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Supplement of

Stochastic simulation of reference rainfall scenarios for hydrological applications using a universal multi-fractal approach

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Supplementary Information

Supplement A:

To get more accurate α estimates for the first scaling regime an iterative DTM procedure is implemented here. Following earlier studies (Hoang et al., 2012) the idea of this procedure is to estimate $\eta_{min} = \left(\frac{C_\Sigma}{C_1}\right)^{\frac{1}{\alpha}} \max\left[1, \frac{1}{q}\right]$ and $\eta_{max} = \left(\frac{1}{C_1}\right)^{\frac{1}{\alpha}} \min\left[1, \frac{1}{q}\right]$: first using an initial guess of α, C_1 (based on initial guesses of η_{min} and η_{max}) then subsequent η range and α, C_1 estimates are obtained in each iteration until there is no longer any change in the η range and therefore the α, C_1 estimates. The codimension (difference between the dimension of the embedding space and that of the dimension of the set under consideration) of non-zero rainfall support $C_\Sigma = 1 - D_\Sigma$ (here D_Σ is the fractal dimension of rainfall greater than the minimum threshold considered). However, the procedure used here is slightly modified: instead of searching for both η_{min} and η_{max} simultaneously in each iteration, the current procedure fixes η_{min} as a constant value (here it is initially 1) and obtains different η_{max}, α, C_1 values in each iteration. If the α estimate is still > 2 or if the α values keep changing even after a certain number of iterations, η_{min} is slightly reduced and the whole procedure is repeated. A q value of 0.8 is used here so that the usable range of η is larger (since the multifractal phase transition due to divergence of moments is more delayed) resulting in more reliable α, C_1 estimates.

References:

Hoang, C. T., Tchiguirinskaia, I., Schertzer, D., Arnaud, P., Lavabre, J., and Lovejoy, S.: Assessing the high frequency quality of long rainfall series, Journal of Hydrology, https://doi.org/10.1016/j.jhydrol.2012.01.044, 2012.

Figures:

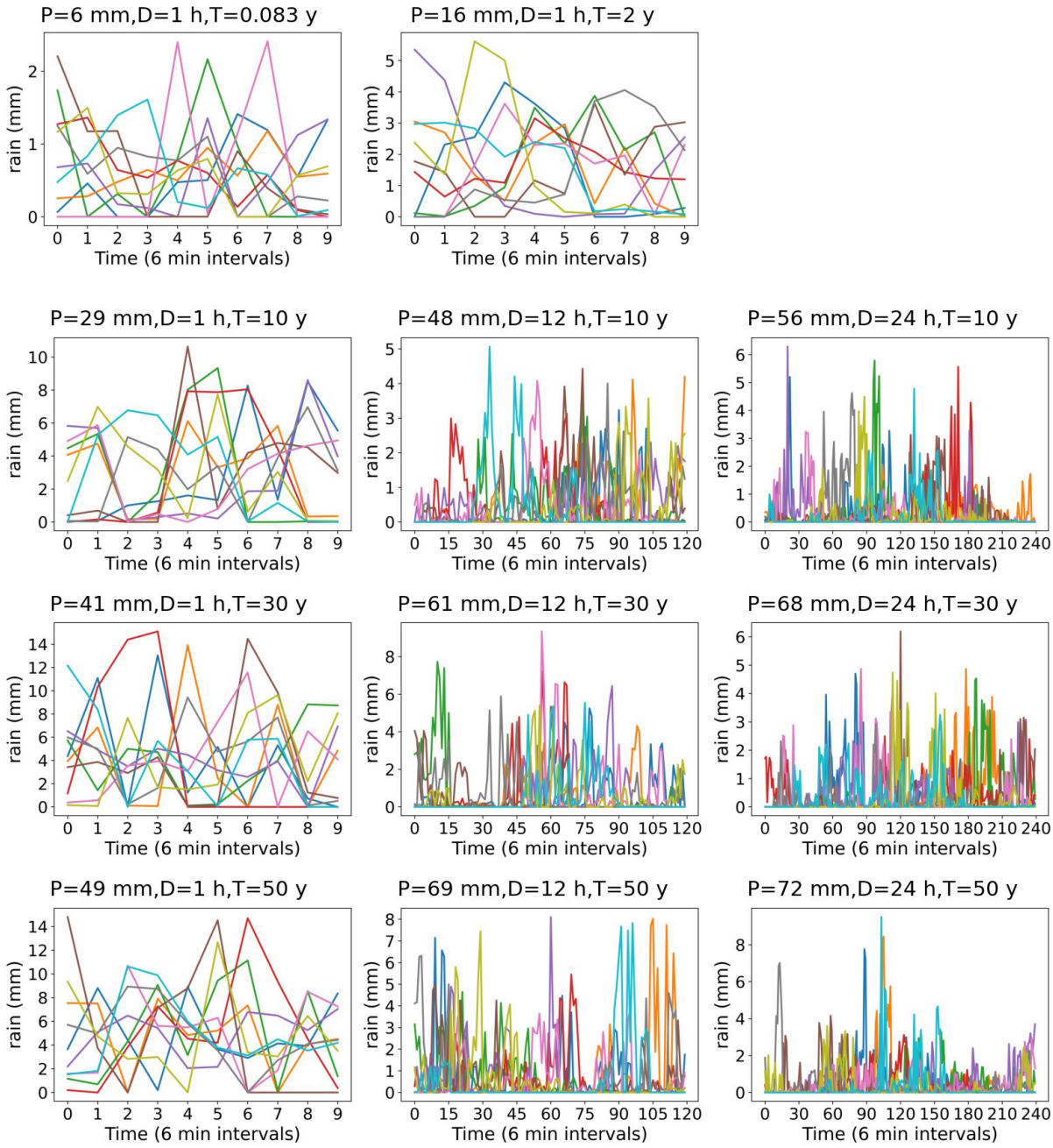

Fig. S1. Ten rainfall scenarios (indicated by different colours) for Nantes with *P* mm rainfall in *D* hours (events such as these or more severe than these occur with a return period of *T* years).

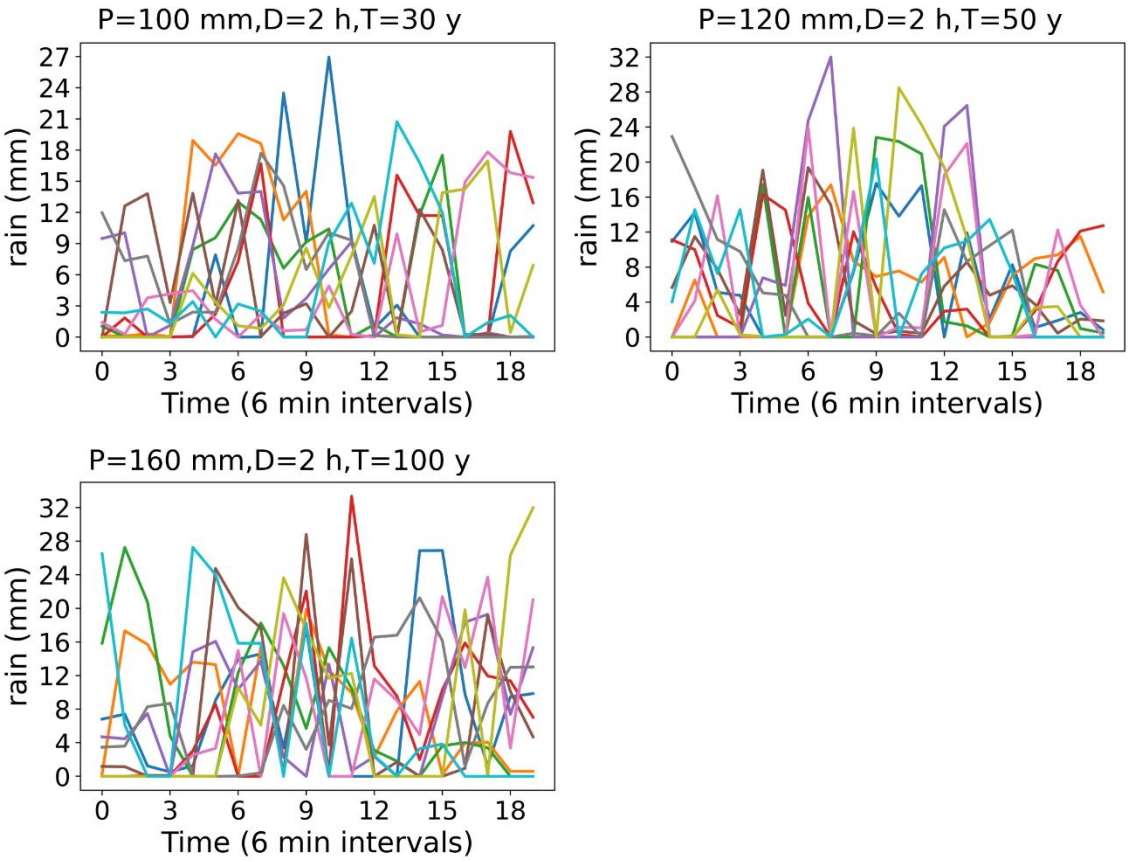

Fig. S2. Ten rainfall scenarios (indicated by different colours) for Aix-en-Provence with P mm rainfall in D hours (events such as these or more severe than these occur with a return period of T years).