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Interactive comment on "Global patterns of leaf nutrient resorption in herbaceous plants" *by* Zhiqiang Wang et al.

Zhiqiang Wang et al.

wang-zq@hotmail.com

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Interactive comment on "Global patterns of leaf nutrient resorption in herbaceous plants" by Zhiqiang Wang et al. Anonymous Referee 1 Received and published: 4 April 2018 My major concern for this paper is its novelty. So far there are many, many publications addressing how nutrient resorption changes with latitude, temperature and precipitation etc. The question is really whether the results in this present ms. lead to a more full understanding of the global patterns and the mechanisms that create them. The methods for analysis, the results and the conclusions in this submission in effect do not signiïňĄcantly differ from existing publications. The statement by the authors ".....at a global scale is still inadequate" is not true.

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Response: Thank you for your comments. Many previous publications have merely concentrated on woody species at local, regional and global level. None of them considered nutrient resorption changes with climate factors in herbaceous plants at global scale. As an important part of terrestrial ecosystem, herbaceous plants also play a substantial role in a range of global-scale processes. Thus we are necessary to further explore global patterns of nutrient resorption in herbaceous plants and comparing difference between different plant life-form groups.

In particular, the authors claimed that they found "similar patterns of NRE, PRE and NRE:PRE with respect to latitude, MAT and MAP " (page 2, line 43 and Figures 2-3).I am getting a little a bit confused with the latitudinal PRE trend because it is generally accepted that the tropics at low latitudes are P-limited. PRE, reïňĆecting the soil nutrient availability, is expected to be negatively correlated with soil P and thus has high a PRE value at a low latitude, i.e., PRE does not increase but decrease with increasing latitudes.

Response: Thanks for your comments. Yuan and Chen (2009) found resorption of N increased with latitude but decreased with MAT and MAP, whereas for P resorption the opposite relationships were true. In contrast, Vergutz et al. (2012) found pattern of negative relationships between NRE, PRE and MAT and MAP, and a positive relationship between NRE and PRE and latitude. This inconsistency with PRE may be due to strong heterogeneity in tropical soils (Richter and Babbar 1991) that leads to a range of nutrient conditions, or to the fact that plants in tropics have adopted other nutrient conservation strategies, such as longer leaf life spans (Aerts and Chapin 2000, Vergutz et al. 2012).

Another concern is that the authors should show awareness of the shortcomings of the methodology due to that they focused on this study on " herbaceous species". Their calculations of nutrient resorption were not corrected by this leaf area, because senescent leaves shrink in herbs and therefore their concentrations can be higher. Furthermore, the authors did not correct their NRE/PRE by a mass loss correction factor

(MLCF), especially important for herbaceous species. See how to do it by Vergutz, Ecological Monographs, 2012, 82(2):205-220.

Response: thanks for your comments. We must pointed out that we used data from papers in which the authors specifically indicated that leaf litter samples came from newly fallen leaves that fell naturally or from freshly filled litter-traps, and reduced the sample size but was likely to maintain a higher level of reliability (Brant and Chen 2015). Thus, our data is no need to correction by MLCF.

There are lots of factors affecting nutrient resorption process. The authors only chose latitude (LAT), mean annual temperature (MAT) and precipitation (MAP). There is the possibility that temperature and precipitation are not the only factors varying at a broad scale. Soil characteristics are in fact more important because they are closely related to plant growth. AET might also be a more important climatic index than MAT/MAP to drive RE. Apparently, the authors have neglected these variables.

Response: We are very appreciated with this important suggestion by the reviewer and agree with this. Therefore, we added the AI (Aridity index), PET (Potential evapotranspiration), and Soil N and P to further analyze the effects of climate, soil and herbaceous type on NRE, PRE and NRE:PRE using partial general linear models (GLM) (Figure 1).

In Table 1, the authors conducted a multiple regression analysis. LAT and MAT (including MAP) are tricky metrics, as often MAT is auto-correlated to LAT and this autocorrelation needs to statistically identify. It is not LAT itself but LAT-related environment variables (e.g,temperature...) that exert effects on plants and ecosystems. Therefore it not suitable to conduct a 3-way ANOVA such as Lat*MAT*MAP. Moreover, using mean annual climatic indices does not consider monthly variations, especially in growing season. So the statistical analysis appears to be incorrect, or at least poorly justiïňĄed. Figs 2-3 show quite clearly that NRE/PRE is not normal, with data points concentrated towards middle LAT/MAP.

Response: According to your suggestions, we re-analyze NRE, PRE and their ratio of different plant functional groups on the climatic and soil variable (MAT, MAP, AI, PET, Soil element and ratio) using stepwise multiple regression (SMR) (Table 1).

More importantly, the predictive power, i.e., the coefïňĄcient of determination, is extremely low. Most r2 is less than 0.05, the lowest r2 with a signiïňĄcant P value is 0.01!! It is impossible to estimate with certainty the resorption efïňĄciency of a certain LAT or MAT/MAP. It therefore appears unwarranted to claim that climate factors could affect nutrient resorption under future climate changes at a global scale. The authors should rather try to explain the large variability of resorption. The great variation and very low coefïňĄcient of determination in resorption efïňĄciency make it impossible to predict the response of resorption in forests to global change. I doubt that a potential change in nutrient resorption efïňĄciency with increasing MAT/MAP will have any implications for the response of resorption to global change.

Response: Thanks for your comments. In this study, although the r2 is relatively low, which indicates the variables of interest explain very little of the variance in NRE or PRE, these trends are indeed existence (nearly all $P < 0.05$).

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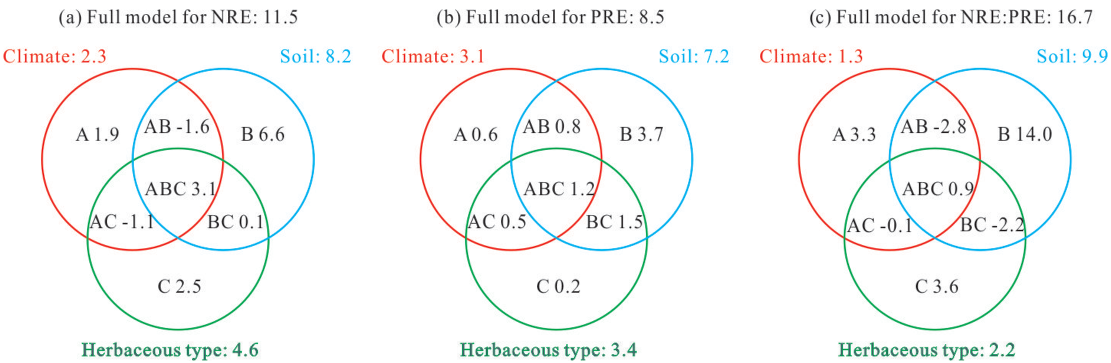

Fig. 1.

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Table 1. Results of stepwise multiple regression (SMR) for the effects of climatic factors and soil variables (MAT, MAP, PET, AI, soil element and ratio) on leaf NRE and PRE of herbaceous plants in global. a, b, and c denote significance at the 0.05, 0.01, 0.001 test level, respectively

Element resorption efficiency	Adj R^2 Full model	Partial regression coefficient					Contribution of predictor (%)				
		MAT	MAP	PET	AI	Soil	MAT	MAP	PET	AI	Soil
Monocot											
NRE	0.164	-0.002	—	>-0.001	—	>-0.001c	34.0	—	18.4	—	47.6
PRE	0.090	—	—	>-0.001a	—	>-0.001a	—	—	55.5	—	44.5
NRE:PRE	0.198	—	—	>-0.001c	—	-0.019c	—	—	44.7	—	55.3
Eudicot											
NRE	0.139	0.008a	>-0.001a	>-0.001a	-0.176b	—	6.2	48.9	8.9	35.9	—
PRE	0.222	0.005	>-0.001c	—	0.186c	<0.001	12.5	65.8	—	13.8	7.9
NRE:PRE	0.111	0.007	—	>-0.001c	-0.171b	-0.009	23.1	—	45.0	23.3	8.6
Graminoid											
NRE	0.163	-0.005a	>-0.001c	—	-0.095a	>-0.001c	29.1	35.7	—	8.5	26.7
PRE	0.234	-0.011c	>-0.001c	<0.001c	0.244c	—	40.2	29.8	15.2	14.8	—
NRE:PRE	0.246	0.010b	—	-0.001c	-0.094a	-0.022c	12.4	—	36.4	4.8	46.4
Forb											
NRE	0.120	0.011c	—	<-0.001c	-0.189c	—	16.3	—	17.7	66.0	—
PRE	0.175	0.015c	>-0.001c	>-0.001	0.233b	>-0.001b	18.4	20.6	23.7	20.2	17.1
NRE:PRE	0.173	—	—	>-0.001c	-0.074c	-0.006	—	—	43.5	51.8	4.7

Fig. 2.

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