Summary:

In this manuscript, Xu et al demonstrate improving leaf C:N ratio representation in ESM by showing how environmental selection drives community leaf stoichiometry and individual plasticity plays a relatively small role.

The manuscript is very interesting and presents the problem and the authors approach well, but I have a question about the robustness of the analysis for Eco-Evolutionary Optimality as presented in the graphs. It looks to me like the main conclusions are affected by a low number of points with very high leverage. Can the results be presented to account for these outliers by log transforming the data or removing these points? A large part of the paper depends on accepting these analyses as robust. Correcting these may change some of the discussion.

Authors: We thank the reviewer for constructive and insightful comments. Our detailed answers are listed below.

Reviewer: Figure 4. These relationships are look like they are affected by a minority of points with a high VcMax25/Ma ratio.

Authors: We agree that the relationships shown in (the new) Figure 5 look as if they might potentially be biased by a few extreme values. However, we checked V_{cmax25} and M_a of the five species with exceptionally high V_{cmax25}/M_a ratios. All but one were found to lie within expected ranges of V_{cmax25} and M_a. Three out of five species with particularly high V_{cmax25} (> 200 µmol m^{-2} s^{-1}) were from high elevations (around 4000 m) where such values are both usual, and predictable (Wang et al., 2017 *New Phytologist*) due to the combination of high light intensity with low air pressure and temperature. At the 4081 m site (see Figure R1 below) half of all species had high V_{cmax25} compared to other sites, but these still lay within the global range of V_{cmax25} (Yan et al., 2023 *Global Ecology and Biogeography*). One species with particularly low M_a (17.9 g m^{-2}) at the 1785 m site was nonwoody. Fig. R2 below shows M_a varying from 11 to 147 g m^{-2} at this site. Species with a similar range of M_a values occurred at many other sites. Just one species at the 2258 m site showed exceptionally high V_{cmax25} at moderate elevation. After we removed this one species, the result of the regression shifted only slightly, and the trend of increasing slope with LAI remained.

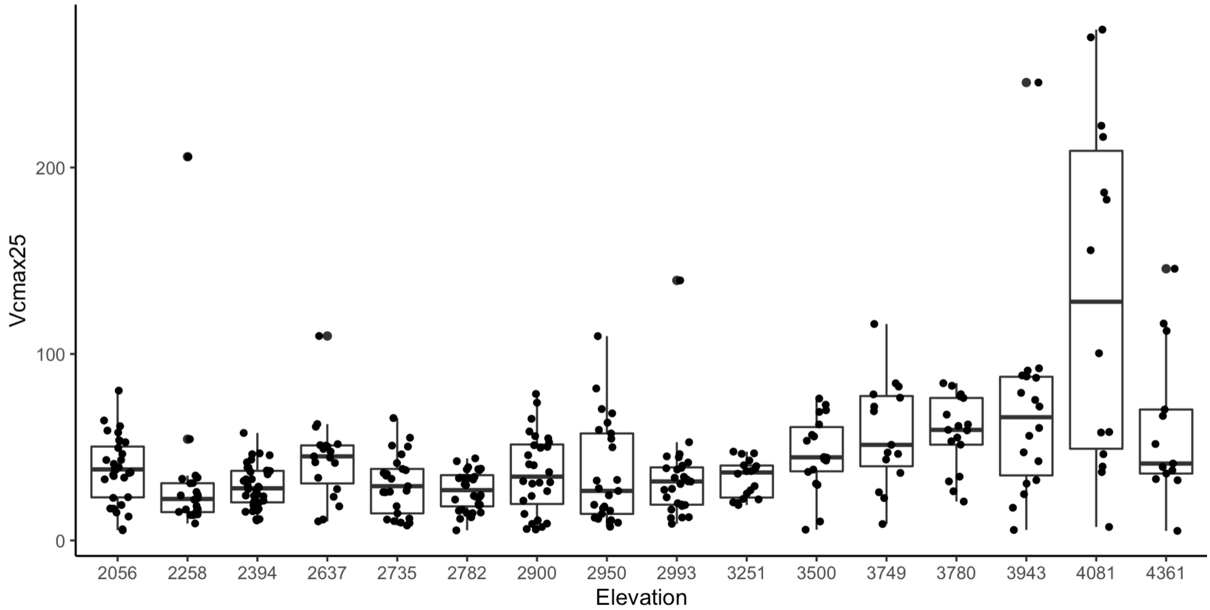

Figure R1 The distribution of V_{cmax25} at sites with high V_{cmax25}/M_a values and adjacent sites along elevation. The dots were individuals sampled at each site. Only sites along adjacent elevation gradients were shown as total number of sites was too many to make figure hard to read.

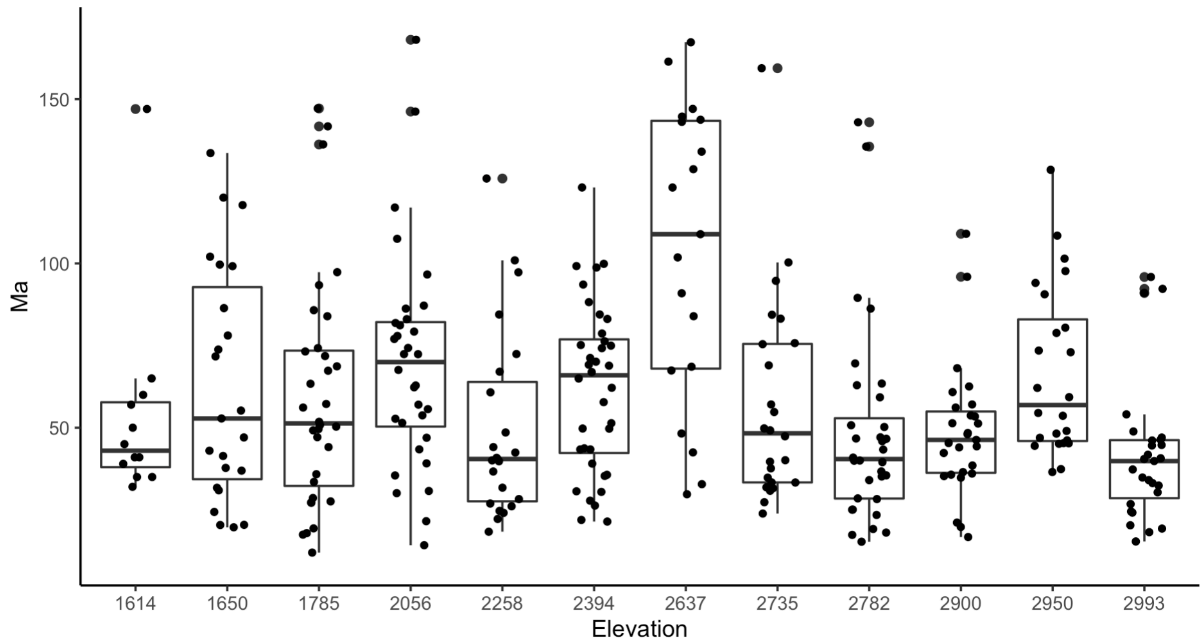

Figure R2 The distribution of M_a at sites with high V_{cmax25}/M_a values and adjacent sites along elevation. The dots were individuals sampled at each site. Only sites along adjacent elevation gradients were shown as total number of sites was too many to make figure hard to read.

Reviewer: Likewise in figure 5c, are the optimality predictions of Nmass skewed by the relatively low proportion of low Nmass species? It looks like the relationship would be very different without these points. Most of the species are between 2 and 2.25 with visually quite a different relationship.

Authors: N_{mass} was indeed underpredicted and constrained within a narrow range, except for some sites (on the left side of the new Figure 6c) that were tropical seasonal forests, with high LAI compared to other sites. When LAI was high, the intercept of the relationship between N_{mass} and V_{cmax25}/M_a was low (despite the steep slope) leading to low predicted N_{mass}. We have provided further discussion about our method to predict N_{mass} and its potential improvement (Lines 336-340):

"However, our predicted N_{mass} was constrained within a narrow range, despite the well-captured variations in M_a and V_{cmax25}. The predicted N_{mass} in tropical forests with high LAI were systematically underestimated due to the low intercept (Supplementary data Table S1). We recognize that our method to predict N_{mass} may overlook additional functions of N in leaves, such as chemical defences, perhaps causing greater variation than predicted. This requires further investigation."

Reviewer: A simple explanation of what exactly Pagels λ is – what is phylogentetic signal – would be useful to readers with a more biogeochemical background as one would expect from this journal

Authors: We have added some explanation about Pagels λ (Lines 156-159):

"Phylogenetic signal was calculated for each trait, using Pagel's λ, which measures the extent to which related species tend to have similar trait values. Pagel's λ varies from 0 to 1, indicating low to high phylogenetic signal. It was calculated using the `phytools` package (Münkemüller et al., 2012; Revell, 2012). The significant values obtained indicate that values of these traits tend to be conserved within lineages."

Reviewer: Why specifically is the China plant trait database used? What advantage is this giving over other trait databases? Given that the rationale is improving models, would a global database be more suitable? Also, if I understand it correcvtly, the physical sampling methods described L76 – 89 are the direct collation of this database? This could be clearer.

Authors: The unique advantage of the China Plant Trait Database is that it provides data from the same populations, sampled at the same time, for M_a, V_{cmax25}, N_{mass} and χ. This was indispensable for our analysis.

We have revised our description of the sampling method for greater clarity (Lines 79-81).

"In CPTDv2, a stratified sampling strategy was consistently used at each site to ensure that the dominant species in each canopy layer were sampled (detailed in Wang et al. (2018)) and avoid bias of different sampling strategies."

Reviewer: L61 – this sentence is quite unclear, not sure if the reference temp of 25 C refers to Vcmax25 or both this and Ma

Authors: The reference temperature of 25˚C only refers to V_{cmax}, not M_a. We have revised the sentence to make this clear:

"We assumed that the metabolic and structural components of leaf N are proportional to carboxylation capacity (V_{cmax25}, at a reference temperature of 25˚C) and M_a, respectively."

Reviewer: L102 – individuals of the same species? Or different species for community averages? If so, how were these determined?

Authors: For each species at a site, leaf C content, N content and $\delta^{13}C$ were measured using three or more individuals of the same species. The community means of traits were averages of all species at a site. We have now revised this description as follows:

"For each species at a site, leaf C content, N content and $\delta^{13}C$ were measured using pooled samples of leaves from at least three individuals of the same species."

Reviewer: L205 – are these fixed values the same across all LSMs? This is unclear to me from the text and from Figure 6.

Authors: The fixed values are almost the same across several LSMs, including CLM4, ED2.1, JSBACH and ORCHIDEE. We have added clarification in the text and figure.

"The target (PFT-specific) values used in several LSMs such as CLM4, ORCHIDEE and YIBs (Fig. 7) are based on datasets nearly 20 years old and fail to represent continuous trait variations that can now be inferred from much larger data sets."

Reviewer: Figure 1 – this figure is really hard to read, it needs to be larger or simpler.

Authors: We have made the text in the figure larger.

Reviewer: Figure 2 – with 11 genera, this could be listed in the caption and reduce reliance on the SI

Authors: We have now put all the information in the caption.

Reviewer: Figure 3 – caption should indicate what the *** mean

Authors: We have added its meaning in the caption.