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We thank the reviewer for her/his comments. Please find below point-by-point response to the reviewer's comments. The major changes in the manuscript are highlighted.

Main comments:

1.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.

We understand that this is not a fully online coupled model. In the text, we have tried to make this clear by either mentioning the word 'combining' or by specifically mentioning 'online' or 'offline' accordingly.

2.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.

This is now clearly mentioned in the text in Section 2.2 Experimental setup-2. Added as the following:

“ To evaluate the individual contribution from the first and second indirect aerosol effects to the total radiative forcings, two additional simulations each (for PI and PD climate) were carried out. We turn off the individual IAEs by prescribing the constant CDNC values for the calculation of one IAE at a time, for example, to evaluate the sole contribution from the first IAE, 3D CDNC fields are used in the computation of CD radius to assess the changes in cloud albedo (1st IAE) and constant CDNC values are used in the scheme for the autoconversion process (2nd IAEs) and vice versa.”

3. 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.

A brief paragraph stating the costs is added in section 5 Conclusions. Read as the following “The calculations were performed on a HP Cluster Platform 3000 with SL230s Gen8 compute nodes, each with two 8-core Intel Xeon E5-2660 ”Sandy Bridge” processors at 2.2GHz. Using three nodes and 48 MPI-ranks, a one year simulation with the online coupled MATCH-SALSA including the cloud activation module takes 20 hours (wall clock time). On the other hand, RCA4 takes approximately 1.5 hours for one year simulation using two nodes and 32 MPI-ranks. ”

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.

The comments mentioned above have been incorporated in the text.

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

Unfortunately, one-to-one comparison of CDNC from MODIS and model is very difficult. MODIS

observes only few hundred meters of the cloud top and the retrievals are done for only fully cloud covered pixels. Emulating such conditions in the model without the use of satellite simulator is challenging. Therefore, we focus instead on evaluating LWP which is an integral measure and also tightly related to all other cloud microphysical properties. The spatial comparison of cloud liquid water path is additionally shown in the revised manuscript. It clearly shows improvements in MOD simulations compared to CTRL simulations. The LWP values are more realistically simulated and the LWP distribution is closer to MODIS in the MOD simulation. The LWP values are however still underestimated in the model over the southern parts of the study area.

- page 905 line 14: what does N. stand for ?
N stands for North. The term 'northern N. Atlantic' has been replaced by N. Atlantic.

- 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 ?
The color scale shows the normalized frequency. So, darker the shading means the highest probability of observing those cloud droplet number concentrations. The value of 500 cm^{-3} is chosen because most predominantly, the regions that are relatively on the darker side mostly correspond with CDNCs below 500 cm^{-3}. It is not particularly a significant number.

- 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 ?
These distinguishable features are not seen in the 'CTRL' simulation mainly because the CDNCs have constant values irrespective of the seasons.

- 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 ?
Numerous past studies suggest a threshold droplet radius for the onset of auto-conversion of cloud droplets to precipitating (falling rain) droplet) to be in the approximate range 10-13 microns . (e.g. Liu et al. 2003, Pawlowska et al 2003).

The original critical threshold used in the NCAR GCM implementation of the Rash-Kristjansson parameterisation used in RCA4 was 5 microns. This low value was likely necessary because of the low resolution of the NCAR GCM and the use of grid box mean liquid water content (LWC) for both cloud microphysical and cloud-radiation calculations. Low values of the critical radius threshold result in frequent drizzle from clouds reducing grid box mean liquid water amounts and inducing an acceptable cloud-albedo based on (a biased low) grid box mean LWC. In RCA3, with a model resolution of 20-50km rather than ~200km in the NCAR GCM use of a 5micron threshold resulted in excessively frequent drizzle (of very low rates ~0.5 mm/day) which did not impact enormously on monthly precipitation accumulations but did impact negatively on e.g. frequency of wet days and through its impact on precipitation-LWC relationships also on cloud albedo and the 2nd indirect aerosol effect. Use of a 10 micron threshold reduces the frequency of low drizzle occurrences in RCA3 and also acts to increase the grid box mean LWC values. Use of a larger value of the critical threshold (beyond 10 microns) negatively impacts on precipitation rates by delaying the onset of rainfall while also leading to a positive bias in LWC and cloud albedo.

We view 10 microns as a reasonable value for this threshold (based on theoretical studies and our own model sensitivity tests) but acknowledge that the actual value is very likely dependent on a multitude of factors, such as ambient pollution, cloud vertical motion and cloud temperatures. All of these factors may have an influence through to the representation of the 2nd indirect effect but are presently beyond the ability of climate models to simulate.

Liu Y, Daum P and McGraw R. An analytical expression for predicting the critical radius in the

autoconversion parameterization GEOPHYSICAL RESEARCH LETTERS, VOL. 31, L06121, doi:10.1029/2003GL019117, 2004
Pawlowska, H., and J.-L. Brenguier (2003), An observational study of drizzle formation in stratocumulus clouds for general circulation model (GCM) parameterizations, J. Geophys. Res., 108, 8630, doi:10.1029/2002JD002679, D15.

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

The sentence is re-phrased as “The steep increase in the aerosol concentrations may be attributed to the increase in anthropogenic pollutant precusror emissions in these countries in the present day (PD). These differences seen in the spatial distribution are reflected as an increase of almost up to 70% increase in CDNCs and correspondingly, an increase of up to 10% in CLWP. ”

- 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.

If one uses the same color scale as the 'MOD' simulation for the 'CTRL' simulation in this figure one would not be able to see the variabilities in the 'CTRL' simulation as the CD radii ranges only from 4 to 5 mm whereas in the 'MOD' simulation, the values range from 4 to 13 mm. Hence, the figure is kept as it is.