

Geosci. Model Dev. Discuss., referee comment RC1  
<https://doi.org/10.5194/gmd-2021-362-RC1>, 2022  
© Author(s) 2022. This work is distributed under  
the Creative Commons Attribution 4.0 License.

## Comment on gmd-2021-362

Anonymous Referee #1

---

Referee comment on "Forest fluxes and mortality response to drought: model description (ORCHIDEE-CAN-NHA r7236) and evaluation at the Caxiuanã drought experiment" by Yitong Yao et al., Geosci. Model Dev. Discuss.,  
<https://doi.org/10.5194/gmd-2021-362-RC1>, 2022

---

In this paper, Yao et al. developed and implemented a new plant hydraulic architecture module "NHA" into ORCHIDEE-CAN based on soil-root-stem-leaf water transport continuum and the relationship between PLC and tree mortality. They compared the model performance of NHA model with two previous versions of the model to prove the efficacy of the new model in capturing the change of sap flow, soil moisture content, and GPP under drought events. They also evaluated model results against field measurements of leaf water potentials, biomass and mortality rates from a tropical lowland rainforest in eastern Amazonia. Their results show great potential of the NHA model to capture the drought-related tree biomass loss and mortality for tropical forests. The new model represents the state-of-the-art development of plant hydraulic model and will be of interest to the research community and readers of GMD. This paper is well written, and the results are nicely presented. I have some general comments as below.

For improvement, first, they should fit their new model into a broader field of mechanistic plant hydraulic models. They mentioned some previous work such as SPA model and Xu et al. (2016) but it's still not very clear how they were motivated, how the new model was built on, and what are the strengths and weaknesses of their new model compared with other similar plant hydraulic models. They had some discussion starting from Line 547, but adding more details would be great.

Second, one of the key limitations of the usage of such plant hydraulic models is numerous parameters, as shown in Table 1 in this paper. The authors focused on one site simulation with well-recorded plants' traits. However some topics such as how sensitive and uncertain these parameters are, and how to parameterize the model at the regional and global scales might be interesting to add to the discussion. The authors may find this paper relevant to their discussion:

*Liu, Y., Kumar, M., Katul, G. G., Feng, X., & Konings, A. G. (2020). Plant hydraulics accentuates the effect of atmospheric moisture stress on transpiration. Nature Climate Change, 10(7), 691-695.*

Third, some references when the authors described the equations in Methods are missing. More information about throughfall exclusion experiment and model simulation set up is needed as well.

Below, I provide more specific comments:

-Line 225: Any references for the sigmoidal relationship? How about other relationships such as linear, logistic, or exponential?

-Line 275: Please provide reference and a simple description for the gs model. L is not defined either.

-Line 280: What's the gs model in the SPA model, is that the same one used in this study?

-Line 332: How is LAI modeled in this study?

-Line 346: More information such as the plot size and duration of the experiment about the TFE site could be added here so readers don't need to read the cited papers.

-Line 353: What are the similarities and differences between SPA model and your model?

-Line 360: What meteorological forcing was used to drive the model, at what temporal resolution? Were the simulations coupled with a climate model or offline?

How was the TFE simulation carried out? Was the precipitation be reduced to 50% of CTL level at each model time step?

Is the model also initialized with real forest inventory data? How do 20 circumference classes correspond to the real-world situation?

-Line 365: Past tense for “run”, and “compare” in line 367.

-Line 384: Could the authors discuss why their new model underestimated sap flow in the dry season but overestimated it under TFE conditions?

-Line 421: What mechanism leads to the larger seasonal amplitude of modeled GPP compared with SPA model?

-Line 550: What's the leaf-level demand of Xu et al. (2016)?

-Figure 2: Color for  $\Psi_{50} = -1.6$  is too weak to be seen.