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Biogeosciences Discussions

Interactive comment on "Effects of precipitation on soil acid phosphatase activity in three successional forests in Southern China" *by* W. Huang et al.

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General comments:

(1) the data base is rather limited with only two sampling points in time.

Response: We understand the referee's worries. It would be better if we sample more times. However, as the research area has a typical monsoon climate that is apparently characterized by two seasons, a wet/rainy season from April to September and a dry season from October to March, we believe that two sampling campaigns divided in wet and dry season should represent the different responses of phosphatase activity to precipitation treatments between wet and dry seasons.

(2) more importantly: what does phosphatase activity really tell us? In this study on acid soils (about pH 4) it was measured at pH 6.5... Is this really acid phosphatase activity? Does it come from microbes or from plants or from both? This should be kept in mind also during the discussion (in particular p. 168 l. 20-25). In fact, phosphatase activity was negatively correlated with available P. This could mean a repression of phosphatase synthesis, or it could simply be related to microbial biomass... (see next comment). The precipitation regimes have a substantial effect on microbial carbon. Thus one should also look at specific phosphatase activity (per unit microbial C).

Response: Thanks for the referee's comment. The process of phosphorus (P) mineralization is catalyzed by soil phosphatase enzymes, which come from both plants and microbes. Phosphatase enzymes are produced when P is required by plants and/or microbes. An increase in phosphatase activity is, therefore, a suitable predictor of P limitation in forest soils. According to the method of Tabatabai and Bremner (1969), the optimum pH for acid phosphatase activity of forest soils was 6.5. Consequently, the phosphatase activity in our study was measured with the modified universal buffer at pH 6.5 with the aim to assay its maximum potential acid phosphatase activity. Both plant roots and microbes secrete phosphatase. Thus, phosphatase activity could not simply be related to microbial biomass. It would be not quite complete when we just look at specific phosphatase activity (per unit microbial C). Correspondingly, we have kept the referee's advice in mind during the discussion in our manuscript. Please see P. 16 L 22 and P. 17 L 1-3 in the revised manuscript.

(3) Some results are a bit awkward. For example, total P changes between wet and dry season -how is this possible?

Response: We agree with the referee's comment about the result that total P changes between wet and dry season is a bit awkward. Since soil total P should be supplied almost entirely from the weathering of parent material in soils, the amount of total P should be relatively stable over time. According to the referee's comment, we recheck our data on total P to analyze the problem. We suspected that the different experimen-

BGD

8, C110–C118, 2011

tal instrument used in the measurement of total P in the wet season might influence the results of total P in the wet season. In order to get more reliable results, we assayed total P of our soil samples in the wet season again with the same experimental instrument that was used in the measurement of total P in the dry season. The outcome verified our suspect. Accordingly, we reanalyzed the data on total P and found that total P did not significantly vary between the dry and wet season. We are so sorry to make this mistake. We have made some relevant revisions in our manuscript. Please see P. 12 L 6-8, P. 12 L 15-20, Table 1 and Table 2.

(4) As far as the statistical analysis is concerned, I don't understand why the correlations are only done per season and not over the whole data set.

Response: Thanks for the referee's comment. In fact, phosphatase is an inducible enzyme. Its production of phosphatase is regulated by end-product inhibition. However, the regulating role is not absolute but depends on the requirement for P by forest ecosystems (including plants and microbes). There would be an increase in phosphatase activity when soil available P does not meet the need. Consequently, phosphatase activity was negatively correlated with available P. If the supply of soil available P to ecosystems is enough, this negative correlation between phosphatase activity and available P would abate or disappear. There were different requirements for P in the wet and dry season due to their different biologically activities. The correlations between phosphatase activity and soil chemical properties thus should be done separately for each season.

(5) Importantly, the N input with the rainfall or its effects on available N in the ecosystems should have been measured.

Response: Agreed. The data on the N input with rainfall is important. We have added this data in our manuscript. Please see P. 20 L 8-10 in the revised manuscript. We also have added a new reference in the part of References. Please see P. 25 L 21-22 and P. 26 L 1 in the revision.

BGD

8, C110–C118, 2011

Specific comments:

(1) Abstract p. 158 l. 5: do we really have good proof that phosphatase activity reflects the capacity of P supply to ecosystems??? This neglects the entire inorganic side of P supply, and even for organic P I am not convinced. . .

Response: Thanks for the referee's comment. This expression that phosphatase activity reflects the capacity of P supply to ecosystems is easily confusing. The supply of the plant requirement for P mainly depends on cycling of P in organic matter. Phosphatase can have the capability of releasing available P from organic P compounds. In our study area, most soil P is bound in organic matter as organic P and remains inaccessible to plants. Therefore, phosphatase activity would be expected to be a good indicator of the organic P mineralization potential, and has been applied in several studies to evaluate P limitation in forest ecosystems (Schneider et al., 2001; Gress et al., 2007). Therefore, we have replaced this sentence in our manuscript with "and its activity reflects the capacity of organic P mineralization potential in soils." Please see P. 2 L 4-5 in the revision. We also added more information in the introduction of our revised manuscript. Please see P. 3. L 7-8 and P. 3 L 13-15 in the revision.

(2) p. 158 l. 7: experiment with precipitation treatments p. 158 l. 17: these results indicate that. . .

Response: Thanks for your good advice. We are sorry to make these small mistakes. We have revised them in our manuscript. Please see P. 2 L 7 and P. 2 L 19, respectively, in the revision.

(3) p. 158 l. 20: the conclusion about reduced P supply because of lower phosphatase activity is not well justified - in fact, available P is lower in moist than in dry soils, isn't it? And other factors such as limited diffusion would probably be more important to determine P supply. . .

Response: Thanks for the referee's comment. The fact that phosphatase activity was

BGD

8, C110–C118, 2011

lower in precipitation treatments when compared with the control in a forest indicates that changes in precipitation would be detrimental to the process of P mineralization for the same forest. Thus, low phosphatase activity could influence P supply. As to available P, since there were nearly not significant differences of available P among precipitation treatments in a forest in the dry season, available P did not become an influencing factor for P supply.

(4) p. 159 l. 13: phosphatase activity cannot be applied – enzymes can be applied (but this is not what you mean), or the method can be applied

Response: You are right. We have revised it. Please see P. 3 L 18-22 in the revision.

(5) p. 159 l. 21: have any investigations been done? Then you should name them.

Response: Agreed. We have revised and deleted the irrelative content in the part of introduction in our manuscript. Please see P. 4 L 1-2 in the revision. We also removed some references cited in the deleted content in the part of References.

(6) p. 160 l. 1: such as the Mediterranean, dry conditions lead. . .p. 160 l. 13: in response to p. 160 17-20: difficult to read. Substitute the hyphens with brackets or commas.

Response: Agreed. We have revised them in our manuscript. Please see P. 4 L 8, P. 4 L 22 and P. 5 L 4-8, respectively, in the revision.

(7) p. 160 l. 26. What is meant by different P requirements?

Response: Thanks for the referee's comment. Since the three forests represent different stages of forest succession, the influencing factors on P requirement in a forest ecosystem, such as plant species, biomass, microbes and net primary production, are quite different. Thus, the three forests possess the characters of different P requirements.

(8) p. 161 l. 1: than in the dry season p. 161 l. 4: what is meant by "patterns of effects"

BGD
8, C110–C118, 2011

- this is very imprecise. In fact, the entire hypothesis 3 is not clear to me.

Response: Agreed. We have revised the small mistake. Please see P. 5 L 18 in the revision. We have revised the hypothesis 3 to make it precise and clear. Please see P. 5 L 21-22 in the revision.

(9) p. 162 l. 14. Slope aspect p. 162 l. 25: what is a PMKit? You should give the measurement principle (e.g. TDR)

Response: Agreed. We are sorry to make this mistake. We have revised the typing error. Please see P. 8 L 5 in the revision. We are so sorry that the confusion about PMkit arises from our typing error. The correct one is MPkit. We have revised it. We also have made an explanation about the MPKit. Please see P. 8 L 18-21 in the revision.

(10) p. 163 l. 26: and swirled the flask slightly

Response: Agreed. We have revised it. Please see P. 10 L 8 in the revision.

(11) p. 164 l. 16: did you analyse separately (not separated) for each season AND forest, or only per season? p. 164 l. 16: correlation coefficients cannot be performed, only calculated.

Response: Thanks for the referee's comment. We analyzed the data separately for each season and forest. We have revised it in our manuscript in order to make it clear. Please see P. 11 L 7 in the revised manuscript. We also have replaced the unsuitable word (performed) with an appropriate one (calculated). Please see P. 11 L 8 in the revision.

(12) p. 164 l. 22: what do you mean by "dry" - 10% in some cases is not really dry. . .

Response: Thanks for the referee's comment. We are sorry that the expression in our manuscript was confusing. Our objective was to compare the difference of soil moisture between the dry and wet seasons (The dry and wet seasons was defined according to

BGD
8, C110–C118, 2011

the former studies in this area.). In our measurement, the mean soil moisture in the dry season was relatively lower than in the wet season. Thus, we have revised the sentence to convey our meaning clearly. Please see P. 11 L 15-17.

(13) p. 165 l. 4: please give also the water holding capacity of the soils in the three forest types. By the way, information about the texture of the soils is missing.

Response: Agreed. We have added the information about the water holding capacity and texture of soils in the three forests in the Materials and methods section of our manuscript. Please see P. 7 L 1-3, P. 7 L 11-13 and P. 7 L 18-21 in the revised manuscript. We also have added a reference in the part of References. Please see P. 30 L 15-18 in the revised manuscript.

(14) p. 165 l. 11. Insert reference to Table 1 at the end of this sentence. p. 166 l. 17: what do you mean by "not remarkable": significant or not? p. 167 l. 12: does not dose

Response: Agreed. We have insert reference to Table 1 at the end of this sentence. Please see P. 12 L 8 in the revision. We have changed the word “remarkable” to “significant”. Please see P. 14 L 1-2 in the revision. We also have revised the typing error. Please see P. 15 L 4 in the revised manuscript.

(15) p. 169 l. 17: but this is not true - available P was negatively correlated with phosphatase activity during the wet season!

Response: Thanks for the referee’s comment. We are sorry to make you confused in this part. The discussion in this paragraph was involved in the dry season. Thus, available P was not correlated with soil acid phosphatase activity in the dry season, which was showed in Table 2.

(16) p. 169 l. 20: what is end production of phosphatase?

Response: The end production of phosphatase is available P.

(17) p. 169 l. 25: key limiting factor

BGD

8, C110–C118, 2011

Response: Agreed. We are sorry about that, and have revised it. Please P. 18 L 14.

(18) p. 169 l. 26: I don't understand this sentence.

Response: Thanks for the referee's comment. We are sorry that this sentence was too long and complicated to read. We have modified this sentence in order to be clear. Please see P. 18 L 15-18 in the revised manuscript.

(19) p. 170 l. 1: what do you mean by wholesome self-regulating mechanisms? In my opinion, for the discussion of MEBF it is important that the soil in the NP treatment was still relatively moist in this forest type.

Response: Thanks for the referee's comment. MEBF is a climax community. This kind of forest has strong capabilities of resistance and resilience (self-regulating mechanisms) in order to keep itself equilibrium. When this ecosystem is disturbed by external interference, such as changes in precipitation, its internal structure and function may not be influenced since it has a high tolerance. Reduced precipitation by NP treatment may be within the tolerance of MEBF. Thus, soil in the NP treatment in MEBF (an old growth forest) could still maintain relatively moist.

(20) p. 170 l. 12: but the difference in pH was significant only for MEBF in the wet season. p. 171 l. 17-19: you are saying the same thing twice (phosphatase activities and forest succession are positively related)

Response: Thanks for the referee's comment. The pH values in MF and MPF was both lower in NP treatment than in the control, although the difference in pH was not as significant as in MEBF. Thus, the increasing acidity of soil might be one of mechanisms involved in the reduction of soil acid phosphatase activity. We also rephrased the expression. Please see P. 19 L 9-12. We have also revised the reduplicative sentence. Please see P. 21 L 6-9 in the revised manuscript.

(21) p. 171 l. 27: the conclusion about P limitation is not valid (in relation to phosphatase activities)

BGD

8, C110–C118, 2011

Response: Agreed. Phosphatase activity could be used as an indicator to evaluate P limitation. However, it is not complete to make a conclusion about P limitation only in terms of phosphatase activities. We have revised the conclusion to make it valid. Please see P. 21 L 16-18 in the revision.

(22) Table 1: please show also the statistics between the seasons.

Response: Agreed. We have showed also the statistics between the seasons in Table 1. Please see Table 1 in the revised manuscript.

Other changes made by authors:

We have revised the content of acknowledgements. Please see P. 22 L 5-8.

References: Gress, S. E., Nichols, T. D., Northcraft, C. C., and Peterjohn, W. T.: Nutrient limitation in soils exhibiting differing nitrogen availablities: What lies beyond nitrogen saturation, Ecology, 88,119-130, 2007. Schneider, K., Turrion, M. B., Grierson, P. F., and Gallardo, J. F.: Phosphatase activity, microbial phosphorus, and fine root growth in forest soils in the Sierra de Gata, western central Spain, Biol. Fertil. Soils, 34, 151-155, 2001. Tabatabai, M. A., and Bremner, J. M.: Use of p-nitrophenyl phosphate for assay of soil phosphatase activity, Soil Biol. Biochem., 1, 301-307, 1969.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/8/C110/2011/bgd-8-C110-2011-supplement.pdf

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