

1 Response to Comments by Anonymous Referee #2

I thank this reviewer for her/his careful reading of our manuscript and his/her helpful comments.

1.1 Major comments

□

1. Indeed that is so. FV conserves mass exactly. This is now stated in the manuscript. The AM modifications were explicitly designed not to alter the mass flux calculations at all, by intervening on the rotational component only of the flow. Another choice, e.g. of altering only the divergent component, would have been possible. I judged exact mass conservation more important for climate simulations than exact vorticity conservation, which is also a property of the FV scheme. The AM mods do change the kinetic energy of the flow, and thus change the energy budget. However, the unmodified FV scheme does not conserve energy. CAM-FV therefore employs an energy “fixer” (analogous to our AM fixer). Along the way, the energy non-conservation is diagnosed at each time-step. This allows us to monitor the impact of the AM mods on energy non-conservation. The result is that there is no systematic effect, either in sign or in magnitude, of the AM mods on the energy non-conservation of the model. We have added a paragraph saying as much at the end of Section 2.4
2. No, we did not check the impact of vertical resolution. From our analysis however, which demonstrates the non-conservation to reside essentially entirely in the shallow-water formulation of the scheme, I do not expect the vertical discretisation to be important. I did extensively test separately the effect of changes in the vertical remapping that is performed between shallow-water steps. This remapping brings the Lagrangian layers back to hybrid levels, and effectively replaces vertical advection in the scheme. I found all reasonable modifications, including a strict AM budget enforcement, to have no impact on AM conservation.

1.2 Minor comments

□

1. fixed the syntax, and split and simplified into two sentences.
2. fixed
3. I’ve expanded the caption trying to include all essential information without having to refer to the text.

1.3 Typos

□

1. fixed

2. fixed
3. fixed
4. removed "local"
5. fixed
6. fixed
7. fixed
8. fixed also – thanks for finding and pointing out all of these!