Atmospheric Measurement Techniques Discussions

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Comment on amt-2021-294

Anonymous Referee #2

Referee comment on "ERUO: a spectral processing routine for the Micro Rain Radar PRO (MRR-PRO)" by Alfonso Ferrone et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-294-RC2, 2021

Review of "ERUO: a spectral processing routine for the MRR-PRO" by A. Ferrone et al.

The authors present a novel processing scheme for the MRR-Pro to enhance sensitivity and and remove interference. I appreciate that the authors not only released the code but also extensively documented the code including Youtube tutorials. The figures are mostly clear and the text contains hardly any spelling mistakes. However, the writing needs to be improved to make the text easier to understand. This might be also the reason why I find a couple of details puzzling. I recommend the paper for publication after addressing the following comments:

Major comments

Writing: The writing of the article needs to be improved. It is too long because, firstly, the authors get lost in insignificant details. Occasionally, the article appears as if the authors would have gone through the code and verbalized every line. I recommend that the authors go through the whole paper and try to focus on the really relevant steps. For example, the authors describe in L460 how they treat the beginnings and ends of a data set differently. Since the code is published as well, I wonder whether this is really relevant or rather distracting information? I give some more recommendations in the minor comments below but this list is not exhaustive. Secondly, often the authors wrote very verbose and complicated so that the actual relevant information is hidden. As an example, the caption for Fig. 8 is "The range of the y-axis in panel b has been artificially reduced to allow the visualization of the three datasets collected at PEA. The fourth bar, associated to the ICEGENESIS dataset, reaches the value -18.1 m/s." It took a while until I realized that the topic of these sentences is not the y-axis, it simply means "Note that the fourth bar, associated to the ICEGENESIS dataset, reaches a value of -18.1 m/s which is outside of the plot's limits." Scientific writing does not mean to write sentences as complicated as possible to sound smart – it is actually the opposite because simple sentences tend to be clearer and clarity is one of the most important things in scientific writing. Maybe the

coauthors can help making the text more straight forward.

Symbols: Apparently, the authors tried to save space by using a lot of symbols which makes it even harder to read. Therefore, I strongly recommend to add a list of symbols in an appendix (and promote it early in the text) and to reintroduce the most import symbols when using referring to them in captions or the summary.

Noise: The authors attempt to correct for noise and speculate it is related to snow on the antenna (L530f, L557, L763). I don't understand what the authors mean by noise because observations are always noisy. Do they mean an increased noise floor? Where exactly can this be seen in Fig. 5d? And do the authors have a physical explanation how snow on the dish can cause noise? I would think the thermal emissions of snow at 24 GHz should be negligible or is that wrong?

General: I would recommend to start the article with an example showing how interference and "noise" impact the data quality and explain the algorithm based on the example. This is already partly done in Fig. 9, but I would show it much earlier.

Section 3.2.3: FMCW radars like the MRR have the quirk that the data appears in the wrong range gate when aliasing is happening. Therefore, the authors must consider this effect when tripling the spectra to account for aliasing effects. See e.g. discussion in Maahn and Kollias 2012.

L415: I'm not sure what is done here. If the authors propose to remove not only mean noise but mean noise plus 3 times its standard deviation from the measurements this would mean that the actual signal is reduced. For small signal to noise ratios this would lead to a negative bias of the algorithm – consistent with the reduced reflectivities for ERUO in comparison to the MRR algorithm (Fig. 7).

L628: If aggregates cause largest differences between backscattering at 24 and 94 GHz, why do the authors accept up to 20% aggregates?

L689: The authors interpolated the signal in a region without any significant vertical gradients, so the good agreement is not surprising. How does the method perform in more challenging conditions?

Fig. 5: To me, it looks like all problems in the MRR data were above 2,5 km, all data was below. If this is true, why was such an extensive detection and reconstruction method developed? And doesn't this mean that the detection of interference and the evaluation of the reconstruction is not very meaningful because it applies to parts of the spectrum

without any signal?

Minor comments

L16: Given that the paper is only about a method, I'm not sure why the introduction starts with a paragraph about Antarctica.

L108: To my knowledge, the TF compensates for a change in receiver sensitivity related to the changing frequency of FMCW radars.

L262: This paragraph reads more like a manual than a scientific paper. I would recommend to remove the paragraph or move this paragraph to an appendix.

Fig 5: Due to the TF, the sensitivity of FMCW radars typically does not scale with range squared as a normal pulsed radar does. I would recommend to mention this to avoid confusion.

L200ff: In theory, the change of sensitivity with height of the MRR-Pro can be calculated from your equation 1 because minimum values of H(sig) should be constant with height. Then, the sensitivity at an arbitrary height level can be used to scale with range squared (or n2 x delta r – see your equation 1) and – this is different to a conventional pulsed radar – TF. If the MRR-pro sensitivity scales as predicted by the theory, the S_fit(n) could be obtained more easily.

L272: Just a comment, the authors could try using xarray with the dask library which is particularly designed for handling datasets larger than the machines memory.

L303: This appears to be a bug by the MRR's firmware. Please report the firmware version of your MRRs somewhere to make sure the broken version is documented.

Sec. 3.2.2: I find the term "reconstruction" confusing, isn't this simply an interpolation?

L313: part should be parts

L328: What do the authors mean by “kept”? Kept for the mask or kept for valid data?

L329: capital SU

L370: This means that only the moments of the most significant peak are estimated. This is totally fine but should be mentioned.

L426: Use equal sign for 0.92 because I assume this exact value is used in the code.

Sec. 5: This section can be drastically cut. Focusing on the relevant information here would also allow the reader to identify the main conclusions of the paper.

General: When referring to figure panels, please repeat the figure number (i.e. “3.a” instead of “a”). This is particularly important when discussing multiple figures at once.

All figures: Something went wrong with the figures, letters are missing. E.g., for Fig. 5, the title is: “06 (line break) s ss”

All figures: Add legends of the lines to all figures.

Figs. 8 & 11: Are these figures and the related discussions really required in the main text?