

Review of “Combining Data from the Distributed GRUAN Site Lauder-Invercargill, New Zealand, to Provide a Site Atmospheric State Best Estimate of Temperature” by Jordis S. Tradowsky et al.

The authors undertake to address the challenge of how to optimally combine periodic measurements from a distributed GRUAN site to create a continuous estimate of the atmospheric state for a target ECV of interest at the central location. The work is novel and interesting in terms of coming up with a potentially robust approach to addressing the challenge. The problem is also clearly in scope for the journal. As such the work is likely eventually publishable in ESD. However, I have a number of concerns which I would suggest be addressed prior to eventual publication. As far as I can tell, these are all concerns which the authors could address in revisions.

Before getting on to matters of a scientific nature, although well written there were times when I had a very strong sense of déjà vu in that entire passages were often repeated almost verbatim twice or more in the text. I would urge careful proofing to ensure that things are either said only once (obviously in the most appropriate place) or said sufficiently distinctly that the reader is not getting such a sense of déjà vu.

My biggest concern regards the results section which is presently in my view an inadequately in-depth assessment of the SASBE product quality. Substantial additional analysis is warranted here to justify publication. I would suggest:

1. Combining the current 4 figures into one single figure that covers the four day sequence.
2. Repeating that analysis for different levels and seasons so that you can satisfy the reader of the verity of the SASBE by showing a range of case studies.
3. Further, producing summary statistics of performance via the leave-one out type approach currently employed but for all levels and the entire SASBE series. i.e if you sequentially leave the Lauder ascents out how well does the SASBE reproduce the launch series given preceding and following Lauder launches and all Invercargill launches? Summary statistics should consider bias and spread based statistics.
4. The comparator of climatology is a necessary but not a sufficient benchmark. Comparison could also be made to the ERA-5 timeseries estimate interpolated to Lauder. As I understand it ECMWF did not, yet, incorporate Lauder ascents into the reanalysis (although that can and should be checked and verified). Thus the ERA-5 analysis would be formally independent of the series of Lauder ascents. As such it would be of great interest to ascertain how the SASBE approach stacks up against a state-of-the-art reanalysis.

The results section would require a substantial and comprehensive redraft in light of this expanded analysis.

In regards of the choice to consider the manufacturer processed data, after carefully checking the GRUAN website I see presently available data streams apparently from both Lauder and Invercargill. These may well be available only for the most recent past meaning that a SASBE processed using GRUAN processed data would be shorter. Nevertheless I think it would greatly benefit the paper were the analysis to be able to be redone using these

data-streams even if the resulting SASBE were much shorter. This would reduce the number of assumptions necessarily encoded in the current SASBE product.

Temperature given its large spatiotemporal scales is arguably the easiest ECV to perform such an analysis upon. I would suggest at a minimum discussing potential extensibility / challenges in considering other variable.

I would suggest being much clearer in Section 3 that the SASBE is being calculated on 16 levels and the justification as to why. Currently, the reader is first made formally aware of this as far as I could tell at the start of Section 4. The fact it is on standard levels and why (for the non-radiosonde experts) should be made much more explicit in building the model through Section 3.

Section 5 really constitutes a discussion section rather than conclusions. I would redraft current Section 5 explicitly as a discussion and add a short Section 6 which highlights concluding remarks.

While it is great to see the SASBE data archived in a long-term sticky archive, given that the primary aim is a tool being developed, arguably the greater value will be in the code. Is the code being archived and made available via e.g. Github? This should be considered and if it is shared how and under what conditions should be documented within the data availability section (would become section 7 if prior comment actioned). If it isn't openly shared then how it can be obtained should be outlined.

Other minor comments

I assume p.3 lines 4-5 is a stub sentence the authors meant to complete but did not do so. Please edit in revisions accordingly.

In p.5 line 5 I assume that the time difference extends in both directions (prior to and after) yet this is ambiguous as written. I would suggest being explicit here as the alternative explanation of providing information only post-measurement could also have been a logical choice.

In introducing the SASBE method in Section 3.1 I would be more explicit from the outset that the diurnal component is purely climatological in nature.

In p.6 line 7 good -> well