Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
https://doi.org/10.5194/hess-2022-361-RC1, 2022

Comment on hess-2022-361

Anonymous Referee #1

Referee comment on "Assessing specific differential phase (K_{DP})-based quantitative precipitation estimation for the record- breaking rainfall over Zhengzhou city on 20 July 2021" by Haoran Li et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-361-RC1, 2022

The study addresses polarimetric radar estimation of extreme rainfall using specific differential phase K_{DP}. The performance of different versions of the K_{DP}-based estimators is compared and tested using rainfall gauge measurements. The authors consider various K_{DP} processing techniques and possible impacts of the DSD variability and raindrop orientations uncertainty on the quality of the polarimetric rainfall estimation.

It is demonstrated that all tested methods optimized by a locally measured DSD in a particular heavy rain event tend to yield reasonably good estimates of rainfall with hourly totals below 100 mm but significantly underestimate heavier rain with rain rates approaching 200 mm/h. The authors speculate that such underestimation can be attributed to a more random orientations of raindrops than is commonly assumed in the derivation of the R(K_{DP}) relation or to a big difference between the radar and gauge sampling volumes.

This reviewer believes that the authors may underestimate the impact of downdrafts which are often associated with a torrential rain. They downplay such an impact arguing that it is not detected by the disdrometer. The fact is that the vertical air motion is *always negligible* near the surface which does not exclude high downdraft speeds just a few hundred meters above the surface where the radar samples rainfall. Under such scenario, radar underestimation of rain is inevitable because of the conservation of a precipitation flux. The authors have a unique chance to check this hypothesis. Of course, direct measurements of the vertical air velocity are usually not available with the operational radars but one can examine indirect radar attributes of downburst such as strong wind divergence near the surface which can be assessed from the Doppler measurements or rapidly descending K_{DP} or Z cores that are proven to be linked to the downbursts / microbursts.

I have several other recommendations and concerns.

- What is the purpose of comparing the data from the Luoyang and Zhengzhou radars? Only the latter radar data are used for a qualitative analysis. Once the maps of rain totals retrieved from the two radar are displayed in Fig. 2, the reasons for discrepancies have to be discussed. Most likely, an apparent shift in the areas of heaviest rainfall is related to the differences in the altitudes of the radar sampling volume and strong vertical gradients of rain rates which are typical for warm rain process.
- Self-consistency factor and Clpf should be defined.
- Averaging window lengths (len) have to be expressed in km.
- Keep in mind that the LP procedure always tend to overestimate K_{DP} because it ignores negative radial slopes of Φ_{DP}. Negative K_{DP} is always coupled with overestimated positive K_{DP} in the close proximity and both shouldn't be quantitatively used. This is a nature of the nonuniform beam filling impact on the K_{DP}
- I don't see any difference between the three panels in Fig. 8, It is not clear what is displayed because the shading is not specified.

English usage has to be substantially improved. Just a few examples follow

- L 32. Should be "coefficient" instead of "ratio"
- L 60. Remove "the" before "progress"
- L 72. K_{DP} is a radial derivative (not derivation)
- L 120. This "may be attributed"
- L 133. "A linear interpolation"
- L 153. "At 274°"
- L 174. K_{DP} is less dependent on DSDs than what?
- L 196. "Earlier" instead of "early"
- L 217. "Analyze" instead of "analysis"
- L 222. Replace "decent"
- L 178. "In-depth" instead of "depth-in"
- L 298. Remove "at the"
- 304. Gridded
- 309. Replace "decent" with "significant" or "noticeable"