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Is the neighbourhood a level suited to the thermal evaluation of energy loss from buildings?

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Abstract:

Pursuant to the Kyoto Protocol, France is committed to reducing its greenhouse gas emissions four-fold (MEDDE, 2013). To fulfil this commitment, the French government has established a legislative and regulatory environment to ensure the contribution of France's local government bodies to the reduction of greenhouse gas emissions (Chanard et al., 2011). This transfer of responsibility for energy action to the local level (Theys and Vidalenc, 2011; Bertrand and Richard, 2014) has to be built on quantified goals (Godinot, 2011) and comprehensive action based on three levels of public intervention: exemplarity of public assets and services, public policies and outreach (Chanard et al., 2011). However, public action at local level stumbles across the difficulty of working on the real energy efficiency of urban forms at the level of the city – and not simply that of a building or block (Maïza, 2007; Arantes et al., 2016).

The modelling and mapping of energy losses offer a tangible quantitative aid to support cities in their decision-making.

Thermal modelling of a built environment is traditionally carried out at urban level, based on macro-economic input data or the typology of buildings (Kavgic et al., 2010), or at building level, based on physical, empirical or statistical data (Magyari et al., 2016, Crawley et al., 2001)). It still has many limitations that need to be addressed. Use of aerial thermography at urban level provides an overview of heat losses from the built environment and is a useful tool in raising residents' awareness of the importance of isolating their homes. However, it does suffer from a number of biases and limitations, and ultimately acts more as a catalyst for precise, expensive studies at building level (Molines et al., 2017).

Between these two levels, the neighbourhood level could produce relatively precise simulations at a reasonable cost. There are various means of tackling this level. These methods are be more or less complex, long and costly to implement and, of course, more or less precise. Here we present the results of a comparative analysis of three methods: one at urban level and two at neighbourhood level (with and without precise thermal data). The aims include checking whether the neighbourhood is a suitable level for thermal study of the build environment with a view to convincing users to carry out energy renovation work. At neighbourhood level, various levels of precision will be provided for simulations, in order to assess the replicability of the studies carried out under more or less simplistic hypotheses.

The simulations will be carried out based on a model combining various software packages (GIS, BIM, thermal simulations) and different data acquisition levels.

The reliability of the results will be given critical consideration. Uncertainties will be considered alongside the potential use of the method by local governments (input data required, development time for the model, cost, etc.).

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