

## Response to RC1's comments

Dear Reviewer,

Thank you very much for helping us to handle the manuscript entitled “**Fluxes, patterns and sources of phosphorus deposition in an urban-rural transition region in Southwest China**” [acp-2022-388]. I am writing a response to the reviewer's comments. The detailed revisions are highlighted in yellow in the manuscript, and the response to comments are listed as follow:

### **Q1: Source/sink (L311-315; L346-357; L388-389)**

A negative correlation between P deposition and country road/forest does not always indicate “sink” land use for P deposition. Because P deposition can be derived from soil particles containing P, a negative correlation indicates lower levels of P sources for P deposition in road and forest than in other land use such as agricultural areas. Although land-use of agriculture is intensive “source” for P deposition, the use of “sink” is carefully modified.

A: Thanks for your comments. Based on it, we make some corrections as follows:

The sentence “*Above all, the land use of “sink” denotes a lower level of P sources and a higher level of P sinks than other land use.*” was added on page 19, L365-366. We modified the sentence “*Based on correlation analysis, it was found that “source” land use might be agro-facility, town, and paddy field areas, while “sink” land use might be forest and country road areas.*” to “*Based on correlation analysis, it was 395 found that “source” land use might be agro-facility, town, and paddy field areas, while “sink” land use, which denotes a lower level of P sources and a higher level of P sinks than others, might be forest and country road areas.*” on page 20, L394-397.

### **Minor comments**

#### **Q2: L13 phosphorus (P) à P**

A: We modified “phosphorus (P)” to “P” on page 2, L13.

#### **Q3: L19 76.13 à 76.1**

A: We modified “76.13” to “76.1” on page 2, L19.

#### **Q4: L45 I don't think that the term “in-situ” is needed in this manuscript. (also**

**L85, L378)**

A: We deleted “in-situ” on page 3-L45, page 5-L87, and page 20-L378.

**Q5: L51 What is “so caused”?**

A: The phrase “so caused” was modified to “the resulting” on page 4, L52.

**Q6: L73 “different” P-containing aerosols: What “different”?**

A: Thanks for your comments. What we would like to express here is the P-containing aerosols in different ways. We modified “different P-containing aerosols” to “P-containing aerosols originated from different ways” on page 5, L74-75.

**Q7: L102 Please clarify how to calculate the total area.**

A: Thanks for your comments. The sentence “*The total area of one land use type was calculated by adding the values in each column, as shown in Table 1, where each column indicates the area occupied by each land use type in nine sites.*” was added on page 6, L106-108.

**Q8: L125 Please provide how many samples for wet deposition were collected.**

A: We added the sentence “*During the sampling period, a total of 923 wet deposition samples were collected, including 858 valid samples.*” on page 7, L133-135.

**Q9: L144 P types: What “types”?**

A: We modified “P types” to TP on page 8, L149. We only measured the concentration of TP both in collecting wet and dry samples.

**Q10: L162 Please add the replication protocol in section 2.2 sample collection and analysis.**

A: Thanks for your comments. We added the sentence “*In addition, three parallel collectors were used at each site to collect atmospheric deposition to ensure three replicate data.*” on page 7, L116-117.

**Q11: L173 no data in February 2015 in Figure 2.**

A: Yes. This study was conducted from March 2015~February 2017, including 24 months.

**Q12: L179 25.0% to 99.7 % would be preferable.**

A: We modified it to “25.0% to 99.7 %”. Please see on page 10, L184.

**Q13: L179 delete “generally”**

A: We deleted “generally” in L184.

**Q14: L184 Please define which months are categorized as summer.**

A: We have defined summer including June, July, and August in this study. Please see on page 10, L188-189.

**Q15: L191 I could not understand “three types of depositions”.**

A: What we would like to express here is “atmospheric wet, dry, and total P deposition”.

**Q16: L194 R=574: probably R=0.574**

A: We modified “R=574” to “R=0.574” on page 11, L199.

**Q17: L218 I could not understand “during almost the whole year”.**

A: As shown in Fig.6, Pearson correlations between monthly dry (b) and total (c) fluxes and areas of the town and paddy field were positive during almost the whole year, except in March and April.

**Q18: L232 1.42-3.11 times higher: suggest “xx degree higher”. Because temperature is also expressed as kelvin in addition to the degree.**

A: The expression “7.44-17.19 degrees higher” replaced “1.42-3.11 times higher” on page 13, L237.

**Q19: L233-235 The effect of temperature is not adequately discussed and supported. Huang et al (2011) referred to in this study deal with sediment, not the atmosphere.**

A: We are sorry for our mistake. Through searching the references, we modified reference “(Huang et al., 2011)” to “(Tipping et al., 2014)” on page 13, L241.

**Q20: L237-249 Is there any possibility that P fertilizer was intensively emitted into the air in autumn, which enhances dry P deposition in autumn?**

A: We agree that P fertilizer was intensively emitted into the air in autumn. We discussed the driving effect of P fertilizer on dry deposition in section 4.4. Please check it on page 18, L349-355.

**Q21: L252 What deposition?**

A: “dry deposition” replaced “deposition” on page 14, L257.

**Q22: L263 What is “construction”?**

A: What we would like to express here is the contribution of wet and dry deposition to the total deposition.

**Q23: L298 Ling et al. (2022) is not listed in the reference list**

A: We are very sorry for our negligence of reference short citation. “Song et al. (2022)” replaced “Ling et al. (2022)” on page 16, L304.

**Q24: L298 I could not understand “this discrepancy”. What differs, although P deposition is higher in agro-facility than in rural, urban, and forested areas, which seems similar to your study?**

A: Thanks very much for your comments. “This discrepancy” means this study’s results of P deposition fluxes were higher than a large number of fluxes on a global scale (mentioned on page 15, L287-289). To accurately express "this discrepancy", we modified the sentence “*This discrepancy could be explained by the collection methods used for P deposition.*” to “*Furthermore, the collecting methods utilized for P deposition can also be used to explain the causes for the discrepancies between the experimental results of various studies.*” on page 16, L305-306.

**Q25: L323 I could not understand “light”.**

A: The word “lighting” replaced “light” on page 17, L332.

**Q26: L335 The correlation seems higher in August.**

A: The month “August” was added on page 18, L345.

**Q27: L358-375 I think the section of 4.5 Management practice of regional P showing surface water quality is not needed. While adequate data regarding P deposition is shown, the data on surface water quality is marginal.**

A: Thanks for your comment. We deleted it on page 19, L359-368, and the sentence “*Since the P deposition in the study area is higher than in many regions, it should be monitored and controlled reasonably.*” was added on page 19, L374-375.

## Response to RC2's comments

Dear Reviewer,

Thank you very much for helping us to handle the manuscript entitled “**Fluxes, patterns and sources of phosphorus deposition in an urban-rural transition region in Southwest China**” [acp-2022-388]. I am writing a response to the reviewer's comments. The detailed revisions are highlighted in yellow in the manuscript, and the response to comments are listed as follow:

### Specific comments

**Q1: L20-21: This is incorrect. Correlation doesn't mean causality. Temperature and precipitation doesn't affect total P deposition! P emissions do!**

A: Thank you very much for your comments. We rewrite the sentence as:

*“Moreover, it was found that the monthly variations of P deposition were strongly correlated with meteorological factors, including precipitation, temperature, and relative humidity.”* on page2, L19-21.

**Q2: L24-25: It is well-known that dry P deposition is the primary form of total P deposition.**

A: Thank you very much for your comments. In this study, wet and dry deposition were measured separately. Therefore, we considered quantifying the ratio of dry and wet in this study area.

**Q3: L62-66: The correlations depend on whether total or wet deposition is analyzed. For instance, wet deposition correlates strongly with precipitation but total deposition doesn't.**

A: Based on your comments, we modified the sentence in L62-66 to “*Additionally, field studies have observed that the meteorological factors, including precipitation and temperature, could influence temporal variations of atmospheric P deposition (Tipping et al., 2014; Zhu et al., 2016; Chiwa et al., 2020).*” on page 4, L64-67.

**Q4: L79-80: Bulk deposition of P is likely very close to total P deposition.**

A: Thank you very much for your comments. Bulk deposition, which includes wet deposition plus a fraction of dry deposition. However, this study measured wet and dry separately and summed to obtain total P deposition. The method of collecting the

sample in this study is quite sparse, which is also mentioned in Tipping et al., 2014. Therefore, the difference between the two should be considered reasonable.

**Q5: L119-121 & 125: I don't believe you can do this manually for two years!**

A: Thank you for your affirmation! Since automatic monitoring is not possible at sampling sites, the manual collection is required. We informed manager site managers about collection methods and precautions to ensure accurate samples were collected.

**Q6: L157-158: Why a radius of 5 kilometers?**

A: The research group published a research article (Deng et al., 2019) which concluded: "N species deposition were significantly affected by the key land use types when radius were 3, 4 and 5 km". Based on this conclusion, we employ the largest radius (5km) of available land use data.

**Q7: L193-197 & Section 4.1: Correlation doesn't mean causality. See comments above.**

A: Thank you very much for your comments. We rewrite the sentence as: *"Moreover, it was found that the monthly variations of P deposition were strongly correlated with meteorological factors, including precipitation, temperature, and relative humidity."* on page2, L19-21.

Besides, in section 4.1, we discussed how meteorological factors affect the process of P deposition.

**Q8: L215-216: Define agro-facility areas first.**

A: Thank you very much for your comments. We added the sentence *"Commonly, agro-facility areas include land designated for livestock and poultry breeding, fertilizer plants, greenhouses with vegetable production, and aquaculture (Current land use classification, GB/T 21010-2007)."* on page 4, L60-63.

**Q9: L258-261: Reference?**

A: Thanks for your suggestion. References "(Mahowald et al., 2008; Das et al., 2011; Gross et al., 2016)" was added on page 14, L265-266.

**Q10: L301: Bulk deposition is measured using a consistently open sampler. For P, I think bulk deposition includes wet deposition and a major proportion of dry deposition.**

A: Thank you very much for your comments. For most studies, P deposition was measured using a consistently open sampler, which collected bulk deposition. However, this study measured wet and dry separately and summed to obtain total P deposition. The method of collecting the sample in this study is quite sparse, which is also mentioned in Tipping et al., 2014. Therefore, the difference between the two should be considered reasonable.

**Q11: L308-309: Any details and evidences?**

A: Thank you very much for your comments. We modified the sentence “Moreover, the potential risk of P deposition in this study area cannot be ignored.” to “*As discussed before, the flux of P deposition in this study area is at a high level. Excessive P deposition poses a certain threat to the ecosystem (Wang et al., 2015). Therefore, the potential risk of P deposition in this study area cannot be ignored.*” on page 16, L313-317.

**Q12: L350-351: Incorrect statement! Forest canopy strengthens deposition!**

A: We are very sorry for our mistake. We modified the statement to “*Notably, monthly fluxes of dry P deposition and total P deposition both had a negative correlation with forest and country roads (Fig. 6b, c). Firstly, a negative correlation indicates lower levels of P sources for P deposition in road and forest than in other land use such as agro-facility and agricultural areas. Secondly, it is well known that forests can absorb harmful gas, aerosols, and dust particles, including P-containing aerosols, which is attributed to the porous sponge-like underlying surface, high productivity, and strong microbial activity (Oladosu et al., 2017; Wang et al., 2017; Zhai et al., 2019). However, forest canopies could elevate P deposition by trapping atmospheric P in the form of dust and particulates (Zhou et al., 2018). Therefore, in this study, a negative correlation indicated that canopy P absorption was greater than trapping of atmospheric P (Parron et al., 2011). Above all, the land use of “sink” denotes a lower level of P sources and a higher level of P sinks than other land use. Due to similar reasons, paved country roads without hardening showed a similar correlation with P deposition.*” on page 18-19, L356-367.

**Q13: L370-374: References?**

A: We are very sorry for our negligence. Reference “Hochmuth et al., 2015” was added on page 20, L380, and “*Hochmuth, G., Rao, M., and Hanlon, A. E.: The four Rs of fertilizer management. UF/IFAS Extension, 1–4, <https://edis.ifas.ufl.edu/publication/ss624>, 2015.*” was added in reference lists, on page

24, L463-464.

**Finally, the ecological effects of P deposition are mediated by N deposition. What about N deposition in this region? This should be discussed somewhere.**

A: We agree with this viewpoint. The study of the N:P ratio is particularly important, especially in forest ecosystems. However, the purpose of this research is to understand the patterns of atmospheric P deposition in this region, from the perspective of temporal and spatial analysis. As a result, N deposition is not covered in this article. In subsequent investigations, we intend to further analyze and discuss N:P ratios in atmospheric deposition, water, and soil.