Impacts of Urban Weather on Building Energy Use

Melissa Allen-Dumas, Srinath Ravulaparthy, Kuldeep Kurte, Jibo Sanya, and Anne Berres

Recent advances in multiscale coupling of high-performance computing models are providing unique insights into how interdependent processes affect one another. Some of these processes are those uniquely observable in urban environments. This data challenge addresses questions at the intersection of the natural environment and urban infrastructure by encouraging participants to examine variations in weather and building energy use, seasonal influences, and the building types most sensitive to weather at daily, monthly, and yearly scales. The datasets for this challenge were generated under a Laboratory Directed Research and Development project aimed at examining the impact of an area's built environment on weather and energy use. Data include a year of simulated weather data taken at 15-min. intervals in a section of downtown Chicago; the latitude/longitude location for each building in the study area, each building's 2D footprint and height; and a year of building-by-building energy use simulation (EnergyPlus) data run by Joshua New, Mahabir Bhandari, Som Shrestha (ORNL, Energy and Environmental Sciences Directorate), and Mark Adams (ORNL, National Security Sciences Directorate).

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 climate, infrastructure, and energy use in urban areas from a systems perspective. The group hopes participants enjoy the interdisciplinary nature of the dataset and its challenges.

These data comprise three elements:

1. High resolution, 90 m simulated weather data for 1 year at 15 min. intervals (with known gaps toward the end of each month). These files are in .csv format.
2. A mapping of individual buildings with individual IDs, their latitude/longitude location, and height. (Excel file)
3. Energy simulation output of these individual buildings, at 15 min. intervals for a whole year. (.json and other files)

The questions that are of interest for this challenge are:

1. Are there interesting variations in the weather and building energy use data for the geographic area?
2. Which buildings in the study are most sensitive to weather (e.g., temperature, humidity, wind, radiation) effects?
3. Are there any interesting visualizations that illustrate the changing dynamics of the simulated urban environment?
4. How can the data best be divided into subsets for meaningful analysis and visualization?
5. How does energy use in each building change throughout the year?
6. How is energy use different during the coldest and hottest months (e.g., January and July) of the year as compared to during those of less extreme temperature?

Participants are welcome to bring in additional datasets to fuse with the provided data to create meaningful insights.