Developing a model for effects of climate change on human health and health-environment interactions: heat stress in Austin, Texas

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Abstract

Human health and well-being are and will be affected by climate change, both directly through changes in extreme weather events and indirectly through weather-induced changes in human and natural systems. Populations are vulnerable to these changes in varying degrees, depending on characteristics such as age, health status, genetic background, economic status, as well as access and proximity to social and health support. Both climate change impacts and the effectiveness of mitigation and adaptation decisions will depend on the patterns of climate stressor exposure and population vulnerability at local scales. The complexity of these interactions calls for the development of scenario modeling tools, based on systems thinking approaches which are applied in spatially-temporally explicit frameworks. The goal of this study was to develop and apply a broadly applicable modeling and support platform for decisions at the local scale that consider potential climate change health effects and the effectiveness of mitigation options.

An initial prototype model of climate change effects on human and natural systems was developed to specifically predict heat stress morbidity and mortality in Travis County, Texas (Austin and vicinity). The model was developed in a manner which will allow it to be readily adapted to other locations and health endpoints as well. The model followed the logical steps: (1) determine spatial and temporal variation in hazard exposure; (2) analyze spatial variation in population vulnerability to hazards; (3) estimate health outcome risk for population groups through hazard exposure and hazard response functions; (4) examine how mitigation options may affect health outcomes and their links to other ecosystem services. In demonstration runs greater heat stress effects were predicted in the urban core and in populations with higher risk factors such as low income, older ages, and pre-existing medical conditions. Scenarios of increased urban tree cover to promote greater shading and evaporative cooling were examined as examples of mitigation options for model analysis.

Key words: climate change, human health, heat stress, model, urban heat island, Austin