Classifying Social Adaptation Practices to Heat Stress—Learning from Autonomous Adaptations in Two Small Towns in Germany

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ABSTRACT: Climate change adaptation planning and implementation have proliferated over the past years. However, we still lack an understanding of how society adapts itself outside of policy sectors and as part of what some refer to as "autonomous adaptation." The way people respond to risk without deliberate interventions of public actors is not well understood. Given the increasing occurrence of climatic changes that affect our daily lives, the topic is regaining attention with an emphasis on behavioral adaptation. This angle, however, does little to enhance our understanding of how society adapts collectively and which practices and routines groups choose to adopt. This study investigates autonomous heat-stress adaptation efforts in two small towns in Germany. Autonomous heat-stress adaptation is approached through a lens of (social) adaptation practices. Small towns are understudied in adaptation research and have played only a minor role when it comes to public adaptation planning due to their lack of formal resources to develop public adaptation strategies. Based on empirical data, consisting of qualitative problem-centered interviews and a quantitative survey, concrete examples of (social) adaptation practices are identified and classified. The presented classification of practices goes beyond earlier attempts by generating insights on the role politics can play in providing a fruitful ground for enabling autonomous adaptation. The paper emphasizes the need for researchers and decision-makers to take a closer look at the wide variety of social adaptation practices already in place. This discloses insights on public–private adaptation mixes, which could ultimately also lift autonomous adaptation from its ad hoc and reactive nature.

SIGNIFICANCE STATEMENT: Social adaptation practices are not yet at the center of research and decision-making. We believe that adding practice-based approaches to adaptation governance widens the debate on who is vulnerable and possible coping mechanisms from within society. It shows that vulnerability and adaptation lie in people's everyday actions. We provide a first classification of heat-health adaptation practices according to their heat-health target, the involved individuals and actors, the degree of coordination involved, and the spatial and temporal scales. This classification draws attention to potential governance leverage points to initiate heat-adaptation practices. Focusing more strongly on already-in-use and possible heat-health adaptation practices puts citizens' wants and needs at the center of adaptation governance by including them directly in the adaptation process. This can be of special interest for small towns that want to introduce citizen-based approaches to heat-risk adaptation.

KEYWORDS: Social Science; Europe; Climate change; Heat wave; Vulnerability; Adaptation

1. Introduction

A range of studies have shown that climate change increases the intensity, duration, and frequency of extreme weather events such as heat waves (e.g., Dosio et al. 2018). There is a need to study how people respond to heat-related health risks and which coping mechanisms they develop, in addition to exploring adequate policy interventions. German policy responses to tackle heat risks still heavily rely on spatial planning approaches that focus on creating green and blue infrastructure or enhancing building design (e.g., Mahlkow and Donner 2017; Umweltbundesamt 2017). These strategies often include large-scale, long-lasting landscape modifications. Their main goal is to reduce the heat hazard and therefore people's exposure to heat by mitigating the heat load in the city.[1]

The strong focus on planning in research and policy making has led to adaptation strategies that are mainly driven by administrative actors and urban planning bureaus. The discourse is dominated by technical and climatological expert knowledge, which is often regarded as essential for initiating adaptation processes (e.g., Umweltbundesamt 2017). However, during extreme weather events, such as heat waves, citizens' abilities and possibilities to act and adjust their behavior are vital. Further, the long-term adjustment of the environment and society they live in, including changed routines and cultural practices, will become more essential as climate change progresses. A holistic perception of climate risks and

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[1] Aside from landscape modifications, the development of heat protection plans has received some attention at national, regional, and local levels. Yet, in Germany's preparation for extreme heat, especially when it comes to the implementation of recommended measures, systemic flaws have been attested, see, for instance, German Alliance for Climate Change and Health (2020).

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how to deal with them includes (everyday) actions, practices, and routines of the citizens of the city, also because "the claim to be able to be protected by the state (against) all conceivable natural hazards . . . is unrealistic" (Grothmann 2017, p. 12). Despite this, very few policy makers engage a nonstakeholder-focused perspective and investigate the ways that citizens (can) take responsibility for the adaptation processes themselves (e.g., Grothmann 2017; Simon et al. 2020). Aside from the growing body of evidence for community-led adaptation efforts (e.g., Westoby et al. 2020), most urban adaptation approaches hardly make use of the agency of citizens and local actors or fall short in considering local priorities and culturally grounded knowledge to adapt to climate impacts.

Heat can have severe consequences for human health specifically (including Matthies-Wiesler et al. 2021; Jahn et al. 2013) but also affects human wellbeing more broadly, including consequences for a whole range of everyday activities. Among them are impacts on traffic safety (Wu et al. 2018), cultural activities (Umweltbundesamt 2020), productivity in everyday work life (Bux 2006; Dunne et al. 2013; Umweltbundesamt 2019, 30 ff.), and people's leisure activities (Umweltbundesamt 2019; Schuster et al. 2017). However, how individuals' everyday wellbeing is affected by heat is a contested and differentiated sociocultural phenomenon. Among other things, this depends on factors such as heating and cooling technologies, types of clothing, social interactions, movement between warm and cool spaces, and consumption of foods and drinks (Fuller and Bulkeley 2013, p. 64). Authors point out that debates on achieving thermal comfort often focus on indoor climates and discuss active cooling as a possible adaptation measure (e.g., Fuller and Bulkeley 2013; Strengers and Maller 2017; Mittermüller 2020). However, there is an evolving body of literature that criticizes air conditioning as an adaptive response to dangerous heat waves (Klinenberg 2002; Maller and Strengers 2011). It contributes to making people more vulnerable toward heat (De Dear and Brager 1998; Lee and Shaman 2017) and is therefore often considered maladaptive (Strengers and Maller 2017).

Referring to these points in this paper, we want to conceptualize heat-stress adaptation practices that do not rely on active cooling technologies. The IPCC 2007 report defines adaptation practices as "actual adjustments, or changes in decision environments, which might ultimately enhance resilience or reduce vulnerability to observed or expected changes in climate" (Adger et al. 2007, p. 720). The IPCC's definition of adaptation practices focuses heavily on planned and public adaptation. Although the most recent IPCC Assessment Report (AR6) mentions adaptation practices as adaptation options more frequently, which are also undertaken by nonstate actors and indigenous communities, the global south and/or central, and South America are the common geographic focus of attention. Adaptation practices continue to carry an image of being "pro-poor" and located in (remote) regions where livelihoods are more resource dependent (e.g., see Castellanos et al. 2022). Hence, the literature has almost exclusively focused on agricultural adaptation practices. Autonomous adaptation, in the broader sense of initiatives undertaken from within society, are not systematically conceptualized and examined. This lack of a more nuanced understanding of adaptation practices and the concrete forms they may take is also reflected in policy making.

Therefore, the paper aims to conceptualize and explore (social) adaptation practices in the context of heat stress based first on a review of literature and second on a collection of real-world adaptation practices gathered by empirical research in two small towns in Germany. The presented findings serve as a pilot study for the development phase of the Governance by Integrated Visions (GoingVis) project. GoingVis is a research-into-use project. The project focuses on the development of novel governance approaches to initiate social adaptation practices to enhance heat resiliency in small towns in Germany. With this paper we aim to increase the understanding of the role and significance practices can have for climate change adaptation by introducing a classification that shows the broad range of these practices. In conclusion, we identify some of the benefits the classification can provide for the introduction of a social practice approach to local adaptation politics.

2. State of the art: Adaptation practices in research and governance

Adaptation is considered to describe a process of adjustment to actual or expected climate change and its effects to moderate harm (e.g., IPCC 2022a). The literature on climate change adaptation is signified by manifold attempts to cluster and typologize adaptation efforts. In the context of human adaptation, adaptation is differentiated across multiple scales (e.g., actors, impact, intent, policy sectors, space, time). A starting point for the analysis of adaptation efforts usually begins by specifying who or what adapts, also known as "exposure unit" or "system of interest" (see IPCC 2001, p. 883). In this context, human and natural systems are often differentiated, in addition to reflections on other exposure units that can be affected by climatic stimuli such as economic systems, groups, or regions (e.g., IPCC 2001, 2022a).

a. The evolution of autonomous vis-à-vis public adaptation

The most common delineation in human system adaptations is the juxtaposition of autonomous and planned adaptation, with the latter understood as conscious intervention in contrast to spontaneous adjustments that are often context specific and emerge from locally available knowledge and resources (e.g., Fankhauser et al. 1999; Tuihedur Rahman et al. 2021). The public–autonomous delineation has sometimes also been described as adaptation that can be motivated by private or public interest (e.g., IPCC 2001). While "private" can refer to action undertaken by individuals, households, or corporations, the term "public" is used for any form of governmental intervention and planned adaptation. In earlier years, private adaptations were also conceptualized as a form of adaptation that occurs "naturally" and without any form of overnmental intervention (Smit et al. 1999; IPCC 2001). The connotation of absent external intervention has also been used to describe adaptations that occur in natural systems and contrast adaptation efforts from human-mediated interventions

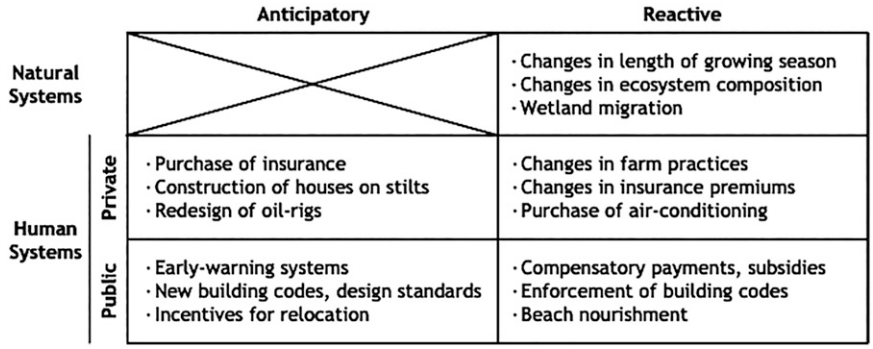

FIG. 1. Types of adaptation, including examples (source: IPCC 2001, p. 885).

and refer to ecosystem-based adaptation (e.g., see IPCC 2022a, 2–9).

In the context of human systems, autonomous–public adaptations are further distinguished by aspects of time; that is, earlier studies considered autonomous efforts to occur without any long-term vision and reactively whereas public and planned adaptation efforts were viewed as an anticipatory form of adaptation (see Fig. 1; e.g., Fankhauser et al. 1999; IPCC 2001). Up until today, autonomous is largely understood to be spontaneous and occurring ex post to an event (e.g., see Tuihedur Rahman and Hickey 2019; IPCC 2022a). Despite significant adaptation progress in recent years—also when it comes to long-term planning, i.e., anticipatory efforts, which is pitted against reactive adaptation—recent evidence suggests very limited transformative adaptation and large implementation gaps (e.g., IPCC 2022a).

b. *From autonomous to public adaptation research and practice*

Despite an early understanding of the variety of forms that adaptation can take (e.g., see IPCC 2001), it was long considered a taboo topic (Pielke et al. 2007) and a defeatist position (Khan and Roberts 2013). While adaptation research galloped in the early and late 2000s, and the scientific understanding of the topic became more profound, adaptations undertaken by public agencies were long called for. On one hand, this was because little public adaptation existed at that time, also based on the long-held assertation that adaptations will not require strategic policy interventions (for more on this, see Fankhauser et al. 1999). On the other hand, the need for public adaptation was emphasized based on the assumption that "optimal" autonomous adaptation is met by fundamental constraints, as individuals are likely to lack the "incentive, resources, knowledge, and skills to adjust appropriately" (Fankhauser et al. 1999, p. 68). Even with the evolution of the climate change governance regime, political practice was still described as taking a "wait and see approach," with governments not seeing much of a task for themselves (Huitema et al. 2016). In recent years, however, this has changed.

c. *Lacking perspectives on how society adapts*

Adaptation has become a hot topic across the globe, reflected in the growing public awareness and political attention, with manifold adaptation efforts, plans, and strategies on the way (also see IPCC 2022b). Yet, regardless of public adaptation progress, which also resulted in increasing specialization and mainstreaming adaptation into different policy sectors, and in contrast to the early years of adaptation research and practice, we lost the bigger picture: How does society adapt outside the governmental realm? Nowadays, there is strong attention on public adaptation interventions and planning strategies. This has coincided with local practices of self-governance and informal adaptations often being overlooked, despite their potential to mitigate some of the core vulnerabilities (Wolf et al. 2009; Teebken 2022).

d. *Autonomous adaptation: Strong focus on the global south*

While there is an apparent lack of research on autonomous adaptation and how people choose to adapt to climatic stimuli in Germany, autonomous adaptation is perceived to be "very common in locations where people are more exposed" (Pörtner et al. 2022, p. 101) with adaptation responses in developing countries often being "autonomous, incremental and focused on managing water-related risks in agriculture. In contrast, responses are more policy-oriented and urban-focused in developed countries" (Caretta et al. 2022, p. 556).

A lot of work on autonomous adaptation has come from the global south, with vast literature bodies on community-based adaptation (CBA) and community-led adaptation (CLA). In contrast to earlier classifications and viewing autonomous adaptation also as a result of absent governmental adaptation in the late 1990s, the emergence of CBA literature is seen against the background of a growing appreciation of local knowledge to increase local adaptive capacity for climate change (for a review of literature, see McNamara and Buggy 2017). In line with this development, command-and-control approaches have come under intense scrutiny, also reflecting upon the risk of maladaptation and the importance of local ownership (McNamara and Buggy 2017).

e. *Research gap: Autonomous adaptation in small cities in the global north*

Autonomous adaptation is considered an often-localized form of adaptation and frequently occurs in climate-affected

communities for sustaining their livelihood activities (e.g., see Tuihedur Rahman et al. 2021). As climate change is progressing rapidly, small cities in Germany are especially challenged, as they often do not have the formal capacities for climate adaptation planning and developing policy strategies (also see Häußler and Haupt 2021). Against this background, communities in small cities are perceived to be confronted by a lack of preparedness, which requires locally tailored solutions (Häußler and Haupt 2021). Despite all of this, there is a lack of understanding of how society in the global north is adapting beyond policy sectors and public planning. Few studies in the global north and outside the agricultural/livelihood perspective have examined the social strategies that people implicitly deploy or develop to adapt to climate change. We will build on some of these existing studies in the following.

f. Recent focus on behavioral adaptation

Considering recent attempts in political practice of increasing the self-efficacy of populations and developing local agency for adaptation, there has been a focus on behavioral forms of adaptation, i.e., an adjustment of behavior as a result of climate change. The attention, however, continues to be limited and commonly focuses on the modification of existing behaviors or adoption of new behavior of individuals at the household level and/or extended families (e.g., Fischer 2019). While this literature touches upon important motivational aspects that lead to adjusted behavior in the context of climate change (e.g., Osberghaus et al. 2010; van Valkengoed and Steg 2019), existing research lacks an understanding of activities that are collectively undertaken and are part of socially coordinated efforts.

A more profound understanding is needed on the individual and social practices that can help to increase adaptive capacity to climate change. Literature on the social dimension of heat load has had valuable insights to offer not just when it comes to the uneven distribution of heat stress, but also when it comes to social factors that impact people's vulnerability and adaptive capacity.

g. Adaptation practices and heat load

Heat-adaptation research started to point out the importance of social practices at the individual and household level over a decade ago (e.g., Wilhelmi and Hayden 2010; Fuller and Bulkeley 2013). Grounded in social and cultural theory, social practice theories encourage a closer look at the everyday routines and material elements that commit people to their lifestyles (Hoolohan and Browne 2020, p. 104). Instead of studying individual behavior, social structures, or discourses, the unit of analysis in practice-based approaches is practices as collectively shared cultural entities that shape perceptions, interpretations, and actions of daily life (Hargreaves 2011). Social practices are defined as routinized, visible, and intentional actions (Reckwitz 2002; Shove at al. 2012; John 2013), such as cooking, working, shopping, etc. Focusing on these routinized actions helps to understand how the existing order of everyday life is maintained, reproduced, or challenged (Hargreaves 2011). Individuals are "carriers" of practices; they act in accordance with what they consider to be normal and their subjective interpretation of the required "know how" to realize the various daily tasks (Evans et al. 2012). However, practice theory is characterized by the analysis of action in context, with a focus on social and material conditions in which routines are situated (Hoolohan and Browne 2020). Examining climate change adaptation through a social practice lens can therefore give valuable insights into how adaptation can be achieved in everyday action.

Research that focuses on heat stress and social practices can roughly be split up into two branches. The first branch puts the social dimension of heat risks at the center of analysis. Authors show how vulnerability to heat can relate to social practices and lifestyle choices of people as much as to age, gender, and socioeconomic factors (e.g., Klinenberg 2002; Wolf et al. 2010a; Großmann et al. 2012, 2017). These studies do not focus on social practices for heat adaptation per se. However, by detecting vulnerability in everyday life, they show how lifestyles might be maladaptive and how a change in existing social practices can help to avoid heat-related health risks. With his study on the 1995 Chicago heat wave, Klinenberg (2002) was one of the first to draw a connection between heat-related deaths and social factors. He showed how cultural habits, social isolation, and poor political precautionary measures have a strong influence on who is at risk from heat. Klinenberg's study exposed that vulnerability to heat is dependent on perceptions of the community, culturally determined norms, and habits. Wolf et al. (2010a,b) and Wolf (2011) took a closer look at social networks and how they influence heat vulnerability. These networks can determine how people perceive their vulnerability; they therefore also shape individual behavioral responses of heat-sensitive individuals. In an analogous manner, Großmann et al. (2012, 2017) studied the social dimensions of heat stress in the city of Leipzig, Germany. They found that heat perception and adaptive capacity depend very much on daily routines and daily obligations that people need to fulfill and are not solely dependent on physical preconditions. Großmann et al. (2012) show that the subjective heat load of elderly, supposedly vulnerable people, can be much lower than that of single parents. The authors explain this with a flexibility of the former to adapt their daily rhythms to heat events, whereas the latter had a much stricter time corset, taking children to nursery or school at a certain time and on certain, potentially heat-exposed, routes (Großmann et al. 2012).

Another branch does not put vulnerability to heat at the center of attention. This line of research focuses on weather responses as important steps to achieving (thermal) comfort in everyday activities (e.g., Fuller and Bulkeley 2013; Strengers and Maller 2017). Authors have presented a wide range of social practices that people pursue during heat waves, among them practices related to heating and cooling technologies in everyday life and types of clothing and dress codes (e.g., Fuller and Bulkeley 2013; Shove et al. 2012; Evans et al. 2012), as well as practices of passive cooling or eating and drinking in times of heat (Fuller and Bulkeley 2013). Spatial and temporal aspects have played an important role in heat-practice studies. Social dimensions and related practices have been examined

for indoor and outdoor heat stress (e.g., Strengers and Maller 2017) and with regard to culturally determined differences in city districts or countries (e.g., Klinenberg 2002; Strengers and Maller 2017). How heat-adaptation practices are influenced by people changing the country in which they live has attracted academic attention with regard to spatial aspects of social practices (Strengers and Maller 2017; Fuller and Bulkeley 2013). Social practices and indoor heat load can also be informed by a body of literature on thermal load and energy consumption; here practices of sheltering and building use are examined with regard to sustainable consumption. There are strong thematic interlinkages with the heat-adaptation literature, for example, about the role of dress codes for thermal comfort (e.g., Evans et al. 2012; Shove 2003; Shove et al. 2012). Studies can also be distinguished by the societal field they focus on; for example, Oppermann et al. (2018) studied heat-related practices as part of people's work life. They showed how outdoor workers deal with extreme environmental heat in Australia's monsoon tropics and reframed climate change adaptation in terms of embodied experiences and everyday practices of the workers—their rhythms, variations, and temporalities. Here, everyday adaptation arises through variation and adaptation of practices such as changing the pace or rate of carrying out tasks, rescheduling tasks, or rotating staff through roles with high exposure. Exposure to hot environmental conditions is one of the means through which experiential knowledge is developed for more adapted practices.

3. Methods

a. *Pilot study on social adaptation practices*

The following findings were obtained in a pilot study, conducted at the beginning of the research and development phase of the GoingVis project. GoingVis addresses small-town adaptation to climate change with and for the people. The project puts citizens and local actors at the center of adaptation activities in the partner towns. They collaboratively develop and implement heat-adaptation activities. The aim was that people integrate adaptation to heat stress comprehensively into their lives in the small towns and by changing social practices contribute to making those towns more resilient to extreme heat events.

b. *Study sites*

Boizenburg, Germany, and the association of municipalities Liebenwerda, Germany, were research sites for this pilot study. The towns are small and located in the German periphery, relatively distant from major German cities such as Berlin, Hamburg, and Leipzig. Climate change mitigation and adaptation are voluntary administrative tasks for German towns. Small towns such as the research sites often face difficulties approaching this task due to constraints in financial and human resources.

Boizenburg is situated in the rural surroundings of the UNESCO Biosphere Reserve River Elbe in the northeast of Germany, right on the eastern strap of the former German border. Before the project started, Boizenburg's administration and politics did not pursue any strategic or systematic approach to tackle climate change. The town's population is growing and reached 11 436 inhabitants by the end of 2021. Apart from the influx of new residents, the town is still characterized by a high and growing number of old and very old people. Even though small, Boizenburg is characterized by a diverse housing situation. There is an old town with brick buildings and little green space surrounded by private allotments and single-family houses and gardens and large socialist-style settlements. Air conditioning is uncommon in Germany. Boizenburg, located at the River Elbe, has been exposed to flooding events over centuries (Meinke et al. 2018). For the future, climate impacts such as droughts and heat events are projected to become more intense, longer, and more frequent (Regionaler Planungsverband Westmecklenburg 2012). Boizenburg experienced two summers of intense heat waves in 2018 and 2019.

The other research site, Liebenwerda, is a new administrative unit made up of four former independent municipalities—it covers an area of 44 585 km^2 and has a population of just 24 250 (2021). The region is characterized by its long coal-mining history and is going through structural changes to define new economic and social directions. Affected by an ongoing demographic change resulting in a massive loss of inhabitants and a rise in people belonging to elderly age cohorts (Bertelsmann-Stiftung 2020), the region is also annually hit by extreme weather events such as heavy storms and droughts (DWD 2019). Different climate scenarios show that Liebenwerda needs to adapt to increasing mean temperatures of up to 3°C by the end of the twenty-first century and will face an increase in maximum temperatures and heat waves (von Storch et al. 2018). The housing situation is similar to Boizenburg—remarkably diverse with various kinds of building structures and forms of habitation.

c. *Mixed-methods design*

Following a mixed-methods design, the pilot study collected data on existing social practices for heat adaptation in the study area. The aim of the field study was to get a clearer image of what kind of interventions could follow during the project to initiate further adaptation action. Qualitative data were collected in spring 2019. From May to August 2018, Germany and many other parts of Europe experienced an extraordinarily long period with temperatures above average that turned into an extreme heat wave (Imbery et al. 2018, p. 1). We conducted a qualitative survey of 27 interviews with residents of Boizenburg and Elbe-Elster, Germany. Interviewees provided insights from different sectors and areas, such as local civil society, the social sector (e.g., daycare), politics, the political administration, and economy in Boizenburg and Liebenwerda. However, they were not interviewed as representatives of societal sectors but as private individuals. Because of the exploratory nature of the study, we used opportunistic sampling to collect data.

The interviews were problem centered, using questions related to existing knowledge, local core topoi, and existing heat-adaptation practices. The problem-centered interview guide was complemented by a sociodemographic survey, which included information on age, gender, district, and occupation.

Interviews lasted approximately 1–1.5 h and were conducted in German, voice recorded, and professionally transcribed. Subsequently, the scripts were analyzed thematically using MAXQDA qualitative software. In addition, a small quantitative survey on the perception of climate change and adaptation practices was conducted in Boizenburg from December 2019 to February 2020. The questionnaire circulated in the local Facebook group. It was not designed as a representative survey but to explore perceptions and practices of the citizens related to climate change adaptation. Thematic clusters of the survey were local participation, communication channels, climate change perception and action, and general expectations of Boizenburg's future. The Boizenburg Facebook group had 4 090 local members at the time of the survey. Approximately 700 people saw the three posts advertising participation and a link to the survey; 137 users completed the questionnaire. Data were analyzed using Statistical Product and Service Solutions (SPSS) and Excel.

4. Findings

In the following paragraphs, we present and explicate social practices to which interviewees referred when asked which practices they pursued during the German heat wave of 2018 or which practices they perceive as necessary. Rather than giving an all-encompassing overview of practices, we present results that represent a range of aspects that we considered relevant for the classification of social practices related to heat adaptation.

a. Results of the qualitative study: Areas of adaptation

1) SHADING

In Boizenburg, different parts of the town suffer from severe heat islands during hot summer days. Among them are the almost-treeless market square in the old town and the train station area. Interviewees expressed the idea to organize a shading initiative as an adaptation practice, which involves the joint initiative of different actors from the economy, civil society, and administration as well as citizens [e.g., interviews (I) 03 (I-03) and I-16]. Instead of individually putting up shading elements, the shading initiative was spoken about as a coordinated effort to achieve the collective goal of adapting the town to heat impacts. On hot days, shopkeepers would coordinate to synchronously put up shading elements such as awnings or sun umbrellas and offer water to people passing by. Although the idea focuses on sector-specific adaptation of small-town businesses, interviewees considered this to have cobeneficial effects of reviving the town center and creating an adaptation effect for the entire town (I-03). Negative impacts of heat are reduced, making shopping or otherwise using public space more enjoyable. The Boizenburg shading initiative creates an informal network of independent actors. There are no codified rules to take part in this social practice other than the need for the public administration's permission to set up shading elements in public.

2) GREENING AND USING GREEN SPACES

Interview partners also identified common greening and planting activities for heat adaptation. They focus on greening practices in public spaces. An interviewed administrative official noted, "But that could of course also be we simply plant more trees or something. And I think it could also be a matter of involving private individuals and promoting this more strongly. Or to make such things easier overall . . . But you can just think again. Where in the urban area could we plant more trees? And at the same time, of course, private individuals can also do that" (I-18).

Initiating public greening practices is relatively easy. Otherwise nonorganized citizens can take part, and the social adaptation practices that focus on green space provision target adaptation on a community level. Interviewees state that planting activities can take place on a regular basis. Various local actors need to be coordinated to realize this social adaptation practice: the administration provides the public spaces and local businesses offer the plants. Citizens then need to get informed or inform themselves to synchronously meet up for the planting events to create "climate proof" public spaces.

Several interviewees referred to using green space as a heat-adaptation practice. They explicitly pointed out the connection between this practice and them living in small towns. For them, the "green" small-town environment enabled sufficient heat-adaptation practices and made them dismiss other forms of adaptation (I-01, I-09). "The fact that it is a green city means that it is possible to evade (the heat). We are not standing on asphalt here. We have the ramparts with the trees; we have the city park, which is leafy. In this respect, there are already green oases here, and it would certainly be nice to have even more. But we also have a huge number of allotment gardens. [During heat waves] everyone crawls into the allotment gardens and then . . . in principle you don't have this asphalt pavement, like you have in big cities, and this heat buildup." Some interview partners also rejected the idea of adaptation to heat as a hazard. They reported an adaptation in social practices related to the heat wave that was not problem oriented but perceived as positive change in routines, "The swimming pool, that you could cycle in a T-shirt . . . Yes, in the evening also [being] longer in restaurants . . . We also like to go out to eat, that you can also sit outside. These are also very positive effects" (I-09).

3) LEISURE-RELATED ACTIVITIES

According to the interviews, adjustments of daily routines also involved the relocation and time shift of leisure and sport activities. Interview partners reported of members of sports clubs, dancing groups, or lose associations collectively deciding to postpone or skip training/meetings and/or switching to less heat-affected locations, "you cannot imagine how to train in the heat. That was disgusting. We also skipped one training session. We came and found out that you can't do anything that day. So, we had to stop physical activity" (I-01). More flexible adjustments of daily routines have been stated in terms of changing location or times of leisure activities individually, for example, gardening work times for elderly people.

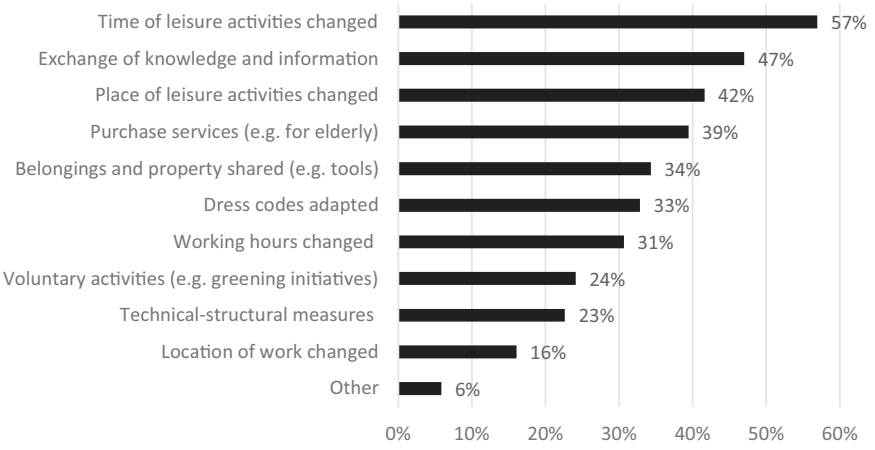

FIG. 2. Responses to "Have you ever done anything to protect yourself or others now or in the future against the impacts of extreme weather events?"

Interviewees reported that leisure activities had to be dropped as some form of heat-adaptation practice, "However, also with older people, a lot of older people just no longer went to their gardens, [allotments]. Because the . . . heat load was enormous. I think it happened to many people, not only the elderly, but with them it was a bit clearer to see. Yes. That was the most important thing. That means that the leisure activities were limited for many people" (I-02).

4) WORK-RELATED PRACTICES

During periods of extreme heat and in the summer of 2018, adjusting working hours, taking longer breaks during peak heat times at noon, and scheduling meetings for the early morning rather than hot afternoon hours were common social adaptation practices reported by interviewees working in the actor group of administration (e.g., I-01, I-07, and I-08). Interview partners also talked about work-time relief practices such as foot baths, open doors to improve airflow, and holding team meetings outdoors (I-01). In many cases, these adaptation practices involved synchronous shifts in temporal and spatial routines. Heat-adaptation practices were a result of coordinated individual actions of different employees who took the freedom to flexibly adjust their work practices. The shared informal routine among coworkers gradually led to a partial institutionalization of these practices during the heat wave. Other interviewees working in the building sector were not able to adapt their work practices during the 2018 heat wave, "While I certainly have a straw hat now, because I've been on the verge of passing out at work several times. When my concrete arrives, no matter how warm it is, I must process it. So, I have alternating day job sites in northern Germany from Flensburg to Kassel. [I] must finish that day no matter what the weather is like. And that's a hazard and extreme. Yeah, you must adjust" (I-03). Dress codes are a typical example for informal norms that are shared (and situationally negotiated) by actors and are relevant for acting in a specific contextual setting. An interviewed member of the administration confirmed the difficulties in adapting social practices to changing circumstances, "In the 2018 summer heat . . . [it was] partly difficult to organize that people [staff] dressed according to their place of work in the administration [council]. This colleague would not have been able to work like that in my department, the way she was dressed. We are not on the beach" (I-01). Dress codes emerge in not only physical but also socio-relational spatial settings. The interview extract shows that shared norms even depend on (role specific) relations within sectors and fields, in this case, the local administration of Boizenburg (e.g., do people need to meet superior authorities on a specific working day?).

b. Results of the quantitative study

In addition to the qualitative data, the quantitative survey contained questions that could further inform the classification of social practices and provide insights for the governance of social practices. Members of the Boizenburg Facebook group were asked about specific practices they already pursued in times of extreme weather events (Fig. 2). Most of the respondents of the survey reported that they already changed their leisure activities to adapt to heat stress (57% changed time, 42% location). To a lesser degree, respondents exchanged knowledge (47%) and shared resources to adapt to climate impacts, for example, by sharing their property or time or providing shopping services or assistance for elderly people (39%). Survey participants pursued adaptation practices at the workplace (33% changed dress codes, 31% working hours, and 16% workplace). These options were chosen less often than the same ones for leisure activities.

Respondents of the quantitative survey emphasized the need for collective action for the adaptation to heat waves (Fig. 3); a majority of 78% does not expect to be able to adapt to climate risks by measures that they take themselves without others being involved. There is a high level of trust in the institutions of civil protection (fire brigades, technical aid organizations). Families, friends, and neighbors are also seen as institutions to support adaptation to climate change (36%).

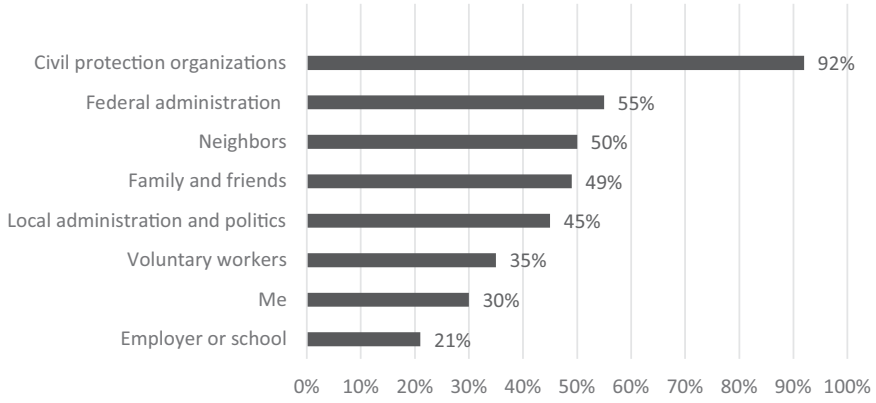

FIG. 3. Responses to "Which individuals or organizations can help protect you from the negative effects of heat waves in the coming years?"

Respondents expressed rather limited trust in the local administration to ensure adaptation. This further supports the need to explore social adaptation practices that go beyond public adaptation plans but focus on integrating heat adaptation into everyday lives in the small town.

5. Classification of social adaptation practices

Based on the literature review and the empirical research, we derived a classification of social practices for the adaptation to climate impacts such as heat waves (also see Table 1).

a. Adaptation targets of social practices: What to adapt?

Literature and empirical data exemplify that social practices for heat adaptation can be differentiated into practices that target the reduction of heat-stress-related vulnerabilities; they have a health-related goal such as shopping services for elderly people during heat waves. Other practices focus on heat relief and achieving thermal comfort and wellbeing. There is a third category of social practices that mainly focuses on non-problem-oriented activities related to heat waves such as sunbathing or extended outdoor activities and others. Moreover, the presented examples show that heat practices can be classified with relation to the sectors and societal functions they are embedded in. We identified work- or leisure-related heat-adaptation practices as well as sector-specific practices (e.g., building sector and administration). Examining these sectors with regard to heat-adaptation practices can give insights for adaptation governance in terms of the flexibility to change practices and react to extreme weather events. We also found that people engage in heat-adaptation practices that interlink with other aims and desires. Interviewees issue link their social adaptation practices with locally discussed topics, values, beliefs, and identities. In both study areas, some interviewees referred to characteristics and experiences of living in small towns; for example, small

TABLE 1. Classification of different adaptation practices: Individual behavioral changes, collective change, and social practices.

Adaptation target (what?)	Carriers of practices (who?)	Coordination (how?)	Space/place (where?)	Time (when?)
Heat-risk dimension: vulnerabilities; wellbeing/thermal comfort	*Single-actor group*: e.g., family, neighborhood, and organized/ unorganized	*Hierarchy*: top-down; bottom-up; hybrid	*Space of interaction*: virtual; physical	*Time scale*: long term; short term
Functional/sector-specific adaptation: e.g., health, transport/ traffic, tourism, water, and air	*Actor groups of one societal field*: e.g., administration, politics, economy, and civil society	*Initiation*: individual (single actor; single person); collective (various actors or people together)	*Spatial scale*: e.g., urban, rural, local, regional, national, global, and relational	*Social rhythms/ frequency*: event related; periodical (at noon siesta; weekly; monthly)
Issue linking: cultural; political; economic	*Actor groups from different societal fields*	*Type of action*: coordinated common action with collective adaptation goal (shared work; one goal); coordinated common action with individual adaptation goal		*Synchrony*: synchronous; asynchronous

towns being very green places. They derived their pursued heat-adaptation practices from these culturally determined perceptions. Social adaptation practices to heat stress were also connected with political issues that have a place-specific component. Topics that are prevalent in small-town political discussions, such as social cohesion or economic resilience in demographic change, were mentioned in connection with social adaptation practices.

b. Carriers of practices: Who?

Many of the expressed social adaptation practices have been carried out by the interviewees themselves with the goal to adapt themselves. However, adaptation practices of the individual can often only be realized in a specific context that involves other people or societal actors. Societal actors are formally organized entities that reproduce institutionalized practices. For the classification, we identified different sorts of actor constellations that we found in social practices for heat adaptation. We found social adaptation practices that were realized by a group of actors of a similar kind, such as one or more families, neighbors, or friends. Adaptation practices of such kind are, for instance, shopping services for elderly in a community organized by a network of neighbors. These social adaptation practices are privately organized and self-coordinated, and the adaptation target is not congruent with the carriers of the social practice. Other social practices mentioned by interview partners are those that realize their adaptation potentials when carried out by a combination of actors from different societal fields, such as politics, administration, economy, and/or civil society. In terms of classifying social practices, it may be useful to differentiate involved actors horizontally between different sectors, e.g., economy (water, energy, etc.), civil society (households, families, registered associations for sports, health, music, etc.) and also vertically, especially in context of administration and political actors.

c. Type of coordination: How?

To realize heat adaptation, social practices often involve more than one person or actor. These actors need to attune their practice-related knowledge and action to realize their practices. Social adaptation practices can be characterized by different coordination types. Adaptation practices differ with regard to who initiated them. On the one hand, they can be instigated top-down with government actors taking initiative of what is done in terms of adapting a community to climate impacts. Climate change adaptation concepts typically contain examples for top-down approaches to adaptation practices, such as catalogues of advice on how to behave in heat waves. On the other hand, our research focused on practices that were initiated bottom-up, or evolved in the contextual settings they are situated in. Practices can also be distinguished according to the power of decision-making around their orientation and goals. We distinguish whether that power lies within the actors that carry out the adaptation practice or whether there is coercion from actors not involved in implementing the practice, an example being forms of legal regulation of indoor/outdoor work conditions during heat waves.

The implicit or explicit organization of decision-making power is an essential question for the coordination of social adaptation practices. These practices can involve hierarchical decision-making or decision-making actors that are in principle equal. One category is social adaptation practices that are characterized by a collaborative connection of different types of practices and actors. These actors contribute to heat-stress adaptation by implementing a shared objective. Each actor carries out different practices and contributes in a different way, bringing in special knowledge and skills to realize the adaptation practice; for example, that could be the case in the mentioned greening initiatives. Another category is social practices that need coordinated joint action to realize social adaptation practices of the individual, but basically every individual contributes in the same way. When a certain number of contributors is reached, it does not matter too much if one contribution is missing—the adaptation goal would nevertheless be fulfilled. An example for this kind of bottom-up social practice of climate change adaptation is the shading initiative mentioned in the interviews.

d. Places in adaptation practices: Where?

Adaptation practices are visible actions; consequently, they emerge in concrete sociospatial settings. The question of a social practice's place/space entails different categories, such as its physical setting, the place of interaction, and its geographical scale. The physical context that a social practice takes place in can be the built or so-called natural environment or both. We observed in the partner towns that the physical setting is important for adaptation practices, as they often relate to experiences of extreme weather events people have had locally in the past or expect for the future. However, the place of interaction between actors may not necessarily be reduced to physical space. Social practices for adaptation can also take place on virtual media. Social practices can be carried out together but in different locations by different actors. These actors are part of a relational network, examples being siesta-like shifts in work hours.

e. Role of time for adaptation practices: When?

Time plays an important role for social practices related to heat-stress adaptation. They are based on local, short-term, and ad hoc (weather) events. However, the time components of heat-adaptation practices are manifold: they are subject to social rhythms, can evolve (a)synchronously, and involve different time-related scales. Social adaptation practices are subject to social rhythms and frequencies. Interviewees reflected on the flexibility of certain groups of people, such as pensioners, to adapt their daily rhythms to heat events, whereas others had a much stricter time corset, e.g., the builder who needs to use certain building materials in a certain time frame. Social practices may be carried out time synchronously but also asynchronously. As already discussed, social practice may be subject to division of labor. Actors may carry out different bundles of practices at different times that could all be part of the same social practice of adapting to climate change. Social adaptation practices unfold on different time-related

scales. Short-term social practices may relate to a short, single event in time but affect longer changes, too. They may be conducted periodically and/or event related. The example of changing the dress code in the administration during the time of a heat wave shows this time component. Dress codes as a specific form of social norms may last over longer time scales but may practically be conducted, including social sanctions, at a single place in a specific situation.

6. Discussion and conclusions

We have looked at social adaptation practices as a form of autonomous adaptation characterized by different adaptation targets and carried out by different actors and actor constellations. Further, we found out that adaptation practices are coordinated differentially through different concepts of hierarchy, various levels of initiation (e.g., individual, collective), or diverse types of action. We also detected distinct concepts of space where adaptation practices might occur, as well as different time patterns involved in climate change adaptation by social practices.

Research has demonstrated that social adaptation practices related to heat stress occur in various forms (e.g., Strengers and Maller 2017; Oppermann et al. 2018; Fuller and Bulkeley 2013). These strands of research often focus on very specific aspects such as adaptations as part of work life (Oppermann et al. 2018), adaptations to increase thermal comfort (Fuller and Bulkeley 2013), or how specific social and demographic groups, such as the elderly, adopt adaptation strategies based on their living environment and daily routines (Großmann et al. 2012). Drawing from these insights and based upon our empirical research, we aim to contribute a comprehensive framework through which different types of adaptation practices can be assessed and understood holistically. This framework not only helps to make sense of the different societal actors engaged in adaptation practices but also their different motivations and ways of doing it.

Further, our findings connect with other viewpoints in the literature that emphasize the dynamic processes and role of practices for sociotechnical transitions (Shove and Walker 2010). The focus on daily practices can help to consider the challenges associated with transitions, but, and in contrast to simply viewing practices as "sites of interaction," practices can also order and orchestrate entities in their own right (Shove and Walker 2010, p. 471). Practices and the role different actors undertake and how they come together are an overlooked item in research, which can help to make sense of wider social change. When it comes to the governance of social practices and ideas of systemic change, one fundamental issue is the often clear-cut distinction of representation in the governance process, i.e., those who govern and those who are governed (Shove and Walker 2010). While we agree with Shove and Walker (2010), who view the distinction between "us" and "them" as misleading based on the understanding that practices are an emergent outcome of the actions and inactions of all, we contend that inherent power structures do matter and must also be assessed as part of autonomous adaptation practices. By means of our classification, it can be distinguished who undertakes what type of adaptation practices with which interests and who potentially dominates adaptation practices with what outcome. In line with Shove and Walker (2010), we find that a reflection of practices, interests, and power structures in the broader context in which they occur can help our understanding of the matter. Thus, it is about moving between the positions, i.e., autonomous adaptation vis-à-vis public/planned adaptation, and understanding how they interrelate. For future research on transformative adaptation, to what extent the adaptation practices maintain or disrupt the status quo will become important, also in conjunction with actions of governmental actors.

Social practices that were mentioned by our interview partners in the small towns resemble the ones that have been identified in previous studies, among them, practices related to clothing and dress codes, passive cooling, and the shift in time and place to pursue activities (e.g., Großmann et al. 2012; Fuller and Bulkeley 2013; Shove et al. 2012). They also resonate with the wider research on climate change adaptation in terms of stressing the importance people attach to the provision of green space for heat-stress relief (Jay et al. 2021). The presented social adaptation practices show that citizens are not just recipients of government-led adaptation action or consultants in participatory planning processes as is often suggested in adaptation research (e.g., Uittenbroek et al. 2019; Wamsler et al. 2020). With social adaptation practices, citizens are actively involved in realizing their own (provisionary) adaptation. As adaptation practices emanate from everyday routines of people, it can be assumed that these practices are also carried out by people who are usually not reached or targeted by participatory offers of adaptation decision-makers. Participation is always an add-on, and for some people, it requires extra effort and taking time off from their everyday life, for instance, getting someone to watch their kids or having to leave work early; (social) adaptation practices are anchored in everyday lives and thus may attract some groups of society more easily (e.g., people of certain ethnic or socioeconomic backgrounds).

The forms of autonomous adaptation that our empirical results revealed are of incremental nature. This is partially in line with the earlier characterization of autonomous adaptation being ad hoc and reactive (e.g., see Fankhauser et al. 1999). Although we find that a lot of adaptation efforts were ad hoc, immediate, and localized, our classification also has insights to offer that run contrary to some of the earlier discussions (see section 2) that perceived only of governmental interventions as anticipatory, prediction based, and goal specific. We find that autonomous adaptations can be goal oriented when it comes to the heat-risk dimension they seek to address (e.g., improving thermal comfort) or functional-/sector-specific adaptations (e.g., for transportation or building sector). This partially contradicts some of the earlier research, which has portrayed only public adaptation as goal oriented, prediction based, and deliberate (e.g., Fankhauser et al. 1999; IPCC 2001). Our examples show that goal orientation can be implicit to autonomous adaptation as well.

a. Lifting some stigma from autonomous adaptation and small cities

The range of social practices related to heat stress that we identified shows that climate change adaptation is also a topic

in smaller towns where successful forms of autonomous and everyday adaptation have developed. This is an important addition to existing climate change literature that often relates to small-town adaptation in Germany in a problem-fixed manner, stressing the lack of planned/public efforts in these towns, especially in comparison with midsize and big cities (e.g., Otto et al. 2021). Especially in small cities, which are often portrayed as lacking the capacity to adapt to climate change, we find that what constitutes "capacity to adapt" may be different, and more tacit, in terms of everyday knowledge that local communities and actors have. Although the initiated adaptation experiments were mainly incremental, i.e., they did not change the underlying causal structures that contribute to vulnerability risk, they may need to be valued differently in small cities with fewer formal capacities. Our empirical findings also indicate that contrary to the broad brush that small cities are painted with, e.g., in terms of having only little adaptation activity and awareness, a lot of activity is already occurring.

When going back to the international literature, there appears to be an implicit connotation that autonomous adaptation exists in countries of the global south, where strong state apparatuses do not (yet) exist and deliberate policy frameworks are not in place. Turek-Hankins et al. (2021) show that there is indeed a dominance in articles on low- and middle-income countries of the global south discussing how individuals adapt autonomously. Aside from the urgent need to problematize this perspective, the insights the global south has to offer for adaptation governance elsewhere, especially when it comes to insights on autonomous adaptation and how they may complement existing policy frameworks, are completely overlooked in the global north. Our study yielded some insights about autonomous adaptation practices that are happening in the global north. Further research could engage in a comparison of similarities and differences of autonomous adaptation practices in the global north and south.

b. *Upscaling opportunities*

When looking at carriers of adaptation, there is tremendous potential for upscaling autonomous adaptation efforts in terms of combining different actors and actor groups from different fields. Local, private actors are best at knowing the resources they do or do not have and using them to address context-specific vulnerabilities, an example being the shading initiative. Putting up shading elements is an individual practice, but it is even more effective for adaptation when it occurs collectively. The classification gives a first insight into different constellations of actors as carriers of different forms of heat practices. Local actors know their environments, neighborhoods, and to whom to reach out to realize this autonomous form of adaptation. Yet, it is exactly this form of tacit local knowledge that needs to inform public adaptation planning and strategy. This is in line with other works that call for a greater congruence between planned and autonomous adaptation to develop concerted and effective efforts to minimize negative impacts of climate change (Tuihedur Rahman et al. 2021).

The network of retailers who join forces in a shading initiative to make the city climate adapted and enable a more pleasant shopping atmosphere, as an example for types of coordination in classification, recalls discussions on "distributed responsibility" known from the literature on governance of sustainable consumption (Evans et al. 2017; Barnett et al. 2011). The responsibility for heat adaptation is not individualized. The shading initiative shows "more collective notions of political responsibility and acknowledgement that responsibilities are distributed across more complex and extensive networks of actors" (Evans et al. 2017, p. 1404). A consensus of a group of decisive actors that common action is necessary enables private but collaborative activities in the urban space. And those activities allow individuals to adapt their behavior to heat without being actively involved in the initiative themselves.

c. *The interplay of public and private adaptation*

Aside from enabling a better understanding of the everyday practices that are already occurring in reaction to extreme heat events, the classification of adaptation practices also enables us to identify interfaces, which can be used to connect autonomous with public adaptation. Autonomous adaptation is often criticized for being ad hoc, incremental, and reactive in nature. Yet, they also present a low-threshold and much-needed collective effort to get adaptation off the ground, especially in places where no formal adaptation planning exists. Earlier works on autonomous adaptation posed insightful questions on the role the state should play that are of increasing relevance today (e.g., Fankhauser et al. 1999). The provision of public goods is a typical area of government involvement (Fankhauser et al. 1999). At the same time, having the ability to adapt requires there be room to change, which is "constrained by law, politics or custom," (Fankhauser et al. 1999, p. 74). Although attention has grown for mixed forms of adaptation, we continue to lack an understanding of how autonomous and public adaptation can enhance each other and what role the state plays for enabling forward-looking and anticipatory autonomous adaptation. Social practice research has given some insights here already (Hoolohan and Browne 2020; Watson et al. 2020); however, we consider this an interesting area for further research. Social adaptation practices cannot and should not replace political efforts that must be undertaken at different levels of government, but they can inform them. The social adaptation practices we identified may well be a starting point for the initiation of public climate adaptation planning in the small cities of Boizenburg and Liebenwerda, where public adaptation efforts were limited at the point of data collection.

Needless to say, governments must fulfill essential roles in the provision of public goods, social safety, and more equally distributed access to them. To what extent these "external" political economic context conditions constrain autonomous adaptation efforts is another avenue for further research.

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