

Geosci. Model Dev. Discuss., referee comment RC3
<https://doi.org/10.5194/gmd-2021-171-RC3>, 2021
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Comment on gmd-2021-171

Anonymous Referee #2

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-RC3>, 2021

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Review of "Numerically consistent budgets of energy, momentum and mass in Cartesian coordinates: Application to the WRF model" By Göbel et al. for GMD

This paper presents the design and implementation of an open-source software package called WRFlux for calculating the budgets of potential temperature, water vapor, momentum etc. on a Cartesian grid for WRF simulations. The paper is well written and is a valuable contribution to the modeling community that GMD serves. I recommend minor revision. Here are my comments:

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As I understood it, the current implementation of WRFlux needs it to run online with WRF. I wonder if there is a way to provide an offline version without significant changes to the WRF code, which will be much easier to use for most people.

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Section 2.1, Equation 11: I think it would be helpful to readers if a reference is made to the fact that all the WRF prognostic variables are so-called "coupled" (multiplied by the mass inside the grid cube per unit area) as explained in the technical notes?

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Line 195: "The fluxes and all budget components except for advection are averaged in time during model integration". I don't know what "fluxes" refer to here. Surface fluxes?

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Line 280: "The only difference between the total tendencies in the terrain-following and the Cartesian formulation is the second term on the left-hand side in Eq. 11, which accounts for the height of the vertical levels being time-dependent". I wonder if the averaging contributes to the difference as well. For the first term in Eq. 11, the averaging is done after dividing by z_{η} .

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The equations numbers are probably wrong in the figure/table labels, shouldn't they be Eqs. 13, 14 and 15 rather than 14, 15 and 16?

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Line 313: "To quantify the differences, we plot the sum of all forcing terms for each budget calculation method against the actual model tendency ..." By that sentence do you mean plotting the LHS and RHS of Eqs. 13, Eqs. 13 with 2nd-order advection, 14 and 15 respectively? If so, It would be clearer to say that explicitly.