Atmos. Meas. Tech. Discuss., 8, C821–C824, 2015
www.atmos-meas-tech-discuss.net/8/C821/2015/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Performance assessment of a triple-frequency spaceborne cloud–precipitation radar concept using a global cloud-resolving model" *by* J. Leinonen et al.

Anonymous Referee #1

Received and published: 25 April 2015

Very interesting paper and utterly important for shaping the next multi-frequency radar missions targeting clouds and precipitation! The paper is generally very well written, with very high quality figures. With the following comments I want to foster the authors to do an extra effort (this is why I ticked the major revisions box) in order to make it even more valuable. I have three major comments

1. The authors are proposing two ACE-mission configurations and they are producing maps of high-quality detection in clouds and precipitation. In order to strengthen the message and sell the mission it would be nice to put their results in the context of the current missions deploying atmospheric radars (i.e. GPM and CloudSat). In other

words I would like to see included in Fig.4 the results for such systems (you can keep your 100% normalization factor to ACE 450 km or maybe use CloudSat as a benchmark). On the other hand Fig7-9-11,.... look quite repetitive: I would eliminate them and include their results in a Table (where it is actual easier to compare results).

2. Validation: I very much appreciated the effort done for producing Fig.2. It would be nice to produce an equivalent figure based on GPM-DPR data to see how well the NICAM model can capture the reflectivity variability in rain. Given the fact that it is just a question of changing configuration it should not be a lot of work. However, it is clear that for this kind of study it is not only about capturing the right pdf of your reflectivity. For what you are doing it is crucial to properly capture also the horizontal variability of clouds (because you are looking at NUBF). Therefore you should also look at that aspect (the paper Evaluation of EarthCARE Cloud Profiling Radar Doppler Velocity Measurements in Particle Sedimentation Regimes, JTech, 2014, Kollias et al., could help).

3. Error definition: there is quite some degree of freedom in defining the classes for erroneous error. First, you should write a line to explain why in eq 26 you are using this combination for evaluating NUBF effect (you want both to check the variability of the effective reflectivity and that of the integrated path attenuation, if I am not mistaken). Second, it is not clear to me why the 2 dB threshold has been selected. You may want to pinpoint at specific references there (if any) or articulate a little bit your reasoning.

Minor comments 1) Line 20 page 4152: effets

2) Line 8 page 4153: I guess you are integrating along track to achieve the sensitivity you have in Table 1. Thus I am not sure you can do this. You are underestimating NUBF.

3) Eq.26: You should write a line here to explain why you are using this combination for evaluating NUBF effect (you want both to check the variability of the effective reflectivity and that of the integrated path attenuation if I am not mistaken).

4) Line 23 page 4155: add ‘‘for all three bands’’ after not satisfied (right?)

5) Line 3 and 10 Page 4159: is it attenuated or is it multiple scattering? I guess both

6) Line 22-24 Page 4159 : I can’t understand how this is possible.

7) Line 23 Page 4160: the only change to only

8) Tab1: This is nominal sensitivity at what integration distance? There is a 5.2 dB difference due to the altitude. You are just approximating it to 5, right? A word about the rationale of not having beam-matched, i.e. for using the same antenna size at all freqs.

9) The pdf of 94 GHz is not ‘‘outstanding”; you are clearly underestimating MS because you are missing a lot of the high reflectivity (dense ice aloft?). That’s why I think it would be good to see if you capture the pdf at Ku and Ka by comparing with GPM-DPR.

10) Fig4: the sum of the 450 km in the top left panel is not 100%! Check all of them.

11) I am a little bit surprised by this result! As a rule of thumb for CloudSat I remember from some of the plots I produced you have a drop of 10-15% coverage once you drop by 5 dB in sensitivity. It is strange now that you get only 5% reduction. This maybe due to the Z distribution problem

12) Fig 12: this profile makes not much sense. It should be all clutter, shouldn’t it? I think going down to 400 m as you assumed is also quite challenging. You may mention how you are going to achieve such performances (keeping sensitivity high!)

13) Fig.14: Vertical cut is missing

14) Page 4163: Line 6 There is also a paper recently published by the same first author in JGR ‘Multiple scattering in observations of the GPM dual-frequency precipitation radar: evidence and impact on retrievals’ which gives evidence of multiple scattering in GPM Ku-Ka observations in presence of dense ice aloft.

15) Page 4164: “dual-polarization techniques” It would be good to explicitly mention what the authors have in mind here (polarization diversity? ref?).

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 4137, 2015.