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Atmospheric Measurement Techniques Discussions
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Interactive comment on "A simple insect removal algorithm for 35-GHz cloud radar measurements" *by* Madhu Chandra R. Kalapureddy et al.

Anonymous Referee #3

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General comments and recommendation for disposition of the paper

Millimeter-band radars are very sensitive to detect small targets such as cloud droplets and also insects and other biological particulates (biota) present in great number in the lower atmosphere. Polarization measurement is an efficient mean to discriminate cloud echoes from non meteorological scatterers that share in common very low reflectivity. Unfortunately most radars are not equipped with polarization measurements. This short paper proposes for these standard radars a simple technique able to separate meteorological and non-meteorological echoes. It uses only successive vertical reflectivity profiles acquired by a 35-GHz radar operated at vertical incidence with a 50 m pulse length and one second temporal sampling. Because of the high spatial and temporal resolution, most of the time only one or no biota target is present in the

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Discussion paper

pulse resolution volume. In contrast, cloud echo is due to millions droplets that fulfill the pulse volume. As a consequence signal variability at a given range between two vertical profiles is much more important for biota scatterers than for cloud echoes. Signal variability is given here by the standard deviation of the reflectivity over the time of five profiles that corresponds to the typical duration of the biota echoes crossing the antenna beam. The threshold value that separates distinctly biota from cloud is obtained from statistical analysis of a large radar observation set. Indeed this value should be adjusted for a radar having different characteristics. The topic of this study enters the scope of the journal and responds to a real issue for anybody who wants to extract physical quantities from radar signal. The work is put into perspective with past equivalent investigations through a large panel of bibliographic references. The work based on well chosen graphics is convincing and above all the methodology is validated with polarization measurements provided by the same radar. In conclusion this paper that presents a good scientific interest is suitable for publication in Atmospheric Measurement Techniques Journal. However this recommendation is subordinated to the authors consideration of the following comments.

Main review points

1) Lines 48 to 50 give the list of the source of non-meteorological echoes which comprises insects and other biological particulates (biota). The title refers only to insect and in the text the word insect is nearly always used. Even if the insects is the main source of biological echoes it is a restrictive term. I propose to use in place the word biota introduced by the authors.

2)- In figure A2 strong vertical gradient of humidity is associated with the presence of cloud echoes. We may deduce that also strong refractivity index gradient exists which can be a potential source of Bragg or specular echoes. For information an explanation that this type of echoes, observable with UHF and VHF band radars, has a very low probability to be detected by millimeter-band radars will be welcome.

3)- The sensitivity of the radar is -60 dBZ at 1 km range (line 95). This value seems to me very optimistic according to the radar characteristics. Give some details on the radar calibration.

4)- May be the high radar sensitivity is due to the use of pulse compression (Table 1). If this mode is used give the effective pulse length, the code moments number and the lower range gate available for the data set presented in the paper.

5)- The term point target is used line 102 for non-meteorological echo. In fact a scatterer is named punctual echo when it is alone in the pulse volume. In that case echo duration is related to the time taken by the target to cross the radar beam, to its radar cross-section and its position relative to the beam axis. All these factors explain the signal variability of biota echoes.

6)- In fig.1, and others equivalent figures, a range (r) correction of the radar signal of the form r2 is used (line 109). It is correct for volume echoes such as cloud echoes, for point targets it is inadequate. The range correction for such backscatters has the form r4.

7)- When there is an echo at a certain range, the signal at the receiver output is the sum of the receiver noise voltage and the detected backscattered wave. It is therefore necessary to remove the noise power in order to get the backscattered power. It is evident that this has not been done for the presentation showed in the figures such as fig.1.

8)- Line 111: Receiver noise is made of thermal noise generated within the receiver chain and also of other sources which are taken into account through the noise figure of Table 1.

9)- Give more details on the computation of the running mean and standard deviation (line 136) of the successive vertical profiles of reflectivity. In particular it is important to precise if these quantities are computed before or after noise removal.

10)- Line 161: Receiver noise is not en echo but a signal generated in the receiver chain.

11)- A statistical de-correlation time is introduced line 174. I do not understand very well how it is computed. I think it is related to the standard deviation of the reflectivity. Give the formula that links de-correlation time and reflectivity standard deviation. In figures 3 and in the text the unity used for the standard deviation is not given.

12)- lines 218 to 219 ...biota that are found to extend less than 2-4 height bins each of 25 m... : vertical spreading of a point echo is expected to extend over half pulse. How do you explain this large spreading that can approach 2 pulse lengths. Is the use of a compressed pulse that produces this increase.

13)- I suppose that the radar has Doppler capability because line 263 and 264 Pulse-Pair and Fourier Transform are cited. Doppler spectra width contains information at the pulse scale on the de-correlation time of the echoes. It could have been used instead of the reflectivity standard deviation. Did you try to analyze this quantity to discriminate echo type.

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