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Geoscientific
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Interactive comment on "The 1-way on-line coupled atmospheric chemistry model system MECO(n) – Part 3: Meteorological evaluation of the on-line coupled system" *by* C. Hofmann et al.

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We thank referee #2 for his/her helpful comments. Replies to his/her suggestions are embedded below.

- *The motivation behind the online coupling should be made clearer, even though this is the third part of a series of manuscripts. It is only shortly mentioned in the introduction. I also find parts of Section 2 and Section 3 difficult to follow. Firstly, to my opinion a model description is more appropriate before describing the evaluation strategy.*
  Due to the nature of this paper, the model description occurs already in the intro-

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duction, whereas Sect. 3 only describes the model setup. Therefore we rename Sect. 3 ("model description and setup") to "model setup".
Furthermore we introduce a new section named "Differences between COSMO and MECO(n): Provision of boundary data", following the introduction and describing the main differences between usual COSMO simulations and MECO(n) simulations.
The motivation of on-line coupling, especially the limitation of additional workload, is already described in detail in the introduction (p.1535, l.12 – p. 1536, l.5). To emphasise the advantages, we mention them again in this new section and add them to the conclusions.

- *Secondly, information about the namelist setups and storage of data on disk (sect. 2) should either be explained more in detailed or mentioned at another place. This would fit better in the model description section.*
  That is another reason why we introduce the new section "Differences between COSMO and MECO(n): Provision of boundary data". We try to explain the reason for storage of data in more detail and give examples for namelist changes.

- *In addition, Fig. 1. seems to have an error in the top left panel.*
  Unfortunately we can't find an error in Fig. 1.

- *Much focus of the evaluation is put on the importance of the lead time of the simulations. I would suggest a more comprehensive discussion on why the lead time may influence the results. "Accumulated errors" are mentioned in the conclusions; please be more specific.*
  As EMAC is a chemistry climate model, it is not developed to simulate special meteorological events like a cold front passage. This, however, can be achieved by the applied Newtonian relaxation (nudging) technique. The longer the lead time, the less influence has the initial condition and deviating EMAC dynamics is only weakly constrained by the nudging. Therefore it is necessary to test how

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the performance of MECO(n) simulations changes with longer lead time. We add this explanation in the section about the evaluation strategy.
We replace “accumulated errors” in the conclusions and explain the reasons for occurring deviations, while simulating specific meteorological events using EMAC as a driving model in detail again.

- *Furthermore, please comment on previous findings on this subject.*
  Unfortunately we do not know any studies, in which the capability of a chemistry climate model to reproduce single meteorological events on synoptical scale was tested. We include a citation in Sect. 3, showing that even simulations performed using the usual NWP-COSMO model vary with different lead time.

- *For future applications, general conclusion about the sensitivity on how the starting time of the respective simulations (global/regional) may affect the performance of the models should be highlighted.*
  We add the conclusions of Sect. 5 to the conclusions.

- *One of the main conclusions is that “MECO(n) is able to simulate key mid-latitude weather systems as accurately as present-day regional weather models”. This conclusion gives the impression that the online coupling has not improved the performance of the models. It should be clearer what really is the outcome/use/advantage of this coupling.*
  In the original version of our paper it was obviously not clear enough that there are two important differences between MECO(n) and a standard COSMO simulation. First, as mentioned by the reviewer, the on-line coupling should lead to an improvement of the simulation accuracy compared to the off-line coupling. However, the second difference is that our standard COSMO simulations are driven by ECMWF analysis fields, whereas with the MECO(n) setup the COSMO

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obtains the boundary conditions from a (weakly nudged) ECHAM simulation. Clearly, these boundary conditions are very likely to be less accurate than the ones from the analyses (which profit from the data assimilation cycle using direct observations). It is therefore an important and open question whether MECO(n), driven by the climate model EMAC, is able to reach a similar accuracy as a standard COSMO simulation in simulating meteorological events. This is required for future applications in simulating atmospheric chemistry during complex weather situations using MECO(n). We add clarifications throughout the article and mention the advantages of MECO(n) concerning the provision of boundary data once more in the conclusions.

- *In addition, as the scope is to perform simulations for atmospheric chemistry etc., I would suggest adding a discussion on how the new model differs from other available chemistry model systems applied for the regional scale.*
  We include a short discussion with citations about similar approaches and its differences (WRF/Chem and COSMO-ART) in the introduction. Because of identical chemistry implementations in both models, the boundary data for chemical tracers in MECO(n) are consistent for each instance. Other models instead use constant boundary fields (WRF/Chem) or inconsistent chemistry implementations (COSMO-ART with boundary data of MOZART).
- *Page 1534, Line 2. I find it hard to understand this sentence.*
  We restate the sentence.
- *Page 1534, Line 4. I would recommend you to use "online"/"offline" instead of "on-line"/"off-line". To me the latter seems rather uncommon.*
  Considering this is the third part of a series of articles and the names are also hyphenated in both previous articles, we didn't change it here.
- *Page 1534, Line 6. Replace "an intense cold frontal passage" with "a cold front*

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passage".
Changed as suggested.

- *Page 1535, Line 1. Comment: COSMO is the atmospheric prediction model whereas the climate version is called COSMO-CLM.*
  We add the citation of Rockel et al. 2008 in that line. Nevertheless, COSMO and COSMO-CLM are different names for the same code driven by different namelist setups. Therefore, there are no differences in coupling MESSy to these models.

- *Page 1535, Line 9. Please be more specific. E.g., what models use this approach?*
  We add a discussion about similar model approaches (see above).

- *Page 1535, Line 17. Remove "easily".*
  Changed as suggested.

- *Page 1535, Line 28-. This sentence is long and difficult to understand.*
  We built two sentences out of this long one.

- *Page 1535, Line 23. Replace subsubmodel by submodel and explain what is meant by a submodel.*
  Line 24. Is this really the difference between int2lm and int2cosmo?
  To avoid confusion, we removed "subsubmodel" and refer to the article Kerkweg and Jöckel 2011 b, which describes the implementation of the pre-processing tool INT2LM into COSMO/MESSy in detail.

- *Page 1536, Line 10. When no comma is used before i.e. or e.g., please replace "i.e."(e.g.) with "i.e.," (e.g.,)*
  Changed throughout the text.

- *Page 1538, Line 15. What do you mean by "one-time"?*
  We changed "one-time" in "once".

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- *Page 1547, Line 26-. Replace "that it is possible..." by "that the MECO(2) system is applicable to different meteorological situations."*
  Changed as suggested.
- *Page 1550, Line 25. Why do you think that the online simulation underestimated the precipitation?*
  Thanks for this comment, we removed this mistake. There are deviations in intensity of precipitation for the on-line simulation as well as for the off-line simulation.

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