EXTREME POINT RAINFALL TEMPORAL SCALING AND ASSOCIATED ATMOSPHERIC PROCESSES

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Previous studies about heavy rainfall events have examined the scaling properties between extreme precipitation depths and their temporal duration at a global scale (Jennings 1950, Galmarini *et al*. 2004, Zhang et al. 2013) similarly as other approaches as those described by Monjo and Martin-Vide (2016) to study the global precipitation concentration at daily scale.

In this presentation, we report recent related results obtained by Gonzalez and Bech (2017) and provide further discussion in terms of possible associated atmospheric processes. Spanish precipitation extremes were obtained processing the Agencia Estatal de Meteorología (AEMET) precipitation databases containing more than 11,000 raingauge stations, some of which exceeded 200 years length, by computing temporal moving windows from 10 minutes to 2 years of selected durations, similarly as described in Galmarini et al. (2004) or Zhang et al. (2013) where updated world rainfall extremes were considered. The resulting list of all-time rainfall records is shown in Table 1 and also is plotted in a log-log diagram in Figure 1 which allows to compare the scale-dependence of both data sets. Last column of Table 1 lists additionally the ratio between the Spanish precipitation record compared to the corresponding World record, indicating that maximum ratios (~30%) are achieved for periods between 20 minutes to 2 days while the others are around 20%. An absolute maximum of 44.8% is found for the 24h period, corresponding to the amount recorded on the 3rd November 1987 in Oliva (Valencia) in the eastern Mediterranean coast, largely influenced by deep moist convection, large moisture availability from the sea and enhancing orographic effects.

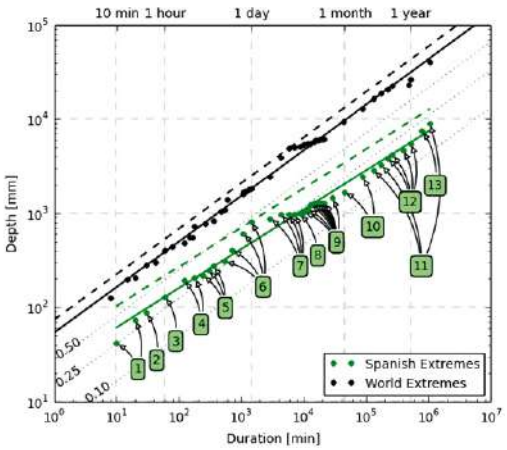

Fig. 1.- Point-based rainfall depth extremes observed for different temporal durations for Spanish Extremes (green dots) and World Extremes (black crosses). Bold lines correspond to a power law fitting and dashed lines to the data envelope. Black dotted lines shows the percentage with respect to the WE fitting line. Green numbers show the episode Id which produced the extreme rainfall (see Table 1) - source: Gonzalez and Bech (2017).

Duration	Id	Location	Depth [mm]	Date	SR/WR [%]
10 min	1	Cuevas de Nerja, Málaga	41.6	21 Set 2007	N/A
20 min	1	Cuevas de Nerja, Málaga	74.2	21 Set 2007	36.0
30 min	2	Sineu, Balearic Islands	87.8	12 Oct 2012	31.4
60 min	3	Santa Cruz de Tenerife	129.9	31 Mar 2002	32.4
2 hours	4	San Sebastian, Gipuzkoa	193.0	1 Jun 1997	39.5
3 hours	4	San Sebastian, Gipuzkoa	204.7	1 Jun 1997	28.3
4 hours	5	Huercal-Overa, Almería	216.3	28 Sep 2012	N/A
5 hours	5	Huercal-Overa, Almería	248.3	28 Sep 2012	N/A
6 hours	5	Huercal-Overa, Almería	275.0	28 Sep 2012	32.7
9 hours	6	Oliva, Valencia	306.4*	3 Nov 1987	28.2
12 hours	6	Oliva, Valencia	408.5*	3 Nov 1987	N/A
18 hours	6	Oliva, Valencia	612.8*	3 Nov 1987	38.6
1 day	6	Oliva, Valencia	817.0	3 Nov 1987	44.8
2 days	7	Javea, Alicante	878.0	1-2 Oct 1957	35.2
3 days	7	Javea, Alicante	978.0	1-3 Oct 1957	24.9
4 days	7	Javea, Alicante	978.0	1-3 Oct 1957	20.1
5 days	7	Javea, Alicante	978.0	1-3 Oct 1957	19.6
6 days	8	Sauces, Santa Cruz de Tenerife	984.8	24-29 Feb 1988	19.4
7 days	9	Grazalema, Cádiz	1023.2	14-20 Dec 1958	18.9
8 days	9	Grazalema, Cádiz	1099.2	14-21 Dec 1958	19.9
9 days	9	Grazalema, Cádiz	1226.2	14-22 Dec 1958	22.2
10 days	9	Grazalema, Cádiz	1273.6	13-22 Dec 1958	22.4
11 days	9	Grazalema, Cádiz	1277.2	12-22 Dec 1958	21.5
12 days	9	Grazalema, Cádiz	1280.0	12-23 Dec 1958	21.5
13 days	9	Grazalema, Cádiz	1282.2	11-23 Dec 1958	21.1
14 days	9	Grazalema, Cádiz	1282.2	11-23 Dec 1958	21.1
15 days	9	Grazalema, Cádiz	1284.8	9-23 Dec 1958	21.1
20 days	9	Grazalema, Cádiz	1454.1	3-23 Dec 1958	N/A
31 days	10	Cortes de la Frontera, Málaga	1674.0	18 Nov – 18 Dec 1989	17.5
2 months	10	Cortes de la Frontera, Málaga	2420.0	Dec 1995 – Jan 96	19.0
3 months	11	Casteloais, Ourense	2866.8	Nov 1959 – Jan 60	17.5
4 months	11	Casteloais, Ourense	3269.9	Nov 1959 – Feb 60	17.5
5 months	12	Casas do Porto, A Coruña	3835.8	Nov 2000 – Mar 01	18.8
6 months	12	Casas do Porto, A Coruña	4176.1	Oct 2000 – Mar 01	18.6
9 months	12	Casas do Porto, A Coruña	4680.1	Aug 2000 – Apr 01	N/A
12 months	12	Casas do Porto, A Coruña	5503.4	Apr 2000 – Mar 01	20.8
18 months	13	Dodro, A Coruña	7523.6	Oct 1984 – Mar 86	N/A
24 months	11	Casteloais, Ourense	8991.5	Feb 1958 – Jan 60	22.1

Table 1.- Observed point-based rainfall depth extremes for different temporal durations in Spain and proportions of Spanish Record to World Record (SR/WR), expressed in % (adapted from Gonzalez and Bech, 2017).

***Rainfall amounts corresponding to 9, 12 and 18h were estimated from the 24h maximum events.**

Further analysis of the results can be performed by examining the likely relevant atmospheric processes associated with each temporal scale, following the classical scale classifications provided by Orlanski (1975), Fujita (1981) or the recent work focused on a seven-day period simulation at mid-latitudes reported by Craig and Selz (2018), where several dynamical regimes were identified, including quasi-geostrophic flow, propagating gravity waves and stationary gravity waves related to orography.

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