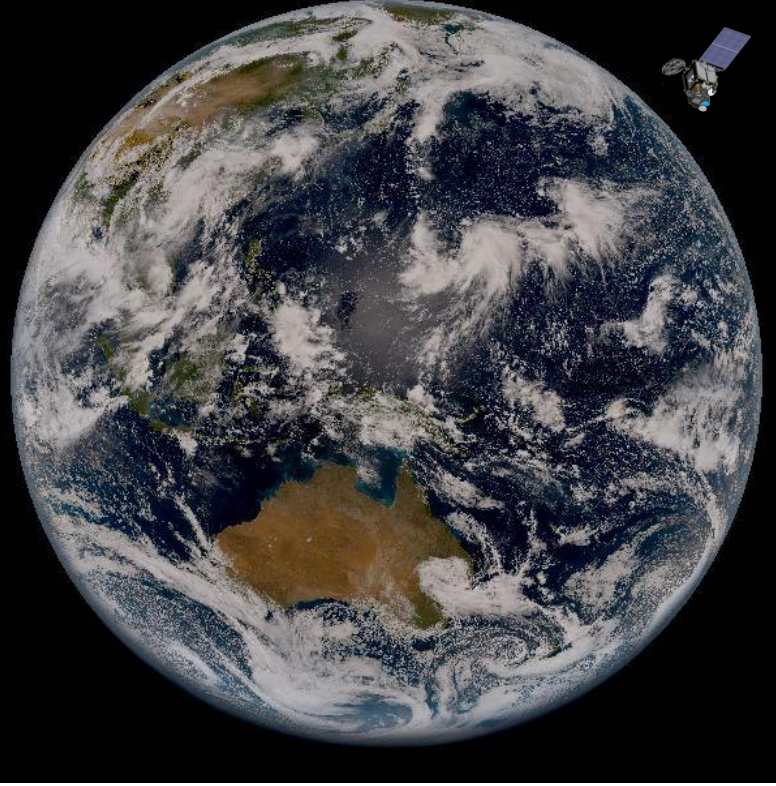
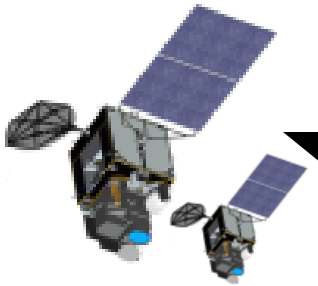
Meteorological Satellite Center (MSC) of JMA

Atmospheric Motion Vector

comparison period :
2022/09/28–2022/10/11



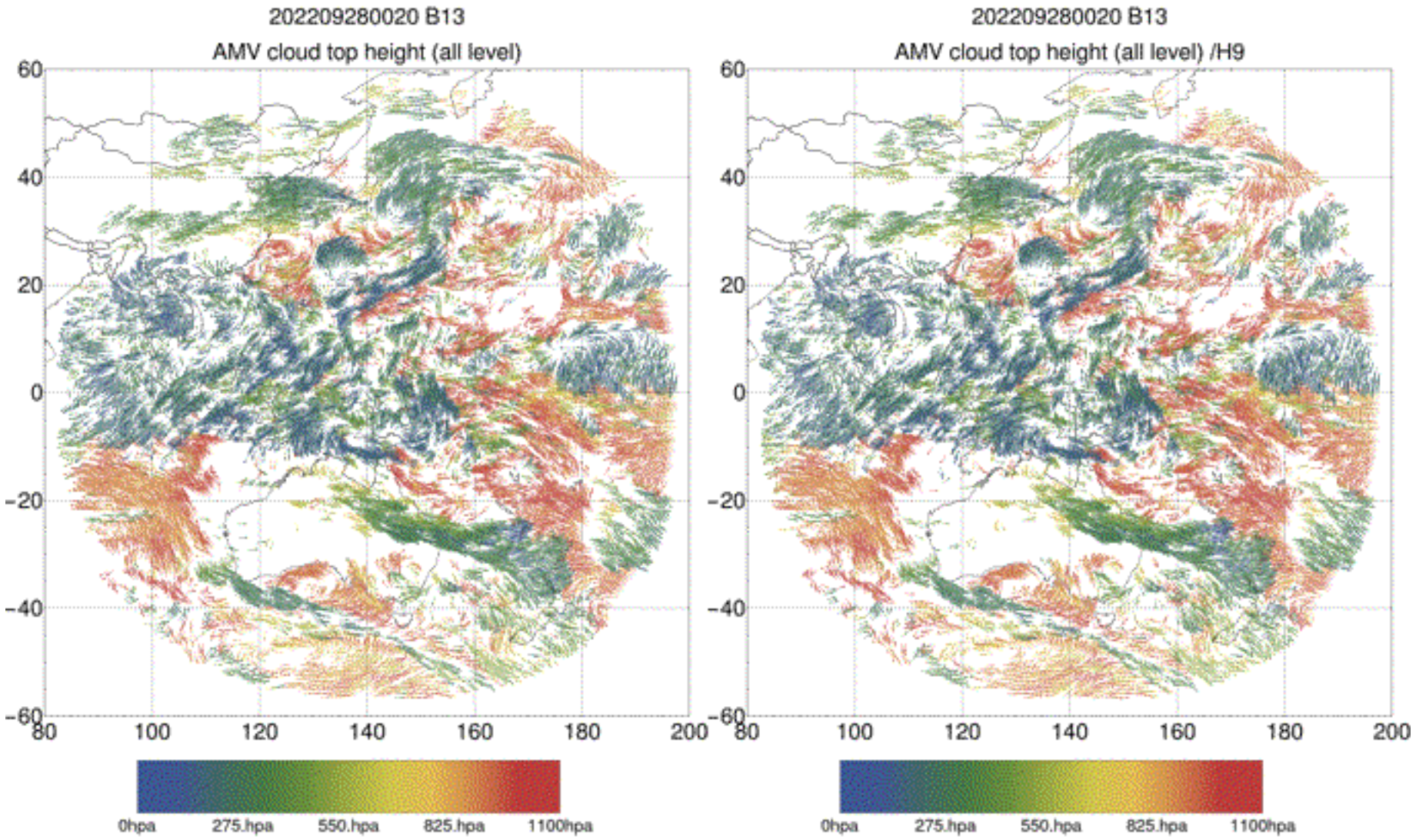
22 November 2022



2014 Himawari-8

2016 Himawari-9

AMV distribution map calculated from Himawari-8 and -9

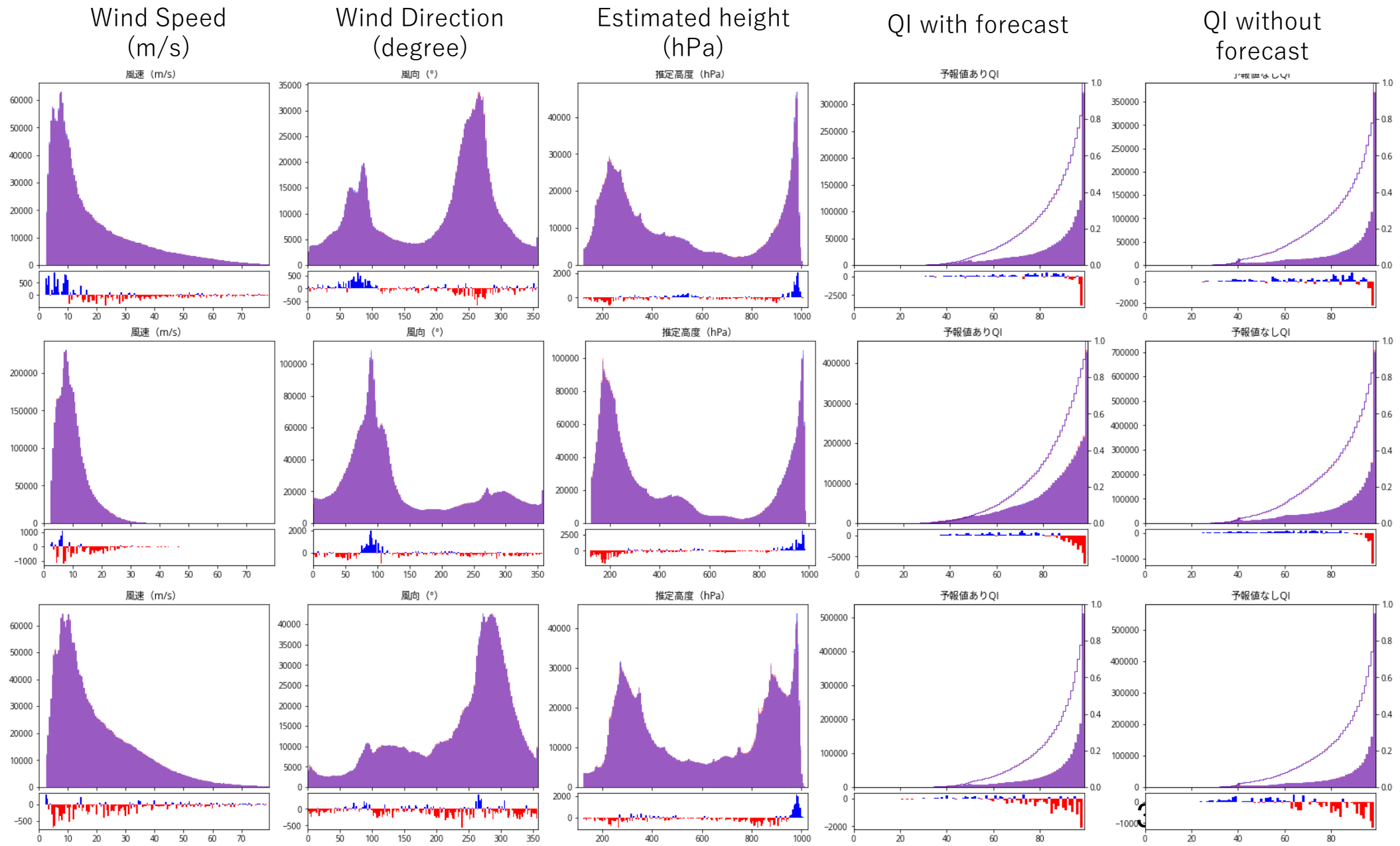


AMV spatial distribution calculated from Himawari-8 and -9 data

Left: Himawari-8; right: Himawari-9
Colors represent pressure height.

Both exhibit similar spatial distribution.

Histogram comparison (Red:H-8, Blue:H-9)



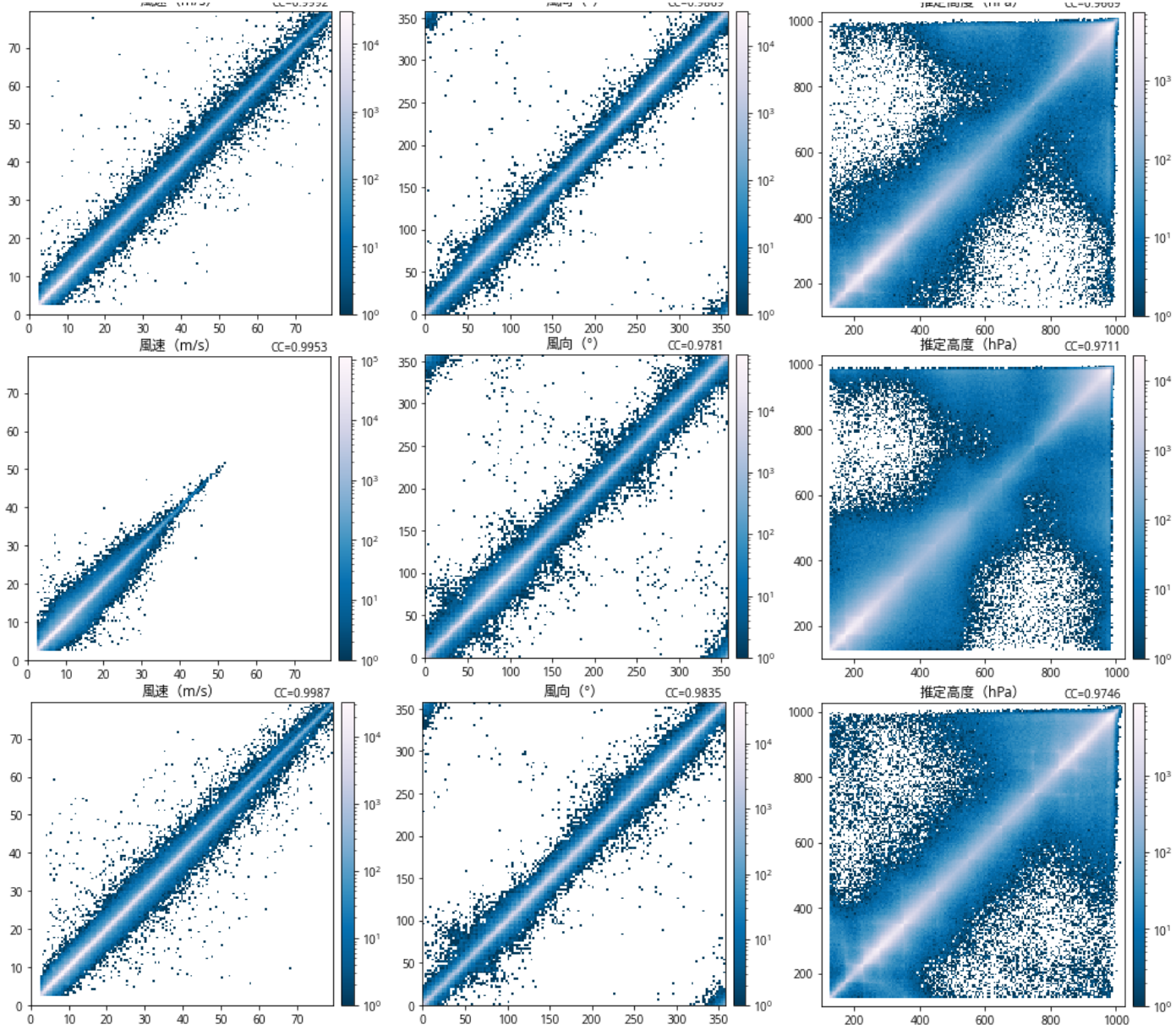
2D histogram for collocated pairs of Himawari-8 and -9 AMVs

Wind Speed (m/s) | Wind Direction (deg) | Height (hPa)

Northern Hemisphere (20N-)

Tropics (20N-20S)

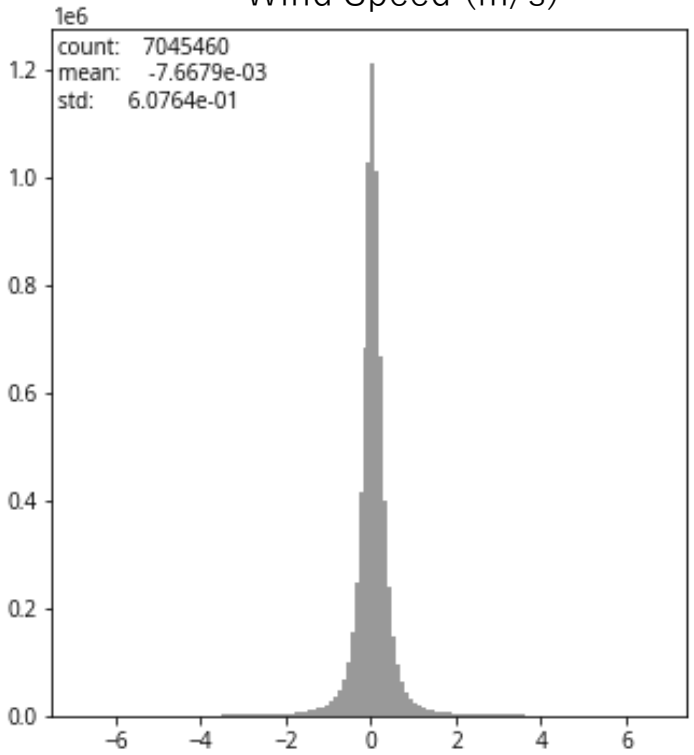
Southern Hemisphere (20S-)



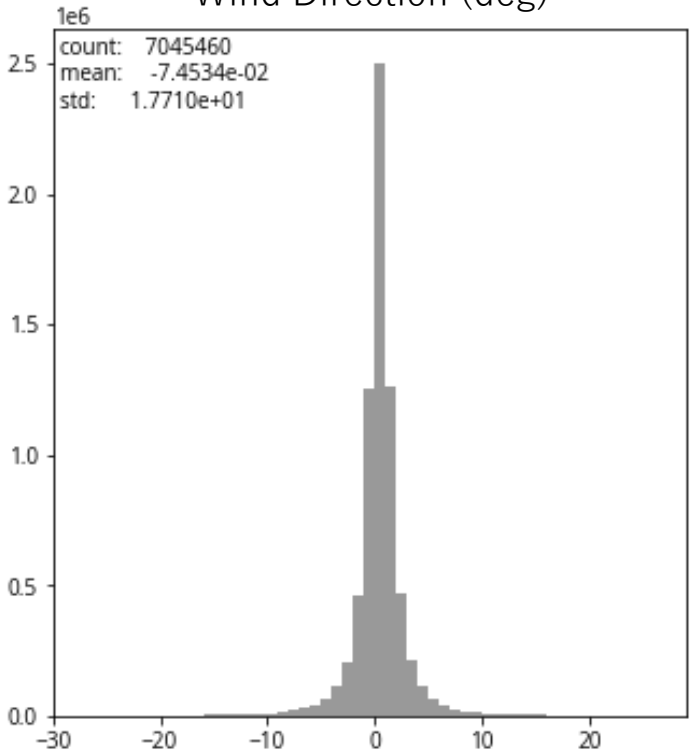
・There is no bias between the calculation elements of Himawari-8 and Himawari-9 AMV

Histogram for difference of collocated H-8 and H-9 AMV

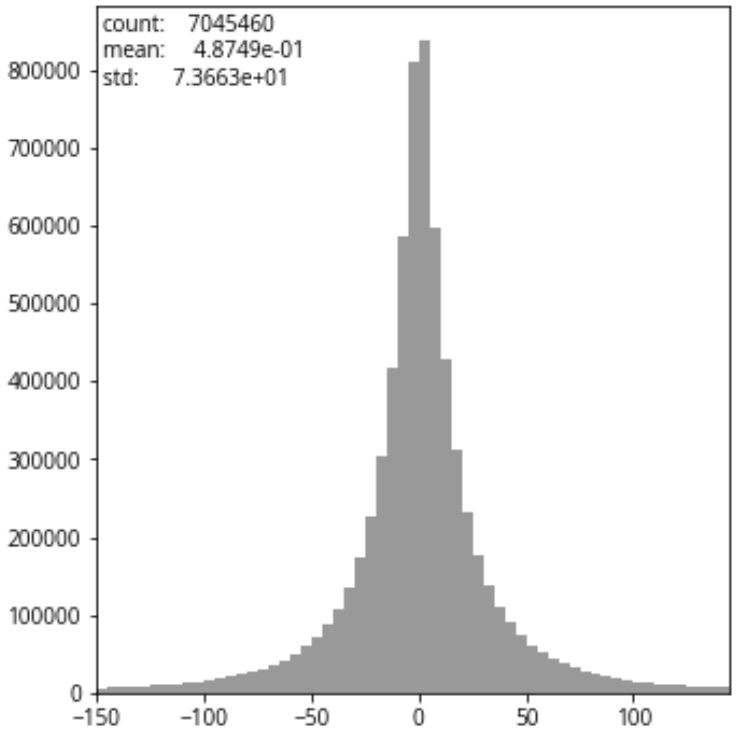
Wind Speed (m/s)



Wind Direction (deg)

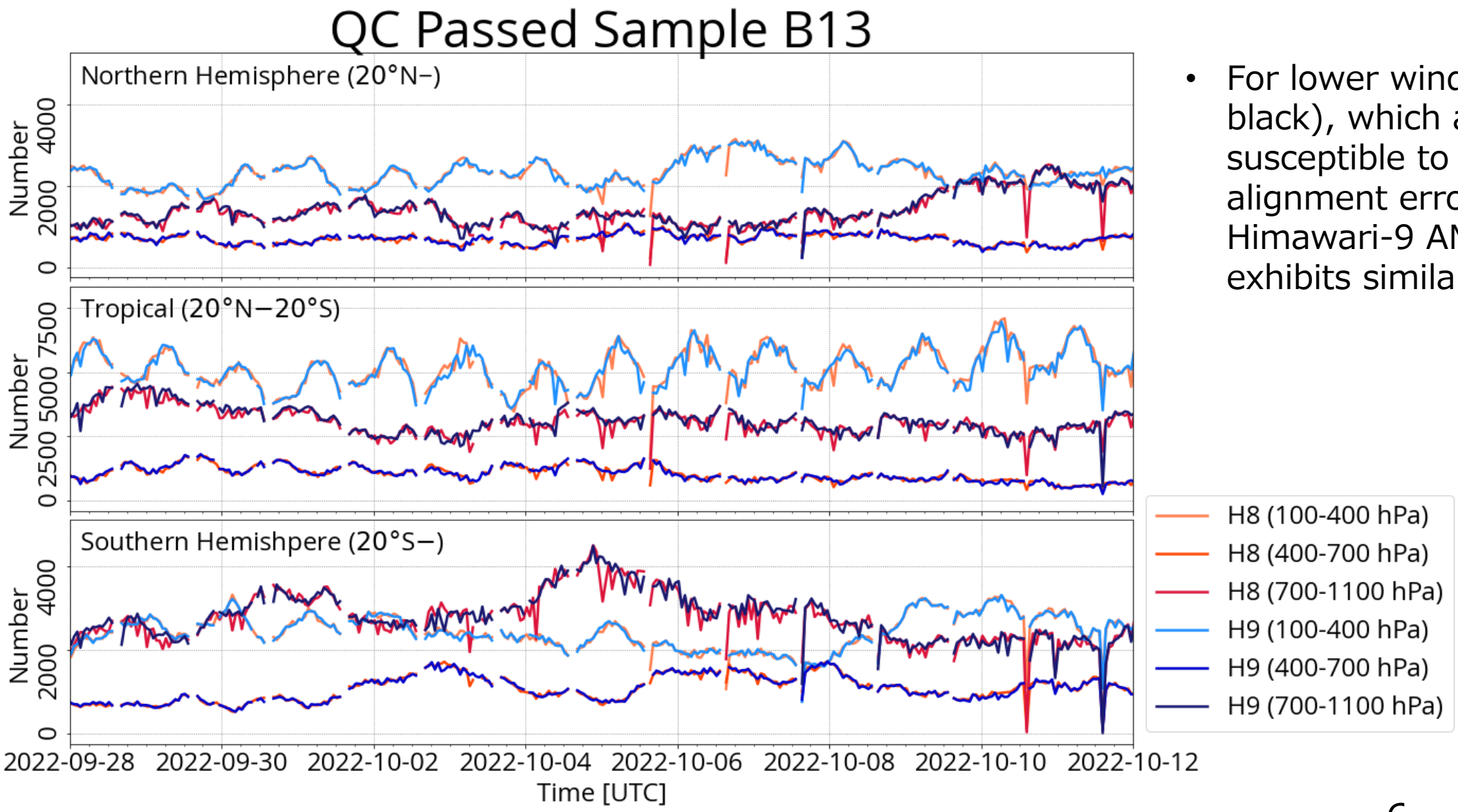


Height (hPa)



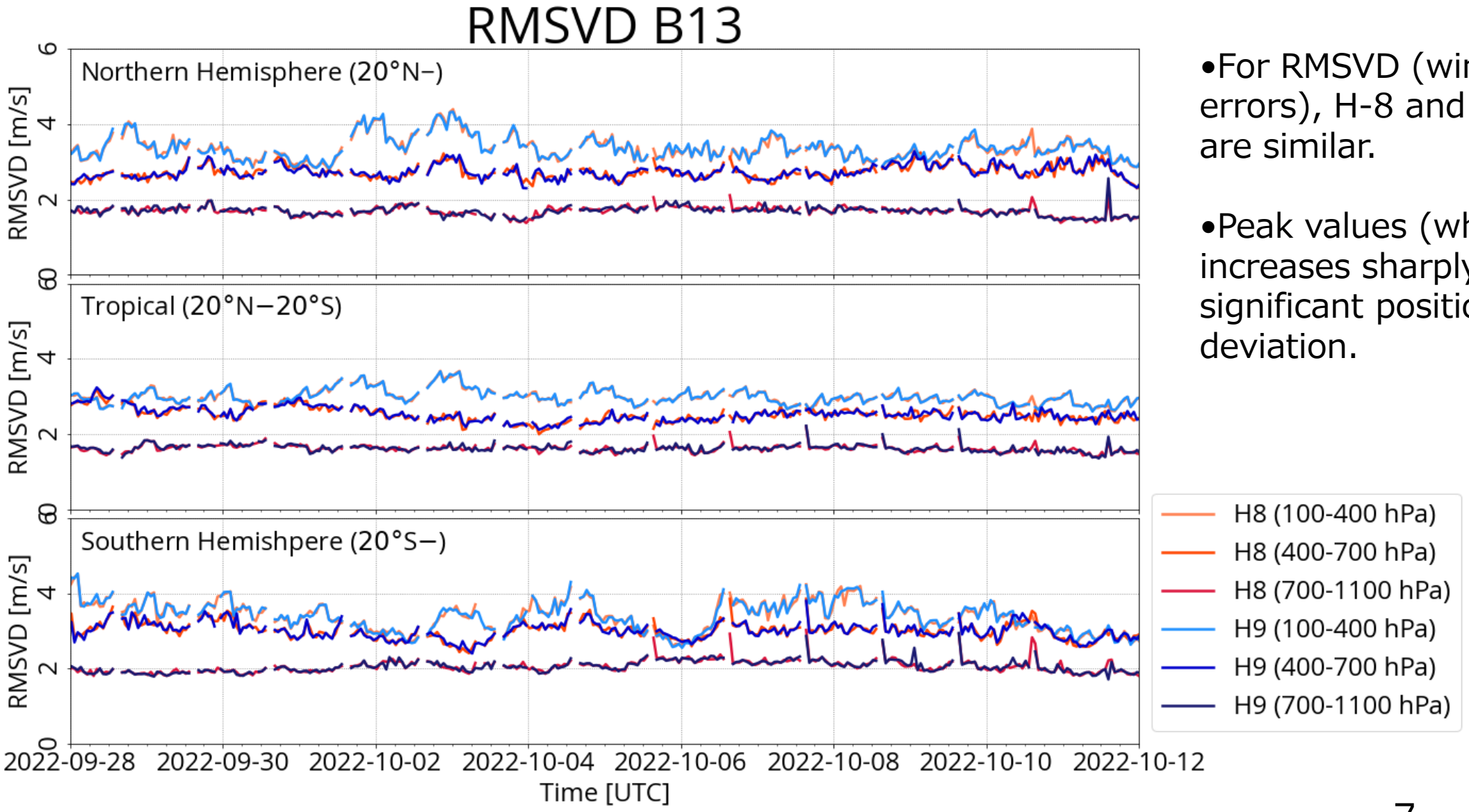
・It is considered that there is almost no significant difference in the bias tendency between H-8 and H-9 AMV in practical use.

Quality-controlled AMV comparison



- For lower winds (red and black), which are highly susceptible to positional alignment errors, Himawari-9 AMV calculation exhibits similarity.

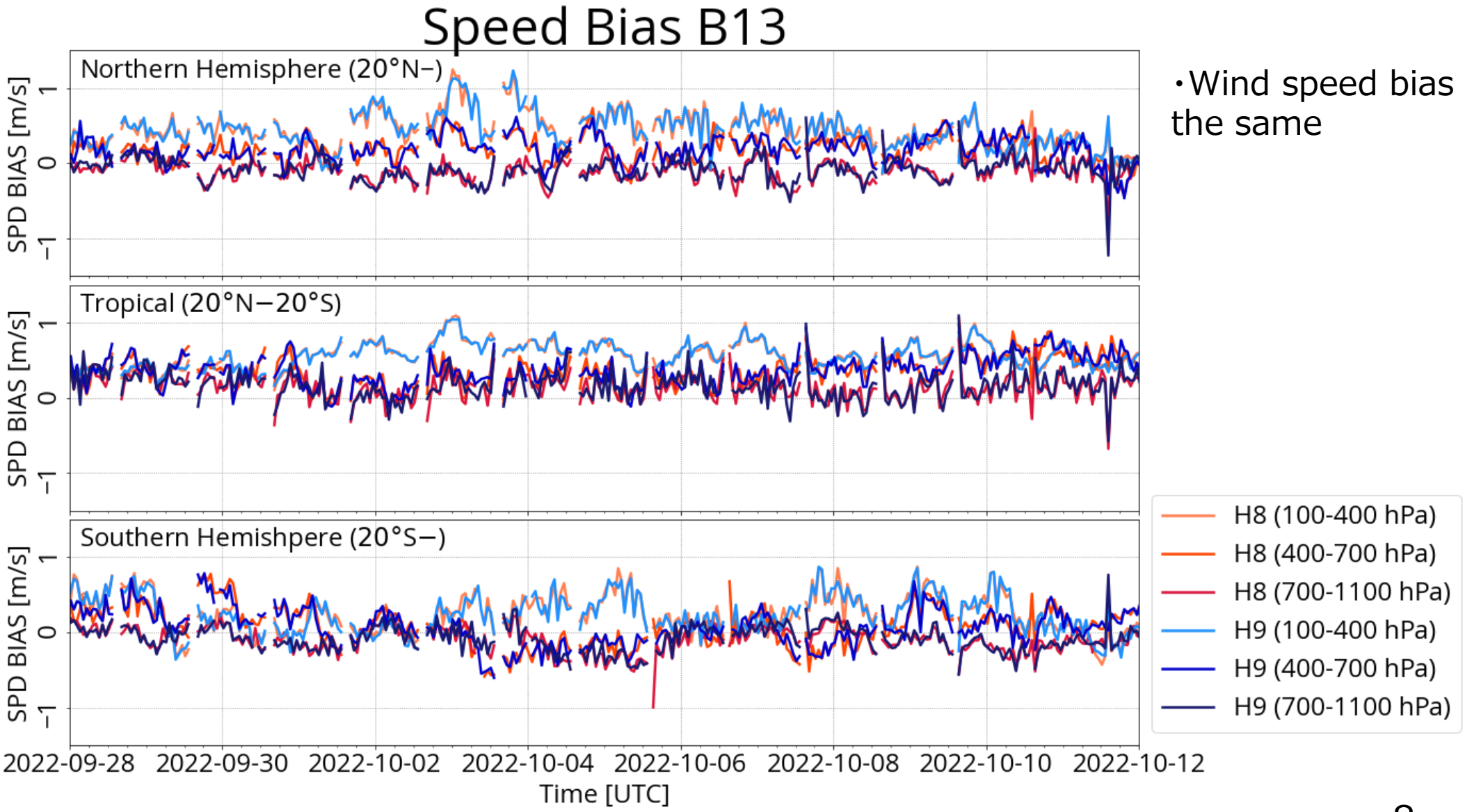
RMSVD (O-B)



- For RMSVD (wind vector errors), H-8 and H-9 AMVs are similar.

- Peak values (where RMSVD increases sharply) exhibit significant positional deviation.

Wind Speed Bias (O-B)



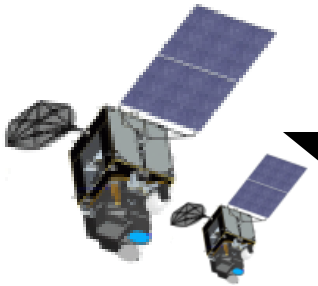
・Wind speed bias is almost the same

Summary (Himawari AMV)

・Himawari-8 and -9 AMVs exhibit similar characteristics and qualities for the evaluation period (9/28 – 10/11, 2022).

・O-B RMSVD and wind speed bias values are similar for the evaluation period, and no significant difference is observed from observation error settings (by NWP users). The evaluation suggests that H-9 AMV usage with H-8 AMV settings will not be problematic.

Fundamental cloud product (FCP) and Clear Sky Radiance (CSR) validation term: 28th Sep. – 11th Oct. 2022



2014 Himawari-8

2016 Himawari-9

Fundamental Cloud Product (FCP)

FCP validation summary

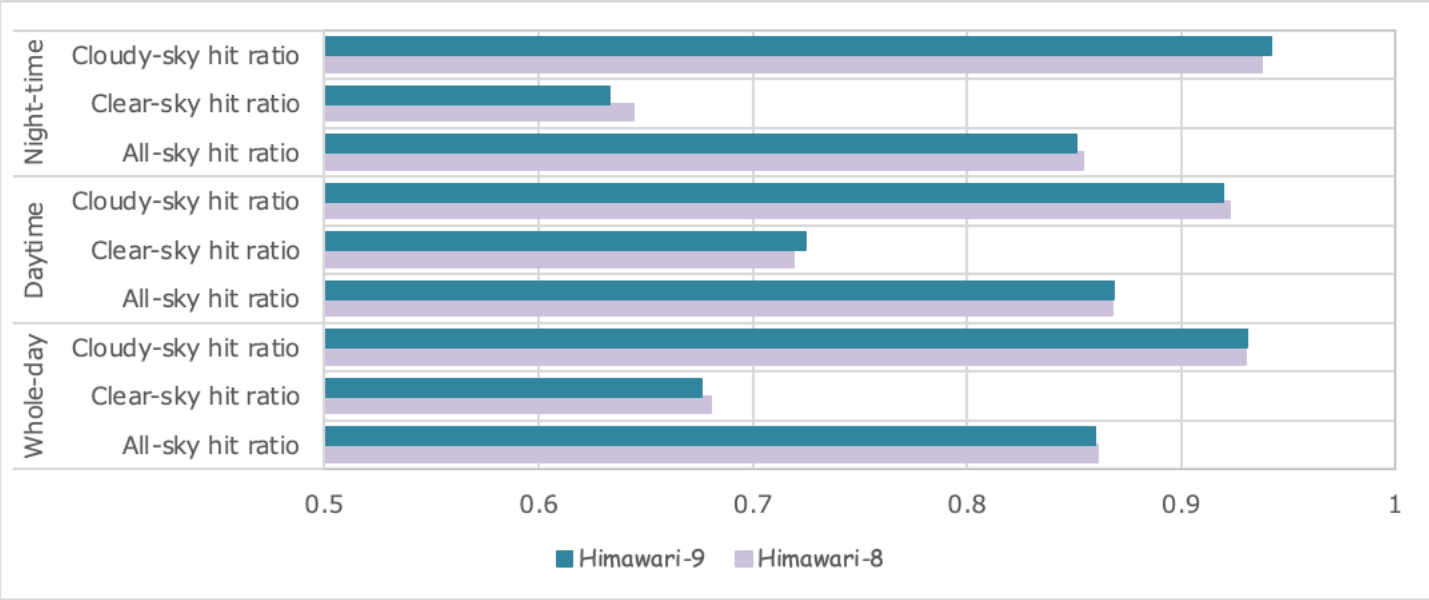
Comparison with MODIS cloud products

- Himawari-9 and -8 cloud mask hit ratios are similar.
- Mean errors and standard deviations of cloud top height are also similar.

Analysis of Himawari-8 and -9 cloud top height correlation

- As the computed coefficient of correlation between Himawari-8 and -9 cloud top heights is significant (greater than 0.9), both can be treated similarly.

The accuracy of cloud mask against MODIS Cloud Mask (MYD35_L2)



✓ All−sky hit ratio of cloud mask

	Whole-day	Daytime	Night-time
Himawari-8	0.861	0.868	0.854
Himawari-9	0.859	0.868	0.851

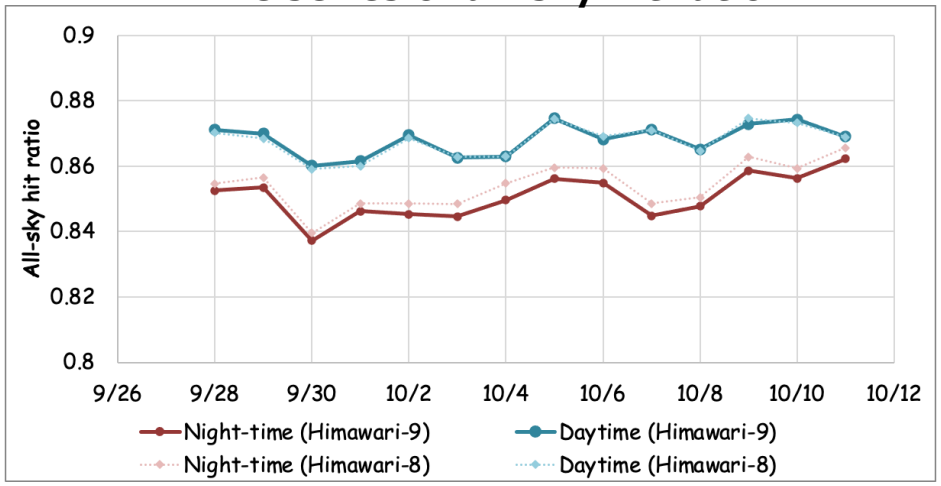
Formulations of hit ratios:

All-sky hit ratio = (A + D) / (A + B + C + D)
Clear-sky hit ratio = A / (A + B)
Cloudy-sky hit ratio = D / (C + D)

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

* A, B, C, and D represent the numbers of pixels with designated conditions.

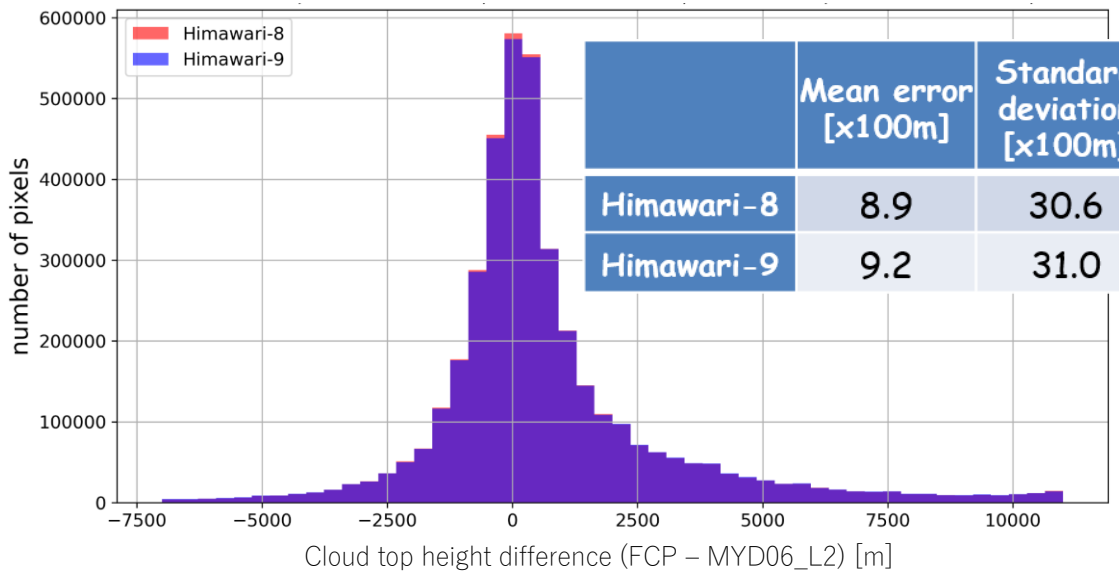
Time series of all-sky hit ratio



- The hit ratios of Himawari-9 and -8 cloud mask are similar.
- The clear-sky and all-sky hit ratios of Himawari-9 nighttime cloud mask are slightly lower

The accuracy of cloud top height

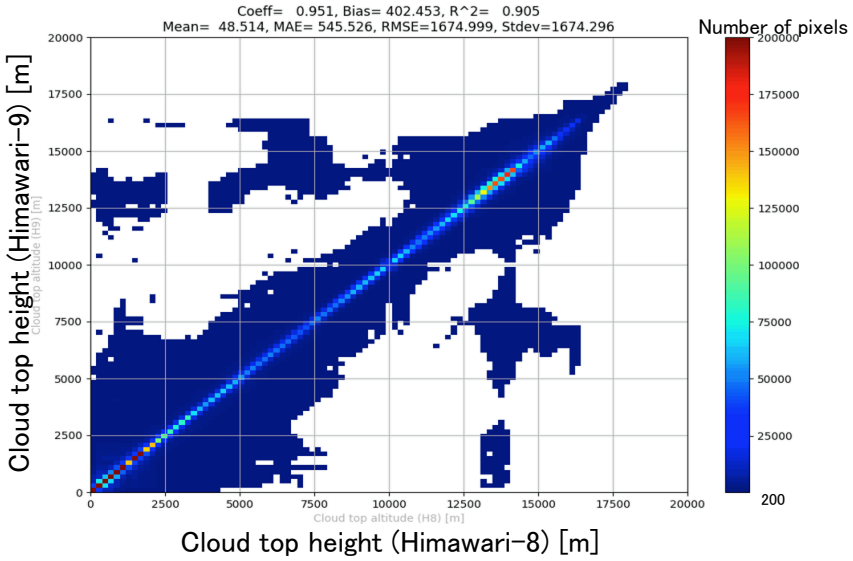
The accuracy of cloud top height (against MODIS cloud product, MYD06_L2)



	Mean error [x100m]	Standard deviation [x100m]	Correlation coefficient
Himawari-8	8.9	30.6	0.79
Himawari-9	9.2	31.0	0.78

Analysis of cloud top height correlation from Himawari-8/9 data

[Observation date: 03:00UTC, 1st Oct. 2022]



Mean error [x100m]	0.5
Standard deviation [x100m]	16.7
Correlation coefficient	0.95

Evaluation of cloud top height accuracy against MYD06_L2

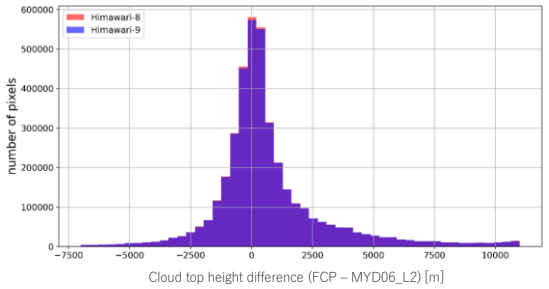
- The mean error and standard deviation of Himawari-9 and -8 cloud top height are similar.

Direct comparison between Himawari-8 and -9 cloud top heights

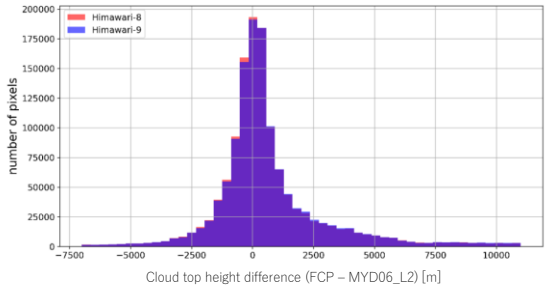
- There is a strong correlation (coefficient greater than 0.9) between Himawari-8 and -9 cloud top heights.
- The mean error of Himawari-9 cloud top heights based on those of Himawari-8 is less than 100 m.

The accuracy of cloud top height (by latitude bands)

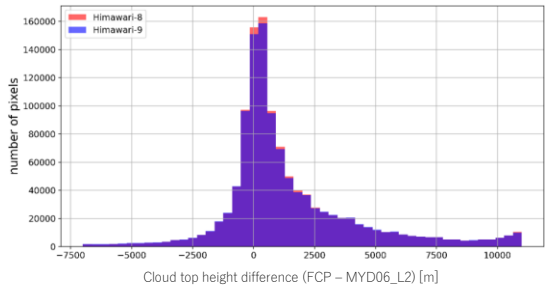
Full disk



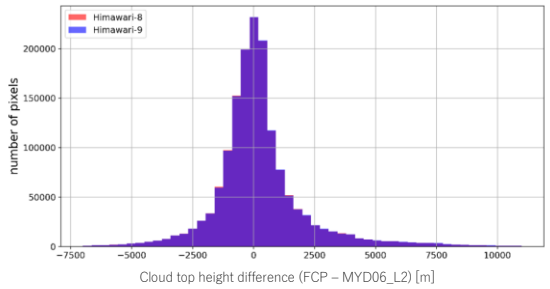
Northern hemisphere



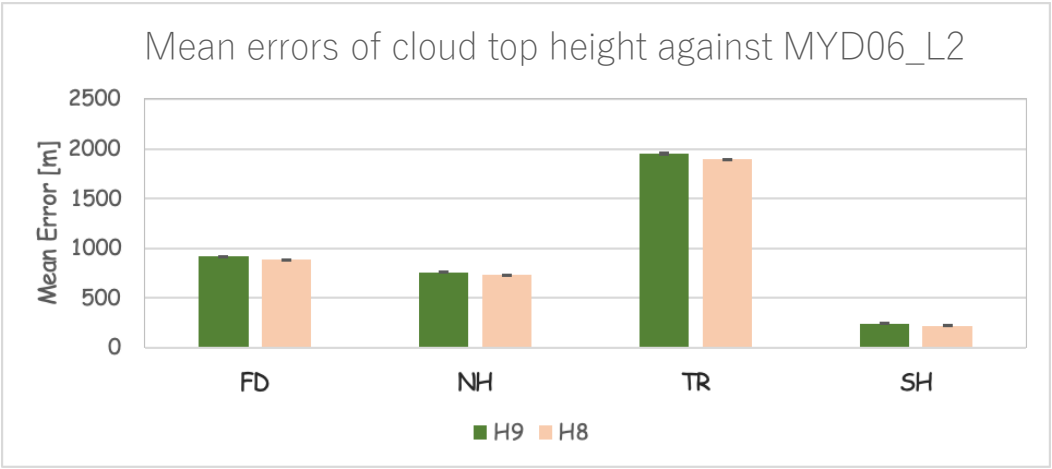
Tropical zone



Southern hemisphere



	Full disk			Northern hemisphere			Tropical Zone			Southern hemisphere		
	Mean error [x100m]	Standard deviation [x100m]	Correlation coefficient	Mean error [x100m]	Standard deviation [x100m]	Correlation coefficient	Mean error [x100m]	Standard deviation [x100m]	Correlation coefficient	Mean error [x100m]	Standard deviation [x100m]	Correlation coefficient
Himawari-8	9.2	31.0	0.78	7.6	26.9	0.78	19.5	41.4	0.72	2.5	21.2	0.82
Himawari-9	8.9	30.7	0.79	7.3	26.7	0.79	18.9	40.7	0.73	2.3	21.0	0.82



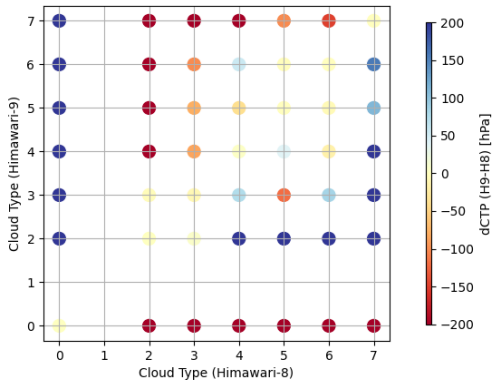
- There is no significant difference in the trend of mean errors in cloud top heights between Himawari-8 and -9.

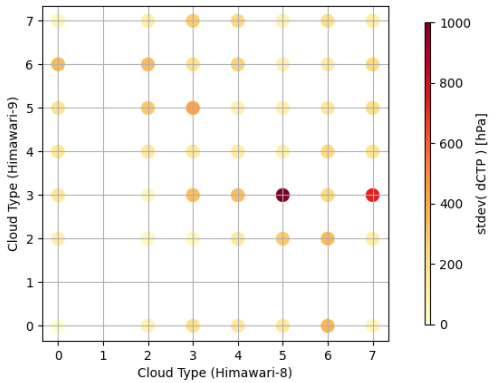
*FD: full disk, NH: Northern hemisphere （>20N), TR: tropical zone (20S-20N), SH: Southern hemisphere (<20S)

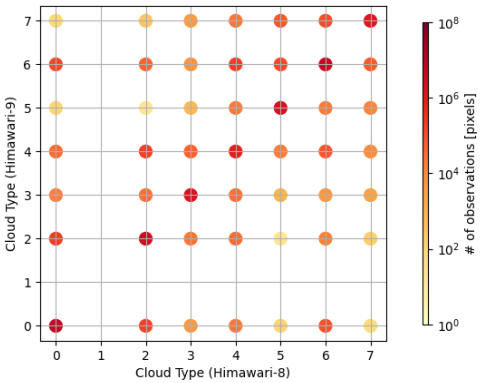
Cloud top height differences for individual cloud types (1st Oct. 2022)

Mean error [m] | Standard deviation [m] | Number of pixels

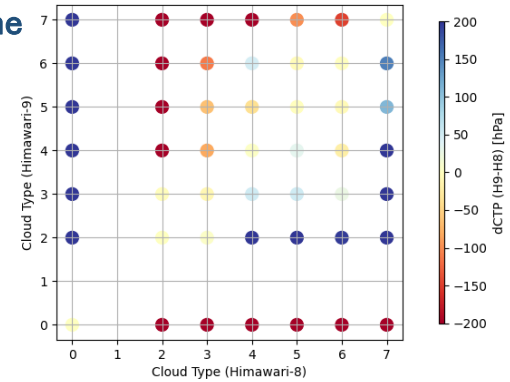
Daytime 03UTC

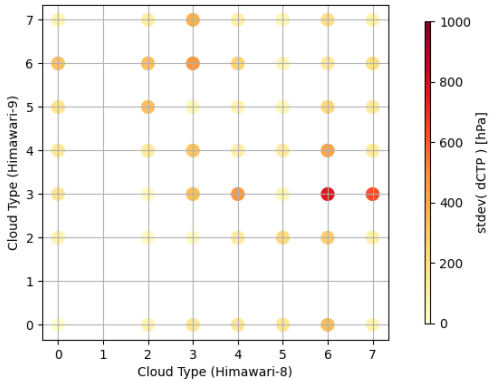


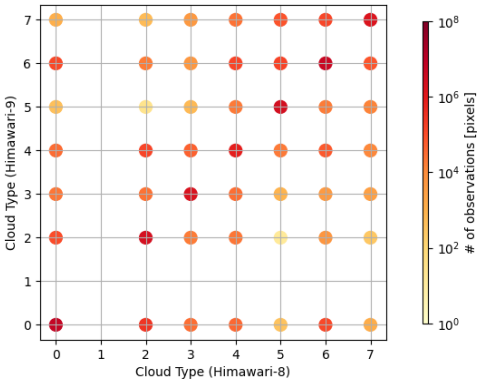




Night-time 12UTC







#	Meaning
0	Clear
1	-- (not used)
2	Liquid Water
3	Supercooled Liquid Water
4	Mixed Phase
5	Optically Thick Ice
6	Optically Thin Ice
7	Multilayered Ice

	Cloud type coincident ratio	
	Incl. clear pixels	Excl. clear pixels
Daytime	0.914	0.923
Night-time	0.915	0.927

- Discrepancies between Himawari-8 and -9 estimated cloud top heights may be significant for different cloud types.
  - Differences in cloud phase (ice or water) contribute significantly to cloud top height variations.
- Cloud type differences between Himawari-8 and -9 account for less than 10 percent of all pixels.

Clear Sky Radiance (CSR)

CSR Validation

Bands 8 and 10

- No significant difference is observed in the statistical properties of Himawari-8 and -9 CSRs.

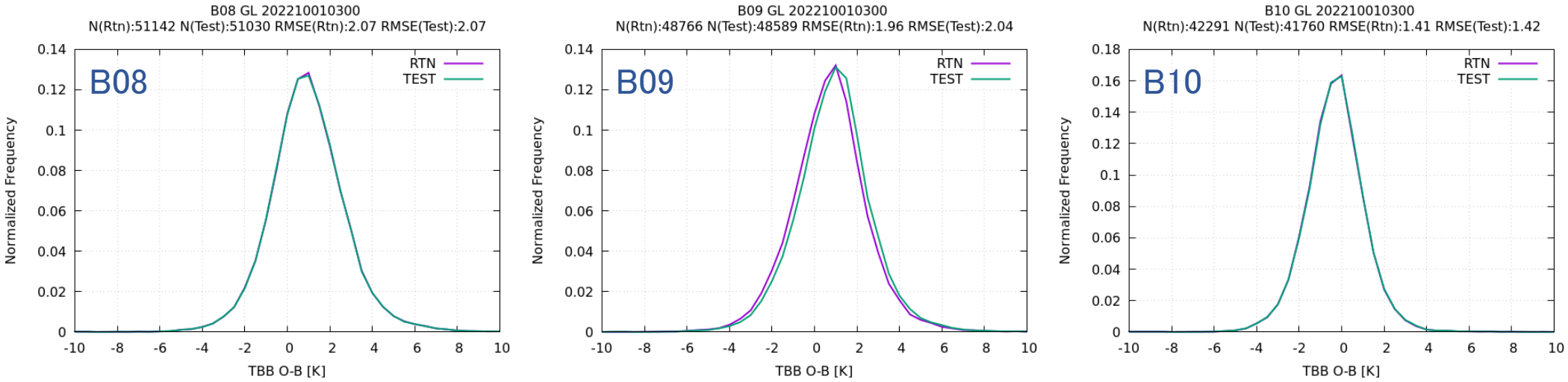
Band 9

- Clear sky brightness temperature and O-B values for Himawari-9 CSR are slightly higher.
  - This is consistent with radiometric calibration results.
- Other statistical properties are similar.

O-B histogram

Comparison of observed minus background departure (O−B) histograms (at 03UTC on 1st Oct. 2022)

Himawari-8 Himawari-9



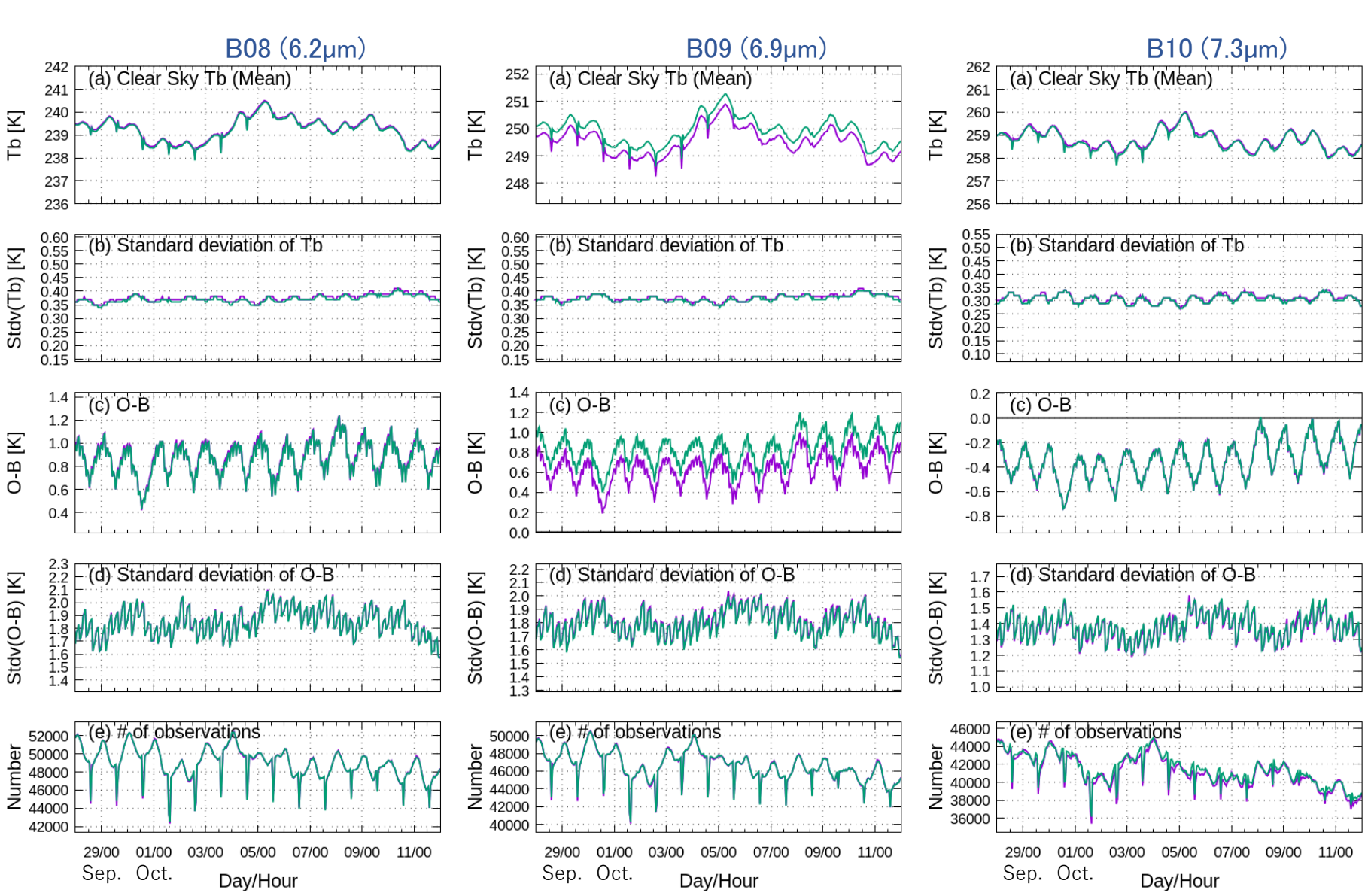
Bands 8 and 10

- The distributions of O-B for Himawari-9 CSR are similar.

Band 9

- The distribution of O-B for Himawari-9 CSR shows slightly higher temperatures (~0.2K) than for Himawari-8.

Time series of statistical properties (water vapor bands)



Bands 8 and 10

- There is no significant difference between Himawari-8 and -9 CSRs.

Band 9

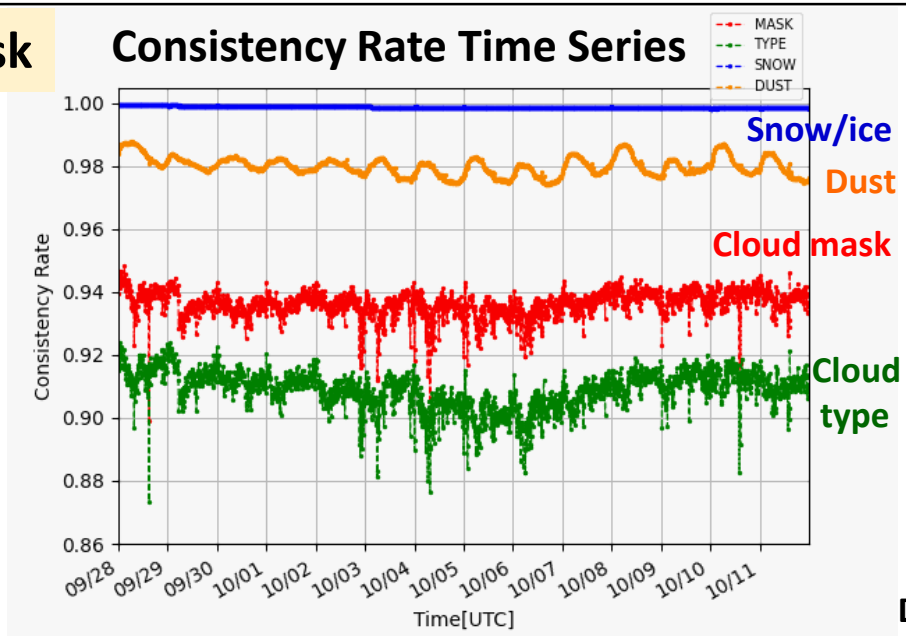
- Clear sky brightness temperature (Tb) and O-B values of Himawari-9 CSR are slightly higher

- The gaps are consistent with those of radiometric calibration and are probably associated with sensor characteristics.

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

High-resolution Cloud Analysis Information (HCAI)

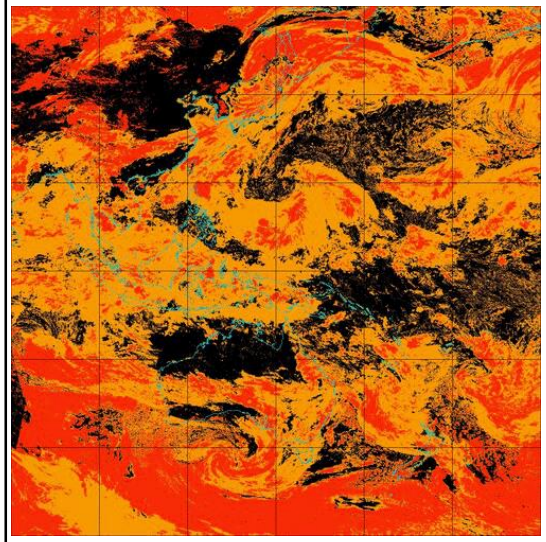
Cloud mask



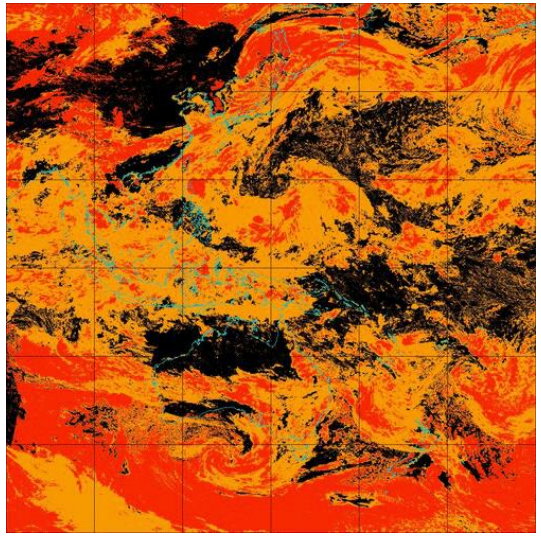
Comparison period between Himawari-8 and -9
28/September-11/October/2022

- 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.

Himawari-8

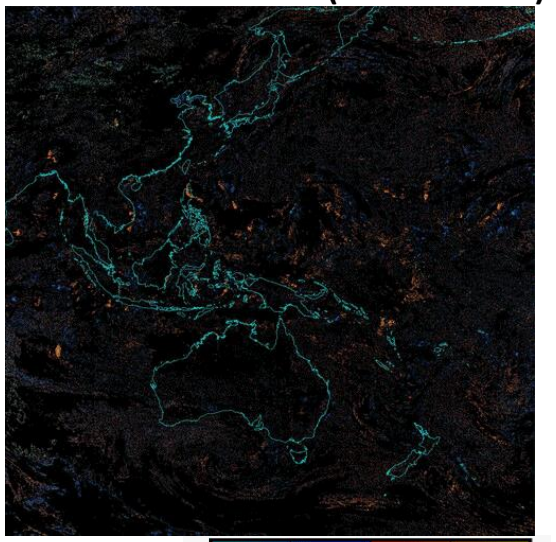


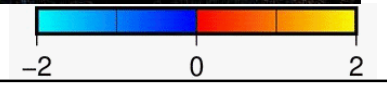
Himawari-9



00:00UTC on 11th October 2022

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

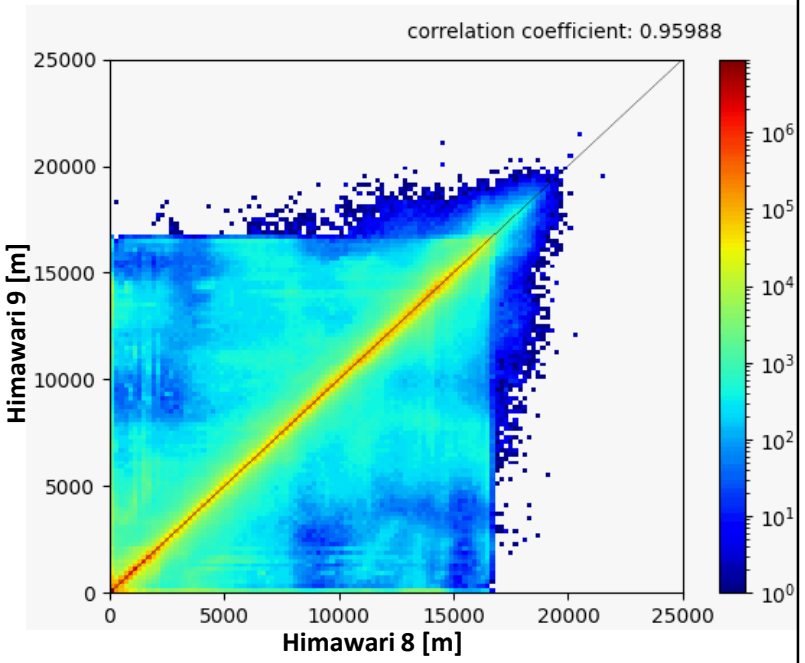




Cloud top height

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

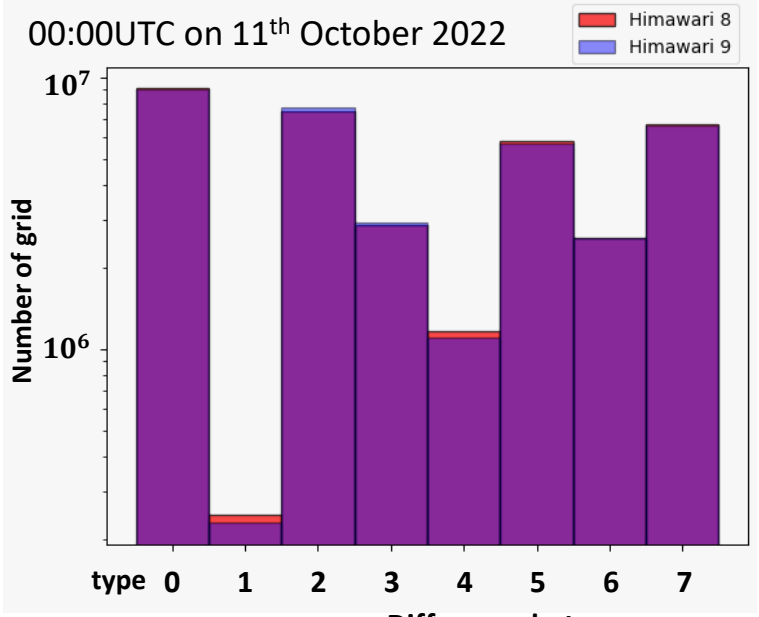
00:00UTC on 11th October 2022

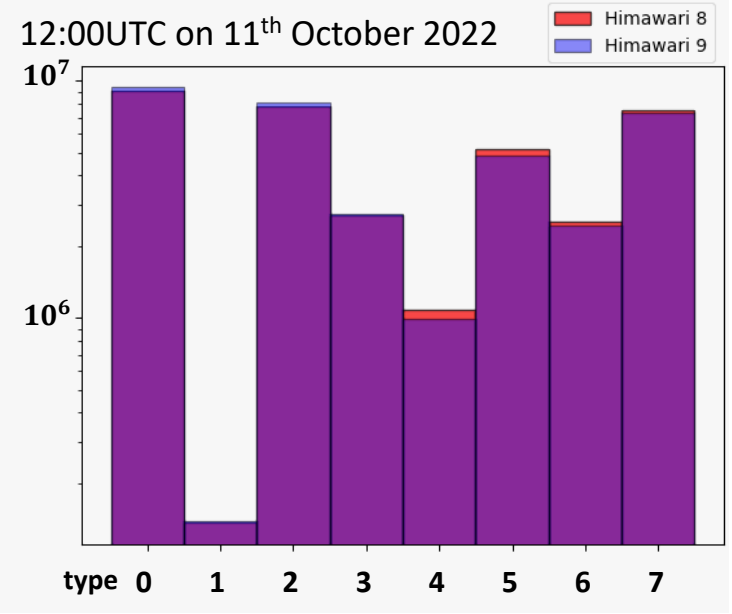


- There is no significant difference in distribution.
- The scatterplot is generally on a straight line of Himawari-8 = Himawrai-9.

Cloud type

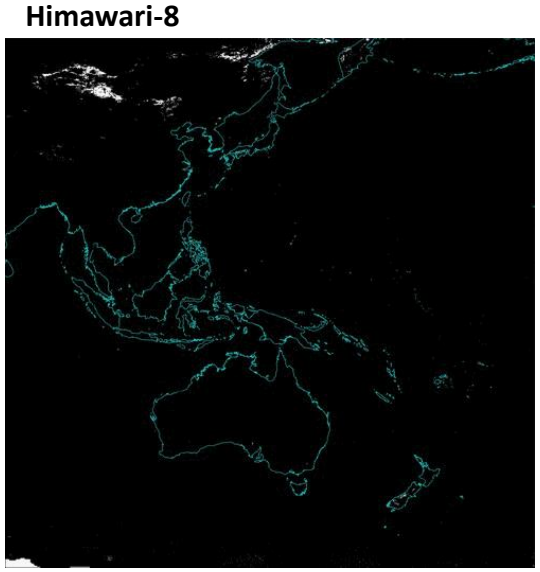
- There is no significant difference in distribution.
- Himawari-9 HCAI cirrus tends to be slightly greater at day and night, while Himarari-8 HCAI low cloud tends to be slightly greater at night.

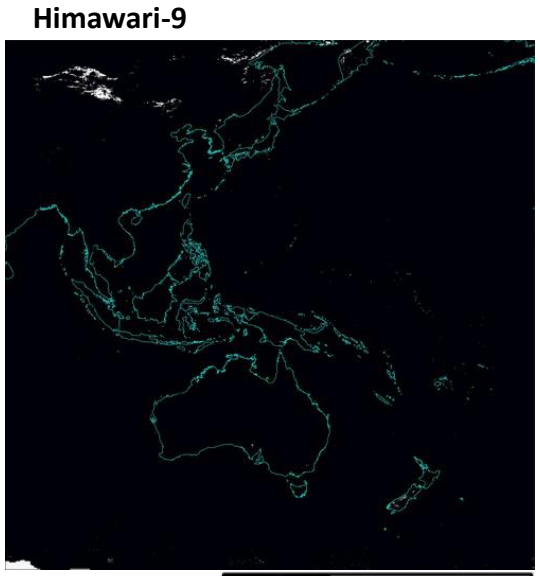


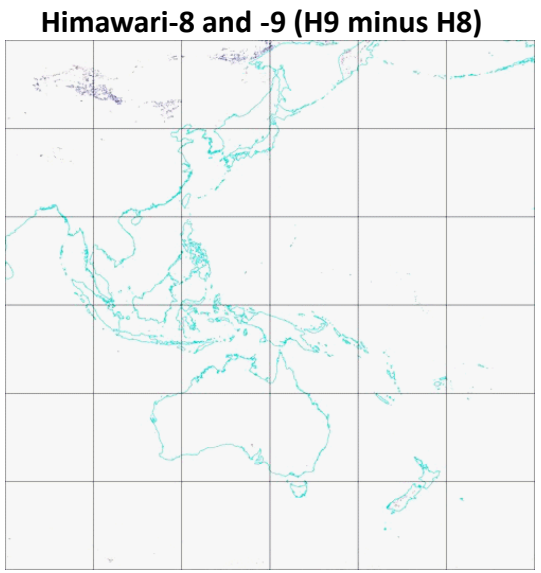


No.	type
0	Clear
1	Cumulonimbus
2	Cirrus
3	Middle cloud
4	Cumulus
5	Stratocumulus
6	Stratus or fog
7	Dense cloud

Snow ice mask







00:00UTC on 11th October 2022

- All meteorological parameters derived from Himawari-9 data are similar to those of Himawari-8.
- Himawari-9 HCAI cirrus tends to be slightly greater at day and night, while Himarari-8 HCAI low cloud tends to be slightly greater at night.
- The area of snow-covered land derived from Himawari-9 data tends to be slightly smaller, while the sea ice area is similar.

- There is no significant difference in distribution.
- As with the last health-check observation, the area of snow-covered land derived from Himawari-9 data tends to be slightly smaller.

Summary (HCAI)

- All meteorological parameters derived from Himawari-9 data are similar to those of Himawari-8.

- Himawari-9 HCAI cirrus tends to be slightly greater at day and night, while Himarari-8 HCAI low cloud tends to be slightly greater at night.

- The area of snow-covered land derived from Himawari-9 data tends to be slightly smaller, while the sea ice area is similar.