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Geoscientific Model Development Discussions

Interactive comment on "Extending Legacy Climate Models by Adaptive Mesh Refinement for Single Component Tracer Transport: A Case Study with ECHAM6-HAMMOZ (ECHAM30-HAM23-MOZ10)" *by* Yumeng Chen et al.

Anonymous Referee #1

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This manuscript describes the implementation of the Adaptive Mesh Refinement (AMR) technique in a climate modeling framework (ECHAM6) for its tracer transport module, without disturbing the basic design of the host model. Climate models typically transport hundreds of tracer species, and it is considered as one of the most computationally expensive components of the modeling system. High resolution climate modeling is technically possible but the associated computational cost is prohibitive. Grid adaptivity is a way to reduce the computational cost, nevertheless, the application of AMR to

the entire modeling system makes modeling very complex. Authors have come up with a novel method to efficiently implement the AMR technique for the transport module through a one-way interaction with the host model, and hence enhance the computational efficiency. I would strongly recommend this manuscript for publication after minor revisions.

Major Comments:-

(1) The ECHAM model uses the conventional lat/long geometry. The global transport schemes FFSL and CISL have special strategy for the cross-polar advection (restricting the lambda-directional Courant number less than 1). The AMR invariably makes transport algorithms more complex around the polar regions, but there is no discussion how the authors addressed the cross-polar transport for their implementation. Authors should discuss this issue in the revision.

(2) The time traces of normalized standard errors for the solid-body rotation test should be produced for the uniform high-resolution grid vs. AMR grid of your choice (Fig.8). The error behaviour (particularly L-infinity) will be interesting.

Minor Comments:-

(1) The lower panel of Fig.8 is virtually useless! The tracer fields over the polar regions are obscured by the AMR grids. You could plot the grid and the fields side- by-side for better clarity. Please consider this issue with the Fig.22 too, where you could plot it bigger.

(2) Please cite the paper bt St.Cyr et al., A Comparison of Two Shallow-Water Models with Nonconforming Adaptive Grids, 2008, Monthly Weather Review 136(6). They have used FFSL/AMR scheme.

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