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Climate of the Past Discussions

Interactive comment on "Effects of CO_2, continental distribution, topography and vegetation changes on the climate at the Middle Miocene: a model study" *by* A.-J. Henrot et al.

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We would like to thank Referee #2 for positive and constructive comments on our paper.

First Comment: As suggested by both Referees, we will amend the corresponding part of the Introduction section, presenting the results of previous Miocene climate modelling studies in a more comprehensive way, in order to better highlight the outcome of our study and notably our findings regarding the vegetation contribution to the Middle Miocene climate.

Second Comment: Comparing Planet Simulator to other EMICs is not entirely straightforward as it has not yet participated in any model intercomparison project. There is currently no paper comparing its results to other EMICs. Nevertheless, we will mention in the revised manuscript the major climatological biases of the Planet Simulator (cold biases at high-latitudes in winter of the hemisphere and overestimation of evaporation), which have been described by Haberkorn et al. (2009).

As suggested, we will also mention the climate sensitivity of the model and discuss the possible difference in its sensitivity under present-day and Middle Miocene conditions. The climate sensitivity to a doubling of CO_2 from a preindustrial level of 280 ppmv is +4.5°C under a present-day configuration. Here, under Middle Miocene conditions, the sensitivity to a CO_2 increase of 300 ppmv (difference between experiment MM4 and MM3) is +4.4°C. The model sensitivity is slightly lower under warmer Middle Miocene conditions. This effect could be explained notably by the reduction of the sea-ice extent and of the snow cover on the continents at Middle Miocene, which leads to a weakening of the ice/snow albedo feedback.

Third Comment: The calculation of the ocean heat flux for the Miocene simulations will be detailed in the revised paper. As both Referees also wanted more precision concerning the LSG experiment we use to force our slab-model, we will amend the Experimental Setup section to include a more fully description of the work that has been done by Butzin et al. (in revision).

Fourth Comment: As suggested, the description of the CARAIB simulations setup as well as the calculation of surface parameters (surface albedo, roughness length and rooting depth) from the CARAIB vegetation distributions will be more fully and clearly described in the Experimental Setup section.

If we understand the question correctly concerning the impact of "biome translation",

we would like to precise that the vegetation parameters used to force the climate model are not derived from biomes but directly from PFT abundances on each pixel. Biomes are here only used to produce vegetation maps. The vegetation parameters of the pixel (surface albedo, roughness length and rooting depth) are calculated from the PFT abundances and the specific albedo, roughness length and rooting depth values of each PFT present on the pixel. The vegetation parameters used to force the CTRL run are calculated from an equilibrium run of CARAIB, forced with 280 ppmv of CO_2 and the climatology of New et al. (2002). All of the experiments are forced with the preindustrial vegetation parameters except for the experiment MM4-veg. In experiment MM4-veg, the vegetation parameters are replaced by their Middle Miocene distributions derived from an equilibrium run of CARAIB forced with 500 ppmv of CO_2 in the atmosphere and the climate derived from the experiment MM4.

Fifth Comment: We thank Referee #2 for drawing our attention to the supplementary information in the Pagani et al. (2010), which provides valuable discussion material relevant to our results on the climate-CO_2 decoupling hypothesis. We will refer to this paper in the Introduction as well as in the Discussion section.

Sixth Comment: We agree that citing Williams et al. (2005) in the part of the Experimental Setup section describing the oceanic conditions will complete the discussion about the use of LSG outputs instead of proxy-based sea surface temperatures reconstructions.

Seventh Comment: Taking into account the previous comments of Referee #2 (as well as the comments raised by Referee #1) will already improve the clarity and precision of the Experimental Setup section. We will also break down this section into subsections to make it easier to read, as suggested.

Eighth Comment: We will state in the text the present-day orbital parameters (eccentricity 0.016724°, obliquity 23.446° and longitude of perihelion 102.04°) and solar constant (1365 W/m^2) used in this study.

Ninth Comment: Following the recommendation of both Referees, we will break down the Results section into subsections in order to present the global and regional results of each Miocene experiment separately and to improve the clarity of the Results description.

References

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