



The development of applying Metop-B/ASCAT to JMA global analysis

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Outline

1. The status and future plans of scatterometer utilization in JMA
2. The quality investigation of Metop-B/ASCAT winds for JMA's numerical weather prediction(NWP)
3. The impact study of Metop-B/ASCAT winds in JMA's NWP



The status and future plans of scatterometer utilization in JMA

Utilization of scatterometer data in JMA

- For numerical weather prediction(NWP)
 - JMA have operated 3 kinds of NWP systems
 - Global NWP system
 - Meso NWP system
 - Local NWP system
 - Data Assimilation(DA) which makes a initial field for NWP models
- For disaster prevention information
 - Typhoon analysis
 - Monitoring weather condition

Global NWP system in JMA



Forecast model
Resolution(H/V)

Global Spectral Model(GSM)
TL959 (20km) / 60 (0.1hPa)

Forecast range
(initial time)

84h (00,06,18UTC)
264h (12UTC)

Data Assimilation
(resolution)

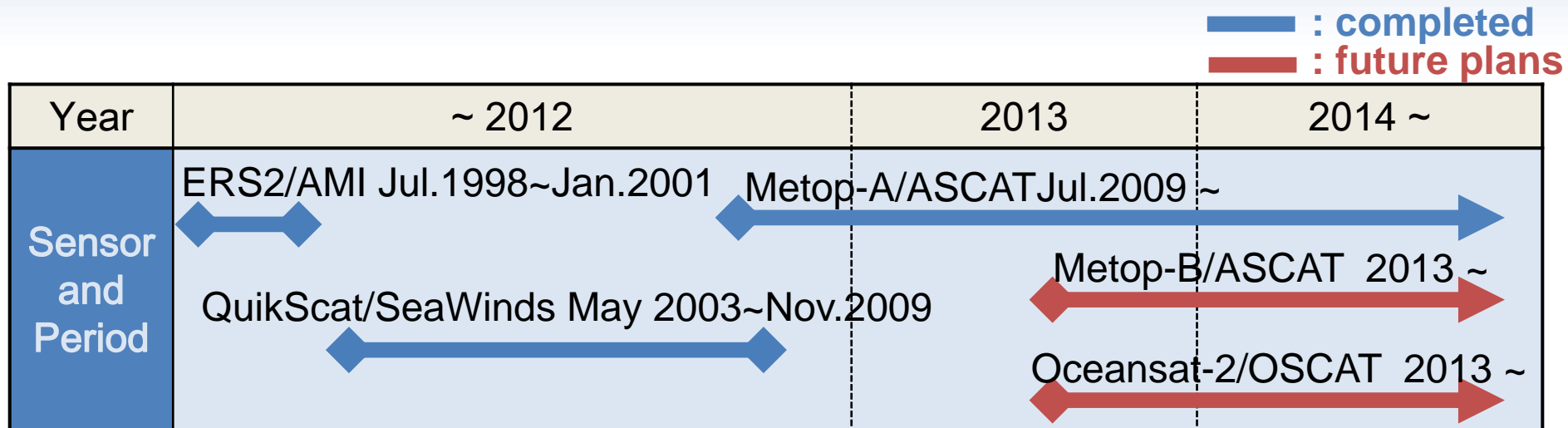
4D-Var
(outer TL959(20km), inner TL319(55km))

Cut off time of
observational data
against initial time

Cycle analysis
+11h55m(00,12UTC), +7h55m(06,18 UTC)
Early analysis
+2h20m(00,06,12,18UTC)

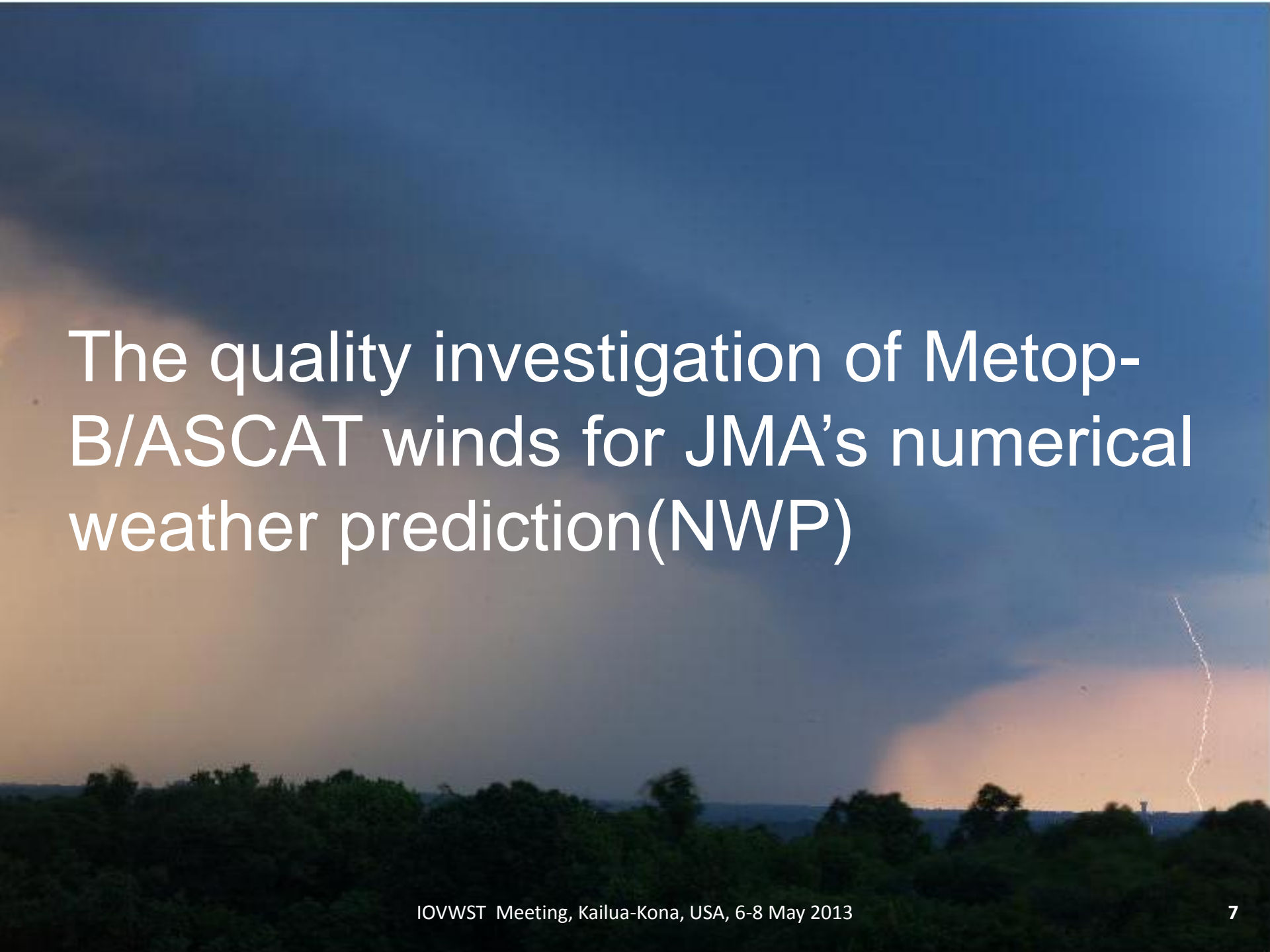
As of 8 May 2013

Future plans of scatterometer assimilation



- At present, Metop-A/ASCAT winds retrieved by OSI-SAF are utilized in Global NWP system
- For the more accurate NWP, we plan to utilize **Metop-B/ASCAT** and **Oceansat-2/OSCAT** winds

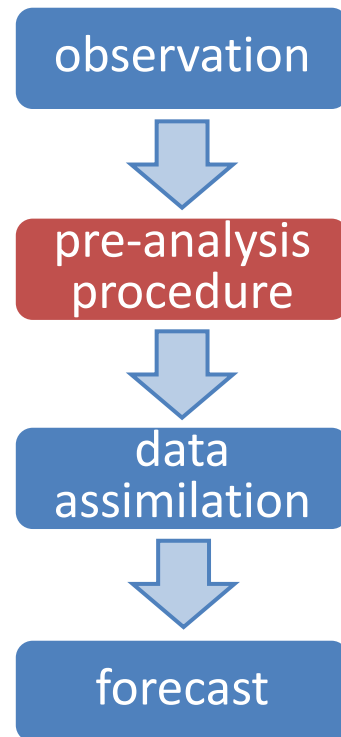
today's
topic

A dramatic sky with dark, heavy clouds and a bright orange glow from the setting or rising sun. A single, bright white lightning bolt strikes down on the right side of the frame. The foreground is a dark, silhouetted treeline.

The quality investigation of Metop-B/ASCAT winds for JMA's numerical weather prediction(NWP)

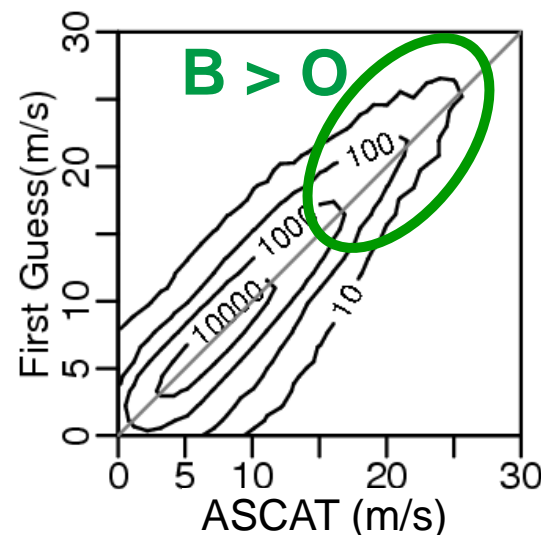
Pre-analysis procedure(1/2)

- Quality Control
 - Flag check(Rain, Land/Sea, Sea Ice, etc.)
 - Gross error check
 - Reject very large |Obs. – forecast| (called **O-B**)
- Ambiguity removal
 - Select the closest wind to JMA's forecast by median filter after nudging
- Data Thinning(100km x 100km box)
 - To reduce calculation cost in 4D-Var
 - Not to introduce spatial observation error correlation



Pre-analysis procedure(2/2)

- wind speed check
 - Metop-A/ASCAT winds has a slow speed bias against GSM first guess above 15m/s
 - It is important for DA to correct a bias or not to use such data
 - In our pre-analysis procedure, winds above 15m/s are rejected simply



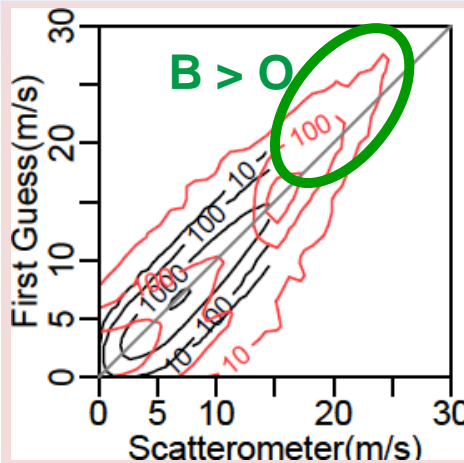
**How about Metop-B/ASCAT
winds' O-B character?**

O-B character with Metop-B/ASCAT

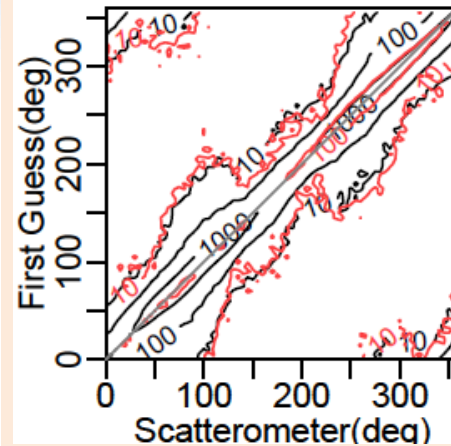
Wind Speed

Wind Drection

Metop-A

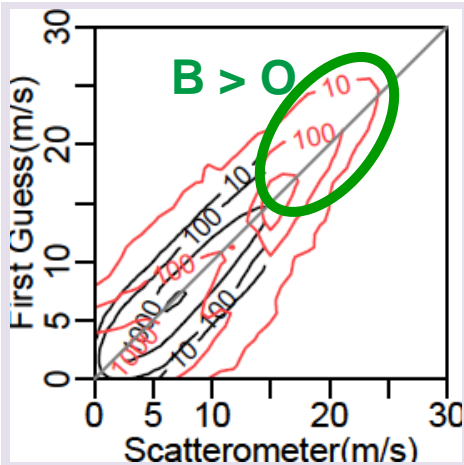


BIAS : 0.12
STDV : 1.29

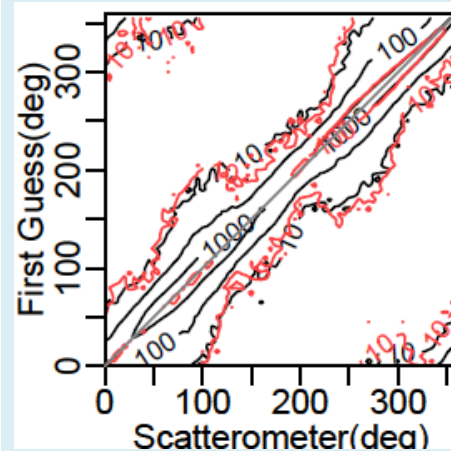


BIAS : 0.34
STDV : 18.0

Metop-B



BIAS : 0.15
STDV : 1.28



BIAS : 0.37
STDV : 18.1

Statistical period : Dec. 2012

black : to be passed in pre-analysis procedure
red : to be rejected in pre-analysis procedure

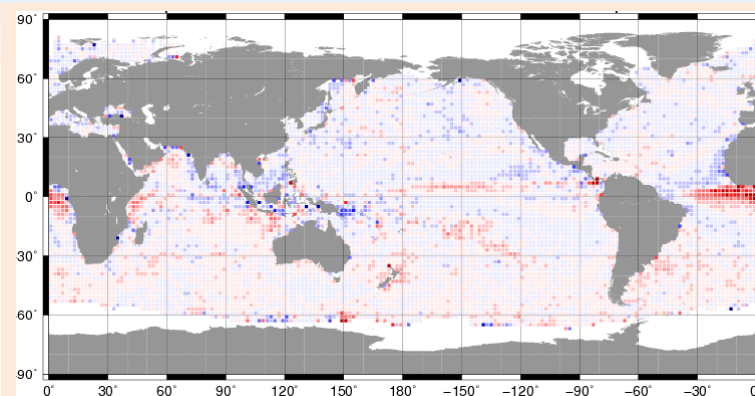
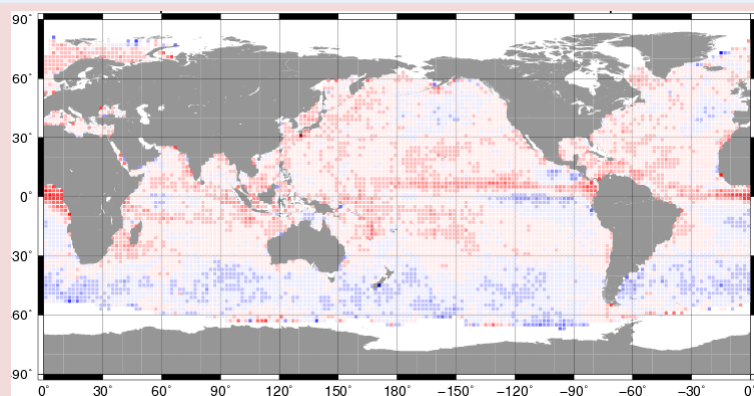
➡ Almost same dependency on wind speed were confirmed

O-B character with Metop-B/ASCAT

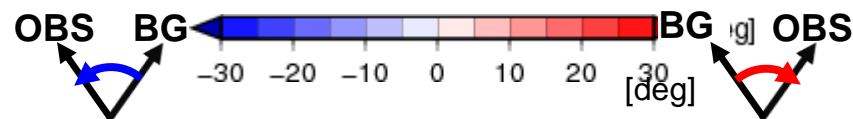
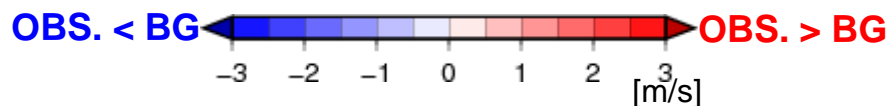
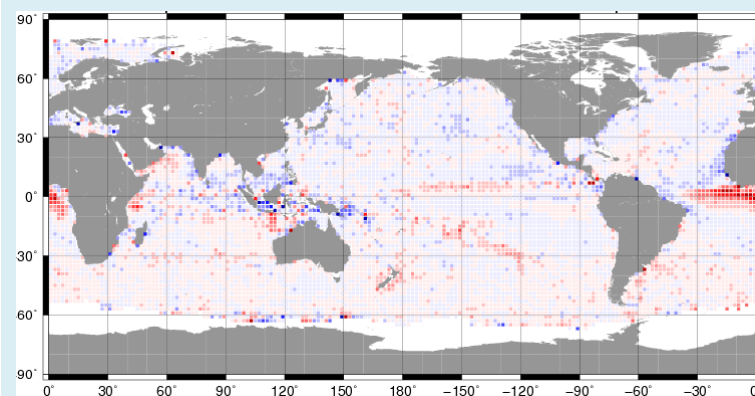
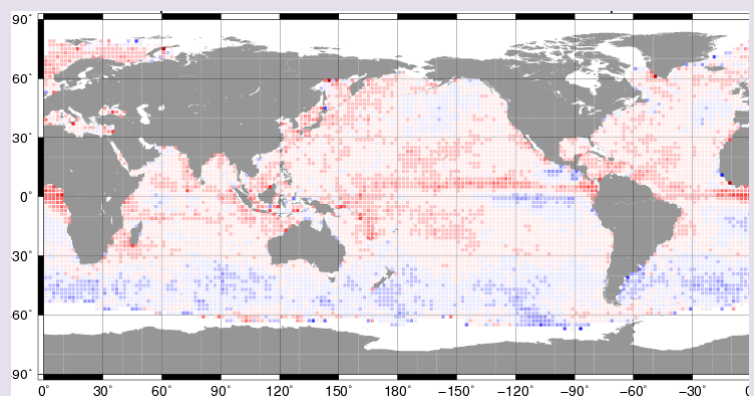
Wind Speed

Wind Drection

Metop-A

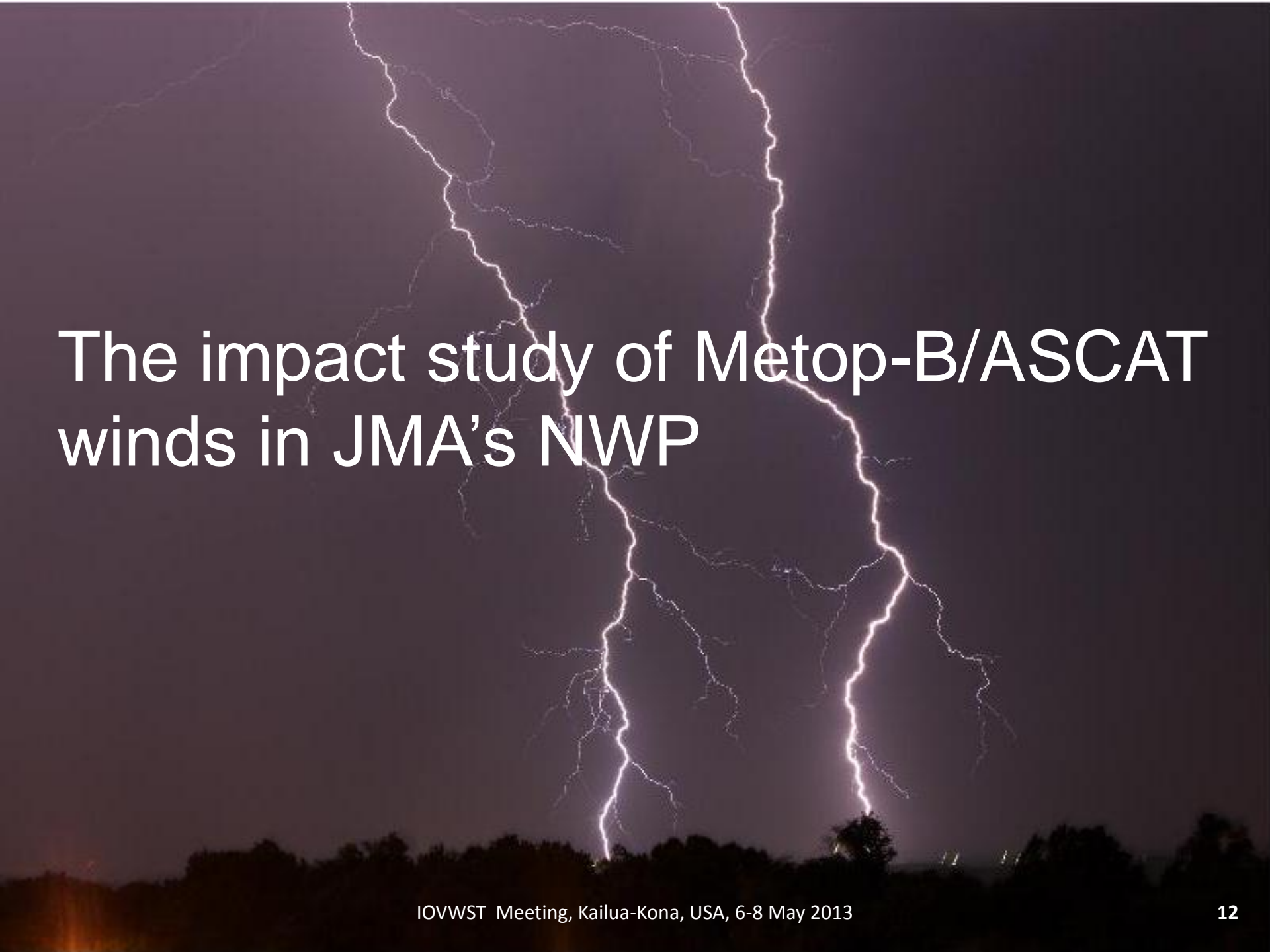


Metop-B



Statistical period : Dec. 2012

➡ Almost same spatial pattern were confirmed



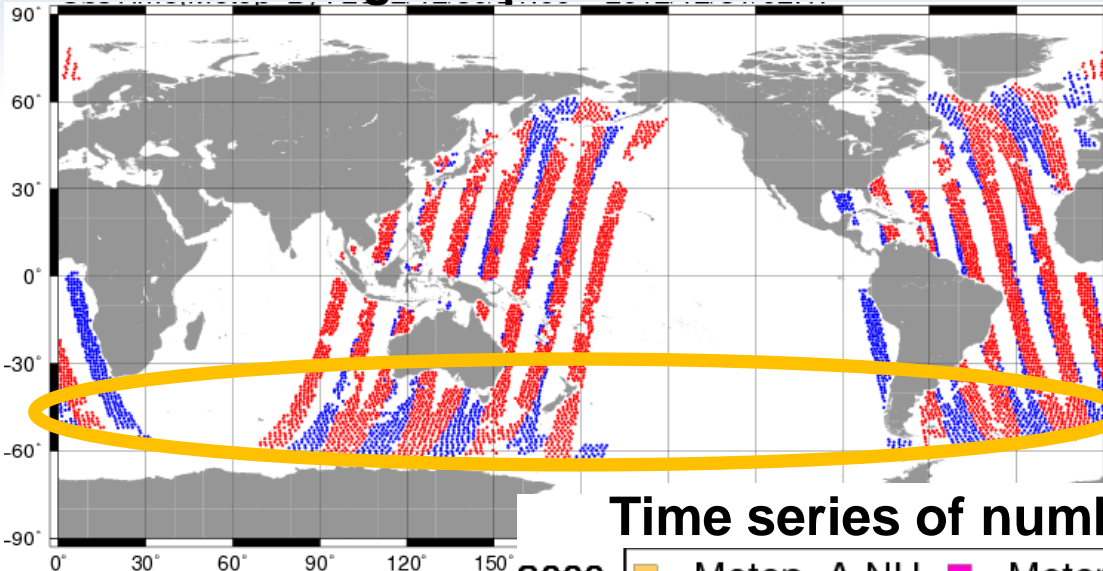
The impact study of Metop-B/ASCAT winds in JMA's NWP

Setup of Experiment

- Names of experiments
 - CNTL : same as operational Global NWP system
 - TEST : CNTL + Metop-B/ASCAT winds
- Assimilation Period
 - From 17 Nov. 2012 to 11 Jan. 2013
- Forecast period
 - From 8 Dec. 2012 to 31 Dec. 2012
- The scatterometer procedure
 - The pre-analysis procedure for Metop-A/ASCAT is applied to Metop-B/ASCAT winds
 - If there are observations from both Metop-A and Metop-B in a same thinning box, Metop-A observation is selected

Distribution of assimilated data

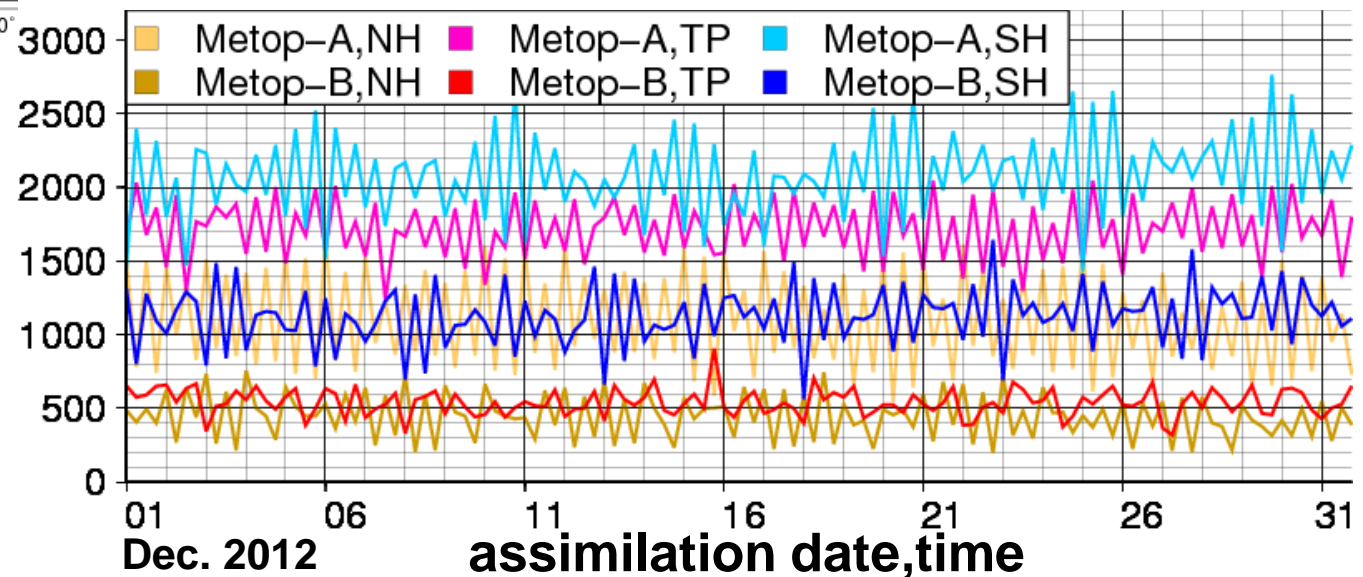
Data coverage map at 1 Dec. 2012 00UTC



**Data increase
is noticeable
in S.Hem.**

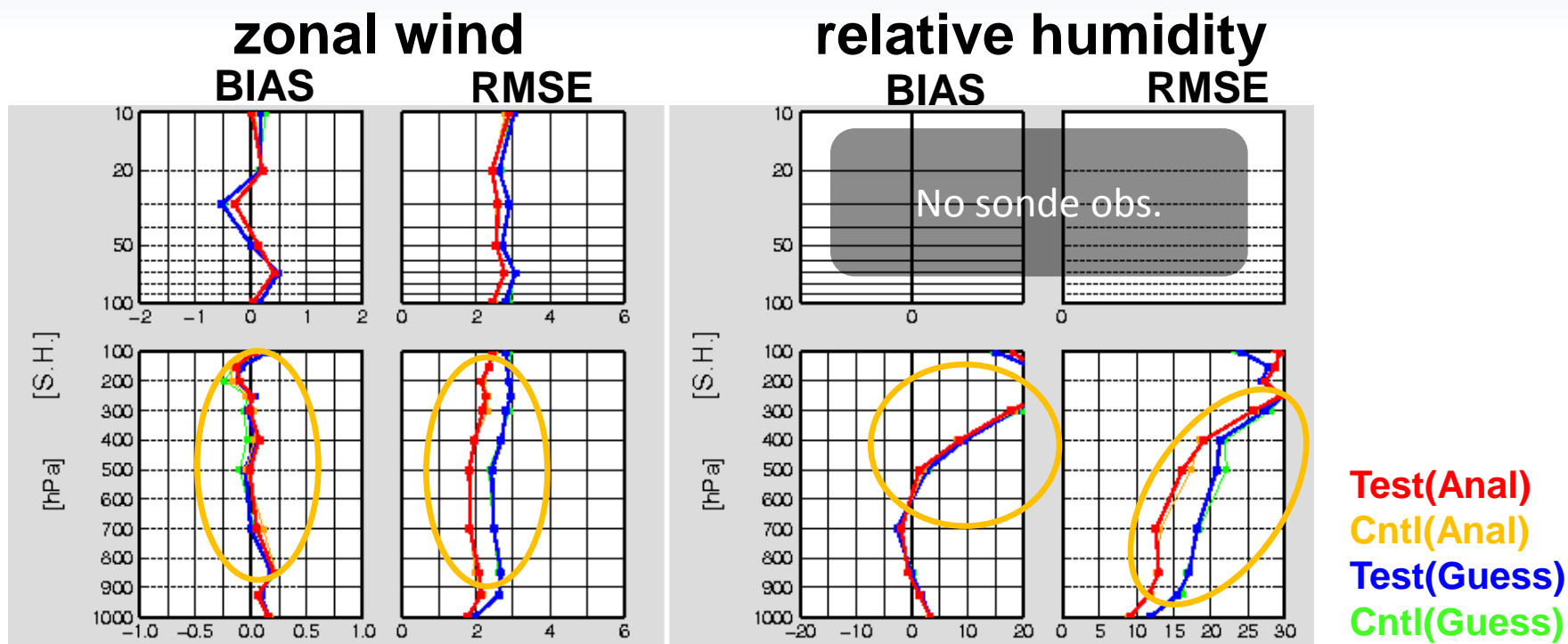
red:Metop-A
blue:Metop-B

Time series of number of assimilated observation



Analysis Field

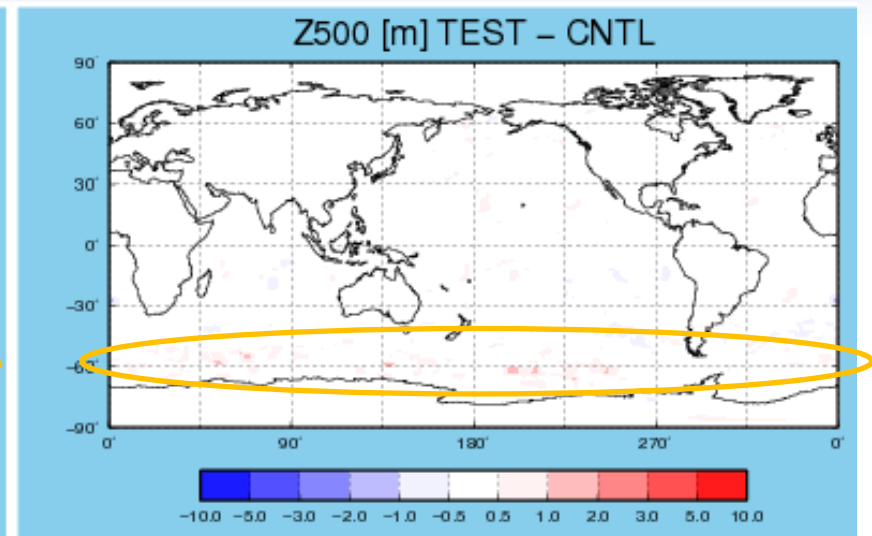
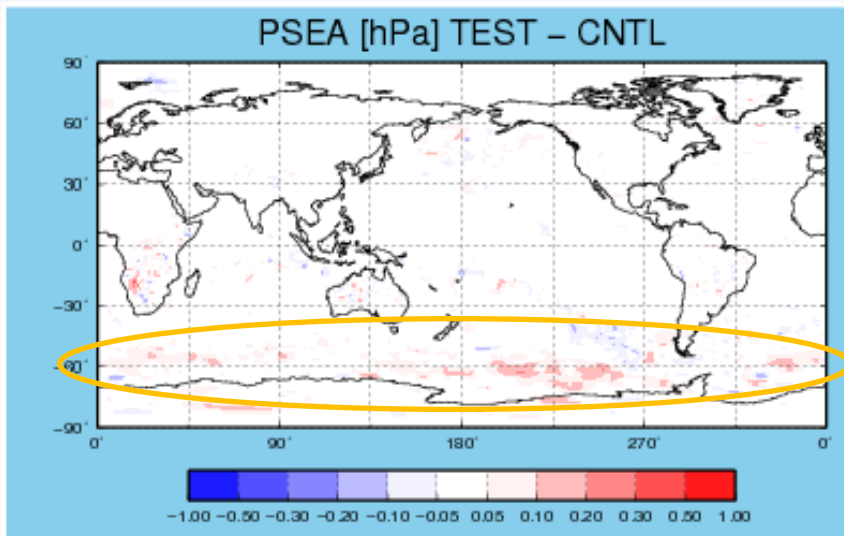
Vertical profile of BIAS and RMSE against sonde obs.



- In southern hemisphere, zonal wind and relative humidity were improved

Analysis Field

Average difference between CNTL and TEST

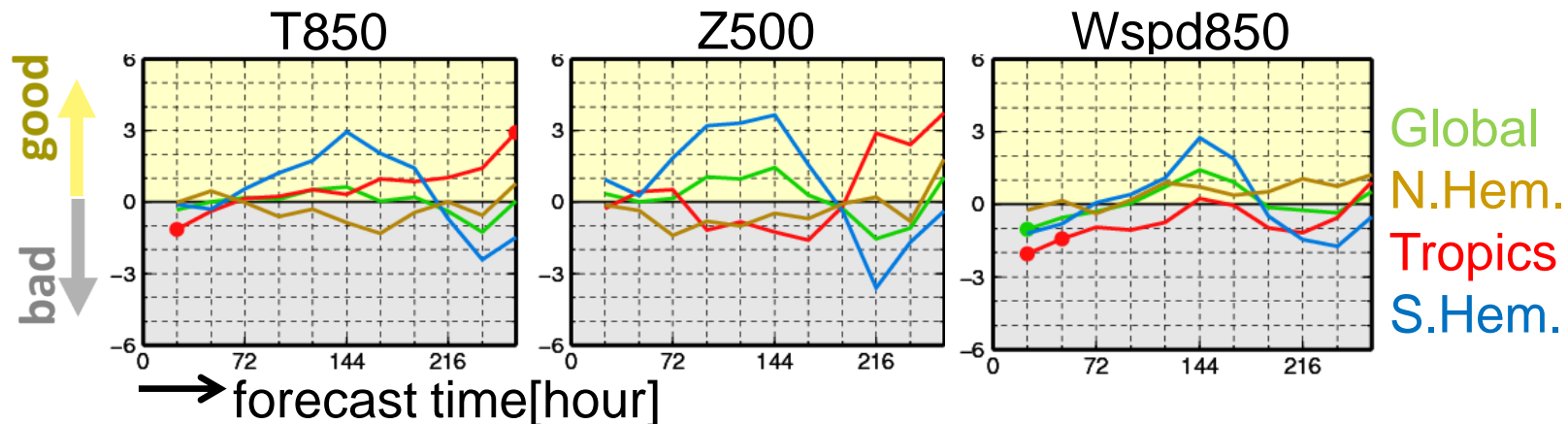


- We can find small differences in PSEA and Z500 in S.Hem.

Rate of improvement of forecast against initial field

$$\text{Rate of improvement}[\%] = (\text{RMSE}_{\text{CNTL}} - \text{RMSE}_{\text{TEST}}) / \text{RMSE}_{\text{CNTL}}$$

$$\text{RMSE} = \sqrt{\sum (\text{Fcst} - \text{Init})^2 / N}$$



5-day Average of rate of improvement

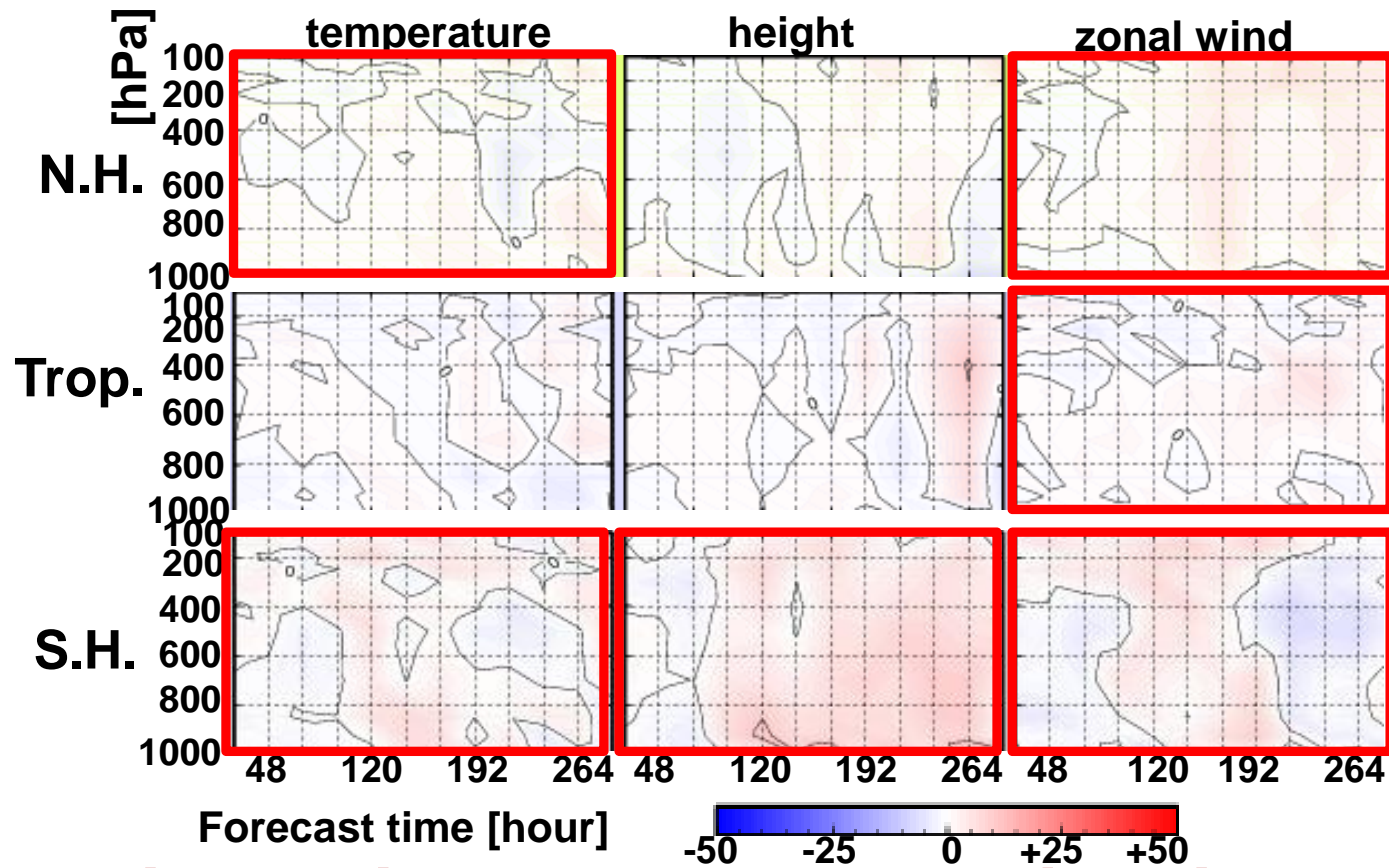
region	T850	Z500	Wspd850
Global	0.10	0.51	-0.23
N.Hem.	-0.10	-0.74	0.12
Tropics	-0.12	-0.26	-1.25
S.Hem.	0.62	1.92	-0.09

- Major indices during 3-8 day forecast in S.Hem. improved, especially T850 and Z500

Rate of improvement of forecast against sonde observation

$$\text{Rate of improvement}[\%] = (\text{RMSE}_{\text{CNTL}} - \text{RMSE}_{\text{TEST}}) / \text{RMSE}_{\text{CNTL}}$$

$$\text{RMSE} = \sqrt{\sum (\text{Fcst} - \text{obs.})^2 / N}$$



In comparison with sonde observation, improvements in N.Hem. and Trop. could also be seen

Summary

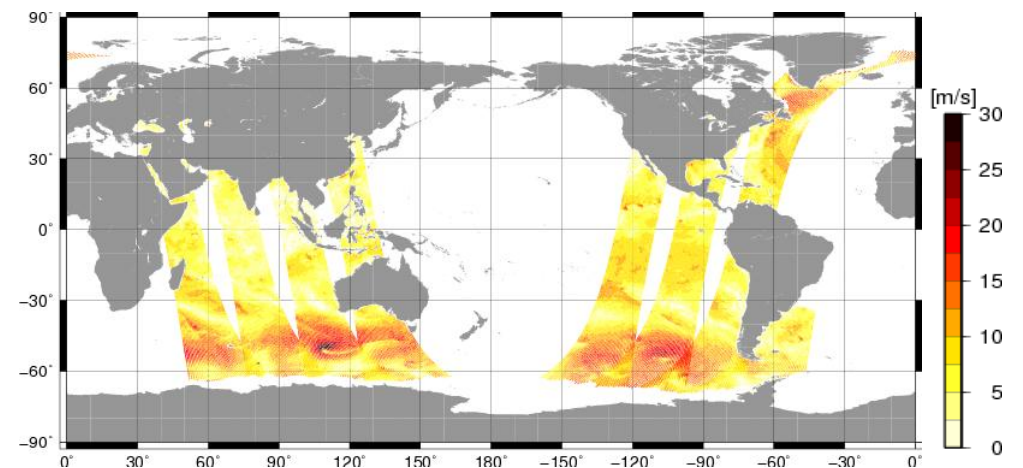
- JMA plans to assimilate Metop-B/ASCAT winds in Global NWP system
- Almost same O-B character among Metop-B/ASCAT and Metop-A/ASCAT was confirmed
- The experiment to assimilate Metop-B/ASCAT wind to Global NWP system was conducted with same pre-analysis procedure for Metop-A/ASCAT
 - The increase of assimilated data is noticeable in S.Hem..
 - We can see the improvement of both analysis and forecast in S.Hem.



THANK YOU

Status and future plans of development of OSCAT assimilation


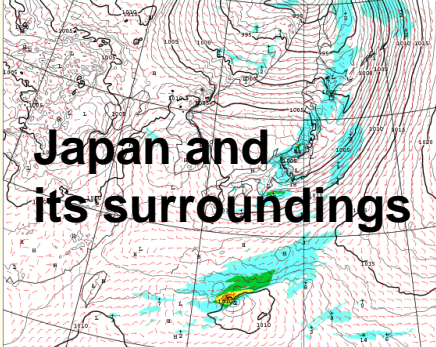
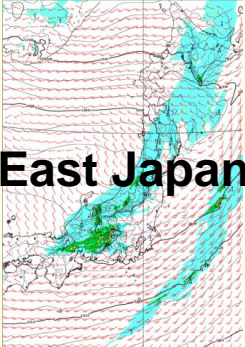
- Status
 - Start getting BUFR file retrieved by OSI-SAF and decode to JMA's NWP decode format on Jan.2012
- Future plans
 - Utilization in Global NWP system
 - Quality investigation
 - Impact study
 - Hopefully, until this autumn



Data coverage map of Global NWP system (25 Apr. 2013, 18UTC initial)

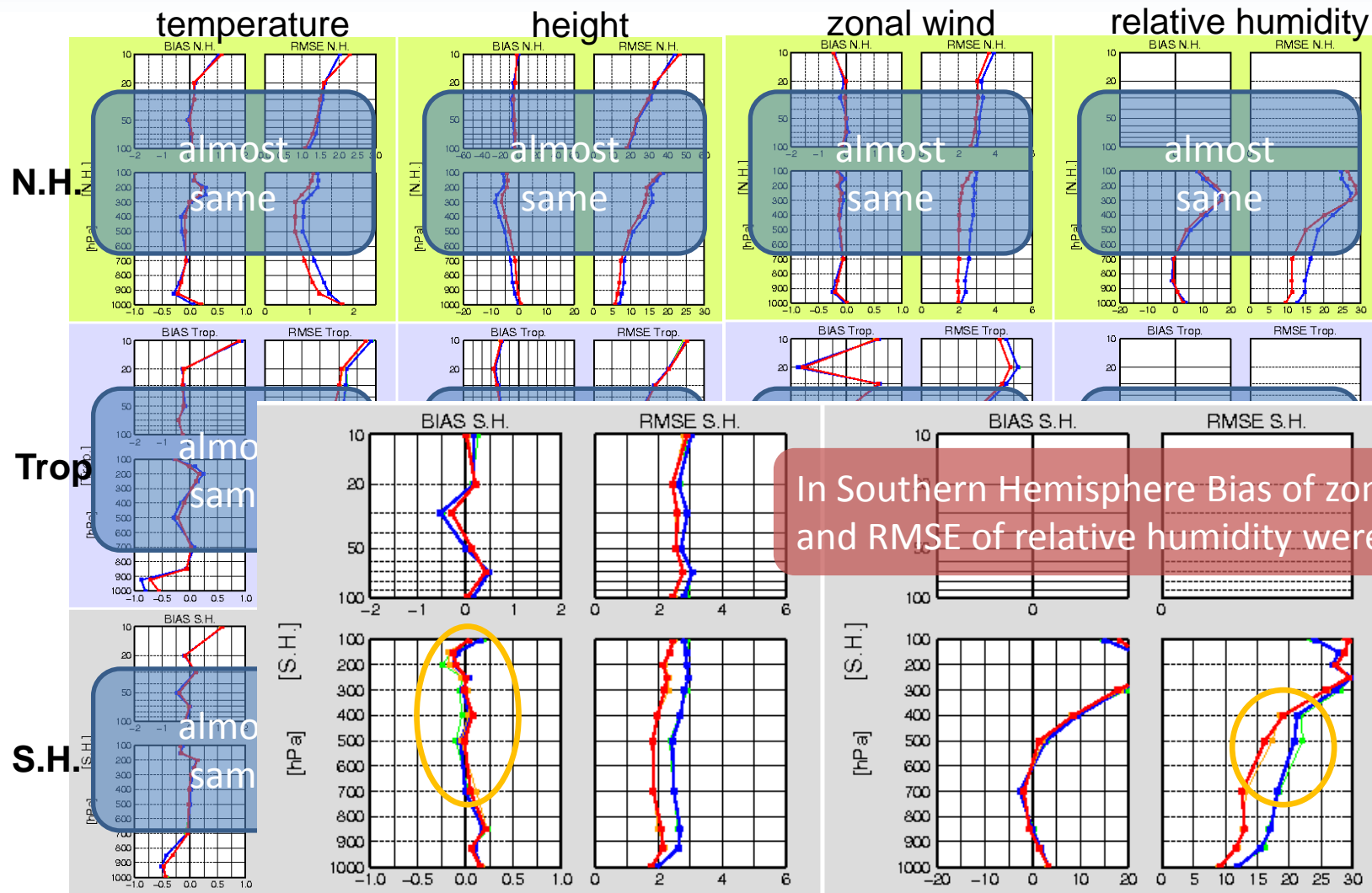
Operational NWP systems in JMA

As of 8 May 2013

NWP system	Global NWP system	Meso NWP system	Local NWP system
Purpose	short-range forecast one-week forecast	Disaster prevention information	Disaster prevention information Aviation services
Forecast model Resolution(H/V)	Global Spectral Model(GSM) TL959 (20km) / 60 (0.1hPa)	Meso Scale Model(MSM) 5km / 50 (21.8km)	Local Forecast Model(LFM) 2km/60(20.2km)
Forecast range (Initial time)	84h (00,06,18UTC) 264h (12UTC)	15h (00,06,12,18UTC) 33h (03,09,15,21UTC)	9h (00,03,06,09, 12,15,18,21UTC)
Data Assimilation (resolution)	4D-Var (outer TL959(20km) inner TL319(55km))	4D-Var (outer 5km inner 15km)	3D-Var (5km)
Cut off time of observational data against initial time	Cycle analysis +11h55m(00,12UTC) + 7h55m(06,18 UTC) Early analysis + 2h20m(00,06,12,18UTC)	+ 0h50m	+ 0h30m
Area			

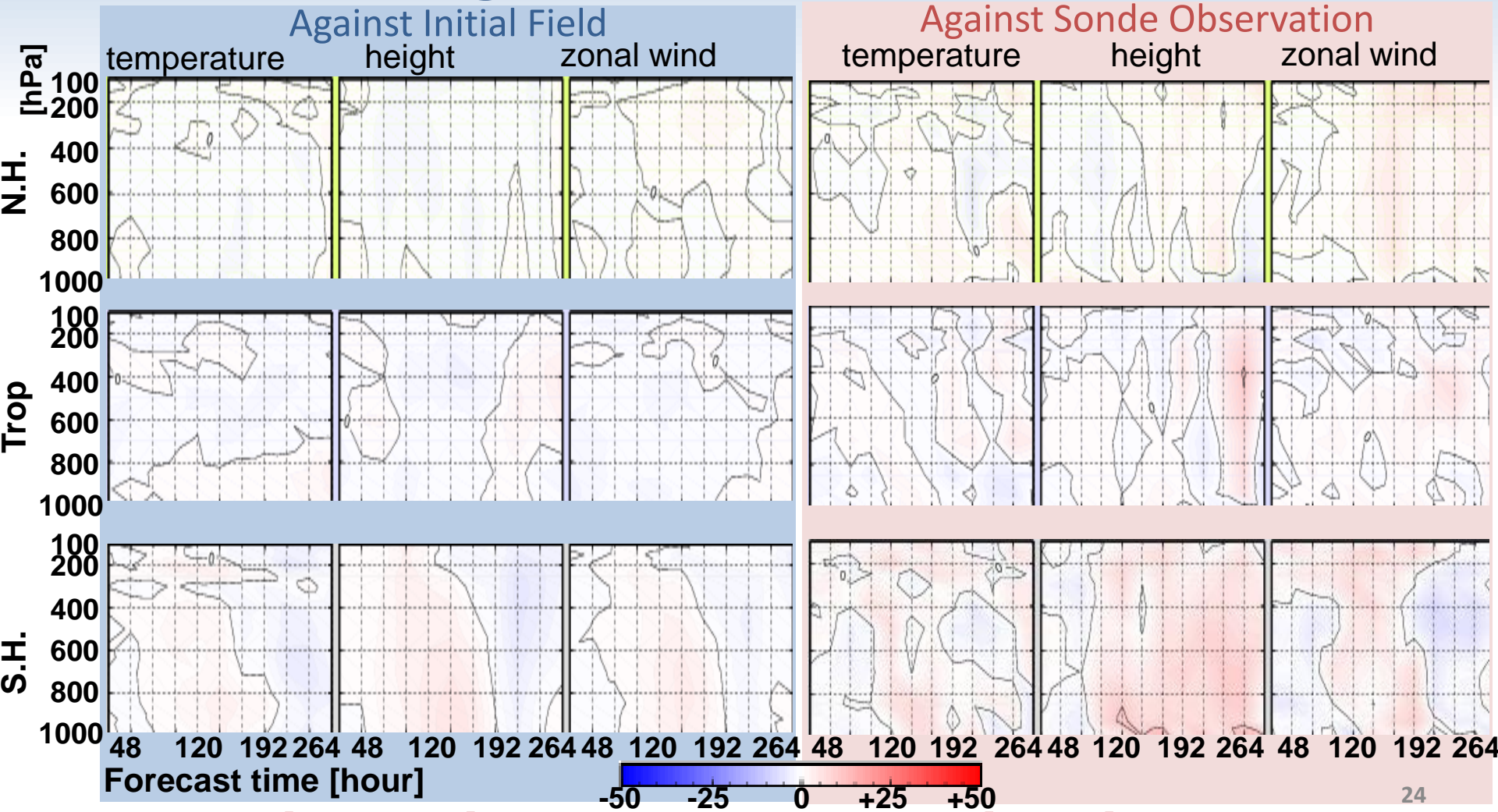
Analysis Field

Comparision with Sonde observation



In Southern Hemisphere Bias of zonal wind and RMSE of relative humidity were improved

Rate of improvement of forecast against sonde observation



In comparison with sonde observation, improvements in N.Hem. and Trop. could also be seen