A numerical insight into the hygrothermal buffering capacity of earthen building materials

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Summary

Raw earth is emerging as a viable building material with a lower carbon footprint than conventional concrete and fired bricks. Raw earth is an excellent passive hygrothermal regulator, which improves occupants' comfort while reducing the need for active heating/cooling. Modelling the coupled hygrothermal behaviour of earthen materials is however highly complex and requires the introduction of some simplifying assumptions. The degree of hygrothermal coupling depends on the chosen equations of moisture and heat transfer including the specific forms of the water/ vapour permeability functions and retention law. The influence of these assumptions is here investigated via a simple one-dimensional transfer model, which simulates the behaviour of an earth wall subjected to time-dependent cycles of temperature and relative humidity on the two faces. Results show that the complexity of the governing equations can be greatly reduced by neglecting the variations of vapour mass and the dependency of suction on temperature without losing accuracy. In addition, the moisture buffering capacity of the material strongly depends on the liquid permeability which, in turn, is a function of both saturated permeability and water retention properties. Keywords: earthen building material, moisture buffering, hygrothermal porous material model, raw earth.