

Interactive comment on “On the sensitivity of the Devonian climate to continental configuration, vegetation cover and insolation” by Julia Brugger et al.

Anonymous Referee #2

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Reviewer 2 – May 2018

Brugger J., et al: On the sensitivity of the Devonian climate to continental configuration, vegetation cover and insolation

Recommendation: Major revision

Let me emphasize that this is an interesting study however the manuscript can be improved-in particular to make its importance clearer to the reader. In the present version, several issues are addressed: (1) continental configuration, (2) vegetation cover and (3) the orbital forcing, but without to extract the major points for consideration. For instance, sections 3.3 and 3.4 present minor findings for the Devonian period, while

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most significant contributions (sections 3.2 and 3.5) remain not enough explored. This problem being easily solvable, I recommend a major revision.

In addition to recommendations listed by the first reviewer I identified several areas requiring clarification.

Major Comments:

(1) The revised manuscript should provide a table showing exactly how vegetation types are parameterized. Surface albedo, roughness, and evapotranspiration coefficient values used for representing bare soil, shrub and tree have to be presented. It would be helpful to have a brief description of what evaporation/roughness is (in the model) because latent and sensible heat fluxes are both affected by these parameters. If relevant, the phenology should be discussed as well.

(2) The vegetation cover is never presented! Maps of vegetation used as boundary conditions for Middle and Late Devonian would be very helpful, especially for comparing with the figure 4. Moreover, as landplants are very sensitive to temperature-moisture regimes, it would be interesting to check if assumptions used to constrain the spreading of plants (shrub and tree) remain in good agreement with model's outputs.

(3) Personally, I'm skeptical about the interest of the section 3.4. The main reason is that the climatic effect remains very weak, so almost impossible to link with temperature estimates based on $\delta^{18}\text{O}$, and potentially dependent on pCO_2 levels. I suggest to remove this part, or significantly reduce its length.

(4) On lines 19-21 p 20. Authors argue that their results are in disagreement with Le Hir et al. 2011 findings. That is not entirely correct. Le Hir et al. 2011 suggested that the progressive change of the continental albedo has induced a warming ($+4^\circ\text{C}$), but they have also noticed that this warming was not observed in their simulations due to the parallel reduction of the pCO_2 . Over the Devonian, the cooling was estimated to $-1,9^\circ\text{C}$ in response to the decreasing effectiveness of the greenhouse effect (carbon

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dioxide level decreases from 6296 to 2125ppmv). To my knowledge, both studies only differ by their climate sensitivity ($\Delta T/\Delta p\text{CO}_2$) to land cover change.

(5) A brief paragraph summarizing limitations of the model/study will be helpful for readers not familiar with models. For instance authors should take more cautions with their conclusions concerning the weak influence of the continental configuration - this result being mainly due to the absence of the climate-carbon feedback.

In addition to the above points, there are a number of minor errors that ought to be fixed:

- line 8 p9: For illustrating the impact of paleogeography, continental temperatures appear more relevant.

- the figure 4 is unreadable in its present state. How to compare Shrub-bare soil and Tree-shrub results ? please add panels showing Tree-Bare soil results. To make a more robust analysis, a plot of the snowline over continents should be included in surface albedo panels.

- line 10 p10: if you want to make that statement, a basic computation of the greenhouse effect may be helpful. (a simple formulation is available in Pierrehumbert 2005. (Climate dynamics of a hard snowball Earth, J. Geophys. Res., 110, D01111, doi:10.1029/2004JD005162.)

- line 14 p11: continental temperatures seem to be more relevant.

- on lines 1-4 p 14, authors conclude that “the discrepancy ... we find that meridional ocean heat transport largely compensates for seasonal and regional differences in insolation caused by changes in orbital parameters.” This result contrast with De Vleeschouwer et al. (2014) and constitutes an interesting finding of this study, so I suggest to include a specific discussion to convince the reader about the importance of the meridional heat transport (a figure will be very instructive).

- line 28 p18 “...increased precipitation ... an increase in latent flux.” The

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phrasing in this sentence is awkward. I am not sure that it is reasonable to mention this process to explain a warming at the surface.

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