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Designing for 'Last-Mile' Climate Resilience with Communities

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Abstract

Technologically supported tools and solutions are essential for mitigating risks and adapting to the impacts of climate change, particularly in vulnerable communities. However, the "last-mile" challenges — challenges to effectively delivering and adopting these solutions at the community level — often prevent implementation and exacerbate building climate resilience at the community level. This workshop focuses on exploring these challenges from a Human-Computer Interaction (HCI) perspective, highlighting how user- and community-centered design, participatory approaches, and technological interventions can support the accessibility, usability, participation, and impact of climate resilience tools. The goal of the workshop is to bring people together to discuss, share, and compare different approaches and strategies, challenges, and design considerations and concerns.

CCS Concepts

• **Human-centered computing** → **HCI design and evaluation methods**; **Empirical studies in HCI**; *HCI theory, concepts and models.*

Keywords

climate resilience, adaptation, community, design, interventions, empowerment, science communication

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1 Motivation

Climate resilience is the ability to prepare for, deal with, and bounce back from natural hazards and other impacts linked to the climate crisis [12, 24, 43]. Developing and maintaining climate resilience is a complex and continuously changing process relevant for all life forms living in risk areas [8, 18, 22]. According to The International Disaster Database, the occurrence and intensity of natural hazards, such as wildfires and floods, have increased globally[1], making climate resilience a more relevant topic than ever. However, available information and technological support are often hard to apply or adapt to local socio-ecological conditions. The problem is part of the **last-mile** gap, which describes the gap between policies and support provided by official authorities and the complexities of implementing or using those locally due to, for example, diverging infrastructure conditions or that such topdown and "one-size-fits-all" solutions rarely consider how everyday life is unfolded in diverse local communities [15, 28, 37, 39]. The situation is further aggravated by official authorities' limited means and resources to comply with their people's safety needs and empower them from the top down.

Bottom-up interventions aim to empower communities and individuals directly, independently of official authorities. Technological-based interventions in this context aim to keep communities up

[1] The International Disaster Database

to date about disaster developments [1, 29], provide social support platforms [17, 31], engage people in local communities in collaborative design processes to co-create everyday technologies, environments, and practices [39], as well as educate members and increase their awareness of their roles, possibilities, and responsibilities to maintain climate resilience [14]. In the development process, a holistic perspective on the local context and community is crucial to consider, highlighting the need for user- and community-driven design processes where community members actively participate in narrating how democratic, just, and sustainable futures may look [20, 39]. However, bottom-up interventions are underexplored [16] and challenging to develop as they require onsite exploration [34], time, and skill to build trust and relationships between researchers and locals [10] and transdisciplinary collaborations [40].

Within Human-Computer Interaction (HCI), the design of technological interventions that support **climate resilience and adaptations** has rarely been explored [19, 34]. Our field, typically, focuses on sustainability and sustainable user behavior to mitigate climate change [7]. However, we are now at a time where communities across the globe can no longer fully prevent the consequences of climate change and must try to live with and adapt to them. Therefore, the HCI discipline must also pivot to adaptation and resilience — this shift requires a change in perspective on climate change and the development and uptake of collaborative design approaches and technological interventions that support local communities in developing and maintaining climate resilience and adapting to the new normal. This includes interventions and collaborations that support social, cultural, and physical mobility, dealing with uncertainties and rapidly happening changes, as well as participatory interventions that approach the wellbeing of the individual, community, and society across diverse stakeholders [5, 38].

Engaging communities in the design process and doing so early is crucial in developing interventions that meet community needs to counteract the last-mile problem. However, this often does not happen at all, happens too late in the process, or happens in a piecemeal way. Additionally, researchers often do not plan for long-term project sustainability and move on to the next project after completion, leaving communities and the relationships built with members behind — these practices that have been common in HCI [13, 33] raise ethical concerns when dealing with vulnerable communities [2, 13, 38]. Communities themselves may also choose not to be involved due to a lack of trust in scientists and authorities conducting research, or simply may not have the time or capacity to engage — vulnerable communities in risk areas often have more pressing concerns than engaging in research projects and may have had traumatizing experiences with prior natural disasters. It requires sensitive communication and collaborative engagement as well as clear expectation management throughout the whole process [30], further emphasizing the relevance and role of science communication in this context.

In response to these open points and challenges, our workshop will bring together researchers and practitioners to discuss the role of HCI research, design, and technology critically. Furthermore, the workshop will identify design approaches and strategies to deal with the complexity of climate resilience and the ethical engagement of communities. The results will outline future directions toward a new design research agenda to approach the last-mile climate resilience problems that communities encounter.

1.1 Background

1.1.1 Communities' Climate Resilience. Developing climate resilience for communities means enabling, supporting, and co-designing for all members, including more vulnerable individuals and non-human entities [27] (e.g., surrounding nature, animals, and plant species), while taking care of shared community assets and places. Empowering communities' climate resilience, therefore, requires a range of skills and expertise, from social skills and understanding to engineering expertise and local knowledge through processes that are rooted in mutual learning between designers and people [6]. In addition, members of communities in risk areas face high emotional stress and pressure [32], considering that belongings, homes, and cultural roots can be destroyed in the next natural hazard. As pointed out by Robertson et al. [35], communities' climate resilience is strongly impacted by the quality of social relationships, sense of shared responsibilities, and openness to change.

1.1.2 Community-Driven Initiatives for the Last-Mile Problem. Given CHI 2026's theme of ""Creating Tomorrow Together", we draw attention to community-driven initiatives in coastal resilience, which have made significant progress in the past years [26, 44]. They are tentatively integrated into the whole process of coastal resilience, starting from the risk assessment and the implementation of nature-based solutions, but more significantly in decision-making [25]. Integrating the community's voices and values in decision-making is essential as it can mitigate risks associated with climate change and additionally promote social and environmental justice. An appealing example is participatory mapping in marine spatial planning (MSP), which historically neglected local knowledge and community values and can perpetuate inequitable decision-making [3]. Figure 1 shows two examples of how our authors conducted participatory design research with local community members. However, mismatches between MSP objectives and the actual impacts have been particularly common due to the top-down approach to the process. Effectively, data and hypotheses that drove the MSP process may contradict local knowledge and be inconsistent and inaccurate with local contexts and values [3]. The inclusion of social and cultural data from the local communities through a participatory mapping from setting objectives to knowledge collection and implementation can enhance the adoption and harmonization of the MSP process across governance scales. Therefore, participatory mapping can improve data inclusivity and strengthen community trust in the MSP process. It also ensures the empowerment of community members, who are directly affected by planning outcomes, in decision-making [9].

Beyond coastal issues, various natural hazards are increasing in frequency and severity, such as wildfires [23]. Similar participatory methods to those discussed above can be leveraged to engage communities in the wildland-urban-interface (WUI) to engender behavior change among community members and support community-level wildfire resilience. Some of our authors have engaged with communities in California that have experienced or are at high risk of wildfire by conducting participatory workshops over the

(a) (b)

Figure 1: Two projects focusing on community-driven interventions: a) a project on coastal communities' resilience in Madagascar, b) a project on wildfire preparedness with local community engagement.

past two years, which can be seen in Figure 1(b) and designing a collection of serious games about their local lived experiences [21].

1.1.3 HCI Approaches to Community-Driven Design. Cultivating climate resilience on a community level calls for local initiatives that take root in common local history [36] and the governing of social, technical, and natural resources at a local level [41]. To scaffold local participation in last-mile initiatives, participatory design approaches [6, 39] may play a central role in engaging local community members in the design of climate resilience solutions. For instance, Teli et al. [42] illustrates how participatory design approaches can shape transformations in local communities formed around shared interests between designers and communities. This shifts design focus away from harnessing novel technological opportunities towards supporting individual and collective action by considering existing sociotechnical community practices [4] to address contemporary engagements with global and societal challenges [38]. In addition, engaging community members through bottom-up initiatives can help ensure members get to choose and engage with local climate challenges over time instead of using developed technologies during the duration of a given research project's [11].

1.2 Workshop Discussion and Submission Topics

To approach these open gaps and questions, we invite participants to submit papers related to the last-mile problem, including position papers, demos, design works, concepts, etc., touching upon one or more of these non-exhaustive aspects of climate resilience:

- **Adaptation:** Living with the consequences and effects of climate change requires adaptation and technological interventions that facilitate behavior adaptation. Climate adaptation can be on an individual, group, or community level.
- **Well-Being:** Community members' physical, mental, and emotional well-being impacts their ability to deal with and react to changes. Designing applications that approach individuals' and the community's well-being is, thus, essential for climate resilience.
- **Information:** Access, accessibility, and provision of information are major challenges, but they determine whether people know where to find reliable, timely, and complete information to support adaptation and resilience.
- **Learning:** Empowering people to help themselves includes teaching them about risks and mitigation potentials as well as skills to use available tools and apply official policies. However, the topic's seriousness can be overwhelming, which is why we see potential in playful approaches and interaction experiences, making use of informal learning technologies.
- **Empowerment:** In addition, empowering to act goes beyond understanding and requires tools, interfaces, and connections to support systems that provide users with the necessary guidance.
- **Collaboration and Participation:** Seemingly simple aspects, such as knowing your neighbors, can already make a difference in emergency cases and contribute to a stronger community. However, nowadays, these local connections and community participation are less common, requiring interventions and approaches that foster engagement and collaboration across diverse stakeholders.
- **Nature Adaptation and Interaction:** Natural hazards are part of daily life, and to live with them instead of against them means adapting and integrating them into daily routines and processes to some extent. This also means fostering a relationship with climate and nature and considering nature-based solutions that may help maintain resilience.
- **Local and Indigenous knowledge and practices** Communities around the world possess local and indigenous knowledge that is employed every day but often unknown or poorly understood by outsiders. Employing this in the design of technologies can lead to better solutions and greater acceptance and trust among communities.

- **Science Communication:** Another challenge of community engagement and in building climate resilience is the science communication of distributing information that is relevant and applicable to community members. Work in science communication is very relevant in this context, but still underexplored.

The list is non-exhaustive, and submissions can concern design approach contributions as well as technological interventions or concepts.

2 Organizers

Linda Hirsch is a postdoctoral fellow of the Center of Coastal Climate Resilience and the Department of Engineering at the University of California Santa Cruz. Her research explores technological interventions that support developing and maintaining climate resilience for local communities and individuals living in natural hazard risk areas through playful interaction experiences. She focuses on flooding risks in this broad range of natural hazards, including heavy rainfalls, coastal flooding, and precipitation.

Rikke Hagensby Jensen is an associate professor at Aarhus University, Denmark. Her research lies at the intersection of sustainability, everyday life, and the design of interactive, intelligent, and computational technology. She currently works with interaction design, energy communities, and alternative, sustainable futures, researching how understandings of everyday practices may shape the design of digital technology in more caring, diverse, participatory, collective, and sustainable ways.

Ando Rabearisoa is a Ph.D. Student in Ecology and Evolutionary Biology at the University of California Santa Cruz (UCSC) with a Designated Emphasis in Coastal Science and Policy. She specializes in studying the involvement of local communities in the design and implementation of marine conservation efforts through the system of Locally Managed Marine Areas in Madagascar. She worked for Conservation International for ten years, where she was in charge of managing the Marine Conservation Program and the development of Marine Policy in Madagascar. She is an award-winner with publications in top journals such as Nature, Science, or PNAS. She commits to finding integrated solutions to achieve social development that promotes natural resources management and conservation.

Jacob Rigby is a lecturer (assistant professor) in the HCI group at the University of York, UK. He has previously worked on projects in East Africa to explore climate adaptation technologies, focusing on how the provision of information about climate, weather, and water can aid livelihood decisions in rural dryland communities. He has collaborated extensively with researchers and practitioners in the fields of hydrology, climate science, international development, and more.

MJ Johns (they/them) is a Ph.D. student in Computational Media at the University of California Santa Cruz (UCSC) with a focus on Serious Games and HCI for Natural Hazard Resilience. Their current work uses participatory design to develop simulation games that raise awareness of the complex issues relating to wildfire preparedness, evacuations, and recovery. The participatory workshops take place in communities in California that have experienced or are at high risk of wildfire, and the games are publicly available and playable in a web browser or on mobile phones.

Rachel Charlotte Smith is Associate Professor of Human-Centred Design at Aarhus University. Her research focuses on everyday digital transformations and sustainable futures through participatory design and design anthropology. She directs the center for Digital and Green Transformation of Cities and Communities (DIGTCOM) with a particular focus on sustainable futures, based on local conditions and contemporary polycrisis. Publications include Routledge International Handbook of Contemporary Participatory Design (2025) and Design Anthropological Futures (2016).

Katherine Isbister is Professor of Computational Media at the University of California Santa Cruz (UCSC), with a research focus on HCI, particularly focused on social and emotional contexts. Isbister's lab is part of an NSF-funded research project focused on wildfire resilience, as well as a project centered on coastal climate resilience, both taking a playful co-design approach to supporting community empowerment.

3 Plans to Publish Proceedings

We expect the following outcomes: 1) a network of researchers and practitioners working with communities on climate-related adaptations and resilience and related topics, 2) collaborative design approaches and interactive tools that support bottom-up empowerment and participation, and 3) revealing open research questions, gaps, and ethical considerations when designing for the last-mile climate resilience problem to outline a design research agenda.

We will write an *ACM Interactions* article, sharing the design research agenda toward climate resilience and community participation with the HCI community. Further, workshop submissions will be shared via Figshare[2].

4 Workshop Length

We plan a workshop for two sessions, so that we can accommodate participants' presentations and hands-on brainstorming and prototyping.

5 Workshop Activities

Our workshop comprises a panel discussion and participant presentations of submitted projects, including a demo and an interactive afternoon session. Please see Table 1 for further details. The schedule is exemplary of how the schedule would look for two 90-minute sessions. We will adjust the schedule to align with the CHI workshop schedule.

5.1 Required facilities and equipment

We will need a room with chairs and tables that can be moved to create group workstations. We need brainstorming material for the interactive group sessions and would appreciate whiteboards or flip charts that we can distribute. As we calculate with about four to six participants per group, we expect to need about four flip charts (or any combination of flip charts and whiteboards). We will also need a projector and soundboxes to share digital content, such as videos, with participants.

[2] https://figshare.com/

Table 1: Exemplary Workshop Schedule for Two 90-minute sessions.

Time	Activity
1:00 - 1:15	Welcome & Icebreaker
1:15 - 1:40	Keynote & Q&A
1:40 - 2:20	Participant Presentations
2:20 - 2:30	Paneldiscussion of Presentations
2:30 - 3:00	Demo Session
3:00 - 3:45	Interactive Session
3:35 - 4:00	Wrap Up & Final Discussion

5.2 Intended audience and recruitment strategy

Our workshop targets professionals and community members working on adaptation strategies to increase climate resilience. This includes researchers and practitioners from Human-Computer Interaction, Coastal Science and Policies, and other related fields, as well as community members involved in ongoing projects related to climate resilience and adaptations or similar initiatives.

We will advertise our workshop on our professional networks and social media channels. Additionally, we will send personal invites to individuals in our network to join. Please consider the call for participation below for further details.

6 Accessibility

We don't have any accessibility requests. Depending on workshop participants, we might reach out to the Plurality, Equity, and Accessibility Chairs closer to the date.

7 Call for Participation

Working on climate resilience and adaptation or related directions? If yes, join us in our CHI'26 workshop, in which we will provide a platform to share, demonstrate, and discuss different participatory and community-centered design approaches, concepts of and developed interactive technologies, as well as encountered challenges and opportunities. In our workshop, we will combine presentations and interactive sessions that will allow us to build a network around the topic. As participants, we will ask you to share your work through a two-page workshop submission paper using the ACM SIGCHI double-column format by February 15th, 2026, AoE. Submissions will be collected via e-mail (lihirsch@ucsc.edu). We accept papers, pictorials, and demos. Please find further information on our website.

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