Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2022-50

Anonymous Referee #1

Referee comment on "Neural networks for data assimilation of surface and upper-air data in Rio de Janeiro" by Vinícius Albuquerque de Almeida et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-50-RC1, 2022

The motivation to replace data assimilation with neural network is attractive. Application of assimilation did demand high computational costs, e.g., forwarding ensemble members in EnKF, maintaining the adjoint and optimization in 4DVar. In this work, simple MLP models are tested to replace a 3DVar assimilation in a relatively small city region with limited number of observations. I would suggest authors to make substantial modification before submitting it again.

Major ones:

- Assimilation like 4D-Var or EnKF did requires huge computation efforts. However, the 3D-Var calculation complexity is proportion to the size of model or observations, it is usually trivial as illustrated in Table 4 (several seconds). Even handling models with larger size or with super data like remote sensing obsers, the issue could be solved through regional analysis easily. The choice of 3D-Var is faint to support the motivation.
- In Figure 3 and 4: The author provides very limited samples or snapshots of analysis for testing their trained NN model, without stating the overall performance in the whole testing dataset.
- Page 9, line 206: only 5 airport measurements are assimilated for analysis. Meanwhile, these same data are used for generation of pseudo-observation for validating the analysis? That is not the corrected way to using the measurements. Crossing validation is required. Please Check Ref: Peter Rayner. Data assimilation using an ensemble of models: a hierarchical approach., 2020, ACP.
- In Table 3, NN-TensorFlow outperforms the 3D-Var? It is not solid, afterall, 3D-Var analysis is the learning object of NN? Performance should be examined in-depth.

Minor:

As long as they described the CPU time for assimilation in 3D-Var, NN-TF, NN-Weka in Table 4. It is essential to illustrate the size of the problem, vec ***x*** and ***y*** in Eq(1), and the solver/environment for 3D-Var and NN. Otherwise, the comparison is unfair.

How to train the NN is unclear, what is the output actually? the analysis over the whole model domain? Or is it trained grid by grid? How many samples in their 4-year dataset?