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Atmospheric Measurement Techniques Discussions

Interactive comment on "Polarimetric radar characteristics of lightning initiation and propagating channels" *by* Jordi Figueras i Ventura et al.

Anonymous Referee #2

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The paper presents comprehensive statistical analysis of lightning data associated with concurrent polarimetric radar observations in the Swiss Alps. There is no doubt that the manuscript contains rich information about statistical characteristics if intra-cloud and cloud-to-ground flashes such as their intensity, duration, area, altitude and temperature intervals where flashes originated, etc. It comes at no surprise that both IC and CG flashes mostly originate in the areas of dry graupel (called rimed particles in the manuscript) and hail well above the freezing level in sufficiently deep convective clouds. The authors relate lightning flashes to the output of the MeteoSwiss semi-supervised polarimetric classification algorithm and even estimate the entropy of hydrometeor classification in the flash locations. I am not sure that the use of such a "big gun" as the

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polarimetric classifier is fully justified in this context. Indeed, polarimetric radar variables such as ZDR, KDP, and hv bear very little classification potential in cold parts of convective storms unless large hail growing in a wet growth regime is observed in the cloud. In fact, discrimination between snow, graupel, and hail aloft is almost exclusively made based on the radar reflectivity factor. Radar reflectivity of hail is larger than the one of graupel and snow. Large entropy simply means high variability of Z in a given spatial domain that spans typical range intervals of snow, graupel, and hail. I am surprised by the fact that the histograms of ZDR in the regions of lightning initiation above the freezing level are almost perfectly symmetric around 0 dB value. Graupel and hail – major source of lightning flashes – can grow only in sufficiently strong convective updrafts commonly manifested by the ZDR columns. Various researchers report close association of lightning locations and ZDR columns which is not examined and even mentioned in the paper. At the same time, there is apparent sign of nozero positive KDP indicated in the histograms in Figs. 7 and 12. What is the origin of these positive values of KDP in cold parts of convective clouds? Horizontally oriented ice crystals in the proximity of graupel and hail or the tops of KDP columns? In the latter situation, ZDR columns with noticeably positive ZDR should be also observed.

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