Review of revision of M. Weimer et al.: A new module for trace gas emissions in ICON–ART 2.0: A sensitivity study focusing on acetone emissions and concentrations

The authors submitted an improved version of their article about their module for trace gas emissions in ICON–ART 2.0. Although I am convinced that all improvements contribute a lot to make the article better understandable to the reader, their deeper analysis also showed some disadvantages of their method. The emission module was used to assess the acetone concentration near the tropopause region that is far away from the surface where emissions take place. The acetone lifetime is estimated to be between 15 and 60 days globally, meaning that acetone is rather well evacuated from the boundary layer into the troposphere. The authors demonstrated that the results do not depend on their choice of the operator splitting and the fact that they inject the emissions into the lowermost model layer. On the other hand, it is not clear whether this method will give good results for other, e.g. very short lived trace gas species. In that respect, I consider the article being very specific and I like to suggest that this is briefly discussed since the method is neither new nor really original.

Generally, I think that the article can be published when the following points are improved.

General comment

This article is meant to describe a general method of bringing trace gas emissions into the ICON model. As stated above, only a very specific application case (acetone) is discussed in detail. For this application, the method is suitable as shown by the authors. On the other hand, for very short lived trace species, this is not so clear. The authors should discuss this point and recommend tests of suitability. Since they implemented surface emissions as flux conditions for their sensitivity studies, it would be great if they would include this method as an alternative in the code that will be distributed.

For me, there is no reason why one would like to follow operator splitting as a principle. I would rather consider any operator splitting as a necessary evil than a fundamental principle.

Specific comments

p.1,l.1: I would prefer “An emission module” instead of “An emissions module”.

Fig.3: Please, mention that lines may be cut, the reader is confused otherwise.

p.9, l.15 ff: As far as I understand ICON, the pressure is not everywhere a “pressure of moist air”. At some places a quasi–hydrostatic pressure of dry air may be used. There is no problem as long as the same pressure is used in equations (4) and (5) of your revised article. The tracer mass conservation is assured for the advection scheme only. So, please, control all the relevant equations whether these are correct for both parts of ICON into which you implemented your emission module.

Appendix A: The Predictor–corrector method is exactly that of Pandis and Seinfeld. Put it into the supplementary online material since this is an article about emission modules.