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Interactive comment on "A diagram for evaluating multiple aspects of model performance in simulating vector fields" *by* Zhongfeng Xu et al.

Zhongfeng Xu et al.

xuzhf@tea.ac.cn

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Thanks for the reviewer's valuable comments. Our point-by-point responses to reviewer's comments are listed below after each RC2 comment.

Page 2, Line 25: The same shortcoming to be ascribed to the correlation of two scalar fields when a constant is added to one of them. However, in both the vector and scalar cases, the RMS difference would change, so the change would still be diagnosed.

Response: Correlation coefficient is commonly used to measure the pattern similarity of two scalar fields. However computing correlation coefficient for the x- and y-component of two vector fields is not well suited for examining the pattern similarity of two vector fields as discussed in Page 2 Line 25. For example, If the x-component of vector field A adds a constant value, the correlation coefficients for both the x- and

y-component do not change, but the direction and length of vector A change, which suggests that the pattern of two vector fields are no longer identical. This is the reason why we develop a vector similarity coefficient in this paper. The centered RMSE used in Taylor diagram cannot detect the change of scalar field when a constant is added to it because the mean difference has been removed in the centered RMSE. As the reviewer argued, RMS difference can detect the change in mean. However RMS difference is not commonly used to measure the pattern similarity. For example, the pattern of scalar field does not change if the field adds a constant but RMS difference changes. Under such circumstance, the changes in RMS difference results from mean value change not the pattern change. Similarly, RMSVD is not suitable to measure pattern similarity, either. The VFE diagram developed in this paper can show how much RMSVD is attributed to the systematic difference in RMSL and how much is due to the poor pattern similarity (VSC).

P2, L27-30: The same issue arises with Taylor diagrams for scalar fields – a change in a model might improve spatial correlation while increasing RMS differences. (However, the motivation to construct a vector-equvalent to the Taylor diagram still remains.)

Response: It is true that a change in a model might improve spatial correlation while increase RMSE, because both the changes in correlation and standard deviation can affect RMSE. RMSE could increase if the modeled standard deviation increase compared with observation although correlation is improved. This is one of the important reasons why we need to examine multiple statistics rather than only one statistical variable. Taylor diagram provide a simple way to show multiple statistics on one diagram and can clearly show the how much change in centered RMSE can be attributed to the change in standard deviation and how much is due to the change in correlation coefficient. As the VFE diagram is a generalized Taylor diagram, VFE diagram can also provide similar information (Page 1 Line 21-23).

P3m L24: The Rv definition is plausible as a measure of similarity, but it may help many readers if some motivation for it were given. For example, you are looking for a measure of similarity that recognizes how much the vectors point in the same direction; you want something that is independent of the average magnitude of the vectors; etc.

Response: We add one sentence to point out the motivation of developing Rv in section 2 in the revised manuscript. The sentence is “To measure the similarity between vector fields A âČŚ and B âČŚ, a vector similarity coefficient (VSC) should be able to recognize how much and to what degree the vectors are in the same direction and the vector lengths are proportional to each other. Thus VSC is defined as follows:”.

P7, L 17-18: The governing influence of longer vectors should be emphasized, for it suggests that error in determining the vector (say, an observational vector) does not undermine the Rv value when there are some vectors in the sequence that are relatively small in magnitude compared to the error, so long as the longer ones have small relative error.

Response: We interpret the governing influence of longer vectors further in the revised manuscript to provide more insight of Rv. The sentences are rephrased as: “A positive (negative) Rv is observed when the 30 vector lengths and included angles are negatively (positively) correlated. This means that the patterns of two vector fields are closer (opposite) to each other when the included angles between the long vectors are small (large). Specifically, the rotation of shorter vector may not undermine RV too much as long as the longer vectors remain unchanged. In contrast, RV would be strongly undermined with the rotation of longer vectors. Simply put, the longer vectors generally play a more important role than the shorter vectors in determining Rv.”

P10, L10: Observations have error. If observations are used as the reference field, can the influence of that error on precise positioning of a model's mark on the diagram. If one assumes random error, can that be folded into the display on the diagram and thus illustrate when model results agree with observations to within the observational uncertainty? Or perhaps illustrate the relative size of some other “noise” quantitites, such as the ranges of values due to interannual variability.

Response: In the revised manuscript, we add a new section (Section 6) to address the observational uncertainty issue. The general idea is that we can use the mean of multiple observational estimates as reference data. All model results and individual observational estimate compare with the reference data and show these statistics on the VFE diagram. The observational uncertainty can be roughly estimated by the spread of symbols those describe the statistics of individual observational estimate against mean of multiple observational estimates. A new figure (Fig.10 in the revised manuscript) is also added to illustrate the observational uncertainty.

Please also note the supplement to this comment:
http://www.geosci-model-dev-discuss.net/gmd-2016-172/gmd-2016-172-AC2-supplement.pdf

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