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## Integrated assessment model-driven 1-km anthropogenic heat emission generation tool

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To understand the impact of cities on the global climate, the level of representation of cities across time and space in climate models is crucial. Global spatiotemporally-varying anthropogenic heat emission (AHE) datasets are essential in urban climate modeling, urban climate-change investigations, and coupled building-energy model development. This work aims to develop an open-source tool for users to generate present and CMIP-consistent projections of AHE datasets at 1-km resolution. To obtain CMIP6-consistent projections of AHE maps at 5-year intervals from 2020, a workflow is constructed based on the following components: (1) top-down AH model, (2) an integrated assessment model (IAM), (3) 1-km scenario-based projections of population, (4) monthly statistics of daily temperature projections. The workflow begins by generating regional-level energy consumptions from the Global Change Analysis Model (GCAM), one of the IAM's used to develop the Shared Socioeconomic Pathways (SSP) in the Coupled Model Intercomparison Project. The modeled projections of energy consumption components are then allocated to countries based on their energy intensity, which relies on GDP data from GCAM and World Bank. They are then utilized as inputs in the AH4GUC model, the base model for mapping the AHE based on the top-down approach. Combining existing global projections of population, heating-degree/cooling-degree days projections, global road network datasets, and satellite datasets, 1-km projections of AHE are achieved.

