

## ***Interactive comment on “Contribution of the coupled atmosphere–ocean–sea ice–vegetation model COSMOS to the PlioMIP2” by Christian Stepanek et al.***

### **Anonymous Referee #1**

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This draft and a companion paper (Samakinwa et al. 2020) nicely summarize the results of PlioMIP2 experiments conducted by COSMOS. The current draft reports the results of the ESM simulations with dynamic vegetation that is a challenging and a novel point of this study compared to other PlioMIP2 studies. The authors also show results of additional experiments, ocean gateway experiments, that is not included in the official PlioMIP2 protocol. The results are very usefulness because such drastic changes in ocean gateways would be essential features of the Mid-Pliocene climate. Due to the meaningful contributions above, I recommend acceptance of this paper, after some revisions to clarify some points listed below.

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## Major comments

More than four models participated to the PlioMIP2 and the results of the simulations were already reported in the PlioMIP2 special issue ([https://www.clim-past-discuss.net/special\\_issue91.html](https://www.clim-past-discuss.net/special_issue91.html)). Why did you limit the comparison of your results with only four models (Page 4 line 15)? In sections 3 and 4, the large-scale features of this model should be briefly compared with other models. Such simple comparisons may be effective to demonstrate that the dynamic vegetation or idealized closed gateways are unique points of this study compared to the other PlioMIP2 studies.

You mentioned that the simulated Mid-Pliocene climate in this model are less equilibrated than the control run (Page 13 line 13-15). It is also noted that the centennial-scale AMOC fluctuations are found after the target period of this study (Page 11, line 11-12). It is much better to add figure showing evolutions of SAT (and AMOC or deep ocean temperature, for example) during the model integrations, especially for e280, eoi400 and eoi400\_GW runs, similar to what you showed in your previous paper (Figure 6 of 2012 GMD paper). It would be OK to include it into the supplement if there would be nothing particular to be noted in the main text.

Page 22, line 14: “a northward shift” Does this also mean a northward shift of vegetation in the Southern Hemisphere? Or a poleward shift? If a northward shift is also found over the Southern Hemisphere, it indicates a equatorward shift, contrasting to the NH. What are the factors?

## Specific comments

Page 13, line 20: lower elevation and the absence of ice sheets

Page 14, line 9-16: The discussion here is closely related to variation in ITCZ related to interhemispheric asymmetry in energy balance. It is better to refer any previous studies here, for example doi: 10.1175/2007JCLI2146.1.

Page 14, Line 33: model. Raomo et al.

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