

Chapter 5

Urban Climate Risk: Flooding Events in Rio De Janeiro (RJ)

from the Perspective of Vulnerable People



Antonio Carlos da Silva Oscar Júnior, Ana Maria de Paiva Macedo Brandão, Luisa Pilar Marques Martins, and Rafaela Torres de Almeida

Abstract The production of urban space promotes significant and fundamental derivations for urban environmental, as example the urban climate, a social construct. Urban floods derive from this context and emerge as one of the most recurrent environmental problems, especially in the humid tropics, but still there is a lack in understanding this problem in the light of those in extreme vulnerability: the homeless population, for example. This chapter, based on risk science, proposes to understand the dimensions of vulnerability to floods, especially considering the homeless population, a segment that is rapidly growing in Brazilian cities. Taking the city of Rio de Janeiro as a case study, specifically the downtown district, from secondary data, field work, interviews, and participatory mapping, the chapter offers theoretical contributions to the studies of vulnerability to urban floods, showing the adaptation strategies, in many times using the space conditions of this adaptation, and offers too new perspectives/guidelines for urban planning and environmental risk management.

5.1 Introduction

Environmental impacts reflect processes of changing ecological and social relations (Coelho, 2009). Since these impacts are a significant category of space analysis, they need to be constantly investigated.

A. C. da Silva Oscar Júnior (✉) · A. M. de Paiva Macedo Brandão · L. P. M. Martins · R. T. de Almeida
Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil
e-mail: antonio.junior@uerj.br; martins.luisa_1@graduacao.uerj.br; almeida.rafaela@graduacao.uerj.br

It is in the urban space that environmental impacts have developed as a direct response to the urbanization processes that are both predatory and unfair. Predatory because, based on the artificialization of the environment (Santos, 2002), urbanization changes the flow dynamics of matter and energy by converting nature and space into merchandise for capital accumulation and unfair because it promotes unequal access to the burdens and bonuses of urbanity. In the case of cities with late, accelerated, and incomplete urbanization, a common situation in Latin America, the problem intensifies as the contradiction between precariousness and modernization prevails (Meyer et al., 2004).

Despite the database limitations (Marcelino et al., 2006), the data between 1900 and 2021 provided by EM-DAT (Emergency Events Database)—maintained by the Centre for Research on the Epidemiology of Disasters at the Catholic University of Louvain—show that around the world, especially in its urban portion, 3,877,333,145 people were affected by floods, of whom 6,991,839 died. According to Jha et al. (2012), regarding the same data up to 2011, a close look at those affected reveals that the flood impact is disproportionate as it is much more significant to the poor, particularly women and children. These data help to dimension and qualify the importance of this issue.

Also according to EM-DAT, between 1900 and 2021, 99,838,092 (25.7%) people were affected, and 106,237 (1.6%) died from flooding events in the Americas. In Brazil, among the top ten natural/biological events resulting in deaths, excluding the COVID-19 pandemic, six were attributed to floods, of which four occurred in the city of Rio de Janeiro (Table 5.1). In this case, urban flooding is intertwined with the city's history. According to Maia (2012), as early as 1575, Father José de Anchieta described, in a letter, the fury of rainwater; Brandão (2009), in turn, found records in newspapers since 1613 of floods impacting the daily lives of the city's inhabitants.

When told from flooding and other environmental impacts, the history of Rio de Janeiro, as well as other cities, reveals the “shelter-threat” duality in the urban space since the population's dwelling, through dynamic and reciprocal transformations of nature and society, offers unequal risks to its residents (Coelho, 2009; Almeida, 2014).

This debate is particularly relevant to urban climatology. After all, in 1976, when professor Carlos Augusto de Figueiredo Monteiro established the theoretical,

Table 5.1 Top ten natural/biological events resulting in deaths in Brazil by number of deaths

Type	Date	Location (state)	Number of deaths
Epidemic	01/01/1974	—	1500
Flood	01/11/2011	Rio de Janeiro	900
Flood	01/23/1967	Rio de Janeiro	785
Landslide	03/19/1967	Rio de Janeiro	436
Flood	01/11/1966	Rio de Janeiro	373
Landslide	01/11/1966	Rio de Janeiro	350
Flood	03/14/1969	Alagoas	316
Flood	1988	Rio de Janeiro	300
Flood	January/1979	Minas Gerais and Espírito Santo	300
Epidemic	May/1984	—	300

Adapted from EM-DAT (2021)

methodological, and philosophical basis of urban climatology studies (Monteiro & Mendonça, 2003), he chose the urbanization process as its centerpiece. In doing so, he turned his attention not only to the city's materiality (form) but also to its function and structure.

From this triad (form, function, and structure), which is very important to Lefebvre (2019) and other authors, it is possible to understand the combination between the spatial processes and environmental impacts (especially in the case of urban climate), which allows us to capture its inscription in time and distinct spatial incidence, changing and being changed by the social class structures and space restructuring (Coelho, 2009).

Given the aforementioned context, the impact of floods on urban spaces is relative, meaning that it stems from the production of each space and the forms of climate appropriation (Santos, 2002; Harvey, 2005; Mendonça, 2010; Nascimento Júnior, 2018). Therefore, it is necessary to diversify the paradigm of approach to urban climate impacts, expanding it to the social processes dimension, which is more coherent with the complex analysis of the multifaceted urbanization process. In this sense, it is relevant to focus on individuals vulnerable to the urban climate (Nascimento Júnior, 2018).

The objective of this chapter is to understand the vulnerability to flooding of the homeless population—one of the fastest-growing population segments in Brazil (Natalino, 2020)—regarding one of the most relevant urban climate environmental impacts on the city of Rio de Janeiro (Brandão, 1997, 2009). To this end, this chapter is divided into two parts: the first debates the transition from susceptibility to vulnerability to floodings in Rio de Janeiro, presenting a conceptual discussion on vulnerability and its dimensions and providing a basis for understanding the analytical proposal. The second combines secondary data from Rio de Janeiro City Hall with fieldwork data, including interviews, to qualify this population segment and discuss its vulnerability to flooding, having the city's downtown as the spatial sample.

Given the qualitative orientation of this study, the choice for the downtown is mainly explained by its privileged position in the urban centrality of Rio de Janeiro. Converging flows and concentrating capital, this region attracts the homeless population due to easier mobility possibilities and availability of donations and jobs (Robaina, 2015). The Homeless Population Census carried out by the Rio de Janeiro City Hall (2020) confirms this concentration when it points that 31.9% of this population is in this neighborhood.

5.2 Vulnerability Dimensions and the Homeless Population

Given Rio de Janeiro's physiographic characteristics, which present a sudden break in the gradient between the hillside and the lowlands at sea level, as well as a high concentration of marshes, swamps, and lagoons (Lamego, 1964) and low soil permeability, it is possible to understand the region's susceptibility to rainfall impact,

especially to flooding, posing significant challenges to its occupation and urbanization process (Lamego, 1964; Abreu, 1987). During the first centuries of urban expansion, due to the lack of dry areas, the city grew over plains and lagoons that were filled in without the proper technical procedures. As stated by Lamego (1964), nearly the entire plain where the city's downtown is located is on hydromorphic soil, configuring, according to data from the Brazilian Mineral Resources Research Company (CPRM, 2017), extensive areas of high and medium flood susceptibility (Fig. 5.1).

Rio de Janeiro has, 456 years after its foundation, 6,320,446 inhabitants (IBGE, 2010) living in an urban site that was completely restructured (Figs. 5.2 and 5.3) through a series of urban planning projects: Pereira Passos Reform (1904), Agache Plan (1926–1939), Doxiadis Plan (1965), Rio Cidade Project (1993–1996), and Cidade Olímpica Project (2012–2016), among others. All these projects have shown a preference for social hygienism, artificial forms, the imperative of fluidity, and disregard for environmental impacts; what is actually observed, therefore, is the transition from a situation of susceptibility to one of vulnerability.

Brandão (1997) recalled the history of storms in the city and analyzed its pluviometry, demonstrating a cyclicity of heavy and extreme rainfall, which may be comparable from the meteorological perspective and related to its transitional position from the climatic perspective (1883, 1884, 1886, 1888, 1966, 1967, 1988, 1996). However, they also present a growing capacity to cause environmental

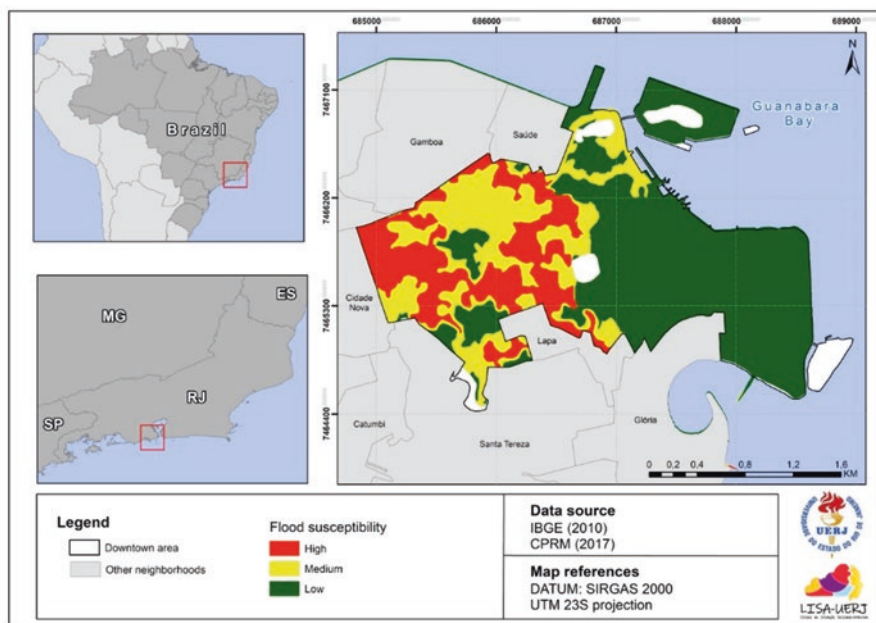


Fig. 5.1 Map of flood susceptibility in the Rio de Janeiro downtown area. (Adapted from CPRM, 2017)

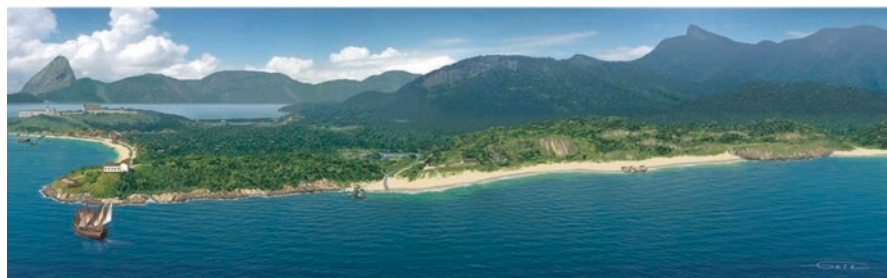


Fig. 5.2 Current downtown area of Rio de Janeiro in 1608. (Photograph Guta/IPP Instituto Municipal de Urbanismo Pereira Passos – public domain)

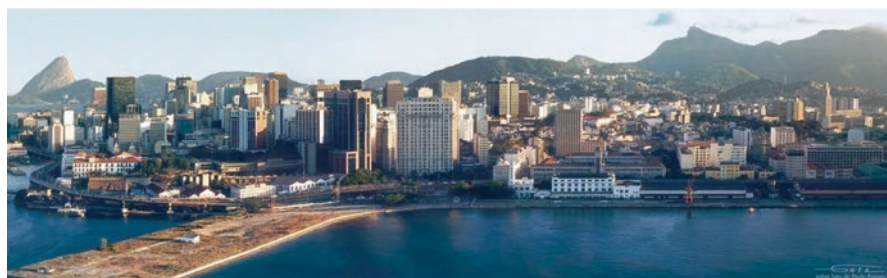


Fig. 5.3 Downtown Rio de Janeiro in 2002. (Photograph IPP – public domain)

damage and socioeconomic calamities. In the same study, the author argues that rainfall impacts stem from the co-participation between the city site and human action, the latter gradually increasing in importance, which corroborates the aforementioned transition from susceptibility to vulnerability to impacts.

In another study on rainfall impacts in Rio de Janeiro, Brandão (2009) analyzed newspaper reports and concluded that, in at least half of the twentieth century years, there were records of heavy rains that caused major floods, whose frequency significantly increased from 1960 onwards. Also according to the researcher, these occurrences stand out in spaces with intense industrial activity, high demographic density, higher rates of building density, degraded slopes, and high concentration of slums and informal housing.

Following the same methodology as Brandão (2009), we have updated the rainfall impacts in the city of Rio de Janeiro, emphasizing floods and looking at the 2006–2020 period. Based on the *O Globo* newspaper archives, 162 occurrences were cataloged throughout the city. Figure 5.4 shows the spatial distribution of these impacts considering the characteristics and limitations of the data collected from the media (Nunes, 2016), particularly the privilege of central areas over the periphery. Two areas of the city's territory stand out: the recent and intensely urbanized Jacarepaguá lowlands, where news focus on Barra da Tijuca (19), and the downtown, which has the highest number of reported impacts in the entire city (25).

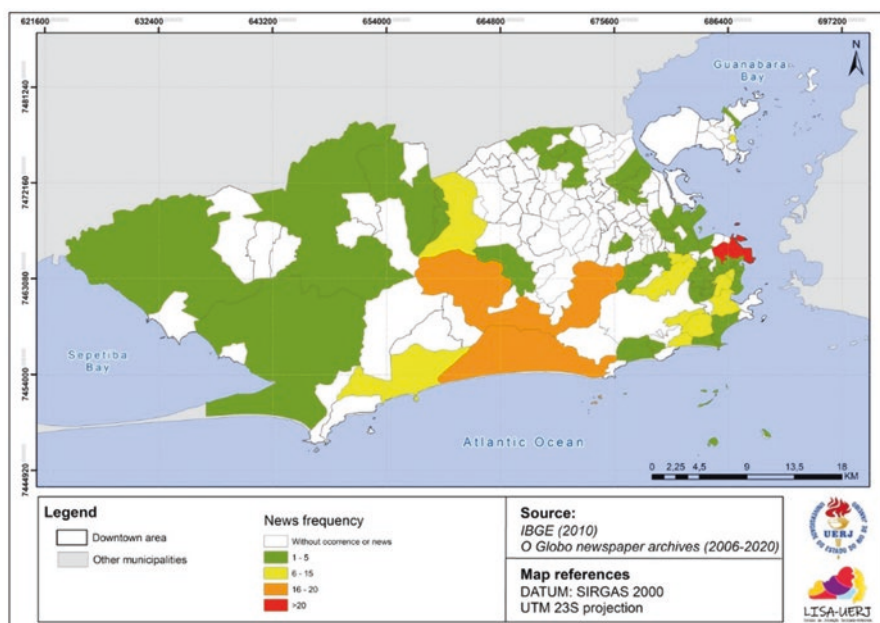


Fig. 5.4 Map of published news on floods in Rio de Janeiro neighborhoods between 2006 and 2020. (Adapted from O Globo archives)

Conceptually, susceptibility refers to an area's propensity to be affected by a particular hazard in an undetermined time, and it must be assessed through the physical predisposing factors for the occurrence of processes or actions (Julião et al., 2009). In this sense, when we understand territory as a category of analysis of spatial dynamics, we must likewise understand that there is a physical framework in constant evolution that is shaped also according to the agents and social structures that appropriate it.

Susceptibility must be understood as the physical and environmental component that assesses creation, development, and propagation conditions of a potentially hazardous phenomenon (Cardona, 2013). Given that landscape physiography is essential to explain flood occurrences such as the one reported in 1575 by Father José de Anchieta, Fig. 5.2 shows that, in the early occupation of Rio de Janeiro, in 1608, the conditions of susceptibility to rainfall impacts prevailed. Since then, the city—especially downtown, Rio de Janeiro's starting point of urbanization and metropolization (Abreu, 1987)—was massively modified due to urban demands and a continuous process of land valuation (Braga, 2020).

With the increased complexity of forms and functions arising from the social production of its space (Fig. 5.3), following different economic, political, and philosophical logics, the pioneer forms have originated new structures, leading to changes of several orders, especially regarding hydrological and sediment flows in urban basins (Costa et al., 2018; Braga, 2020) and the local climate (Brandão, 2009).

Thus, the centrality held by the downtown neighborhood creates an environment vulnerable to rainfall impacts, as it has installed infrastructure and attracts people, capital, goods, companies, and investments, which are fostered by the various phases of spatial restructuring. The susceptibility to flooding is further confirmed by the gathering of journalistic data (Fig. 5.4).

Vulnerability, in turn, must be understood as the social conditions to face risks and impacts or the lack thereof, interfering directly in the people, infrastructure, properties, and activities level of exposure to the impacts. According to Marandola Jr (2009), it is up to the concept of vulnerability to precisely understand the situations of predisposition to rupture, that is, to take a procedural character in the analysis of risks and impacts. Moreover, vulnerability can dimension the multiple realities associated with this context since in some situations the risk will be the same, as well as the occurrence of hazards and impacts, although the way they will reach places and populations will be different (Marandola Jr, 2009).

If the very nature of production of space and the reproduction of society is unfair and unequal (Smith, 1988; Harvey et al., 2006), there is no reason to fantasize that the insertion of people and territories in this model is not as well. The importance of capital in this model increases the space relevance (Harvey, 1989), fostering the differentiation of places and influencing how impacts will be spatially distributed, which will, in turn, cause an unequal distribution of impacts and risks (Marandola Jr, 2009). The urbanistic projects developed in downtown Rio de Janeiro are a great example since they had as their sole objective the reproduction of capital at the expense of environmental quality, landscape resilience, and population welfare, which turned a highly susceptible region into a highly vulnerable one.

Therefore, vulnerability, from its multidimensional perspective, allows a processual analysis of risks and impacts, unveiling the factors that help to explain it: the form of territorial occupation, lack of adequate infrastructure, inefficiency of organizational, and political systems, among others (Marandola Jr, 2009; Nunes, 2009). As Marandola Jr and Hogan (2006) point out, depending on the scope of the study and the epistemological choices of the researcher, some dimensions will be more relevant than others; thus, for this discussion, five dimensions of vulnerability emerge as fundamental for the analysis of homeless populations: exposure/receptivity, responsiveness and adaptation, programmatic, individuality, and existentiality (Fig. 5.5).

Exposure includes the socioeconomic and demographic component, which captures the predisposition of a population group to be harmed by a hazardous phenomenon. This predisposition results from the level of marginality, social segregation, and economic weakness to which a particular population group is subjected. Often, the exposure is manifested in the territory receptivity due to the absence of infrastructure, which potentializes and catalyzes dangerous and impactful processes and, consequently, the population exposure.

According to Mendes et al. (2019), the homeless population refers to the population segment *composed of the poorest of all*, an expression of social inequality, especially given the political, social, and economic changes that have occurred in

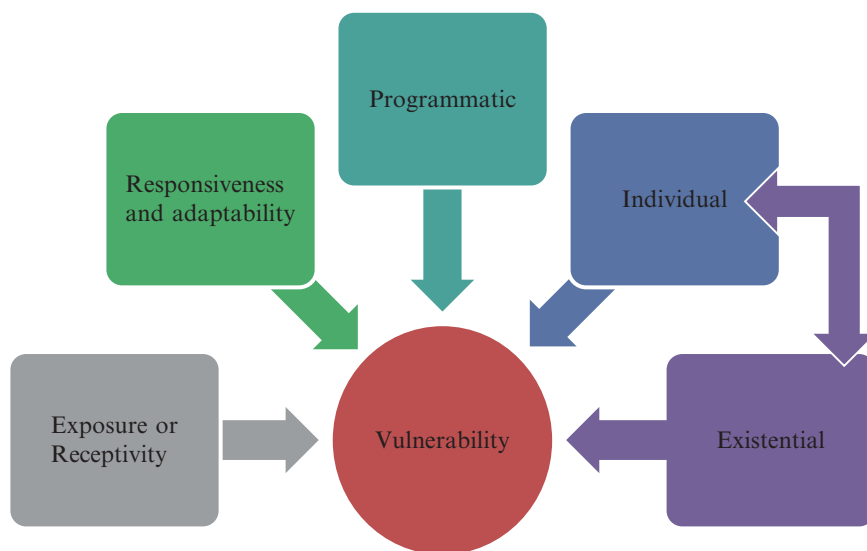


Fig. 5.5 Vulnerability dimensions of the homeless population in downtown Rio de Janeiro

Brazil since 2016, which have intensified the marginality and invisibility of certain social groups.

In the case of this population, it comprises individuals or groups that produce different territorializations (micro-territorialization) of urban space, also producing spatial logics of public space appropriation (Robaina, 2015). They are also significantly impacted by urban environmental problems since they do not benefit from the safety of a home. The shelter-threat duality in the urban space disappears for this population, given its complete exposure to the multiple threats constantly produced by the urbanization process, among them the urban climate impacts.

For Castel (1995, 1997, 2007) and Castel & Poletti (2008), a homeless person occupies a socio-spatial position of instability and precariousness of life standards, whether regarding the work dimension or the primary sociability interrelationships. This scenario causes them to be more fragile and vulnerable, thus more exposed to economic or social turbulence.

The consequence of the precarious primary interrelationships of this population segment is marginality and social segregation—the most notable by-products of a capitalist society that, operating from psychosocial logics (Costa, 2004), produce social invisibility. Social invisibles are subjects or groups deprived of dialogic social relations due to the power relations (political, economic, cultural, scientific) established in society, which is evidenced in the interaction with other social groups (e.g., Souza, 2006; Tomás, 2012).

Social invisibility has repercussions on the access of individuals or social groups to the fundamental rights defined in the Brazilian constitution, thus making them the most vulnerable segment to the several types of risks and impacts. Despite this

characteristic, the literature still devotes little attention to this issue, especially regarding vulnerability assessment methodologies. This only reinforces the invisibility of this population.

As Ojima (2013) points out, we cannot link vulnerability to exposure alone (Moser, 1998). We must also incorporate the dimension of coping and response capacity, as well as adaptation, which will enable a prospective understanding of vulnerability (Queiroz & Barbieri, 2009) through the analysis of the adaptation potential of social systems towards the impacts (Ojima, 2009).

Rollin and Vicent (2007) understand adaptive capacity as determined by the interaction of multiple variables, directly related to its ability to operate in a common purpose while facing multiple threats (Smit & Wandel, 2006; Young, 2010). In this sense, it is in fact determined by the interaction of social structures (Paterson et al., 2017) describing the dynamic quality of social actors in history and involving the power, information, and asset flows between actors (Zaidi & Pelling, 2015).

Resilience is a process related to adaptability that links resources (capabilities) to outcome (adaptation). Adaptation, in turn, refers to deliberate interventions in the functioning structure of systems to establish a condition to cope with and recover from collapse. Therefore, with regard to the social systems, Adger et al. (2009) propose that adaptive capacity is partially determined by the technology availability and learning capacity.

Given the political, economic, cultural, and scientific invisibility of the homeless population, as well as the lack of material conditions to cope with impact scenarios, the adaptation dimension helps to understand how the collective and public processes that, by denying to hear and acknowledge the demands of this social group, affect the increase of their vulnerability and exposure to impacts and risks. However, according to Adger et al. (2009), we cannot forget that the learning capacity is also inherent to it; despite the lack of access to resources and material conditions and technologies to face and adapt to the impact scenarios (which should, in this case, be a public power responsibility), we cannot disregard the role of creativity and the collective and individual strategies aimed at this population segment that, although still far from ideal, impact damage mitigation.

The programmatic dimension has a particular importance when compared to the institutional one since it discusses the role of institutional spaces in the mitigation or intensification of vulnerabilities. It is a dimension traditionally addressed in the health sciences that helps qualify vulnerability as a process that, in the case of the homeless population, precedes the fact. It also contextualizes the disarticulation of the entire social welfare structure and the absence of public policies, ranging from the precariousness of shelters to the urbanism model implemented by the State (specifically by municipalities) in partnership with the private sector and in the context of the corporate urbanization that has developed in Brazil (Santos, 2013).

This urbanization model leads to the militarization of urban spaces, characterized by a “hostile architecture” that appeals to security but perpetuates prejudices and symbolic violence against those who are invisible (Melgaço, 2010). This can increase the exposure of homeless people to the risks and impacts of the urban climate as it reduces the options for a growing population.

As Frangella (2005) points out, this fact shows that the repulsion of the civil population and the State itself materializes in different ways, from the architecture that produces the militarized spaces (symbolic violence) to the actions of public agents that remove these people from the streets, most of the time in an aggressive and humiliating way (using physical violence). These actions take place under the excuse of the “functional uniqueness of urban space” but, in the end, contribute to the maintenance of something that is situational (Frangella, 2005).

The level of analysis of the programmatic (or institutional) dimension of vulnerability seeks precisely to assess how these processes influence the socially given conditions of vulnerability. In other words, how do the actions of institutions and public agents impact on the exposure or vulnerability of these social groups? How much do they promote the emancipation of these subjects from vulnerable situations (Ayres et al., 2006)?

For this reason, the diagnosis of vulnerabilities and, consequently, the elaboration of intervention proposals must always consider the mediation exercised (and to be exercised) between the subjects and the social contexts of the available programs and services. There are key elements to consider, such as the services and programs’ degree and quality of engagement; the available resources; the values and competencies; the monitoring, evaluation, and feedback of the actions; the sustainability of the proposals; and, especially, their permeability and stimulus to the participation and autonomy of the various social subjects.

Vulnerability also carries the individual dimension, associated with both the biological and psychological singularities of each human being. According to Marandola Jr and Hogan (2006), there have been studies based on the theory of entitlements and the importance of knowledge to enhance the empowerment of people, which are essential mechanisms for reducing vulnerabilities (Watts & Bohle, 1993; Heijmans, 2004; Kasperson et al., 2005).

Being able to transform opportunities involves empowerment and entitlements, which may occur through vertical or horizontal processes. The latter can be both an object of public policies and a way that the population itself finds to deal with the impacts, reducing their vulnerabilities (Marandola Jr & Hogan, 2006).

Such individual aspects are also conditioned by cultural and social processes, dimensions that play a key role in delineating vulnerability. In this chapter, however, we chose to disassociate such processes from the individual dimension and call it the existential dimension in order to also comprise collectivity.

The literature on risks recognizes the importance of people’s perception of risk/impact (Saarinen, 1966; Hewitt & Burton, 1971). The discussion regarding risk perception, in turn, is fundamental for revealing the individual scale of occurrence of the phenomena while also associating it to the collective scales that decisively contribute to its formation (Marandola Jr & Hogan, 2006).

In this dimension, the imaginary (existential) and the culture (including religion) are key elements to understand, for example, the acceptability of certain risks at the expense of others. This acceptability is often linked to vulnerability: if the individual is able to protect themselves in the face of danger, the risks are reduced, making

the danger more tolerable. However, in the absence of resources available for the individual to adjust, the risk is heightened.

The two dimensions (individual and existential) resort to the specificities of individuals who are part of any social segment, including the homeless population, which is under specific conditions that make it more or less exposed to the impacts of urban climate. This population in particular brings with it psychosocial constructions and individual belief systems that, even when inserted into a group, lead to a specialization of vulnerabilities that should not be dimensioned not only from collective forces but also from individual ones (Janczura, 2012).

5.3 Analysis of Urban Flooding from the Perspective of Vulnerable People: The Homeless Population in Downtown Rio de Janeiro (RJ)

As there is no official count of the homeless population in Brazil, except for some isolated initiatives of local administrations, many of the national data are estimates obtained from demographic models or official databases that underestimate the real situation of this group. In 2020, IPEA (Institute for Applied Economic Research acronym in Portuguese) released the most recent estimate indicating that, in September 2012, this population was comprised of 92,515 individuals; in March 2020, they reached a total of 221,869 people, meaning a 140% increase (Natalino, 2020). In regional terms, the Southeast Region stands out in the concentration of this population, totaling 124,698 individuals in March 2020, or 56.2% of the national total.

Among the isolated initiatives, the municipality of Rio de Janeiro performs censuses of the homeless population, and the most recent survey also took place in 2020. This on-site survey identified 7272 people experiencing homelessness, a number 57.1% higher than that one from the 2018 census. According to national and municipal surveys, this significant growth was strongly influenced by the COVID-19 pandemic, which has affected the economy and job availability in Brazil (Costa, 2020).

We resorted, as a secondary source, to the survey carried out in 2020 by the *Pias do Bem* project—which was kindly made available to us by the Laboratory for Studies on Society-Atmosphere Interactions of the State University of Rio de Janeiro—as a strategy to understand the distribution of the groups of homeless individuals, which is crucial to the objective of this chapter. The primary source, however, was the fieldwork conducted on the early morning¹ of January 25, 2021 (on foot) and January 31, 2021 (by car), which aimed to map the groups of homeless

¹ Given the territorialization logic of this group, according to Robaina (2015), the early morning hours were chosen for both the safety of the researchers and the spatial permanence of homeless people, more associated with the sleeping period.

people throughout the neighborhood. On May 20, 2021 and May 25, 2021 (both on foot), also in the early morning, additional fieldwork focused on a qualitative analysis of these groups.

The *Pias do Bem* project was developed by engineer Ana Paula Rios together with architects and the team of the *Banho da Alegria* project and carried out in the context of the pandemic. Its goal is the installation of public sinks that offer both homeless people and workers access to some form of sanitation. The team cycled from the downtown neighborhood to Copacabana (approximately 10 km) to map potential areas for installation of the sinks based on the density of homeless individuals.

From the aforementioned secondary and primary data, it was possible to draw up the map of density of groups of homeless individuals (Fig. 5.6), that is, the concentration hotspots of this population in the downtown neighborhood. Their spatialization, as previously pointed out by Robaina (2015), was striking; it is concentrated near public buildings and on high-flow streets. Furthermore, the map shows the strong spatial relationship between the location of marquees and the concentration of these groups. This spatialization results from the strategies of protection (for instance, from climate phenomena) and resource gathering by these individuals, and it reflects the choice of time for data collection by the research team. The rhythms and actions of this population respect the dynamics of the city and, therefore, are

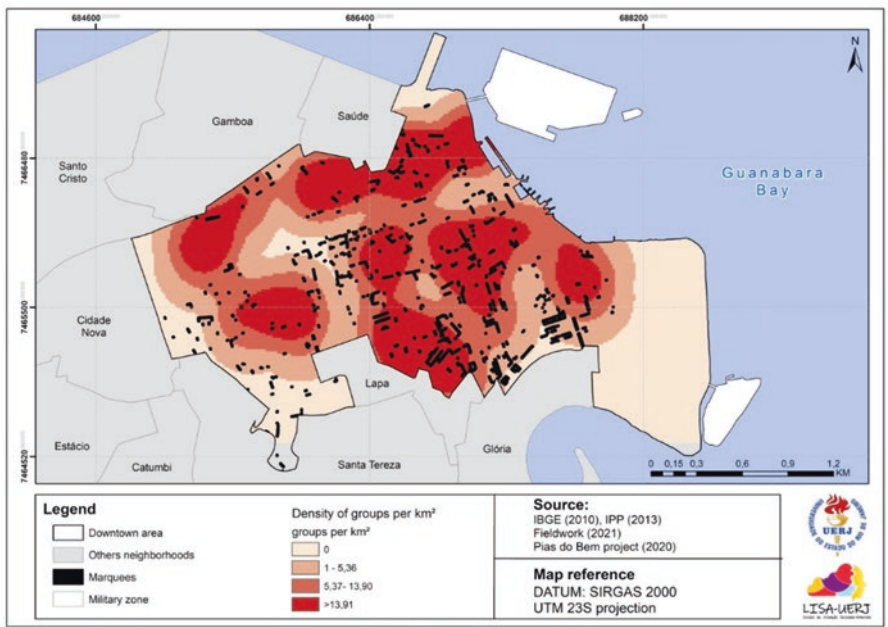


Fig. 5.6 Density of groups of homeless individuals in the downtown neighborhood between 2020 and 2021. (Adapted from the authors 2021, and Pias do Bem project 2020)

endowed with a high ephemerality while keeping some socio-spatial logic (Robaina, 2015).

Figure 5.7 shows the intersection of the clustering points of homeless individuals (49) with the flood susceptibility classes: 67.3% (33) of these groups were located in areas of high and medium susceptibility to flooding. On the one hand, this data helps to dimension the exposure of this population to floods insofar as it demonstrates the territorialization of space based on spatial permanence (Robaina, 2015), meaning the same groups tend to occupy the same spaces, especially to sleep. On the other, we cannot neglect the fact that the field surveys were not conducted on rainy and flood days, events that significantly alter the urban dynamics and spatialization of this population (Robaina, 2015), as well as the perception of the interviewees.

To circumvent the limitations imposed by the episodic spatialization of this population and, above all, encompass its heterogeneity, given the different levels of homelessness, we opted for a qualitative analysis of vulnerability. This means that the sample focused not on the quantity but on the diversity of profiles and experiences in the face of the impacts. Thus, we conducted semi-structured interviews with seven individuals with distinct profiles (Table 5.2), of which five are male² and two female (cis and trans); four are young and three middle-aged; and four have

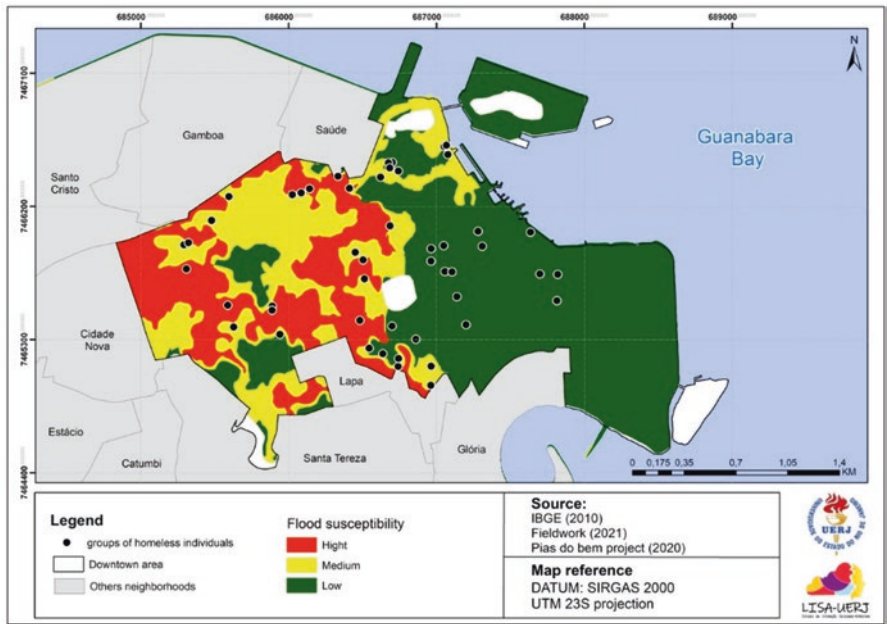


Fig. 5.7 Groups of homeless individuals and susceptibility to flooding in the downtown neighborhood. (Adapted from the authors 2021, Pias do Bem project 2020, and CPRM, 2017)

² We deliberately chose to interview more men than women because, according to the 2020 census data, 81% of homeless people in the city of Rio de Janeiro are men (Rio de Janeiro City Hall, 2020).

Table 5.2 Characteristics of the interviewees

Characteristics	Interviewee						
	1	2	3	4	5	6	7
Gender	Man	Trans woman	Man	Man	Man	Cis woman	Man
Age group	Young	Young	Middle-aged	Middle-aged	Middle-aged	Young	Young
Length of time on the streets	3 years	1 year	10 years	6 years	1 month	6 months	1 year
Main reason	Financial	Family	Narcotics	Undefined	Nomadism	Financial	Family

been living in the streets for 1 year at most while three have been in this situation for over 1 year. As for the reason for their homelessness, two are for financial reasons, two for family reasons, one for narcotics use, one due to being nomadic, and one for an undefined reason. The interviews were categorically analyzed using three of the five dimensions of vulnerability discussed in the previous section: exposure/receptivity, responsiveness/adaptability, and programmatic.

The exposure/reception dimension is what outlines our research problem. After all, data and literature point to a significant recurrence of floods in the central area of Rio de Janeiro, mainly due to its physiographic characteristics, which include deep changes in permeability and artificialization of the space due to the interference of the subway infrastructure in the drainage system (Braga, 2020). Field surveys and census data confirm that the population chosen for this study is concentrated mainly in these areas at risk of flooding. Although the surveys were not carried out during periods of rain—which causes this population to spatially reorganize—the data show that these individuals are exposed to risk, especially in the case of concentrated rainfall and flash floods. This is worsened by their almost complete lack of material conditions and resources to cope with the impacts.

Rain is highly significant in terms of impact, but it is not the only factor, as high humidity and frequent winds also contribute to the discomfort caused by the cold. Furthermore, the ensuing floods directly affect their routine by restricting their ability to move about the city both for those who work with collection of recyclable material and for those who sell goods or rely on donations. For the latter, since their earnings are determined day by day, their vulnerability is heightened by the rain.

Regarding responsiveness/adaptation, it became evident, as in Robaina (2015), that the spatial intelligence of this group is their main coping artifice against flood impacts and risks. It comes from the experiences, experiments, and spatial appropriations of individuals who, by recognizing the multiple possibilities, rhythms, and risks, put forth by the urban space, constantly elaborating and reworking their spatialization strategies. The interviews show that the length of time spent on the streets is a key factor: the longer an individual has lived on the streets, the clearer they are as to the possibilities of moving around and staying on the streets, as well as to the several types of risks they face.

For example, interviewees reported that their main protection strategy under rainy conditions is to look for marquees, as extensively discussed in the literature

(Kunz, 2012; Robaina, 2015; Honorato & Saraiva, 2017) and easily perceivable from empirical observation. However, there is a complex power dynamic associated with urban spaces and public and private property (Costa Gomes, 2002), and thus there are specific streets where marquees should be avoided, such as Graça Aranha, which has a large concentration of stores and, consequently, security guards who act to repel homeless people.

When it rains, the permanence of this population near the churches and the metropolitan cathedral is also a strategy, as those places are the main donors of blankets, food, and water. Conversely, the interviewees cited as places that should be avoided the neighborhoods of Lapa and Catete, close to downtown. They also cited the Largo da Carioca (Fig. 5.8), in the heart of downtown Rio de Janeiro, which sits over a pond formerly named Lagoa de Santo Antônio (Fig. 5.9). This explains the frequency of flooding events and corroborates the aforementioned argument of transition from susceptibility to vulnerability to rainfall impact in Rio de Janeiro.

We also identified that in very extreme situations of rain and cold—and depending on the available financial resources—individuals resort to accommodation in hotels/motels located in the central area of the city, whose overnight stay varies between R\$10.00 and R\$15.00 (\$1.93 and \$2.90 according to the July 2022 exchange). As for public shelters, they are not a viable option: none of the seven interviewees showed interest in them, claiming they are unsafe and unhealthy spaces, with rigid schedules that hinder their work activity.

Due to insecurity, insalubrity, and lack of adherence to the needs and contexts of the homeless population, public shelters bring to light the pragmatic dimension, that



Fig. 5.8 Largo da Carioca area (former Lagoa de Santo Antônio), in downtown Rio de Janeiro. (Photograph the authors)



Fig. 5.9 The pond and the convent of Santo Antônio in 1650 (present-day Largo da Carioca). (Source PortalGeo, IPP – public domain)

is, the institutional policies that fail to properly mediate the subjects and their social contexts. They end up exposing this population to other risks, thus exacerbating their vulnerability. Moreover, these shelters are also associated with physical violence—all the interviewees who have been living on the streets for more than a year (3) were forcibly taken to public shelters during the mega sporting events, which created a negative perception of these spaces, leading this population to reject them and thereby rule them out from their coping strategies.

Another extremely relevant aspect is the access to health services. In Brazil, access to health care is a public, free, and universal right, but the interviews showed how difficult it is for this population to access it. The public health system is not entirely available to these people, as there are specific places for assistance and reception, such as hospitals and clinics linked to the Consultório na Rua (“Street Clinic”) project.

According to Silva et al. (2015), the Street Clinic is a project implemented through the National Policy for Primary Health Care that aims to expand the users’ access to the health services network. However, what actually happens is that professionals and institutions not linked to the project are reluctant to provide care to this population, restricting their access to the system and increasing their vulnerability to the impacts of the urban climate on health (e.g., waterborne, heat or cold stress-related, respiratory diseases, among others). In the case of downtown Rio de Janeiro, the homeless population must always go to the Marcolino Candau Municipal Health Center (Fig. 5.10), located in the adjacent neighborhood of Cidade Nova. This displacement can worsen the individual’s health situation, and flood events may even impede or hinder this action. In other words, this population’s access to health care is limited.

The discussion about access to health care has another facet: the denial of access to public buildings, including hospitals and clinics, which neglects the citizenship of the homeless population and reinforces the role of institutions and their agents in worsening their vulnerability. The interviewees reported that the security guards of these buildings stop them from accessing, and Silva et al. (2015) identified

Fig. 5.10 Leaflet promoting the Street Clinic project provided by one of the interviewees



RIO

Para afastar morador de rua, prédios no Rio retiram marquise e usam até arame farpado

Em alguns casos são usadas até grades para proteger patrimônio

Giselle Ouchana e Guilherme Ramalho

08/08/2017 - 04:30 / Atualizado em 08/08/2017 - 11:43

Fig. 5.11 News from O Globo newspaper about urban interventions to displace the homeless population. The image reads: “In order to repel homeless people, buildings in Rio remove marquees and even use barbed wire.” (Ouchana & Ramalho, 2017)

segregation in the reception and treatment of homeless people even in the units of the Street Clinic project.

Finally, the analysis of the interviews also highlighted this population’s right to the city. Inasmuch as urban planning policies are primarily the responsibility of the State and its institutions, the “hostile architecture” implemented with the approval of the public authorities, even in public buildings and facilities, helped to gauge the importance of programmatic vulnerability.

In 2017, the newspaper *O Globo* (Ouchana & Ramalho, 2017) reported marquee removals and use of barbed wire in Rio de Janeiro, including in downtown, in order to repel homeless people (Fig. 5.11). All marquee removals or railings reported

were in private buildings, but they were authorized by public agencies. As discussed earlier, marquees are the main coping strategy and the preferred place for this population to occupy. Their removal, based on the logic of social hygienism, increases their exposure to the risks and impacts of the urban climate. This is reinforced by the action of public agents who confiscate the few belongings of these people, including blankets, tents, mattresses, and cardboards, which relates directly to the programmatic dimension.

The interviewees are fully aware that many of the interventions carried out in public or private spaces are mainly aimed at hindering their spatial permanence. They also highlighted the use of oils on streets, floors, and benches and the replacement of urban furniture for designs that prevent individuals from staying for a long time or using it to sleep, as in the example of Fig. 5.12, which shows a bench with a structure that prevents people from lying down.

While the homeless population develops strategies to cope with the adversities, risks, and impacts imposed by urbanity, other institutional agents related to the production of urban space compete with strategies to limit the permanence of these individuals. This increases the exposure of this segment to factors such as urban climate risks, decisively interfering in the response/adaptation capacity by disrupting coping strategies. Faced with the almost absolute deprivation of goods and capital, creativity and spatial intelligence are the main resources of this population in the face of the impacts. Thus, the space is taken as a condition, competing directly with the interests of the producers of urban space in the capitalist system, in which the State, together with economic agents, acts directly and indirectly in amplifying the vulnerability of this population to the detriment of promoting their emancipation, safety, and welfare.



Fig. 5.12 Bench in a square located in the Cinelândia neighborhood. (Photograph the authors)

5.4 Concluding Remarks: Climate as a Risk and Space as a Condition

Methodological proposals have been emerging for mapping and establishing vulnerability and susceptibility metrics to various phenomena, especially floods, one of the processes that cause the most disruption to the urban population, with material and economic damage and loss of human life. However, we have reached a stage in risk science in which it is imperative to recognize the specificities of vulnerable groups, valuing not only the collective but also the individual strengths, as well as expanding approaches beyond the exposure and receptivity of the territory.

To dismiss this approach means to reinforce, through science, the invisibility of many of these groups, leaving them to their fate in the face of the risks and impacts imposed by urbanity and the urbanization process. In the scope of urban climatology, this means understanding, from the ideas proposed by Monteiro & Mendonça (2003), the psychosocial diversities that resonate in the impacts and risks of different social segments, such as street vendors, public conservation workers, favela residents, and the homeless population, among others.

It is from the urbanization process that stems both the urban climate and the homeless population, taking on the roles of risk and endangered, respectively. This dialogical process motivated us to understand the vulnerability to floods in downtown Rio de Janeiro, focusing on the homeless population and taking as categories of analysis the five dimensions of vulnerability: exposure/receptivity, responsiveness and adaptation, programmatic, individuality, and existentiality. However, due to the current stage of our research, in this chapter we have only considered the first three.

The mapping of spatial concentrations allowed us to demonstrate the exposure of this group to flood risk insofar as it revealed that they are primarily concentrated in the areas of flood recurrence. The qualitative analysis, in turn, allowed us to demonstrate that, faced with the unavailability of goods and material resources, this population uses its own space as a condition for establishing coping strategies towards urban risks and impacts. Conversely, the institutional strategies aimed at deepening the vulnerability of the homeless population disorganize and compete with their strategies, as expressed in the lack of public policies that would empower this population and offer possibilities to overcome their condition and gain dignity and protection. What occurs is institutional discrimination from hostile and repellent architecture, which affects the dignity of these human beings, their fundamental rights as citizens, and, ultimately, the right to the city.

More than data and a conclusive analysis, we offer elements for the expansion and diversification of research work, especially those who look at the urban climate, giving more detailed contours to vulnerable groups as well as providing peremptory elements for the concrete implementation of actions to overcome and intervene in these realities. Thus, we stress the role of geography and its object, the space, in the core of these actions and strategies, since these actors already recognize it as a condition.

References

- Abreu, M. D. A. (1987). *Evolução urbana no Rio de Janeiro*. Jorge Zahar Editor.
- Adger, W. N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D. R., et al. (2009). Are there social limits to adaptation to climate change? *Climatic Change*, 93(3), 335–354.
- Lamego, A. R. (1964). *O homem e a Guanabara*. Instituto Brasileiro De Geografia E Estatística, Conselho Nacional De Geografia.
- Almeida, A. C. L. D. (2014). Chuva, lamaçal e inundação no Rio de Janeiro do século XIX: entre a providência divina e o poder público. *Revista do Arquivo Geral da Cidade do Rio de Janeiro*, 8, 117–134.
- Ayres, J. R. D. C. M., Calazans, G. J., Saletti Filho, H. C., & Franca Junior, I. (2006). *Risco, vulnerabilidade e práticas de prevenção e promoção da saúde*. Tratado de saúde coletiva; organizadores Gastão Wagner de Sousa Campos...[et al.].
- Braga, F. F. (2020). Reconstituição histórico-geográfica da área central do Rio de Janeiro: o passado e o presente. *Humboldt-Revista de Geografia Física e Meio Ambiente*, 1(1).
- Brandão, A. M. D. P. M. (2009). *Clima Urbano e enchentes*. Impactos ambientais urbanos no Brasil. 5th. ed. Bertrand Brasil.
- Brandão, A. M. P. M. (1997). As chuvas e a ação humana: uma infeliz coincidência. In L. P. Rosa & W. A. Lacerda (Eds.), *Tormentas Cariocas* (pp. 21–38). UFRJ.
- Cardona, O. D. (2013). The need for rethinking the concepts of vulnerability and risk from a holistic perspective: A necessary review and criticism for effective risk management. In *Mapping vulnerability* (pp. 56–70). Routledge.
- Castel, R. (1995). De la exclusión como estado a la vulnerabilidad como proceso. *Archipiélago*, 21, 27–36.
- Castel, R. (1997). A dinâmica dos processos de marginalização: da vulnerabilidade à "desfiliação". *Caderno Crh*, 10(26).
- Castel, R. (2007). Los desafíos de las mutaciones sociales, políticas y económicas del siglo XXI. *Temas y debates*, 13.
- Castel, R., & Poletti, I. D. (2008). *As metamorfoses da questão social: uma crônica do salário*. Vozes.
- Coelho, M. C. N. (2009). Impactos ambientais em áreas urbanas: teorias, conceitos e métodos de pesquisa. In *Impactos ambientais urbanos no Brasil* (pp. 19–45). Bertrand Brasil.
- Costa, S. D. S. (2020). Pandemia e desemprego no Brasil. *Revista de Administração Pública*, 54, 969–978.
- Costa Gomes, P. C. (2002). *A condição urbana: ensaios de geopolítica da cidade*. Bertrand Brasil.
- Costa, A. J. S. T., Silva Conceição, R., & Oliveira Amante, F. (2018). As enchentes urbanas e o crescimento da cidade do Rio de Janeiro: estudos em direção a uma cartografia das enchentes urbanas. *Geo UERJ*, 32, 25685.
- Costa, F. B. (2004). *Homens invisíveis: relato de uma humilhação social*. Globo Livros.
- CPRM (Brazilian Geological Service). Prevenção de Desastres. [S.l.: s.n], 2017. and exclude Serviço Geológico do Brasil (2017).
- EM-DAT. The OFDA/CRED. (2021). *International Disaster Database*. Retrieve January 21, 2021., from <http://www.em-dat.net/>.
- Frangella, S. M. (2005). Moradores de rua na cidade de São Paulo: vulnerabilidade e resistência corporal ante as intervenções urbanas. *Cadernos Metrópole*, 13, 199–228.
- Harvey, D. (1989). *Condição Pós-Moderna*. São Paulo: Edições Loyola.
- Harvey, D. (2005). *Producao Capitalista Do Espaco*, a. Annablume.
- Harvey, D., Sobral, A. U., & Gonçalves, M. S. (2006). *Espaços de esperança*. Loyola.
- Heijmans, A. (2004). *From vulnerability to empowerment*. In: Bankoff, G.; Frerks, G.; Hilhorst, D. (Ed.). *Mapping vulnerability: disasters, development and people*. London: Earthscan, 115–127.
- Hewitt, K., & Burton, I. (1971). Hazardousness of a place: A regional ecology of damaging events.

- Honorato, B. E. F., & Saraiva, L. A. S. (2017). Quando a Casa é a Marquise, o Albergue, a Rua: discursos e políticas sociais para pessoas em situação de rua em Belo Horizonte. *Administração Pública e Gestão Social*, 9(4), 175–253.
- IBGE. (2013). *IBGE, censo 2010, resultados*. Retrieved from <https://censo2010.ibge.gov.br/resultados.html>
- Janczura, R. (2012). Risco ou vulnerabilidade social? *Textos & Contextos*, 11(2), 301–308.
- Jha, K. A., Bloch, R., & Lamond, J. (2012). *Cidades e inundações: um guia para gestão integrada do risco de inundação urbana para o século XXI*. The World Bank.
- Julião, R. P., Nery, F., Ribeiro, J. L., Castelo Branco, M., & Zêzere, J. (2009). *Guia metodológico para a produção de cartografia municipal de risco e para a criação de sistemas de informação geográfica (SIG) de base municipal*. Autoridade Nacional de Protecção Civil.
- Júnior, L. N. (2018). O clima urbano como risco climático: contribuição da geografia do clima aos estudos sobre os climas das cidades. *Geo UERJ*, 33, 36827.
- Kasperson, J. X., Kasperson, R. E., Turner, B. L., Hsieh, W., & Schiller, A. (2005). Vulnerability to global environmental change. In *The social contours of risk* (pp. 245–285). Routledge.
- Kunz, G. S. (2012). *Os modos de vida da população em situação de rua: narrativas de andanças nas ruas de Vitória/ES*. Doctoral dissertation, Dissertação de Mestrado, Universidade Federal do Espírito Santo, Vitória, ES, Brasil.
- Lefebvre, H. (2019). *A revolução urbana*. Editora UFMG.
- Maia, A. C. N. (2012). Imagens de uma cidade submersa: o Rio de Janeiro e suas enchentes memória de escritores e fotógrafos. *Revista da Fundação Casa de Rui Barbosa*, 6(6).
- Marandola, E., Jr. (2009). *Tangenciando a vulnerabilidade. População e mudança climática: dimensões humanas das mudanças ambientais globais* (pp. 29–52). Campinas, Nepe/UNFPA.
- Marandola, E., Jr., & Hogan, D. J. (2006). As dimensões da vulnerabilidade. *São Paulo em perspectiva*, 20(1), 33–43.
- Marcelino, E. V., Nunes, L. H., & Kobiyama, M. (2006). Banco de dados de desastres naturais: análise de dados globais e regionais/Natural disaster databases: Global and regional analysis. *Caminhos de Geografia*, 7(19).
- Melgaço, L. D. M. (2010). *Securização urbana: da psicoesfera do medo à tecnoesfera da segurança* Doctoral dissertation, Universidade de São Paulo.
- Mendes, K. T., Ronzani, T. M., & Paiva, F. S. D. (2019). População em situação de rua, vulnerabilidades e drogas: uma revisão sistemática. *Psicologia & Sociedade*, 31.
- Mendonça, F. (2010). Riscos e vulnerabilidades socioambientais urbanos a contingência climática. *Mercator-Revista de Geografia da UFC*, 9(1), 153–163.
- Meyer, R. M. P., Grostein, M., & Biderman, C. (2004). *São Paulo Metrópole*. Editora da USP.
- Monteiro, C. A. F. M., & Mendonça, F. (2003). *Clima Urbano*. Editora Contexto.
- Moser, C. O. (1998). The asset vulnerability framework: Reassessing urban poverty reduction strategies. *World Development*, 26(1), 1–19.
- Natalino, M. (2020). Estimativa da população em situação de rua no Brasil (setembro de 2012 a março de 2020). Nota Técnica nº 73. Brasília: Instituto de Pesquisas Econômica Aplicada (IPEA).
- Nunes, L. H. (2009). Mudanças climáticas, extremos atmosféricos e padrões de risco a desastres hidrometeorológicos. In D. J. Hogan & E. Marandola Jr. (Eds.), *Populações e mudanças climáticas: dimensões humanas das mudanças ambientais globais* (pp. 29–52). Núcleo de Estudos de População (NEPO) e Fundo de População das Nações Unidas (UNFPA).
- Nunes, L. H. (2016). Riscos do clima ou riscos da comunicação? A cobertura jornalística do furacão Sandy (2012) em um periódico nacional. *Revista Brasileira de Climatologia*, 19.
- Ojima, R. (2009). Perspectivas para a adaptação frente às mudanças ambientais globais no contexto da urbanização brasileira: cenários para os estudos de população. In D. J. Hogan & E. Marandola Jr. (Eds.), *População e mudança climática: dimensões humanas das mudanças ambientais globais*. Núcleo de Estudos de População (NEPO) e Fundo de População das Nações Unidas (UNFPA).
- Ojima, R. (2013). Entre Vulnerabilidades e Adaptações: Notas Metodológicas sobre o Estudo das Cidades e as Mudanças Climáticas. In: OJIMA, R.; MARANDOLA JR, R. (orgs.). *Mudanças Climáticas e as cidades*, 253–263.

- Ouchana, G., Ramalho, G. (2017). Para afastar morador de rua, prédios no Rio retiram marquise e usam até arame farpado. O Globo, Rio de Janeiro, 08th August, 2017. Avaliable on: <https://oglobo.globo.com/rio/para-afastar-morador-de-rua-predios-no-rio-retiram-marquise-usamate-aram-farpado-21680773> (Access on 18th January, 2023).
- Paterson, S. K., Pelling, M., Nunes, L. H., Araújo Moreira, F., Guida, K., & Marengo, J. A. (2017). Size does matter: City scale and the asymmetries of climate change adaptation in three coastal towns. *Geoforum*, 81, 109–119.
- Queiroz, B. L., & Barbieri, A. (2009). Os potenciais efeitos das mudanças climáticas sobre as condições de vida e a dinâmica populacional no Nordeste brasileiro. In D. J. Hogan & E. Marandola Jr. (Eds.), *População e mudança climática: dimensões humanas das mudanças ambientais globais* (pp. 159–186). Núcleo de Estudos de População (NEPO) e Fundo de População das Nações Unidas (UNFPA).
- Rio de Janeiro City Hall (2020). Secretaria Municipal de Assistência Social da Cidade, Instituto Pereira Passos. *Censo da População em Situação de Rua 2020*. Rio de Janeiro, SMAS e IPP.
- Robaina, I. M. M. (2015). *Entre mobilidades e permanências: uma análise das espacialidades cotidianas da população em situação de rua na área central da cidade do Rio de Janeiro*. Doutorado em Geografia, Instituto de Geociências, Universidade Federal do Rio de Janeiro, Rio de Janeiro.
- Rollin, J., & Vincent, V. (2007). *Acteurs et processus d'innovation sociale au Québec*. Réseau québécois en innovation sociale.
- Santos, M. (2002). *A natureza do espaço: técnica e tempo, razão e emoção* (Vol. 1). Edusp.
- Santos, M. (2013). *A urbanização brasileira* (Vol. 6). Edusp.
- Saarinen, T. F. (1966). Perception of the drought hazard on the great plains. Department of Geography Research. Chicago: University of Chicago, 183p.
- Silva, C. C. D., Cruz, M. M. D., & Vargas, E. P. (2015). Práticas de cuidado e população em situação de rua: o caso do Consultório na Rua. *Saúde em Debate*, 39, 246–256.
- Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16(3), 282–292.
- Smith, N. (1988). *Desenvolvimento desigual: natureza, capital e a produção de espaço*. Bertrand Brasil.
- Souza, J. (2006). *A invisibilidade da desigualdade brasileira*. Editora UFMG.
- Tomás, J. (2012). A invisibilidade social, uma construção teórica. *Colóquio "Crise das Socializações"*, 1–12.
- Watts, M. J., & Bohle, H. G. (1993). The space of vulnerability: The causal structure of hunger and famine. *Progress in Human Geography*, 17(1), 43–67.
- Young, O. R. (2010). Institutional dynamics: Resilience, vulnerability and adaptation in environmental and resource regimes. *Global Environmental Change*, 20(3), 378–385.
- Zaidi, R. Z., & Pelling, M. (2015). Institutionally configured risk: Assessing urban resilience and disaster risk reduction to heat wave risk in London. *Urban Studies*, 52(7), 1218–1233.