Authors' responses to referees' public peer review comments on the manuscript titled "Wet and dry atmospheric deposition of microplastics at urban, suburban, rural and mountainous sites in Switzerland"

We thank the referees for reviewing our manuscript and providing useful comments. Below are our responses (in regular font) to the referees' comments (in italics) and corrections made in the manuscript (in bold and quotations).

We also provide at the end of this document an update regarding the original [technical] comment by the journal's editorial support team.

Referee 1

The revised paper addressed my comments and paper can be published after addressing my further comment outlined below:

While the paper explicitly states that tire-wear particles were excluded and that "MPs" means microplastics excluding tire-wear particles, a concern still need to be raided. Tire-wear particles are widely considered one of the dominant sources of environmental microplastic pollution. Therefore, excluding them can substantially bias mass-based MP deposition flux downward. The bias may be less predictable for particle number, because tire-wear particles have complex size distributions and many may be below the paper's 20 µm detection limit. The exclusion of tire-wear particles, the 20–215 µm analytical window, and the conversion of 2D particle images to mass mean that the reported mass fluxes should not be interpreted as total atmospheric plastic-particle deposition. The underestimation is likely most serious for urban environments and for mass-based fluxes. The authors should state more prominently in Abstract and Conclusion that their 219 tonnes yr^{-1} estimate excludes tire-wear particles, particles <20 µm, particles >215 µm, and high-altitude areas >2000 m.

Thank you for your comment. We fully agree with your observation that excluding tire wear particles (TWPs) and having a 20–215 µm analytical window likely introduces a downward bias to the total mass deposition estimates, especially in urban environments.

On this note, we would like to point out that we are currently preparing a follow-up manuscript based on data collected in a parallel study on TWPs. This parallel study explicitly quantified TWPs (using different analytics) at the same sites and sampling periods as the present study on "conventional" MPs. We intend to publish the comprehensive comparison between conventional microplastics and TWP deposition separately in the near future.

In full agreement with your suggestion, which ensures transparency for the reader, we have added text to clarify these boundaries and framed our results more appropriately in the Abstract, Results, and Conclusions sections. The specific changes have been implemented as follows.

Revision in the Abstract: "Based on the determined deposition rates and land-use statistics, an annual deposition of 219 tonnes or $3.8 \cdot 10^{14}$ particles was estimated for **MPs of the analyzed 20–215 µm size fraction excluding tire wear particles, in** regions < 2000 m above sea level across Switzerland. **Corresponding** annual atmospheric inputs of MPs to Swiss agricultural land and surface waters were estimated at 78 and 10 tonnes, respectively."

Revision in Results (Section 3.4): "Summing over all grid cells provided the total mass- and number-based annual atmospheric MP deposition for Switzerland, which were 219 tonnes and $3.8 \cdot 10^{14}$ particles, respectively. These values represent the first observationally based national-scale estimates **for 20–215 µm sized MPs excluding tire wear particles.** … Based on the more detailed land use information and our determined deposition rates, we estimate that **a corresponding** 10 tonnes of MPs per year are deposited onto Swiss surface water bodies, and 78 tonnes of MPs per year are deposited onto agricultural land."

Revision in Conclusions: "Although a seemingly small fraction, this corresponded to an annual MP deposition of 219 tonnes **for MPs in the 20–215 µm size fraction excluding tire wear particles** across regions < 2000 m a.s.l. in Switzerland, of which an estimated 10 tonnes deposited directly onto surface waters. Relative to WWTPs, which are estimated to discharge a mass of ~5 tonnes **of corresponding MPs** to Swiss surface waters annually, the atmosphere plays an important role in the occurrence of MPs in surface water bodies."

Referee 3

This study collected wet and dry deposition samples of microplastics (MPs) at five sites across Switzerland and quantified deposition rates at each location. The resulting dataset improves our understanding of MP deposition patterns. However, the data could be further analyzed to generate additional, more broadly useful datasets for the scientific community—particularly for researchers modeling MP transport using chemical transport models (CTMs).

In CTMs that simulate the transport and deposition of MPs, the dry deposition velocity (Vd) is a key parameter that must be parameterized. The deposition fluxes reported in this study could be used to derive size-resolved and/or bulk Vd values, which would enhance their applicability for future modeling efforts. Moreover, comparing these measurement-data derived Vd values with theoretical estimates from established deposition schemes would provide valuable

validation. Since particle density is an important parameter in Vd modeling, it would be useful to know whether density measurements are available for the MPs collected in this study.

For wet deposition, a commonly used framework in the literature is the scavenging ratio approach. It would therefore be highly beneficial if the wet deposition data presented here could be used to estimate scavenging ratios, further increasing the utility of this dataset for future studies.

Thank you for your valuable suggestions regarding the integration of our dataset into atmospheric transport modeling frameworks. We agree that our data holds significant utility for validating these parameters, and we welcome further use of our data by the scientific community.

Regarding the dry deposition velocities and CTM modelling:

To address this we are currently collaborating with an expert in atmospheric transport modeling to simulate microplastic transport to our monitoring locations. This ongoing exercise will examine deposition velocities and clarify source-receptor relationships. However, incorporating a comprehensive parameterization and validation scheme into the present manuscript would introduce a new topic and overload the work. We look forward to publishing these modeling results as a dedicated follow-up study.

Furthermore, from a methodological standpoint, deriving empirical values of dry deposition velocities directly from our measurement data is unfortunately not possible. While our study successfully quantified the dry deposition rates, we did not perform parallel measurements of the ambient airborne microplastic concentrations. Therefore, empirical dry deposition velocities values cannot be determined.

Regarding particle density:

We did not measure the specific densities of the individual collected MP particles due to practical challenges in isolating such small particles. Instead, to convert our 2D particle images into mass estimates, we assigned standard material densities based on established literature values for the specific polymer types identified, which are listed in the Supplement of the manuscript.

Regarding wet deposition scavenging ratios:

We certainly agree that this information would be highly beneficial. However, we are cautious in this regard, as we do not have sufficiently good knowledge of airborne microplastics as only wet and dry deposition were measured. In the paper we provide an estimate for the number concentration of airborne MP based on assumed MP deposition velocities obtained from

literature. The aim of this simple estimate is merely to give an idea of which number concentrations are compatible with the observed deposition rates and to compare the MP number concentration in the observed size range with the number concentration of other types of aerosol particles. This is also relevant when planning (future) measurements of airborne microplastics. With an estimated number concentration of about 0.1 MP/m3 this means that with our analytical setup we would need to sample about 1000 m3 of air to have on average 100 MPs on a filter, a number that is above the critical level and the limit of detection (29 and 58 MPs, respectively). We believe that a more precise knowledge of deposition velocities of MPs from atmospheric transport models (see above), or from parallel measurements of dry and wet deposition and airborne concentrations is needed for calculating scavenging ratios. We therefore suggest leaving this for future studies. However, to ensure absolute clarity regarding the limits of our ambient air estimates, we have revised the text in Section 3.3 as follows:

"Assuming MP deposition velocities of 0.1 m s^{-1} and 0.2 m s^{-1}, which respectively correspond to particles of diameters 20 µm and 40 µm (Emerson et al., 2020), the mean dry deposition rate of 683 MPs m^{-2} d^{-1} measured at the Zurich site corresponds to an airborne MP number concentration of approximately 0.08 MP m^{-3} to 0.01 MP m^{-3}. **Although the assumed deposition velocities are only a rough estimate and the resulting number concentrations of airborne MPs should be interpreted with caution, the values** fall within the interquartile range of 0.002–0.1 MPs m^{-3} based on n = 925 measured airborne MP concentrations reported globally (Evangelou et al., 2026)."

Editorial support team's original comment

Your reference list includes a work "submitted for". Such works can be cited upon submission if being available to the reviewers. They cannot be cited in the final, accepted manuscript, unless published, accepted for publication, or available as preprint with a DOI.

The work in question was published recently. We have updated the citation accordingly.