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Atmospheric Chemistry and Physics Discussions

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Interactive Comment

Interactive comment on "Uncertainties in future climate predictions due to convection parameterisations" *by* H. Rybka and H. Tost

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We would like to thank the anonymous reviewer for the valuable comments.

1. Title. The current title does not accurately reflect the content of this paper. The authors didn't present results from a coupled simulation with transient external forcing, so it's better not to use "future climate predictions".

Considering our papers title we don't want to change it, although we didn't perform coupled AOGCM simulations with a transient increase of CO2. The underlying setup in our study describes one possible future climate scenario and the conclusions from the study would not be significantly different with a transient external forcing except for a

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better representation in changing maritime convection as mentioned in the last section. We associate with the expression “future climate prediction“ rather a prognosis of one climate state than a classical forecast.

2. Abstract. The introductory part "In the last ... e.g. sampled treatment of the cloud microphysics." is almost half of the whole abstract. Consequently, a few useful conclusions are not included or not provided in sufficient detail. For example, the sentences with "affect the amount", "highly ambiguous", and "uncovering a shift" could be more specific.

Our abstract has been changed and include more specifications.

3. Inter-annual variability and significance. It would be nice to include the inter-annual variability (one standard deviation) for the numbers shown in table 2 and table 3. Are the differences between simulations using various convection schemes statistically significant? Where are the statistically significant and insignificant regions? A Student’s t-test or Kolmogorov–Smirnov test would be helpful.

Furthermore, the inter-annual variability has been calculated and student t-tests have been performed in order to display regions where differences in the temperature change are statistically significant. The evaluation of these tests is based on overall 6 t-tests for each resolution covering all possibilites to compare two different convection schemes. Results reveal that significant regions encompass the whole ITCZ as well as regions where the variabiliy of the temperature change is greater then 2 K. Moreover, significant differences occur at the lowermost model layer over the oceans although SSTs are prescribed. It is suggested that the diverse representation of downdrafts influence the boundary layer over the oceans.

4. Previous studies. In the Results section, when the authors discuss their findings, it would be helpful to add comparisons between the present work and other related work.

Additionally, comparisons with other studies are included in the reviewed version of the

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manuscript.

5. Humidity and Radon. [...] In my opinion, this suggests that, for changes in water vapor response, transport may not the dominant factor. Changes in evaporation (caused by using different convection schemes) can play a more important role.

The convective transport is indeed a dominant factor regarding short lived trace gases in contrast to changes in the water vapour profile but should be treat carefully with respect to the UTLS region. Injections of water vapour into the lower stratosphere caused by convective events should not be neglected (Wang et al., 2009) and are rarely simulated with our model setup (Lelieveld et al., 2007). Evaporation rates can play an important role and vary especially over land dependent on the chosen convection scheme. Changes in land evaporation rates are strongly correlated to changes in precipitation patterns and consequently induce a higher variability for lower tropospheric moisture. One direct impact of these changes is visible over Africa in the lower resolution simulations displaying a high variabiliy in temperature increase because of opposing changes in precipitation/evaporation rates in the EC simulation compared to the other convection schemes. This has been included in section 4.1.

6. Even though the model layer height in PBL is smaller than those at other levels, the high concentration near surface should still result high radon ratios. I think the problem might be that you averaged radon concentration over land and ocean areas.

According to figure 7: Pure radon concentrations are decreasing with increasing altitude (highest concentrations near surface). However, radon ratios are calculated by multiplying radon concentrations, gridbox (air) masses and the ratio of molar masses of radon and dry air and dividing this by the total atmospheric radon mass (in kg). The profile of gridbox mass looks like the following: air mass increases continuously from model layer 31 (surface) up to model layer 23 following a decrease above level 23 and more or less constant values for model levels 5 and above. The lowermost gridbox contains approximately 0.8 % of the total grid column atmospheric air mass, whereas

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layer 23 has 4.5 %. This strong increase for the lowermost model layers is higher than decreasing radon concentrations. Consequently, radon ratios are not the highest for surface model layers (averaging radon concentrations over land wouldn't qualitatively change the distribution of radon ratios).

Due to personal communication we have changed some parts of section 4.4 (Cloud Radiative Focing and Cloud Types) to avoid misinterpretations, especially table 3. We have clarified the meaning of changing cloud radiative forcing and cloud radiative feedbacks to avoid ambiguities. Additionally, suggestions have been made for further studies to quantify the real cloud radiative feedback.

References:

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Lelieveld, J. and Bruhl, C. and Jockel, P. and Steil, B. and Crutzen, P. J. and Fischer, H. and Giorgetta, M. A. and Hoor, P. and Lawrence, M. G. and Sausen, R. and Tost, H., 2007: Stratospheric dryness: model simulations and satellite observations, Atmospheric Chemistry and Physics, 7, 1313-1332.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 26893, 2013.

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