XVI World Water Congress

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UNIVERSIDADE ESTADUAL PAULISTA
"JÚLIO DE MESQUITA FILHO"

DETERMINING THE RAINFALL INDICES EXPECTED IN A RETURN PERIOD FOR THE REGION OF GUARATINGUETÁ – SP - BRAZIL

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- Frontal systems;
- Orography;
- Convective rains;
- Continental and Sea breezes.

Latitude 22° 45' S
Longitude 45°10'W
Altitude of 536m

Fonte: Thinglink.

Water Balance

Fonte: Grupo Escolar.

The rainfall present in the hydrological cycle can be predicted through the return period, which is the average time (measured in years), used to analyze the planning of a construction, in order to evaluate the probability of rainfall that can be equalized or even exceeded for a given period and is necessary in the formulation of a project, so that it can support this rainfall variation.

Objective

The objective of this work is to determine the period of return or period of recurrence of rainfall totals, in order to facilitate the construction of works and serve as a preventive measure for works already carried out.

Aeronautics Ministry Meteorological Station

Department of Water and Energy of the State of São Paulo

National Institute for Space Research

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ANNUAL RAINFALL
PERIOD FROM 1974 TO 2012

Year	Rainfall(mm)
1974	1059,3
1975	1500,3
1976	2027,7
1977	1065
1978	1145,6
1979	1062,4
1980	1039,1
1981	1200,9

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SEASONAL RAINFALL
PERIOD FROM 1962 TO 1991

Year	Summer	Autumn	Winter	Spring
1962	794,1	69,5	118,3	579,9
1963	454,2	7,4	8,1	438,4
1964	661,7	174,8	112,1	367,5
1965	683,1	181,3	112,2	617,1
1966	694,2	101,5	129,9	733,6
1967	790,1	70,8	68,6	503,6
1968	460,7	33,6	81,1	404,2
1969	466,6	88,3	82,2	490,2

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Methodology

FREQUENCY → FX → MEAN RAINFALL(Σ FX/FREQ.)

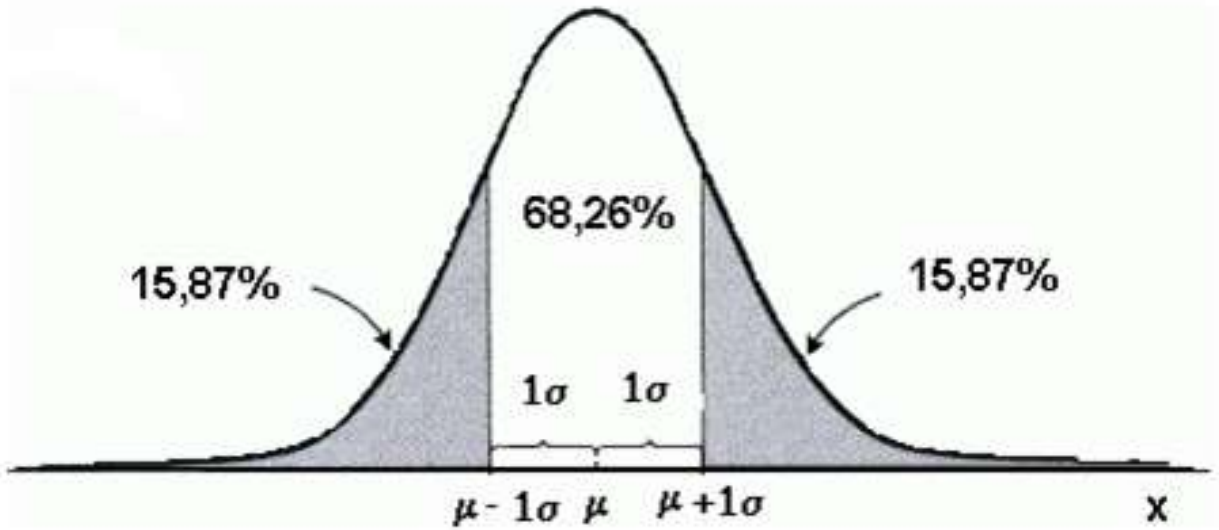
Rainfall (mm)	Classes	Midpoint (X)	Frequency	F. X	Y	F . Y	$(F.Y)^2$

The distribution function of Gauss's Law is expressed by:

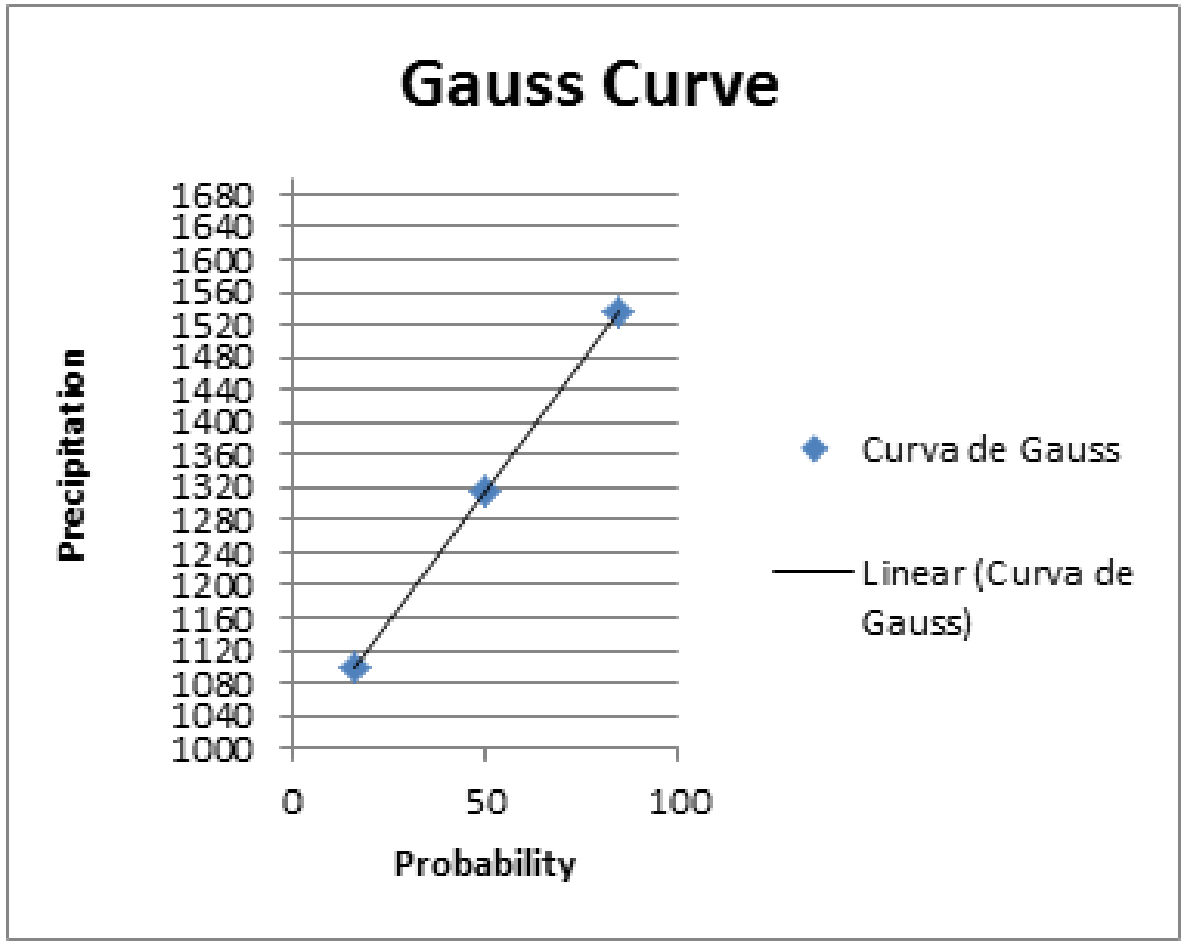
$$F(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{z} e^{-z^2/2}\, dz$$

F(x): probability of an annual total being less than or equal to x;
X: a determined annual total precipitation;

1. $F(\mu) = 50$
2. $F(\mu - \sigma) = 15{,}87$
3. $F(\mu + \sigma) = 84{,}13$



Source: UFPA



Return Period

Return Period

	Probabilities of Expected Rainfall Heights	
Return Period	**Maximum**	**Minimum**
2 years	50%	50%
5 years	80%	20%
10 years	90%	10%
20 years	95%	5%
50 years	98%	2%
100 years	99%	1%
1.000 years	99,90%	0,10%
10.000 years	99,99%	0,01%

Source: Villela e Matos, 1975.

Results

Annual Rainfall

	1974-2012	1974-1983	1984-1993	1994-2003	2004-2012
Mean Rainfall (mm)	1317,18	1304,00	1324,00	1318,00	1323,33
Standard Deviation (mm)	219,13	144,653	134,746	107,22	84,55

Return Period	1974-1983	1984-1993	1994-2003	2004-2012
10 Years	Max. 1473,528 40% Mín.1134,472 10%	Max. 1489,505 20% Mín.1138,495 20%	Max. 1443,649 20% Mín.1192,351 20%	Max. 1422,539 Mín.1224,121
20 Years	Max.1490,481 20% Mín.1117,519 20%	Max.1507,056 10% Mín.1120,944 0%	Max.1456,214 Mín.1179,786	Max.1432,46 Mín.1214,20
100 Years	Max.1511,672 Mín.1096,328	Max.1528,994 Mín.1099,006	Max.1471,92 Mín.1164,08	Max.1444,861 Mín.1201,799

Seasonal Rainfall (1962-1991)

	Summer	Autumn	Winter	Spring
Mean Rainfall (mm)	616,00	158,00	123,67	502,00
Standard Deviation (mm)	209,11	125,58	80,03	192,44

Return Period	Summer	Autumn	Winter	Spring
10 Years	Max.861,07 Min.370,93	Max.305,18 Min.10,82	Max.217,46 Min.29,88	Max.669,52 Min.334,48
100 Years	Max.916,22 Min.315,78	Max.338,29 Min.0,00	Max.238,57 Min.8,77	Max.707,22 Min.296,78

Conclusion

Decades

- Rainfall distribution - homogeneous;
- Obtaining rainfall averages for decades that vary no more than 20mm but present increasing averages over decades;
- The interval also presented rainfall averages that, after a high rainfall, decreased the following year, until reaching a low rainfall, only to increase again, showing a cyclic distribution throughout the period.

Seasonal

Averages behave according to the season for tropical climate of altitude, with summer being more rainy, followed by spring, autumn and the driest one, winter, with a difference of average rainfall between summer and winter of 492.33 mm.

Tomaz, Plínio.(2010) *Cálculos Hidrológicos e Hidráulicos para Obras Municipais – Chapter 3 : Return Period. Available from:* www.pliniotomaz.com.br/downloads/Novos_livros/livro_metodo_calculos_vazao/capitulo03 *[accessed* 30th auguste 2016].

Leal, Leila do Socorro Monteiro; Bouth, Celesta do Vale; Silva, Mauro Mendonça. *Determinação do Período de Retorno de Totais Pluviométrico Através do Método de Gumbel para Belém do Pará - Universidade Federal de Viçosa. Available from:* www.cbmet.com/cbm-files/13-4d48e8aa65609ca4a6e7bbb437016865.pdf *[accessed 30th auguste 2016].*

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THANK YOU

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