



Interactive comment on “Physically-based data assimilation” by G. Levy et al.

Anonymous Referee #1

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This paper seems to propose a new method of data assimilation. The method has a basis on low-dimensional features of both model and data, which enable us to reduce computational costs of data assimilation, compared with standard methods such as the Kalman filter and the 4D-Var. Demonstration using sea-ice model is also shown.

As a whole, the present paper reads ambiguous and does not fully explain the method.

1. Why “physically- based” ? Where is the “physics”?

The meaning of the term “physically-based”, which appears even in the title, is unclear. The term should be explained in the text. If the model is constructed on physical laws, data assimilation based on the model may be called in the same way.

2. Relation between the low-dimensional model features and model variables

According to section 2.1, the low-dimensional model features can be transformed into

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the model variables. If the model variables are diagnostic ones, which can be derived from the low-dimensional features, control variables of the data assimilation need to include the low-dimensional features alone, and the rest model variables can be excluded. In this case, the computational costs for the data assimilation can be reduced as a matter of course, even using the traditional data assimilation methods. Where is the advantage of the proposed method?

3. Relation between the traditional data assimilation methods

In connection with the previous comment, the proposed method is not fully explained. It should be described in contrast with the traditional methods such as the ensemble Kalman filter and the 4D-Var.

4. Necessity of the fuzzy verification metric

As in section 2.1, the fuzzy verification metric seems to be used to evaluate mode-to-data misfit, which is typically done with the innovations. The fuzzy metric seems a part of core ideas of the proposed assimilation method. But its importance is unclear.

5. Description of the sea-ice model

The model used in the assimilation experiment is described in Appendix A, and it is too long when we remember the main topic of the present paper, physically-based data assimilation. The description should appear elsewhere. The present paper needs more description of the proposed data assimilation method instead.

6. Examination of the result

The authors should examine the details of the result, which is shown in Figure 2. Why the differences appear between the control run and the experimental run? Why is the control and the experimental runs produce skills not in-phase?

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