The authors would like to thank all reviewers for their kind words and feedback. A point-by-point response to the reviewer's comments is provided below.

Reviewer 1

Specific comments:

P1, L10: not sure if there is a word missing, or just that the word after the semi-colon shouldn't be capitalized.

All instances of capitals following semi-colons have been corrected.

P1, L16: it's clear to me what you mean, but "shortening" surface clutter is an awkward phrase.

Following the reviewer's suggestion, we have revised this senstence:

"Out of all configurations tested, the 7 dB more sensitive EarthCARE-CPR performs best (only missing 9.0% of cloudy columns) indicating that improving radar sensitivity is more important than decreasing the vertical extent of surface clutter for observing cloud cover."

P4 L101–103: this sentence is hard to parse and could do with restructuring or perhaps replacing the em-dashes with commas. Something like, "... information from CloudSat-CPR to evaluation the performance of current spaceborne sensors in this regime (Section 2.1), ARM measurements used as a benchmark (Section 2.2), and how we forward-simulate..."

Following the reviewer's suggestion, we have revised this paragraph:

"The next sub-sections describe how we extracted cloud and precipitation information from raw CloudSat-CPR to evaluate its performance (Sect. 2.1), ARM measurements which act as a benchmark (Sect. 2.2) and how we forward-simulated alternative spaceborne radar configurations (Sect. 2.3)."

P4, L107: referring to CloudSat making observations "twice a day" or "once a day" is misleading; this refers to the day-time and night-time parts of a CloudSat orbit, of which there are many each day.

Following the reviewer's suggestion, we have revised this paragraph:

"The CloudSat-CPR has been collecting observations since May 2006. It follows a sun-synchronous orbit set to cross the equator at 13:30 local mean time, repeating its ground track every 16 days. The CloudSat-CPR went offline between May and October 2011 because of a spacecraft battery failure. After it returned online, it was placed in daylight-only mode [Stephens et al., 2018]. Periods when CloudSat passed within a 200 km radius of the ARM ENA ground-based facility are used to evaluate the CloudSat-CPR's ability to characterize WMBL clouds and precipitation (results presented in Sect. 3.0); this happened on 138 instances since the ground-

based site was made permanent at the end of 2015. For this site, daylight-mode operations make it such that data is collected only around 15:00 UTC between August and April but at both 4:00 and 15:00 UTC between May and July."

P5, L160–164: is it possible to use KAZR measurements to comment on how conservative (or aggressive) this approach to clutter filtering is? The argument is made in the conclusions (P15, L518) that improvements are possible, but I couldn't find (and this may easily be my oversight, and if so I apologies) where this was stated in the results section.

To clarify, the authors made this argument based on their visual comparison of raw and masked CloudSat-CPR observations and not because of comparison to KAZR. The text was revised accordingly:

"Comparison of raw and masked CloudSat-CPR's observations suggest that the clutter mask part of the GEOPROF version 4.0 product is relatively aggressive, and we believe the CloudSat-CPR's performance could perhaps be somewhat improved by revising this clutter mask; That being said a sensitivity study of the thresholds in the CloudSat-CPR clutter mask is beyond the scope of this study."

A one-to-one comparison between the CloudSat-CPR and a "truth" would ideally be used to quantify the performance of the clutter mask. Since the KAZR and the CloudSat-CPR do not have the same temporal and spatial resolution, the KAZR cannot directly be used as "truth"; as such this effort would require the development of appropriate methods beyond the scope of this study.

P7, L212: the word after a semi-colon shouldn't be capitalized.

All instances of capitals following semi-colons have been corrected.

P8, L249: When discussing times it is clearest to state that all times are in UTC, but also provide important information about local time so we know what to expect with respect to the diurnal cycle.

All mentions of time are now accompanied by "UTC". Graciosa's local time is "UTC-1" during the winter months and "match UTC" during the daylight savings time months. This means that for the particular example presented in Fig. 1 local time is "UTC-1". The first sentence of the paragraph referring to this figure was modified to provide this information:

"Between 0:00 and 10:00 UTC (23:00 and 9:00 local time), cloud top height was observed to rise at a rate of roughly 21m hr^{-1}."

P8, L258: remove "both"

The word "both" was removed.

P10, L317: If I understand the caption of Fig. 5 correctly, CloudSat-CPR is shown by a royal blue line.

The royal blue line on Fig. 5b represents: *"the surface clutter profile as simulated for the CloudSat (royal blue line)"*. While the broken black line and dotted black lines on Fig. 5b represents: the surface clutter profile "*as observed by the CloudSat-CPR between May 2010 and November 2017 (broken black line marks the median, dotted black lines mark the interquartile range)".*

The particular statement on P10 L317 could be supported by either CloudSat-CPR line. The statement was revised to clarify that we support it using the CloudSat-CPR observations rather than forward simulations.

"*Thus, we would expect that the CloudSat-CPR, with its -27dBZ MDS (observed performance depicted by the broken black line on Fig. 5b), should have the capability to detect at best 80% of all cloud and/or echoes forming at any given height, de facto missing at least 20% of hydrometeor echoes"*

P11, L373: should read "...a factor of 0.5 times the pulse length..."

This typo was corrected.

P13, L436: should be Fig. 6c

We would like to thank the reviewer for catching this oversight. It was corrected.

P14, L474–3: should be something like "...warm marine boundary layer (WMBL) clouds and precipitation, and spaceborne radars' ability to characterize them, is..."

This typo was corrected.

P14, L485: should be "...such that..."

This typo was corrected.

P14, L491: remove "both"

The word "both" was removed.

P15, L505: "...length of its highly sensitive pulse..."

This typo was corrected.

P16, L546: remove "study"

The word "study" was removed.

P17, L583: should be Fig. 5b

We would like to thank the reviewer for catching this oversight. It was corrected.

P17, L589, should be "...this secondary lobe is confined..."

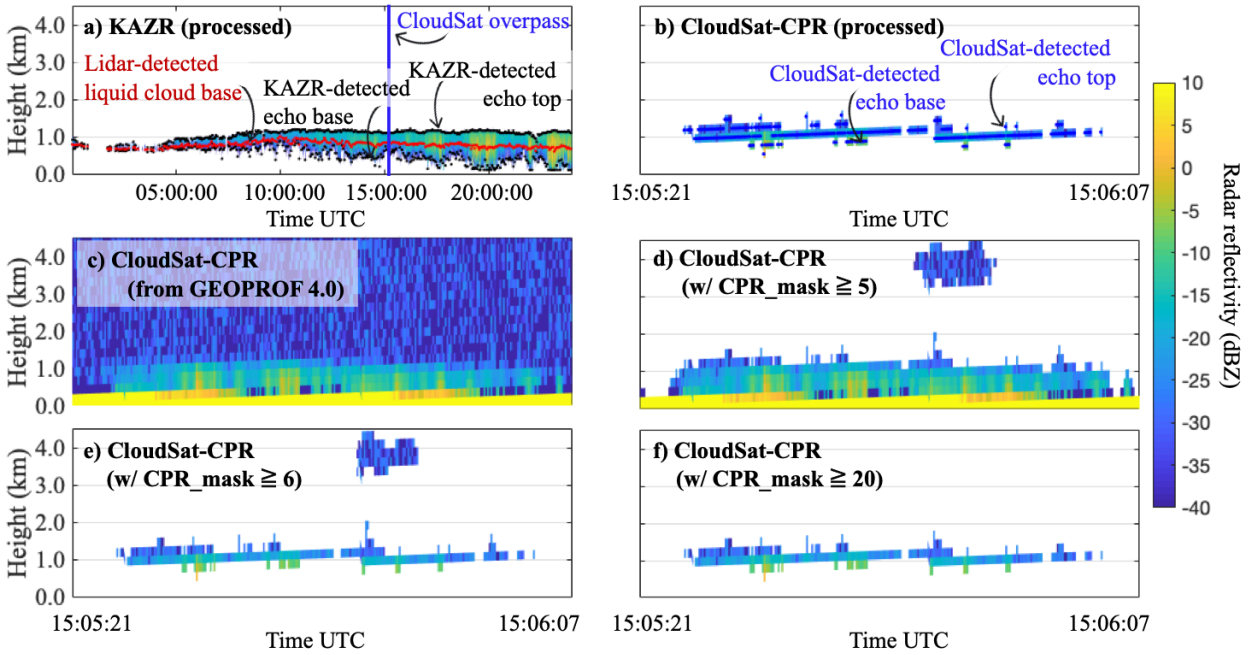
The word "lobe" was added.

P22, L728, Figure 1: should be "...ground-track taken in ~7 minutes is shown..."

We would like to thank the reviewer for catching this oversight. It was corrected.

Figure 1: I (a color-blind reader) have a lot of difficulty distinguishing the blue dots in Figure 5b from the underlying radar reflectivity (also blue). Since they are not on the same subplot, would it be acceptable to make these dots black as well?

While the authors understand that it may be difficult for some to decipher the blue dots from their background in Fig. 1b, the authors are hesitant to make them black as this would disrupt the color story used throughout the manuscript. Throughout the manuscript blue is used to represent all things related to the CloudSat-CPR and black is used to represent all things related to KAZR. Since the dots in Fig. 1b are there more so for additional guidance than to present a result, we propose instead to add clarifications about their location in the caption. Hopefully this change and the arrows and labels already included in the figure provide sufficient guidance.



"Figure 1. Hydrometeor radar reflectivity measured on Feb. 27, 2016 a) by the KAZR located at the Eastern North Atlantic (ENA) observatory over the course of 24 hours and b) by the CloudSat-CPR when it overpassed the 200-km radius region around the KAZR between 15:05:21 and

15:06:07 UTC. In (a) the blue line marks the time when CloudSat overpassed KAZR, the red dots represent the location of the ceilometer-determined cloud base and black dots represent the boundaries of the KAZR radar echo; the latter coincides with the center of the first and last radar range gates containing signal (post-processing). In (b) blue dots represent the boundaries of the CloudSat-CPR radar echo; they coincide with the center of the first and last radar range gates containing signal (post-processing). Also plotted are the CloudSat radar reflectivity c) raw, d) for significant returns (CPR_mask >5), e) for echoes deemed very weak and stronger (CPR_mask > 6) and f) for echoes deemed weak and stronger (CPR_mask > 20)."

Figure 1: To make clear the fact that the KAZR and CPR data are on different time- series, it may be useful to mark the time of the CPR overpass with a vertical line on the KAZR timeseries. This would also aid comparison of the cloud fields at the same time.

We would like to thank the review for this suggestion. A vertical line was added on the KAZR time-series reflecting when the CloudSat overpassed.

Figure 2: The y-label "factors of the pulse length" is unclear; the label and the sign convention should make it very clear which is the "leading edge" and the which the "trailing edge" of the radar pulse in the direction of propagation.

We agree with the reviewer. The figure caption was modified to clearly indicate which part of the range-weighting function represents the leading edge of the forward-simulated pulse.

"Figure 2. Symmetrical (blue) and asymmetrical (black) range weighting functions for the forward simulated radar architectures detailed in Table 1. Negative values are associated with the leading edge of the pulse in the direction of propagation."

P24, L745–748, Figure 3: In the text is seemed clear that these values (e.g. hydrometeor cover) are fractions of profiles excluding those containing high, mid- and layered clouds. If so, best to re-state this in the caption.

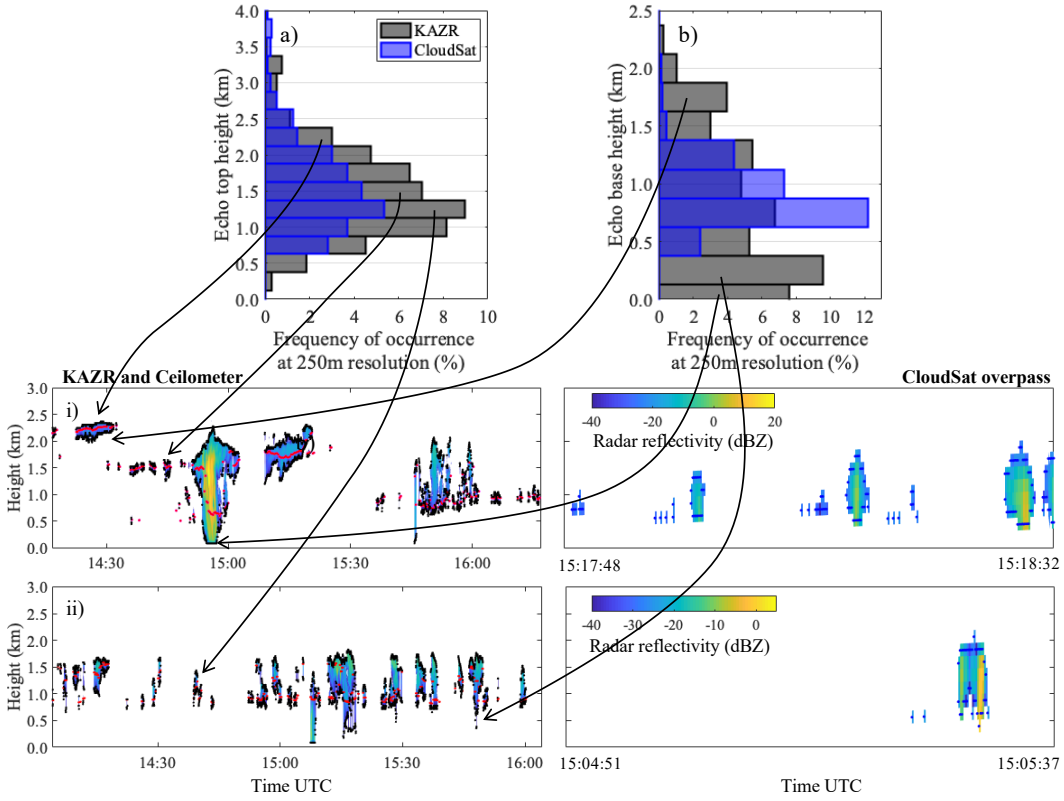
We would like to thank the review for this suggestion. The captions of Fig.3 and Fig. 5 have been revised to include this detail.

"Figure 3. For 103 instances where CloudSat overpassed the 200-km radius region centered on the ENA observatory, a) fraction of observed profiles with cloud or rain (i.e., hydrometeor cover) and b) hydrometeor fraction profile. Both estimated from CloudSat-CPR observations within a 200-km radius of the ENA observatory (blue) and ground based KAZR observations collected within ± 1 hr of the CloudSat overpass (black). Fractions are estimated based on the total number of observed profiles excluding those determined to contain high, deep or ice clouds."

"Figure 5. From ground based KAZR observations collected between 10/2015 and 02/2018, a) profile of cloud (solid black line) and sub-cloud layer rain (dotted black line) fraction, and the fraction of either cloud (solid red line) or sub-cloud-layer rain (dotted red line) echoes located below a certain height. Fractions are estimated based on the total number of observed profiles excluding those determined to contain high, deep or ice clouds. […]"

Figure 4: It may again be useful to show the time of the CloudSat overpass on the KAZR timeseries.

The revised figure now shows observations collected within +/- 1 hr of the CloudSat overpass centered on the overpass time.



"Figure 4. For 103 instances where CloudSat overpassed the 200-km radius region centered on the ENA observatory, distribution of a) echo base height, and b) echo top height, estimated from CloudSat-CPR observations within a 200-km radius of the ENA observatory (blue) and ground-based KAZR observation collected within ± 1 hr of the CloudSat overpass (grey). For references are examples of hydrometeor radar reflectivity measured on i) Feb. 11, 2017 and ii) Oct. 24, 2016 by the ground based KAZR within ± 1 hr of the CloudSat overpass and by the CloudSat-CPR within 200-km of the KAZR location. Dots on these figures represent the boundaries of the radar echo (black and blue dots for the KAZR and the CloudSat-CPR respectively) and the location of the ceilometer-determined cloud base (red dots)."

P26, L 766, Figure 5: should be "...located below a certain height."

We would like to thank the reviewer for catching this oversight. It was corrected.

P28, L795, Figure 7: "...which is CloudSat operating with..."

We would like to thank the reviewer for catching this oversight. It was corrected.