Observing system experiments of MTSAT-2 Rapid Scan Atmospheric Motion Vector for T-PARC 2008 using the JMA operational NWP system

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Outline

- T-PARC 2008
- Global and Meso-scale Experiments Specification
- Experimental design
  - Trial of 2-step thinning scheme
- Results of OSE
- Summary and Future plan

THORPEX Pacific Asian Regional Campaign (T-PARC 2008)

- Objectives
  - Research the mechanism of genesis, recurvature and extratropical transition for tropical cyclones in the northwestern Pacific.
  - Assess the effectiveness of Global Interactive Forecasting System (GIFS) for tropical cyclones.
  - Improve the performance of numerical weather prediction for tropical cyclones.

THORPEX Pacific Asian Regional Campaign (T-PARC 2008)

- International Cooperation
  - Project by the Asian, North American and European THORPEX Regional Committees.
  - JMA contributed to the provision of forecast sensitivity analysis and special observations.

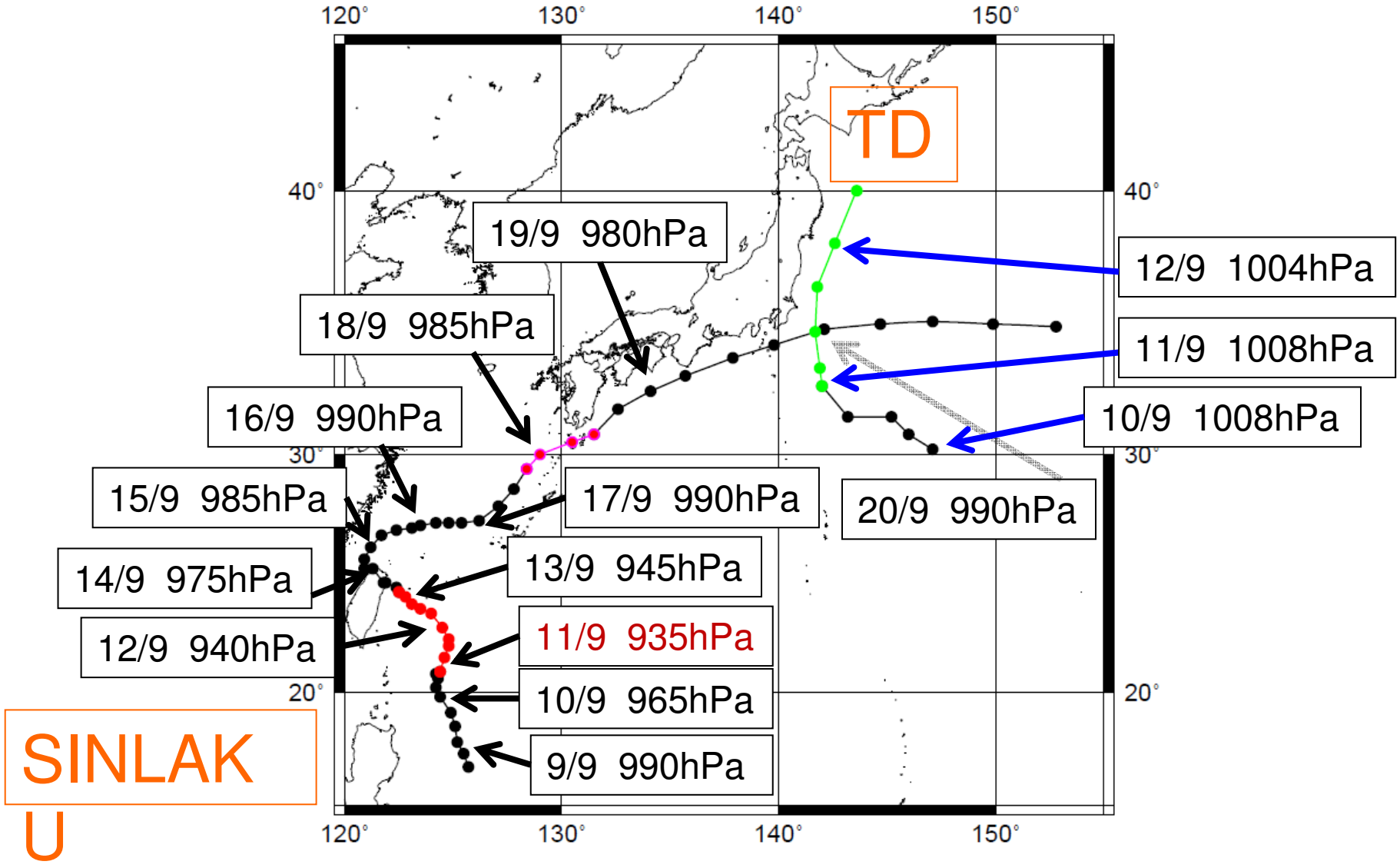
Aircraft Dropsonde	Upper-Sounding By Observatories	Upper-Sounding By JMA Vessels	MTSAT-2 Rapid-scan
			
Sep. 11 (36 Dropsondes) Sep. 17 (29) Sep. 28 (21)	Aug. 19 12UTC – 20 12UTC Sep. 10 12UTC – 12 12UTC Sep. 27 12UTC – 28 12UTC	Aug. 19 12UTC – 20 12UTC Sep. 10 12UTC – 14 06UTC Sep. 27 12UTC – 28 00UTC	Sep. 10 12UTC – 13 06UTC Sep. 17 12UTC – 18 12UTC Sep. 27 12UTC – 28 12UTC

Global and Meso-scale Experiments Specification

	GSM Hydrostatic Global Spectral Model	MSM Non-hydrostatic Meso-scale Model
Horizontal rez./ Vertical rez.	20 km / 60 level	5 km / 60 level
Top	0.1 hPa	21,800 m
Inner-loop model rez. for DA	80 km	15 km
Assimilation method	4D-Var	4D-Var
Time windows	6 hour	3 hour
Forecasts	84 hours (00,06,12,18UTC)	15 hours (00,06,12,18UTC) 33 hours (03,09,15,21UTC)

- Target Tropical Cyclone (TC)
  - SINLAKU and Tropical depression (TD)
    From 18UTC 10/09/2008 to 06UTC 13/09/2008
    From 18UTC 17/09/2008 to 12UTC 18/09/2008

SINLAKU and TD Track map



Experimental Design

- **TEST** – MTSAT-2 rapid scan AMVs are assimilated.
- **CNTL** – No MTSAT-2 rapid scan AMVs are assimilated.

Utilization of special observations

	TEST	CNTL
MTSAT-2-RS-AMVs	○ (use)	×
Dropsonde and Special upper sounding (3-hourly)	× (no use)	×
TC BOGUS	×	×
The other observations	○	○

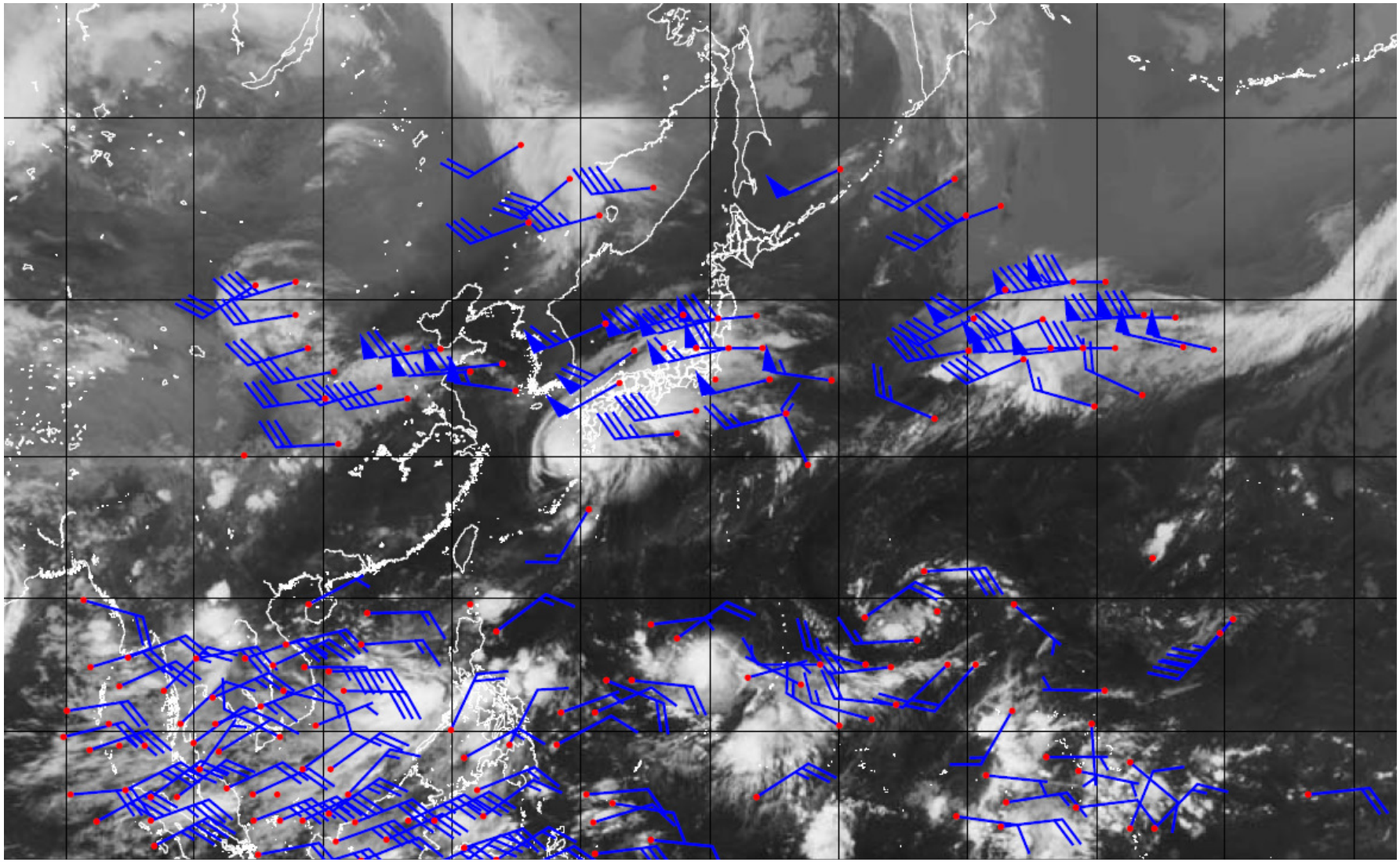
Trial of 2-step thinning scheme for MTSAT-2 rapid scan AMVs

- Step 1
  - Equal-distance thinning with 200km (one AMV in 2deg. x 2deg. x 100hPa box)
  - One AMV selected per box in the 6 hour time window.
- Step 2
  - Equal-distance thinning with 100km (one AMV in 1deg. x 1deg. x 100hPa box)
    - For MTSAT-2 rapid scan AMVs (IR and WV, 4 or 7 min. intervals)
  - One AMV selected per box in the hourly time window.
  - Small observation error correlation

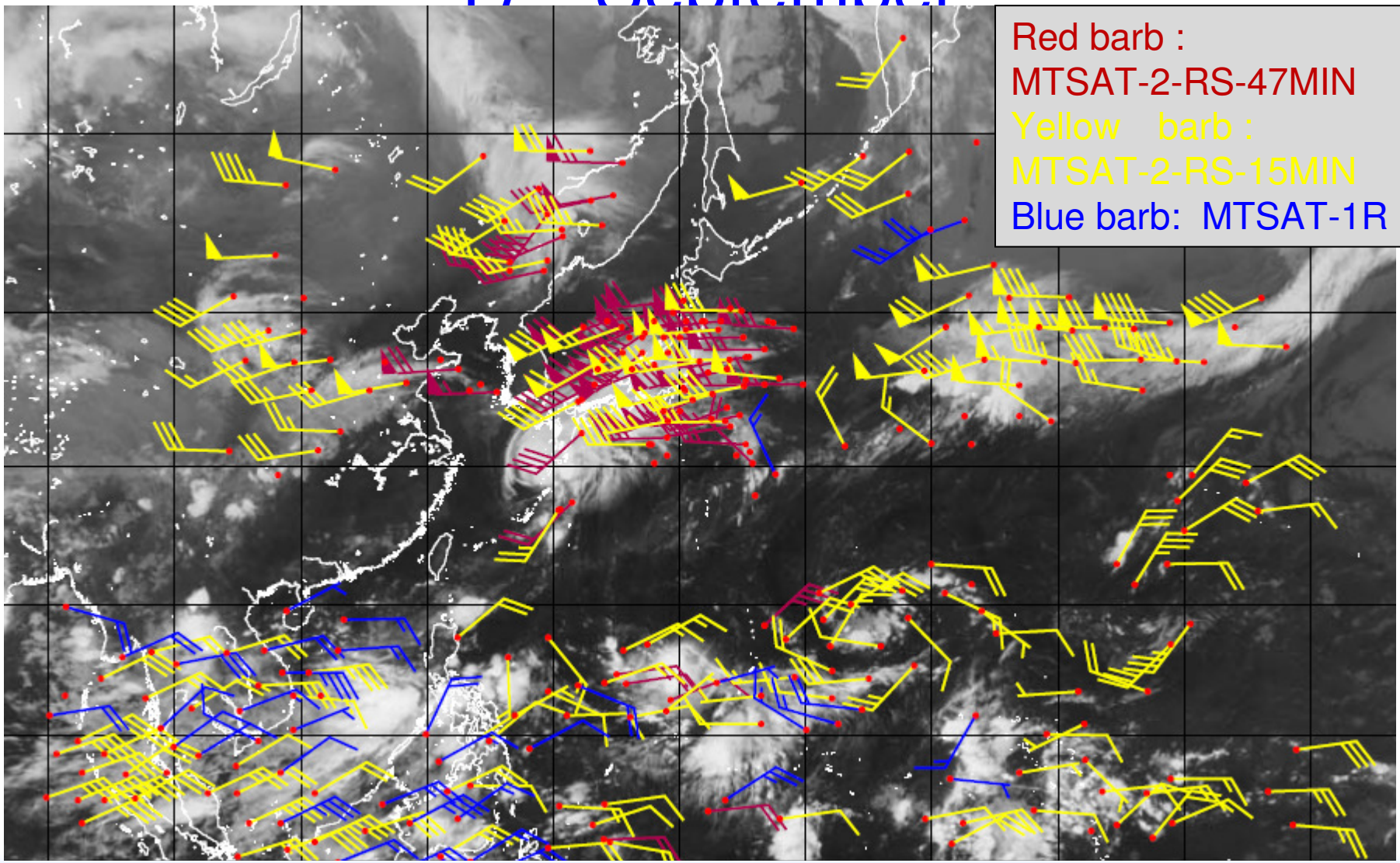
※ MTSAT-2 Rapid Scan AMVs have as almost same accuracy as MTSAT-1R.

Presented by K. Shimoji and S. HOSHINO

Example of MTSAT-1R AMVs (CNTL) after QC at 300hPa in 17-19UTC 17th September



Example of MTSAT AMVs (TEST) after QC at 300hPa in 17-19UTC 17th September



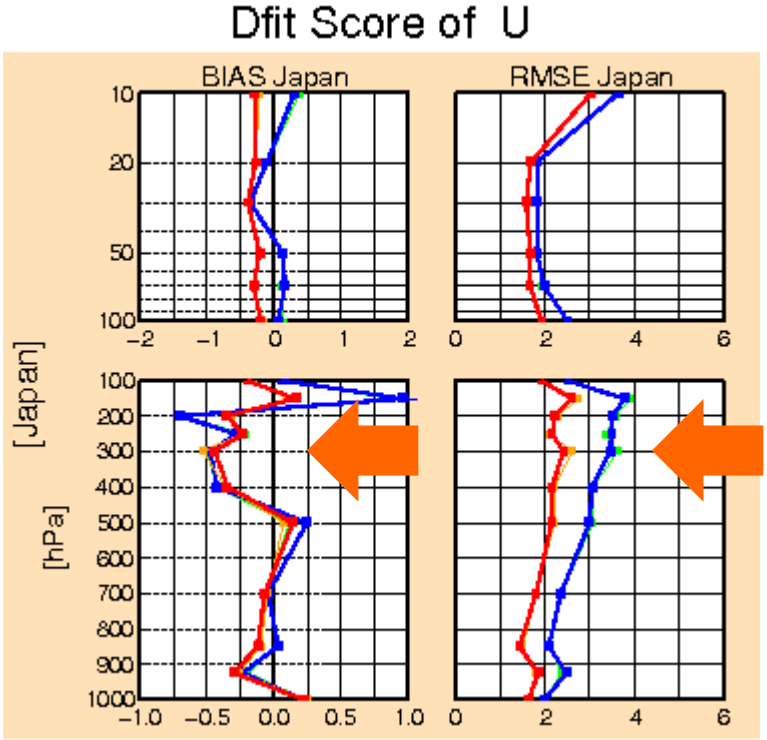
Experimental results for GSM-DA

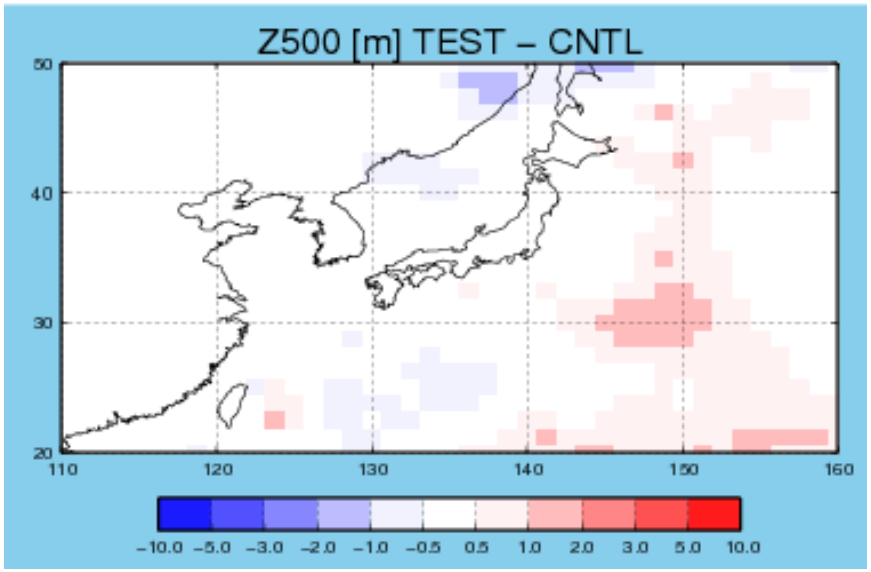
Analysis and First-guess against radiosonde observations

- BIAS and RMAE of wind analysis for GSM-DA using MTSAT-2 rapid scan AMVs reduced.

Ex.

U-comp. wind speed BIAS and RMSE, and Z500 difference from 11 to 13 Sep.





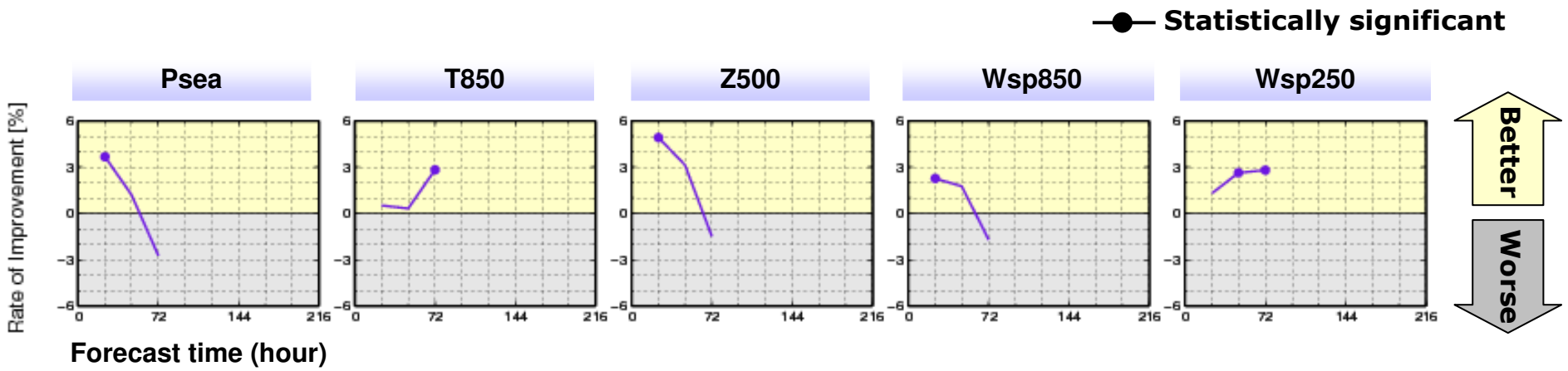
Anl TEST Guess TEST

Anl CNTL Guess CNTL

Normalized score against initial forecast (FT=0)

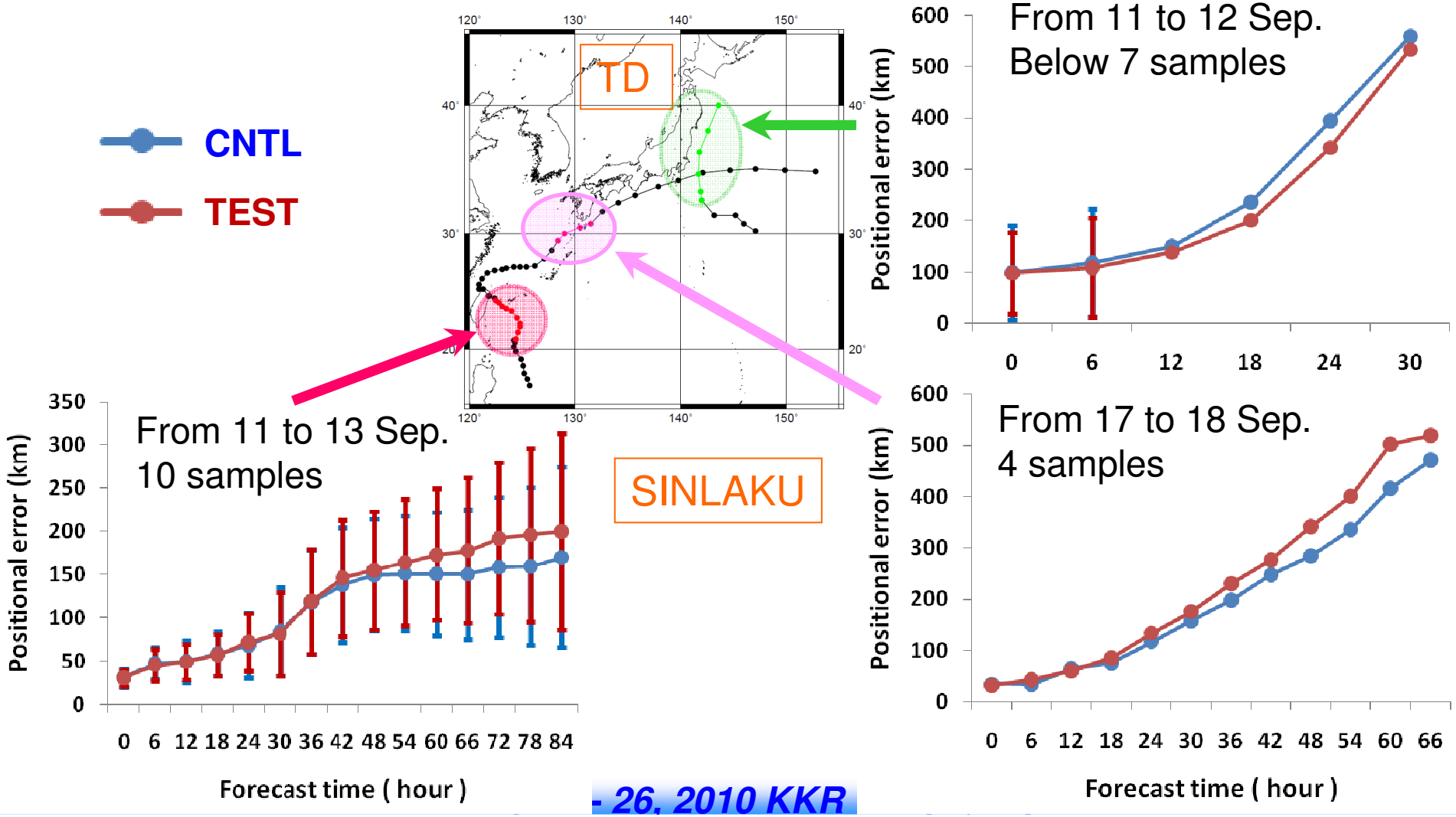
- Significantly positive impacts (average ~3%) on three-day GSM forecast in Japan area.

Ex. **Forecast Improvement Rate wrt RMSE for 1-3 day forecasts**
(CNTL-TEST)/CNTL from 11 to 13 Sep. in Japan area.



Mean TC Track Forecast Error

- SINLAKU track predictions were worse in the late-forecast time. But TD predictions were better.

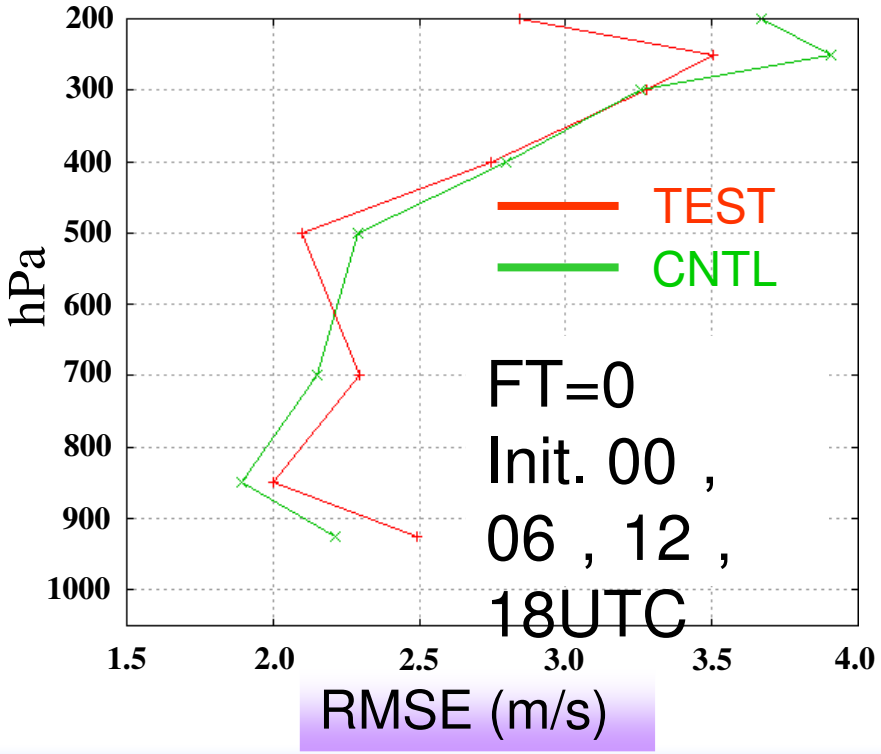


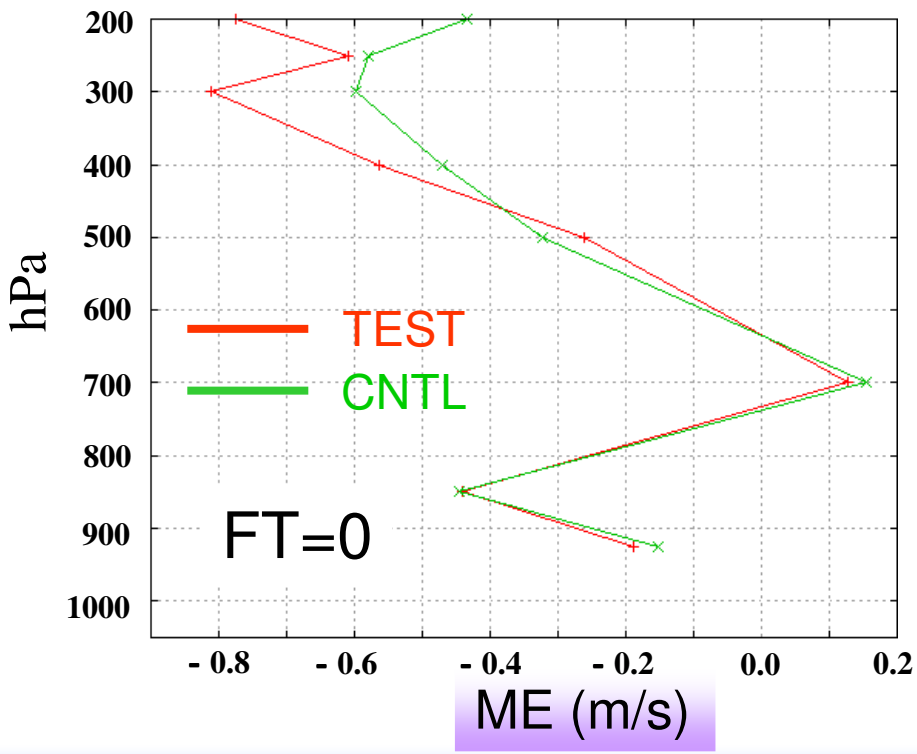
Experimental results for MSM-DA

Initial forecasts against radiosonde observations

- RMSE above 500hPa level were reduced, where many MTSAT-2-RS-AMVs were assimilated.

Ex. RMSE and ME against Japan Radiosonde Wind speeds both 10-13 and 17-18 September 2008 (FT: Forecast time)

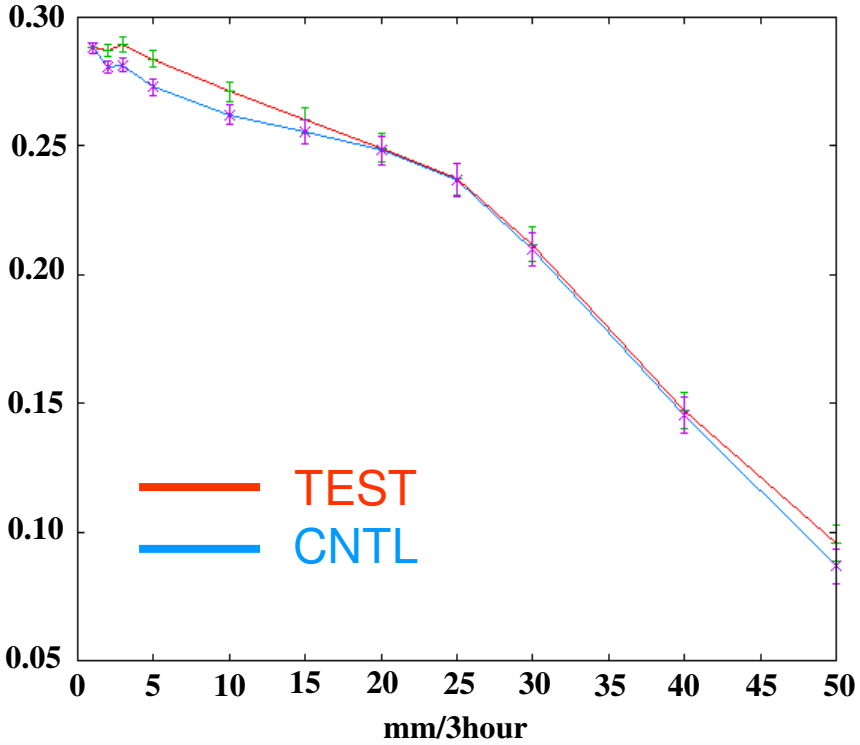


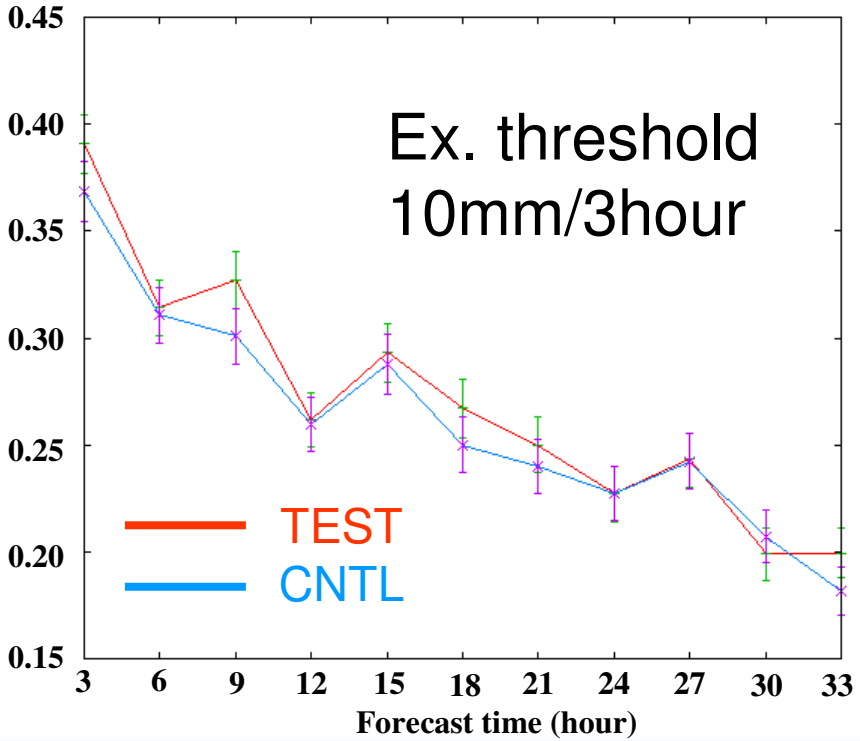


Equitable Threat Score against Precipitation

- There was a improvement of rain in one-day forecasting for precipitation over 1-15 mm per three hours around Japan.

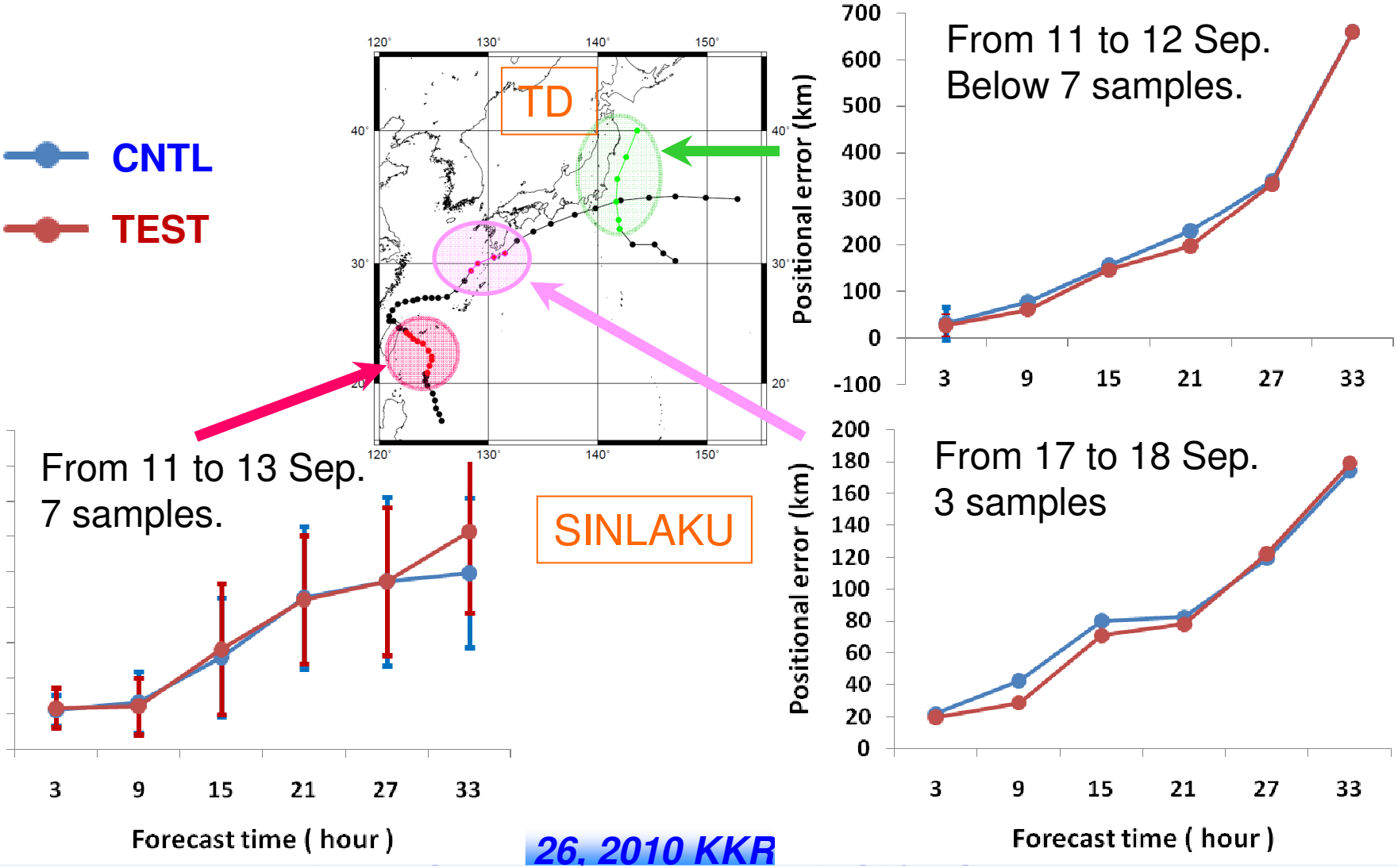
Ex. Equitable Threat Score against Radar-Rainfall composite precipitation data in Japan both 10-13 and 17-18 September 2008
(Init. 03,09,15,21UTC : Error bar : 95% confidence interval)





Mean TC Track Forecast Error

- SINLAKU track predictions were slightly better in the after-recuvature stage. Another TD predictions were better.

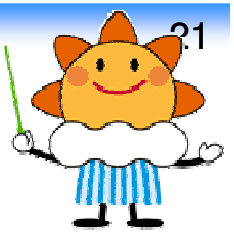


Summary

- OSEs for MTSAT-2 rapid scan AMVs using the global and meso-scale NWP system were conducted.
- The trial of 2-step thinning scheme for MTSAT-2 rapid scan AMVs was performed.
- This scheme contributed to the increase of AMVs in the vicinity of Japan where AMVs data was sparse heretofore.
- BIAS and RMSE of wind analysis in GSM and MSM reduced against radiosonde observations using AMVs.
- This better wind analysis brought the improvement of forecasts in GSM and MSM.
- SINLAKU track predictions were improved or neutral in GSM and MSM except the late-forecast time of GSM.

Future Plan

- We will investigate the reason why SINLAKU track predictions were worse in GSM.
- We will perform more OSEs for MTSAT Rapid Scan AMVs to validate accuracy 2-step thinning scheme.
- Considering usage of the other satellite rapid scan AMVs (METEOSAT-8 etc.)

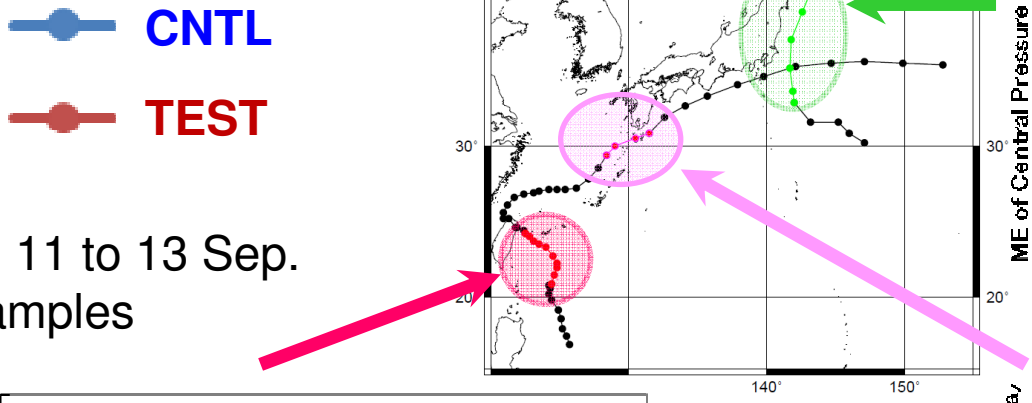


Thank you for your attention

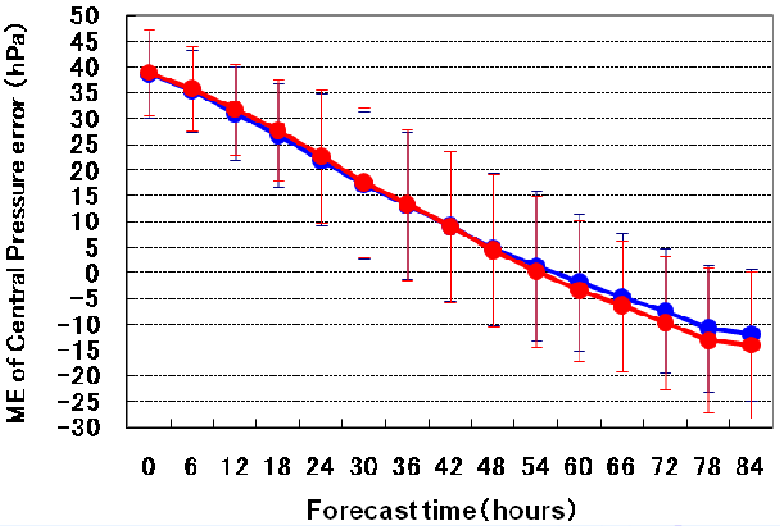
Back up slide

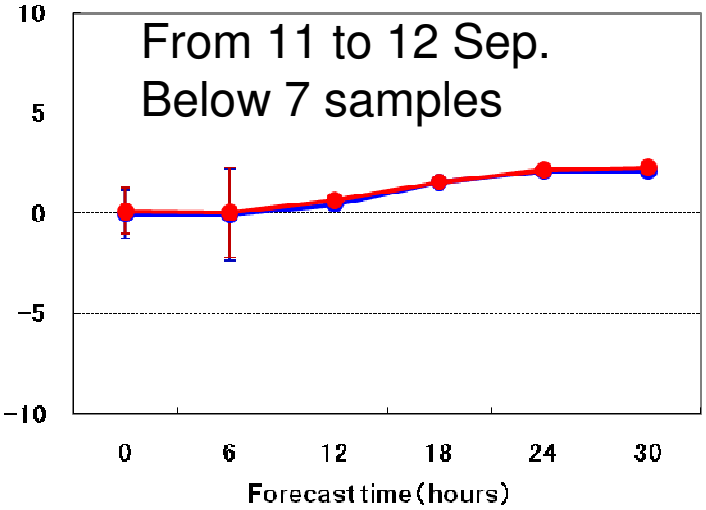
Mean TC Intensity Forecast Error (GSM)

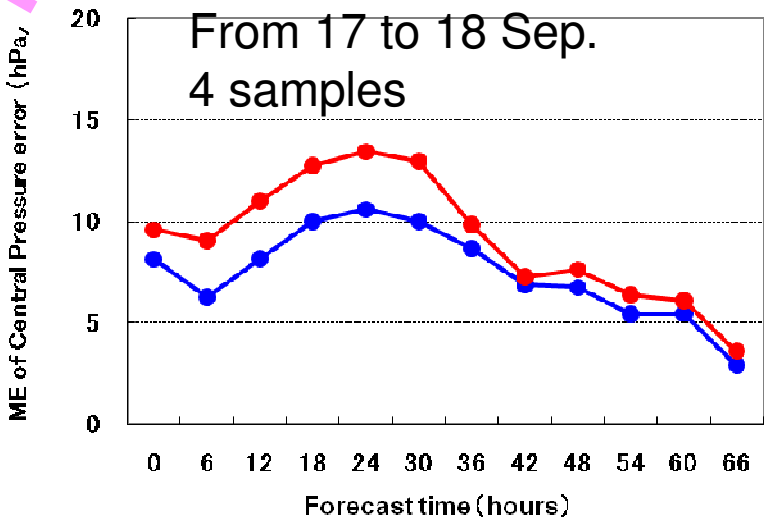
- SINLAKU intensity predictions were worse in the beginning-forecast time in the after-recurvature stage. TD predictions were newtral.



From 11 to 13 Sep.
10 samples

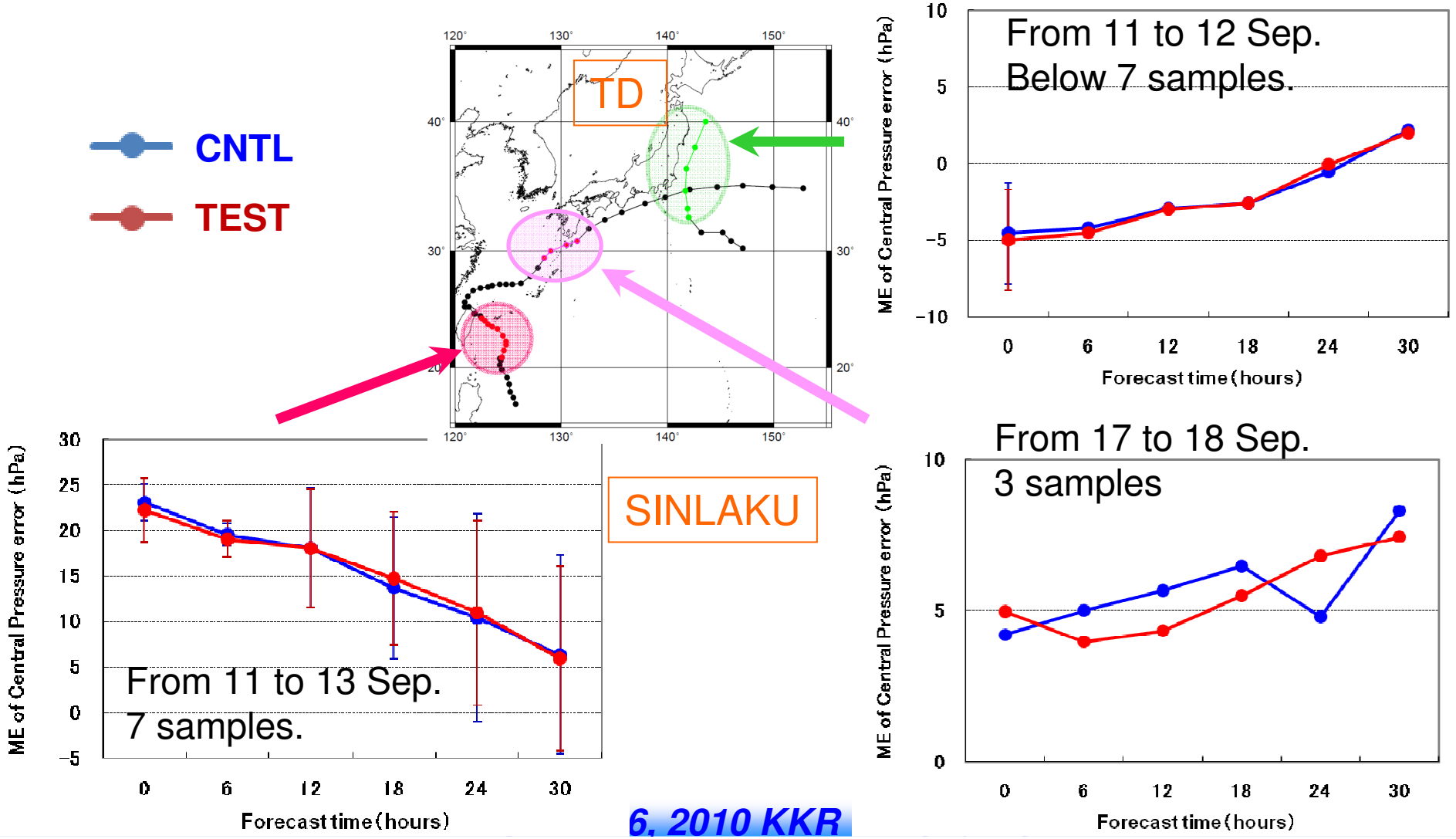




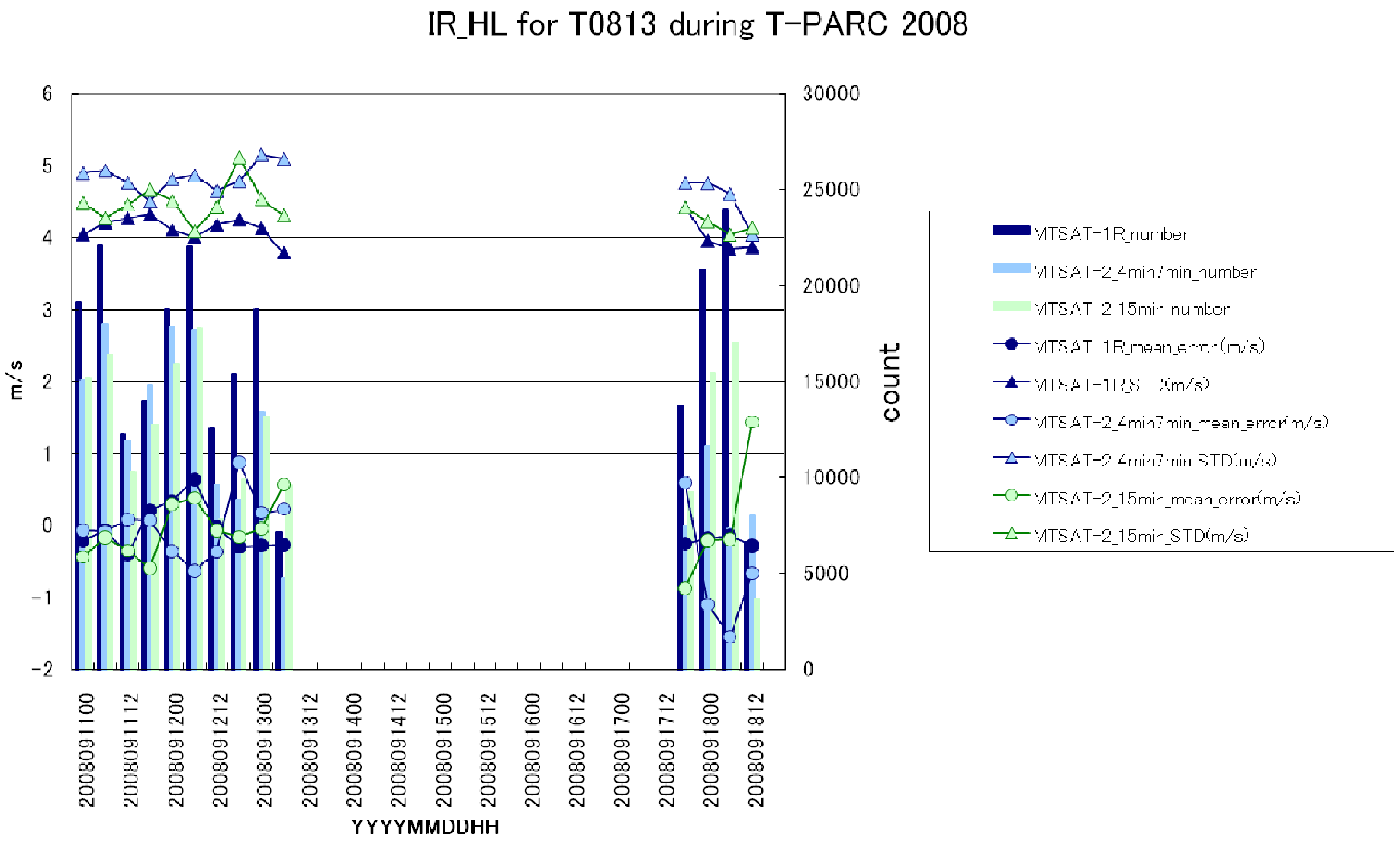


Mean TC Intensity Forecast Error (MSM)

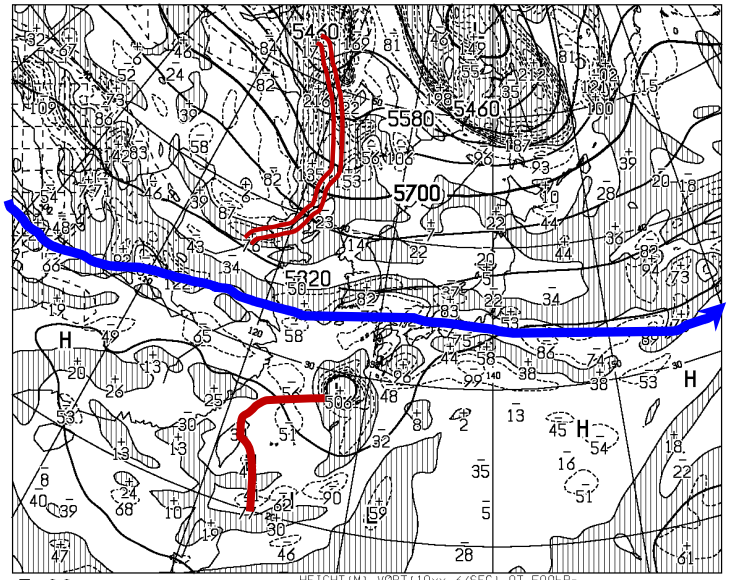
- Mean TC intensity predictions were almost neutral impact.

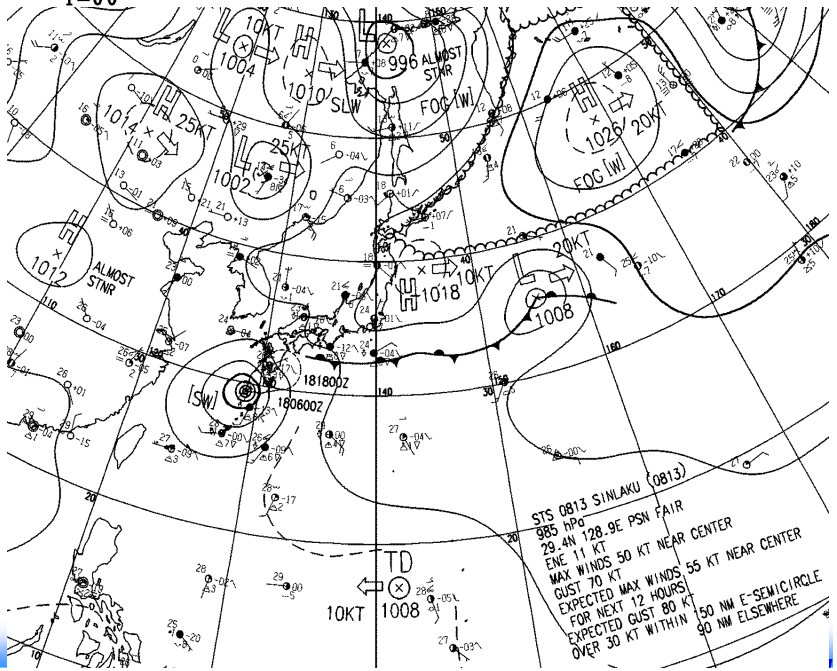


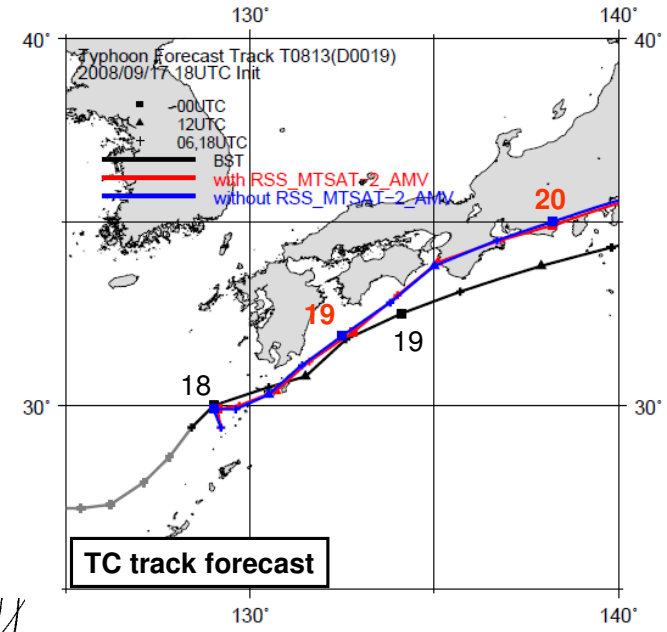
MTSAT-2 Rapid Scan AMV comparison



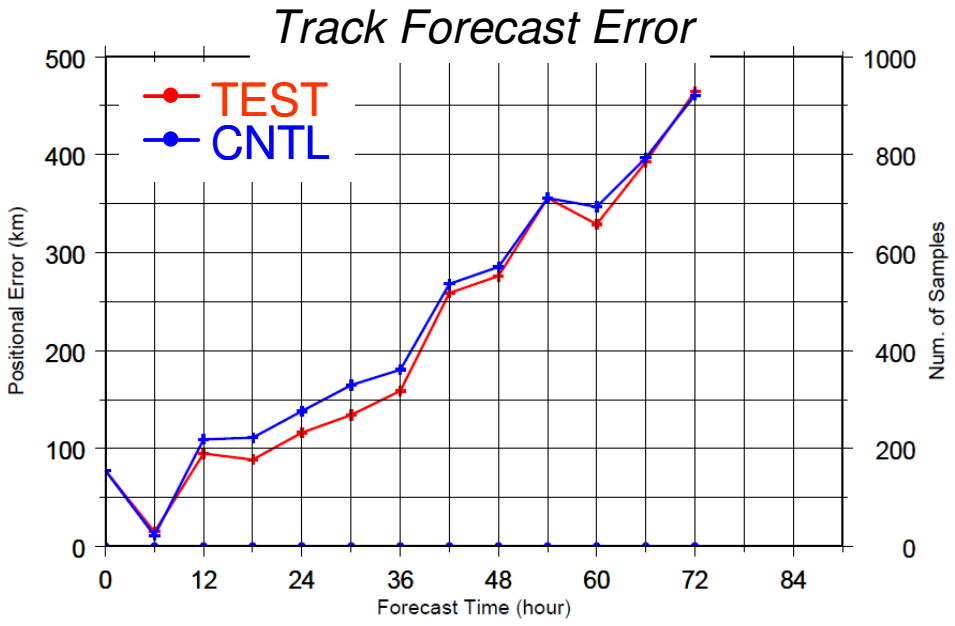
Case study with initial time of 18UTC 17/09/2008





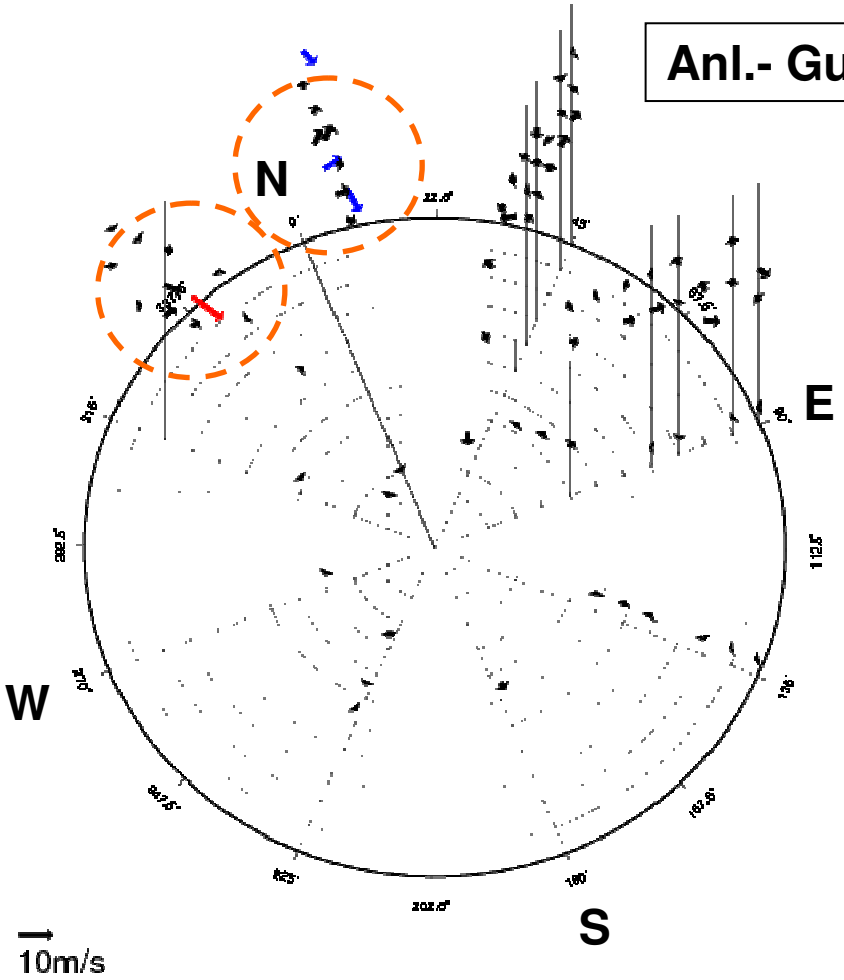


Slightly improvement of slow bias speed for TC track forecasts

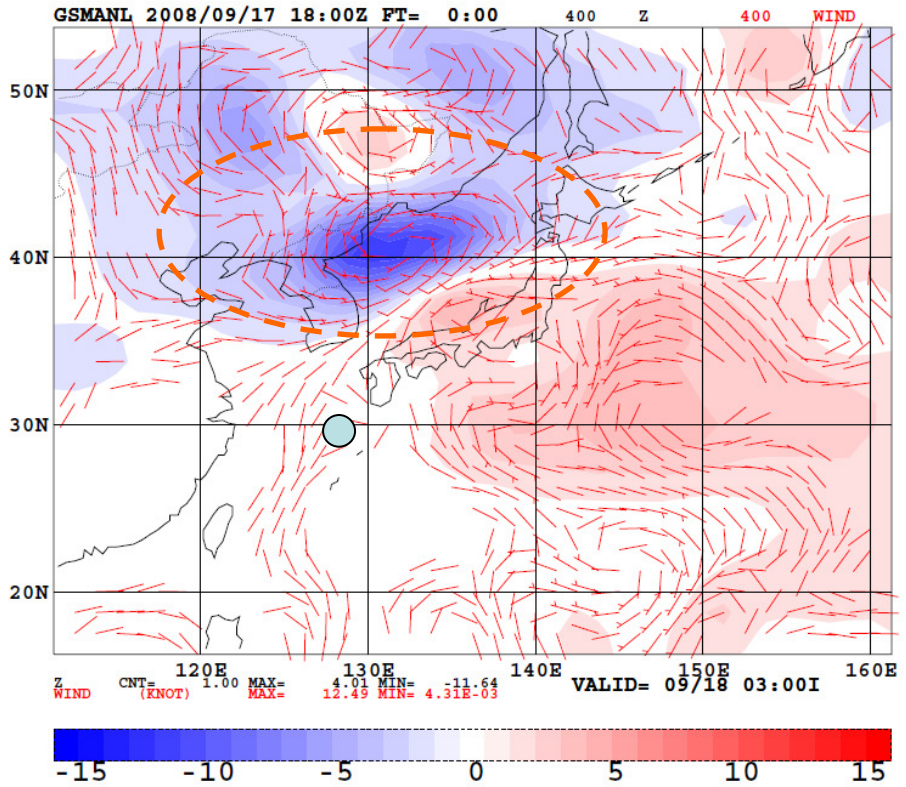


Case study with initial time of 18UTC 17/09/2008

- Impact of MTSAT-2-RS-AMVs in the north or north-west side on 300 – 400 hPa.

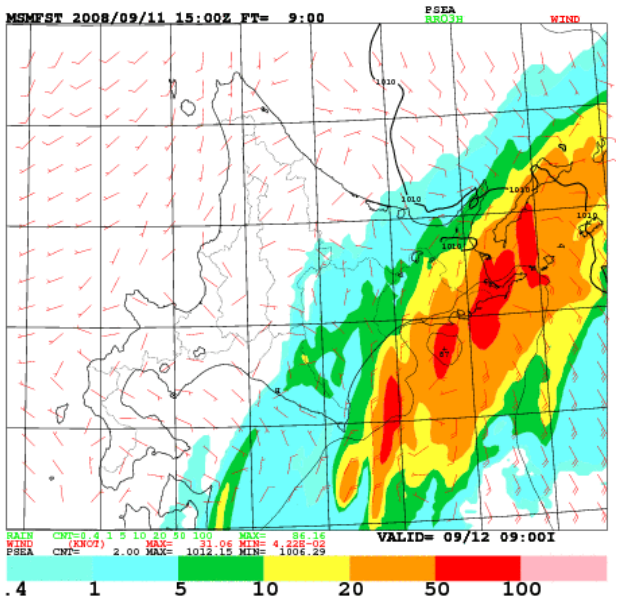


TEST-CNTL

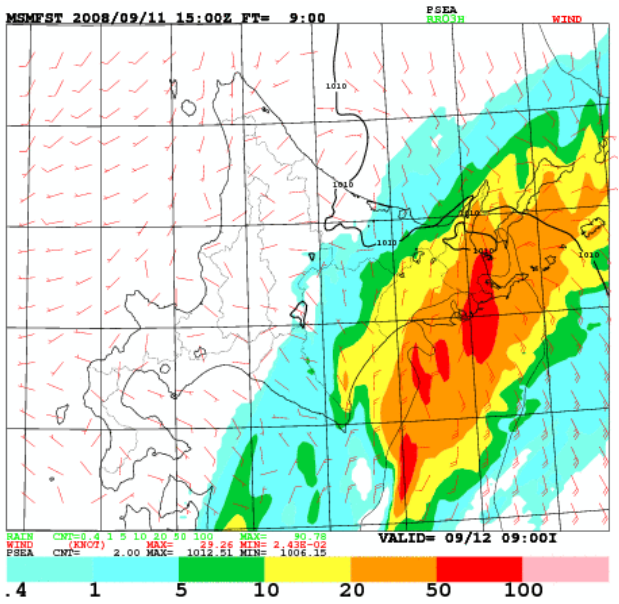


Case study with initial time of 15UTC 11/09/2008 for MSM

CNTL



TEST



Rader-Rainfall