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Discussions

Interactive comment on "Optimizing observations of drizzle onset with millimeter-wavelength radars" *by* Claudia Acquistapace et al.

Anonymous Referee #2

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General comments

This paper investigates the sensitivity of the Doppler radars data quality to the raw data processing settings and determines the best configuration for the observation of drizzle development in liquid clouds. This seems a bit technical but this is an original and precious work in the sense that papers describing the optimization of radar data processing in the light of observational needs are very rare. And it is probably for this reason that currently, most of the radars of the type considered in this paper are not using the optimal settings (for drizzle observation at least), an important finding of this work. Overall, this manuscript is well written and is well suited for the readers of the Journal of Atmospheric Measurement Techniques (AMT). Though, I have several important comments (more details and discussions are required for some specific points and grammar and figure quality can be improved), and a number of very minor issues

- see below. I recommend publication after these points are addressed.

Specific comments

1. Page 5, line 18: It would be good to expand a little bit the description of the interpretation of skewness as this is not as simple: 0 skewness does not necessarily means that a spectrum is Gaussian, nor that it is symmetric (since two different tails on each side can still compensate for each other).

2. Page 6, line 4: This is also interesting to see how the apparent thickness of the cloud seems to decrease with shorter time integration. In this regard, decreasing the integration time from 2 to 0.4 seconds seems to have a big effect. Please comment.

3. Section 3.1: this whole section is a bit messy and difficult to read (some examples follow). It would be good to rephrase and reorder, and/or add some subsections. 3.1. Page 7, line 21: "Larger" at the beginning of the paragraph looks a bit odd. Instead, I would either not change paragraph, or start the new paragraph from line 15. On the other hand, the sentence starting with "Moreover" (line 30), is very different from what was previously discussed. This looks like a good place to start a new paragraph.

3.2. Page 7, line 10: you explain that integration time has a larger impact on higher moments at cloud base because of wider DSD. Few lines further (line 23), you have now another explanation for Doppler velocity and spectrum width which is the "more variable vertical motions".

3.3 Page 8, line 23 to 29: First, you say that you will focus the analysis on integration time, second you discuss the effect of SNR, third you say that you will focus the analysis on the drizzle case and then you discuss again the effect of SNR. All these sentences seem to be just juxtaposed and it is really difficult to follow the reasoning. Please try to rephrase in order to make the reading easier. 4. Page 8, line 1: Please make clear how you derive the skewness uncertainty ("derived from the skewness time series"). Do you simply calculate the standard deviation?

5. Page 10, line 20: The advantage of using simulations is that you know the truth. Why don't you show the distributions of the moments coming from the ideal Doppler spectra (without random noise and sampling effects)? On this note, it is actually not perfectly clear how you simulate the DeltaT effect: do you simulate the I/Q time series? More details are required.

6. Few paragraphs starting on page 10 line 26: same as specific comment 3). For example, one page 10, line 34: You can easily simplify and make three sentences in a single one! For example: "As for the observations, the mean values of Sw increase with larger integration while the nfft has a negligible effect.

7. Page 11, line 11: This sentence is a bit clumsy. First, I don't understand why it is separated from the previous paragraph, and after "Despite the missing negative Sk values in our simulations", I would expect that you now describe some agreement with the observations. However, you are describing that the mean value of skewness distribution is changing with the integration time. This is a completely new behaviour that was not seen in the observations. Did you expect this? Why don't we see it in the observations? Why do you need to focus on a region of coherent skewness in order to see it? More discussion is needed here.

8. Page 11, line 14: Honestly, I have real difficulties to convince myself that observations from Fig 11 confirm the behaviour of skewness in the simulation. Very few points are used to produce the pdfs of Fig 11, you need to be very cautious in your interpretations here. Can you really discuss the behaviour of the extreme when you have only 50 values in your sample (and even less for the 10 s integration time)? Even the mean value is only slightly showing the shift with time integration, with a range much smaller than in the simulations. Either you need more data, either you must be less affirmative in your conclusions.

9. Page 11, description of Figure 12: The interpretation of Figure 12 (skewness behaviour as function of the LWC ratio and drizzle mean size) is not easy. You need to

increase the number of points for rLWC<1. Why is there no data for rLWC=0? The skewness of a cloud Doppler spectrum should be 0, so I understand that all these lines are supposed to start from 0. Then, for large drizzle radius, it is difficult to understand why the skewness is first increasing very quickly and then decreasing again. In order to help the reader, please add a figure with some sketches of the Doppler spectra at different stages of the drizzle formation (for different rLWC) and for a drizzle radius of e.g., 10, 30 and 60 micrometers.

10. Page 12, line 22: Decreasing the integration time will both avoid the turbulence-induce increase of Sw and preserve large values of Sk. I don't see any compromise here. On the other hand, there is certainly a compromise with the required sensitivity.

11. Figure 3 and 4: The white periods in the main time-height plots are not satisfying: it looks like you are zooming in during a period where there is no data. I understand that they correspond to the special radar operation aimed at recording the I/Q data, and that the standard output datafiles are not available for this period. But, it should be easy to process the corresponding I/Q data using the standard settings and fill in the hole in the main figures. Seeing the evolution of the cloud over the whole one-hour period would help in understanding how representative your I/Q sampling periods are.

12. Figure 6: Since the same figure for the non-drizzle case is only shown in the supplementary material and that you are mainly describing the drizzle case, it would ease the comparison between the two cases (lines 30-32 on page 8) if you add a line on each subplot showing the non-drizzle pdf for, e.g., the 0.4 s integration time.

Technical corrections

1. Page 2, line 27: The use of semi-colon for citation in the middle of the sentence is inadequate. Better separate them by using "and". 2. Page 2, line 30: "the" appears twice. 3. Page 3, line 16 and 25: You probably want to refer to Kollias 2007b (instead of Kollias 2007a). In any case, I can't find the discussion of nfft = 512 for ARM radars, in any of these papers. By the way, the title of Kollias 2007a is not complete. 4. Page

5, line 22: "to the right" does not sound very rigorous: you may better use "asymmetry towards positive velocities (e.g., to the right of the main peak in Fig. 2)". 5. Page 6, line 32: Please correct the reference to "Kollias et al. (2014)". 6. Page 9, line 15-to the next page: "was", "helped", "allowed" ... For clarity, I would stick to the present form. 7. Page 10, line 14: Either the convoluted spectrum is dominated by the cloud peak, either the contribution of the drizzle is larger than the cloud peak. 8. Page 10, line 20: For clarity, please move "into account" forward just after "take". 9. Page 11, line 2: "address" does not seem to be right verb. "Explain" would be more sensible. 10. Page 13, line 13: The verb is missing. 11. Table 2: Instead of referring to Table 2 in the caption of Figure 1, it would be more readable to refer to both in the text. 12. Table 3: There is no reference to this table in the text. 13. Comment for most of the figures: A lot of Figure labels appear blurred on screen while perfectly neat when printing.