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Geoscientific
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Interactive comment on "Towards an online-coupled chemistry-climate model: evaluation of COSMO-ART" *by* C. Knote et al.

C. Knote et al.

christoph.knote@empa.ch

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Anonymous Referee #2 Received and published: 13 September 2011

R2.0) The paper "Towards an online-coupled chemistry-climate model: evaluation of COSMO-ART" by Knote et al is a model evaluation paper. Measurements used for the model evaluation include ground based observations of key gaseous and aerosol species satellite and ground based remote sensing products, aerosol chemical composition and size distribution. I suggest publication of this work, after minor revisions.

General comments

The positive aspects of this work are:

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Discussion Paper

1)The evaluation methodology used is sound and complete: proper metrics are used and the validation includes validation of meteorology and chemistry both for gaseous and particulate matter

2)The paper is well written and constructed without any obscure sections

3)There are generally adequate references in literature (see below specific comments)

4)The issues arising from the evaluation are discussed properly and plausible explanations are provided

5)Directions for future work are suggested, as a result of the evaluation work The majority of the limitations in the parametrization and the implementation of the current modeling system (schemes, boundaries, etc) are already addressed and should be included in the next model update, as pointed by the authors.

Specific comments

R2.1) In the conclusions is mentioned that: "The coupling to a meteorological core that is actively used and developed for both short-term weather forecasting as well as climate simulations is regarded as a key benefit." I guess that the meteorological core is the COSMO model. What about the external forcing? The current modeling system is externally forced by ECMWF-IFS: does IFS provide only operational weather forecasts or there is the possibility to provide also boundaries for long-term climate simulations? If a long term climate-chemistry simulation will be attempted in the future with COSMO-ART, how will it be externally forced? If the external forcing is provided by a different model (GCM) then we have a different modeling system, practically, which will have to be evaluated again. Please, refer to existing literature to investigate the importance of external meteorological forcing on climate-chemistry simulations. A common methodology to evaluate a climatechemistry model is to perform at the beginning a perfect lateral boundary condition experiment for a present decade (i.e. forced by reanalysis which is as close to reality as possible) and then perform an identical simulation with

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the selected GMC coupled. Such an analysis reveals the impact of the external forcing on chemistry resulting from the induced large scale circulation patterns, which is supposed to be crucial aspect in long-term climate-air air quality simulations. I would tend to think that the characterization of the current modeling system as a climate-chemistry system is at the moment a bit pre-mature.

First of all we want to thank the reviewer for his considerations and remarks regarding our work.

We have chosen our title with consideration - “towards a chemistry-climate model” should indicate that we are indeed not there yet. Our evaluation focused on the ability to simulate gas-phase and aerosol chemistry. Forcing is provided by ECMWF IFS data, which is a standard method used also in operational COSMO simulations and can therefore be seen as a benchmark (except for the missing data assimilation). We agree that changing the lateral forcing to a different GCM might introduce substantial differences. There are possibilities, however, to facilitate a simulation on climate timescales with very similar forcing, either using the ERA40 or ERA-INTERIM reanalyses based on the IFS model, or e.g. the ECHAM-HAM-MOZART or EMAC model systems, which both originally evolved out of the IFS.

We have already altered the introduction due to comments from reviewer 1 to better reflect that we do not propose a complete chemistry-climate model, but rather show a step in the evaluation towards a complete system. We have added an additional sentence in the methods section to note that forcing on climate timescales can be very similar to our approach due to the use of comparable GCMs: “For runs on climatic timescales boundary data could e.g. be provided by the ECHAM-HAM (Stier et al., 2005) or (for past episodes) by ERA-40 (Upalla et al., 2005) / ERA-Interim (Simmons et al., 2007) reanalyses, which are all based on the IFS and would therefore deliver comparable meteorology.”

R2.2) Technical corrections

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Figure 3, Figure 5, Figure 8, Figure 11 could be re-sized to be more easily read.

The figures are actually bigger in the final version and are only rescaled for the discussions online version. Figure 8 has already been revised due to comments from reviewer 1 and is now double column wide. See our response to comment R1.37.

R2.3) Page 1836, line 20 & Page 1843, line 25-26: You could rephrase, I am afraid the judgment is too generous.

Reviewer 1 also mentioned this and we have already corrected the text at several points. Page 1836, line 20 has been changed as well. We like the reviewer to keep in mind though that the comparison is made against a statistical dataset and a 1:1 correspondence would not have been expected after all. The sentence in the conclusions has been altered as well, see our response to reviewer 1 in R1.24.

References:

Simmons, A., Uppala, S., Dee, D., and Kobayashi, S.: ERA-Interim: New ECMWF reanalysis products from 1989 onwards, ECMWF newsletter, 110, 25–35, 2007.

Stier, P., Feichter, J., Kinne, S., Kloster, S., Vignati, E., Wilson, J., Ganzeveld, L., Tegen, I., Werner, M., Balkanski, Y., Schulz, M., Boucher, O., Minikin, A. and Petzold, A.: The aerosol-climate model ECHAM5-HAM. Atmospheric Chemistry and Physics, 5 (4). pp. 1125-1156, 2005.

Uppala, S., Kallberg, P., Simmons, A., Andrae, U., Bechtold, V., Fiorino, M., Gibson, J., Haseler, J., Hernandez, A., Kelly, G., et al.: The ERA-40 re-analysis, Quarterly Journal of the Royal Meteorological Society, 131, 2961–3012, 2005.

Interactive comment on Geosci. Model Dev. Discuss., 4, 1809, 2011.