Atmos. Meas. Tech. Discuss., 7, C4140–C4147, 2014
www.atmos-meas-tech-discuss.net/7/C4140/2014/

Atmospheric Measurement Techniques Discussions

Interactive comment on "The Midlatitude Continental Convective Clouds Experiment (MC3E) sounding network: operations, processing and analysis" *by* M. P. Jensen et al.

M. P. Jensen et al.

mjensen@bnl.gov

Received and published: 9 December 2014

We thank the reviewers for their thoughtful feedback on the discussion edition of our manuscript. We have made several important changes to the manuscript based on this feedback. Most notably we have included a discussion of how the humidity corrections and quality control applied to the MC3E soundings impact the derived large-scale forcing (Xie et al. 2014). For these additional contributions, we have added S. Xie and Y. Zhang as co-authors on the manuscript. We have also added some clarification on the application of scaling of the sonde humidity measurements to ground-based remote sensing observations of precipitable water vapor. Finally, we have removed one figure,

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

changed one figure to a table, and enlarged several figures that were difficult to read in the previous version.

========== Anonymous Referee #2

Referee comment: “Figure 2 is unnecessary”

Author reply: Agreed.

Changes in manuscript: We have removed figure 2 and changed the numbering of the subsequent figures.

===== Referee comment: “Question: the text states: “note: as will be discussed in Sect.3.1 it was found that the GPS observations induced a dry bias in the corrected humidity profiles, and so we did not use them for scaling)” How do you determine that the GPS introduces a dry bias? Are there other studies that discuss how that may be the case? A study by Wang and Zhang (J. Clim, 2008, DOI: 10.1175/2007JCLI1944.1) found a dry bias in the Vaisala RS 92 relative to GPS PW. How do you determine the absolute accuracy of the PW measurements? It seems that here it is assumed that the Microwave Radiometers are judged to be most accurate. Is that a valid assumption? If so, how is that justified?”

Author reply: Current Figure 5 shows our comparison of sonde, MWR and GPS PWV estimates at the CF where the instruments were collocated. For all but one time interval the GPS shows a lower (albeit within instrument uncertainties) PWV compared to the RS92 and the MWR. Analysis at the other MC3E sounding sites (not included) shows similar results when comparing nearest neighbor GPS to sounding observations. Although we cannot make any claims regarding the absolute accuracy of the PWV measurements we do know that previous studies have determined an uncertainty in the MWR retrieval of PWV on the order of 0.2-0.5 mm (Cadeddu et al. 2013, Turner et al. 2007), while the uncertainty of GPS estimates of PWV is on the order of 1.2 mm (Wang et al. 2007)

AMTD

7, C4140–C4147, 2014

Changes in manuscript: In the note pointing the reader to the discussion in Section 3.1, we have added an explicit call to figure 5 which shows the comparison between the sonde, MWR and GPS PWV.

===== Referee comment: "Figure 3 This figure adds little information to the paper. The caption stations that bars are color coded, but the only color I can see is blue, with some lines thick and others thin). The information may be better conveyed in a table, but really isn't needed. A sufficient summary is given in the text and in Table 2."

Author reply: The new Figure 2 provides a very simple visualization for a data user to determine where data gaps exist, where high-resolution data was collected and the vertical extent of the soundings obtained. We believe that this is added-value and makes this figure worthy of inclusion. The current version of the plot does not include indeterminate or bad data and so no color coding is necessary.

Changes in manuscript – The figure has been updated with no color-coding. The figure caption has been changed to reflect this. Also note that this figure is now #2.

===== Referee comment: "Figure 5 would be better displayed as a table than a bar graph."

Author reply: Agreed

Changes in manuscript: The information displayed in former Figure 5 is now included in Table 4.

===== Referee comment: "Comment: the paper states: "The SONDEADJUST VAP takes the sounding that has been corrected for known biases and then uses an independent retrieval of PWV to scale the radiosonde water vapor measurements (Turner et al., 2003). M09 is specific to RS92s. Turner et al. 2003 is for RS80s. For this measurement campaigns my understanding is the RS92 was used. Is the Turner adjustment valid for that? If so, is there a publication that can be referenced?

Author reply: Cady-Pereira et al. (2008) show that scaling of the RS90s generations

AMTD

7, C4140–C4147, 2014

of Vaisala soundings can be used to correct daytime dry biases in column-integrated PWV.

Changes in manuscript: We have added a reference to the Cady-Pereira paper in the discussion of scaling of the radiosonde water vapor observations.

===== Referee comment: I'm also a bit confused why two corrections are done. My understanding from reading M09 is that the corrections applied improve the PW estimate from the RS92 as compared to the ground based PW measurement. Why is the second correction needed?

Author reply: There are multiple reasons why we believe it is appropriate to apply the M09, but then also scale to match the MWR PWV: 1) As stated in M09, "The daytime bias correction must be used with caution, as it is only accurate for clear-sky or near-clear conditions owing to the complicated effect of clouds on the solar radiation error." Thus scaling to a reliable independent PW source will help to mitigate problems with this "clear-sky correction" issue, 2) There is also an issue to changes in RS92 accuracy related to using sondes from different batches (i.e.,"calibration batch dependencies" Miloshevich et al. 2009). Again scaling to a time-consistent, independent PW source will help with this issue and 3) Based on GRUAN RH uncertainly estimates (Yu et al. 2014), TPW uncertainty in RS92 sonde data is +/- 2 mm; TPW uncertainty in MWR is 0.2-0.5 mm (Cadeddu et al. 2013). These justifications were outlined in the paper under the same discussion of the SONDEADJUST VAP.

Changes in manuscript: No further changes were required to the manuscript.

===== Referee comment: Wang and Zhang, 2008 (see above) note day and night differences with RS92s (in a comparison with GPS PW). Are such corrections applied as well to this data set? (Is that dealt with in the adjustment from a 66 degree SZA?)

Author reply: The M09 corrections that are applied here include a correction for the dry bias due to solar heating based on the work of Vomel et al. (2007) and Cady-Pereira

AMTD

7, C4140–C4147, 2014

et al. (2008) which are similar in nature to the Wang and Zhang (2008) differences. The inclusion of the solar radiation dry bias adjustment is noted in the first paragraph of section 3.1. The adjustment from a 66 degree SZA is part of this correction.

Changes in manuscript: No changes to the manuscript were needed.

===== Referee comment: A single scaling factor is used at all altitudes (over a large range in water vapor content). How is that justified?

Author reply: We do recognize that the use of a single scaling factor at all altitudes may be an oversimplification, however, without a priori knowledge of the nature of the corrections a more complicated scaling model is not justified. The technique used here is consistent with that used by previous studies such as Turner et al. 2007 and Cady-Pereira et al. 2008.

Changes in manuscript: No changes were made to the manuscript.

===== Referee comment: The paper has a lot of discussion on how indices are impacted by corrections, but no discussion on whether the corrections produce indices that are more realistic. It would be a much more interesting study if it included discussion of whether corrected versions of CAPE from a sounding leads to a better prediction of the convection that actually occurred on the day of the sounding. This would add a bit more science to what is currently a very technical paper.

Author reply: We have added an analysis of the impact of the corrections and quality control to the radiosonde observations on the calculation of the large-scale forcing dataset which was the main motivation for the sounding array operations. This analysis indicates that there is a significant impact of the corrections on the domain-averaged vertical velocity.

Changes in manuscript: We have added section 4.2.3 Impacts on Large-Scale Forcing that discusses the impacts of the humidity corrections and quality-control on the derived large-scale forcing as in Xie et al. (2014). We have also added a new figure, currently

AMTD
7, C4140–C4147, 2014

Figure 12, showing a time series of the derived profile of large-scale vertical velocity using the corrected soundings, and the difference between the derived vertical velocity using the corrected and original soundings.

========== Anonymous Referee #3

Referee comment: While clearly these end analyses were not the purpose of this work, the limited focus on the treatment of the moisture data leaves wide open questions of how the sounding data might contribute to characterizing the large-scale forcing fields for which it was developed. Even allowing for the narrow context of the examination of the convective indices presented in the paper, the authors fail to provide any insight into how the differences they do find might impact large-scale budgets. In short, are these differences that make a difference? And if so, how?

Author reply: With collaborators Xie and Zhang, we have done some analysis of the impact of the humidity corrections and quality controls discussed in the paper on the large-scale forcing dataset described in detail in Xie et al. (2014).

Changes in manuscript: We have added section 4.2.3 Impacts on Large Scale Forcing that shows a significant impact on the derived large-scale vertical velocity due to the application of the humidity corrections and quality control described in the paper. We have also added a new figure (Figure 12). For these additional contributions we have added Shaocheng Xie and Yunyan Zhang as co-authors on the manuscript.

===== Referee comment: p. 9279, first paragraph: A WRF model simulation was used to determine the optimal configuration of the sounding array, and the statement is made that leveraging of the operational wind profiler network reduces the biases and RMS errors over the VAD network compared other configurations. What is meant by the wind profiler leveraging, and more importantly, what, if anything, does the choice of the network configuration have to do with the results presented later in the paper? Reading this paragraph suggested that a far more ambitious analysis was going to be presented than the paper actually had.

AMTD
7, C4140–C4147, 2014

Author reply: The leveraging of the operational wind profiler network is meant to describe the inclusion of profiles of the horizontal wind observed by wind profilers that that are part of the NOAA operational network in the derivation of the large-scale forcing datasets. One purpose of the manuscript is to document the details of the MC3E sounding network operations. An important component of this is the considerations, both scientific and logistic, for the configuration of the network.

Changes in manuscript: We have added some text to the 2nd paragraph of section 2.2 to clarify that the operational networks are used in the derivation of the large-scale forcing dataset used for the WRF simulations.

===== Referee comment: p. 9280, first paragraph, line 11-13: Here it is stated that humidity corrections in the C3700 Vaisala ver. 3.64 software were turned off and applied during post-processing. However, Section 3.2 says the humidity corrections were made with the ARM SONDEADJUST algorithm which incorporates the corrections in Miloshevich et al. (2009). Does this mean that the ver. 3.64 software applies the same corrections as SONDEADJUST? If so, then this should be stated.

Author reply: The exact nature of the Vaisala post-processing software is proprietary and therefore we are unable to verify that the corrections that are applied are the same as those in M09. We chose to use the same post-processing software across all platforms because: (1) The upgraded software could not be run on some of the older systems that were being used, and (2) we wanted to be sure that any corrections and quality control that was applied was consistent among all platforms.

Changes in manuscript: We have rewritten the sentence in question to more clearly indicate why we turned off these corrections and how we applied the corrections in post-processing.

===== Referee comment: p. 9281, first paragraph: It is stated here that GPS retrievals of precipitable water vapor (PWV) were used at the five non-central stations in the network, but in the end these were not used for scaling. This statement was somewhat

AMTD
7, C4140–C4147, 2014

confusing coming as it does in a paragraph about scaling.

Author reply: We agree that this was confusing. While we did investigate the use of the GPS stations (which were not always directly collocated), we found that they were noticeably drier than the MWR (at the CF) and corrected radiosonde profiles.

Changes in manuscript: We have edited the text in order to clarify how the GPS observations were used. We have also added some text quantifying the distance between the sounding observation and the GPS observations.

===== Referee comment: Figures: Although the figures are well drafted, the labeling is far too small.

Author reply: Agreed

Changes in manuscript: We have enlarged and resubmitted new versions of the figures.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 9275, 2014.