We sincerely thank the reviewer for the constructive comments and suggestions, which helped us to substantially improve our manuscript. Please find the point-to-point responses (blue) to the comments (black) as listed below.

Reviewer 2

P2 Line 14-15: logic leaps exist in the statement 'Moderate-cycling IP was mainly regulated by aboveground plant biomass with KH_2PO_4 addition, while by soil pH and plant biomass with addition of $Ca(H_2PO_4)_2$'. Please change 'plant biomass' into 'plant P uptake'.

Response: As suggested, we have reworded "plant biomass" into "plant P uptake" and changed the parameter when re-running the SEM model (P. 2 Line 14).

P2 Line 24: Please change the keyword 'soil phosphorus' into 'nitrogen enrichment'.

Response: As suggested, we have changed the keyword "soil phosphorus" into "nitrogen enrichment" (P. 3 Line 1).

P3 Line 3: change '50-90%' into '50%-90%'.

Response: As suggested, we have changed "50-90%" into "50%-90%" (P. 4 Line 3).

P3 Line 17-18: 'labile/ available P (Olsen P), moderate-cycling P fractions (Al-P, Fe-P, Ca_2-P and Ca_8-P)'. according to the Methods introduced by the authors, 'Olsen-P was extracted from air-dried soil with 0.5 M $NaHCO_3$ (pH 8.5)(Olsen et al., 1954)', while 'Ca_2-P was determined by shaking 0.5 g soil with 25 ml 0.25 M $NaHCO_3$ (pH 7.5)' , and in contrast to Fig. 3a,b and Fig5.a,b, Ca_2-P is more suitable to classified into 'labile' fraction. The statement should be 'labile P (Ca_2-P)/ available P (Olsen P), moderate-cycling P fractions (Al-P, Fe-P, and Ca_8-P)'.

Response: Thanks for the comments. We fully agree with the comment and define Ca_2-P as labile P in the study. The statement has been changed into "labile P (Ca_2-P) / available P (Olsen-P), moderate-cycling P fractions (Al-P, Fe-P and Ca_8-P)" (P. 4 Line 17).

P3 Line 21: delete 'understanding'.

Response: Yes, we deleted “understanding”.

P4 Line 1: reword ‘content’ into ‘concentration’.

Response: We have replaced ‘content’ into ‘concentration’ (P. 5 Line 7)

P5 Line 6: suggest to rephrase ‘release of P from soil organic P’ into ‘mineralization of soil organic P’.

Response: As suggested, we have replaced ‘release of P from soil organic P’ into ‘mineralization of soil organic P’ (P. 6 Line 12).

P5 Line 25: ‘soil labile IP (Olsen-P)’: ‘Soil labile IP (Ca_2-P) or available P (Olsen-P)’.

Response: As suggested, we have replaced ‘soil labile IP (Olsen-P)’ into ‘soil labile IP (Ca_2-P)’ (P. 7 Line 6).

P6 Line 1: remove ‘Ca_2-P’.

Response: We have removed Ca_2-P in the sentence (P. 7 Line 7).

P7 Line 12-13: maybe, this sentence should be written as ‘The plants were sorted to species and oven-dried at 65 for 48 h, then weighed and ground’? Because the way you did these should be to determined aboveground net primary productivity and get plant samples ground to measure plant P concentration.

Response: As suggested, we have changed the description into ‘The plants were sorted to species and oven-dried at 65 for 48 h, then weighed and ground’ (P. 8 Lines 22-23).

P7 Line 24: change 0.5g into 0.5 g.

Response: As suggested, 0.5g were changed into 0.5 g.

P8 Line 16-18: change ‘Total IP (TIP) concentration was defined as the sum of moderate-cycling IP (Al-P, Fe-P, Ca_2-P and Ca_8-P) and recalcitrant IP (Ca_{10}-P and O-P).’ into ‘Total IP (TIP) concentration was defined as the sum of labile IP (Ca_2-P), moderate-cycling IP (Al-P, Fe-P and Ca_8-P) and recalcitrant IP (Ca_{10}-P and O-P).’

Response: Thanks for the suggestion. We have changed ‘Total IP (TIP) concentration was defined as the sum of moderate-cycling IP (Al-P, Fe-P, Ca_2-P and Ca_8-P) and recalcitrant IP (Ca_{10}-P and O-P).’ into ‘Soil total IP (TIP) concentration was defined as the sum of soil labile IP (Ca_2-P), moderate-cycling IP (Al-P, Fe-P and Ca_8-P) and recalcitrant IP (Ca_{10}-P and O-P)’ (P. 9 Line 24-P. 10 Line 1).

P9 Line 24: plant P uptake should be incorporated in the SEM model instead of plant biomass. If plant biomass is included, it should be explained by P fractions/ P availability. But do not use plant biomass to explain P fractions.

Response: As per suggestion, we used P uptake instead of plant biomass in the SEM and reanalyzed the SEM.

P 12 Line 12: Even though plant biomass production consume soil P, it would be better to directly use the parameter of plant P uptake as you calculated in P 9 Line 5.

Response: As per suggestion, we changed “plant biomass” into “plant P uptake” (P. 14 Line 2).

P15 Line 16-17: In this study, you were unable to determine the relative transformation rates of the two compounds. But the results of higher O-P and Ca10-P suggested that a higher proportion of $Ca(H_2PO_4)_2$ was converted into stable inorganic P forms. So, please correct this point.

Response: Thanks for the comment. We have corrected the sentence into “This suggests that a higher proportion of $Ca(H_2PO_4)_2$ was converted into stable inorganic P forms than the more soluble KH_2PO_4 (P. 17 Lines 7-9).

P16 Line 7 & 22: Be aware that the mechanistic description might change if you replace the parameter of plant biomass with plant P uptake.

Response: Thanks for the reviewer’s observation. We have updated the description in the Result and Discussion section.

P18 Line 19-20 change ‘Phosphate Release Kinetics in Calcareous Grassland and Forest Soils in Response to H+ Addition’ into ‘Phosphate release kinetics in

calcareous grassland and forest soils in response to H^+ addition'

Response: Yes, we have corrected 'Phosphate Release Kinetics in Calcareous Grassland and Forest Soils in Response to H+ Addition' into 'Phosphate release kinetics in calcareous grassland and forest soils in response to H^+ addition'

P19 Line 9: *Lolium perenne* and *Pinus radiata*, italic.

Response: Yes, we changed Lolium perenne and Pinus radiata into *Lolium perenne* and *Pinus radiate*.

P20 Line 1-2: change 'Do Nutrient Limitation Patterns Shift from Nitrogen Toward Phosphorus with Increasing Nitrogen Deposition Across the Northeastern United States?' into 'Do nutrient limitation patterns shift from nitrogen toward phosphorus with increasing nitrogen deposition across the Northeastern United States?'

Response: This has been corrected.

P20 Line 24-25: change 'Soil fertility and fertilizers an introduction to nutrient management' into 'Soil Fertility and Fertilizers: An Introduction to Nutrient Management'

Response: Yes, we have changed 'Soil fertility and fertilizers an introduction to nutrient management' into 'Soil Fertility and Fertilizers: An Introduction to Nutrient Management'.

P24 Line 20-21: change 'Nitrogen Fertilization Effects on Grassland Soil Acidification: Consequences on Diffusive Phosphorus Ions' into 'Nitrogen fertilization effects on grassland soil acidification: consequences on diffusive phosphorus ions'

Response: Yes, we have changed 'Nitrogen Fertilization Effects on Grassland Soil Acidification: Consequences on Diffusive Phosphorus Ions' into 'Nitrogen fertilization effects on grassland soil acidification: consequences on diffusive phosphorus ions'.

P26 Line 1: ‘Larix gmelinii’, italic?

Response: Yes, we changed ‘Larix gmelinii’ into ‘*Larix gmelinii*’.

P30 Line 8: ‘P’, italic.

Response: Yes, we changed “P” into “*P*”.

P33 Line 8: ‘P’, italic.

Response: Yes, we changed “P” into “*P*”.

P35 Fig. 6: reshape the ‘Structural equation model’ and rewrite the Results and Discussion sections related to the SEM.

Response: As suggested, we have reshaped the SEM and rewrote the Results and Discussion sections related to the SEM (P. 13 Line 23-P. 14 Line 3, P. 16 Lines 19-20, P. 17 Lines 20-24).

P36 Fig. 7: The content in the figure is hard to read because of the background color. Remove Ca_2-P from the ‘moderate-cycling P’, and instead of using Olsen as labile P, I suggest the authors use Ca_2-P as labile P.

Response: As suggested, we have changed the background color in Fig. 7. We removed Ca_2-P from the ‘moderate-cycling IP’ and use Ca_2-P as labile IP.