

Geosci. Model Dev. Discuss., author comment AC2
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Reply on RC2

Joseph Mouallem et al.

Author comment on "Multiple same-level and telescoping nesting in GFDL's dynamical core" by Joseph Mouallem et al., Geosci. Model Dev. Discuss.,
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Thank you for the careful assessment and valuable comments.

(1) In terms of the multiple same level nesting, it is mentioned in Section 3.1 that, there is no limit on the number of nests at a particular level. However, it is not clear whether or not the same level nests can overlap with each other. If so, how the over-lapped areas are treated, especially when the two-way nesting feedback is turned on?

It is mentioned in section 3.1-L103: "The nests at the same level can overlap (with no direct communication whatsoever) but are required to stay within their parent tile", and in section 3.1-L107: "For two-way coupling, the updates occur in the opposite direction from last to second grid from last to top level". No attempt is made to blend data from the overlapping nests when performing the two-way update; the two-way updates are done independently and in succession.

(2) Also, related to the two-way nesting feedback, it is stated (lines 127-128) that "At this moment, only temperature, surface pressure and the three wind components are used for the two-way updates." Could the author comments, why only these variables are currently considered/implemented for two-way nesting feedback? How about other prognostic variables (3-d pressure or geopotential height, 3-d microphysics tracer variables, surface variables, etc.)? In the meantime, have the authors considered/compared among different nesting settings, for example, full two-way nesting feedback vs partial (say 50%) two-way nesting feedback vs one-way nesting without feedback?

We will update the text and provide more information when we submit the revision. Currently, only temperature and the winds are updated from the nested grid and the parent. This trivially ensures mass conservation of the dry air and of all tracers on the global domain, a crucial need for longer-term simulations. Results from previous studies show that this does not degrade scientific performance. The smaller number of updated variables also greatly reduces the data that needs to be passed between the grids, improving model efficiency especially for simulations with complex microphysical, aerosol, or chemical schemes.

We have not performed a comparison of different nesting settings in this study; however, previous studies have analysed one-way vs two-way nesting. FV3 does allow partial two-way feedback, which is performed in the Rayleigh damping layer to reduce the effect of the update in the upper levels of the parent domain. This capability may be expanded in a future release of FV3.

(3) In Table A1, It looks to me that, the parent and multiple and telescopic nested domains all use the same dt_atmos (physic time step), though they may have different dynamics and acoustic time steps (when using different k_split/n_split settings). Is this (using the same dt_atmos for parent and nests) a requirement/limitation for the current nesting implementation in the FV3 dynamical core, or one could choose to use different dt_atmos values for different parent/nested domains?

That is correct, at the moment, all nested grids follow the dt_atmos of the top parent grid and it is indeed a requirement for the current nesting implementation. We will add text to clarify this information.