**To Reviewer #2**

**General Comments**

**[Comment 1]** *This paper provides a spatio-temporally map of vegetation cover on the Tibetan Plateau. These data would be very useful for the Holocene terrestrial ecosystem studies of the Plateau.*

**[Response]** Many thanks for your encouragement, constructive comments, and suggestions. The point-by-point responses are listed following each comment.

**[Comment 2]** *In Modern pollen dataset, some of the samples from same paper are given the same coordinates, because in some old references the authors didn't provide precise locations of each sample. But if these samples were from mountainous area, the vegetation at each site are certainly different. How do the authors deal with these sites, will it affect the vegetation reconstruction?*

**[Response]** Thank you for your insightful comment. The modern pollen dataset used in this study was compiled by Cao et al. (2022) from multiple regional modern pollen datasets, which underwent rigorous quality control during collection and integration. Low-quality samples (e.g., extremely low pollen concentration, very few taxa, incomplete data, or pollen percentage sums outside 90–110%) were removed, and the datasets were standardized by calibrating geographic coordinates and harmonizing taxon names. The majority (>90%) of samples were collected after the 1990s using GPS, ensuring precise coordinates. For older samples, geographic positions were estimated using topographic maps or proportional maps and further corrected using

DEM-based elevation fitting and Google Earth satellite imagery (Zhuo et al., 2013). These datasets have been widely used for paleoecological reconstructions and demonstrated high accuracy, supporting their reliability (Yu et al., 2000; Cao et al., 2013, 2014; Chen et al., 2021; Liu et al., 2020; Wang et al., 2022).

Considering the possibility of duplicate records across datasets and the fact that modern pollen samples from lake sediment surfaces may originate from multiple samples of a single fossil pollen record after 1950 CE, we averaged the pollen percentages of samples sharing identical coordinates but containing different taxa. Following your suggestion, we then performed a sensitivity analysis to assess whether retaining these samples would bias vegetation reconstruction. Specifically, we identified records with duplicate coordinates (n = 1011 samples, representing 330 coordinate sites or 4.3% of all sites), including 133 sites (1.8%) located in mountainous areas as defined by the global mountain of Kapos et al. (2000), which objectively accounts for altitude, slope, and relative relief (Sayre et al., 2018).

We constructed two Random Forest (RF) models based on (i) all sites (n = 7587) and (ii) sites with duplicate coordinates removed (n = 7287. The results showed that removing duplicate sites did not affect model performance: the accuracy of RF models was the same ($R^2$ = 0.79), and reconstructed vegetation cover was highly consistent ($R^2$ = 0.99) between the two models (Figure R1). Therefore, the inclusion of a small proportion of modern pollen sites with identical coordinates does not compromise the accuracy of vegetation reconstruction. This information has been incorporated into the revised manuscript.

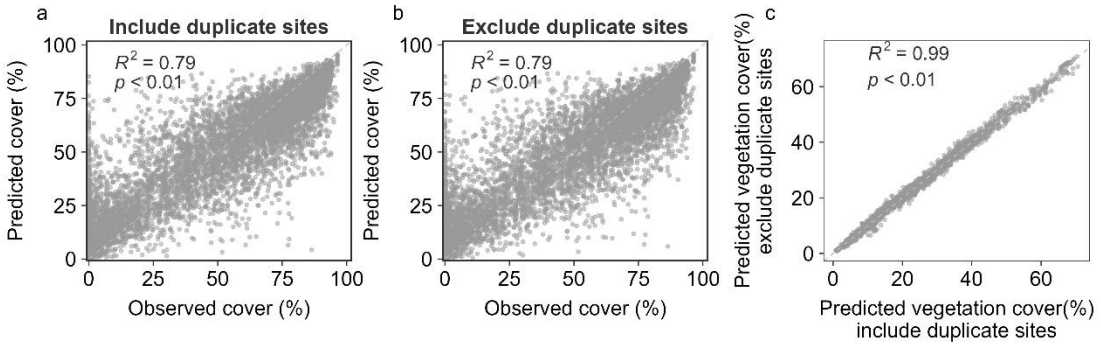


**Figure R1.** Model validation and vegetation cover reconstruction with and without duplicate-coordinate modern pollen sites. (**a-b**) Accuracy of RF models trained using all sites (a) versus those with duplicates removed (b). (**c**) Comparison of reconstructed vegetation cover between models with and without duplicate-coordinate sites.

**[Comment 3]** *Moreover, some of the sites' coordinates are very rough, e.g. only with degree, would these represent the real localities and true vegetation type? did the author deleted these?*

**[Response]** Thanks for your thoughtful comment. To ensure accurate correspondence between modern pollen sites and true vegetation cover, we have removed sites with coordinates reported only at the degree level (n = 245, accounting for 3.1% of all sites).

To further verify the robustness of using the remaining modern pollen sites as training data for vegetation reconstruction models, we conducted a sensitivity test by introducing random perturbations to site coordinates. Specifically, we randomly selected 10% of the pollen sites—only those from the 1990s dataset exhibited potential coordinate uncertainty, and these accounted for a very small proportion of the dataset—and applied random shifts within a range of 0 to 0.05° (~5.6 km). The

choice of 0.05° is reasonable, as coordinates derived from map-based estimates typically have an error of about ±2 km depending on latitude (Whitmore et al., 2005). We then re-extracted vegetation cover values using the perturbed coordinates, reconstructed Random Forest (RF) models, and compared the results to models based on the original coordinates.

Our perturbation tests showed that the RF models built with perturbed coordinates achieved comparable accuracy to those based on the original dataset ($R^2$ = 0.79), and the reconstructed vegetation cover exhibited highly consistent ($R^2$ = 1) (Figure R2). This consistency likely results from the strong spatial autocorrelation in modern vegetation cover datasets derived from remote sensing products, where adjacent pixels exhibit similar vegetation composition. Additionally, vegetation distribution patterns at regional scales typically form continuous belts or patches (Turner et al., 2001). Therefore, even when pollen site coordinates have slight uncertainties, the associated vegetation coverage values remain relatively stable, confirming the robustness of our modern pollen dataset for RF-based vegetation reconstruction. This information has been added to the revised manuscript.

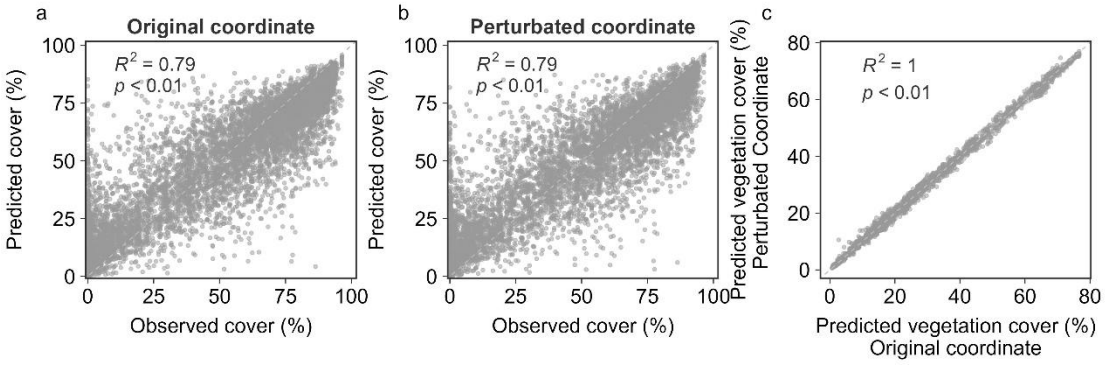


**Figure R2.** Model validation and vegetation cover reconstruction based on modern pollen sites with randomly perturbed coordinates. (**a-b**) Accuracy of RF models

trained using original (a) and perturbed (b) coordinates. (**c**) Comparison of reconstructed vegetation cover between models using original and perturbed coordinates.

**Specific Comments**

**[Comment 4]** *There is still few Chinese characters in the text, i.e. line 112.*

**[Response]** Thank you for pointing this out. We have carefully checked the manuscript and replaced the remaining Chinese character with its correct English equivalent (Line 134, Page 5).

## Reference

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