

Editor Comments and Responses:

1.1 — Please address the comments from Reviewer 2 and 3.

5 **Reply:** Thank you for the opportunity to revise our manuscript. We have fully addressed the comments raised by Reviewer #2. In particular, we have clarified the scope regarding the use of “P surplus” across different land types and provided explanations for the importance of P inputs from non-agricultural areas. Detailed responses to these comments are included below. Additionally, we note that Reviewer 3 did not provide any new comments during this revision.

1.2 — Please also perform a formatting and consistency check for ESSD Journal:

10 Manuscript format:

- Verified compliance with the ESSD guidelines for structure, font, and referencing style.

Reply: The manuscript has been reviewed to ensure compliance with ESSD guidelines for structure, font, and referencing style.

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- All sections (Title, Abstract, Introduction, Methods, Results, Discussion, Conclusions, References) are correctly formatted.

Reply: All sections, including Title, Abstract, Introduction, Methods, Results, Discussion, Conclusions, and References, are correctly formatted.

Figures and Tables:

- Ensured that all figures are high resolution.

20 **Reply:** All figures have been checked and verified to be of high resolution.

- Checked that tables are formatted with appropriate headers and units. .

Reply: Tables are appropriately formatted with headers and units clearly defined.

Dataset Compliance:

- Verified that the dataset adheres to FAIR principles (Findable, Accessible, Interoperable, Reusable).

25 **Reply:** The dataset has been reviewed to ensure adherence to the FAIR principles (Findable, Accessible, Interoperable, Reusable).

- Added README files in the dataset repository for clarity.

Reply: README files have been added to the dataset repository to enhance clarity and usability.

References:

- 30 – Cross-checked all citations in the text with the reference list.

Reply:

All in-text citations have been cross-checked against the reference list to ensure accuracy.

- Reformatted references to match ESSD citation style.

Reply: References have been reformatted to match the ESSD citation style.

- 35 **Supplementary Materials:**

- Organized supplementary materials, ensuring all files are properly labeled and linked in the manuscript.

Reply: Supplementary materials have been verified to ensure proper labeling and linking within the manuscript.

Reviewer #2 Comment and Response:

40 **Comment:** I still feel it is weird to mix P inputs on non-agricultural land and P surplus on agricultural land together. The contribution of non-agricultural P surplus to the total P surplus cannot prove the importance of P weathering and deposition on non-agricultural land. The so-called P surplus on non-agricultural land is usually efficiently used by ecosystems and may not cause serious P pollution. The high contribution of P surplus on non-agricultural land may mainly result from the large area of non-agricultural land.

45 **Reply:**

Thank you for raising this point. While we understand that P weathering and deposition on non-agricultural land are often efficiently utilized by natural ecosystems and may not directly contribute to significant P pollution, our objective here is to provide a comprehensive overview of the P surplus budget across all landscapes, including both agricultural and non-agricultural areas. This broader perspective is essential for understanding not only the dynamics of P inputs and
50 outputs across diverse landscapes but also the fate of P surpluses in receiving water bodies (e.g., groundwater, lakes, rivers) for effective water quality assessments. Such assessments, particularly conducted at catchment or basin scales, require P surplus data from all areas and sources — not just agricultural land — to reliably quantify and analyze total catchment P export.

Moreover, in response to the reviewer's previous suggestion, we have now explicitly provided the different components
55 of the gridded P surplus budget, including P inputs (e.g., mineral fertilizers, manures), P outputs, and the resulting P surplus. In this context, our databases are designed to be flexible and user-oriented, enabling users to conduct analyses based on their specific objectives – for example, for estimation of the P surplus with components focusing on the components that are dominant in agricultural areas.

We believe our comprehensive approach addresses the reviewer's concerns and enhances the utility of our dataset for
60 a wide range of applications. We have added the following texts in the revised manuscript to further emphasis on these points (in section 7 at line 1008 and 1018). Thank you once again for your constructive feedback.

*With a broader aim of analyzing P dynamics across diverse land use types, the dataset highlights the importance of understanding both inputs and outputs across all land types, including areas where agricultural P sources are not dominant. Specifically, studies on water quality assessment at a catchment scale require P surplus data from both agricultural
65 and non-agricultural areas to quantify and analyze total catchment P export.*

Furthermore, by providing detailed components of the gridded P surplus budget—including P inputs (e.g., mineral fertilizers, manures) and P outputs — our databases are designed to be flexible and user-oriented. This flexibility, for example, enables users to conduct P surplus analysis focusing on the components that are dominant in agricultural areas.