

ASSIMILATION EXPERIMENTS OF HIMAWARI RAPID-SCAN ATMOSPHERIC MOTION VECTORS

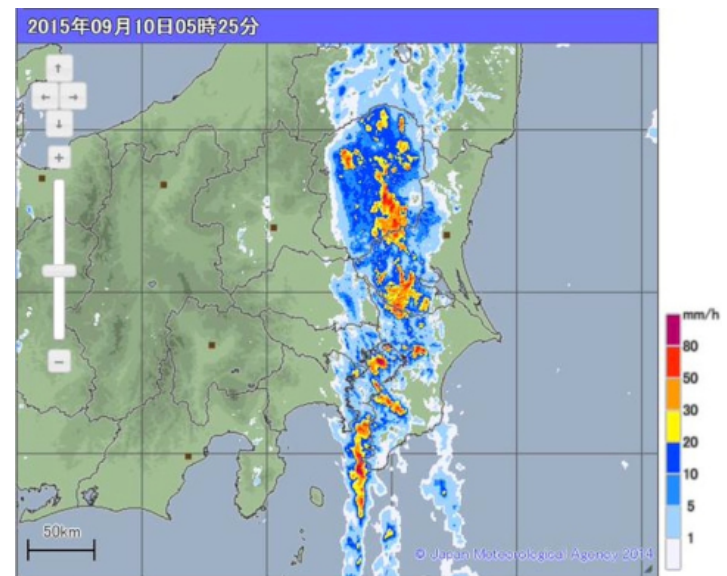
Otsuka, M., M. Kunii, H. Seko
(Meteorological Research Institute) ,
K. Shimoji (Meteorological Satellite Center)

Purpose of research

- Improve the accuracy of short-range forecasts of heavy rainfalls and other meso-scale severe weathers by utilizing high temporal and spatial resolution Himawari-8 data for assimilation

Heavy rainfall over the Kanto and the Tohoku region
(9th – 11th Sep. 2015)

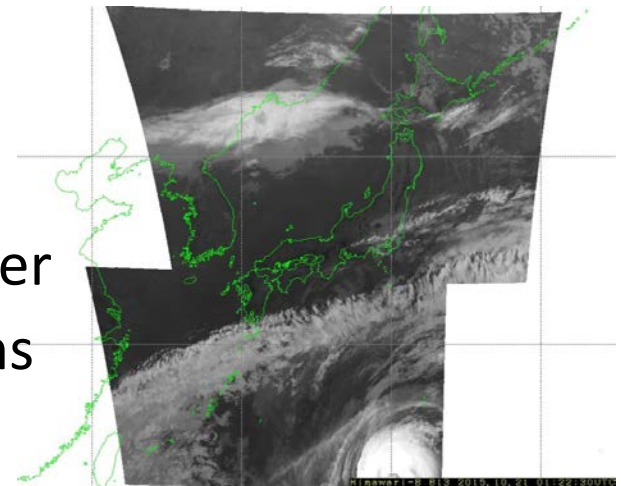
Levees broke along the Kinu River after torrential rain



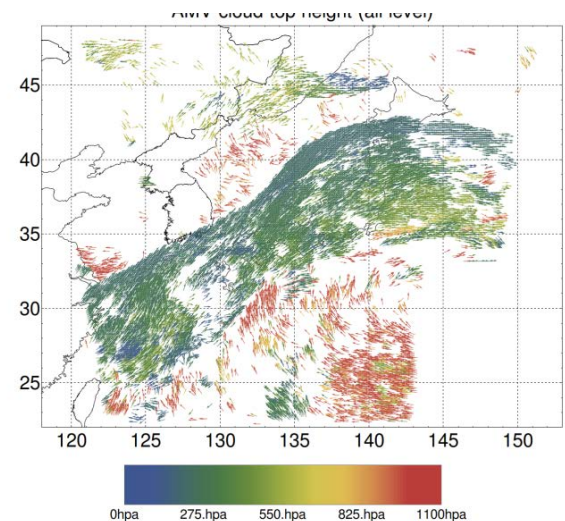
<http://www.tokyo-np.co.jp/article/national/list/201509/CK2015091102000122.html>

Rapid Scan Atmospheric Motion Vectors (RS-AMV)

- MTSAT-1R (Himawari-6)
 - 00 – 09 UTC 1st July – 30th September
 - Derived from 5 min. RS observations
 - IR: $\Delta 4$ km, VIS: $\Delta 1$ km, 5 ch.
 - Positive impact on forecasts of a heavy rainfall (Otsuka et.al 2015)
- Himawari-8
 - Derived from 2.5 min. RS observations
 - 5 min. interval time for AMV retrieval
 - IR: $\Delta 2$ km, VIS: $\Delta 0.5$ km, 6 ch.



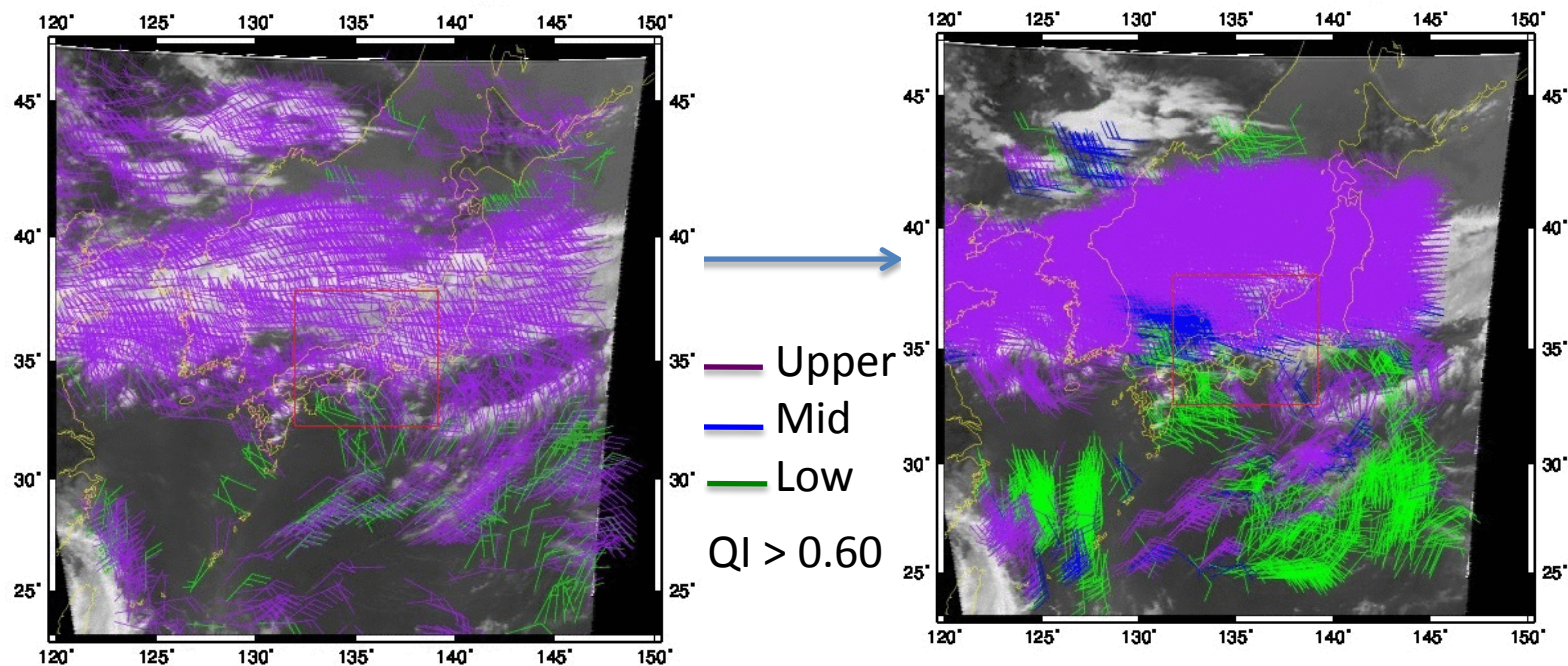
RS area by Himawari-8



Himawari-8 RS-AMV

AMV derived with improved algorithm

- Shimoji (2014)
 - New schemes for tracking and height assignment
 - Adapted for Himawari-8 high resolution observations
 - Enable to obtain high density meso-scale AMVs at a variety of heights

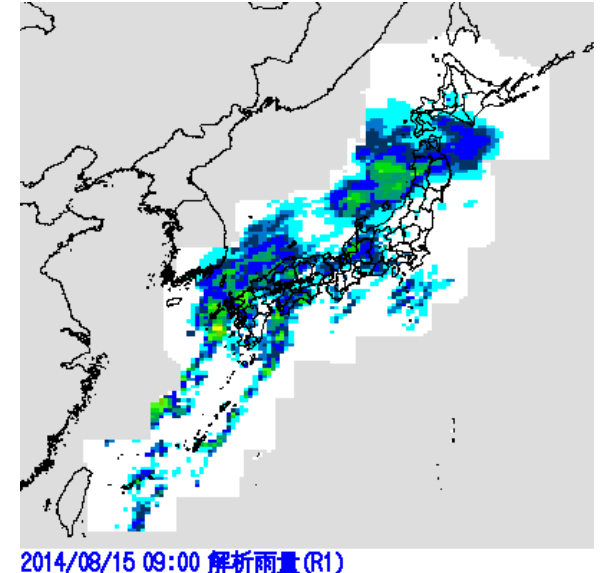
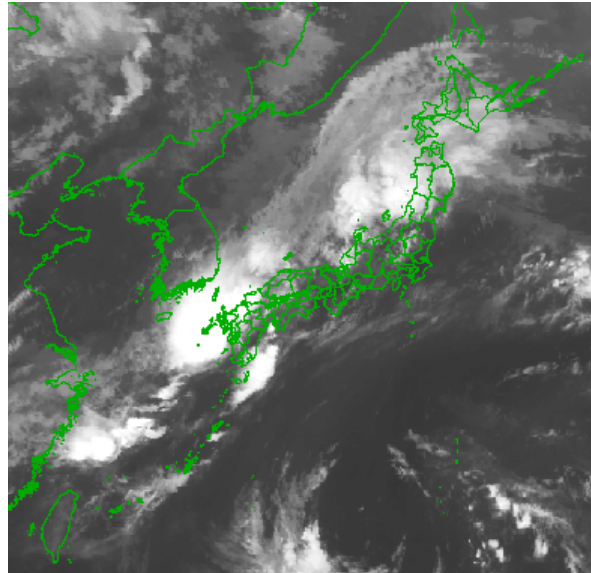
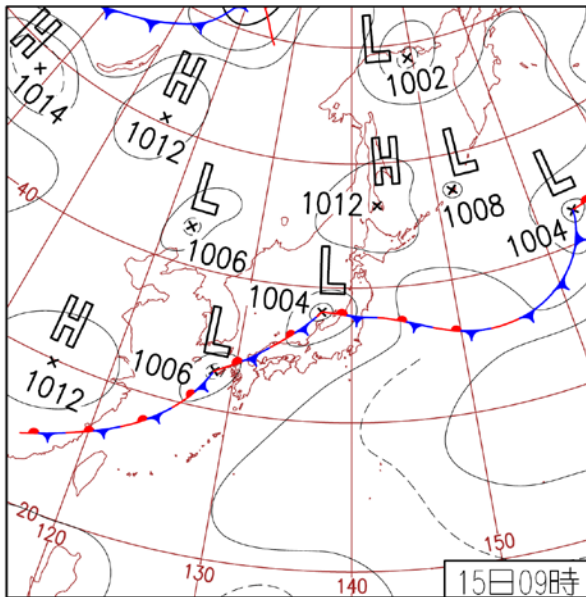


MTSAT-1R RS-AMVs obtained with the new algorithm (06:40 UTC 13th Jul. 2013).

Assimilation Experiments of MTSAT RS-AMV

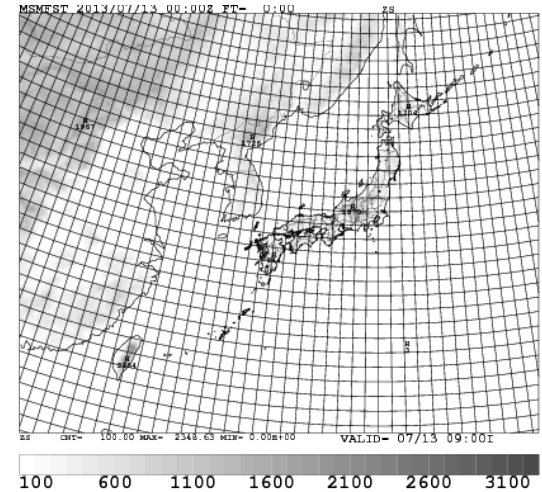
Heavy rainfall caused by stationary front

- 15th – 20th Aug. 2014
- Heavy rainfalls occurred nationwide especially in western Japan
- To see the overall impact of assimilation of RS-AMVs for the period



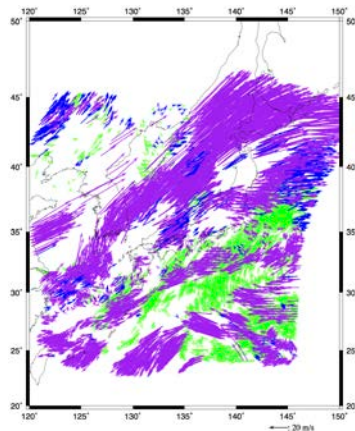
Data assimilation system and RS-AMV

- NHM-LETKF (Kunii 2014)
 - $\Delta 15 \text{ km} \cdot 50$ layers, 50 members
 - 200 km/0.2 InP localization
 - 6-hour window, 1-hour time slot
- RS-AMV
 - 00- 09 UTC 15th – 20th Aug. 2014
 - Derived from 5 min. MTSAT1-R RS with the new algorithm
 - Super observation ($\Delta 50 \text{ km} \cdot 50 \text{ hPa}$)

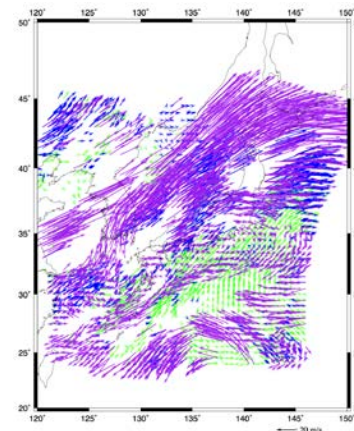


Domain for assimilation

RS-AMV

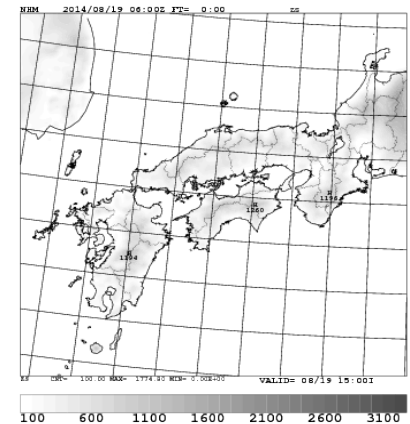
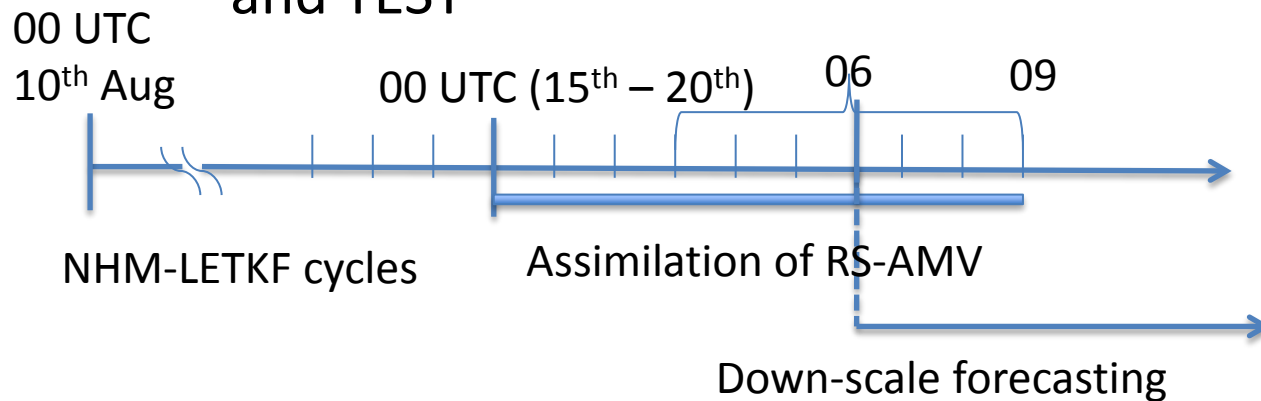


Super Observation



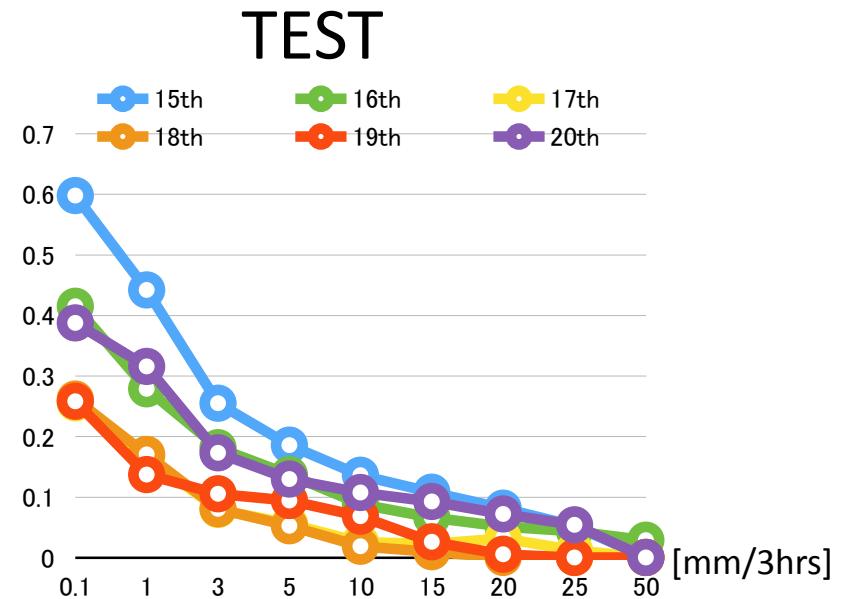
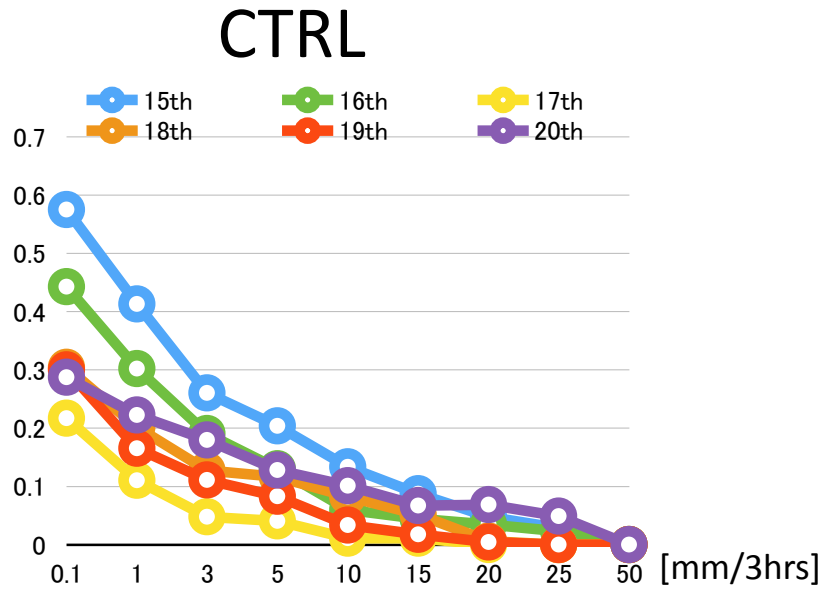
Assimilation experiment

- CTRL
 - observational data used for operational JMA meso-analysis
- TEST
 - MTSAT RS-AMVs besides the data used in CTRL
- Downscale forecasts by CTRL and TEST
 - $\Delta 5\text{km}$, Initial time 06UTC, up to 9 hours
 - Compare rainfall forecast verification scores between CTRL and TEST



Domain of forecast

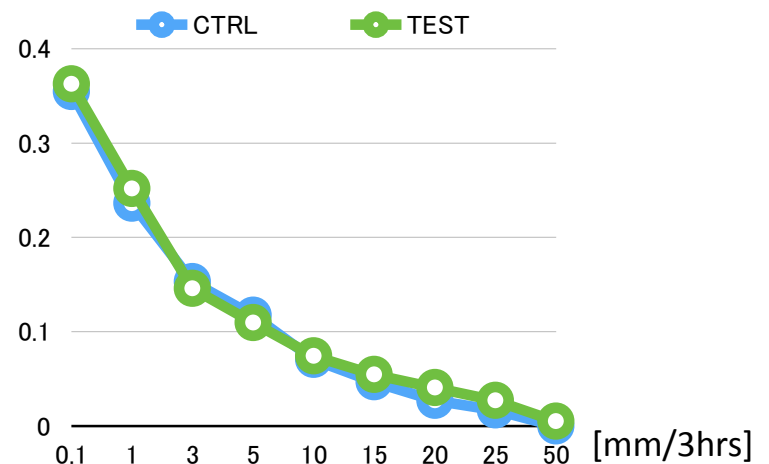
Forecast verification – threat score



* Resolution for verification: 10km

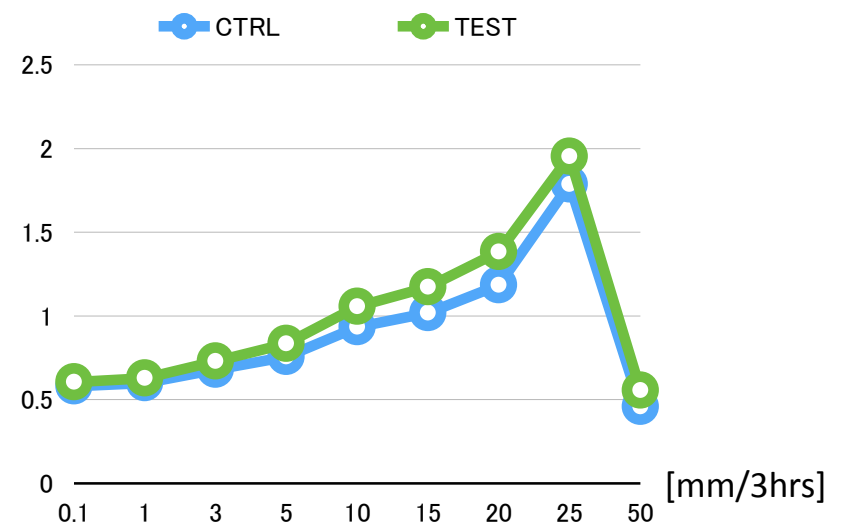
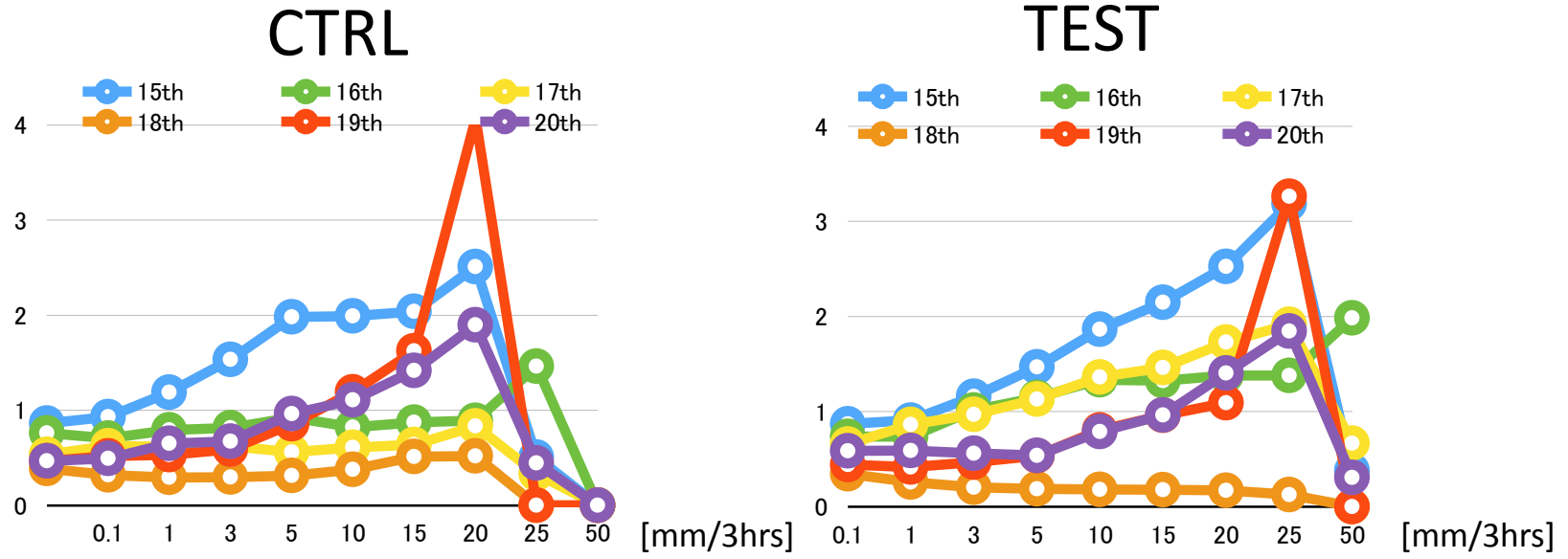
* Against JMA Radar/Raingauge-Analyzed Precipitation

- Slight improvement over the whole experiment period



Averaged for six days

Forecast verification– bias score



- Tendency to overforecast heavy rainfall

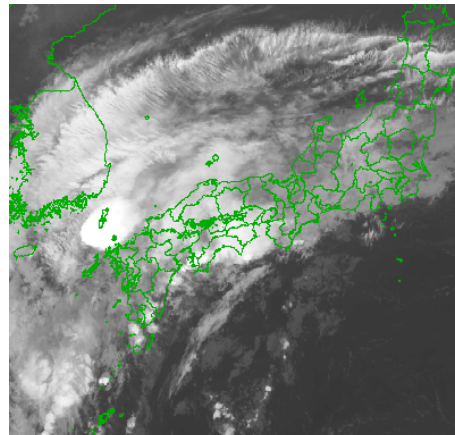
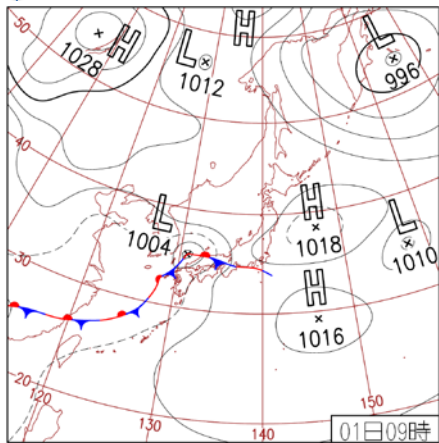
Averaged for six days

Assimilation Experiments of Himawari-8 RS-AMV

Heavy rainfall case for experiment

Case 1

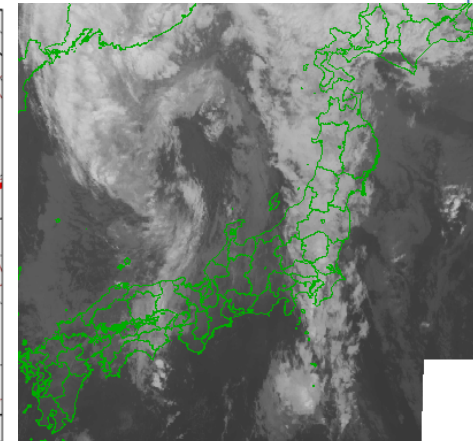
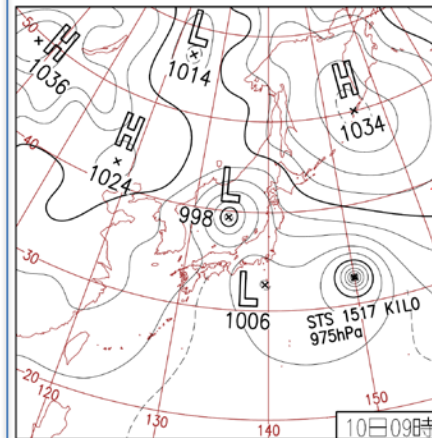
- 31st Aug. – 1st Sep. 2015
- Local heavy rainfall over Tsushima Island



2015/09/01 00:00 衛星B13 IR1

Case 2

- 8th – 10th Sep. 2015
- A band shaped precipitation system associated with two typhoons

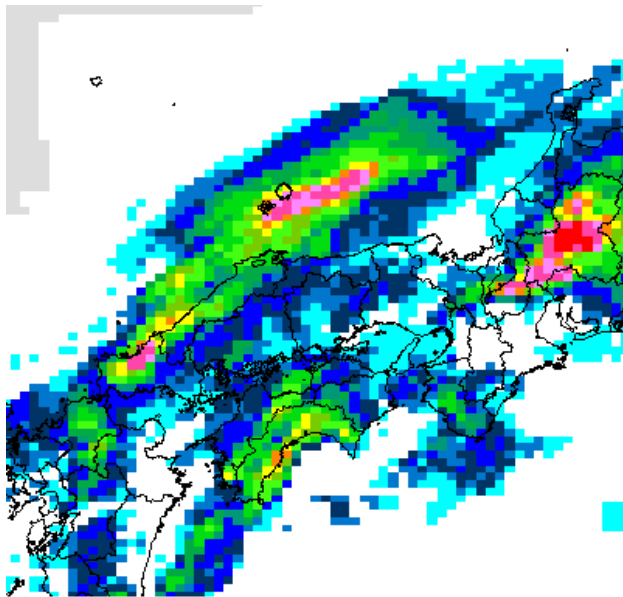


2015/09/10 06:00 衛星B13 IR1

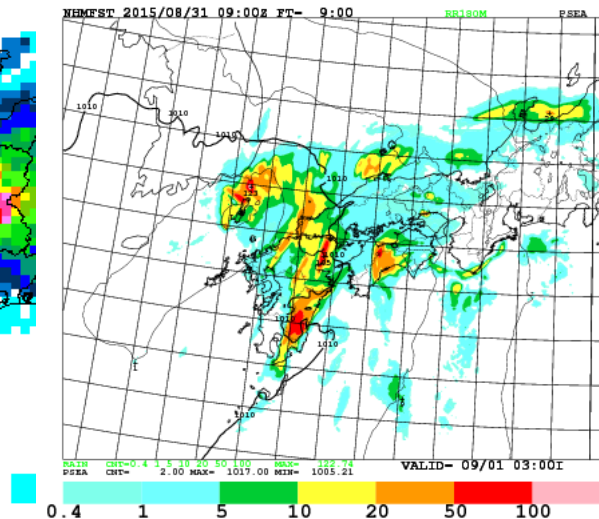
Case 1: Results -3-hour rainfall forecast

TEST: w Himawari-8 RS-AMV

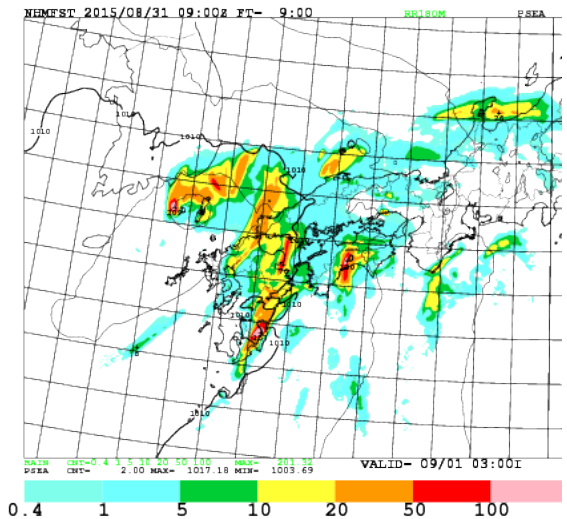
CTRL: w/o Himawari-8 RS-AMV



2014/08/16 03:00 解析雨量3H(R3)



TEST



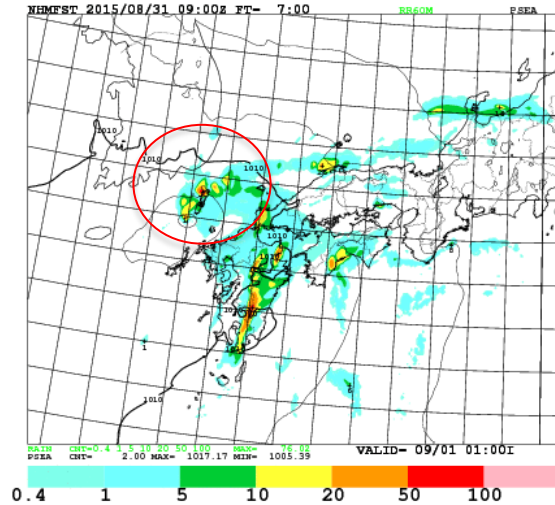
FT = 09

CTRL

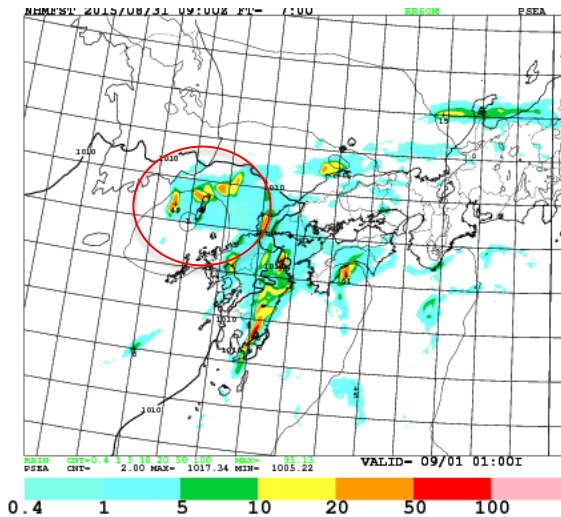
The track and the shape of intense rainfall area around Tsushima were better in TEST

Case 1: Results -hourly rainfall forecast

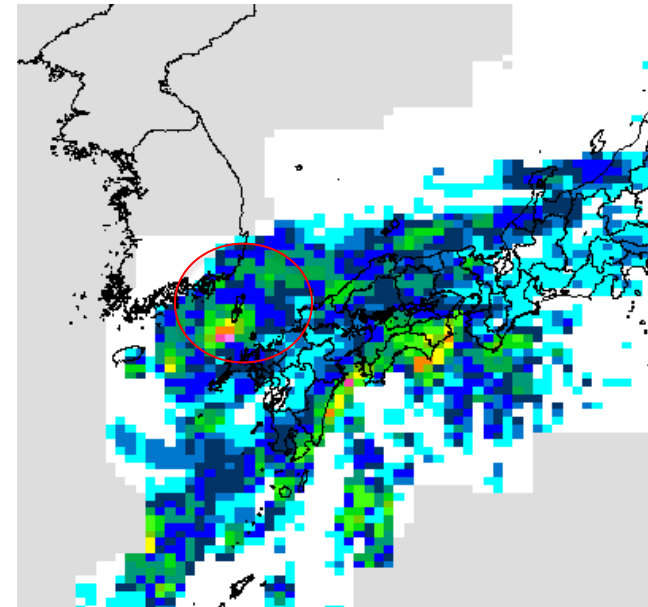
Forecast time : 07 – 09 hrs.



TEST



CTRL



2015/09/01 01:00 解析雨量(R1)

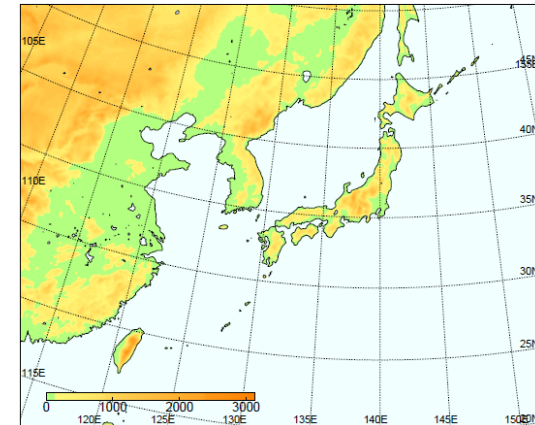
The track and the shape of intense rainfall area around Tsushima were better in TEST

Case 2 : DA experiment

Experiment	AMVs
CTRL	Operational AMVs from MTSAT-1R
TEST	High-reso AMVs from Himawari-8

NHM-LETKF specifications

Ensemble size	100
Grid size	409 x 331 x 50 ($\Delta x = 10$ km)
Covariance inflation	RTPS (Whitaker and Hamill 2012)
Covariance localization	200 km, 0.2 ln p
Analyzed variables	u, v, w, t, p, qv, qc, qr, qci, qs, qg
Observation data	MA CDA4 (u, v, t, rh, ps, tpw) + AMVs from MTSAT-1R or Himawari-8
Extended forecast	817 x 661 x 50 ($\Delta x = 5$ km), up to 48 hr



Domain for the DA experiment

Summary and Future Plan

- The results of DA experiments suggested positive impact of RS-AMVs on forecasts of heavy rainfalls.
- To utilize RS-AMVs more effectively
 - Quality control
 - Optimal settings of observation errors, data thinning
 - Higher resolution assimilation experiments