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Geoscientific Model Development Discussions

Interactive comment on "Bolchem: an On-Line Coupled Mesoscale Chemistry Model" *by* Rita Cesari et al.

Anonymous Referee #2

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The article presents the BOLCHEM online coupled model. It is pleasant to read, well structured and understandable. The introduction puts the model and its development back into the global environment of online modeling. BOLCHEM aims to be a state-of-art model, as shown by the part 2, describing in detail the main features of its meteorological and chemical parameterizations. Finally part 3 shows validation simulation performed and comparison against atmospheric concentrations for several pollutants. BOLCHEM model provide good results for both gazeous species and particulate matter. Thus, this paper perfectly fit the scope of GMD journal.

However, more or less serious issues are present in the paper. First of all, the author does not define the version actually analyzed. Nor is it specified whether the model is a global model or a limited area model. In the introduction part, it is said that BOLCHEM

is one of the pioneers of online coupling in Europe without mentioning the others. In general, there are few references to other comparable models.

In the model description, the author says that the development was not done simply by coupling chemistry to a meteorological model, but by taking great care to integrate physical and chemical processes, hence the description of the physical modules that follows. However, it is also indicated that BOLCHEM is based on the BOLAM model, and even (line 14 of the introduction) that it is a "one-way" coupling. This is totally contradictory: a simple quotation from a previous article describing BOLAM is sufficient for meteorological components such as transport or diffusion. Thus, parts 2.1, 2.2 and 2.5 are either to be removed or developed, in particular by indicating the equations of the different parameterizations and how the interactions between chemistry and meteorology are taken into account. As they stand, they are superficial and therefore do not provide any relevant information. Section 2.6 presents how the model manages surface exchanges. Again, the information provided is incomplete. Rather than describing the anthropogenic emissions available in the TNO-MACC-III inventory (one quotation is sufficient), the author should explain how they are distributed over the "3 levels" of the model. Why not include desert dust, which is a major contributor to primary aerosols, in this publication? The reader is often lost between what is really included in the described model and what is not. Part 2.8 (model configuration) is very general and does not provide any relevant information.

Part 3.1 describing the model configuration is incomplete. What is the maximum altitude of the model, the number of levels, how are the conditions adapted to the chemical limits? A table could provide an quick overview to the reader. In addition, the chemical boundary conditions provided by CAMS are, as the author points out, very limited. How are boundary chemical conditions treated for species not provided by the CAMS service? Section 3.2 presents the results of the model. The analysis that is made is too brief. No attempt to analyses the observed biases (underestimation of ozone in winter, overestimation of PM in summer). There is also no analysis of the results of the

upper levels. Finally, it would have been interesting to compare the model results with the CAMS set, which would have been possible by choosing a more recent simulation year.

In conclusion, this article does not currently meet the criteria required for publication

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