Comments on 'Characterization of surface clutter ..' by Manconi et al., egusphere-2024-2779

Simulators are useful for predicting the performance of instruments and helpful in understanding various error sources and in devising algorithms to extract the maximum amount of information. In this paper a simulator for the proposed WIVERN W-band radar is used to examine the behavior of the reflectivity and Doppler profiles over mountainous terrain.

Although I have several questions on the details, I found the paper informative. Since the WIVERN radar will be used primarily for cloud sensing, I expected to see some results on the atmospheric effects on surface cross section and Doppler but perhaps that will be dealt with in a separate paper. I recommend publication after the authors address the comments below.

Table 1: It's not clear to me whether the radar will transmit H and receive H and V (and transmit V and receive H and V) or whether it will transmit H and receive H only and transmit V and receive V only.

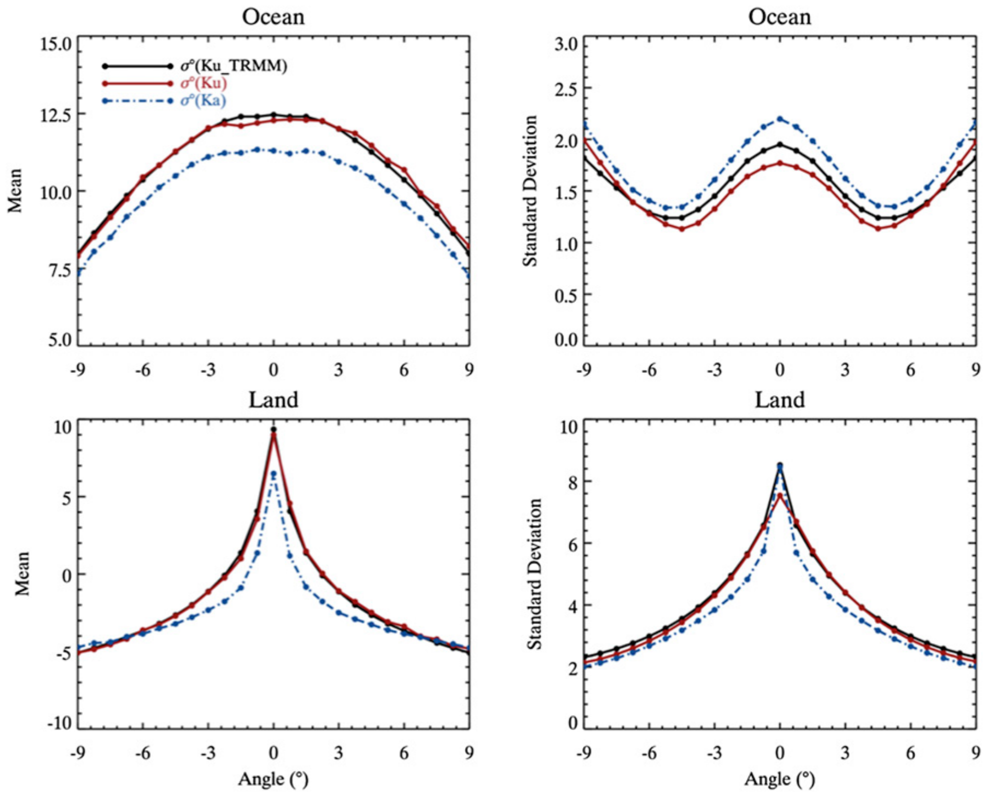
More generally, I'm not clear about the meaning of the 'ghost pulse' and how this affects the Doppler processing. This issue comes up later in the paper where the rho(HV) parameter, which implies that the cross-pol will be measured, is used to categorize the results. A few more sentences would be helpful to explain how this parameter is related to the scattering properties of the surface.

Fig. 4. The DPR (dual-frequency precipitation radar on the GPM satellite) surface cross-section data (Ku/Ka-band) over land shows a sharper decrease with angle in moving off nadir than the results shown here. The DPR data covers the angle range from nadir to 18 deg so airborne data are needed to fill in at the higher incidence angles.

I couldn't remember how sharp the drop-off with angle was but found the figure below. The land data are not categorized by surface type – all surface types are included.

The radar frequency is not mentioned in Fig. 4 and while the DPR database shows the Ku & Ka-band are similar in their angle dependencies over both land and ocean, the W-band data might depart significantly from the lower frequency data.

Unfortunately, there doesn't seem to be much off-nadir sigma-zero data at W-band, at least that I'm aware of. One advantage of the simulator is that the surface scattering model can be updated as new information becomes available.



Mean values of DPR sigma-zero from 1-month of data are shown on the left for ocean (top) and land (bottom). These data were taken from 35^0 S to 35^0 N to match the TRMM coverage. The Ka-band cross section over land decreases by about 12 dB going from nadir to 9^0. (Since the data used here were measured early in the mission, the Ka-band data extended only to 9^0.)

Lines 148-155. I had trouble following this discussion. First, it would be clearer to say something like: 'Land surfaces are generally categorized by large values of depolarization (-10 to -3 dB) and low values of rho(HV) (0.4 to 0.8).'

My confusion comes in the next sentence. 'While there is not much correlation for the co-polar surface signals ..' *(does this mean between rho(HH) and rho(VV))* '...there is an excellent correlation between the cross-polar signals …'. – italics mine. But the previous sentence stated that these values are low so I must be missing something.

Is 'rho' in lines 157 and 159 the same as 'rho(HV)' in the previous paragraph? If so, the same notation should be used.

Fig. 6 caption: 'wo' → 'two'.

Line 166: I see a blue 'X' but not a black cross.

I'm a bit confused by Fig. 7 and the associated discussion. It is assumed that the antenna is pointed in a direction orthogonal to the satellite velocity vector so if the sigma-zero were uniform over the footprint, then the Doppler would be zero - as shown by the red line. The variation in range in the Doppler is presumably caused by NUBF so a positive Doppler (assuming positive is toward the radar) would be caused by the return power from the forward portion of the beam being larger than that from the backward portion of the beam. Is this correct?

I would have expected the reflectivity profile to be much more variable in range than the blue line shown in Fig. 7 left panel. How typical is this; how much does it change when a field of view over the mountains is taken?

Not sure if side lobes are included in the antenna pattern but these would add to the Z variability, especially in the mountains.

Fig 9 caption on explanation of the bottom two panels, right-hand side. Presumably, means are given by the blue lines and std dev's are given by the red lines. This should be mentioned.

Does '1 km averaging region of elevation' mean that for calculation of the surface cross section the radar return power is used over a 1 km range window to compute mean and std dev? For example, if the mean & std dev at a particular point are (15, 5) dB, does this mean that about 66% of the data falls within 10 to 20 dB?

Does the phrase 'with the antenna scanning at the side of the satellite ground track' mean that the data are taken at an azimuthal angle at 270 deg?

Line 209: correspondence

line 213: '.. this value is expected to be zero (*for fields of view orthogonal to the direction of spacecraft motion*)..' . - italics mine. Although this was noted earlier, I think it's important to emphasize that the direction along the incidence angle is perpendicular to the spacecraft motion.

Line 218: should the fourth category be:

7 dB < std(s0) < 25 dB ?

Use of 'dB' here and use of 'meter' for the std dev of height might make this more readable and remind the reader of the units.

Line 220: 'A few ' rather than 'Few '. 'Few' implies 'Only a few'.

Lines 221-222: point 1 is difficult to understand and should be rewritten.

One possibility: The classes have been defined to include a significant number of cases in each. Those classes where the standard deviation in elevation is small have a high-count number because much of the terrain in the segment chosen is relatively flat.

(The unwritten assumptions are that low std dev in elevation implies relatively flat terrain which implies a small standard deviation in sigma-zero. But I think these assumptions are OK.)

Fig. 11: I'm having trouble understanding the behavior of the Doppler in the middle figures. From the title of the left middle figure, it seems that phi(A) is being varied from -15 to 15 deg but wouldn't the Doppler be the same regardless of a change of sign in phi(A)? What parameter is being changed to produce the positive and negative Doppler.

For the forward-looking case, the large Doppler shift induced by the satellite motion has been subtracted off, correct?

Line 242: renormalised