General comments:

In the manuscript by Grazioli et al. the authors analyze a unique dataset of ground-based in-situ and remote sensing observations collected at Dumont d'Urville, Antarctica. The in-situ observations of an optical snow particle imager were used to derive statistics of the dominant particle types. A weighing gauge is used together with a vertically pointing rain radar to estimate snowfall rates and separating blowing snow from snowfall events. The one-year snowfall accumulation derived from the rain radar indicates a larger total accumulation as compared to ERA-Interim reanalysis data.

Although the total observation period is limited to only one year (some data only during summer period), I think this paper is an important contribution to characterize precipitation statistics and microphysical aspects of precipitation in Antarctica, a place where such observations are extremely rare. The analysis presented in this manuscript are certainly worth to be published in TC. Overall I find the paper well-structured but sometimes I think the English formulations and grammar could be further improved. I list some of them in the technical comments but I recommend an additional check by an English native speaker.

My major comment is related to the MRR relative calibration with the MXPol (section 2.2.1): You derive in Fig. 4 a linear correction for the MRR based on the assumption that the MXPol observations are correct. I assume that cm-sized snowflakes are rare in that area else you couldn't just compare X and K-Band reflectivities because the larger particles at K-Band would already deviate from Rayleigh scattering. I think you should mention this aspect somewhere in the text. Assuming the presence of mostly small particles, I am fine that no frequency correction is applied here. I am more curious to know how much you can be sure about the correct calibration of the MXPol? Did you perform any calibration with an external target (corner, sphere) for the MXPol? I think the question of the reliability of your Z-reference (MXPol) is quite important because an offset might cause a considerable bias in your MRR snowfall estimates whose deviation from ERA-Interim is one major conclusion of this paper. I think you should also discuss that more in the light of the findings in Palerme et al., TC, 2014 who found tha CloudSat snowfall estimates and occurrences and ERA-Interim agree quite well. I am aware that radar calibration is a delicate issue especially in such an environment but then you have to add this to your uncertainty estimate of your snowfall rates. One possible way of checking the absolute calibration is to use CloudSat overpass statistics since CloudSat is probably our currently best calibrated radar. Of course, the frequency difference and footprint is an issue, but one can use it as a sanity check to rule out larger biases. Examples how to do such a comparison are described for the MRR in Maahn et al., JGR, 2014 (in your reference list) or the earlier work for ground-based ARM radars by Protat et al., JTECH, 2010, 2011. I recommend to try such a calibration check if enough overpasses are available since it will enhance the confidence in your findings.

Specific Comments:
(Page, Line: Comment)

1, 4 and also 2, 32: Not clear what you mean with "model-free" here. I assume you mean more direct observations compared to re-analysis data, but also a Z-S relation is a certain kind of "model".

1, 7: "riming often occurs": "Often" is quite subjective and could for example also mean it occurs 90% of the time. Be more specific.

5, 44: "weather radar" is maybe a bit misleading. Cloud and precipitation radars are both observing "weather". I think the terms precipitation and cloud radar are better because they imply directly to

which particle sizes the radars are sensitive to. There are several studies using cloud radars which showed that cloud radars are sensitive to certain amounts of super-cooled liquid water (e.g. Shupe et al., JTECH, 2004).

Table 2: Just for clarification, I suggest adding a comment that all Z-S relations are derived for X-Band.

8, Table 2 and Z-S discussion: Did you consider to use your hydrometeor classification to derive separate Z-S relations for different hydrometeor mixtures. In that way you could present a solution to constrain the uncertainty range of future deployments by a combination of in-situ (or polarimetry) and vertically pointing radars.

9, 6: I am sceptical that you can say that you illustrate the "performance" of ERA-Interim when you compare it only at one grid box with pencil-beam observations. The model based method could perform over 99% of Antarctica well and just have an issue in this particular reagion which would mean that the model-based method is still quite good.

10, 14: "the most immediate microphysical parameter": I don't think hydrometeor type is more immediate than for example particle size or mass. Hydrometeor type is also quite ambiguously defined because what exactly is the definition of an aggregate or a rimed particle?

Figure 11b: I am wondering why the curve for the MRR is steadily increasing towards lower thresholds. Is that because the MRR noise is misinterpreted as precipitation signal below the MRR sensitivity limit?

17, 5-6: I find the argumentation a bit confusing. If it is known that blowing snow cannot reach more than 200m above ground, how should the MRR be able to see it with the first usable range gate at 300m? If you would configure it in a different way it probably would detect it. Apart from using a smaller range gate spacing you could also tilt the MRR to operate slant.

20, 49: I question that the Z-S relation would become less uncertain if you just use longer time series of in-situ data. In fact, the problem lies – as you mention – in the unknown variability of PSD and particle properties. I think it is worth mentioning that the addition of polarimetry or multi-frequency techniques are probably the currently only promising way to further constrain snowfall rate estimates.

Technical Corrections/Typos:

1, 4. Check whether "including of" is correct, I think "of" should be removed.

2, 38: I suggest removing "before anything else". Either there is a need or not.

3, 24: Rephrase "instruments were as illustrated in"

3, 25 and other occasions: I think you can remove "hereafter" after the instrument acronym.

5, 46: "for the day of the 15th December 2015": Why not simply "for the 15th December 2015"?

7, 62: "MRR radar": Leave "radar" it's already included in the acronym.

7, 68: and throughout the document: Sometimes you write "K-Band" with a dash, sometimes "X Band" without a dash. Sometimes you make the band letter italic sometimes not. Please make consistent throughout the text.

7, 74: Standard deviation of logarithmic reflectivities should be dB.

8, 96: “illustrates how the” -> “illustrates that the”

9, 3: Rephrase “as it is thought to provide” into for example “as it is considered to provide”

10, 19: Rephrase “instrument being close to the ground level, both…”

10, 23: Full stop after “height levels” and split in two sentences.

Figure 7: I suggest to add to the legend that height is above ground level and not above mean sea level

11, 30: “has been summarized” -> “is summarized”

11, 31: “hydrometeors too small” -> “hydrometeors being too small”

Figure 8: Explain the abbreviations used in the Pie-chart in the caption.

Figure 9: Legend indicates blue line color for Pluvio but in the plot it’s black

13, 9: Rephrase “longer source of information”

13, 14: Remove “it” before “appears”

13, 17: Rephrase “this allows us to observe how the year under investigation had an extremely dry January”

15, 25 and other occasions: “cumulated” isn’t accumulated more commonly used? Please check.

15, 25: The sentence is a bit complicated. To me it appears that you simply want to say that there are compensating errors that lead to the final agreement.

15, 34: I don’t understand the “but” in this context.

16, 37: Remove “given the goal of the paper”.

16, 38: “several times” please provide a range like “are conducted one to three times a day”

17, 11: Add a comma after “however”

18, 37: “underestimates”; split in two sentences after (illustrated in Fig. 11)

18, 4-5: Add a reference to Fig. 9 because it was not clear to me in which figure I am supposed to see the ERA underestimation after the discussion was mainly about overestimations by ERA.