



# Bridging the gap between will and action on climate change adaptation in large cities in Brazil

Gabriela Marques Di Giulio<sup>1</sup> · Roger Rodrigues Torres<sup>2</sup> · David M. Lapola<sup>3</sup> · Ana Maria Bedran-Martins<sup>4</sup> · Maria da Penha Vasconcellos<sup>4</sup> · Diego Rafael Braga<sup>3</sup> · Marcos Paulo Fuck<sup>5</sup> · Yohanna Juk<sup>5</sup> · Veruska Nogueira<sup>2</sup> · Ana Carolina Penna<sup>2</sup> · Tiago Jacaúna<sup>6</sup> · Marcelo Fetz<sup>7</sup> · Zoraide Pessoa<sup>8</sup> · Rylanneive Pontes<sup>8</sup> · Marize Schons<sup>9</sup> · Adriano Premebida<sup>9</sup>

Received: 17 September 2018 / Accepted: 9 October 2019 / Published online: 1 November 2019  
© Springer-Verlag GmbH Germany, part of Springer Nature 2019

## Abstract

All over the world, there is a pressing need to better understand how climate change has been incorporated into governmental agendas, and evaluate the status of adaptation planning and interventions at the local level. In this paper, we seek to contribute towards bridging this gap by identifying local practices connected to climate adaptation in six large Brazilian cities, and presenting a framework, based on the existing literature, for assessing constraints to adaptation across the municipal level. Although local governments are not the only actors who can take the lead through their actions, the employed framework considers that effective adaptation planning in urban areas is highly dependent on municipal efforts. Our findings indicate that six aspects have the highest levels of impact on adaptation in the Brazilian cities studied: administrative practices, political will, level of commitment, mismatch between the scale of urban issues and the extent of local government authority, pressures from private sectors, and inspection. Although these barriers are not specific only to climate issues and can be identified in other environmental arenas, when combined, they cause and worsen constraints to advancing urban adaptation at the local level. Specifically concerning the local dynamics of urban planning, the combination of pressures from private sectors and insufficient inspection negatively affects the ability of these cities to consolidate adaptation interventions. Our results are helpful in the context of large cities, particularly in Global South, where, as in Brazil, competitive urbanism and specific interest groups confront municipal efforts, and make achieving adaptation more difficult.

**Keywords** Climate change · Adaptation · Local governments · Cities · Brazil

## Introduction

Globally, cities face significant risks from climate change. The impacts of this phenomenon create numerous challenges, including changes in air temperature and precipitation (mean and extreme), sea level rise, and increased intensity and frequency of natural hazards. This increases the frequency and

severity of flooding, landslides, and heat waves and compromises critical services such as electricity, water supply, health, and emergency services (IPCC 2014). City governments worldwide are increasingly introducing adaptation actions to minimize these impacts; however, the speed of this varies widely (Carmin et al. 2013). Adaptation is part of a socio-environmental-political process (Brown and Westaway 2011), which is closely dependent on the willingness to undertake adaptive measures, the availability of and the ability to deploy resources appropriately, and the arrangement of conditions that facilitate or hamper the consolidation of initiatives. Although local governments are not the only urban actors who can lead and deliver adaptation actions—rather, a set of state and non-state actors play key roles (Broto 2017; Araos et al. 2016)—we assume that effective adaptation planning in urban areas is closely dependent on municipal efforts. This assumption is even more deeply rooted in the context of large cities in

---

Communicated by Robbert Biesbroek

**Electronic supplementary material** The online version of this article (<https://doi.org/10.1007/s10113-019-01570-z>) contains supplementary material, which is available to authorized users.

---

✉ Gabriela Marques Di Giulio  
ggiulio@usp.br

Extended author information available on the last page of the article

Global South, characterized by globalization, competitive urbanism, and austerity measures, where one can observe the rise of powerful regimes and interest groups that make achieving sustainable adaptation even more difficult (Chu et al. 2017).

While the literature describes some common barriers for adaptation (Araos et al. 2017; Ford et al. 2011; Eakin and Patt 2011; Burch 2009, 2010; Moser et al. 2010), few frameworks focus on the Global South. To address this, this paper reviews a set of dimensions that affect the ability of local governments to advance in adaptation, and presents a framework, based on existing literature, for assessing constraints on adaptation across the municipal level. The goal is to illustrate the potential uses of this framework through its application to six large Brazilian cities, located in four different macro-geographic regions, where climate impact stressors are expected to compound serious problems associated with historically haphazard processes of urbanization, dominated by private interests. The analysis provided in this paper addresses two policy-relevant and critically important research questions: (1) What has been implemented in terms of adaptation practices in large Brazilian cities? and (2) What are the most critical aspects for advancing adaptation in these cities? With this paper, we aim to present the first attempt at characterizing the status of adaptation planning and interventions in Brazilian metropolitan cities, and provide insights, which may be helpful to local urban planners, practitioners, and decision-makers in the South global context.

From this perspective, this paper provides, in the “[Literature review and conceptual framework](#)” section, an overview of the literature and the conceptual framework, which includes five dimensions that restrict local government efforts to advance in adaptation. The “[Methodology](#)” section presents the methodology, and the “[Results](#)” section contains the results, which include practices connected to adaptation in the six cities, application of the framework and qualitative assessment. The “[Discussion and conclusion](#)” section provides a reflection on the applicability of the framework.

## Literature review and conceptual framework

Empirical studies highlight that advancing climate policies and adaptation initiatives requires flexibility for governments to be able to frame climate change in relation to local problems, i.e., promoting sustainable development and improving communities’ quality of life (Ryan 2015; Bulkeley 2010). Identifying opportunities to advance urban adaptation is a challenge for decision-makers and practitioners. A mainstreaming approach may be helpful to create synergetic effects, increase resource efficiency, reduce contradictions between policies, and avoid competition between adaptation and other policy priorities (Runhaar et al. 2018; Uittenbroek et al.

2014; Aylett 2015). Aligning climatic responses with urban sustainable measures potentially delivers multiple economic, social, and environmental benefits that go beyond adaptation. Interventions to improve green infrastructure and urban mobility are examples of adaptive measures that help cities to achieve sustainable outcomes, bringing co-benefits such as mitigation of heat island effect, better air quality, and reduced congestion (Geneletti and Zardo 2016; Rosenzweig et al. 2015). Cities must also be prepared to deal with climate impact stressors, including changes in air temperature and precipitation, sea level rise, and increased intensity and frequency of natural hazards (Rosenzweig et al. 2015). Thus, adaptation should also be focused on specific actions, e.g., preventative and response planning, monitoring systems, risk mapping, and simulations (Eakin et al. 2014). Combined, these actions improve the capacity of a city to cope with climate change and reduce the negative effects of flooding, landslides, and heat waves, for example.

While interrelated opportunities are important, a number of barriers hamper urban adaptation progress. For example, Burch (2009, 2010) in her studies of Canadian cities shows that, despite having relatively similar levels of the resources needed to respond to climate change, the municipalities have nevertheless followed very different paths, which suggests that there are further aspects to be considered when assessing adaptation policies. Moser et al. (2010) present a systematic framework to identify barriers at each stage of an idealized adaptation process. Their framework combines problem detection and awareness raising; information; (re)definition of problem; development, assessment, and selection of adaptation options; monitoring the environment and outcome of the realized options; and evaluation. However, when applying this framework in the context of coastal management on the North Coast of São Paulo, Brazil, Simões et al. (2017) found that many of the stages identified by Moser et al. were not entirely applicable to the Brazilian context. They suggest making information on climate risks available and accessible, fostering anticipatory planned adaptation, and developing leadership are preconditions to overcome the most prevalent barriers identified for adaptation in the region (e.g., perception of signal, information, management context, and leadership).

Ford et al. (2011) identify that institutional challenges, political-short termism, and complacency towards climate change are the most common barriers to adaptation development and implementation in developed countries. Using selected case studies of adaptation planning, Eakin and Patt (2011) highlight that lack of motivation, insufficient resources or financing, lack of technical capacity, insufficient information, inadequate or inappropriate policy incentives, and cultural factors are significant constraints to adaptation. In their study in Dhaka, Bangladesh, Araos et al. (2017) found that the lack of coordination between local government

organizations, lack of transparency, and the limited human and financial resources act as barriers to municipal adaptation planning.

While these selected examples of the literature endorse some common barriers for adaptation, they shed light on the fact that adaptation actions on the ground are primarily local and context-specific, and their implementation is dependent on the individual socio-political situation (Klostermann et al. 2018). Consistent with these findings, and considering the under representation of the Global South in the existing literature, in this section, we propose a framework that includes five dimensions and 13 elements that affect the ability of local governments to advance in adaptation. The framework provides an opportunity to understand how the elements influence and interact with each other in shaping climate adaptation, and to explore to what extent they explain the delays to adaptive actions (Fig. 1).

### Cognitive factors

Most analyses recognize that the perception that cities are at greater risk of damage is one of the main motivations for initiating adaptation planning and implementation at the local level (Runhaar et al. 2018; IPCC 2014; Carmin et al. 2013). Aligned with risk perception, the level of awareness of practitioners, planners, and decision-makers about the urgent need for promoting adjustments to minimize climate effects is a critical cognitive factor that affects adaptation (Runhaar et al. 2018). Indeed, shifting temperatures and precipitation will affect the availability of resources (e.g., water, energy, food), amplify existing social vulnerabilities, and negatively influence the well-being of residents (Aylett 2015; IPCC 2014; Carmin et al. 2013). Reframing climate change as a local problem that affects all of us and realizing that local governments play an important role in climatic governance and transformative urban processes are crucial for bringing adaptation into the municipal agenda (Broto 2017; Bulkeley 2010). The cases of Durban and Quito, two cities in the Global

South, for example, well illustrate the relevance of this cities' government realization to lead development paths, which promote sustainability and resilience by addressing the projected impacts of climate change (Carmin et al. 2012).

### Staff, information, and financial resources

The literature highlights that resources, including staff, information, and funding, are critical aspects for advancing urban adaptation (Runhaar et al. 2018; Aylett 2014; Carmin et al. 2013; Bulkeley 2010; Bulkeley & Broto, 2013). Given the cross-acting nature of effective responses to climate change, integrated actions involving technical competence of staff in multiple planning and operational procedures in key areas are required (e.g., land-use regulation, building codes, transportation) (Sherman et al. 2016; Aylett 2014, 2015; Carmin et al. 2013; Bulkeley 2010). Mainstreaming climate adaptation to achieve more efficient interventions also requires information. Despite the amount of climate change information available, the scholarship still recognizes that the lack of scientific information on the potential climate impacts on specific urban areas and socio-environmental vulnerability assessments affects the capacity of local governments to design and implement effective adaptation measures. Climate information uptake by decision-makers and planners has also been patchy (Morgan and Di Giulio 2018; Serrao-Neumann et al. 2018; Lemos and Kirchhoff 2016; Aylett 2014; Moser and Boykoff 2013; Bulkeley 2010). Concerning financial resources, the literature highlights the relationship between the availability of economic resources and investment aimed at reducing vulnerabilities to extreme events, and better preparedness (Eakin et al. 2014). At the local level, access to financial resources also influences the ability to conduct urban climate studies and vulnerability assessments; while a lack of public funding for adaptation may lead cities to be dependent on the private sector to implement adaptive interventions. Angelovski et al. (2016) demonstrate how this economic dependency exacerbates socio-spatial inequalities across diverse

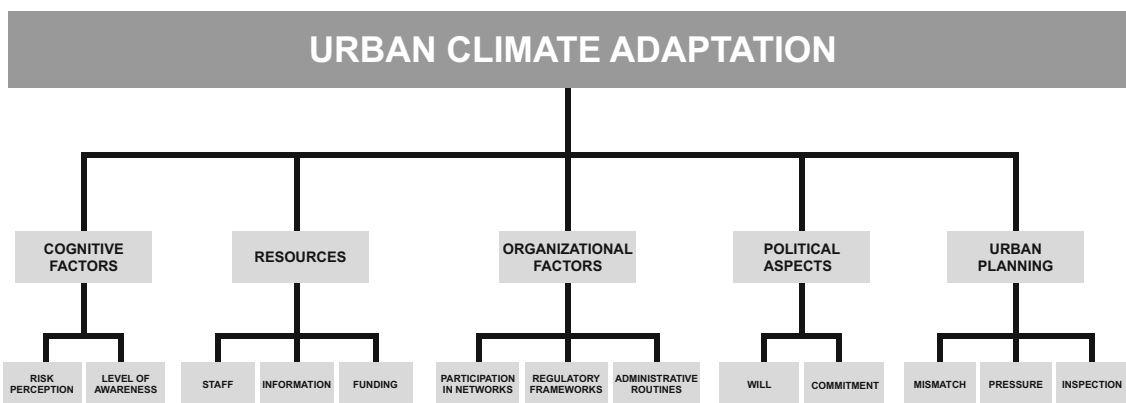


Fig. 1 Note: This data is mandatory. Please provide

developmental and environmental conditions, affecting and displacing less affluent communities and prioritizing wealthier groups.

### Organizational factors

Empirical studies shed light on the importance of participation in international municipal networks (e.g., ICLEI and C40), and subnational and local committees/forums in helping cities commit to fighting climate change, integrating this into municipal policies and encouraging local governments to provide supportive regulatory frameworks (Broto 2017; Leck and Roberts 2015; Ryan 2015; Aylett 2014; Bulkeley 2010). Concerning regulatory frameworks, it is relevant to stress that, although the existence of municipal climate change laws might indicate support and some level of politicization of climate issues, climate change may not necessarily be part of the political debate, nor is there a guarantee of concrete government actions. This is the case of some Global South cities (e.g., Buenos Aires and Mexico City), where empirical studies highlighted that the transition from urban climate planning to the implementation stage is affected by the gap between policy discourses and political reality (Ryan 2015). In addition, the ability to implement urban adaptation measures is greatly affected by administrative routines and practices. Empirical analyses find that climate change issues are still concentrated in environmental departments, which may limit municipal capacity for two main reasons. First, these departments are often marginalized within municipal authorities. Second, the cross-acting nature of climate change responses means that a single department is frequently not able to implement actions to effectively address the problem (Bulkeley 2010; Aylett 2015). The subdivision of responsibilities within municipal bureaucracies is also a critical aspect, and frequently causes difficulties for effective collaboration, information sharing, and coordinated action among municipal staff (Aylett 2014).

### Political factors

Urban adaptation is mostly dependent on political will and levels of political commitment. Studies have highlighted that politicians and political actors involved in municipal politics may facilitate or hamper the implementation of climate initiatives (Aylett 2014, 2015; Ryan 2015). Frequently, local governments are more likely to develop and advance climate-friendly policies if they can generate other socioeconomic and environmental benefits, improving communities' quality of life, helping cities meet other goals, and elevating their political leadership (Anguelovski and Carmin 2011). Empirical studies in Global South cities (e.g., Buenos Aires, Mexico City and Santiago) have shown that implementing climate initiatives that often require local government to take politically difficult

decisions and costly measures is a critical element that negatively affects adaptation (Ryan 2015). Policy makers, as Broto (2017) argues, may abandon aspirations to achieve a global vision of urban futures in favor of more pragmatic approaches that enable action. From the politicians' perspective, climate change competes with other relevant areas such as health, housing, or economic growth, which are frequently considered more urgent daily concerns by society, in terms of resources and priorities.

### Local dynamics of urban planning

Lastly, urban planning, which includes land regularization, housing policy, and provision of urban infrastructure, is widely regarded by scientific and professional communities as playing a critical role in influencing climate adaptation both positively and negatively (McClure and Baker 2018). Combining planning horizons and climate change scenarios is a complex issue for cities, particularly the challenge of fitting planning models based on historical data and trend modeling, into the context of the complexity and uncertainty surrounding climate change, which may require radical, transformative adjustments (Biesbroek and Lesnikowski 2018; Bulkeley 2010). At the local level, resistance to adaptation measures is closely associated with land-planning regulation and land values, and is highly affected by powerful regimes and interest groups, particularly in the context of large cities in Global South (Chu et al. 2017). Three main aspects related to local dynamics of urban planning are relevant in the context of Global South: mismatches between the scale of the urban issues and the extent of local government authority, pressures from private sectors, and inspection.

### Methodology

Drawing on empirical studies of six large Brazilian cities, we used an interdisciplinary mixed-method approach, combining qualitative and quantitative data, part of the CiAdapta Project that seeks to understand how the governments of these Brazilian cities are coping with public policies and actions for climate adaptation. In consonance with the literature, we understand that these large cities are places that combine cosmopolitan communities with high carbon lifestyles and communities of informal workers who lack basic services, requiring local governments to reduce emissions and vulnerabilities, and advance in an effective adaptation planning (Broto 2017; Araos et al. 2016).

These six Brazilian cities were chosen to represent cities with low (Porto Alegre and Curitiba), medium (São Paulo and Vitória), and high (Natal and Manaus) socio-climatic vulnerability (Darela-Filho et al. 2016), covering a range of socioeconomic and climatic conditions within the Brazilian context

**Table 1** Characteristics of the six Brazilian cities

Cities	Territorial area <sup>a</sup> (km <sup>2</sup> )	Population density <sup>a</sup> (hab/km <sup>2</sup> )	GDP per capita <sup>a</sup> (US\$)	HDI <sup>a</sup>	Green public areas <sup>a</sup> (%)	Socio-climatic vulnerability index <sup>c</sup>
Natal	167	4.805	6.391	0.763	45	High vulnerability
Manaus	11.401	158	8.668	0.737	24	High vulnerability
Porto Alegre	497	2.838	12.267	0.805	83	Low vulnerability
Vitória	97	3.338	17.219	0.845	65	Medium vulnerability
Curitiba	435	4.027	11.868	0.823	76	Low vulnerability
São Paulo	1.521	7.398	14.457	0.805	75	Medium vulnerability

<sup>a</sup> IBGE 2010

<sup>b</sup> Dollar variation on June 4, 2018 (1 US\$ = 3.76 R\$)

<sup>c</sup> Darela-Filho et al. (2016)

(Table 1). Furthermore, these cities highlight both the resources and problems that plague urban systems, making them critical cases for advancing current insights in urban adaptation governance in Brazil and in the Global South.

### Climate projection contextualization for the six cities

Under different climate projections, temperatures in the six cities are expected to increase, with the highest temperature increase projected in São Paulo and Manaus (IPCC 2013; Torres and Marengo 2013, 2014). The projections indicate an increase in precipitation in Curitiba and Porto Alegre and a probable decrease in Natal and Manaus. Regarding climate extreme events, models indicate that the projected increase in the annual amount of precipitation in Curitiba and Porto Alegre may manifest itself in the form of intense precipitation events, and that Natal, Manaus, Vitória, and São Paulo may experience longer dry periods in the future climate (Sillmann et al. 2013). Additionally, projections show, with medium to high confidence, an increase in hot days and nights throughout Brazil (Donat et al. 2013). See Supplementary Material 1 for the summary of projected climate change in the cities.

### Methods

We reviewed environmental and urban public policies and legislations in these six cities, focusing on municipal climate change policies, master plans, urban mobility, and management of climate risks. Empirical data was collected from semi-structured interviews with 40 practitioners who work in these cities in different municipal departments (see Supplementary Material 2). The interviews aimed to collect information related to extreme events, which have become increasingly frequent in these cities, government strategies, and elements that influence the city's adaptive capacity (see Supplementary Material 3). The recordings were transcribed and the transcripts were analyzed for themes in the discussions.

Guided by the need to exchange information between researchers and end-users, the CiAdapta Project comprised six interactive workshops with practitioners who work on urban, climate, and environmental issues in these six cities. The workshops were organized by the research team in collaboration with local practitioners who are actively engaged in urban climate governance. The participants of the workshops were identified and invited through a purposive and selective sampling approach, based on the meeting organizers' knowledge and experience. As the discussions were based on the perspectives of selected individuals (from 8 participants in the smallest group in Natal to 25 participants in the biggest group in Manaus), we recognize that the narratives and views reported are limited. However, the interactive mode adopted at the workshops was crucial to engage a variety of practitioners with different experiences, knowledge, and expectations, and build a trustful environment to reflect on climate issues and adaptation measures. Workshop reports were produced and analyzed for themes in the discussions.

Data used to inform this paper is based on content analysis of workshops reports, documents, transcripts of semi-structured interviews, and participant observation in selected interactions (e.g., meetings and forums) in the six Brazilian cities. Guided by the triangulation of sources and findings, we structured the presentation of results by identifying practices connected to climate adaptation and then applying the framework to analyzing the data. In concordance with our comprehension of the nature of barriers to climate change adaptation proposed by Biesbroek et al. (2013), we assume that what is considered a barrier is closely dependent on the actor's subjective or collective interpretations of operating factors and conditions. Barriers could emerge from individual actors, the system of governance or other relevant system, and can have a negative influence on the process, reducing the chances of successful outputs (Biesbroek et al. 2013). Based on the data, we qualitatively assessed and evaluated the impact of each element of the framework on the ability of these cities to advance adaptation. The qualitative assessment includes a

**Table 2** Summary of practices connected to adaptation in the six Brazilian cities

Cities	Examples of interventions connected to mainstreaming approach	Examples of specific measures to manage climate risks
São Paulo	<ul style="list-style-type: none"> <li>° Creating rural areas in the city within a sustainable plan Municipal Atlantic Rainforest Plan to protect green areas (PMMA 2017)</li> <li>Incentives to create vertical and urban gardens, and roof gardens</li> <li>°° Urban Mobility Plan (PlanMob/SP2015), with incentives to create bike lanes, bicycle parking spots, roads with some priority for public transport, exclusive bus lanes</li> </ul>	Risk mapping – the most recent was concluded in 2009; contingency plans; warning systems; urban drainage; monitoring of rain
Porto Alegre	<ul style="list-style-type: none"> <li>° Implementation of green and ecological areas</li> <li>°° Improvements to the public transport system; bike lanes; exclusive bus lanes</li> </ul>	Urban drainage, including gates and dams; monitoring of areas at risk of flood and landslides; monitoring of rain; contingency plans
Curitiba	<ul style="list-style-type: none"> <li>° Maintenance of green areas (parks); incentives to create urban gardens</li> <li>°° Access to the European Union Program “Mobilise Your City” for sustainable urban mobility; improvements to the bike lanes, exclusive bus lanes and speed monitoring</li> </ul>	Mapping of areas at risk of flooding; disaster warning system; urban drainage; contingency plans; monitoring of rain
Vitória	<ul style="list-style-type: none"> <li>° Interventions focused on post landslide reconstruction and reforestation; incentives to create urban gardens</li> <li>°° Public transport policies with incentives to create alternative transport, and bike lanes</li> </ul>	Monitoring of sea level rise, rain, flooding, and landslides; contingency plans
Manaus	<ul style="list-style-type: none"> <li>° Establishment of conservation units to preserve the Amazon forest in urban area; planting trees on the main roads in the city</li> <li>°° Urban Mobility Plan (PlanMob/Manaus 2015), with incentives to bike lanes, and public transport</li> </ul>	Monitoring of rain, landslides, and flooding risk areas; contingency plans
Natal	<ul style="list-style-type: none"> <li>° Incentives for recovering and creating green areas; interventions focused on protection against erosion</li> <li>°° Creation of a Municipal Council for Public Transport and Urban Mobility, and Executive Committee for Policy Coordination of the Urban Mobility Plan</li> </ul>	Risk mapping - the most recent was concluded in 2008; contingency plan (in elaboration); warning systems; monitoring of rain

°Green infrastructure

°°Urban mobility

scale of three different levels of impact, in terms of relevance: high (meaning that the element has high relevance for hampering adaptation), moderate (meaning that, while important, the element is not the most critical factor for advancing adaptation), and low (the impact of the element is low).

## Results

### Practices connected to adaptation

We identified that the Brazilian cities provide, albeit at different stages, examples of interventions connected to mainstreaming adaptation, i.e., solutions for green infrastructure and urban mobility, and specific measures to manage climate risks, including, for example, risk mapping, contingency plans, warning systems, and urban

drainage. Table 2 provides a summary of these interventions.

Despite the relevance of these examples of local interventions, they are far from enough to ensure that Brazilian cities are sufficiently well prepared to anticipate future climate stresses and deliberate appropriate responses to climate change. On the contrary, analysis of interviews and workshop reports highlights that, from the practitioners' points of view, far more needs to be done. A set of actions was identified focusing on urban occupation, selective waste collection, urban drainage, sewage systems, evacuation of risk areas, updating diagnostics of urban problems, public education, and participatory processes. Respondents argue that progress on adaptation is hampered by a number of barriers to adaptation. In the next subsection, we present the application of our framework and assess the relevance of each element for hampering adaptation.

## Application of the framework

### Cognitive factors

Our results highlight that practitioners are interested in climatic issues and are aware of the importance of climate change in rethinking their cities in the upcoming years to make them more sustainable and resilient. For example, in the workshop with practitioners from São Paulo, they expressed that climate change imposes transformations on all sectoral policies; thus, all municipal departments must consider the impacts of extreme events and adapt accordingly.

From 40 interviewees who work in these cities in different municipal departments, only 2 practitioners (5%) did not connect extreme events directly to climate change, and 31 (77.5%) recognized that change in precipitation (positive and negative trends) is the most frequent cause of extreme events in these cities. This was the case in São Paulo, for example, which had to deal with a severe drought (2013–2016), a result of lower rainfall, increased water demand, and an absence of adequate water management planning. “I see more intense and short periods of rain. Above all, there is this long dry season. Secondly, a long period of heat and the almost complete disappearance of the drizzly winters that we used to have” (practitioner, Department of Green and Environment, São Paulo, 2016). A similar situation was observed in Vitória, where the analysis of interviews and the workshop report confirm that changes in precipitation have become more frequent.

When asked about what makes people in these cities more vulnerable to extreme events, the most cited factor was irregular occupation of risk areas. In Manaus, for example, the housing deficit (22.9%) is critical, which explains the irregular occupation. “[...] people are looking for places to live that are totally inappropriate [...] including river banks, permanent preservation areas, and slopes, which leads to vulnerability” (practitioner, Department of Environment, Manaus, 2016). In Natal, where the population density is high (4,805 hab/km<sup>2</sup>) and the entire urban zone is occupied, subnormal residential clusters have been built in protected areas, most of them on highly unstable dunes. The practitioners from these cities studied all agreed that improvements in income level, education, health, and provision of public services, including housing, are relevant factors in achieving reductions in vulnerability.

### Staff, information, and financial resources

The practitioners highlighted three main common points in terms of staffing. Firstly, despite the fact that staff in general have the skills and capacity for their daily practice routines, there is a need to continue improving local technical expertise to tackle the complexities of climate change. Secondly, they requested efforts to mobilize practitioners in multiple planning

and operational procedures in key areas, involving different departments. Thirdly, they stressed the current process of dismantlement of the civil service, which puts the administrative legacy, the engagement with the civil service, and the commitment to effective actions in jeopardy. In Vitória, for example, these aspects are particularly critical for the Department of Environment, which is responsible for the municipal climate agenda. “In public administration, the long-term issues [such as climate change] are associated with career professionals, and today there is no great appreciation for the civil service in public institutions [...] Management teams are usually changed, and replaced with people who have no experience of public administration” (practitioner, Department of Environment, Vitória, 2017). This concern was also repeatedly mentioned during the workshops in Curitiba and São Paulo, where practitioners expressed the opinion that a permanent qualified technical team is a crucial aspect for urban climate governance.

Concerning information, most of the interviewees pointed out that information on extreme events has been disseminated by their own networks, local agencies (e.g., Civil Defense, Center of Emergency Management), the media, national agencies, and research institutions (e.g., National Center for Monitoring and Early Warning of Natural Disasters – CEMADEN, National Institute for Space Research – INPE). However, 20% of the interviewees recognized problems with the flow of climate information in their municipal administrations, which is still centered around specific departments. This was the case in São Paulo and Natal: “We do not have a network that receives this information and is able to facilitate action based on climate information” (practitioner, Department of Environment and Urban Planning, Natal, 2017). Improving access to scientific climate information is another critical aspect. Up-to-date diagnostics, information on climate projections with better spatial resolution, and local vulnerability assessments were common requests observed in the analyses of the interviews and workshop reports.

In terms of financial resources, most of the interviewees pointed out that public funding for climate adaptation is inadequate. Tax revenues have been affected by the current Brazilian economic recession, which has lasted 4 years and has compromised municipal budgets. This creates challenges in giving continuity to projects, and innovating and managing mechanisms to self-fund them in the long term. For example, in Porto Alegre, an important local institution focused on Information Communication Technology (ICT) and responsible for the management of a range of municipal data has been dealing with financial problems, which may compromise urban planning and adaptation actions in the upcoming years. However, despite the economic constraints, the practitioners recognize that political decisions have a far greater effect on public funding for adaptation than the availability of funding. As described by an interviewee from São Paulo: “the

municipal budget is shared between the departments [...] so investing in climate adaptation is dependent on the will of the government” (practitioner, Department of Department of Infrastructure and Building, São Paulo, 2016).

### Organizational factors

In terms of regulatory frameworks, of the six cities studied, only São Paulo and Manaus had municipal climate change policies in operation in 2016–2017. In 2009, São Paulo became the first Brazilian city to launch a Municipal Climate Law with specific goals, which include a mandatory 30% reduction of aggregate municipal GHG emissions in CO<sub>2</sub>eq by 2012, relative to the 2003 baseline values reported in the municipal inventory published in 2005. In the case of Manaus, the Municipal Policy to Combat Global Warming and Climate Change was launched in 2010, encouraging sustainable practices, including the obligatory use of equipment aimed at the intelligent use of energy and water in buildings. All six cities integrated the International Council for Local Environment Initiative (ICLEI), and two of them (São Paulo and Curitiba) have joined the Cities Climate Leadership Group (C40), which brings together cities committed to reducing GHG emissions and mitigating climate threats. In the last few years, the cities studied have also implemented local networks/committees/forums related to climate change.

The analyses of the interviews and workshop reports highlight common points in terms of administrative routines and practices of these six cities. The practitioners argue that there are disconnections between sectoral policies, and a lack of definition of responsibilities, competencies, and priorities in terms of investments and strategic actions. As described by interviewees from São Paulo and Vitória: “The sectors do not plan together” (practitioner, Department of Green and Environment, São Paulo, 2017); “There is a lack of integration to raise awareness of other sectors, not only environmental or urban departments” (practitioner, Department of Environment, Vitória, 2016). Another critical point is the bureaucratic and political utilitarian perspective that characterizes the public administration. In Vitória, an interviewee stated that “the formal procedures are very slow and bureaucratic,” which can hinder municipal climate governance (practitioner, Department of Environment, Vitória, 2016). In Manaus, the practitioners who attended the workshop reaffirmed the urgent need to institutionalize positive municipal initiatives to give them legitimacy, regardless of party-political changes.

### Political factors

Our results shed light on the fact that urban adaptation is usually negatively affected by the politically hostile conditions, competing with other priorities in the decision-making agenda. Politicians’ interests also affect climate responses and urban adaptation. This fact was observed by interviewees from São Paulo

and Manaus: “Brazilian politicians have a very short sighted practice of denying or interrupting what others have done before. These administrative discontinuities generate a lot of problems” (practitioner, Department of Traffic Control, São Paulo, 2016).

The practitioners recognized that, in fact, political will and the level of commitment may hamper the implementation of climate initiatives. As described by an interviewee from Natal: “Political will should play a smaller role in some public policies, such as climate planning, and land use and occupation, which transcend political mandates” (practitioner, Department of Environment and Urban Planning, Natal, 2017). Disputes and conflicts between different levels of public administration (municipal and state, for example) might also impact urban climate responses. In Natal, for example, disagreements over effective interventions for reducing impacts of coastal erosion in some areas led to conflicts between municipal and state governments. “[...] nobody wants to spend money for the others, as if climate change in fact will choose who will be affected” (practitioner, Department of Environment and Urban Planning, Natal, 2017).

### Local dynamics of urban planning

As described by the participants in the workshops, it was clear that resistance to adaptation measures increases if they involve land-planning regulation, affect land values, or cause economic impacts to public or private sectors. For example, in the city of São Paulo, pressures from the private housing market and other sectors cause delays in implementing important proposed parts of the Master Plan (e.g., promoting the construction of buildings that contribute to the reduction of GHG emissions, prioritizing bus fleet fueled by clean energy sources). “The conflicts of interests, in general, do not arise during the processes of Master Plan review; rather, they emerge during the processes of approval and regulation” (practitioner, Department of Traffic Control, São Paulo, 2016). This was also recognized by an interviewee from Porto Alegre: “Our Master Plan changes a lot according to specific interests” (practitioner, Department of Environment, Porto Alegre, 2017).

The practitioners also recognized that urban planning is highly affected by bureaucratic perspective, and insufficient inspection, common characteristics in Brazilian cities. In Vitória, an interviewee stated that, although urban planning is helpful to avoid urban sprawl and occupation of vulnerable and risk areas, “the inspection is lacking,” which compromises the city’s development and capacity to deal with climatic impacts in the long term (practitioner, Department of Environment, Vitória, 2016).

Another element pointed out by the practitioners is the mismatch between the scale of urban issues and the extent of local government authority. For the practitioners, because these cities are located in large metropolitan areas, critical policies and issues related to urban planning and adaptation (i.e., land planning and water resource) are subject to multiple



jurisdictions, which may compromise the capability of local governments to carry them out. Collaborative working, engaging other cities, is an opportune pathway for the upcoming years. This has been a challenge for São Paulo, for example: “We have been working on an integrated urban development plan encompassing the 39 municipalities of the São Paulo Metropolitan Region. However, the plan is not advancing” (practitioner, Department of Traffic Control, São Paulo, 2016).

**Qualitative assessment**

Our findings highlight that the five dimensions of our analytical framework have different levels of impact for advancing adaptation in the six cities studied (Fig. 2). We find that administrative routines and practices (from the third dimension), political aspects (fourth dimension), and local dynamics of urban planning (fifth dimension) have the highest levels of impact on climate adaptation. We also find that participation in networks (third dimension – organizational elements) is positively presented in all six cities, and only two had municipal climate change policies in operation in 2016–2017. Although participation in networks and regulatory frameworks indicate some support for climate issues, they are not necessarily a guarantee of concrete government actions, as the cases of São Paulo and Manaus well demonstrated. Thus, the level of impact of both elements is low.

Concerning the first dimension, we find that cognitive factors positively motivate climate adaptation. There is a common perception from practitioners that the risk of local damage is real, the availability of resources is affected by climate events, and the magnitude of climate impacts on different sectors makes communities vulnerable. The practitioners’ perceptions are in line with the current climate model projections and highlight the close connection between development and adaptation. Thus, the level of impact of cognitive factors for hampering adaption is low. The practitioners’ realization that climate change is a local problem, their technical competence, and their efforts to access climate information (despite the problems with the inter-departmental information flow) indicate that staff and information, while important, are not the most critical factors for advancing adaptation in these cities. In fact, in terms of staff, the six cities count on technical and administrative support; however, the current process of dismantlement of the civil service might cause problems in the medium and long term, which puts this resource at a moderate level of impact. Information has the same moderate level of impact, as practitioners have access to, but complain about, the flow and lack of specific scientific climate information. The same is true for financial resources. Despite the fact that the current Brazilian economic recession has affected tax income, compromising municipal budgets, the inadequacy of public funding for adaptation is closely associated with political decisions and is not considered the main barrier to concrete interventions.

Framework		Assessing constraints for adaptation across the municipal level					
Dimensions that affect the ability of local government to advance in adaptation	Main elements	SPO	VIT	POA	CUR	NAT	MAN
Dimension 1 - Cognitive factors (to motivate climate adaptation)	risk perception	+	+	+	+	+	+
	level of awareness	+	+	+	+	+	+
Dimension 2 - Resources (to advance the adaptation agenda)	staff	+++	+++	++	+++	++	++
	information	+++	++	++	++	+++	++
	funding	++	++	+++	++	++	++
Dimension 3 - Organizational factors (to deploy resources and integrate adaptation as a central theme)	participation in climate networks	+	+	+	+	+	+
	climate regulatory frameworks	+	(-)	(-)	(-)	(-)	+
	administrative routines/practices	+++	+++	+++	+++	+++	+++
Dimension 4 - Political aspects (to implement climate initiatives)	political will	+++	+++	+++	+++	+++	+++
	level of commitment	+++	+++	+++	+++	+++	+++
Dimension 5 - Local dynamics of urban planning (to consolidate adaptation interventions)	mismatch between the scale of urban issues and the extent of local government authority	+++	+++	+++	+++	+++	+++
	pressures from private sector	+++	+++	+++	+++	+++	+++
	inspection	+++	+++	+++	+++	+++	+++

+ low impact; ++ moderate impact; +++ high impact; (-) no existence

Fig. 2 Note: This data is mandatory. Please provide

## Discussion and conclusion

The application of the framework and assessment indicates six elements that have a highly negative impact on adaptation: administrative practices, political will, level of commitment, mismatches between the scale of urban issues and the extent of local government authority, pressures from the private sector, and inspection. Although these elements are not climate-specific barriers (Biesbroek et al. 2013) and are identified in other environmental arenas, when combined, they produce and worsen barriers to advancing local urban adaptation. For example, disconnections between sectoral policies, lack of definition of responsibilities and priorities, and the bureaucratic perspective of formal procedures are critical administrative routines that hamper the ability of these cities to deploy resources and promote the integration of adaptation as a central theme in development planning. In Brazil, the experience of more than three decades of democracy has not been sufficient to establish an effective political-institutional system of planning. There are a number of conflicts over jurisdiction and distribution of responsibilities between different levels of government and state organizations, in addition to the low accountability of these organizations (Oliveira 2017).

Combined with the patrimonialism that controls many public organizations and contracts, the political utilitarian perspective is strongly influenced by political trends and has a high level of impact on climate adaptation. Specific politicians' interests (will) and politically hostile conditions to environmental issues (commitment) in general also hinder the implementation of climate initiatives. In the case of Brazil, the current political scenario is already recognized as one of the major drivers of deforestation and carbon emissions, putting the commitments made by Brazil in the Paris Agreement at risk (Rochedo et al. 2018).

Concerning local dynamics of urban planning, the combination of pressures from private sectors, insufficient inspection, and the mismatch between the scale of urban issues and the extent of local government authority negatively affect the ability of these cities to consolidate adaptation interventions. In Brazil, zoning and building regulations are established by municipal laws, approved by the local legislature and enforced by municipal agencies. However, the implementation of regulations is usually characterized by pressure groups lobbying for changes, benefiting certain sectors (Marques 2013). Insufficient inspection in the governance of building regulations is widespread. It is not uncommon for certain groups to ignore or disregard the rules. These difficulties and the fact that these Brazilian cities are located in large metropolitan areas, where critical policies and issues related to urban planning and adaptation fall under multiple jurisdictions, compromise the capability of local governments to carry them out.

Our results indicate that staff and information, while important, are not the most critical factors for advancing

adaptation in these cities. However, the current process of dismantlement of the civil service is relevant as in Brazil municipal public servants are considered central actors in the process of political decision-making, influencing the formulation and facilitating the implementation of public policies in their specific areas of government (Gomes et al. 2017).

Our findings suggest that our framework is useful and can be piloted in other large cities, particularly in Global South, where, as in Brazil, municipal efforts play a key role in adaptation, all the while being confronted with specific interest groups and pressures from private sectors. Moreover, we hope that our framework will be used not only as an analytical device but also as a means to encourage municipalities to review their opportunities to advance climate policies, mainstream climate adaptation, and design governance procedures to achieve more efficient interventions.

While we recognize the important role that local governments play in addressing and leading climate adaptation, we also appreciate that deliberative discussions regarding social responses to climate change are critical. Interactions between sectors, levels of government, and state and non-state actors affect how cities respond to climate change (Romero-Lankao et al. 2018). Therefore, investigating individual and private sector responses to climate change, and their role in implementing sustainable adaptation, is still necessary for future studies on urban climate governance in Brazil.

**Acknowledgments** We are grateful to the all practitioners of the six studied cities that participated in this project.

**Funding information** This study is part of the CiAdapta project funded by Brazil's National Council for Scientific and Technological Development – CNPq (Proc. 446032/2015-8).

## References


- Anguelovski I, Carmin J (2011) Something borrowed, everything new: innovation and institutionalization in urban climate governance. *Current Opinion in Environmental Sustainability*. 3:169–175. <https://doi.org/10.1016/j.cosust.2010.12.017>
- Anguelovski I et al (2016) Equity impacts of urban land use planning for climate adaptation: critical perspectives from the Global North and South. *J Plan Educ Res* 36(3):333–348. <https://doi.org/10.1177/0739456X16645166>
- Araos M et al (2016) Climate change adaptation planning in large cities: a systematic global assessment. *Environ Sci Pol* 66(2016):375–382. <https://doi.org/10.1016/j.envsci.2016.06.009>
- Araos M et al (2017) Climate change adaptation planning for Global South megacities: the case of Dhaka. *J Environ Policy Plan*. <https://doi.org/10.1080/1523908X.2016.1264873>
- Aylett A (2014) Progress and challenges in the urban governance of climate change: results of a global survey. MIT, Cambridge
- Aylett A (2015) Institutionalizing the urban governance of climate change adaptation: results of an international survey. *Urban Clim* 14:4–16. <https://doi.org/10.1016/j.uclim.2015.06.005>

- Biesbroek G et al (2013) On the nature of barriers to climate change adaptation. *Reg Environ Chang* 13:1119–1129. <https://doi.org/10.1007/s10113-013-0421-y>
- Biesbroek R, Lesnikowski A (2018) The Neglected Dimension of Polycentric Climate Governance. In: Jordan A et al. (eds) (2018). *Governing Climate Change - Polycentricity in Action?* Cambridge University Press. <https://doi.org/10.1017/9781108284646>
- Broto VC (2017) Urban governance and the politics of climate change. *World Dev* 93(1–15):2017. <https://doi.org/10.1016/j.worlddev.2016.12.031>
- Brown K, Westaway E (2011) Agency, capacity, and resilience to environmental change: lessons from human development, well-being, and disasters. *Annu Rev Environ Resour* 36:321–342. <https://doi.org/10.1146/annurev-environ-052610-092905>
- Bulkeley H (2010) Cities and the governing of climate change. *Annu Rev Environ Resour* 35:229–253. <https://doi.org/10.1146/annurev-environ-072809-101747>
- Bulkeley H, Broto V (2013) Government by experiment? Global cities and the governing of climate change. *Trans Inst Br Geogr* 38:361–375. <https://doi.org/10.1111/j.1475-5661.2012.00535.x>
- Burch S (2009) In pursuit of resilient, low carbon communities: an examination of barriers to action in three Canadian cities. *Energy Policy*. <https://doi.org/10.1016/j.enpol.2009.06.070>
- Burch S (2010) Transforming barriers into enablers of action on climate change: insights from three municipal case studies in British Columbia, Canada. *Glob Environ Chang* 20:287–297. <https://doi.org/10.1016/j.gloenvcha.2009.11.009>
- Carmin J et al (2012) Urban climate adaptation in the Global South: planning in an emerging policy domain. *J Plan Educ Res* 32(1): 18–32. <https://doi.org/10.1177/0739456X11430951>
- Carmin J, Dodman D, Chu E (2013) Urban climate adaptation and leadership: from conceptual understanding to practical action. OECD Regional Development Working Papers, 2013/26. OECD Publishing, Paris. <https://doi.org/10.1787/5k3ttg88w8hh-en>
- Chu E et al (2017) Climate adaptation as strategic urbanism: assessing opportunities and uncertainties for equity and inclusive development in cities. *Cities* 60:378–387. <https://doi.org/10.1016/j.cities.2016.10.016>
- Darela-Filho J et al (2016) Socio-climatic hotspots in Brazil: how do changes driven by the new set of IPCC climatic projections affect their relevance for policy? *Clim Chang* 136:413–425. <https://doi.org/10.1007/s10584-016-1635-z>
- Donat MG et al. (2013). Updated analyses of temperature and precipitation extreme indices since the beginning of the twentieth century: The HadEX2 dataset. *JGR Atmospheres*. 118:2098–2118. <https://doi.org/10.1002/jgrd.50150>
- Eakin HC, Patt A (2011) Are adaptation studies effective, and what can enhance their practical impact? *WIREs Clim Chang* 2:141–153. <https://doi.org/10.1002/wcc.100>
- Eakin H et al (2014) Differentiating capacities as a means to sustainable climate change adaptation. *Glob Environ Chang* 27:1–8. <https://doi.org/10.1016/j.gloenvcha.2014.04.013>
- Ford JD et al (2011) A systematic review of observed climate change adaptation in developed nations. *Clim Chang* 106:327–336. <https://doi.org/10.1007/s10584-011-0045-5>
- Geneletti D, Zardo L (2016) Ecosystem-based adaptation in cities: an analysis of European urban climate adaptation plans. *Land Use Policy* 50:38–47. <https://doi.org/10.1016/j.landusepol.2015.09.003>
- Gomes MDL et al. (2017) Capacidade estatal e formulação de políticas sociais por municípios sob a ótica da gestão pública democrática. *Soc. e Cult.* 20:83–104. <https://doi.org/10.5216/sec.v20i1.51065>
- IBGE Censo 2010. <https://censo2010.ibge.gov.br/>
- IPCC (2013) In: Stocker TF, Qin D, Plattner G-K, Tignor M, Allen SK, Boschung J, Nauels A, Xia Y, Bex V, Midgley PM (eds) *Climate change 2013: the physical science basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge 1535 pp
- IPCC (2014) *Climate change 2014: impacts, adaptation, and vulnerability*. Part A: global and sectoral aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. In: Field CB, Barros VR, Dokken DJ, Mach KJ, Mastrandrea MD, Bilir TE, Chatterjee M, Ebi KL, Estrada YO, Genova RC, Girma B, Kissel ES, Levy AN, MacCracken S, Mastrandrea PR, White LL (eds) . Cambridge University Press, Cambridge 1132 pp
- Klostermann J et al (2018) Towards a framework to assess, compare and develop monitoring and evaluation of climate change adaptation in Europe. *Mitig Adapt Strateg Glob Chang* 23:187–209. <https://doi.org/10.1007/s11027-015-9678-4>
- Leck H, Roberts D (2015) What lies beneath: understanding the invisible aspects of municipal climate change governance. *Curr Opin Environ Sustain* 13:61–67. <https://doi.org/10.1016/j.cosust.2015.02.004>
- Lemos MC, Kirchoff CJ (2016) Climate information and water management: building adaptive capacity or business as usual? In: Conca K, Weintal E (eds) *The Oxford handbook of water politics and policy*. Oxford University Press
- Marques E (2013) Government, political actors and governance in urban policies in Brazil and São Paulo: concepts for a future research agenda. *Braz Polit Sci Rev* 7(3):8–35. <https://doi.org/10.1590/S1981-38212013000300001>
- McClure L, Baker D (2018) How do planners deal with barriers to climate change adaptation? A case study in Queensland, Australia. *Landscape and Urban Planning*. 173:81–88. <https://doi.org/10.1016/j.landurbplan.2018.01.012>
- Morgan E, Di Giulio G (2018) Science and evidence-based climate change policy: collaborative approaches to improve the science-policy interface. In: Serrao-Neumann et al. (Org.) *Communicating climate change information for decision-making*. Springer International Publishing, p. 13–28
- Moser S, Boykoff MT (2013) *Successful adaptation to climate change: linking science and practice in a rapidly changing world*. Routledge, London
- Moser SC et al (2010) *Proc Natl Acad Sci U S A* 107(51):22026–22031. <https://doi.org/10.1073/pnas.1.007887107>
- Oliveira JAP (2017) Brazilian public administration: shaping and being shaped by governance and development. *Chin Polit Sci Rev* 2:7–21. <https://doi.org/10.1007/s41111-017-0052-4>
- PMMA 2017. Plano Municipal de Conservação e Recuperação da Mata Atlântica do Município de São Paulo, Prefeitura Municipal de São Paulo, Secretaria do Verde e Meio Ambiente, apoio SOS Mata Atlântica, novembro de 2017, 533 pgs
- Rochedo P et al (2018) The threat of political bargaining to climate mitigation in Brazil. *Nat Clim Chang* 8:695–698. <https://doi.org/10.1038/s41558-018-0213-y>
- Romero-Lankao P et al (2018) Urban transformative potential in a changing climate. *Nat Clim Chang* 8(9):7154–7756. <https://doi.org/10.1038/s41558-018-0264-0>
- Rosenzweig C et al (2015) ARC3.2 Summary for city leaders. Urban Climate Change Research Network. Columbia University, New York
- Runhaar H et al (2018) Mainstreaming climate adaptation: taking stock about “what works” from empirical research worldwide. *Reg Environ Chang* 18:1201–1210. <https://doi.org/10.1007/s10113-017-1259-5>
- Ryan D (2015) From commitment to action: a literature review on climate policy implementation at city level. *Clim Chang* 131:519–529. <https://doi.org/10.1007/s10584-015-1402-6>
- Serrao-Neumann S et al (2018) *Communicating climate change information for decision-making*. Springer International Publishing. <https://doi.org/10.1007/978-3-319-74669-2>

- Sherman M et al (2016) Drawing the line between adaptation and development: a systematic literature review of planned adaptation in developing countries. *WIREs Clim Chang* 7:707–726. <https://doi.org/10.1002/wcc.416>
- Sillmann J et al (2013) Climate extremes indices in the CMIP5 multimodel ensemble: part 2 Future climate projections. *J Geophys Res* 118:2473–2493
- Simões E et al (2017) Barriers and opportunities for adapting to climate change on the North Coast of São Paulo, Brazil. <https://doi.org/10.1007/s10113-017-1133-5>
- Torres RR, Marengo JA (2013) Uncertainty assessments of climate change projections over South America. *Theor Appl Climatol* 112: 253–272
- Torres RR, Marengo JA (2014) Climate change hotspots over South America: from CMIP3 to CMIP5 multi-model datasets. *Theor Appl Climatol* 117:579–587. <https://doi.org/10.1007/s00704-013-1030-x>
- Uittenbroek CJ et al (2014) Political commitment in organising municipal responses to climate adaptation: the dedicated approach versus the mainstreaming approach. *Environ Polit* 26:1043–1063. <https://doi.org/10.1080/09644016.2014.92056>

**Publisher's note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

## Affiliations

Gabriela Marques Di Giulio<sup>1</sup>  · Roger Rodrigues Torres<sup>2</sup> · David M. Lapola<sup>3</sup> · Ana Maria Bedran-Martins<sup>4</sup> · Maria da Penha Vasconcellos<sup>4</sup> · Diego Rafael Braga<sup>3</sup> · Marcos Paulo Fuck<sup>5</sup> · Yohanna Juk<sup>5</sup> · Veruska Nogueira<sup>2</sup> · Ana Carolina Penna<sup>2</sup> · Tiago Jacaúna<sup>6</sup> · Marcelo Fetz<sup>7</sup> · Zoraide Pessoa<sup>8</sup> · Rylanneive Pontes<sup>8</sup> · Marize Schons<sup>9</sup> · Adriano Premebida<sup>9</sup>

Roger Rodrigues Torres  
roger.torres@unifei.edu.br

David M. Lapola  
dmlapola@unicamp.br

Ana Maria Bedran-Martins  
bedran.ana@gmail.com

Maria da Penha Vasconcellos  
mpvascon@usp.br

Diego Rafael Braga  
diego1987@gmail.com

Marcos Paulo Fuck  
marcospaulofk@gmail.com

Yohanna Juk  
yohannajuk91@gmail.com

Veruska Nogueira  
veruska@cbhsapucai.org.br

Ana Carolina Penna  
acarol.penna@gmail.com

Tiago Jacaúna  
tiagojacauna@ufam.edu.br

Marcelo Fetz  
marcelofetz@gmail.com

Zoraide Pessoa  
zoraidesp@gmail.com

Rylanneive Pontes  
pontesrylanneive@gmail.com

Marize Schons  
marizeschons426@gmail.com

Adriano Premebida  
premebida@hotmail.com

<sup>1</sup> School of Public Health, University of São Paulo (USP), Av. Dr. Arnaldo, 715, São Paulo, SP 01246-904, Brazil

<sup>2</sup> Federal University of Itajubá, Itajubá, Brazil

<sup>3</sup> University of Campinas, Campinas, Brazil

<sup>4</sup> University of São Paulo, São Paulo, Brazil

<sup>5</sup> Federal University of Paraná, Curitiba, Brazil

<sup>6</sup> Federal University of Amazonas, Manaus, Brazil

<sup>7</sup> Federal University of Espírito Santo, Vitória, Brazil

<sup>8</sup> Federal University of Rio Grande do Norte, Natal, Brazil

<sup>9</sup> Federal University of Rio Grande do Sul, Porto Alegre, Brazil