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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Rapid and reliable assessment of methane impacts on climate" *by* Ilissa B. Ocko et al.

Anonymous Referee #2

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The paper shows the importance of surrogate models in order to compare the impact of different climate species with low computational effort and tries to evaluate the open source surrogate model MAGICC by comparing the temperature responses to historical methane and CO2 emissions from MAGICC and GFDL CM3. This is an important work as surrogate models are very useful for analysing mitigation scenarios as they are computational effective and can assess small forcings. Nevertheless it is difficult to evaluate surrogate models with small forcings with a complex model with large internal variability.

Specific comments

1. Simplified models have beside the lower need of computational resources the advantage that the internal variability is small or zero and it is possible to assess the

impact of small changes, while the internal variability in complex models is too large therefore. But this makes it at the same time difficult to compare them and evaluate the simplified model. As Reviewer #1 stated it is difficult to evaluate forcings which are in the same order as the unforced internal variability (Fig 7) and the variation of different ensemble members (e.g. Fig. 5, 1960). The fact that the internal variability of CM3 is very large compared to CMIP5 models, should be mentioned earlier in the text to make it easier to put the results in the right context. The text is partly formulated as CM3 is the truth and MAGICC should reproduce the same features. While this is important if the features are physically base, it is not the case if the features are due to internal variability, as the benefit of simplified models is that the results are almost free of internal variability. Additionally Fig 4 suggests that MAGICC provides better agreement with observations than CM3 does. Similar to reviewer #1 I would suggest putting more focus on the fact that it is difficult to evaluate simplified models by complex models with large variability. In addition some possible ways to overcome this problem could be provided, e.g. larger number of ensembles or simulations with a quasi-chemistry-transport model mode (e.g. Deckert et al., 2011).

2. For my opinion the description of the models and simulations should be more detailed. I had for example some difficulties to exactly understand what the models use as an input and which parameter were calculated by the models.

- Are the concentrations (p4-l1) or the emissions (p4-l7) prescribed in MAGICC?

- Was the choice of the ensemble members of CM3 randomly or did you choose years with extreme or mean values?

- How is the RF calculated in CM3?

- Why does All Forcing in MAGICC have a large variability, while the CO2 and CH4 do not have one? Are the forcings (except CO2 and CH4) prescribed?

- Why does CO2 show negative Forcing in Fig 2 although the concentration increases?

- Why are direct and indirect CH4 effects anti-correlated or have a time lag? Is there a physical explanation or is it an artifact of the internal variability?

- Why is the temperature change of CH4 of CM3 negative although the forcing is positive?

p6-l5 MAGICC simulates from 1750-2100, but in p4-l1-9 only information about concentrations and forcings between 1765 and 2014 are given

P6 l21 Does the 'downloaded' version of MAGICC include tuning to the multi-model-mean or can be chosen which AOGCM is used for calibration?

P8-25 A description about the kind of data used should be included

Technical comments

P5-l12 comma is missing after carbon dioxide

P6-29 Here RF is defined at the tropopause, while it is defined at the top of the atmosphere in p7-23

P8-3 change 'slightly offset' in âĂŽoffset' (1W/m2 is large compared to the forcing)

P11-1 change 'accurately' in 'adequately'

Is there a reason why the Fig starts in different years (1860, 1870 or 1880)?

Publikation: Deckert, Rudolf und Jöckel, Patrick und Grewe, Volker und Gottschaldt, Klaus-Dirk und Hoor, Peter (2011) A quasi chemistry-transport model mode for EMAC. Geoscientific Model Development, 4, Seiten 195-206. Copernicus Publcations. DOI: 10.5194/gmd-4-195-2011 ISSN 1991-959X

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