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Comment

## ***Interactive comment on “Development of prognostic aerosol–cloud interactions combining a chemistry transport model and a regional climate model” by M. A. Thomas et al.***

### **Anonymous Referee #2**

Received and published: 9 April 2015

This manuscript, submitted to Geoscientific Model Development, presents a new modeling tool, which is a combination of a regional climate model (RCA4) and a chemistry transport model with aerosol dynamics (MATCH-SALSA). The objective of the study is to show the importance of cloud microphysical properties in regional climate modelling, by comparing two simulations: one (named MOD) where the cloud droplet number concentration (CDNC) is calculated by MATCH-SALSA and then included in RCA4, and the other one (named CTRL) where a standard CDNC formulation is imposed. Results show strong differences between both simulations, and notably an improvement in the representation of cloud liquid water path when comparing to MODIS observations, and consequently also for radiative fluxes at the top of the atmosphere when comparing to

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CERES data. The paper is clear and well written, and I suggest that authors correct the following points before publication in GMD.

#### Main comments:

- Since there is no on-line coupling between the regional climate model and the chemistry-transport model (with aerosol dynamics), I suggest to remove the word “coupling” from the text to refer to the interactions between RCA4 and MATCH-SALSA, which is quite misleading from my point of view. The term “combination” is much more adapted to this methodology, as it is actually indicated in the title of the manuscript. However, there is a true online coupling between MATCH and SALSA.
- With regards to the estimation of the first and second indirect effects, I did not understand how the authors could quantify separately these two effects ? I think additional simulations were needed, but this should be stated more clearly.
- It would be interesting to have an idea of the cost of the different simulations, in order to know (1) if this modelling system can be used for multi-decadal simulations, and (2) if in future this coupling between RCA4 and MATCH-SALSA could be online.

#### Specific comments :

- page 900 line 2: remove the bracket
- page 900 line 8: I wouldn't be so affirmative, I think indeed online integrated modeling is a relevant option to improve the representation of aerosols and chemistry in future models, but you should mention that it depends on the objective of the study.
- page 901 line 4: the coupling ... is
- page 901 line 26: please define NMVOC and DMS.
- page 902 line 1: please define EC and OC.
- page 904 line 6: 4 should be an indice.

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- page 905 line 7-11: is it possible to have a more precise comparison with MODIS data ?

- page 905 line 14: what does N. stand for ?

- page 905 line 16: CDNC values are not always lower than 500 cm-3, notably in DJF Eastern Europe and JJA Central Europe. Is this value of 500 cm-3 very significant ?

- page 906 line 19-21: This sentence explains the decrease of droplet radii in summer compared to winter for the MOD simulation. However, it is not true for the CTRL simulation, how do you explain that droplet radii increase in summer, notably in northern Europe ?

- page 907 line 6: How has this threshold of 10 mm been fixed ? Do you have an idea of the impact of this choice on large scale precipitation ?

- page 909 line 27: one word may be missing after “these”

- Figure 7: it would be better to keep the same color scale for the MOD and CTRL simulations, in order to make the comparison clearer for the reader.

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Interactive comment on Geosci. Model Dev. Discuss., 8, 897, 2015.

**GMDD**

8, C421–C423, 2015

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