Responses to reviewer 1

Reviewer comments:

1. *The current manuscript focused on a thorough investigation of the atmospheric settling behavior of microplastics, particularly glitters and fibers. The study is well-designed and well-written. And the authors have carried out extensive experimental work. In my view, the study would be highly valuable for publication. However, prior to a successful publication, I would recommend some changes to the manuscript.*

We sincerely thank the reviewer for taking the time to evaluate our manuscript thoroughly! The positive feedback and the constructive suggestions are very much appreciated. We carefully considered all comments and believe to have made the necessary revisions to address all comments.

Below we repeat the referee's comments in black italics, followed by our replies in blue regular font and quotes from the manuscript highlighted in green regular font.

2. *There are many abbreviations in the manuscript, please provide an abbreviation list at the begin of the paper.*

Thank you for the suggestion. We agree that too many abbreviations reduce the readability of the manuscript. In response to this comment, we reduced the number of abbreviations in the text to a minimum and made sure to define the remaining ones at first use, which we believe ensures readability without requiring such a dedicated list.

3. *A schematic diagram of the experimental setup is necessary in the '2.2 Experimental setup'.*

Thank you for pointing this out. We agree and added the schematic below (Figure 1 (b) in the revised manuscript) for clarification.

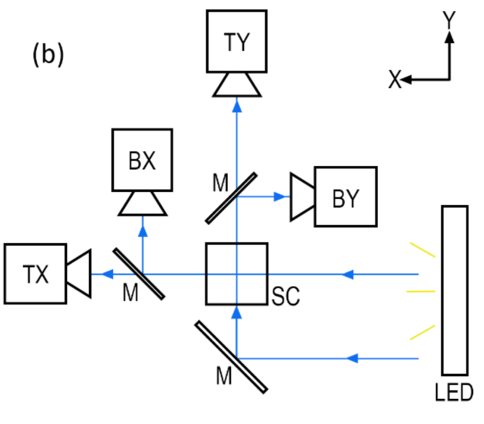

Figure 1. Experimental Setup. (b) Schematic view of the experimental setup showing the two upper cameras (TX) and (TY), the two lower cameras (BX) and (BY), the mirror (M) arrangement, as well as the settling chamber (SC), the LED, and the illumination/imaging paths.

4. *Please include a sensitivity analysis or error quantification in FLEXPART simulation.*

Thank you for this useful suggestion.
In response to this comment, we explored the sensitivity of the FLEXPART simulations to wet deposition, as the (currently unknown) exact scavenging efficiencies are a major uncertainty. We tested the sensitivity to low and high in-cloud and below-cloud scavenging efficiencies. The sensitivity analysis indicated a low impact of in-cloud and below-cloud scavenging for the coarse particles in this modeling setup.
The following statement has been added to the manuscript:

"In the wet scavenging scheme of FLEXPART, the cloud condensation nuclei (CCN) and ice-nucleating particle (INP) efficiencies were set to 0.001 and 0.01, representing hydrophobic particles. Scavenging efficiencies for rain and snow were assumed as 1. However, the exact scavenging efficiencies of microplastics are currently unknown. To address this uncertainty, we explored the sensitivity of FLEXPART to high CCN (0.5) and IN efficiencies (0.8) (Evangeliou et al., 2020). We also tested low scavenging efficiencies for rain (0.6) and snow (0.5) (Wang et al., 2014). We found that atmospheric lifetime and transport distances were relatively insensitive to the tested range of wet scavenging parameters, with a total variation below 5 % (Table S1). This is caused by the dominance of dry deposition driven by gravitational settling."

The following table has been added to the supplementary materials:

	CCN	IN	Crain	Csnow	Mean rel. difference travel distances (%)	Mean rel. difference residence times (%)
Base simulation	0.001	0.01	1	1	-	-
High CCN	0.5	0.01	1	1	1.93	3.83
High IN	0.001	0.8	1	1	1.86	4.01
Low. Crain	0.001	0.01	0.6	1	1.71	3.82
Low Csnow	0.001	0.01	1	0.5	1.87	3.79

Table S 1. Wet scavenging parameters that have been varied for the sensitivity test: cloud condensation nuclei efficiencies (CCN), ice-nucleating particle efficiencies (IN), and scavenging efficiencies for rain (Crain) and snow (Csnow). The parameters were selected based on the values proposed by Evangeliou et al. (2020) and Wang et al. (2014). Indicated are additionally the relative differences averaged over all particle sizes between the base simulations and sensitivity analyses.

References

Evangeliou, N., Grythe, H., Klimont, Z., Heyes, C., Eckhardt, S., Lopez-Aparicio, S., & Stohl, A. (2020). Atmospheric transport is a major pathway of microplastics to remote regions. *Nature Communications*. doi:10.1038/s41467-020-17201-9

Wang, X., Zhang, L., & Moran, M. (2014). Development of a new semi-empirical parameterization for below-cloud scavenging of size-resolved aerosol particles by both rain and snow. *Geoscientific model development*. doi:10.5194/gmd-7-799-2014