

Atmos. Meas. Tech. Discuss., referee comment RC3
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Comment on amt-2021-349

Anonymous Referee #3

Referee comment on "A scheme to detect the intensity of dusty weather by applying microwave radars and lidar" by Xuebang Gao and Li Xie, Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-349-RC3>, 2022

This manuscript presents theoretical calculations of radar sensitivity to dust particles for radar operating frequencies from L- to W-band. Radar detection thresholds are estimated as a function of range and dust storm intensity quantified by a visibility index. It appears that detecting sand and dust storms with currently deployed weather radars would be a good use of those radars to help protect cities and urban environments.

While the manuscript presents theoretical calculations, the manuscript does not show any radar observations of sand or dust that validate the theoretical calculations. Also, contrary to the manuscript title, the manuscript does not present a method or 'scheme' to detect sand or dust with weather radars that discriminates sand or dust radar measurements from backscattered energy from raindrops.

The manuscript needs a review for English grammar and word usage.

Specific Comments

1. Abstract. The abstract does not present the results of the study. Also, the abstract states (line 10) that 'The scheme can be efficient to detect sandy dust weather...' A scheme is not presented in this manuscript, just radar calculations to determine whether simulated radars have the sensitivity to detect sand or dust populations. Rewrite the abstract to describe the purpose of the study, methods of the study, results from the study, and potential impacts from the study.

2. The manuscript presents scattering calculations of sand and dust particles to determine range detection curves. But, the study does not repeat the calculations for raindrops which would show whether the simulated radars are capable of detecting raindrops. Do the

simulated radars have the same sensitivity as operational weather radars? Can the simulated radars detect raindrops at 100 km, or 200 km? Please extend the calculations to raindrops.

3. Section 2.2.2, line 74, and line 118. The maximum sand or dust particle is limited to diameters of 80 microns (line 74). The shortest radar wavelength is about 3 mm from W-band radar. The size parameter (line 118) is given as $x = 2\pi a / \lambda$. Using $a = 40$ microns and $\lambda = 3$ mm, the size parameter is approximately 0.15. This maximum size dust particle is still within the Rayleigh scattering regime for W-band radar wavelengths. The Mie scattering approximations (equations 8 and 9) are superfluous and will revert to the Rayleigh approximation for these small size parameters. Section 2.2.2 is making the calculations more complicated than necessary.

4. Line 158. I do not know of a civilian scanning weather radar operating at L-band. Most scanning weather radars have antenna beamwidths no larger than 1 degree. An L-band antenna would have to be large to produce a 1 degree beamwidth. If the authors know of an L-band scanning weather radar, it would be interesting to see details of that radar.

5. Lines 118 to 194. The manuscript presents effective detection ranges with 1-meter resolution. For example, line 159, the detection range is 2671 m. Given the assumptions in the calculations, this is a false sense of accuracy. What are the simulation uncertainties for detection range? Asked another way, given a 3 dB uncertainty in signal-to-noise ratio, what is the uncertainty of the detection range?

6. Figure 2. Why do the detection ranges only go out to 10 km when weather radars typically have ranges out to 100 to 300 km?

7. Section 2 presented theoretical calculations of radar detection. Are there any radar observations of sand or dust storms that can validate these calculations? Without showing any real radar observations, the simulations have not been validated or put into real-life context.

8. Section 3 "The scheme of using meteorological radar to detect sand and dust weather". This section does not present a "scheme" or method of detecting sand or dust weather. It appears that some thresholds have been set and shown in Fig. 4, but no flow diagram showing the decision logic is presented in the manuscript. Also, it does not present a method to discriminate scattering from sand or dust from scattering from raindrops. How does the method determine whether sand or dust is being detected rather than raindrops?