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Geoscientific
Model Development
Discussions

Interactive comment on "Numerical issues associated with compensating and competing processes in climate models: an example from ECHAM-HAM" *by* H. Wan et al.

Anonymous Referee #2

Received and published: 26 March 2013

The paper considers the effect of different formulations of 1st-order time-integration schemes for solving a gas concentration evolution equation in the aerosol module of a climate model. The results demonstrate the improvements in performance that can be achieved by more careful formulations and the authors offer clear proposals for future developments, which must be useful to the climate modelling community.

Remarks/questions:

Eq 2: should be "+ \Delta t P"?

Scheme 2: I didn't find the description of the "Euler-backward [adjustment] factor" in the second stage clear. It looks like the term in N is updated according to an Euler-

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forward step using the initial stage solution S* and the term in C is further updated by an Euler-backward step, but there is no further update to the term in P. Could this be explained and justified more clearly?

In testing variations of Schemes 1 and 2:

- formally, the trapezoidal scheme has \alpha=0.5 by definition - if you are only considering the case with \alpha=0.5, why bother including \alpha in (9)? (And relates to comment on description of scheme 3 below.)

- for Scheme 1Im, it is mentioned that all available H2SO4 gas is able to condense - different to the 95% of the explicit schemes. Explain why this change is made.

For scheme 3 (and related to above): the implicit scheme in eq. 15 is the "trapezoidal" scheme introduced earlier (so you could make that connection clear), but then the value \alpha=1 is used, which makes the scheme (15) the "Euler-backward" scheme, also referred to earlier, but without the need for introduction. Why not simply state that the Euler-backward scheme is used to update (12)?

Should there be a reference from the text to Figure 3e from the last para on p696?

p.699: Runge-Kutta schemes are a family of predictor-corrector schemes, i.e. shouldn't be "[RK] and explicit predictor-corrector"

p.699: "visually indistinguishable" - can you put a number on it? The former is rather dependent on how you choose to plot! A number would also make it comparable to the later remark of a 1% difference achieved with the adaptive sub-stepping.

p.700, discussion of Figure 6: "confirm that if the clipping factor 95% is changed to 100%, the solution ... starts to oscillate again". From the figure, both solutions demonstrate the oscillations wrt number of sub-steps.

Figure 1 caption: use "Scheme 1" and "Scheme 2" for consistency with the text

Figure 2: the scheme labels in each plot are very small. Perhaps better: a single

GMDD

6, C145–C147, 2013

Interactive Comment

legend at the side?

Figures 3 and 5: sub-plots are too small to be comfortable to read.

Interactive comment on Geosci. Model Dev. Discuss., 6, 685, 2013.

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6, C145–C147, 2013