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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Training a convolutional neural network to conserve mass in data assimilation" *by* Yvonne Ruckstuhl et al.

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This is a well-written manuscript with very interesting results. My major comment is that this manuscript is rather short and that it could be extended to give more insightful results.

Major comments:

1) I would be in favour to see how the conclusions change depending of the grid size and the ensemble size.

2) There is a trade-off between mass conservation and low RMSE for u and h. What happens if in the experiments with the additional penalty term for mass conservation instead of a linear activation function for u and h, the "relu" activation function is used

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for both u and h as well as for r? Is the trade-off smaller then?

3) Authors remove the climatological mean from u and h. What happens if the climatological mean is not subtracted? Is the bias too high for the methods to handle?

Minor comments:

1) l.8: The last sentence of the abstract is rather vague. Please elaborate.

2) l.146: Does the loss function $\hat{J}_\gamma$ account for the mass twice: in J and in the penalty term?

3) Please change γ to something else, since it is already reserved for the gravity wave speed.

4) Why is the penalty term chosen in such a way, namely L1 norm and not L2 as in J?

5) If I look at Fig. 2(a) I see that NN is performing slightly better than QPEns. Is there an explanation for that?

6) l.92: “For the EnKF negative values for rain are set to zero if they occur”. This is the variable r, if I understand correctly. However, if I look at Figure 7, I see negative values of r for EnKF. Could authors please explain?

7) A table consistent of wall-clock time for different methods would be insightful for the computational cost gain.

8) I do not want to be self-promoted but authors could have a look at Dubinkina 2018 and decide if they would like to refer to it in their manuscript.

S. Dubinkina, "Relevance of conservative numerical schemes for an Ensemble Kalman Filter", Q.J.R. Meteorol. Soc., 144 (2018), pp.467-477, doi:10.1002/qj.3219

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