We thank the reviewer for the constructive comments and suggestions.

The manuscript investigates how vertical resolution of soil-plant hydraulics and integration schemes influence a hydrodynamics-enabled biosphere model, FATES-HYDRO. The study conducted simulations by combining different numbers of top soil layers to create a gradient of different resolutions. They also use point-level simulations to explore the impacts of integration schemes.

Overall, I think the topic can be useful to the plant hydraulics and ecohydrological modeling community although I feel the design, interpretation, and presentation of the study can be further improved.

First, I think the underlying pathways of AGB changes under different resolutions are still elusive to me. Mixing top soil layers will surely influence hydraulic properties (as suggested by Fig. 4) but can also change the plant water accessibility right?

Mixing top soil layers will not change the total root biomass that can access water. However, it may change the solution of leaf water potential, thus the stress factor defined by Eq. 4 in the manuscript. It also triggers hydraulic failure mortality when a certain threshold is met. Hydraulic failure mortality begins when plant fractional loss of conductivity (ftc) reaches a threshold (ftc,t, default is 0.5):

$$M_{hf,coh} = \begin{cases} \frac{ftc-ftc,t}{1-ftc,t} m_{ft} & \text{for } ftc \geq ftc,t \\ 0.0 & \text{for } ftc < ftct \end{cases} \quad \text{(R1)}$$

where m_{ft} is the maximum mortality rate (yr^{-1}).

The stress factor modifies the top of canopy leaf photosynthetic capacity and the Ball-Berry leaf stomatal conductance as shown in Eqs. R2 and R3 below:

$$V_{c,max} = \beta V_{c,max} \quad \text{(R2)}$$

$$g_s = m \frac{A_n}{C_s/P_{atm}} h_s + \beta b \quad \text{(R3)}$$

where $V_{c,max}$ is the maximum rate of carboxylation (μmol CO_2 m^{-2} s^{-1}), g_s is the leaf stomatal conductance (μmol m^{-2} s^{-1}), m is a plant functional type dependent parameter, A_n is leaf net photosynthesis (μmol CO_2 m^{-2} s^{-1}), C_s is the leaf surface CO_2 partial pressure (Pa), P_{atm} is the atmospheric pressure (Pa), h_s is the leaf surface humidity, and b is the minimum stomatal conductance (μmol m^{-2} s^{-1}), β is the stress factor defined by Eq. 4 in the manuscript.

AGB changes due to the above modifications due to the change in numerical solution.

I am not sure how FATES calculate the soil-to-root conductivity but I guess root biomass/area matters? How big an effect this can be, especially if the distribution of root biomass is exponential?

Yes, root biomass/area matters for the soil-to-root conductivity. In FATES, soil-to-root conductivity is proportional to the root fraction in each layer, i.e., the longer the root in a layer, the larger the conductivity.

Furthermore, does soil moisture influence AGB mainly by influencing growth or mortality, which ultimately drives equilibrium biomass? Would be helpful to plot the difference of (relative) growth/mortality if they are in the standard output

Thanks for the suggestions. Soil moisture influence both growth and mortality as they are coupled.

Second, I am not sure how much I can trust the XGBoost analysis especially since the out-of-sample accuracy is 67% (just a little different from random...). I guess including some variables on plants can help? (for example, average plant hydraulic traits within each grid cell?) In addition, using soil water potential rather than soil water might be better when looking at biomass differences...

Thanks for the suggestions. We'll consider how to improve the model.

Third, the AGB responses to the number of soil layers seem to be nonlinear and not necessarily monotonic in most of the 4 point-simulation sites (Fig.6). Why would this happen? Maybe some analysis of this point-level simulations can shed light upon large scale patterns.

Thanks for the comment. We don't expect the response of AGB to number of soil layers to be linear because of the nonlinearity of soil water retention curve and plant vulnerability curve and different layer soil properties.

Finally, I find the integration scheme analysis is simplistic and weak. For example, does a longer time step with explicit integration is computationally more efficient with a reasonable loss of accuracy? What would be the longest tolerable time step for plant hydraulics? How about other integration schemes such as Runge-Kutta? Such tests do not need to be long, I guess a few weeks worth of simulation is good enough so global simulations with different integration schemes might be possible.

Thanks for the suggestion. We will consider further analysis.

A few minor comments:

Line 165-200, this section is not easy to read with many parameters and poorly formatted equations, and some typos (e.g. in eq. 8, the higher order term should be o(delta^2) instead of 0). Please consider having a full editorial check and improve the readability.

Thanks for catching the typos. We’ll correct and improve the readability of the equations.

Line 250, negative delta_AGB --> overestimate reads very unintuitive. Please use experiment - reference simulations when calculating delta values.

Line 255, what is soil water saturation? Is it relative soil water?

Soil water saturation is the volume of water divided by volume of voids in the soil.

Figures:

Fig1 and Fig2 can be combined together since they both talks about vertical soil columns

Fig. 5, what are X axes in panels (a) and (b)? # of trees?

X axes in panels (a) and (b) are number of iterations or epochs for training.