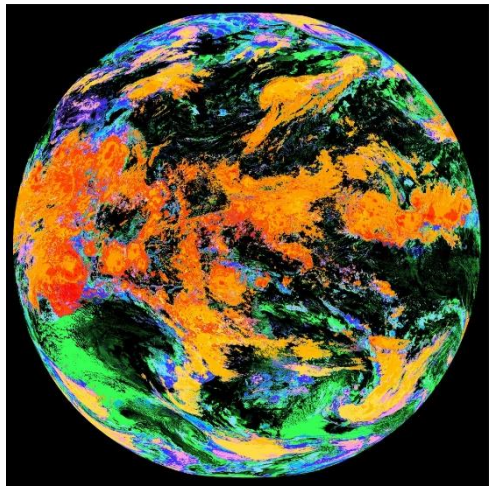
6 Fundamental Cloud Product (FCP)

Cloud Mask | Cloud Type | Cloud Top Height

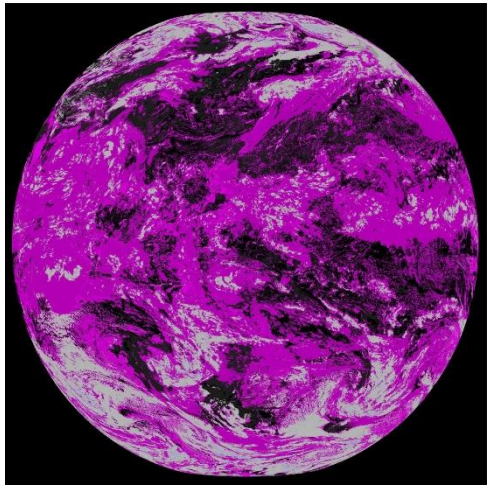
H8

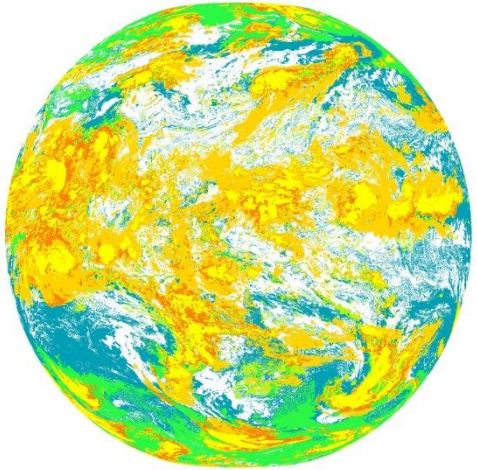


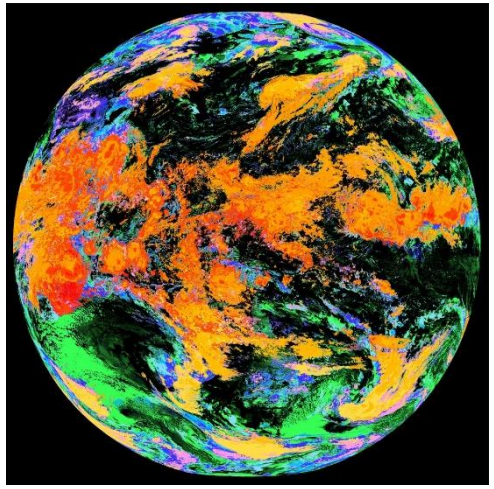


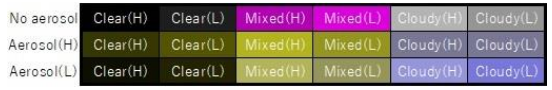


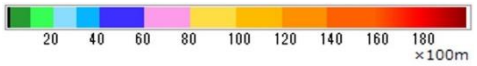
H9











03 UTC 1st Oct. 2022

Cloud information such as cloud mask, cloud type, and cloud top height are derived as Fundamental Cloud Product (FCP) and utilized in the subsequent Level 2 products.

- There is no significant difference in the spatial distribution.

⑦ Hit ratios against MYD35 L2

FCP

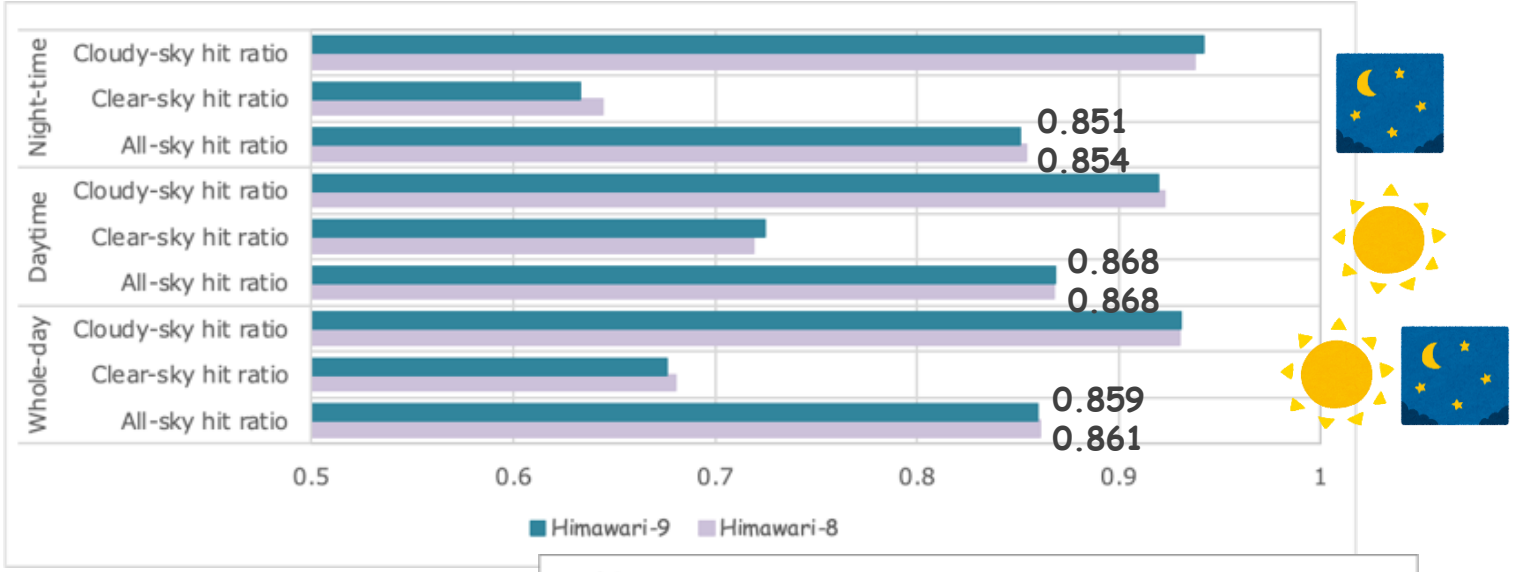
28th Sep. – 11th Oct. 2022

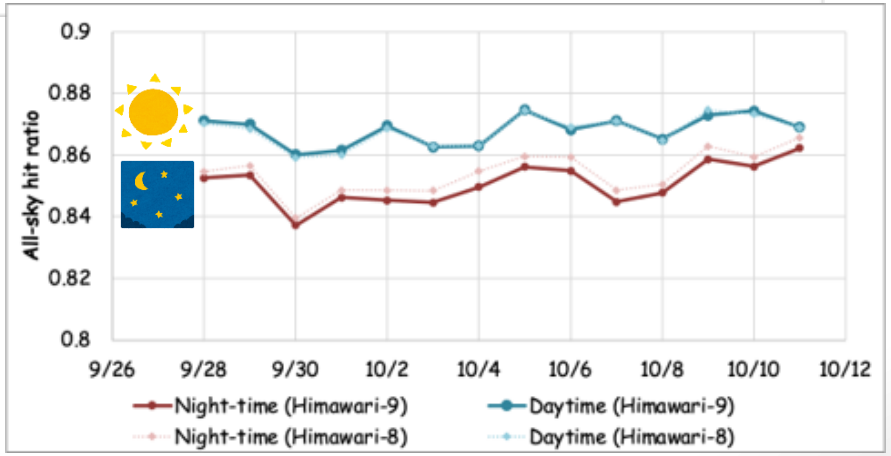
The accuracy of cloud masks is compared against MODIS Cloud Mask, MYD35 L2 (Ackerman et al. 2017).

Formulations of hit ratios:

All-sky hit ratio = (A + D) / (A + B + C + D)
Clear-sky hit ratio = A / (A + B)
Cloudy-sky hit ratio = D / (C + D)
* A, B, C, and D represent the numbers of pixels with designated conditions.

		MYD35_L2	
		clear	cloudy
FCP/ cloud mask	clear	A	B
	cloudy	C	D





- The hit ratios of H9 cloud mask are almost identical to those of H8.
- The clear–sky and all–sky hit ratios of night–time for H9 cloud mask are slightly lower than those of H8.

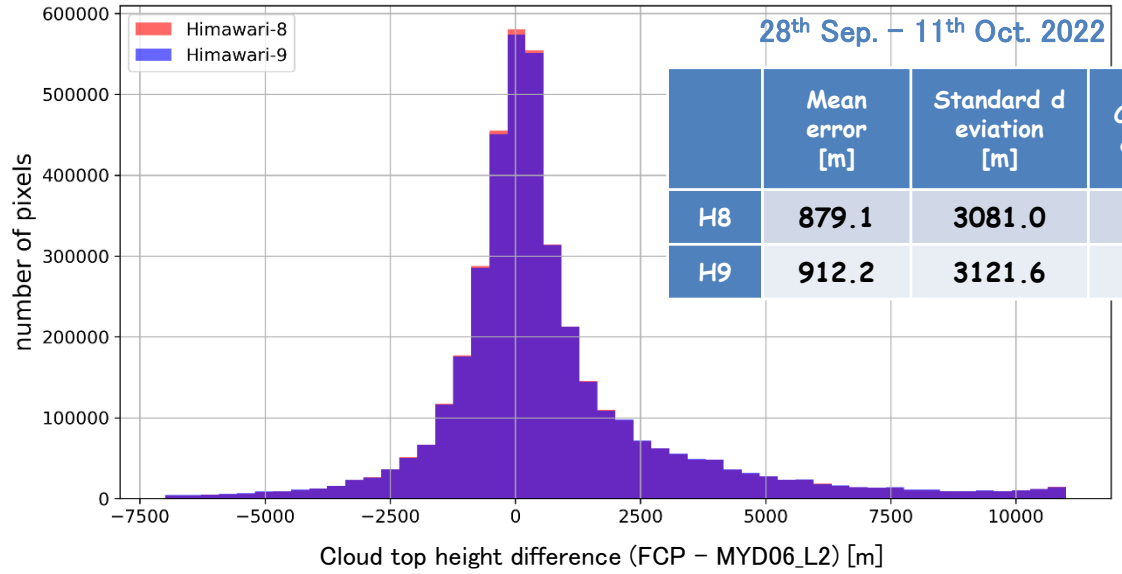
8 Cloud Top Height

FCP

Cloud top height is validated against MODIS cloud product, MYD06_L2 (Platnick et al. 2015), and directly compared between H8 and H9.

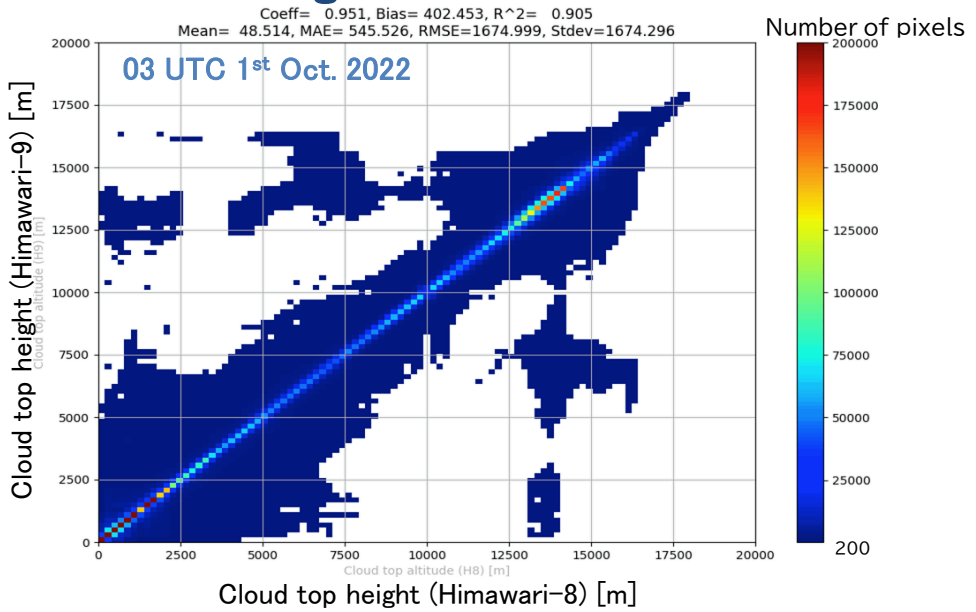
Histograms of difference from MYD06_L2

Himawari-9: ME= 912.2, MAE= 1848.8, Stdev= 3121.6, R= 0.782, Stderr= 1.551, Num=4049952
Himawari-8: ME= 879.1, MAE= 1819.8, Stdev= 3081.9, R= 0.788, Stderr= 1.530, Num=4059198



	Mean error [m]	Standard deviation [m]	Correlation coefficient
H8	879.1	3081.0	0.788
H9	912.2	3121.6	0.782

2D Histogram of H9 vs H8



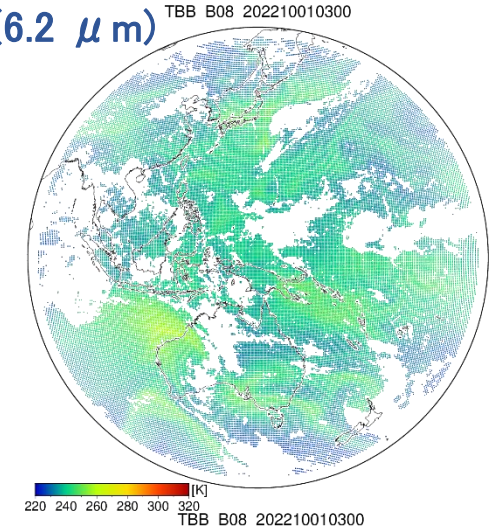
- The mean error and standard deviation of H9 cloud top height are almost identical to those of H8.
- There is a strong correlation between cloud top heights of H8 and H9.

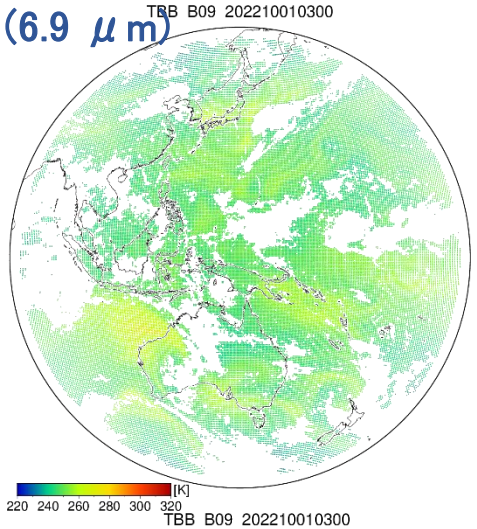
Mean error [m]	48.5
Standard deviation [m]	1674.3
Correlation coefficient	0.951

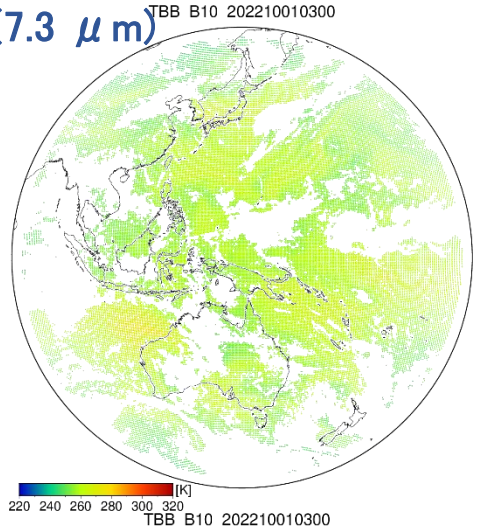
9 Clear Sky Radiance (CSR)

B08 (6.2 μm) B09 (6.9 μm) B10 (7.3 μm)

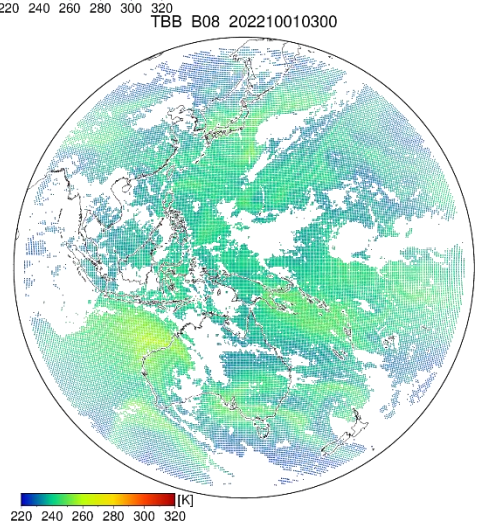
H8

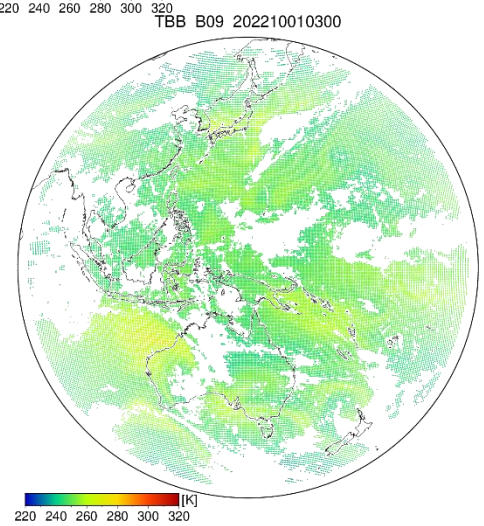


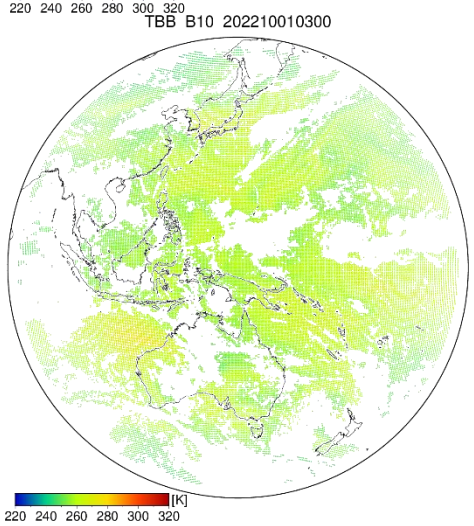




H9







03 UTC 1st Oct. 2022

Clear Sky Radiance (CSR) product provides area-averaged (16×16 pixel box) brightness temperatures for cloud-free pixels.

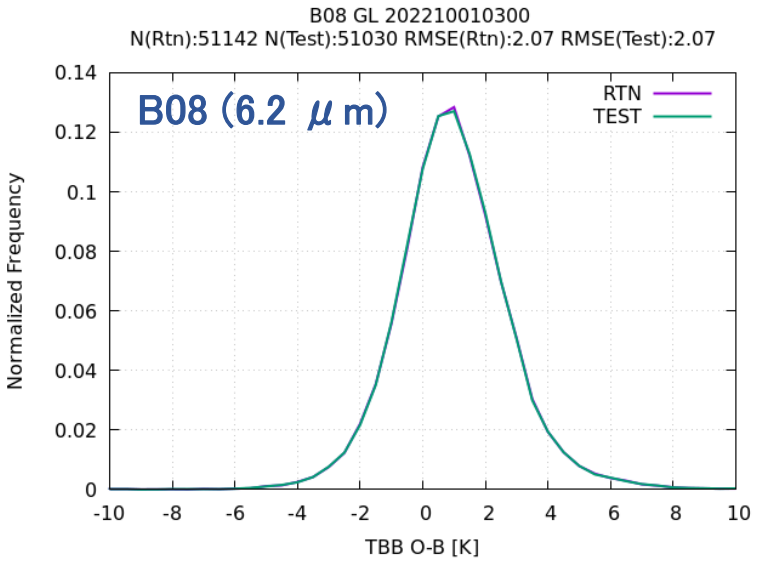
- There is no significant difference in the spatial distribution.

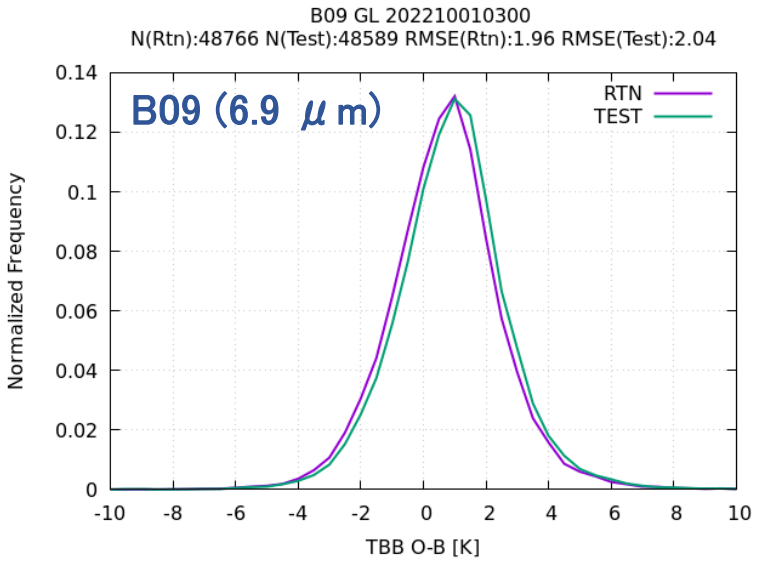
⑩ O-B Histogram

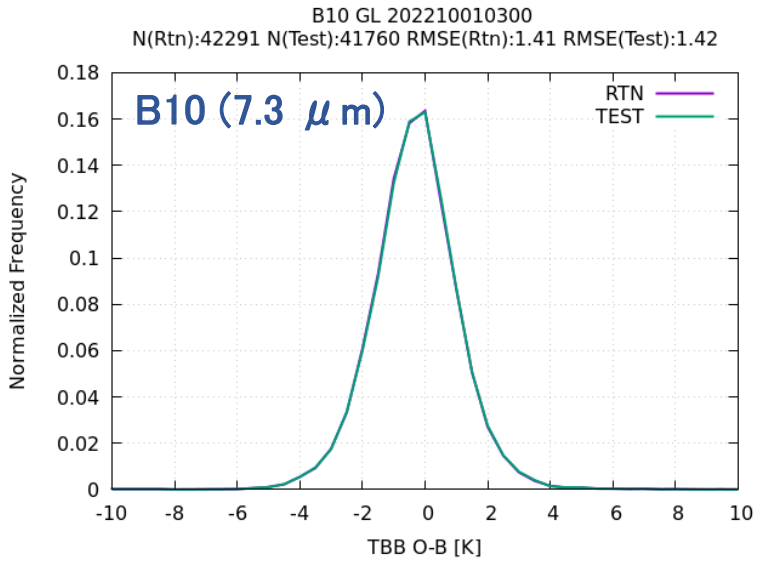
03 UTC 1st Oct. 2022

Background departure (O-B) of CSR

Himawari-8 Himawari-9







Bands 8 and 10

- The distributions of O-B for H9 CSR are almost identical to those of H8.

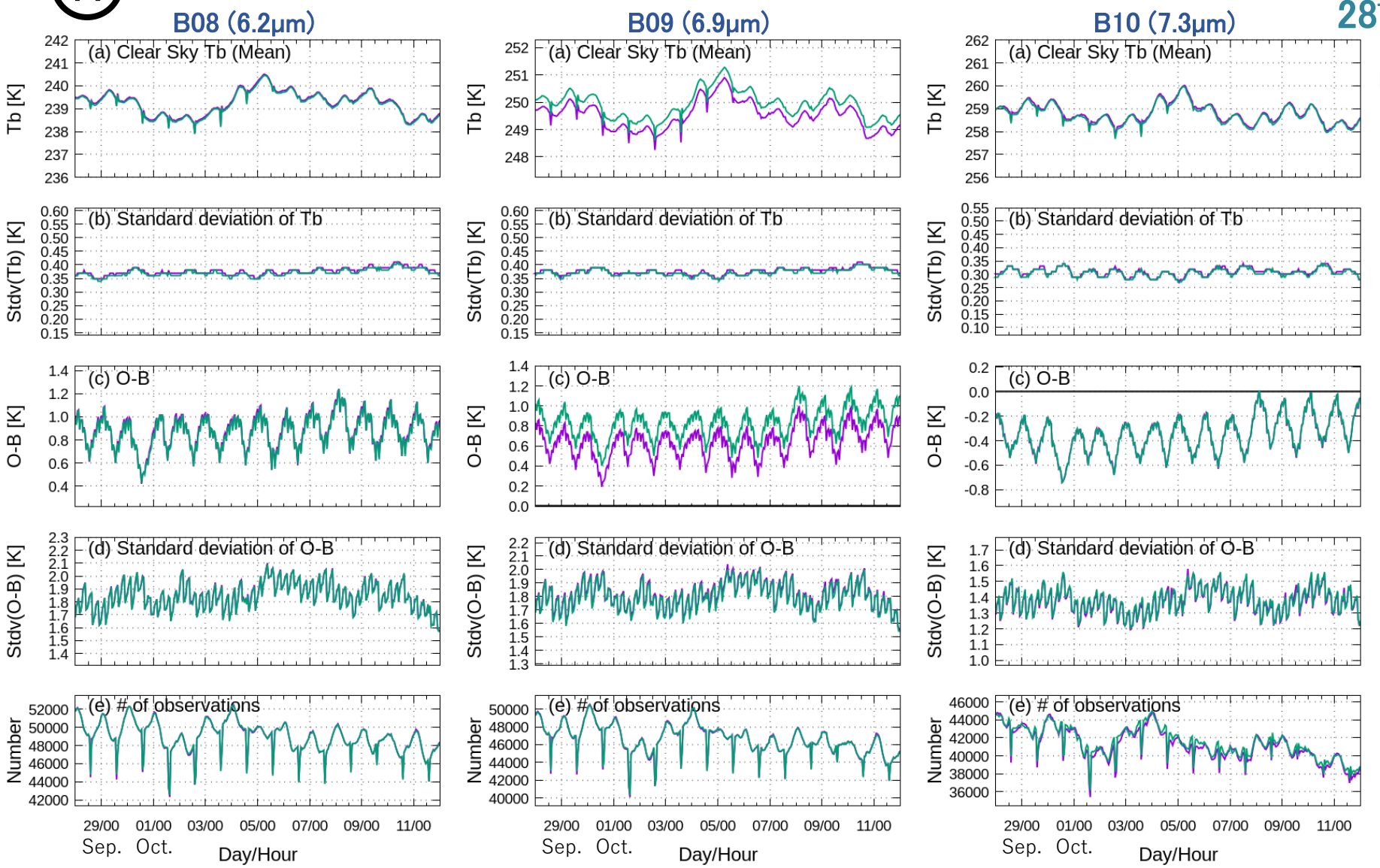
Band 9

- The distribution of O-B for Himawari-9 CSR shows slightly higher temperatures (~0.2 K) than for H8.

⑪ Time Series of Statistical Properties

CSR

28th Sep. – 11th Oct. 2022



Himawari-8 — Himawari-9

Bands 8 and 10

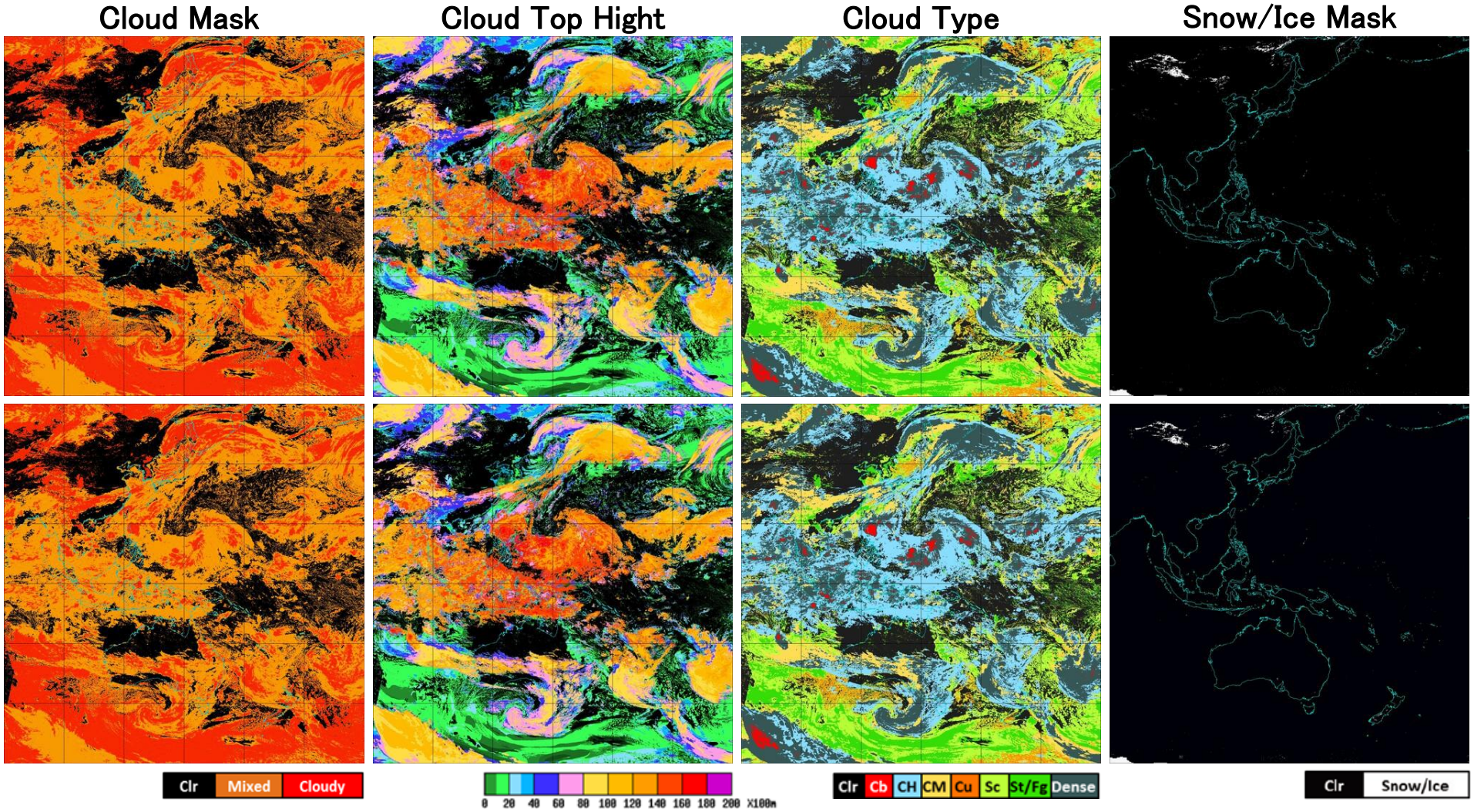
- There is no significant difference between H8 and H9 CSRs.

Band 9

- Clear sky brightness temperature and O–B value of H9 CSR are slightly higher than for H8.
- The gaps (~0.2 K) are consistent with the radiometric calibration and probably comes from the sensor characteristics.

*The drops in sample size around 15UTC is due to Sun avoidance

12 High-resolution Cloud Analysis Information (HCAI)



00 UTC 11th Oct. 2022

High-resolution Cloud Analysis Information (HCAI) provides 0.02°-grid data, covering the area from 60°N to 60°S and from 80°E to 160°W.

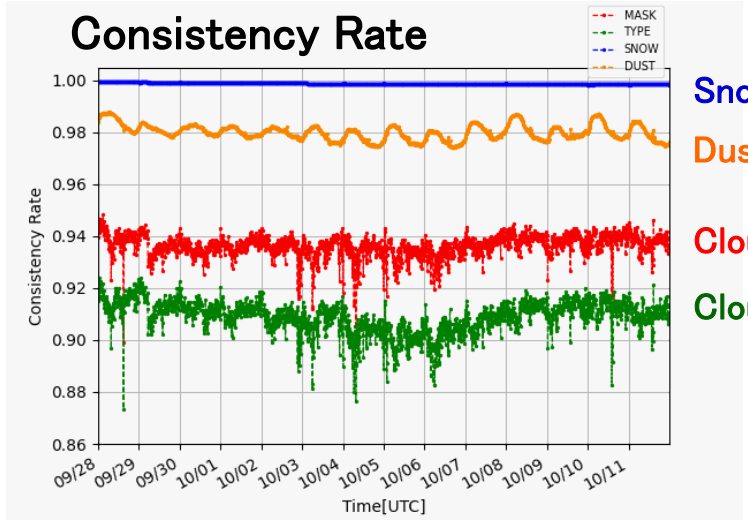
- There is no significant difference in the spatial distribution.
- The area of snow-covered land derived from H9 data tends to be slightly smaller than that from H8.

⑬ Statistical Comparison

HCAI

Consistency Rate

- Consistency rates are generally greater than 0.9 for snow/ice mask, dust mask, and cloud type as well as cloud mask.
- There is no significant variation in difference by time of day.



Snow/ice Mask

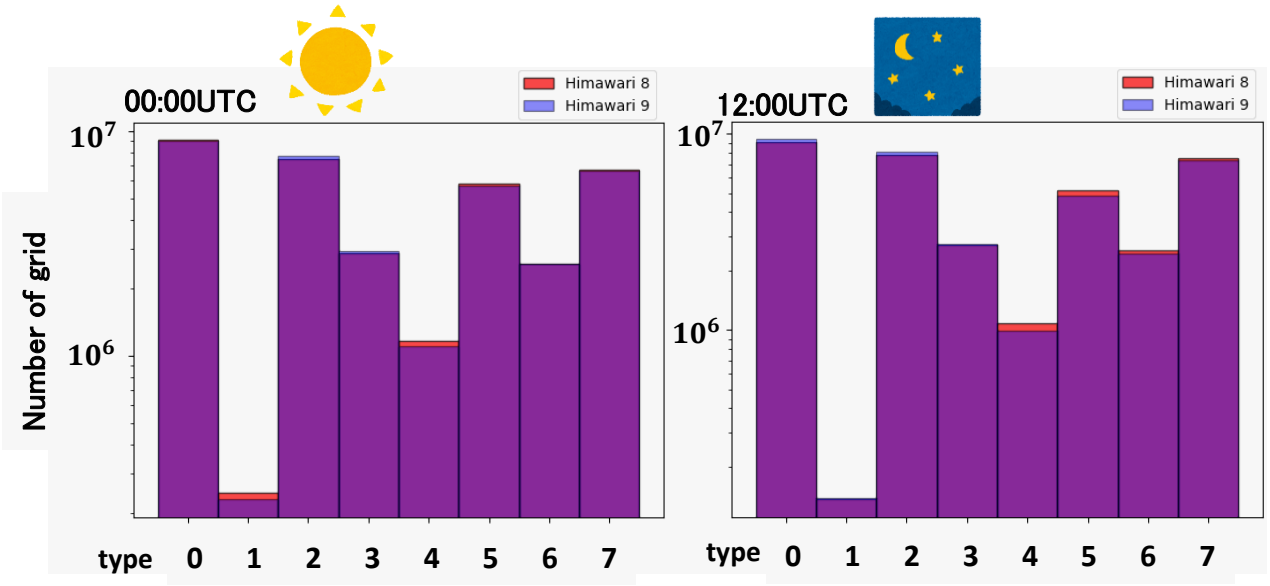
Dust

Cloud mask

Cloud type

Cloud Type

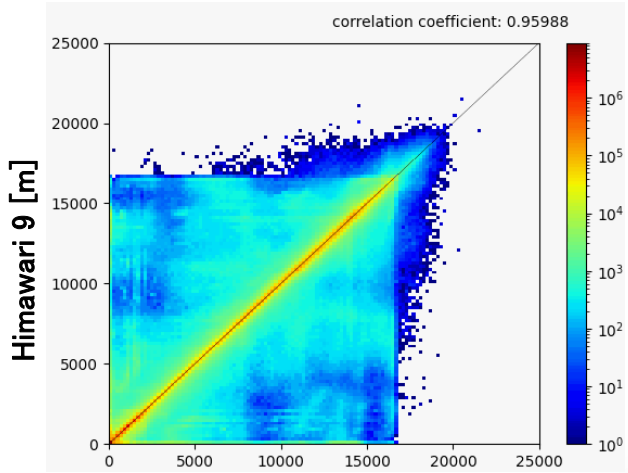
- Cirrus of H9 HCAI tends to be slightly more than that of H8 at day and night.
- Low clouds of H9 HCAI tend to be slightly less than that of H8 at night.



#	type
0	Clear
1	Cumulonimbus
2	Cirrus
3	Middle cloud
4	Cumulus
5	Stratocumulus
6	Stratus or fog
7	Dense cloud

Cloud Top Height

- The scatterplot is generally on the line of H8 = H9.



11th Oct. 2022

⑭ Summary

Himawari-9/AHI Level 2 products were validated.

- Atmospheric Motion Vector (AMV)
  - H9 AMV is almost identical to H8 AMV, and there is no region- or height-dependent difference between them.
- Fundamental Cloud Product (FCP)
  - The accuracies of cloud mask and cloud top height against MODIS cloud products are almost identical between H8 and H9.
  - The correlation coefficient between H8 and H9 cloud top height is larger than 0.9, and both can be treated in the same manner.
- Clear Sky Radiance (CSR)
  - There is no significant difference in statistical properties of Band 8 (6.2 μm) and Band 10 (7.3 μm) CSR between H8 and H9.
  - Band 9 (6.9 μm) clear sky brightness temperature and O-B departure of H9 CSR are slightly higher than those of H8 CSR, corresponding to the radiometric calibration validation.
- High-resolution Cloud Analysis Information (HCAI)
  - Cirrus of H9 HCAI tends to be slightly more than that of H8 at day and night.
  - Low clouds of H8 HCAI tend to be slightly more than that of H9 at night.
  - The area of snow-covered land derived from H9 data tends to be slightly smaller than that of H8, while the sea ice area is almost identical.