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Atmospheric Chemistry and Physics Discussions

Interactive comment on "

Modeling the climate impact of road transport, maritime shipping and aviation over the period 1860–2100 with an AOGCM" *by* D. J. L. Olivié et al.

Anonymous Referee #2

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Overall Remarks This study investigates climate response to different transportation sector emission modes using transient simulations in an advanced climate model with a detailed description of the atmosphere, ocean and sea-ice but no coupled chemistry for carbon or the short-lived forcers. Generally, the atmospheric concentrations of the forcing agents are prescribed based on values calculated in other studies elsewhere with Chemistry-Transport Models (CTMs). The study assesses historical and future (next 100 years) time periods following the IPCC SRES A1B scenario. The study is

important because most assessments of transportation sector climate impacts have presented only radiative forcing values. Furthermore, this study contains new information because it quantifies climate responses other than temperature due to non-CO2 forcings (e.g. sea level rise, NAO index). I find that the authors do a good job of clearly explaining the modeling transient climate change for an audience that might be more familiar with CTMs. I have a number of questions that need to be addressed before publication can be considered.

1. The approach is off-line (prescribe concentrations of forcing agents) and therefore what has been assumed throughout is that the resultant climate changes do not feed back and affect the forcing mechanisms. Is this valid? For example, in a region where there is a large change in predicted precipitation, that would have large effects on the aerosol forcing.

2. NOx emissions influence aerosol formation (for, example, Shindell et al., Science, 2009) and the carbon cycle (for example, Sitch et al., 2007 and Collins et al., JGR, 2010). These indirect forcings are not accounted for in this study.

3. For the statement: "These models are currently able to reproduce the temperature change observed in the 20th century, and confidence exists in the quality of their projections of future climate change." Specify the magnitude of confidence and please supply a reference.

4. The statement "We slightly modify the data between the year 1990 and 2010 to obtain a smooth transition between total observed CO2 concentration until 2000 and the total modeled CO2 concentration from 2000 onwards." Please offer more quantitative replacement for 'slightly modify'.

5. Why is the simple formula for CO2 RF shown (equation 1) if the model's radiation scheme determines the radiative forcing for the imposed CO2 concentration changes?

6. It is not obvious to me why the 2 different ozone methodologies are applied in this

particular study and not use only the 3-D fixed fields only from the CTM QUANTIFY studies that may be more consistent with the off-line aerosol fields used anyway? For example, in the dynamical run the NOx and CO concentration distributions have been determined using different dynamics and radiation than the resultant O3 . At the same time, I am confused by the non-CO2 and non-CO2* definitions. In Section 2.3 'Experiments', these are defined as non-CO2 = dynamical ozone and non-CO2* = fixed ozone (or consistent with CTM aerosol forcings). Then in section 3.2 'TOA Forcing', " With this method we obtain from the non-CO2 simulations the summed impact from contrails and aerosols, and from the non-CO2* simulations the summed impact from O3, contrails and aerosols. By taking the difference between these approaches one can also derive the separate O3 impact." Is this because in non-CO2, the dynamical O3 is not coupled to the model radiation scheme? Then, why include this dynamical O3? Why not just run an aerosol-only non-CO2 simulation? Related, in terms of the aviation results in Figure 10, I do not understand why (1) there is local cooling at high latitudes for aviation non-CO2* towards the end of the century and (2) non-CO2 is more warming towards the end of the century than non-CO2*. Does not seem consistent with the forcings presented in other studies (e.g. Lee et al., 2009; 2010).

7. The scenario for the future projections assumes large growth in aviation and large decrease in road vehicles 2100-2000. Is it realistic that aviation will increase in global source strength by a factor of 7-10 across this time period without efforts by humanity to mitigate emissions? What about NOx stringency rule?

Minor comments: 1. Figure 8 – too much yellow, can you change colour bar to show more information in the figure? 2. Figure 9 (RHS) the thin black lines are difficult to read, is it possible to change to light grey? 3. Include some evaluation/validation of the model contrail-cirrus model representation.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 19769, 2011.