

## Comment on **essd-2020-398**

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Referee comment on "Patterns of nitrogen and phosphorus pools in terrestrial ecosystems in China" by Yi-Wei Zhang et al., Earth Syst. Sci. Data Discuss.,  
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Zhang et al. mapped distributions of N and P pools in China terrestrial ecosystems, based on the most intensive field measurements in China ever, including all major (semi-)natural ecosystem types and ecosystem components. The study is generally well performed, and the manuscript is well written. I think the paper deserve a publication on Earth System Science Data and would be highly influential one after published. Before its publication, the authors may improve the manuscript by considering my comments and suggestions as follows.

### Major comments

- I think the authors should justify their use of artificial neural network for mapping. This method is a complex one but necessarily be the best one. Did the authors test or use other methods such as random forest?
- Ideally, the authors may also show and discuss the relative importance of the predictors in predicting the nutrient densities. This will help readers to build a more mechanistic view of the patterns. Not sure whether neural network can do this.
- While I agree with the authors' argument that "the first time, we mapped N and P densities of leaves, woody stems, roots, litter and soil in forest, shrubland and grassland ecosystems across China", there are some previous estimates of nutrient stocks in China, maybe only for one ecosystem component or one nutrient. I think a comparison of the authors' estimates with previous estimates, e.g. Tian et al. (2010), would benefit the study. It will make the study well in context of previous studies, and will also show how the estimates are improved compared to previous estimates.

Tian, H., Chen, G., Zhang, C., Melillo, J.M. & Hall, C.A. (2010). Pattern and variation of C:N:P ratios in China's soils: a synthesis of observational data. *Biogeochemistry*, 98, 139-151.

Minor comments

L18-19: "the limitation of these two" may be changed to "their limitations".

L26-31: the numbers are unreadable. Mg is million gram? Given the use of  $10^6$ , you may use bigger units (e.g., Tg).

L49: here you may also cite Sun, Y., Peng, S., Goll, D.S., Ciais, P., Guenet, B., Guimberteau, M. *et al.* (2017). Diagnosing phosphorus limitations in natural terrestrial ecosystems in carbon cycle models. *Earth's Future*, 5, 730-749.

L91-92: Not very clear. Du *et al.* (2020) showed either N or P limitation. If you mean ubiquitous limitation by N and P, you may refer to Elser *et al.* (2007), LeBauer and Treseder, K.K. (2008), Augusto *et al.* (2017), and more recently Hou *et al.* (2020). Similarly, L46-60 may cite more recent papers on the topic to reflect recent progresses in the field.

LeBauer, D.S. & Treseder, K.K. (2008). Nitrogen limitation of net primary productivity in terrestrial ecosystems is globally distributed. *Ecology*, 89, 371-379.

Hou, E., Luo, Y., Kuang, Y., Chen, C., Lu, X., Jiang, L. *et al.* (2020). Global meta-analysis shows pervasive phosphorus limitation of aboveground plant production in natural terrestrial ecosystems. *Nature Communications*, 11, 637.

Augusto, L., Achat, D.L., Jonard, M., Vidal, D. & Ringeval, B. (2017). Soil parent material is a major driver of plant nutrient limitations in terrestrial ecosystems. *Global Change Biology*, 23, 3808-3824.

L100: "a high-resolution map" to "high-resolution maps"

L111-112: are all plots the same size for forests, shrublands, and grasslands?

L123-126: you may give references for the methods here.

Equation 1: should the sum symbol with "i = 0" to "n" added? n is the total number of plant species. Similar for Equation 2.

L259, the unit of 5?

L269-281: one digit after decimal is enough and would be easier to read.

L295: I can't understand the reason. The reason may be expanded to be clear.

L303: "the predicted SDs" is confusing. You may mean "SDs of the predictions"

L313: remove "the"

L330: You may also cite the classic paper on this topic: Walker, T.W. & Syers, J.K. (1976). The fate of phosphorus during pedogenesis. *Geoderma*, 15, 1-19.

L346: not necessarily more accurate predictions, depends on whether the models are informed by measurements such as those used in this study. "could" may be changed to "may".

Fig. 3 color legend in panel (a) may include colors only for leaf/stem/root, with colors for vegetation/soil moved to panel (c), because panel (a) and (b) do not have vegetation vs. soil.

Fig. 4: is there a reason for the slopes to be consistently higher than 1.0 across ecosystem components and nutrients? It seems to be a systematic bias in the models: overestimate when observed values are low and underestimate when observed values are high.

