This study presents the status of two publicly available tools for the analysis of radar Doppler spectra named PEAKO and peakTree. The tools were first introduced in 2019 but went under appreciable development particularly targeted to allow the synergistic use of them. Despite the work done on the algorithm is rather technical, the authors provide a considerable amount of application examples that greatly elevate the scientific interest of the study.

The manuscript is well-written and easy to follow. The conclusions are derived from the experimental results offered. The data is presented clearly and the quality of the figures is consistent with the highest standards for scientific publication.

Despite the overall quality of the paper I still see a few points that I suggest to address before publishing. The main limitation I see in this paper, considering its intended goal, is the lack of a clear description of the added value of the combined PEAKO-peakTree tool. It is unclear what the two algorithms can do individually, what are the overlapping capabilities, and what kind of benefit (either additional scientific information extracted or reduced effort to use) one can derive from the combination of them. Moreover, I think that the results derived in section 4.3 highlight some limitations of the radar Doppler analysis which I believe are worth a more extended discussion. I believe addressing these points does not require substantial work or additional experiments, but rather some work on the manuscript text. Thus, I recommend the paper to be published after minor revisions.

1 Major points

1. Figure 1. I had some difficulties in using this figure to facilitate my understanding of the paper. First, as far as I understood, the training phase of PEAKO requires human intervention. In this case, I would add this to the input block of PEAKO. Further, PEAKO also identifies peaks itself, right? At least in subsequent figures there are PEAKO-found peaks which is not an output of PEAKO in fig.1 I would add the complete list of output of PEAKO to the figure, as well as the output that is not given to peakTree.

2. Section 3. Aren't the results derived from a very limited case study and using specific assumptions regarding particle properties (scattering and fallspeed)? A different case comprising different particles might be easier to manage (i.e. a mixture of ice, snow and graupel/hail) or much more difficult (small ice crystals mixed with supercooled liquid, or snow and drizzle). Also, the assumptions made in term of scattering properties and fallspeed of particles might have a noticeable impact on the peak prominence and separation respectively. Is there a specific reason to use that particular case and simulation setup and derive general conclusions from that? I would suggest exploring some different options in terms of scattering and fallspeed to assess the effect of those assumptions on your conclusions, and perhaps to include a few cases (also as supplementary material) that might be completely fictitious, and not based on measurements, to illustrate some clearly easy separable situations and a very difficult one.

3. This is connected to my previous comment about Fig. 1. It is unclear when PEAKO and peakTree are used as separate instances and when they are combined. Fig. 1 and the discussion about PEAKO seem to suggest that the purpose of this algorithm is to facilitate the job of peakTree, though it is unclear what might have been different for peakTree without the use of PEAKO and it seems that PEAKO is a valuable software by itself for peak-finding and it is also used with this purpose later in the results. The contribution of peakTree to the overall scientific analysis can also be emphasized because sometimes there is a feeling that PEAKO is used to identify peaks and peakTree is left without a clear purpose. This can be addressed in a number of ways:

    - Restructure Fig. 1 as suggested in my previous comment including all input and output of the two software.
    - Clearly write what is the added value of having peakTree ingesting the optimized configuration file of PEAKO. Or alternatively, state what one would have had to do with peakTree without the use of such optimized configuration.
    - Declare at the beginning of subsections 4.2 and 4.3 what is the intended purpose of the use of PEAKO and peakTree. In particular what information is aimed to extract from the capabilities of peakTree to separate various peaks and their moments.

4. Section 4.3 - The analysis of the results seems to describe a situation with a classic Arctic mixed-phase cloud consisting of ice particles with liquid at cloudtop and a more unusual additional liquid layer at the bottom. However, from the HOLIMO observations, the results of the forward simulations and the discussion at lines 480-493 suggest that this cloud, and especially its reflectivity signal, is largely dominated by supercooled drizzle, while the frozen mode is of little importance. Perhaps this is interesting and should be emphasized as a limitation of the spectral analysis tool because I have the feeling that without the HOLIMO instrument, one would have very rapidly attributed the main peak at -1m/s to snow particles instead of supercooled drizzle while the faster falling emerging mode would have been classified as rimed snowflakes.

5. Fig. 7c it is surprising that the algorithm did not catch the supercooled drops peak which is quite obvious in the spectrum. Can you comment a bit on this and declare if you plan work on the algorithm in order to better catch these situations? I also have the feeling that a human would have labeled it and a pure ML algorithm such as PEAKO could have identified it as well. This is particularly discouraging because even the PAMTRA simulation seems to model the Doppler spectrum particularly well. Perhaps, one can envision using PAMTRA as a generator of synthetic Doppler spectra to train PEAKO on a very large number of situations without the need for a human intervention.

2 Minor points

1. Line 3 - The phrasing "convoluted by dynamical effects" puzzled me. It suggests that different hydrometeors would produce distinct peaks if not disturbed by turbulence or vertical and horizontal wind shear (combined with radar finite aperture and pulse duration). In reality, various particle spectra would overlap anyway. The caveat of addressing only particles with "sufficient different terminal fall velocities" seems again to not make it clear enough. Particles with clearly distinct peaks can still have significant tails in the velocity distribution and by a change in the total number concentration of one population the second one can appear in the spectrum or be completely masked by the tail of the other population. So, I would try to simplify this statement by clearly stating that Doppler spectra of different hydrometer types overlap and turbulence and other dynamical effects further smear the observed Doppler spectrum. But I understand that I am being very picky.

2. Line 74, 177, 341, 349, 358, 366, 369, 370, 558 - the term "user" is a nice shortcut, but it feels odd. The person that is tasked to label peaks is not really a user. It might be a user of PEAKO, but again, it is not necessary, it could be anyone with sufficient "motivation" to perform such an effort. I would call this capable person: expert, labeller, decisor, identifier, and similar depending on the context. But again, I am very picky

3. Section 3. I do not like the term "preconditions", or, at least, I do not understand these conditions come before what exactly. Why not just call them "conditions"?

4. I think the ice lollipops were first named ice lollies according to Keppas et al. 2017 (https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017GL073441). I know that Pasquier already called them ice lollipops, but it might be better to keep it consistent and avoid possible confusion in the future. Similarly at line 531, the term droplet lollipop seems misleading because, out of context it might be thought to be a strangely-shaped liquid drop.

5. Fig. 6e In the label in the figure says number of peaks detected by peakTree in the caption PEAKO. As long as these are distinct software it is better to clarify which one is responsible for the peak detection.