SCALING OF THE IDF CURVES FOR MULTIFRACTAL RAINFALL

D. Veneziano (Dept. of Civil & Env. Eng., MIT, Cambridge, MA 02139; 617 253 7199; e-mail: venezian@mit.edu) and P. Furcolo (Dip. di Ingegneria Civile, Univ. di Salerno, Fisciano (SA), Italy; e-mail: furcolo@diima.unisa.it)

At any given geographical location, the annual maximum rainfall intensity over a window of duration D is a random variable I(D). It has been repeatedly observed that, over a wide range of durations, the distribution of I(D) satisfies the simple-scaling relation $I(D) \stackrel{d}{=} r^H I(rD)$, with H typically in the range 0.6-0.8. It follows that $i_p(D) = g(p)D^{-H}$, where $i_p(D)$ is the value exceeded by I(D) with probability p and g(p) is some function of p. A second frequent observation is that, for small p, $g(p) \propto p^{-\alpha}$ for some α. Recently, Benjoudi et al. (EGS, The Hague, 1999) have related the values of H and α to multifractal properties of the rainfall time series. We make the same basic assumptions as Benjoudi et al. on the multifractality of rainfall but reach different conclusions on the scaling of the IDF curves. Our main results are as follows. Let K(q) and $c(\gamma)$ be the moment scaling and codimension functions of temporal rainfall and let γ_1 and q_1 be the values of γ and q that satisfy $c(\gamma_1) = 1$ and $K(q_1) = \gamma_1$. We find that, for small p, the IDF curves satisfy the above self-similarity conditions with $H = \gamma_1$ and $\alpha = 1/q_1$. These scaling exponents are in good agreement with results from simulated multifractal rainfall and historical precipitation records.