

Interactive comment on “Assimilation of lidar planetary boundary layer height observations” by Andrew Tangborn et al.

Anonymous Referee #3

Received and published: 26 August 2020

General comments:

The paper describes the impact of assimilating PBLH observations from active remote-sensing Doppler lidar system into the NU-WRF model. The assimilation resulted in reducing the PBLH RMS difference compared to independent radiosonde measurements in late afternoon although the impact was little during the night and early morning. Also the forecast covariance of state parameters with the PBLH variable have also been analysed. I think the article presents a novel research and would be a nice contribution supporting active remote-sensing network data assimilation for mesoscale as well as synoptic systems. However, I would request the author to make a few changes in the manuscript before publishing.

Major comments:

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1. Line 212 – "...the assimilation reduces the RMS differences with sonde profiles significantly by 22 UTC for both models." From Fig. 2, the RMS difference of potential temperature, WVMR and V component of velocity have reasonable impact but there is little or no impact on U wind. Please correct the statement if it was a mistake, or, if not, please elaborate how the impact is significant. Also please adjust the Y axis limits of V wind to the same as that of U wind.

2. In Figs. 3 and 4 both analysis and forecasts profiles of potential temperature, WVMR and velocities, U and V, coincide each other at 4 UTC. However, in Fig. 1, the PBLH at 4 UTC is not the same for MYNN forecast although MYJ forecast PBLH has the same value as the radiosonde. The PBLH difference of MYNN forecast to radiosonde is around 300 m from Fig. 1 which creates a doubt regarding Fig. 4 (MYNN scheme) at least if not Fig. 3. May be the innovation was not large enough to create an impact in the assimilation system. Also another reason for doubt is due to the significant magnitude of covariance of PBLH with the variables for 4 and 8 UTC. Hence, I would suggest the author to create the same Figs. 3 and 4 with an additional background profile (may be use a dashed line of the same colour) for each of the variables to remove the doubt.

Minor Comments:

1. I would suggest the author to include a brief description of Doppler lidar just after the ceilometers. A brief description on the pros and cons of Doppler lidar (with references to the system used) and how it is superior to ceilometers could be added.

2. Line 134 - Please add some more details regarding the assimilation design in the methodology section. The sentence "...experiments are all less than 24 hours from the most recent global analysis" is not clear enough for readers. Line 98 - "The assimilation is done on 22 hourly WRF forecast fields. . ." may be omitted or modified after the above addition in the methodology section.

3. Line 178 – Radiosonde launches were 6 times in total. The reader understands

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MYJ has 5 radiosonde comparisons since it stopped at 22 UTC whereas MYNN has 6 radiosondes. Please clarify this point.

Typos and corrections:

1. Line 59 – “Wulfmeyer et al. 2015” not found in the reference section.
2. Line 67 - Please check “Brooks, 2003”. I could not find the reference in the reference section.
3. Line 144 – The sentence “Instead we use. . .error statistics” should be corrected.
4. Line 119 – “We use profiles from. . .” feels like repetition from line 115.
5. Line 129 – Please describe “W”.
6. Line 220 – Please change “plue” to “blue”.
7. Line 244 – “Demoz et al 2006; Crook, 1996” could not be found in the reference section.
8. Line 272 – “an” is used twice, please correct.
9. The following references were found in the reference section without citation in the manuscript. Please cite these wherever necessary.

“Banks, R. F., J. Tiana-Alsina, F. Rocabenbosch, and J. M. Baldasano (2015) Performance evaluation of the boundary-layer height from lidar and the Weather Research and Forecasting Model at an urban coastal site in the north-east Iberian Peninsula. *Bound.-Layer Meteor.*, 157, 265–292, <https://doi.org/10.1007/s10546-015-0056-2>.”

“Cohen, A.E., S.M. Cavallo, M.C. Coniglio and H.E. Brook (2015), A Review of Planetary Boundary Layer Parameterization Schemes and Their Sensitivity in Simulating Southeastern U.S. Cold Season Severe Weather Environments, *Wea. Forecast.*, 30, 591-612.”

“Tucker, S.C., S.J. Senff, A.M. Weickmann, W.A. Brewer, R.M. Banta, S.P. Sandberg,

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D.C. Law and R.M. Hardesty (2009), Doppler Lidar Estimation of Mixing Height Using Turbulence, Shear, and Aerosol Profiles, J. Atmos. Ocean Tech., 26, 673-688.”

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-238, 2020.

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