



**The operational non-hydrostatic
meso-scale model for quantitative
precipitation forecasts at JMA**

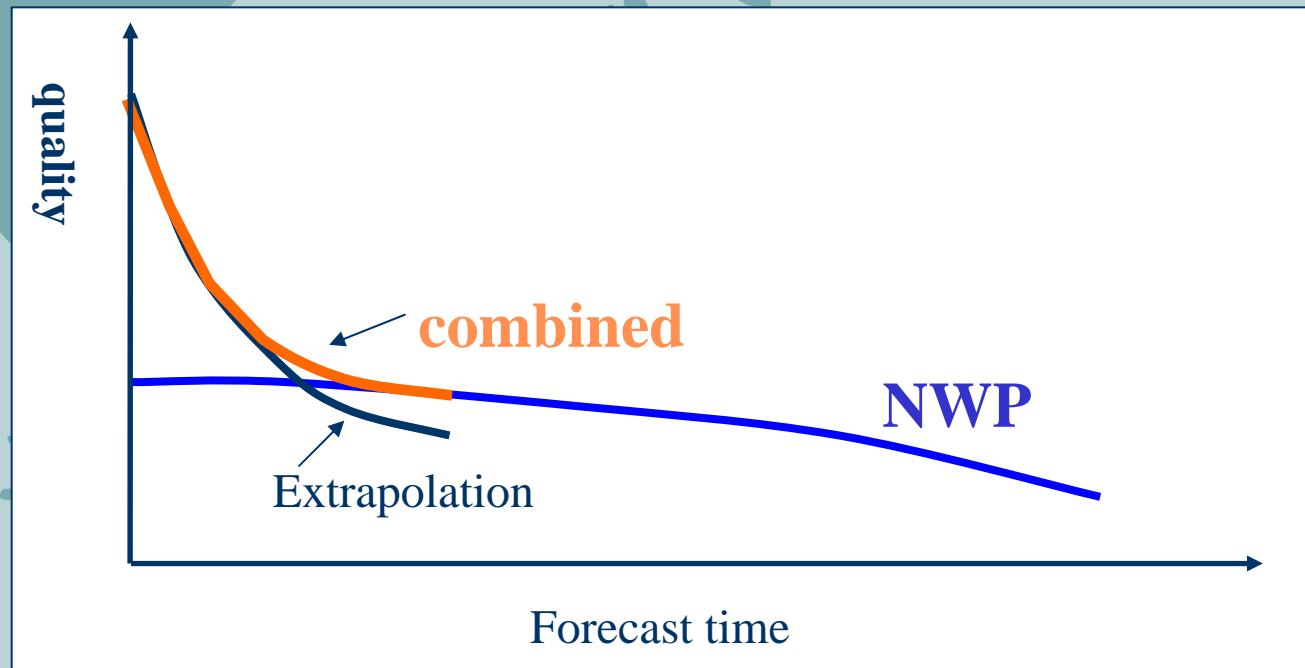
HARA Tabito

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Precipitation forecasts at JMA

- **Precipitation Nowcast**
 - Only extrapolation of observation (w/o NWP)
 - Run every 10 minutes, 1-hour forecast
 - Without orographic effect
- **Very Short Range Forecast of precipitation**
 - Run every 30 minutes. 6-hour forecast
 - Introduce orographic effect
 - Combine extrapolation of observation and forecast of meso scale model (MSM).
 - The weights of MSM are increased as the forecast time proceeds.

Quality of extrapolation and NWP



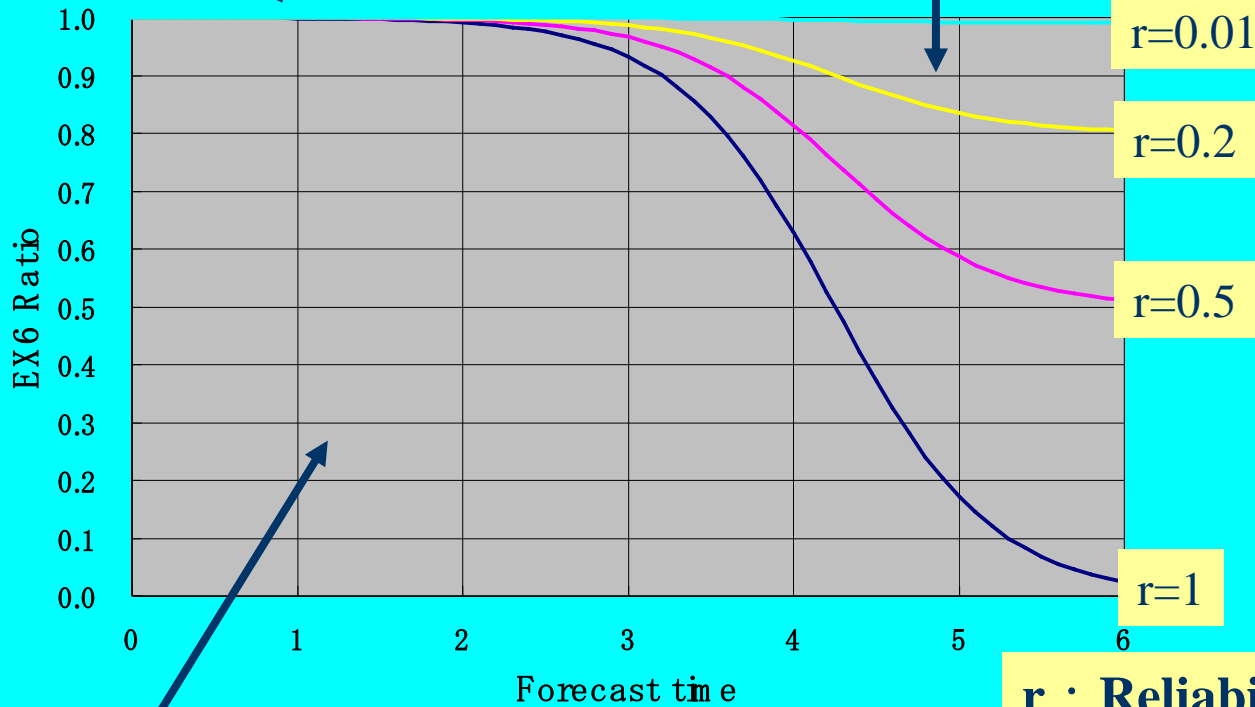
For short forecast time, extrapolation of observation shows good performance, but its quality is rapidly degraded.

The weight of extrapolation

In first 3 hours,
EX is more weighted

Weight of EX

Weight of extrapolation

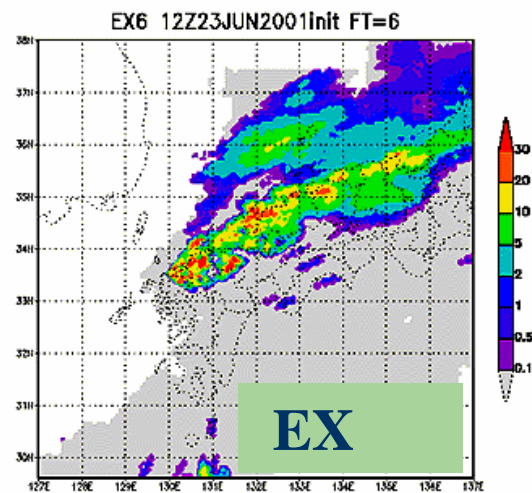
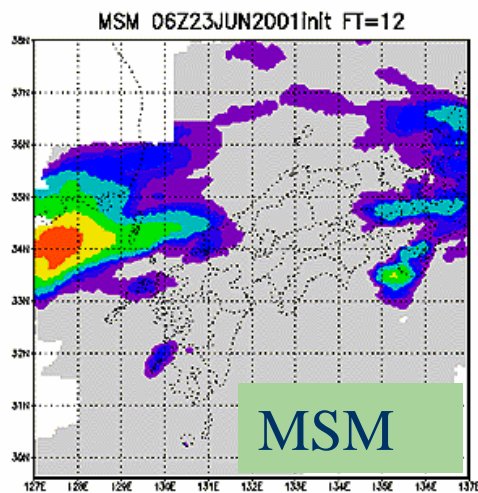
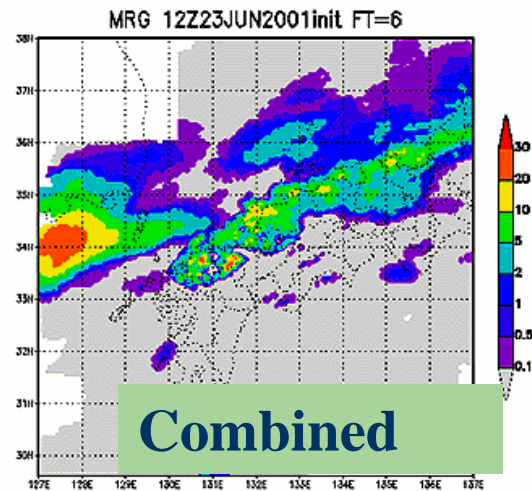
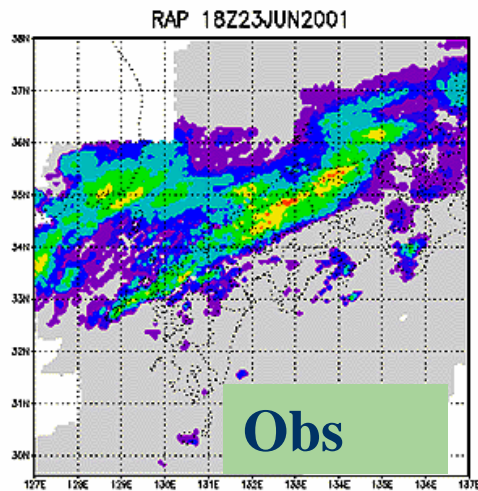


Use EX

Use MSM

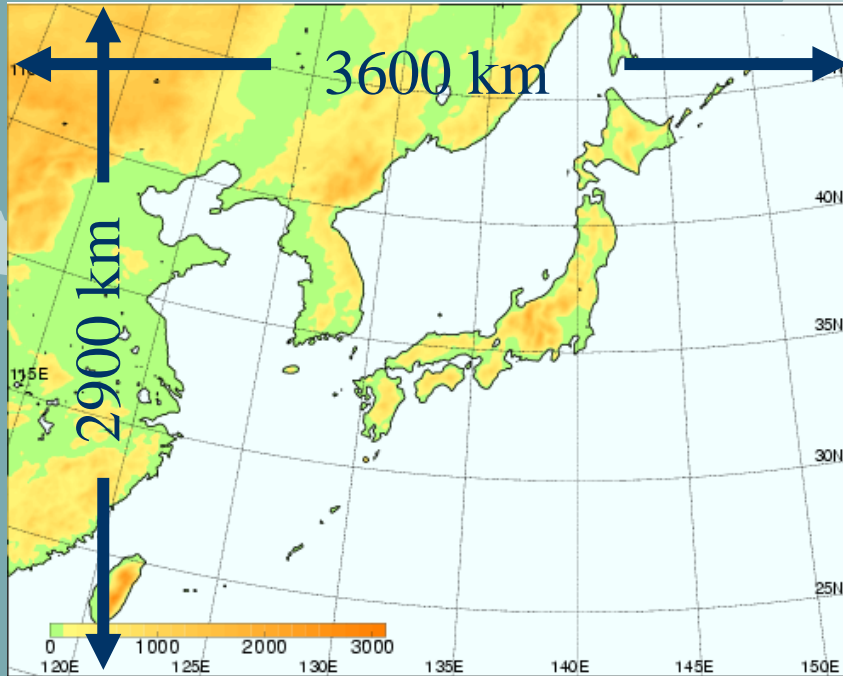
r : Reliability of MSM

Reliability of MSM is estimated by previous 3-hour forecast.



Combined one is more similar to observation than only extrapolation and MSM.

Meso scale model (MSM) at JMA



Computational domain

- Dynamics

- Split explicit scheme(HE-VI)
- Stable operation with relatively large time step
: 40 seconds → 24 seconds

- Moist process

- Cloud microphysics(3-ice : cloud ice, snow, graupel)
- Convective parameterization (Kain-Fritsch)

Use a non-hydrostatic model (JMANHM) operationally.

Until Feb. 2006, From Mar. 2006,

Horizontal resolution : 10km
→ 5km

Forecast 4 times a day

→ 8times a day

Forecast hour: 18hours

→ 15 hours

Improvement for 5km model

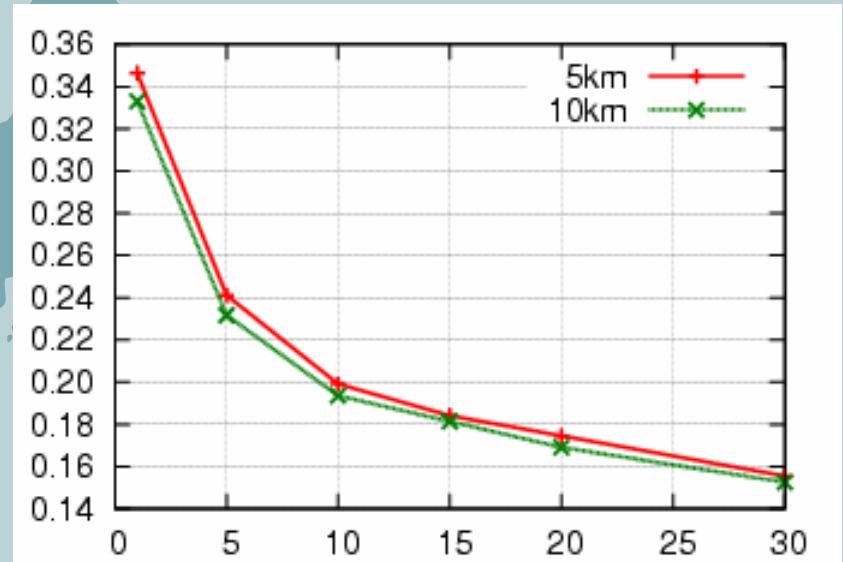
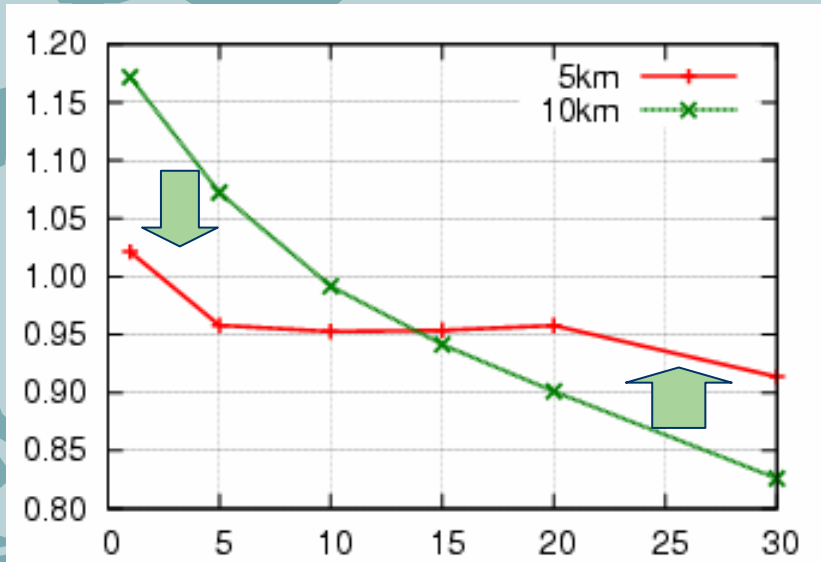
- **New radiation process**
- **Improvement of land and boundary layer process**
 - Positive biases of surface temperature and wind are reduced.
- **Tuning of parameters of KF**
 - Lifetime of deep convection is decreased.
 - Frequency of middle rain is increased.
 - Lifetime of shallow convection is decreased.
 - Excessive precipitation in winter is suppressed.

Verification of new 5km model

Summer(May 31 – Jul 31, 2004, 248 initials)

Bias Score

Threat Score



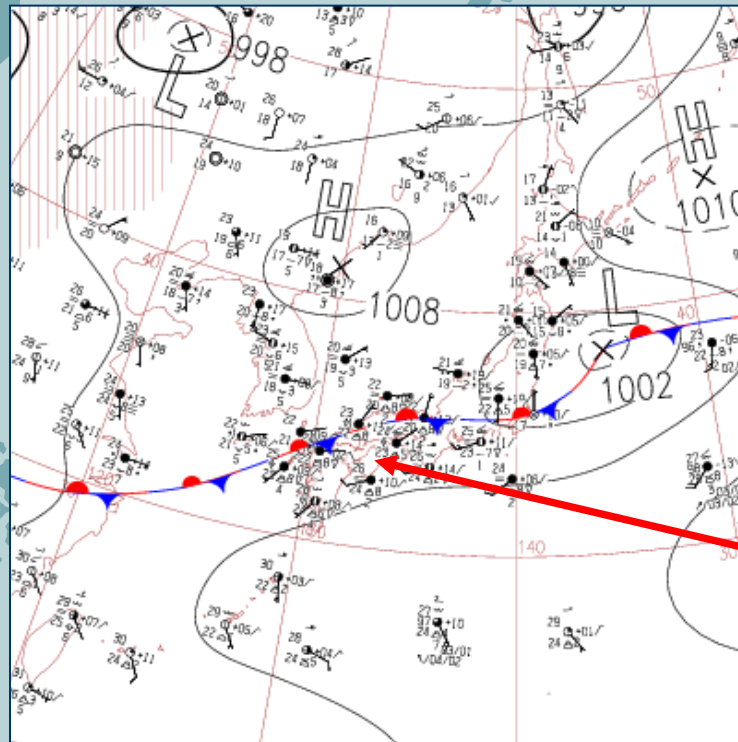
Threshold(mm/3hr)

Threshold(mm/3hr)

- The bias scores for both weak and heavy precipitation were improved.
- Especially, the frequency of forecast of heavy rain is increased.
 - possible to represent the peak of precipitation more appropriately.

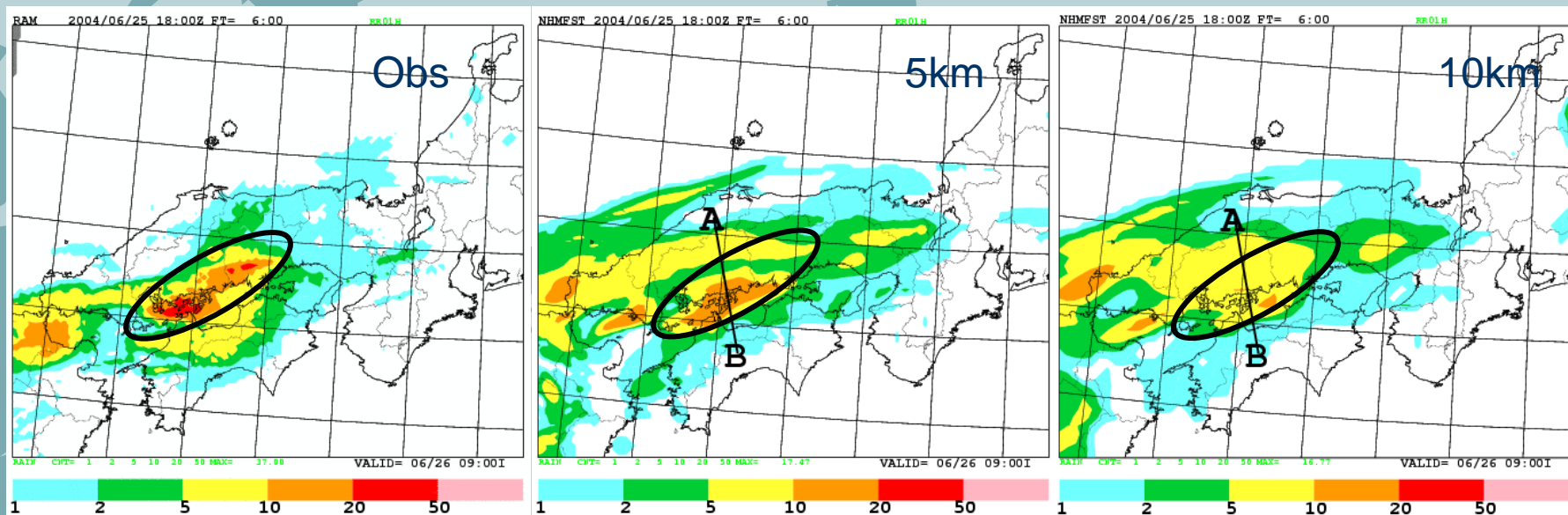
Case study

Heavy rain at west Japan on June 26, 2004



June 26, 2004 00UTC,
surface

- Good representation for precipitation of more than 5mm/hr in both 5km and 10km.
- Especially, precipitation of over 10mm/hr is well represented.



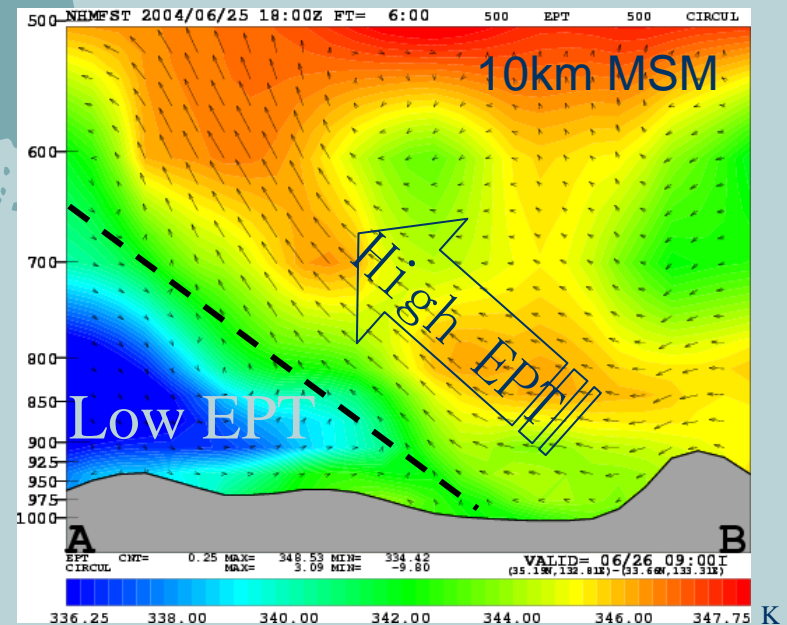
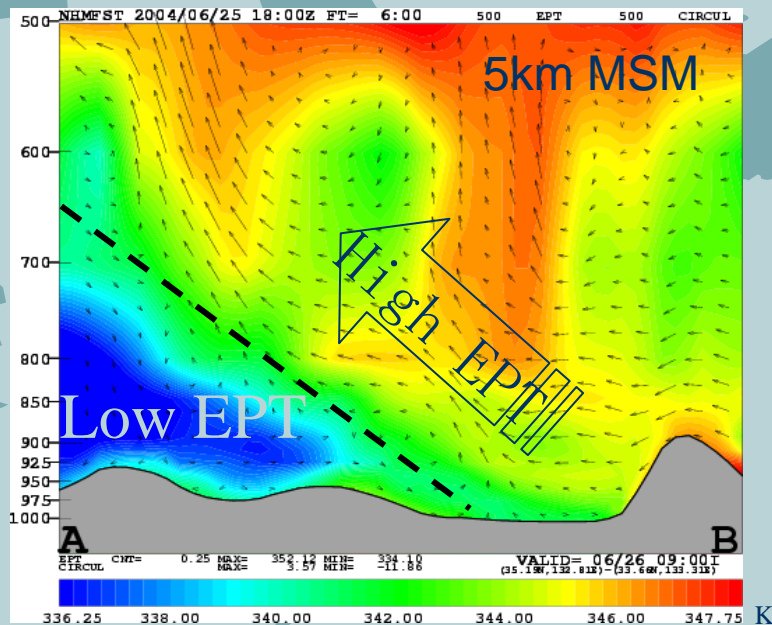
Jun 26, 2004 00UTC 1-hour precipitation

NWP: June 25, 2004 18UTC Initial, FT=06

The representation of the stationary front

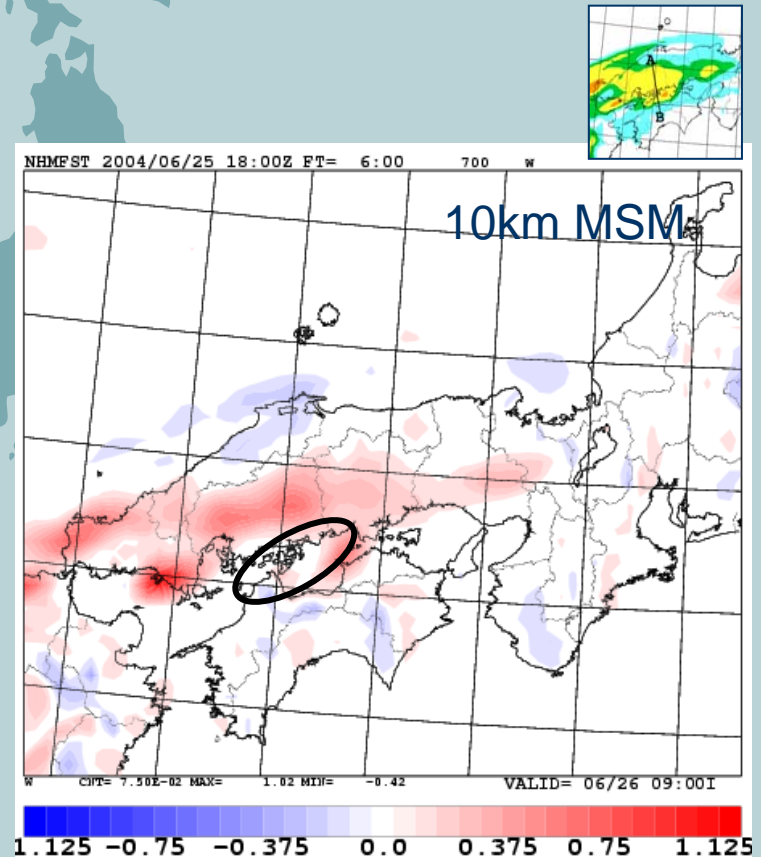
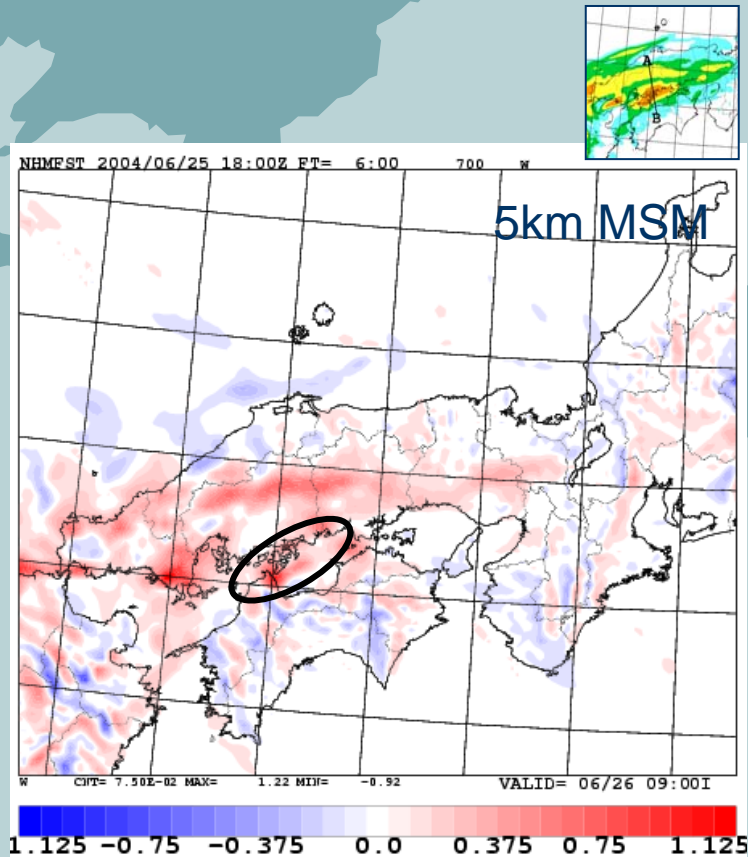
High EPT air at the south side (B) rises on low EPT air at the north side (A).

This characteristics is well represented in both 5km and 10km.



vertical cross section of EPT (K) along line AB

In 5km model, the large updraft is shown corresponding to heavy precipitation.

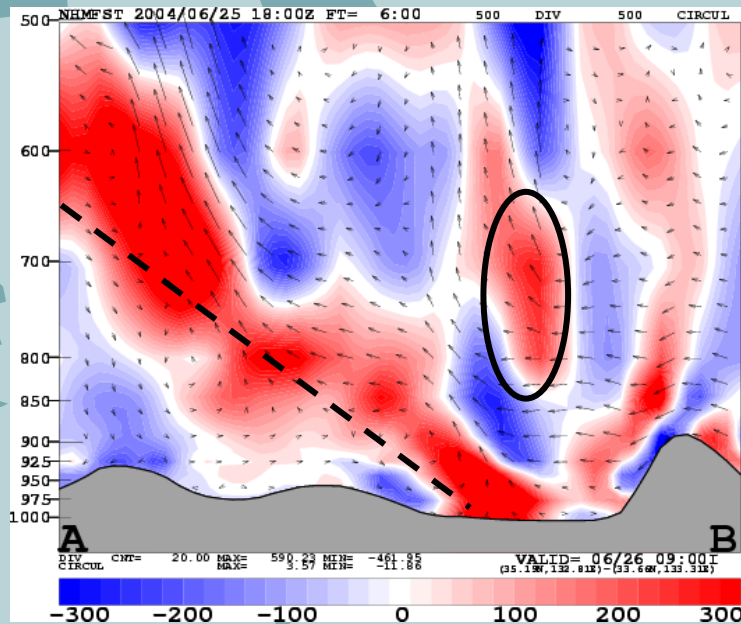


Vertical velocity at
700hPa (m/s)

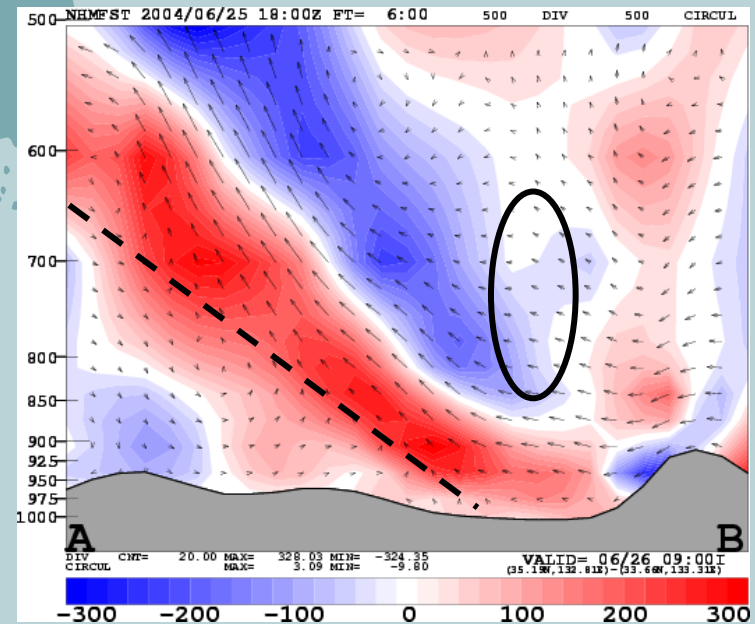
red: updraft blue: downdraft

In the warm side, convergence and updraft whose width is about 30km are represented.

5km MSM



10km MSM



Vertical cross section of horizontal convergence (/s) along line AB.

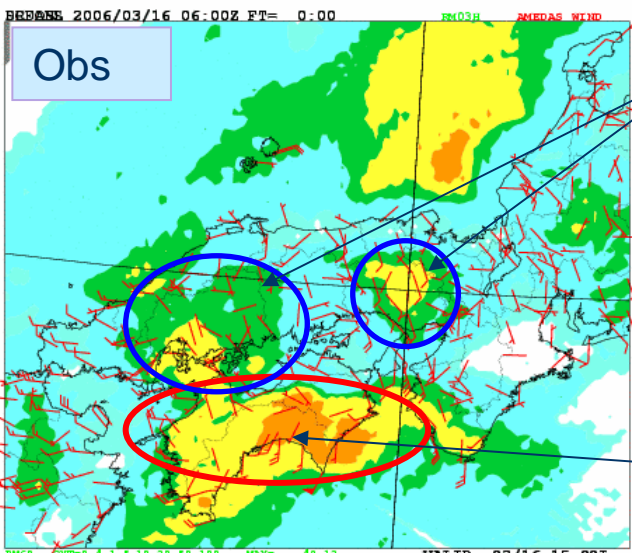
red: convergence, blue: divergence

Advantages of the rapid update of the model forecasts

- Recent observations can be assimilated to capture short-lived, small scale phenomena.
- By comparing results of different initials, we can determine how the forecasts are trustworthy or not.
- Possible to prepare two or more scenarios.
 - Generally, quality of precipitation forecast by NWP is degraded as the forecast time proceeds.
 - Precipitation forecasts include uncertainty.

Case: Mar 16, 2006 06UTC

3hour precipitation



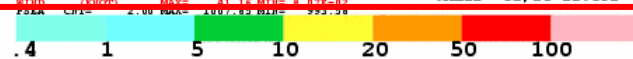
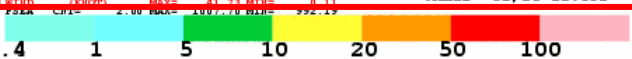
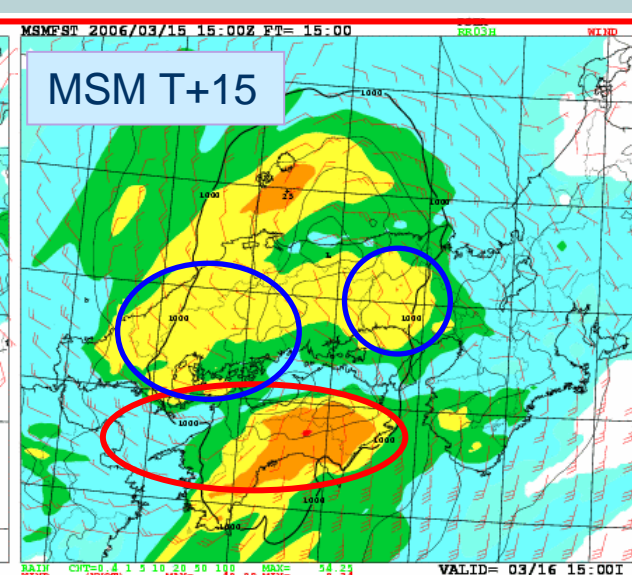
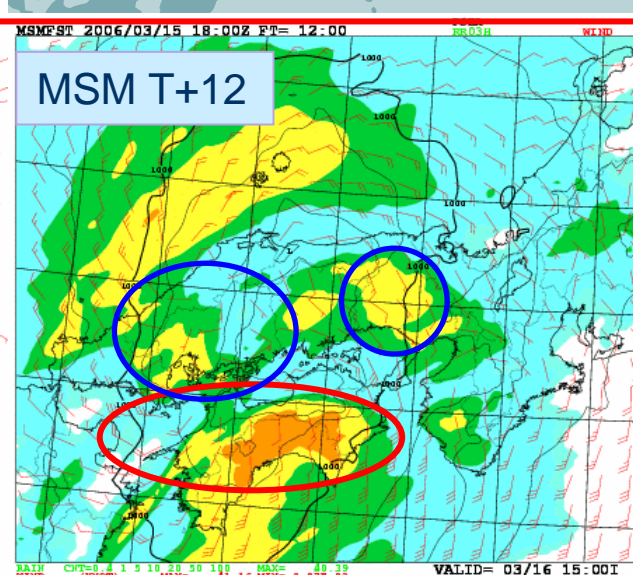
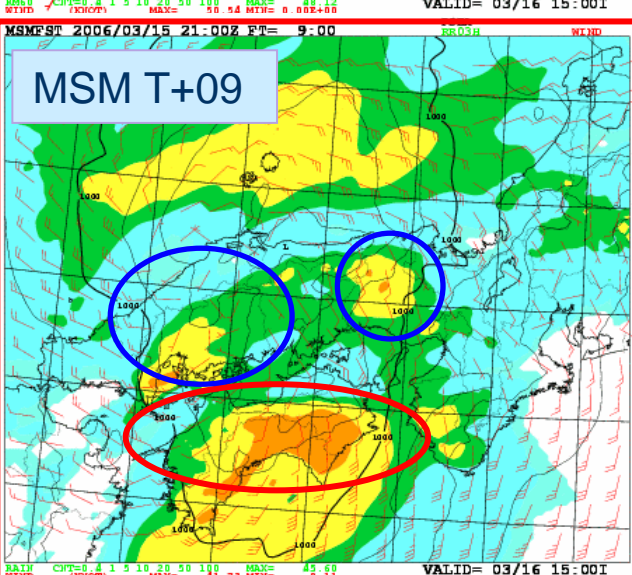
Precipitation over 10mm/3hr was observed, separated to 2 areas.

First, it was forecasted like one belt, but newer forecast is similar to observation.

Precipitation over 20mm/3hr was observed.

It was forecasted from first to last.

Reliability of this forecast is higher.



Summary

- **Extrapolation of observation and forecasts of meso scale model are combined for quantitative precipitation forecasts at JMA.**
- **From March 2006, non-hydrostatic meso scale model (JMANHM) whose horizontal resolution is 5km is operated. It is confirmed that the higher resolution meso scale model can represent smaller scale phenomena. It makes its precipitation forecast more appropriate.**
- **Rapid Updates of forecasts are advantageous to determine their reliability.**