

Reviewer #1

This manuscript presents measurements of soil water holding capacity in primary forest, secondary forest, and rubber plantation in the humid tropical island of Hainan, China. The main findings are that primary forest has significantly higher water holding capacity than the disturbed landscapes, and that these differences are associated with higher macroporosity. The manuscript includes interesting time series measurements of measurements of water content and soil hydraulic properties during the wet season and through the transition into the dry season. The hydraulic differences between secondary forest and rubber plantation are also somewhat discussed. The main strength of this manuscript is an interesting and quite complete dataset of soil hydraulic and chemical properties across the three sites, and with some time series component.

This manuscript has significant shortcomings in both the scientific novelty and the analysis. Beginning with scientific novelty, it has been well-established for several decades that forest conversion leads to soil compaction and reduced hydraulic function, e.g., Bruijnzeel, L. A. 1990. *Hydrology of Moist Tropical Forests and Effects of Conversion: A State of Knowledge Review*; Bonell, M., and L. A. Bruijnzeel. 2005. *Forests, Water and People in the Humid Tropics*. Both these reviews and the works cited within provide in-depth exploration of the same topics presented in this current manuscript. The main findings of this paper show quite extensively that several different soil water retention properties are related to several different soil porosity parameters - Figures 5, 7, and 8. More recently, studies cited within this manuscript also found the same results - Wen et al., 2017 and 2019.

Perhaps just as importantly, the analysis of the data has several shortcomings that hinder interpretation and comparability with the literature. First, three sites are used in total in a space for time approach - however, the land use history of the three sites is not mentioned in the manuscript. Moreover, the three sites appear to have considerable differences in their climate and geological setting, although the manuscript claims otherwise. Figure 1 indicates that though the sites are within a few miles of each other, each site has significantly slope and topographic setting. Particularly, the primary forest site appears to be up to 1000 meters higher altitude than the rubber monoculture site in the lowlands at roughly sea level. Accordingly, soil textural and mineralogical composition at the site appears significantly different (Figures 2 and 3). The manuscript indicates that the changes in soil texture are caused by the land use differences (line 146-147), but this link is more likely confounding, not causal. Furthermore, as a reviewer I am speculating that the precipitation would differ between the three sites, especially due to the elevation gradient. This is not acknowledged or discussed even though water storage is presented as a primary finding. In general, the confounding differences between the sites need to be addressed as a major limitation in the interpretation of results and especially causality.

Reply: We sincerely thank the reviewer for dedicating their valuable time to review our manuscript and for providing such insightful, detailed, and constructive comments. These comments have been immensely helpful in allowing us to recognize the shortcomings of the manuscript and have pointed us toward key areas for improvement. Based on the reviewer's suggestions, we have carefully formulated a detailed revision plan. Below is our point-by-point response:

1. Regarding the scientific novelty, we fully agree with the reviewer's perspective. The negative impact of forest conversion on soil physical properties is indeed a classic conclusion in tropical hydrology. We will more accurately position our study in the introduction section by explicitly acknowledging this broad scientific consensus. However, we believe the core novelty of this study lies not merely in re-validating this general pattern, but also in utilizing high-frequency time-series observations to reveal the dynamic patterns of soil hydraulic properties in different ecosystems (particularly primary forest, secondary forest, and rubber plantation) and their influence on soil water storage during the transition between wet and dry seasons.

2. Concerning the shortcomings in data analysis, we must clarify that we selected a typical land-use conversion pathway within the region: specifically, the degradation of primary forest to secondary forest, followed by further conversion to rubber plantation. We have already detailed the duration of these conversions in the methods section. Secondly, although the primary forest site differs significantly in elevation from the other two sites, the forest conversion process involved only the clearing of above-ground vegetation without intense disturbance to the soil, we believe these three sites share the same soil texture and mineralogical composition. Finally, regarding the reviewer's concern about precipitation differences, we conducted on-site monitoring. Despite the elevation gradient, the actual rainfall monitored at the three sites was similar due to their close geographical proximity.

I also want to briefly address line 43-44: “However, in recent decades, economic development and slash-and-burn cultivation by ethnic minorities have led to extensive degradation of primary forests”. It is wholly inappropriate and scientifically irrelevant to comment on ethnic minorities as a cause of deforestation.

Reply: We deeply regret the inappropriate expression in the original manuscript and have revised it: Historical agricultural expansion and economic activities have led to extensive degradation of primary forests.

This project's strength lies in the data collection performed over time. Figure 6A is genuinely interesting, particularly the wide difference in soil water storage during the dry season. Linking

this behavior to observed soil traits (and likely precipitation differences) would provide useful new insights into ecosystem hydrological function. This may be a path to publication in the future, but the manuscript in its current form is not suitable for publication in EGU SOIL.

Reply: We would like to once again express our sincere gratitude to the reviewer for their insightful comments. As rightly highlighted by the reviewer, the significant differences in soil water storage during the dry season, as shown in Figure 6a, represent a particularly interesting finding. In the revised manuscript, we will place greater emphasis on this temporal dynamic dimension of our study in both the introduction and discussion sections. We will also conduct an in-depth analysis and discussion on the reasons behind the substantial differences in soil water storage between the dry and wet seasons, and more closely link soil water storage with observed soil properties (such as soil porosity, soil organic matter, soil bulk density, etc.). We hope that the revised manuscript will meet the standards for publication in EGU SOIL.

Specific comments:

Title is redundant, remove “by altering soil properties”

Reply: We appreciate the reviewer's valuable input on the manuscript title. In response, we have changed it to "Forest conversion reduces soil water retention in tropical rainforest."

Introduction: the state of previous literature is not well explained, and therefore knowledge gaps are not identified. Question-motivated research will improve the quality of the analysis and presentation as well.

Reply: We fully accept this important criticism from the reviewer. Accordingly, we plan to rewrite the Introduction section in the revised manuscript to follow a clearer, question-motivated logical structure. The revised Introduction will generally adhere to the following framework:

First, it will emphasize the critical role of tropical forest ecosystems in hydrological regulation and the carbon cycle, as well as the potential threats posed by large-scale land-use changes (such as conversion to rubber plantations) to these functions.

Second, it will summarize the established consensus in the field. In particular, we will explicitly acknowledge the classical conclusion mentioned by the reviewer that forest conversion generally leads to soil compaction and a decline in hydrological functioning (Bruijnzeel, 1990;

Bonell and Bruijnzeel, 2005). At the same time, recent regional studies (e.g., Wen et al., 2017, 2019) will be cited to illustrate the current research focus and progress achieved in this area.

Subsequently, we will identify key research gaps. First, the link between static soil properties and their dynamic hydrological effects remains poorly understood. Second, comparative studies on the seasonal dynamics of soil water storage across different land-use types are still lacking.

Finally, it will present the research objectives of this study: (1) to reveal the effects of primary forest conversion to secondary forest and rubber plantations on soil water retention capacity; (2) to utilize high-frequency time-series observations to uncover the seasonal dynamics of soil water storage (during both wet and dry seasons) and to clarify the differences in hydrological functioning among ecosystems facing seasonal water stress; and (3) to identify the main factors regulating soil water retention and storage capacity.

Materials and methods - the site description is not complete. The three sites clearly have some differences - why were they selected, what is their history, what are their differences and how will that affect the study?

Reply: We sincerely thank the reviewer for raising this important issue. We will substantially expand and clarify the Methods section in the revised manuscript.

First, our site selection aimed to identify plots with similar environmental conditions while representing the most common and typical land-use types (undisturbed primary forest, secondary forest that has naturally regenerated after the clearance of primary forest, and rubber plantations converted from natural forests) in the tropical region of Hainan Island.

Second, the selected secondary forest and rubber plantation sites both originated from previously undisturbed forests and underwent similar conversion processes involving only vegetation removal without severe soil disturbance. Therefore, we consider that these sites share comparable soil parent material, climatic conditions, and topographic settings. This careful selection enables our study to minimize the influence of varying environmental factors and better isolate the effects of forest conversion. We are confident that through this improved experimental design and more detailed methodological description, our findings can provide a reliable assessment of how forest conversion affects soil properties.

Materials and methods - litter collection data shown, but not mentioned in the methods

Reply: We sincerely thank the reviewer for their careful reading and valuable reminder. We deeply apologize for the omission regarding the litter collection method. We will add the following content to Section 2.2 Study Method Design and Sample Acquisition: Within each

plot, aboveground litter was collected following a five-point sampling method, with one subplot (1 m × 1 m) established at each sampling point. All collected litter was transported to the laboratory, oven-dried, and weighed to determine litterfall yield.

Results/conclusions: water holding capacity over time is discussed but not shown - just the actual water storage is shown. This would be quite interesting data to see.

Reply: We are very grateful to the reviewer for this valuable suggestion. In our subsequent research, we actually measured and analyzed the differences in soil water retention capacity between the dry and wet seasons. We found that soil water retention capacity did not show statistically significant changes between the dry and wet seasons, with only minor numerical fluctuations. The seasonal dynamics we observed were primarily reflected in the soil water storage. Precisely because the water retention capacity remained relatively constant, the significant differences observed in soil water storage can be more strongly attributed to the influence of different land use types on the water balance.