We would like to thank the associate editor for the feedback. We have carefully considered every comment. Below we provide the detailed answers to the comments – in bold black the comments from the editor, in black our replies to the comments and in italic black passages from the updated manuscript.

<u>Associate Editor Decision</u>

Comments to the Author:
Please elaborate on these points in the manuscript based on the text in response to review. This text inserted is insufficient. You have inserted non-quantitative sentences when you could be both specific and quantitative (as you have been in the response). Thank you.

1) **Based on the results from Hasager et al. (2020) one can assume that at this rain intensity the tip speed will be reduced around this value. (This sentence needs work, the meaning is unclear, use quantitative responses)**

We agree that the formulation of this sentence is not good. As we included some information about the use of the presented nowcast during heavy rain, we included our intended message of this sentence in the new paragraph (see point 4 for details).

2) **Bech et al. (2018) propose reduce the tip speed during severe precipitation events to limit erosion and to extend blade lifetime. (by how much, to what effect, see also response to 2nd reviewer).**

We included the proposed rain intensity thresholds for active erosion-safe mode control and the related tip speed reductions. Furthermore, the influence on the expected lifetime and the AEP are described now in more detail (line 19 to 26).

Bech et al. (2018) propose to reduce the tip speed during severe precipitation events to mitigate the effect of impacting hydrometeors on the leading edge. They present five different erosion-safe modes where the tip speed of 90 m/s is reduced depending on the rain intensity (RI). For RI ≥ 20 mm/h the tip speed is reduced between 20 and 35 m/s, for RI ≥ 10 mm/h between 10 and 25 m/s and for RI ≥ 5 mm/h up to 20 m/s. These erosion-safe modes lead to an increase in the expected lifetime from 1.6 years up to 107 years assuming a specific rain climate. Furthermore, they investigate the influence of the turbine control during intense rain events on the annual energy production (AEP). The calculated AEP values range from negligible reductions to significant increases. These calculations are based on the assumption that the time of reduced tip speed is 3 times longer than the actual time with RI above the mentioned thresholds.

3) **Raindrops have diameters up to 8 mm, although raindrops with 10 mm have been observed in tropical areas (Jones et al., 2010). (Not detailed enough).**

We included more details about possible sizes of raindrops (line 65 to 69):

In general, a single raindrop has a diameter between 0.1 mm and 8 mm, although raindrops with a diameter of 10 mm have been observed in relation to tropical clouds (Jones et al., 2010). Small drops up to around 1 mm are spherical, while larger drops *have the shape of a flattened sphere. However, raindrops with a diameter above 6 mm are rare as they break up due to their flatten shape and the related hydrodynamic instability or due to collision with another raindrop.*

4) **As mentioned in point (2) it is difficult to define a general applicable worst-case scenario. Furthermore, it is shown that profit is already gained by reducing the tip speed at rain intensities around 1 mm/h. As our intention is to show frequent occurring rain conditions, we do not see a need to re-calculate the theoretical fall time for more extreme values. (Not quantitative/detailed enough 1mm/hr is light rainfall. Its reasonable to ask what happends in heavy rainfall, please be specific about dropsize/amounts)**

Our assumption was that the tip speed is already reduced at rain intensities of 1 mm/h, as Hasager et al. (2020) showed an increase in profit using this threshold. We agree that this assumption was not clearly mentioned and might not be satisfactory to all readers. Therefore, we included following information (line 90 to 91):

For comparison, a larger raindrop with a diameter of 2.5 mm has a terminal velocity of around 7 m/s and needs 214 s (3.6 min) for the same distance.

Furthermore, we wrote following paragraph mentioning an observed increase of drop size towards ground during a convective event (resulting in a higher rain intensity) and possible consequences for the nowcast (line 141 to 148).

Although the tip speed has maybe already been reduced when observing heavy or violent rain events (RI > 10 mm/h), following the suggested RI thresholds from Bech et al. (2018) or Hasager et al. (2020) for applying an erosion-safe mode, it is still important to measure events with such a high RI. Adirosi et al. (2016) observe an increase of the median volume diameter of raindrops from 1.25 mm at 1050 m AGL to 2.07 mm at 105 mm AGL during the convection phase of a rain event with high RI. This increase is probably due to coalescence and drop sorting. Therefore, it is possible that the RI at the wind turbine is higher than measured at some distance for the nowcast. The nowcast would not be so effective, except measurements closer to the wind turbine would be included to check for such an increase. As larger drops fall faster, the time for reducing the tip speed in due time is shorter.

We also tried to make the pros and cons of an MRR-PRO for the nowcast clearer (line 150 to 156):

Nevertheless, an advantage of a MRR is that the height information of the melting layer can also help to identify the risk of blade icing, especially in cold climates. Furthermore, the MRR measurements are not disturbed by the flow around the sensor in contrast to in-situ sensors like disdrometers (Testik and Rahman, 2016). However, in events with notable vertical wind (e.g. thunderstorms), the calculated RI based on the MRR-PRO raw data includes some error as still air is assumed. The radar beam of the MRR-PRO is attenuated stronger in upper heights (> 1 km) during violent RI compared to C- or S-band radar beams. The parameter Path Integrated Attenuation (PIA) of the MRR-PRO contains this information and can help to identify violent rain events.

5) **Furthermore, the use of C- and S-band based weather radars, which are usually installed onshore, includes some limitations, e.g. precipitation does not fill completely the scanned volume, height of radar beam is above precipitation and reflections caused by the wind farm infrastructure wrongly indicate precipitation. These limitations can be corrected only to some extend and lead to some uncertainty in the precipitation parameters. (Check for typos, expand using the detailed text in response to reviewers.)**

As suggested we included the detailed text provided in the answer to the reviewer in the manuscript (line 102 to 112).

National operated and usually onshore installed C- and S-band weather radars cover large areas, including many offshore wind farms, with a temporal resolution of ≥ 5 minutes. However, some notable disadvantages of these weather radars for a nowcast of precipitation for offshore wind farms are:

- *Partial beam filling: The precipitation does not fill completely the scanned volume, because it increases with increasing distance from the radar. This condition can lead to an underestimation of RI.*
- *Overshooting: The height of the radar beam is above the precipitation, because the height of the radar beam increases due to the scan elevation angle and the curvature of the Earth. This condition can lead to an underestimation of RI or even failure to detect precipitation.*
- *Clutter caused by wind farms: Reflections produced by wind farm infrastructure indicate wrongly precipitation.*

These and other limitations like anomalous propagation of the radar beam can be detected but for some cases a correction is difficult (e.g. beam filling). This situation leads to some uncertainty in the precipitation parameters.