

Geosci. Model Dev. Discuss., referee comment RC1  
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## **Comment on gmd-2021-171**

Anonymous Referee #1

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Referee comment on "Numerically consistent budgets of potential temperature, momentum, and moisture in Cartesian coordinates: application to the WRF model" by Matthias Göbel et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-171-RC1>, 2021

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This paper introduces a budget tool for the WRF model and shows a successful closure of this budget with very small residuals based on a Cartesian formulation of the advection terms. There are many details considered in achieving this, especially how the time-varying heights of coordinate surfaces in the mass-coordinate model are represented. The paper is valuable in describing this and WRFlux looks like it would be useful to the community by saving rediscovering these details when others want to do accurate budgets.

The paper is very close to acceptable as is. I will note some minor issues and some confusion regarding references to equation numbers that have to be corrected for publication.

### Minor Points

1. Line 235. It would be good to mention the length of the simulation here as this surface flux would only be reasonable for a period of a few hours.
2. Figure 2 caption. Should this be Eq. 8 instead of 6?
3. Line 292-295. Some orders of magnitude here seem ten times too large compared to Figures 1 and 2.  $10^{-3}$  and  $10^{-4}$  look more accurate.

4. Figure 4. Should be Eq. 13, 14 and 15.

5. Table 1. Also should be Eq. 13, 14 and 15.

6. Line 303. Is this the lowest level only?

7. Figure 5. Labels 15 and 16 should be 14 and 15. Caption appears correct.

8. Line 318. References to Eq. 15 and 14 should be 16 and 15.

9. Line 339. Maybe "total" is better than "final" here.

10. Figure 2. Comment: This large difference is interesting and I would like to have a better conceptual idea of why. Is it because the Cartesian representation is somehow less sensitive to coordinate motion? In Fig. 2b are we looking at the expansion of the coordinate layers with heating?