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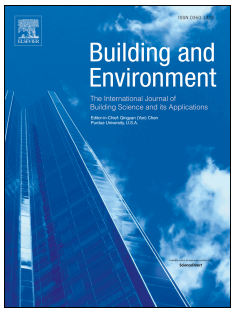

Forecasting indoor temperatures during heatwaves using time series models

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Forecasting indoor temperatures during heatwaves using time series models

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Abstract

Early prediction of impending high temperatures in buildings could play a vital role in reducing heat-related morbidity and mortality. A recursive, autoregressive time series model using exogenous inputs (*ARX*) and a rolling forecasting origin has been developed to provide reliable short-term forecasts of the internal temperatures in dwellings during hot summer conditions, especially heatwaves. The model was tested using monitored data from three case study dwellings recorded during the 2015 heatwave. The predictor variables were selected by minimising the Akaike Information Criterion (*AIC*), in order to automatically identify a near-optimal model. The model proved capable of performing multi-step-ahead predictions during extreme heat events with an acceptable accuracy for periods up to 72 hours, with hourly results achieving a Mean Absolute Error (*MAE*) below 0.7°C for every forecast. Comparison between *ARX* and autoregressive moving average models with exogenous inputs (*ARMAX*) models showed that the *ARX* models provided consistently more reliable multi-step-ahead predictions. Prediction intervals, at the 95% probability level, were adopted to define a credible interval for the forecast temperatures at different prediction horizons. The results point to the potential for using time series forecasting as part of an overheating early-warning system in buildings housing vulnerable occupants or contents.

Keywords: time series forecasting; machine learning; black-box model; predictive model; ARX model; heatwave.

Declarations of interest: none

1. Introduction

1.1. Background

Overheating in homes and residential care facilities is increasingly acknowledged as a serious problem for developers, property owners/managers, landlords, tenants, health care providers and policy makers [1–3]. Climate change projections indicate that the majority of the world's most populated regions will experience more frequent and more intense heat wave periods over the coming decades [4,5]. Warmer than average summers coupled with an increased frequency of extreme heat wave events [6] pose obvious risk factors in relation to overheating in the built environment.