

## ***Interactive comment on “Unraveling hydrometeor mixtures in polarimetric radar measurements” by Nikola Besic et al.***

### **Anonymous Referee #4**

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The paper “Unraveling hydrometeor mixtures in polarimetric radar measurements” introduces classification method which quantifies the dominant contributor to the polarimetric variables in the radar resolution volume and separates it from the secondary contributors. The authors refer to it as bin based de-mixing. The method is novel and merits publication. Nonetheless the paper can be improved and made friendlier to readers. I list in no particular order the more significant issues.

The first part of the paper can stand on its own and I don't see the reason for introducing the Principal Component Analysis, other than to show it is not possible to find linear combinations of the polarimetric variables mutually orthogonal. They state this fact as follows “This implies that PCA cannot be really used as a de-mixing tool, because the coherent backscattering proportion does not correspond to the backscattering of

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a "pure" hydrometeor type, but rather to the backscattering of the mixture." They also write in the conclusion "there is not a significant rise in incoherency in case of hydrometeor mixtures, on one side strengthens the proposed bin-based approach, and on the other side makes the tools as PCA and ICA less useful in the context of weather radar decomposition/de-mixing." Therefore I suggest they eliminate the section on PCA and ICA. Concentrate on the first part and try to explain better how they do the de-mixing.

I have issues with the terminology "coherency in backscattering" and also with "potential incoherency in the backscattering from different hydrometeors". "Coherent backscattering" is a well-defined and accepted terminology. Check the internet and also look up the articles by Jamison and Kostinski: "Direct Observations of Coherent Backscatter of Radar Waves in Precipitation" and "Partially Coherent Backscatter in Radar Observations of Precipitation" (both in J. At. Science). Here is what they say "The results agree with the earlier conclusions in the previous work, namely that coherent scatter occurs in both rain and snow, that it is larger in snow than it is in rain, and that it can be significant at times." So "coherent backscattering" can occur, it is rare, and not considered in radar meteorology. To be significant the spacing of the drops (hydrometeors) should be comparable and or smaller than the wavelength. For example if the spacing is  $\frac{1}{2}$  of wavelength there would be tremendous enhancement of the returned signal. This is not the case, and I am sure the authors do not mean that it is. They use "coherent" in a different context. So they must devote a paragraph or more to explaining what they mean. After reading the paper I still am not sure? It seems to me they mean the similar type of hydrometeors contribute to the polarimetric variables (like  $Z_h$ ,  $Z_v$  etc) so that the powers of the backscattered signal from each scatterer add, and the cross product (mutual interactions) cause the variability which is reduce through signal processing.? It this is what they mean they should state so. If I am correct then they could use the term "dominant contribution" for the ones from two or more species, perhaps the dominant can be quantified by %, like if the total of discernible contributions is more than say 60% than these contributors are dominant, the rest is a residue.

For most part the writing style is but there are quite few awkward spots. Next are some examples and my preferences. Please avoid use of targets as these are not missiles, or planes but are hydrometeors or scatterers. Copolar is one word (see the IEEE standards). Check if “hydrometeorly” is an accepted word? The rhv is copolar correlation coefficient (not just correlation). Page 4: By equalizing – should be “by equating”. More severely should be “more strictly”. This approach “raises” not “rises” (your spell checkers did OK, but no spell checker is yet logical, so let’s make one and get rich). Many of your sentences are way too long making these unnecessarily complicated. Example P 14 starting with “This effect, allowing . . . . Has about 58 words.

To be fair to Straka – and true, you should list, “ Straka, J.M., 1996: Hydrometeor fields in a supercell storm as deduced from dual-polarization radar. Preprints, 18 Conference on severe Local Storms, San Francisco, AMS. p 551-554. In that paper the fuzzy logic is used, but the weighting functions are pulse like (had top) and are overlapping – which is the essence of fuzziness. And add an appropriate statement – of first use of the technique in pol classifications.

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[Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-58, 2018.](#)

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