Answer to Reviewer 1

We thank the reviewer for his time spending on the review and for positive comments and constructive hints.

The reviewer comments are displayed in italics, our answers in bold. The modifications in the manuscript text are shown in blue.

The T-bird is a great idea and the ability to make measurements down low where an aircraft cannot operate opens up great possibilities.

Thanks, yes, T-bird offers new possibilities for future research.

I would think a more apple-to-apple comparison would have been nice. Since the instruments in the T-bird are not large, having those in the aircraft in addition to what they call the standard instruments would have made for a more apt comparison, in my opinion.

We agree, but this could not be organized for this first campaign. In the future we will try the inclusion of the T-bird instrumentation in the aircraft. This is mentioned now in the Conclusion Section, where we write:

To support better intercomparison and validation of observations, future measurement campaigns will also aim to integrate the T-Bird aerosol instrumentation into the aircraft itself, where feasible. Thereby, it will be kept in mind, that the much higher payload and available space on the aircraft allow for operation of more precise (e.g. ultra-high sensitivity spectromenter, UHSAS instead of POPS) instrumentation.

I think a good use for the T-bird could be to porpoise the platform up and down to generate a profile of the conditions below the aircraft

Yes, this is to some extent also our plan for the future. At least we could obtain wind and temperature profiles. However, for turbulence measurements one always needs longer measurement time in one height for statistical reasons. Also, for the aerosol measurements one might need longer measurement than the nominal 1 Hz time resolution of the Partector 2 and POPS instruments due to the extreme low concentrations. However, the time ~15-minutes (was wrongly stated ~10-minutes in the manuscript, now corrected) that we have spent at a single altitude during most of the flights during BACSAM was not chosen due to the T-Bird instrumentation, it was chosen because of the scanning mobility particle sizer's time resolution (5-minutes) onboard the aircraft. The following texts were added to section 3.3.1:

The length of the legs was chosen such, that independent of SMPS's exact scan start time, it was guaranteed, that two full scans could be performed at that single altitude.

And:

The T-bird also offers the possibility of measuring vertical profiles of meteorological properties such as temperature, pressure, wind components during climb and descent. POPS and Partector have a time resolution of 1Hz, however the Partector has a 4-32 s averaging window,

which is manually set dependent on the expected concentration. For the derivation of turbulence properties (e.g. fluxes, turbulent kinetic energy) from high resolution wind and temperature measurements we need leg lengths at constant altitude of at least 8-10 km for statistical reasons.

I think I would adjust the title of the paper. There is very little in here about the wind and turbulence part of the platform instrument suite. I am not sure referencing it need to be in the title. If it does, then it shouldn't be listed before aerosol properties which is what the paper is about. I will be interested in seeing the follow on to this paper about the winds and turbulence data. For the little that it talks about it, I do have some questions.

Yes, indeed the paper concentrates mainly on aerosol. The name T-Bird reflects the development of this tool during recent years, which concentrated first on turbulence equipment. In the revised version we changed the order in the first line so that the new title is:

The T-Bird – A new aircraft-towed instrument platform to measure aerosol properties and turbulence close to the surface: Introduction to the aerosol measurement system.

What Aventech 5-hole probe model are you using. They list nothing on their website that has a response at 100 Hz. Are you using their pressure transducers? Is this an AIMMS instrument. Definitely need more info here and description. At best their stuff updates at 40 Hz and even then their frequency response tails off when you get to 10 hz or so from my experience.

Our information about the turbulence equipment was misleading. We do not use an AIMMS20. Only the 5-hole measurement boom is from Aventech including also a purge system for water in tubes after flights in clouds. The latter is used, however, not during measurement legs. So, the boom itself is not involved in data conversion or data storing. We use pressure transducers from Setra (Setra 239 R and Setra 278 , more details in Ehrlich et al., 2019) in combination with NI Compact Rio AD conversion modules reaching a data rate of 100 Hz. This information is given now in the revised version. In some earlier campaigns we used also the AIMMS20, which was installed at the aircraft wing in addition. Thus, we know that our system at the noseboom is faster than the AIMMS20. The following changes were made in the text, in section 2.1.1 (description of the T-Bird turbulence equipment):

Namely, the same five-hole probe (Aventech) is installed at the front of the T-Bird (Fig. 2) and provides static and dynamic (Pitot) pressure and differential pressure measurements to derive the angles of attack and sideslipe and finally the 3D wind vector with a frequency of 100 Hz (Hartmann et al., 2018).

was changed to:

Namely, the same five-hole probe (Aventech) is installed at the front of the T-Bird (Fig. 2), wherein Setra 239 R and Setra 278 pressure transducers in combination with NI Compact Rio AD conversion modules provide static and dynamic (Pitot) pressure and differential pressure

measurements to derive the angles of attack and sideslipe and finally the 3D wind vector with a frequency of 100 Hz (Hartmann et al., 2018).

and in section 2.3 (description of the Polar 6 turbulence instrumentation):

The aircraft was equipped with a nose boom hosting the instrumentation bunch for turbulence observations. This consist of a five-hole probe (Aventech) and Pt100 temperature sensor (Rosemount, type 102E).

Was changed to:

As already mentioned, the aircraft was equipped with a nose boom hosting the instrumentation bunch for turbulence observations. This consist of a five-hole probe (Aventech) with Setra 239 R and Setra 278 pressure transducers and Pt100 temperature sensor (Rosemount, type 102E).

I haven't seen any other listing of a Rosemount 102 deiced TAT sensor that updates at 100 hz, can you provide some more info. Even if you want to sample that fast, it generally only responds at most at a couple of hertz and much slower than the non-deiced version.

Both in the aircraft and in the T-Bird, the temperature sensors are not de-iced. We think that this was a misunderstanding. In the manuscript we only state, that additionally to the 100 Hz not deiced sensors, in the aircraft we have a de-iced temperature sensor mounted as well, which was not used for the data analysis in this manuscript. And as you say, that sensor does not reach a 100 Hz resolution.

The text:

Additionally, there are a deiced (heated) Pt100-temperature sensor (Rosemount, type 102E) and a humidity sensor (Vaisala HMT333) mounted on Polar 6 with dedicated inlets.

Was changed to:

Additionally, there are a deiced (heated) Pt100-temperature sensor (Rosemount, type 102E , not used here for data analysis) and a humidity sensor (Vaisala HMT333) mounted on Polar 6 with dedicated inlets.

All in all I think this is a good introduction to the T-bird but some more details would be nice to see. I am also not an aerosol person so they may have way more to say than I since this turned out to be an aerosol paper. I don't see any showstoppers here but some more fleshed out info would be nice.

The main purpose of the manuscript is to introduce the T-Bird as a useful device for characterizing the lowermost layer of the Arctic atmosphere. The data presented here, are therefore mainly to prove the T-Bird's functionality, and outline options for further improvements as well as for future applications. In our opinion, the presented information and data suffice to fulfill that goal. More detailed information will be presented, e.g., in a

follow-up paper focusing on the determination of aerosol particle fluxes in the Arctic based on the second scientific T-Bird campaign (BACSAM II).

References

Ehrlich, A., Wendisch, M., Lüpkes, C., Buschmann, M., Bozem, H., Chechin, D., ... & Zanatta, M. (2019). A comprehensive in situ and remote sensing data set from the Arctic CLoud Observations Using airborne measurements during polar Day (ACLOUD) campaign. *Earth System Science Data*, *11*(4), 1853-1881.