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Interactive comment on "Downscale cascades in tracer transport test cases: an intercomparison of the dynamical cores in the Community Atmosphere Model CAM5" *by* J. Kent et al.

Anonymous Referee #2

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This is a well written paper with a nice review and introduction. The authors compare several different advection schemes in the Community Atmosphere Model, using 4 prescribed velocity test cases in three-dimensional spherical geometry. All of these advection schemes have been documented in more idealized settings, such as for 2D solid body rotation. But it is valuable to compare their performance in a more realistic setting, and it is especially valuable to compare them in their final configuration as used in a IPCC-class model like CAM.

The usual approach for advection test cases would compare various types of errors as a function of resolution, and would basically favor methods which can maintain some

level of shape preservation with as little (variance) dissipation as possible. I like the approach the authors take here where they focus on the under-resolved case. Their test cases have well defined minimum length scales which are well resolved on a high-resolution (1/8 degree) grid, and poorly resolved on their target 2 degree grid. As the tracer cannot be exactly represented on the 2 degree grid, the exact solution, down-scaled to the 2 degree grid will show a measurable amount of dissipation. Since advection schemes in atmospheric models will always be running at in an under-resolved regime, they should be evaluated on their ability to reproduce the dissipation observed in the downscaled exact solution. The test cases don't have analytic solutions, but the authors establish that the tracer is well resolved at 1/8 degree and use the 1/8 degree solution as a reference solution.

Although this is a nice approach - the end result confirms that a more conventional error-norm based evaluation is sufficient. In particular, all the methods with some amount of shape preservation produce significantly more dissipation than the down-scaled reference solution. And the lower the error, the lower the dissipation. Hence the "best" method in this downscaling metric, remains the method with the lowest error and a sufficient amount of shape preservation.

The weakest part of the paper is test 4, which looks at spurious mixing across a separatrix. This is yet one more way to quantify the amount of excess diffusion in the advection schemes, and the performance on this test is exactly as what would be expected based on the previously presented results.

Interactive comment on Geosci. Model Dev. Discuss., 5, 1781, 2012.