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Interactive comment on "ASIS v1.0: an adaptative solver for the simulation of atmospheric chemistry" *by* Daniel Cariolle et al.

Anonymous Referee #2

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The manuscript of Cariolle et al. describes the development and testing of a chemical solver suitable for implementation in models of atmospheric chemistry (ASIS). It appears that this solver is not intended to be available to the community due to the restrictive nature of the "code availability" (Section 7). Rather, it appears that the authors have chosen for their own reasons to develop an in-house solution instead of adopting an open source solver package such as KPP, and wish to use this publication to describe its basic features.

The formulation of the solver and its implementation are described at a level of detail appropriate for a paper in a technical journal such as Geoscientific Model Development. After describing the formulation of the scheme, a number of tests are described. The scheme is compared with standard reference schemes in a box model for two 24 hour test cases representative of the polluted urban boundary layer, and the mid

stratosphere, where the scheme is found to perform adequately. Further to describing these test results, the manuscript goes on to describe the results of 3 month simulations in global chemical transport models of Earth and Mars. The ASIS scheme is shown to improve the results of simulations in these CTMs due to its ability to adjust its sub-timestep based on the stiffness of the chemical system in each model grid cell. Two examples of improved performance are given for the simulation of the Earth's atmosphere: improved simulation of nighttime NOx chemistry in the boundary layer, and improved simulation of Antarctic ozone depletion in the stratosphere. These improvements come at the cost of increased model runtime; approximately 5 times more execution time is required compared to the simulations performed using the original chemical solver in the MOCAGE CTM. The authors speculate that various optimisations may help to reduce this performance penalty. It isn't clear to me though, why such an expensive solver should be preferred over similarly expensive solvers available through open source packages such as KPP which can provide comparable accuracy and runtimes. If the authors do not seriously intend to make their code generally available to the community, and are content with limiting its use to in-house applications, differentiating their product from other alternatives in this way is arguably outside the scope of the manuscript.

I find it a shame that only 3 month simulations are performed with the global models using the ASIS scheme. It would be very interesting to know what effect the replacement of the chemical solver would have on many other features of global atmospheric chemistry, such as the global oxidising capacity and related aspects such as the methane lifetime and tropospheric ozone budget. Such simulations would require much longer runs, of at least 12 months plus adequate spinup time. Perhaps the authors have avoided such longer simulations due to the high cost of running their model with the ASIS solver. While I regard the short length of the global test simulations as a shortcoming of the paper, I think that performing longer test simulations would be outside the scope of this study. I would just recommend that the authors do not consider this new solver to be completely evaluated until such comparisons have been performed.

In general the manuscript is clearly structured, but contains a large number of grammatical mistakes and non-idiomatic language. Somewhat surprisingly, I did not find that these language issues prevented clear understanding of the scientific and technical details being communicated. Nevertheless the manuscript would benefit from copy editing for correct English before being accepted into GMD.

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