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The difference between building anthropogenic heat flux and building energy consumption

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Buildings are a major source of anthropogenic heat emissions, impacting energy use and human health in cities. The difference between building energy consumption and building anthropogenic heat emission magnitudes and time lag and are poorly quantified. Energy consumption (Q_{EC}) is a widely used proxy for the anthropogenic heat from buildings ($Q_{F,B}$). Here we revisit the latter's definition. If $Q_{F,B}$ is the heat emission to the atmosphere due to human activities within buildings, we can derive it from the changes in energy balance fluxes between occupied and unoccupied buildings. Our derivation shows the difference between Q_{EC} and $Q_{F,B}$ is attributable to a change in the storage heat flux induced by human activities (ΔS_{o-u0}). Using building energy simulation (EnergyPlus) we calculate the energy balance fluxes for an isolated building with different occupancy states. The non-negligible differences in diurnal patterns between $Q_{F,B}$ and Q_{EC} caused by thermal storage. With this definition negative $Q_{F,B}$ can occur as human activities reduce heat emission from buildings but are associated with a larger storage heat flux. Building operations (e.g., open windows, use of HVAC system) modify the $Q_{F,B}$ by affecting not only Q_{EC} but also the ΔS_{o-u0} diurnal profile. This study demonstrates the difference between $Q_{F,B}$ and Q_{EC} and the proposed new method for estimating $Q_{F,B}$ could provide data for future parameterization of both anthropogenic heat and storage heat fluxes from buildings.