

Interactive comment on “Quantifying the value of redundant measurements at GRUAN sites” by F. Madonna et al.

Anonymous Referee #2

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Overall the subject matter and innovative approach of the manuscript are well-suited to AMT. The manuscript presents a novel method for quantitatively determining the correlation between time series or profiles made for the same measurement site by different measurement techniques. This method generalizes familiar statistical techniques that are best suited to normally distributed, linearly correlated datasets for datasets that may have substantially non-normal probability distributions and may have non-linear or non-monotonic correlations. This generalization represents a significant improvement over current state-of-the-art given the statistical properties of many observational datasets of interest in atmospheric science.

General comments: 1. Overall, the innovation and utility of the proposed method is that it is insensitive to outliers and does not assume underlying normal (Gaussian) statistics.
C1884

tics. This is a big advantage relative to many common methods used in atmospheric science. I think the paper could be more compelling if this aspect of the demonstrated method appears before 6337/19-22.

2. The concepts of entropy and mutual correlation presented here are may be unfamiliar to many readers. Although it is beyond the scope of the paper to provide a comprehensive introduction to these concepts, it would be beneficial to these readers to include some more illustrative introductory material. Something like Anscombe's quartet (Am. Stat. 1973) adapted to atmospheric data might be very powerful. Alternatively some text describing the kinds of differences that can be discerned in using entropy rather than standard deviations could be provided.

3. About "redundant information": one challenge in presenting this material is that "redundant" has the connotation of "unnecessary" to some readers, whereas in fact redundancy is highly beneficial for reducing uncertainty and increasing the credibility and scientific value of atmospheric datasets. A short paragraph providing an overview of the meaning and benefits of redundancy would be useful for this reason.

Specific comments: 6328/16 not sure what is meant by "conditioning" of the lidar measurements here

6332/17 "MC can be applied to" or "MC is applicable to"

6334/15-16 Generalized distances and metrics may be too unfamiliar to the average AMT reader; an introductory citation or sentence or two of elaboration would be useful

6335/8-9 "a relative error ... at 7 km a.g.l. of <25%"

6335/28 "ancillary information" seems unclear; maybe "additional measurements"?

6336/20-25 Would be useful to have a discussion of the disadvantages of too many bins in this paragraph or previous to it.

6338/1-15 A table summarizing the estimated uncertainties for the different IWV mea-

surements would be useful in interpreting this paragraph

6339/13 Would be useful to have a citation for the AERI retrieval used. The standard retrieval product available through the ARM archive uses the Feltz et al. (J. App. Meteorol. 2003) algorithm that utilizes a variety of a priori information. Information in this retrieval product for altitudes greater than 3 km is likely to be from the a priori. There is a newer optimal estimation algorithm (Turner and Loehnert J. Appl. Meteorol. Climatol. 2014) that is probably better in this respect, but is not operationally available. In any case, the paper should specify which algorithm is used for the product that is investigated.

6341/5-19 This paragraph is a bit abstract and challenging to follow. I can imagine synergistic products that utilize multiple measurements to a) reduce uncertainty via redundant information, or b) to add information by combining all-weather capability with cloud-sensitive measurements, or imaging with hyperspectral data. It is difficult to interpret this paragraph definitely with these different possibilities in mind. I would suggest either adding some specific details of synergistic products and implications of the analysis for developing these products, or more specifics on the types of synergies the authors have in mind.

6342/1 Not sure what is meant by "higher-order terms in the PDF"

6343/21-24 This conclusion seems less clear-cut to me; figure 4 suggests to me that MWR is a clear winner for SGP, but not for PAY or LIN.

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