



Hanging on a Wire

Understanding the Impacts of Climate Change on Networked Infrastructures in South Louisiana

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ABSTRACT

How will we stay connected amidst a climate crisis? Conditions associated with climate change, such as sea level rise and increasing extreme weather events, can destabilize already vulnerable network and digital infrastructures. While existing infrastructures are in dire need of maintenance, additional infrastructures are simultaneously being built to address imbalances in network access and distribution. My dissertation project attends to these intersecting precarities as a way to reconsider how digital infrastructures can be reworked to address overlapping questions of environmental and digital inequities. My research is situated within marginalized coastal communities in south Louisiana, where legacies of petrochemical extraction has led to deep socioeconomic and ecological disparities, while increased intensity of storms and floods have begun to impede and damage an already sparse network infrastructure. In my project, I use archival, ethnographic, and design research methods to examine longer histories of environmental degradation, investigate current practices of maintaining and developing network infrastructures, and develop approaches for researchers in HCI and related computing fields to re-envision just and equitable network infrastructures.

CCS CONCEPTS

• Human-centered computing; • Human computer interaction (HCI); • Empirical studies in HCI;

KEYWORDS

climate change, networked infrastructures, environmental justice, digital inequality

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1 INTRODUCTION

My research examines the ecological, social, and political implications of digital technologies using qualitative and design research methods. In my dissertation project, I combine archival, ethnographic, and design research methods to examine the practices of

sustaining and expanding more equitable and resilient network infrastructures in a time of overlapping social and ecological issues. My project is situated in vulnerable coastal communities in south Louisiana, where efforts to expand network connectivity and maintain existing infrastructures are happening against the backdrop of climate change. In particular, I investigate how recent federal and state policy initiatives that aim to broaden broadband access across this state play out within landscapes shaped by environmental and social inequality. The ongoing legacy of oil extraction and petrochemical production has led to uneven development and deep socioeconomic disparities in this region, while increased intensity of storms and floods due to climate change have begun to impede and damage network infrastructure. I examine these relations with attention to local community access efforts and environmental justice movements, where a history of uneven development and environmental degradation have pushed community members to build affordable and inclusive communication networks.

2 CONTEXT AND MOTIVATION

Given the rising severity of extreme weather events associated with climate change, the infrastructures that we rely on for computing are at risk of breakdown[13]. South Louisiana exemplifies the widespread scenario of infrastructures that are already weakened by a lack of maintenance by private service providers and government institutions. For example, in 2005, the aftermath of Hurricane Katrina in New Orleans revealed the vulnerabilities of an aging infrastructure in conjunction with other factors like declining economies and precarious social orders [7, 32]. While existing infrastructures are in dire need of maintenance and repair, additional infrastructures are simultaneously being built to address national imbalances in network access and distribution. According to a 2018 report by the U.S. Census, 78.1% of the population in Louisiana has access to broadband, compared to the 85.1% in the United States on a whole [26]. This unequal access to Internet became salient during the COVID-19 pandemic when many activities shifted online. Current projects funded at the federal and state level, such as the American Jobs Plan and Broadband for Everyone in Louisiana (BEL), work towards addressing these gaps in network service.

These intersecting precarities present a need to reconsider how communication networks can be reworked to address overlapping questions of environmental and digital inequities. My dissertation project examines the maintenance and development of network infrastructures in vulnerable coastal communities in south Louisiana, where the push to expand network connectivity is constrained by increasing climate change related weather events. In addition to events like floods and storms that impede network connectivity, I examine the longer trajectory of social, environmental, and political circumstances on the development of regional network

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infrastructures. These relations and circumstances are viewed through the lens of maintenance as a way to understand how infrastructures are kept going in light of, and in spite of, ongoing ecological crises. How is the balance between maintaining existing networks while building additional infrastructures part of the “arts of living” within landscapes shaped by social and environmental degradation [37]?

3 KEY RELATED WORK

My dissertation project contributes to emerging conversations on HCI and climate change. For more than a decade, questions related to the environment and computing have fallen under the umbrella of sustainable HCI (SHCI). Early authors were motivated by concerns for the environment caused by issues like climate change, pollution, and overconsumption [4]. This initial work included a framework that categorizes work under SHCI as sustainability in design, or through design [25]. Sustainability in design pertains to material and energy use in the design of HCI products, while sustainability through design considers how HCI can support sustainable decision making. While this work has pushed HCI as a whole to consider question of environmental sustainability, scholars in SHCI have often struggled over shared terminology, goals, and metrics of success [6, 10, 11].

However, as questions around climate change become more dire, other areas in HCI have addressed the field’s relationship with the environment. Collapse informatics, centered around “the study, design, and development of sociotechnical systems in the abundant present for use in a future of scarcity,” takes a long view towards responding to future scenarios where processes such as climate change have resulted in inhabitable areas [36]. Another approach draws from posthumanism and multispecies theory as a way to use technology to expand how humans fundamentally relate to the world around them. Work in this vein uses technology design as a way to imagine urban cohabitation with nonhumans [33], collaborations with fungi [23], and “symbiotic encounters” in agriculture [24]. However, for Knowles et al., they see that work in SHCI and adjacent areas are already doing fundamental work in addressing concerns around climate change [21]. To resolve previous drifts in the SHCI community, the authors suggest climate justice as a unifying cause, where the main focus is to shift from extractive capitalism. to justice-based economies.

In my project, I build on these ongoing dialogues to envision HCI’s engagement with climate change. Specifically, I draw from three interlinked themes: critical disaster studies, digital infrastructures and inequality, and material dimensions of computing. Within each theme, I place literatures from HCI, science and technology studies, and media studies in conversation with each other. Together, these themes place a focus on how long-term inequities driven by uneven development need to be addressed as part of an agenda for climate change mitigation and adaptation.

3.1 Critical Disaster Studies

South Louisiana is no stranger to disaster. This is a region where events, such as tropical storms that brings high winds and flooding, punctuate longer term situations like the accumulation of pollution from petrochemical facilities and creeping land loss due to sea level

rise. My project draws from literature in critical disaster studies research that is attuned to the “expansive historical and structural conditions productive of disaster vulnerability, dynamics, and response [16].” This approach to examining broader circumstances of disasters lends itself to understanding how disasters reveal formations of power and inequality. Rather than disasters as sudden or unexpected events, work in this area emphasizes the slowness of how the effects of phenomena like environmental racism or poverty lead to destruction over time [14, 27]. This framing of “slow disasters” views “disasters not as discrete events but as long-term processes linked across time” [22]. For instance, Barbara L. Allen describes how the aftermath of Hurricane Katrina highlighted existing disparities through discussing environmental justice issues that emerge in the storm’s aftermath [1]. My project draws from this work by placing histories of infrastructure development, specifically those relating to extractive economies like slavery and oil production, in conversation with patterns of inequality throughout the region.

Examining the broader circumstances of disasters in this line of research also informs how disasters should be understood and what the response should look like. For example, competing narratives of urgency can overshadow movements for careful responses that seek to rectify existing societal imbalances. In “A Tale of Two Sandys,” a white paper from the Superstorm Research Lab, researchers describe the stark differences between how Hurricane Sandy was experienced by communities, institutions, and residents throughout New York City [3]. In turn, these different views led to correspondingly different responses for what should be emphasized in post-disaster recovery efforts. In focusing on how vulnerable coastal communities envision and use alternative communication networks, my project contributes to understanding how infrastructures can be developed to address longstanding environmental and social injustices.

3.2 Digital Infrastructures and Inequality

Access to digital connectivity and network infrastructures is a perennial issue among vulnerable communities, based on factors like race, income, and location [9]. As research in infrastructure studies shows, examining questions of infrastructural access reveals how inequality is embedded in seemingly benign sociotechnical systems [2, 5, 15]. The imbalance of access to the Internet often is framed as digital inequality, where there are perceived benefits to Internet access, such as increased job and education opportunities [38]. These policies frame Internet access as leading to economic development, where increased connectivity will allow people to access resources like jobs and education, often overlooking other uses such as accessing social media or “idleness” [30, 31]. This framing has been described by Daniel Greene as the “access doctrine,” where “the problem of poverty can be solved through the provision of new technologies and technical skills, giving those left out of the information economy the chance to catch up and compete” [17].

In my research, network access is made more crucial due to the impact of climate change. Social media platforms and other applications can provide important information before, during, and directly after a disaster [28]. This information includes contacting emergency resources and services, locating friends and family

members, and tracking ongoing recovery efforts. Additionally, the focus on growing access can often overshadow the much-needed work of maintaining network infrastructures. This work of maintenance is made even more dire in the context of south Louisiana where the ongoing legacy of oil extraction and petrochemical production has exacerbated inequality in this region.

3.3 Material Dimensions of Computing

Sustaining and expanding network infrastructures are not without material constraints. Writing on undersea cables, Nicole Starosielski describes how visions of the Internet as an endlessly expansive technology “fails to register the extensive financial, social, and environmental investments required to establish new systems and maintain existing ones” [35]. This criticism is echoed in Pargman and Wallsten’s proposition for a socially just Internet, where in a time of ecological crisis, what counts as innovation should be reframed and redirected to address network imbalances [29]. In their case, the researchers suggest an extensive copper recycling program in order to build a less resource intensive local network infrastructure. My work is situated within this literature to address questions of environmental and social justice within computing research.

Within the field of human-computer interaction (HCI), this topic of materiality has largely been examined through studies on e-waste and repair. Repair as a practice and waste as a material are used to examine relationships between people and objects throughout contexts that span art-making, amateur fix it clinics, repair shops around the world, remote rural communities, and design studios [8, 18–20]. Central to this work is a conceptual reframing of breakdown. Rather than viewing breakdown of technologies as singular or discrete, Houston et al. suggests that “breakdown is everyday, rather than exceptional, and that the recuperative processes of repair are central to the maintenance of social orders across time” [18]. In my project, I build on this view of breakdown, where the impacts of climate change, although punctuated by extreme events, also unfolds at a daily pace. This framing provides us a way to understand how maintenance of network infrastructures aligns or mismatches with the impacts of climate change.

4 SPECIFIC RESEARCH QUESTIONS

My research project addresses the following questions:

How and to what extent are histories of extraction and regional infrastructural development reflected in current network infrastructures?

How are practices of maintaining and expanding network infrastructures in vulnerable coastal communities shifting to respond to the impacts of climate change?

What are alternative approaches to maintaining and expanding network infrastructures in vulnerable coastal communities?

5 RESEARCH PROGRESS TO DATE

I conducted preliminary fieldwork research between November 2020 to June 2021 following all necessary COVID-19 restrictions. During this time, I conducted initial interviews and participant observation that informed the development of my dissertation research proposal. I am currently preparing for fieldwork research

that will take place in south Louisiana between January – September 2022.

Additionally, I have completed all requirements in my PhD program for candidacy, which includes completing relevant doctoral coursework in preparation of research. Since Fall 2020, I also have gained significant research experience in my role as a Graduate Research Assistant for NSF #1955125: Understanding and Improving the Social Impact of High-Bandwidth Farm Networking Infrastructure, advised by Dr. Phoebe Sengers. On this project, I conduct ethnographic research and analysis, in addition to fulfill project management responsibilities.

6 RESEARCH APPROACH, METHODS, AND RATIONALE

I employ archival, ethnographic, and design methods to address my research questions. My approach to studying network infrastructure in coastal communities builds on Susan Leigh Star’s description that infrastructures are “both relational and ecological,” where ‘relational’ points to how different groups understand and interact with infrastructures, while ‘ecological’ refers to how infrastructures are inseparable from “actions, tools, and the built environment” [34]. I further Star’s meaning of ‘ecological’ by looking beyond the built environment to consider how network infrastructures are inseparable from the effects of climate change and longer histories of land use. As fiber optics are buried underground and cell towers are constructed on sinking land, my research examines how network infrastructures are embedded into existing ecologies.

To examine the historical dimensions of extraction and infrastructure development, I use archival methods, document analysis, and secondary sources. I focus on legacies of plantation and oil economies as a catalyst for both environmental change and infrastructural development in south Louisiana. Using the archival data I collect, I will construct an interactive digital map to examine historical patterns of infrastructure development. I will design this artifact in a manner that reflects the temporal and spatial aspects of our data. To examine the extent of how these historical developments are reflected in current network infrastructures, I will add additional layers of data that shows broadband access using available data from organizations like the Census Bureau, FCC, and NTIA. Throughout our research, this map will evolve and serve as a tool for our ethnographic and design research analysis.

To address my research question on practices of maintenance and network expansion, my study uses ethnographic methods such as participant observation and semi-structured interviews with people involved in the maintenance and development of network infrastructures, in addition to the people who use these networks. Participants involved in the maintenance and deployment of network infrastructures include employees at internet service providers (ISPs) and policymakers. Participants involved in the use of the infrastructures include local residents, community organizations, and local businesses. Through this range of participants, we partake in what Biao Xiang calls multi-scalar ethnography, which is “concerned with how social phenomena . . . are constituted through actions at different scales [40]” How a local resident may attend to network infrastructure will differ from that of a local ISP or state representative. By attending to these different scales, I will build

an expanded understanding of how network infrastructures and sustained and developed.

Finally, to address alternative approaches to expanding and maintain network infrastructures in vulnerable coastal communities, I employ design research methods to imagine just and equitable possibilities of infrastructure for the region. I will facilitate these alternatives through the creating and facilitating two design research workshops with community members. The format and content of the workshop will build on results from our ethnographic and historical analysis. In these workshops, we will draw from speculative design to develop approaches for infrastructural development that addresses both environmental and social issues raised in earlier aspects of the research. Speculative design is a design approach that incorporates values and preferences that may not be present in current products [12]. In our case, we will expand upon speculative design to create speculative infrastructures, infrastructures that embody alternative values and preferences. To do so, we draw upon Wong et al.'s "infrastructural speculations," which "calls attention to the cultural, regulatory, environmental, and repair conditions that enable and surround particular future visions [39]" through a series of discussions and design activities.

Altogether, these methods are combined to gain a deep understanding of how climate change is impacting networked and digital infrastructures, and construct paths towards just alternatives.

7 RESULTS AND CONTRIBUTIONS TO DATE

The results from my preliminary fieldwork provided crucial framing for my dissertation proposal. Primarily, this work attuned my project to focus on the overlapping layers of extractive economies at play in south Louisiana as a foundation for understanding current inequalities in digital technology access.

My approach to examining historical underpinnings of digital technologies is reflected in my CSCW publication co-authored with Dr. Phoebe Sengers titled "Legibility and the Legacies of Racialized Dispossession in Digital Agriculture." This paper examines how structural racism influenced the development of agricultural technology, and the implications that this influence has for emerging digital agricultural systems. In my dissertation work, I will follow similar analytical practices that combine historical and ethnographic methods.

8 EXPECTED NEXT STEPS

The expected next steps for my research is to complete the fieldwork necessary for my dissertation project. The fieldwork for the dissertation project will take course in two overlapping phases over the course of 10 months. In the first phase, the ethnographic and historical analysis will be conducted starting from November 2021 until June 2022. Additionally, in this phase, preliminary work for the design research analysis will be conducted. Starting in January 2022, I will be located in New Orleans, allowing me to conduct interviews and participant observation at field sites in-person, pending COVID-19 concerns. New Orleans is accessible to most of my field sites within a day's driving distance. The second phase will begin in April 2022 and includes the design research analysis that will take place over the following 5 months.

9 DISSERTATION STATUS AND LONG TERM GOALS

My dissertation research is currently in progress. As outlined earlier, I am currently about to embark on dissertation fieldwork for the next year. When I conclude fieldwork in Fall 2022, I aim to have my research analysis completed and ready for my program's graduate requirements by Summer 2023. During this time, I plan to enter the job market, where my goal is to obtain a research and teaching position at an academic institution. My long-term goal is to build a research program to understand and address the intersections of environmental and digital inequality.

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