AN OBSERVING SYSTEM EXPERIMENT OF MTSAT RAPID SCAN AMV USING JMA MESO-SCALE OPERATIONAL NWP SYSTEM

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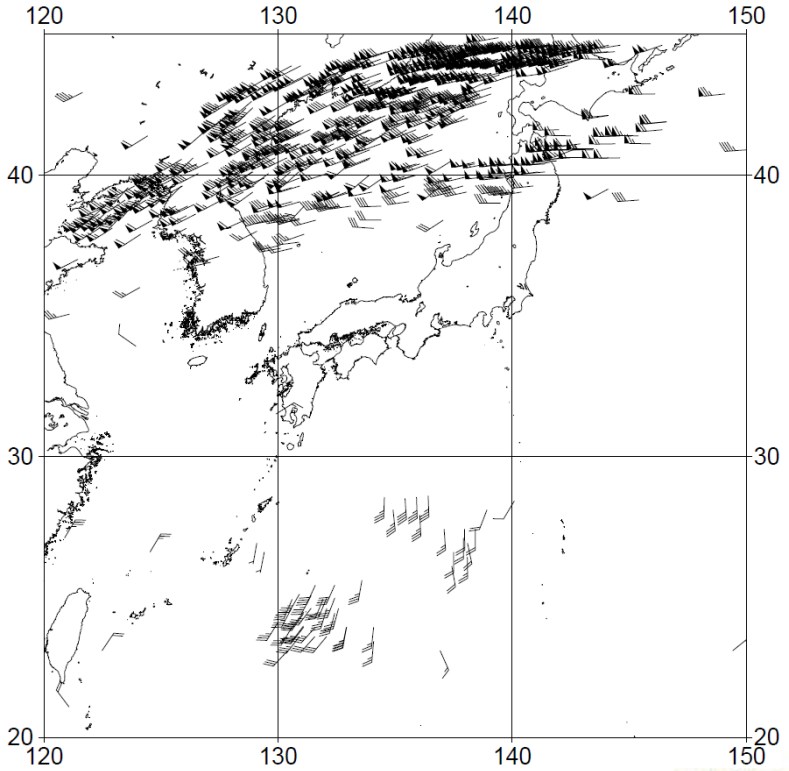
Outline

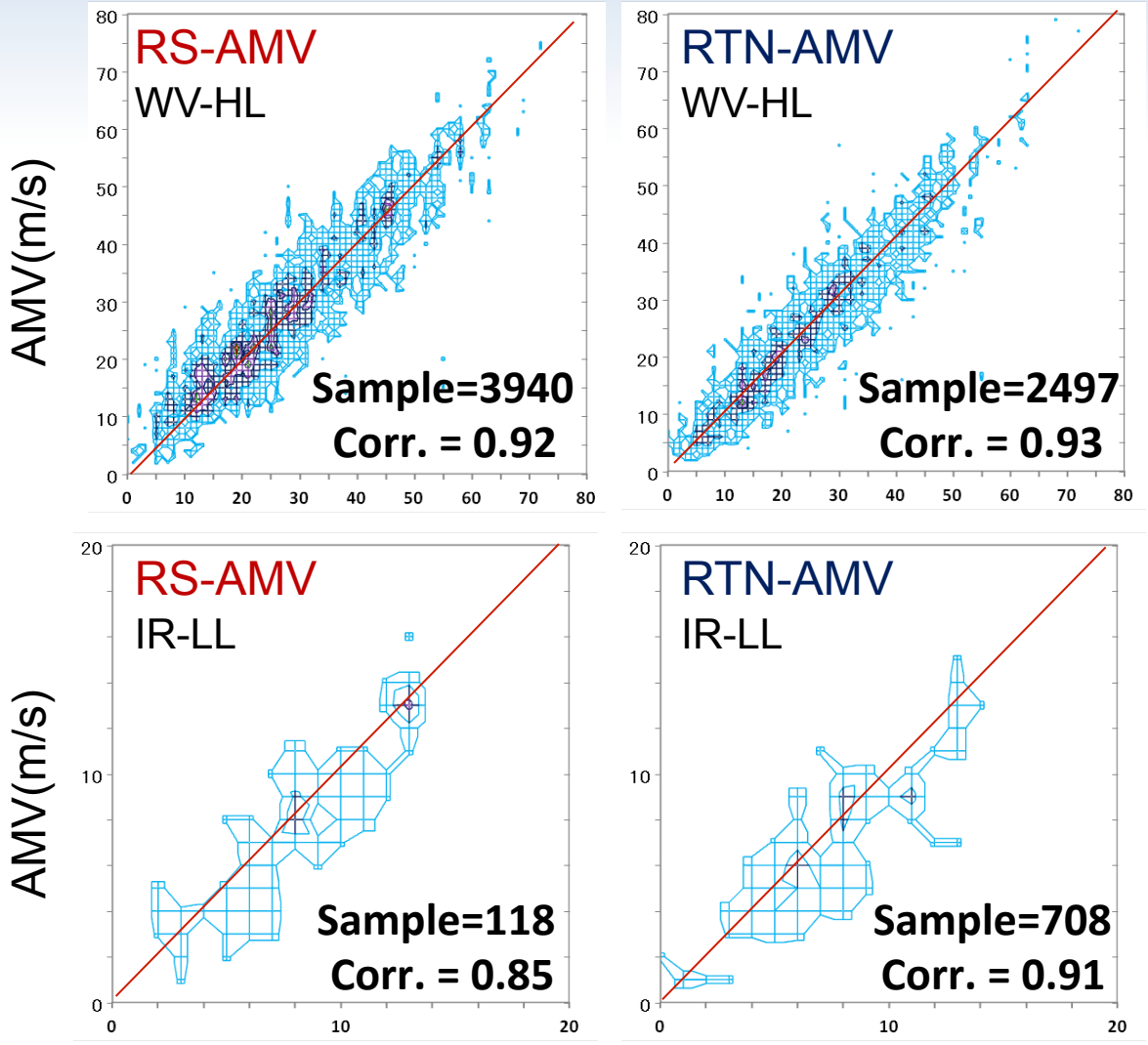
- Verification of RS-AMV
  - Summer and autumn 2010 and 2011
- OSE of RS-AMV with Meso DA system in 2010
  - Experimental design
  - Results of OSE
- Summary and future plan

Verification of RS-AMV in 2010 and 2011

- Conditions (From E120 to E150, N20 to N45)
  - Period: From 00UTC 12 August 2010 to 18UTC 03 September 2010
    From 18UTC 01 June 2011 to 18UTC 30 September 2011
  - Only for the AMV data with the QI value more than 85
- Comparison base
  - MTSAT operational AMVs (RTN-AMV) with the intervals of 15 or 30 minutes using the operational NWP system
- Statistics
  - Against radio sonde observations
  - Against GSM first-guess
  - Observation error correlations in 2010

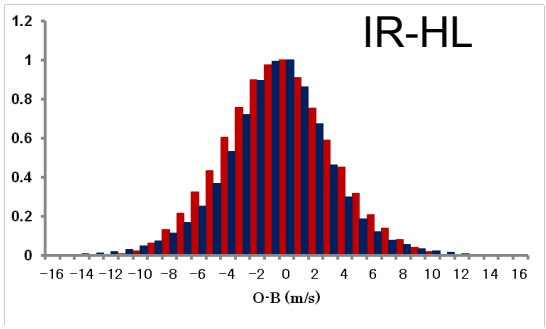


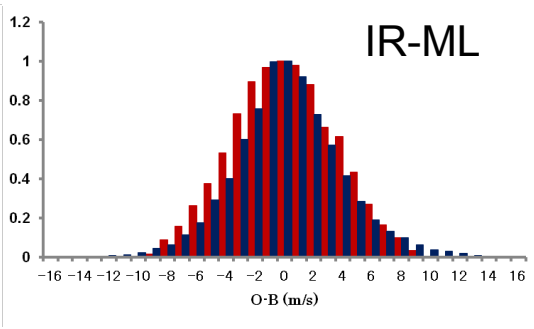
RS-AMV wind speeds against radio sonde observations in 2010

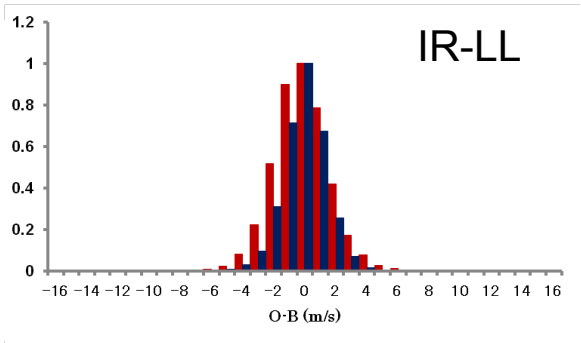


IR: infrared sensor
WV: water vapor
HL: 10-400 hPa
LL: 700-1000 hPa

RS-AMV wind speeds against GSM in 2010
(O-B (AMV-Background) statistics)

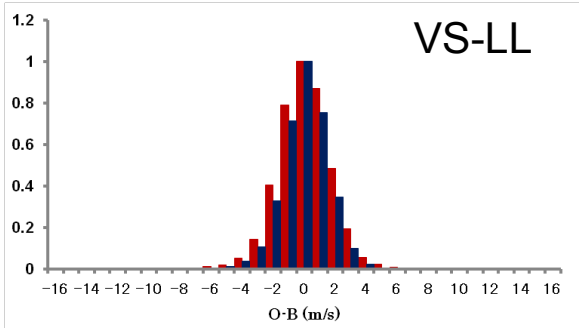


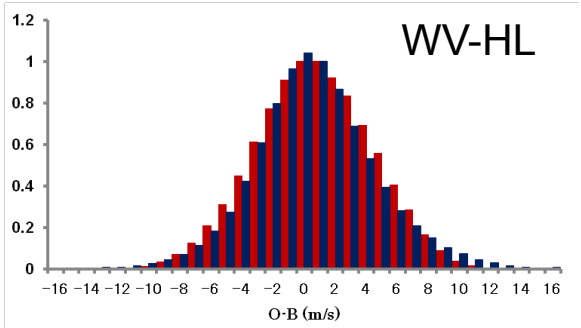




RS-AMV

RTN-AMV



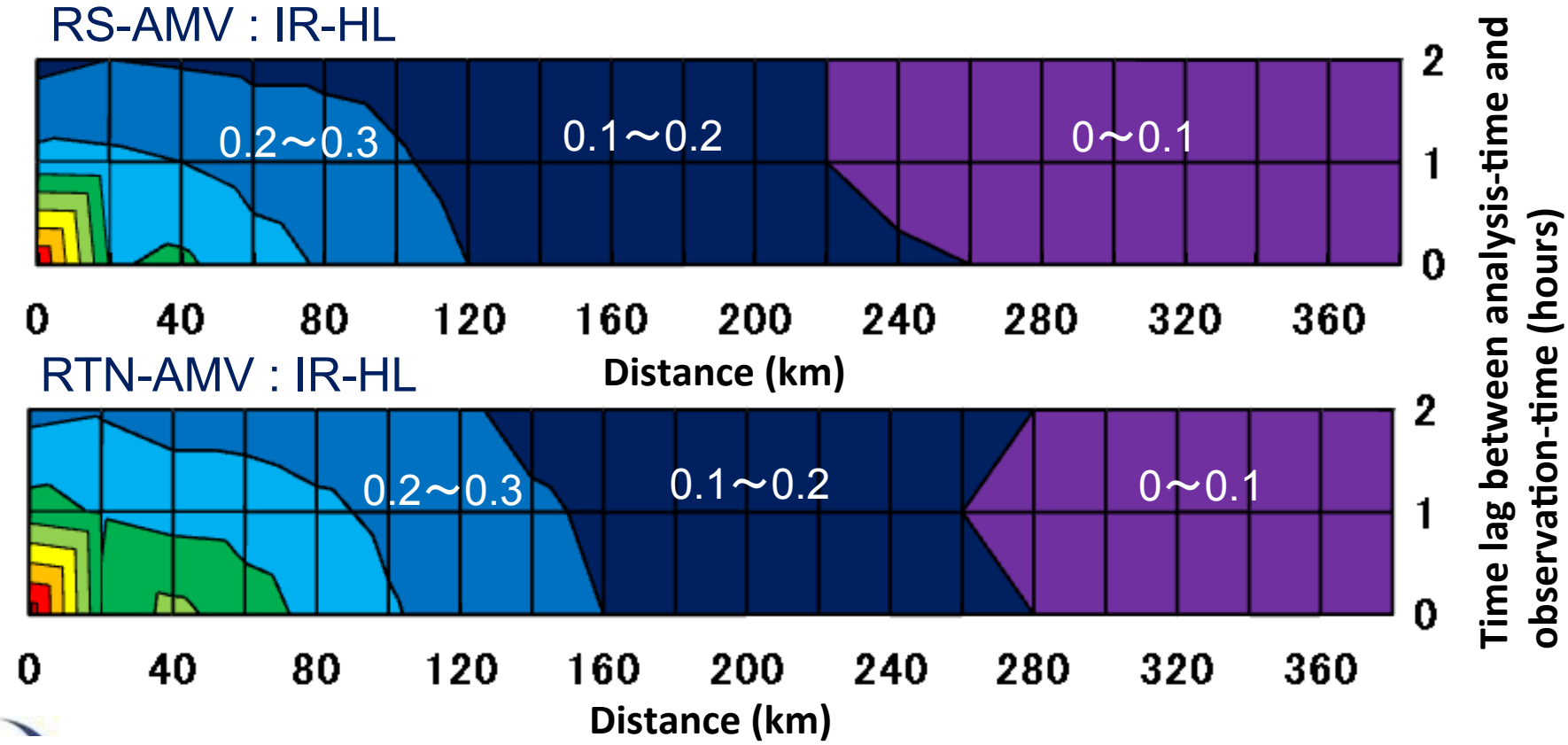


IR: infrared sensor
VS: visible sensor
WV: water vapor
HL: 10-400 hPa
ML: 400-700 hPa
LL: 700-1000 hPa

	RS_AMV			RTN-AMV		
TYPE	COUNT	ME (m/s)	STD (m/s)	COUNT	ME (m/s)	STD (m/s)
IR-HL	84588	-0.44	**3.67**	201842	-0.76	**3.75**
IR-ML	7673	0.08	3.49	16771	0.13	3.78
IR-LL	17495	-0.10	**1.79**	91486	-0.09	**1.42**
VS-LL	11395	0.09	**1.70**	20795	-0.01	**1.47**
WV-HL	152747	**0.77**	**3.73**	248160	**0.58**	**3.98**

Observation Error Correlation (OEC) in 2010

- O-B error correlations as alternative OEC were calculated.
- AMVs are needed to have small OEC for saving the computational cost of 4D-Var system. RS-AMVs have smaller O-B error correlations than RTN-AMVs.



OSE OF RS-AMV WITH MESO DA SYSTEM IN 2010

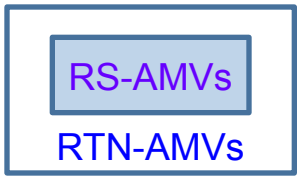
Meso-scale Experiments Specification

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

- Case study Heavy Rain and Typhoons (TCs: LIONROCK,KOMPASU and NAMTHEUN: tracks draw with brown lines) in Okinawa, the western and northern part of Japan
- Period

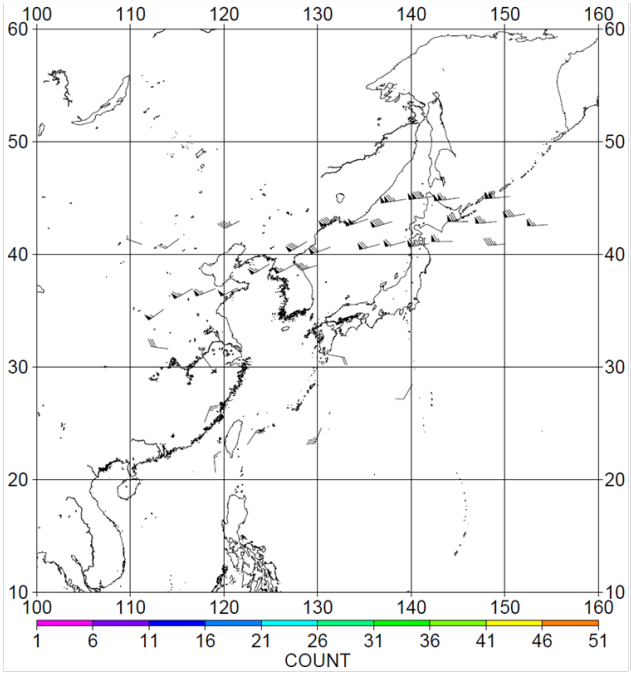
Data assimilation (DA) : From 00UTC 24 August 2010 to 21UTC 03 September 2010
Forecast : From 00UTC 25 August 2010 to 21UTC 03 September 2010

Experimental design

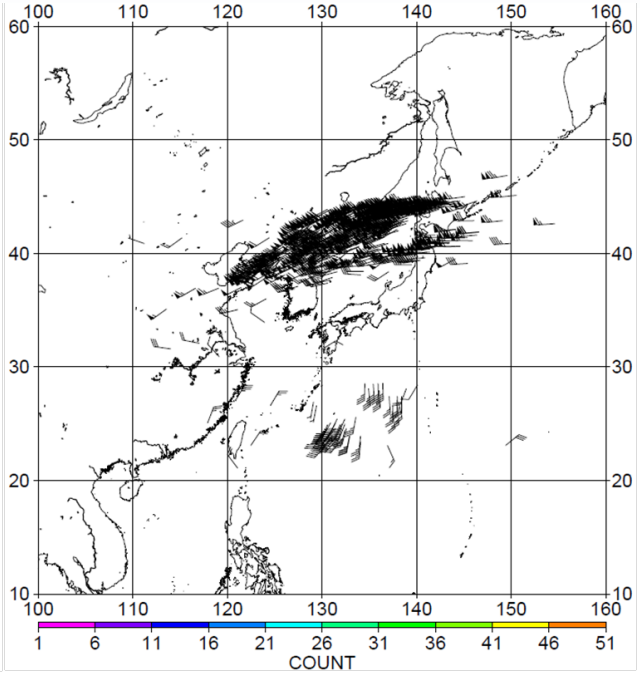
Name	Specification
Routine	A scheme of the 200 km thinning of RTN-AMVs in the 3 hour time window
2-step thin 	2-step thinning scheme ➢ A combination scheme of the 100 km thinning of RS-AMVs in hourly time window and the 200 km thinning of RTN-AMVs in 3 hour time window
200kmSuper-ob	Super-observation procedure ➢ Average of AMVs (RS-AMVs and RTN-AMVs) directions and speeds with 200 km intervals in hourly time window ➢ Averaging about time, level, space, wind directions and speeds
100kmSuper-ob	Same as above with 100 km intervals

Distribution of MTSAT AMVs after QC on 300 hPa at 06 UTC 26/08/2010

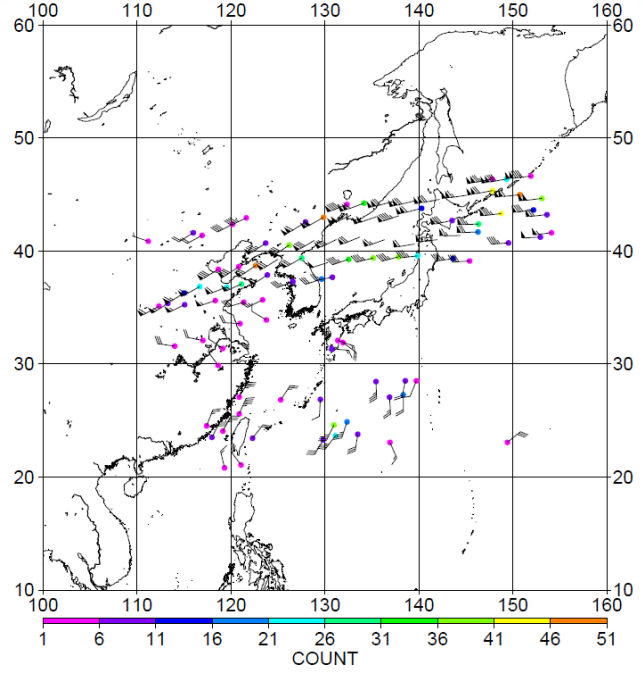
Routine



2-step thin : RS-AMV use



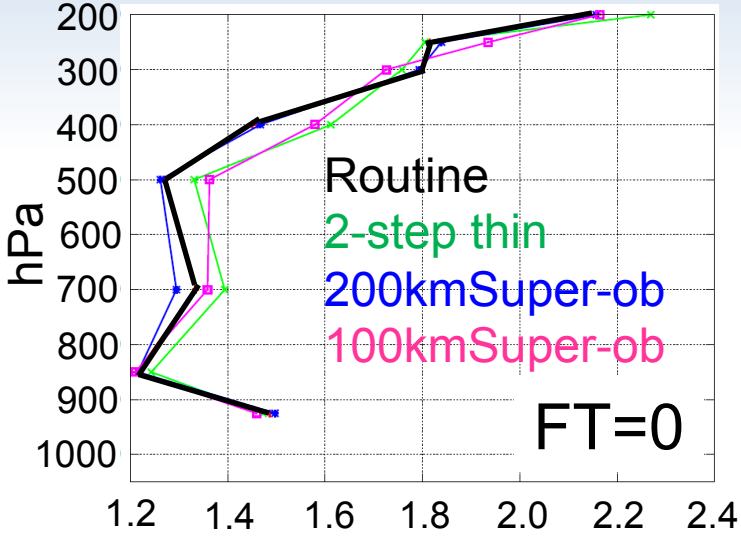
200kmSuper-ob: RS-AMV use

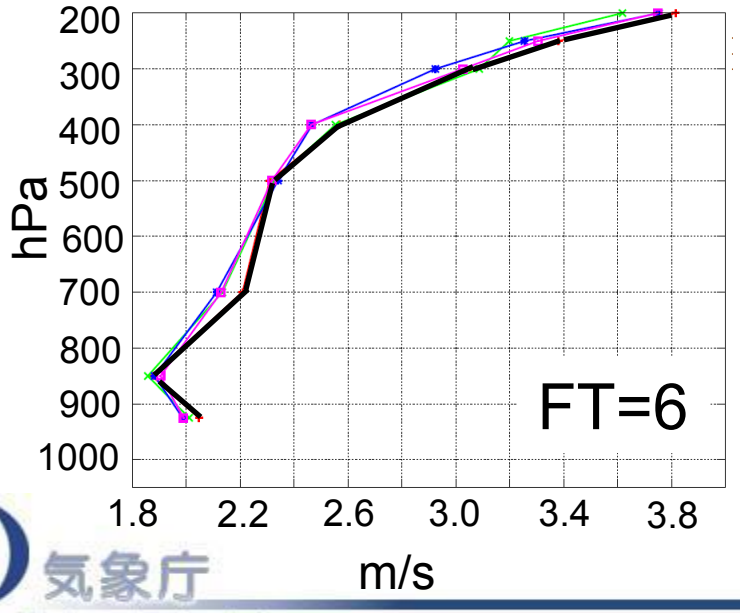


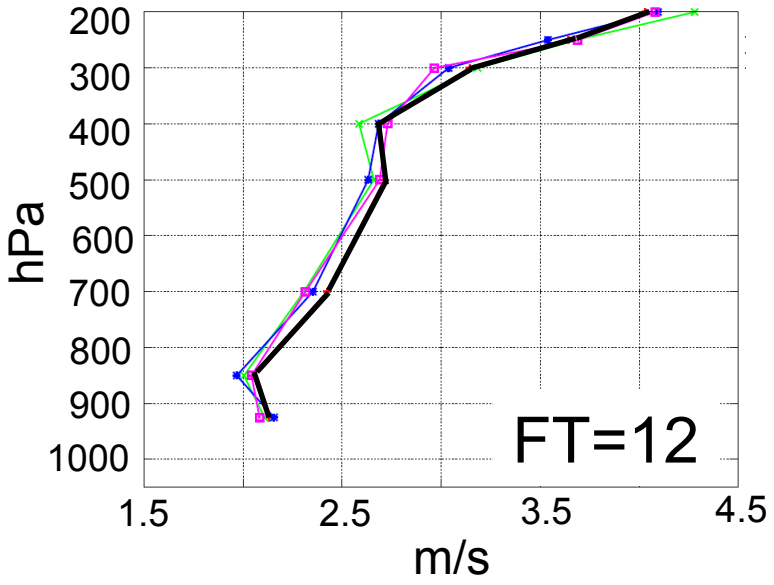
- RS-AMVs concentrate in N40 latitude belt and southern sea of Japan as 2-step thin.
- Expansion in number of available AMVs by RS-AMVs


RESULTS OF OSE

RMSE of forecasts against Japan radiosonde wind speeds



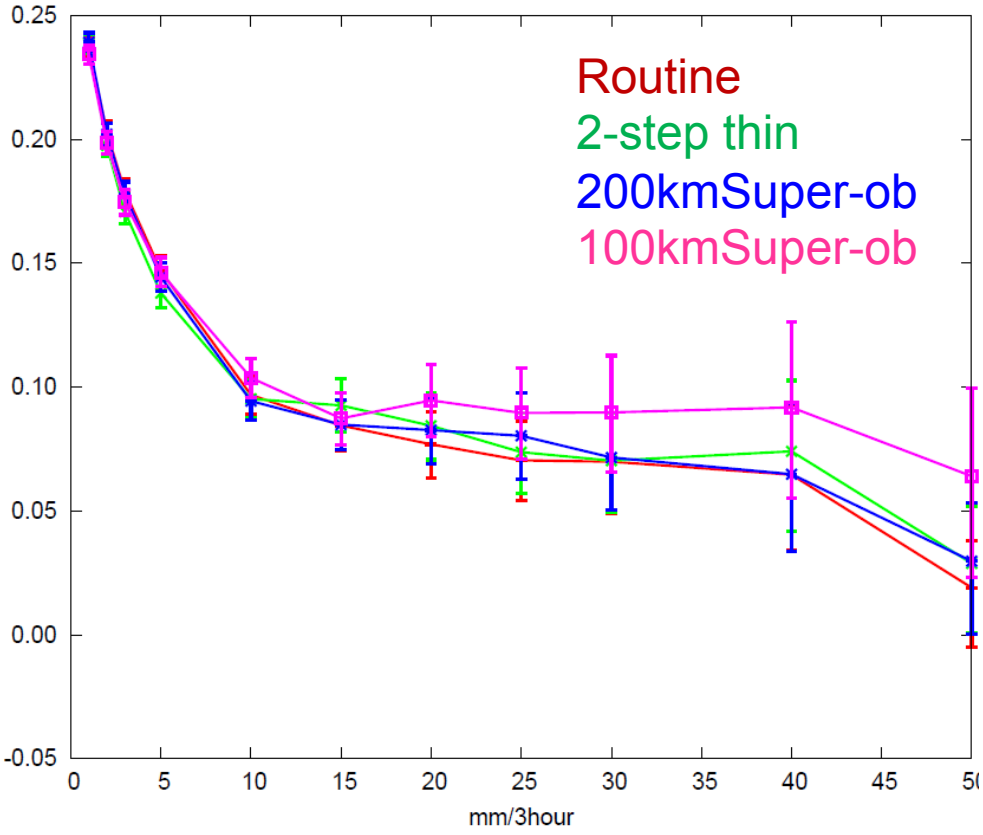




- RMSEs in almost all level were slightly reduced in OSEs of RS-AMV except initial forecast time (FT=0).

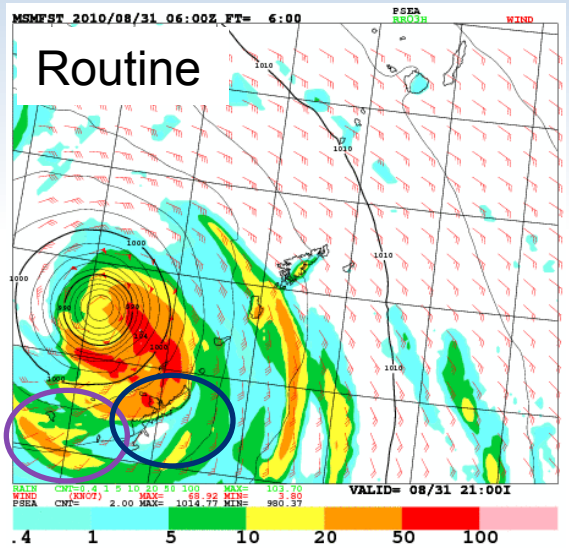
Equitable Threat Score for Precipitation in Japan

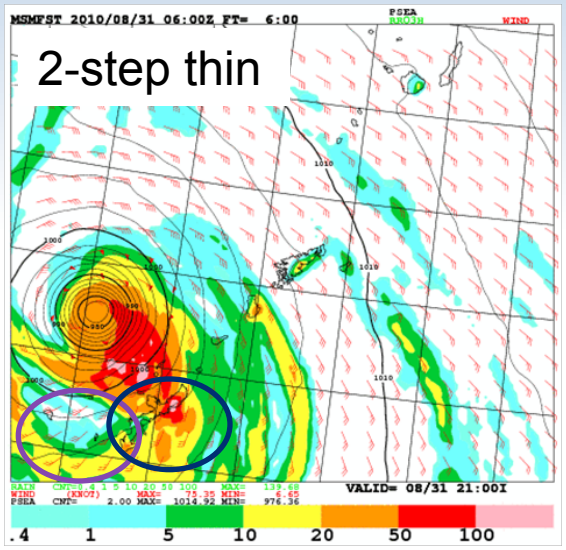
Improvement of precipitation forecasts over 15 mm per three hours in 15-hours forecast (especially 100kmSuper-ob)

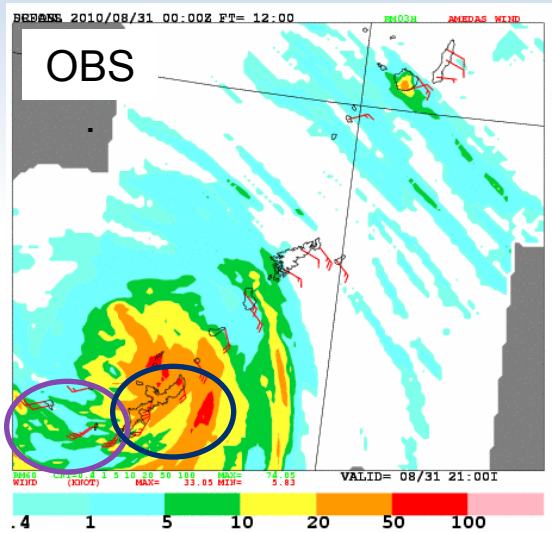


- Condition
  - Initial forecast time : 00,06,12 and 18 UTC
  - Resolution of validation in grid size : 20 km

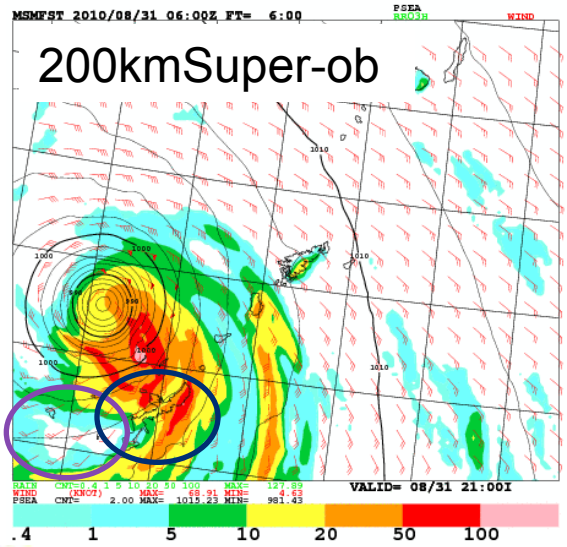
A case study of FT=06 at 06 UTC 31 Aug. 2010

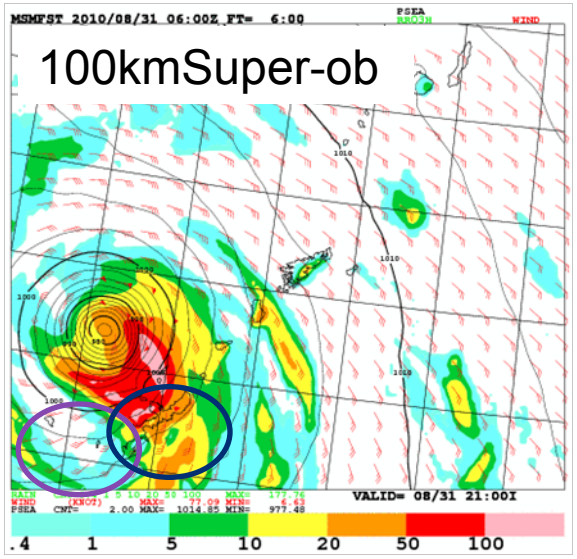






Radar-Rainfall composite precipitation





- Similar to the pattern of OBS. (RS-AMV use)

Summary

- Wind speeds of RS-AMV were verified with RTN-AMV in summer and autumn 2010 and 2011
  - Slightly small correlation against sonde observations
  - Positive bias above 400 hPa in WV-HL AMVs against first-guess
  - Standard deviation against first-guess
    - Smaller above 400 hPa / Larger below 700 hPa
  - Small observation error correlation against first-guess
- OSEs of RS-AMV using the meso-scale operational NWP system in 2010 were performed. The results showed:
  - Smaller wind speed forecast errors (RMSE) at almost all level against sonde observations
  - Better moderate precipitation forecasts in 15-hours forecast
  - Slightly better mean TC forecast (both track and intensity)
  - Good performance of 100kmSuper-ob in this case study

Future plan

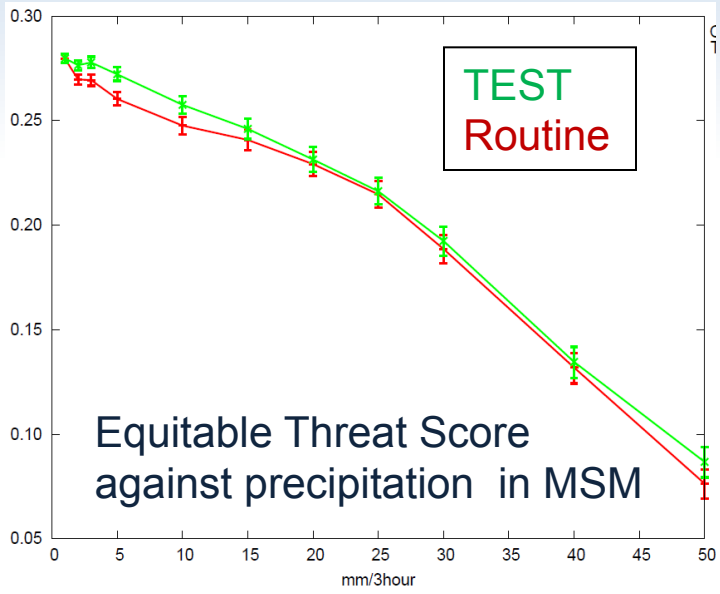
- We plan to perform more OSEs for MTSAT RS-AMVs to confirm performance of procedures, although 100kmSuper-ob has good scheme in this case study.
  - Consideration of procedure
    - 2-step thinning
    - Super-observation
      - Averaging the close individual AMVs
        - » Use of wind directions and speeds
        - » Use of U- and V-component winds
        - » Use of median wind speeds etc.
  - We will select a good performance scheme from many case studies.
- We plan to use RS-AMVs in the operational NWP system from June 2013.

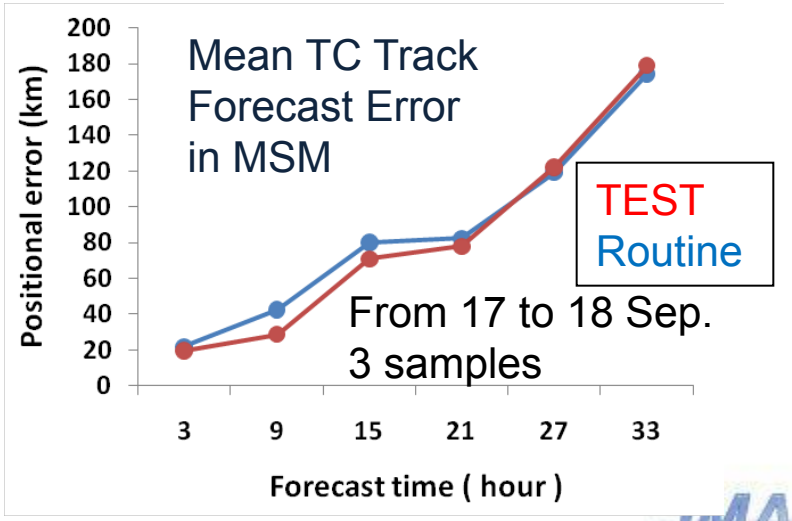
Thank you for your attention.


BACK UP SLIDE

Review of OSE using RS-AMV
～TPARC 2008～

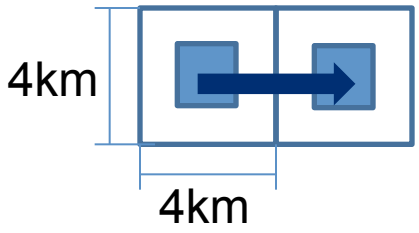
- The OSEs of 2-step thinning scheme (TEST) were performed with Global and Meso-scale DA system.
- BIAS and RMSE of wind analysis reduced against radiosonde observations with this scheme.
- With this better atmospheric analysis, the consequent forecasts showed the better results.
  - Precipitation forecast
  - Track predictions of typhoon SINLAKU were improved in one day forecast.





Features of RS-AMV and RTN-AMV

- Difference of time interval of satellite images for AMV
  - RTN-AMV : 15 or 30 minutes
  - RS-AMV : 5 minutes
- Minimum wind speed of AMV
  - RS-AMV wind speeds are faster in average than RTN-AMV.
  - For example : thinking of 1 pixel move of a target



RTN-AMV : 4000 (m)/900 (s) ≒ 4.44 (m/s)

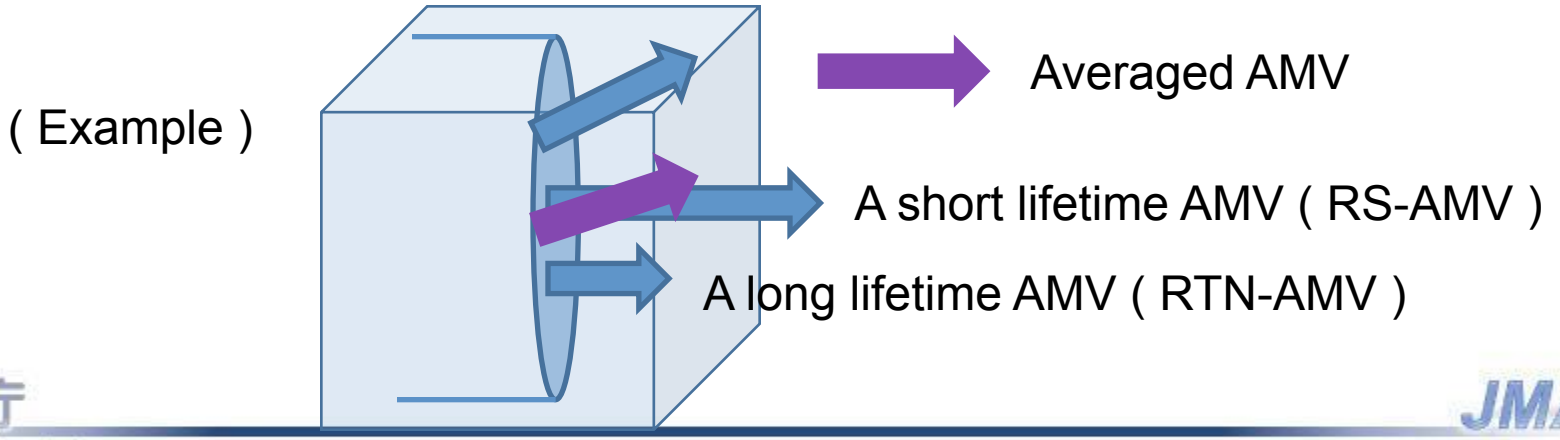
Catching long life winds

RS-AMV : 4000 (m)/300 (s) ≒ 13.33 (m/s)

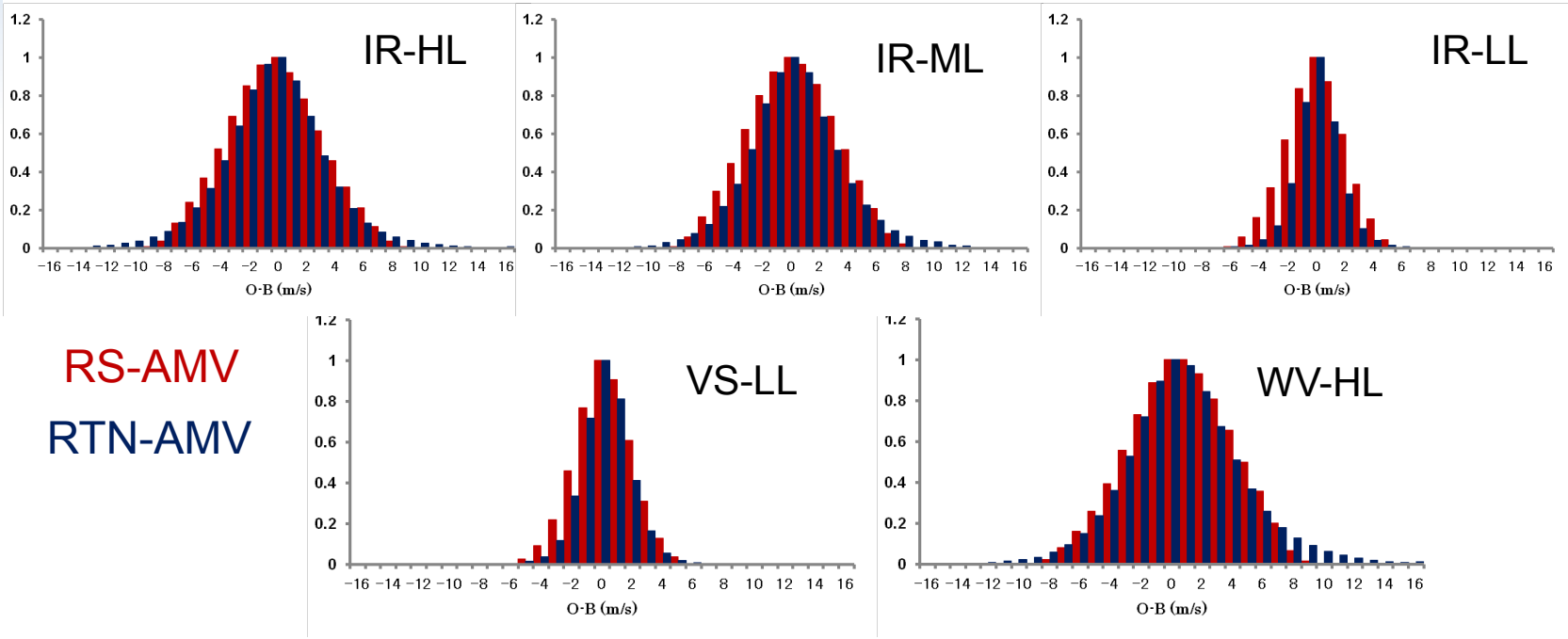
Catching short life winds

Super-observation procedure

- The procedure averaging the close individual AMVs
  - Utilization of natural AMVs such as long lifetime winds and short lifetime winds (RTN- and RS-AMV)
  - Prevention of observed information loss of many AMVs by thinning
  - Reduction of observation error correlation



RS-AMV wind speeds against GSM in 2011 (O-B statistics)



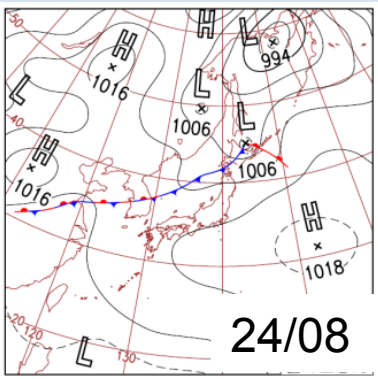
RS-AMV

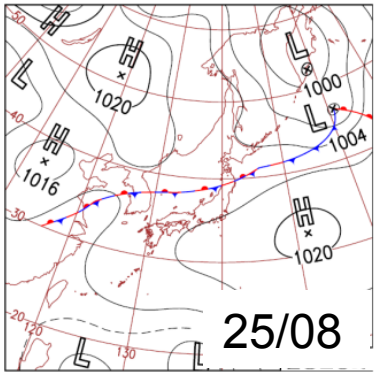
RTN-AMV

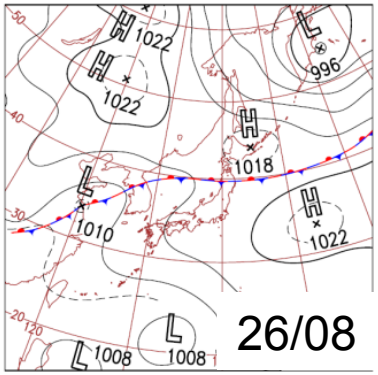
IR: infrared sensor
VS: visible sensor
WV: water vapor
HL: 10-400 hPa
ML: 400-700 hPa
LL: 700-1000 hPa

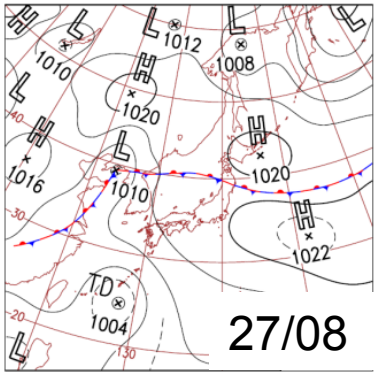
	RS_AMV			RTN-AMV		
TYPE	COUNT	ME (m/s)	STD (m/s)	COUNT	ME (m/s)	STD (m/s)
IR-HL	1854928	-0.15	**3.24**	596912	-0.42	**3.78**
IR-ML	150608	0.18	3.04	41251	0.12	3.45
IR-LL	193829	0.01	**2.02**	109905	-0.09	**1.63**
VS-LL	219818	0.21	**1.86**	39957	0.12	**1.65**
WV-HL	3102424	0.69	**3.27**	834293	0.70	**3.93**

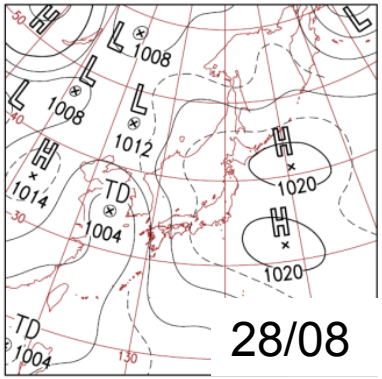
Weather charts from 24/08 to 03/09 in 2010

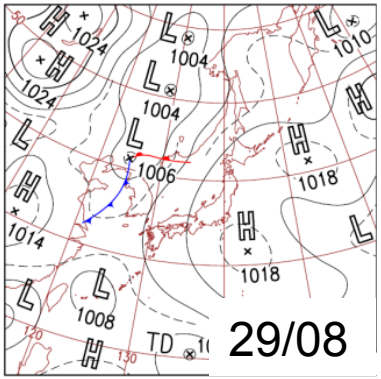


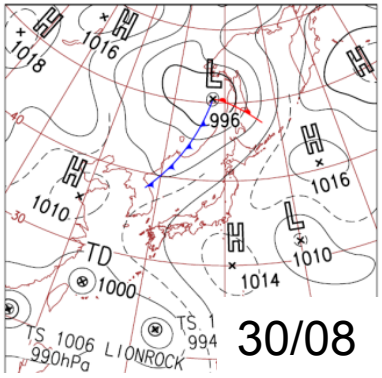


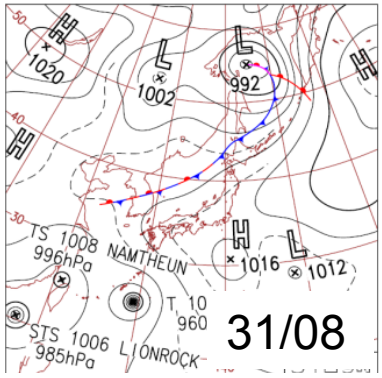


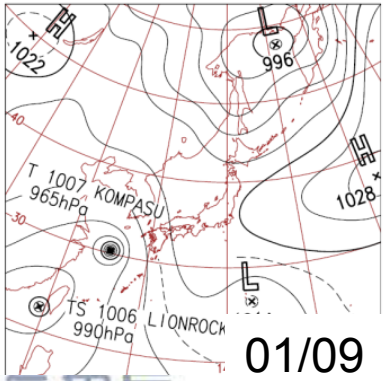


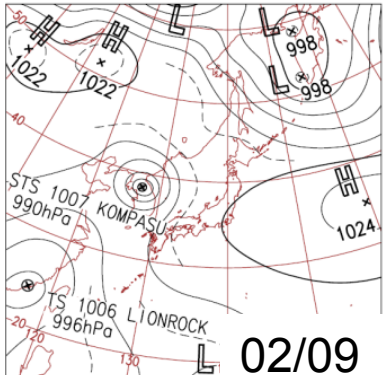


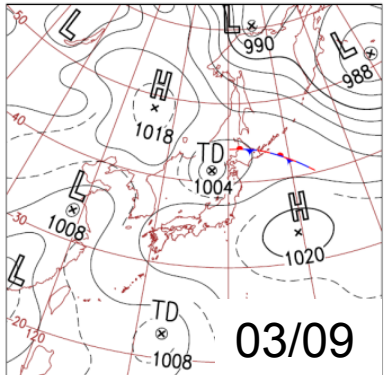






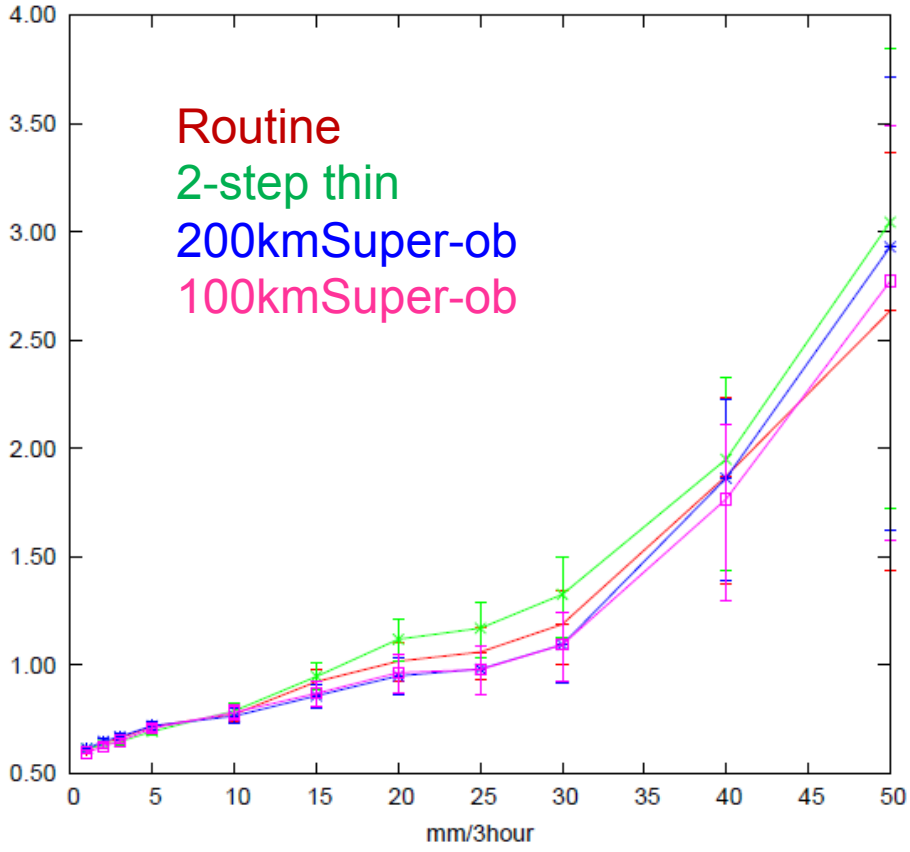






Bias Score for Precipitation in Japan

- Larger bias score of precipitation forecasts over 20 mm per three hours in 15-hours forecast
- Best performance of 100kmSuper-ob in OSEs

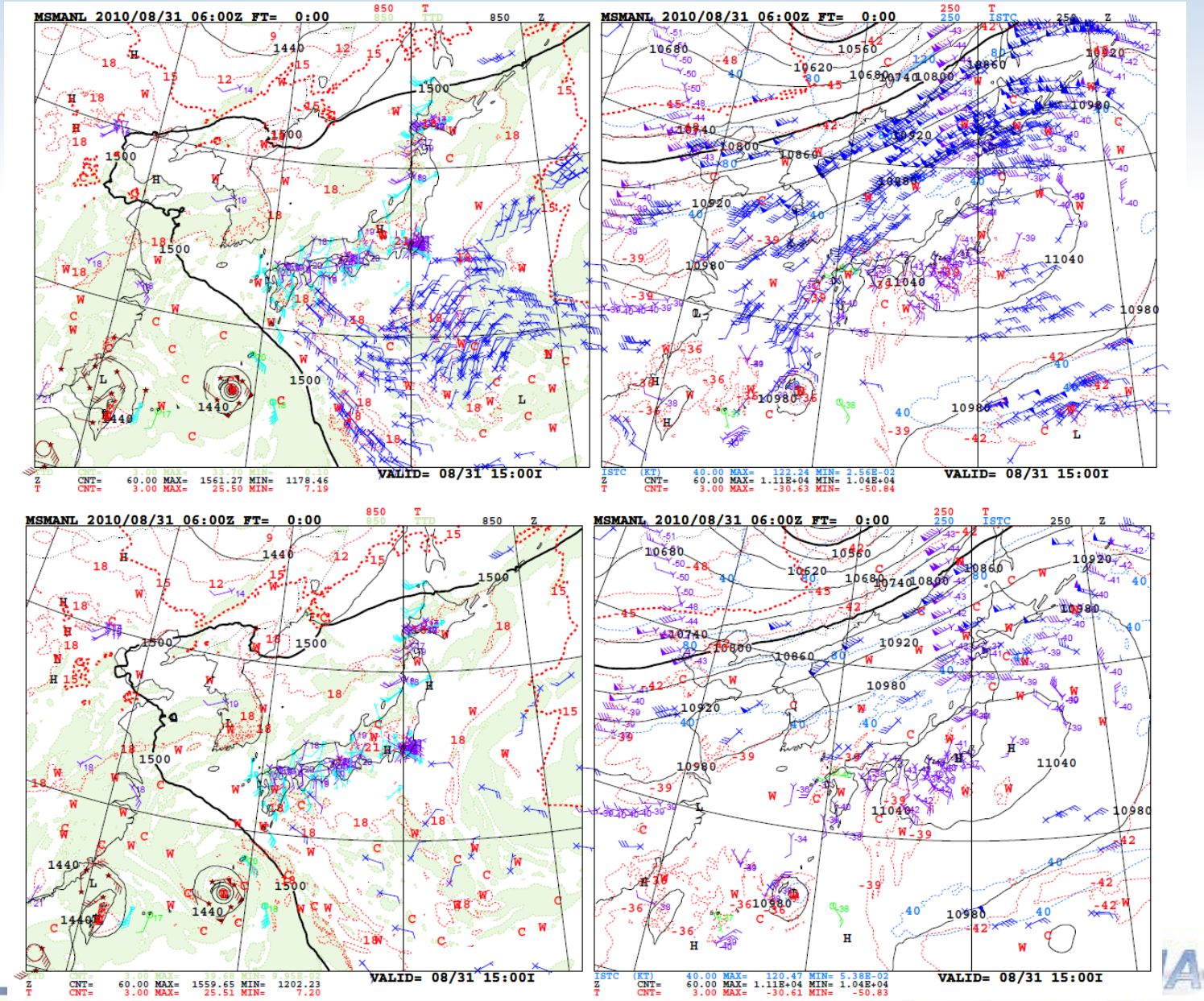


- Condition
  - Initial forecast time : 00,06,12 and 18 UTC
  - Resolution of validation in grid size : 20 km

Analyzed fields of 06 UTC 31 August 2010

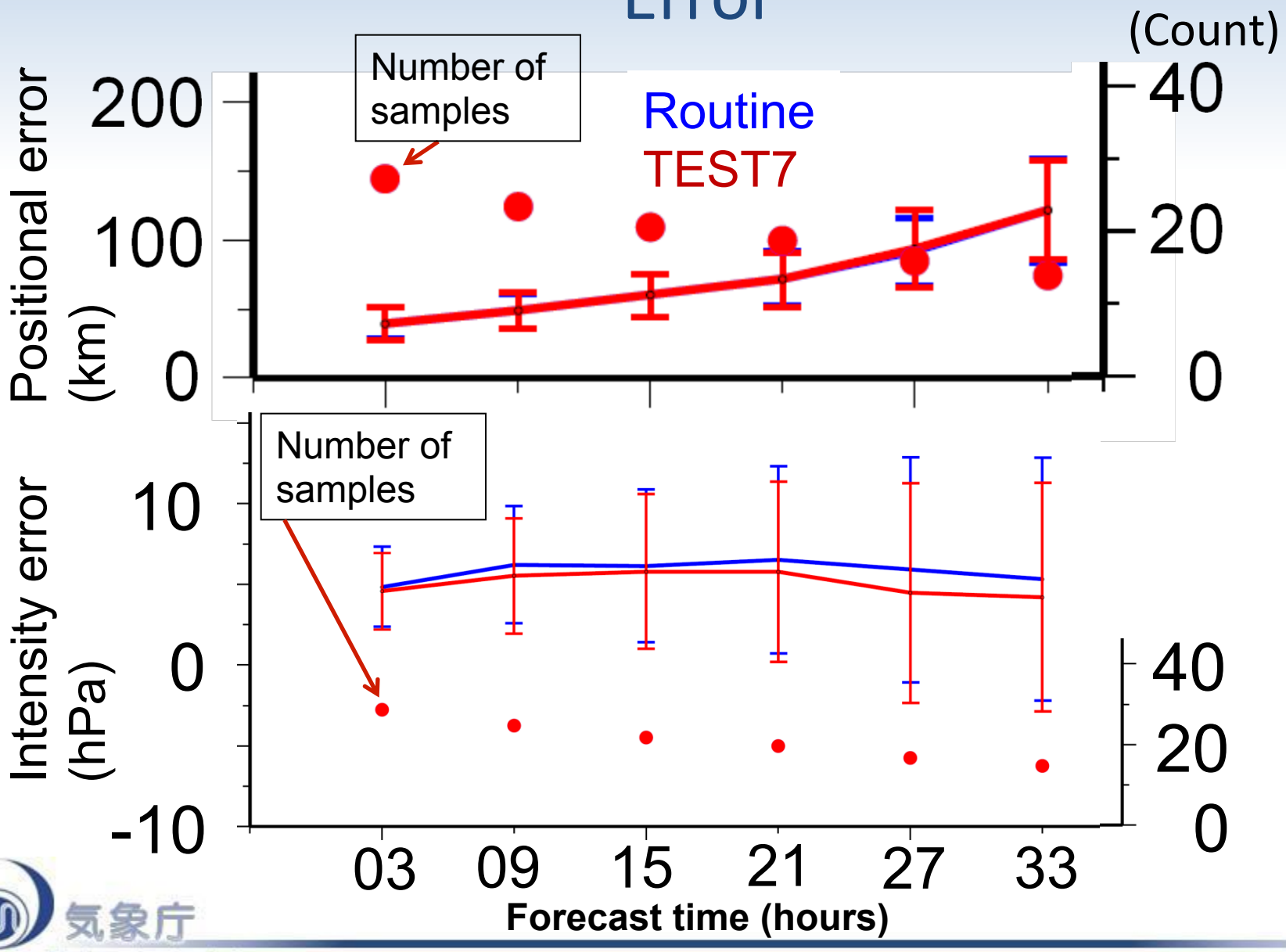
100kmSuper-ob

Routine



Japan Meteorological Agency 気象庁

Mean 4 TCs Track and Intensity Forecast Error



Mean TC Track Forecast Error

- Almost neutral