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Multifractal analysis of different products of X-band radar data in Greater Paris

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Precipitation is a very complex phenomenon because of its extreme variability over wide range of spatial and temporal scales. Therefore, the highest resolution possible is desired for precipitation measurements. In many developed countries, networks of C-band radar are operated by national meteorological services. More recently, X-band radars equipped with dual polarization and doppler capabilities have been introduced mainly in the research field. Their shorter wave length (smaller antenna) makes them easier to install and enable operating them so that they provide higher resolution data than conventional C-band radars. They notably enable a much refined analysis of extreme and localised events. For such events, a power law relation between the specific differential shift (Kdp) measured by the radar and the rainfall rate is used (R). This R-Kdp relation is relies on two parameters, a pre-factor and an exponent.

In this paper, we suggest to analyze and to inter-compare different products of a X-band radar operated by Ecole des Ponts ParisTech (hmco.enpc.fr). Several rainfall events selected during the recent period (2016-2017) were studied over a 64km x 64km grid , largely covering the greater Paris area with a resolution of 250 m, using a variety of radar products (filtering methods, radar algorithms and parameters).

The analysis is based on the widely used C_1Universal Multifractals (UM). In this framework, the variability across scales of a field is fully characterized with the help of only three parameters with physical meaning: the mean intermittency (C1) and the multifractality index (alpha) and the degree of non-conservation (H) They are estimated for all radar products via spectral analysis and Trace Moment and Double Trace Moment.C_1

Scale break between two separate regimes is identified, and its location (between 2 km and 4 km) often depends on the radar product. The issue of multifractal phase transition and whether the estimation of alpha during the phase transition can lead to spurious results was also investigated. Obtained results demonstrate that some of these products enable to retrieve a behaviour that are much more compatible with the expected scaling one, opening the path to new product selection methodologies.