

Interactive comment on “Simulating oxygen isotope ratios in tree ring cellulose using a dynamic global vegetation model” by S. G. Keel et al.

Anonymous Referee #1

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Motivated by paleo-climate/hydrological applications Keel et al. have implemented oxygen isotope diagnostics for tree ring cellulose in a dynamic vegetation model. They show that the model is able to reproduce measured modern-era oxygen isotope ratios of tree ring cellulose with a significant skill, and conclude that the model is a useful tool for paleo-interpretations of tree ring cellulose.

In my view the manuscript would be suitable for publication with moderate revisions taking into account the following questions and comments.

General comments. The paper is well written and the methodology is predominately well described with well-motivated choices for how the isotope diagnostics are imple-

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mented. Overall I think that structure and order of the figures related to the text could be improved, which would make manuscript easier to follow (see also detailed comments below). Although I think that the comparison to data and validation of the model is generally well thought out, I miss a more thorough discussion/test of how changes in seasonality could affect the interpretation. E.g. how would the timing of spring melt affect results in high-latitude regions? How would changes in precipitation seasonality affect humidity limited regions? What are the implications of southern versus northern slope proximity of trees? These questions are particularly important for palaeoclimatic interpretation. I am aware that a full study would be beyond the scope of the study, but the authors could provide some more insights regarding these questions from the work with the modern data.

Detailed comments. P18465, L2 Other references to millennial-scale tree ring isotope records include Edwards et al. 2008.

P18465, L18 For comparisons between variability of modelled and ice core d18O see Sjolte et al. 2011 and Masson-Delmotte et al. 2015.

P18468, L18 Replace “... carbon (C) and N dynamics...” with “... carbon (C) and nitrogen (N) dynamics...”

P18469, L12 Please clarify the choice of 0.8 for the ratio between the CO₂ mole fraction in the stomatal cavity and the ambient air.

P18472, L24 Please clarify that this paragraph is an evaluation of the input data.

P18473, L7-12 Optimally model output for daytime Rh should be applied. Variations in cloudiness etc. has large impacts on daytime Rh how valid is the 10% correction on longer time scales? E.g. decadal vs. intra-seasonal variations?

P18477, L9 I think that especially the results section, and the paper in general, could benefit from grouping figures differently. I suggest grouping maps that are similar together as figures with several sub-panels with 2-4 panels per figure. At least figure

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5 and 6 could easily be merged. Additionally, all sub-panels and sub-plots should be clearly marked with figure indices.

P18478, L15 For the comparison with the measured data: is there a bias in the model elevation that could explain some of the discrepancy between model and data?

References

Thomas W.D. Edwards, S. Jean Birks, Brian H. Luckman, Glen M. MacDonald, Climatic and hydrologic variability during the past millennium in the eastern Rocky Mountains and northern Great Plains of western Canada, *Quaternary Research*, Volume 70, Issue 2, September 2008, Pages 188-197, ISSN 0033-5894, <http://dx.doi.org/10.1016/j.yqres.2008.04.013>.

Masson-Delmotte, V., Steen-Larsen, H., Ortega, P., Swingedouw, D., Popp, T., Vinther, B., Oerter, H., Sveinbjornsdottir, A., Gudlaugsdottir, H., Box, J., Falourd, S., Fettweis, X., Gallée, H., Garnier, E., Gkinis, V., Jouzel, J., Landais, A., Minster, B., Paradis, N., Orsi, A., Risi, C., Werner, M., and White, J. W.: Recent changes in north-west Greenland climate documented by NEEM shallow ice core data and simulations, and implications for past-temperature reconstructions, *The Cryosphere*, 9, 1481-1504, doi:10.5194/tc-9-1481-2015, 2015.

Sjolte, J., G. Hoffmann, S. J. Johnsen, B. M. Vinther, V. Masson-Delmotte, and C. Sturm (2011), Modeling the water isotopes in Greenland precipitation 1959–2001 with the meso-scale model REMOiso, *J. Geophys. Res.*, 116, D18105, doi:10.1029/2010JD015287.

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