VIGNA DI VALLE
PRECIPITATION CLIMATOLOGY

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TIPICAL METEOROLOGY

Vigna di Valle site, close to Bracciano Lake, is characterized by a wind regime of SW-NE dominant flows. During autumn and spring, max recorded intensity precipitations (RI [mm/h]) lasting for at least several minutes generally depends on thunderstorms-rain and showers linked to cold-warm fronts mainly coming from SW (from sea "breeze"). The worst situations start when perturbations meets the Bracciano Lake humidity supply. Same situation during summer: intense precipitation events (but less frequent) with dominant wind from E and from Rome zone "hot island".

During precipitation events, we record a medium wind speed of 10kt - 5m/s, except in cases of big Tower cumulus (TCU) or Cumulonimbus (CB) outflows (stronger winds) that usually precede intense showers for several minutes (120-240 mm/h).

Any kind of information about other meteorological fields (temp., solar rad., humidity, ect) are in site available and could be discussed during technical meeting of next autumn.

PRECIPITATION CLIMATOLOGY – METHOD

Attached to this report, it's possible to find 2 kinds of statistical investigations for precipitations:

1. Distribution of cumulated precipitation caught by our station gauge throughout the last 7 years (2005 included) from Gen to Dec of each year and the cumulated precipitation distributions of each year divided in 12 months (first graphs group).
2. Statistical determination of cumulated probability (P) or time of return (Tr [years]) for rainfall intensity extreme events (RI[mm/h], same catching gauge). The *Gumbel max value asymptotic type I cumulated distribution* has been chosen to represent data: *cumulated probability* $P[x] = \exp\left(-e^{-y}\right)$ with reduced variable $y = \alpha\left(x - x_0\right)$ and *α,x0 Gumbel parameters* calculated on experimental data *x* (=max rainfall intensity values recorded on last 6 years 1999-2004). Math treatment of Gumbel distribution according to the following formulas and tables:

- ✓ *Pluvio-intensity possibility curve:* $RI = a \cdot t^{n-1} = a$ *[mm/h] for t=1 (Extreme events duration strictly > 1 minute as requested in WMO IOC Final Report, Trappes 24-28 nov 2003, pg.9)*
- ✓ *Gumbel asymptotic distribution type I: P[I(t=1)]=exp(-exp(-α1*(a-x01)))=P[a]; Gumbel distribution parameters for t=1: α1, x01*
- ✓ *Reduced variable t=1:* $y = \alpha_1 \cdot (a - x_{01})$
- ✓ *ai = experimental data; a=theory data*

Experimental DATA:

YEAR	ai = MAX RI [mm/h]	Cum/year mm	MaxCum 24h mm	N° events	N° events	N° events
				≥100 mm/h	≥150 mm/h	≥200 mm/h
1999	270	836	48,8	13	5	2
2000	240	831	85	15	4	3
2001	185	624	36	5	2	0
2002	275	869	56,2	5	3	3
2003	420	750	69,4	16	6	3
2004	216	> 614	41,8	17	5	1

YEAR	N° events	N° events	N° events
	≥250 mm/h	≥ 300 mm/h	≥ 400 mm/h
1999	1	0	0
2000	0	0	0
2001	0	0	0
2002	1	0	0
2003	2	1	1
2004	0	0	0

Tab A

YEAR	N	ai [mm/h]	(ai-μ1)^2
2003	1	420	23195,29
2002	2	275	53,29
1999	3	270	5,29
2000	4	240	767,29
2004	5	216	2672,89
2001	6	185	6839,29

Gumbel Parameters:

μ1=(1/N)*∑ai	**σ1**=[1/(N-1)*∑(ai-μ1)^2]^0,5
267,7	81,9
α1=1,2825/σ1	**x01**=μ1-0,45006*σ1
0,01566044	230,8

(1) Cumulated probability P, time of return Tr, Gumbel reduced variable and Likelihood(*) calculations for 6 experimental data.

			Tab B			
YEAR	i	ai [mm/h]	P[ai]=exp(-exp(- α1(ai-x01)))	Tr=1/(1-P[ai])	Reduced var y	Likelihood* %
2003	1	420	0,95	19,86	2,96	5,0
2002	2	275	0,61	2,54	0,69	39,4
1999	3	270	0,58	2,39	0,61	41,8
2000	4	240	0,42	1,73	0,14	57,9
2004	5	216	0,28	1,40	-0,23	71,7
2001	6	185	0,13	1,15	-0,72	87,1
				[years]		

(*)***Likelihood*** *[%] = (1-P)*100 = probability (0-100%) to have a value ≥ RI value*

For ***90%*** *confidence curves evaluation.*

Up	Down	ai [mm/h]
609.3822549	230.6177451	420
343.4251499	206.5748501	275
336.5305308	203.4694692	270
297.5890524	182.4109476	240
269.5882711	162.4117289	216
238.9182607	131.0817393	185

(2) Cumulated probability P, time of return Tr, Gumbel reduced variable and Likelihood(*) calculations for theory data but with the evaluated Gumbel parameters.

Tab C
Theory data with experimental Gumbel parameters

a [mm/h]	P[a]	Tr=1/(1-P[a])	y	Likelihood %
50	0,00000004	1,00	-2,83	100,0
100	0,00042844	1,00	-2,05	100,0
150	0,03	1,03	-1,27	97,1
200	0,20	1,25	-0,48	80,2
250	0,48	1,91	0,30	52,3
300	0,71	3,48	1,08	28,7
350	0,86	6,98	1,87	14,3
400	0,93	14,66	2,65	6,8
450	0,97	31,46	3,43	3,2
500	0,99	68,25	4,22	1,5

(3) Additional table of cumulated probability P, RI values and Likelihood(*) calculations for Tr theory data but with the evaluated Gumbel parameters.

Tab D
Theory data with experimental Gumbel parameters

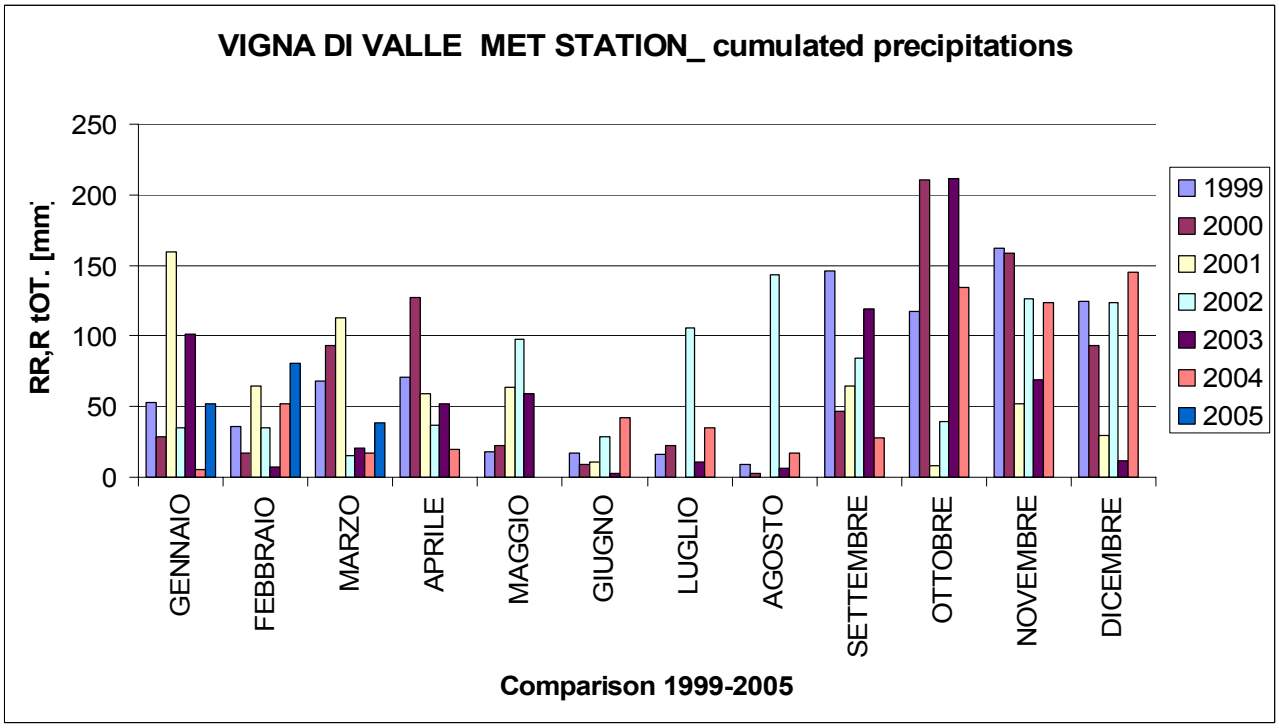
Tr[years]	P=1-1/Tr	a [mm/h]	Likelihood %
1.01	0.009901	133.14	99.0
2	0.500000	254.20	50.0
3	0.666667	288.44	33.3
4	0.750000	310.36	25.0
5	0.800000	326.58	20.0
6	0.833333	339.48	16.7
7	0.857143	350.20	14.3
10	0.900000	374.50	10.0
15	0.933333	401.53	6.7
20	0.950000	420.46	5.0

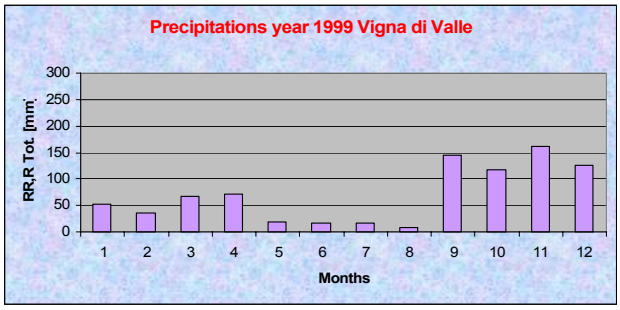
(4) Evaluation of empirical frequencies Fi (≈cumulated probability P) with the Plotting Position method and related Reduced Variable Yi according to *Weilbull* and according to *Gringorten.*

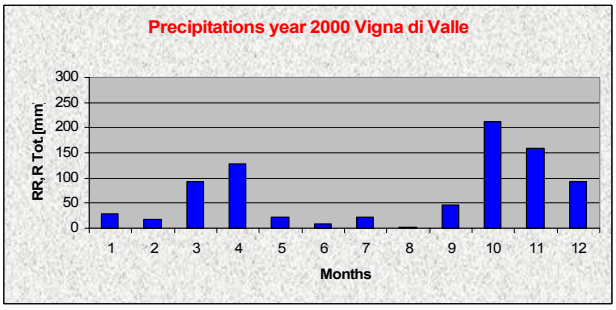
			Plotting position Weilbull	*Reduced var*	*Plotting position Gringorten*	*Reduced var*
YEAR	**i**	**ai [mm/h]**	**Fi=(N-i+1)/(N+1)**	**Yi=-ln[-ln(Fi)]**	**Fi=(N-i+1-0,44)/(N+0.12)**	**Yi=-ln[-ln(Fi)]**
2003	1	420	0,86	1,87	0,91	2,34
2002	2	275	0,71	1,09	0,75	1,22
1999	3	270	0,57	0,58	0,58	0,61
2000	4	240	0,43	0,17	0,42	0,14
2004	5	216	0,29	-0,23	0,25	-0,31
2001	6	185	0,14	-0,67	0,09	-0,87

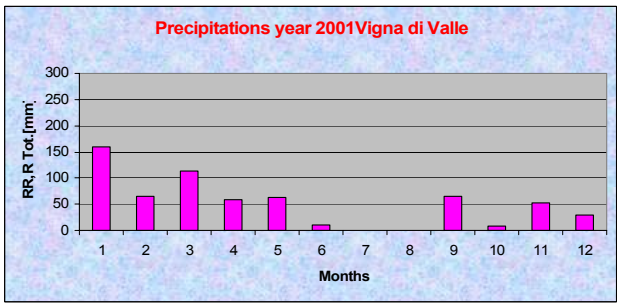
This method has been used to represent experimental data on the first 2 plots (Reduced Variable Y *versus* RI values) of second graphs group and to make comparisons with Gumbel standard linear curve and its 90% confidence curves. According to them, Gumbel statistical distribution seemed to be the best way to estimate Time of return (years) and Likelihood(%) of high rainfall intensity events (see last plots of second graphs group).

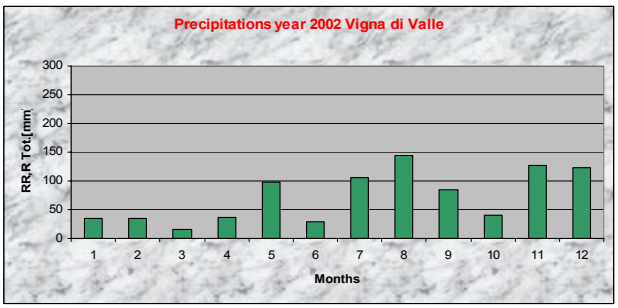
First Graphs Group: Time distribution of cumulated precipitation

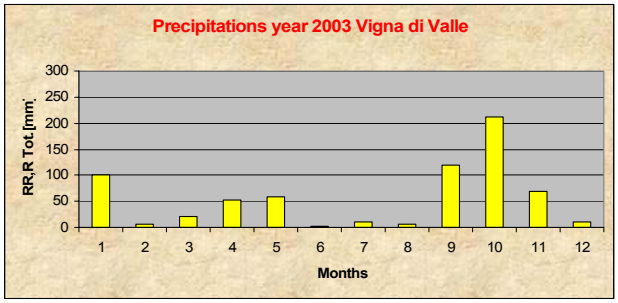


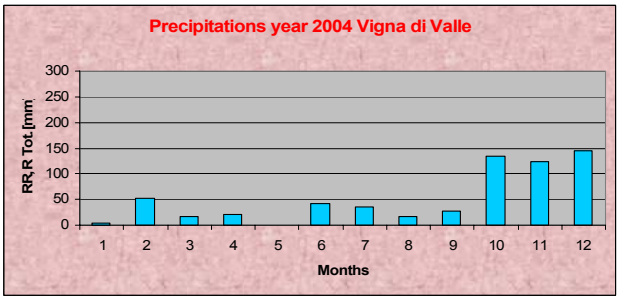




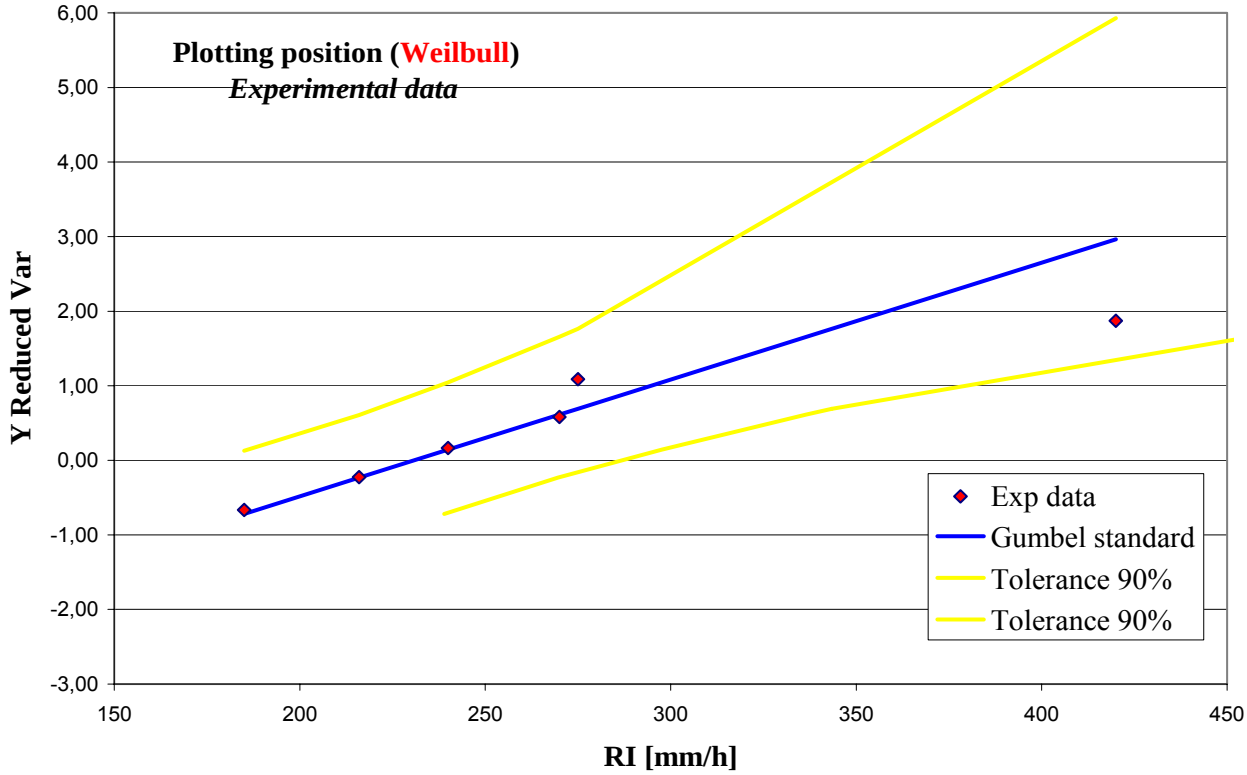


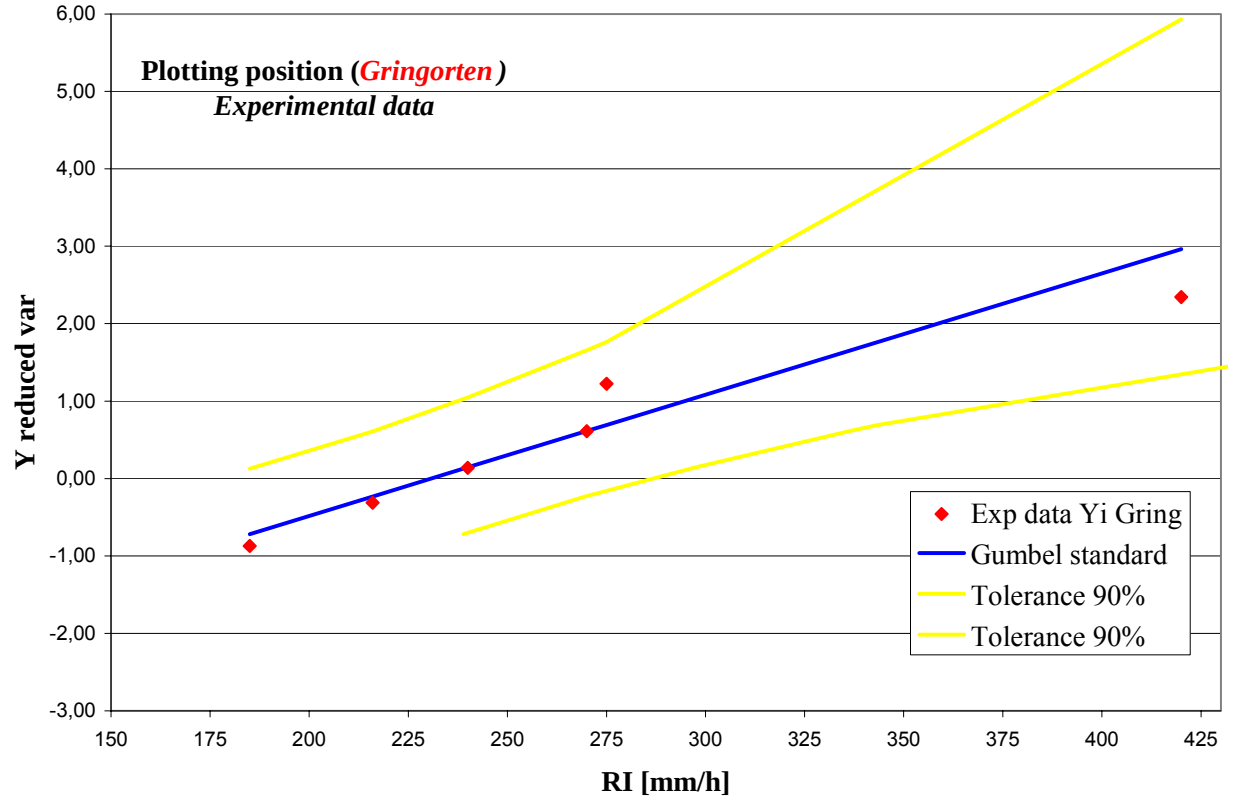




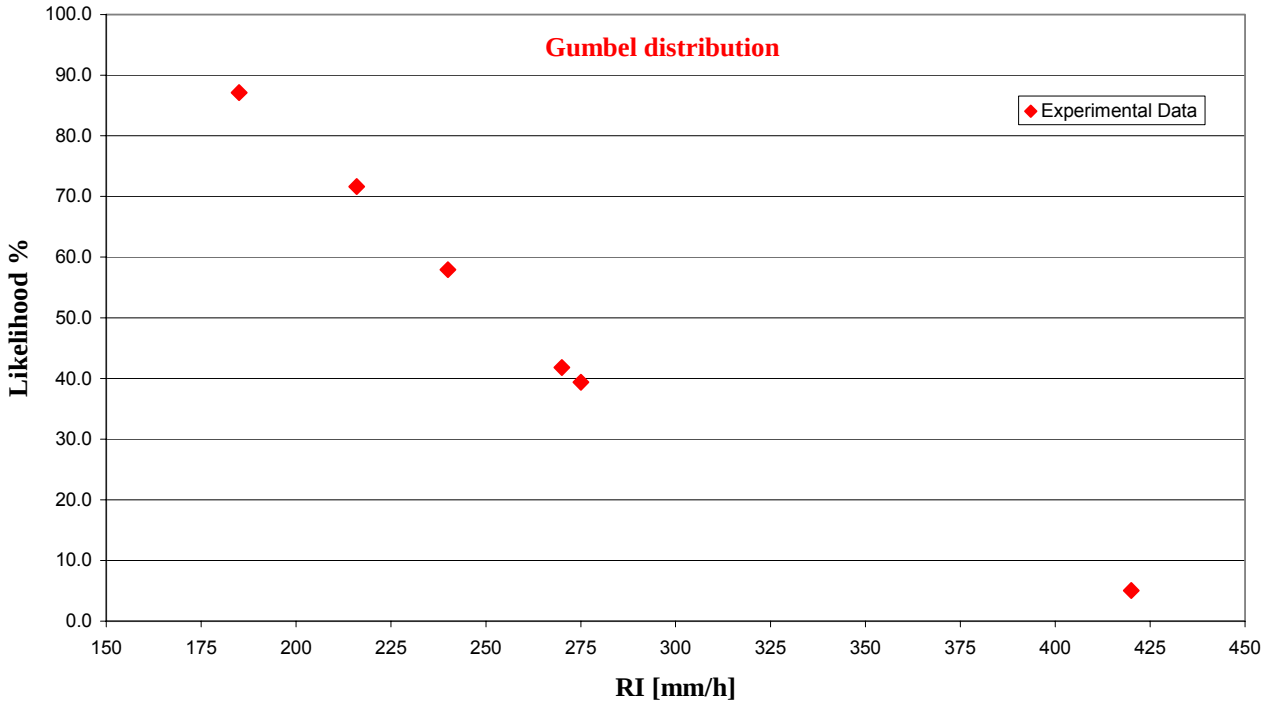


Second Graphs Group: Statistical determination of cumulated probability for high RI events

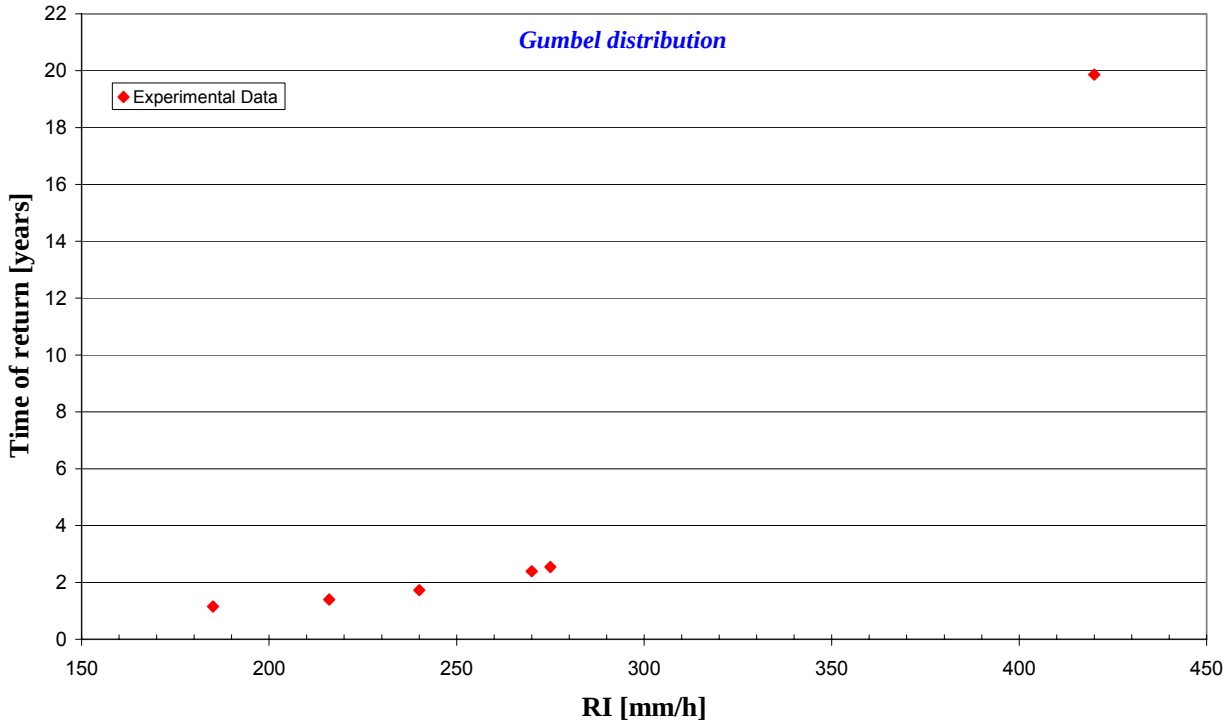




Likelihood(%) and Time of Return (years) for high RI[mm/h] values for 6 experimental data.



Likelihood *[%] = (1-P)*100 = probability (0-100%) to have a value ≥ RI value*



Likelihood(%) and Time of return (years) for high RI[mm/h] events for <u>theory data</u> but <u>with the evaluated Gumbel parameters</u>.