

# **Goal 2: Development of a regional cloud-resolving ensemble analysis and forecast systems**

**(領域雲解像アンサンブル解析予報システムの  
開発と検証)**

Meteorological Research Institute,  
Japan Agency for Marine-Earth Science and Technology,  
Japan Meteorological Agency,  
Tohoku University,  
Kobe University,  
Disaster Prevention Research Institute, Kyoto University, etc.

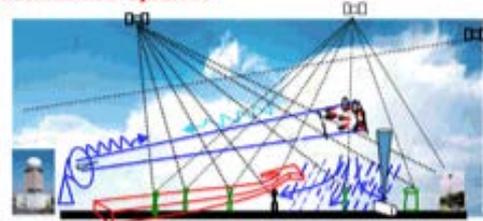
# Ultrahigh Precision Meso-scale Weather Production

Goal1

**Goal 1: Development of cloud resolving 4 dimensional data assimilation systems**

Assimilate high-resolution observation data (moisture and wind) from Doppler radar, GPS, etc., into cloud-resolving models

Meteorological Research Institute; JAMSTEC; Disaster Prevention Research Institute, Kyoto University; National Research Institute for Earth Science and Disaster Prevention (NIED); Institute of Statistical Mathematics; Numerical Prediction Division of JMA

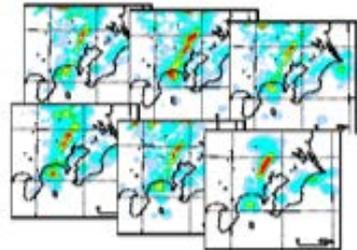


Goal2:  
Development of  
a regional cloud-resolving  
ensemble analysis and  
forecast systems

**Goal 2: Development and validation of a cloud resolving ensemble analysis and prediction system**

Conduct probability forecast of torrential rains less than half-day earlier, while specifying the occurrence time, location and intensity using the cloud-resolving ensemble forecast

Meteorological Research Institute; JAMSTEC; Tohoku University; Disaster Prevention Research Institute, Kyoto University; Numerical Prediction Division of JMA



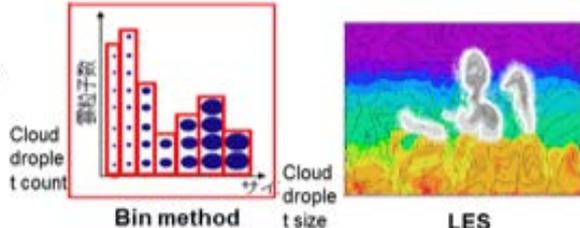
Estimate prediction reliability based on multiple forecast examples

Goal3

**Goal 3: Basic research using very high resolution atmospheric models**

Improve the cloud-resolving models  
Remove uncertainty  
Enhance forecast of tropical cyclone intensity using cloud-resolving simulations

JAMSTEC; Meteorological Research Institute; Atmosphere and Ocean Research Institute, The University of Tokyo; National Defense Academy of Japan; Tohoku University; Disaster Prevention Research Institute, Kyoto University; Numerical Prediction Division of JMA; Hydrospheric Atmosphere Research Center, Nagoya University; University of Tsukuba; Advanced Institute for Computational Science



Cloud droplet count

Bin method

Cloud droplet size

LES

<http://www.jamstec.go.jp/hpci-sp/en/strategy/mswp.html>

**Forecast of torrential rains**

# Goal 2: Development of a regional cloud-resolving ensemble analysis and forecast systems (領域雲解像アンサンブル解析予報システムの開発と検証)



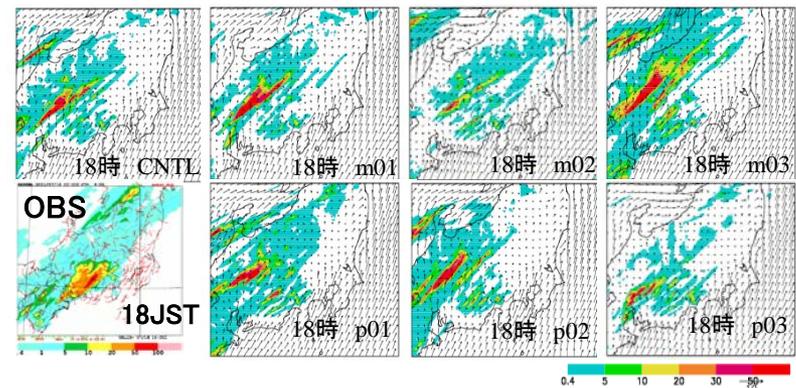
## Goal2: Development of a regional cloud-resolving ensemble analysis and forecast systems

Conduct probability forecast of torrential rainfalls less than half-day earlier , while specifying the occurrence time, location and intensity using the cloud resolving ensemble forecasts.

## 第2目標：領域雲解像アンサンブル解析予報システムの開発と検証

雲解像アンサンブル予報により、集中豪雨の半日以上前の予測を、時間・場所・強度を特定して確率的に行う。

気象研究所・海洋研究開発機構・東北大学・京都大学・神戸大学・数値予報課



Ensemble forecast of torrential rainfall that occurred on 14 July 2010



## Goal 2: Development of a regional cloud-resolving ensemble analysis and forecast systems

(領域雲解像アンサンブル解析予報システムの開発と検証)

- The ensemble forecast systems are under development using the K-computer, and then applied to several phenomena such as heavy rainfalls (京によるアンサンブル予報システム開発).
- The outputs of ensemble forecasts have been used as input data of flood and landslide predictions in this project (洪水モデルや土砂災害モデル等への応用).

Results of the ensemble forecast systems and the applications using the outputs of ensemble forecasts, which will be not present in the following talks of this session, are shown briefly (Web等で紹介している前年までの成果や、時間の都合等で今回の研究会で発表できない成果を紹介します).

## Goal 2: Development of a regional cloud-resolving ensemble analysis and forecast systems

(領域雲解像アンサンブル解析予報システムの開発と検証)

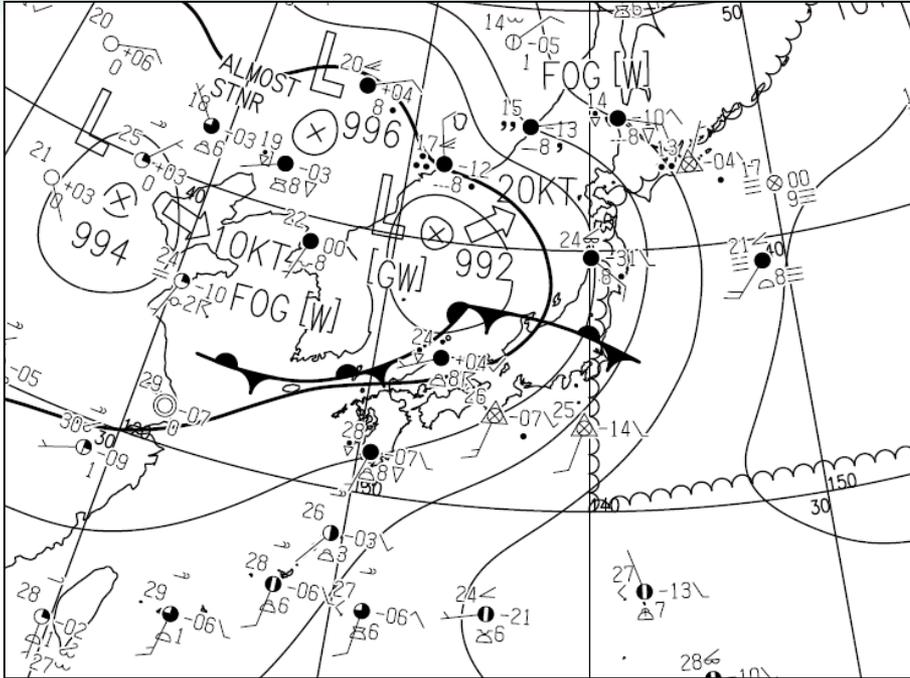


### Leading products

- Northern Kyushu heavy rainfall in July 2012  
(2012年の九州北部豪雨の再現実験)
- Simulation of Sea breeze  
(海風侵入のシミュレーション)
- 1000 member's ensemble forecasts  
(1000メンバーのデータ同化実験)

# Northern Kyushu heavy rainfalls in July 2012 (2012年の九州北部豪雨の再現実験)

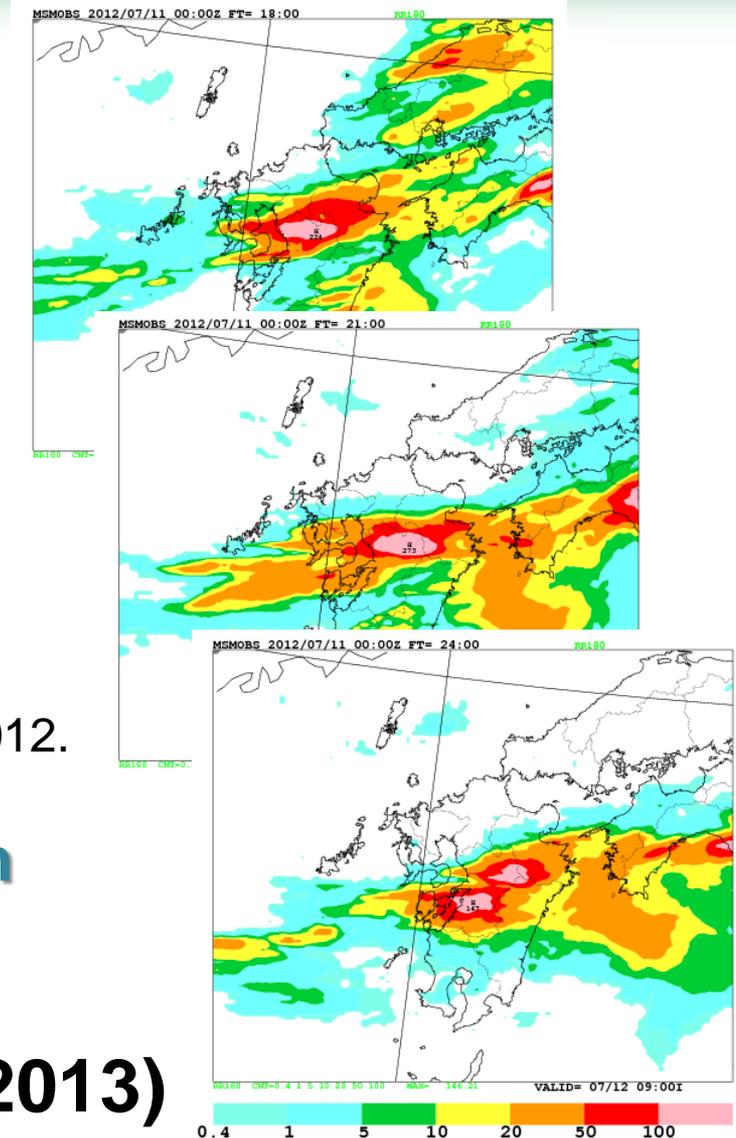
3-h accumulated rainfall (OBS)



Surface weather map on 1800 UTC 11 July 2012.

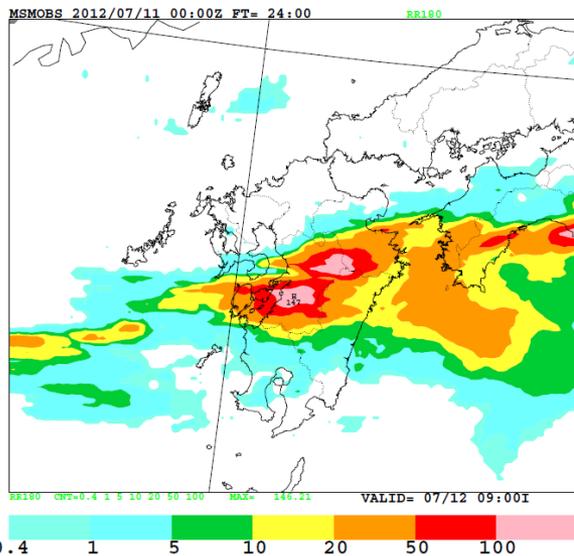
**Rainfall totals reached as much as 800 mm over 5 days.**

**(Kunii, 2013)**

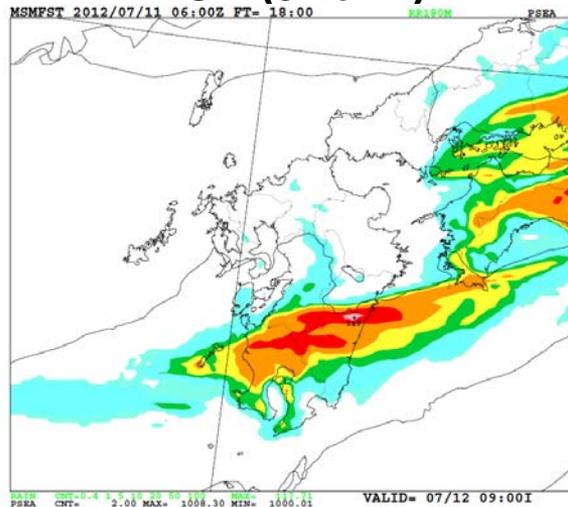


# Forecast results (FT=18)

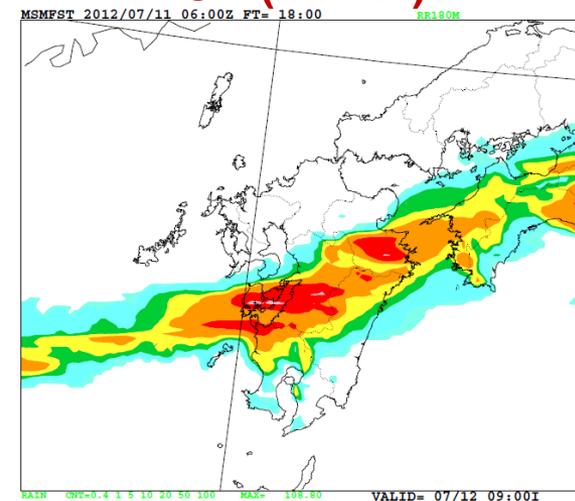
### OBS



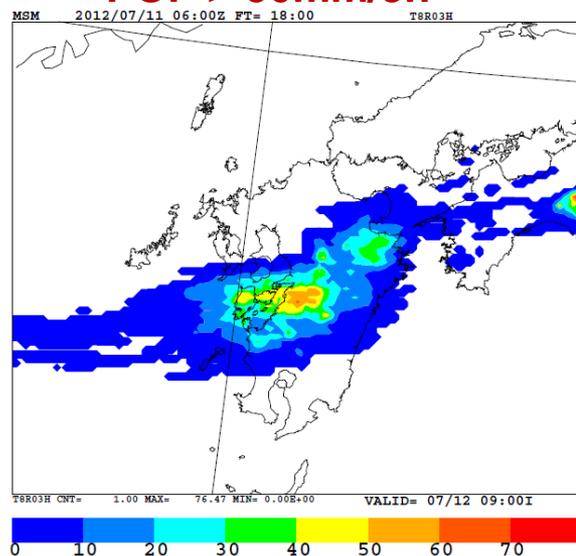
### MSM (JNoVA)



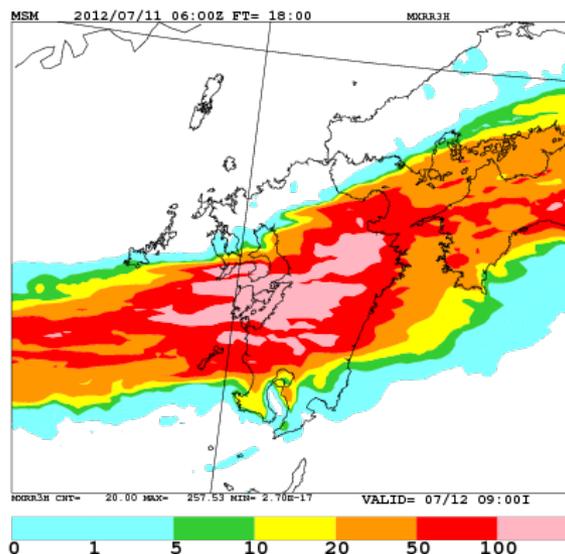
### MSM (LETKF)



### POP > 50mm/3h



### Maximum



These information would contribute to decision-making process.

(Kunii, 2013)

## 京コンピュータによる平成24年7月九州北部豪雨の予測について

### 発表日

平成25年8月30日

### 概要

京コンピュータによる平成24年7月九州北部豪雨の予測実験を行った結果、大雨の予測が大きく改善されました。

### 本文

平成24年7月九州北部豪雨による大雨について、発生半日～1日前からの計算で高い確率で予測できる例があることが気象研究所による研究で分かりました。気象防災に関する京コンピュータを用いる研究の最初の本格的な成果で、将来的な集中豪雨の予測の改善にもつながるものと期待されます。

図表等を含めた資料全文については、下記「資料全文(京コンピュータによる平成24年7月九州北部豪雨の予測について)」をご参照ください。

### 問い合わせ先

気象研究所 企画室  
電話:029-853-8535

<http://www.mri-jma.go.jp/Topics/press/20130830/press20130830.html>

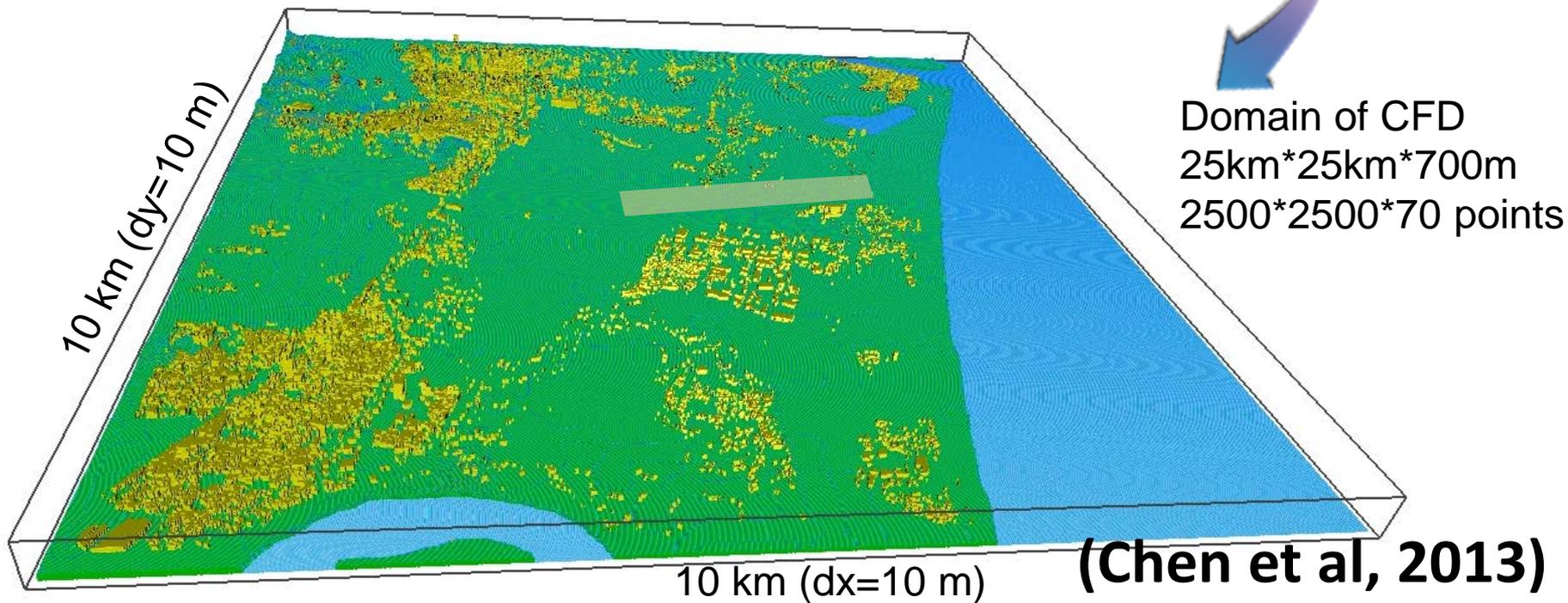
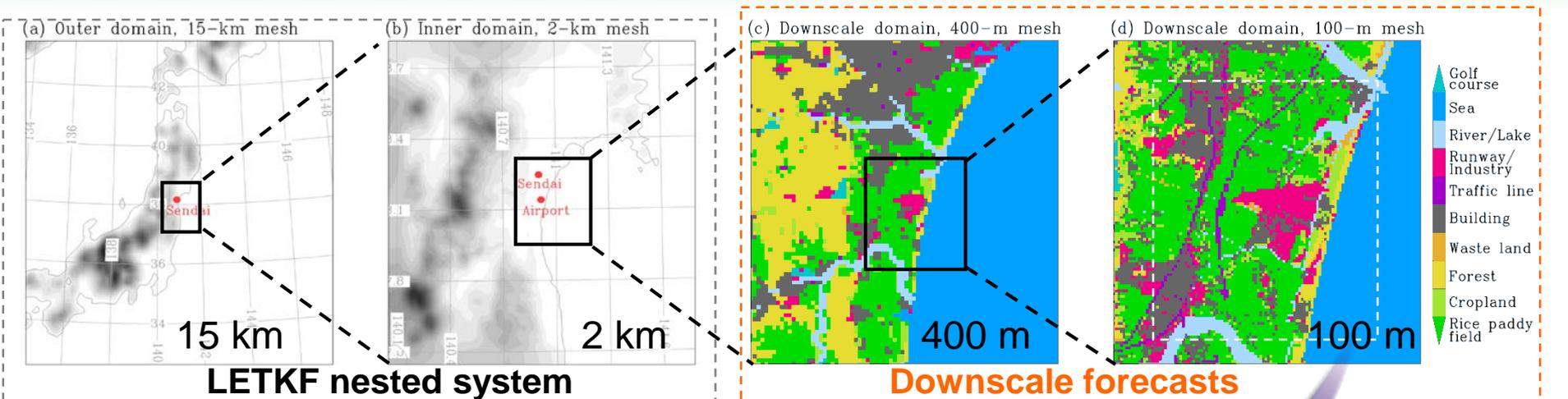
Weather and Forecasting 2013 ; e-View doi: <http://dx.doi.org/10.1175/WAF-D-13-00032.1>

**Mesoscale data assimilation for a local severe rainfall event with the NHM-LETKF system**

**Masaru Kunii**

Forecast research department, Meteorological Research Institute

# Simulation of Sea breeze (海風侵入のミュレーション)



# 東北大学ダウンスケールシステムDS3を用いた京コンピュータによる海風前線三次元構造の超高解像度数値実験

## Results of Research

### Super high-resolution modeling of 3D structures of the sea breeze front head by the Down-Scaling Simulation System (DS3)

#### Summary

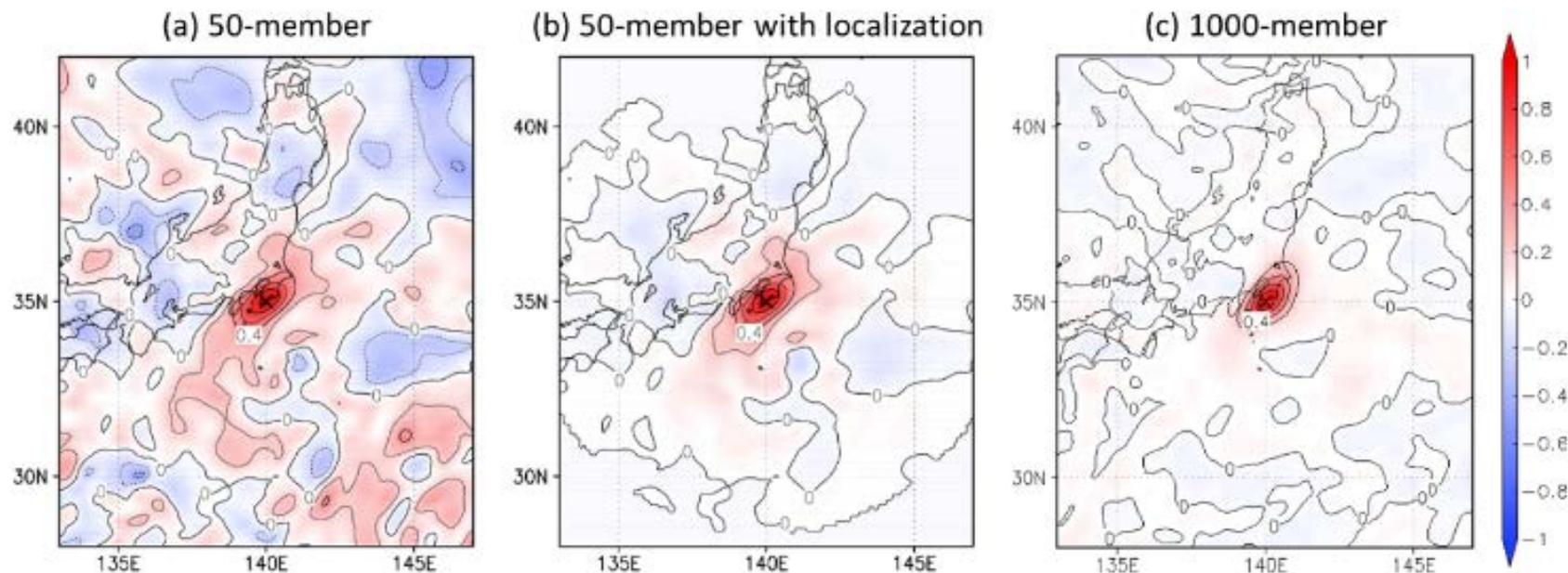
The sea breeze has an important influence on the local weather and environment over the coastal areas. In particular, the passage of sea breeze front can bring a sudden change of winds, temperature, air quality, and even convective weathers. To date, however, it still remains a big challenge to realistically predict the detailed structures and progress of the sea breeze front over coastal city.

[http://www.jamstec.go.jp/hpci-sp/info/research\\_results/research\\_results\\_chen.en.html](http://www.jamstec.go.jp/hpci-sp/info/research_results/research_results_chen.en.html)

# 1000-member ensemble forecast

## (1000メンバーのアンサンブル予報実験)

- The EnKF has an advantage that a flow-dependent background error covariance can be estimated explicitly in the process.
- The finite ensemble size introduces a sampling error into the background error covariance, leading to degradation of the accuracy of the analysis fields.



Maps of the horizontal distribution of the error correlation of the horizontal wind at the 500-hPa level from the center location. **(Kunii, 2014)**

# 研究成果

気象庁非静力学モデルを用いた京コンピュータによる1000メンバーアンサンブルカルマンフィルタの実行

## Results of Researches

The 1000-member ensemble Kalman filtering with the nonhydrostatic numerical weather prediction model on the K computer.

### ▶ Summary

For improving numerical weather prediction (NWP) for severe phenomena such as local heavy rainfalls and tornados, an accurate initial condition of NWP models is essential in addition to the improvement of NWP models. The initial condition of the NWP model is prepared through the data assimilation process,

[http://www.jamstec.go.jp/hpcisp/en/research\\_results/enkf1000.html](http://www.jamstec.go.jp/hpcisp/en/research_results/enkf1000.html)

# Results of the ensemble forecast systems and applications using outputs of ensemble forecasts



## (1) 2012年台風第15号の多重壁雲と風速特性

折口 征二(気象研究所)

## (2) 高解像度大気海洋結合モデルを用いたアンサンブルカルマンフィルタの構築

國井 勝(気象研究所)

## (3) Urban weather forecast at super high resolutions using a full scale nested local prediction

陳 桂興(東北大学)

## (4) 「京」を用いた広域を対象にした豪雨の高解像度実験

大泉 伝(海洋研究開発機構、気象研究所)

## (5) 土石流発生予測ソフトHydro-debris2D&3Dの開発と

スーパーコンピューティングへの応用 山敷 庸亮(京都大学)

## (6) アンサンブル洪水予測

小林 健一郎(神戸大学)

## (7) 超高精度アンサンブル降水予測情報を用いた洪水早期警報への適用評価

ユ・ワンシク(京都大学 防災研究所)

# Results of the ensemble forecast systems and applications using outputs of ensemble forecasts



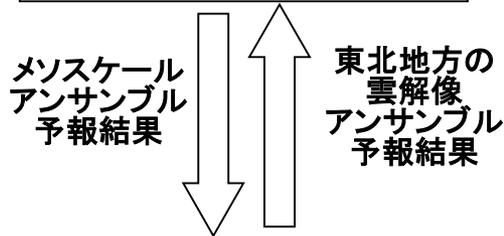
- **Multiple eyewalls and wind features in the 2012 Typhoon BOLAVEN** Seiji Origuchi (MRI)
- **Implementation of a high-resolution atmosphere-ocean coupled model with an ensemble Kalman filter** Masaru Kunii (MRI)
- **Urban weather forecast at super high resolutions using a full scale nested local prediction** Guixing Chen (Tohoku. Univ.)
- **Super high resolution experiment of heavy rain in large area using the K computer** Tsutao Oizumi (JAMSTEC)
- **Development of Hydro-Debris 2DH / 3D for HPCI and it Izu-Oshima and Hiroshima disaster.** Yousuke Yamashiki (DPRI)
- **Ensemble flood prediction** Ken-ichiro Kobayashi (Kobe Univ.)
- **Application of Flood Early Warning using High-Resolution Ensemble Rainfall from NWP model** Yu Wansik (DPRI)

# 雲解像度アンサンブル予報データの検証

領域雲解像アンサンブル  
解析予報システムの開発

全国を対象とした  
メソスケール/  
雲解像アンサンブル  
解析予報システム

気象庁気象研究所  
気象庁予報部数値予報課



東北を対象とした  
雲解像アンサンブル  
解析予報システム

東北大学



データ  
ハンドリング  
ツールの改良  
データ利用補佐

京都大学

予報の防災上の情報価値の  
検証の検証

高解像アンサンブル予報による強風場の  
精度検証

マルチ分布型流出モデルと粒子フィルタに  
よる実時間アンサンブル流出予測

アンサンブル予報結果のダム貯水池短期操  
作への利用可能性の検討

突発的気象現象に対する湖／内湾の影響  
評価モデルの構築

アンサンブル予報結果を用いたアンサンブル  
波浪予測

高解像アンサンブル予報による洪水流出・  
氾濫追跡の予測精度検証

京都大学防災研究所、京都大学  
神戸大学