Some Climatic Variability on the Argentina Regions

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The following presentation is a sample of the lines of work performed by an investigation group which respond to the following objectives:
Climatology of precipitation, temperature and streamflow extremes.
Low variability (climatic jumps, trends) .
Synoptic Climatology of precipitation and temperature. Relationship between climatic and hydrologic variables.

In an attempt to explain climatic jumps and variabilities observed in precipitation series and water vapor advection over the southern cone of South America, the estimated low frequencies of pressure series at the center of south Atlantic anticyclone are presented and compared with data from continental coastal stations (Buenos Aires Observatory and Rio de Janeiro). In figure 1 we can distinguish a low frequency wave in phase and therefore certain properties of the center of the anticyclone can be inferred from the pressure series over the continent. This is also related to the Río Paraná streamflow and rainfall in northwestern Argentina. These variabilities are accompanied by climatic jumps in annual precipitation which were found for the years shown in figure 2 over the argentine territory. Nevertheless this effect is non existent in Chile, where the annual precipitation series only present trends . It is important to point out that these jumps coincide with important changes in the economic activities of the region (specially agriculture). This changes can be inferred from the progressive expansion of cultivated areas towards semi arid or arid regions, due to the lapse of above normal precipitations in the region caused by the climatic jump. One of the regions of the Rio de la Plata Basin with greatest flood risk and considerable impacts is the Uruguay river basin. In this area the necessity of a hydrologic forecast requires the study of precipitation properties and their relationship with streamflows. First of all, the basin is affected by different precipitation regimes which are clearly defined by the annual cycle. It can be inferred, trough the mean area precipitation and streamflow in the gauge stations which limit the runoff area in each subregion, different annual patterns as those in figure 3. In the case of the northern region, called R1, streamflows are total values and not differences between stations as in the other Rs. It is clear that a precipitation – streamflow model for the Uruguay basin there, should contemplate the different relationships between the cited variables determined by the soil in each sub – basin. Another element of interest and which reflects the kind of relation between the mentioned variables and its stability is given by the laws of probability associated with the anomalies. In this case, it is of interest to compare the amount of negative anomalies each year and the sequences of those properties. In this sense a binomial and a geometric law are proposed and the precipitation and streamflow series at selected points of the basin are fitted. The stations chosen for fitting monthly precipitation are Rio de Janeiro and Concordia, and Santo Tome and Concordia are selected in the streamflow adjustment. In both cases it is intended to show the conditions in the northern and southern limits of the basin. On the other hand, this basin presents the peculiarity of being very extended in latitude when compared to its maximum zonal extension. Tables 1 show the respective fittings and it can be inferred that precipitation fits very well throughout the basin indicating similar processes in the climatic scale, which are not observed in the streamflow, which although statistically homogeneous along the river, do not present the same fitting models in the case of negative monthly anomalies. This is due, mainly, to two facts: persistence is greater in streamflow and double maximums are generated in the number of monthly anomalies each year. This indicate that the physical relation between precipitation and streamflow is not linear.

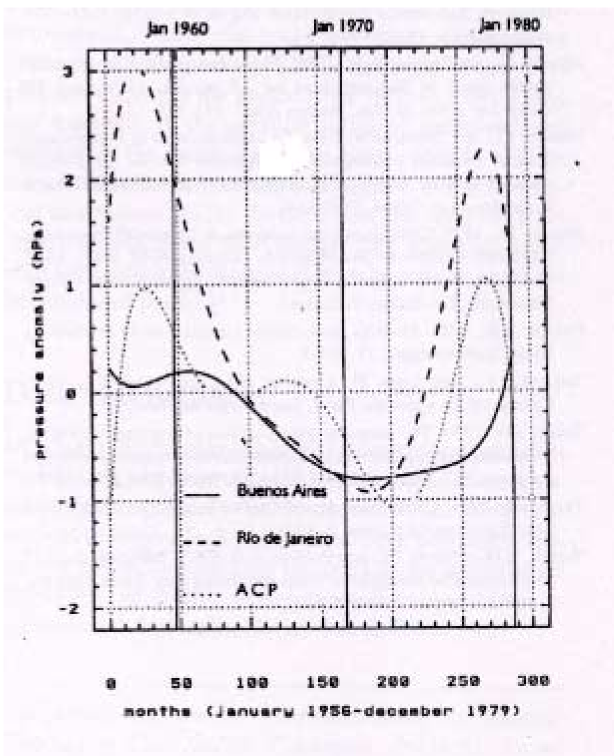

Fig. 1: Pressure anomaly series of the Anticyclone center (ACP), Buenos Aires and Rio de Janeiro.

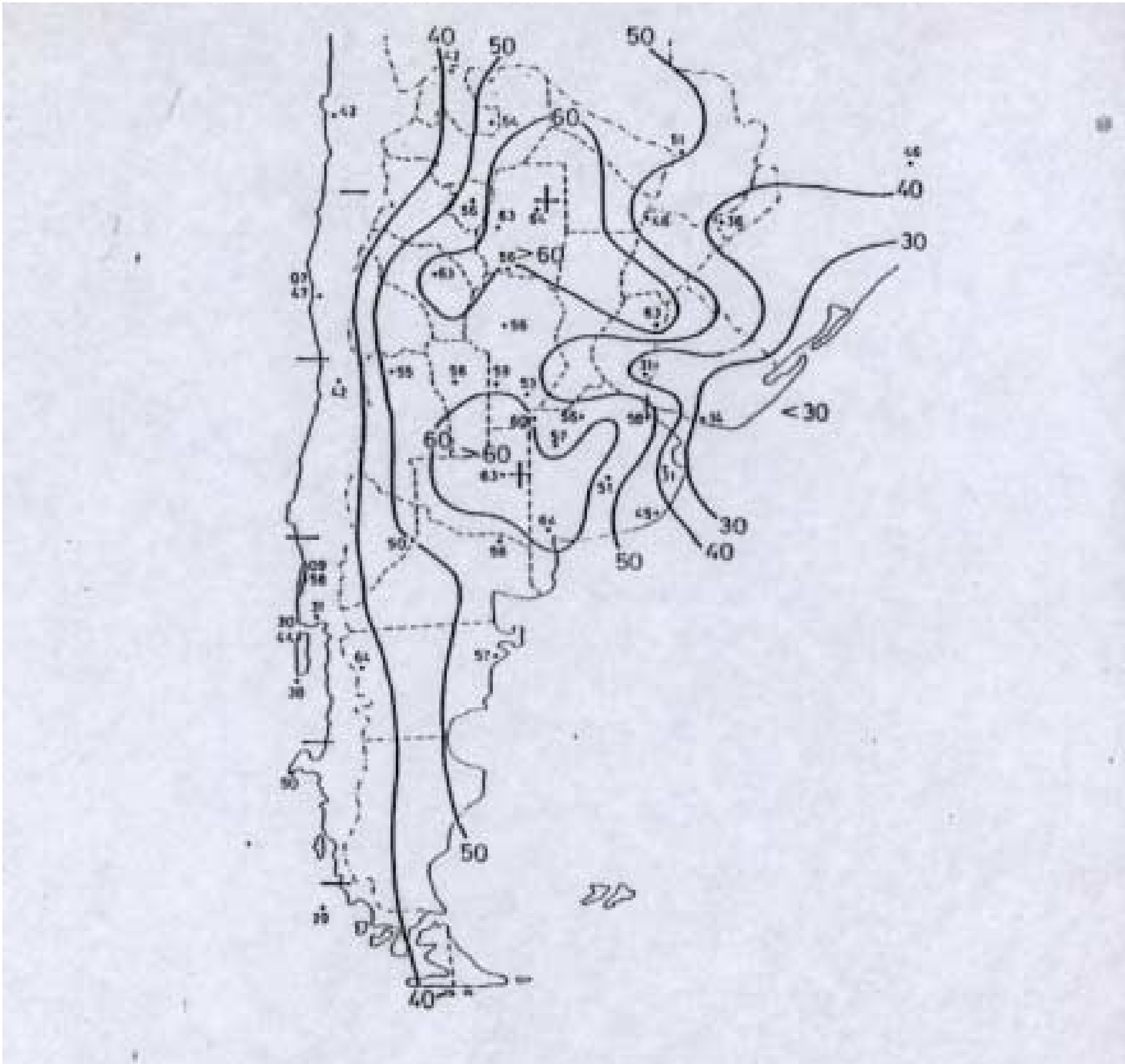

Fig. 2 Isochrons of years registering the main change in the mean of annual precipitation. Each number must be read plus 1900.

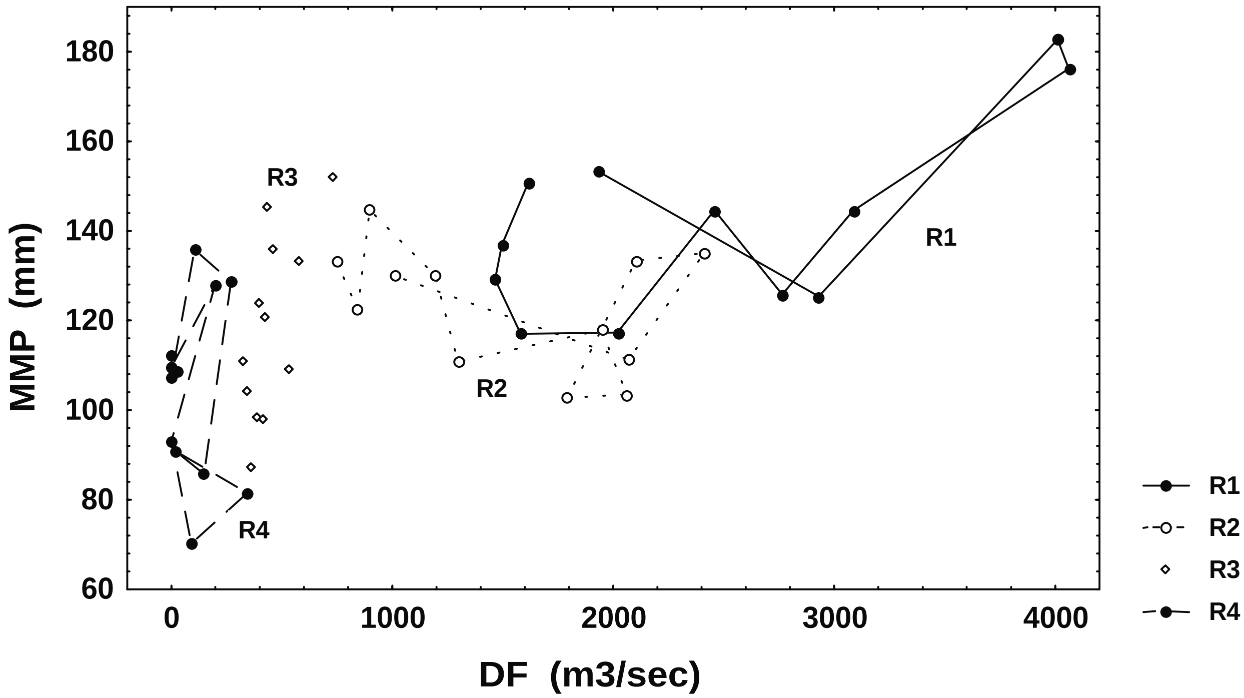

Fig 3. Annual monthly means precipitation (MMP) vs discharges (DF) at four basins of the Uruguay River

<u>NEGATIVE ANOMALIES</u>
PRECIPITATION

a) BINOMIAL DISTRIBUTION

CONCORDIA

K	Fk	PROB. ESTIMATE	FREQ. THEORETICAL
0	**1**	.000027	**0.0**
1	**0**	.000449	**0.0**
2	**1**	.003474	**0.3**
3	**0**	.016277	**1.4**
4	**6**	.051470	**4.5**
5	**9**	.115737	**10.3**
6	**19**	.189768	**16.8**
7	**17**	.228600	**20.3**
8	**15**	.200798	**17.8**
9	**13**	.125423	**11.1**
10	**5**	.052881	**4.7**
11	**3**	.013513	**1.2**
12	**0**	.001583	**0.1**

〉ζ 2 = 2.781

RIO DE JANEIRO

K	FK	PROB. ESTIMATE	FREQ. THEORETICAL
0	**0**	.000037	**0.0**
1	**0**	.000592	**0.0**
2	**1**	. 004367	**0.5**
3	**5**	.019534	**2.6**
4	**8**	.058977	**8.0**
5	**20**	.126625	**17.3**
6	**23**	.198234	**27.1**
7	**27**	.228005	**31.2**
8	**27**	.191223	**26.1**
9	**17**	.114043	**15.6**
10	**4**	.045910	**6.2**
11	**3**	.011201	**1.5**
12	**2**	.001253	**0.1**

〉ζ 2 = 3.96

b) GEOMETRIC DISTRIBUTION

CONCORDIA **RIO DE JANEIRO**

K	F	PROBABILITY ESTIMATE	**FREQUENCY THEORETICAL**	K	F	PROBABILITY ESTIMATE	**FREQUENCY THEORETICAL**
0	**387**	.592453	**1372.0**	0	**561**	.56962	**538.2**
1	**140**	.241452	**151.6**	1	**215**	.24515	**231.6**
2	**54**	.098404	**61.7**	2	**92**	.10551	**99.7**
3	**24**	.040104	**25.1**	3	**41**	.04541	**42.9**
4	**14**	.016344	**10.2**	4	**14**	.01954	**18.4**
5	**3**	.006661	**4.1**	5	**11**	.00841	**7.9**
6	**2**	.002715	**1.7**	6	**2**	.00362	**3.4**
7	**3**	.001106	**0.6**	7	**4**	.00156	**1.4**
8	**1**	.000451	**0.2**	8	**4**	.00070	**0.6**
9	**0**	.000184	**0.1**	9	**1**	.00028	**0.2**
10	**0**	.000075	**0.0**	10	**0**	.00012	**0.1**
11	**0**	.000031	**0.0**	11	**0**	.00005	**0.0**
12	**0**	.000000	**0.0**	12	**0**	.00000	**0.0**

⟩ζ 2 = 7.65 ⟩ζ 2 = 22.03

NEGATIVE ANOMALIES

RUNOFF

a) BINOMIAL DISTRIBUTION

CONCORDIA **SANTO TOME**

K	**Fk**	PROB. ESTIMATE	**FREQ. THEORETICAL**	K	**FK**	PROB. ESTIMATE	**FREQ. THEORETICAL**
0	**0**	.000015	**0.0**	0	**0**	.000010	**0.0**
1	**1**	.000273	**0.0**	1	**0**	.000193	**0.1**
2	**4**	.002286	**0.2**	2	**2**	. 001712	**0.1**
3	**3**	.011619	**1.1**	3	**2**	.009186	**0.7**
4	**13**	.039863	**3.8**	4	**8**	.033277	**2.7**
5	**10**	.097269	**9.4**	5	**8**	.085727	**7.0**
6	**6**	.173051	**16.7**	6	**10**	.161032	**13.2**
7	**7**	.226194	**21.9**	7	**16**	.222235	**18.2**
8	**18**	.215584	**20.9**	8	**7**	.223635	**18.3**
9	**16**	.146113	**14.1**	9	**10**	.160031	**13.1**
10	**5**	.066844	**6.48**	10	**7**	.077299	**6.3**
11	**8**	.018533	**1.7**	11	**7**	.022629	**1.8**
12	**6**	.002355	**0.2**	12	**5**	.003036	**0.2**

⟩ζ 2 = 136.22 **⟩ζ 2 = 74.74**

b) GEOMETRIC DISTRIBUTION

CONCORDIA | **SANTO TOME**

K	**F**	PROBABILITY ESTIMATE	**FREQUENCY THEORETICAL**	K	**F**	PROBABILITY ESTIMATE	**FREQUENCY THEORETICAL**
0	**289**	.46326	**210.3**	0	**249**	.44877	**180.8**
1	**57**	.24865	**112.8**	1	**57**	.24738	**99.6**
2	**27**	.13346	**60.5**	2	**24**	.13636	**54.9**
3	**27**	.07163	**32.5**	3	**13**	.07516	**30.2**
4	**13**	.03845	**17.4**	4	**19**	.04143	**16.7**
5	**11**	.02064	**9.3**	5	**16**	.02284	**9.2**
6	**8**	.01108	**5.0**	6	**9**	.01259	**5.0**
7	**8**	.00594	**2.7**	7	**6**	.00694	**2.7**
8	**8**	.00319	**1.4**	8	**0**	.00382	**1.5**
9	**2**	.00171	**0.7**	9	**3**	.00211	**0.8**
10	**3**	.00092	**0.4**	10	**5**	.00116	**0.4**
11	**1**	.00049	**0.2**	11	**2**	.00064	**0.2**
12	**0**	.00	**0.0**	12	**0**	.00000	**0.0**

〉ζ 2 = 132.46 〉ζ 2 = 98.49

TABLES 1