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Atmospheric Measurement Techniques Discussions

Interactive comment on "Total variation of atmospheric data: covariance minimization about objective functions to detect conditions of interest" *by* N. Hamilton

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General comments: This paper offers a new interesting method to analyse a multivariable atmospheric data set. The method is clearly described, and the data analysis is thorough. It seems like a very versatile method with potentially many different usage scenarios. The manuscript would benefit by considering the points below.

The language could be simplified at times and some sentences could be broken up for easier reading.

Abstract: The problem statement in the abstract could be shortened, while at the same

time there could be more information on the subject/method itself. The abstract would also be improved by including main results and findings.

Sections 2 and 3 could be shortened a bit. This would give the main part (section 4) of the paper more focus. A suggestion: Perhaps Table 1 and corresponding text could be removed as it is not so relevant for the focus in the paper.

It is not completely clear what parts of the method are novel and what has been done before. This could be pointed out.

The paper would benefit from a stronger discussion, perhaps in a dedicated section of its own.

A thought: When we apply specific objective functions, we generally decrease the total variation and find conditions of interest by minimizing the total variance. Would we find similar conditions by not applying any objective functions and maximizing the total variation instead?

Are there any available codes or scripts with this method implemented?

Specific comments:

In the abstract lines 3-4: "Most often, conditions of interest are determined as those that occur most frequently. . ." And similarly, p. 3, lines 12-13: "Within any wind plant data. . ." This statement would benefit from a reference, because it could be argued that the opposite often holds true. E.g. for wind turbine site assessment and certification, the conditions of interest are critical weather and extreme conditions.

Introduction, p. 2, lines 25-27: This is quite a strong statement – it would benefit from a citation or further argumentation. Introduction, p. 2, lines 27-29: Direct comparison of statistical quantities to what? Why does that discount the coupling between quantities that underpin atmospheric physics? This could be clarified and explained further.

Figure 1 a): The numbers on the colorbar are missing the number 9 in front of 00 and

50.

Equation 4-5: Should just be a single equation with one number. Further, I cannot see how the matrix multiplication would result in the covariance matrix. Unless the average of each column has been subtracted from the values in D ÌĆ and the values have been divided by m. If that is the case, it should be mentioned. At this point in the paper normalization has not been mentioned.

Figure 6: It does not seem that the histogram adds up to 100%. Has the data been cut off at Total Variation=0.3? It would be better to show the whole range of the Total Variation.

Figure 7 a) is not mentioned anywhere in the text. It should be commented and explained in the text.

Page 12, equation 12-13. Again, should just be one equation. Also, what objective function is used for the TI? It is not mentioned.

Page 12: When the objective function eq. 9 is applied to the wind speed, what objective functions are then applied to the direction change and TI at the same time?

Page 12, lines 17-18: "Defining specific functions, even of the same forms, would likely increase the average value and spread of V. . .". Are you certain of this? According to Figure 9 a) the average value and spread of V has decreased by subtracting the objective functions from the data. As you mentioned, subtracting the objective function acts as detrending, and therefore it should be expected that the total variation would always decrease, as it is only the stochastic part of the data that determines the covariance of the remaining data.

Figure 9: Includes two subfigures named (d). Also, these are not mentioned in the text, but should be. What is fit frequency - is it connected to eq. 11? Could you elaborate?

Section 5: The data used in this section is synthetic, and provides a very illustrative example of the sensitivity. However, I wonder if the removed points can be interpreted

as outliers. Could we not say that these are extremes? Maybe the outliers could be assigned standard deviations outside of the range [0, 10], to ensure that they represent "real" outliers due to e.g. measurement errors.

Page 16, line 25: ". . . the method is independent of the length of the data record. . .". How can this statement be supported by the current analysis?

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