SUPPLEMENTARY MATERIAL

APPENDIX A

CHIRPS is a set of infrared rain data, distributed over a network of stations. The project is an initiative of the climate-associated hazard monitoring group and is based on previous approaches to 'intelligent' and high-resolution interpolation techniques (0.05°X0.05°) from a long period of rain observations.

Data from the zonal and southern component of wind, specific humidity and long wave radiation (OLR) data, derived from the National Centers for Environmental Prediction (NCEP–NCAR I) set, between 1991 and 2020, at 2.5°x2.5° spaced grid points, will be used to evaluate the meteorological systems involved in each SACZ performance pattern.

Table.I: Stations used to collect rain and flow data.

STATIONS		BASIN/ Data availability
Rain	Flow	
Seriquite	SERIQUITE	Piranga (D01)
Santa Bárbara	RIO PIRACICABA	Piracicaba (D02)
Morro do Pilar	Belo Oriente	Santo Antônio(D03)
Malacacheta	Vila Matias -Montante	Suaçi (D04)
Itanhomi	Belo Oriente	Caratinga (D05)
São Sebastião da Encruzilhada	São Sebastião da Encruzilhada	Manhaçu (D06)
CHIRPS	Resolution: 0.05°	https://www.chc.ucsb.edu/data/chirps
NCEP/NCAR	Resolução: 2.5°	https://psl.noaa.gov/data/gridded/data.ncep.reanalysis.html.
ANA		https://www.snirh.gov.br/hidroweb/apresentacao
CPRM-SACE		http://www.cprm.gov.br/sace/index_bacias_mo

Data from 32 stations of water quality parameters were collected from the environment portal of the state of Minas Gerais. For this study we evaluated the following parameters: Biochemical Oxygen Demand (DBO), Water Temperature (T), Total Coliforms (Col), PH, Nitrate (NIT), Phosphorus (Pho), Total Dissolved Solids (DST), Total Solids (Sol), Turbidity (TB) (Table 2).

Table II: Stations related to the collection of data from water quality parameters

Altitude	Stations

m	RD001	590	RD027	561	RD056
610	RD001	533	RD029	119	RD057
610	RD004	510	RD030	117	RD058
602	RD007	232	RD031	510	RD064
590	RD009	232	RD032	94	RD065
651	RD013	191	RD033	94	RD067
402	RD018	191	RD034	204	RD049
292	RD019	226	RD035	130	RD053
291	RD021	198	RD039		
306	RD023	198	RD040		
235	RD025	163	RD044		
614	RD026	163	RD045		

Table III: Average precipitation (mm/day) in months with SACZ events for each pattern. Padrão Norte (NP), Padrão Sul (SP), Padrão Centro (CP), DO – representa o código de cada sub-bacia do rio doce, Minas Gerais.

Month	**Piranga (DO1)**			**Piracicaba (DO2)**			**Santo Antônio (DO3)**		
mm/day	NP	CP	SP	NP	CP	SP	NP	CP	SP
JAN	17	15.4	7	24.8	24.5	12	16	15.3	6.4
FEB	12	12.4	3	12	20	6	11	13	4.5
MAR	11.5	14.5	5	12	18.5	6.3	10	14	6
APR	4	10	0	11.5	14.5	0	4.5	9.5	0
OUT	6	10	1.3	4.5	7.5	7.5	7	10.5	7.5
NOV	8	14	9.5	9.5	15	6.3	9.8	13	6.3
DEC	14	16	16	14.5	18	14	13.5	15.2	14

Month	**Caratinga(DO5)**			**Manhuaçu (DO6)**			**Suaçuí (DO4)**		
mm/day	NP	CP	SP	NP	CP	SP	NP	CP	SP
JAN	17	15.4	7	24.8	24.5	12	17	7.4	3.5
FEB	12	12.4	3	12	20	6	14.4	6.3	2.5

MAR	11.5	14.5	5	12	18.5	6.3	14.4	6.4	1.5
APR	4	10	0	11.5	14.5	0	4.3	16.3	0
OUT	6	10	1.3	4.5	7.5	7.5	15.4	6.2	0
NOV	8	14	9.5	9.5	15	6.3	14.3	13.6	6
DEC	14	16	16	14.5	18	14	15.7	13.8	7.4

Table IV: Average flow rates (mm/day) in months with SACZ for each standard

.

Month	Piranga (DO1)			Piracicaba (DO2)			Santo António (DO3)			Suaçuí (DO4)			Caratinga (DO5)			Manhuaçu (DO6)		
m^3/s	PN	PC	PS	PN	PC	PS	PN	PC	PS	PN	PC	PS	PN	PC	PS	PN	PC	PS
JAN	19*	24*	19*	82*	70*	63*	890*	795*	790*	890*	80	150*	850*	780*	770*	270	250 *	245*
FEV	9	14	9	49*	49	62.2	630*	550	400	650*	100*	70	625*	595	400	298*	158	101
MAR	11.5	9.3	9.3	43	53	31	520	600	400	550	120	120	480	600	400	152	150	100
APR	19	0	0	41	42	0	575	570	0	590	50	0	560	580	0	120	155	0
OUT	6.3	11	6.3	12	21	20	210	225	215	180	30	25	200	255	220	50	60	50
NOV	14	9.8	9.8	20	39	21	250	390	385	245	30	70	350	395	380	98	100	98
DEZ	15*	23*	15*	29	70*	50	600	700*	600*	550	170*	75	585	765	570*	300*	250	104*

Table 1. Monitoring stations, municipalities served, and reference quotas.

ESTAÇÃO	CÓDIGO	Cota de Alerta	Cota de Inundação
Ponte Nova	56110005	280	330
Nova Era	56661000	350	470
Mário de Carvalho	56696000	540	620
Belo Oriente	56719998	860	900
Vila Matias	56825000	660	700
Gov. Valadares	56850000	320	360
Tumiritinga	56920000	400	450

Atmospheric Analysis

Figure 1 shows the behavior of the SACZ in different patterns in the Doce river basin and the performance of the main meteorological systems, responsible for the spatial distribution of rainfall in the basin, such as The High of Bolivia (AB), Northeast Dug (CN) and the Subtropical Anticyclone of the South Atlantic (ASAS) (Cupolillo,2008).The northern standard (NP) presented 356 days of operation of the SACZ, the Central (CP) 432 days and the Southern (SP) 257 days, being the least frequent in the entire historical series analyzed. The minimum values of long wave radiation are associated with the regions of greater convection and consequently convective rainfall with a propensity to trigger extreme events and floods (António, 2021).

In the NP, the maximum convection is concentrated from the center to the north of the basin, with values between 200 and 210 w/m^2. The Center (CP) standard shows convection throughout the basin, this result allows us to infer that, with the performance of this pattern there is a propensity for high rainfall accumulated throughout the basin, that is, this is the pattern that rains the most in the basin (Fig.9). On the other hand, in the ER, only one northeast and extreme southern part of the basin present significant values of convection. In addition to these it is observed that the spatial variation of meteorological systems is different for each pattern, when this happens, the rainfall distribution regime may be different for each region (Reboita et al., 2010).

In the NP, the crest associated with high Bolivia stretches to approximately 48°W and the northeast trough has a straighter slope (dashed line in blue). This wide configuration makes the availability of humidity more concentrated in the north of MG, due to the performance of a low anomalous that appears at latitude of 35°S (Fig.9 and Fig.10). In this way, the rainfall regime is also changed. With regard to CP, the extension of PHC is more elongated around 42°W, and the NEB pit has a slope more towards the continent, configuring most of the convection to the north and center of MG, covering the entire basin of the sweet river. Thus, the performance of this pattern favors the distribution of rainfall throughout the basin.

In the SP, the high-level vortex (VCAN) is formed, with Bolivia's rise more elongated towards the Pacific Ocean, this dynamic causes moisture to be mostly concentrated in the state of São Paulo and Paraná, thus causing a moisture deficit throughout the Doce river basin, which is consequently related to softest rains. Thus, depending on the pattern, meteorological systems have a differentiated variation, varying convection and humidity. However, although in the north and south pattern, convection favors part of the west and extreme south of MG, some areas of the basin experience moisture deficit, such as south central and northern basin. These dynamics of weather systems significantly alters the rainfall regime.

Fig.1:long wave radiation in the different patterns of performance of the SACZ in the sweet river basin: PN (North Standard), PC (Southern Standard) and PS (Southern Standard). The current lines represent the wind at high atmospheric levels (300 hPa), illustrating the main systems.

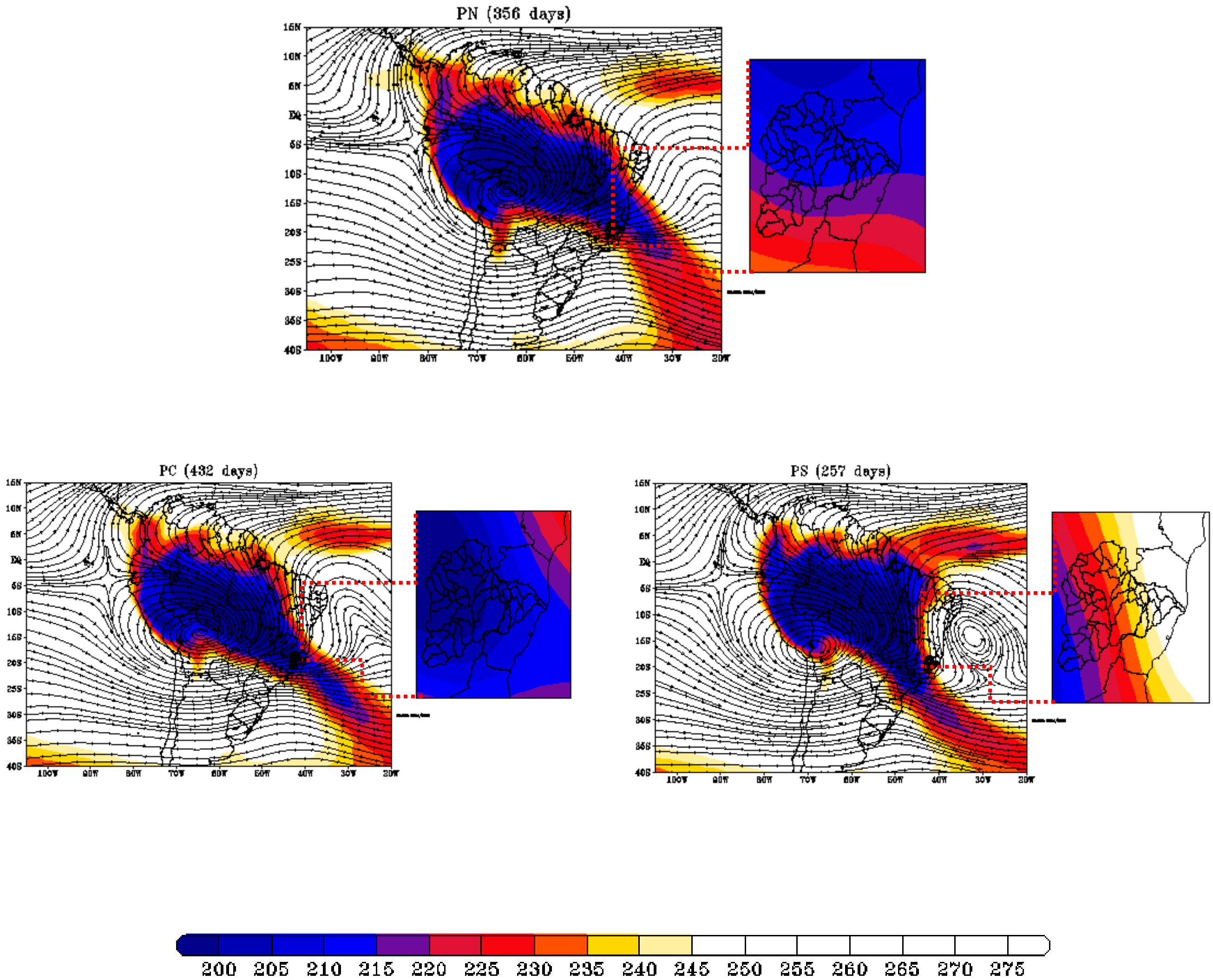

Fig. 1:Wind anomalies at low levels (925 hPa) and integrated humidity transport from 300 to 1000 hPa (ms^-1.kg^-1), for the three main standards of performance of the SACZ .