

A High-Resolution Canopy Energy Transport Model Based on GPU Technology

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Goal

- Build and validate a model for energy transport in urban/agricultural canopies that can:
 - Simultaneously resolve plant-scale and city-scale processes
 - Simulate an entire city on a desktop computer in ~ 1 min (1000+ buildings, 1000+ trees)
 - Include complicated physics such as radiation scattering and plant trait variability
- Develop a physical model for radiation and temperature distributions in complex plant canopies (and general participating media).

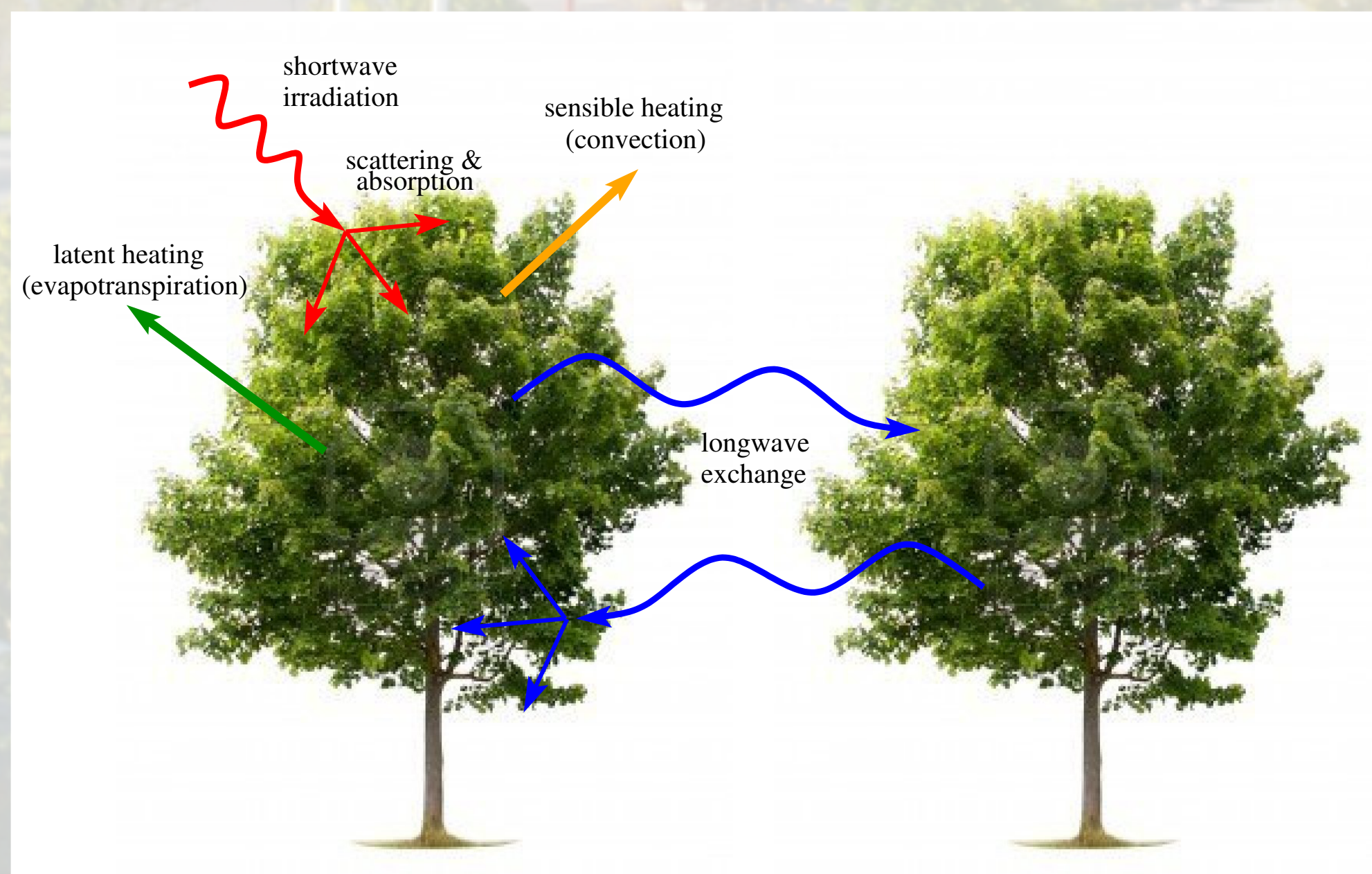


Figure 1. Schematic of the tree energy budget

Research Methodology

MODEL FRAMEWORK

- Based on graphics processing unit (GPU) technology
- NVIDIA OptiX ray-tracing
- Outputs predictions of:
 - Surface temperature
 - Surface fluxes (radiative, sensible, latent)
 - Evapotranspiration rates
 - Soil temperature/moisture
 - Wind velocity



Figure 2. Example of a rendered image using NVIDIA OptiX.

VALIDATION EXPERIMENTS

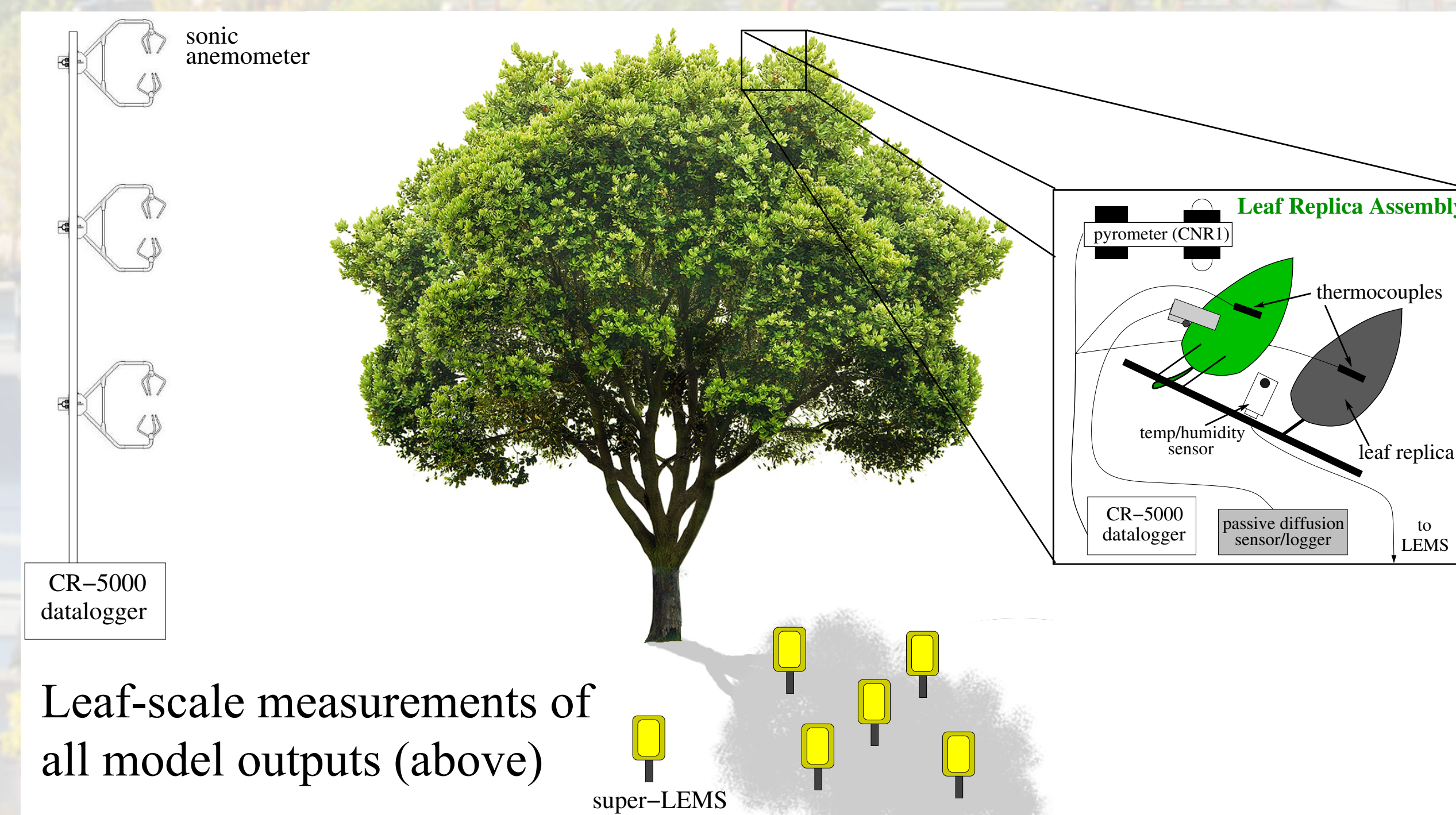


Figure 3. Experimental schematic.

Results

POTENTIAL APPLICATIONS:

- Asses 'green infrastructure' and city planning projects
- Water use by urban vegetation
- Provides microclimate for epidemiological models
- General radiative transport problems for participating media

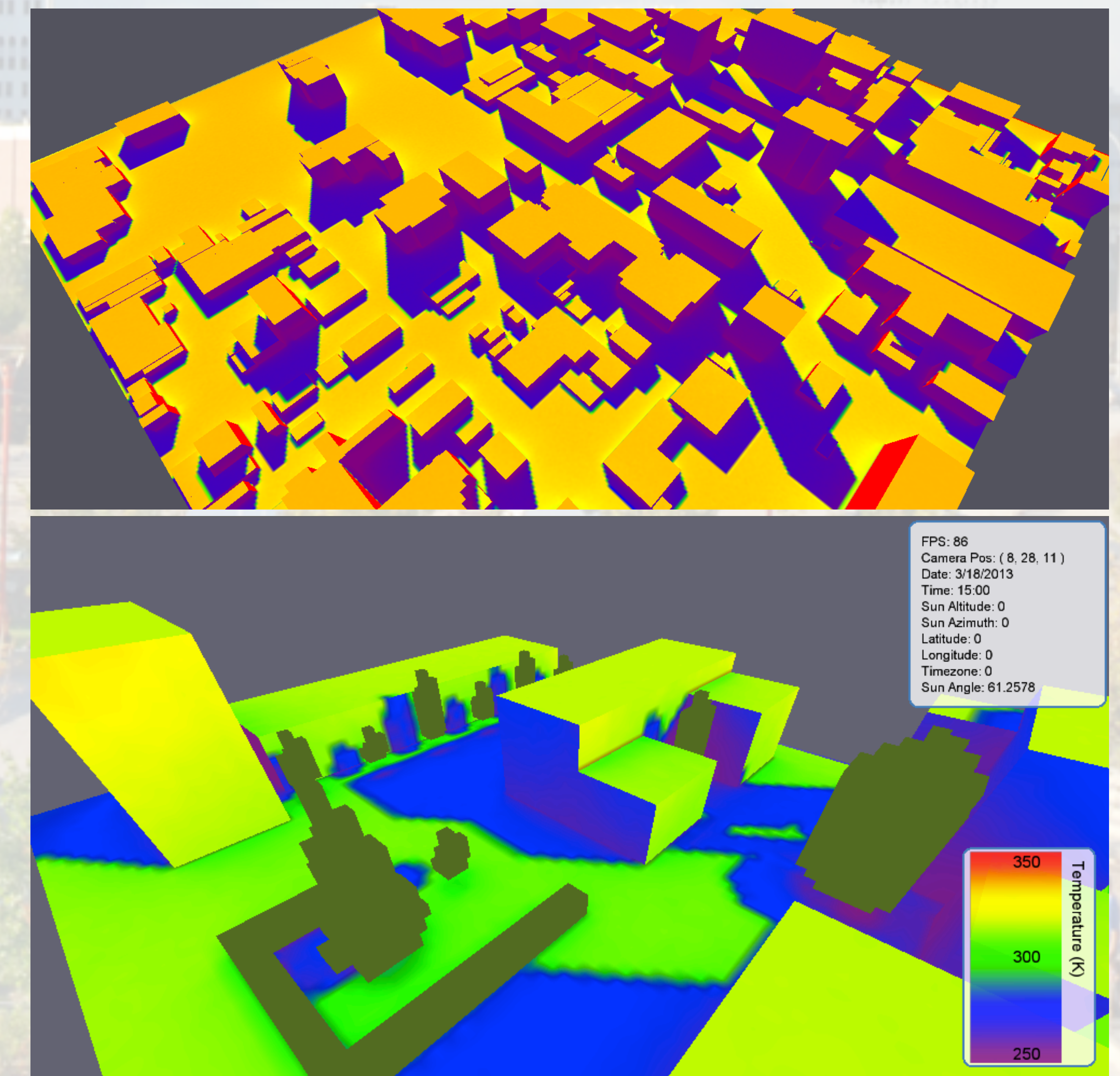


Figure 4. Sample visualizations of model output.

