

A study for constructing a long-term regional reanalysis system over Japan assimilating only conventional observations

**従来型観測のみによる日本域を対象とした
長期領域再解析システム構築に向けた研究**

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Motivation

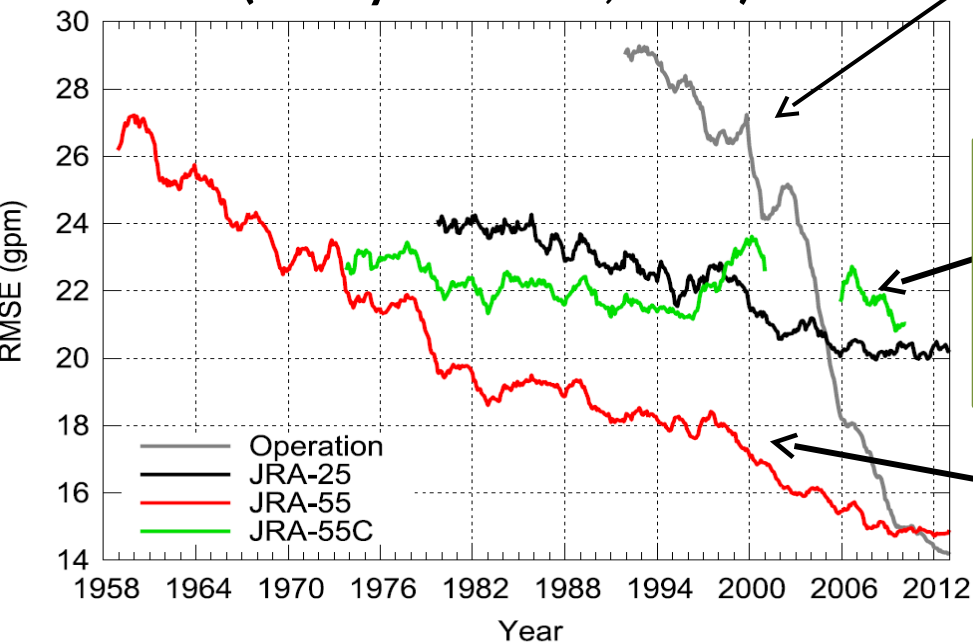
- Reproduce past extreme meso-scale events
- Evaluate regional-scale responses to climate variability and change
- Estimate artificial impacts on weather (e.g. Urban heat island)
- Input for models that needs meteorological variables such as hydrological model.

Need the data that are

- ✓ Accurate
- ✓ Long-term consistent
- ✓ High-resolution

Long-term consistency

RMSE for Z500(20-90N) at FT= 48h
(Kobayashi et al., 2014)



Operational Analysis

DA scheme, Obs. system, and model are changed with the times

JRA-55C

Assimilate conventional Obs. only with the cold system
the quality is long-term consistent

JRA-55

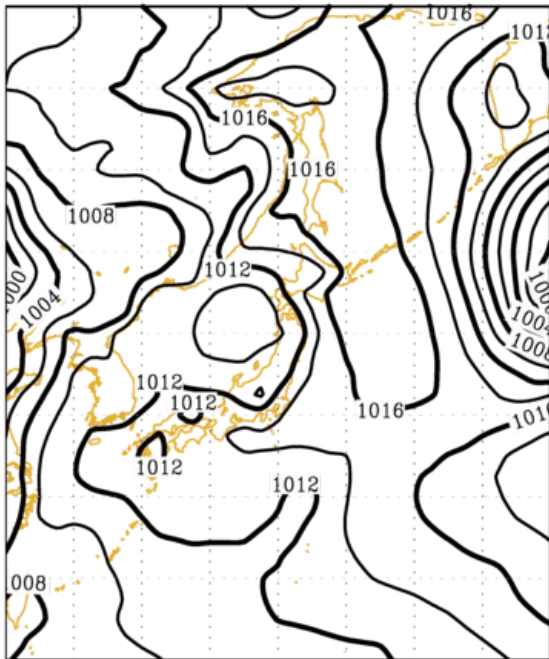
Assimilate all the available Obs. with the cold system

Assimilate conventional observation data only to maintain the long-term consistency of the quality

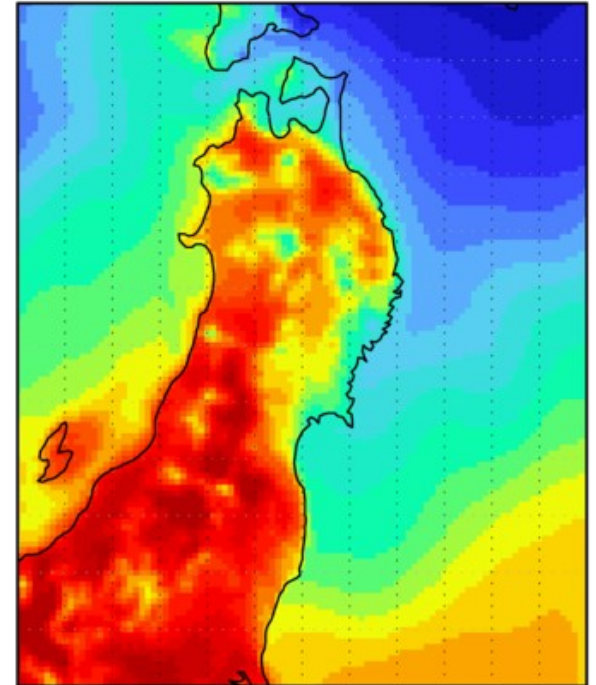
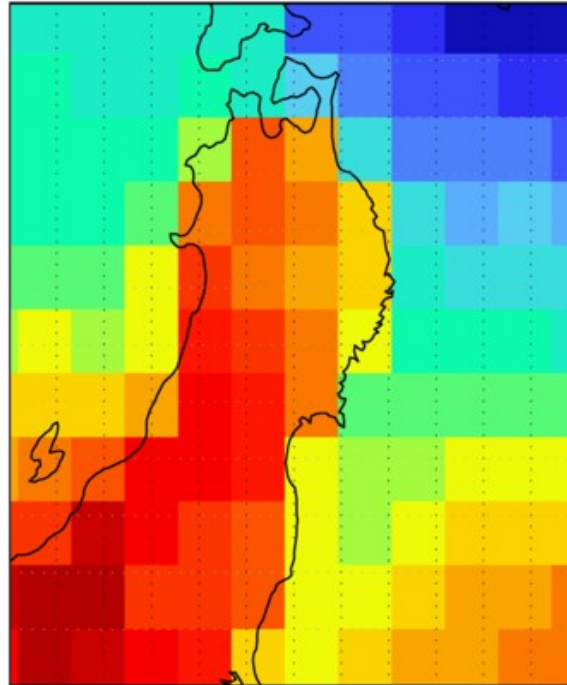
High-resolution

2013年5月13日15JST #この時の観測は、仙台で10.1°C、28.7°C at

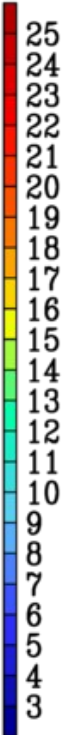
Psea JRA55



Ts JRA-55 (dx~55km) Ts MA (dx=5km)



[°C]



High-resolution models are necessary to reproduce regional-scale phenomena

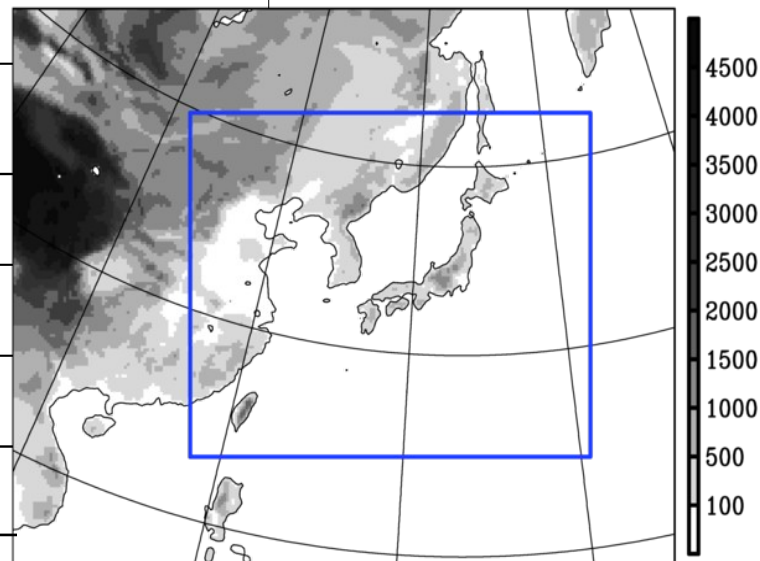
Objective

Produce a long-term consistent regional Reanalysis using conventional observations

Evaluate the potential for the regional reanalysis by comparing an assimilation experiment using conventional observations only and simple downscalings

The system for DA (NHM-LETKF)

NHM-LETKF based on the system in Kunii (2014)	
Grids	241x193x50; dx=25km
Initial conditions	JRA-55 at initial time in randomly chosen years
Lateral boundary	JRA-55 (not perturbed)
Ensemble size	10
Localization	200 km / 0.2 $\ln p$
Covariance inflation	1.5 (multiplicative)
Assimilation window	6hour
Validation data	JMA's Meso-scale Analysis [MA] (inside the blue frame in the Fig.)
Experimental period	12UTC 1 Aug – 00UTC 1 Sep 2014

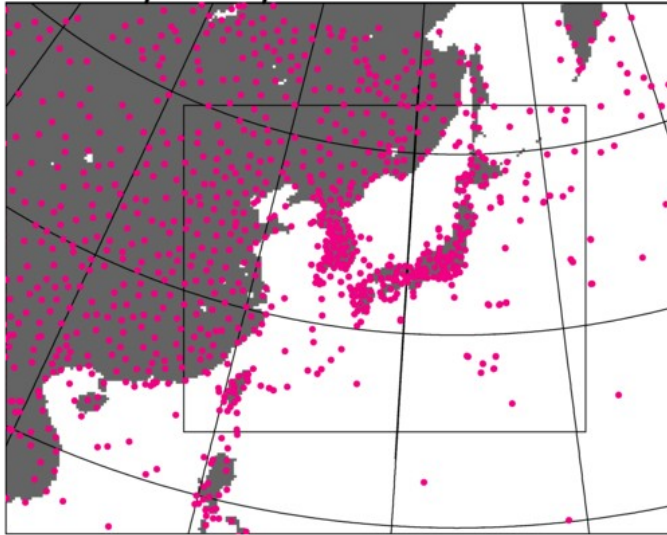


Observation data for DA

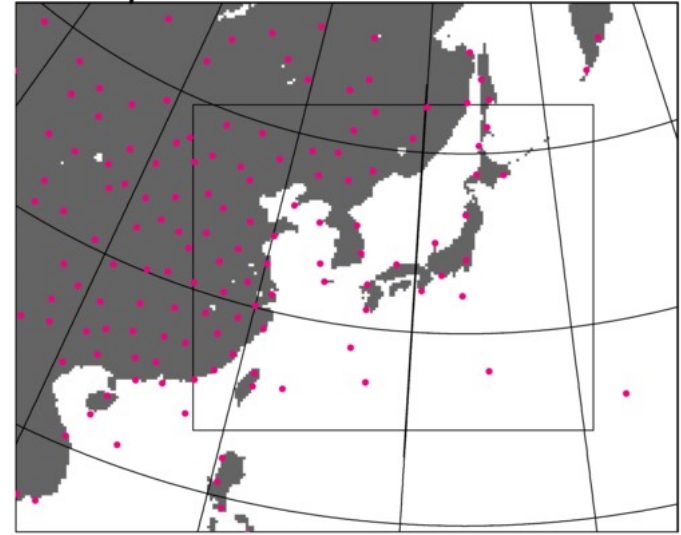
Quality controlled for JMA's operational analysis

Use only **conventional observations** available for long in order to maintain long-term consistency

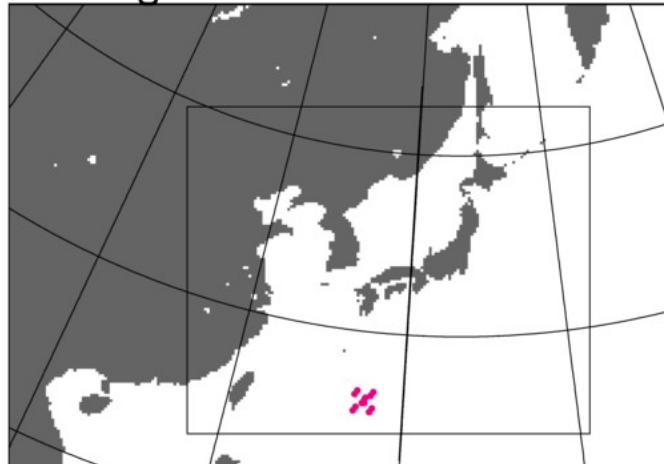
SYNOP/SHIP/BUOY



TEMP/PILOT



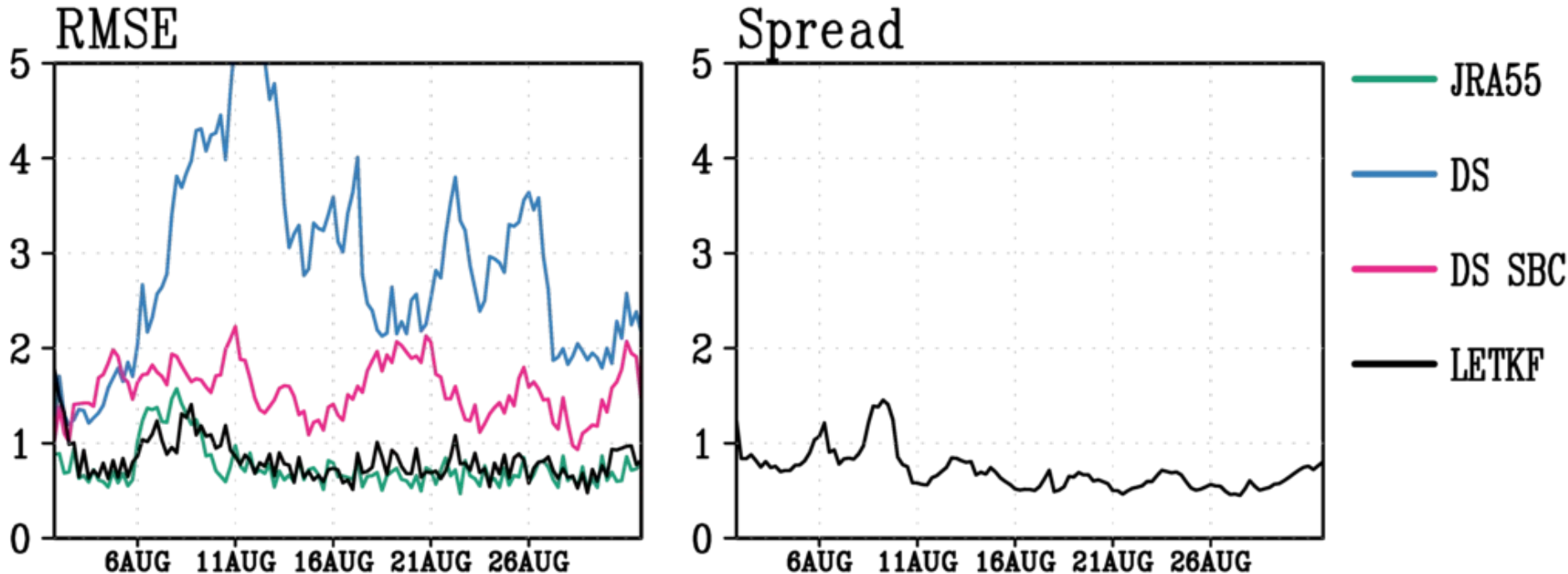
TC Bogus



Time series (sea level pressure)

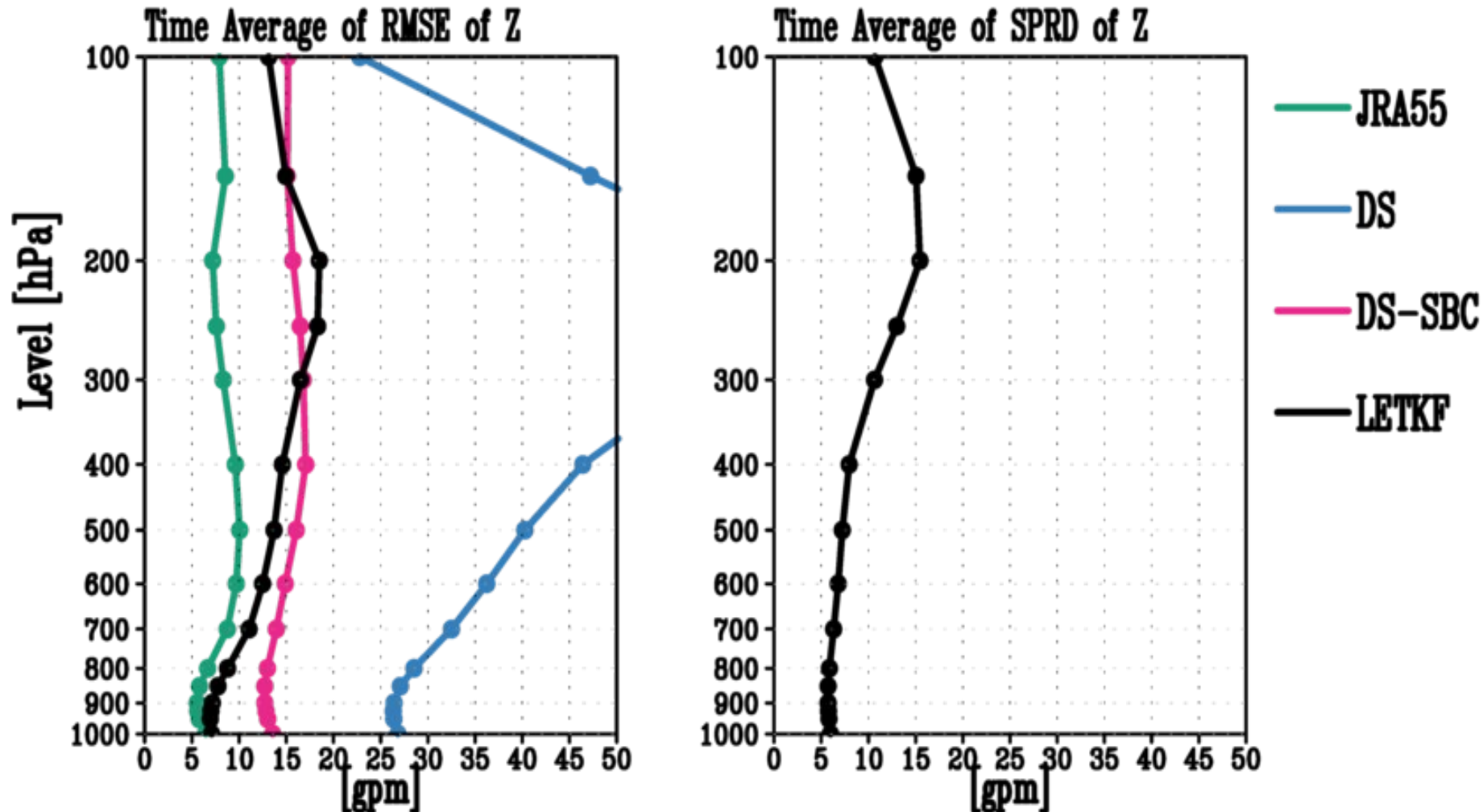
- LETKF outperforms both DS and DS-SBC.

RMSE & Spread for Psea (vs MA) [MA domain]



Vertical profile (geopotential height)

➤ The improvement can be seen up to 300 hPa.



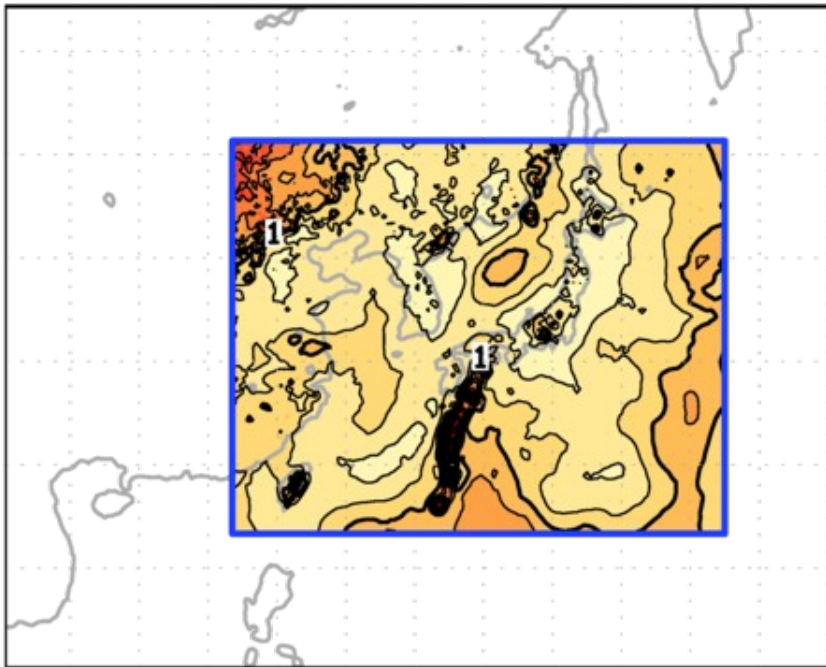
Averaged over 12UTC 6 Aug. - 00UTC 1 Sep.

Spatial distribution

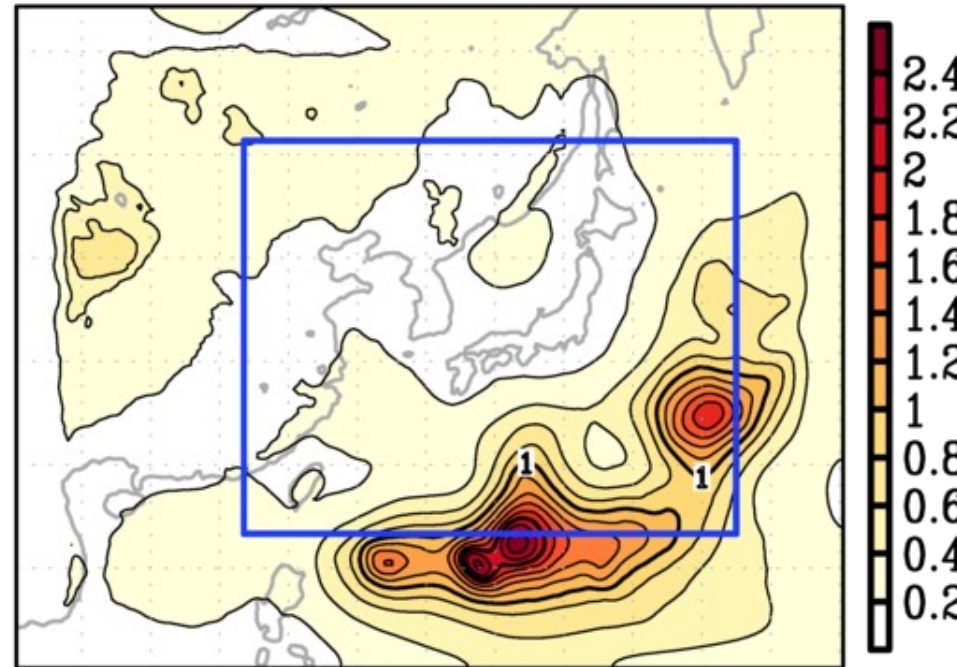
- Spreads reflect the density of the observing networks

Psea [12z06Aug-18z31Aug2014] mult1.5 noLBP FT=00h

(a) RMSEs



(b) Spreads



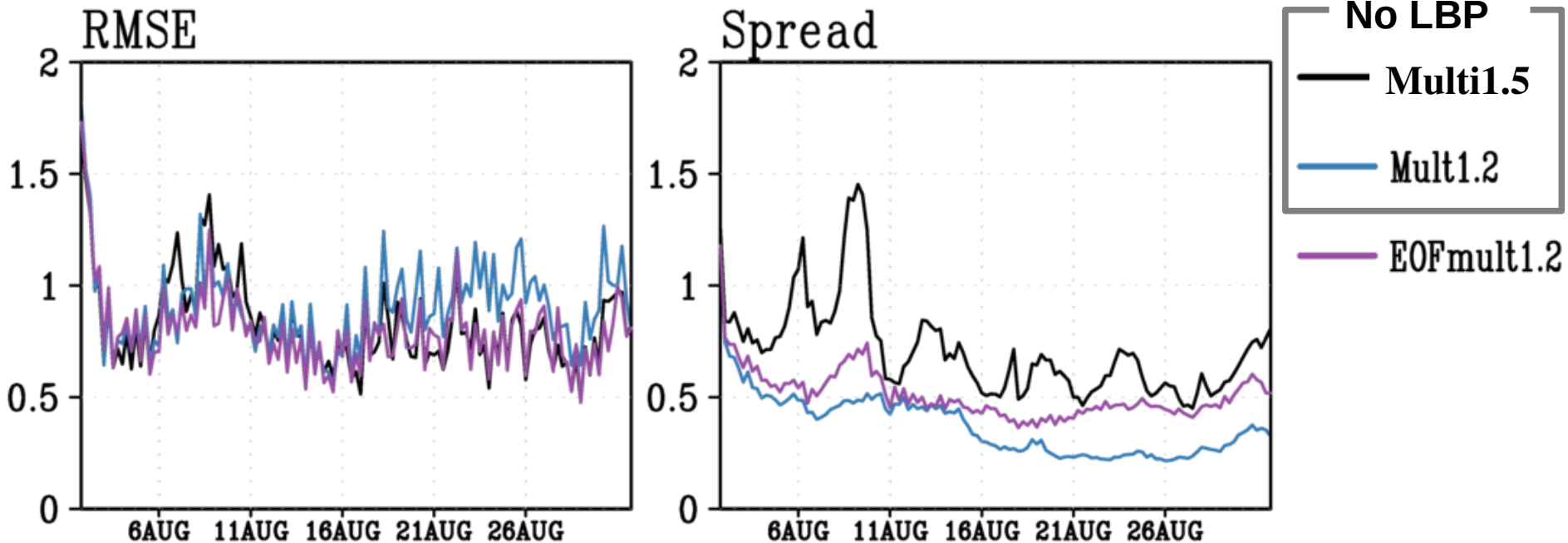
Impact of the implementation of LBP

Lateral boundary perturbation

Conduct a EOF analysis for Psea of JRA-55 (August in 1958-2014)
plus/minus 5 leading modes

The amplitude is 0.7 hPa

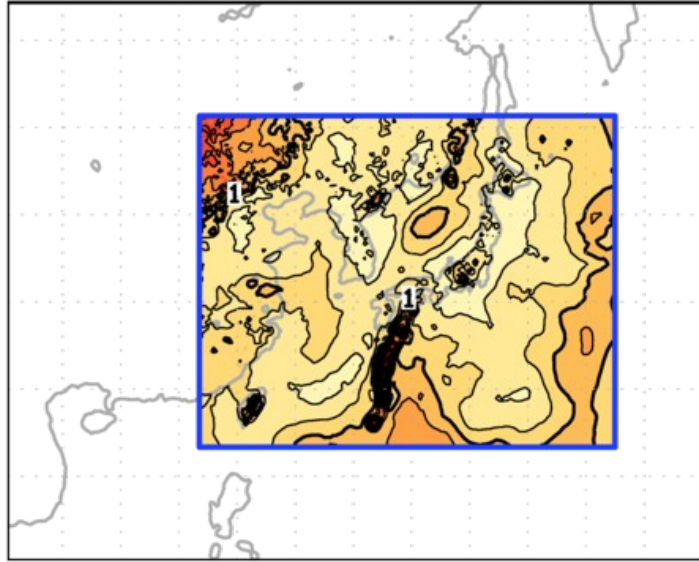
RMSE & Spread for Psea (vs MA) [MA domain]



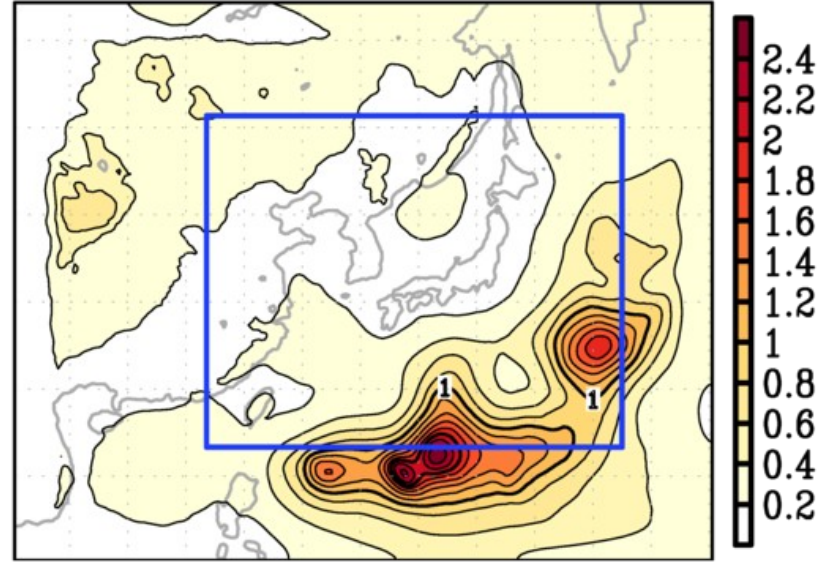
Impact of the implementation of LBP

Psea [12z06Aug-18z31Aug2014] mult1.5 noLBP FT=00h

(a) RMSEs

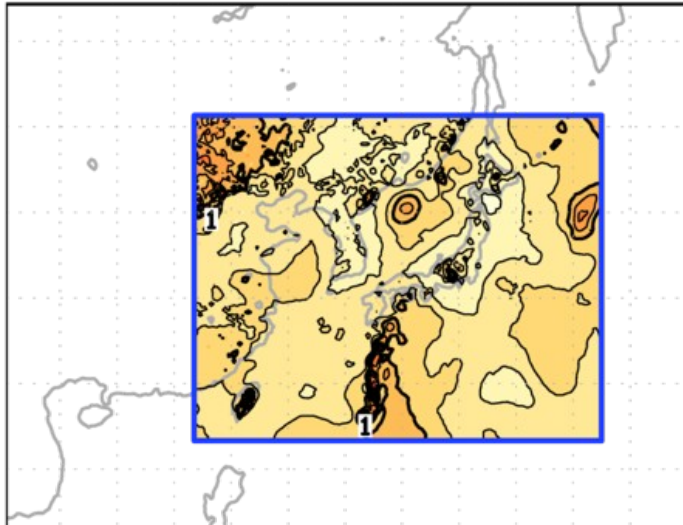


(b) Spreads

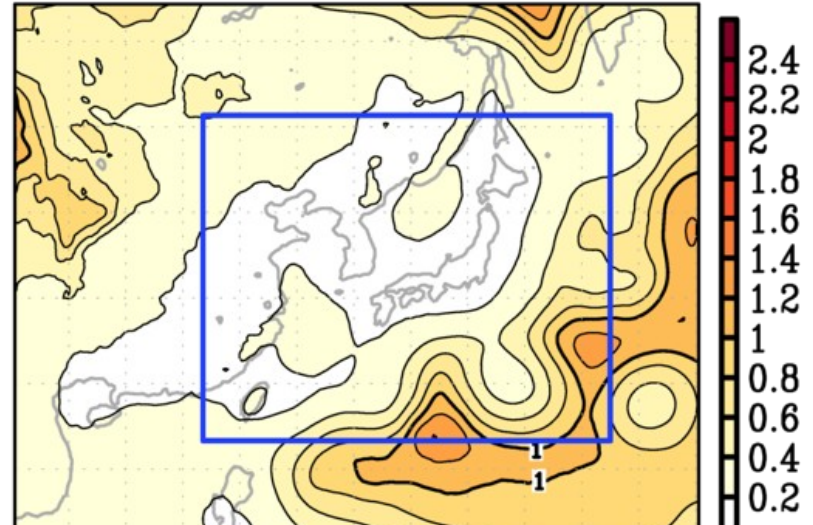


Psea [12z06Aug-18z31Aug2014] mult1.2 EOF FT=00h

(a) RMSEs



(b) Spreads



Summary

We examine the NHM-LETKF assimilating conventional observation only to assess the feasibility of the long-term consistent regional RA

- The DA has a significant improvement over the simple DS up to near 300 hPa.
- The implementation of LBPs can improve the analysis fields with smaller inflation factor.

