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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Data-driven versus self-similar parameterizations for Stochastic Advection by Lie Transport and Location Uncertainty" *by* Valentin Resseguier et al.

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Answer to reviewer #2

First of all, we would like to express our warm thanks to the reviewers and the editor for the evaluation work they did and for all the comments and suggestions the reviewers have provided on our study. Hereafter, we will answer in details the questions of the referee #2. Accordingly, we will propose some changes that we could do in a revised version, if the editor enables a revised submission.

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Discussion paper

"General: This paper introduced the stochastic subgrid parameterizations which express the unresolved velocity from the large-scale velocity. Self-similar schemes with SALT and LU frameworks are proposed with details and compared with the data-driven models in the Surface Quasi-Geostrophic (SQG) model. The authors focus on their common challenge: the parameterization choice. The results show that both parameterizations lead to high quality ensemble forecasts."

Thank you for this summary of our work.

"This paper is well organized, and also contains some interesting components."

Thank you for the interest.

"I think it is suitable for publication in NPG, however, there are some issues to be addressed."

1. **"Page 6, the authors compared figures 2 and 3 in line 171, indicated some features of the homogeneous parameterization in line 174. Actually, only the first row of figure 3 was referred here. In Page 8 line 205, they state 'Figure 3 confirms that this modulation enables a more accurate spatial distribution of the stochastic foldings', it is more convincing if the reference distribution is in the same figure. I suggest to merge figure 2 and 3."**

   You are right, it would be clearer if figures 2 and 3 are merged. We have separated them because the figure was originally too large for the page. Nevertheless, we can try to merge them again in a revised version.

2. **"Page 19, line 370 and line 378, it is not recommended to say SALT-LU SQG dynamics. Although the slight difference between the SQG SALT and the**

SQG LU models are not considered in this section (indicated in line 318), they are not combined. So, please use an other abbreviate."

In a revised version, we propose to use instead either only "LU" or "SALT and LU", depending on the readability of the sentence.

3. **"Page 16, the caption of figure 4 is not correct."**

   Yes this is right. We have written :

   "Buoyancy (m.s$^{-}2$) at $t = 0, 10, 30, 50$ and 70 days of advection (top) and its spectrum (m^2.s$^{-}4$/(rad.m$^{-}1$)) at $t = 50$ days of advection (bottom) for the deterministic SQG model at resolution 512^2."

   Instead of :

   "Buoyancy (m.s$^{-}2$) (left), KE spectrum (m^2.s$^{-}2$/(rad.m$^{-}1$)) (middle) and ADSDs (m^2.s$^{-}1$/(rad.m$^{-}1$)) (right) at $t = 0, 30, 50$ and 70 days of advection, for the deterministic SQG model at resolution 512^2."

   We will correct that.

   There is also a typo in the caption of figure 6 – "$t = 17$ days" instead of "$t = 100$ days" – that will be corrected.

4. **"A legend is required for the right plot of figure 6. Also the colors for different number of EOFs are difficult to distinguish in that plot."**

   Indeed, the plot is not easy to read. We will add a legend and try colors which are more different.

5. **"Figure 7, although the SALT-LU dynamics is not worse than a low-resolution deterministic simulation, it did not show many advantages as figures 2&3 shown. The scenarios of figure 7 and figure 2&3 have different resolutions (128^2 and 64^2) and different integration days(day 15 and day**

110). Give reasons why both data-driven and self-similar parameterizations have very weak improvements in figure 7."

For the short-term simulations, our stochastic subgrid parameterizations have often weak improvements on the low-resolution simulations, even though, sometimes, the stochastic subgrid parameterization can improve the simulation. Indeed, Resseguier et al. (2017b) show that the LU dynamics at a resolution 128x128 can trigger filament instabilities by random destabilization, and hence obtain a more realistic proportion of eddies and filaments. This is confirmed by the figures 2 and 3 of our submitted draft, also at a resolution 128x128. In figure 7, the resolution is coarser (64x64). Therefore, the stabilizing deterministic subgrid tensor (hyper viscosity) is stronger. This may explain an inhibition of filament instabilities here, and hence less difference between deterministic and stochastic coarse simulations.

We could add this discussion to the subsection "3.3 One realization" in a revised version of our draft.

Nevertheless, our main goal is not improving a single simulation. Our main goal is improving the uncertainty quantification without deteriorating single simulations.

6. **"Page 22, line 393, why the error estimation is 1.96 times the point-wise std?"**

   Mean $+/-1.96$ times the point-wise std bound the 95%-confidence interval for Gaussian variables. Here, the buoyancy is not Gaussian. However, we believe that $+/-1.96$ times the point-wise std remains a simple and convenient approximate metric to define an acceptable bias.

   We should explain more this choice in a revised version.

7. **"Mark the grid points chosen for figures 10 and 11 in figure 9."**

   We will do this.

8. **"The authors have shown the predictability time for one realization is about 2 weeks. They also showed that the ensemble forecast can capture well the reference dynamics of the center of the ensemble distribution for longer period in figures 10 and 11. It is hard to tell the predictability time for ensemble forecast from the first column of figure 9. The authors should plot the ensemble mean of each SQG dynamics analogs to figures 7 and 8, and make a statement about the predictability time of ensemble forecast."**

   We will add these plots in a revised version.

We thank again the reviewer for all these useful comments and questions.

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