Geoscientific
Model Development
Discussions

Interactive comment on "A mask-state algorithm to accelerate volcanic ash data assimilation" *by* Guangliang Fu et al.

Anonymous Referee #1

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General comments:

The article presents a nice study of Ensemble Kalman Filter application for the prediction of volcanic ash and an extension for acceleration. Indeed, the analysis step involves large computational cost and this cost is reduced by employing the existence of "zero rows" in the ensemble matrix. As parallel computing is efficiently used (e.g. Khairullah et al. 2013) to reduce the analysis time in data assimilation and the authors also use parallel computing facilities only for the forecast step, which can be treated as an under utilization of the resources. Certainly inclusion of parallel computing (mentioned as a future work) also in the analysis step (both for the conventional and MS EnKF) would make the work more complete. Nevertheless, the reported work is an important research and is worth reading. Some improvements/clarifications/modifications are suggested below.

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Specific comments:

1. The variable notation N_{ash} should changed to n_{ash} as the small n presents number of grid points (line 4.30).

2. Equation (15) indicates whether we would have speedup by the MS method (line 4.5). Could it be extended to explicitly specify the expected amount of speed up (with some assumptions if necessary)?

3. Some explanations are necessary about the involved operations in the others part for the clarification and justification of the less (by 0.03h) computational time (Table-1).

4. The computational overhead involved to transform the full matrix to a small one and vice versa should be explicitly discussed. The effect in the computation time should be also discussed.

5. Line 3.20 : It is mentioned that 72% of the total runtime is spent on the analysis step. This information can be further extended (preferably with mathematical formulation) to predict the maximum computational speedup (e.g. 3.57 for the case in this paper). c.f. Amdahl's law (Amdahl, Gene M. (1967). "Validity of the Single Processor Approach to Achieving Large-Scale Computing Capabilities". AFIPS Conference Proceedings (30): 483–485.)

6. Related to the above point, a further discussion about the discrepancy in the actual speedup (e.g. 2.24 for the case in this paper) from the predicted speedup could be included.

7. It is understood form equation (15) the total speedup is quite low, is there any statistical data regarding the value of n_{ash}/n to know the probability of the applicability of the proposed method and justify the weight of the work?

8. The paper investigates actually a single method (MS) to accelerate volcanic ash data assimilation. Other methods are only referred (e.g. parallelization of the analysis step) or contrasted (e.g. localization) and are not really investigated in this paper. So,

the plural form (e.g. strategies) should be omitted.

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