The 12th Asia-Oceania Meteorological Satellite Users' Conference

Pre-operational Validation of AHI on Himawari-9, in navigation and calibration

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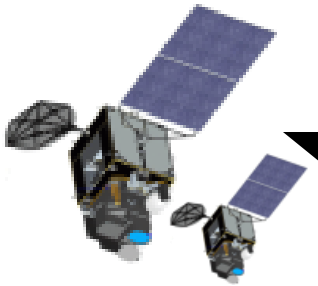

2014 Himawari-8
2016 Himawari-9

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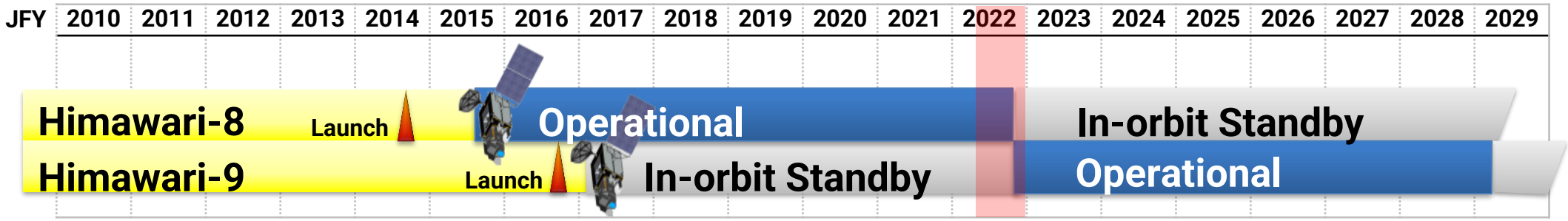
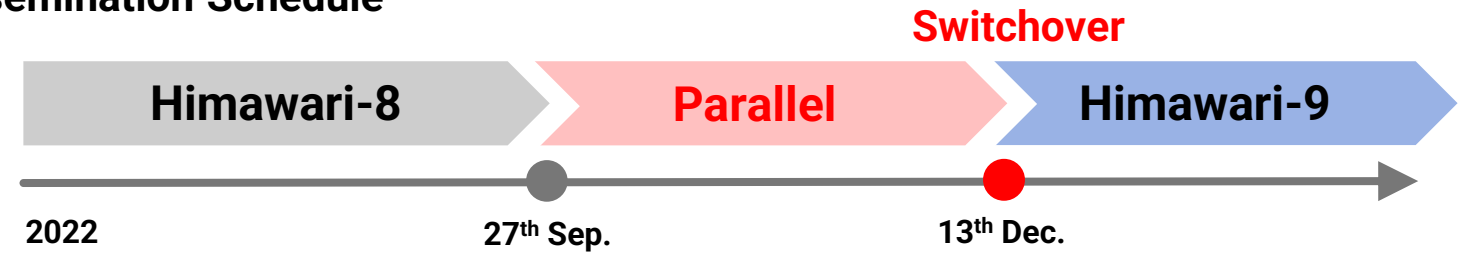
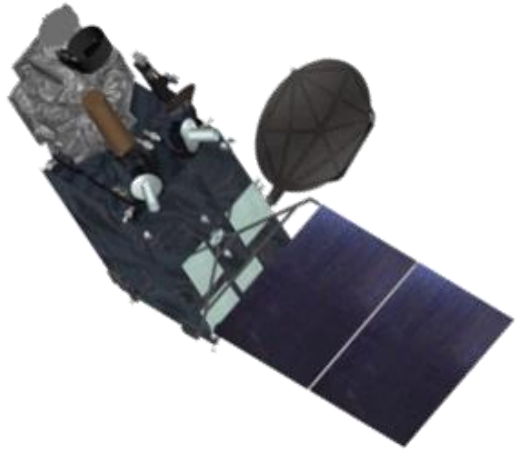
Mission Overview

- Himawari-8 and -9 are the third generation geostationary meteorological satellites operated by Japan Meteorological Agency (JMA).



Dissemination Schedule

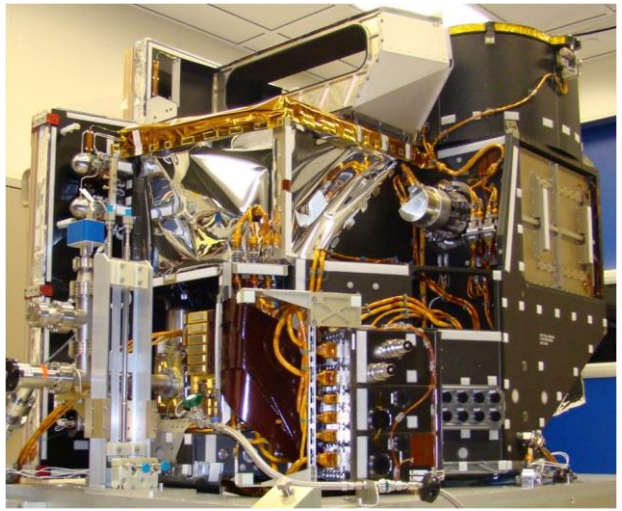




- **Switchover** of operational satellite from Himawari-8 to -9 is planned on **13th December 2022**.
- **Parallel dissemination** of Himawari-9 products started on **27th September**.

AHI Specifications

- Advanced Himawari Imager (AHI) onboard Himawari-8 and -9 is the same series imager as ABI on GOES satellites and AMI on GK2A.



Band	Wavelength [μm]	Spatial Resolution at SSP [km]	
1	0.47	1	RGB band Composited
2	0.51	1	
3	0.64	0.5	
4	0.86	1	
5	1.6	2	
6	2.3	2	
7	3.9	2	
8	6.2	2	Water Vapor
9	7.0	2	
10	7.3	2	
11	8.6	2	SO_2
12	9.6	2	O_3
13	10.4	2	Atmospheric Window
14	11.2	2	
15	12.3	2	
16	13.3	2	CO_2

Spectral Response Functions

Himawari-8
Himawari-9

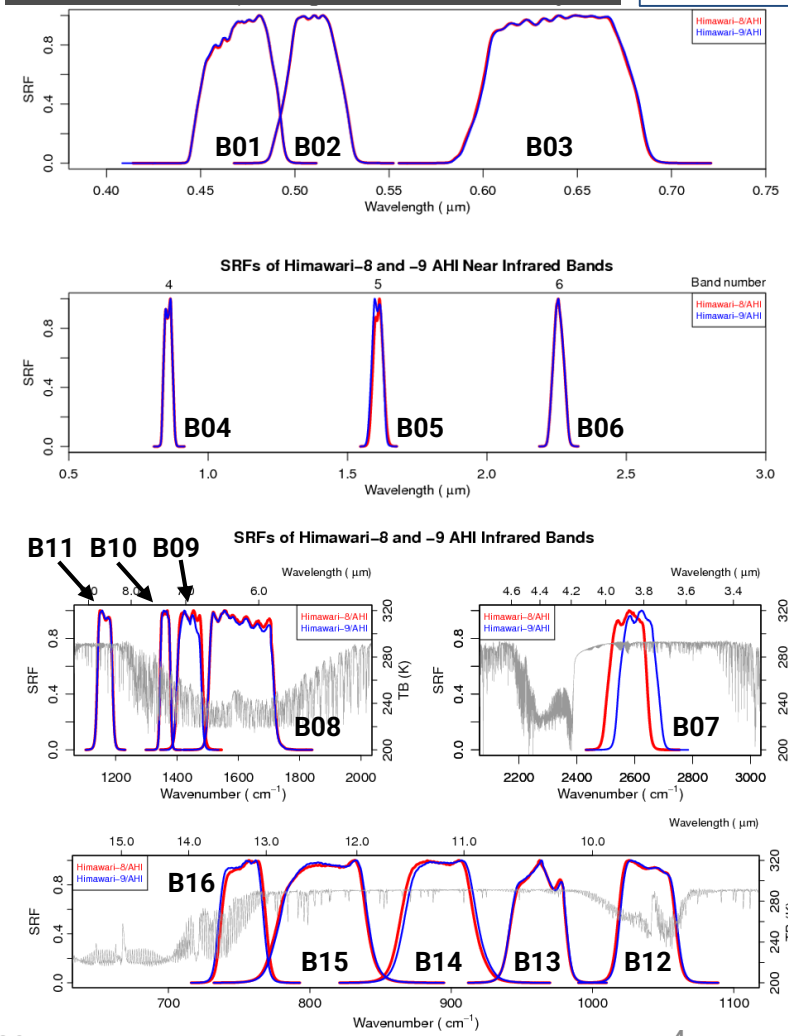


Image Navigation and Registration (INR)

Navigation accuracy

- Absolute navigation accuracy is analyzed by landmark matching approach using observation imagery and referential maps.
- The landmark analysis indicates a Himawari-8 and -9 navigation accuracy of ~0.3 km.
- Information on daily Himawari-8 and -9 accuracy is available on the monitoring web page.

https://www.data.jma.go.jp/mscweb/data/monitoring/navigation.html

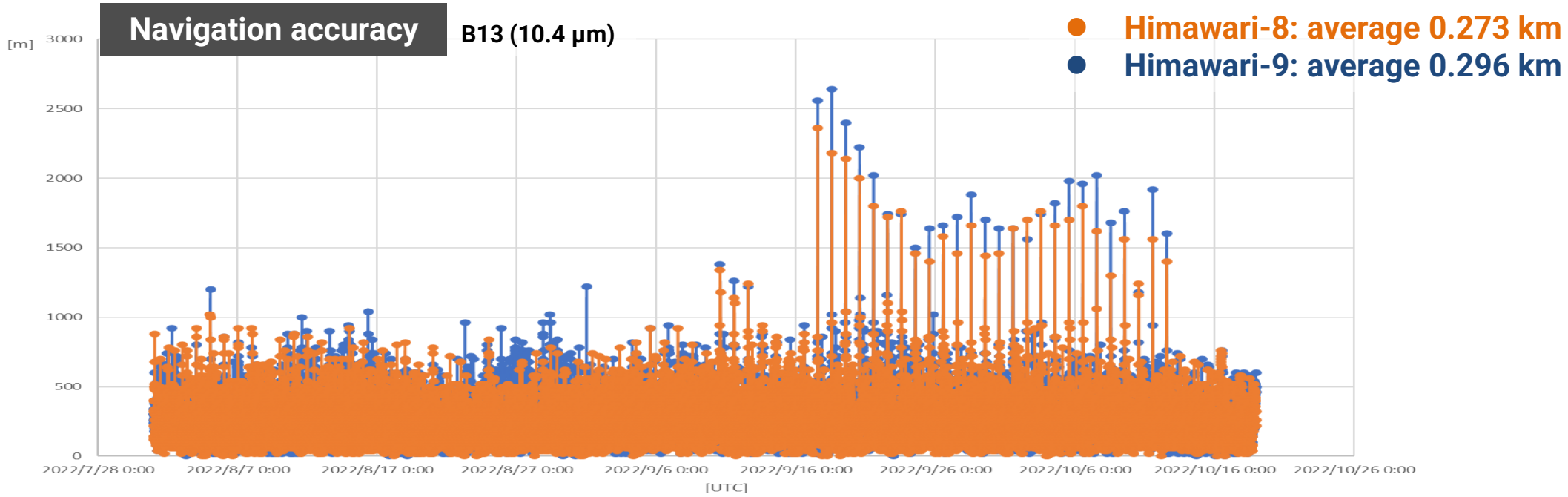
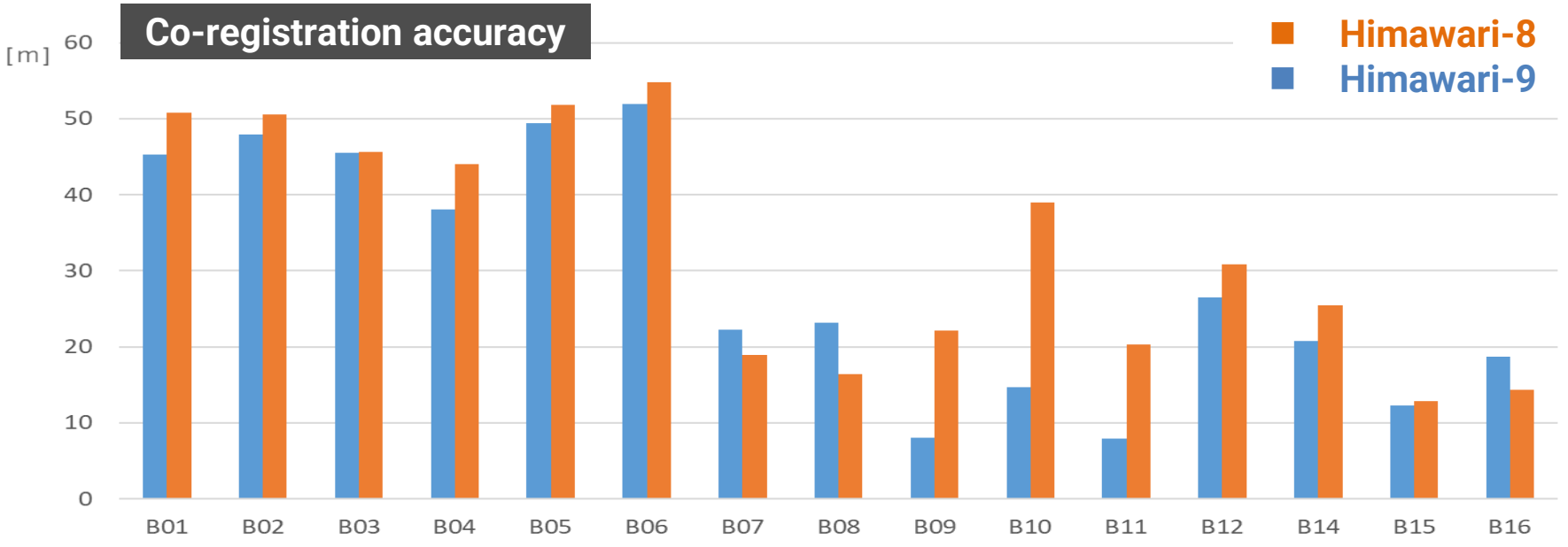


Image Navigation and Registration (INR)

Inter-band navigation (co-registration) accuracy

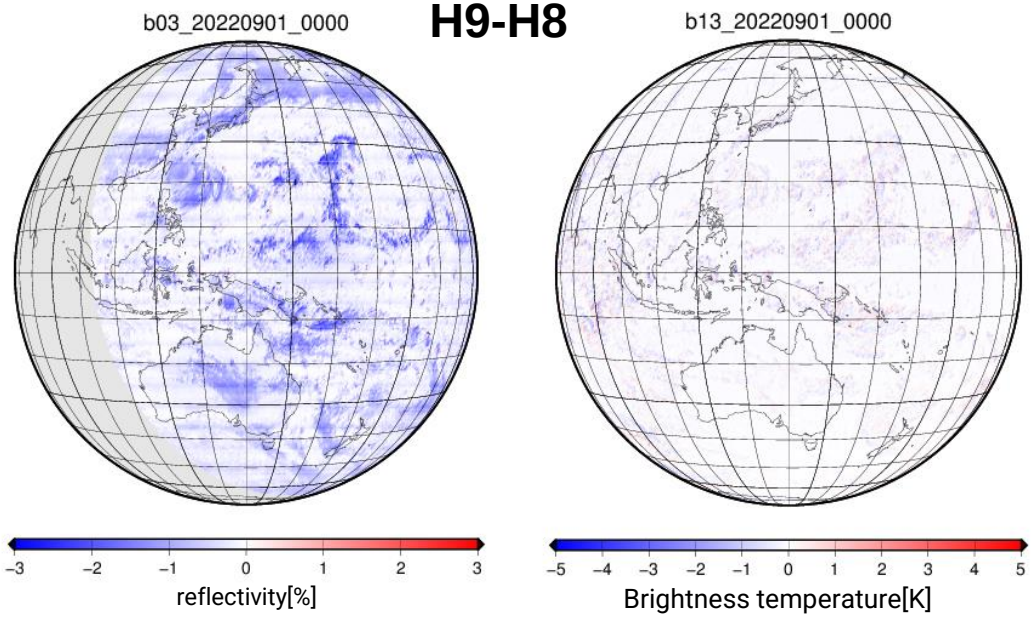
- Relative navigation accuracy is analyzed via pattern matching between imagery of the reference band and the other bands.
- Himawari-9 navigation accuracy with respect to Band 13 is ~40 m for VNIR bands and ~20 m for IR bands, which is almost identical to those of Himawari-8. (20 m corresponds to 0.01 pixel for IR bands at SSP.)

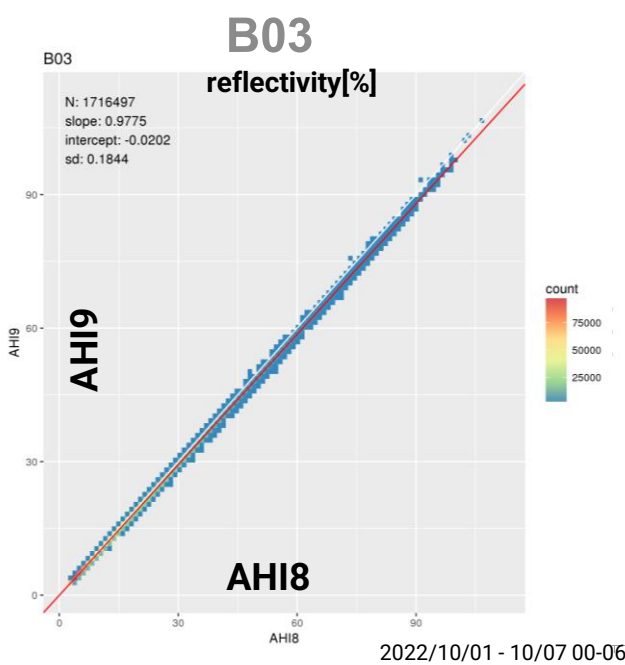


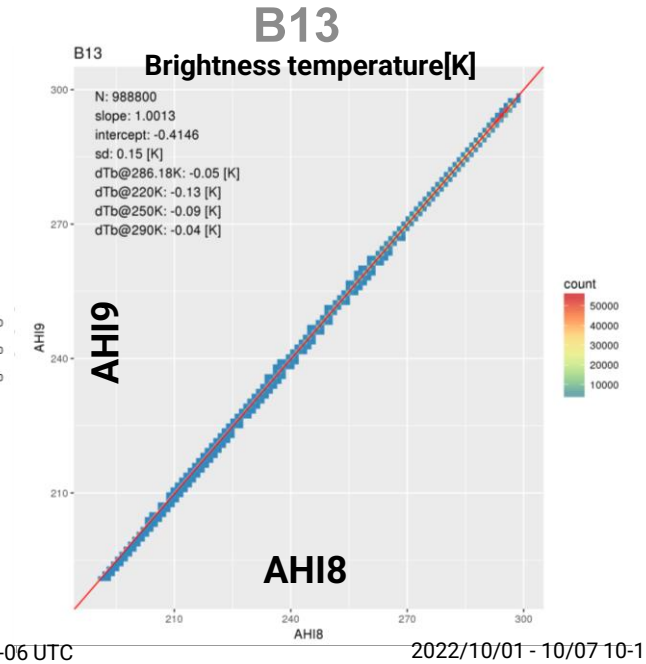
Reference: B13 (10.4 μm)
24h average on 18 Oct. 2022

Radiometric Calibration(vs Himawari-8)

- Direct comparison between Himawari-8 and Himawari-9 data is also made.（SRF difference between Himawari-8 and Himawari-9 AHI is not considered.）
- The figure shows the difference between Himawari-8 and Himawari-9.
- The difference between Himawari-8 and Himawari-9 is about -3% in B03 and within ± 1K in B13.
- The graphs shows scatter plots of Himawari-8 and Himawari-9 data with the regression line.







Radiometric Calibration(vs Himawari-8)

	slope	intercept
B01	1.047504	-0.192599
B02	1.005938	-0.030515
B03	0.977463	-0.020175
B04	0.996984	-0.001054
B05	0.944775	-0.014441
B06	0.983935	0.005019

	slope	intercept	H9-H8 @StdTb	H9-H8 @220K	H9-H8 @250K	H9-H8 @290K
B07	0.991184	2.709637	0.189 @285.95K	0.770	0.506	0.153
B08	0.997591	0.555582	-0.010 @234.65K	0.026	-0.047	-0.143
B09	1.004864	-0.808532	0.378 @243.85K	0.262	0.408	0.602
B10	0.998054	0.510754	0.015 @254.59K	0.083	0.024	-0.054
B11	0.998931	0.286968	-0.016 @283.82K	0.052	0.020	-0.023
B12	0.997384	0.630637	-0.048 @259.45K	0.055	-0.023	-0.128
B13	1.001289	-0.414588	-0.046 @286.18K	-0.131	-0.092	-0.041
B14	0.997660	0.615102	-0.054 @286.10K	0.100	0.030	-0.064
B15	1.002840	-0.756607	0.049 @283.78K	-0.132	-0.046	0.067
B16	0.970155	6.296058	-1.754 @269.73K	-0.270	-1.165	-2.359

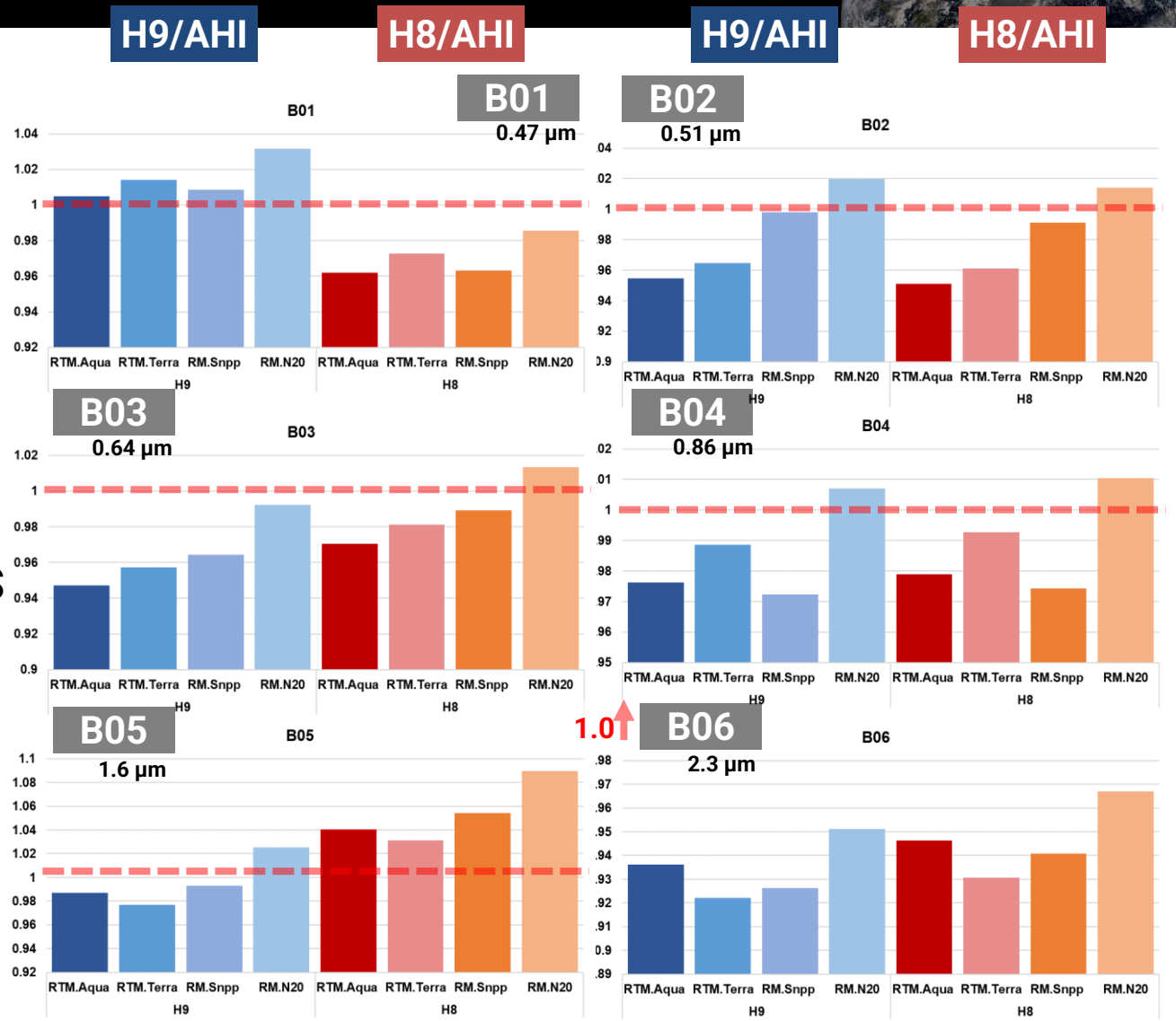
- The table shows the slope, intercept, and brightness temperature difference for each band.
- In VNIR bands, there are differences of about 5%.
- In IR bands , there are differences of - 0.1K to 2K at standard radiance.

Data period：2022/10/01–07 B01–B06: 00–06UTC, B07–B16: 10–13UTC
SRF difference between Himawari-8 and Himawari-9 AHI is not considered.

Radiometric Calibration (VNIR bands)

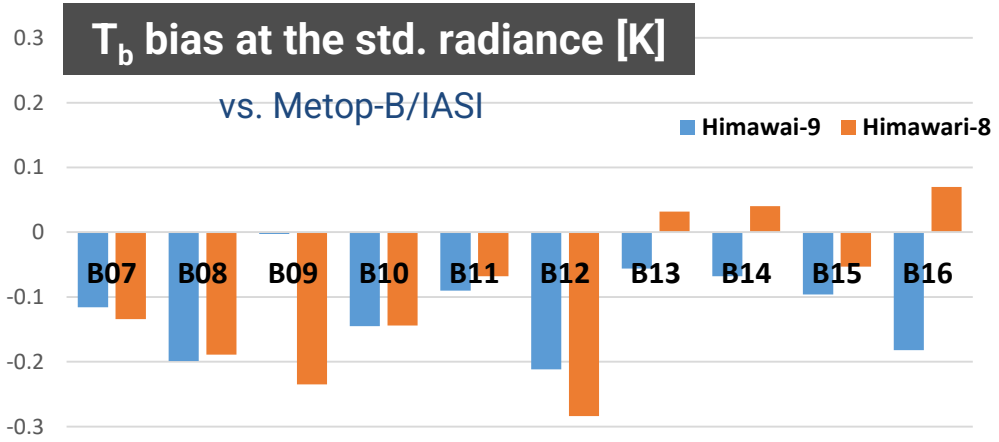
- Calibration accuracy is validated by following approaches developed under the GSICS framework.
  - RTM based approach utilizing MODIS (Aqua and Terra)
  - Direct comparison (ray-matching approach) with VIIRS (SNPP and N20)
- Although there are differences depending on the methods and the reference satellites, observation values of Himawari-9 are within ~5% from the references.
- B06 differs from Himawari-8 by ~1–2%, but there is a bias of 5–9% in comparison with MODIS and VIIRS
- The bias correction coefficients have not been determined yet. The correction coefficients in the header part of the Himawari-9 Standard Data (HSD) will be updated in the future when the validation period gets enough to catch the annual variation.

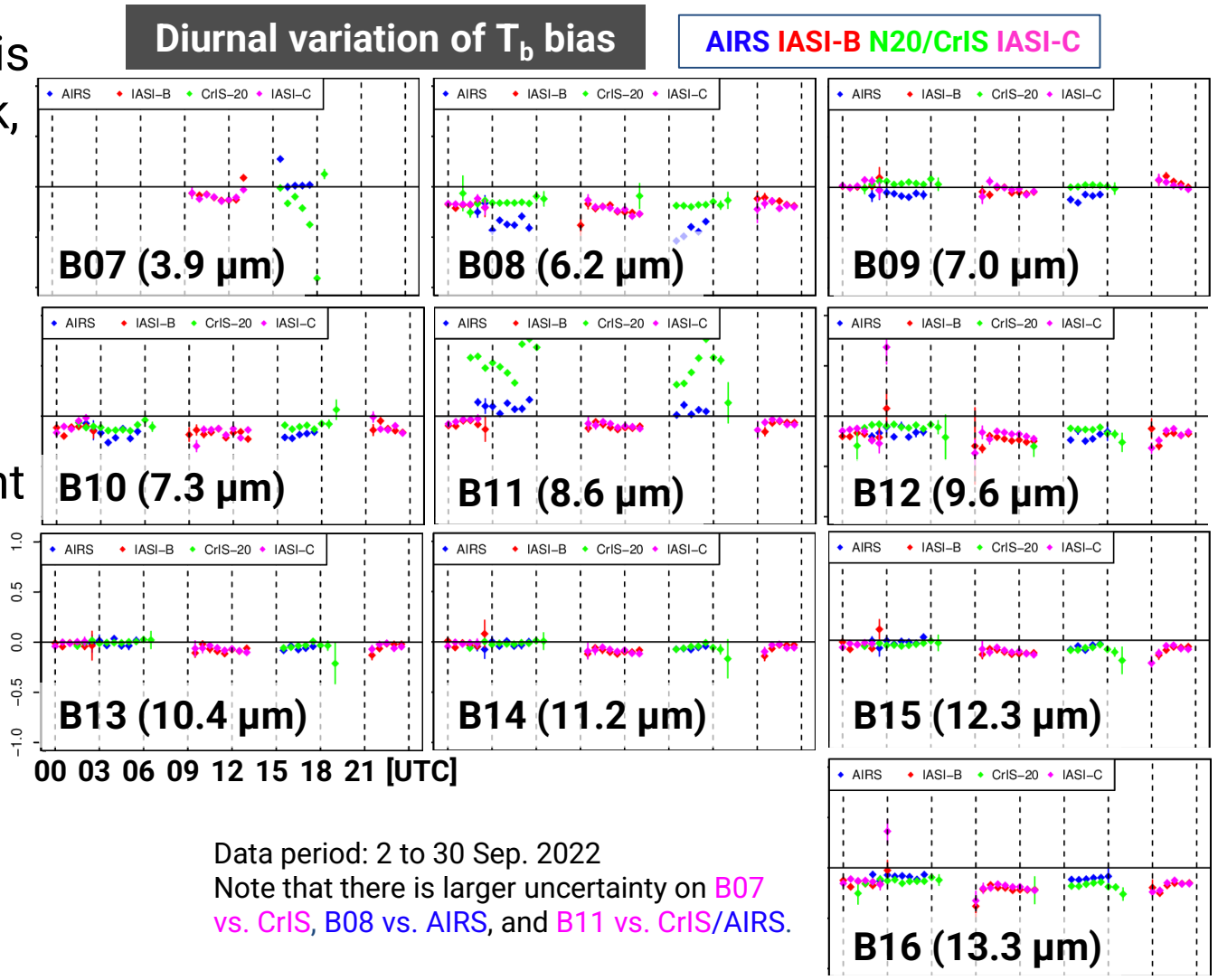
Data period:
1 to 30 days in Sep. 2022,
depending on the references.



Radiometric Calibration (IR bands)

- Calibration validation method for IR bands is also developed under the GSICS framework, which utilizes hyper spectral IR sounders.
- The brightness temperatures (T_b) observed with Himawari-9 are within 0.3 K from the reference at a standard radiance. (T_b corresponding to clear sky ocean surface).
- Similar to Himawari-8, there is no significant diurnal variation for the T_b bias.



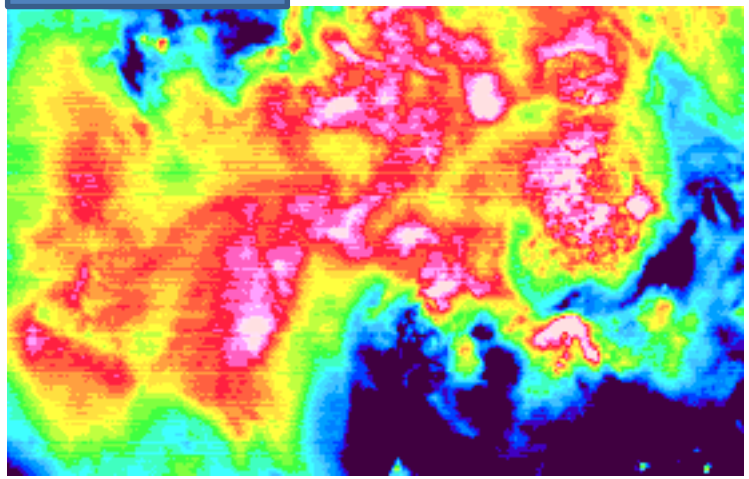


Data period: 2 to 30 Sep. 2022
Note that there is larger uncertainty on B07 vs. CrIS, B08 vs. AIRS, and B11 vs. CrIS/AIRS.

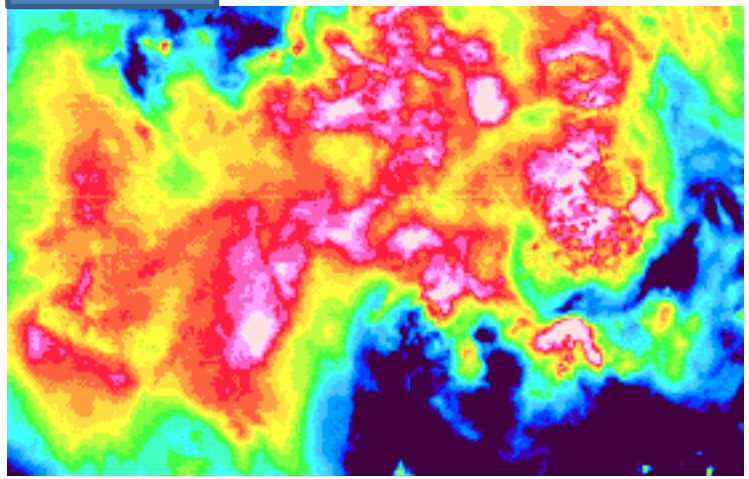
Destriping（B03）

- In the visible bands , stripes can be seen especially in high radiance.
- By utilizing a north-south (NS) scan, it is possible to estimate the sensitivity difference between the detectors and calculate the correction coefficients.
- The correction coefficients have been applied in B03 to reduce stripes seen in high radiance.

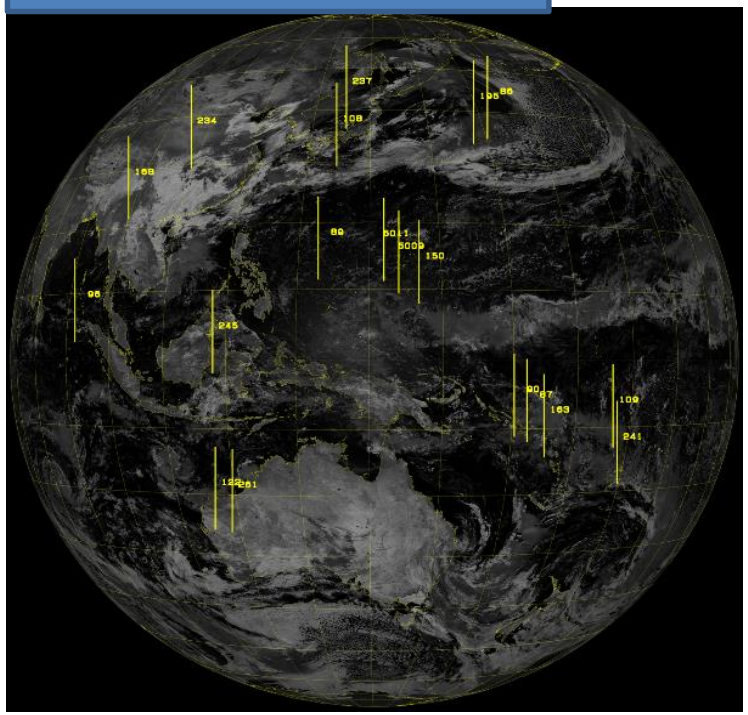
not corrected



corrected



Concept of the NSscan



Summary

- Switchover of operational satellite from Himawari-8 to -9 is planned on 13th December 2022.
- Validation of Himawari-9/AHI Data Quality
  - INR accuracy is ~0.3 km (for reference mapping) and 40 m (between bands) at SSP.
  - VNIR bands observation is within ~5% from the reference. The bias correction coefficients have not been determined and will be updated in the future.
  - The observed brightness temperatures (T_b) are within 0.3 K from the reference at the standard radiance, and their bias has no significant diurnal variation.
  - The stripes has been reduced in B03 by utilizing NS scan.