Geoscientific

Model Development

Discussions

[GMDD]

Interactive

comment

Interactive comment on "Adding Four Dimensional Data Assimilation by Analysis Nudging to the Model for Prediction Across Scales – Atmosphere (Version 4.0)" *by* Orren Russell Bullock Jr. et al.

Anonymous Referee #2

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The manuscript "Adding Four Dimensional Data Assimilation by Analysis Nudging to the Model for Prediction Across Scales - Atmosphere (Version 4.0)" provides a description of the implementation of a nudging scheme into the MPAS model and provides results from an experiment testing this scheme by assimilating synthetic observations from a target field into the MPAS model state.

While the manuscript is well-written and provides a detailed description of the implementations, experiments and results, I find some major issues which should be addressed before publication (see comments below). Therefore, I recommend "major

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Discussion paper

revision" for the manuscript.

Major comments:

1) As the focus of the manuscript is nudging as a DA method, the authors should extend the introduction section with the focus being more on nudging and less on air quality.

2) The implementation of the nudging algorithm and the setup of the experiment is well documented in the manuscript. However, there are some issues with the experiment setup which in my opinion are important to discuss: a) The observations assimilated into the model state are synthetic observations generated from NCEP analysis fields. As the implementation does work as expected, the nudged simulations closely resemble the input data. However, one major advantage of the nudging algorithm is to allow for a free simulation the atmospheric processes corresponding to the model physics while being (temporally) constraint to the observations (or the target field in this case). With respect to the experiment design, the authors should add more discussion (and probably analysis) on this aspect. The experiment without PBL assimilation seems to be a natural starting point for this. b) The setup of the experiment is based on the truth being represented by the target field. The synthetic observations are drawn from this field in a homogeneous and dense fashion. With this setup, it is not difficult to achieve an accordance of the model with the target and the result will not strongly depend on the nudging coefficient(s). However, in reality, observations of the truth are heterogeneous, sparse and rare. Therefore, finding a reasonable and balanced setup which produces sound estimates of the atmospheric states is much harder especially with respect to the temporal availability of observations. Do the authors intend to do such experiments/simulations in the future? The authors should also provide results of sensitivity experiments with respect to the nudging coefficient.

3) The authors should provide plots containing information on the analysis increments from the nudging with respect to its spatial and temporal variability.

Minor comments:

C2

Page 2 Line 17: Please provide a reference for the Voronoi mesh.

Page 2 Line 23: Is the mesh really unstructured?

Page 6 Line 4: "show" instead of "shows"

Page 7 Line 3f: I a not able to comprehend what the authors want to say with this sentence.

Page 8 Line 29: It would rather say "are larger" instead of "are much larger"

Page 9 Line 11: "RMSE" instead of "RMSA"

Page 10 Line 2: "than" instead of "that"

Discussion on Figures 10 to 13: The shape of the bottom and top diagram differ mostly by amplitude. Does this behavior arise from the fact that a majority of observations is coming from the CONUS region? Please elaborate on this.

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Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2017-246, 2017.