

**Review:**

“Is transport of microplastics different from that of mineral dust? Results from idealized wind tunnel studies”

**Summary:**

In their manuscript, Esders and colleagues investigated the detachment process of spherical polyethylene (diameters: 42, 69, 115 um) and borosilicate (diameter: 69 um) particles from a glass slide surface using wind tunnel experiments. The study explored the influence of the substrate's hydrophobicity/hydrophilicity on the detachment process of the particles. The authors employed different cleaning and coating strategies to coat the substrates accordingly. In addition, they investigated the impact of relative humidity on the detachment process. They didn't directly control the relative humidity but rather used filtered air connected to the outside air source, with humidity levels measured continuously throughout the experiments, varying between 20 and 60 %. Furthermore, the researchers included the examination of impact-induced detachment from the spheres themselves in their data set. By comparing their experimental data with a model, the study ensures validation of their findings.

The primary aim of this explorative study is to gain first insights into the release mechanisms of microplastics in the atmosphere, starting with the investigation of one type of microplastic and comparing it to a well-studied mineral particle. The manuscript makes a valuable contribution to the field of microplastic aerosol research. Considering the significance of its findings, the work presented certainly warrants publication in ACP, after major revisions.

**GENERAL COMMENTS:**

- One major concern I have with the manuscript is the lack of discussion on the diversity of microplastics (MP). The authors exclusively studied one type of microplastic, namely polyethylene, without acknowledging the vast diversity that exists within the category of MP. Even within polyethylene (PE), there are different variations like high density PE (HDPE), linear low-density PE (LLDPE), etc. each with varying shapes, additives, and characteristics. Consequently, the title may be misleading, as the conclusions drawn are limited in scope and pertain solely to the spherical PE particles utilized in the study, not all microplastics.

Additionally, the manuscript does not address the fluorescent nature of the PE particles used. I assume that the PE particles contain a dye that fluoresce. In this case, could the dye have an influence on the results? If yes, are the findings then comparable to other spherical PE particles that lack the fluorescent dye? I think it would be beneficial if the authors took measures to validate the material. For instance, conducting Raman or FTIR spectroscopy could provide insights into the presence and distribution of the dye or any other additives on the surface of the plastic particles used. The authors show in their

manuscript that the surface chemistry of the substrate influences the detachment process of the particles, so I assume the surface chemistry of the particles is also important, right?

## **SPECIFIC COMMENTS.**

### *Title:*

- The title appears to be misleading as it seemingly generalizes the study to all MP, while the research focuses solely on spherical PE particles.

### *Introduction:*

- In general, the Introduction is well-composed, encompassing the current state of the art and adequately essential aspects.
- Page 2; Line 42: I miss the following citations: Materić, et al., 2022
- Page 2; Line 46, 47: There are multiple detachment processes that can occur in the environment through which MP can be released into the atmosphere. For instance, one mechanism involves MP release through bubble bursting in the ocean, which differs from the phenomena that govern detachment from soil. To provide clarity, specify and explain the detachment processes investigated by Tian et al. (2022) and Yang et al. (2022) in the second sentences of this paragraph.

### *Methods:*

- All equations miss numbering.
- Page 4; Equation1: “u” is not defined in the text.
- Page 5; Line 115: Figure A5 is wrongly linked here.
- Page 5; Equation 2: “k” is not defined in the text.
- Page 5, Line 121: The authors could perhaps briefly explain how the algorithm works to facilitate understanding of the methods.
- Page 5; Line 124: Can you add the step size?
- Page 5, Chapter 2.4: The authors do not discuss why they chose PE particles for the study. Is there any specific reason for it?
- Page 6; Table 1: Why is the contact angle for “substrate a” not described as a discrete number?

- Page 6; Line 134-136: Which method (image processing technique etc.) did the authors use to quantify the roughness of the particles? Also, the link to the Figures in the Appendix is missing.
- Page 6; Line 142: Please elaborate in more detail how the microspheres were deposited onto the substrates. Gravitational settling is not a sufficient explanation.
- Page 15, Chapter A2: I miss the discussion on how the hydrophilicity changes by the cleaning procedures. Which reactions are occurring that the surface energy changes?

*Results & Discussion:*

- Page 11; Figure 4: The caption claims that the data in the graph represents box plots. However, it is evident that it is in fact not. Please provide the correct representation or update the caption accordingly for clarity.
- In general, the authors have chosen to name the substrates alphabetically, referring to them as "substrate a," "substrate b," etc. However, this can be somewhat overwhelming when seen independently in the text. To improve readability and clarity, I would recommend using italics or capital letters to distinguish the substrates, such as "*Substrate A*," "*Substrate B*," and so on. This will make it easier for readers to identify and follow the different substrates throughout the text.
- Page 14; Chapter 3.4 (Figure 9): Chapter 3.4 misses the discussion regarding the comparison of data of PE115 & PE42 from Figure 9 to PE69, as shown in Figure 5.

*Conclusion:*

- As the dominant fraction of MP found in our environment are rather irregular-shaped fragments and fibres, wouldn't the authors think it would be a good reason to study these as well as they are environmentally more relevant than spheres?

*Appendix A:*

Page 17; Line 333: There is a space missing between the sentences: [...] (see Fig.A4) At [...]”

**References:**

Materić, D., Kjær, H. A., Vallelonga, P., Tison, J. L., Röckmann, T., & Holzinger, R. (2022). Nanoplastics measurements in Northern and Southern polar ice. *Environmental research*, 208, 112741.

Tian, X., Yang, M., Guo, Z., Chang, C., Li, J., Guo, Z., Wang, R., Li, Q., & Zou, X (2022).: Plastic mulch film induced soil microplastic enrichment and its impact on wind-blown sand and dust, *Science of The Total Environment*, 813, 152 490

Yang, M., Tian, X., Guo, Z., Chang, C., Li, J., Guo, Z., Li, H., Liu, R., Wang, R., Li, Q., & Zou, X. (2022): Effect of Dry Soil Aggregate Size on Microplastic Distribution and Its Implications for Microplastic Emissions Induced by Wind Erosion, *Environmental Science & Technology Letters*, 9, 618–624