RC1

The manuscript discusses a new approach to sampling ice-nucleating particles (INPs) onboard of a tethered balloon system (TBS). It is well-written and the first minor corrections only improve an already very good manuscript. Especially the approach of openly sharing the design of the setup (Profiling Upper altitudes For Ice Nucleation, PUFIN) as well as the data, and the approach of offering the sampling system for other scientists are especially commendable. I recommend publication after some minor comments are addressed.

We thank the reviewer for their input on the revision of this manuscript. We agree with most of their remaining comments and have addressed them as discussed below. All revisions are visible in the track-changes version of the revised manuscript and newly-added text is shown below in green.

1. Minor comments

1. The setup is mounted below a TBS, which does not offer a way of controlling the direction or the altitude as precisely as an uncrewed aerial vehicle (UAV) might. It is clear that a TBS offers many other advantages, but I do wonder how the PUFIN is oriented in relation to the wind. Do you have a way to make sure that the filter inlets are oriented towards the wind or away from the wind?

2. The blank correction is quite a debated topic within the ice nucleation community. Handling blanks are of course especially important during field campaigns and at new setups. The manuscript describes the averaging of all blanks to take a representative handling blank, which is subsequently subtracted from the aerosol filters (line 246). It would be worthwile to show the different handling blanks in comparison to the water background to show how they differentiate from the water as well as how large the spread is between the different handling blanks. With the describes setup you get one handling blank filter for each flight, why not use the specific handling blank that was taken during the same flight, instead of an averaged spectra?

As a general rule, we use the average handling blank for each deployment to correct all flights, as variability among individual blanks is typically minimal. However, for one deployment at CRG, we applied flight-specific handling blanks because some sampling days exhibited substantially higher blank values than others.

The handling blanks and water backgrounds for each deployment are shown in Figure S6.

In Section 3.2, we added: “All blanks from a given campaign are averaged to generate a representative blank spectrum (expressed as INP per blank filter; see Figure S1 full complete field blank and DI background spectra).”

3. What is the pressure drop across the filter? This could be mentioned to allow the comparison to ground-based filter setups, especially since the filter material is not very rigid.

The pressure drop across the 47 mm, 0.2 µm polycarbonate filters was measured during laboratory testing using the same in-line filter holder configuration employed for PUFIN sampling. At a maximum sampling

flow rate of approximately 11 L min^{-1}, the pressure drop is 64 kPa. For membrane filters, pressure drop is expected to increase approximately linearly with flow rate under laminar flow conditions, consistent with Darcy's law. Assuming this relationship, the pressure drop would range from approximately 0.8 to 68 kPa at sea level over the flow rates used in this study (0.1-11 L min^{1}), encompassing both IcePuck and PUFIN sampling conditions. Comparing the average operating conditions of PUFIN with those of the ground-based filter samplers, estimated pressure drops are approximately 40-50 kPa for typical PUFIN flow rates (7-9 L min^{1}) and 50-65 kPa for the flow rates measured at BNF, CRG, SGP, and GUC, on average. These values indicate that the pressure differentials from both systems are broadly comparable despite differences in sampling configuration.

We now added the following to Section 2.4.1: "Based on a measured pressure drop of 64 kPa at 11 L min-1 across the filter in PUFIN's in-line holder, estimated pressure drops are approximately 40-50 kPa for typical PUFIN flow rates (7-9 L min-1) and 50-65 kPa for the flow rates of the ground-based filters measured at ARM sites where PUFIN has operated, on average. These values indicate that the pressure differentials from both systems are broadly comparable despite differences in sampling configuration."

2. General comments

1. Generally, I would recommend to use Kelvin instead of degree Celsius for any discussion of relative temperatures, i.e. when discussing rates or differences. For example, in line 227 the rate should be 0.33 K min−1 and the uncertainty of the thermocouple ±0.2 K. Similarly, in line 242 when discussing the width of the temperature bins.

We appreciate the reviewer's suggestion. However, temperatures have consistently been reported in degrees Celsius in our previous publications, and to maintain consistency throughout the manuscript and with our established body of work, we have retained the use of °C.

2. Sub- and superscript should be upright, when they are made of an abbreviation or a word, i.e. in line 237 drop, suspension, air should all be upright. The same is true for a couple of occurences in the main text.

This appearance results from the equation formatting feature used in Google Docs. Any necessary formatting adjustments will be made during the proofing stage to ensure compliance with AMT style requirements.

3. Sometimes, the ~ symbol is used, when instead the ≈ symbol is more appropriate, i.e. in line 296, 332, etc.

We prefer the use of the tilde (~) to denote approximate values and have therefore retained this notation throughout the manuscript. As noted above, any necessary formatting adjustments will be made during the proofing stage to ensure consistency with AMT style requirements.

2.1 Comments on tables and figures

1. Figure 1: The right side of the figure is cut off (air inlet / blank).

Thank you for catching this oversight! The figure has been revised.

2.2 Technical comments

1. Line 121: Space is missing between number and unit.

Fixed.

2. Line 341: While I understand the use of before in the context of cooling down the droplets, the appropriate term would be ”below −15 ◦C”.

Fixed.

3. Lines 347-348: July should not be abbrviated, since the other months are also written in full in the main text.

Thank you for catching this mistake; fixed.

4. Line 352: ”colder temperatures” -> ”lower temperatures”.

Fixed.

5. Lines 372-378: The exponent of the units is not written as a superscript.

Fixed.

6. Line 391: Do you have any doubt why it would not be able to capture Pseudomonas Syringae? Given a high enough concentration, the detection should be straight-forward. I think this sentence could work better in the conclusion, where you can discuss some tests at sites, where biological activity is increased.

The reviewer is correct that detection of *P. syringae* should be straightforward. *P. syringae* has been successfully collected on filters in previous studies, and there is little doubt that it would also be captured by our sampling approach, particularly given the small filter pore sizes used. Accordingly, we have removed the original sentence. We chose not to add further discussion to the Conclusions because the shapes of our freezing spectra, together with the extensive history of collecting INPs using in-line filter units and polycarbonate filters, do not suggest a need for additional discussion regarding tests. Previous studies have already demonstrated that such filter-based methods effectively collect warm-temperature INPs. The primary reason these types of INPs have not been observed more frequently in PUFIN samples is likely the relatively short collection durations, which limit the sampled aerosol mass.

7. Line 448: ”Lasher et al., 2024” -> ”Lacher et al., 2024”.

Fixed.