CURRENT STATUS OF ATMOSPHERIC MOTION VECTORS AT JMA

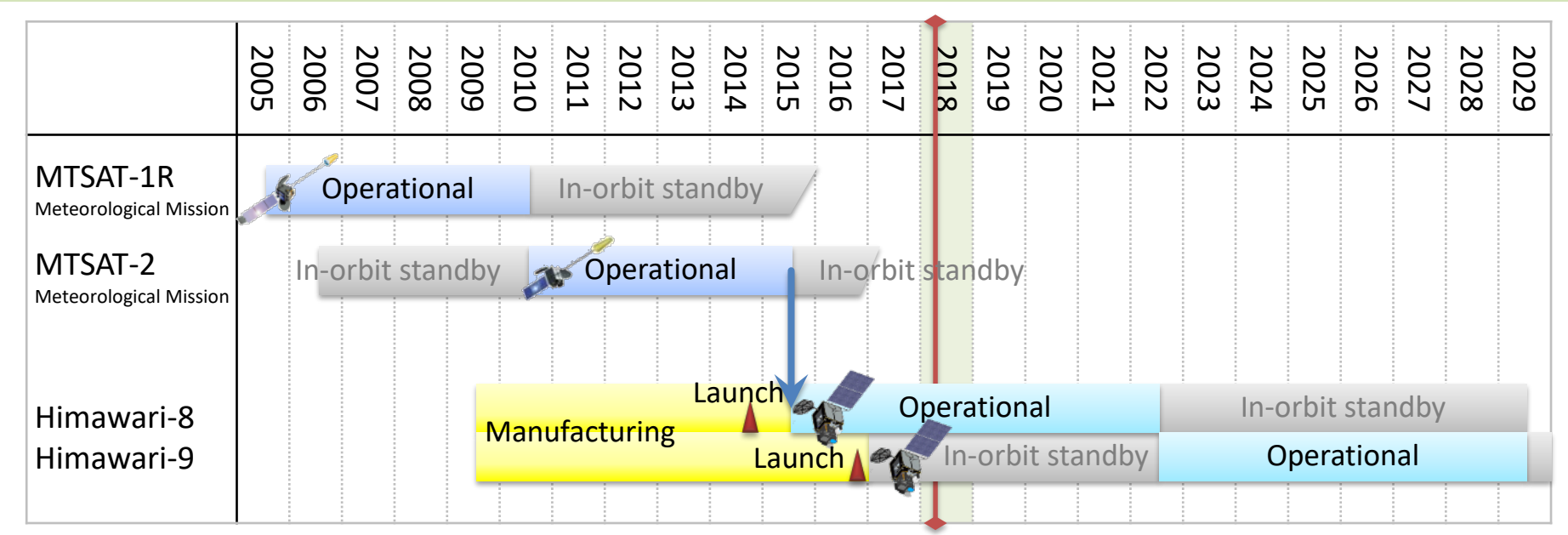
JMA/MSC
Kenichi Nonaka

IWW14@Jeju, 23-27 April, 2018

Contents

- Mission schedule and configuration of Himawari-8/-9
- Navigation and Calibration errors of Himawari-8/-9
- AMV of health check operations of Himawari-9
  - Comparison between H-8 AMV and H-9 AMV by using the Health Check data
- Current status of Himawari-8/9 AMV
- Summary

Himawari-8/9 Mission Schedule

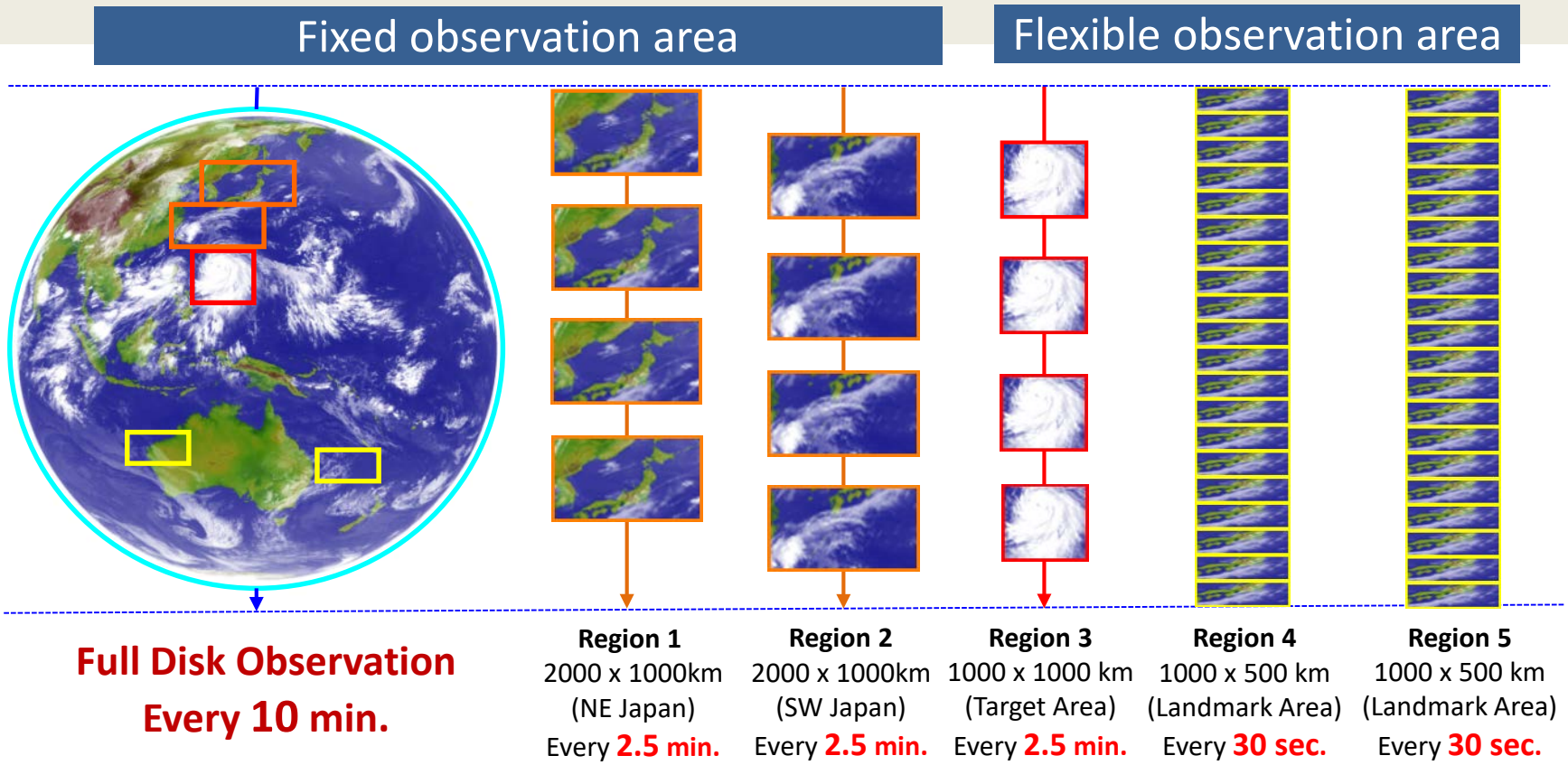


- Himawari-8 has been operational since July 2015.
- Himawari-9 was launched in November 2016 and has started in-orbit standby since 10 Mar, 2017 and MTSAT-2 terminated its meteorological mission.
- Himawari-9 will continue in-orbit standby until 2022 and it will be operational until 2029 as a successor to Himawari-8.

Contingency Plan

- In case of Himawari-8 anomaly or scheduled maintenance, Himawari-9 performs back-up of the observation.
- Himawari-9 data dissemination quickly starts after the anomaly;
  - VIS (Band 01-03) : ~ 4 hours after
  - NIR/IR (Band 04-16) : ~ 24 hours after
- Himawari-8 observation is cancelled due to a scheduled maintenance basically once a year for several hours.
- Himawari-8 and -9 system ensures the availability of equivalent observation data until 2029.

Full Disk / Regional Observation in 10 min Repeat Cycle

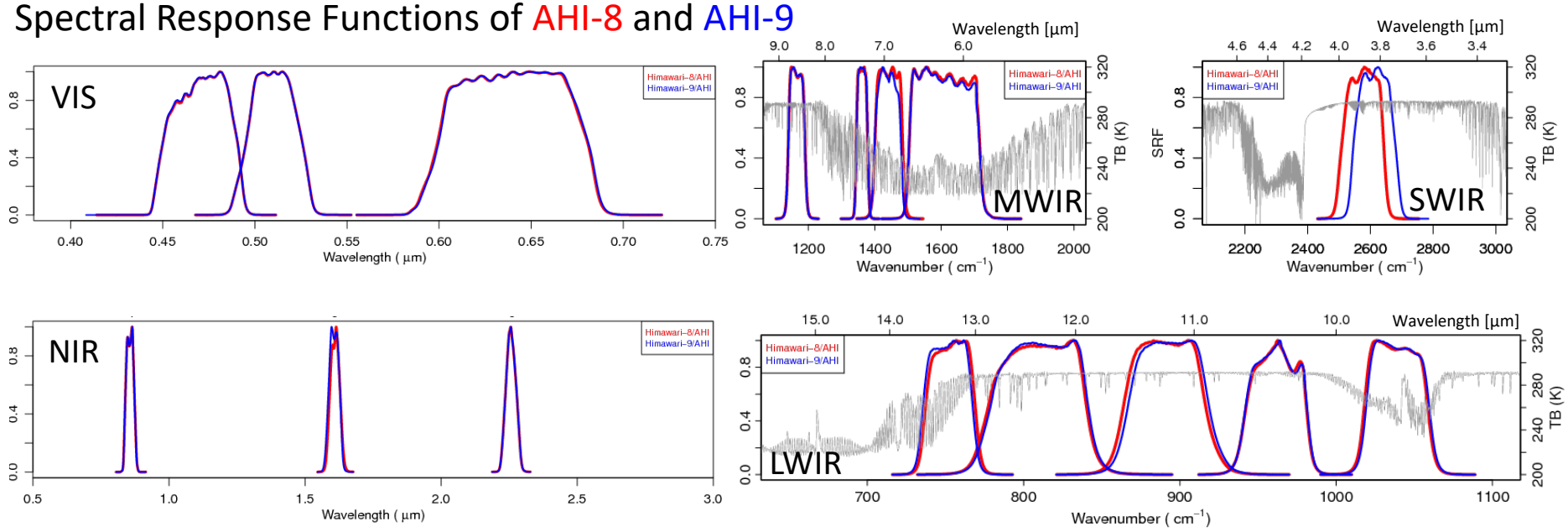


Configuration and Characteristics of Himawari-8/-9 AHI

AHI Band Configuration

	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
Central Wave length [μm]	0.47	0.51	0.64	0.86	1.6	2.3	3.9	6.2	6.9	7.3	8.6	9.6	10.4	11.2	12.4	13.3
Spatial Resolution [km]	1	1	0.5	1	2	2	2	2	2	2	2	2	2	2	2	2

Spectral Response Functions of AHI-8 and AHI-9



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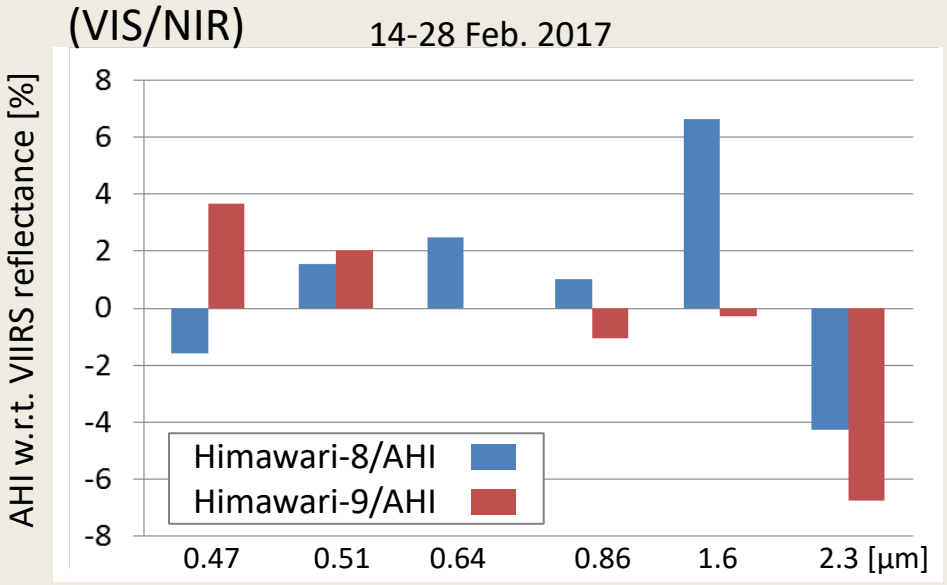
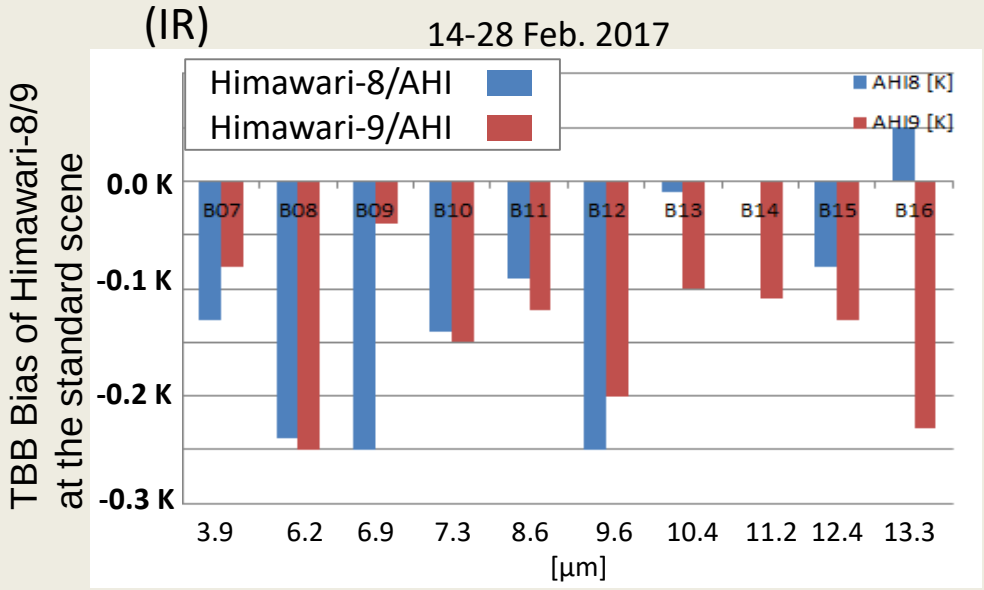
Calibration Validation in AHI-8/-9



Relative biases of Himawari-9: between +4% and -7%

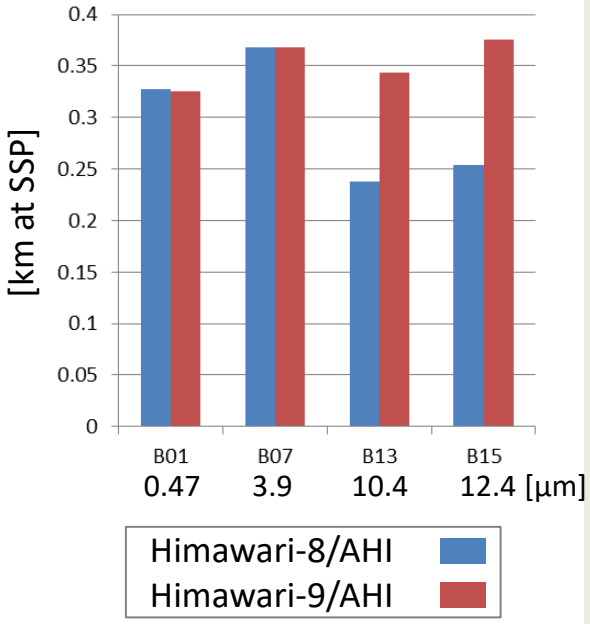


Brightness temperature of infrared bands was validated with regard to the LEO hyper-spectral sounder (Metop/IASI) at the standard scene.

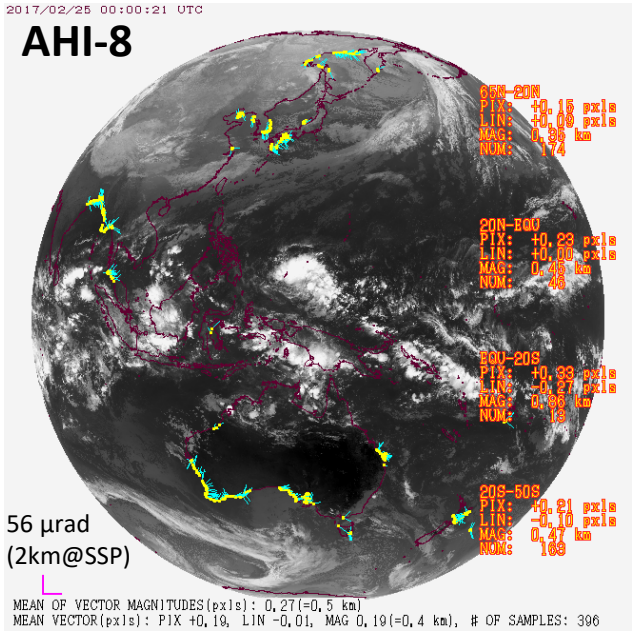
Himawari-9's TBB biases: within -0.25 K

Image Navigation Error in AHI-8/-9

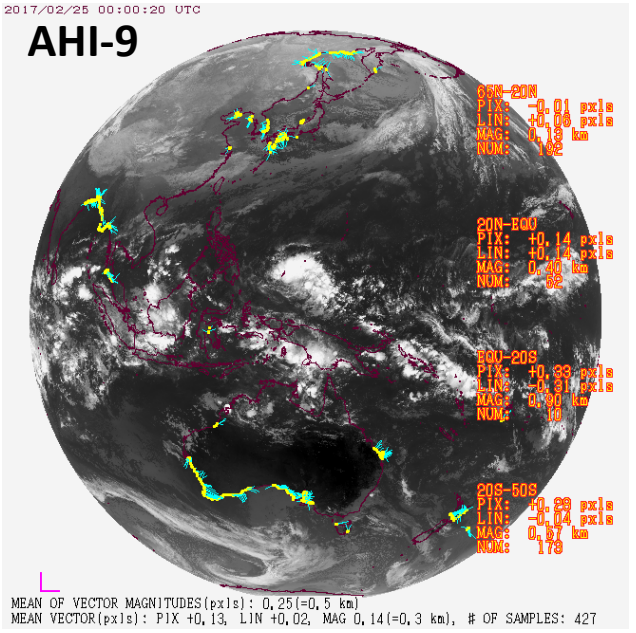
Diurnally-averaged image navigation errors on 25 Feb. 2017



B13 (10.4 μm) image navigation error at 00 UTC on 25 Feb. 2017



Reference points
Navigation error vector



Reference points
Navigation error vector

Generally less than 11 μrad (0.4 km) at sub satellite point (SSP)

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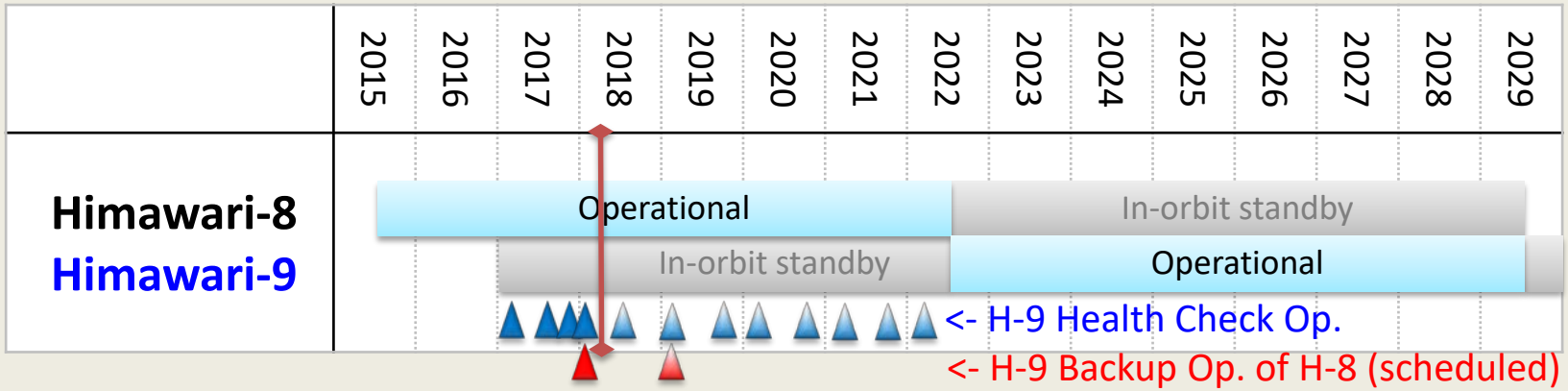
Himwari-9 Health Check and Backup Operation

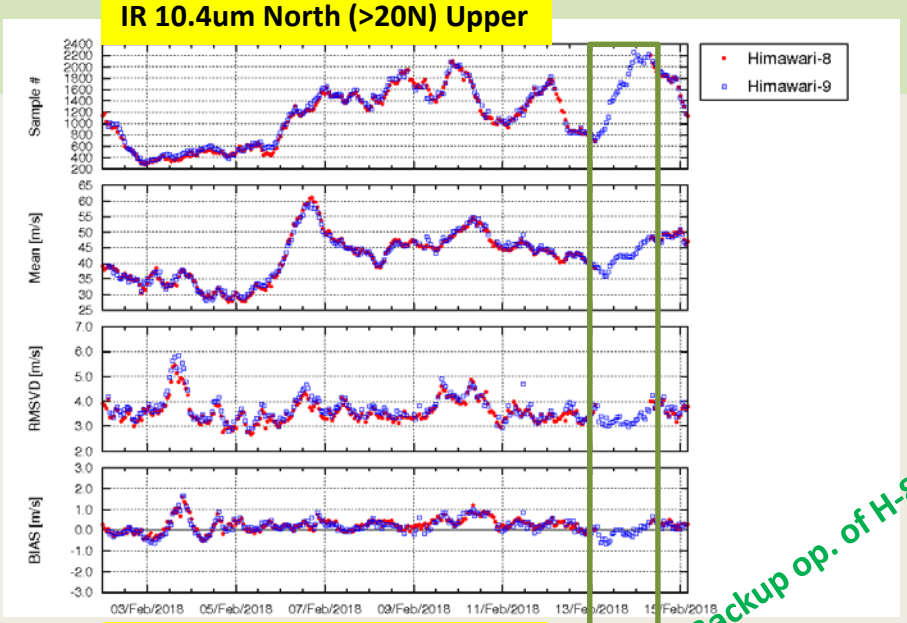


Himawari-9 started back up operation of Himawri-8 since 10 March, 2017.
Health check operations were performed four times (HC-1 to 4).

Health check operation (HC)	Operation term	except maintaining and tuning
HC-1	29 May – 12 Jun, 2017	31 May – 12 Jun
HC-2	29 Aug – 13 Sep, 2017	31 Aug – 13 Sep
HC-3	28 Nov – 12 Dec, 2017	1 – 12 Dec
HC-4 and Backup Operation	31 Jan – 15 Feb, 2018 (13 Feb – 14 Feb, 2018)	2 – 14 Feb

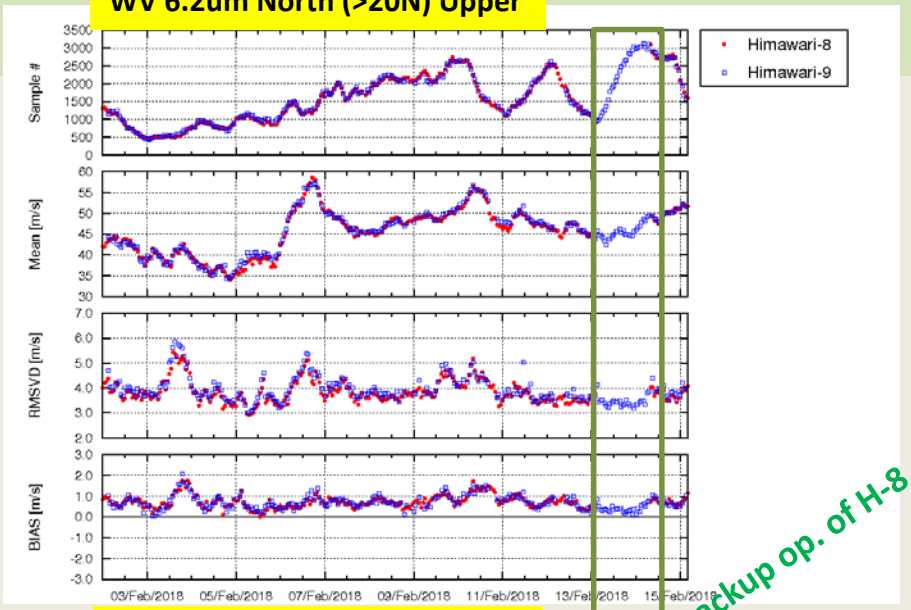
Time Series of O-B Statistics of Himawari-9 AMV Health Check (02 – 15 Feb, 2018) including H-9 Backup Operation (13 – 14 Feb, 2018)

IR 10.4um North (>20N) Upper



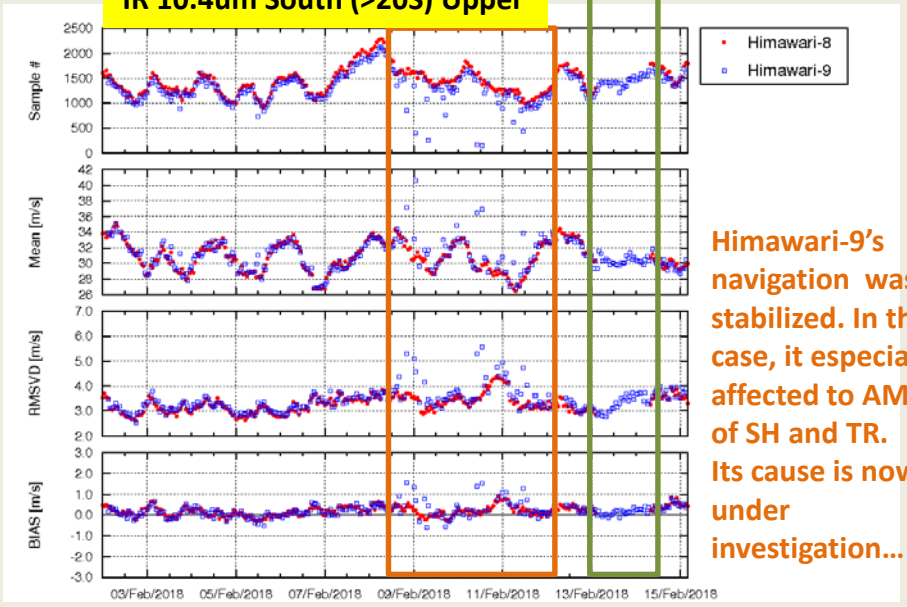
Backup op. of H-8

WV 6.2um North (>20N) Upper



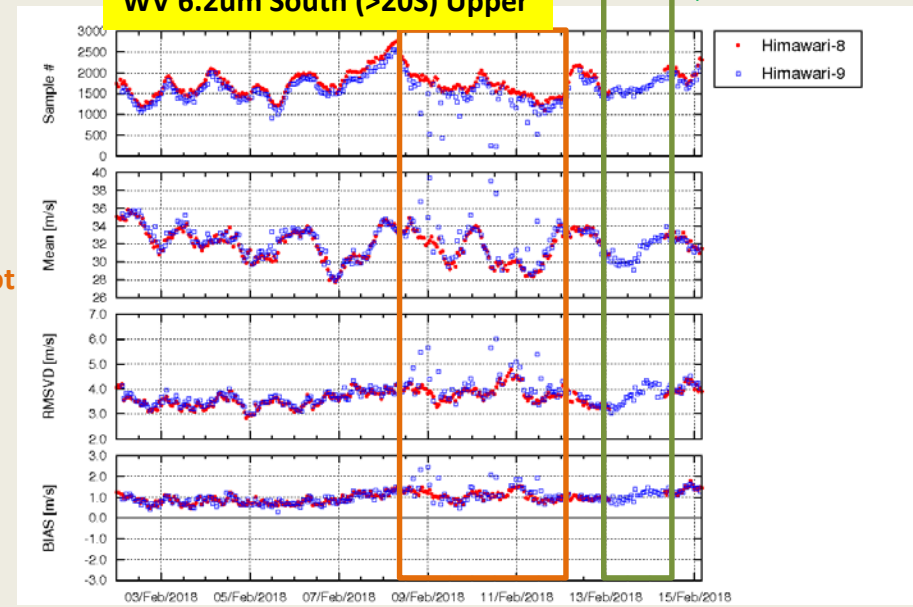
Backup op. of H-8

IR 10.4um South (>20S) Upper



Himawari-9's navigation was not stabilized. In this case, it especially affected to AMVs of SH and TR. Its cause is now under investigation…

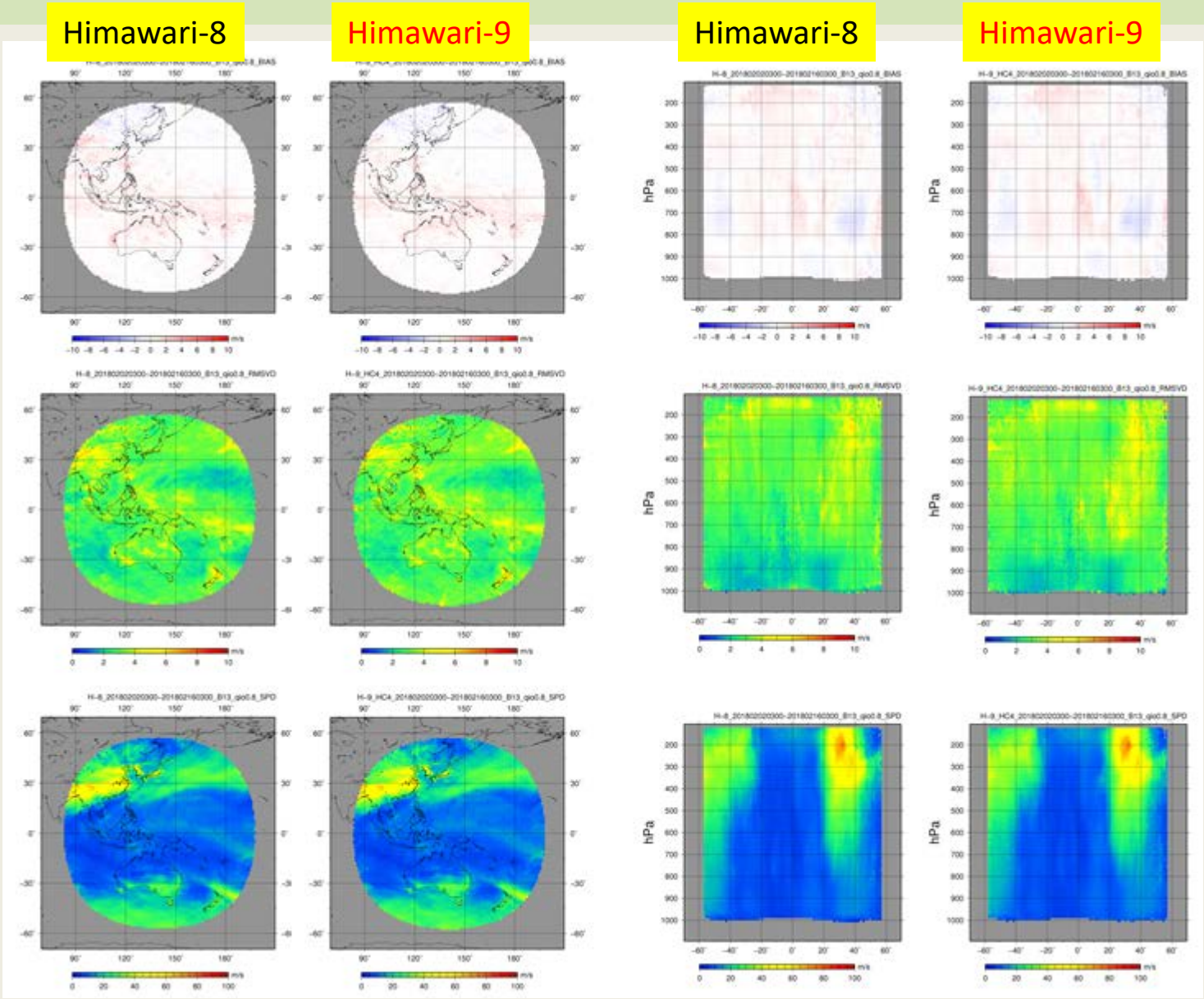
WV 6.2um South (>20S) Upper



O-B statistics of Himawari-8 and -9 @HC-4

IR (Band13, 10.4um)

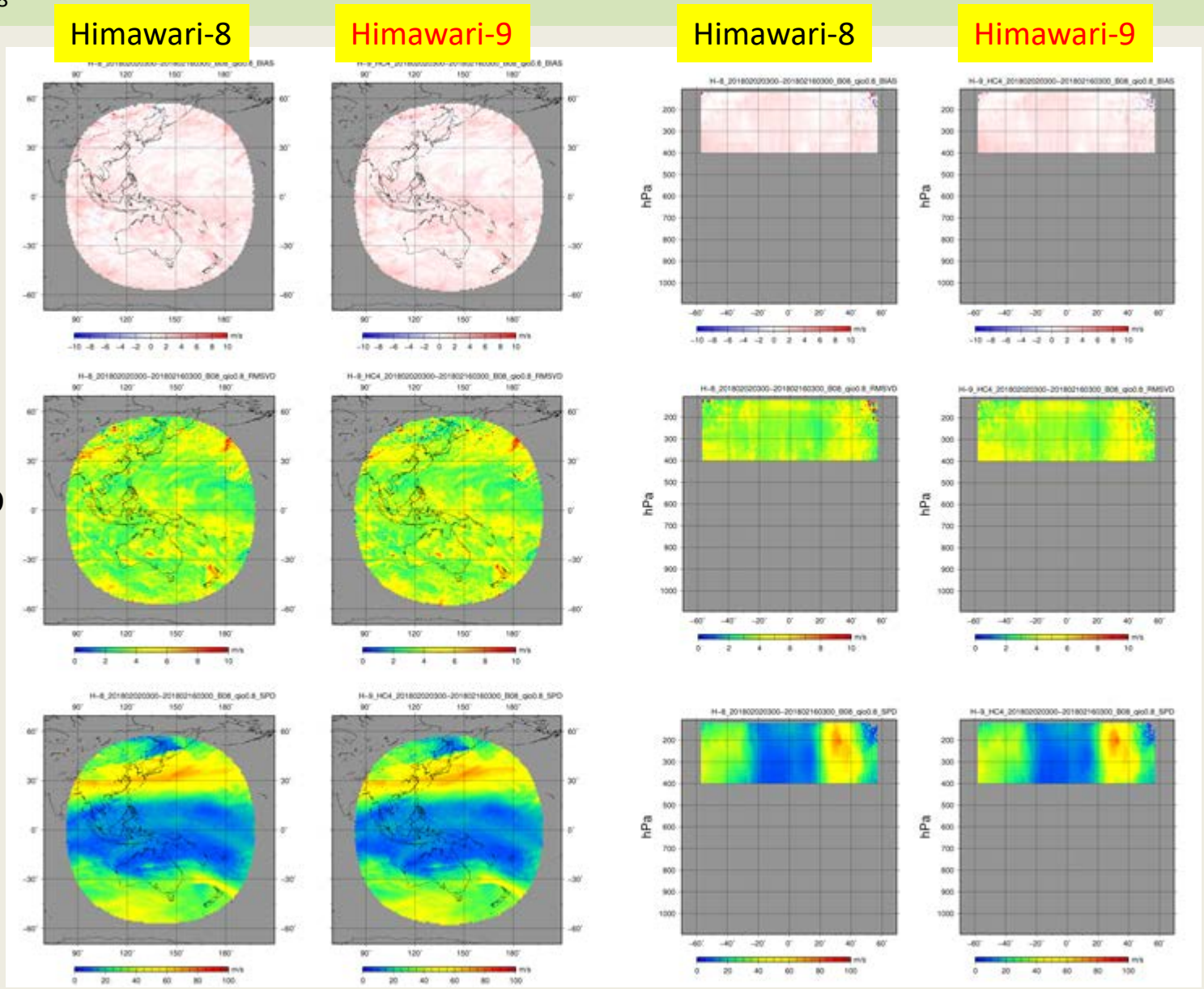
QI(w/oFCST)>0.8



O-B statistics of Himawari-8 and -9 @HC-4

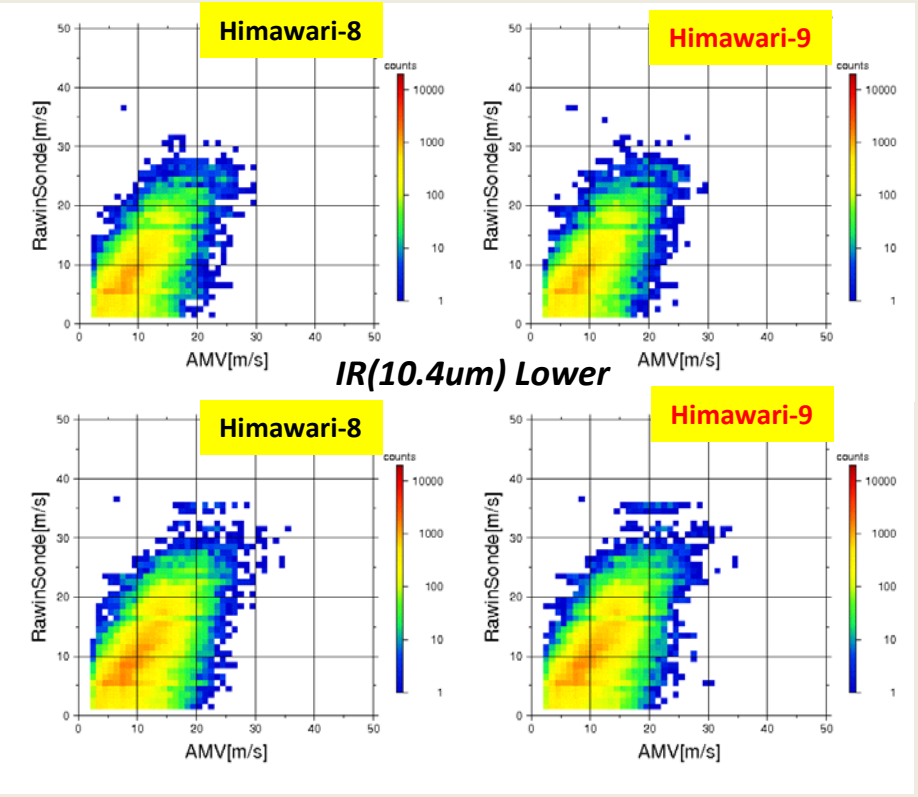
WV (Band08, 6.2um)

QI(w/oFCST)>0.8



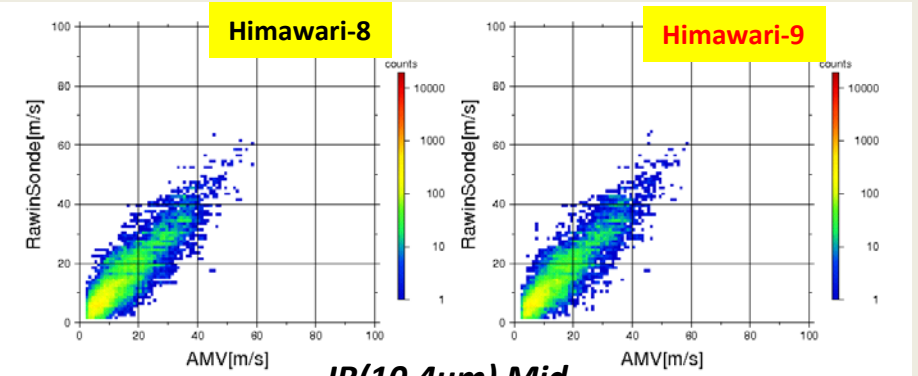
Rawinsonde statistics of Himawari-8 and -9 @HC-4

VIS(0.64um) Lower

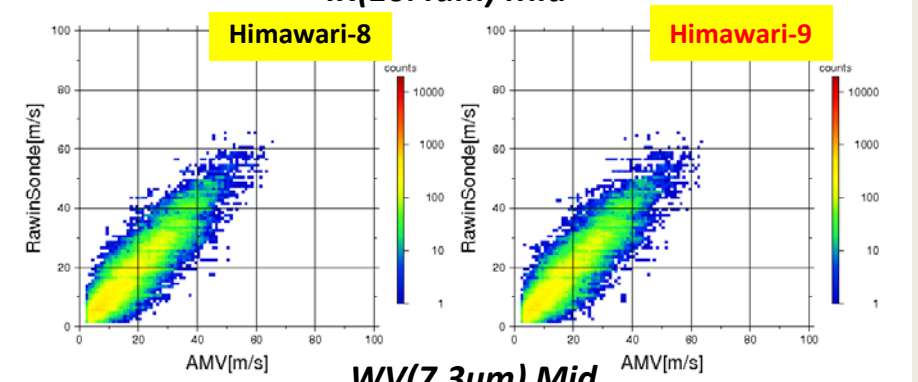


IR(10.4um) Lower

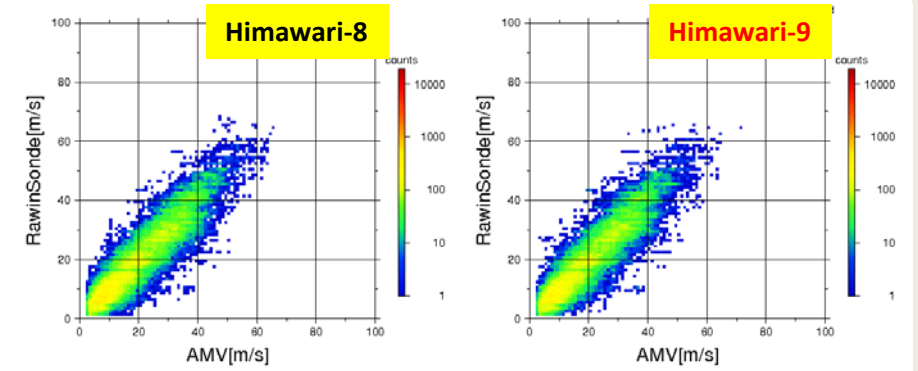
VIS(0.64um) Mid



IR(10.4um) Mid



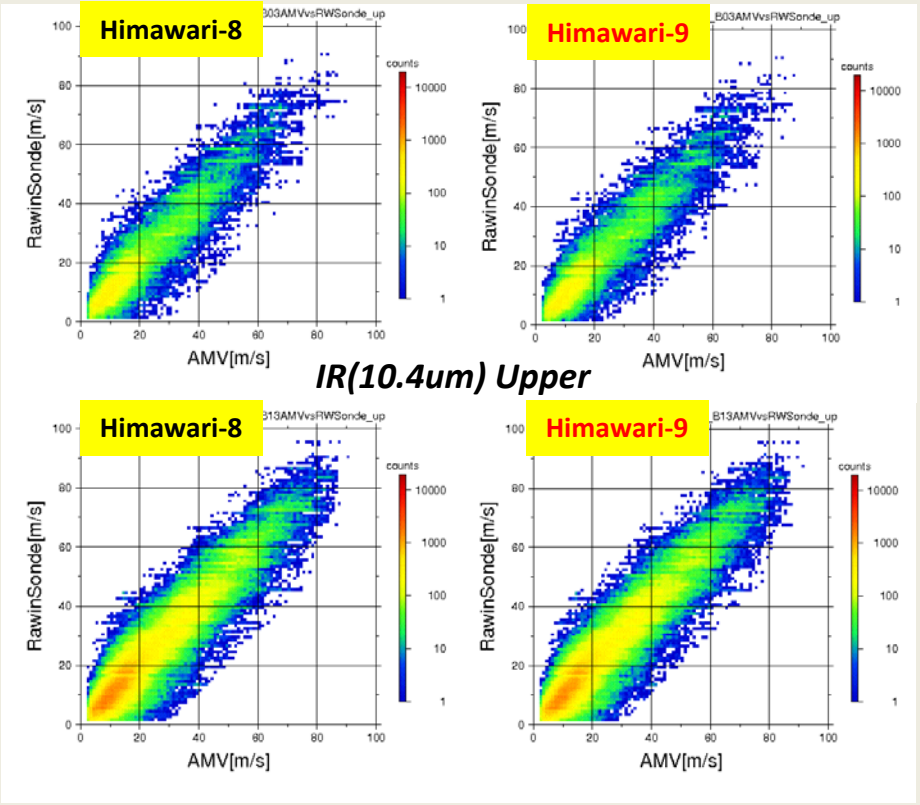
WV(7.3um) Mid



Sonde Statistics Collocation cond.
QI(w/ fcst) > 0.85
within 150 km FM station
AMV Height within 50hPa (< 700hPa)
AMV Height within 35hPa (>700hPa)

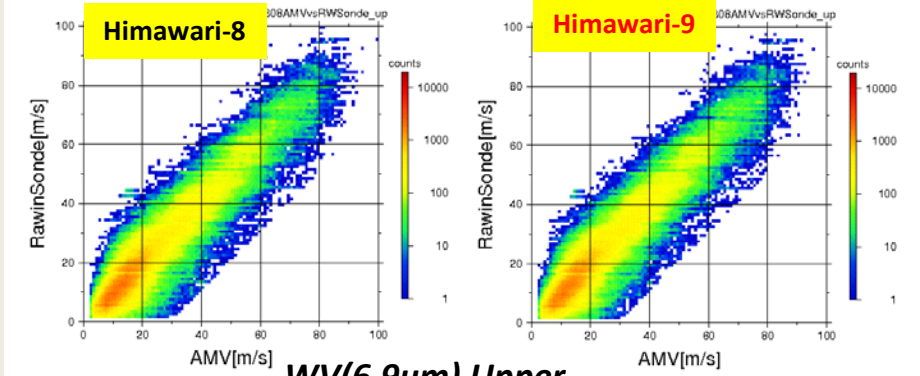
Rawinsonde statistics of Himawari-8 and -9 @HC-4

VIS(0.64um) Upper

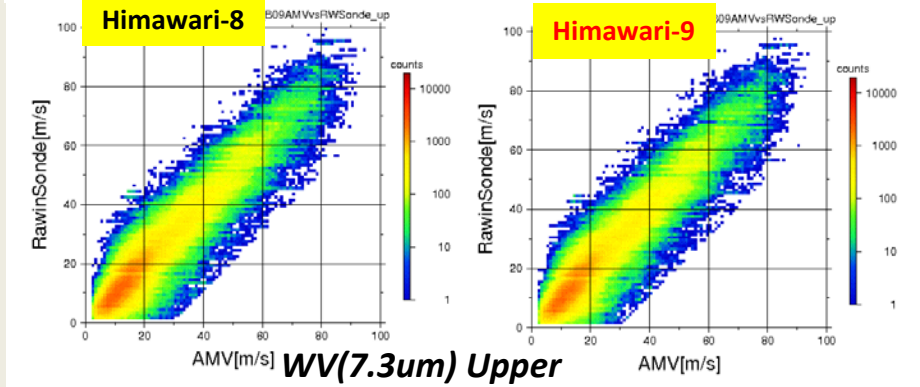


IR(10.4um) Upper

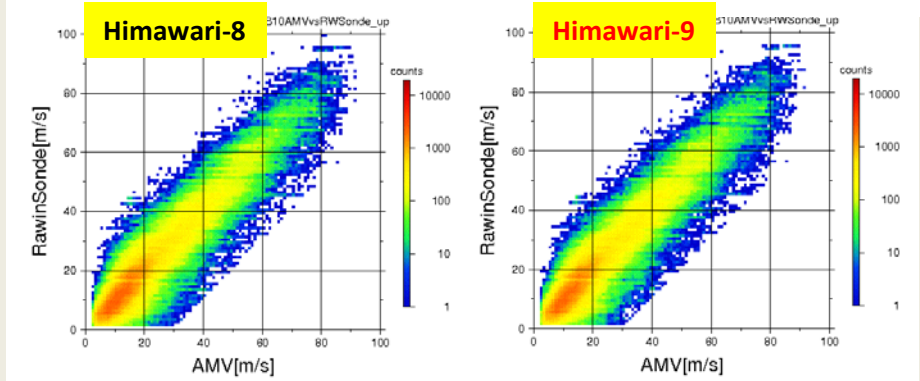
WV(6.2um) Upper



WV(6.9um) Upper



WV(7.3um) Upper



Sonde Statistics Collocation cond.
QI(w/ fcst) > 0.85
within 150 km FM station
AMV Height within 50hPa (< 700hPa)
AMV Height within 35hPa (>700hPa)

Contents

Current Status of Himawari-8/9 AMV

AMV for global NWP

AMV for global NWP
- spatial density : 34 km at nadir
- temporal density : Hourly computed
- Input data resolution : 2km and 10 min.

High-resolution AMV for global NWP
- spatial density : 18 km at nadir **(x 3)**
- temporal density : half-hourly computed **(x 2)**
- Input data resolution : 2km and 10 min.

AMV for mesoscale NWP

AMV for mesoscale NWP (Japan area)
- spatial density : 20 km at nadir
- temporal density : Hourly computed
- target box size : 7x7 and 31x31 pixels
- Input data resolution : 2km and 10 min.

Hi-Res AMVs and RS-AMVs
→ ・typhoons monitoring
・NWP trial using
from July 2017 (now internal only)

RS-AMV for Japan area
- spatial density : 3.5 km at nadir
- temporal density : 10 min.
- target box size : 7x7 and 31x31 pixels
- Input data resolution
  - IR and WV : **2km and 5 min.**
  - VIS : **0.5km and 2.5min.**

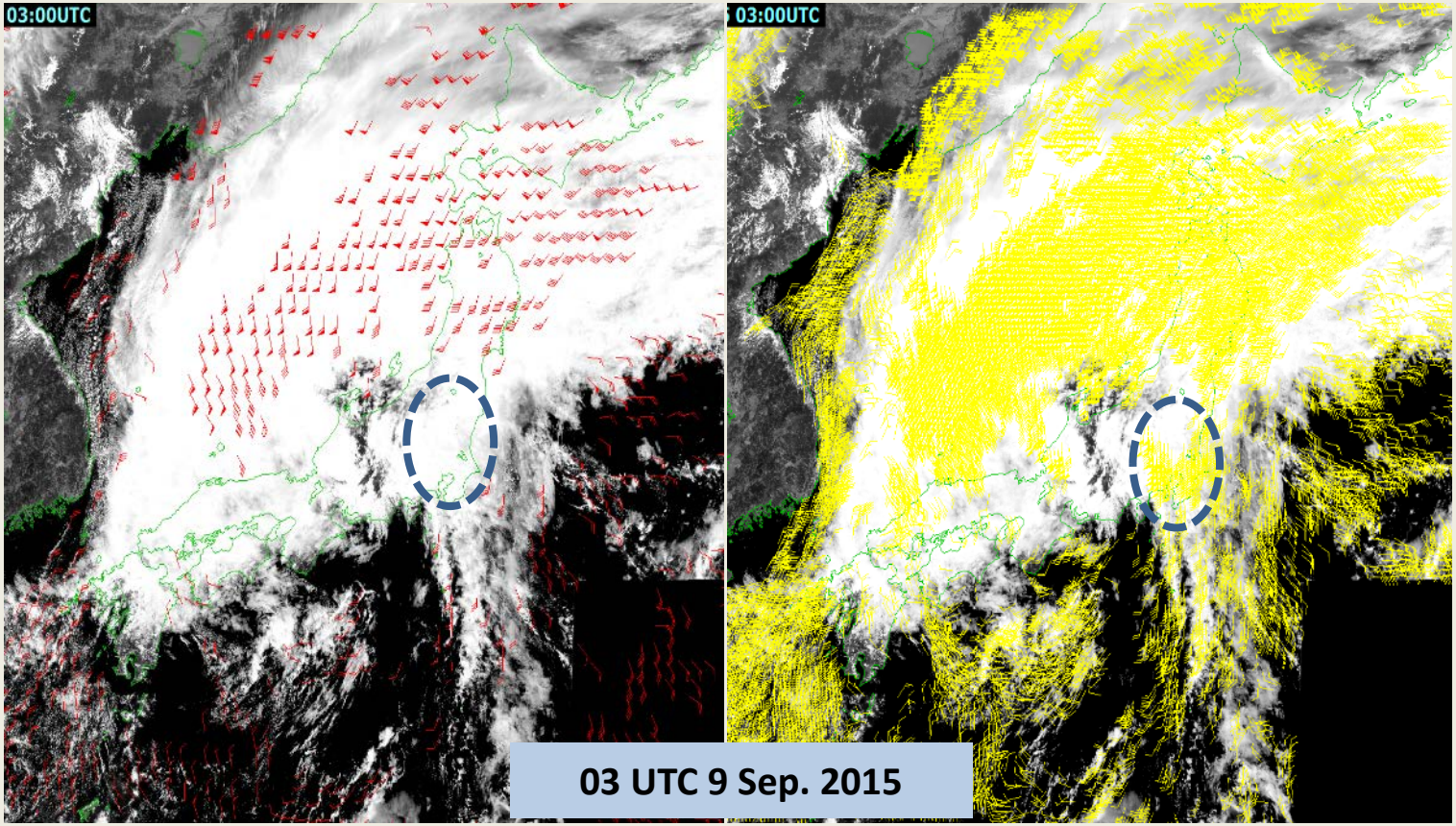
RS-AMV for target observation
- spatial density : 2.5 km at nadir
- temporal density : 10 min.
- target box size : 5x5 and 31x31 pixels
- Input data resolution
  - IR and WV : **2km and 5 min.**
  - VIS : **0.5km and 2.5min.**

- **New AMV products started providing operationally from July 2017 *for internal users* .**
- **Dissemination of new products to overseas is planed to start after establishment of transmission way**

Himawari-8 RS-AMVs for mesoscale NWP

Severe heavy rainfall event occurred in Kanto and Tohoku regions of Japan, 9 to 11 Sep. 2015.

courtesy of Kunii, M. , JMA



Himawari-8 AMVs (operational) **RapidScan-AMVs**

Quantity is enhanced in Himawari-8 RapidScan AMVs

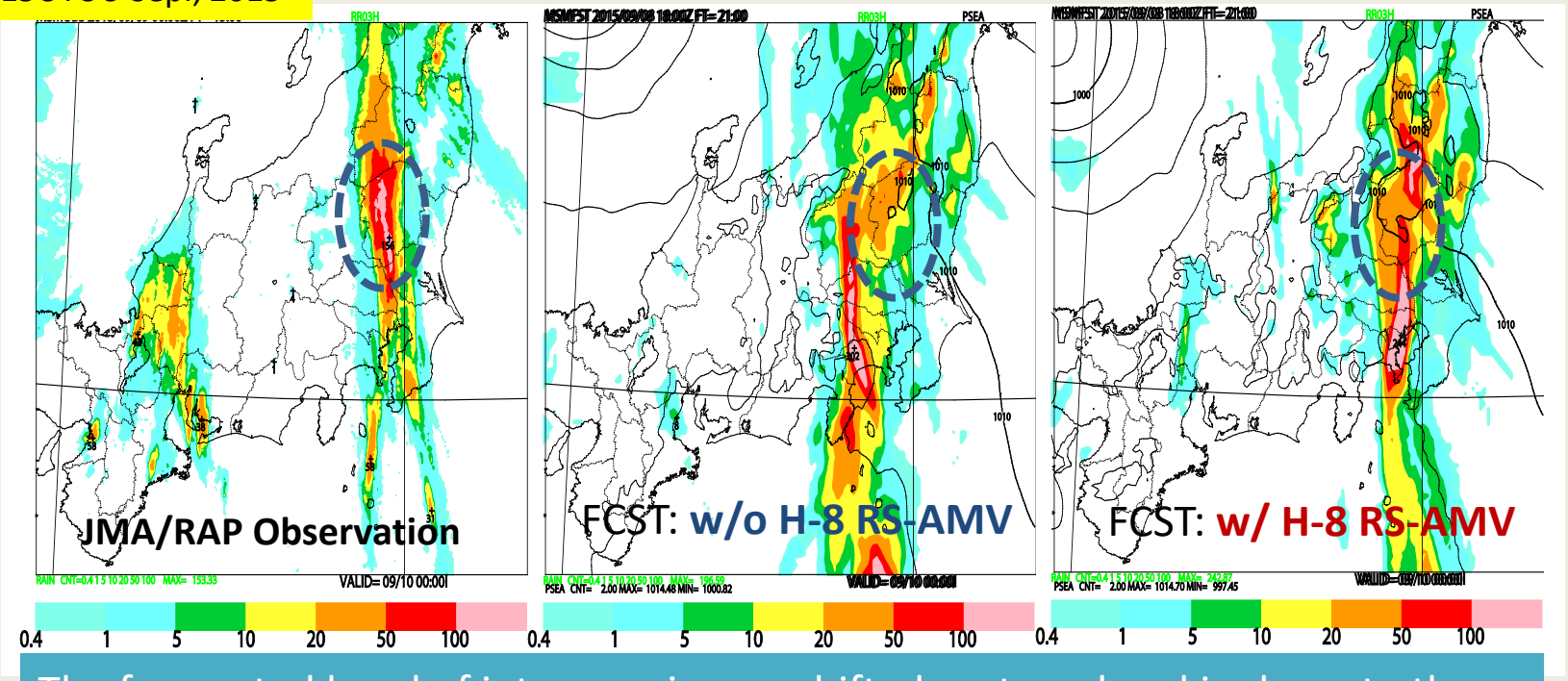
Impact of RS-AMVs on mesoscale NWP

Example of the RS-AMVs were assimilated by a mesoscale regional model.

- **Severe heavy rainfall**
  Kanto and Tohoku region in Japan in Sep. 2015

3-hr accumulated rainfall (mm)
OSE at JMA/MRI with NHM-LETKF.

15UTC 9 Sep., 2015

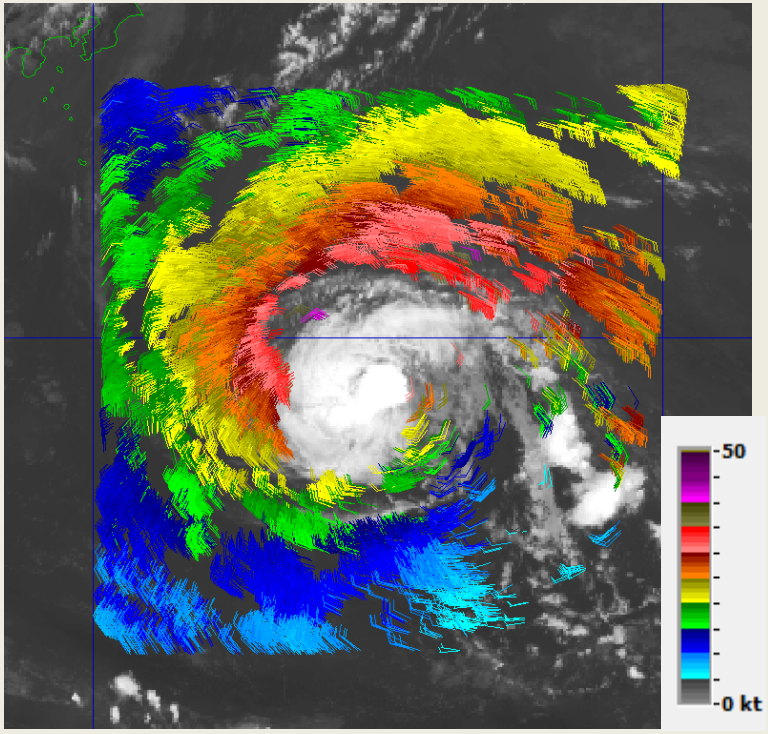


The forecasted band of intense rain was shifted eastward and is closer to the observation by the assimilation of the RS-AMVs from Himawari-8.

Kunii, M. et al., 2016: Ensemble Data Assimilation and Forecast Experiments for the September 2015 Heavy Rainfall Event in Kanto and Tohoku Regions with Atmospheric Motion Vectors from Himawari-8. *SOLA*, **12**, 209-214.

Himawari-8 RS-AMVs for typhoon analysis

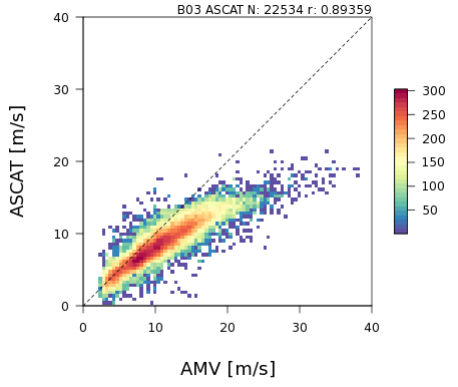
Between low level AMVs and sea surface winds of ASCAT, they have good correlation around a typhoon. Sea surface winds estimated from low-level AMVs are provided to the Tokyo Typhoon Center to use for their operational typhoon analysis.

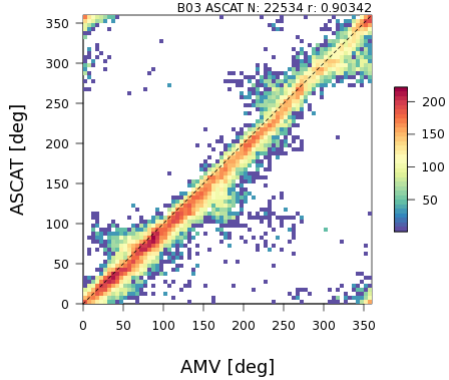


Estimated sea surface wind by VIS AMV 03UTC 26 Jul. 2017

Estimated sea surface wind from the low-level RS-AMVs (IR and VIS) that are calculated every 10min using 5min/2.5min interval images.

low-level AMV vs ASCAT





Low level AMVs (AMV height ≥ 700hPa , QI(w/o forecast) ≥ 0.8)

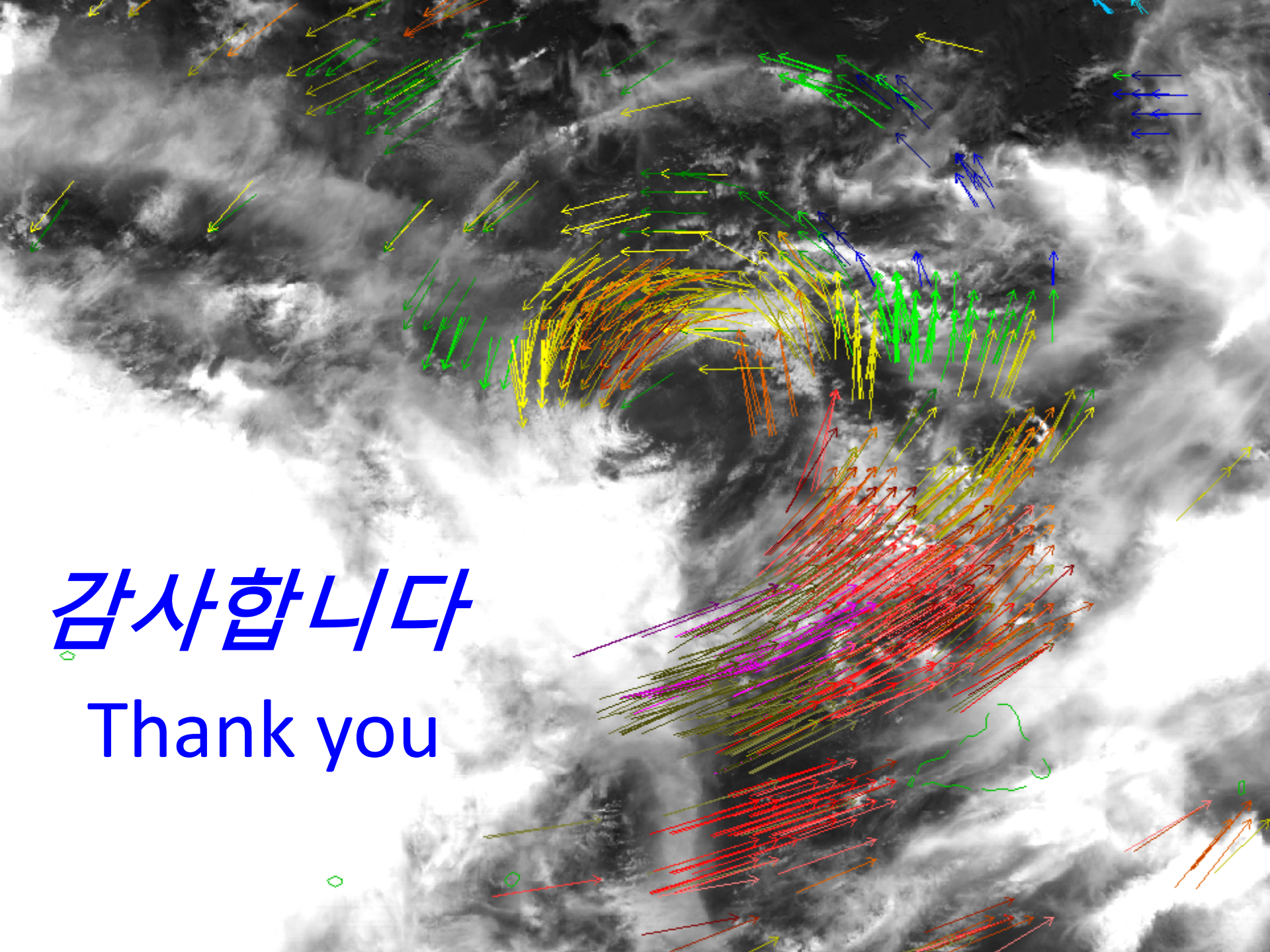
To estimate ocean wind speed by low-level AMVs around a typhoon using linear regression -> monitor typhoons

Summary

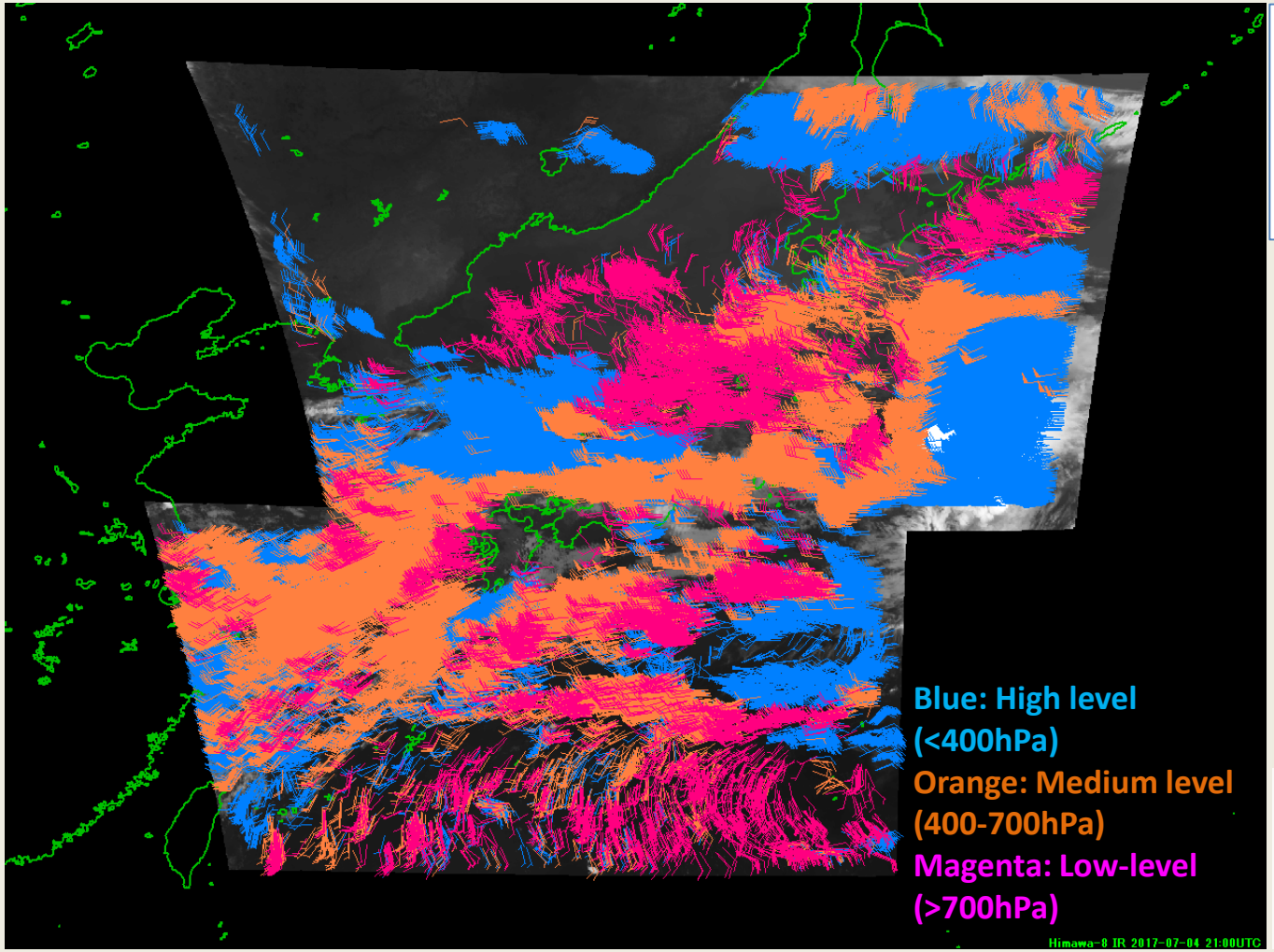
- Himawari-9 was launched in Nov 2016 and its backup operation of Himawari-8 started from May, 2017.
- H-9 health check operations has been performed and its AMVs were checked by using these data. AMVs of Himawari-8 and -9 had almost same statistical features.
- Health Check operations of Himawari-9 are planned a few times a year and Himawari-9 and its AMV will be checked continuously.
- RS/Hi-res AMV of Himawari-8/9 has begun to be used for JMA's typhoon monitoring and has started to be used for assimilation studies.

Other Topics of Himawari-8/9 AMV

- Himawari-8 AMVs were not disseminated due to the image quality degradation during 25 March, 2018. The quality degradations were related with image navigation and it had occurred occasionally since 10 March, 2018. But this anomaly was restored at 02UTC 27 March, 2018.
- JMA's super computer system is updated on Jun 2018. Himawari AMVs are derived and are provide by the new system from this time.


감사합니다
Thank you

Rapid Scan AMV (RS-AMV) from AHI Japan area observation

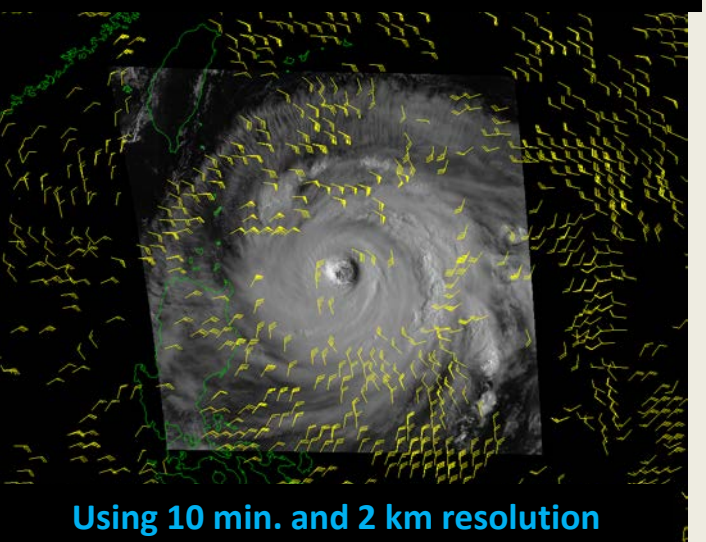


<- AMV derived from IR (10.4um) imagery
Resolution: 2km
Interval: 5min

Target box size :
7x7 (14km) and
31x31 (62km) pixels

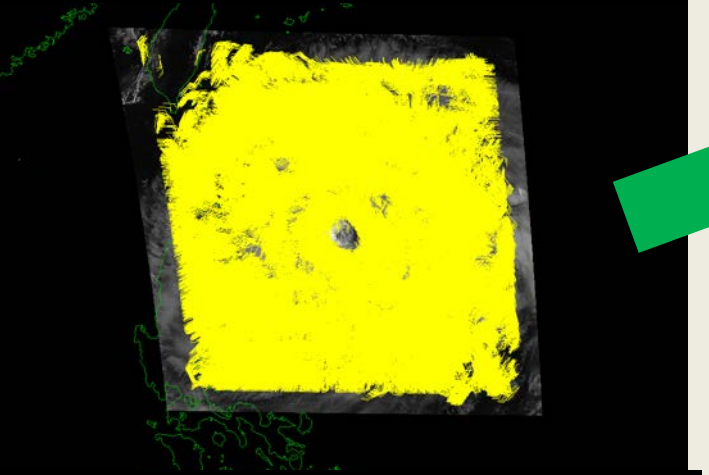
RS-AMV from AHI target observation (Typhoon)

Operational Himawari-8 AMV



Using 10 min. and 2 km resolution

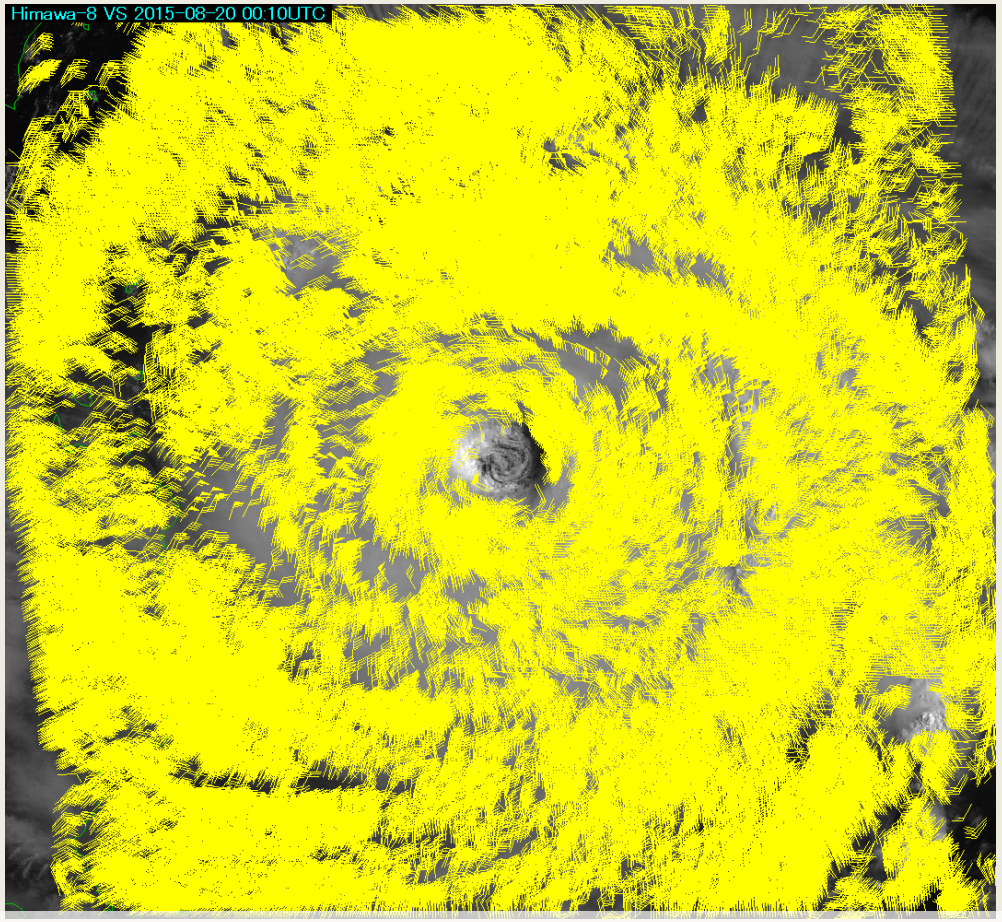
Himawari-8 Rapid Scan AMV



Using 2.5 min. and 0.5 km (VIS)

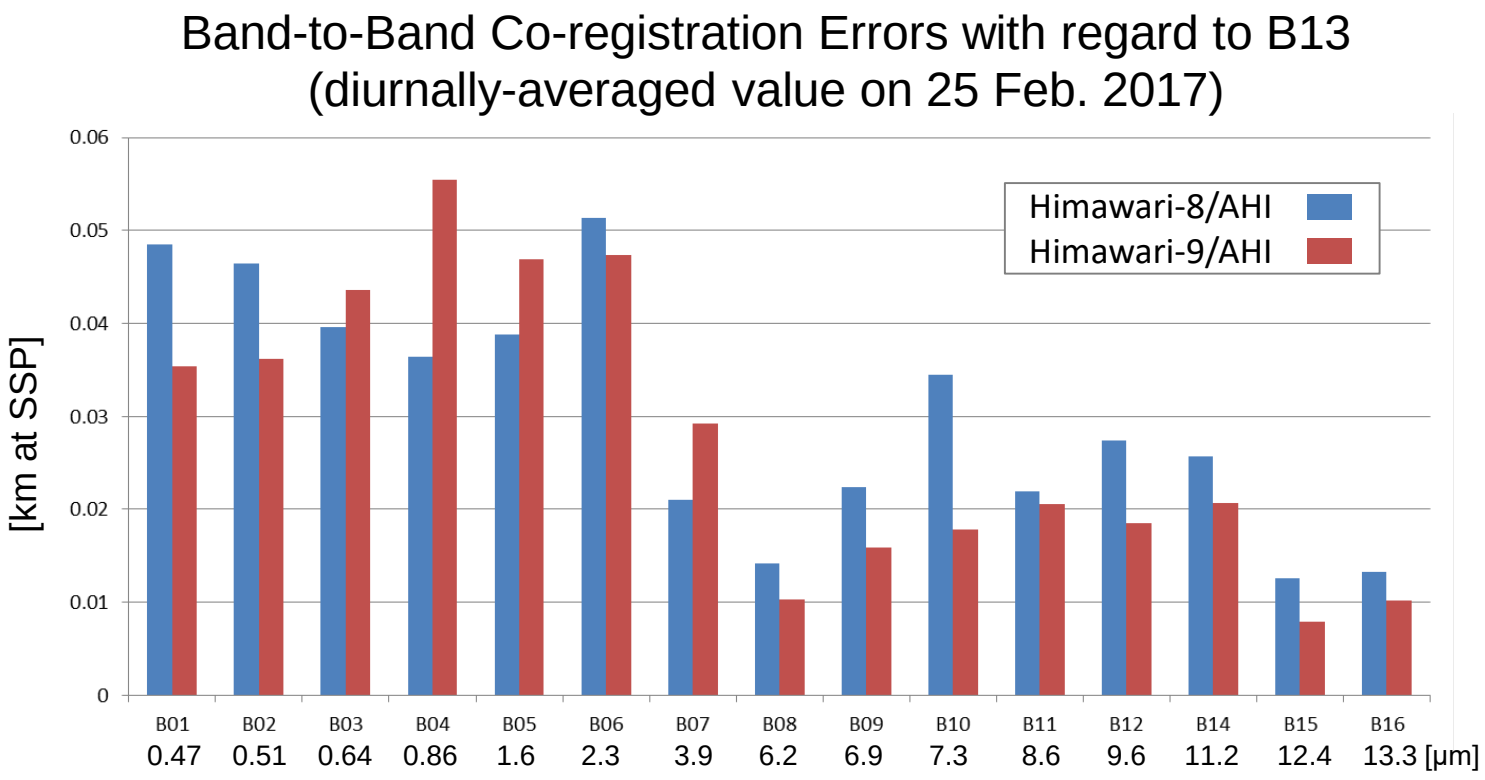
IR and VIS AMVs (QI>60, 00UTC August 20th 2015)

- ✓ Increase of data quality and quantity ->
  Improvement on temporal and spatial resolution



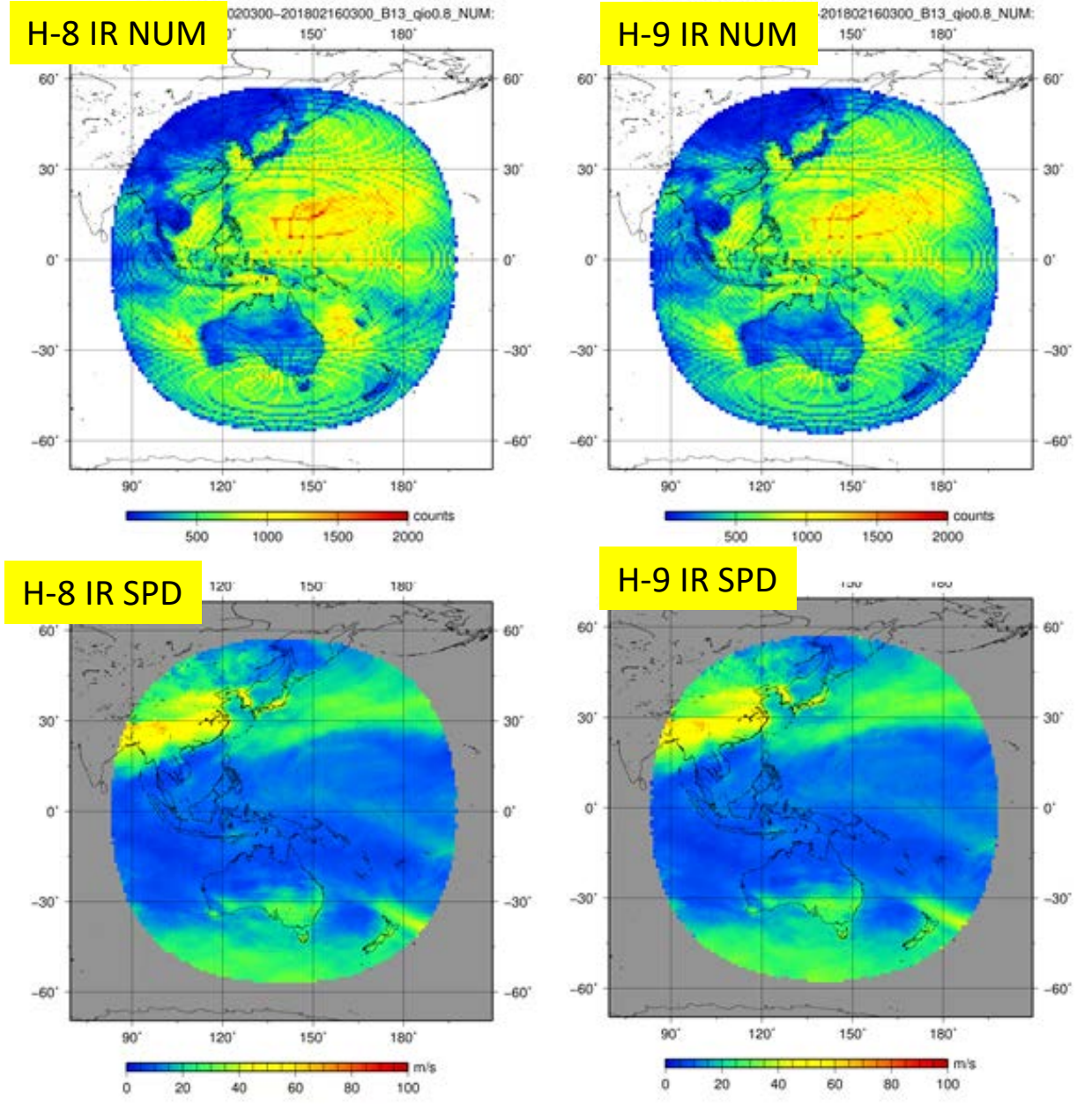
Target box size : 5x5 (2.5km) and 31x31 (15km) pixels

Band-to-band co-registration errors in AHI-8/-9



Less than 1.6 μrad (0.06 km) at sub satellite point

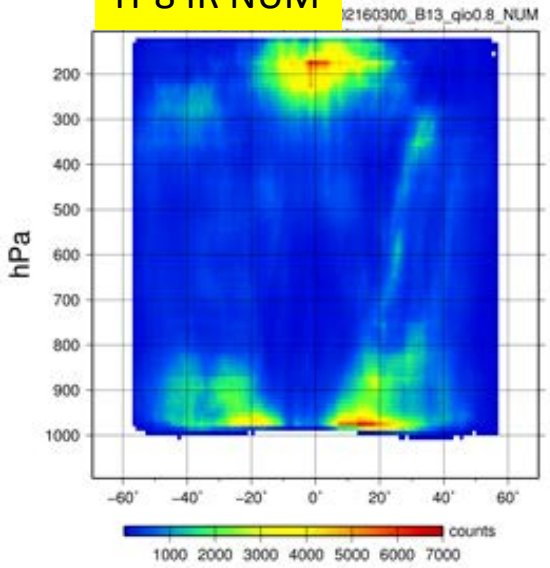
First guess departure O-B statistics H-8 vs H-9 @HC-4



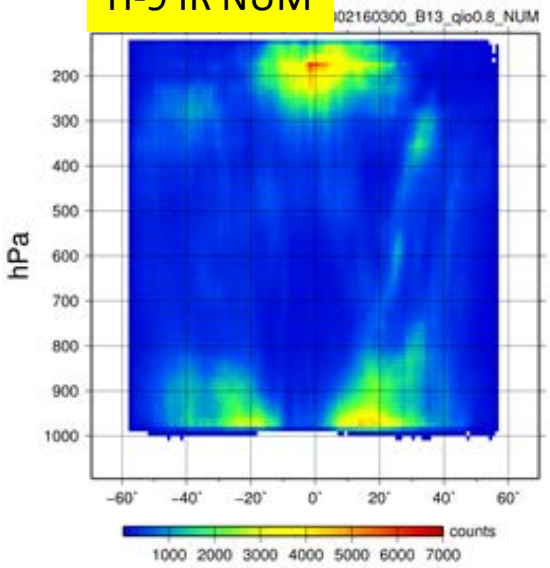
QI(w/oFCST)>0.8

First guess departure O-B statistics H-8 vs H-9 @HC-4

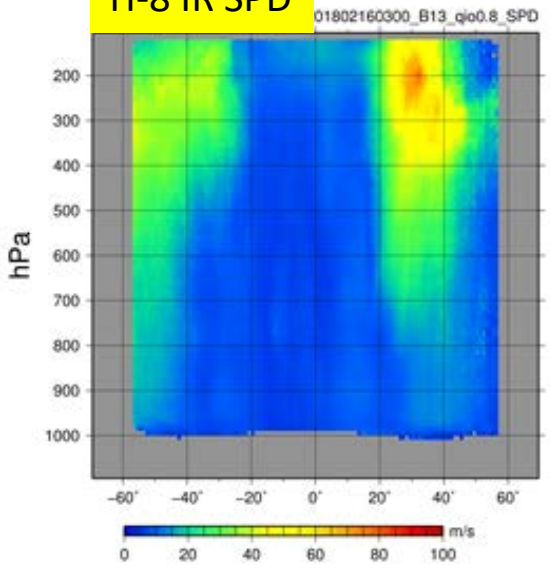
H-8 IR NUM



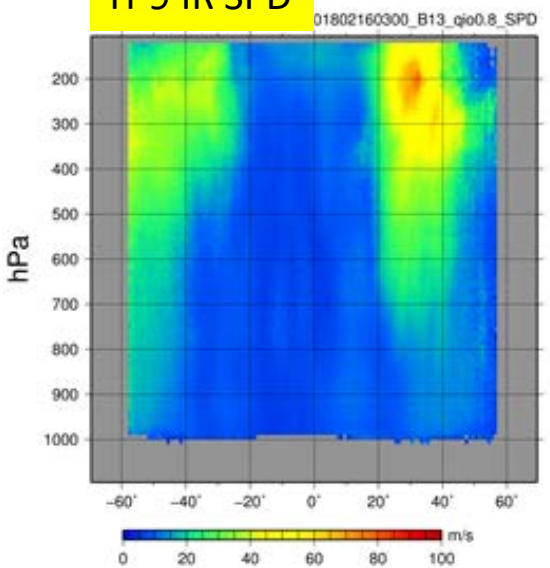
H-9 IR NUM



H-8 IR SPD



H-9 IR SPD



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