

# Data assimilation experiment on the K computer

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# Motivation

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- The EnKF is an approximation to the KF
  - Accuracy depends on **the number of samples**
  - The number of samples depends on **the computational resources**
- Elimination of the sampling error
  - Spatial and temporal localization
  - Variable localization
- EnKF on the K computer with numerous samples
  - Implementation of the EnKF analysis **with accuracy**
  - Contribution to the further development of localization schemes **as a useful reference.**

# Progress situation

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- Modification of the **NHM-LETKF** originally developed by Miyoshi and Aranami (2006).
  - With the latest version of the NHM and LETKF core
- Application to local heavy rainfall cases
  - Examine the **performance of the system** with configurations for super computers.
- DA experiment with 900 members
  - Running on the K computer now ...

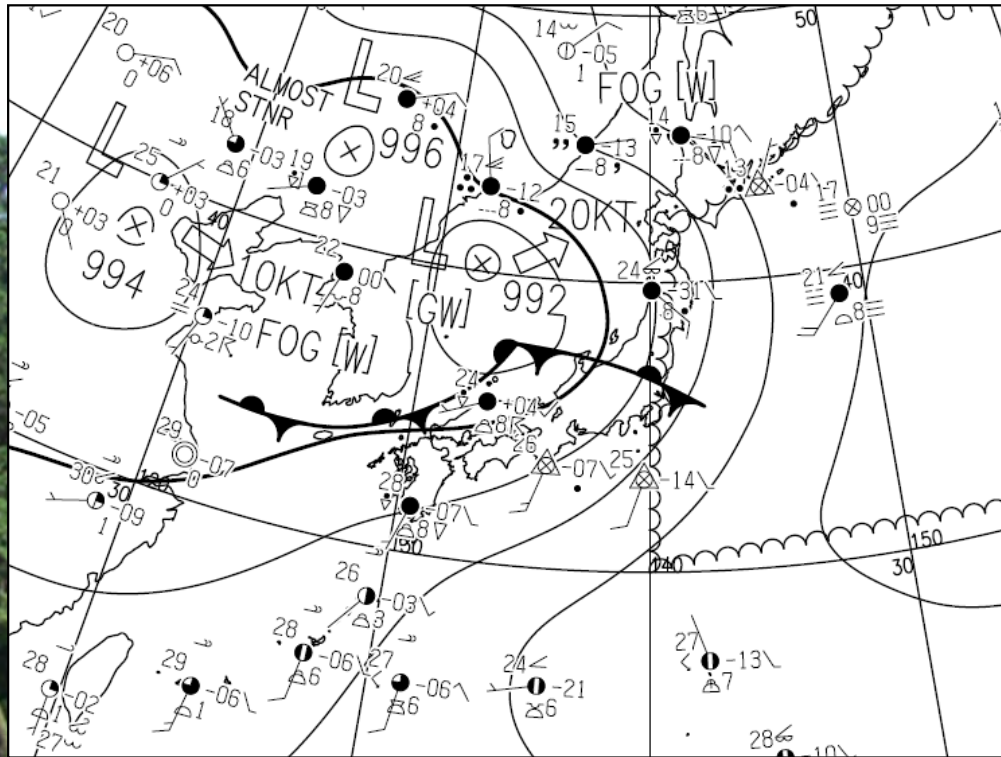
# NHM-LETKF

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- LETKF (Hunt et al. 2007) with the JMA nonhydrostatic mesoscale model (NHM, Saito et al. 2006; 2007).
- Based on the WRF-LETKF (Miyoshi and Kunii 2012)
  - The latest version of LETKF core
  - Effectively utilize feedbacks from WRF-LETKF users
- Research use
  - Simple (NOT include QC processes)
  - Independent of computing environment

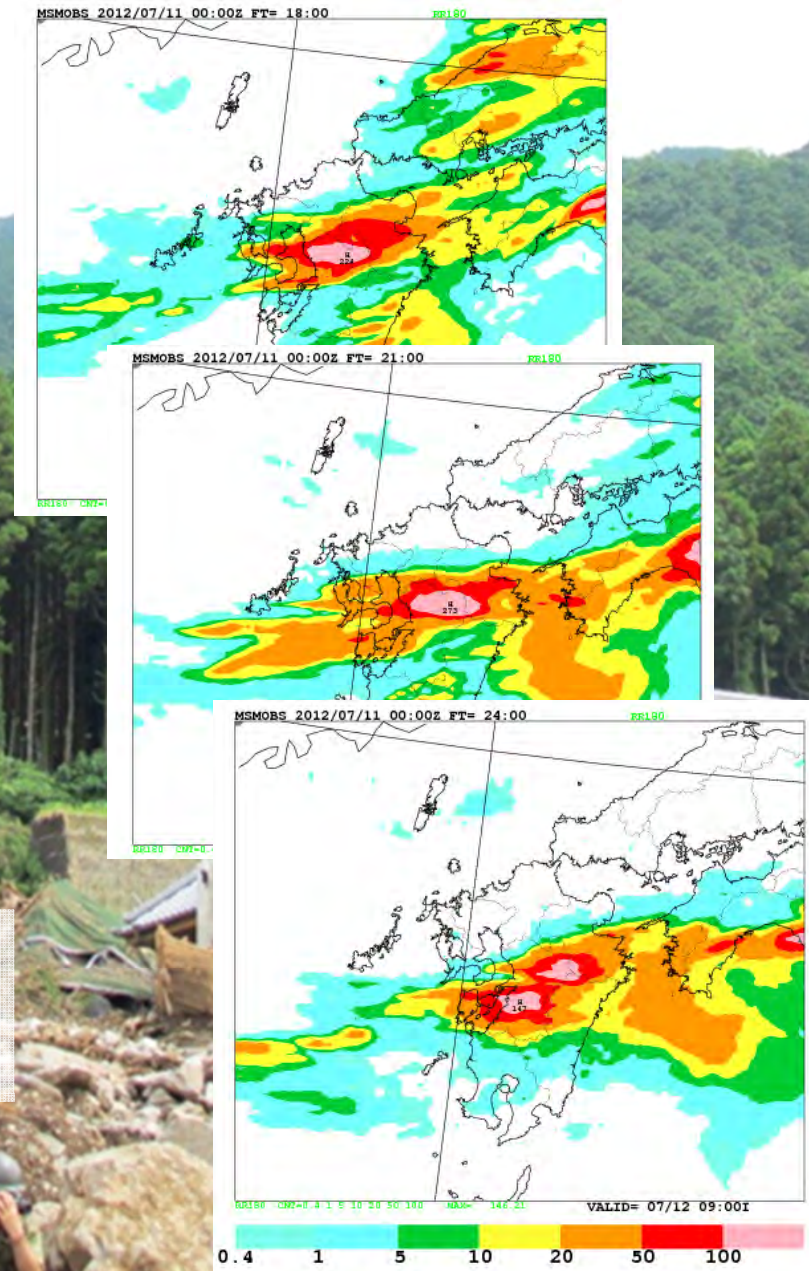
# Northern Kyushu heavy rains in July 2012

## 3-h accumulated rainfall (OBS)



Surface weather map on 1800 UTC 11 July 2012.

Rainfall totals reached as much as 800 mm over 5 days.



# Experimental Settings

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- LETKF settings

Ensemble size	50
Lateral boundary conditions	JMA Global Forecast (+ PTBs from JMA Global EPS)
Covariance inflation	Adaptive (Miyoshi 2011)
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, TPW)

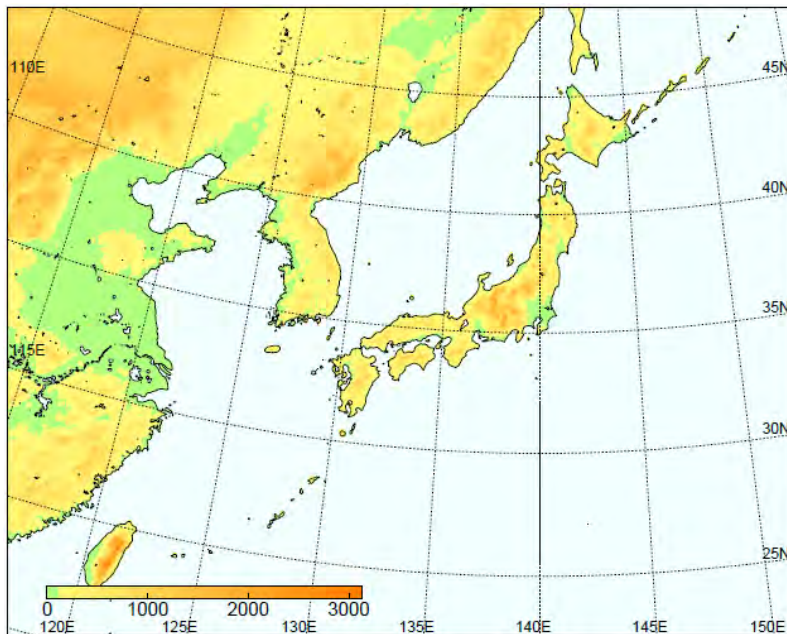
- NHM settings

Domain size	241 x 193 x 50
Horizontal grid spacing	15 km
NHM version	JMA NHM as of August 2012

# Experimental Settings

- EPS settings

Ensemble size	51 (50 + CNTL)
Lateral boundary conditions	JMA Global Forecast + PTBs from JMA Global EPS
Domain size	721 x 577 x 50
Horizontal grid spacing	5 km



Domain for the EPS experiment

NHM configurations are almost similar to operational one.

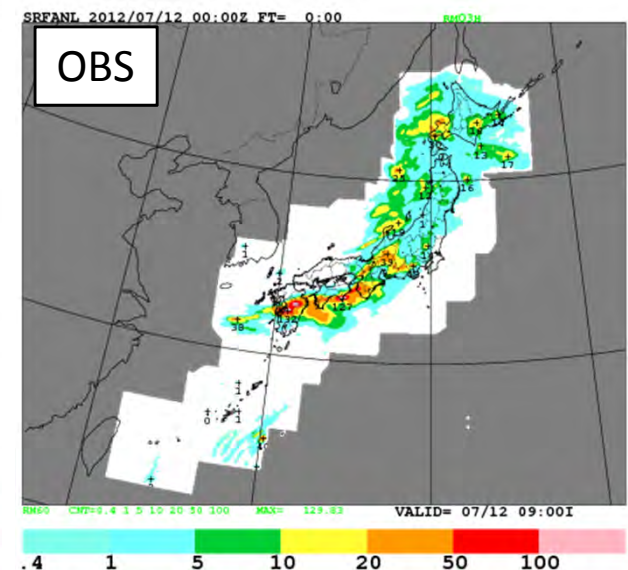
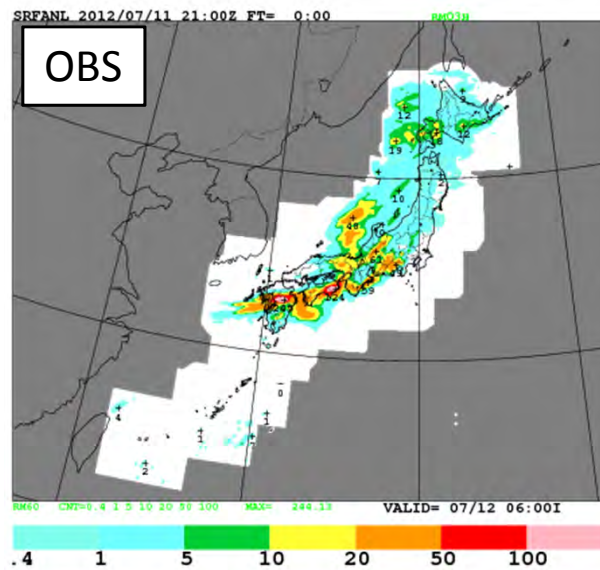
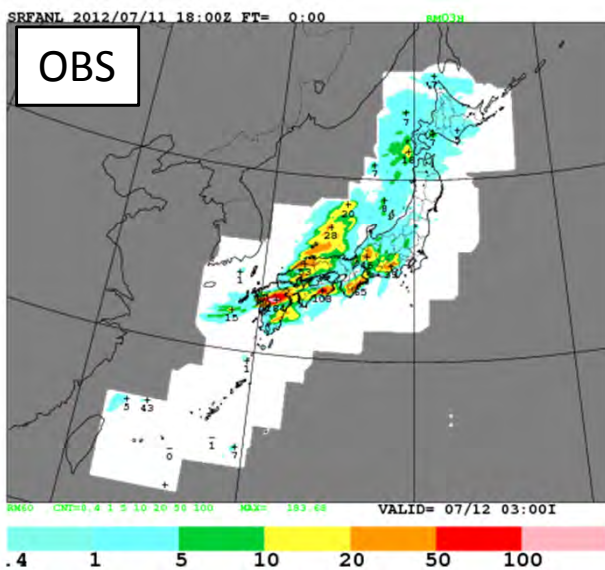
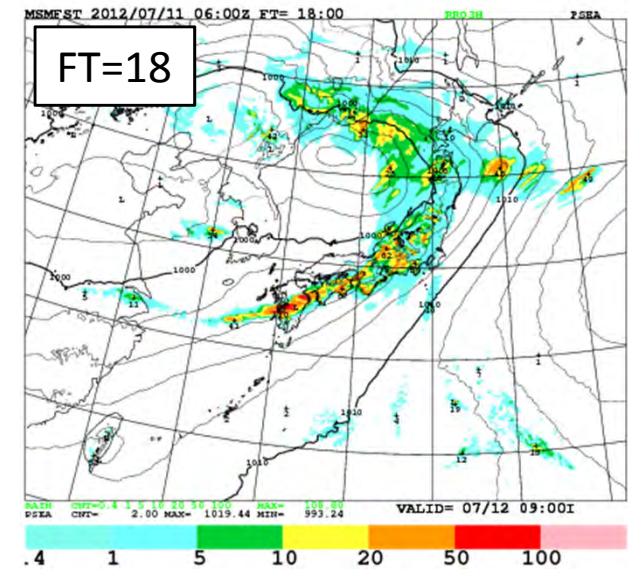
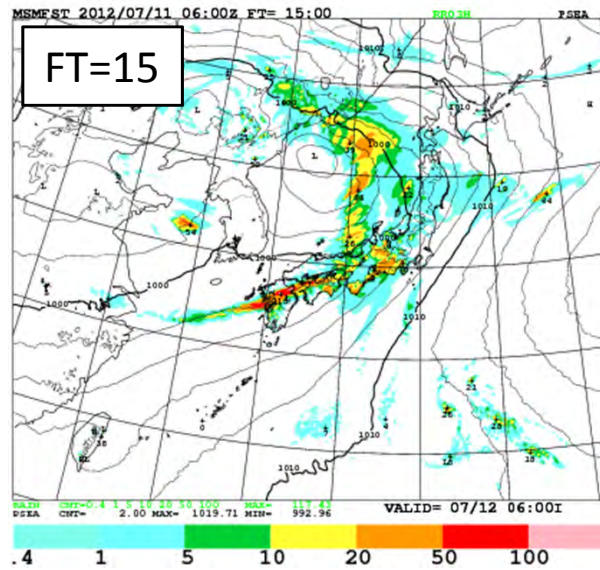
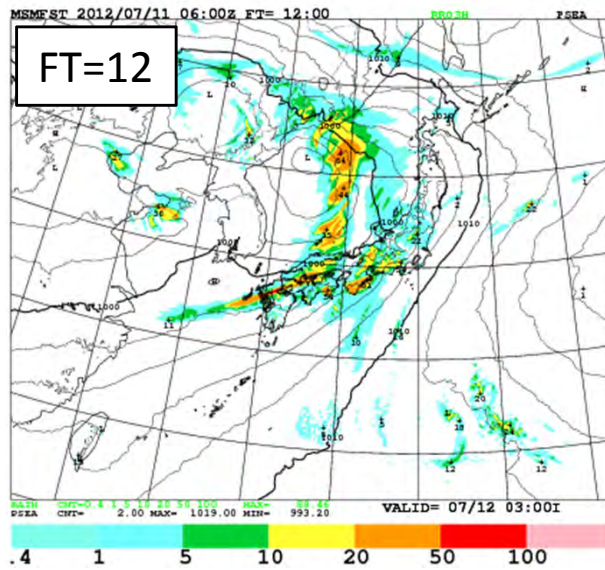
**EPS experiment:**

20120710 1200 UTC – 20120713 1200 UTC  
every 6-hr (13 cases)

# Control Forecast

## Forecast result of NHM with LETKF analysis

Init: 20120711 0600 UTC

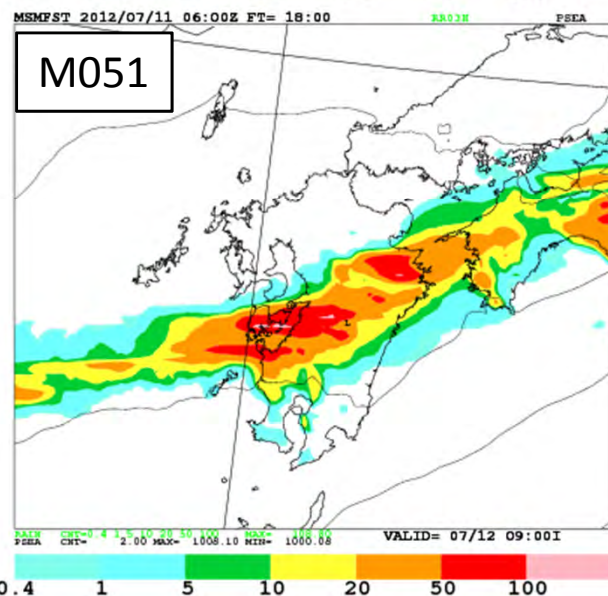
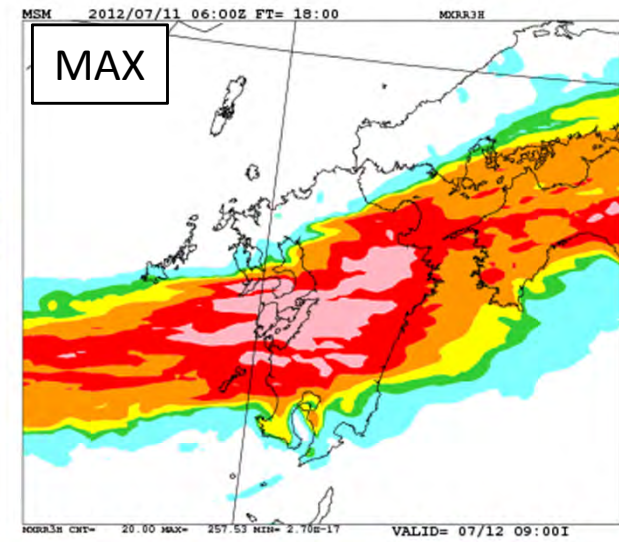
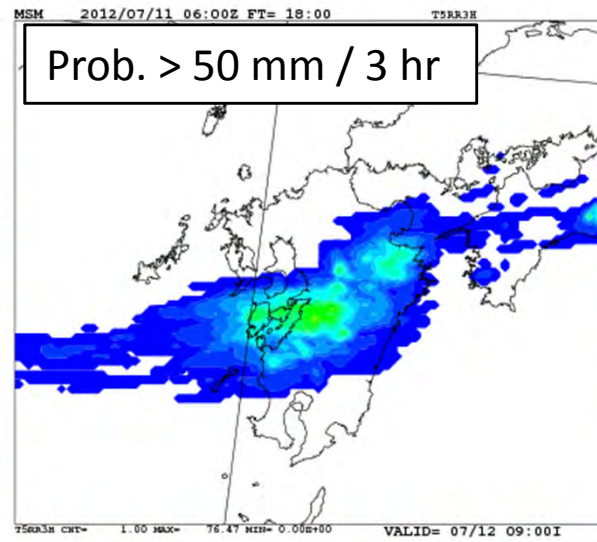
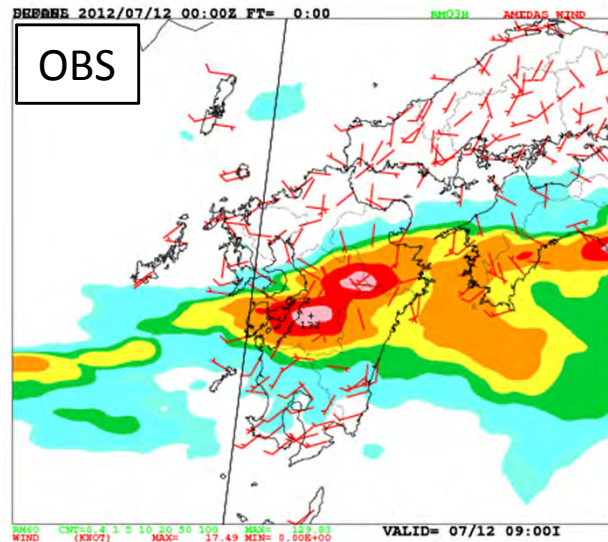




# Ensemble Forecast

## Forecast results of NHM with LETKF analyses

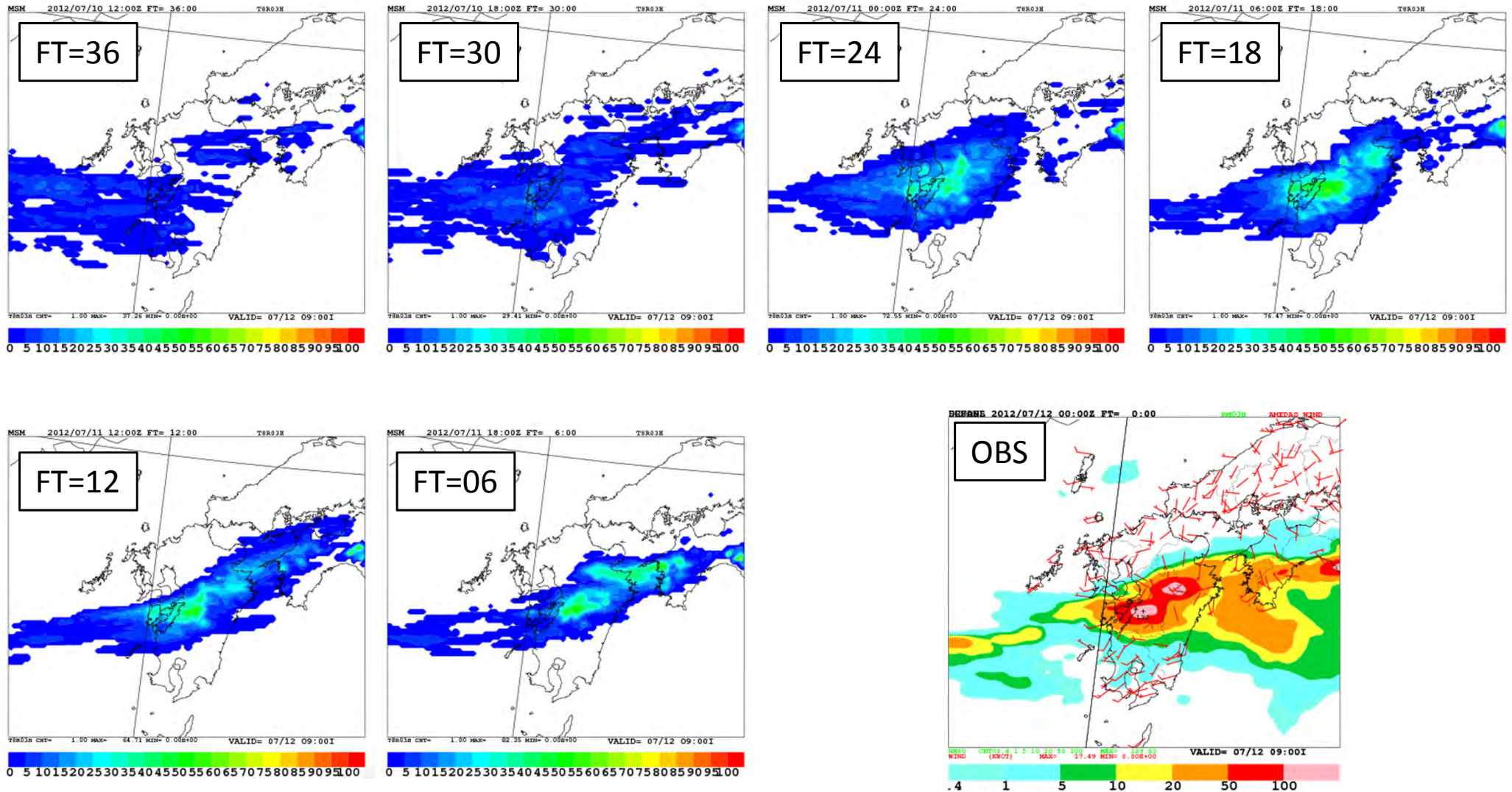
Init: 20120711 0600 UTC, FT=18



These information would contribute to decision-making process.

# Probability with longer leads

## Probability of precipitation (50 mm > 3-hr) with different lead times

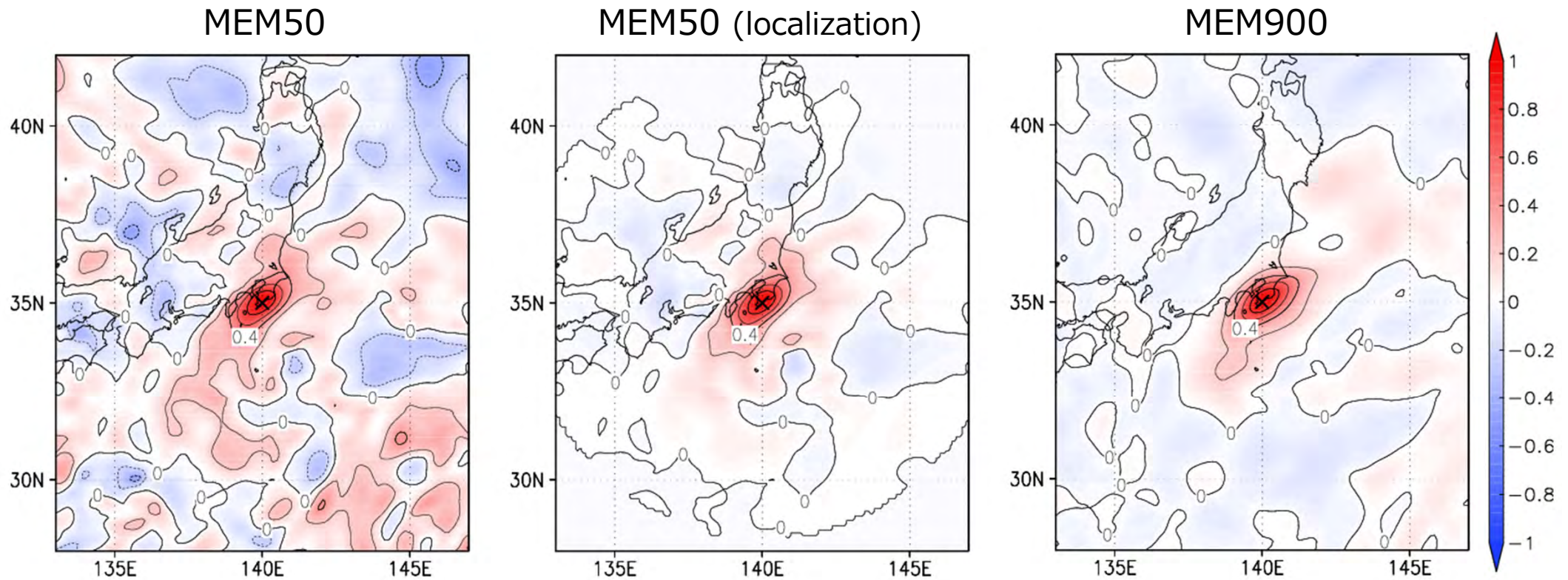


EPS successfully captures the occurrence of the heavy rainfall before 24 hours.

# Error covariance structure

NHM-LETKF with 900 members on the K computer

Horizontal error covariance maps of **U** at 500 hPa level

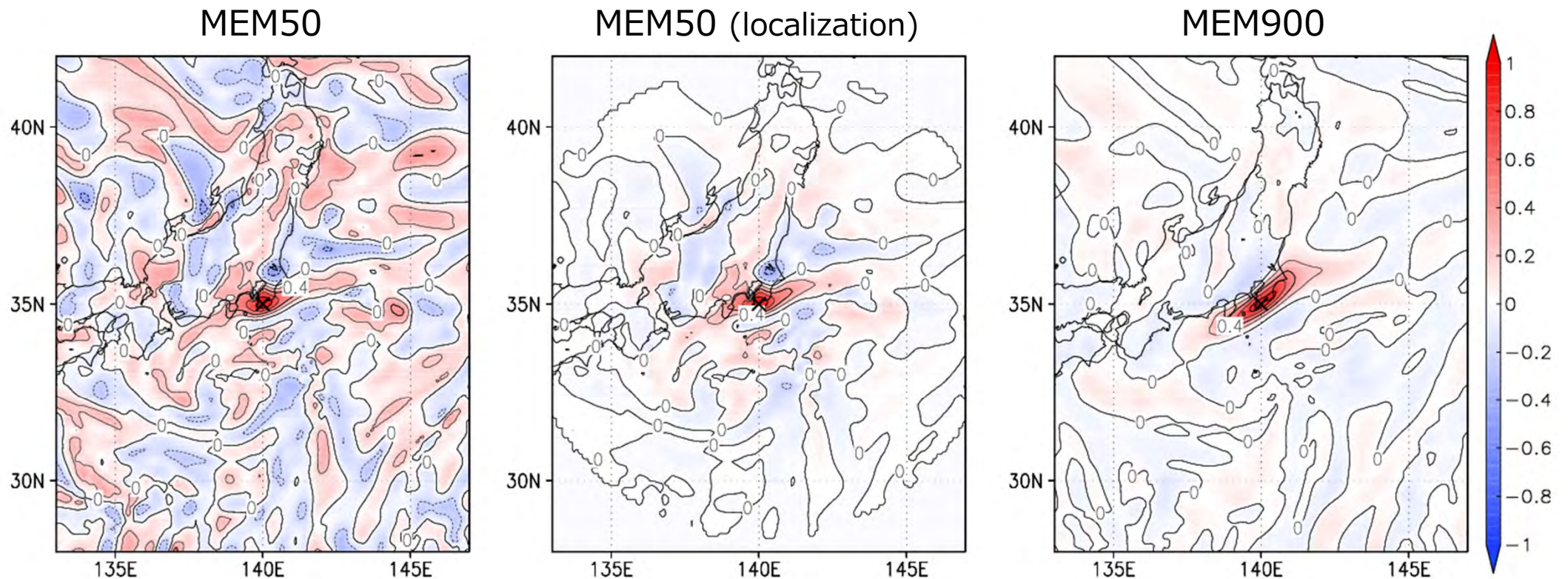


After 5 days cycle

# Error covariance structure

NHM-LETKF with 900 members on the K computer

Horizontal error covariance maps of QV at 925 hPa level



After 5 days cycle

# Summary

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- Modified NHM-LETKF is applied to the local severe weather event in July 2012.
  - NHM-LETKF **successfully captured** the intense rainfall.
  - Probabilistic information derived from ensemble forecasts would be **useful for decision-making process**.
- NHM-LETKF with 900 members is implemented on the K computer.
  - Investigation of the covariance structure suggests **the usefulness as a reference**.
  - DA experiment is now running.