***Neighborhood-scale Climate Adaptation***

***Improving Community Resilience to Urban Heat Stress and Air Pollution***

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**Abstract**

Planning organizations throughout the United States are attempting to mitigate and adapt to the imminent consequences of a warming planet. Cities pose an immediate threat to and opportunity for improving the capacity for socio-ecological resilience to climate-induced impacts to citizens, businesses, and society at large. Indeed, with the majority of humans now living in urban areas, a critical policy and planning mandate is to develop effective approaches to reducing emissions of climate warming gases, and ameliorating the impacts to those most impacted by climate change, particularly extreme weather events. While mitigation of green house gases (GHGs) is well underway by many cities in the Western Hemisphere, adaptation strategies are only emerging (Adger, 2006). Moreover, there are mechanisms of planning and policy that directly reduce the implications to the health and welfare impacts of climate change on urban citizens, and especially those who are least able to cope with extreme climate events (e.g. flooding, urban heat islands, tropospheric ozone, etc.). To address these challenges, planning organizations seek to understand approaches effective in reducing vulnerability and improving resiliency of local communities.

Understanding urban space with the socio-ecological system model, our paper assesses human vulnerability to heat stress and degraded air quality (Cutter et al. 2006). Our work entailed engagement of local planners, community organizers, and researchers in a process of *co-production of knowledge* that paired a local university with regional stakeholders. Few studies combine a collaborative and participatory model with data-intensive mapping exercises that forecast the social, environmental and economic impacts of alternative spatial options. To ground our approach we examined conceptual descriptions of vulnerability and the extent to which human communities are impacted by urban heat stress and degraded air quality. Our efforts focus on the formally adopted ‘Climate Action Plan for the City of Portland, Oregon, a municipality known for having written the first climate plan in the United States, and for its continued development of approaches focusing on adaptation. Cognizant of three dimensions of vulnerability – exposure, sensitivity, and adaptive capacity – we engage local stakeholders in assessing Portland neighborhoods, sub-systems of the urban socio-ecological system, for climate-induced stressors of urban heat, land-use and urban form specific to air quality, interaction of the two, and specific ‘hot spot’ neighborhoods experiencing both McLaughlin and Dietz, 2008).

We integrate data from stakeholder workshops with empirically derived high-resolution urban heat island geography with corresponding air quality assessments, as well as datasets describing the socio-demographic and built environments. The resulting map series provides an intra-urban comparative perspective, then further integrated with relevant land use, land cover, transportation, and other data through a regression-tree analysis to identify specific stressors by neighborhood. The identification of neighborhood-scale stressors, for example, urban heat islands within socially vulnerable areas, enables stakeholders to gain leverage for adaptive strategies in the short- and long term. The results are captured in an interactive, web-based tool, which allows individuals, communities, and relevant public and private organizations to query and assess the urban heat and air quality of a specific neighborhood. We conclude with discussion of the organizing principles that enabled a co-production model to be implemented in the Portland region. Although our paper focuses on Portland, the process we have developed for engaging researchers and planners is generally applicable, as are our findings.

As an ultimate outcome of this project, we intend for community resilience plans to usher in an adaptive future wherein human well-being in cities is not only protected, but also improved, in the face of intensifying climate hazards. A practical and conceptual turn that portends this development is a “monitoring and phasing” (ibid.) approach to adaptation planning. Namely, in a recent paper, Abunassr and colleagues (2015\_ argue that adaptation planning should deploy mechanisms of monitoring and phasing in order to overcome barriers of temporal uncertainty in climate change forecasting. In their prescriptions on planning, they center “no-regrets” policy options that address an immediate need and also incrementally rebuild social and physical infrastructure that recursively improves adaptive capacity.

The output of the first phase of our co-productive effort yielded synthesized, visually comprehensible, and geographically specified analysis of the factors of vulnerability as conceptualized by expert stakeholders. We recognize, however, that even with the multiplicity of data used to create them, these maps reduce the landscape to readily measurable dimensions and cannot describe the phenomenon as experienced by human subjects. As suggested by the heterogeneity of patterns by which vulnerability, or more accurately, its risk factors, presents itself on the city’s socio-ecological landscape, there is wide variety in the mechanisms by which vulnerability operates as a phenomenon. It is impossible to make informed decisions on planning for resilience without understanding the diverse means by which vulnerability presents socio-ecological problems in human experience.

**References**

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