

## Review of

# Calibration of a 35-GHz Airborne Cloud Radar: Lessons Learned and Intercomparisons with 94-GHz Cloud Radars

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## General comments:

The article describes investigations concerning the calibration of a 35 GHz radar and its validation very comprehensively and detailed. Although accurate measurements of radar reflectivity are very important for the retrieval of cloud properties radar calibration is still a big challenge for each radar operator. Therefore, this paper is very valuable, because it verifies the manufacturer's calibration carefully in the laboratory and in addition by means of various comparisons to independent sources. The paper is logically structured and well written. The figures are of very good quality. Nevertheless, I have some general and specific comments.

1. The abstract may not only summarize the subject of the investigations but should also present essential results.
2. The term “radiometric calibration” is used at various places in the text. I wonder if it is used correctly in this context. As I know so far this term only involves the calibration of the receiver part. Here it is used to denote the complete calibration of a radar. Could you briefly explain your usage in the context of radar calibration or provide corresponding references?
3. One of the main topics is the redefinition of the calibration itself, which is validated by comparisons to other independent sources or systems. The improvement compared to the “old”, “original” or “initial” calibration is highlighted in Fig. 7 and 13. To my mind, the most significant difference between “old” and “new” calibration is the redefinition of the receiver sensitivity instead of the consideration of longer waveguides or the additional attenuation through the belly pod, which is straightforward. Furthermore, different terms are used for old (initial, original) and new calibration.

## Specific comments:

page 1.; line 9-20: The importance of clouds and inaccuracies in the retrieval of microphysical quantities cannot be restricted only to climate models but numerical weather prediction models should also be mentioned here.

Page 3; line 3: Do you really mean "... *any instrument* ..." or rather "... *any system component* ..."?

page 6; line 20 – 21: I do not quite understand what the reason is for the 1 dB higher on-way-attenuation of the belly pod. Do you mean the increased thickness of 0.3 mm?

page 8; Fig 2: Would it be wise to mark all parameters with an asterisk to match with line 10? Where does the green solid line in the last gate go?

page 9; line 10: The height dependency of  $P_n$  should be given by the equation.

page 9; line 20: It would be interesting to get an idea about the size of  $c_2$ .

page 10; line 5: The SNR should have the unit dB.

Page 10; line 7: I am confused about the term "*receive window lengths*". I suppose you mean different matched filter? Furthermore, the unit used in the text (see also p.11, l2; l19; p.12, l17,18,27) is "*ms*" instead of "*ns*" as indicated in Figure 3.

page 11; line 1: Where is an orange line in Figure 3?

Page 11; line19: Figure 4a does not exist. Write left and right or mark the two figures with "*a*" and "*b*".

page 16; Figure 5: An explanation should be added to clarify what the red circle means.

page 18; line 17-28 and Figure 7 (right): It's hard to find the content of the text in the figure. How do you estimate or calculate  $\Delta\sigma_0$ ? Are these mean values? I wonder if the modeled values are independent of wind direction, because the CM values are only given for different wind speeds? In any case, the figure caption should be completed for the right part.

page 18; line 27: "... *as well as measured values...*" better "... *as well as independently measured values...*"

page 21; line 1-12: Too many "*again*" in these two paragraphs.

page 21; line 16-18: Is there a reference for RASTA and how was the system calibrated?

page 21; line 20: Please remove "*cover*".

page 22; line 14: "*For this reason ...*" was used just before as a sentence beginning.

page 23; Figure 12: What does the thin black line between 0.5 and 1.5 km show? Furthermore, the lower panel shows measurements of MIRA and the upper panel of RASTA and not vice versa as written in the figure caption. Did you calculate the reflectivity of HAMP MIRA using the new calibration?

page 24; Figure 13: Some additional information about the content of this figure are required. Neither from the figure caption nor from the text it becomes clear which common reference point the value pairs have. Do the reflectivity pairs have been used for a certain altitude (range) and the same time or the same coordinates? Based on Fig. 12 it seems that the regression line essentially depends on the selected altitude (range). If the offset is specified for RASTA, it should clearly be mentioned in the caption.

### Technical corrections:

page 3; line 19: Please use *ground-based* instead of *ground-borne*

page 3; line 23: Please use uniform spelling of “mono-disperse”, in caption of Fig. 1 “monodisperse”

page 6; eq. 2: “ $\tau_p$ ” instead of “ $\tau$ ” as written in the text page 5, line 11

page 14; line 3: 25°C instead of 25C

page 14; line 6: “*a correction*” instead of “*an correction*”

page 16; line 12: Colon points are missing in the time value

page 16; line 15: Colon points are missing in the time value

page 17; Figure7: Meaning of the abbreviation *RCS* is clear, but not explained.

Page 20; Figure 9: Please write “*GHz*” instead of “*Ghz*” in the legend.

page 20; Figure 10: Figure caption, please insert a blank between “*at*” and “*35*”.

page 21; line 22: Add a blank between “*km*” and “*height*”