Climate change, risks and adaptation in the megacity of São Paulo: a perspective from Human Sciences

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Abstract

Megacities have an important role in debating new paradigms to build adaptive capacity to respond to climate change for two reasons: (1) lifestyles associated with urbanization are the drivers of climate change; (2) cities are more susceptible to risks and severe impacts related to this phenomenon. The megacity of São Paulo, Brazil, where more than 11 million people live (15% live in precarious settlements), is a good example of this. Models and projections of climate change in this city point out that climate issues may bring a set of environmental hazards that would worsen urban problems. In this paper, we will examine our preliminary results of an empirical research that seeks to understand: (i) how this megacity has been mobilized to deal with climate risks and threats; (ii) how stakeholders of science, policy and civil society perceive climate risks in the local sphere, and how they think about the city's capacity for self protection and adaptation.

Keywords: Climate change, adaptive capacity, megacities, São Paulo, perception, vulnerability

Introduction

Environmental and climate change has increased in salience in citizens' daily life with an intensity that never been previously observed, and highlights a need for theoretical and methodological approaches to understand a new set of risks and threats that would further exacerbate the current adverse situations in urban areas. Responses to these risks and threats involve elements that shape our contemporary lifestyles (Di Giulio, 2014). At local level, where people are directly affected by climate and environmental risks, and adaptive actions must be urgently implemented (Serrao-Neumann et al., 2013; Kasperson et al., 2005; Ribeiro, 2010; Diling and Lemos, 2011; Lemos et al., 2012), these responses need to be linked to key questions of urban governance.

Megacities, which are the main arena for contemporary transformation, have an important role in promoting a wider, level headed debate about new paradigms in order to build adaptive capacity to respond to climate change. There are two reason for this: (1) lifestyles associated with urbanization are the drivers of climate change; (2) cities are more susceptible to risks and severe impacts related to this phenomenon.

São Paulo city, Brazil, home to more than 11 million people, is a good example to consider when reflecting on this role, its opportunities and challenges. Like other cities in the South hemisphere, São Paulo is characterized by intense, chaotic growth, and environmental and social degradation (Rolnik, Klink, 2011; Singer, 1973; Santos, 1994; Carlos, 2008). This megacity exhibits all the main elements of an urban environment, and highlights the problems and challenges faced by decision makers and residents, such as irregular settlements on slopes or banks of rivers and reservoirs, scarcity of sanitation, traffic congestion and pollution – all of which impacts seriously on quality of life. More than 15% of the population live in precarious settlements (CEM/Cebrap, FUNDAP, 2013). Models and projections of climate change in the city demonstrate that climate issues may bring a set of environmental hazards (Ambrizzi et al., 2012) that would worsen urban problems. Aware of these potential future scenarios and climate threats, São Paulo is part of the C40 Cities Climate Leadership Group (C40) – a network of the world's megacities committed to addressing climate change. It is also one of the few Brazilian municipalities to have had a Municipal Policy on Climate Change since 2009 (Back, 2012; Cortese, 2013; Furriela, 2011), although the goals have not yet been achieved (Di Giulio and Vasconcellos, 2014).

Based on the idea that cities have become the vanguard jurisdictions for the governance of climate change by experimentation (Bulkeley and Broto, 2013) as they test different social and technological approaches in response to climate change, in this paper we will examine our preliminary results of an empirical study that seeks to understand: (i) how this megacity has been mobilized to deal with climate risks and threats; (ii) how stakeholders of science, policy and civil society perceive climate risks in the local sphere, and how they think about the city's capacity for protection and adaptation.

Climate change at the local level

At the beginning of this 21th century, most social, political and technological changes have been take place in cities, which have to deal with the most drastic impacts of environmental change, urban problems and increasing vulnerabilities to climate change.

Within the megacity of São Paulo the importance of issue of climate change threats and responses has been rising in both on societal and governmental agendas as a recent series of severe climate driven events (flooding and, particularly, the recent drought) have mobilized public opinion and research.

In this context, one of the biggest challenges for this Brazilian megacity is linking public policies related to climate change to housing policy, sanitation, urban planning, water management and to the review of possibilities of urban mobility in order to reach a better solution for current urban problems. The process of rethinking the city and proposing solutions to urban problems that would be further exacerbated by climate issues can be structured through taking account of (i) individual and collective concerns on climate change, (ii) the role of the State in democratizing the public access to the collective engagement, (iii) public policies that cover all social groups (Barbieri and Vianna, 2014), (iv) and differing exposure of people and place's to risks and disasters, including differences of responses and adaptive capacities. This heterogeneity, particularly in terms of access to resources, levels of poverty and abilities to interact with climate change, is an important issue for the debate about responses to climate change in São Paulo.

The climate projections for São Paulo in this century, despite uncertainties, give a warning that indicates relevant changes in the distribution, intensity and geographic

frequency of risks related to meteorological conditions, and shed light on the capacity (or lack thereof) of this city to respond to these risks and threats.

The current water crisis (São Paulo has been enduring a long, dry spell) has provided motivation to reflect on how climate debate goes beyond natural climate variability and climate change associated with anthropic actions. There is an urgent need to better understand the impacts of the increase in exposure and vulnerability of place, people, community and demographic groups to hazards, as well as the impacts related to direct human action on the environment (changes of land use, urbanization and pollution). There is also an urgent need to rethink urban governance, and how the city has (or doesn't have) the ability to create a 'propitious environment' through actions from society, entrepreneurs, research institutions and universities, in a way that brings social groups that still deal separately and diversely with environmental issues closer together.

Climate responses at the local level

As the effort to centralize the international governance of climate change has failed to coalesce, the governance of climate change has shifted to smaller jurisdictions such as municipalities (Victor et al., 2005; Bulkeley, 2005; Betsill and Bulkeley, 2006; Rabe, 2007; Byrne et al., 2007). Consequently, policy experimentation has emerged as a critical option for those seeking to take action of from climate impact, expand authority or resource claims, or express an ideological position on climate change across governing scales (Hoffmann, 2011).

However, as Lemos et al. (research project, 2015) point out, there is relatively little research that investigates what factors drive these experiments, especially concerning the different resources, actors and infrastructure that for basis of their capacity to design, implement and eventually scale up experiments on climate adaptation. Some research suggests that communities are limited in their capacity to adapt by their ability to act collectively. Here, social capital, trust, and organizations greatly influence this capability to act collectively (Pelling and High, 2005). Others narrow in on institutions, governance, and management as critical influences on a systems or individual's capacity for adaptation to climate change (Lemos et al., research proposal).

Case-based research on areas of environmental/resources management has identified how different capacities might critically affect the ability of different systems to respond

to climate threat. One empirically identified factor is the presence of policy entrepreneurs who play a pivotal role in placing climate related issues in governmental and societal agendas, and who usually foster adaptive action such as the ones pursued by cities' experiments around the world. Another is a combination of different kinds of capacities (generic and specific) that synergize to allow for both development and risk management (Eakin et al., 2014; Lemos et al., 2013). A third element is the role of knowledge and inclusionary, multi-level and adaptive governance in fostering adaptation (Walker et al., 2002). Finally, research has identified that the means through which the process of designing and implementing adaptation policy happens – that is as stand-alone policy or through streamlining into already existing processes, also plays a role in facilitating or constraining adaptation (Denton et al., 2014).

If different capacities affect the ability of different systems to respond to climate threat, the same happens with contextual factors, such as risk perceptions and impact of climate-driven extreme events that influence the municipal action associated with climate change.

Perceptions of risks linked to climate change reflect the way in which people (individuals, politicians, decision makers) process what their senses observe (the so-called physical signals) and the information they receive (such as the news conveyed by the media, public bodies and corporations; information shared between neighbors and family members; and access to the results of studies). In addition, perceptions also reflect how people's judgments are formed, including their experiences, the contextual variables, values, trust in the organizations and institutions involved, and uncertainties (Renn, 2008; Hannigan, 2006; Douglas et al., 2003).

Studies of risk perception and environmental change have shown that individuals' perceptions are constructed through a process of association and emotion, based on the information they have, the attention they pay to the subject and their confidence in the data provided (Weber, 2010).

An absence of technical and scientific information on climate change and risk and the difficulty of using available information in decisions are also two important limitations that individuals, both at institutional and collective level, face when acting and making decisions in risk situations. This difficulty is related, in particular, to the controversies and uncertainties linked to the causes and effects of environmental changes and of climate change, which makes it more difficult to adopt and support environmental

measures and policies. Besides the uncertainty, another difficulty in using scientific knowledge in decisions is related to the way in which information is disseminated (Di Giulio et al., 2014). The use of elaborate scientific language can make it difficult to achieve one of the objectives of communicating science: to create knowledge that will serve as a basis to change attitudes and practices and to exert influence on the adoption of public policies orientated towards promoting individuals' wellbeing. As Lemos et al. (2012) recognize, there is a persistent gap between knowledge production and use. In other words, there are processes and mechanisms that still need to be better understood concerning the movement of information from what producers of climate information ('producers' henceforth) hope is useful, to what users of climate information ('users' henceforth) know can be applied in their decision-making.

We argue that the dissemination of scientific knowledge about environmental changes could help decision makers in making their choices, which could impact on individuals' current and future quality of life. Hence, by having access to and understanding of the information conveyed, those in power could decide to mitigate the effects of environmental change, and stakeholders (both governmental and non-governmental) could choose to adapt their daily lives, investing in consumption patterns and habits centred on the changes already underway (Patt and Dessai, 2005). However, at this juncture, it is worth recalling that there is not necessarily a linear relationship between science and politics. The existence and availability of a technical and scientific information do not necessarily lead to rational and correct political decisions (Pielke Jr, 2007).

On the other hand, the usability of (scientific) information also depends on three interconnected factors: users' perception of information; how new knowledge interplays with the existing; and the level and quality of interaction between producers and users (Lemos et al., 2012).

The case of the megacity of São Paulo

In order to investigate how the megacity of São Paulo has been mobilized to deal with climate risks and threats, how stakeholders of science, policy and civil society perceive climate risks in the local sphere, and how they think about the city's capacity for

protection and adaptation, we proposed a workshop[1] aiming to exchange information on climate science, risks and adaptation between scientists, practitioners, and journalists.

The narratives obtained in this workshop, combined with results from documentary research, observations and interviews (methods that have been used in our study), shed light on the relationships between city capacities and the contextual factors that influence the municipal action associated with climate change.

Over one and a half days, the participants of the workshop were divided into five panels (megacity, water resources, extreme weather events, urban forests and mobility) and encouraged to debate the challenges and opportunities for climatic adaptation and how different resources and deficits feedback on each other both positively and negatively to build the resilience and sustainability of São Paulo.

The workshop provided the opportunity to reflect on the current knowledge, knowledge gaps and challenges related to climate change, and helped to clarify some relevant aspects of climatic adaptation in São Paulo. One of these, which has been adopted by the city of São Paulo government, is the design and implementation of actions by streamlining them into existing policy. This means that, while there are specific interventions in urban socio-technical systems (mobility, housing, green infrastructure) that are designed to respond to the imperatives of mitigating and adapting to climate change in the city, they have not been openly described as "climate change actions". This strategy, which elsewhere is called 'adaptation by stealth' (Kalafatis and Lemos, in review) are implemented under the guise of other frameworks such as "smart development", "green infrastructure", "sustainable development."

One clear example of this is related to the urban mobility policies that have been implemented in recent months, giving priority to public transport and bicycles. This public policy that "promotes mobility to people not to vehicles", as an architect from Company Traffic Engineering (CET) explained during the workshop, demonstrates how the climate dimension has been internalized in the Municipal Plan of Urban Mobility, without binding these actions to the 'climate change slogan' – which still has a negative connotation in most societies, including Brazil, where climate change is still a low priority, even when it is compared to other environmental issues that affect nations (Leiserowitz, 2007/2008; Di Giulio et al., 2014; Di Giulio and Vasconcellos, 2014).

[1] The workshop was organized by researchers from University of São Paulo (BR) and University of Michigan (USA), with support from São Paulo Research Foundation (Fapesp – Grant 2014/50313-8).

Research on climate change action in cities suggests that these kinds of experimental public policies are critically shaped by the context from which they emerge (Bulkeley 2010; Bulkeley and Broto, 2012), and that there are a wide variety of context-based motivations behind such experiments, including: (i) cities pursuing innovative climate change policies because such work helps them fulfill their own internal goals or reduce perceived risks (Bassett and Shandas, 2010; Anguelovski and Carmin, 2011); (ii) taking the initiative to act on climate change is a way for some cities to positively differentiate themselves as leaders while enhancing their profile and asserting their ability to exert political pressure on larger scales of governance (Anguelovski and Carmin, 2011; Eisenhauer et al., in review); (iii) cities pursue climate change work as a means to realize other existing goals such as "green" initiatives or sustainability, social justice, reducing potential expenses, supporting economic development or attracting investment and economic migration (Barclay et al., 2013).

The participants of the workshop, in general, agreed that dealing with climate threats and reducing vulnerabilities requires structural and non-structural measures, including local government actions and changes in social practices. Accountability, co-responsibility, precautionary position, dialogue between academics and practitioners, as well as collective decision-making processes are key issues to be addressed in order to solve the complex equation: "climate + environmental change + urban dynamics + sustainability = ?" (Di Giulio and Vasconcellos, 2014).

The narratives from interviews with representatives of two Brazilian NGOs (that act in the megacity of São Paulo), as well as observation of seminars on climate change and impacts at the local level have highlighted that, in general, climate issues are not a daily concern public in São Paulo or in Brazil – or at least not at the moment, as would be expected, considering their relevance. Even when people comment on and perceive climate change, it seems that they do not associate it with their daily practices. In terms of adaptation, pressure on decision makers and behavioral changes have been highlighted as important steps in dealing with climate issues by stakeholders of science and civil society. However, both of these actions will take a long time.

At this point, we should consider that the recent approval of the new city plan and urban design could be an indicator that, over the next 16 years, the megacity of São Paulo will strive and seek for changes in its urban culture and sociability, and seeks to include climate and environmental issues in the future actions. The new city plan includes, for

example, payment for environmental services, building of new public parks (green areas), and investments in public transport (with more and better-structured bus and bicycle lanes). A recent poll about urban mobility in São Paulo pointed out that most of the 700 interviewees were supportive of these mobility actions (Rede Nossa São Paulo, Oct 2014[2]).

Thus these acts might affect the ability of the city to respond to climate threat, while contextual factors (in particular risk perception and impact of climate-driven extreme events) might influence the municipal action associated with climate change.

Two important issues must be considered in our argument: (i) a recent public opinion poll (Datafolha, May 2014 with 825 participants[3]) about environmental perceptions in São Paulo; (ii) the current water crisis and the fact that São Paulo has been enduring a drought.

The public opinion poll highlighted that the main environmental problems in the megacity for the majority of interviewees was pollution (41%), followed by waste (16%), sanitation (14%), rivers (8%), deforestation (4%), and finally climate (2%) – no response for global warming.

When asked about global warming, most of the interviewees (96%) had heard about it, and 20% considered themselves well informed on this issue – 54% more or less informed, 21% poorly informed. The poll suggested that 88% of the interviewees recognized that the effects of global warming are having a serious impact on the planet, 85% on Brazilians, and 81% on their own lives. One in each five (74%) consider that industries (including power plants and car factories) have lots of responsibility for global warming; 65% consider that people in general are responsible for this phenomenon.

All interviewees had pointed out that they have information that the lack of rain has made lower the volume of the water tank used to supply the city. The pool indicated that, in May 2014, 35% of the interviewees had been affected for water cutoffs at home in the last 30 days. Most of them believe that governments, consumers and industries

[2] <http://www.nossasaopaulo.org.br/noticias/rede-nossa-sao-paulo-e-ibope-lancam-oitava-pesquisa-sobre-mobilidade-urbana>, 28 oct. 2014.

[3] <http://www1.folha.uol.com.br/seminariosfolha/2014/06/1464903-para-paulistano-poluicao-e-o-que-mais-preocupa-na-cidade-e-no-pais.shtml>. 16 jun. 2014.

are responsible for the risk of water cutoffs. According to the responses, 73% of the interviewees believe that State government has a lot of responsibility for this risk, 70% for the Federal government, and 68% for Municipal Government.

The current water crisis in São Paulo State, with serious repercussions in the megacity of São Paulo, has gained attention from the politicians, the media and the society in general. Brazilian scientists recognize a climate anomaly for the lack of rain; however, highlight that the poor governance is responsible for the ensuing predicament (Escobar, 2015; Academia Brasileira de Ciências and Academia de Ciências do Estado de São Paulo, 2014). The São Paulo water crisis has left the megacity "teetering on the brink", as an article of the British newspaper released. "Though domestic use accounts for only a fraction of the water consumed in the state of São Paulo – where extensive agriculture and industry places intense pressure on available resources – for paulistanos, as the city's residents are called, learning to use water wisely is suddenly the most pressing need of all" (The Guardian, Feb 2015[4]). Residents of São Paulo had to learn to live with less water and arrange to store the liquid at home. There are also incentives to use less water, fines for those who use too much and the possible installation of more water-efficient taps (The Independent, Feb 2015[5]).

The biggest question that emerges from this is if the water crisis (also understood as an impact of climate-driven extreme events) will (and how) influence the municipal action associated with climate change, and individual perceptions and responses to climate change.

The capacity to respond to climate (and environmental) change at the local level is related to some key issues of urban governance, including social, environmental, economic and health issues. The local governments are able to influence behaviors and habits that are responsible for large greenhouse gas emissions, and have an important role in mitigation measures through public policies, regulations and planning in strategic sectors. However, we also argue that the local governments might provide political and institutional structures to help the cities to adapt to climate change impacts, based on the idea that what we (as society) need right now is a transformational adaptation – not only measures to adapt to climate chance, but also measures for a

[4] http://www.theguardian.com/cities/2015/feb/25/sao-paulo-brazil-failing-megacity-water-crisis-rationing

[5] http://www.independent.co.uk/news/world/americas/brazil-water-shortage-sao-paulo-devastated-by-its-worst-drought-on-record-10065071.html

collective change in the ways of live. As Kates et al. (2012, p. 7156) recognize, "although many transformative adaptations are technological, they are also behavioral, affecting how individuals and society make decisions and allocate resources to cope with climate change. They may alternatively include fundamental changes in institutional arrangements, priorities, and norms".

A proposal of analysis on the micro level

While climate change will expose regions to similar effects, the extent of those effects and responses on a local level will be determined not only by the location's sensitivity and vulnerability but also by local groups and individual capacity, including their institutional links, social networks and motivation, for action. People's responses to climate change (that would further exacerbate problems and the risks to which they are exposed) are determined by levels of on-the-ground social inequality, lack of representation, and inadequate systems of social protection, planning and risk management (Tanner et al., 2015). Thus, a livelihood perspective, which places people at the center of the research analysis (Tanner et al., 2015), is crucial to understand people's perceptions of risk and their capacities to take actions (individually or collectively).

Considering that environmental impacts of climate change are experienced within the day-to-day timeframe, and within the living space, our empirical study is also focused in a specific region in the megacity of São Paulo: Butantã, which is representative of urban diversities and social and economic inequalities in São Paulo. Beyond the main campus of the University of São Paulo and some prime areas including commercial and residential buildings, the region (428,217 people) has more than 70 precarious settlements (Civil Defense, 2014), around 20 risk areas with flooding and landslides (risk assessment, IPT, 2010), and until very recently two neighborhoods in high risk areas (approximately 2,240 families).

At a deep level, we seek to analyze how people understand their vulnerabilities in a context of extreme events, and how they imagine that climate risks exacerbate their vulnerabilities.

Through the meetings with the local authorities of the sub-city hall (the city of São Paulo is divided in 32 sub-cities halls; of which Butantã is one) and practitioners who

work at the departments of Urban Planning, Social Assistance and Housing Policy, it has been possible to understand the complexities of this region.

Through observations of meetings and virtual messages posted by participants of a local network, it is possible to point out at least three crucial urban and environmental issues that have been exhaustively debated by the participants (and that are relating to climate change): the current water crisis, urban mobility and land use.

The water crisis motivated the launching of an initiative that joins people and social movements who are involved in debates and actions about water issues. This initiative includes parades and actions on the social media, and struggles for transparency with information that has been released about water crisis, a more democratic water management, and for actions to recover and preserve local rivers and reservoirs.

A specific work group from the local network has discussed urban mobility issues, in order to bring contributions to the São Paulo Municipal Plan of Urban Mobility. Participants of this work group highlight the need for more investments in the quality of public transport (including investments of electrical bus fleet or bus with renewable energy), and new ways to manage the costs of this sector. Participants also bring propositions for changes and improvements in the local traffic.

The current review of the zoning law is another issue that has been discussed by the participants of the local network. They express concerns about a possible large density without previous assessments, and about the inability of the region to absorb the impacts from the densification. For them, the municipal plan of promoting a large density in the region would further exacerbate the urban and environmental problems to which residents are exposed, in particular transport, public facilities, energy and water supply.

The next step of our research seeks to comprehend how people associate these issues to climate change. How do they understand and perceive climate change and its effects? How do they imagine that climate risks exacerbate their vulnerabilities? How to adapt the urban habitat to the socioenvironmental perspective of climate change? Which resources do vulnerable individuals and groups bring to their everyday strategies of security and betterment?

The possible answers for those questions will be analyzed from sociological perspectives, which understand risk as a social construction: what is defined and seen as

a risk depends on social relationships, cultural beliefs, trust in institutions, scientific knowledge, experiences, emotions, discourses, collective memories and practices (Boholm, 2003; Beck, 2010; Giddens, 1995; Lupton, 1999; Hannigan, 2006). Risk discourse is thus dialogic and dynamic. It means that its structure based on syntax and semantics is not only scientific or logical, but also cultural, social and political (Boyne, 2003).

In addition, the interpretation and selection of what is considered relevant as an environmental problem/risk is a social process, in which different elements are present, such as social communication (media), science, aspects of morality and politics (Beck, 1995,1998, 2009, 2010). Judgments on risks are political, moral, esthetical and are constructed through cultural frameworks (Douglas 2003; Douglas e Wildavsky, 1982). Risks are carried on by traditional and ethical values which have a direct and indirect role in affecting individual perceptions, and add an emotional bias to the conflicting information that we receive (Kasperson e Kasperson, 2005; Giddens, 2009; Douglas et al., 2003; Boholm, 2008; Boyne, 2003; Renn, 2007, 2008; Beck, 2006, 1999, 1998, 1996, 1995; Hannigan, 2006; Pidgeon et al., 2003; Leach et al, 2005). The possible lack of urgency and responsibility on climate issues is also a problem of communication, as climate change effects are psychologically remote, and seen as distant (in terms of time and space). Individual perceptions on climate risks and impacts are contextual and quite diverse (Wardekker, 2004), and are directly related to uncertainties and ambiguities on this phenomenon (its causes, effects, risks and threats) (Naustdalslid, 2011, Renn, 2008; Beck, 2009, 2010).

Conclusions

In this paper we sought to examine our preliminary results of an empirical research that seeks to comprehend how the megacity of São Paulo has been mobilized to deal with climate risks and threats, and how stakeholders of science, policy and civil society perceive climate risks in the local sphere, and how they think about the city's capacity for protection and adaptation.

Our preliminary results show that the city of São Paulo government has started to design and put some actions in place by mainstreaming it into existing policy, that is, while there are specific interventions in urban socio-technical systems (mobility,

housing, green infrastructure) that are designed to respond to the imperatives of mitigating and adapting to climate change in the city, they have not been openly described as "climate change actions".

The recent approval of the new Master planning and urban design, for the next 16 years, could be an indicative that the megacity of São Paulo strives for changes in its urban culture and sociability, and seeks to include climate and environmental issues in the future actions. The Master planning includes, for example, payment for environmental services, building of new public parks (green areas), and investments in public transport (with more and better-structured bus and bicycle lanes).

Thus these acts might affect the ability of the city to respond to climate threat, while contextual factors (in particular risk perception and impact of climate-driven extreme events) might influence the municipal action associated with climate change. We had argued that two important issues must be considered about this point: (i) a recent public opinion poll about environmental perceptions in São Paulo, which demonstrated that climate and global warming are not seeing as main environmental problems in the megacity; (ii) the current water crisis and the fact that São Paulo has been enduring a long, dry spell – the biggest question that emerges from this event is if the water crisis (also understood as an impact of climate-driven extreme events) will (and how) influence the municipal action associated with climate change, and individual perceptions and responses to climate change.

Finally, in this paper we also sought to present the next steps of our research, based on the idea that a livelihood perspective, which places people at the center of the research analysis (Tanner et al., 2015), is crucial to understand people's perceptions of risk and their capacities to take actions (individually or collectively). Drawing on empirical research in a specific region of the São Paulo, we could observe that the current water crisis, urban mobility and land use are crucial urban and environmental issues that have been exhaustively debated by the residents who are integrated in a local network. Our next research challenge is understanding how people associate these issues to climate change, and how they imagine that climate risks exacerbate their vulnerabilities.

Acknowledgements

The authors wish to thank the São Paulo Research Foundation (Fapesp – Grants: 2013/17665-5 and 2014/50313-8).

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