Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-101-RC1, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Boundary layer evolution over the central Himalayas from Radio Wind Profiler and Model Simulations" *by* Narendra Singh et al.

Anonymous Referee #1

Received and published: 9 May 2016

General comments:

This paper presents 5 months of PBL height detection in case of sunny days by a radio wind profiler in the complex topography of the Himalayas. The measured PBL height is then compared to model results, and a sensitivity analysis of the PBL height, the ozone and BC concentrations depending on the model parameters is also done. PBL height measurements and modeling at high altitude sites in complex topography are rare and worth publishing. The authors explain quite well their methodology to detect the ML height from the SNR signal. Two examples are given that allow the reader to compare the ML heights estimated from WRP and from the virtual potential temperature and the specific humidity from radio-sounding measurements. If the ML height is clearly

Printer-friendly version

Discussion paper

reported on Fig. 3a and 4 a (RWP measurements), it should also be reported on Fig. 3b-c and 4b-c illustrating the ML height estimation from the virtual potential temperature and specific humidity. On the 17.12.2011, the specific humidity profiles give the ML height at about 0.3 km at 0622 and 1148, in good relation with the RWP. A ML height at about 0.25 km at 0622 is found from the virtual potential temperature (Parcel or bulk Richardson methods), but no ML height at 1148 (no unstable profile). As already mentioned in the quick review, a real validation of the MH height detection method by the RWP is necessary. For convective cases (unstable virtual potential temperature profiles), the Parcel or bulk Richardson should be applied. The stable boundary layer (stable potential temperature profiles) can be characterized by a surface-base temperature inversion and its top can be estimated by the height at which the gradient of the potential temperature ==0. The ML height can be also detected from the specific humidity gradient (maxima). A comparison of the three detection methods for the 78 good weather days is really necessary to assess the applied ML height detection method.

Minor comments:

- P. 1 line 12: “The standard criterion of the peak in the signal-to-noise ratio profile” : can you please shortly specify what is “the standard criterion”.

- P. 1 line 15: is it really “the daytime average” or the average of the daily maximum of the boundary layer height ? Please specify if the BL height is a.g.l. (due to site elevation, it is probably not a.s.l.)

- p. 1 lines 20-21: revise the English (the introduction as a lot of language problem, please check it)

- P. 2 line 14: “to probe troposphere through atmospheric boundary layer”: please rephrase.

- P.2 lines 19-21 and lines 24-26: rephrase, not comprehensible

- P. 2 line 27: distantly transported =Long-range transported?

- P. 2 line 28: " as well as . . .": rephrase

- P. 3 line 3: comprising four launches. . .

- P.3 lines 5-6: RWP wind measurements are used to provide continuous. . .

- P. 3 line 8 "the best possible" or " a better tool than " ?

- P.3 lines12-13: rephrase

- P.3 line 17: as simulated by a regional model: rephrase

- p.3 line 27: " as prominent as that as in high pressure regions": rephrase

- p. 4 2.1 observational site: please refer to Fig. 2 (and inverse therefore Fig 1 and 2)

- p. 4 line 14-15: rephrase

- p. 4 line 17 from a vertical beam or from one vertical beam ?

- p. 4 lines 25-30: please give a reference for the number given to describe the vertical structure of the PBL.

- p.4 line 30 to p. 5 line 6: please give a reference for the describe phenomena. At other high altitude site (for example at JFJ, see Ketterer et al., . . .) a maxima of the SNR was always measured in case of convective boundary layer. Perhaps the vertical velocities and the peak widths at the lowest time resolution (seconds or minutes, probably given as raw data) could help to describe this phenomena.

- Same place: as stipulate under "general comments", a validation of your detection method (< 6BD) has to be given.

- P.6 §3.1: please specify what is the method to diagnose the PBL height in your WRF model.

- P.7 line 6 can we really speak of a "smooth" diurnal cycle ?

- P.7 lines 10-12, Figures 3 and 4: the ML heights (calculated from both the plotted

profiles and from RWP) should be reported on the virtual potential temperature and humidity profiles. The ML heights estimated from the potential T and the specific humidity seems to be somewhat different on the 17.12.2011, whereas they seem to be in good accordance for both (0608 and 1139) sounding on the 15.3.2011. For that day, the ML heights detected from the RWP seem however much higher than the ones of the sounding.

- Case 15.3.2011: the virtual potential temperature and the specific humidity both show changes at 500 and 1800 m. The SNR signal is decreasing abruptly at about 0930. Can you explain these phenomena (for example also with vertical velocity if this is an effect of subsidence).

- P. 7 line 23:"both profiles" instead of "both the profiles"

- P.8 line 3: " with the least diurnal variability"

- P.8 lines 6-9 and §4.3: 1) What is the causes of the high wind velocities measured in March during night? Are they local valley winds, synoptic advective winds ? Does the wind direction change between day and night ? Are these winds well-known during spring in central Himalayas ? 2) the denomination of the boundary layer has to be clarified. LBL, ML, ABL, stable boundary layer and residual layer are all mentioned in §4.3. LBL induce a local effect and should be bounded with local winds induced by the topography. ABL has to be estimated by aerosol measurements (Lidar or ceilometers) or eventually by humidity profiles. Stable boundary layer should be estimated by the T profiles and the residual layer is often composed of several distinct layers. I hope that you can clarify this very interesting case with all the measurements at your disposal (wind horizontal and vertical velocities, wind direction, T and humidity profiles, perhaps wind measurements at other stations if synoptic advective winds are suspected or model results).

- P.8 line 16 "during the rest of the night"

- P.8 line 26 “in mixing depth. Errors. . .”

- Fig. 7b: if the points were colored as a function of the months, the deviations from the fitted slope could be estimated for each month.

- P. 9 line 14-15 and Table 2: Perhaps just mention if the monthly means of the model results are comprised in the variability ($\pm$ 1 sigma). The use of “more” is not appropriate

- P. 9 line 22: do you have an explanation or a suggestion to explain the overestimation of the model by a factor of 2 ?

- Fig. 9 and 10: The figure caption should describe what are the black and red points.

- Fig S1 and text related: it seems that the effect of the convective parameterization are quite small. I would not really conclude that the BL decrease is much faster between 11h and 13h. It seems that the high ML height at 13h is a kind of compensation of the low point at 12h.

- Fig. S3: the figure caption should be more comprehensive with the description of the points and the lines.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-101, 2016.

Printer-friendly version

Discussion paper