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ORIGINAL PAPER

Mapping vulnerability to climate change-related hazards: children at risk in a US–Mexico border metropolis

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Abstract There are significant human impacts associated with climate change. This paper introduces a model for identifying small area risks associated with children's vulnerability to climate change-related hazard exposures, which is transferable to other regions and adaptable to varied population and exposure scenarios. The cross-national El Paso-Ciudad Juárez (US-Mexico) metropolis serves as the study area for model implementation, which involves mapping social vulnerability, hazard exposure, and cumulative climate change-related risks. This study addresses two limitations of extant fine-scale climate change vulnerability mapping

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studies. First, rather than focusing on one exposure variable, it assesses the combined risks of multiple exposures (extreme heat, peak ozone, and floods) and, thus, offers a model for mapping neighborhood-level cumulative climate change exposure risks. Second, it provides a model for small area spatial analyses of climate change vulnerability within low-/middle-income countries and in contexts where climate change risks (and appropriate responses) are cross-national in scope.

Keywords Climate change · Vulnerability · Hazard · Risk · Children · GIS · US–Mexico border

Introduction

Global climate change is an increasingly pressing environmental and public health concern. Major human health impacts of climate change are anticipated to occur in the coming decades due to changes in the environment, including increased heat, changes in precipitation regimes, and degraded air quality. For the western US–Mexico border region, the Intergovernmental Panel on Climate Change (IPCC) (2007a) projects temperature increases of 3–5°C by 2100, with possible decreases of 5–8% in precipitation. Regional variability appears to be increasing so that even though some areas will experience drought, extreme precipitation events will become more common (IPCC 2007a). As a result, extreme heat, air pollution, and flood events are expected to increase in frequency and intensity (Ebi and McGregor 2008; Portier et al. 2010). Research to assess and characterize population vulnerability to adverse impacts due to climate change has been identified as critically important (Portier et al. 2010). Certain US–Mexico border populations are expected to be more vulnerable to climate change risks, including children, pregnant women, the elderly, people of low socioeconomic status, and residents of large cities (Portier et al. 2010). However, little research has focused on the potential fine-scale (e.g., within a city) impacts of climate change on vulnerable populations in cross- or bi-national contexts. The identification of risk factors for those most vulnerable to adverse effects at the US–Mexico border is needed to reduce and prevent illness and death, and improve quality of life for residents.

This paper presents a spatial approach to characterizing social and biophysical dimensions of children's risk to climate change at the neighborhood level within a large and rapidly urbanizing area spanning the US–Mexico border: El Paso-Ciudad Juárez (EPCJ). It provides a model for small area spatial investigations of

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