



Assessing Urban Heat-Stress Risk Under Future Climate Scenarios: A Case Study of Vilnius, Lithuania

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Climate change is altering the frequency, intensity, and spatial patterns of extreme weather events. Urban areas are particularly affected because population, critical infrastructure, and economic assets are concentrated in a relatively small area, which increases the potential impacts of extreme events. Climate risk depends not only on the hazard itself, but also on what is exposed and how sensitive it is to the damage. Understanding climate risk requires considering how hazards interact with exposure and vulnerability. For this reason, risk-based approaches are increasingly needed to support climate adaptation and decision-making. The increasing availability of open-source tools, including the CLIMADA model, has made climate risk assessment more accessible. This study applies the CLIMADA risk assessment framework to evaluate urban heat-stress risk in Vilnius, Lithuania.

The analysis focuses on heat stress as an illustrative case to examine potential impacts on human health under three levels of global warming: the recent past, +2 °C, and +4 °C relative to pre-industrial conditions. Climate hazards are characterised using projections from climate models, and uncertainty in future conditions is represented through an ensemble of simulations. This ensemble consists of five CMIP6 models: CanESM5, ACCESS CM2, GFDL-CM4, MPI-ESM1-2-LR, and NorESM2-MM. Heat-stress intensity affecting people is quantified using the Humidex index, which is calculated from gridded air temperature and relative humidity data and used as the hazard intensity in the risk assessment. Exposure is defined as the spatial distribution of people and relevant assets. Because this study focuses on heat-stress risks to human health in urban areas, exposure is characterised using a set of socio-demographic and urban indicators, including population distribution, age structure, the locations of critical infrastructure, and urban surface characteristics. Vulnerability describes how sensitive exposed people or assets are to the hazard and is represented through vulnerability functions. In this analysis, vulnerability is expressed through the mean damage degree and the percentage of affected assets, which are used together to estimate the mean damage ratio.

Preliminary results are presented as risk maps showing the spatial distribution of heat-related health risk in Vilnius under different climate change scenarios. This spatial information supports the identification of priority areas for adaptation planning and risk reduction.