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Atmospheric Measurement Techniques Discussions

Interactive comment on "Determining the temporal variability in atmospheric temperature profiles measured using radiosondes and assessment of correction factors for different launch schedules" *by* D. Butterfield and T. Gardiner

Anonymous Referee #2

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This study uses a set of intensive radiosonde observations at Manus to quantify diurnal variability. Results from Manus are then generalized to Lindenberg and to ARM SGP. This provides an estimate of the uncertainty from the unresolved diurnal cycle introduced by using twice daily radiosondes. A correction factor is calculated and applied to the Lindenberg sondes, and this is used to estimate the uncertainty introduced by temporal mismatch between different observing systems. The results of this study are potentially relevant to intercomparisons studies of temperature from different measurement systems. However, the manuscript needs a rigorous justification of the analysis,

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and more careful interpretation and presentation of the results.

My first major concern is the lack of physical interpretation of the results. Here are some thoughts on physical interpretation that aren't discussed: Lindenberg and Manus have radically difference climates, with SGP somewhere in between. How applicable are the results from one location to the others? The manuscript especially needs some discussion of the relative amplitudes of the diurnal cycles over Manus, over northern Europe and over Oklahoma. In a similar vein, the vertical variations in the differences shown in Figure 2 suggest some sort of standing wave structure. Does this have implications for later results? Also. . .what about the annual cycle? If the diurnal cycle is small but the annual cycle is large, then it could explain some of the difference in the figures of seasonal mean.

My second major concern is the applicability of the proposed methodology. Basically, the estimation method is sound, but the reason for that will not be obvious to non-specialists. The paper is motivated by a laudable need to estimate the errors from temporal mismatch. However, this analysis is applicable to particular sampling timing: observations taken at systematically different local times, as happens when a sun-synchronous satellite is compared to synoptic radiosondes. If the measurements have random time differences (say, dedicated sondes against satellites, or, GPS RO against sondes or other satellites), then the temporal mismatch adds a random error. This study addresses only systematic mismatch errors. The manuscript needs to be much clearer about the nature of the proposed correction, and its applicability be made much more obvious. This is touched on in on p. 8341 around line 25, but it should be clearly stated that the method used here requires a systematic time difference between sondes and satellite to be valid. On the plus side, this analysis is appropriate for comparison between sun-synchronous satellites and all operational sondes launched synoptically– not just those intended for satellite comparisons. Another strong selling point is that the time difference between sun-synchronous satellites and sondes at synoptic times 0Z and 12Z varies monotonically with longitude. Quantifying this effect

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is a strong justification for this work – but it is not mentioned in the manuscript.

That said, this applicability should be weigh against the small-proposed correction factors of order 0.1 K. This is significantly smaller than the typical errors from all satellite instruments except GPS RO. This needs to be part of the discussion.

The discussion of the methodology is incomplete. The description of Figure 3 simply states the correction factors "were calculated". Similarly, for Figures 4 and 5 the meaning of the term "calculations repeated" is unclear. The correction needs to be discussed in much more detail, maybe including an explicit definition with an equation. As for Figures 4 and 5, sondes are launched every 12 hours yet the calculations are shown for every six hours. Presumably these are time-corrected, but the discussion is missing. More explanation of the basic calculation methodology is needed before this manuscript can be published.

Finally, most of the results in Table 2 and Figure 6 are simple rescaling by dividing the first set of standard deviations by the square root of 30, and by 10. This does not justify their inclusion in the paper, and a simple discussion would suffice to summarize this result. Similarly, the conclusions twice state that 4 sondes launches are needed to resolve the diurnal cycle. Since the Shannon sampling theorem states the same thing (more or less), this is not an important result.

Here are addition comments:

Abstract first sentence. A preposition is missing, probably "of".

Abstract body. Say where the data were acquired, mention limitations to fixed time differences.

Abstract line 12. Another missing preposition.

p. 8340, line 19. "Upper atmosphere" should read "upper troposphere and stratosphere".

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p. 8341, line 14. Randal is a misspelling.

p. 8342, line 11. “Diurnal cycle” is more appropriate than current wording.

p. 8342, line 22. State explicitly how the difference is calculated (later time minus earlier time). See comment below about Figures 4 and 5.

The sentence on top of p. 8344 reads “The correction factor. . . were calculated”.

p. 8344, line 13. Four sondes are sufficient to resolve fully resolve a 24 hour cycle. The semidiurnal component of the variability will alias onto the mean.

p. 8345, line 5. Where are the changes in radiosonde type and analysis procedures that could explain the difference?

p. 8346. What sort of correction should be applied (presumably bias), and is the included “uncertainty” random?

p. 8346, line 10. See comments above about four samples per day resolving the diurnal cycle. Eight will resolve the diurnal and semidiurnal components.

Figure 4 and 5. The dash in the figures could be interpreted as 00:00 minus 06:00. Also, the caption should define the error bars as is done in the text.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 8339, 2014.