Sustainable Cities: Socioeconomics, Building Types, and Urban Morphology

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In urban environments, demographic, and infrastructural characteristics co-evolve and together determine risks, vulnerability and resilience. Infrastructure systems such as energy and water determine many environmental risks and provide access to various essential services. These risks and benefits are transferred across long distances and differentially across demographic and socioeconomic subgroups. Additionally, urban environments have significant effects on public health and population level resilience, especially to extreme events such as heat waves. However, interactions among urban microclimate, urban morphology, socioeconomic heterogeneity, and anthropogenic activities are not well understood. To begin to understand these interactions, our team has developed three new datasets for the Las Vegas Metropolitan Statistical Area, and we challenge the participants to combine these data sets (and other relevant data of participants' choosing) to answer our challenge questions.

We look forward to presentations using novel methods for interpreting and visualizing this data that draw on machine learning and other big data techniques, and we welcome new collaborations to complement the work of understanding how current and future neighborhood morphological patterns can contribute to the development of smart and sustainable cities.

- Microsoft building shapefile dataset. Data type: ESRI shapefile (size: 4378MB). https://www.arcgis.com/home/item.html?id=3b0b8cf27ffb49e2a2c8370f9806f267

- Building archetypes for the city based on an open-source aggregation scheme that reflects the statistical occurrence of each building type in the city including estimates of building use type, number of stories or building height, total floor area, and year built for each building/parcel. Data type: csv (size: 160MB).
  Data available from: https://zenodo.org/record/4552901#.YDfE4thKjzM
  Visualization available from: https://evenstar.ornl.gov/autobem/virtual_vegas/

- Census block group summaries of building characteristics pertaining to construction type and quality, parcel layout, lot value, and numerous home characteristics, i.e., economic characteristics associated with building size and shape in each block group. Data type: csv (size: 6.69MB).
  Data DOI: 10.13139/ORNLNCCS/1772222. https://doi.ccs.ornl.gov/ui/doi/328

- Census tract level files containing 100m resolution urban parameters for each 5m vertical level. Parameters include frontal area density, plan area density,

roof area density, mean building height, building surface to plan area ratio, complete aspect ratio, height to width ratio, and many more. Data type: csv (size 22.7MB).
Data DOI: 10.13139/ORNLNCCS/1770306. https://doi.ccs.ornl.gov/ui/doi/323

Challenge questions:

1. How does the number and arrangement of buildings, along with the building surface to plan area ratio in a given block group relate to building construction quality and value?
2. What is the distribution of commercial, industrial, and residential buildings within each block group? Do these distributions correlate with building age? Building value? Building size?
3. Using temperature data from a source of the participant's choosing, are there locations within the city that tend to be warmer than others? How does this relate to building density and building type?
4. How does the built environment and the local scale experience of heat co-vary with socio-economic and demographic characteristics of residents?
5. Using additional data on urban landscaping (an example is here: https://koordinates.com/layer/97329-las-vegas-nv-trees/download/ but your own data finds are welcome, too), how does greenspace vary with urban temperature and demographic distribution?

References:

Joshua New, Brett Bass, Mark Adams, & Anne Berres. (2021). Model America—Clark county (Vegas) extract from ORNL's AutoBEM [Data set]. Zenodo. https://doi.org/10.5281/zenodo.