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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The effect of reported high-velocity small raindrops on inferred drop size distributions and derived power laws" *by* H. Leijnse and R. Uijlenhoet

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We would like to thank both reviewers for their positive comments. Both reviewers have raised some issues regarding the manuscript. We will address each of these issues below. The reviewers' comments are given in italics, followed by our response.

Referee 1, comment 1. *At the beginning of Section 3.1, it is stated that for diameters below 0.6 mm, all drops are assumed by the authors to fall at their theoretical terminal fall velocity. I assume this is based on Montero-Martínez et al., but a reference and explanation would be appropriate.*

The reviewer has possibly misunderstood the statement between parentheses on lines

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18-19 on p. 9129. We assume that all drops *above* 0.6 mm fall at their theoretical fall velocities (see Section 2 and Fig. 2, which contains data from Fig. 2a of Montero-Martínez et al.). In the revised manuscript, we will add "see Sect. 2, Fig. 2, and Fig. 2a of Montero-Martínez et al., 2009" after "terminal fall velocity" on line 19 of p. 9129.

Referee 1, comment 2. *I had difficulty interpreting Figure 4: perhaps different line plotting options could be tried to make the curves more quickly discernable.*

In the revised manuscript, we will increase the widths of the lines in Figs 4–7. We feel that this has indeed increased the discernability of the different curves (see the figures at the end of this document).

Referee 1, comment 3. *More importantly, it isn't clear from the text where Table 1 comes from and how it relates to the different velocity ratios which are being analyzed.*

Table 1 is referred to in the last sentence of p. 9127, and later used in Table 3 and Figs 4–7 (it is also referred to in the corresponding text). In the revised manuscript, we will include an additional column in the table stating which assumptions correspond to the different distributions given in the table. This column with header "assumptions" has the following entries: (i) no high-speed small drops, no turbulence; (ii) no high-speed small drops, turbulence; (iii) high-speed small drops, no turbulence; (iv) high-speed small drops, turbulence. We will append the caption of Table 1 with ", with the corresponding assumptions regarding the presence of the effects of high-speed small drops and turbulence-induced variations in fall velocities".

Referee 1, comment 4. *At the end of Section 3.2, the statement is made that "Another aspect of these graphs is that the effect of turbulence-induced variations in fall velocities becomes apparent..." but it is not explained how this is apparent.*

We assume that the reviewer means Section 4.2. The lines corresponding to distributions (ii) and (iv) are modelled DSDs where turbulence-induced variations in fall velocities are taken into account. The fact that these lines are different than those cor-

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responding to distributions (i) and (iii) (i.e. without the effect of turbulence), respectively, indicates that turbulence-induced variations do affect the retrieved DSDs. We feel that the additional column in Table 1 (see our reply to comment 3 of referee 1) partially clarifies this issue. In the revised manuscript, we will add "This can be concluded from the fact that there is a difference between the lines corresponding to distributions where turbulence is ((ii) and (iv)) and is not ((i) and (iii), respectively) taken into account. Especially at 10 mm h^{-1} (top panels of Fig. 5), this difference is larger than the difference between the lines corresponding to distributions where high speed small drops are ((iii) and (iv)) and are not ((i) and (ii), respectively) taken into account (see also Table 1)." at the end of line 22 on p. 9134.

Referee 2, comment 1. *In Table 1 and subsequently in the document, the authors should remind what the assumptions and physical model behind the distributions i, ii, iii, and iv is. This would make interpretation of Figs 4 to 7 easier for the reader.*

In the revised manuscript, we will include an additional column in the table stating which assumptions correspond to the different distributions given in the table (see also our reply to comment 3 of referee 1).

Referee 2, comment 2. *In Fig. 4 to 7, thicker lines would make the figures more clear.*

In the revised manuscript, we will increase the widths of the lines in Figs 4–7 (see also our reply to comment 2 of referee 1, and the revised figures at the end of this document).

Referee 2, comment 3. *On Fig. 3 it doesn't seem obvious why the range (gray area) is situated above the red curve and not spread 'around it'. The author could explain a bit more in the text how the 'range' is to be interpreted.*

We would like to thank the reviewer for raising this issue. In the description of the correction method, we had omitted the fact that any occurrences of negative drop concentrations after correction are set to zero, which may lead to an increase of values of

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bulk rainfall variables.

In the revised manuscript, we will add a new paragraph on line 8 of p. 9130: “It should be noted that the correction method of Eq. (16) could potentially yield negative drop concentrations. These negative concentrations are set to zero. Correcting for high-speed small drops can therefore lead to higher values of bulk rainfall variables.”.

In order to describe the behavior observed in Fig. 3, we will add the following to the revised manuscript (p. 9130, after “shaded area.” on line 26): “It is clear from Fig. 3 that for R, k_{27}, and Z, the largest part of the band is generally below the corrected line. For k_{opt}, the largest part of the band is above it. Because k_{opt} is a low order moment (2^{nd} order) of the DSD, it is very sensitive to the concentration of small drops. If all drops are assumed to be at the lower edge of the drop size class, the correction may yield a much larger number of small drops, whereas the correction may not have any effect if all drops are assumed to be at the upper edge of the class. This is particularly the case for low rainfall intensities (but above 2.5 mm h^{-1}) because (1) small drops generally dominate at these intensities, and (2) the effect of the correction may be limited so that the difference between the assumed distributions within drop classes is largest.”.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 9121, 2010.

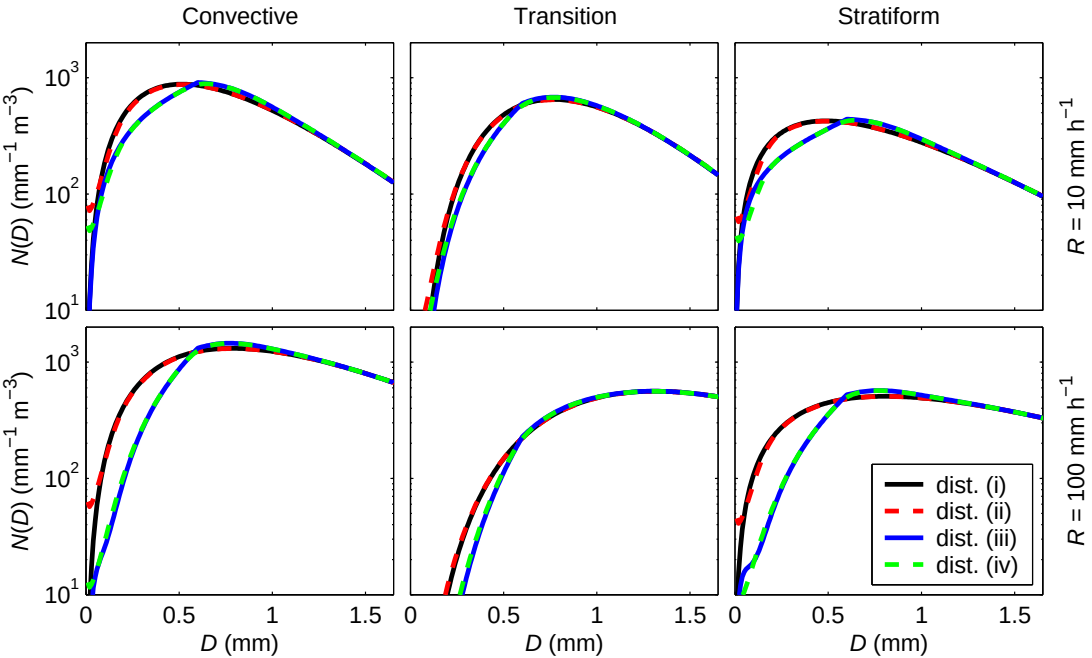

Fig. 1. revised version of Figure 4

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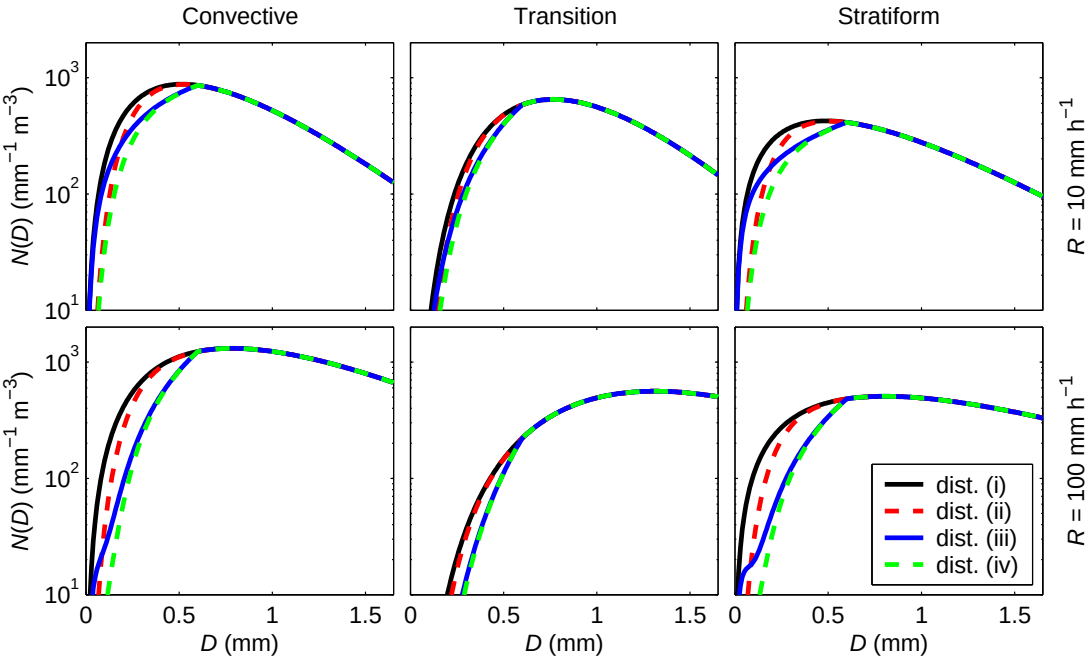

Fig. 2. revised version of Figure 5

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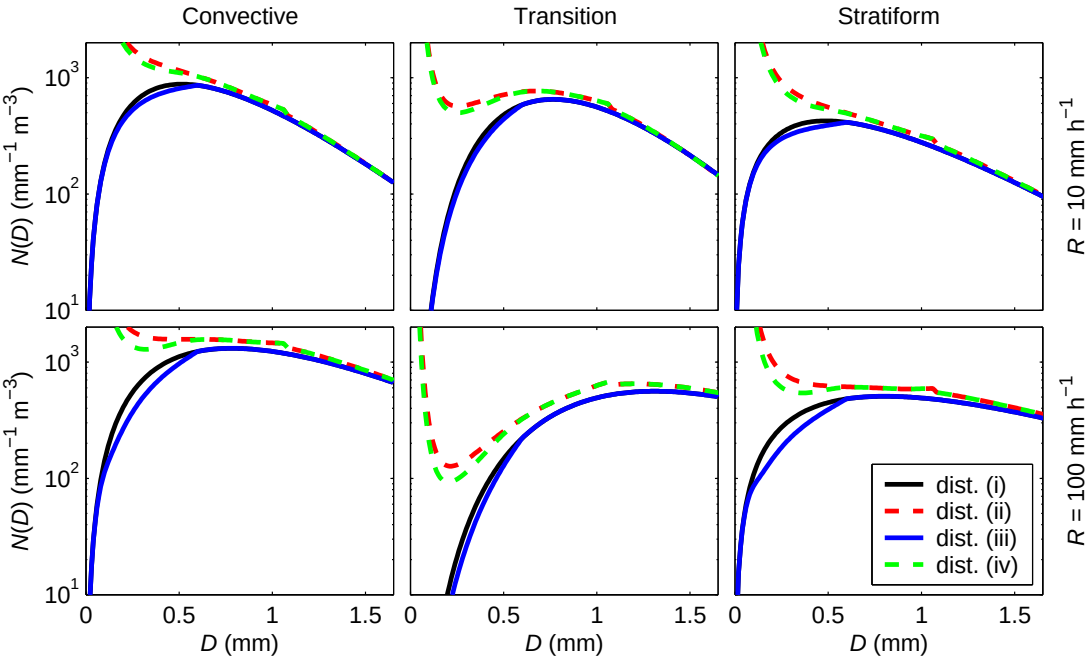

Fig. 3. revised version of Figure 6

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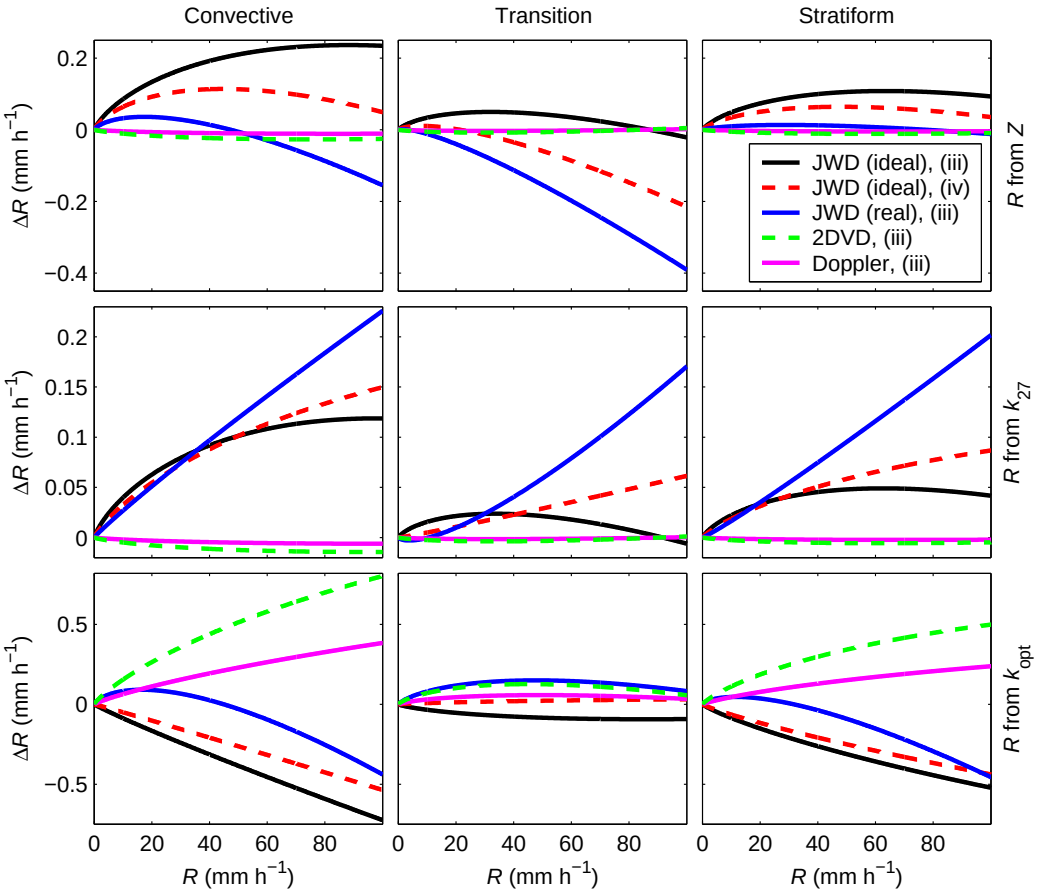

Fig. 4. revised version of Figure 7

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