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Author(s):
Gires, Auguste; Tchiguirinskaia, Ioulia; Schertzer, Daniel

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The effects of temporal variability of DSD features on pseudo-radar algorithms

A. Gires*, I. Tchiguirinskaia¹, D. Schertzer¹

1 Hydrology Meteorology and Complexity, École des Ponts ParisTech, UPE, Champs-sur-Marne, France

*Corresponding author: auguste.gires@enpc.fr

Abstract

Rainfall Drop Size Distribution (DSD) has been shown to exhibit strong variability in both space and time. Such feature has some strong consequences on the retrieval of rainfall with the help of weather radars. Indeed dual polarimetric weather radars measure the horizontal reflectivity (Zh), the differential reflectivity (Zdr), the differential phase shift (Kdp) while hydrometeorologists are interested in the rain rate (R). Radar algorithms are used to convert the former to the latter. They usually basically consist in power law-relations with fixed values of prefactor and exponent whereas these parameters actually depend on the DSD. The three basic relations Zh-R, R-Kdp and R-Zh-Zdr are investigated in this paper.

These relations are studied with the help of pseudo-radar data. Such data was reconstructed from 30s DSD data collected with the help of disdrometers (Gires et al. 2016, 2018). Three co-located optical disdrometers of two types (two OTT Parsivel² and one Campbell Scientific PWS100) installed on the Ecole des Ponts ParisTech campus are used (Figure 1). We generated radar observations corresponding to the ones that would be observed with such DSD. It should be reminded that the reconstruction of such data relies on strong simplistic assumptions notably the homogeneity of DSD within a radar bin which has severe consequences (Schertzer and Tchiguirinskaia, 2012).

In a first step we show that all the parameters of the radar relations exhibit a strong variability both between events and even within events. In a second step rainfall times series obtained from pseudo-radar data and radar relations are generated and compared with direct observations from disdrometer data. “Climatic”, “event based” and “local” (from 20 min moving window) parameters set are tested. Comparison is done in an innovative way by checking the ability of a given radar algorithm to reproduce the excellent scaling behavior of observed rainfall time series. This enables a robust scale invariant performance assessment of radar algorithms. It appears that the classical hybrid model with a Z-R relation for low rain rates and R-Kdp relation for great ones was the one performing best. Significant improvement with a more local tuning of radar parameters is also found for all radar algorithms. Limitations of this punctual approach will be discussed.

Finally, preliminary results obtained by extending this methodology to actual radar data will be mentioned. For this the data collected with the help of a Dual-pol X-band radar (Selex 50DX) operated by Ecole des Ponts Paris in the framework of the Fresnel Platform will be used.
Fig 1: Location of the three disdrometers used in this study.

References

