

**Tier 2 Pilot Grant Letter of Intent: Establishing Proof-of-Concept  
Winter 2025**

**Project Information**

<b>Project Title</b>	Integrating Mental Health into Urban Planning: A Pilot Study on Social Media-Expressed Helplessness During Climate Extremes
<b>Budget Request from Initiative</b>	\$50,000
<b>Budget Match (if applicable)</b>	\$10,000 - 20,000 from CSDE (to be adjusted)
<b>Total Project Budget</b>	\$60,000 – 70,000

**Applicant Information**

**Tzu-Hsin Karen Chen (Co-PI)** [kthchen@uw.edu](mailto:kthchen@uw.edu)

Assistant Professor, Department of Urban Planning and Design, College of Built Environments, and  
Department of Environmental and Occupational Health Sciences, School of Public Health

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Assistant Professor, Department of Psychiatry and Behavioral Sciences, School of Medicine

**Narjes Abbasabadi (Co-PI)** [nabbasab@uw.edu](mailto:nabbasab@uw.edu)

Assistant Professor, Department of Architecture, College of Built Environments

**Shirley Huang (Co-PI)** [eseto@uw.edu](mailto:eseto@uw.edu)

Data Scientist, Department of Environmental and Occupational Health Sciences, School of Public Health

**Mehdi Ashayeri (Co-PI)** [mehdi.ashayeri@siu.edu](mailto:mehdi.ashayeri@siu.edu)

Assistant Professor, School of Architecture, Southern Illinois University

**Edmund Seto (Senior Personnel)** [eseto@uw.edu](mailto:eseto@uw.edu)

Professor, Department of Environmental and Occupational Health Sciences, School of Public Health  
Director, UW Center for Environmental Health Equity

**Project Research Plan**

Extreme climate events are becoming more frequent and severe, posing risks to mental and emotional health. Research has shown that individuals living in poorly designed built environments are disproportionately impacted by these events, exacerbating psychological issues. For example, insufficient building setbacks may increase exposure to heat, noise, air pollution, flooding, and reduced natural lights, all of which are environmental stressors to mental health. Despite evidence linking environmental stress and mental health, urban planning and building codes largely overlook how the built environment can mitigate this impact. A major barrier to evidence-based urban planning policy is the lack of large-scale, high-resolution data capturing psychological responses across diverse built environments. Traditional methods like surveys are infrequent, costly, and lack spatial granularity. Social media platforms offer a novel opportunity to evaluate real-time emotional expression, allowing for insights into geographic and temporal patterns of psychological responses during climate extremes.

This pilot study focuses on helplessness, a psychological response characterized by perceived inability to control adverse situations, often linked to environmental disadvantage. Helplessness is a known risk factor for depression, suicide, and reduced resilience. We hypothesize that disadvantaged built environments contribute to a higher prevalence of helplessness, while resilient social and built environments (e.g., with green space and reduced stressors) may serve as protective factors.

### **Case study**

The West Coast recently experienced an extreme heat event in the summer of 2021 that resulted in over 1200 excess deaths across Washington, Oregon, and California, while even more experienced heat-related illnesses, making the June 25 – July 7 heat wave the deadliest heat event in Washington state's history (Vogel et al. 2023). We will collect two weeks' of geotagged data over the three states, as well as two other weeks in the year before in 2020 as the baseline.

### **Emotion analysis**

We will analyze helplessness patterns during extreme heat and wildfire smoke events using geotagged social media data in West Coast cities from X (formerly Twitter). Using natural language processing and machine learning, we will identify helplessness-related expressions in posts and calculate their prevalence within a geographic unit that maintains a sample size above five (e.g., block group, tract, or county). We will filter for concurrent major events and incorporate multiple baseline periods to isolate emotional patterns linked to extreme climate events. Vulnerable groups will be identified by extracting self-revealed demographic information from users' historical posts, including race/ethnicity, gender, teenagers, pregnant women, veterans, the homeless, and individuals with chronic pain.

### **Covariates**

We will estimate daily environmental exposure for each neighborhood using EPA's granular heat data. Built environment characteristics will be quantified, including setback distance using Microsoft's building footprint, green space accessibility using remote sensing data, and land use mix derived from the OpenStreetMap data. Socioeconomic factors that affect resilience, including education, income, and race/ethnicity, will be incorporated using ACS datasets. CDC's Places dataset will be used to estimate the prevalence of compounding health conditions (e.g., diabetes for heat and asthma for air pollution) at the tract level.

### **Research questions**

These combined datasets will address three questions: (i) What are the hotspots of helplessness during extreme climate events across West Coast cities relative to baseline periods? (ii) What are the associations between built environment factors and helplessness? (iii) Do these associations vary based on vulnerable and compounding health conditions? These analyses will inform resilient urban planning policies by identifying protective factors for mental health that have yet to be integrated into building and land use regulations. This proof-of-concept will support larger grant applications, including NIH R01 and the NSF Regional Resilience Innovation Incubator.

### **Appendix - References**

**Project Evaluation Plan (1-page with timeline)**

1. Measures of success
  - (1) Generate spatial patterns of emotion during a heat wave and their sociodemographic factors.
  - (2) Build an interdisciplinary team to collaborate on environmental mental health research.
  - (3) Submit a journal article on the analytical framework using social media and census data.
  - (4) Outline built-environmental factors with significant protective effects in a media report.
  - (5) Provide proof-of-concept for an NSF/NIH grant.
  
2. This pilot study will position our team to pursue future proof-of-concept projects. First, we will develop an analytical framework to explore emotions during a heat wave. The pilot study will enable feasible results within an eight-month period. These preliminary findings focusing on one single emotion – helplessness – will lay the groundwork for advancing AI-based emotion models, with broader emotional responses. Additionally, we will establish the role of the built environment and vulnerability variables in emotional responses, which will enable further studies on factors of the built environment. While social media data captures a certain demographics in the total population, this study will layout the foundation for identifying demographic characteristics in Tweeter users at an aggregated level.

**Project Timeline**

Milestone	Months			
	1-3	4-6	7-9	10-12
Collect Twitter data, temperature, built environment, and sociodemographic data				
Train an AI model to measure helplessness in tweets				
Evaluate spatial distribution of helplessness before and during heat waves (Q1)				
Assess built environment factors of helplessness (Q2)				
Identify how built environment factors vary by vulnerability characteristics (Q3)				
Write a manuscript				

**Biographies (limit of 250 words per I)**

**Dr. Tzu-Hsin Karen Chen** is an Assistant Professor of Urban Design and Planning and Environmental & Occupational Health Sciences at the UW. Her research focuses on urban planning and mental health inequality, and how climate-related hazards mediate this process. She finds great interest in the synergy of machine learning and satellite imagery analysis in assisting environmental health research.

**Dr. Marianna Gasperi**

Assistant Professor, Department of Psychiatry and Behavioral Sciences, School of Medicine. Her research focuses on chronic pain and mental illness for vulnerable population, such as women veterans. She also studies environmental exposure and lack of infrastructure support lead to higher risk in pains.

**Dr. Narjes Abbasabadi** is an Assistant Professor of Architecture at the UW. Her research focuses on developing multidisciplinary computational methods and technologies to aid designers and policymakers in addressing critical societal challenges, particularly climate change. She works on advancing data-driven AI techniques to investigate human systems and environmental impacts.

**Dr. Shirley Huang** is a Data Scientist at the Department of Environmental and Occupational Health Sciences. Dr. Huang has background in computer science and exposure assessment.

**Dr. Mehdi Ashayeri** is an Assistant Professor in the School of Architecture at Southern Illinois University. His research is centered on environmental performance and their implications for human health and justice. This involves developing frameworks, tools, and digital platforms using data-driven techniques, such as natural language processing and social media data analysis.

**Senior personnel**

**Dr. Edmund Seto** is Professor of Environmental and Occupational Health Sciences and Director of UW Center for Environmental Health Equity. Dr. Seto has a background in Computer Science and Exposure Science and combines work in these two fields to examine large complex data related to environmental exposures and their relationships to population health.

### Project Budget

	Requested from Initiative	Funding Match
<b>Salaries</b>		
Faculty	\$31,715	\$2,646
Staff	0	
Student/Postdoc/Research scientists	\$6,480	
<b>Benefits</b>		
Based on Payroll Load Rate in Effect	\$11,805	\$659
<b>Supplies and Materials</b>	0	\$20,000
<b>Equipment</b>	0	0
<b>Tuition</b>	0	0
<b>Other</b>	0	0
<b>Total Direct Costs</b>	<b>\$50,000</b>	<b>\$23,305</b>

### Budget Justification

#### Personnel

**Dr. Chen** (0.063 FTE) will be responsible for overall project management, leading the environmental exposure component, supporting the built-environment component, driving an interdisciplinary publication with team, and developing future grants.

**Dr. Gasperi** (0.063 FTE) will be responsible for conceptualizing the connection between social media expressions and mental well-being, designing, validating, and refining the model of emotion detection.

**Dr. Abbasabadi** (0.063 FTE) will be responsible for leading the built environment component and support Twitter data collection component.

**Dr. Huang** (0.063 FTE) will be responsible for analyzing individual- and neighborhood-level vulnerability characteristics, as well as supporting analysis with epidemiological approaches.

**Dr. Ashayeri** (0.063 FTE) will be responsible for designing the emotion analysis along with the psychology input from Dr. Gasperi. He has also developed an online tool that can minimized bot data during Twitter data collection and thus maximize the data that are associated with residents and their well-being.

#### Senior Personnel

**Dr. Seto** (0 FTE) will serve as an advisory role in support of conceptualizing the sociodemographic disparity in emotion response to heat.

#### Personnel from Chen's Start-up Matching Fund

**Dr. Chen** (0.02 FTE) will match additional 0.02 FTE using her start-up fund for her role in managing and coordinating different components in this interdisciplinary project.

**Supplies and Materials from CSDE's Matching Fund**

**Twitter data** (\$20,000): Center for Studies in Demography and Ecology will support 4 million geo-tagged tweets within Washington, Oregon, and California, during and before heat waves.

**Letter of Support**

We are planning to invite two letters of support:

Dr. Seto's letter of support as 0 FTE senior personnel

CSDE's letter of support in data storage and study design feedback