REPLY to REVIEWER 1

We thank the reviewer for their review and their detailed comments.
Below you will find the reviewer's comments in bold and our replies.

My main concern is on the criteria used to find coincidences. It seems that the Authors considered surface footprint coincidences only (with a given imposed uncertainty in the definition of coincident foot prints as in their Tab. 1) between a reference nadir- (or quasi-nadir) pointing radar platform and a conically scanning one. However, in the studied configurations you could have coincidences not only in the ground footprints (i.e. the lon, lat surface level) but also aloft (lon, lat, altitude) whenever two radar ray paths intersects each other. I think that last case is more relevant when considering natural ice clouds for calibration. It would be nice if the Authors could better elaborate this point in the main text. In addition, as I can understand, two parameters are important in the definition of a calibrating natural target: Z_{min} and h_{min} being the former the sensitivity of the radar system whereas the latter the minimum altitude wrt. to the surface considered to identify an ice clouds. Maybe these two parameters could be added in the scheme of Figure 1.
We consider this effect negligible. In fact the difference in the distance of the two intersections, one measured at a certain altitude from the ground and the other measured at the sea level, is negligible compared to the high distance criteria we introduced in the intersection criteria. In fact, if we consider the maximum altitude of an anvil cloud ($\sim$ 20 km), the distance between the radar path intersection at that altitude and a footprint intersection at sea level would be 20 km, very small if compared to the 1000 and 2000 km distance constraints.

In Section 2.2 you state that "the measured reflectivity of an ice cloud observed at nadir and at slant incidence angles are almost identical". In general, I agree with you but I am thinking that the slanted geometry maybe could be more prone.

The comment seems to be incomplete. In general the reflectivity may be slightly different in presence of non-sperical particles which are preferentially oriented. However we tend to use reflectivity value that are large, i.e. which tend to correspond to randomly oriented aggregates, which tend to have backscattering cross sections independent from incidence angle. Attenuation can introduce a difference because of the difference between slant paths and nadir path but this could be minimised trying to avoid deep convection.

With reference of results argued in figure 8, what happens if you also a random noise to the "biased measurements" of Z. Maybe this could help to check the calibration performances when assuming a different error structure in the system being calibrated.
In Fig.8 the random noise is implicitly included in the figure because we are considering clouds sampled at different distances (500 and 1000 km in the left and right panel, respectively). So we are sampling different clouds.

Do you have some evidence of scan strategy of Tomorrow-io radar, i.e. reference or personal communication? It will be nice to add them in the manuscript. Unfortunately we have only some informal personal communications on this.

L 35. The general statement: near nadir looking "normalised backscattering cross section is insensitive to changes of the wind speed and the wind direction" seems to disagree with common radar altimeters applications (es. AltiKa). AltiKa is a nadir looking altimeter in Ka band and it is sensitive to wind speed as testified by its products (https://space.oscar.wmo.int/instruments/view/altika). Maybe, in this case, the range resolution (hundred meters) of meteo Ka and W-band with respect to radar altimeters (order of cm)

can play a role in the ocean wind insensitivity. When you say that the W-band nadir-looking calibration procedures are impractical for conically scan systems, maybe you can mention that at slanted (>40°) off zenith angles, the sea surface is specular, isnt'it?
That statement is referred to the condition where the incident angle is 10°. Therefore is not applicable to altimeter which are nadir looking.

Section 2. Step1. Maybe the term "coincident footprints" is misleading because it recalls surface footprint. If I understand well you are interested to any "range path intersection" between vertically and slanted pointing radar system.
We will use the term quasi-coincident overpasses to avoid confusion.
L 85 there is a repetition in the word: "calibration".
Corrected.
Page 8, Figure 4a is not found. Please specify Figure 4, left panel, or add labels on figure 4.
Corrected.

Section 2.3. At the beginning of this section it is not clear to the reader why you should sample two PDFs at a given separation distance? I think that this is made to simulate differences in the sampling position when actual conical scan measurements will be available compared to the nadir-based ones. Please explain.
By taking in consideration one of the intersection criteria, all points sampled by the two radars that are closer than the distance defined by the selected intersection criterion are intersection points. With this procedure we want to observe what is the similarity of clouds sampled at that specific distance defined by the selected intersection criterion, since we know that those clouds will not be identical. This procedure is needed to establish, with a statistical analysis, what is the number of intersection points required in order to detect a certain miscalibration in the radar with the selected intersection criterion. In fact, the looser the criterion is the larger the number of intersection points; however the clouds at that separation distance are less correlated and more points are needed to detect that certain miscalibration. We will include this explanation in the revised paper.

Not clear of the PDFs A and B are those extracted by vertical slices 500 km apart.
Yes this is the case. We will update the caption.

Not clear, from the figure's legend, compared with main text and inner figure text, if the two panels differ from the frequency band considered only or they also differ by the separation distance considered in the selection of Z profiles.
They also differ by separation distance. We updated the caption.