World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:14, No:07, 2020

# Empirical Modeling and Spatial Analysis of Heat-Related Morbidity in Maricopa County, Arizona

**Authors :** Chuyuan Wang, Nayan Khare, Lily Villa, Patricia Solis, Elizabeth A. Wentz

**Abstract :** Maricopa County, Arizona, has a semi-arid hot desert climate that is one of the hottest regions in the United States. The exacerbated urban heat island (UHI) effect caused by rapid urbanization has made the urban area even hotter than the rural surroundings. The Phoenix metropolitan area experiences extremely high temperatures in the summer from June to September that can reach the daily highest of 120 °F (48.9 °C). Morbidity and mortality due to the environmental heat is, therefore, a significant public health issue in Maricopa County, especially because it is largely preventable. Public records from the Maricopa County Department of Public Health (MCDPH) revealed that between 2012 and 2016, there were 10,825 incidents of heat-related morbidity incidents, 267 outdoor environmental heat deaths, and 173 indoor heat-related deaths. A lot of research has examined heat-related death and its contributing factors around the world, but little has been done regarding heat-related morbidity issues, especially for regions that are naturally hot in the summer. The objective of this study is to examine the demographic, socio-economic, housing, and environmental factors that contribute to heat-related morbidity in Maricopa County. We obtained heat-related morbidity data between 2012 and 2016 at census tract level from MCDPH. Demographic, socio-economic, and housing variables were derived using 2012-2016 American Community Survey 5-year estimate from the U.S. Census. Remotely sensed Landsat 7 ETM+ and Landsat 8 OLI satellite images and Level-1 products were acquired for all the summer months (June to September) from 2012 and 2016. The National Land Cover Database (NLCD) 2016 percent tree canopy and percent developed imperviousness data were obtained from the U.S. Geological Survey (USGS). We used ordinary least squares (OLS) regression analysis to examine the empirical relationship between all the independent variables and heat-related morbidity rate. Results showed that higher morbidity rates are found in census tracts with higher values in population aged 65 and older, population under poverty, disability, no vehicle ownership, white non-Hispanic, population with less than high school degree, land surface temperature, and surface reflectance, but lower values in normalized difference vegetation index (NDVI) and housing occupancy. The regression model can be used to explain up to 59.4% of total variation of heat-related morbidity in Maricopa County. The multiscale geographically weighted regression (MGWR) technique was then used to examine the spatially varying relationships between heat-related morbidity rate and all the significant independent variables. The R-squared value of the MGWR model increased to 0.691, that shows a significant improvement in goodness-of-fit than the global OLS model, which means that spatial heterogeneity of some independent variables is another important factor that influences the relationship with heat-related morbidity in Maricopa County. Among these variables, population aged 65 and older, the Hispanic population, disability, vehicle ownership, and housing occupancy have much stronger local effects than other variables.

**Keywords :** census, empirical modeling, heat-related morbidity, spatial analysis
**Conference Title :** ICCCUR 2020 : International Conference on Climate Change and Urban Resilience
**Conference Location :** Prague, Czechia
**Conference Dates :** July 09-10, 2020