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Dynamic Anthropogenic actiVities and feedback to Emissions (DAVE): – An agent based model for heat and exposure to other anthropogenic emissions

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Two thirds of global energy consumption, and over 70% of CO2 emissions came from urban areas in 2020, when 56% of the global population lived in towns and cities. It is predicted that further rapid urbanization will lead to almost 70% of the world's population living in urban areas by 2050 (https://www.iea.org/reports/world-energy-outlook-2021). Therefore, for future energy and climate predictions it is key to model urban climates accurately. Modelling urban climates creates several challenges and considerations, including the additional term in the surface energy balance of anthropogenic heat flux (Q_F). These heat emissions linked to people's activities vary with human/animal metabolism, transport, and energy consumption within buildings.

Here, a bottom-up approach is taken to model Q_F accounting for both urban form and function allowing a dynamic response to a wide range of factors. The model DAVE (Dynamic Anthropogenic actiVities and feedback to Emissions), informed by a predecessor (DASH, https://doi.org/10.5194/gmd-13-4891-2020), is coupled to a surface energy balance model (e.g., SUEWS, https://doi.org/10.1016/j.jhydrol.2011.10.001), a building energy model (STEBBS, https://doi.org/10.5194/gmd-13-4891-2020) and a transport model (MATSDA). Extensive data mining provides the inputs for the building and transport modules (Hertwig et al. 2023 – this meeting), for the cities simulated. People's dynamic behaviour is informed by probabilities derived from time use surveys (https://doi.org/10.5255/UKDA-SN-8128-1). Combined, the impacts of energy use and exposure in different environments are simulated for both places and people as daily activities occur.

Examples of applications of how the coupled modelling system can be used are to:

- model the exposure of people to air pollution and heat, for example those from different age or neighbourhood cohorts
- model dynamics of energy demand across urban regions.

- simulate feedbacks between weather and climate on intra-neighbourhood Q_F emissions

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