3.7 New challenges for multifractals and precipitations

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Almost three decades ago, multifractals introduced a radical paradigm shift in precipitation modelling: stochastic modelling could become physically based. Indeed, instead of being either stochastic phenomenological models or scale truncated deterministic models, cascade models are based on the symmetries of the precipitation process over a wide range of scale. This provides at once a physical basis and a convenient framework to understand the strong intermittency of precipitation and its extremes. In particular, the ubiquitous scale dependence of hydrological observables, particularly that of a fundamental quantity such as the precipitation rate, was understood as a symptom that theses observables are singular with respect to measures of time and volumes, i.e. they do not admit densities with respect to them as currently assumed. Not only the source of the problem was clarified, but multifractals provided also a means to transform them into scale independent observables. The latter are obviously much more convenient both for observations and modelling. For instance, fat tailed probability distributions are rather generic for multifractal fields. However, multifractals still suffer from important limitations in applications. For a large part this is presumably due to the fact that operational hydrology has long suffered from a divorce with theoretical hydrology. However, this could also be related to the fact that whereas the original idea was to understand the precipitation process as a cascade coupling of wind dynamics and water content, it has been oversimplified into a unique, scalar precipitation rate cascade. This oversimplification had been certainly useful to start with, because the coupling is much more demanding and the techniques to handle it were not yet available. Fortunately, the situation has changed and we will present vector cascades that bring many insights on this coupling and should alleviate many limitations. They bring in fact many challenging questions to precipitation observations.