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Geoscientific Model Development Discussions

Interactive comment on "Comparison of the ensemble Kalman filter and 4D-Var assimilation methods using a stratospheric tracer transport model" *by* S. Skachko et al.

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We appreciate very much the Anonymous Referee 3's comments. We have answered all questions. Each answer starts with "ANSWER:". We have kept the original Referee's comments in Bold.

Major comments: 1. The overall conclusion from this paper on the comparison between 4D-Var and EnKF suggests no significant difference between the two data assimilation methods. However, Fig. 5 shows 4D-Var outperforms EnKF only very slightly but quite consistently. If the statistical hypothesis testing (or statistical inference) considers the correlations in time series, statistical signifi-

cance may be obtained to support 4D-Var's advantage. However, it appears that the paper does not consider correlations in statistical inference, this does not seem a wise choice to make the comparison of time series. I would suggest performing statistical inference with correlations considered, that may lead to different conclusion.

ANSWER: Fig.4 shows the OmF statistics and the statistical T- and F-tests for all pressure levels during the period of one month, where the difference in performance of the two systems is the most important. And the statistical tests show that there is no significant difference for confidence interval of 95% between the 4D-Var and EnKF OmF's at any pressure level. Fig.5 shows the same OmF statistics but for a particular pressure level during the whole experiment. The T- and F-tests may be performed for any given day of the temporal error evolution on Fig.5, but they provide similar results (not shown): the difference between the 4D-Var and EnKF OmF's is insignificant for the same confidence interval. Moreover, considering the correlations for the standard deviations and biases may be difficult to interpret.

Minor comments: 1. P.340, L.2, "The" -> "An"

ANSWER: Done

2. Eq. (18), the notations of rho and the Schur product do not look precise, need revisions. Eq. (17) assumes that rho has the same shape as the B matrix, and that the open circle operator indicates the element-wise product. Eq. (18) uses the same rho and open circle operator but applied to HBH, that has the matrix shape of the R matrix, not B. The same applies to Eq. (19). Also, Eq. (18) is an approximation, should not use the equal sign.

ANSWER: Done. We added indexes m and o to the matrix ρ and added the following sentence to the text: 'The indexes m and o are introduced to show that the dimension of the matrix ρ corresponds to the model and observation space dimensions, when the Schur product is applied to the matrix $\mathbf{B}_e\mathbf{H}^T$ and $\mathbf{H}\mathbf{B}_e\mathbf{H}^T$, respectively.'

3. P.352, L.13, zeta in Eq. (4) is not an analysis increment, but control variables.

ANSWER: Yes. We corrected the sentence.

4. P.352, L.24, "mathematical" -> "statistical" ?

ANSWER: Yes.

5. P.372, Fig. 2, the values of alpha and r in figure caption are not consistent with legend and main text.

ANSWER: We checked the text.

6. P.357, L.11, I do not understand why 48 analyses. Does this mean EnKF analysis is computed 48 times during the 24-h period? It is necessary to clarify what "48" means.

ANSWER: The model time step is 0.5 h. So, during 24 h, model performs analyses 48 times. The text is checked.

Interactive comment on Geosci. Model Dev. Discuss., 7, 339, 2014.