We thank Anonymous Referee #2 (AR2) for their helpful feedback on our manuscript. AR2's comments are copied below in black with our responses to each in red.

-Lines 49, 50 and 51: According to the Markewitz et al. (2010) study (cited), 10% of water uptake by roots occurs at depths between 550 cm and 1150 cm. So, correct this information! Moreover, instead of using only one modeling study for this information, use these two observational studies: **https://doi.org/10.1002/hyp.6211** and **https://doi.org/10.1002/hyp.11143**

Thank you for this comment and for bringing the two observational studies to our attention.

L47-L51 has been updated:

In a modeling study of an artificial throughfall exclusion experiment at Tapajós National Forest in northern Brazil (Nepstad, 2002; Nepstad et al., 2007; Davidson et al., 2011), Markewitz et al. (2010) noted that while the percentage of RWU occurring at depths between 5.5 and 11.5 m was relatively small (10%), model results suggest it was critical to survival.

Directly afterwards, the following sentences have been added:

Soil moisture observations collected by Bruno et al. (2006) in an Amazonian forest reflected withdrawal of soil moisture up to 10 m below the surface. Broedel et al. (2017) collected soil moisture observations from the central Amazon and found root uptake below 4.8 m during a year that was exceptionally dry.

-Lines 85, 86 and 87: This sentence about the studies in Table 2 is wrong and should be corrected or deleted.

This sentence at L88-L90 has been updated:

From Table 2, we see that representations of deep, dynamic RWU that do exist involve more complexity than needed for our purposes or do not include both deep and dynamic RWU.

-Line 150: Mention here the depth at which most of the water uptake by the roots of Amazonian trees occurs (based on the two observational studies recommended previously).

This sentence at L152-L154 has been changed accordingly:

This means hydrologically active soil layers in modified Noah-MP are deep enough to capture RWU consistent with uptake depths in the Amazon observed or inferred to be 4.8-18 m (Davidson et al., 2011; Bruno et al., 2006; Broedel et al., 2017).

-Subsections 2.4 and 3.2: The GLEAM product consists of a set of algorithms to estimate the components of evapotranspiration, driven by satellite data. However, the maximum soil depth in this product is shallow (2.5 m). This should be mentioned as a limitation in these two subsections. Moreover, there are flux towers in the Brazilian state of Rondônia (with data freely available on the internet), and these should be considered.

The following has been added at L237-L238 in subsection 2.4:

An important limitation of GLEAM is the soil module used in deriving the evaporation estimates, which includes shallow soil layers that only extend to 2.5 m (Martens et al., 2017). Despite this limitation, GLEAM is valuable in its temporal availability and partitioning of ET into components.

Additionally, the following has been added at L388-389 in subsection 3.2:

Keeping in mind the shallow soil module used to produce the GLEAM estimates, we note that the GLEAM values may be lower than if deeper soils were included.

We are aware that flux tower data exists in Rondônia from the LBA project. However, data are only available for the early 2000s, coinciding with the years of model output we discarded to allow for spinup of the deep soil layers. This detail has been added to the manuscript at L239-L242:

We note that flux tower data is available within our domain from the Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA; Restrepo-Coupe et al., 2021). However, these data are only available for the early 2000s, coinciding with years that were discarded from the model output to account for spin up of deep soil layers.

-Results Section: In the case of the Southern Amazon, it is more correct to refer to the austral summer (DJF) as the purely rainy season, and the austral winter (JJA) as the purely (and relatively) dry season. Or, to the period of the South American Monsoon as the rainy season (NDJFM), and the period completely outside this monsoon, as the relatively dry season (MJJAS).

The first paragraph of the Results section has been updated to reflect this comment:

Figure 2 depicts simulation mean water table depth (WTD) and uptake shallower than 1 m in the ROOT experiment for all months, relatively dry months outside of the South American monsoon period (Jun-Sep), and relatively wet months during the monsoon period (Nov-Feb). Mean WTD is generally deeper in drier months (Fig. 2a), reflecting seasonal availability of moisture from precipitation. WTD is consistent with simulated values for the same region from other studies (Martinez et al., 2016a; Fan et al., 2017). Fractional uptake shallower than 1 m (Fig. 2b) varies between dry and wet periods, with a clear shift in uptake to depths below 1 m during drier months. This is consistent with a seasonal shift in RWU from shallower to deeper areas of the root zone as moisture from precipitation becomes scarce during drier months.

The caption of Fig. 2 has also been updated in response to this comment.

-DISCUSSION SECTION:

--Lines 378 and 379: Mention that this refers to an offline model!

These lines (L407-L408) have been updated accordingly:

The results of this work reflect a major advancement in the representation of the link between subsurface and atmospheric fluxes of moisture via RWU in the offline configuration of Noah-MP.

--Line 380: Mention that it was evaluated in the southern Amazon.

The following has been added at L408-L409 :

To demonstrate this, we focus on a region centered on the state of Rondônia in the southern Amazon.

--Lines 393 and 394: Are you sure that the Amazon rainforest is water-limited?????

'Water-limited' has been removed from this part of the text.

--Overall: This subsection needs to be expanded and improved. One suggestion is that several studies that analyzed root depth and dynamics are mentioned in tables 1 and 2, and although some are simpler approaches than those in the present study, a comparative discussion of their results with the results of previous studies is important.

The following paragraph has been added to the Discussion section as the first paragraph. It includes text that was originally in the Conclusion, as well as a comparison of results from previous studies with our work:

Overall, we find that the results of this work support the hypotheses detailed in the Introduction and are in accordance with previous studies that motivated these hypotheses. These include Fan et al. (2017), which highlighted the importance of groundwater as a moisture source for vegetation during dry periods, and Miguez-Macho and Fan (2021), which clarified that while moisture from groundwater is important in valleys, deep vadose zone storage of past precipitation is critically important in uplands during dry months. Additionally, the findings of this study are in line with others listed in Table 2, all of which found that inclusion of deep and/or dynamic RWU in Noah-MP improved model performance (Gayler et al., 2014; Wang et al., 2018; Liu et al., 2020; Niu et al., 2020; Li et al., 2021). In particular, Niu et al. (2020) and Li et al. (2021) noted improvements in Noah-MP's performance during drier periods after enhancements were made. Zanin (2021) is the only study in Table 2 that focused on the Amazon region and included the domain for this study. Similar to our work, they found changes in seasonality of soil moisture in shallow and deep layers resulting from addition of deep RWU. While simulation of sensible heat flux improved in Zanin (2021) when deep RWU was activated, latent heat flux was overestimated.

-CONCLUSIONS SECTION:

--The first three paragraphs are a large summary of what was done in this article, and should be eliminated or simplified to a small paragraph.

Thank you for this comment. Based on this suggestion and a similar suggestion from AR1, we have removed many of the details from the first few paragraphs of the conclusion. Additionally, to improve the organization of this section, we have added two subsection headings: 'Summary of findings' and 'Significance and future work'.

--The fourth and fifth paragraphs should be placed in the discussion section.

These paragraphs include a summary of our findings, and as such, we leave them in the conclusion. However, as mentioned above, the organization of this section has been improved and the summary of findings has been reduced considerably. The intent of these changes is to improve the clarity of the discussion and conclusion sections. In consideration of this comment, the third to last paragraph was moved to the discussion section.

--The last three paragraphs are the only ones appropriate for the conclusions section, and should be explored further.

As mentioned above, the third to last paragraph was moved to the discussion section as we felt it made more sense to include it there. In response to this point as well as a similar comment from AR1, we added more detail to this section, including an additional paragraph that elaborates on avenues of research made possible by this study:

Noah-MP with DynaRoot enabled can be used to investigate a number of different science questions with wide-ranging implications. Given the role of plant trait diversity in resilience of the Amazon as studied by Sakschewski et al. (2016) and the identification of deep-rooting as a drought resilience strategy by Chen et al. (2024), DynaRoot could be used to study changes in forest resilience under deforestation scenarios. Moreover, given that moisture varies slowly in subsurface soils (Amenu et al., 2005), DynaRoot makes it possible to characterize the role of deep soil moisture memory in influencing surface moisture via transpiration in a coupled land-atmosphere framework. Such research has been alluded to in Niu et al. (2020) and Zanin (2021), and could have implications for predictability of atmospheric moisture on longer timescales. Dominguez et al. (2024) discuss two multidecadal convection-permitting simulations that were completed for the entire South American continent. In their analysis of these runs, Zilli et al. (2024) identified land-atmosphere coupling in CPMs as an outstanding area of investigation. This motivates potential future work that focuses on the role of fine-scale land surface characteristics—such as water table depth and vegetation traits (including rooting depth)—in simulating convection. DynaRoot would be applicable in such work, particularly in global convection-permitting simulations that have become a priority in the climate modeling community (Satoh et al., 2019; Caldwell et al., 2021; Feng et al., 2023).