Interactive comment on "Multiple scale error growth in a convection-resolving model" *by* F. Uboldi and A. Trevisan

Anonymous Referee #2

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This paper investigates the multi-scale instabilities in a non-hydrostatic forecast model based on the bred vectors which are normally used to generate the initial perturbations to initialize an ensemble forecast system at NWP centers. Although many interesting results are presented in various numerical experiments, some of them need to be further investigated before drawing conclusions. The manuscript needs to be revised and some statements or issues need to be clarified or addressed before it is considered for publication.

Comments:

1. Bred vectors are designed to efficiently generate the initial perturbations for an ensemble of forecasts. The main goal of the breeding technique is to find the dominant initial errors that exist in the analysis field produced by the data assimilation system.

Once the ensemble forecasts based on these bred vectors start, the error growth and multi-scale features are also impacted by the model related errors from the physical parameterizations in the sub-grid scales, especially in this convective-resolving non-hydrostatic model. In my opinion, the model errors have had major impacts on the results in Figures 1-4 and 8 showing the error growth features as a function of forecast lead time. The impacts should not be attributed only to different bred vectors with different update frequencies and rescaling magnitudes. This major issue should be addressed by the authors.

2. Another major issue is about the multi-scale feature. The authors simply assume that the spatial scales of bred vectors are defined by the rescaling amplitudes and time interval of the breeding cycles. This is not necessarily true. The rescaling amplitudes defines the sizes of the bred vectors. When a bred vector is scaled up or down by constant values, the spatial pattern is not changed. The spatial scales should be based on the spatial patterns in a geographical distributions, either horizontal or vertical direction. One way to estimate the spatial scale of an error field is based on the spatial de-correlation length which can be computed, for example. At the very least, the authors should demonstrate that the bred vectors with smaller/larger rescaling amplitudes indeed have the respective smaller/larger scales.

Other minor comments:

1. P449, L15, shading should be shedding. 2. P453, L6, which control state? 3. P455, 1st sentence in last para is confused, needs to be modified. 4. P456, last para, TUV scalar product is not clearly defined or explained, why it becomes dimensionless. 5. P461, L15, "A supplementary 12 bred-vector set ….", it is not clear how this set is different from the original set, it appears the same. 6. P465, L6, analysis should be analyses. 7. There are some other sentences that need to be improved across the manuscript.

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