3.9 Validation of a spatio-temporal multifractal model of small scale rainfall variability with the help of dense networks of point measurements

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Universal Multifractals (UM) have been extensively used to model and simulate geophysical fields extremely variable over a wide range of spatio-temporal scales such as rainfall. They rely on the concept of multiplicative cascades and enable to characterize the rainfall scaling variability with the help of only 3 parameters. In this paper we validate a refinement of this model in the discrete case that enables to better take into account the numerous zeros of the rainfall field (i.e. a pixel with no rainfall recorded). More precisely the zeros are introduced at each scale within the cascade process dependently on the value of the intensity and in a probabilistic scale invariant way. The results hint at possible standard values for UM parameters for the rainy areas. Theses results are validated with the help of two data sets consisting of dense network of point measurement rainfall devices deployed over areas of approximately 1 km2: 16 optical disdrometers (Particle Size and Velocity, PARSIVEL, rst generation) that were deployed for 16 month over the campus of Ecole Polytechnique Federale de Lausanne (Switzerland), and 16 raingauges deployed over the campus of Bradford University. The methodology implemented consists in downscaling a rainfall field with a resolution of 1 km and 5 min (obtained by averaging the rainfall data from the various devices) to a resolution comparable with the point measurements one (few tens of cm and 1 min). The downscaling suggested here consists in retrieving the scaling properties of the rainfall field on the available range of scales and stochastically continuing the underlying process below the scale of observation. Finally the variability among the generated “virtual” point measurement devices is then compared with the observed one. It appears that the results are in agreement with theoretical expectations. The small differences observed between the results for the two rainfall measurement devices are discussed. Finally the consequences of this small scale rainfall variability on the comparison of radar data (whose resolution is of roughly 1 km in space and 5 min in time for operational C-band radar networks of Western European meteorological services) and raingauge data is revisited. For example a set of expected value of standard scores (biais, RMSE, Nash-Sutcliff,…) is provided for several rainfall events in Seine-Saint-Denis (North-East of Paris).