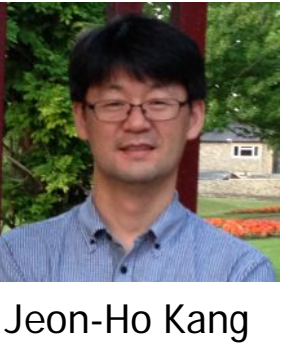


Introduction

The Korea Institute of Atmospheric Prediction Systems (KIAPS) data assimilation team has been developing the Observation Processing System to provide optimal observations to the data assimilation system. Most meteorological observations contain errors and those errors varies depending on the type of observation. Observation Processing System has a critical role which figures out the observation errors and corrects or filters out raw data bias.

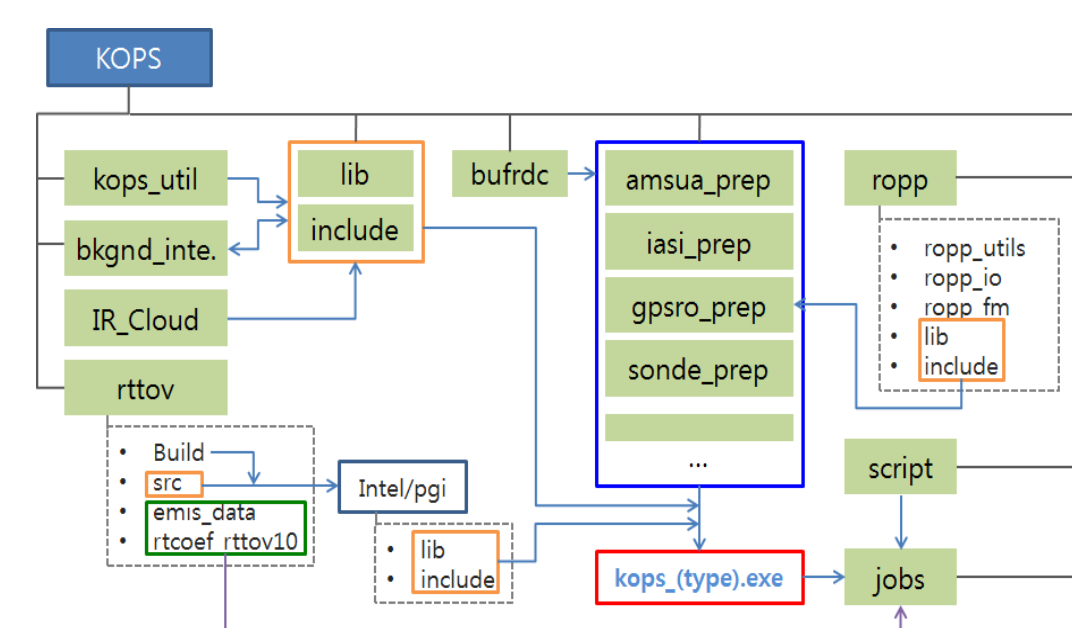
We have a question such that if the NWP model performance is not good enough and also we don't know the true state of the atmosphere, then what is the best way of the observation data processing system for the successful data assimilation. We used the UM outputs which are operationally forecasted by the Korea Meteorological Administration (KMA) as background data for the BC and QC of the satellite based observations. And as a first stage of study for the question, three types of vertical interpolation methods are applied on background field ingest process. In this study, we examined the status of the background fields and departure (O-B) characteristics of AMSU-A, IASI, and GPS-RO data according to the vertical interpolation method.



Data and methods

KIAPS Observation data Processing System

- construction of directory structure according to the function/observation types
- applied package: RTTOV_v10, ROPP, BUFRDC, IR Cloud screening (ECMWF)
- shell scripts for the task management



Background ingest process on KIAPS Observation data Processing System

- using NetCDF type background converted from UM forecast (KMA, pp type)
- interpolate forecast variables from model grid to the observation space
 - H : bi-linear interpolation
 - V : weighting interpolation using geopotential height or logarithmic pressure (calculate geopotential height at each level)
- variable transform and calculation of the 2nd (additional) variables
 - e.g.: RH → Q / θ → T / ...

Vertical interpolation methods

- A. arithmetic mean

$$\Pi_{\theta} = \frac{\Pi_{\theta-\frac{1}{2}} + \Pi_{\theta+\frac{1}{2}}}{2} = 0.5(\Pi_{\rho} + \Pi_{\rho+1}) \quad (T1)$$
- B. weighted average using logarithmic scaled pressure

$$\Pi_{\theta} = \frac{\Pi_{\rho+\frac{1}{2}} - \Pi_{\rho-\frac{1}{2}}}{k(\ln P_{\rho+\frac{1}{2}} - \ln P_{\rho-\frac{1}{2}})} = \frac{\Delta \Pi_{\rho}}{k \Delta (\ln P)_{\rho}} \quad (T2)$$
- C. linear weighted average using geopotential height Z_k (Z_k calculation is applicable only for the lowest 50th levels from the surface) $< 50^{th} level : Z_k = Z_k + h \left(1 - \frac{\eta_k}{\eta_{p50}}\right)^2$

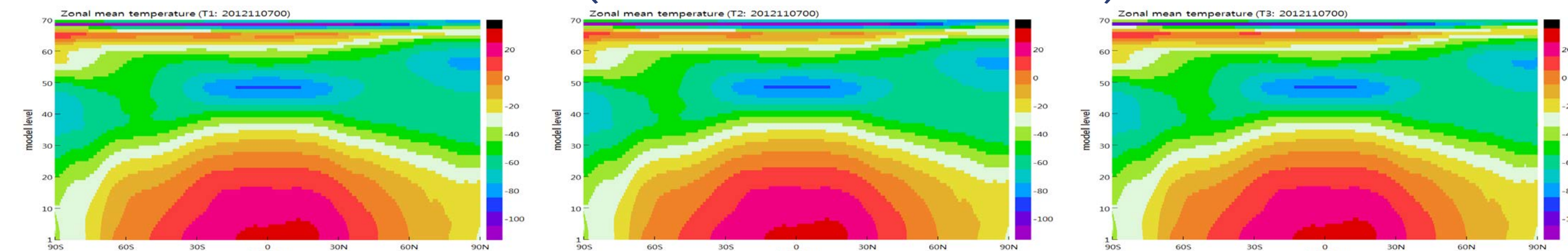
$$\Pi_{\theta} = \beta \Pi_{\rho_i} + (1 - \beta) \Pi_{\rho_{i+1}} \quad (T3)$$

$$\beta = \frac{Z_{\rho_{i+1}} - Z_{\theta}}{Z_{\rho_{i+1}} - Z_{\rho_i}}$$

Comparison of background fields

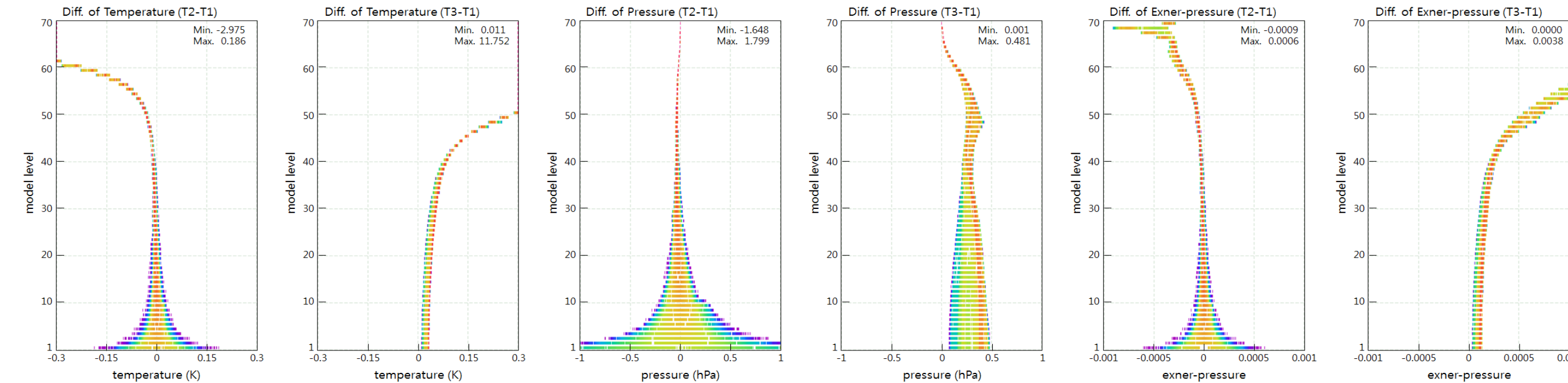
Zonal averaged temperature at model levels

- Case: 00UTC 7. Nov. 2012 (2012110618 +9Hr forecast)



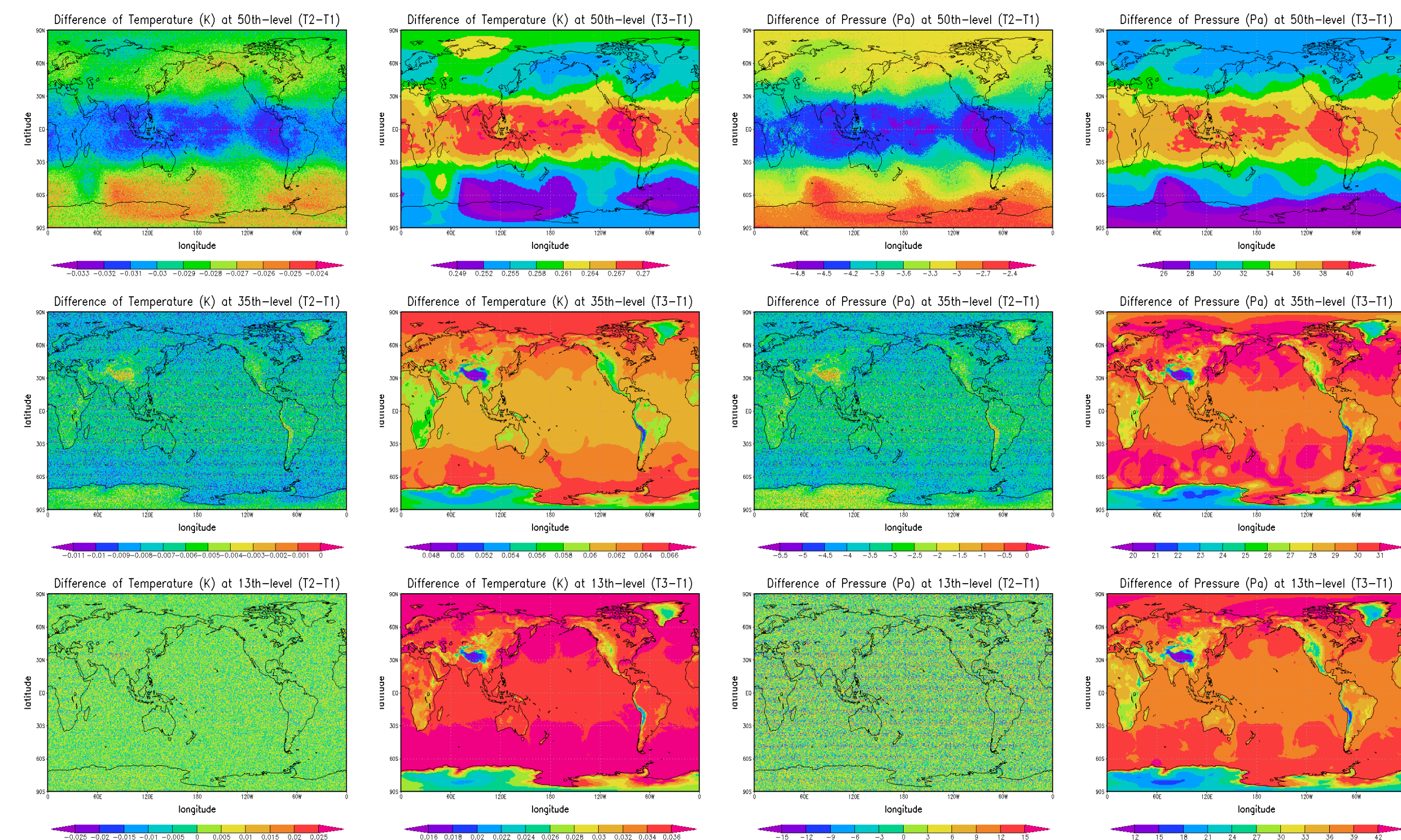
Histogram analysis (T, P, and Exner-P)

- difference of T2 and T3 from T1 at each level



Spatial distribution of difference (Temp. and Pressure)

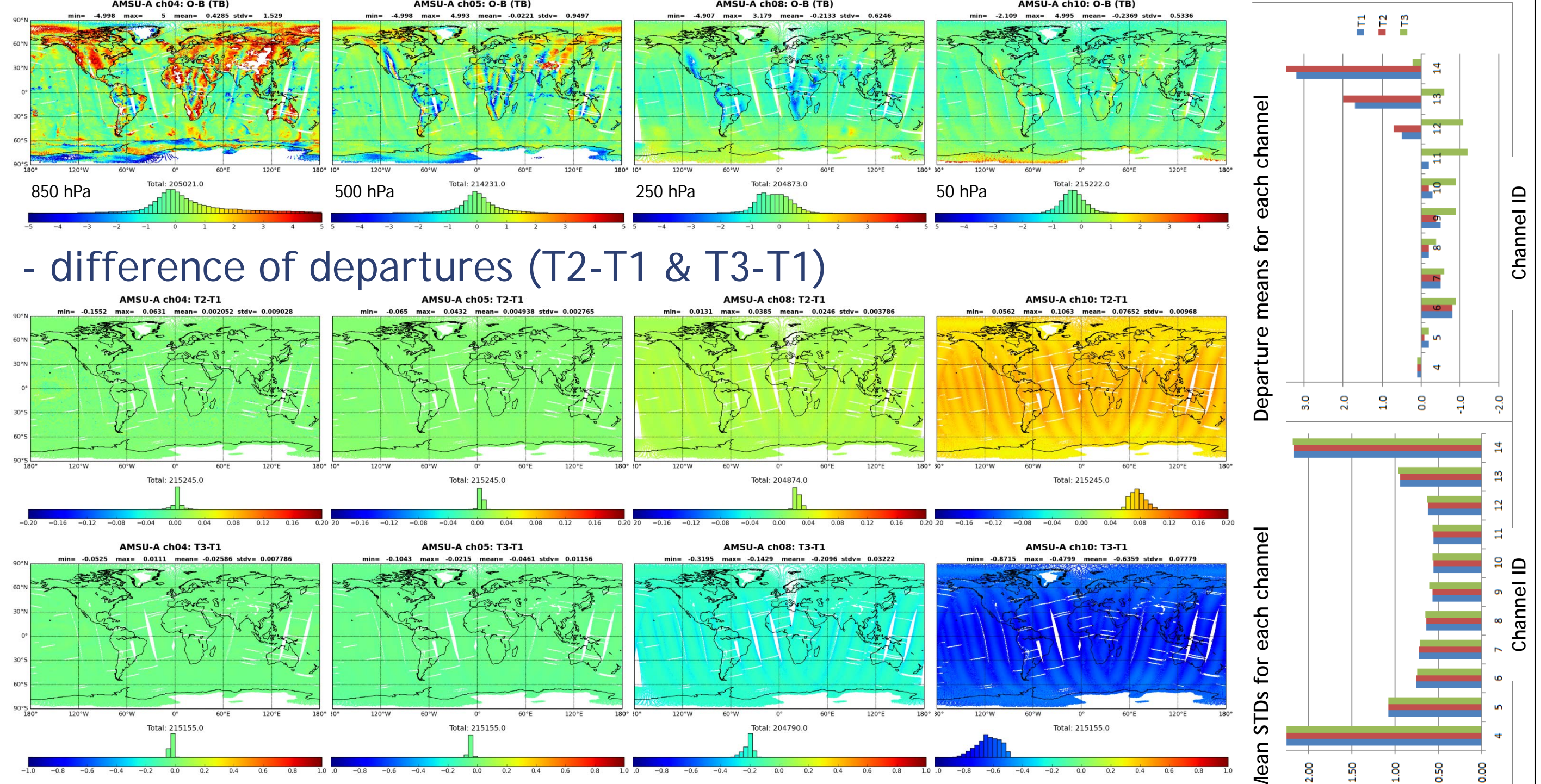
- difference of T2 and T3 from T1 at 13th, 30th, and 50th level



Preliminary results

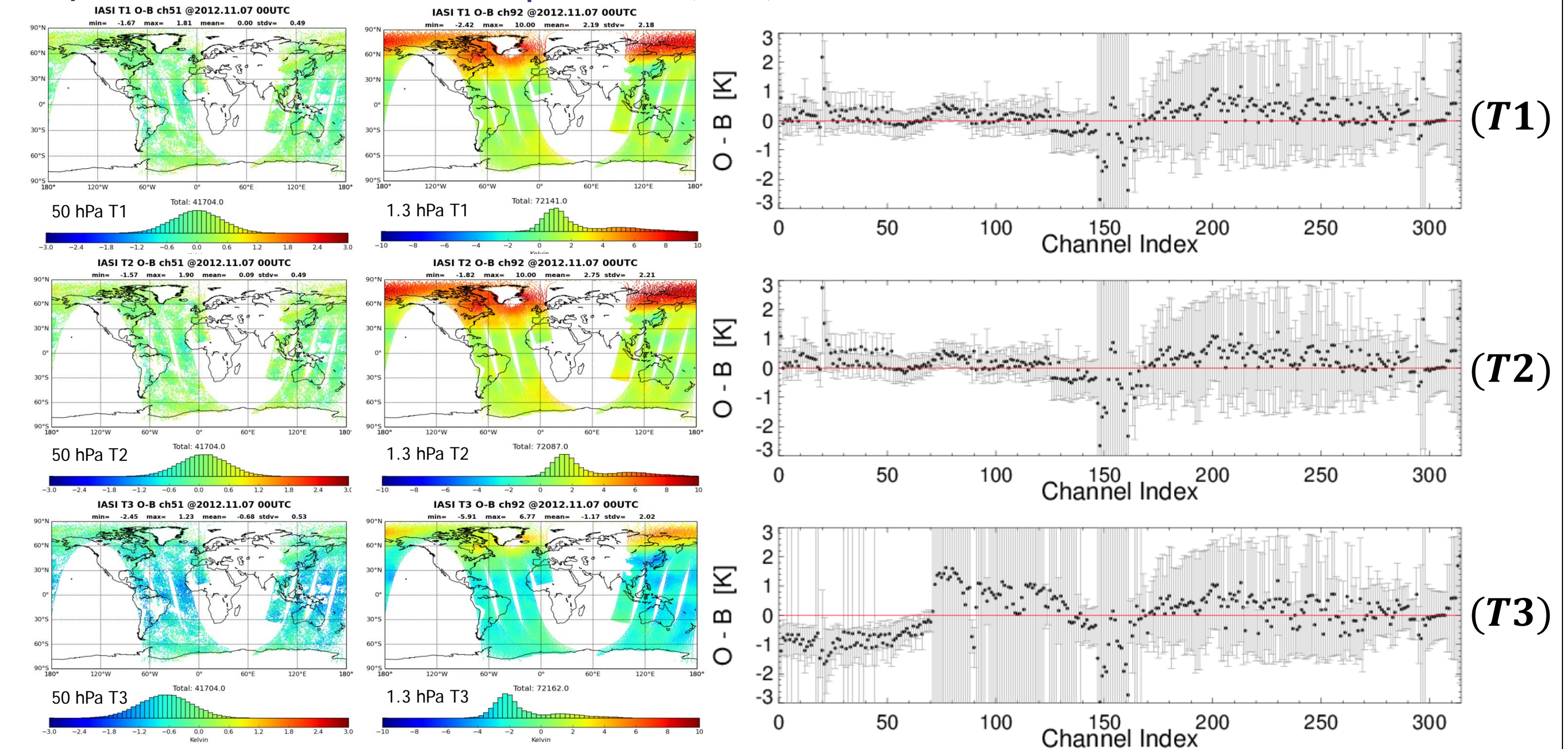
AMSU-A

- spatial distribution of departure (O-B) from T1 method



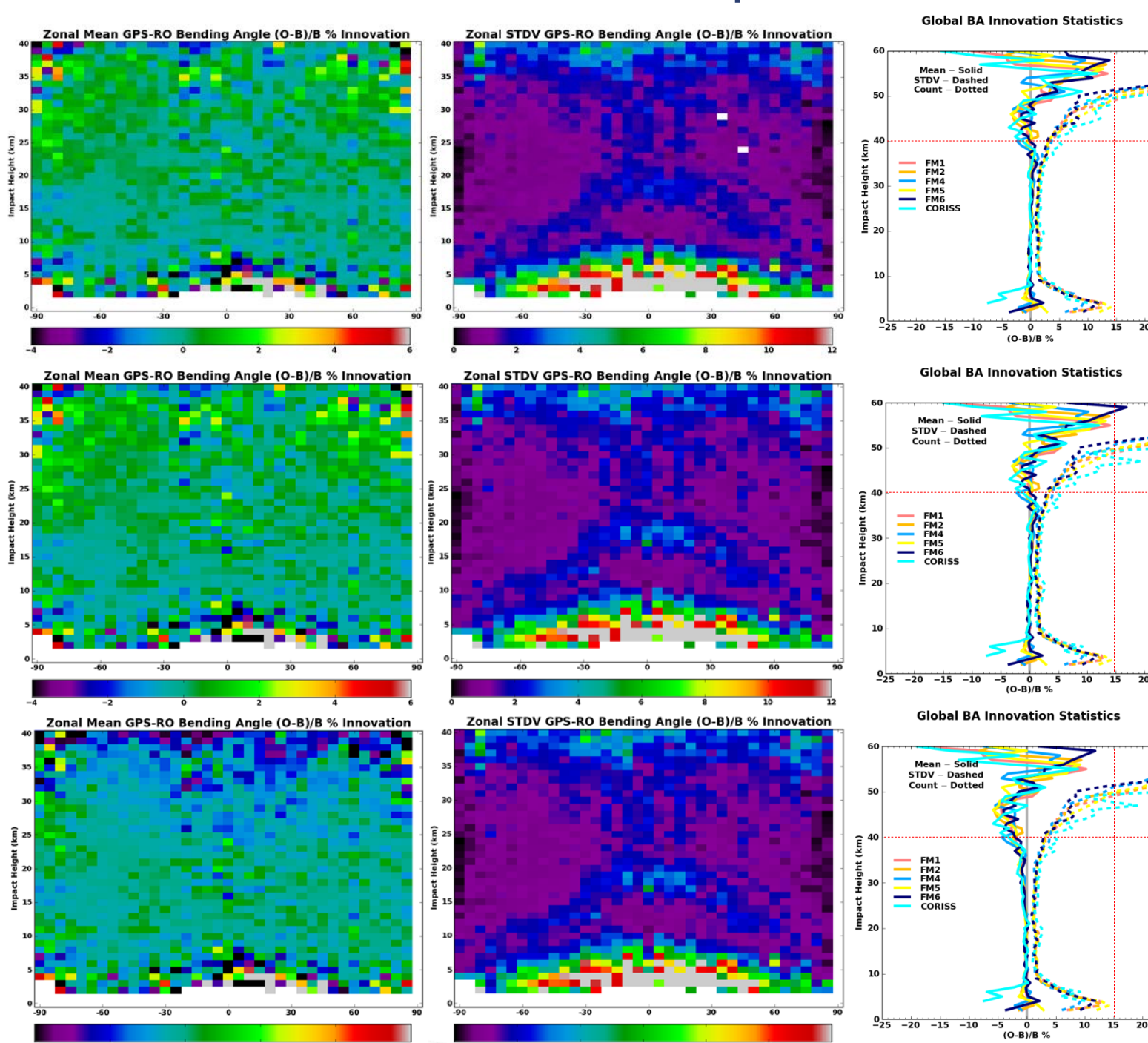
IASI

- spatial distribution of departure (O-B) at 50hPa, 1.3hPa and IASI totals



GPS-RO

- zonal mean GPS-RO BA departures



Totals		(D: difference from T1)		
		T1	T2	T3
Background Temp. (C)	Min	-118.336	-2.975 (D)	0.011 (D)
	Max	36.763	0.186 (D)	11.752 (D)
Background Pressure (hPa)	Min	0.004	-1.648 (D)	0.001 (D)
	Max	1039.459	1.799 (D)	0.481 (D)
AMSU-A O-B 850hPa	Mean	0.429	0.430	0.406
	STD	1.529	1.529	1.533
O-B 200hPa	Mean	-0.213	-0.189	-0.423
	STD	0.625	0.624	0.628
O-B 50hPa	Mean	-0.237	-0.161	-0.873
	STD	0.534	0.531	0.549
IASI O-B 50hPa	Mean	0.00	0.09	-0.68
	STD	0.49	0.49	0.53
O-B 1.3hPa	Mean	2.19	2.75	-1.17
	STD	2.18	2.21	2.02
GPS-RO O-B				

Summary and discussion

- KMA operational UM forecast data are used as a background field for the BC and QC of satellite observations.
- Three types of vertical interpolation methods are applied to investigate the effect of background pressure level assignment on the AMSU-A, IASI, and GPSRO data. The background T, P profiles and departures of observations shows larger differences with increasing altitude.
- More investigations via data assimilation, forecast, and FSO should be made to find out a best interpolation method.
- The departures using a new approach showed as consecutively smaller than those from exactly correct model state.