Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-296-RC2, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "Numerical simulations and Arctic observations of surface wind effects on Multi-Angle Snowflake Camera measurements" *by* Kyle E. Fitch et al.

Anonymous Referee #2

Received and published: 13 October 2020

The manuscript investigates the aerodynamic impact of the particles' fall speed measured by a Multi-Angle Snowflake Camera (MASC) using field measurements and Computational Fluid Dynamics (CFD) simulations. It compares the fall speed PDF measured by the MASC and the K-band radar located at the same site. The distribution of fall speed differs from the two instruments and the numerical simulations suggested that the fall speed measured in strong winds (> 5 m/s) would record slower falling particles when not shielded. Similar results were found using the simulations. Overall, this study helps to improve the quality control procedure of the MASC data and contributes significantly to the field of snowfall measurement. It fits well in this journal as it improves the methodology to be used to quality control MASC data. The

Printer-friendly version

Discussion paper

manuscript is very well written and clear. The figures are also clear and well described in the caption. I have, however, a few main and minor comments should be considered before publication.

Main comments

1. The manuscript gives the impression that the main point is the CFD simulations where it would have been used to study the collection efficiency or to develop transfer function to adjust the MASC measurements. After reading the manuscript, the CFD simulations are used only to explain the field measurements. Given that, I think that the authors should add a methodology section after the introduction that explains the approach taken in this study, which includes the field measurements and the simulations. It may also be useful to present the measurements before showing the results from the simulations.

2. More details should be given about the simulations conducted such as, for example, the number and shape of the mesh used. Did you use the integrated trajectory simulations or developed one? Could you add a figure that includes examples of particles' trajectories? In Table 2, only one size of particle was used. For dry snow and aggregates, the fall speed does not change much with diameter according to Rasmussen et al. (1999). However, the fall speed of rimed particles can vary a lot with sizes. Why not use more particles' sizes? What would be the impact on your results? Why did you choose a diameter of 2 mm and not 1 mm? Please also describe in more details the simulations. For example, is there an updraft as found in previous studies (ex: Colli et al. 2016a,b; Theriault et al. 2012) for the Geonor (shielded and not)? How do you explain that slower falling snowflakes fall is detected by the MASC in stronger winds? Add any other details that could help better understanding the results from the simulations.

3. The simulation as well as the measurement shows that an unshielded MASC leads to a decrease of the fall speed. Can you add a brief explanation in the manuscript? It seems counterintuitive as faster falling particles would tend to fall in the gauge in

stronger winds.

4. At lower wind speed, larger aggregates tend to be more detected by the MASC than at higher wind speeds. In theory larger ones would fall faster and would not be deflected. How do you explain this finding? Could it be because larger aggregates in strong winds would breakup? Or is it common to report large aggregates in windy conditions at that site ? Did you compare with the climatology of solid precipitation at that location?

Some minor comments:

1. Lines 5-7: This sentence mentions that the simulations are compared with observations. However, I understood that in this study that the catch efficiency of the instruments is not computed from the simulations and compared with the measured one. But the simulations are used to explain the decrease in fall speed measured in strong winds. This is related to major comment #1. It should be rephrased for clarity.

2. Lines 45: Newman et al. (2009) also conducted CFD simulations in the vicinity of a snowflake video imager. Should probably add the paper to this paragraph. Newman, A. J., P. A. Kucera, and L. F. Bliven, 2009: Presenting the Snowflake Video Imager (SVI). J. Atmos. Oceanic Technol., 26, 167–179, https://doi.org/10.1175/2008JTECHA1148.1.

3. Figures 7, 9, 11 and 13: Those figures compare data taken with an unshielded and a shielded MASC. Please clarify in the caption that the shielded and unshielded data were collected during two different periods.

4. Lines 185: Usfc is defined. Could you explain it further and how it compares with standard measurements of wind speed at the instrument's height (or at 10 m)? I may have missed the explanation in the text.

5. Lines 189-194: The authors forgot to introduce figure 10. Only Figure 10c is referred to.

6. Lines 200-201: Please clarify that sentence. I don't understand what you mean by

'more vertical'?

7. Lines 224-229: For clarity, the authors could remind the reader that larger aggregates fall slower than the rimed particles as in Figure 10.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-296, 2020.

Printer-friendly version

Discussion paper