

EXTREME EVENTS, CLIMATE CHANGE AND ADAPTATION IN THE STATE OF SÃO PAULO¹

GABRIELA MARQUES DI GIULIO²
ROGER RODRIGUES TORRES³
MARIA DA PENHA VASCONCELLOS⁴
DIEGO R. G. C. BRAGA⁵
ROSA MARIA MANCINI⁶
MARIA CARMEN LEMOS⁷

1 Introduction

In recent years, the literature on the role of cities vis-a-vis climate change has grown significantly worldwide. This interdisciplinary area of study recognizes its importance in different aspects of livelihoods, landscapes, climate impacts and governance. On the one hand, cities account for the high rate of sources of emission of greenhouse gases, on the other hand, they are important for elaborating and carrying out coping strategies associated to mitigation and adaptation (BULKELEY, 2010; BULKELEY, BROTO, 2013; AYLETT, 2014; LECK, ROBERTS, 2015; RYAN, 2015). Recently, international organizations, such as the United Nations, have stressed the need of looking at cities and their citizens not only as those conducting policies of national and state interest, but also as generators of solutions to global and local issues (HABITA-ONU, 2017).

In Brazil, a country with high rates of population living in urban areas - over 80% -, cities are critical players regarding climate change impact, particularly because they concentrate areas more likely to be exposed more severely to extreme events such as in-

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2. Holds a doctoral degree in Environment and Society, a faculty member at the Department of Environmental Health, School of Public Health, Universidade de São Paulo. E-mail: ggiulio@usp.br. <https://orcid.org/0000-0003-1396-9788>

3. Holds a doctoral degree in Meteorology, a faculty member at the Institute of Natural Resources, Universidade Federal de Itajubá. E-mail: roger.torres@unifei.edu.br

4. Holds a doctoral degree in Public Health, a faculty member at the Department of Environmental Health, School of Public Health, Universidade de São Paulo. E-mail: mpvascon@usp.br

5. Pursuing a master's degree in Territorial Planning and Management, Universidade Federal do ABC. E-mail: diego1987@gmail.com

6. Pursuing a doctoral degree in Environmental Science, Universidade de São Paulo. E-mail: rmancini@sp.gov.br

7. Holds a doctoral degree in Political Science, faculty member at the School for Environment and Sustainability, University of Michigan. E-mail: lemos@umich.edu

creased rainfall and temperature (NOBRE et al., 2010). These impacts tend to exacerbate the risks commonly occurring in Brazilian cities, as well as revealing the inadequacies in the capacities of local governments to deal with deficits in infrastructure and in the supply of basic services (DI GIULIO, VASCONCELLOS, 2014).

Despite the efforts made to integrate the climate issue in its policies and directives, Brazil has played a relatively conservative role in mitigating and adapting to climate impact (BASSO, VIOLA, 2017). Few are the Brazilian cities that incorporated climate change as guidelines for public policies in their agendas (BARBI, 2015). One of the reasons is the lack and inadequacies related to the incipient record of fundamental data for decision-making, monitoring, protection and prevention actions – a still common fact in Brazilian municipalities. In this sense, the State of São Paulo (SP) does not differ from the other states of the federation. Although the largest Brazilian state in terms of population (over 43 million inhabitants) and economic development, (over 32% of the national GDP, SEADE, 2018), São Paulo is one of the earliest states to consider the climate issue in Brazil, with advances in legal and regulatory aspects, including the enactment of the State Policy for Climate Change in 2009 and of the Climate Protocol in 2015. However, concrete actions have been limited (SIMÕES et al., 2017). For example, only three cities in the state joined the Global Covenant of Mayors for Climate & Energy (2017)⁸, while 33 other Brazilian cities joined.

In this scenario, we argue that the approaches adopted so far, such as, for example, the ones described above – whether or not adequate – have yet to mainstream the climate issue Brazilian and São Paulo municipalities. This deficit, together with the absence or little knowledge about what is actually at stake regarding climate change impact – such as the extension of the consequences and effects on different social, economic, cultural, and political aspects of systems and livelihoods suggest the need for their better understanding. Considering the importance of local urban agendas in the XXI century, in the global macro political contexts, we need for more refined analyses of the interfaces between Brazilian cities and climate change.

These concerns are at the heart of this paper. We provide an analysis of the secondary data deriving from questionnaires about climate change and adaptation filled in by municipal agents acting in SP cities. The questionnaires were sent to all the SP municipalities by the Coordination of the GreenBlue Municipality Program (PMVA), connected to the State of São Paulo Secretariat for the Environment (SMA), in 2015, and answered in that same year. In 2015, the State of SP faced, at different levels of intensity in its municipalities, a water crisis associated to the lack of rain in the summer of 2013/2014 and 2014/2015 and to inefficiencies in terms of water resource management.

Based on a theoretical framework on urban climate governance, which highlights the role local governments play in proposing strategies for dealing with climate change (BULKELEY, 2010; BULKELEY, BROTO, 2013; AYLETT, 2014; LECK, ROBERTS, 2015; RYAN, 2015), the paper presents and discusses the information provided by the municipal agents about the occurrence of extreme climate events in the SP municipalities,

8. Available at: <<http://sams.iclei.org/novidades/noticias/arquivo-de-noticias/2017/mais-de-30-cidades-Brazilian-assu-mem-o-compromisso-com-o-pacto-global-de-prefeitos-pelo-clima-e-energia-em-recife.html>>, accessed in 15/10/2018.

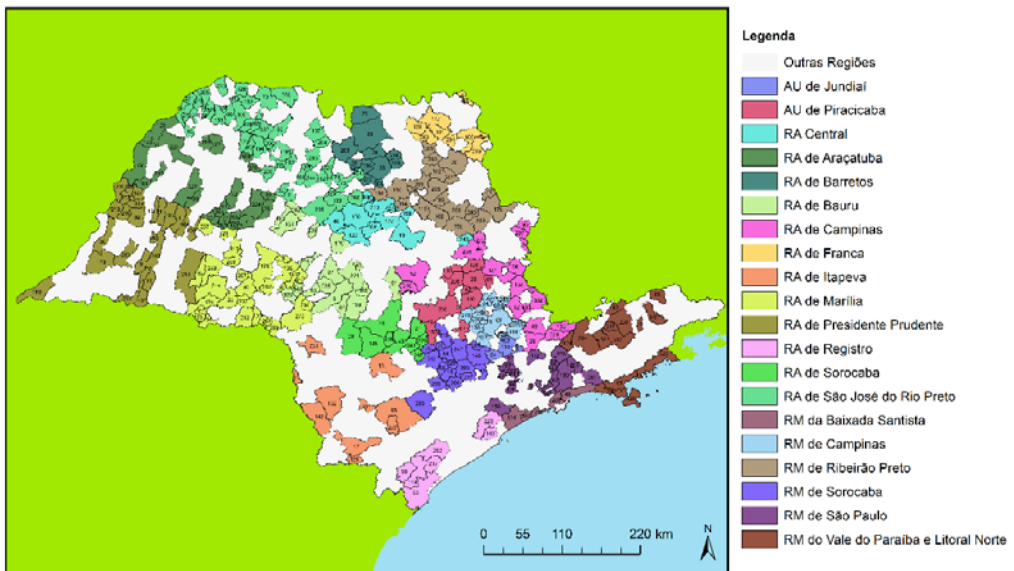
the impacts of these events on different sectors, the perceptions about climate change and the actions more frequently adopted by the municipal public managements. The analysis of the data allows directing the paper to a central question in the context of urban climate governance: what are the barriers and hindrances hampering these cities adaptation process?

2 Methodological aspects

The paper is structured on the analysis of the questionnaire on climate change and adaptation applied to the 645 municipalities of the State of SP in 2015 by the PMVA Coordination, connected to the SMA. The number of valid questionnaires filled in by municipal public agents was 332, corresponding to 51.5% of the total municipalities of the State. Figure 1 presents a map indicating the responding municipalities.

Figure 1 – Georeferencing of the municipalities that answered the questionnaire on climate change and adaptation sent in 2015 in the ambit of the PMVA-SMA, indicating the urban agglomerations, administrative regions and metropolitan regions they belong to.

Georreferenciamento PMVA 2015



PMVA Georeferencing 2015

Source: The authors' elaboration

The instrument applied encompasses the respondent's profile; information on the municipality; perception of climate events (frequencies and impacts); coping actions; responses to climate change; and information on the phenomenon itself. Access to the responses was granted in 2016⁹.

For analyzing the material accessed, a database was elaborated, using the software Statistical Package for Social Sciences (SPSS) for verifying the consistency of the data and for converting the response values.

3 Contextualization - The GreenBlue Municipality Program (PMVA)

Since 2007/2008, SMA has developed the PMVA, a platform that seeks to foster the construction of a common sustainability agenda for the State and with voluntary adhesion on the part of the municipal governments. The rules for participating in the Program are annually edited, but imply taking some steps, among which: 1) Having the Mayor sign the Term of Adhesion to the GreenBlue Municipality Protocol of Intent; 2) Knowledge of the Environmental Directives, consisting of a set of actions relevant to the municipal environmental management; 3) Appointing a technical person, denominated "Interlocutor", to be the representative of the Municipal Government at the SMA, and responsible for collecting data from the different secretariats and departments of the Municipal Government, besides passing them on to the SMA, thus forming a network of commitments.

The PMVA directives indicate that the interlocutors must be dedicated to a wide range of themes and be alert to their surroundings (MANCINI, 2016), which qualifies them to answer the questions analyzed herein. The interlocutors that answered the questionnaire in the ambit of the PMVA are understood to be strategic persons in the municipalities, seeing that they transit the different secretariats and their performance in the ambit of the municipal government, besides having direct connections with the environmental issues.

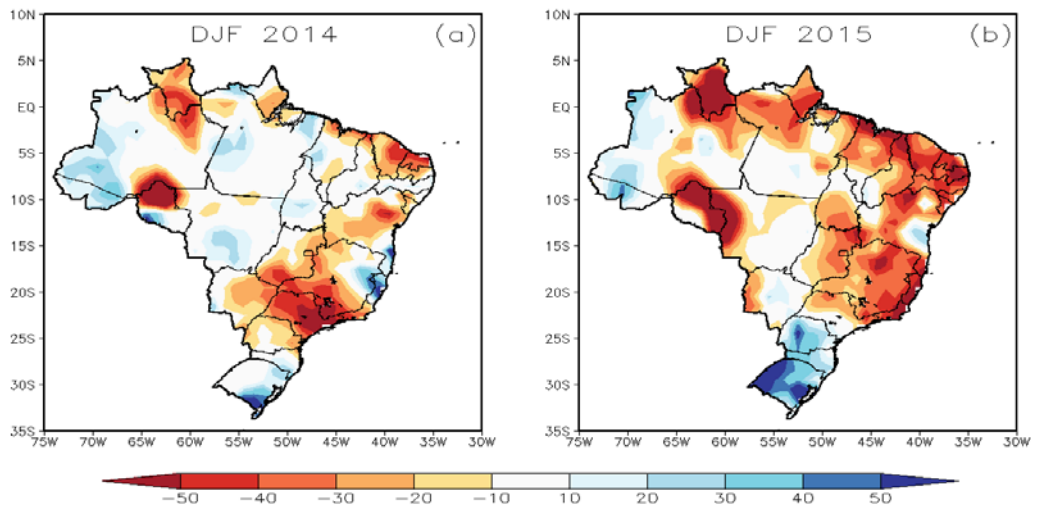
4 Climate contextualization of the period analyzed

From the 2013/2014 summer to January 2016, the Southeast region faced an intense drought, being the worst ever registered by the weather stations established in the region since 1961 (COELHO et al., 2016a,b; CAVALCANTI et al., 2017). The peak of the rainy season in the region occurs between December and February, when the highest rainfall volumes are generally observed, whereas the minimum values are observed from June to August (REBOITA et al., 2010; MARENGO, ALVES, 2016). During these months, the climatological patterns (average of weather data calculated for consecutive 30-year periods) of accumulated rainfall for the region are from 500 to 800 mm (COELHO et al., 2016a). However, in 2014, the driest year in the period, some localities in the Southeast region experimented rainfall deficits of over 300 mm

9. Access to the questionnaires by the team of researchers was only possible in the mid-2016 due to political-administrative issues at the SMA; the results were then analyzed as secondary data.

(Figure 2), that is, approximately 50% less rainfall than the climatology (COELHO et al., 2016a,b; TAFFARELLO et al., 2016).

Figure 2 – Rainfall anomaly (%) for the summer months (December to February - DJF) in 2014 (a) and in 2015 (b). The rainfall data are originally from the Global Precipitation Climatology Centre - GPCC.



Source: The authors' elaboration

This meteorological event led to a series of impacts on water availability, affecting water resources, food and energy production (COELHO et al., 2016a,b; TAFFARELLO et al., 2016; NOBRE et al., 2016). The reservoirs that supply the cities of São Paulo, Rio de Janeiro and Belo Horizonte, for example, reached dangerously low levels in the late 2013 and early 2014, and remained very low over 2014/2015, due to deficient rainy seasons, followed by high temperatures ($\sim 2^{\circ}\text{C}$ above the average) and an increase in the demand for water (TAFFARELLO et al., 2016; MARENGO, ALVES, 2016; NOBRE et al., 2016).

Different studies have been investigated the physical causes of this intense drought event (e.g., COELHO et al., 2016; MARENGO, ALVES, 2016; CAVALCANTI et al., 2017), as well as its impacts (e.g., NOBRE et al., 2016; TAFFARELLO et al., 2016). These studies indicate that the main cause for the lack of rain was a persistent anomalous high air pressure system acting over the Southeast region, which inhibited the upward air movement and, consequently, hindered the formation of clouds (MARENGO, ALVES, 2016), besides serving as a barrier to the humidity coming from the Amazon to the region (CAVALCANTI et al., 2017). Moreover, Seth et al. (2015) and Coelho et al. (2016a) identified that this anomalous system of high air pressure was correlated to warmer waters than the climatology in the Southwest region of the South Atlantic Ocean and West of the tropical Pacific Ocean.

Besides the atmospheric conditions, studies recognize this water crisis as a combination of factors that also include the lack and/or inadequacy of water resource mana-

gement (MARENGO et al., 2015), evidencing important discussions regarding the high losses in the supply network, conflicts of interest in the concession models, alternative supply sources, behaviors related to water safety and sustainability and justice for water (SORIANO et al., 2016).

5 Data of the questionnaires responded

5.1 Profiles of the institutional interlocutors

In the context of the questionnaire applied by the SMA, considering the background and familiarity with the environmental science areas was important to understand whether there is or not a correspondence between the profile of the interlocutors and the themes proposed by the Secretariat. In this sense, an analysis of the respondents' profiles reveals that the majority has completed their higher education (75%); four higher education courses were clearly more common: Agronomy, 14.2%; Environmental Engineering, 12.7%; Biology, 11.7%; and Environmental Management, 9.6%. These respondents are allocated in different sectors within the municipal governments, the following standing out: secretariats (34.9%) and departments/sectors/boards (27.7%) – related to environmental issues; and civil defense (20.2%).

5.2 Occurrence of extreme climate events

According to the literature, we here conceptualize the set of extreme climate events including: a) mild, moderate and severe flooding; b) landslide, collapse and slip; c) drought. Among these events, drought was pointed out as the most frequent event by the respondents in the two years (in 2014, 38.6% of the responses; in 2015, 29.8%), as shown in Table 1.

Table 1 – Occurrence of climate events in 2014 and in 2015.

Event	2014							
	Yes		No		NR		Total	
	Abs.n.	%	Abs.n.	%	Abs.n.	%	Abs.n.	%
Mild, moderate and severe floods	98	29.5	133	40.1	101	30.4	332	100.0
Land slide, collapse and slip	53	15.0	166	50.0	113	34.0	332	100.0
Drought	128	38.6	102	30.7	102	30.7	332	100.0
None of these events occurs	56	16.9	0	0.0	276	83.1	332	100.0
Other events	45	13.6	131	39.5	156	47.0	332	100.0

Event	2015							
	Yes		No		NR		Total	
	Abs.n.	%	Abs.n.	%	Abs.n.	%	Abs.n.	%
Mild, moderate and severe floods	88	26.5	140	42.2	104	31.3	332	100.0
Land slide, collapse and slip	41	12.3	171	51.5	120	36.1	332	100.0
Drought	99	29.8	127	38.3	106	31.9	332	100.0
None of these events occurs	52	15.7	17	5.1	263	79.2	332	100.0
Other events	43	13.0	131	39.5	158	47.6	332	100.0

Source: PMVA-SMS. Elaboration: VCV

Note: NR “no response”

5.3 Impacts of extreme climate events

Regarding the impacts of these events, in the three events analyzed, a greater adhesion of responses was observed to the very low and low risk for the four sectors included in the questionnaire: population, infrastructure, economy and health, as shown in Table 2.

Table 2- Impacts of climate events on the population, infrastructure, economy and health.

Impact on the Population	Event					
	Mild, moderate and severe floods		Land slide, collapse and slip		Drought	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
1 - Very low	59	17.8	68	20.5	36	10.8
2 - Low	48	14.5	22	6.6	34	10.2
3 - Moderate	52	15.7	17	5.1	49	14.8
4 - High	19	5.7	18	5.4	37	11.1
5 - Very high	17	5.1	6	1.8	23	6.9
NR	137	41.3	201	60.5	153	46.1
Total	332	100.0	332	100.0	332	100.0

Impact on the Infrastructure	Event					
	Mild, moderate and severe floods		Land slide, collapse and slip		Drought	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
1 - Very low	78	23.5	65	19.5	68	20.5
2 - Low	46	13.9	26	7.8	44	13.3
3 - Moderate	40	12.0	20	6.0	33	9.9
4 - High	19	5.7	10	3.0	20	6.0
5 - Very high	8	2.4	7	2.1	7	2.1
NR	141	42.5	204	61.4	160	48.2
Total	332	100.0	332	100.0	332	100.0

Impact on the Economy	Event					
	Mild, moderate and severe floods		Land slide, collapse and slip		Drought	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
1 - Very low	90	27.1	83	25.0	42	12.7
2 - Low	50	15.1	22	6.6	29	8.7
3 - Moderate	32	9.6	14	4.2	51	15.4
4 - High	10	3.0	3	0.9	38	11.4
5 - Very high	2	0.6	2	0.6	21	6.3
NR	148	44.6	208	62.7	151	45.5
Total	332	100.0	332	100.0	332	100.0

Impact on Health	Event					
	Mild, moderate and severe floods		Land slide, collapse and slip		Drought	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
1 - Very low	96	28.9	83	25.0	41	12.3
2 - Low	41	12.3	25	7.5	24	7.2
3 - Moderate	32	9.6	10	3.0	54	16.3
4 - High	11	3.3	6	1.8	38	11.4
5 - Very high	4	1.2	1	0.3	23	6.9
NR	148	44.6	207	62.3	152	45.8
Total	332	100.0	332	100.0	332	100.0

Source: PMVA-SMS. Elaboration: VCV

5.4 Perception of climate change

The responses allow identifying the opinion of the respondents about the presence of climate change in the municipalities and whether these alterations constitute a problem to be tackled in those cities. The analysis shows that for 88% of the respondents, the phenomenon occurs in their municipalities (6.3% said no and 5.7% did not respond). When asked whether climate change was an issue to be tackled in their municipalities, 81.9% responded yes; 11.1%, no and 6.9% did not respond. Regarding their (individual) level of concern with climate change in their municipalities, an expressive percentage of the respondents indicated high (31.9%) and very high (19.3%) concern.

In a 1-6 scale of importance, 6 being the most important, the majority (53.9%) responded that rivers, streams and water basins were the aspects mostly affected by climate change. Plants and animals (38.6%), and the poorer population (33.7%) were next pointed out in degree of importance. Regarding the events and facts that had occurred in the past five years in the municipalities, an expressive majority pointed out a greater occurrence of heat waves (90.7%) and longer drought periods (88.3%). Also recognized by the majority was the increase in built areas in the municipality territory (75.3%), increase in local population (59.3%) and decrease in ground water (51.5%).

5.5 Municipalities actions

The set of responses about the actions more usually adopted by the municipalities reinforces the verification of routine actions conducted by the civil defense, that is, contention and punctual responses of interventions aided by solidary practices. Among these, the following can be detached: blocking access to risk areas, issuing warnings, distributing food and water and requesting help from the state government.

The respondents pointed out the need for medium and long-term public policies and expected these policies to be the object of execution by the secretariats they are connected to at a local action level. In this sense, from a list of actions mentioned in the questionnaire to be adopted by the municipalities and understood as priorities by the respondents (in a 1-5 scale, 5 being the most important), the following received the highest percentage of responses as the most important: environmental education (46.7%), preservation of riparian forests and of watersheds (with 34.9% and 34%, respectively) and planting trees (30.1%). From the list of actions mentioned and directly associated with climate issues, five stood out: preservation of riparian forests (92.2%), planting trees (91.3%), watershed preservation (88.3%), environmental education (84.3%), renewable sources of energy (76.5%) and fostering the cultivation of the region native plants (75%).

Of the 332 municipalities, a little over one-third - 113 (34%) – count on some specific plan for preservation and response to risk and emergency situations. Nevertheless, even more expressive is the percentage of municipalities that, according to the respondents, present Master Plans that do not include prevention actions or response to climate change (63%) or to extreme events (55.7%).

Another relevant datum refers to the participation of the municipalities in associations, entities and/or networks related to climate change. Although 42.8% of the respondents failed to answer the question, the analysis of the responses shows that only 15.1% of the municipalities participate in an association, unspecified in the questionnaire.

Regarding the responsibility attributed by these respondents to prevent issues associated to the three sets of extreme climate events, it can be observed that the government, in its three levels, starts ahead of the other groups of actors, receiving high and very high responsibility, as shown in Table 3.

Table 3 – Scale of responsibility by the federal, state and municipal Governments, universities, private productive, individual and community sectors.

Scale of responsibility by the Federal Government	Event					
	Mild, moderate and severe floods		Land slide, collapse and slip		Drought	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
1 - Very low	36	10.8	46	13.9	37	11.1
2 - Low	36	10.8	28	8.4	21	6.3
3 - Medium	56	16.9	43	13.0	33	9.9
4 - High	46	13.9	49	14.8	60	18.1
5 - Very high	81	24.4	60	18.1	83	25.0
NR	77	23.2	106	31.9	98	29.5
Total	332	100.0	332	100.0	332	100.0

Scale of responsibility by the State Government	Event					
	Mild, moderate and severe floods		Land slide, collapse and slip		Drought	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
1 - Very low	15	4.5	24	7.2	32	9.6
2 - Low	25	7.5	23	6.9	17	5.1
3 - Medium	62	18.7	50	15.1	38	11.4
4 - High	83	25.0	67	20.2	62	18.7
5 - Very high	70	21.1	63	19.0	83	25.0
NR	77	23.2	105	31.6	100	30.1
Total	332	100.0	332	100.0	332	100.0

Scale of responsibility by the Municipal Government	Event					
	Mild, moderate and severe floods		Land slide, collapse and slip		Drought	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
1 - Very low	12	3.6	12	3.6	41	12.3
2 - Low	11	3.3	8	2.4	15	4.5
3 - Medium	71	21.4	56	16.9	52	15.7
4 - High	67	20.2	61	18.4	45	13.6
5 - Very high	107	32.2	97	29.2	79	23.8
NR	64	19.3	98	29.5	100	30.1
Total	332	100.0	332	100.0	332	100.0

Scale of responsibility by the universities and research centers	Event					
	Mild, moderate and severe floods		Land slide, collapse and slip		Drought	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
1 - Very low	76	22.9	70	21.1	58	17.5
2 - Low	62	18.7	47	14.2	33	9.9
3 - Medium	49	14.8	48	14.5	44	13.3
4 - High	25	7.5	24	7.2	37	11.1
5 - Very high	29	8.7	26	7.8	45	13.6
NR	91	27.4	117	35.2	115	34.6
Total	332	100.0	332	100.0	332	100.0

Scale of responsibility by the private productive sector	Event					
	Mild, moderate and severe floods		Land slide, collapse and slip		Drought	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
1 - Very low	72	21.7	67	20.2	52	15.7
2 - Low	62	18.7	60	18.1	33	9.9
3 - Moderate	57	17.2	43	13.0	40	12.0
4 - High	24	7.2	21	6.3	42	12.7
5 - Very high	28	8.4	26	7.8	51	15.4
NR	89	26.8	115	34.6	114	34.3
Total	332	100.0	332	100.0	332	100.0

Individual Scale of responsibility	Event					
	Mild, moderate and severe floods		Land slide, collapse and slip		Drought	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
1 - Very low	56	16.9	60	18.1	62	18.7
2 - Low	40	12.0	39	11.7	20	6.0
3 - Medium	70	21.1	56	16.9	44	13.3
4 - High	23	6.9	18	5.4	39	11.7
5 - Very high	51	15.4	40	12.0	54	16.3
NR	92	27.7	119	35.8	113	34.0
Total	332	100.0	332	100.0	332	100.0

Scale of responsibility by the community	Event					
	Mild, moderate and severe floods		Land slide, collapse and slip		Drought	
	Abs.n.	%	Abs.n.	%	Abs.n.	%
1 - Very low	33	9.9	34	10.2	52	15.7
2 - Low	37	11.1	38	11.4	24	7.2
3 - Medium	76	22.9	69	20.8	49	14.8
4 - High	49	14.8	35	10.5	38	11.4
5 - Very high	55	16.6	44	13.3	62	18.7
NR	82	24.7	112	33.7	107	32.2
Total	332	100.0	332	100.0	332	100.0

Source: PMVA-SMS. Elaboration: VCV

Note: NR "no response"

6 Discussion

The PMVA expectation is that the respondents of this questionnaire, due to the functions they perform in the municipal management, have a direct connection with the environmental issues; besides, their professional qualification and circulation among the different municipal secretariats/departments, should make them capable of filling in the data adequately. Hence, the high percentage of absence of responses to several questions is surprising, particularly those concerning climate events occurrences, their impacts on different sectors and scales of responsibility in preventing them. This lack of response may be interpreted in the light of the three arguments discussed herein and which are at the base of the barriers to advancing the process of adapting to climate change.

The first regards the limitations related to the organization and systematization of information, including that about recording the occurrence of events, and of sharing this information among the municipal secretariats and departments. Originally, in the questionnaire, the question involved the free recording by the respondent of the number of events occurred in 2014 and in 2015. For analyzing these responses, we opted for interpreting them in terms of the occurrence (yes, in case of 1 or more events) or non-occurrence of these events (in case of record 0) in the two years mentioned. Even so, the rate of no responses for the set of the three events in the two years shows that at least 3 out of 10 respondents opted for not responding or did not know how to respond to what was requested. The organization, systematization and availability of this type of information requested in the questionnaire is not always trivial in public management; furthermore, there are difficulties in the internal communication among the secretariats and departments, which do not always have access to the information or follow the decisions and actions taken. Given the cross-acting nature of effective responses to climate change, the subdivision of responsibilities in municipal management and its bureaucracies hamper a more effective collaboration among secretariats and departments, hindering information sharing and coordinated actions (AYLETT, 2014).

The second argument refers to the technical personnel's difficulties in getting acquainted and of measuring the impacts deriving from climate events. Even though in recent years the advances in scientific knowledge on climate change have been expressive, its causes, potential risks and effects (IPCC, 2007, 2013), including those in the Brazilian ambit (NOBRE et al., 2010; AMBRIZZI et al. 2012; MAGRIN et al., 2014), the level of use of scientific information when making decisions is generally below that desired (KIRCHHOFF, 2013). It can be concluded that this difficulty is related to the appropriation and understanding of the information generated (DI GIULIO et al., 2016). However, there are other disconnections that tend to hinder the use of information, such as: (i) disconnection between knowledge production and its application, made unfeasible by the lack or inadequacy of economic, human and/or technological resources in a city management; (ii) disconnection between the knowledge understood as necessary by the researchers and that demanded by managers for planning and management. These gaps constitute critical barriers, especially as regards adapting to climate change, seeing that adaptive capacity is also built with investments in information and knowledge (CAR-

VALHO, FURTADO, 2015), considering that the production, the distribution and communication means available may encourage the institutions to allow for changes and to incorporate learning.

Lastly, the third argument concerns the difficulties in establishing responsibilities to deal with extreme events, even though the responses analyzed show a trend towards identifying the government as the major responsible, as compared to the productive sector, universities or research centers, individuals and the community. In this sense, the important role played by the government is recognized, especially the municipal/local one, in the process of seeking synergies between adapting to and mitigating climate change and sustainable development by means of experimentations, testing different social and technological approaches (DI GIULIO et al., 2017); however, coping with climate change demands sensitization for changing attitudes and behaviors (RENN, 2011; GIDDENS, 2009). Multisectorial coalitions are therefore important for effective climate governance in the cities (ROMERO-LANKAO et al., 2015; AYLETT, 2014; LECK, ROBERTS, 2015).

Climate change and connections with urban issues

From the analysis of the questionnaires responded, three other important barriers for the adaptive process of the SP cities are evidenced: (i) difficulties in teaming urban management and policy with adaptive actions; (ii) lack or inefficiency regarding specific prevention plans and responses to climate risks; and (iii) limited or inexistent participation by the municipalities in networks or in entities related to climate change.

Even though there is an understanding that adaptation may be (and often is) integrated to the already existing public policies and actions, such as urban planning (UITTENBROEK et al., 2014), most of the respondents recognize that the Master Plans in force in their municipalities do not include prevention actions or responses to extreme events or to climate change. It is hence possible to think that these municipalities miss the opportunity of teaming this important instrument of management and urban policy, which governs planning policies and encompasses different areas, such as infrastructure, basic sanitation, transport, land use, among others, with the adjustment processes to anticipate the adverse impacts of climate change, and thus reduce vulnerability. They therefore miss the opportunity of seeking to improve their adaptive capacity, understood as the potential of changing into a super desirable state vis-a-vis the climate change impacts or risks (EAKIN et al. 2014).

The analysis of the questionnaires also shows that most cities do not count on a specific prevention plan or for responding to the risks and emergencies. In Brazil, the passing of Federal Law 12608, which instituted the National Policy of Protection and Civil Defense (PNPDEC) in 2012, established the need of integrating the PNPDEC with the territorial ordination policies, urban development, climate change and the other sectorial policies, so as to promote sustainable development and to take more effective measures to reduce disaster risks (BRAZIL, 2012). By not counting on a plan to prevent and to respond to the risks and emergencies, these municipalities also undermine their adaptive capacity, particularly that related to the specific dimension, which presupposes

tools and the necessary specific skills to identify, anticipate and effectively respond to climate threats (EAKIN et al., 2014).

Another relevant analysis refers to the low participation by the municipalities in associations, entities and/or networks related to climate change. Studies indicate that participating in national, international and transnational networks expands the opportunities to the municipalities, especially for facilitating the cooperation with other cities and attracting investments from the public and private sectors for the actions aiming at adaptation and sustainable development. Furthermore, it potentializes the ability of the technical personnel and municipal managers of disseminating and of learning good practices (BULKELEY, 2010; SETZER et al., 2015; RYAN, 2015).

7 Conclusions

The data show that, even though most of the respondents believe climate change is already occurring in their municipalities and constitutes a real problem to be tackled, a gap persists between the perception of the phenomenon and its concreteness in terms of actions and strategies at the local level. As discussed herein, along with the absence of responses about occurrences, impacts and scales of responsibilities, standing out is the understanding that the necessary actions are still more aligned to medium and long-term public policies focused on the performance of the very secretariats/departments which the respondents are with at a local action level – most of which related to the environmental area or civil defense. Despite playing important roles, these divisions are not sufficient as regards climate change. As shown by different examples, local actions, from those seeking to minimize greenhouse gases (mitigation) to the adjustment processes (adaptation), tend to be more easily implemented when seeking synergies with policies, resources and other already existing measures aiming at sustainability, quality of life and infrastructure. If not devised and planned in a more integrated perspective, aligned to the local issues and, therefore, involving different municipal secretariats/departments and the population, it will be difficult for climate change to go from the status of an object of concern to an object impelling action. An aggravating aspect in this scenario, as shown by the analysis, is that the Master Plans in force in most of these SP municipalities do not include prevention actions or responses to extreme events or to climate change.

Besides the difficulty in coupling urban management and policy to mitigation and adaptive strategies, this paper highlights other important hindrances that hamper the adaptation process of the SP cities: information systematization and sharing; gaps in knowledge about local impacts related to climate events; difficulties in establishing responsibilities to deal with these events; lack and/or limitation of specific plans for preventing and responding to climate risks; and low adhesion by the municipalities to networks and organisms working directly on climate change. As well as the important clues on urban climate governance in the SP cities, by means of the analysis of the questionnaires responded to, we deem important to highlight that, although the instrument applied in the ambit of PMVA has the merit of capturing how these cities begin to delineate actions and responses to climate change and to evidence hindrances hampering adaptive processes,

the questionnaire, in the version analyzed herein, was not replicated in the other issues of the program. This discontinuity is worrisome, once it impairs a more continuous view on how the cities have incorporated these issues in their agendas, which could also direct SMA strategies towards a more integrated perspective of climate change in the State of SP. Certainly a historical series including data such as those the questionnaire sought to survey is crucial to understand how the largest Brazilian state, in terms of population and economic development, advances towards adaptation and mitigation of climate change.

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Original Article

EXTREME EVENTS, CLIMATE CHANGE AND ADAPTATION IN THE STATE OF SÃO PAULO

GABRIELA MARQUES DI GIULIO
ROGER RODRIGUES TORRES
MARIA DA PENHA VASCONCELLOS
DIEGO R. G. C. BRAGA
ROSA MARIA MANCINI
MARIA CARMEN LEMOS

EVENTOS EXTREMOS, MUDANÇAS CLIMÁTICAS E ADAPTAÇÃO NO ESTADO DE SÃO PAULO

Resumo: O artigo traz uma análise de dados secundários provenientes do preenchimento de questionários sobre mudanças climáticas e adaptação por agentes municipais que atuam em 332 dos 645 municípios do Estado de São Paulo. Com base em um referencial teórico sobre governança climática urbana, que destaca o papel que os governos locais desempenham na proposição de estratégias para lidar com as mudanças climáticas, o artigo apresenta e discute informações providas pelos agentes municipais sobre a ocorrência de eventos climáticos extremos nos municípios paulistas, os impactos desses eventos, a percepção sobre mudanças climáticas e as ações e respostas. A análise dos dados permite ampliar o conhecimento sobre como o maior estado brasileiro em termos populacionais e econômicos tem avançado no enfrentamento das mudanças climáticas e quais são os principais entraves que dificultam o processo de adaptação das cidades.

Palavras-chave: mudanças climáticas, eventos extremos, adaptação, cidades, Estado de São Paulo

EXTREME CLIMATE EVENTS, CLIMATE CHANGE AND ADAPTATION IN THE STATE OF SÃO PAULO

Abstract: In this paper, we analyze secondary data from surveys focusing on climate change and adaptation in Sao Paulo municipalities. The survey was completed by municipal actors who work in 332 of the 645 municipalities in the State. In this paper, we use a theoretical framework on urban climate governance, which highlights the role that local governments

play in proposing strategies to deal with climate change, to present and discuss data related to: 1) the occurrence of extreme climatic events in these municipalities; 2) the impacts of these events; 3) local government actors' perception about climate change; and 4) local actions and responses. Our analysis of these data significantly contributes to better understanding how cities in the most populous and economically developed state in Brazil perceive, respond and deal with climate change and what critical challenges hamper climate adaptation in these cities.

Keywords: climate change, extreme events, adaptation, cities, São Paulo State

EVENTOS EXTREMOS, CAMBIOS CLIMÁTICOS Y ADAPTACIONES EN EL ESTADO DE SÃO PAULO

Resumen: El artículo trae el análisis de datos secundarios provenientes del llenado de cuestionarios sobre cambios climáticos y adaptación por agentes municipales que actúan en 332 de los 645 municipios del Estado de São Paulo. Con base en una referencia teórica sobre gobernanza climática urbana, que destaca el papel que los gobiernos locales desempeñan en la proposición de estrategias para lidiar con los cambios climáticos, el artículo presenta y discute informaciones proveídas por los agentes municipales sobre la ocurrencia de eventos climáticos extremos en los municipios paulistas, los impactos de esos eventos, la percepción sobre cambios climáticos y, las acciones y respuestas. El análisis de los datos permite ampliar el conocimiento sobre cómo el mayor estado brasileño en términos poblacionales y económicos ha avanzado en lo enfrentamiento de los cambios climáticos, y qué aspectos críticos dificultan el proceso de adaptación en estas ciudades.

Palabras-clave: cambios climáticos, eventos extremos, adaptación, ciudades, Estado de São Paulo
