

Response to reviewers of the manuscript

“A 3D-Var Assimilation Scheme for Vertical Velocity with the CMA-MESO v5.0”

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for Geoscientific Model Development

Response to Reviewer #1

Reviewer #1

The authors have addressed all my comments. I suggest to publish it after a minor revision.

Response: Thanks very much for taking your time to review our manuscript. I really appreciate all your comments and suggestions. Please find my responses in the following and my revisions/corrections in the resubmitted files.

Line 20-23: The FSS and ETS statements can be merged.

Response: Thank you for your valuable comments. The statements have been revised to “Further assimilation of w , in addition to the assimilation of conventional and radial wind data, significantly improves the forecast accuracy of precipitation, resulting in higher FSS (frequency skill score) values and higher ETS (equitable threat score) skills at higher thresholds (5 and 20 mm h⁻¹.” in the revised manuscript (Lines 20–22).

Line 318-320: It would be better to say "The adjustments in temperature and humidity increments are achieved by weak physical constraints" first and then pose a potential solution to introduce multivariate correlation in the static BEC. Also, need some references here regarding the multivariate correlation.

Response: Thank you for your suggestion. It has been revised to “1) The adjustments in temperature and humidity increments are achieved by weak physical constraints, and it would be better to take into account the multivariate correlation between control variables (Hollingsworth and Lönnberg, 1986; Barker et al., 2004).” as suggested (Lines 319–321 in the revised manuscript).

Line 323: it would be better if say "assimilating w from these observations".

Response: Thank you for your suggestion. It has been revised as suggested (Lines 323–324 in the revised manuscript).

We thank the reviewer again for taking the time to review our manuscript.

Response to Reviewer #2

Reviewer #2

The authors have addressed most comments, and the quality of the manuscript improves a lot. I suggest publishing it after a minor revision. I am grateful for the chance to review the updated manuscript. The author has adequately addressed my previous concerns and suggestions, leading to a more organized and articulate structure, as well as improved language expression. I think the manuscript is now ready for publication after some additional language refinement as follows.

Response: We sincerely thank the reviewer for thoroughly reviewing our manuscript and providing very helpful comments to guide our revision.

1. Line 20: “The further assimilation...”, delete “The”; “in addition to the conventional and radial wind data assimilation” revised to “in addition to the assimilation of.....”.

Response: Thank you for your suggestion. It has been revised as suggested (Line 20 in the revised manuscript).

2. Line 29: Change “defining” to “the definition of”.

Response: Thank you for your suggestion. It has been revised as suggested (Line 28 in the revised manuscript).

3. Line 35: Revise “in enhancing the forecast accuracy of convective precipitation” to “for improving the accuracy of convective precipitation forecast”.

Response: Thank you for your suggestion. It has been revised as suggested (Line 34 in the revised manuscript).

4. Line 70: Change “to other model state variables for minimizing” to “to other state variables of the model to minimize”.

Response: Thank you for your suggestion. It has been revised as suggested (Line 69 in the revised manuscript).

5. Line 83: Change “nonhydrostatic” to “non-hydrostatic”.

Response: Thank you for your suggestion. Revised as suggested (Lines 81–82 in the revised manuscript).

6. Line 113: Change “under the terrain-following vertical coordinate” to “under the vertical coordinate that follows the terrain”.

Response: Thank you for your suggestion. It has been revised as suggested (Line 113 in the revised manuscript).

7. Line 115: “links the w variable to the u, v...”, change “to” to “with”.

Response: Thank you for your suggestion. Revised as suggested (Line 115 in the revised manuscript).

8. Line 128 : Add “the” before “term”.

Response: Thank you for your suggestion. Revised as suggested (Line 128 in the revised manuscript).

9. Line 146: Change “The background field’s w value” to “The w value of the background field”.

Response: Thank you for your suggestion. It has been revised as suggested (Line 146 in the revised manuscript).

10. Line 160: Change “It is worth noting” to “It should be noted”.

Response: Thank you for your suggestion. Revised as suggested (Line 160 in the revised manuscript).

11. Line 161: It should be better to say “there are currently no constraints on the propagation of the impact of the w assimilation in the vertical direction”.

Response: Thank you for your suggestion. It has been revised as suggested (Lines 160–161 in the revised manuscript).

12. Line 162: Change “thus leading” to “which leads”.

Response: Thank you for your suggestion. Revised as suggested (Line 162 in the revised manuscript).

13. Lines 178-179: Change “the assimilation experiment’s scope” to “the scope of the assimilation experiment”.

Response: Thank you for your suggestion. It has been revised as suggested (Lines 178–179 in the revised manuscript).

14. Line 179: Change “that” to “what”.

Response: Thank you for your suggestion. Revised as suggested (Line 179 in the revised manuscript).

15. Line 190: Change “the maximum w value” to “the maximum value of w”.

Response: Thank you for your suggestion. Revised as suggested (Line 190 in the revised manuscript).

16. Line 207: Change “run” to “ran”.

Response: Thank you for your suggestion. Revised as suggested (Line 207 in the revised manuscript).

17. Line 236: “demonstrate” should be “demonstrates”.

Response: Thank you for your suggestion. Revised as suggested (Line 236 in the revised manuscript).

18. Line 268: Change “The heavy precipitation center” to “The center of heavy precipitation”.

Response: Thank you for your suggestion. Revised as suggested (Line 268 in the revised manuscript).

19. Line 300: Change “assimilating” to “the assimilation of”.

Response: Thank you for your suggestion. Revised as suggested (Line 300 in the revised manuscript).

20. Line 327: Change “given that” to “since”.

Response: Thank you for your suggestion. Revised as suggested (Line 328 in the revised manuscript).

I commend the authors for their efforts and cooperation, and look forward to seeing the article published.

We appreciate the warm work of the reviewer in earnest and hope that the correction will meet with approval. Once again, thank you very much for your comments and suggestions.