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Comment on amt-2021-342

Anonymous Referee #1

Referee comment on "Observation error analysis for the WInd VElocity Radar Nephoscope W-band Doppler conically scanning spaceborne radar via end-to-end simulations" by Alessandro Battaglia et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-342-RC1, 2022

I found this an interesting and generally well-written paper. It describes a radar simulator code that appears flexible enough to model the signals from a variety of spaceborne weather radars. After the introduction, the paper describes the end-to-end simulator, including orbit and geometry, atmospheric model, radar scattering and signals, and inclusion of error sources. Section 3 provides an example of the simulation of WIVERN data acquisition, including an analysis of errors. I particularly appreciated the description and diagrams showing the dual-polarization operation.

One thing that could aid understanding could be a brief description of different types of radar models. As I understand it, the model described here simulates mean quantities and uncertainties, followed by generation of noisy samples (see my comment below). Perhaps a discussion of why this is used versus simulation of, for example, received amplitudes from collections of point scatterers. Another possible discussion would be validation of the model. Besides the one example in Section 3, were there other tests, either similar to Section 3 or perhaps idealized cases?

Some specific comments and questions are below:

Are there plans to go beyond Mie theory?

Antenna pattern – for example, a sinc function would be approximated as a Gaussian main beam plus sidelobes?

On page 12, line 20 “convoluted” is maybe better “convolved”.

My understanding from pp. 15-16 is that the theoretical uncertainties are used to generate properly distributed noise that is combined with the calculated means. Is this correct? Does the code also output the underlying means and uncertainties?

Maybe more details could be provided on the simulated brightness temperature, such as bandwidth, integration time, and resulting uncertainty. Are the brightness temperature samples computed the same way as radar observations, namely, by generating means and then adding noise?

I initially got confused by the text at the bottom of page 18, which mentions "Panel B" and Figures 11A and 11B. As stated it's all correct, but, for clarity, perhaps the discussion of Figure 8 could be its own sentence. This could be followed by new sentence, such as "For this full scan circle, Figure 11 shows the antenna weighted hydrometeor water content, as computed using the following".

In Figure 12, why is the surface Doppler (height 0) in the lower right panel so weakly modulated by azimuth angle?

P. 21, around line 12 – not sure I understand the comment that "the ghosts are significantly smaller over land than over ocean". The effects in Figure 14 seem larger over land.

p. 25, line 10 – "20 full revolutions" – is this the same mean reflectivity and velocity but different noise or this is 20 different scenes from the full track?