Vertical localization of non-local observations

- Some observations are non-local, but the impact in the LETKF analysis is limited to a certain range by localization
- Examples: satellite radiances, VIS / cloud observations, PS
- KENDA:

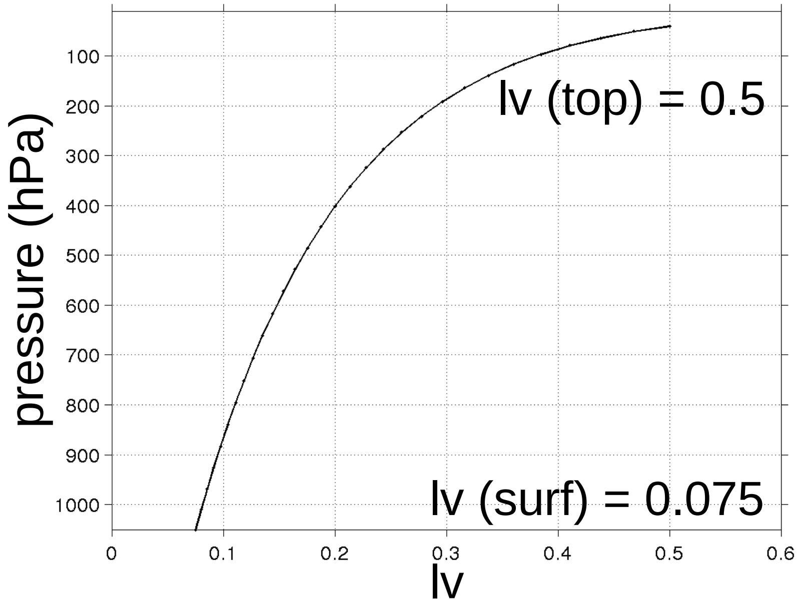
  linearly varying localization

  from the surface to the top

  -> observations near the

  surface are localized more

  than upper air observations

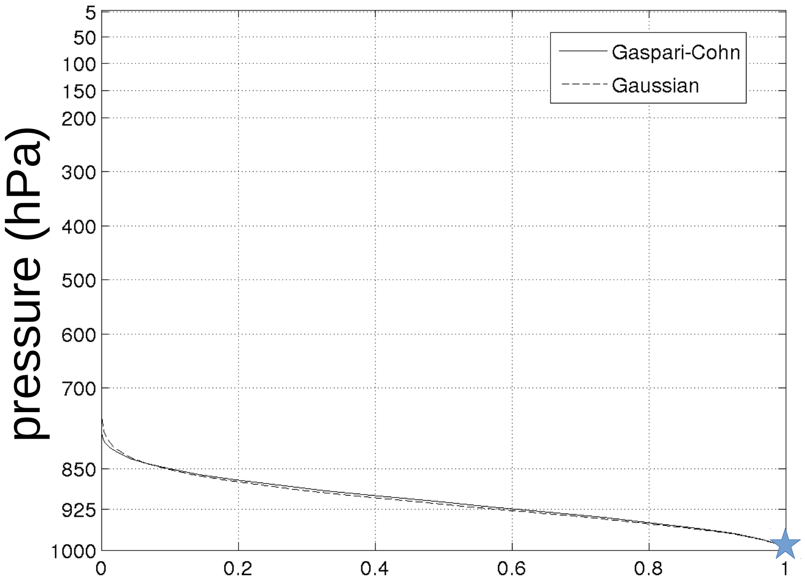


Vertical localization of surface pressure

- KENDA: vert. localization

  lv = 0.075 for all surface obs

  (here at 1000 hPa ★)



- Recent studies suggest that the vertical localization for surface pressure observations should be rather broad

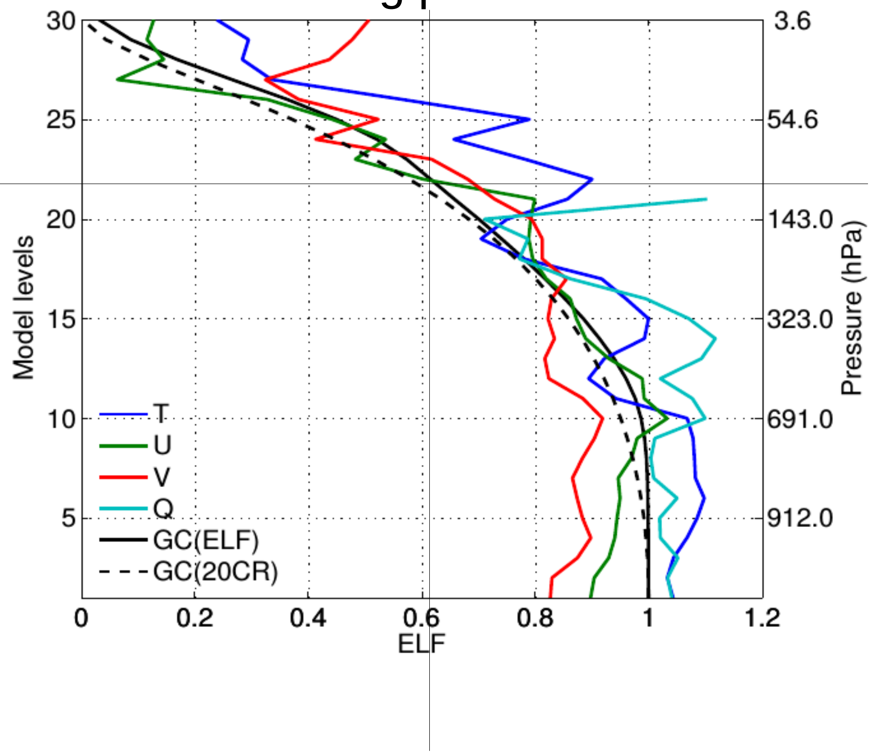
  e.g. Madaus et al. 2013 (localization radius 14 km);

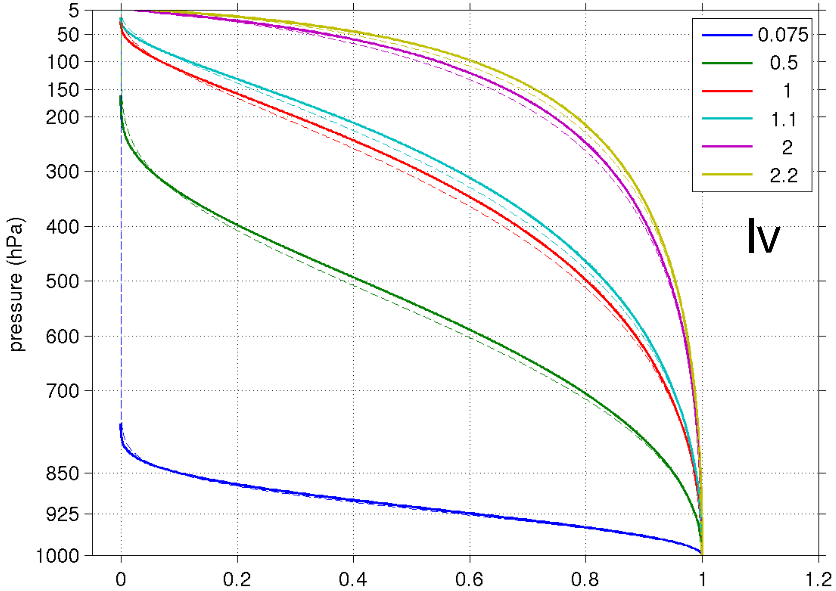
  Compo et al. 2011 (localization of 4 scale heights)

  Lei and Anderson, 2014 (halfwidth 4 log p units)

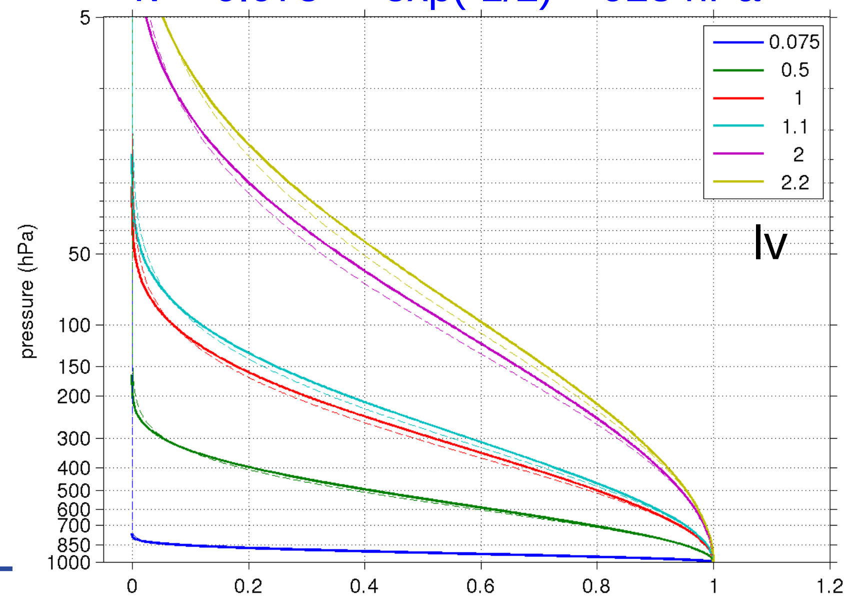
Vertical localization of surface pressure

Compo et al (2011):
4 scale heights
Lei and Anderson (2014):
halfwidth 4 log p units





lv = 2 -> exp(-1/2) ~ 135 hPa
lv = 1 -> exp(-1/2) ~ 368 hPa
lv = 0.075 -> exp(-1/2) ~ 928 hPa



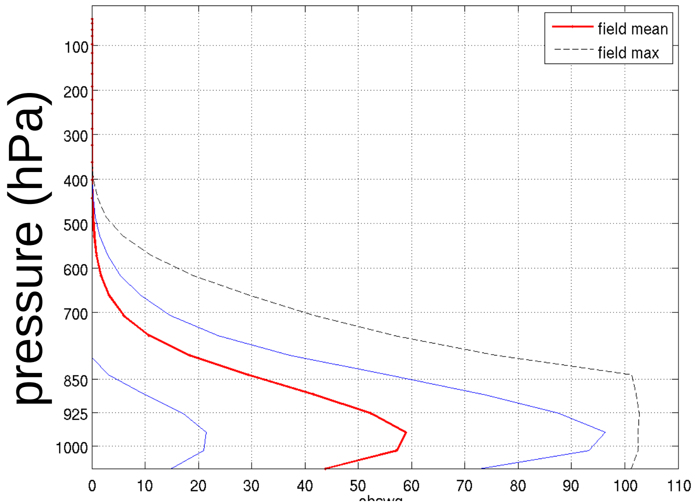
solid = Gaspari-Cohn
dashed = Gaussian

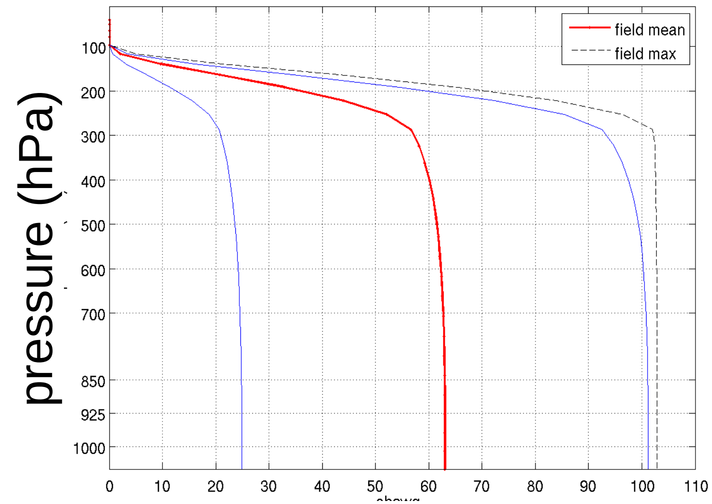
KENDA experiments: SYNOP PS only

exprtpsPSd: lv = (0.075, 0.5)

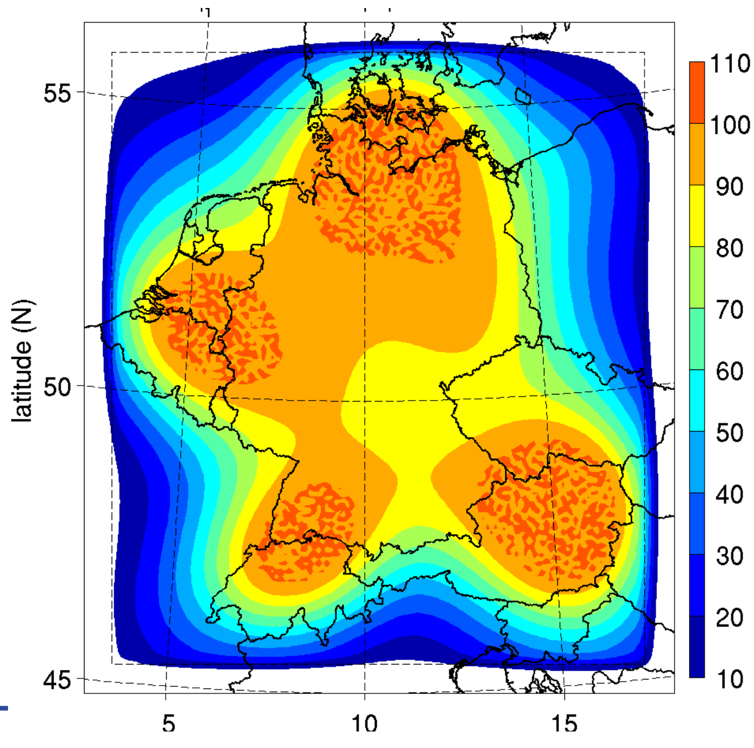
exprtpsPS: lv = (2.0, 2.0)

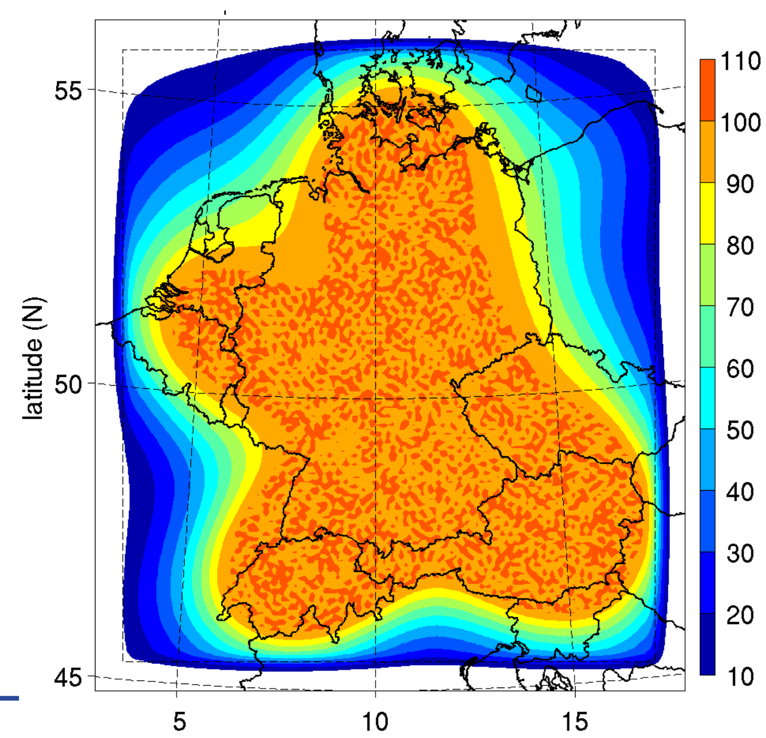
Sum of obs weights (with adap. lh): mean / max /min in the domain





Sum of obs weights (with adap. lh): at about 1000 hPa

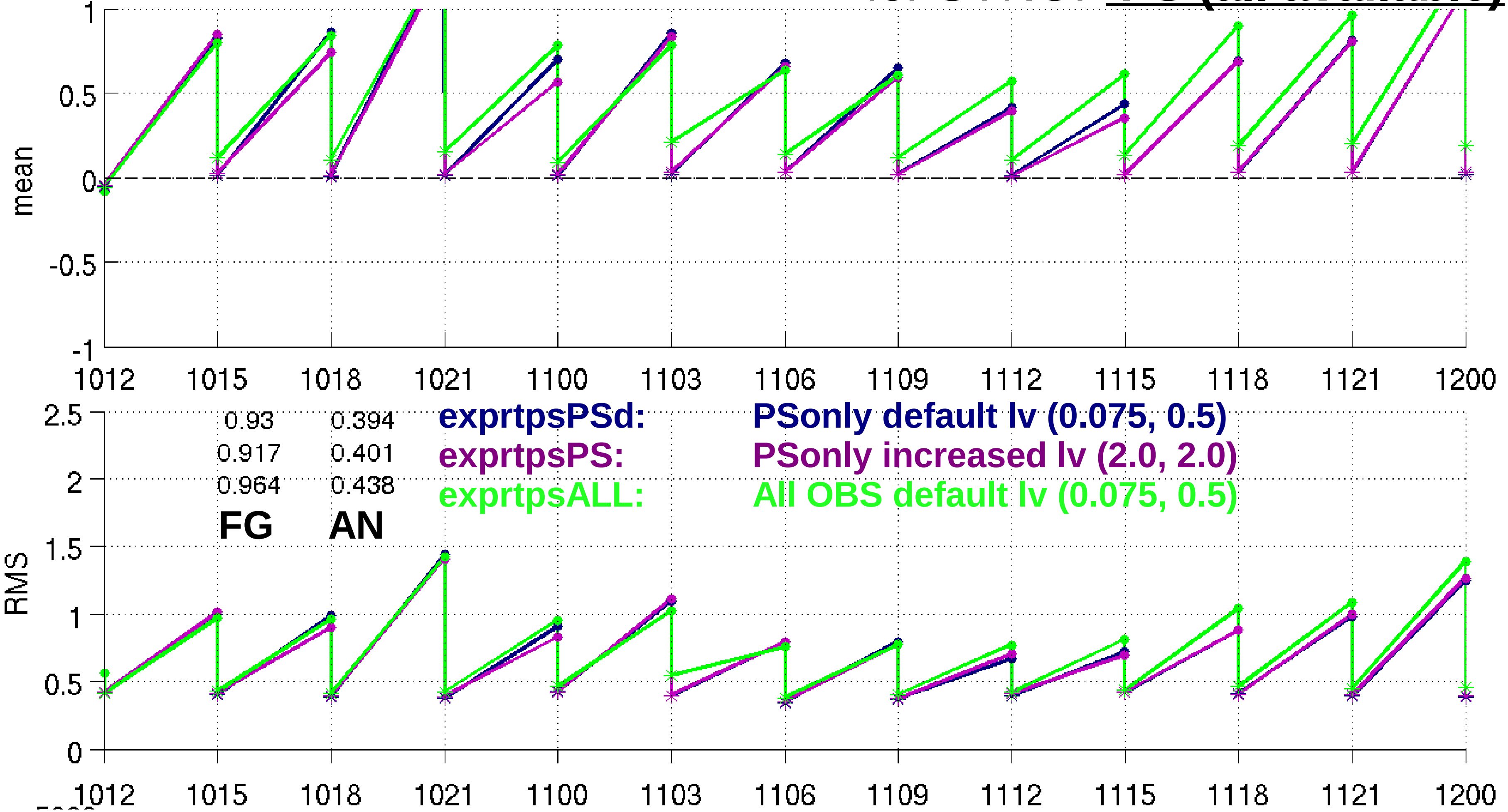




KENDA experiments: SYNOP PS

Mean / RMS of observation departures y - H(x)

for SYNOP **PS (all available)**



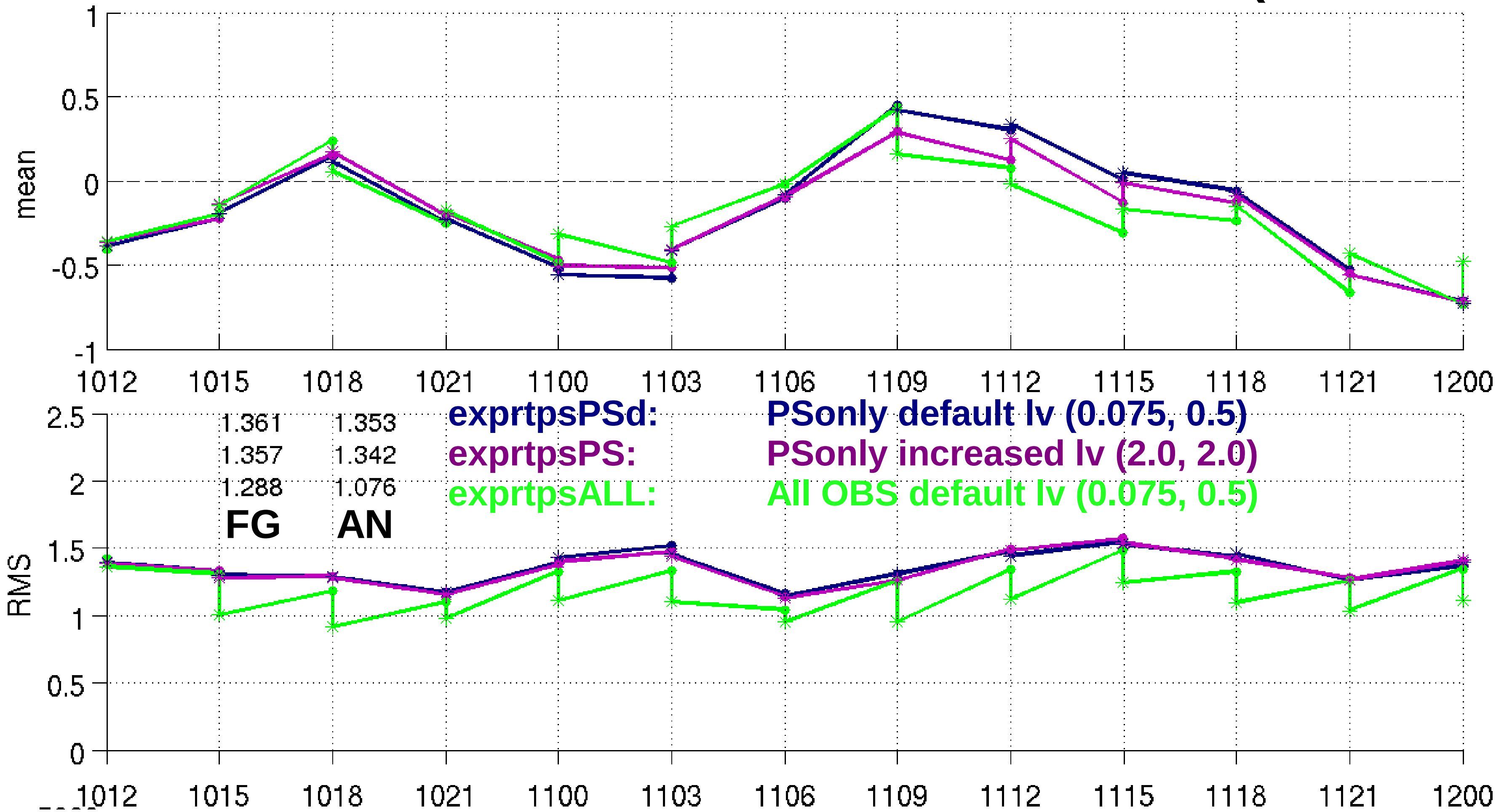
day / time (UTC) June 2011

horizontal localization set to 100 km, adaptive scheme = .TRUE.

KENDA experiments: SYNOP PS

Mean / RMS of observation departures y - H(x)

for SYNOP T**<u>2M (all available)</u>**



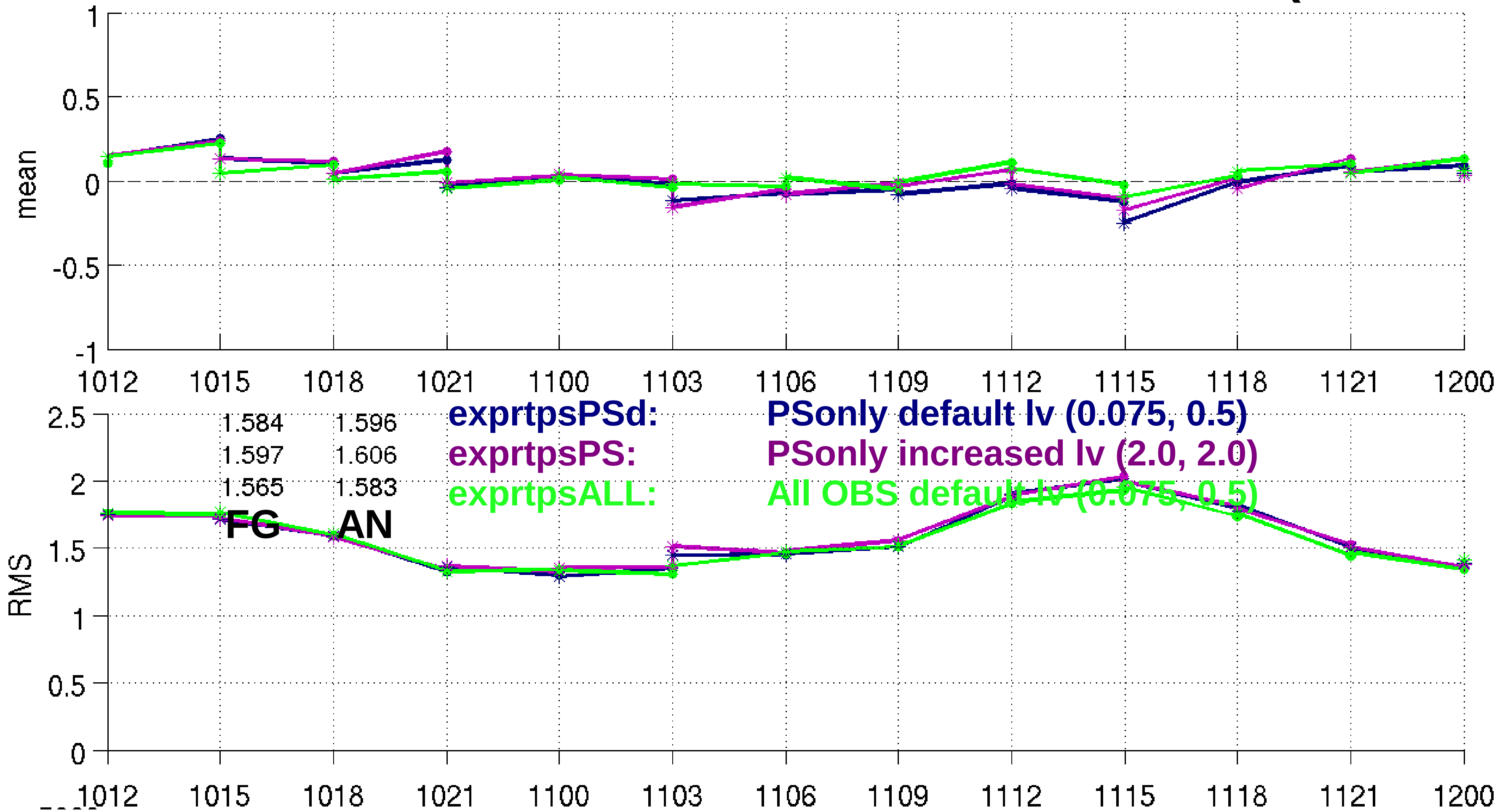
day / time (UTC) June 2011

horizontal localization set to 100 km, adaptive scheme = .TRUE.

KENDA experiments: SYNOP PS

Mean / RMS of observation departures y - H(x)

for SYNOP **U10M (all available)**

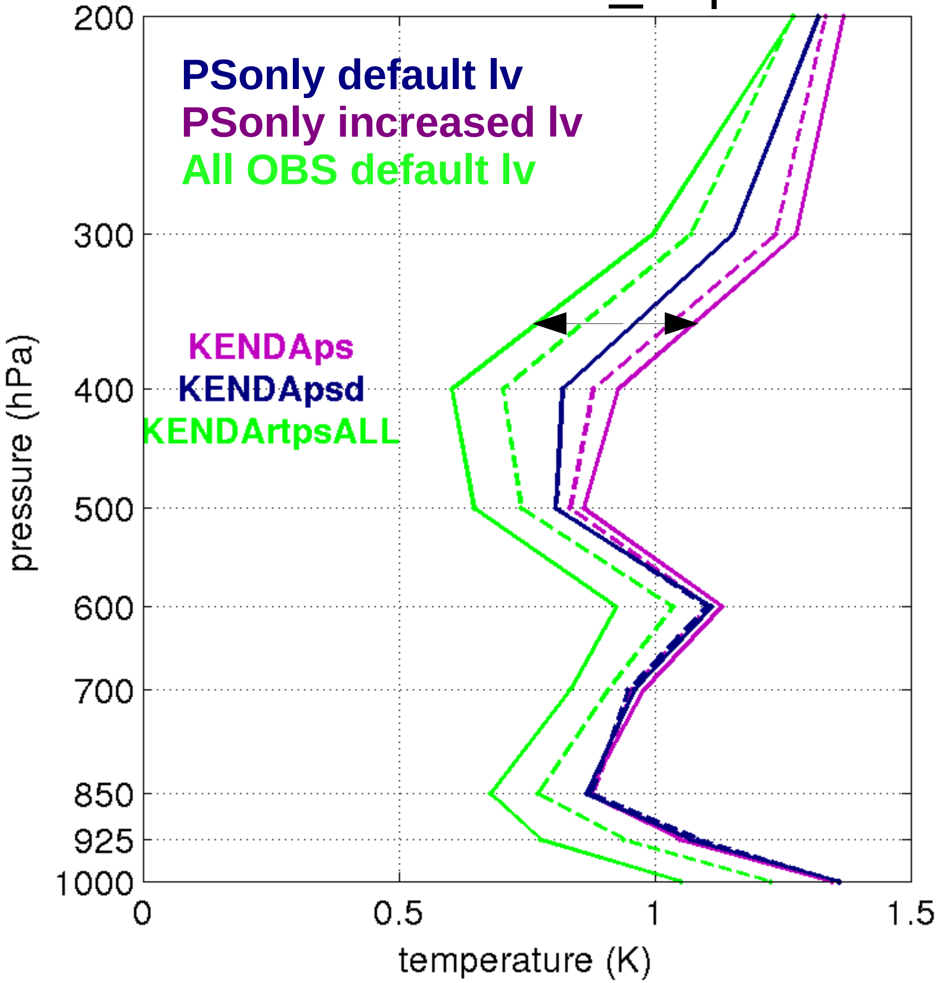


day / time (UTC) June 2011

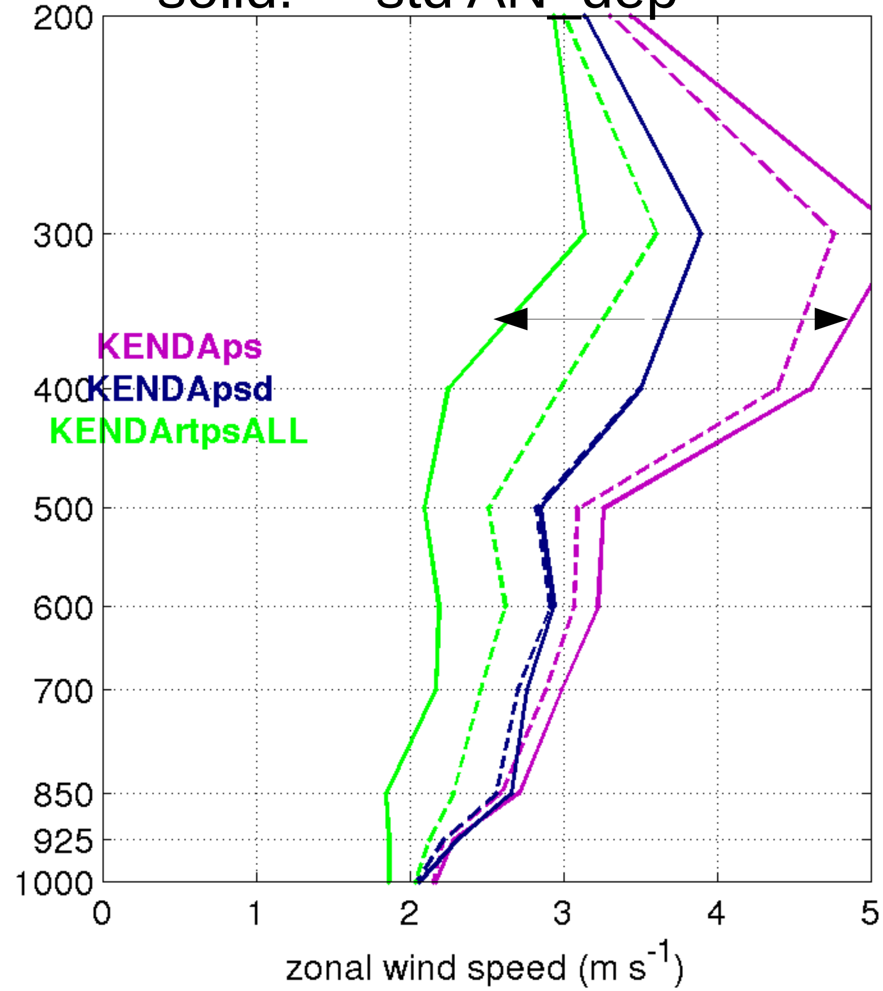
horizontal localization set to 100 km, adaptive scheme = .TRUE.

Verification against upper-air obs

<u>AIREP temperature</u>
dashed: std FG_dep
solid: std AN_dep



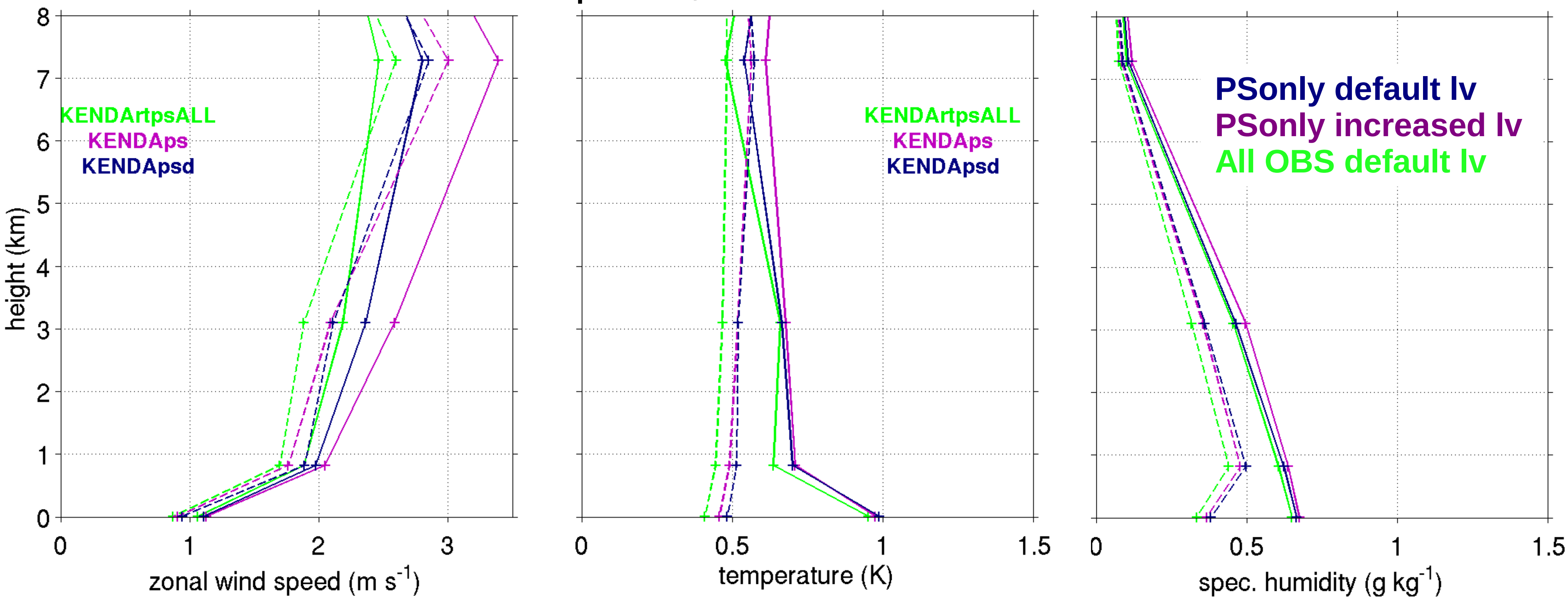
<u>AIREP zonal wind speed</u>
dashed: std FG_dep
solid: std AN_dep



→Problem: ensemble mean AN fit gets worse compared to FG fit

Verification against COSMO-DE analysis

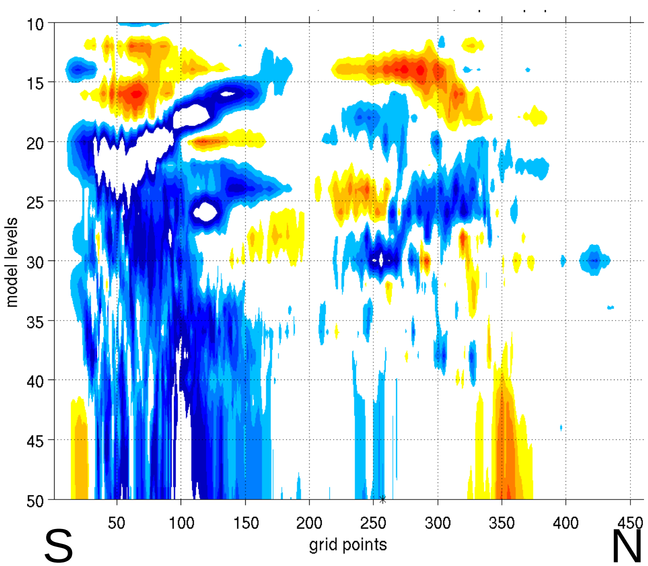
dashed = FC ens spread, solid = FC ens mean RMSE



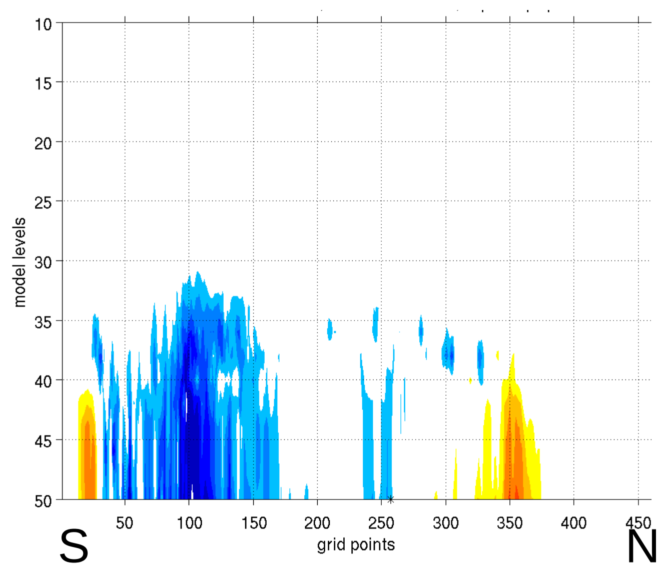
Analysis increments for zonal wind speed U

(first DA cycle)

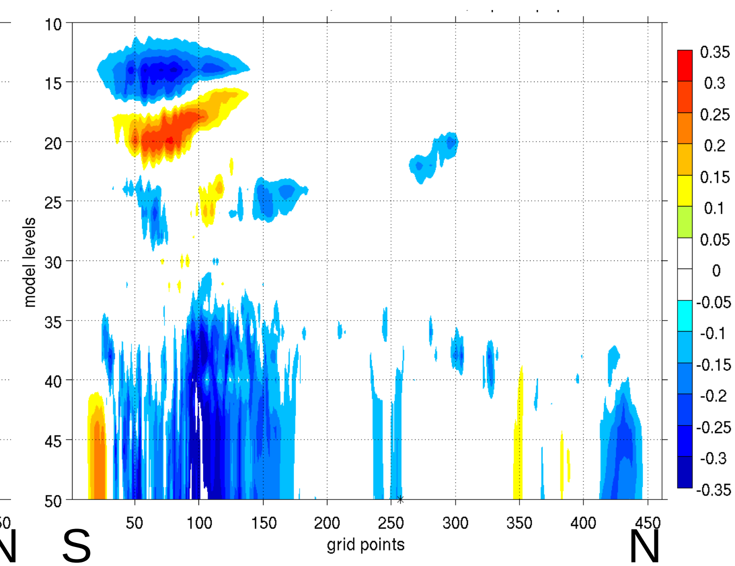
PSonly increased lv | **PSonly default lv** | **All OBS default lv**



S N

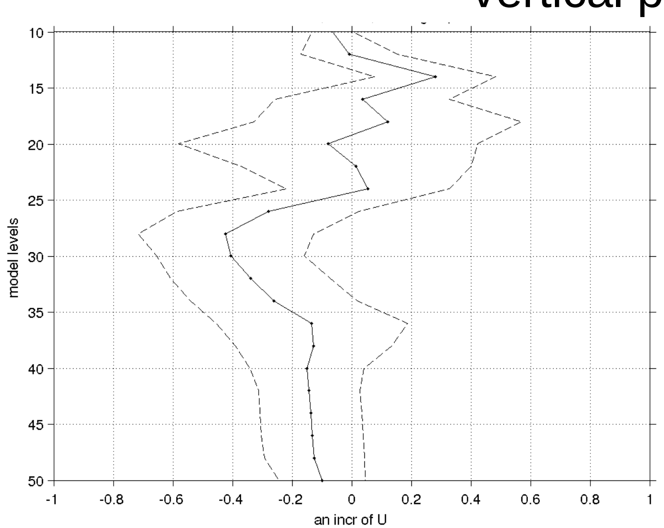


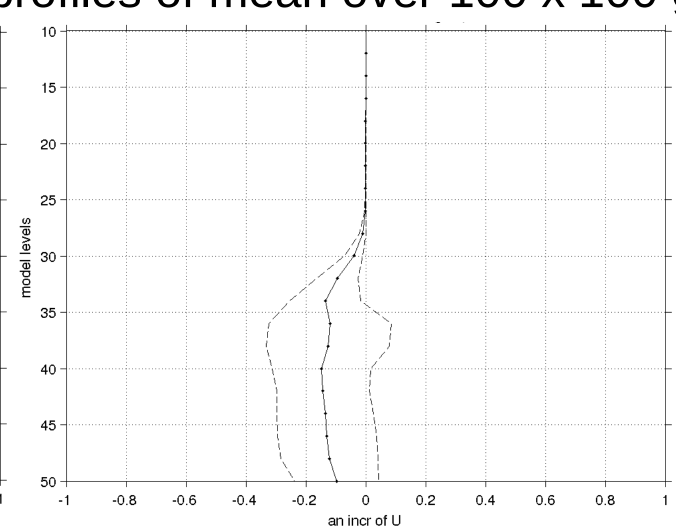
S N

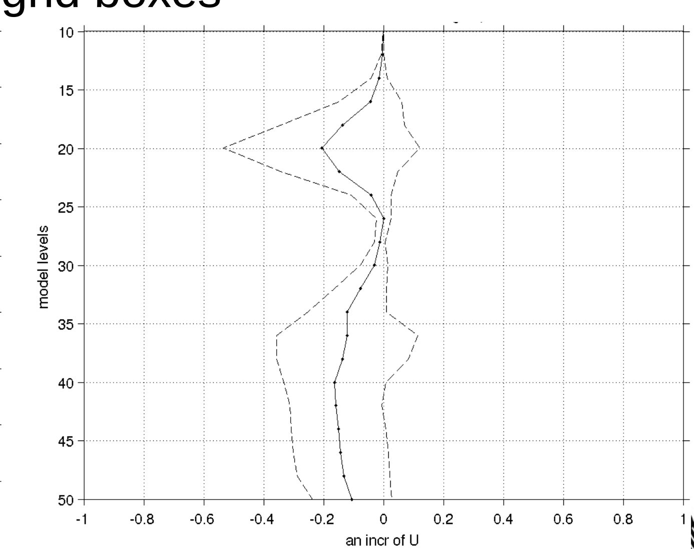


S N

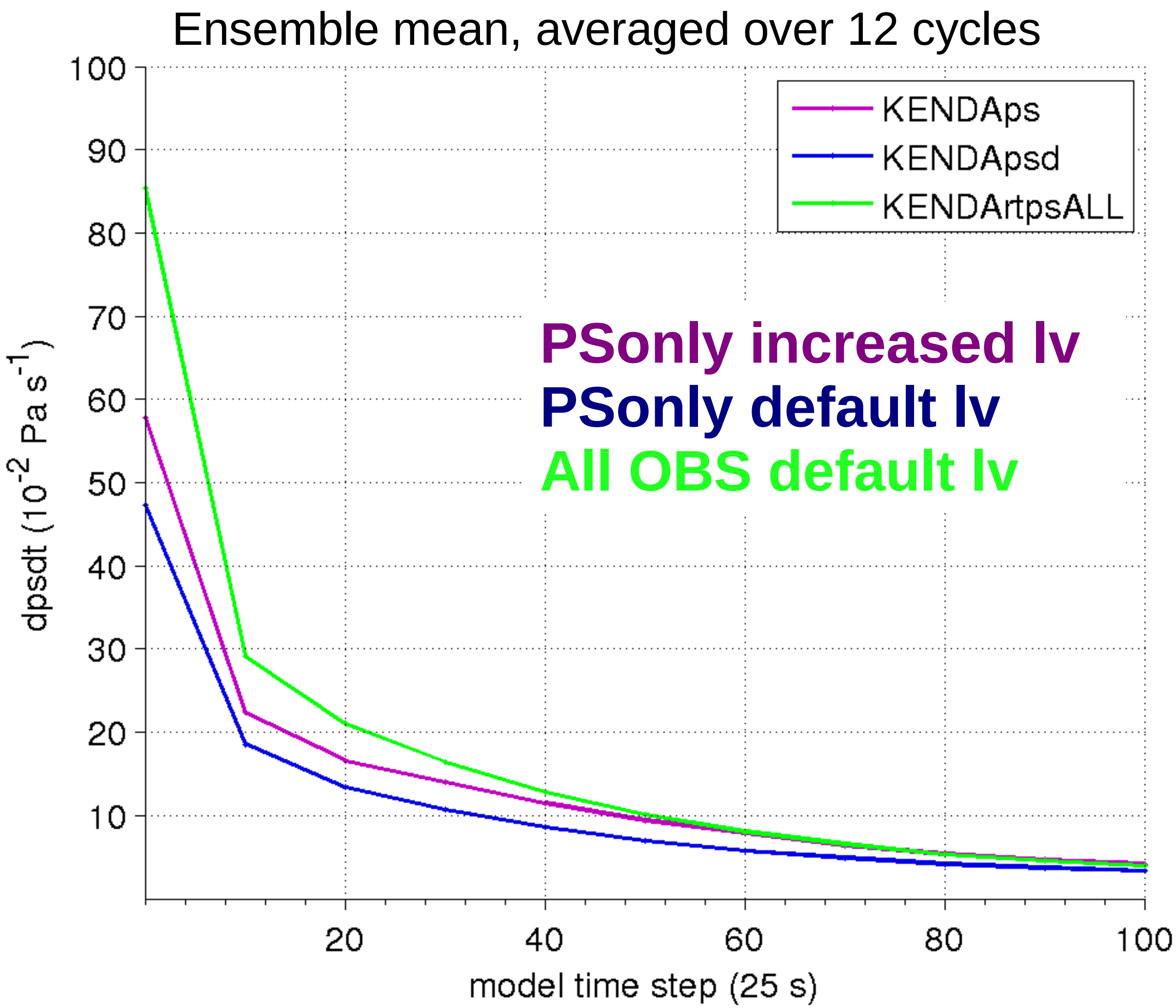
vertical profiles of mean over 100 x 100 grid boxes







dpsdt evaluation

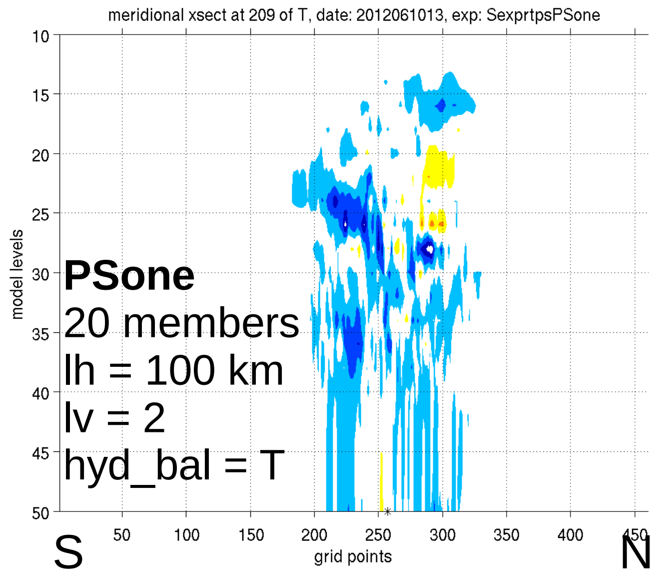


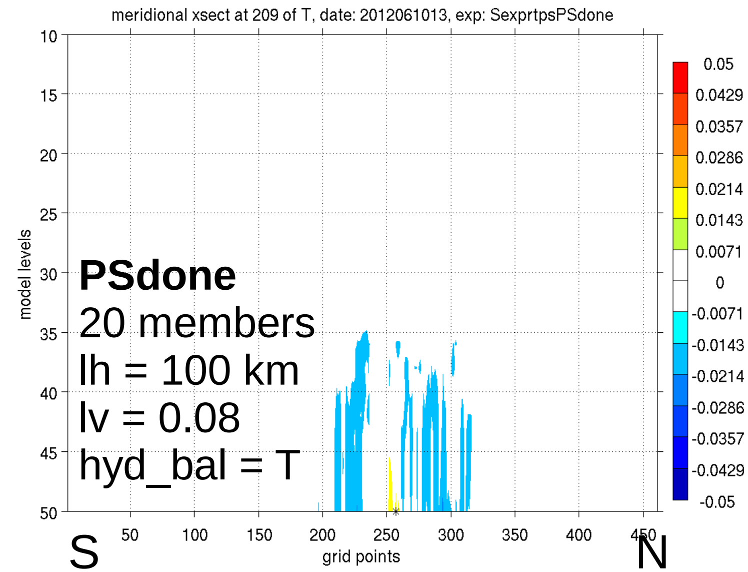
hyd_bal = T
for all exps

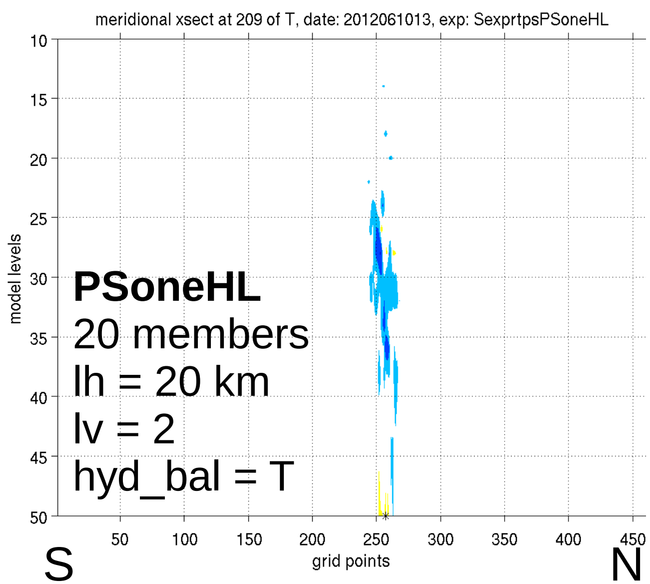
- Using broad vertical localization seems to increase noise

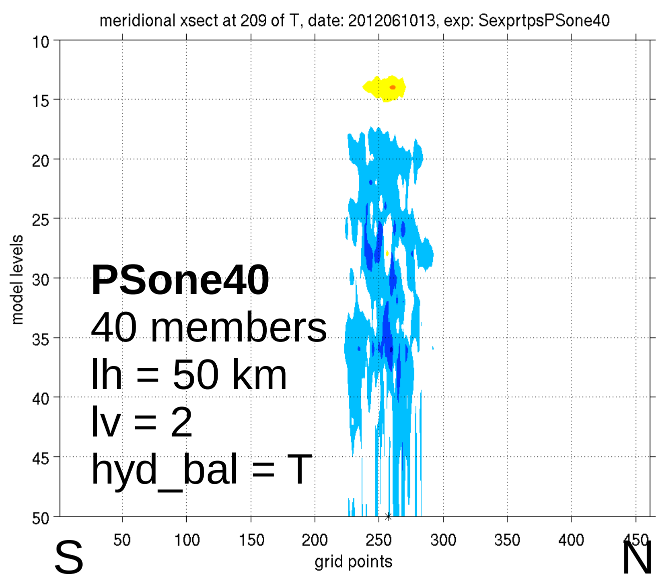
Single observation experiments

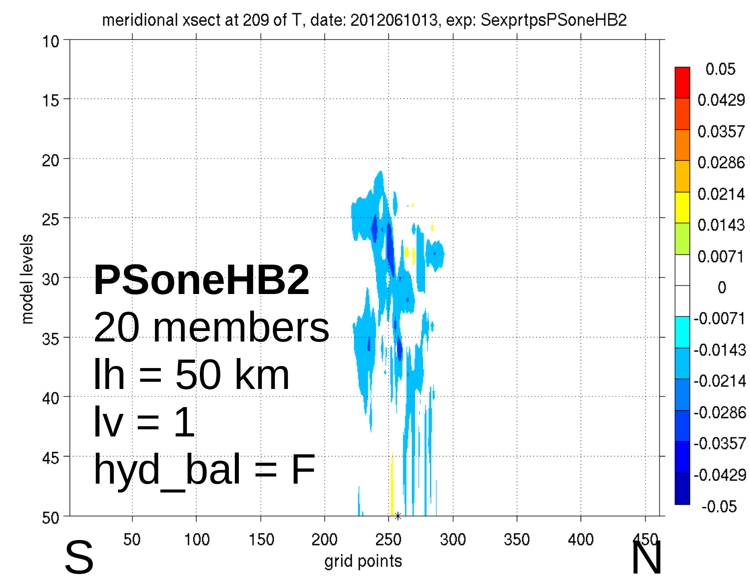
temperature
analysis increments
after 3 DA cycles with
1-hourly window





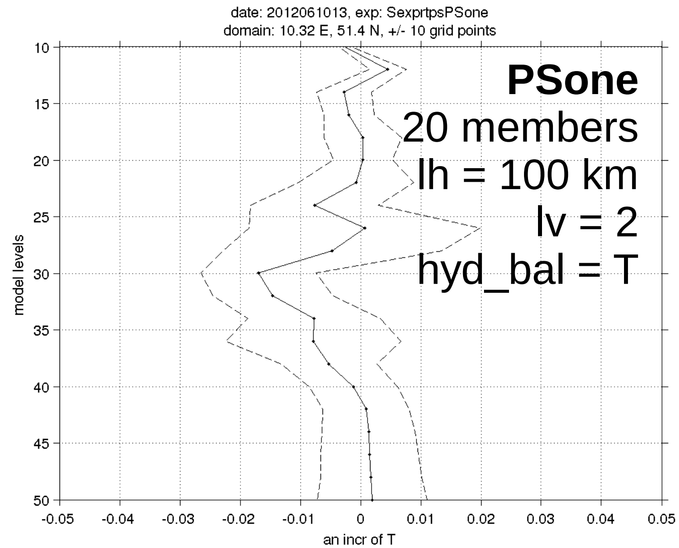


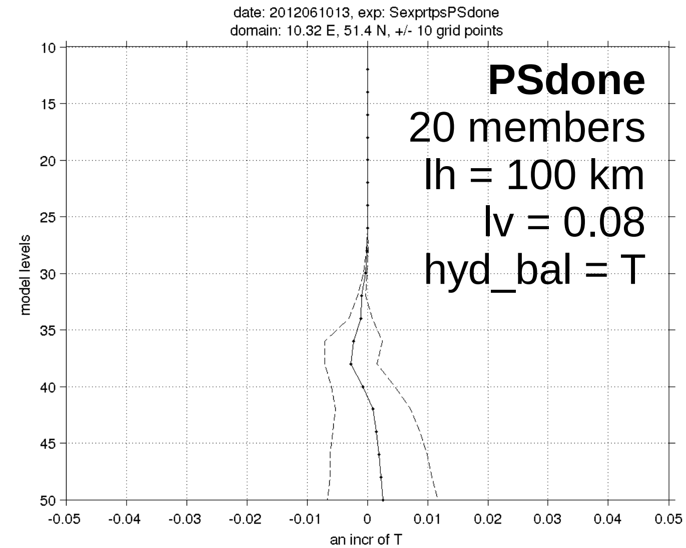


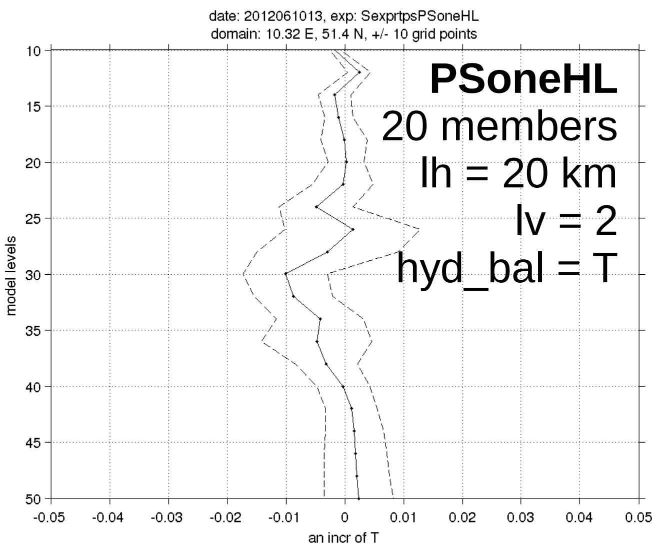


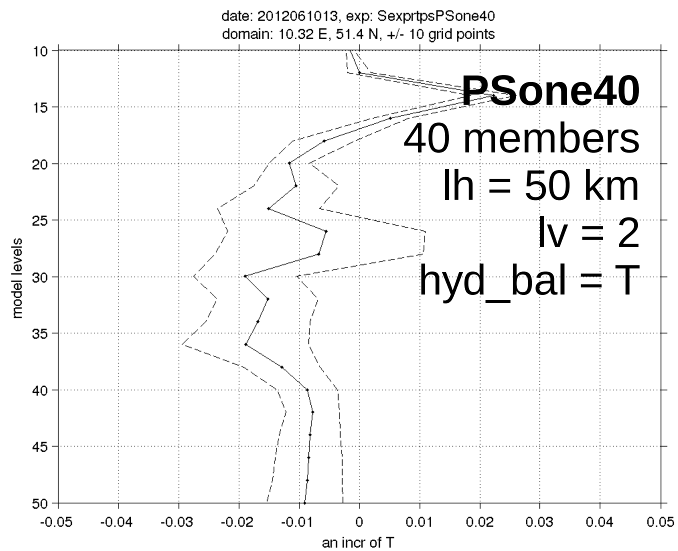
Single observation experiments

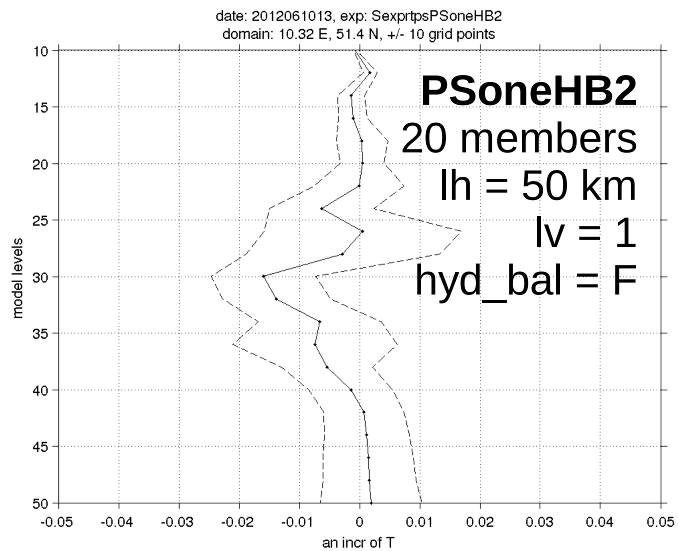
temperature
analysis increments
after 3 DA cycles with
1-hourly window:
mean over domain
+ / - 10 grid points of
observation location











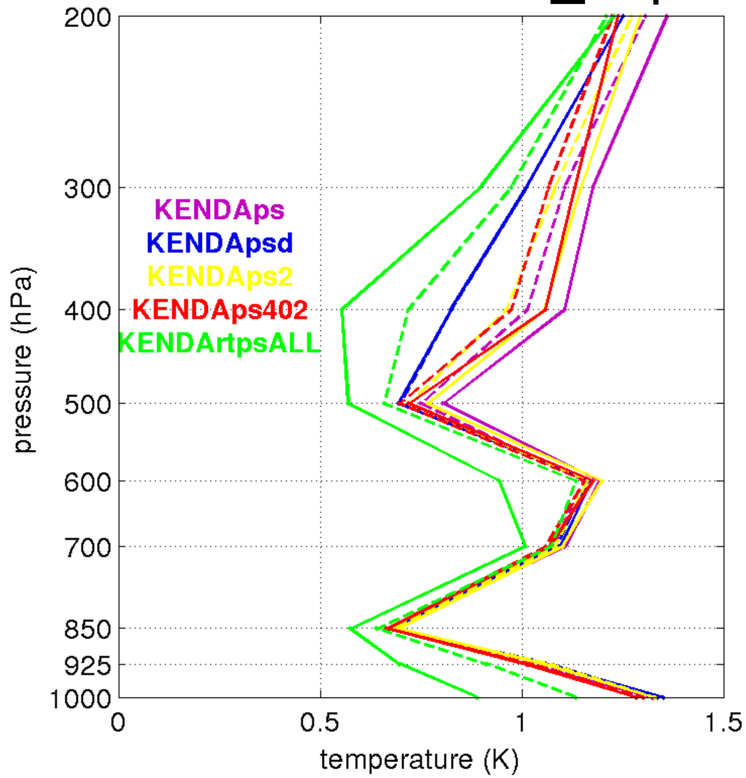
Summary

- PS is an integral observation -> vertical localization should be broader than for other surface variables
- Shallow vertical localization does not produce too large increments
- Unclear how to extract useful upper-air information from PS observations -> it seems that noise dominates and the performance is degraded by broad vertical localization
- Impact for other observations?

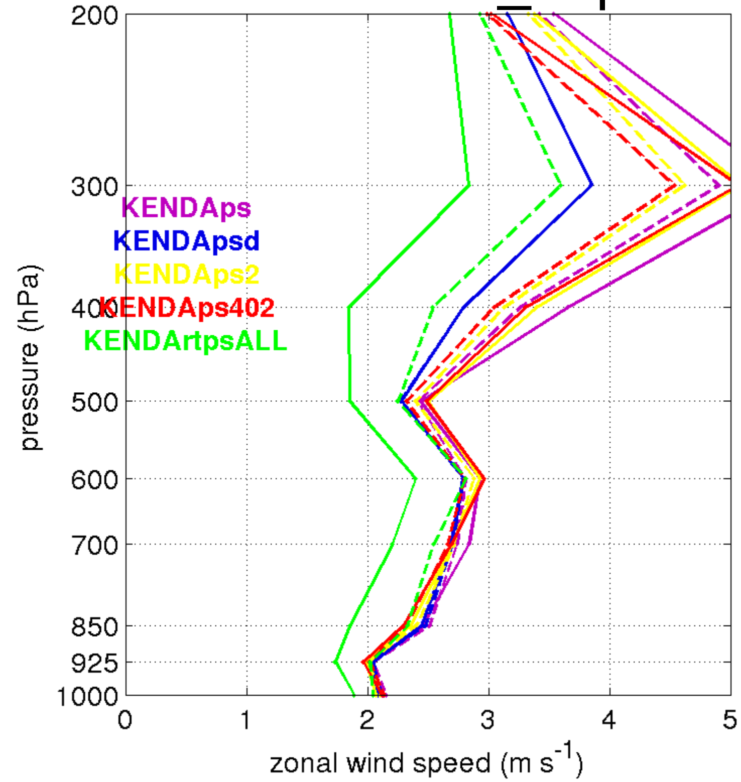
Verification against upper-air obs

2012061012
- 2012061021

AIREP temperature
dashed: std FG_dep
solid: std AN_dep



AIREP zonal wind speed
dashed: std FG_dep
solid: std AN_dep



PSonly: n=20, lv =2.0
PSonly: n=20, lv = 0.08
PSonly2: n=20, lv = 1.0, lh = 50 km
PSonly402: n=40, lv = 1.0, lh = 50 km
All OBS default lv