Urban form impact on the energy and water budget

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Research Goals

How does urban form impact water and energy use?

- Collect local energy measurements across campus
- Analyze energy and water budget data for spatial variability and the signature of different types of land cover
- Create a QUIC City builder model of the area with tree and building dimensions

Study Site

USTAR/Molecular Biology Building Domain (top)

Salt Lake City, UT (middle)

University of Utah Engineering Quad (bottom)
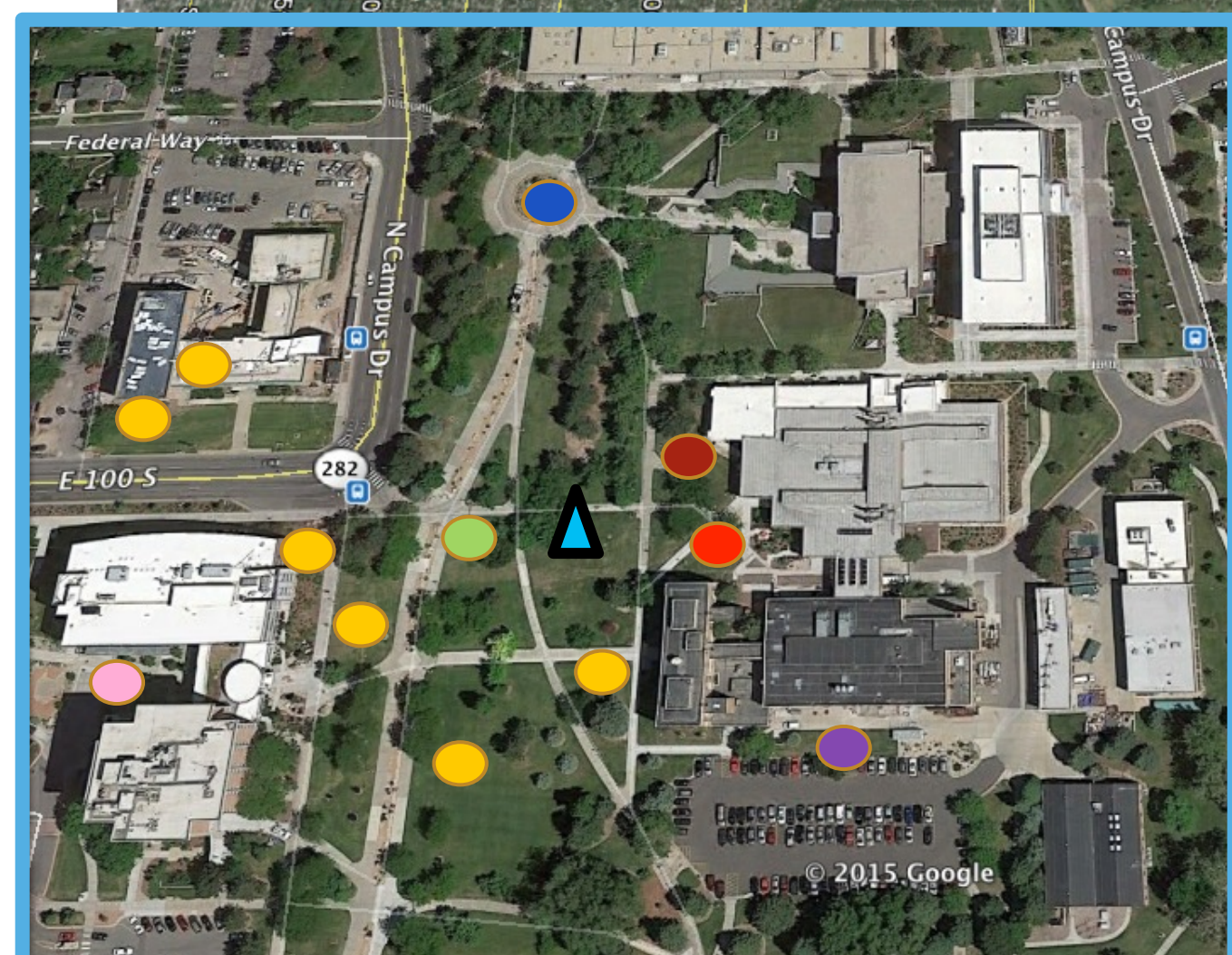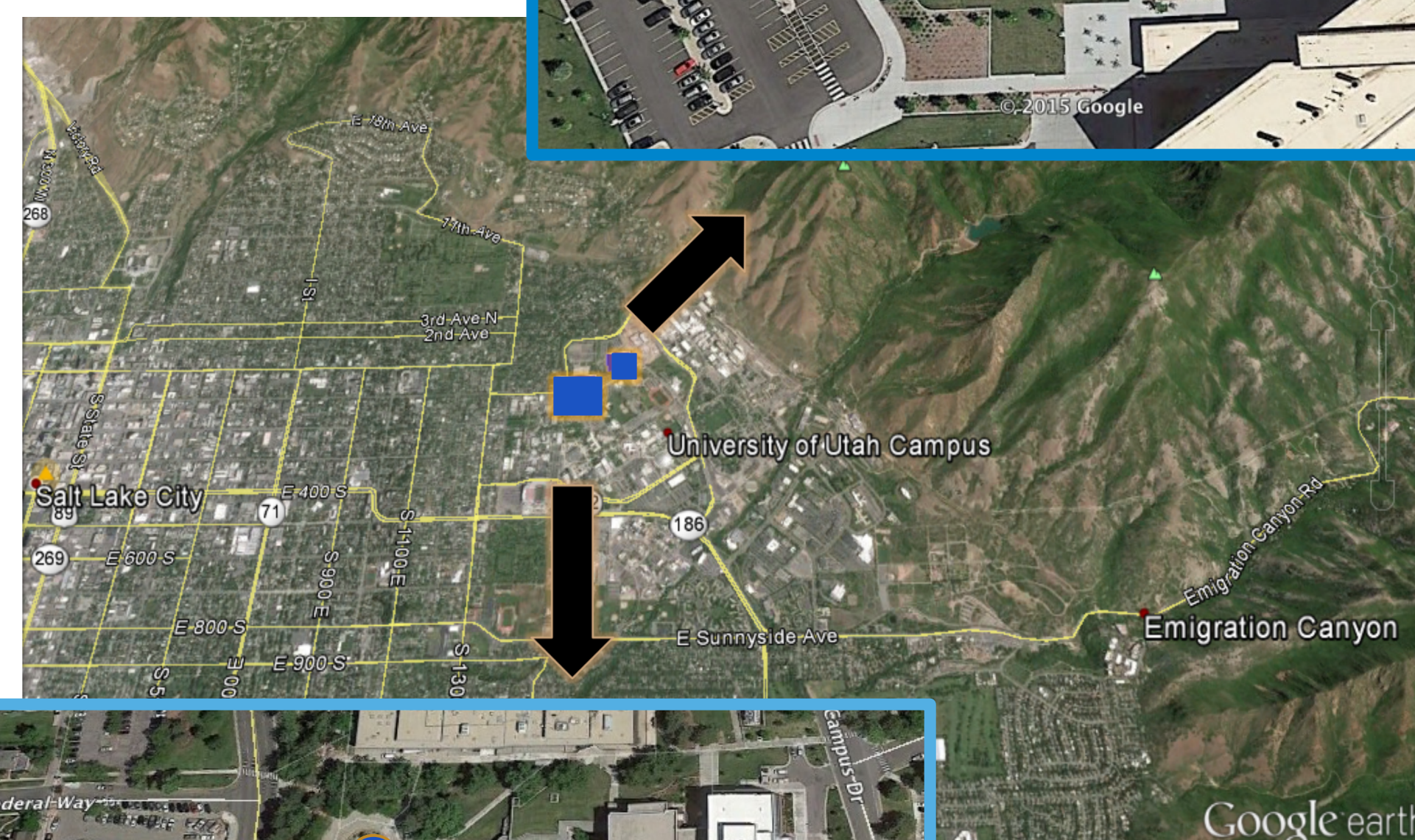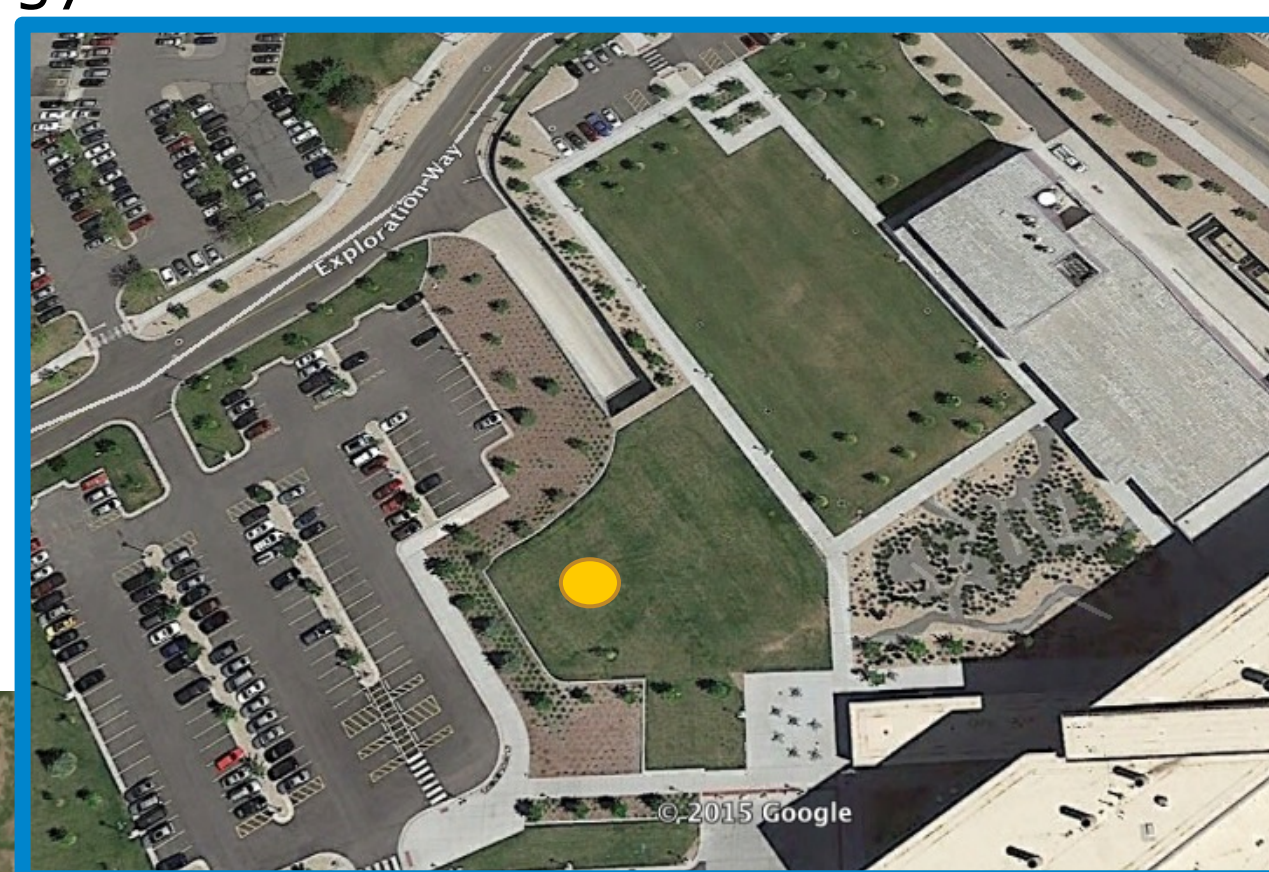
Legend
- ▲ Flux Tower
- ● LEMS E
- ● LEMS F
- ● LEMS I
- ● LEMS M
- ● LEMS H
- ● LEMS K
- ● LEMS

Research Methods

Water Budget

Precipitation = Infiltration + Runoff + Evaporation

Energy Budget

Net Radiation = Sensible Heat Flux + Latent Heat Flux + Ground Heat Flux


Install 13 Local Energy Measurement Stations (LEMS) which are small weather stations built with an open source Arduino microcontroller, to record data every 10 seconds

- Wind speed and direction (Davis Anemometer)
- Infrared ground temp. (TN9)
- Humidity and air temp. (SHT 15)
- Temp. inside box (BMP 085)
- Solar radiation (Licor LI200)
- 2 soil moisture and temp. probes (Decagon 5TM)

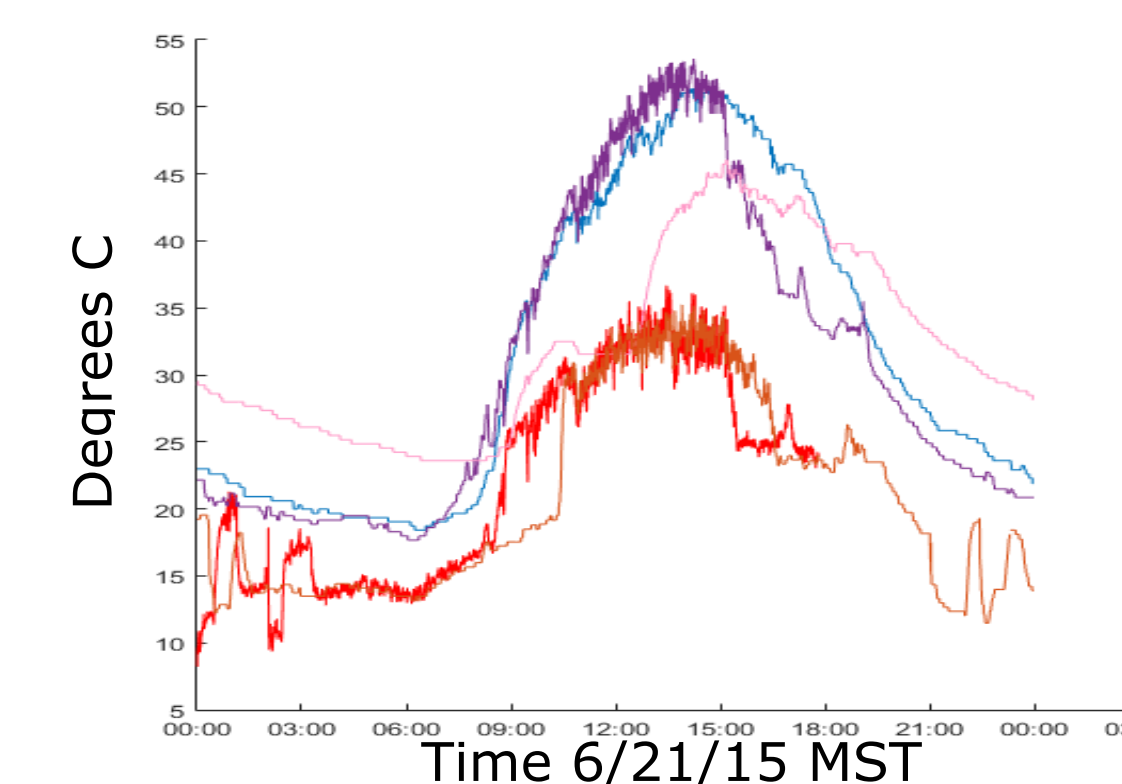Figure 3: Local Energy Measurement Station

Install flux tower to record turbulence fluxes of heat, moisture and momentum, and direct measurements of soil heat

Collect surrounding tree and building dimensions with an impulse 200 laser rangefinder and create a computerized QUIC City Builder Model
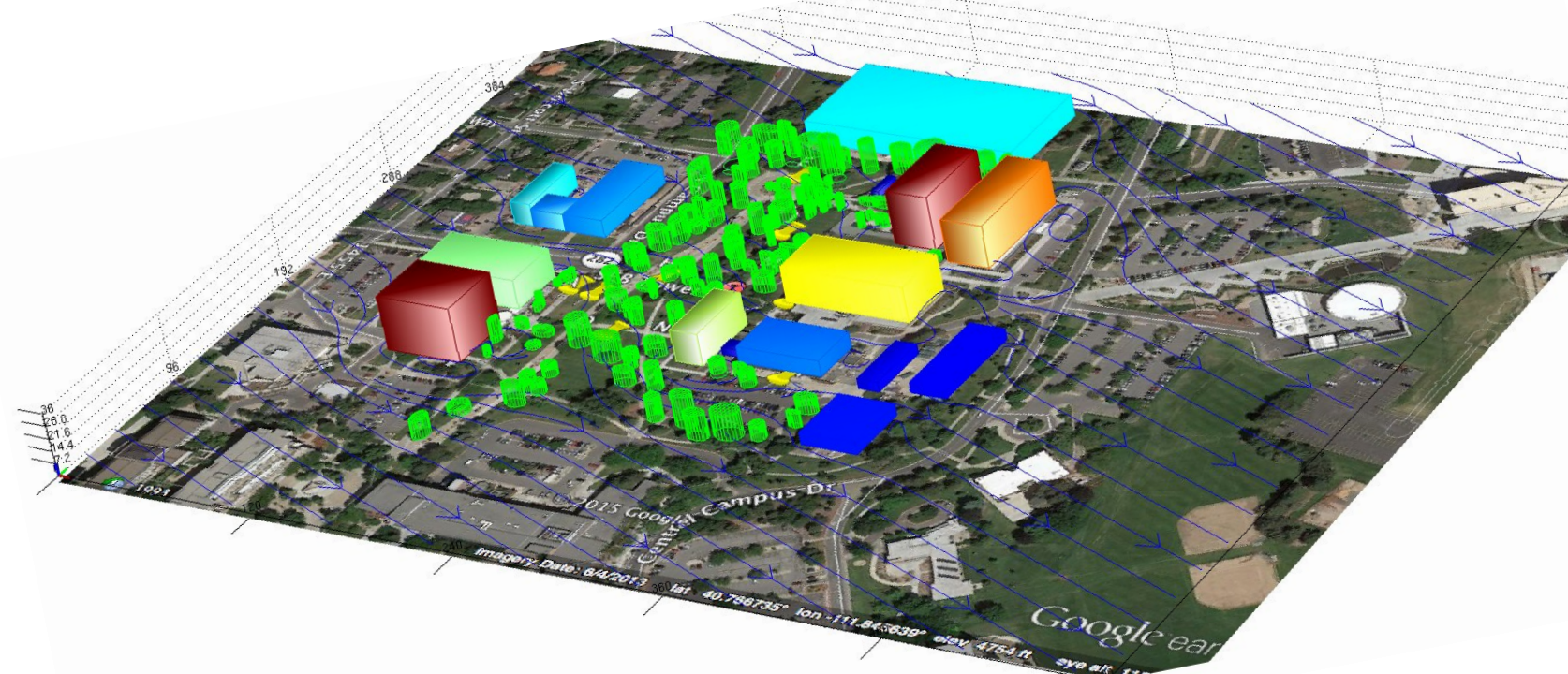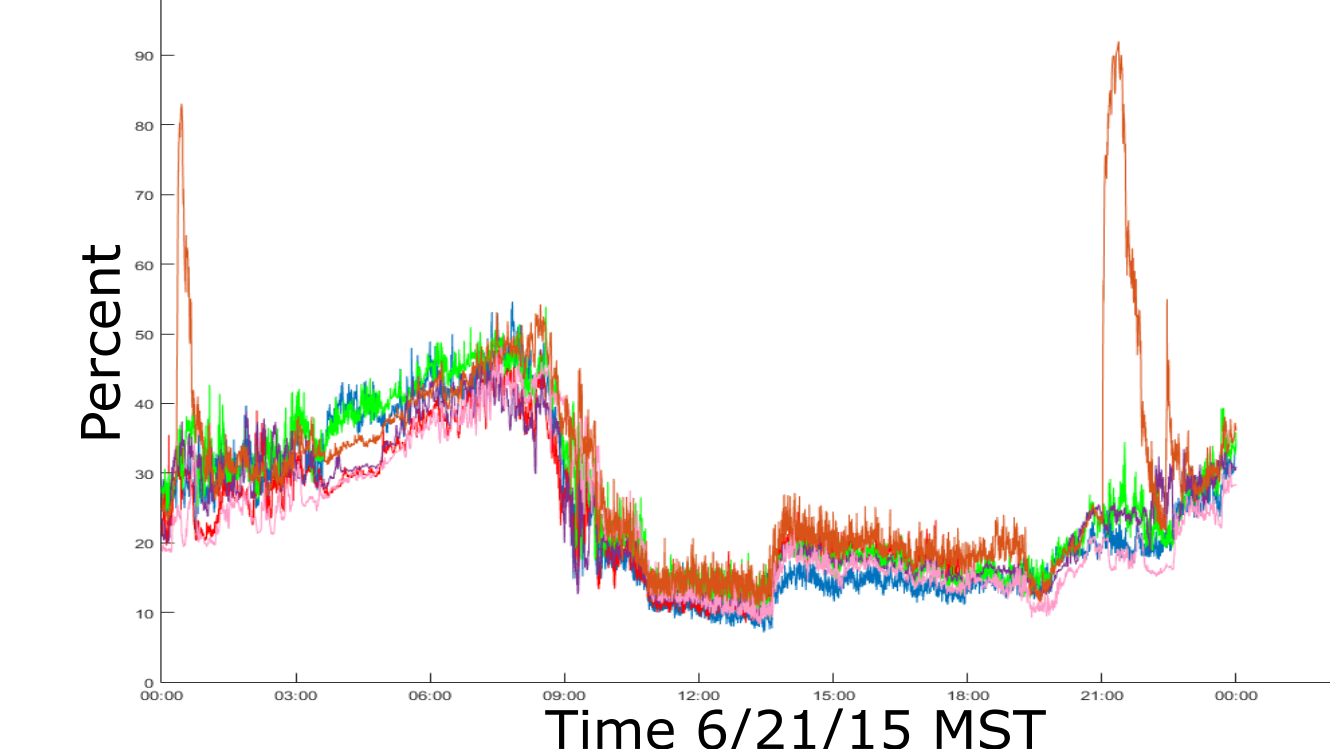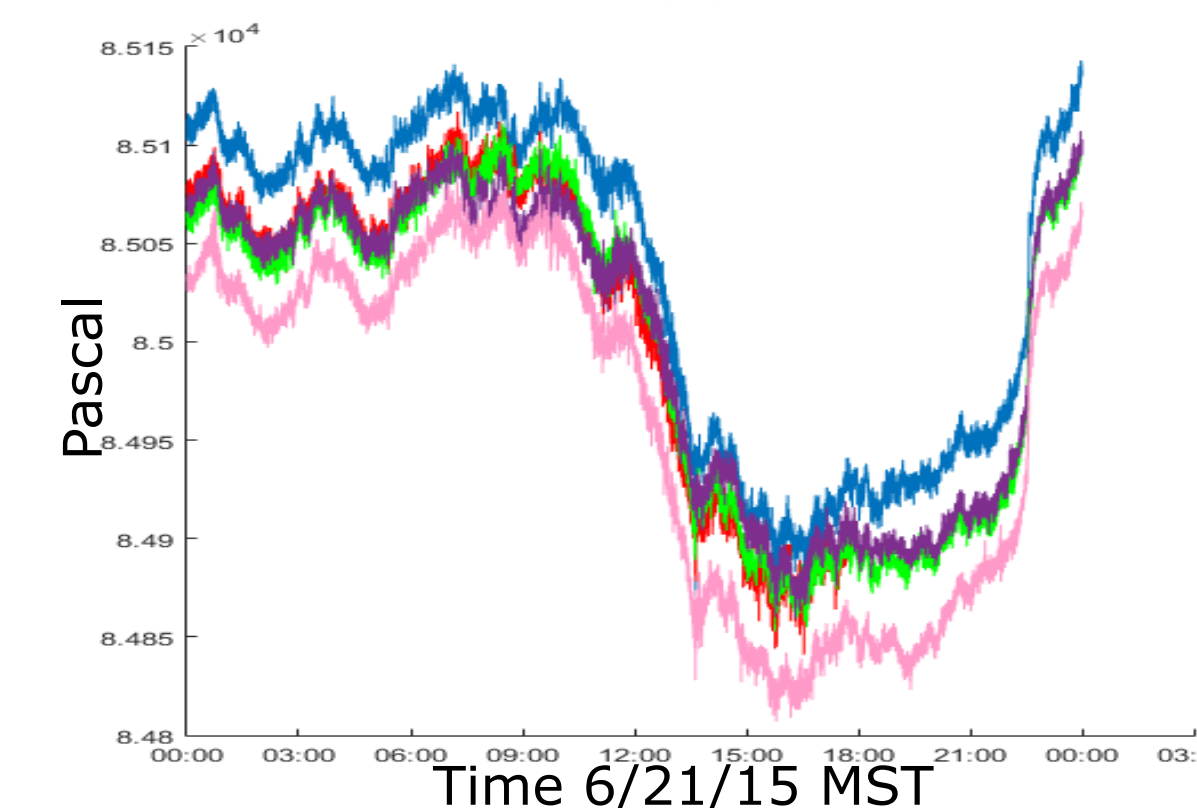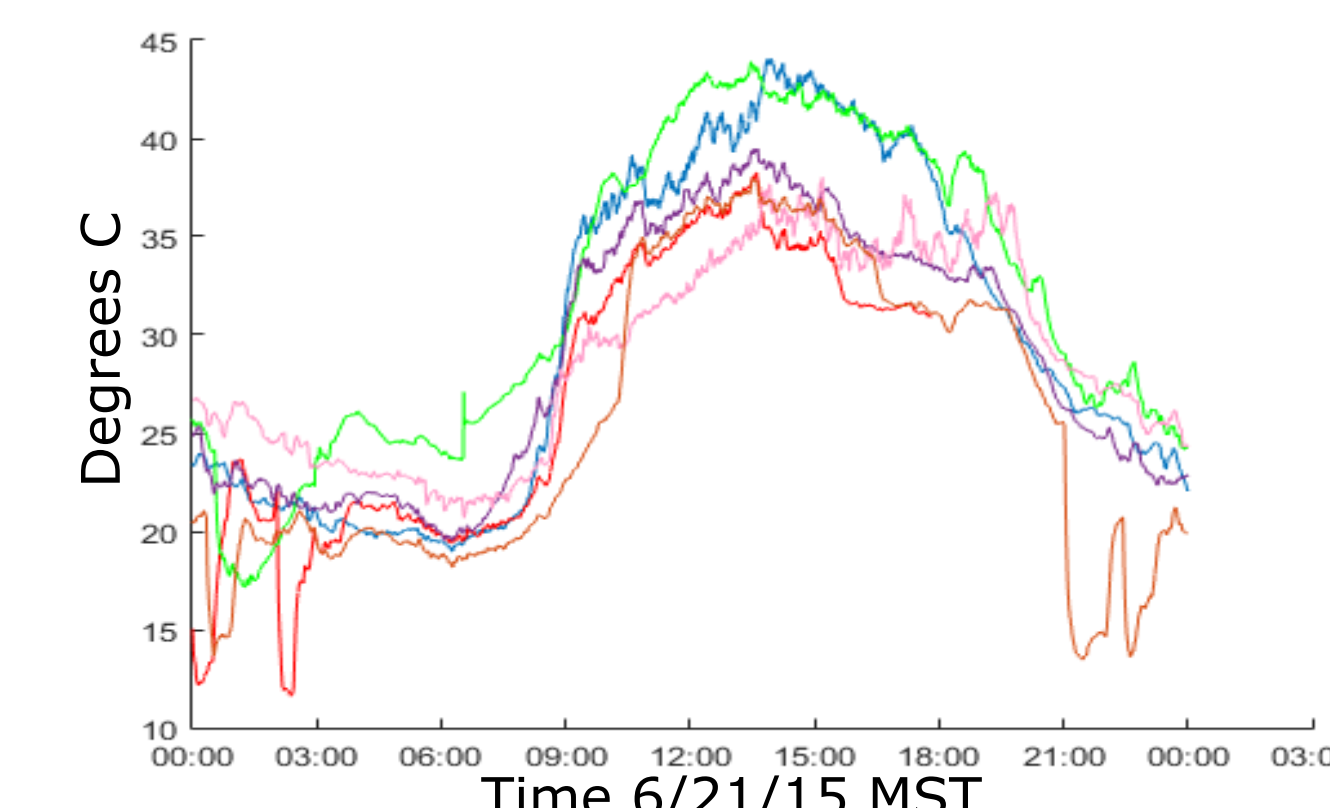

Results

Infrared Ground Temp.

Relative Humidity

Pressure

TN9 Amb.

Wind

LEMS E   LEMS I   LEMS H
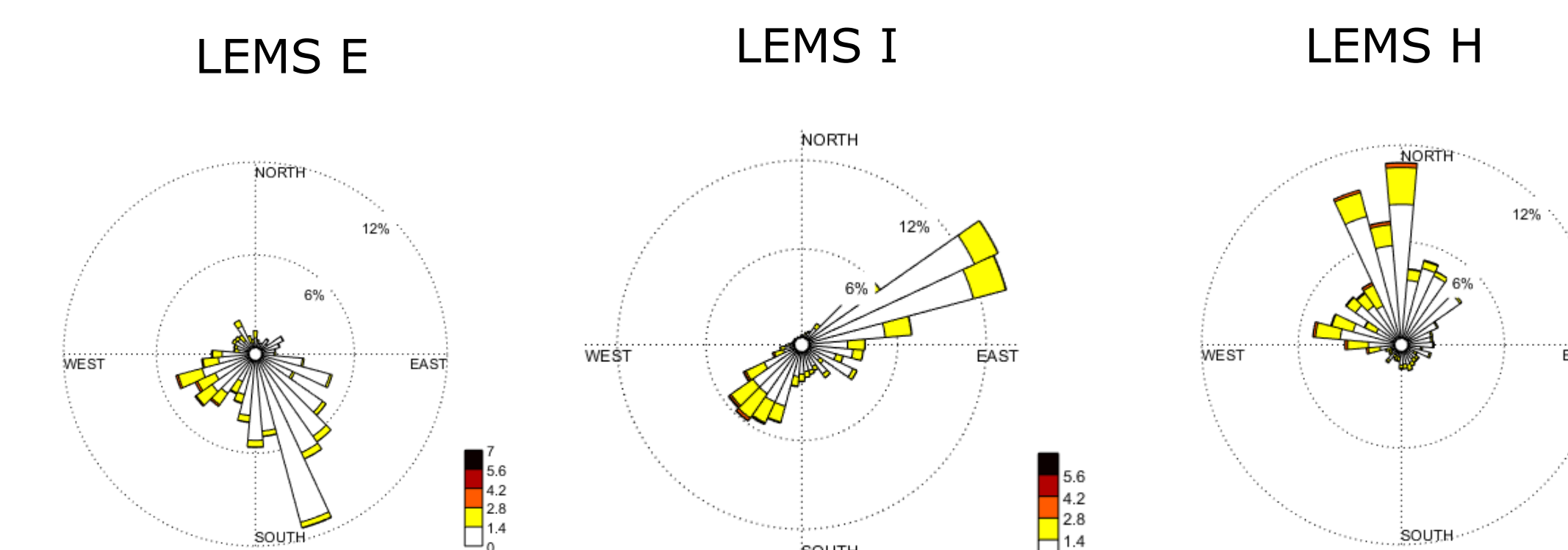
Data shows components of the energy and water budget which compares spatial variability of LEMS measurements across various urban forms.

Impact

With this information analyzing how the form of an urban setting impacts energy and water use, it can be determined how an urban layout can be improved to be more resource efficient and influence future landscaping decisions.

The QUIC City developed will be useful to validate the model, It can be used as a predictive tool to apply to other urban settings to determine how the urban form impacts the water and energy budget.