Dear Referee,

We would like to thank you for taking the time to review our paper and for all your constructive suggestions, which definitely helped to improve the quality of the manuscript. We reply to your comments below. Our response to the comments appears in bold and revised text as *italic*.

General comments:

- 1. I appreciate that the authors have added markers to certain figures to highlight 1-minute instantaneous and 15-min min-max sampling. I do find the markers a bit too large, though. Maybe there was a reason to use the large crosses as markers. But smaller makers, maybe with a thiner edge and maybe some transparency could mitigate the overplotting that is unavoidable in the figures. Or maybe you could give the individual markers a small horizontal offset. Or maybe use three different maker types?

  We agree that it was somewhat hard to see where all markers were. Therefore, we have changed the markers to transparent markers with a different shape per device. Together with your third comment, the figures are now as follows:

Fig. 6:

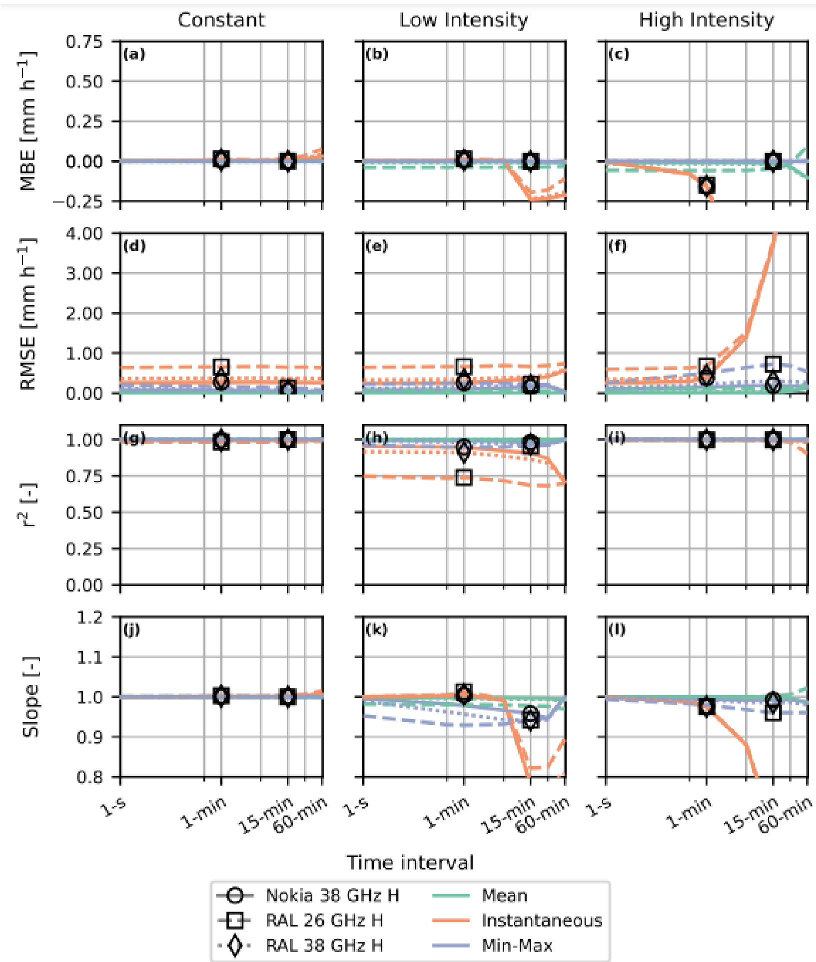
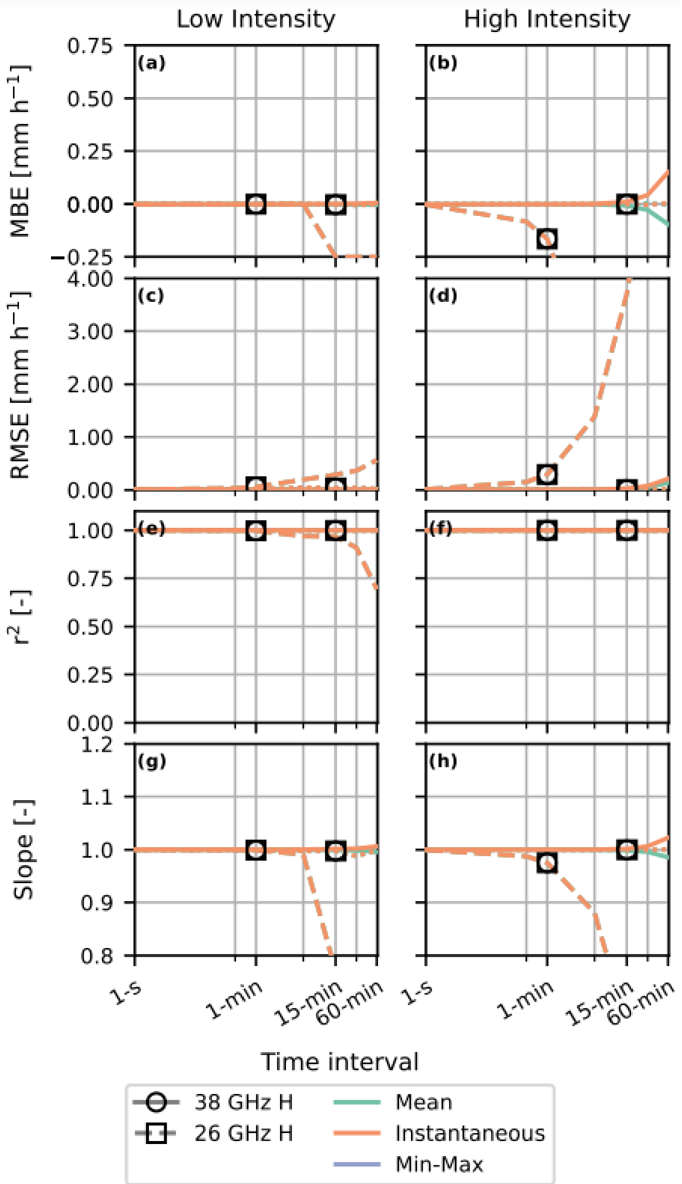


Fig 7:



- 2. Reading through the paper and looking at the (updated) plots I am again automatically concentrating mostly on a comparison between 1-minute instantaneous and 15-minute min-max. I understand that the authors want to provide, as they wrote in their response letter, a systematic overview of the consequences of different sampling strategies. However, as I already stated in my last review, there is significant importance to the comparison between 1-minutes instantaneous and 15-minutes min-max. There is still not a dedicated discussion on this, even though some figures have now been updated to mark these two different sampling strategies. Since I was again dedicatedly looking for this information, I have two suggestions:
  2a: It would be beneficial to have a short (sub-)subsection in section 3 or 4 to discuss the comparison of 1-minute instantaneous and 15-minute min-max.

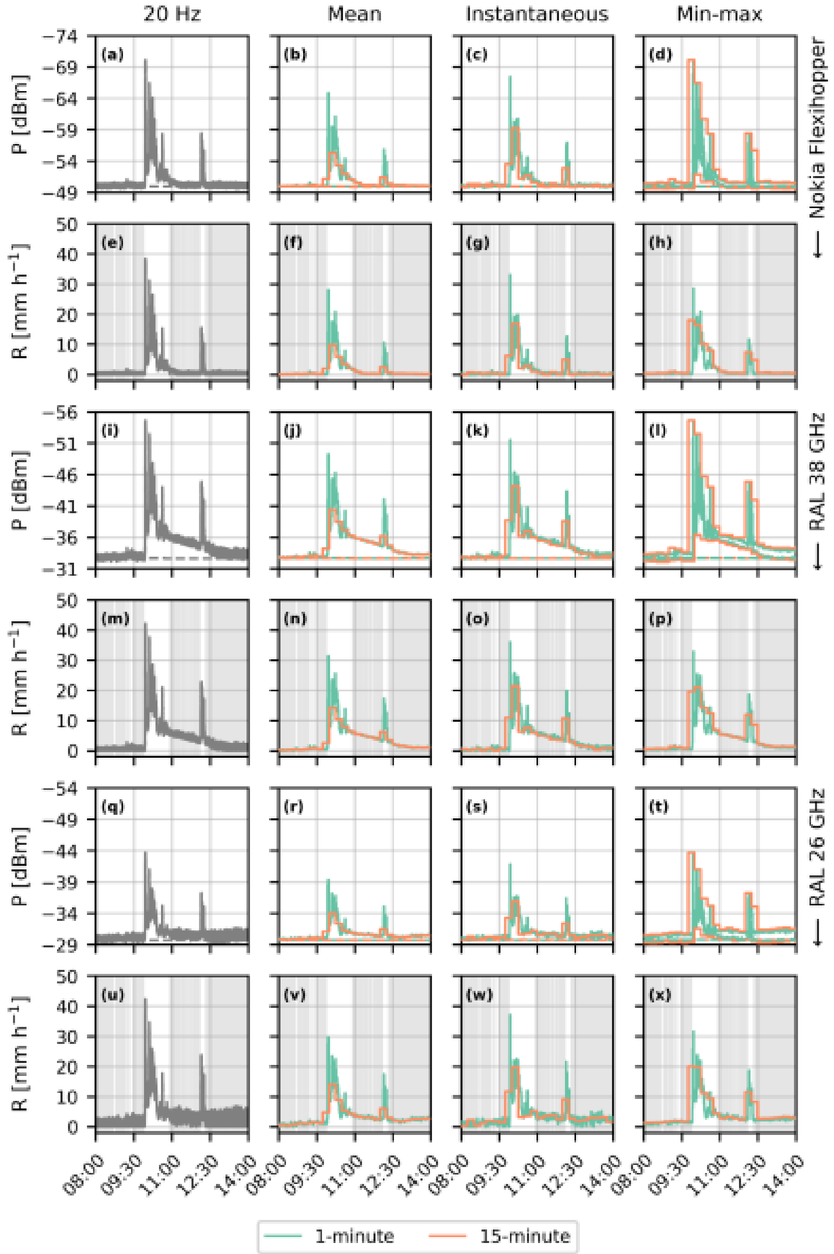
We added the following paragraph to Section 4.1:

When comparing the conventional 15-minute min-max and 1-minute instantaneous sampling strategies, the overall statistics are similar. For the theoretical low-intensity event with sliding window for a 38 GHz noiseless link (Fig. 8), the 15-minute min-max sampling strategy shows a reduced performance in comparison to the 1-minute instantaneous sampling strategy. For the high-intensity event, the performances of the sampling strategies are on average more comparable. Overall, this could imply that in regions where low rainfall intensities are more prevalent than high intensities, it could be beneficial to use a 1-minute instantaneous sampling strategy instead of the 15-minute sampling strategy. For the actual data (Fig. 10), the r^2 *and the slope for the 15-minute min-max sampling strategy are on average for all devices slightly lower (i.e., further from one) than for the 1-minute instantaneous sampling strategy. However, these differences are not of the same order of magnitude as differences with other time intervals. A reduction in sampling time interval for both sampling strategies (namely instantaneous versus min-max) would result in a larger increase in performance than the difference in performance between these sampling strategies, especially for the 15-minute min-max sampling strategy.*

2b. It would be beneficial to add a version of Fig 5 (and also Fig 4) to the supplementary material that only shows 20 Hz, 1-minute instantaneous and 15-minute min-max, maybe also 1-second instantaneous because some CML data is available at 10-second resolution and higher resolution data might become available the future. If you use separate columns with one line each, you could add the 20 Hz data always in the background.

Thanks for the suggestion. We have added similar figures as Figs. 4 & 5 in the supplementary materials, but with 1-minute and 15-minute lines (Figs. S5 & S6). This allows for an easy comparison with Figs. 4 & 5.

Example Figure S6:



- 3. The new results in Fig 8 are interesting and well described. However, I found it complicated to visually compare the results to Fig 7 and Fig 6 to understand how the temporal shift affects performance compared to adding noise. Since the colors are the same but with different meaning in Fig 8, and since the x axis is linear instead of log in Fig 8, it requires some effort to detect differences. I wonder if this could be improved, but I do not have a solution. Maybe an easy fix could be to add data from Fig 6 or Fig 7 with a very light color in the background. But this could also make the plot too busy.

  We agree that is hard to compare these figures with each other. We have switched the colour and line styles in Figs. 6,7 & 10, so that the colours are consistent with Fig. 8. See our reply to your first comment for the new figures.

Specific comments:

- Fig 6: The updated information in the text clearly explains why R_2 is so low for the low intensity event. But why is this not happening in Fig 10? I assume that most rainfall in the real dataset comes at low intensities, hence R_2 is most likely dominated by these low rainfall intensities. But at 1-minute instantaneous sampling there is only a very small difference between RAL 26 and RAL 38 in Fig 10, even though RAL 26 has a high noise level relative to the rain-induced attenuation (as you describe in your updated text related to Fig 6). It would be good to explain this behavior because, from Fig 6, one concludes that the (relative) noisiness of RAL 26 has a significant impact, while for the statistics from the real dataset in Fig 10 one would not draw that conclusion. Maybe wet antenna increases the attenuation in the real data so that low attenuation during low rainfall is less often smaller than zero (which happens for the theoretical events due to added noise)?

  Indeed, a similar behaviour would be expected in the real dataset. We attribute this as you suggest to the wet-antenna attenuation, which increases the attenuation in the real dataset. We have added as follows:

  It should be noted that differences in baseline power levels between sampling strategies and wet-antenna attenuation are not included in these theoretical events, while in Section 3.1 these clearly affected the rainfall intensity estimates. For example, wet-antenna attenuation makes the previously described behaviour of the instantaneous sampling strategy for the RAL 26 GHz link less likely to occur in the actual data, because the lowest attenuation levels will increase as a consequence of wet antennas. Differences in baseline power levels are only slightly reflected in the theoretical events as caused by the added noise, which might slightly affect the median signal intensity for the computation of the baseline power levels.

- L284: „…instantaneous and min-max sampling strategies seem to be more prone to errors in retrieving high rainfall intensities…“ Some lines below you write that instantaneous sampling is good in capturing the peaks intensities. This is also what I would get from Fig 5, of course not for 60-minute aggregation. But at 5-minute sampling the height of the second peak is, surprisingly, best captured with instantaneous sampling. Maybe this is a general tendency because the mean can easily get biased towards underestimation, as you write elsewhere. But I am not sure if this is the reason here.

  Based on Figs. 4 & 5, we tried to explain here that for the shortest time intervals (e.g., 1-second intervals) the instantaneous sampling strategy is able to capture the peaks (because of the short time intervals), while for longer time intervals this is not necessarily the case (as one would also expect). Indeed the 5-minute sampling in Fig. 5 quite nicely captures the peak intensity, because the sampled intensity is representative for the entire time interval. We did not mean to refer here to the subsequent sections where the underestimation of the mean sampling strategy is addressed. We added some references to Fig. 5 and added as follows:

Generally, the instantaneous and min-max sampling strategies seem to be more prone to errors in retrieving high rainfall intensities. For the event on 21 June (Fig. 5), the mean sampling strategy results, as expected, in decent estimates of the evolution of the rainfall event on average, both in timing and intensities (though the peak rainfall intensities are obviously averaged out). The instantaneous sampling strategy seems to be most sensitive to an increase in the length of the time interval, because its performance depends on the representativeness of a single measurement for the whole time interval. The timing and intensity of the estimated peak rainfall intensity for the shortest time intervals are often relatively good, due to the large signal intensity fluctuations as a consequence of variations in rainfall intensity in comparison to the instrument noise, while for longer time intervals the sensitivity of the performance to the representativeness of a single measurement for the whole time interval heavily increases (e.g., the 5-minute instantaneous sampling strategy in Fig. 5 captures the peak intensity at 12:00 better than the mean and min-max sampling strategies). For the min-max sampling strategy, the timing of the peak intensity is generally well-captured, but the estimated peak rainfall intensity can be inaccurate. Additionally, for this specific case, this method strongly overestimates the rainfall sum for the 60-minute interval, due to the peak taking place around the full hour, so that two subsequent intervals cover this peak.

- L289: What is meant with „signal-to-noise“ ratio here in the context of comparing instantaneous with the other sampling methods?

  We refer here to the relatively large fluctuations in signal intensity as a consequence of changes in rainfall intensity in comparison to the instrument noise. To clarify, we added as follows:

  The timing and intensity of the estimated peak rainfall intensity for short time intervals are often relatively good, due to the large signal intensity fluctuations as a consequence of variations in rainfall intensity in comparison to the instrument noise, while …..

- L290: Which „sensitivity“ increases with larger time intervals?

  We refer here to the sensitivity of the representativeness of a single measurement for the whole time interval. We realize that this could be phrased differently. We changed as follows:
  ….longer time intervals the sensitivity of the performance to the representativeness of a single measurement for the whole time interval heavily increases….

- L587-L591: What about shorter link length? Of course, one expects the opposite of what happens for longer link lengths (which is described in the new text). But given that it has been reported that very short instantaneously sampled CMLs (with lengths of hundreds of meters or even only tens of meters) are prone to overestimation of rain rates, can you make a statement on the question if instantaneous sampling is a potential reason for this overestimation and not (only) the wet antenna estimation (which is undoubtedly a large source of error for very short and thus insensitive CMLs)? If I assume that the positive MBE of instantaneous sampling around 5-minutes in Fig 10 is shifted to the left (maybe to 30-s or below) for very short CMLs, that could be the case.

Thank you for this suggestion. This is indeed a connection that we had not made yet. We added the following lines at the end of this paragraph:

…. For shorter link lengths, an opposite behaviour is expected. This could, for example, imply that part of the overestimations found for short 38 GHz links are not only a consequence of wet-antenna attenuation (Fencl et al., 2019), which does play a significant role, but also of sampling strategy.