

Improvement of Himawari-8 observation data quality

The Japan Meteorological Agency (JMA) updated its Himawari-8 ground processing system to improve the quality of Himawari-8 imagery provided in Himawari Standard Data (HSD) format and related products at 05:00 UTC on 16 November 2016. The update included:

- 1) improvement of band-to-band co-registration and image navigation performance; and
- 2) addition of observation area information in true-color images from target area observation.

Note: The HSD format has not changed as a result of this update.

1) Improvement of band-to-band co-registration and image navigation performance

To mitigate band-to-band co-registration error, a new co-registration process was applied to infrared bands 7, 8, 9, 10, 11, 12 and 15 on 9 March 2016. The process was also applied to the remaining infrared bands (14 and 16) as well as visible bands 1, 2 and 3 and near-infrared bands 4, 5 and 6 at 05:00 UTC on 16 November 2016.

The algorithm for visible and near-infrared bands in the daytime is identical to that for infrared bands, whose correction is determined using pattern-matching analysis. In the algorithm for visible and near-infrared bands at nighttime, correction is re-optimized using past sensor temperature data. As the band-to-band co-registration error of visible and near-infrared bands with respect to reference band 13 tends to increase during the night, this new process is expected to reduce nighttime error. The mitigation of band-to-band co-registration error is also expected to reduce image navigation error.

Figure 1 shows the co-registration error of band 5 with respect to band 13.

Co-registration error was mitigated from 0.83 pixels (equivalent to 1.66 km at the sub-satellite point) to 0.03 pixels (0.06 km) in the HSD 2 km-resolution band after implementation of the new process.

Table 1 shows the results of diurnally averaged band-to-band co-registration for all

bands with respect to band 13 observation validated using observation data on 3 September 2016.

The results indicate that co-registration error for all bands was consequently reduced.

The new process will be applied to remaining bands in this update, thereby reducing the average co-registration error of all bands to approximately 0.04 km.

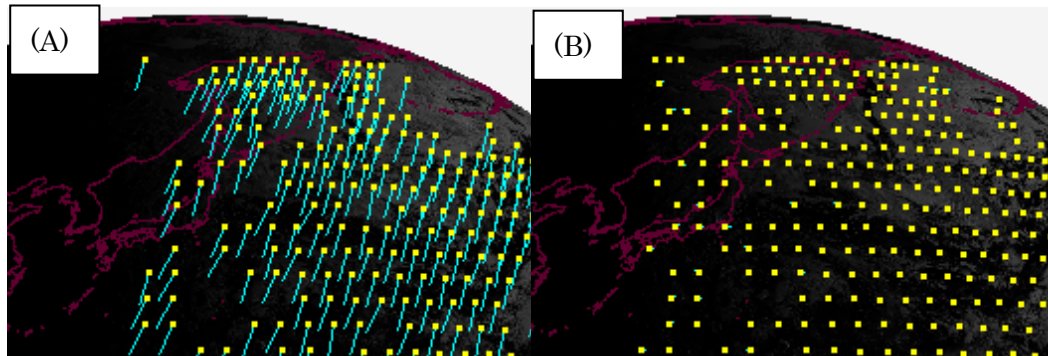


Fig. 1. (A) Band-to-band co-registration error of band 5 w.r.t. band 13 observation at 21:00 UTC on 3 September 2016. (B) As per (A), but with the new process. Yellow dots show validation points, and light-blue line segments with yellow dots represent the direction and length of the error to be corrected.

Table 1: Diurnally averaged band-to-band co-registration error of each band w.r.t. band 13 observation data for 3 September 2016

The before and after columns show errors for co-registration before and after the implementation of the new process in terms of pixel size, with each pixel corresponding to 2 km at the HSD sub-satellite point. (*Before* values are not shown for bands 7, 8, 9, 10, 11, 12 and 15, for which the new process was implemented on 9 March 2016.)

Band	Co-registration error w.r.t. band 13		Update status
	Before	After	
1	0.290	0.025	Updated on 16 November 2016
2	0.291	0.027	
3	0.413	0.024	
4	0.315	0.020	
5	0.801	0.023	
6	0.187	0.027	
7	----	0.012	Updated on 9 March 2016
8	----	0.012	
9	----	0.012	
10	----	0.012	
11	----	0.011	
12	----	0.010	
13	Reference band		
14	0.120	0.011	Updated on 16 November 2016
15	----	0.008	Updated on 9 March 2016
16	0.019	0.009	Updated on 16 November 2016

In addition to the new band-to-band co-registration process, part of the image navigation process for the ground processing system was also updated. Navigation bias in the columnar direction was previously greater than that in the linear direction. This update mitigates bias in the columnar direction, bringing both biases to a similar level.

Table 2 shows image navigation error as evaluated via landmark analysis for the reference band (band 13) on 3 September 2016.

The results indicate a slight reduction of error as a result of the update.

Table 2: Diurnally averaged root mean square error of image navigation error evaluated for band 13 (reference band) on 3 September 2016. Before and after values represent image navigation error before and after implementation of the new process in pixels, with each pixel corresponding to 2 km at the sub-satellite HSD point.

	Image navigation error of reference band			
	Linear direction (north-south)		Columnar direction (east-west)	
	Before	After	Before	After
Mean error	0.047	0.041	-0.110	-0.009
RMSE	0.112	0.110	0.162	0.121

2) Addition of observation area information in true-color images for target-area observation

The target observation area of the Advanced Himawari Imager (AHI) on board Himawari-8/-9 can be readily changed. To clarify the observation area, related data are included with true-color images (PNG format) of the target area as outlined below.

Position: Text information field (tEXt) of ancillary chunk (with the keyword "Description")

Table 3: Modified ancillary chunk field

	Before	After
Title	True_Color_Image	No change
Author	Japan Meteorological Agency	No change
Description	Target_area	Latitude/longitude information*

In line with the update, latitude/longitude data for the top-left/bottom-right points (including the black part outside the observation area) are indicated in the tEXt part of the ancillary chunk of true-color image files with the keyword "Description" rather than the phrase "Target_area."

Latitude and longitude are expressed as five-digit fixed-length positive real numbers, respectively, with a single character indicating northern (N) or southern (S) latitude, eastern (E) or western longitude (W). Spaces are inserted as required at the beginning of the string (example below).

Figure 2 shows a target-area true-color image based on latitude/longitude grid coordinate projection. The difference in latitude/longitude between the top-left and bottom-right positions is 15 degrees in each direction.

* Example of modified information (description code)

(26.0N,112.0E)-(11.0N,127.0E)

(2.0S,152.0E)-(17.0S,167.0E)

(28.0N,168.0W)-(13.0N,153.0W)

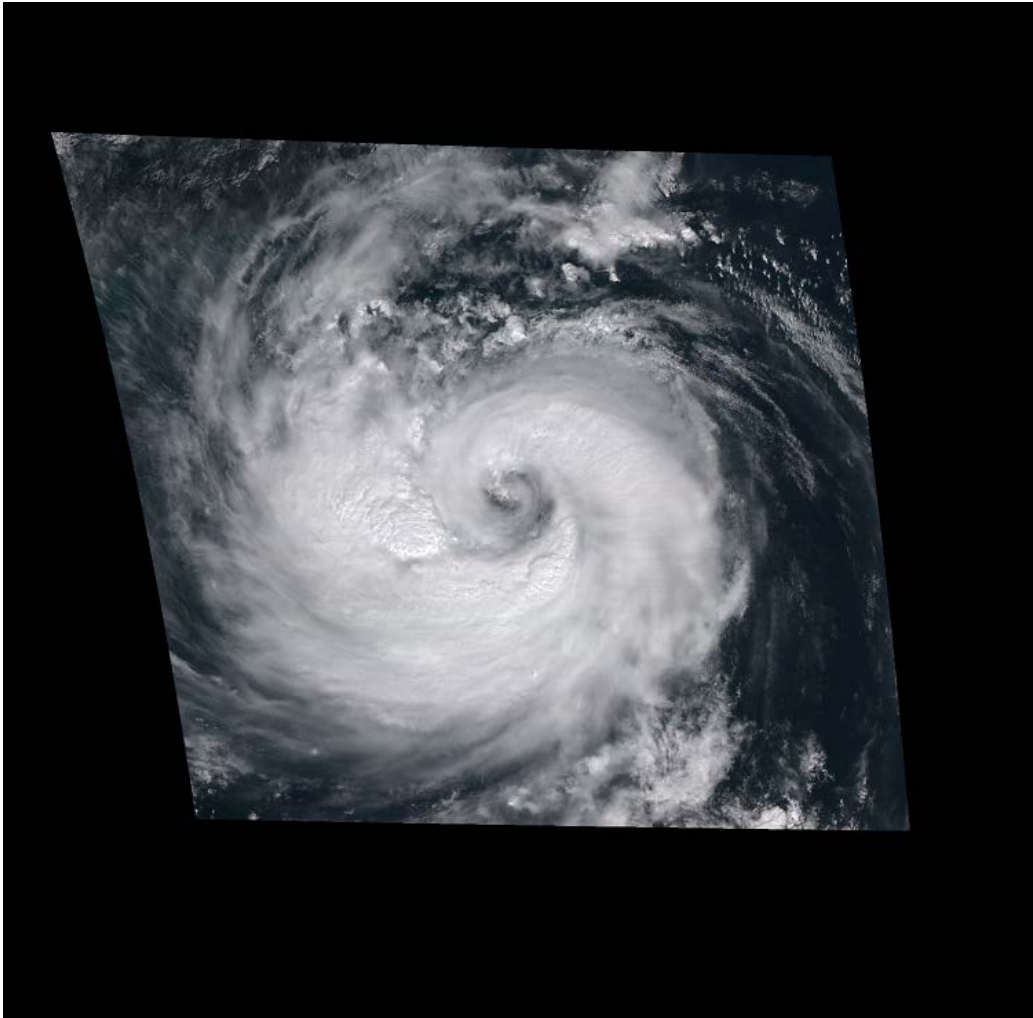


Fig. 2 True-color image from target-area observation

The top-left position of the image (including the black area outside the observation zone) is 26.0°N , 112.0°E , and the bottom-right position is 11.0°N , 127.0°E .

The modified information for the ancillary chunk field is “(26.0N,112.0E)-(11.0N,127.0E)”.