

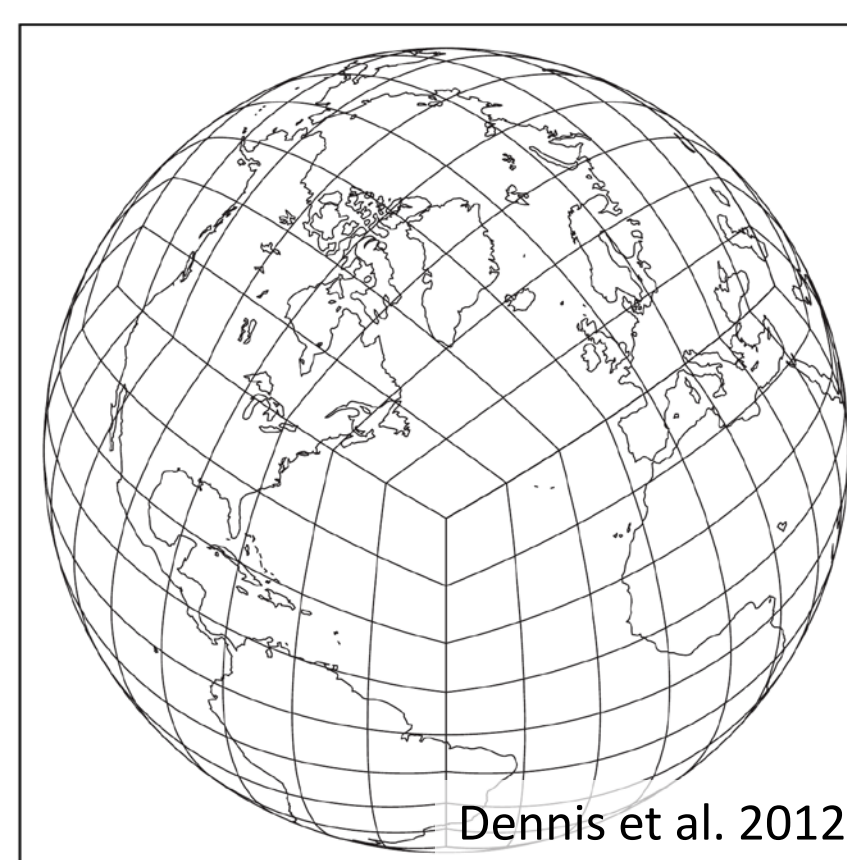
# Local Ensemble Transform Kalman Filter Data Assimilation System Implemented to a Next-Generation Global Model of KIAPS

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## Introduction

Korea Institute of Atmospheric Prediction Systems (KIAPS) has been developing a next-generation global numerical weather prediction (NWP) model as well as advanced data assimilation systems. As one of the most advanced data assimilation methods, **Local Ensemble Transform Kalman Filter** (LETKF, Hunt et al. 2007) has been developed for the KIAPS global model (hereafter referred to as **KIAPS-GM**) since January 2013. LETKF data assimilation system has been first implemented to NCAR CAM-SE (Dennis et al. 2012) model that has *fully unstructured quadrilateral meshes based on the cubed-sphere grid*, because KIAPS-GM now being developed has the same coordinate system. Therefore, our ensemble data assimilation system (**KIAPS-LETKF**) implemented to NCAR CAM-SE could be immediately used for KIAPS-GM when released. We have made several important modifications on the standard LETKF code that was originally developed by Dr. Miyoshi and has been widely used for many global and regional models.



In order to verify the current version of KIAPS-LETKF data assimilation system, we have conducted **Observing System Simulation Experiments (OSSEs)** with conventional data and AIRS retrieval data (V6 L2; Olsen et al. 2013). We have tried to do OSSEs with realistic observation distributions in time and space.

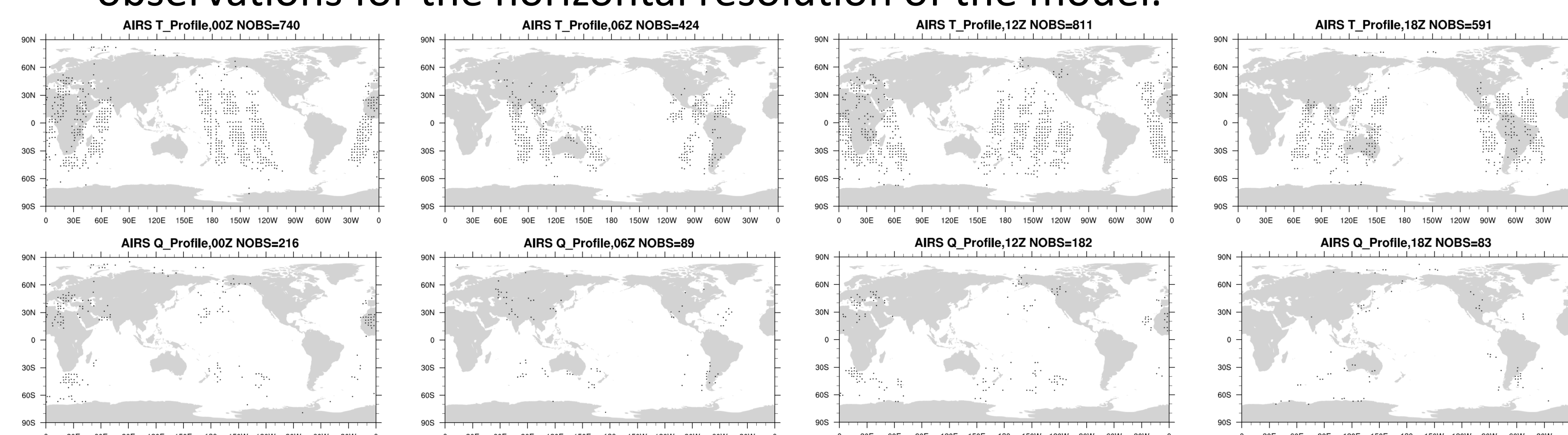
## Experimental Design

### Model: NCAR CAM-SE

- ne16np4 (~2 deg.) horizontal resolution
- 30 vertical levels with model top at 2.3 hPa
- It is coupled with land surface model, and sea-ice model for nature run, while sea-ice component is turned off for the forecast.

### Simulated observations

- Conventional data from NCEP bufr for U, V, T, q, Ps
- AIRS retrieval data of T and q profiles
  - Temporal and spatial distribution, and observation errors have followed the real data.
  - We have applied very simple thinning to have appropriate density of observations for the horizontal resolution of the model.



### LETKF Data Assimilation

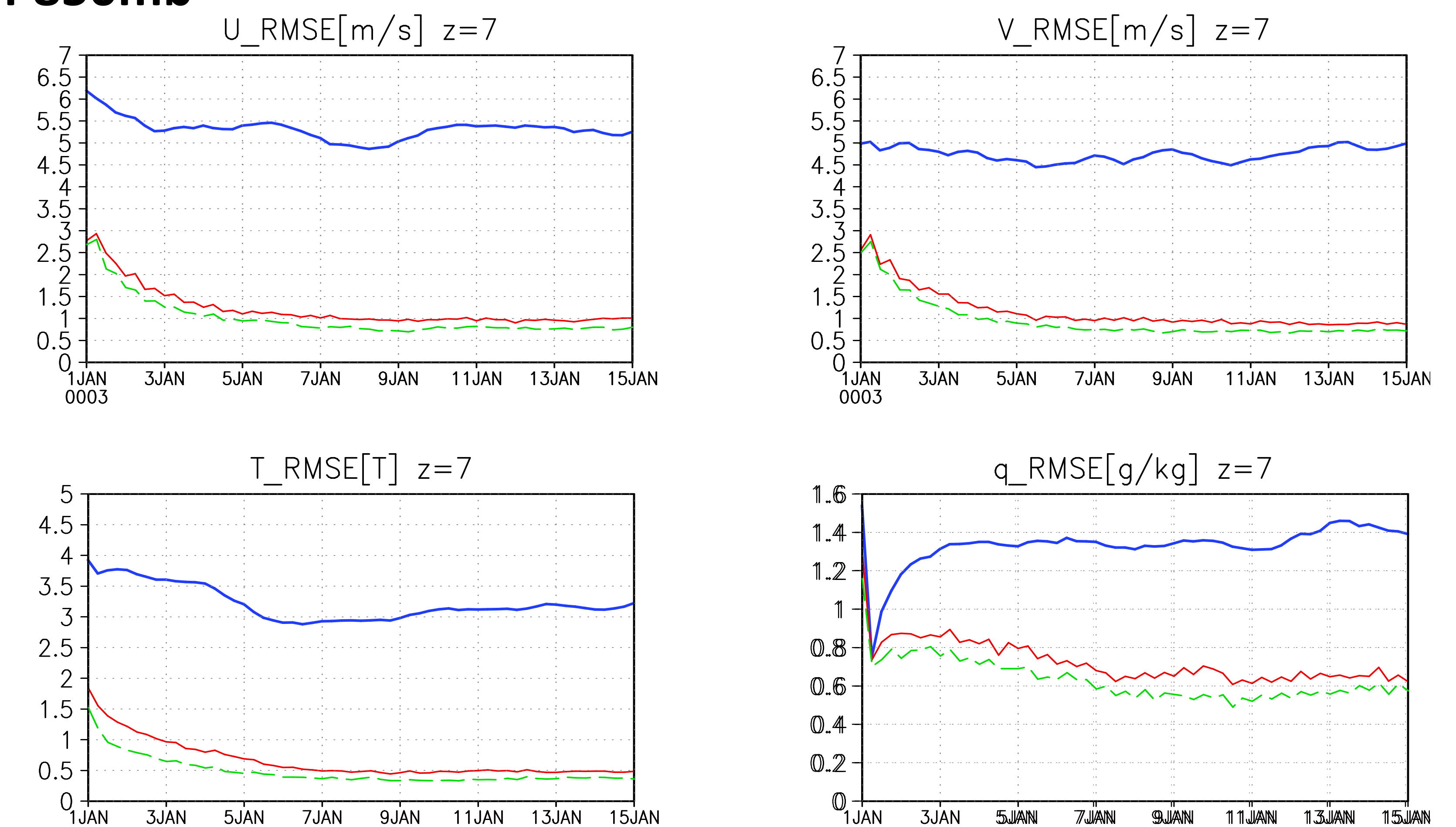
- 64 ensembles for every six hour forecast step
- Random initial condition
- Adaptive multiplicative inflation (Miyoshi, 2011) and additive inflation (Whitaker et al. 2008)

### Experiments

- No\_DA**: no data assimilation involved
- DA\_RAobs**: assimilating conventional data
- DA\_wAIRS**: assimilating AIRS retrieval T & q profile data in addition to conventional data

## Results

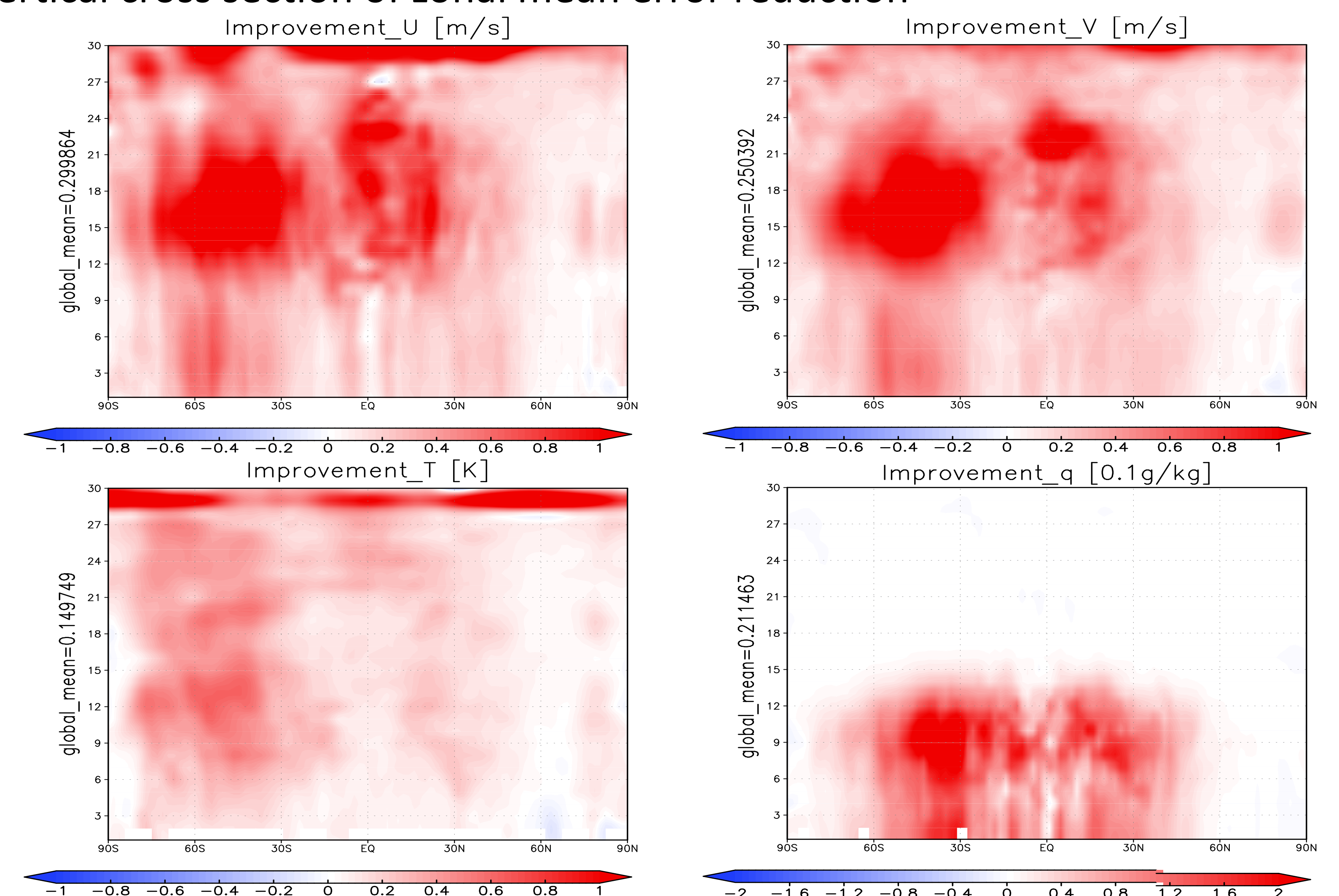
### Global RMS error of analyses from three experiments at the level of 850mb



- No\_DA** does **not** converge to the true atmosphere till the end of analysis period. Specific humidity field shows drastic convergence just after a 6-hour forecast due to correct forcing data used for forecast step. However, the errors caused by imperfect initial condition grows in time and are maintained till the end of analysis.
- DA\_RAobs** shows **significant improvement** of analysis from **No\_DA** in all prognostic variables, while an addition of AIRS retrieval data (**DA\_wAIRS**) further improves the results overall.

### Analysis error reduction of DA\_wAIRS from DA\_RAobs:

vertical cross section of zonal mean error reduction



- Positive values indicate that **DA\_wAIRS** outperforms **DA\_RAobs**.
- Improvement caused by adding AIRS data appears mainly over Southern hemisphere and mid-troposphere where there are not many radiosonde data.

## Summary and Plan

We have implemented LETKF data assimilation system to NCAR CAM-SE model that has the same coordinate system as KIAPS-GM now being developed. KIAPS-LETKF data assimilation system has been examined under OSSEs, and it shows very promising results. Now, we are working on assimilating GPS RO data within KIAPS-LETKF, and plan to assimilate radiance data of AMSU-A and IASI. In the meantime, real observation data will be assimilated within KIAPS-LETKF in the near future

## References

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