Assimilation of Earth Rotation Parameter observations to constrain and evaluate atmospheric models

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Table 1. Overview of assimilation experiments performed.

Experiment name	Assimilated Quantities
NODA	none
ERP	p_1, p_2, ΔLOD
RST	Radiosonde temperatures
RST+ERP	Radiosonde temperatures, p_1, p_2, ΔLOD

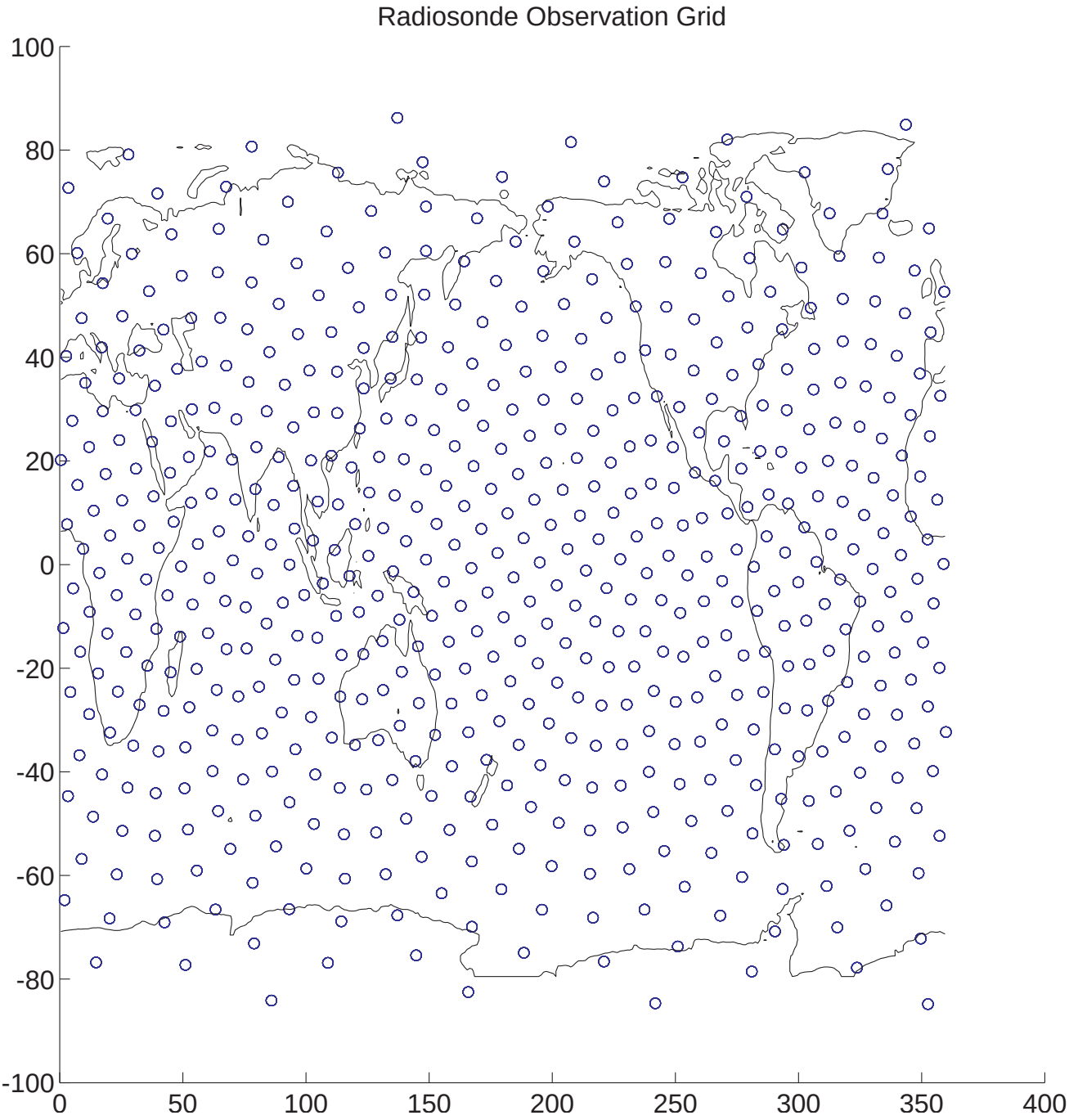


Figure 1.

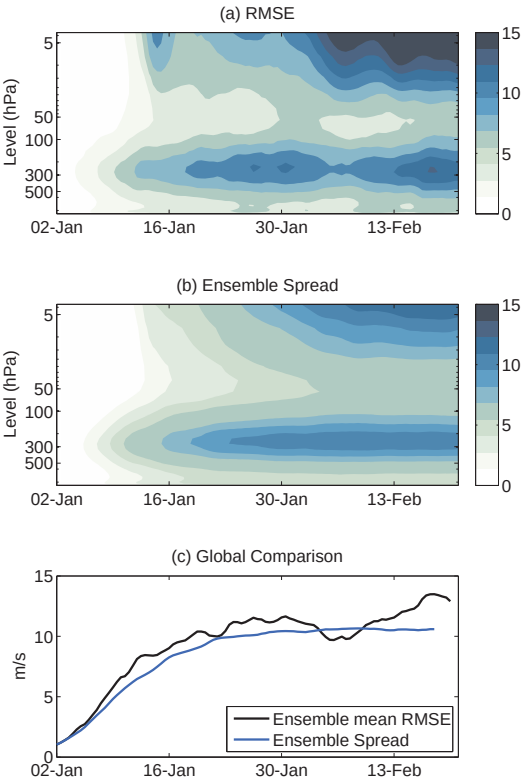


Figure 2. (a) Evolution of the RMS of the error (ensemble mean minus forecast) growth in zonal-mean zonal wind at 300 hPa. (b) Evolution of the ensemble spread in the same field. To Do: remove the global error panel (it's redundant), make the axes nicer.

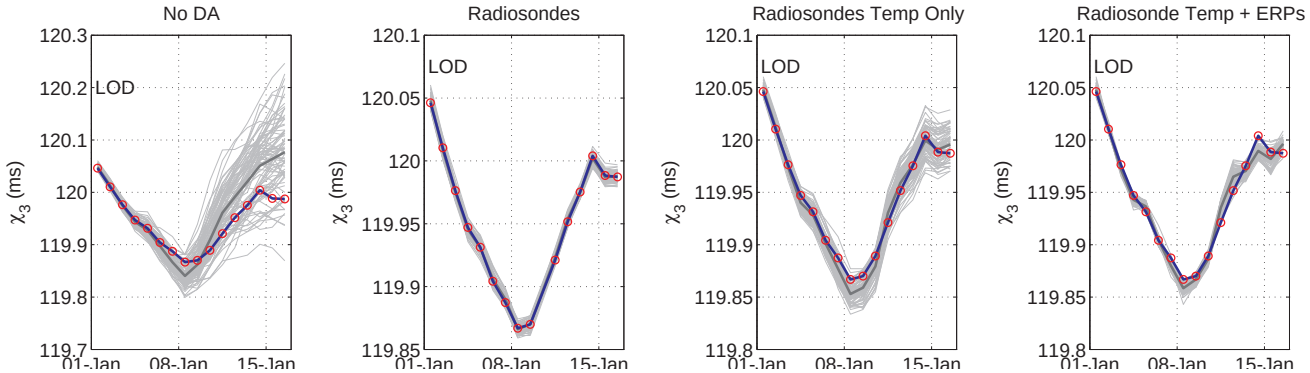
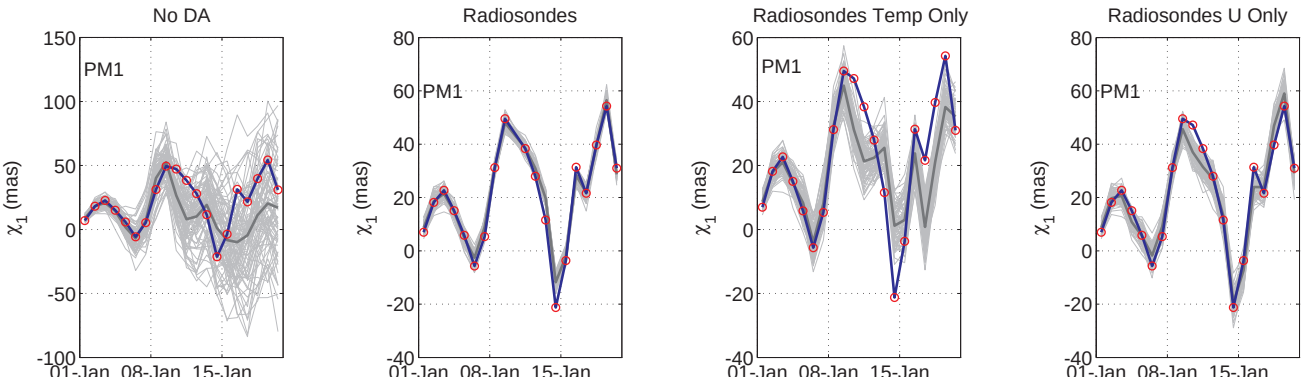
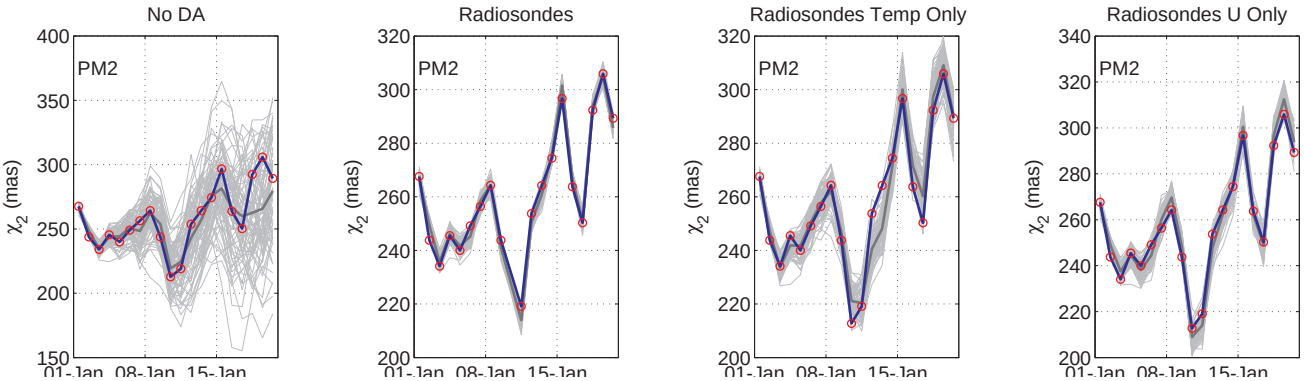


Figure 3. The DART ensemble (gray) compared to the true state (blue) and its observations (red) in terms of the length-of-day, one of the three ERPs. Each panel shows one of the four assimilation experiments summarized in Table 1. In each plot, the ensemble mean is shown as a thick gray line. Take out the Radiosondes experiment and instead put in the ERP-only experiment here. Also add letter labels to the titles. After these fixes decide which ERP is the most useful to show.


No DA
Radiosondes
Radiosondes Temp Only
Radiosondes U Only
PM1
χ_1 (mas)
01-Jan
08-Jan
15-Jan


No DA
Radiosondes
Radiosondes Temp Only
Radiosondes U Only
PM2
χ_2 (mas)
01-Jan
08-Jan
15-Jan

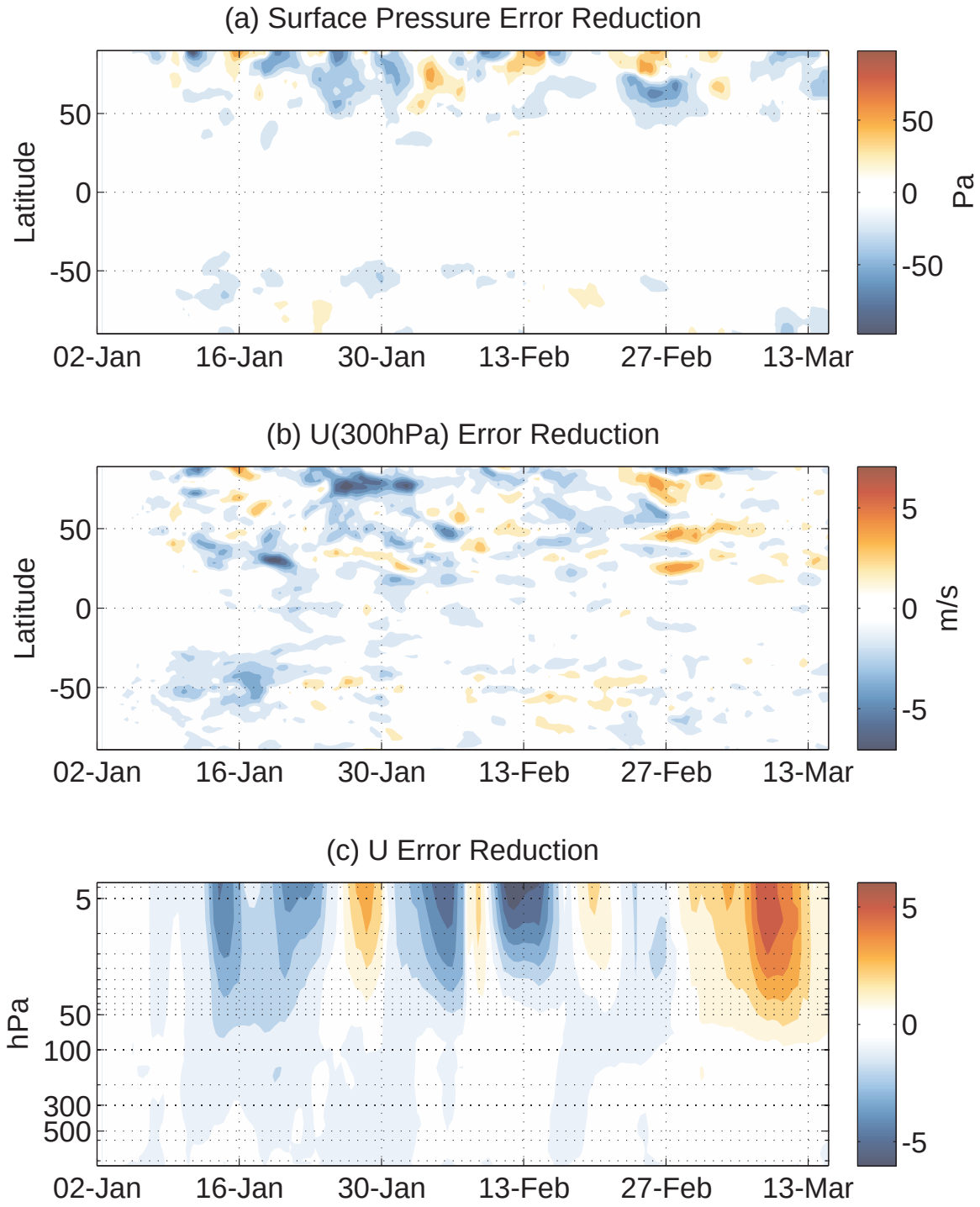


Figure 4. Error reduction in the surface pressure and zonal wind fields, along with the increment, as the ERP assimilation progresses in time. We see that both ensemble spread and error are reduced somewhat, but mostly at the model top.

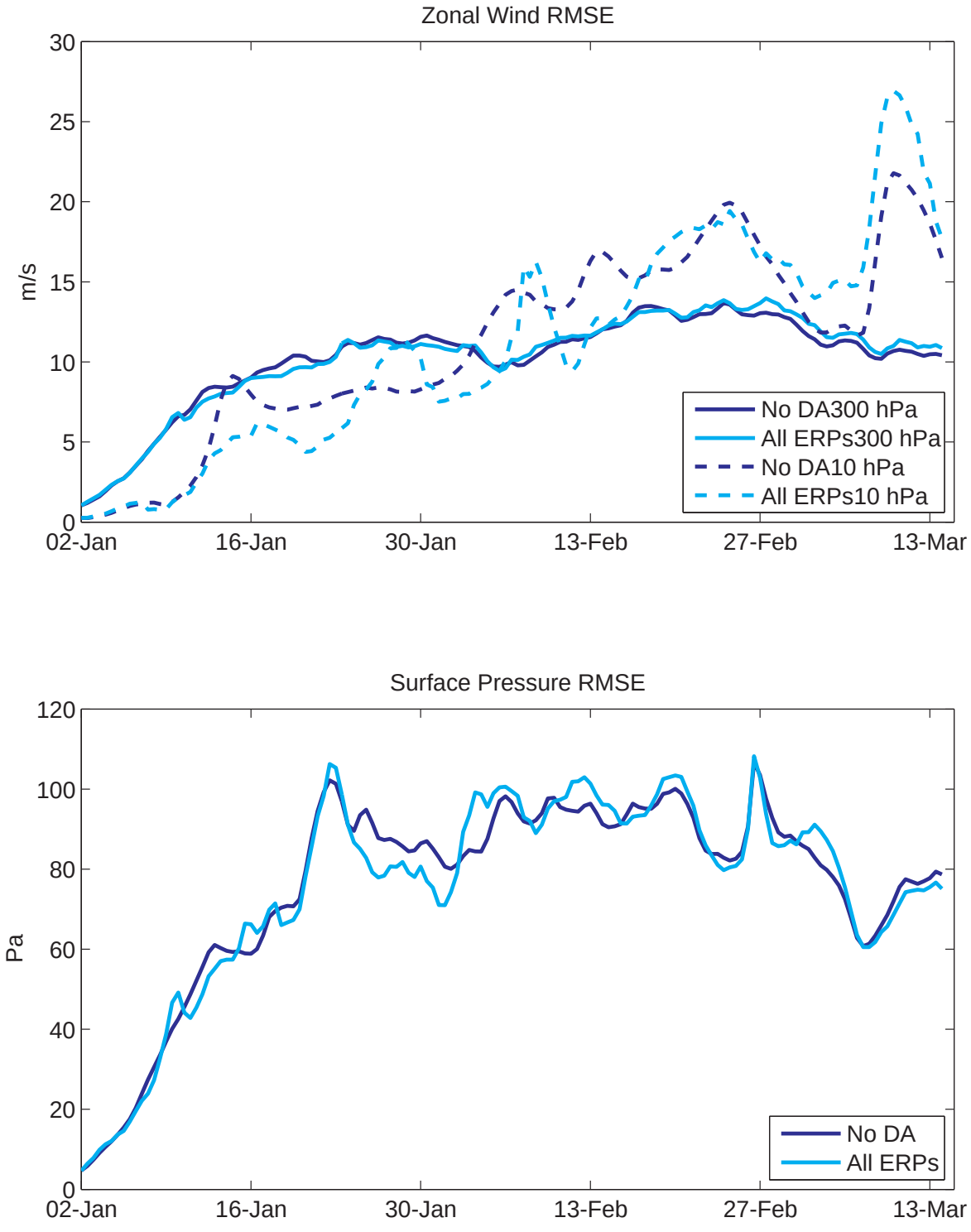


Figure 5. Global RMSE in the zonal wind at 10hPa and 300hPa (a), as well as the surface pressure (b), comparing ensembles with and without assimilation of ERPs.

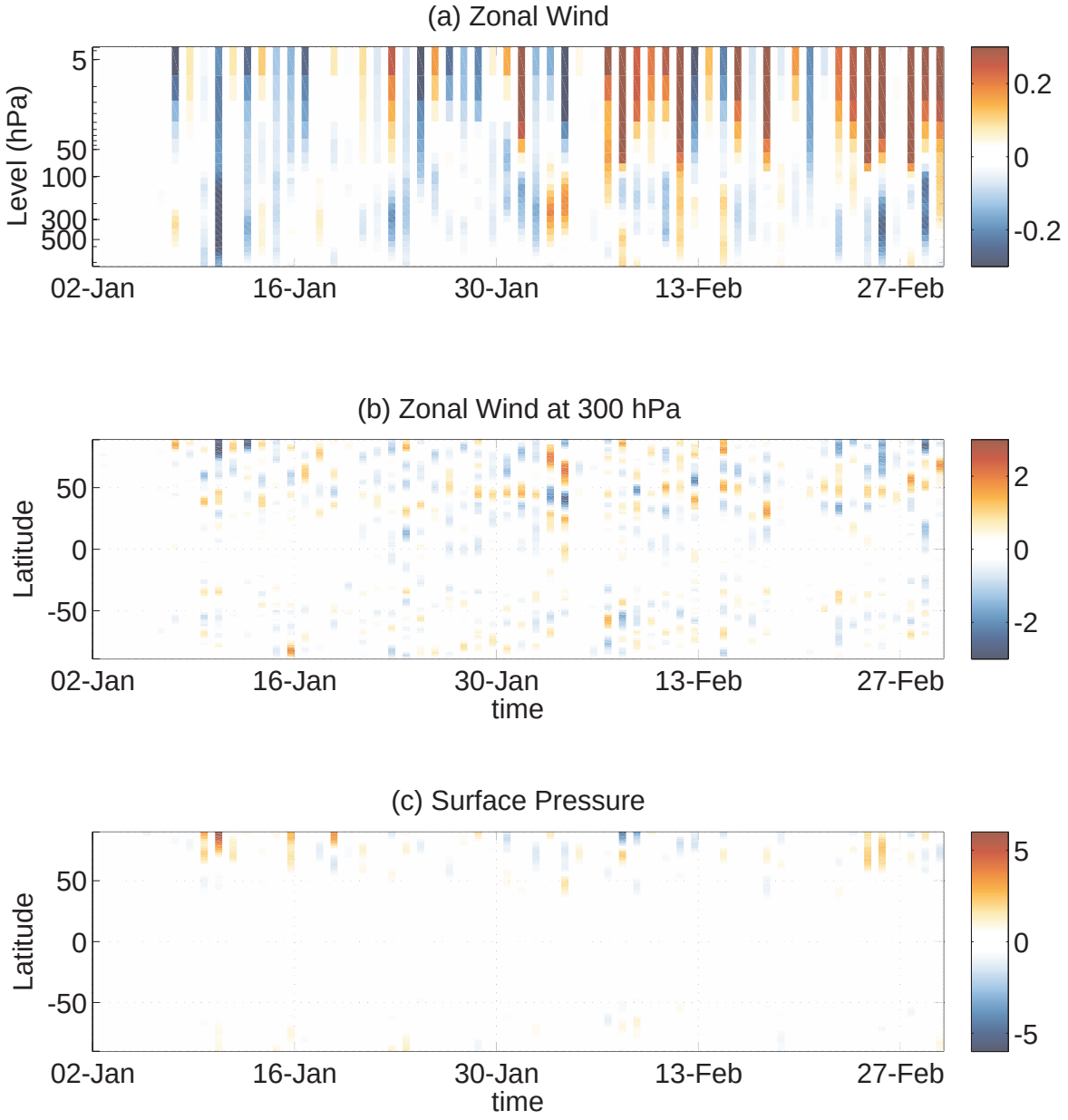


Figure 6. Innovations in the zonal wind and surface pressure fields. We see that it takes a while to rev up, and then most of the innovations are concentrated up high (why?)

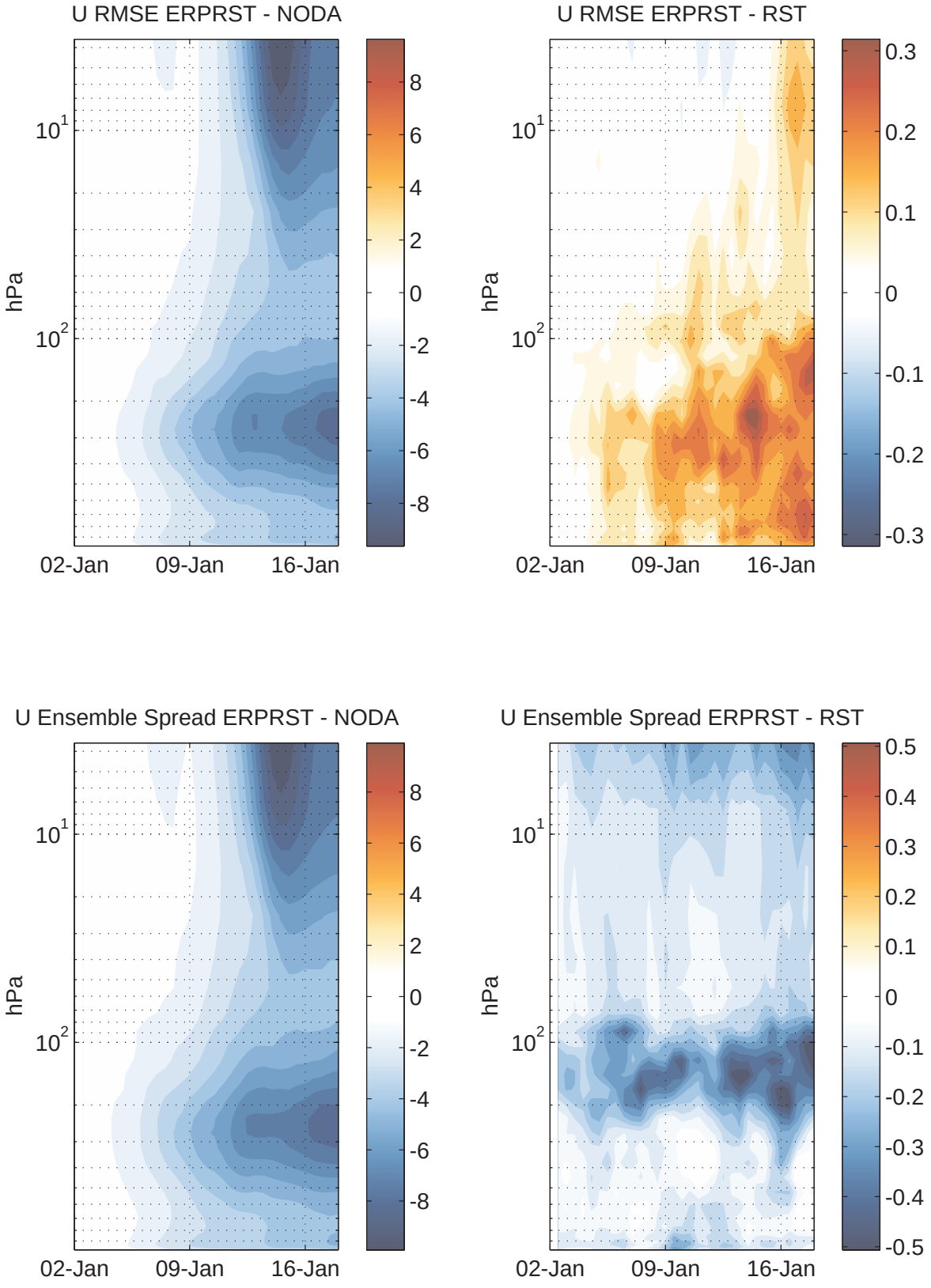


Figure 7. (a) RMSE in zonal-mean zonal wind as a function of vertical level and time, in an experiment assimilating local temperatures along with global ERPs, relative to the temp-only experiment. (b) The difference in the ensemble spread in the zonal mean zonal wind.To Do: remove the left column of plots. Also unify the color axis.