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Geoscientific Model Development Discussions

Interactive comment on "3-D radiative transfer in large-eddy simulations – experiences coupling the TenStream solver to the UCLA–LES" *by* F. Jakub and B. Mayer

Anonymous Referee #2

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This manuscript describes progress to couple an explicit solver for three-dimensional radiative transfer with a large-eddy simulation LES hydrodynamic code. Two numerical choices are explored (the iterative solver and the preconditioner) with emphasis on both strong and weak scaling efficiency. Solving the three-dimensional radiative transfer problem (rather than one-dimensional problem in which every model column is treated independently) is incompatible with one of the algorithmic choices underlying the current treatment of radiation in the LES code, namely the "Monte Carlo Spectral Integration" algorithm in which the spectral interval for each column is chosen randomly. The authors perform simulations to assess whether a weaker version of the MCSI (where spectral points are held constant across the domain but are chosen ran-

domly in time) is still a viable approach to coupling radiation to LES.

This is technical work that will enable some potentially very interesting research on whether three-dimensional radiative transfer effects systematically affect large-eddy simulations. It's not clear how useful it is to report this work in isolation. The particular performance results for preconditioners and matrix solvers are specific to the problems (including domain size and the amount of cloudiness) and to the computer systems used for testing, while the results on the weak form of MCSI will no doubt need to be revisited for new problems. Personally, I'd advise students of my own to include this material in the subsequent papers describing results, and if GMD has explicit editorial standards for novelty and relevance the editors may want to look closely at whether this manuscript is adequate.

With that caveat, the manuscript is generally successful at what it attempts to do. It would be improved most by a little pruning and reorganization aimed at more cleanly separating the two classes of issues (weak MCSI vs. algorithmic choices) and providing a more consistent level of detail to support the argument, keeping in mind that readers will come from both the LES and radiative transfer communities. Some general guidance is provided below.

The authors might consider a modified hierarchy for the manuscript to reflect the different concepts being explored. To this reader the top-level ideas/headings might be: Introduction LES and Ten-stream models Weak MCSI Numerical scaling Conclusions

The introduction might be similarly reorganized to reflect the separate concepts. The discussion of the broad motivation for the work âĂŤ that radiation influences cloud development, and that three-dimensional radiative transfer is normally neglected âĂŤ could be expanded by three or five sentences so readers understand why the problem is relevant. It will likely to be easier to discuss three-dimensional issues, including the need for efficient algorithms (ten-stream) and implementations (numerical issues to be explored here) before MCSI issues because the motivation for examining weak MCSI

comes from wanting to use three-dimensional RT. The general motivation for MCSI (that is, most of the discussion on 9023) should be deferred to the section describing the tests of weak MCSI.

In section 2.3, and again on 9033, it should be more clear if the experiments with weak MCSI use one- or three-dimensional radiative transfer calculations. On a related note it would be useful to explain why one set of experiments is used to test weak MCSI and another set used to assess performance of the ten-stream solver.

Pincus and Stevens 2009 included an experiment in which the mean radiative driving was suppressed and only the noise remained. It would be useful to repeat these experiments with weak MCSI.

What is the point of the clear-sky experiment? One would think that three-dimensional radiative transfer would be irrelevant in the absence of significant scattering, so it's not clear what is being tested or learned with these experiments.

More minor comments:

9022, line 24: Surely the idea of radiation coupling to cloud dynamics predates Muller and Bony 2015.

9024, line 9-10: formatting of references is incorrect

9024, line 13: It would be kind to add one sentence explaining how the ten-stream solver works for those not familiar.

9026, line 21: This is an abrupt transition. It also sounds a bit like advertising.

9029, lines 16-26: the explantion of weak and strong scaling is valuable but could be 50% shorter.

9031, line 3: "Retrieving the transport coefficients from the look-up table" ... what transport coefficients? what lookup table? Readers who don't know the ten-stream model well are here left behind.

9032, line 6: What is the Mistral computer?

9032, line 15: Pure speculation about the causes for reduced efficiency is not particularly helpful.

Interactive comment on Geosci. Model Dev. Discuss., 8, 9021, 2015.