We thank the editor, Paquita Zuidema, for her careful reading and constructive suggestions for our manuscript. Below, we have addressed her questions and comments and indicated the changes in the manuscript:

The authors have done an excellent job of addressing the concerns of the two reviewers and I do not feel they need to be asked to re-review. As editor, I am motivated to make an additional comment on the MARSS-SEVIRI LWP comparison shown in Fig 11 and discussed on p. 16. I'm surprised to see the authors rely solely on an assumption of a LWC profile that is constant with height (their eqn 2) when many papers now point to the more realistic applicability of an adiabatic profile. Painemal and Zuidema 2011, which they cite, is just one of many examples and indeed they mention applying a linearly-increasing LWC with height on line 14, p. 19. This would change the factor 2/3 to a factor of 5/9 in eqn 2, further reducing the SEVIRI-retrieved LWP and increasing the discrepancy from the MARSS values.

To reflect the adiabatic nature of the cloud formation, we have modified equation 2 in the manuscript and use 5/9 instead of 2/3:

"Considering an adiabatic cloud, the LWP from SEVIRI is derived from the retrieved COT and CER using the following relationship:

$$LWP_{SEVIRI} = \frac{5}{9}\rho_l \times COT \times CER \qquad (2)$$

where ρ_l is the density of liquid water. It should be noted that the effective radius at the cloud top is expected to be slightly larger than the CER retrieved by SEVRI because of penetration depth effects (Platnick, 2000), which could lead to a small underestimation of the LWP from SEVIRI."

Figures S7 in the supplement and 11 in the manuscript have been changed accordingly.

Given that the effective radii retrievals match reasonably well in Fig. 10, another explanation for the LWP difference might be in the MARSS LWP. There is no error analysis included within the description of the MARSS data and we do not know its retrieved LWP uncertainty. Larger drizzle/precipitation sized drops will increase the microwave emission beyond that expected by the microwave retrieval algorithm - the authors don't say, but I suspect the algorithm assumes Rayleigh scattering. The C050 comparison, for which the drop sizes are the largest in Fig. 10, could be an example of that. C042, in which the MARSS and SEVIRI LWPs match fairly well until about 10:15 (which actually serves to support both retrievals, up to that point), breaks down thereafter, and precipitation could explain this, as it would also reduce the visible optical depth. I am not sure why an ref comparison is not included in Fig. 10 for C042 - was the CDP not working for this flight? I note that Seethala and Horvath, 2010, 10.1029/2009JD012662, use a threshold of 180 g/m^2 to distinguish when precipitation starts impacting satellite microwave LWP retrievals, and the MARSS instrument operates at higher frequencies than the satellites, with the MARSS frequencies more susceptible to enhancement of the brightness temperature by rain (there's also some relevant discussion in Grosvenor et al., 2018, 10.1029/2017RG000593 p 435-436, containing other references).

The following paragraph has been added at the end of section 3.a.ii:

"Errors in the MARSS LWP retrievals arise from several sources, including errors in the forward model used in the retrieval, the instrument noise and calibration errors. Instrument noise and calibration errors are estimated to be less than 1K, and the combined instrument and forward-model error in the retrieval is assumed to be uncorrelated with a standard deviation of 2K. The overall uncertainty in the retrieved LWP is estimated by combining the posterior error covariance from the retrieval with sensitivity estimates derived by perturbing fixed input parameters such as the sea surface temperature, wind speed, cloud top and base heights, and water vapour profile within plausible ranges. The total uncertainty is estimated to be approximately 40 g m^{-2} at low LWP (< 200 g m^{-2}) and it increases with increasing LWP becoming about 10-12% at large LWP (> 400 g m^{-2})."

As pointed out by the editor, the retrieval assumes Rayleigh scattering. It also makes the further assumption that the cloud droplets are purely absorbing, and neglects scattering effects. To assess the impact of larger cloud drops on the LWP retrieval, simulations have been performed using full Mie scattering optical properties for cloud droplets, considering a 1 km thick cloud with constant liquid water content, and a similar particle size distribution to the SEVIRI retrievals. The plots below show the impact of the effective radius on the simulated brightness temperatures for 3 values of LWP at the two frequencies used. The left-hand column shows the brightness temperatures, and the right-hand column shows the difference between the full-scattering calculation and the "Rayleigh-absorption-only" assumption used in the retrieval. For the largest CDP-derived CER in the manuscript (~15 µm) the difference is less than 0.1K. For a CER of 48 µm, which is amongst the largest values observed during CLARIFY-2017, the error is less than 0.2K. For these reasons, we do not think that the discrepancies between the SEVIRI and the MARSS LWP come from the cloud drop size.

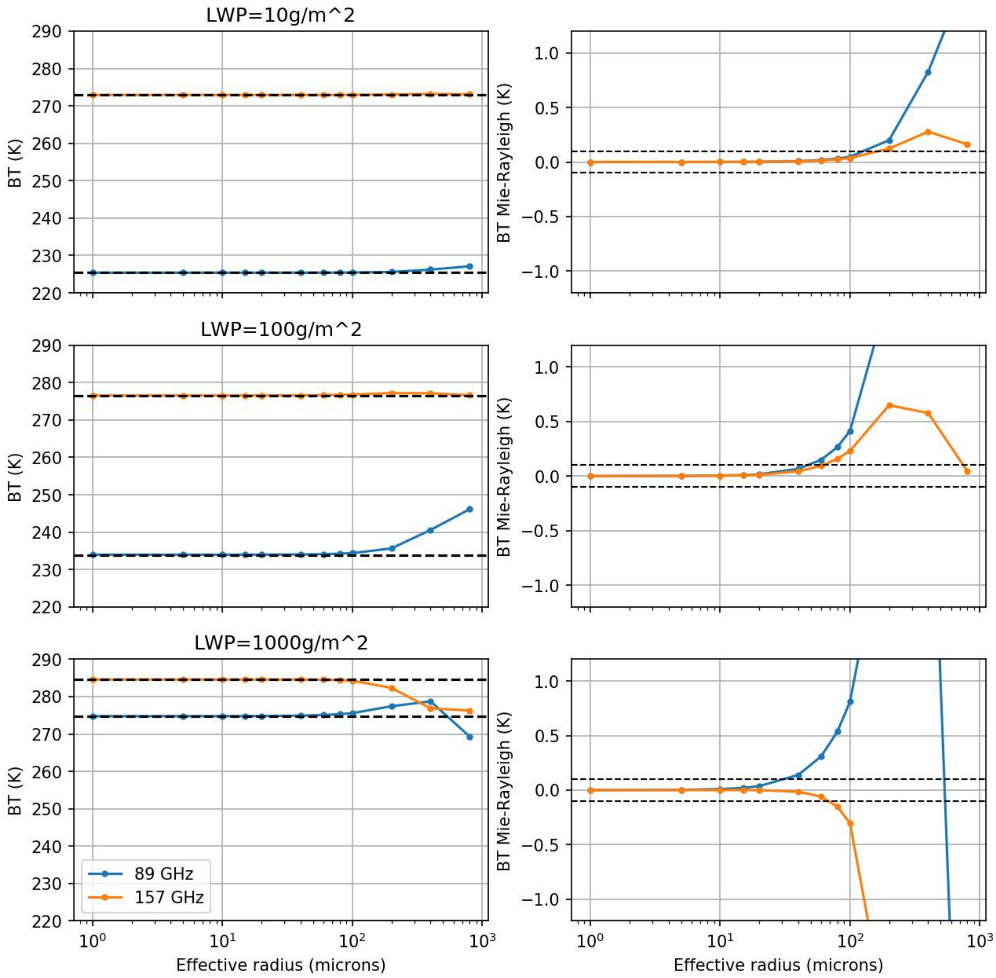

Figure 1: Impact of the cloud droplet effective radius on the Brightness Temperature (BT) at the frequencies used to retrieve the LWP from MARSS.

For precipitating cases, the MARSS retrieval makes no distinction between cloud liquid and precipitation, and returns the total liquid water path. However, it still makes the "Rayleigh-absorption-only" assumption, even for precipitation. Simulations have been performed to determine the likely errors induced by this assumption by performing further full-scattering calculations as follows. In this case, the cloud liquid is assumed to be uniform between 1000 and 1500 m, with a LWP of 400 g m^{-2}. The precipitation is assumed to be uniform between 0 and 1500 m and the rain water content is adjusted to give different values of total water content (i.e. cloud and rain). The cloud effective radius is assumed to be 20 µm (effective variance of 0.077), and the rain effective radius is assumed to be 100 µm (effective variance of 0.3). The plot below compares the full scattering simulations (coloured lines) with the Rayleigh-absorption-only simulations (dashed lines, left-hand plot). The right hand plot shows the difference between the two, which indicates that non-Rayleigh and scattering effects are still only ~1K even at the highest values of total water path, and are therefore reasonably accounted for already in the forward model uncertainty estimate.

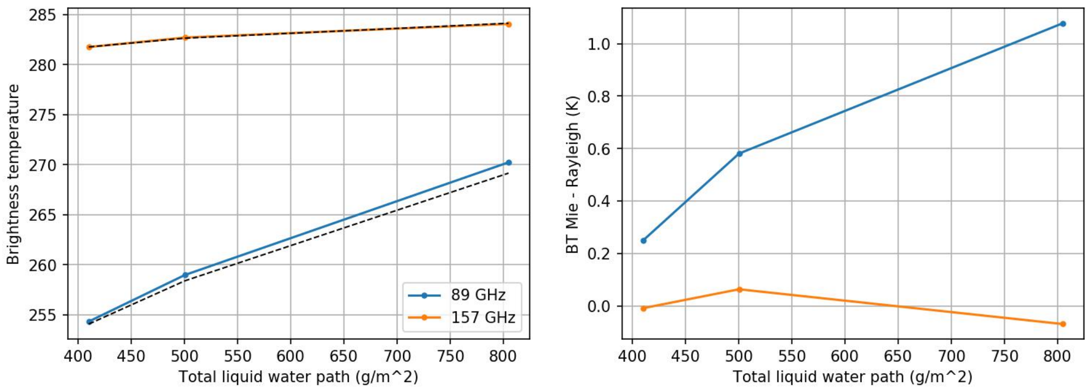

Figure 2: Evolution of the brightness temperature at MARSS frequencies as function of the total liquid water path (i.e. cloud and precipitation) using full scattering simulations (coloured lines, left plot) and Rayleigh-absorption-only simulations (dashed lines, left plot) and difference between the two simulations (right plot).

On the other hand, the LWP obtained from SEVIRI does not account for precipitation. The following text has been added to section 3.d.ii:

"It is also important to add that the MARSS retrieval makes no distinction between cloud liquid and precipitation, and returns the total liquid water path. On the other hand, the LWP obtained from SEVIRI does not account for precipitation. Therefore, the LWP from MARSS is expected to be larger than SEVIRI in the presence of rain and drizzle drops."

"Moreover, the peaks of LWP from MARSS and the overall larger values than SEVIRI could also be attributed to the contribution of drizzle and precipitation which is not accounted for in the LWP derived from the satellite. In-flight visual observations report drizzle during the 3 flights and droplets with an effective radius larger than 100 µm were detected by a 2 Dimensional Stereo probe during C049 and C050. There is no clear evidence of precipitation in the measurements from the vertical profiles but it is difficult to completely discount this type of local precipitation events during the long runs above cloud top that were performed with MARSS."

The reason for the missing C042 plot in the CDP comparison figure (Figure 10 in the manuscript) is that no SLR has been performed within the cloud during that flight.

> *Another cause for the discrepancy could be that the SEVIRI-retrieved cloud top effective radius for the two-layer cumulus-under-stratocumulus regime that dominates the cloud field at Ascension (some examples are shown in the cited Abel et al., 2020; others overlapping with the CLARIFY time period are also shown in Zhang and Zuidema, 2019, ACP SI), is not representative of the column, with the upper stratiform layer consisting of smaller drops than the lower-lying cumulus. The authors could use the aircraft data to test for this; it also seems suggested by Fig. 9.*

For the 3 flights analysed in section 3.d.ii, the cloud regime consisted of stratoculumus above shallow cumulus. The CDP measurements from the vertical profiles indicate that the shallow cumulus layer consisted of smaller droplets than the upper stratocumulus. The following sentences have been added at the beginning of the section:

"The dominant cloud regime around Ascension Island typically consists of a stratocumulus layer above shallow cumulus (Zhang and Zuidema, 2019). For the flights selected here, the CDP measurements from the vertical profiles indicate that the shallow cumulus layer consisted of smaller droplets than the upper stratocumulus and that the liquid water content increases with height."

> *The LWP comparison is summarized on p. 18, line 11 as revealing a limitation to the COT retrieval (the upper limit), but I am not sure that that is what is going on here.I would like to ask the authors to discuss whether or not precipitation may be unrealistically enhancing the MARSS LWPs - is there data from ascent/descent profiles that could be used to look for precip? The ref/LWC profile? And to revisit the relevant text in their manuscript based on the considerations raised above.*

The following sentences have been added to the conclusion:

"Although the variations of the satellite LWP follows those of the aircraft observations, the LWP obtained from SEVIRI is typically smaller than the measurements from MARSS. The drizzle observed during these flights partly explain this discrepancy as the LWP from SEVIRI does not account for drizzle and rain while the MARSS instrument does. An underestimation of the LWP due to an underestimation of the COT by SEVIRI can also be expected in case of extremely large LWP (i.e. > 600 g.m^{-2}) because the algorithm is limited to a COT of 80."

> *A small further comment is to revisit the reference list and update where appropriate; the Wu paper is now published for example.*

The references to Wu et al. (2020) and Redemann et al (2019) have been updated.