# Thermal resilience performance of personalized environmental control systems (PECS) in a multi-occupied office

Douaa Al-Assaad

*KU Leuven, M3-BIORES group, Department of Biosystems*
*30 Kasteel Arenberg,*
*3001 Heverlee, Belgium*

## ABSTRACT

Across disciplines, resilience was defined as “a performance characteristic that describes the extent to which a system can absorb sudden disruptive events, withstand its effects within an acceptable degradation range, and recover from it back to its designed performance within a suitable time”. In the framework of indoor environmental quality (IEQ), this refers to the ability of a building and its systems to maintain the thermal, indoor air quality, acoustic and visual quality of the environment that will eventually determine the physiological and psychological resilience responses of occupants. When it comes to understanding and improving thermal resilience, current literature has focused on manipulating building system and envelope designs (window to wall ratio, thermal mass, shading, passive cooling) with the rough assumption that the impacts of such interventions will be uniform and instantaneous across the built environment. However, indoor flow fields are complex and highly non homogenous, and “total-volume” interventions can have a slower response time. This can overestimate the improvement in occupant-level resilience. Thus, resilience has strong temporal and spatial dependencies and would benefit from occupant-centric strategies that could create habitable personal zones regardless of the background environment. A potential solution lies in personalized environmental control systems (PECS) where the asymmetrical conditions created around the person could even shift the personal zone from habitable to even comfortable. The aim of this work is to assess through computational fluid dynamics (CFD) simulations pseudo-coupled to thermoregulation and comfort models, the thermal resilience performance of personalized environmental control systems (PECS), particularly personalized ventilation and chair fans, during an overheating event in a typical office environment caused by a failure of the cooling system. Compared to mixing ventilation, PECS contributed to a lower cumulative degree. hours and faster recovery rates and in turn reduced discomfort across the heat period. This shows their potential as a mitigating strategy during heat stress events in multi-occupied spaces.

## KEYWORDS

Thermal resilience, personalized environmental control systems (PECS), computational fluid dynamics (CFD), cooling system failure