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Rain rate time series as an integrated multiplicative process

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High resolution rain rate time series derived from disdrometer measurements are analyzed on an event-by-event basis. The rain rate process is found to be an integrated non-stationary cascade (H=0.53 in the framework of Universal Multifractals). This result is in contradiction with the usual modeling of rain rate time series as pure stationary multiplicative cascades (H=0) based on daily or hourly measurements. In order to resolve this apparent difficulty, we show that, at these low resolutions, multifractal analysis techniques are profoundly biased by rain on-off intermittency. Therefore a new model for rain rate time series is proposed. The latter is based on an integrated multiplicative cascade thresholded in order to reproduce rain on-off intermittency. These synthetic time series are able to reproduce correctly the fractal dimension of rain periods, the non-stationarity of rain rate at high resolution and the artificial stationary multiplicative cascade when only low resolutions are considered. Finally, the analysis of non-intermittent radar rain maps leads to the same conclusion in space, although the value H is lower, which could be explain by the uncertainty of the relation between rain rates and radar reflectivities.