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Interactive comment on "Soil properties determine the elevational patterns of base cations and micronutrients in plant-soil system up to the upper limits of trees and shrubs" *by* Ruzhen Wang et al.

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Comment 1: It is not clear to me to which extent the different sites of a given elevation gradients are comparable or not. The flora, soils, parent material seem quite different among altitudes. It is possible that initial heterogeneities among altitudes are the cause of the inconsistent relationships between elevation and ecosystem properties. Reply: Initially, we expected to find consistencies and comparability for the distribution of base cations and micronutrients in plant-soil systems among sites. Therefore, we collected samples in a similar way under the same and most common tree species and shrub species and identify their elevational ranges for each site (mentioned in Lines

132-133). Samples were collected at upper limits of treeline and shrubline, middle elevation and the lowest elevation of tree/ shrub distribution. As suggested by our results, the elevational distribution of base cations and micronutrients were not so comparable among sites. We now mention that initial differences in soil properties (e.g., parent material) may have played a role in the inconsistent relationships between elevation and ecosystem properties (please see Lines 343-349). Comment 2: The manuscript is too long. Indeed, it reports results that are already obvious and well-established relationships (for instance: lines 251-257; line 258; lines 262-267; Figure S2; lines 362-364). I recommend to shorten the manuscript and to focus it on what is new (for instance lines 279-281): that is to say, the weak relationship between elevation on the one hand, and base cations and micronutrients on the other hand. Reply: Thanks so much for the constructive comment. We have re-written and shortened the manuscript. The already obvious and well-established relationships have been deleted and replaced by the new findings (Lines 268-273, Lines 276-282). Comment 3: Lines 29-32: these patterns are not restricted to mountains but are relevant for all soils. Reply: We agree with the reviewer's comment. Therefore, the statements have been replaced in Lines 29-36 to emphasize the difference between our findings and the well-established relationships. Comment 4: Lines 43-44: not useful. Reply: This information has been rephrased as 'exchangeable calcium (Ca) and magnesium (Mg) are predominant base cations responsible in buffering soil acidity'. Please see Lines 47-48. Comment 5: Lines 45-46: I disagree. See for instance (Naples & Fisk, 2010; Baribault et al., 2012; Sardans & Peñuelas, 2015). Reply: Thanks so much for the suggestion and valuable references. These studies have proven that limitation of Ca, Mg and K can occur in terrestrial ecosystems, particularly when they are exposed to acid rain. We have revised the text into '. . . and deficiency of these nutrients can occur in terrestrial ecosystems' and cited these recommended papers. Please see Lines 48-51. Comment 6: Lines 49-51: This applies also to Mn and Zn (see the book of Marschner, and the book of Graham et al.; both cited by the authors). Reply: Thanks for the suggestion. We have rephrased the statement and cited the mentioned references here (Lines 54-55). Comment 7: Lines 54-59: these relationships are well-known. Reply: We agree with this and have deleted the statement of "Both soil pH and soil organic matter are fundamental controllers over base cation and micronutrient availability and subsequently their concentrations in plant tissues". Comment 8: Line 148: this kind of analysis should be made on fresh samples (not dried samples). Reply: Indeed, we extracted available nitrogen from fresh soils. Therefore, we have revised the text to make it clearer (Lines 149-150 and Line 155). Comment 9: Line 159: replace "slurry" by "soil-solution suspension". Reply: This has been replaced (Line 166). Comment 10: Line 293-297: It depends on the range of pH values in each site (small ranges are unable to put such relationships into evidence). I recommend to use different symbols in the Figure S2 (one symbol per study area). Reply: We agree with this point that small pH ranges are unable to put such relationships into evidence. In our study, soil pH ranged from 4.5 to 4.8 for Changbai (wet-temperate Mt.), from 5.0 to 6.2 for Balang (subtropical Mt.), and from 7.2 to 8.1 for Qilian site (dry-temperate Mt.). Across the three sites, the relatively large soil pH range would be enough to analyze such relationships. Also, we have used different symbols in the Figure S2 (one symbol for per study area). Comment 11: Line 300: replace "decomposed" by "decomposable". Reply: Thanks for pointing this out but we disagree with this comment. In our opinion it should be decomposed. "Decomposable" refers to the recalcitrance of SOM, but that is not what we mean here. What we mean is that SOM that is more decomposed tends to have a lower C:N ratio (because the C is burned off) and tends to have more functional groups that are negatively charged (Line 310). Comment 12: Lines 302-303: This reference is about croplands. It seems to be not relevant. Reply: The reference has been replaced by a study conducted in forest ecosystems (Haberhauer et al., 1998) (Lines 312-313). Comment 12: Lines 333-336 and 343-345: another explanation could be that initial differences in biogeochemical properties among elevation positions were larger than the effects of elevation. In other words, an elevation effect might exist, but it is of a too small magnitude to be detected with this study design. Reply: Thanks so much for the suggestion. We agree with the

view that an elevation effect might exist but is of too small to be detected in this study. Related information has been added in Lines 347-349. Comment 13: Lines 353-354: I disagree. See for instance the compilation in Marschner's book. Reply: Thanks for the comment. We have deleted the statement of "Very limited progress has been made towards base cation and micronutrient translocation among plant tissues". Comment 14: Table 1 should be merged with Table 2. Reply: As suggested, Table 1 and Table 2 have been merged. Comment 15: Table 4: these relationships are not new. Please move this table to supplementary materials. Reply: Table 4 has been moved to supplementary materials as Table S3. Comment 15: Table S1: –MAP values are probably along the elevation gradient in Balang and in Qilian (such as in Changbai). Therefore, please indicate the range of MAP values for all sites. –MAT: please indicate range of values for temperature. –Soil parent materials are important drivers of soil biogeochemistry (Castle & Neff, 2009; Augusto et al., 2017). This information should be provided. Reply: The range values of MAP and MAT have been provided in Table S1. We agree that soil parent materials are important drivers of soil biogeochemistry. Thus, information about soil parent materials and mother rock has been added in Table S1. Comment 16: Figure S2: in panels c and e, the relationships are clearly non-linear. Hence, why using a linear fitting? Reply: Thanks so much for pointing this out. The relationships in panels c and e have been changed to fit using a power function curve. Comment 17: I suggest to change site names. For instance, "Balang" by "Subtropical mountain". Reply: We have changed the site names of "Balang", "Qilian" and "Changbai" into "subtropical Mt.", "dry-temperate Mt." and "wet-temperate Mt." in both text and figures.

Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2017-298/bg-2017-298-AC1-supplement.pdf

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Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2017-298, 2017.

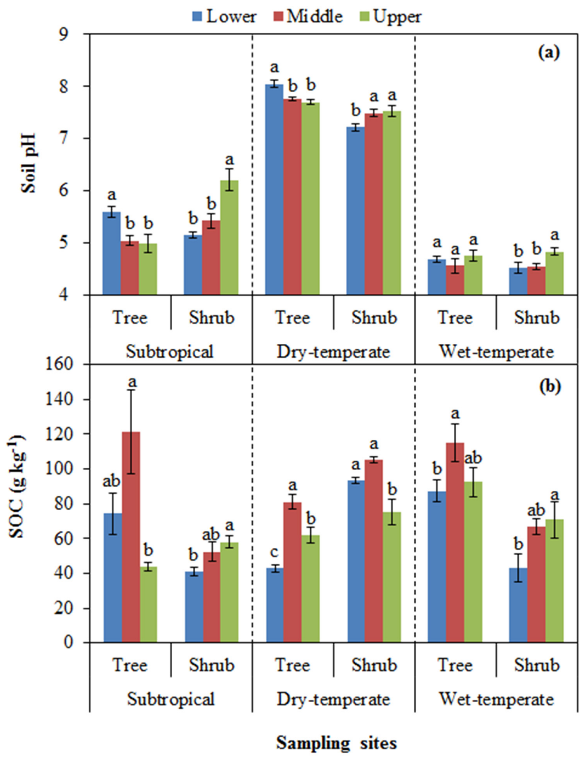

Fig. 1. Soil pH values (a) and soil organic carbon (SOC) concentration (b) at lower and middle elevations as well as at the upper limit of treelines or shrublines for each of the three sites.

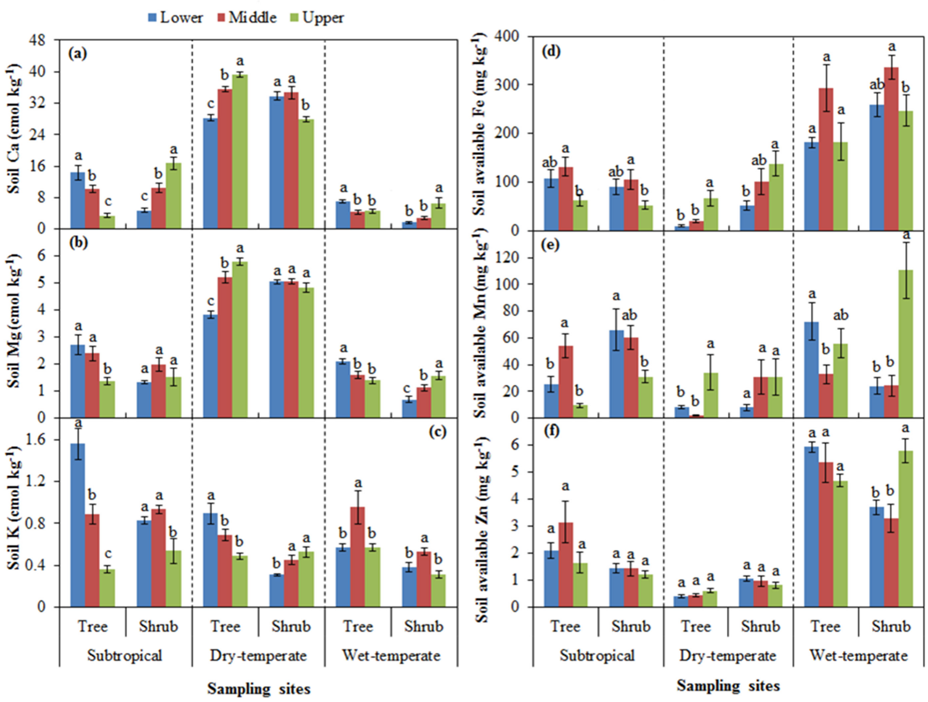

Fig. 2. Concentrations of soil exchangeable base cations of Ca (a), Mg (b) and K (c) and available micronutrients of Fe (d), Mn (e) and Zn (f) at lower and middle elevations as well as at the upper limit.

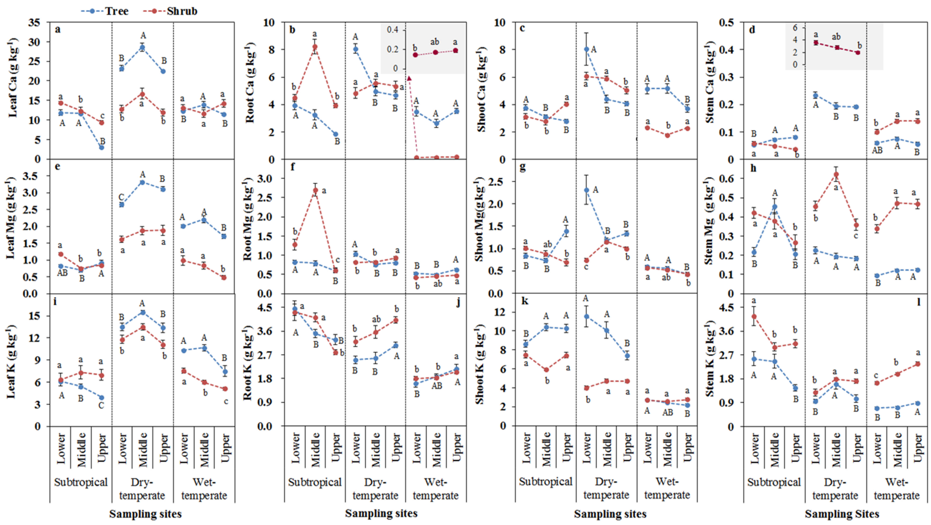

Fig. 3. Base cation concentrations of Ca (a, b, c, d), Mg (e, f, g, h) and K (I, j, k, l) in plant tissues of leaf, root, shoot and stem sapwood at lower and middle elevations as well as at the upper limit.

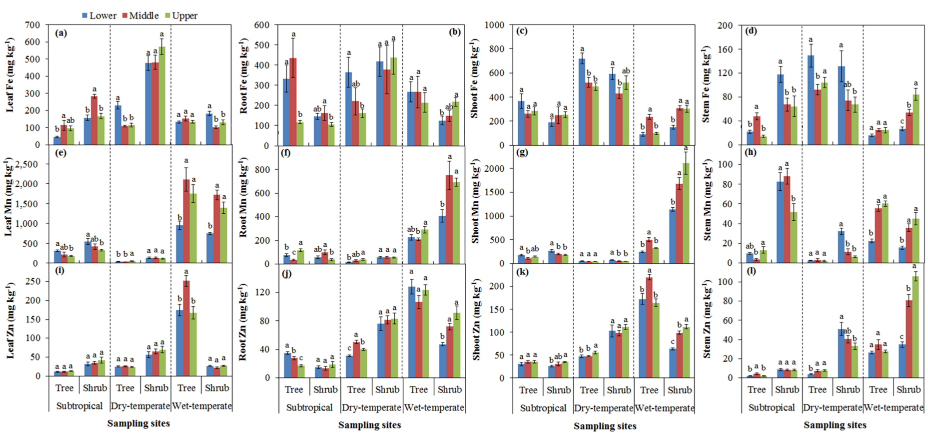

Fig. 4. Micronutrient concentrations of Fe (a, b, c, d), Mn (e, f, g, h) and Zn (I, j, k, l) in plant tissues of leaf, root, shoot and stem sapwood at lower and middle elevations as well as at the upper limit