Outline

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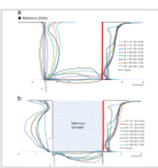
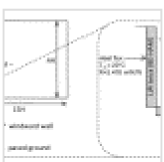
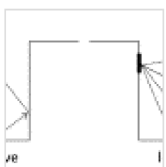
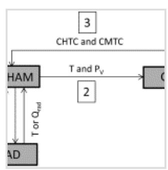
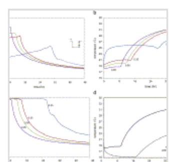
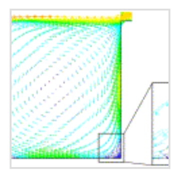
Figures (7)

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Tables (1)

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Coupled CFD, radiation and porous media transport model for evaluating evaporative cooling in an urban environment

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Abstract

Urban heat islands affect the energy use for cooling in an urban environment, as well as human comfort and health. Water evaporation from moist surfaces could potentially reduce the local temperature in urban areas, a process known as evaporative cooling. This paper introduces a coupled model to study the effect of evaporative cooling on the temperature conditions in an urban street canyon. A computational model for determining convective heat and mass exchanges between the canyon walls and the air is proposed. The model couples three sub-models: (i) a Computational Fluid Dynamics (CFD) model, which solves heat and vapor transfer in the air, (ii) a Building Envelope Heat and Moisture (BE-HAM) transport model which solves heat and moisture transfer within the porous building walls and (iii) a radiation model (RAD) which determines the radiative heat exchange between the surfaces. An efficient coupling strategy has been developed and applied to investigate the drying of a wet windward wall of a street canyon. The effect of evaporation on the reduction of the surface and air temperatures in a street canyon is analyzed and the influence of these temperature reductions on the Physiological Equivalent Temperature (PET) is shown to be important.

Highlights

► A Coupled model to study effect of evaporative cooling in urban area is proposed. ► Drying of a wet porous windward wall in a street canyon is studied. ► Results show lower air temperature in the street canyon due to evaporation. ► Lower air temperature is shown to result in higher comfort level in the canyon.

Keywords

Convective heat transfer coefficient; Convective mass transfer coefficient; Drying of porous media; Evaporative cooling potential; Street canyon; CFD; Radiation; Thermal comfort; PET

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