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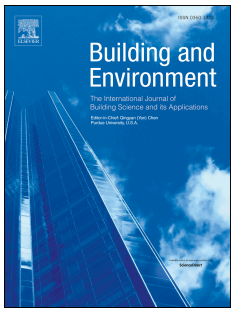


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# Probabilistic adaptive thermal comfort for resilient design

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## Abstract

Adaptive thermal comfort theory has become the bedrock of much thinking about how to judge if a free-running environment is suitable for human occupation. In design work, the conditions predicted by a thermal model, when the model is presented with one possible annual weather time series (a reference year), are compared to the limits of human comfort. If the temperatures are within the comfort limits, the building is judged to be suitable. However, the weather in many locations can vary year-on-year by a considerable margin, and this begs the question, how robust are the predictions of adaptive comfort theory likely to be over the many years a building might be in use? We answer this question using weather data recorded for up to 30 years for locations within each of the five major Köppen climate classifications. We find that the variation in the annual time series is so great that the predicted comfort temperature frequently lies outside the acceptable range given by the reference year. Return periods for the excursions of the time series are calculated for each location. The results for one location are then validated using the world's longest temperature record. These results suggest that industry and academia would be best advised to move to a probabilistic methodology, like the proposed one, when using adaptive comfort theory to judge the likely conditions within a building. Extra pertinence is provided by concerns over increases in mortality and morbidity in buildings due to a rapidly warming climate.