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Blunt discrete Universal Multifractals cascades: development and rainfall applications

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Scale issues are ubiquitous in geosciences and particularly in atmospheric sciences, notably for rainfall. This has been often illustrated with the help of discrete multiplicative cascades, whose tree structure is rather pedagogic, but has problematic consequences in particular with respect to translation invariance. In spite of these drastic limitations, discrete cascades have been also used for engineering applications. Fortunately, continuous in scale cascades had enabled to straightforwardly overcome these difficulties and link them to pushback transforms of fields and pull forward transforms of measures, i.e. their transforms under change of space-time scale that could be not only continuous, but also infinitesimal. This is indeed needed by generating equations such as fractional differential equations.
In this communication we consider a sort of intermediate structure by interpolating at each step of a discrete cascade the random multiplicative increments at a higher resolution than the desired final one. The interpolation is performed geometrically on the increments or equivalently linearly on their corresponding singularities. We show that the simulated fields also exhibit a multifractal behaviour, at least with a very good approximation level, including with the help of Universal Multifractal (UM) simulations on a given range of UM parameters. Finally the methodology to use this newly introduced blunt discrete cascade process to address three common geosciences issues (downscaling, guessing the missing half of a field and interpolation) is presented and illustrated with rainfall fields.