URBANOVA and WSU Smart Cities Research in the Spokane University District

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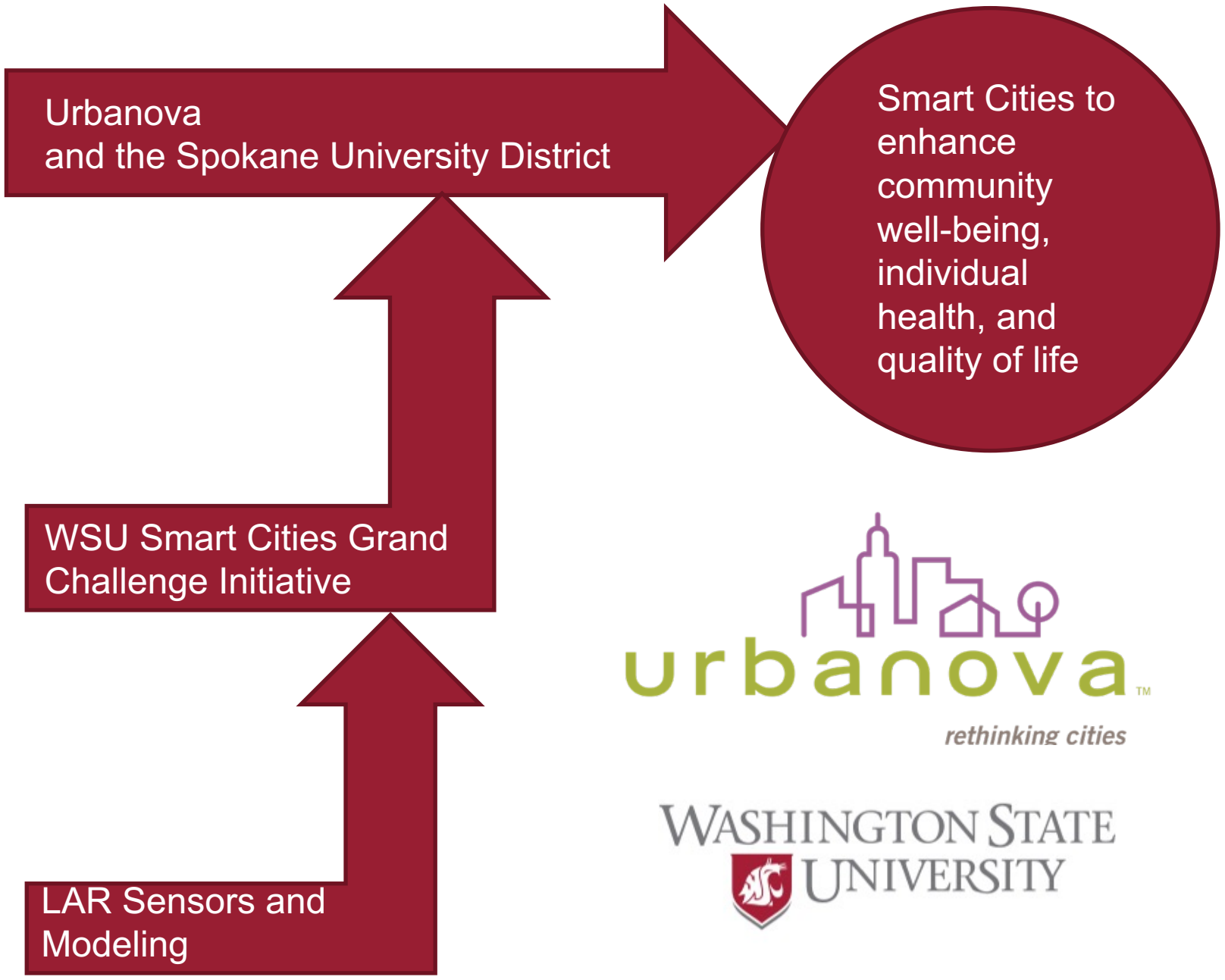
Urbanova and Smart Cities Research



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What is Urbanova?

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Rethinking Cities

Cities across the globe are growing. Today, 50 percent of the population lives in cities. This growth–combined with other urban challenges like infrastructure, energy, water usage, traffic, safety, health, and waste–drives the need for innovation.

To meet this need, cities are using technology to enhance their livability, workability, and sustainability. They're called smart cities, and Urbanova is one of the innovators in this movement.

Urbanova is a living laboratory to design cities for the future. Located in Spokane, Washington, we harness data to gain insights, empower people and solve urban challenges in new ways.

Founding Partners

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AVISTA

CITY OF SPOKANE

Itron

McKinstry
For The Life Of Your Building

University District

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Urbanova Goals

- **healthier** citizens
- **safer** neighborhoods
- **smarter** infrastructure
- more **sustainable** environment
- **stronger** economy

Urbanova is a community of learning for healthy cities

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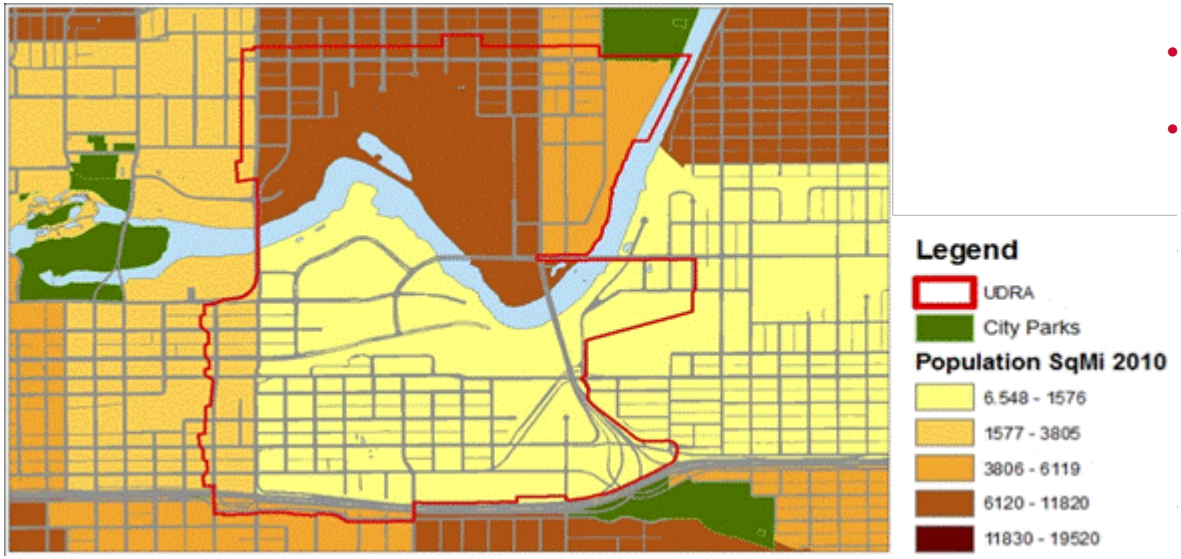
Initial Urbanova Projects

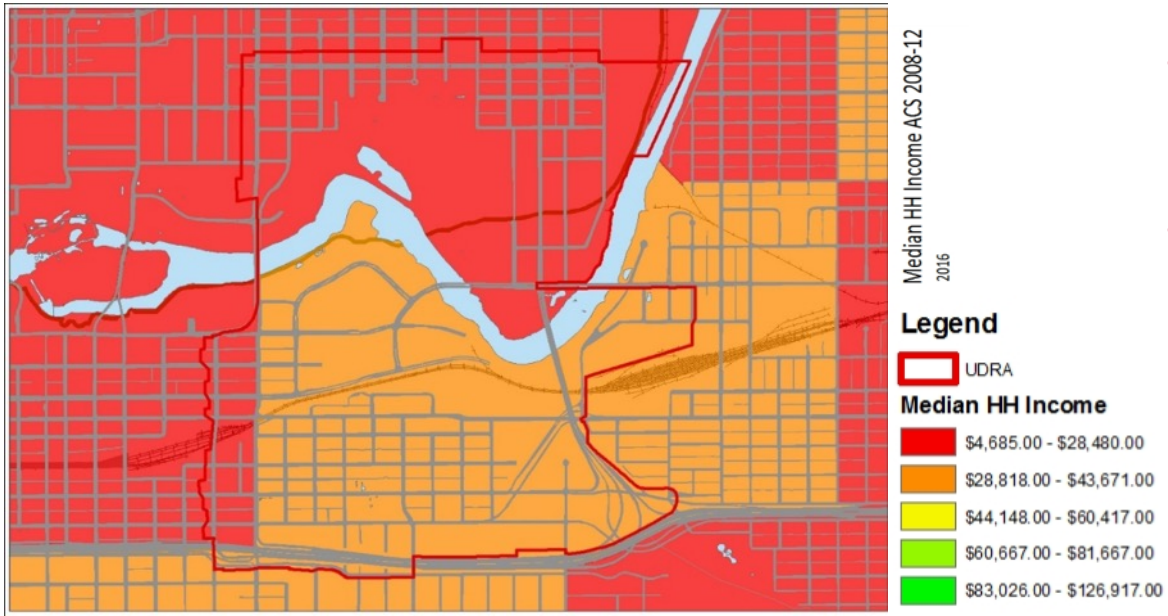
- Smart and connected streetlight pilot project
  - Includes neighborhood air quality sensor packages and AQ modeling
  - Avista, Itron, WSU-LAR
- Shared energy economy model pilot—Smart Grid, ESIC
- Gallup "Phase 0" Project—population statistics and mining
- Smart city research grant proposals—various collaborators

Spokane University District

- Near central downtown Spokane
- Mix of university, commercial and residential neighborhoods
- Cut through by the Spokane River
- Bisected by I-90 E-W freeway, major N-S surface arterials, and E-W railroads

Spokane University District
A diverse urban landscape



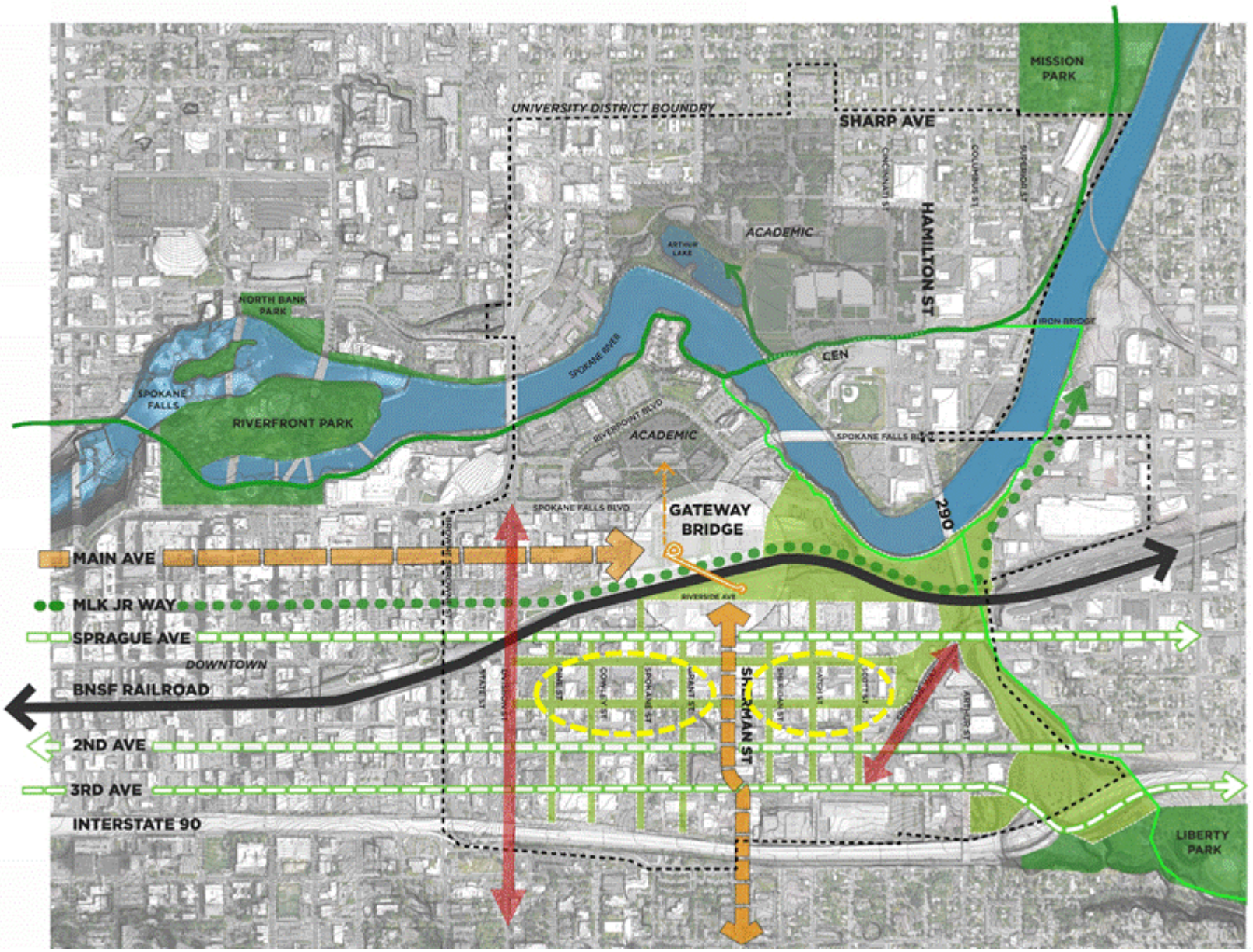


- > 10,000 residents
- Average age 33.7 years old.

  Median age varies from 20-22 years old in the university district area to 68 in the Logan neighborhood

  31.4% of the Logan community holds a BS or higher degree
- This number drops down to only 16.5% in East Central.
- Household neighborhood median income ranges from $18K to $26K

Major Development Plans: Gateway bridge, new retail/housing centers, MKL Way extension

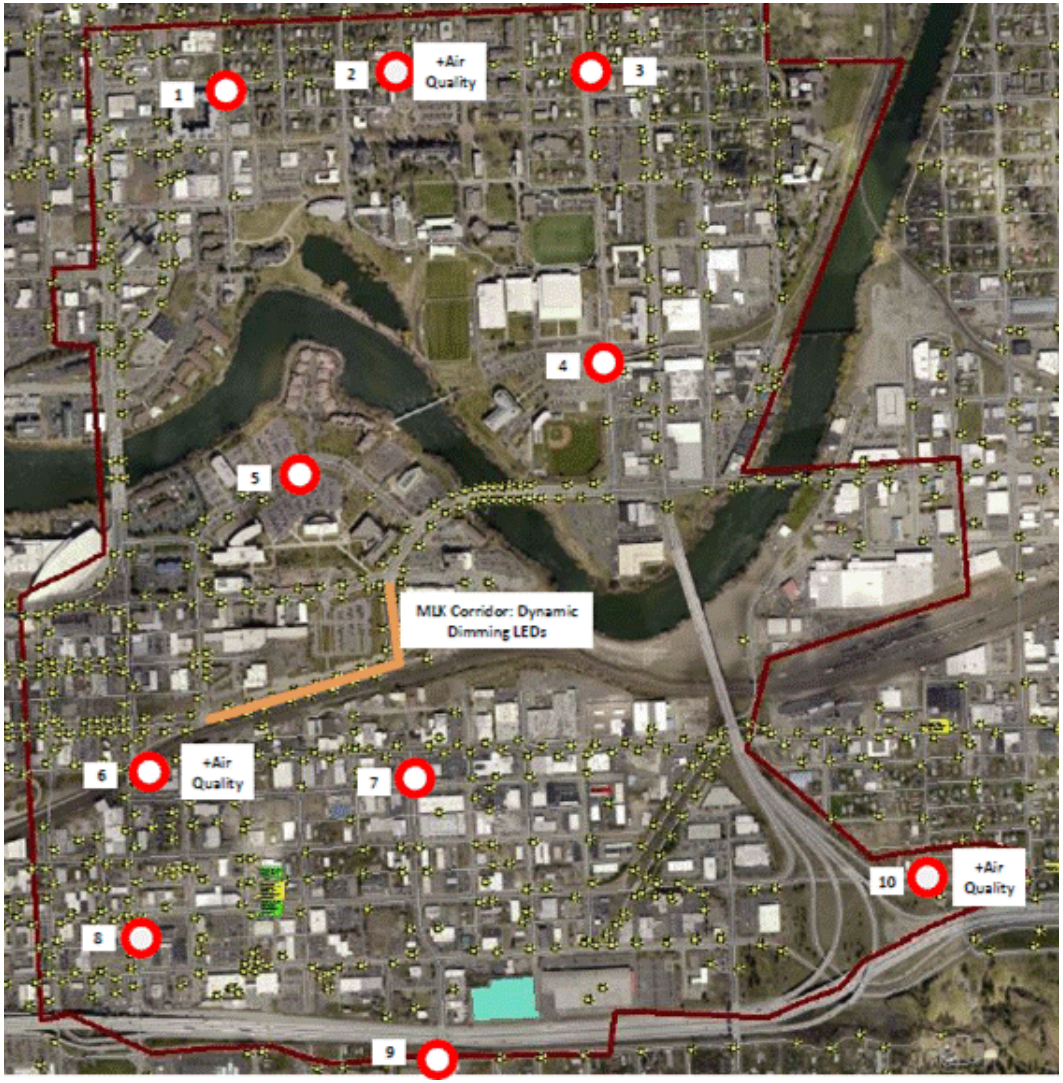


Visioning the South University District

WSU Grand Challenges Research Grant

- Five-year, $1.5 million initiative funded by WSU
- Objective is to build interdisciplinary research capacity
- Emphasis on human-centered systems and population health impacts
- Focused on changes in the natural and built environment and the effects on community function, well-being, and individual health
- Initial participants
  - Laboratory for Atmospheric Research
  - Energy Systems Innovation Center
  - Elson S Floyd College of Medicine
  - Institute of Sustainable Design
  - Department of Civil & Env. Eng.

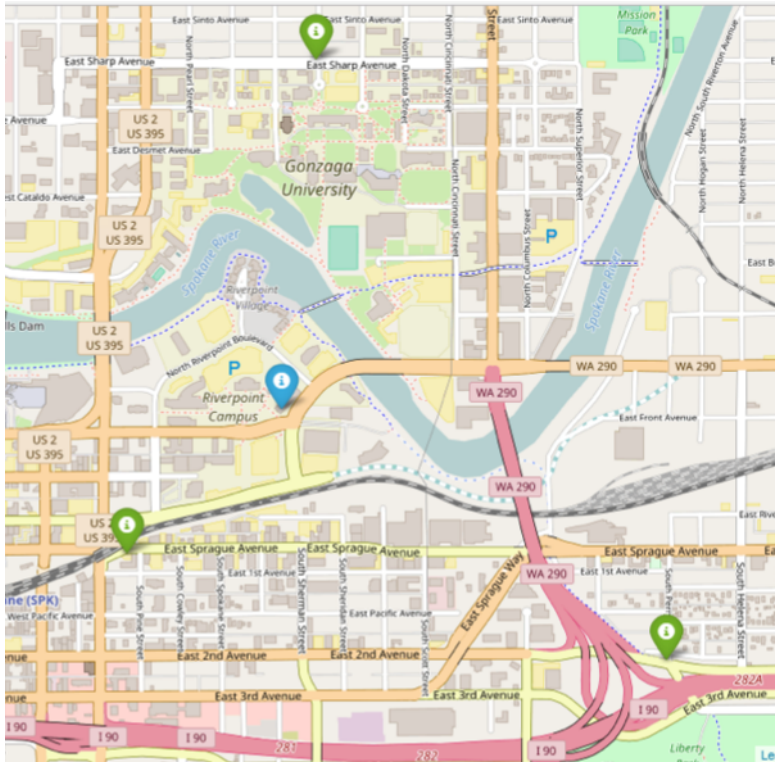
Smart and Connected Streetlights and Initial Air Quality Sensor Array

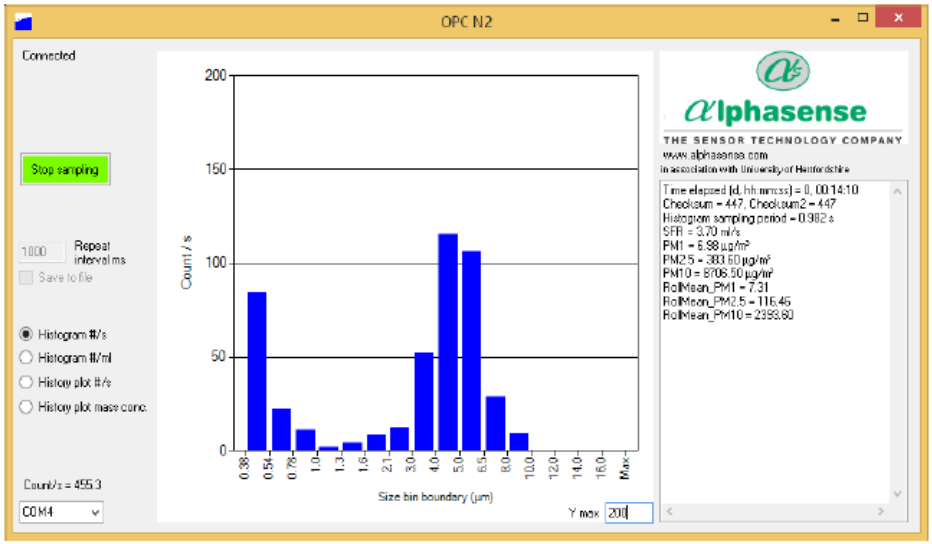


- 10 lights initially
- 100 lights eventually
- Smart lights includes dimming, pedestrian movement, & air quality
- Sensor packages connected via Itron smart network connections
  - Real-time data access

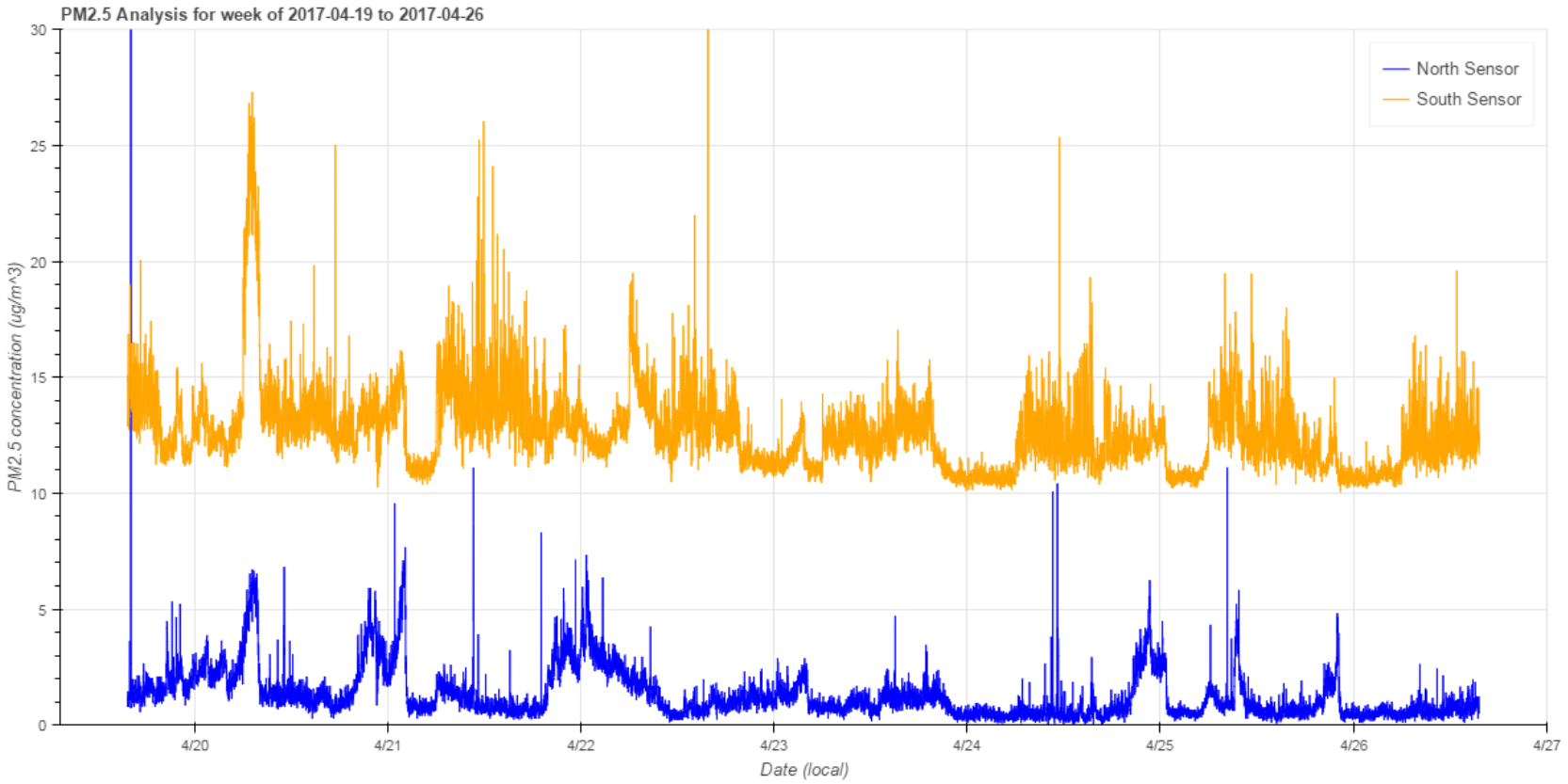
Initial Air Quality Sensor Array

- Objective: Explore new sensor technology for Smart City developments
- Approach: deploy ~ 10 small packages on smart streetlights and city rooftops
- Initial package design: Pi Raspberry computer and data acquisition, cell phone modem
  - CO_2 Alphasense K-30
  - PM Alphasense OPC-N2, 16 size channels
  - T, RH





PM2.5 Concentrations April 20-27, 2017



http://sila.paccar.wsu.edu/~vonw/urbanova/AQnetMap.html

http://sila.paccar.wsu.edu/~vonw/urbanova/weekly/

http://sila.paccar.wsu.edu/~vonw/urbanova/weekly/UrbanovaWeekly_PM2.5_2017-05-22_2017-05-29.html

CO_2 Concentrations April 20-27, 2017

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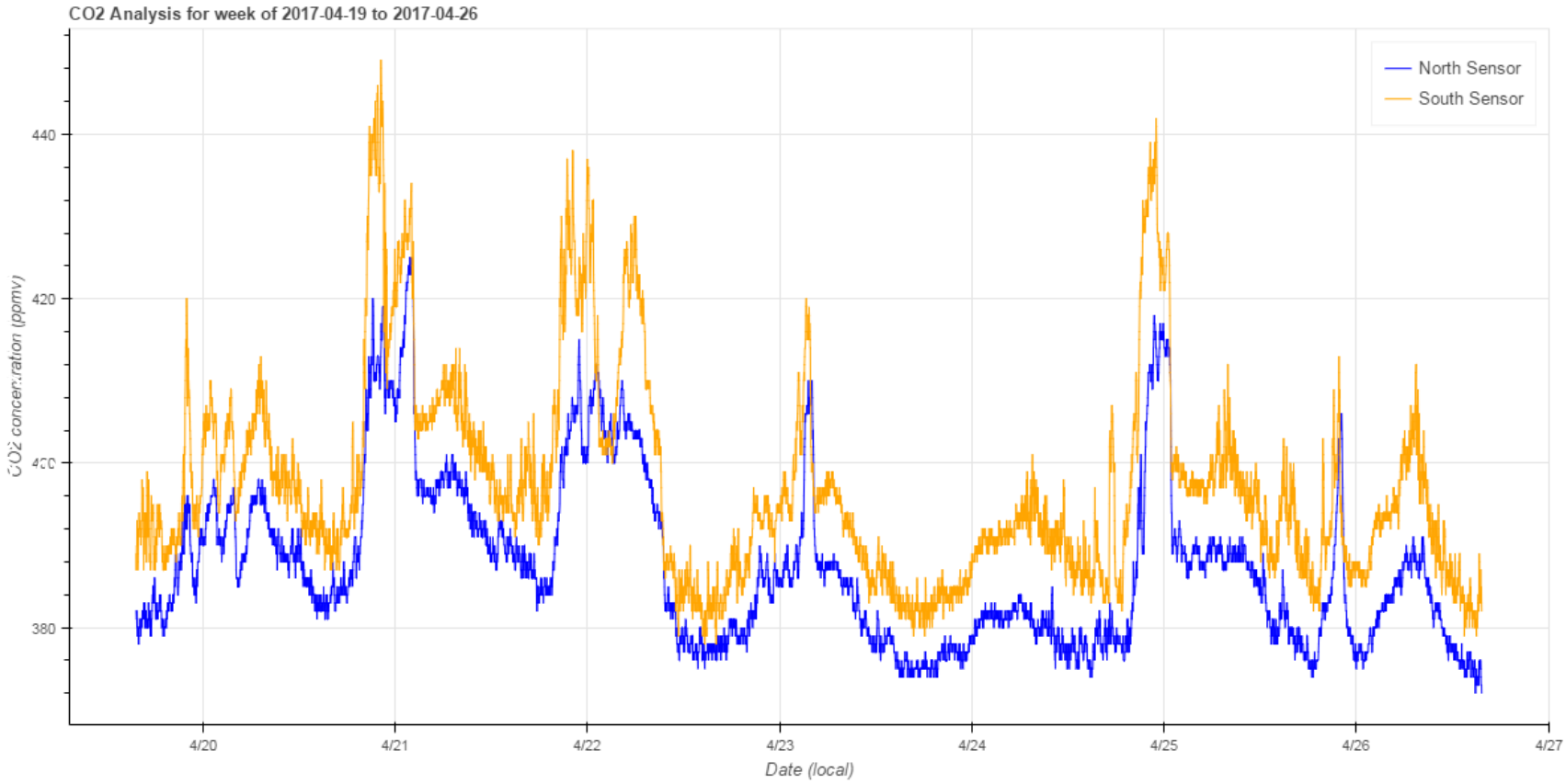
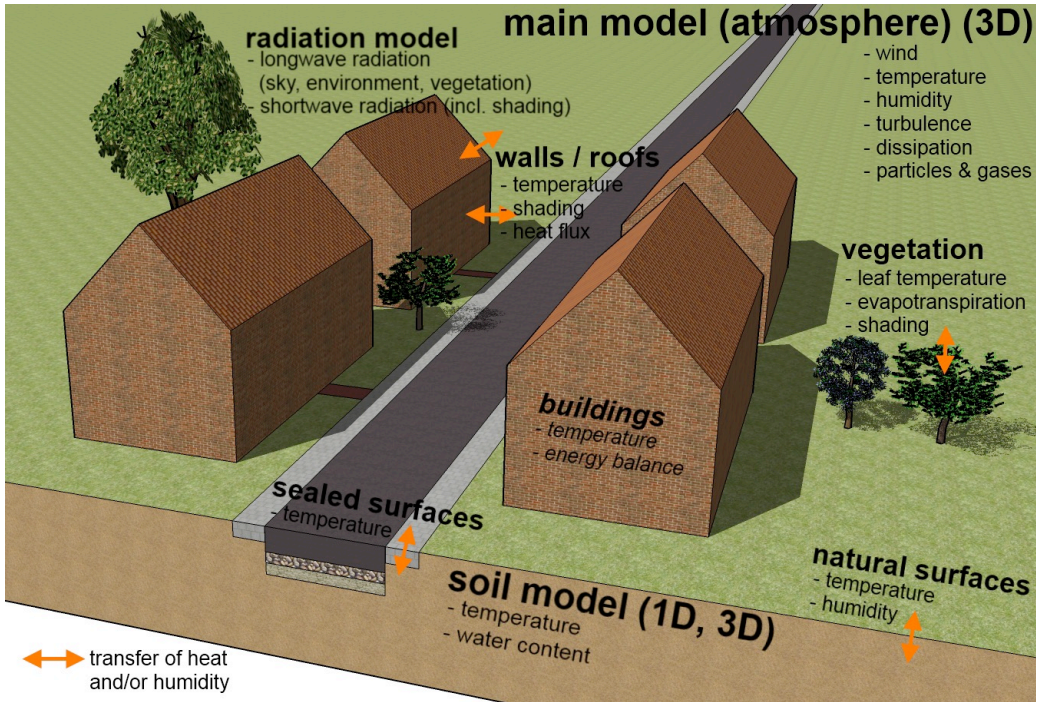


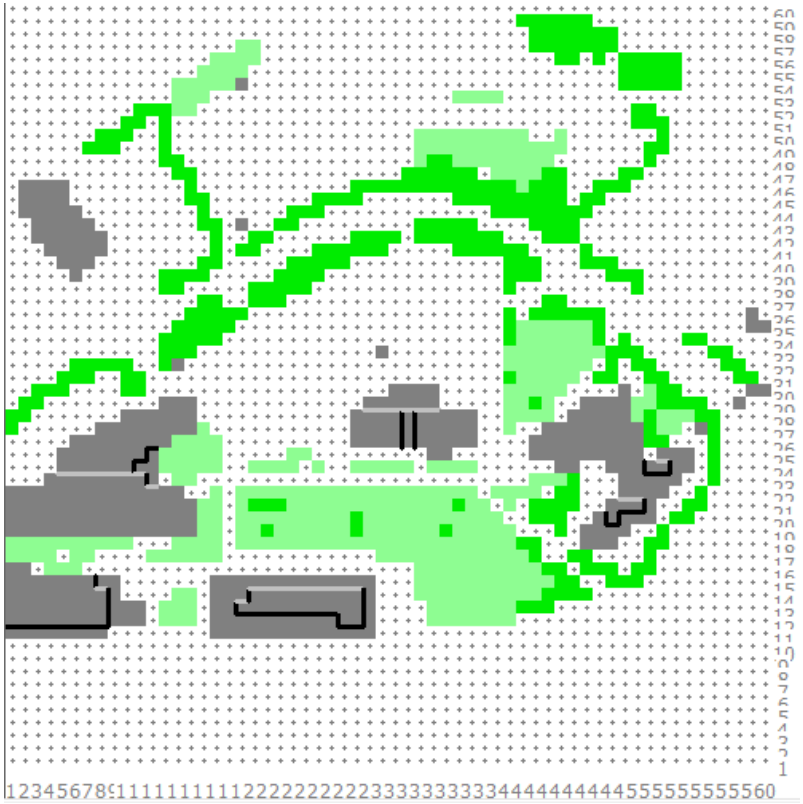
Urban Climate and Air Quality Modeling

- AIRPACT
  - 1.33 km grids
  - Domain centered on Spokane
  - Resolution is insufficient for micro-climate modeling
  - Use 1.33 runs to provide BCON for micro-scale modeling
- ENVI-Met computational fluid dynamics urban model

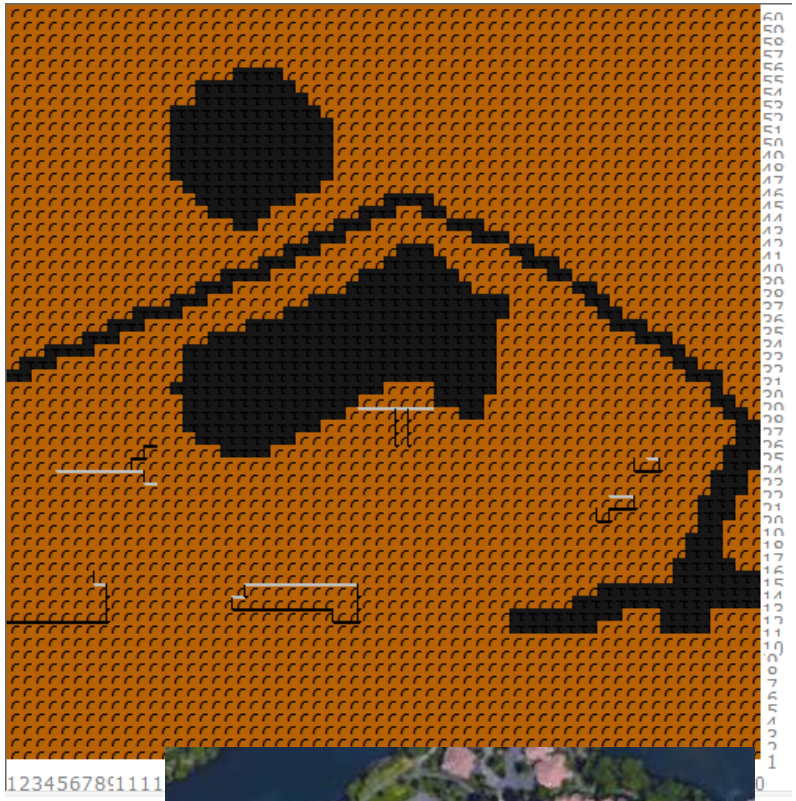


- CFD k-e code
- Grid sizes of a few meters
- Developed in Germany beginning in 1995
- Comprehensive treatment of urban landscapes, building surfaces, and vegetation
- Available free or in advanced purchased versions
- Only runs in a windows pc environment

Buildings and vegetation



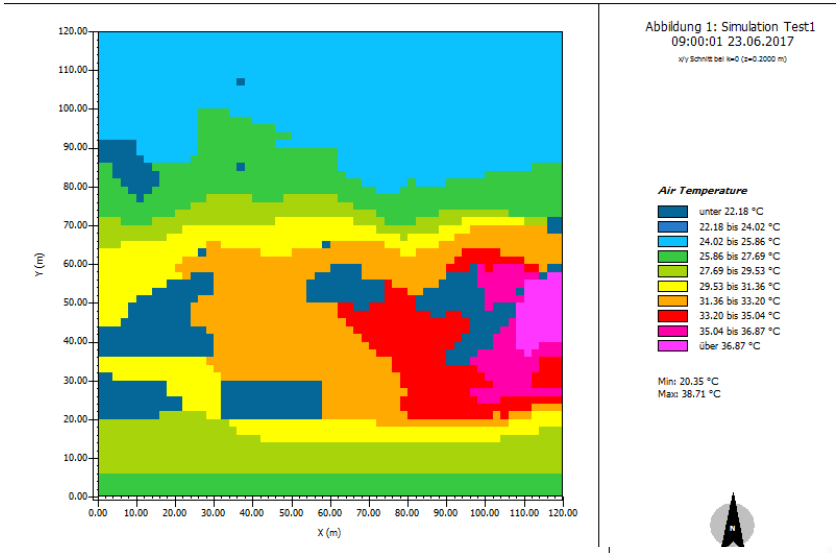
Surfaces



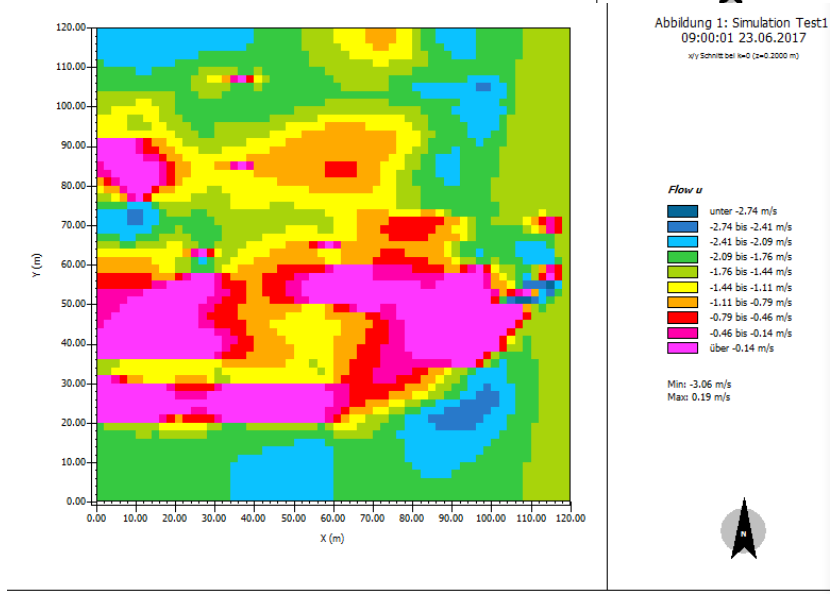
Jill Peery, WSU 2017 REU student

Start date	23/6/2017
Start time	7:00am
Total run time (hrs)	4 hrs
Output intervals for receptors and buildings (min)	30.00
Output interval for all other files (min)	60.00
Wind speed at 10m (m/s)	4
Wind direction (degrees from North)	90
Roughness length at measurement site	0.01
Initial temperature of atmosphere (°C)	21.00
Specific humidity at 25000m (g/kg)	7.0
Relative humidity in 2m (5)	50

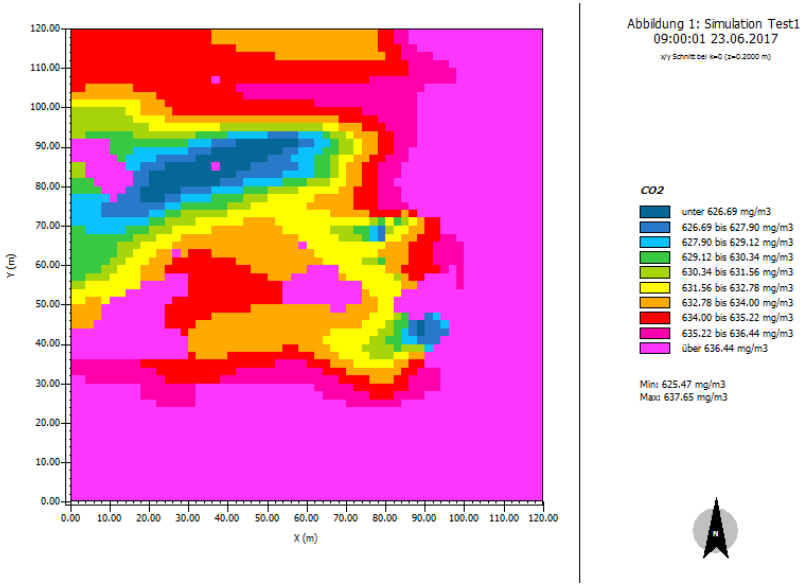
Temperature



Wind Speed



CO2



Looking forward

- Deploy additional sensors on rooftops and other locations throughout the university district
- Establish a rooftop reference site on a university building
  - Fitted with research grade instruments
  - Co-located with sensor packages
  - Available for additional intensive measurement campaigns
- Mobile sampling along university district roadways
  - Sensor packages on city buses
  - New WSU instrumented van
  - Backpack bicycle or pedestrian monitoring
- Develop and apply urban modeling framework
  - AIRPACT at 1.33 km
  - ENVI-Met at high resolution
  - WRF-Urban
  - Large Eddy Simulation (WRF-LES)
- Integrated effort with health, social science, and other physical science and engineering faculty

Questions?