Assimilation of IASI radiance in the KMA convective-scale model

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1 INTRODUCTIOIN

< Supplement to humidity information in convective-scale model >

- KMA operational convective-scale model (LDAPS) has been run since 2016, which uses conventional obs., radar, and scatwind.
- To improve the humidity fields on the analysis, ground GNSS and AMSU-B have been assimilated since January 2018.
- Assimilation of IASI with high vertical resolution is expected to improve the humidity in upper troposphere.

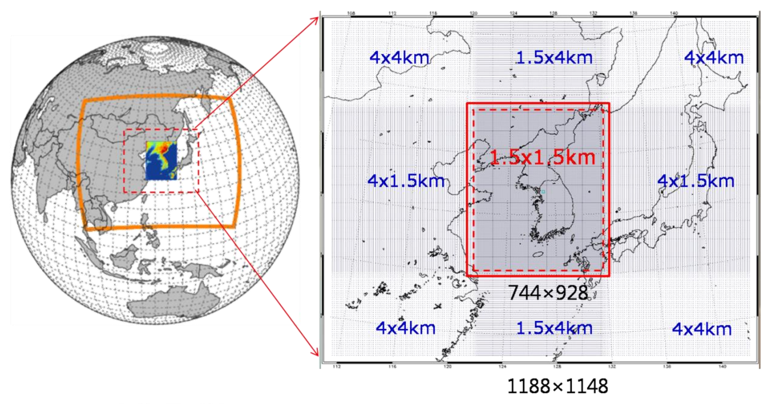
< For optimization of IASI assimilation >

- For further LDAPS performance, **OSE with two configurations** is conducted.
- **Decision on Bias correction Coefficients (BC) for LDAPS**
  - Static bias correction scheme based on Harris & Kelly (2001)
  - In previous study, bias correction for convective-scale model used BC from global model.
  - New BC are calculated from the LDAPS background during a year to consider the seasonal variation of air mass.
- **Sensitivity to thinning size**
  - The diagonal of matrix is considered as the observation error covariance matrix.
  - Thinning size is adjusted to reduce the error correlations.

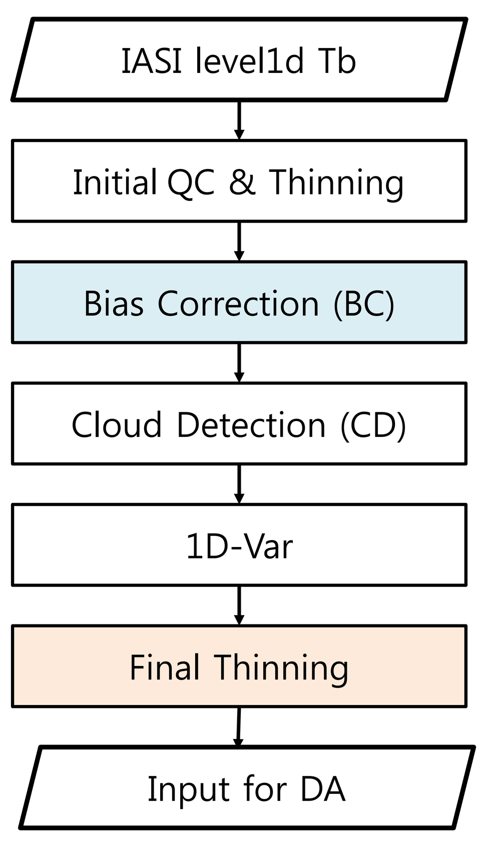
2 EXPERIMENTAL DESIGN

< Local Data Assimilation and Prediction System, LDAPS >

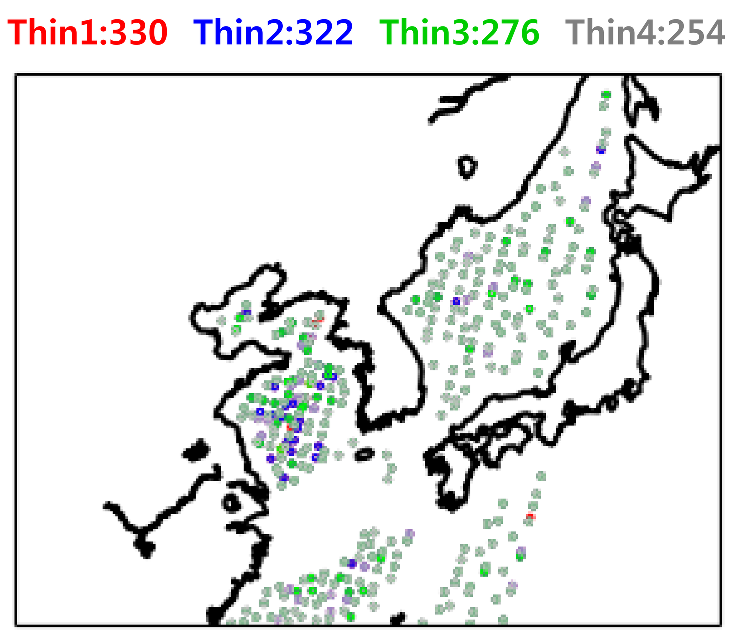
- Unified Model Vn 10.1 & ENDGame dynamic core
- Spatial resolution: 1.5 - 4 km
- Vertical resolution: L70 (~ 40 km)
- Target length: ~36 hrs/ 6 hourly cycle
- Assimilation scheme: 3D-VAR
- Operator for satellite: RTTOV-9



< IASI Observation Processing System (OPS) >



- MetOp-A/B are launched at 2006, and 2012, respectively.
- Spatial resolution: ~25 km (1FOV per 1FOR)
- Channel subsets (98) for local model (Weston, 2014)
  - T(61), Window(13), Water vapor(24)
- Observations over the sea are used.



< Flow chart for IASI OPS > < IASI data distribution at the first assimilated time>

< Experiment >

- Period
  - Cold-run: July 2016
  - Cycle-run: 29 June - 10 July 2016
  - Verification: 1 - 10 July 2016

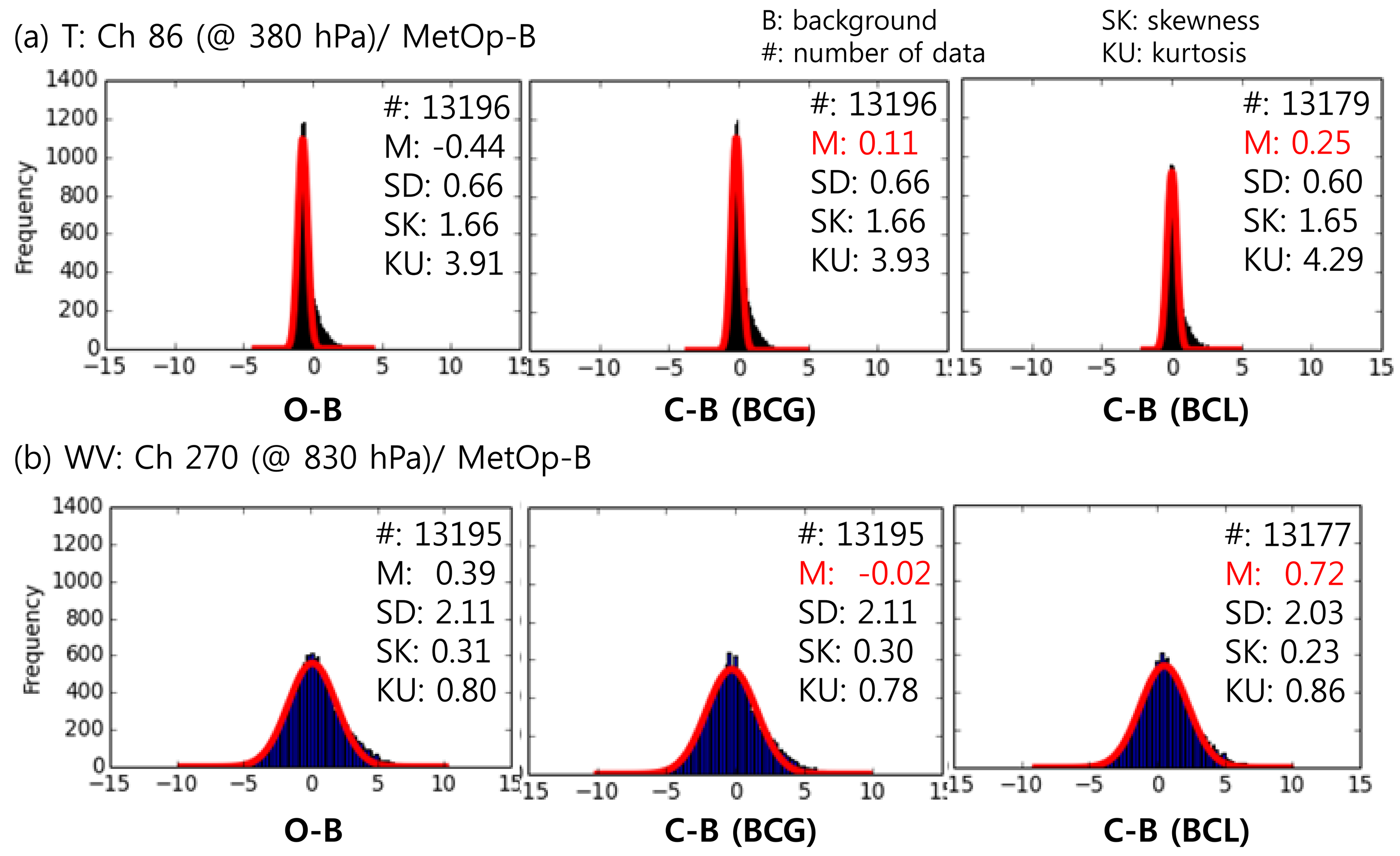
Cycle-run	Bias correction Coefficients (BC)	Thinning size	Used data
CNTL	Without IASI		Surface, Sonde, Aircraft, Radar, Scatwind
BC1	BC from global model (BCG)	90 km	Used data in CNTL + Ground GNSS, AMSU-B, IASI
BC2	BC from LDAPS (BCL)		
Thin1	BCG	No thinning	Used data in CNTL + IASI
Thin2		25 km	
Thin3		50 km	
Thin4		60 km	

3 RESULTS

< Comparison between BCG and BCL >

- The distributions of increment have positive skewness regardless of BC.
- Analysis increment using BCL is more biased than using BCG, especially on the water vapor channels.

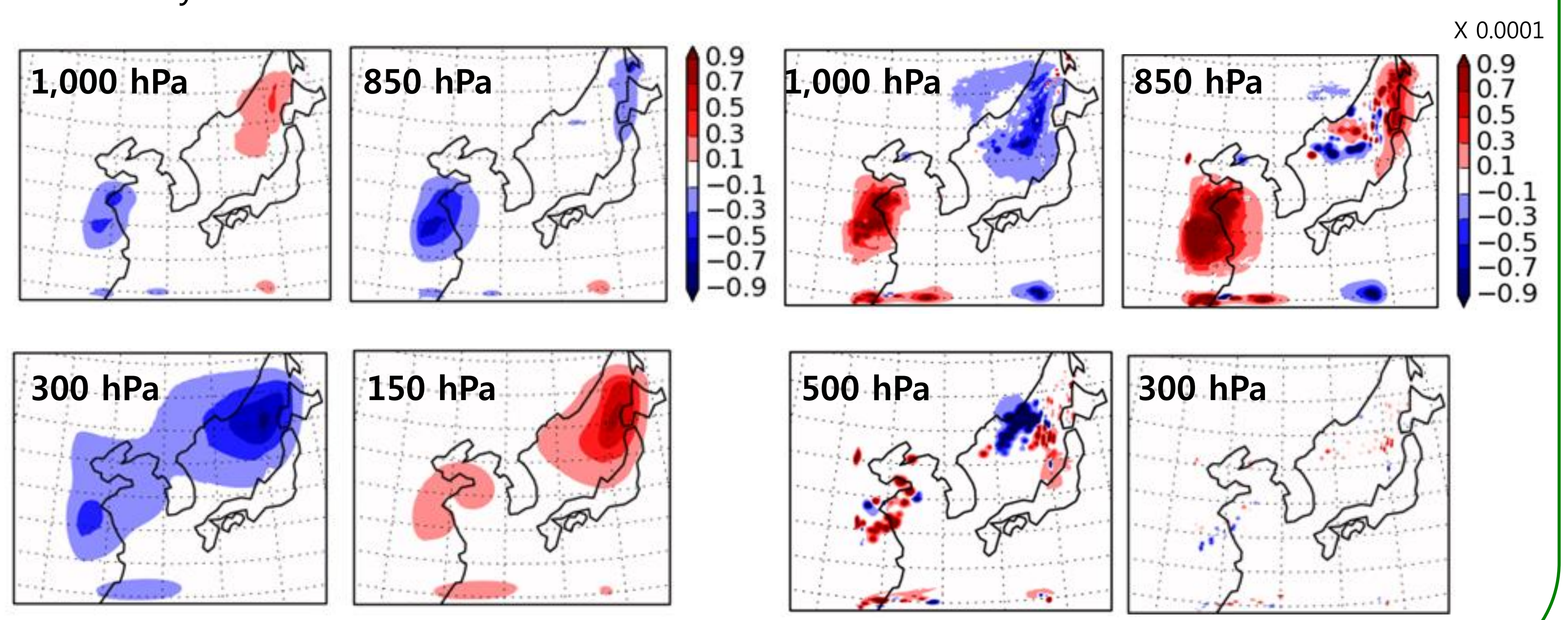
* O: observation
C: corrected observation
B: background
#: number of data
* M: mean
SD: standard deviation
SK: skewness
KU: kurtosis



< Histograms for analysis increment from cold-run >

< Difference of analysis increment (CNTL-Thin1) >

- IASI is assimilated for the first time at 29 June 2016 03 UTC.
- IASI mainly affects the potential temperature up to 100 hPa and the specific humidity under 850 hPa.

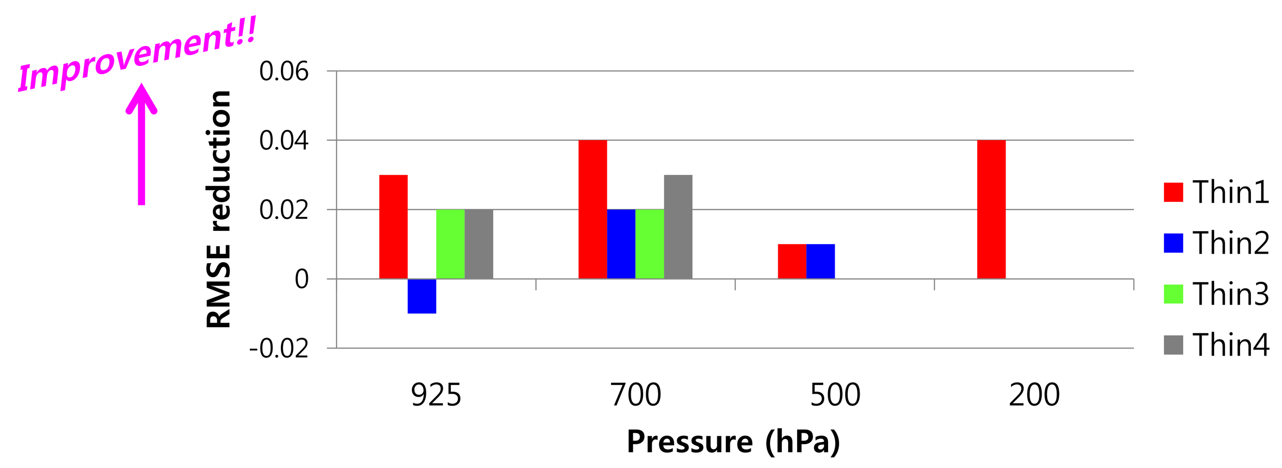


< Potential temperature fields > < Specific humidity fields >

4 VERIFICATION

< Against Sonde observation>

- IASI slightly improves GPH, T, wind, and RH forecast fields.
- Thin1 shows the best performance among the thinning experiments.

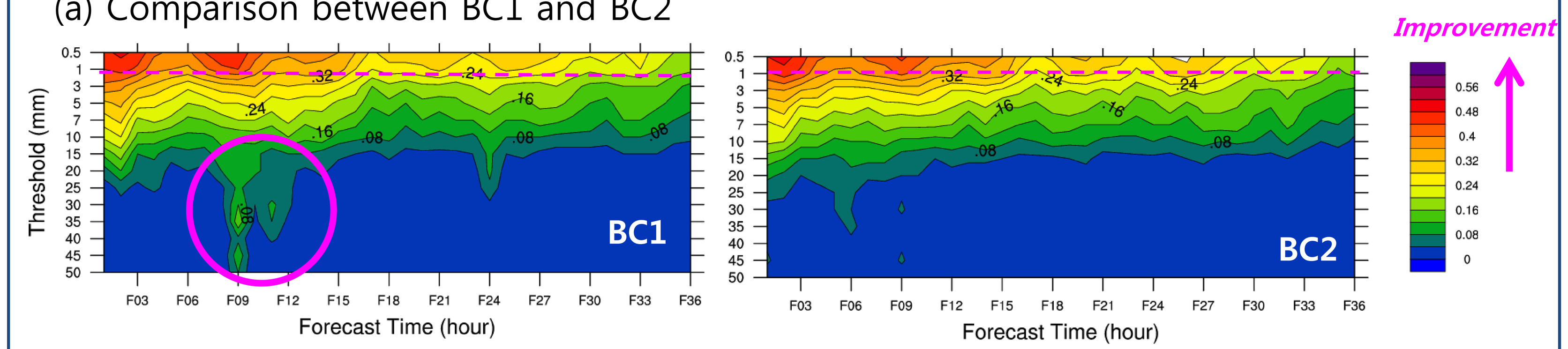


< RMSE reduction on temperature 6 hr forecast fields >

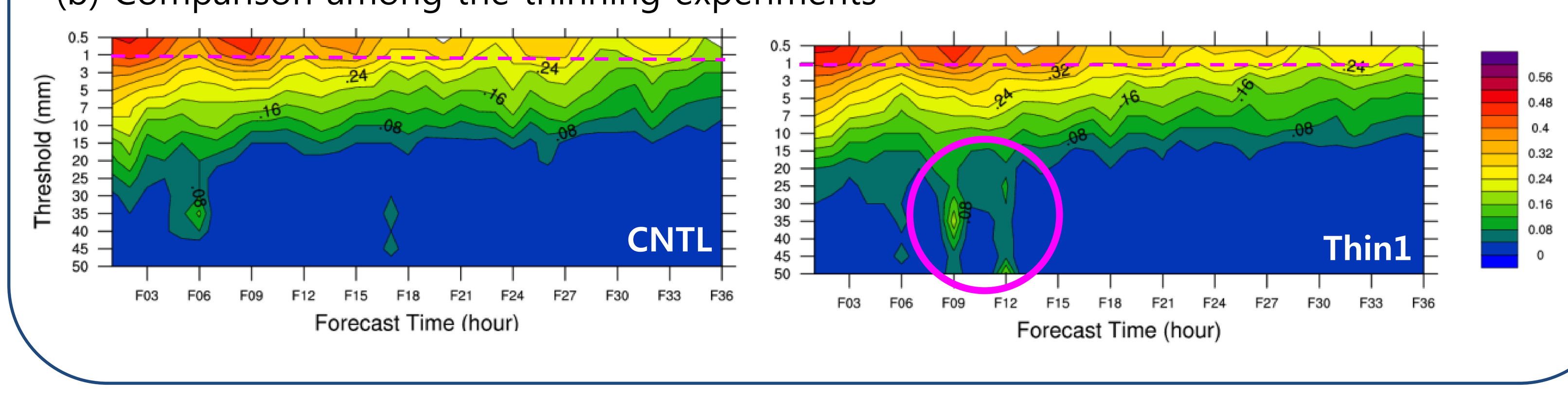
< CSI score of Precipitation >

- Score of BC1 is higher than BC2, especially on 9 hr forecast field.
- Thin1 shows the highest score among the thinning experiments (not shown), and enhanced CSI score against CNTL on rainfall over 20 mm.

(a) Comparison between BC1 and BC2



(b) Comparison among the thinning experiments



5 SUMMARY & FURTHER PLAN

- IASI observations in LDAPS showed positive impact on the analysis and the forecast fields including rainfall prediction.
- Bias correction using global information was more appropriate to correct the observations than using information from the convective-scale model (LDAPS).
- Dense data without thinning of IASI showed higher performance in LDAPS.
- The usage of all FOV is expected to lead further improvement of LDAPS performance.
- The assimilation of IASI over land considering the emissivity and the sensitivity to the observation error covariance matrix will be examined.