AIRPACT Spokane 1.33 km domain preliminary results

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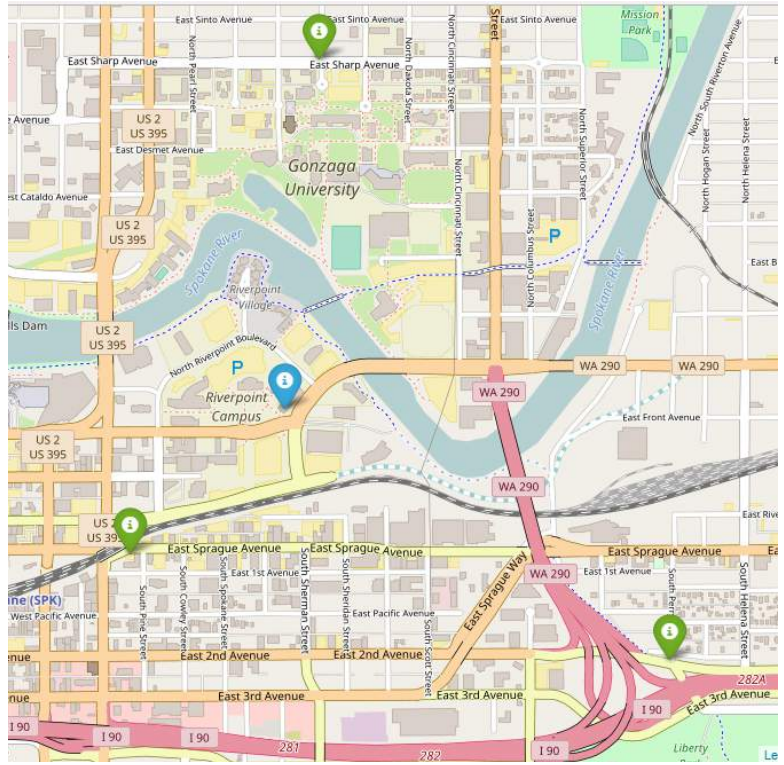
Urbanova Updates

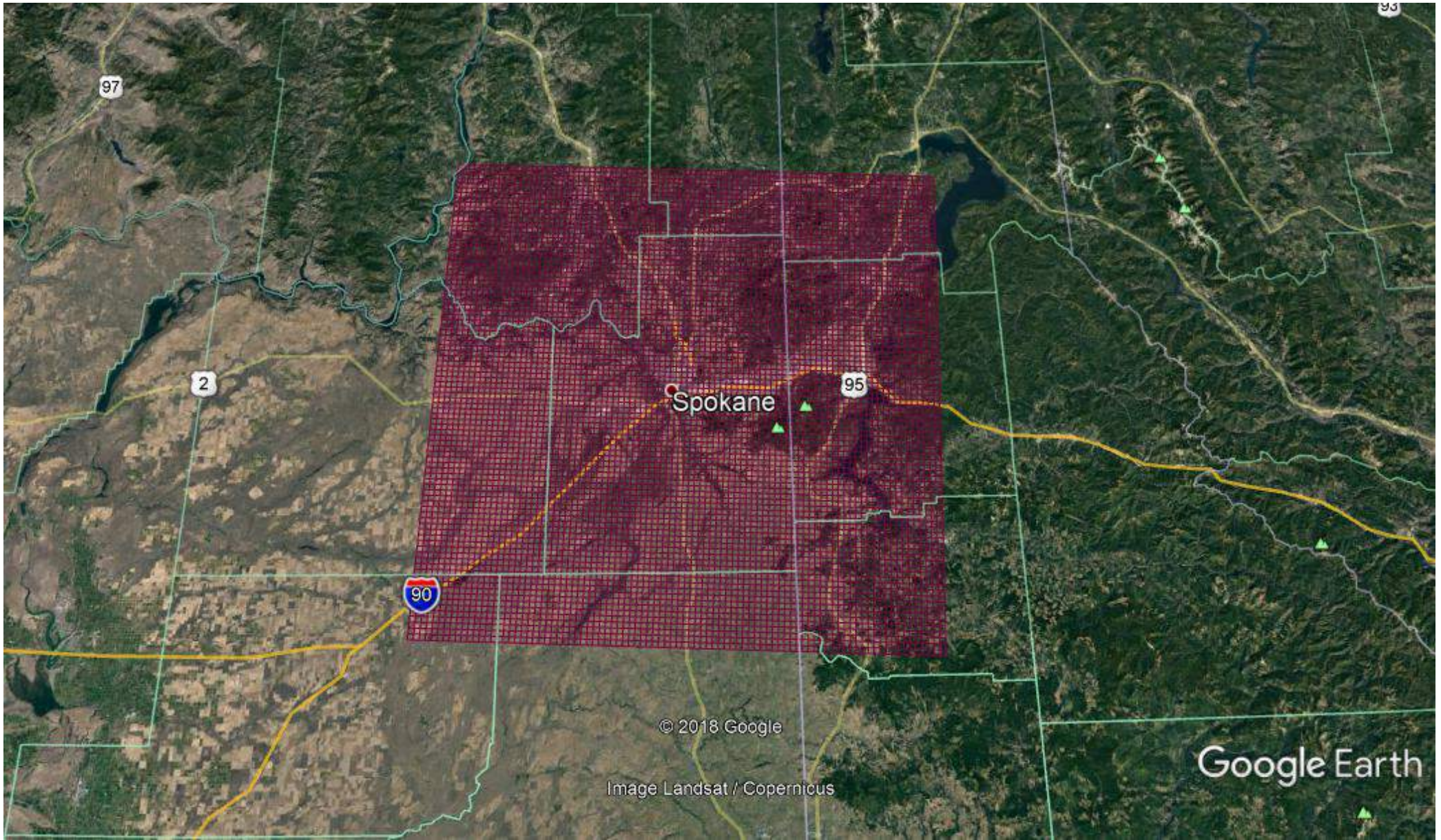
- 3 sensor packages installed on smart streetlights in early 2017—one is still working
- Reference site established on the roof of the EWU building on the Spokane campus—SO_2, NO_x, O_3, $PM_{2.5}$, CO_2, and weather data
- 6 new sensor packages are being assembled for deployment to the reference site for cross-calibration and environmental correction development
  - These will then be deployed on building rooftops in the Urbanova domain
  - 1 package will be deployed on a transit bus operating in the area
- 1.33 km domain AIRPACT forecast now operational—website needs to be implemented

Reference Site for the Urbanova Air Quality Sensor Array

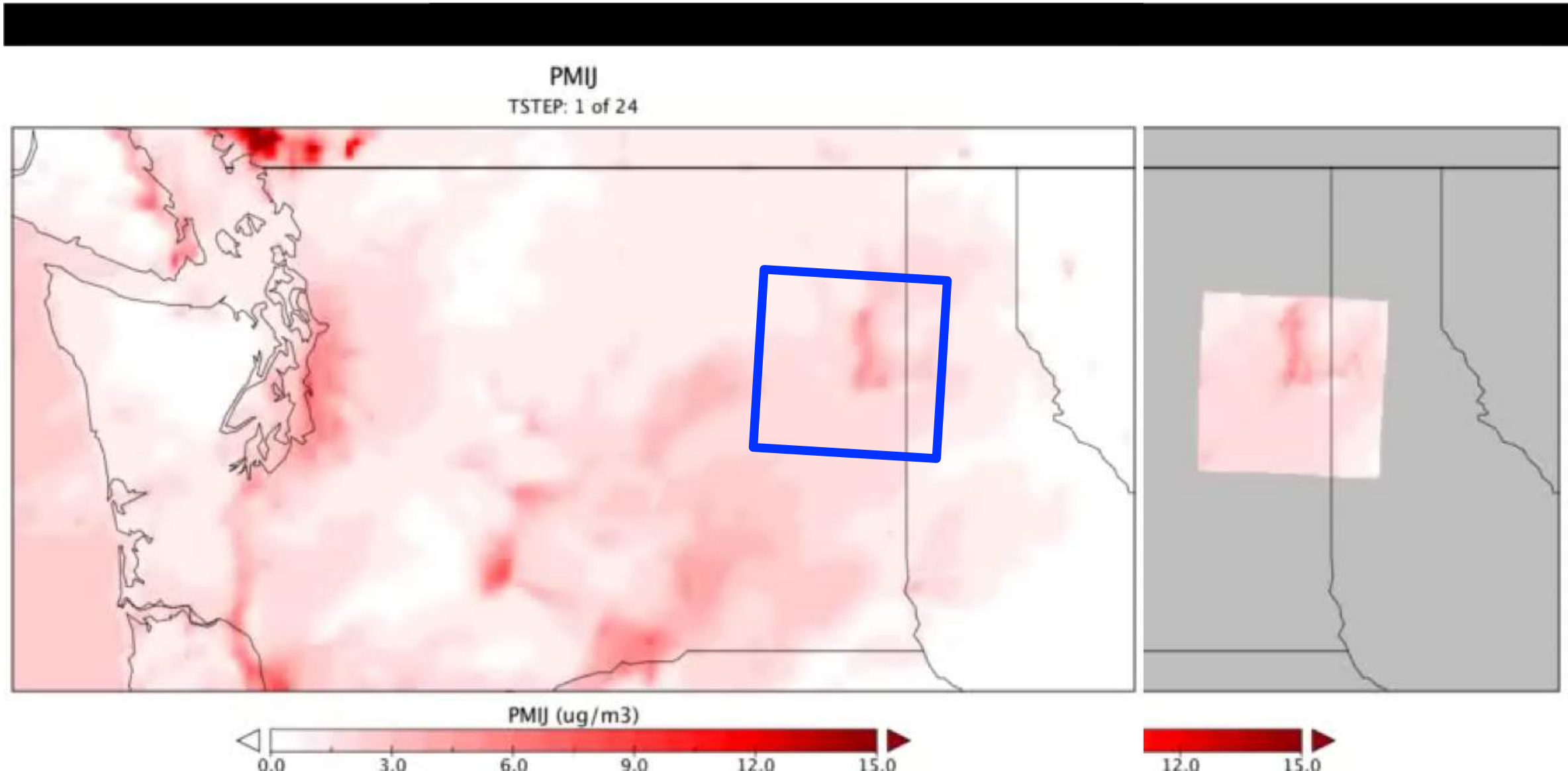
- Weather station (MaxiMet GMX600; Gill Instruments)
  - T, P, RH, Precip, WS, WD
- $PM_{2.5}$ monitor (E-BAM PLUS; Met One Instruments)
- CO_2/H_2O Closed-path gas analyzer (LI-840A; LICOR Biosciences)
- O_3 gas analyzer (Model 205; 2B Technologies)
- NO, NO_2, NO_x gas analyzer (Model 405 nm; 2B Technologies)
- SO_2—Teledyne gas analyzer
- VOC diffusion tubes (LC State College, N. Johnston)



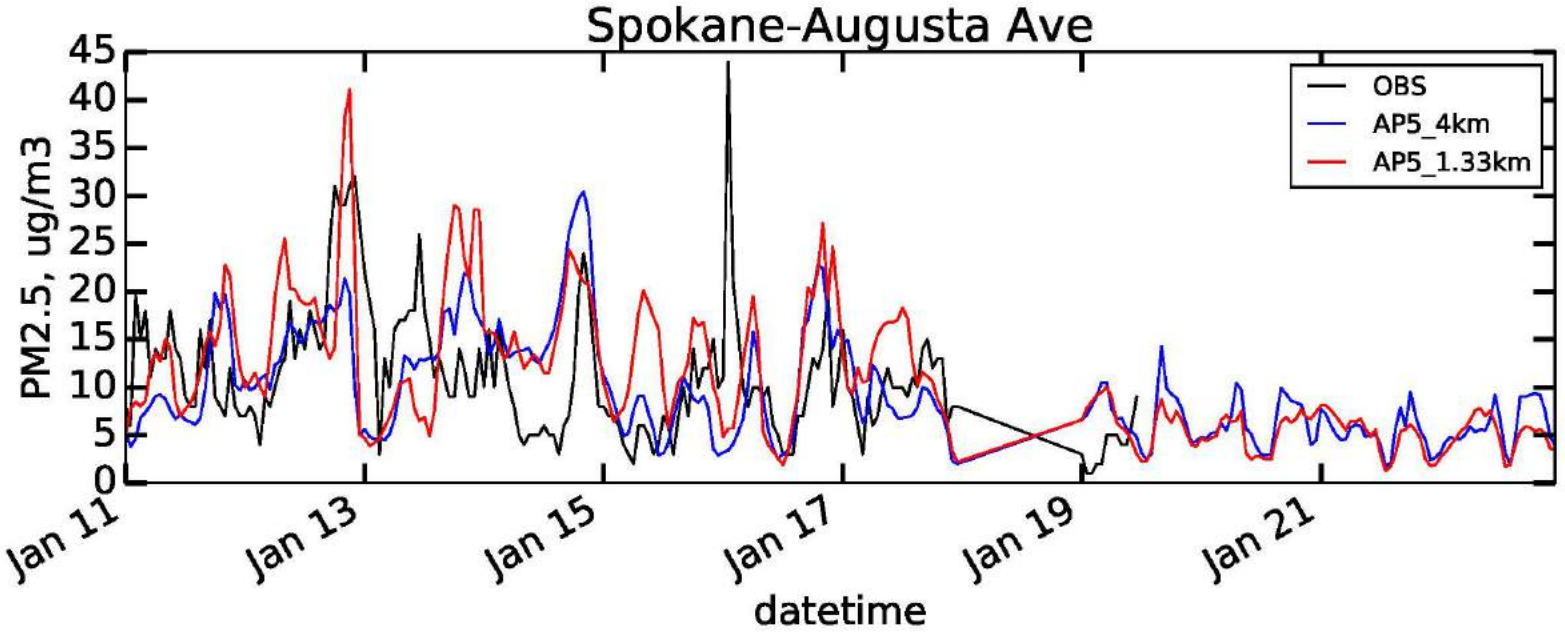
AIRPACT 1.33 km Spokane Domain

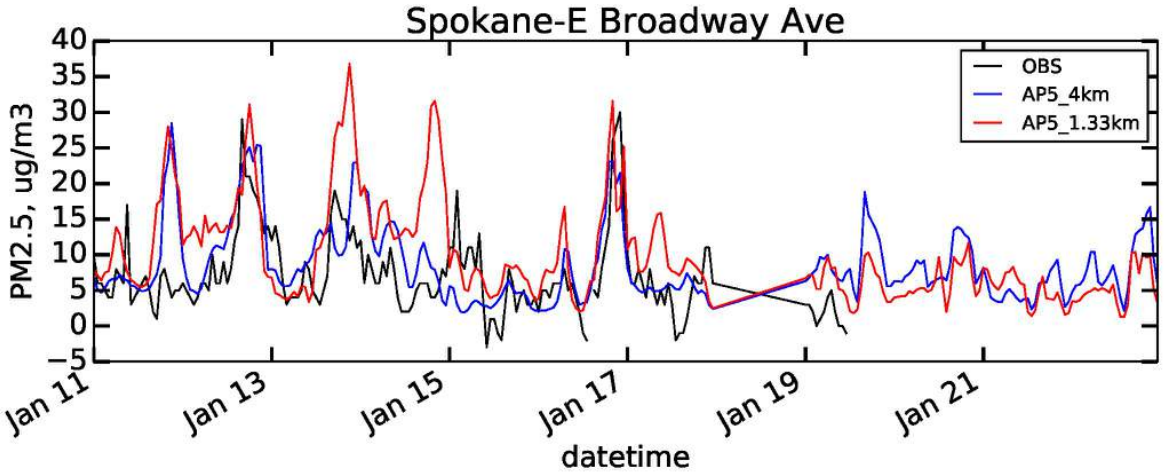


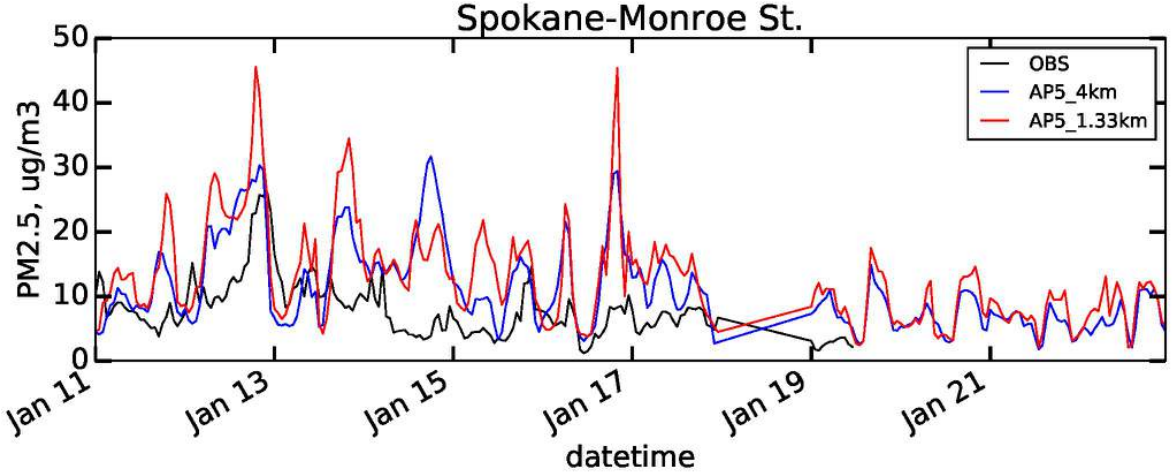
$PM_{2.5}$ at 4 km and 1.33 km for Jan 22, 2018

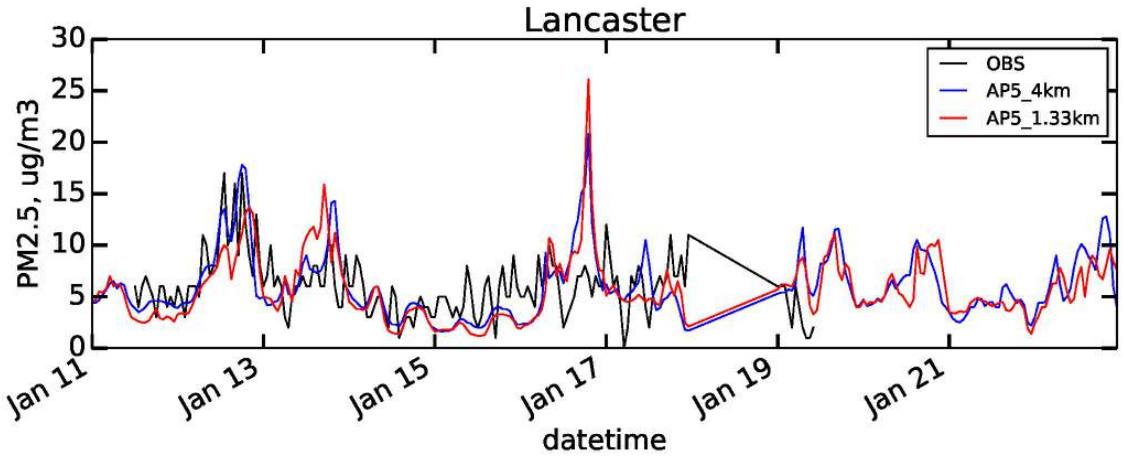


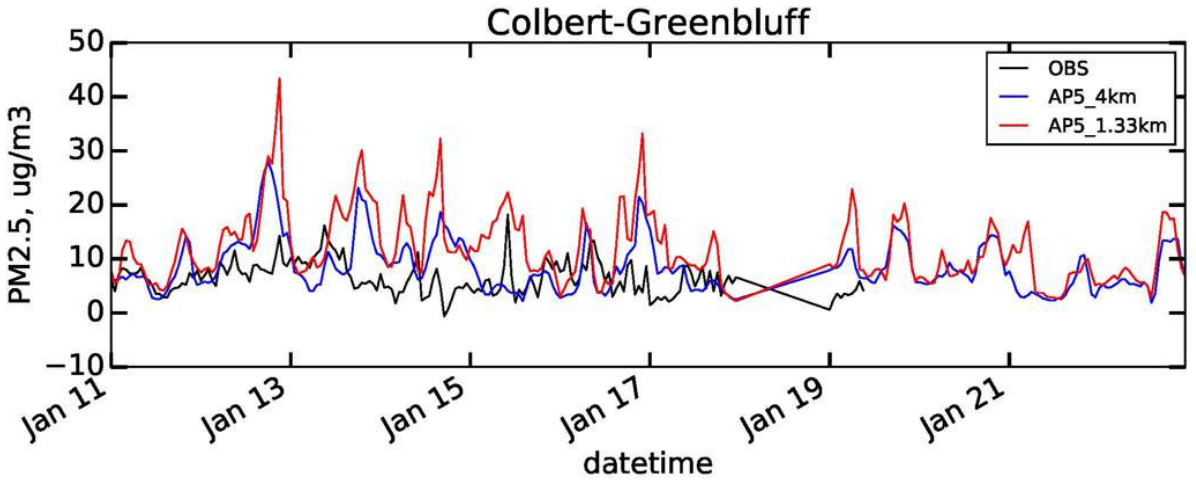
$PM_{2.5}$ at Spokane Urban Sites

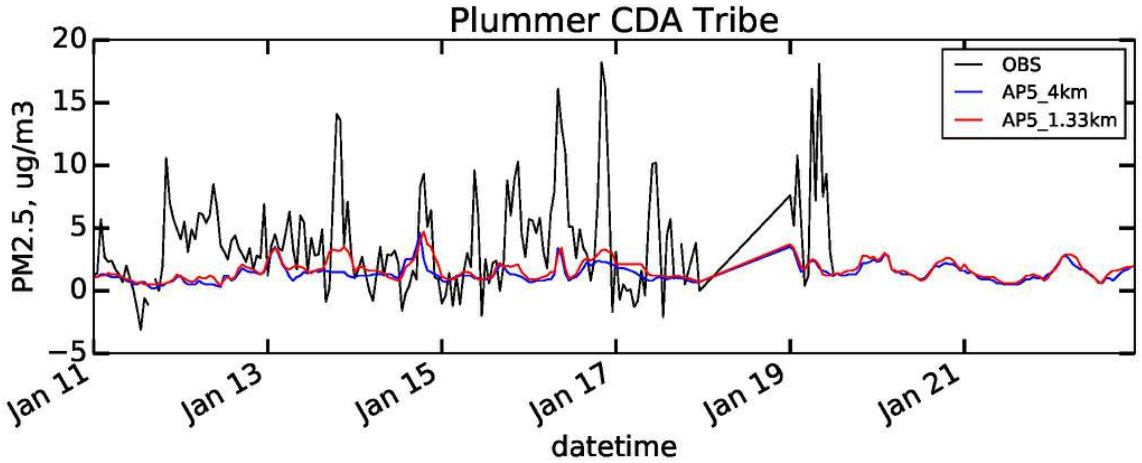




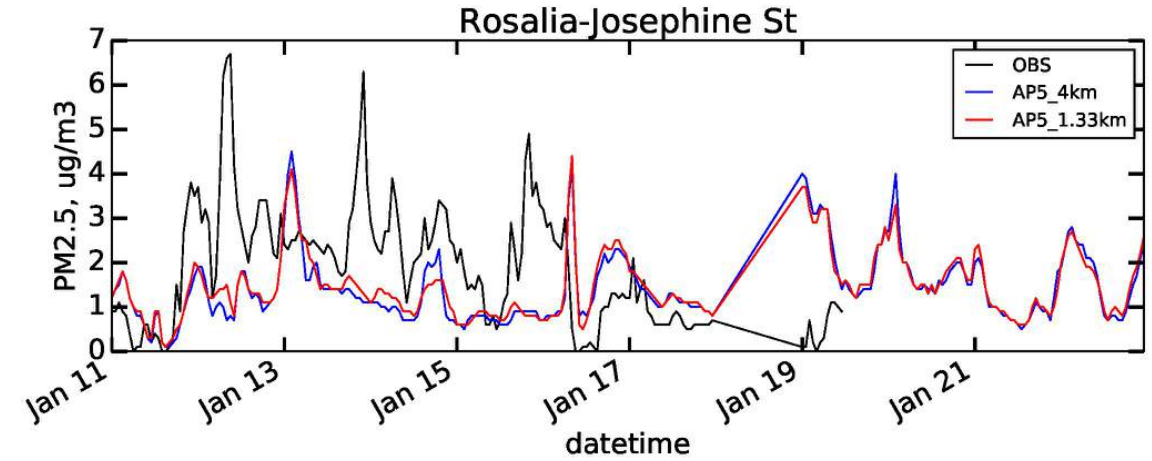


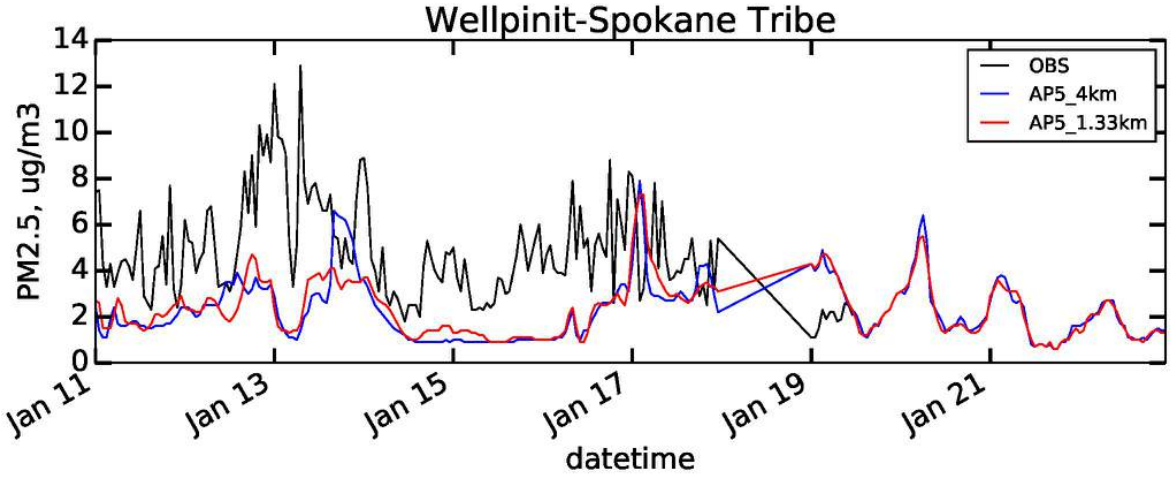






$PM_{2.5}$ at Rural Sites





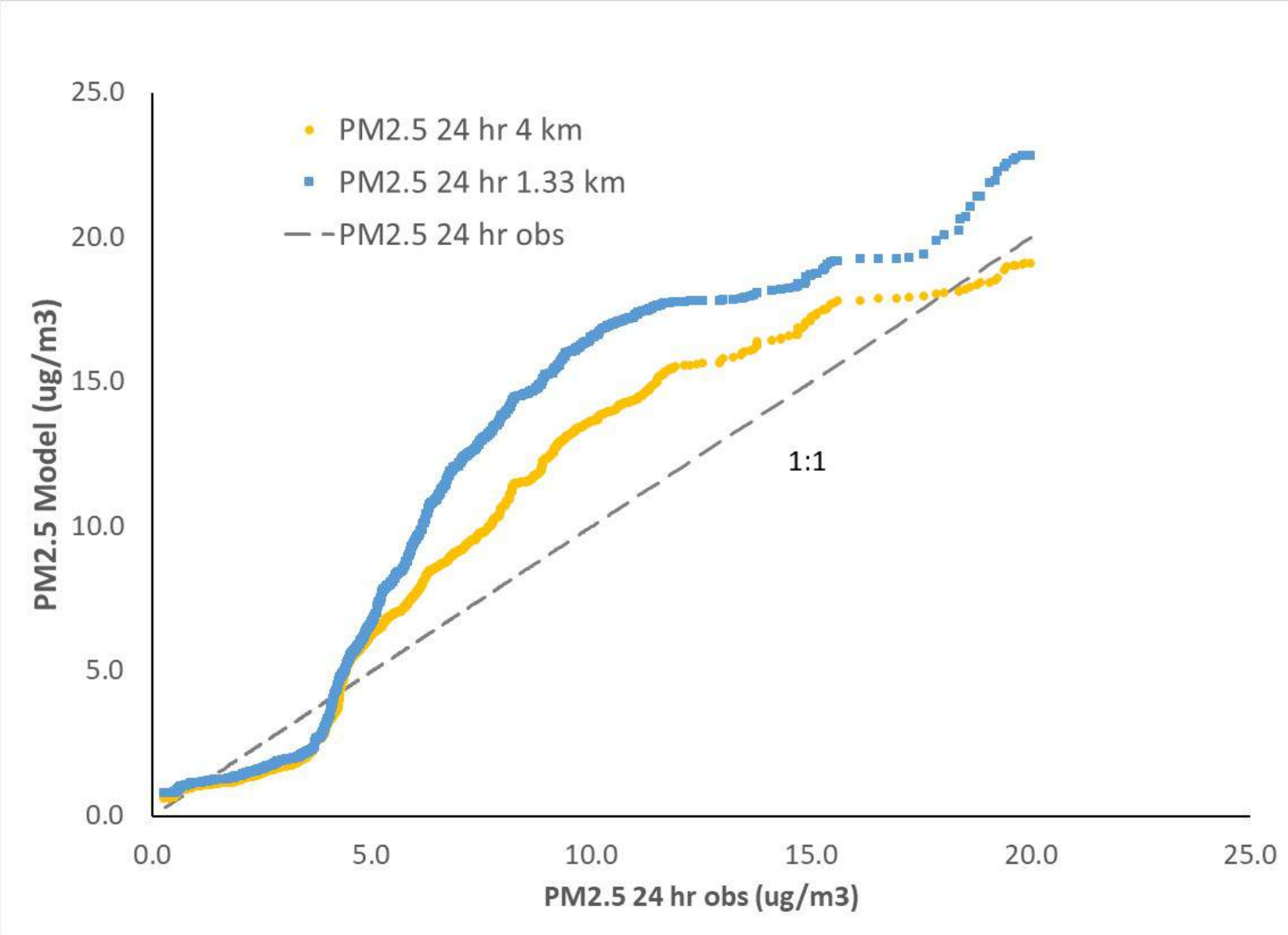
$PM_{2.5}$ Model Performance for the 4 km Domain, Jan 11-22, 2018

4 km Domain	Mean obs (ug/m³)	Mean (ug/m³)	Max Obs (ug/m³)	Max (ug/m³)	mean bias (ug/m³)	mean error (ug/m³)	% bias	% error
Spokane-Augusta Ave	9.1	9.8	20.0	18.0	0.6	2.9	6%	30%
Spokane-Monroe St.	6.8	11.2	15.6	19.1	4.4	4.6	39%	41%
Colbert-Greenbluff	6.1	8.6	10.3	14.7	2.5	3.0	29%	35%
Spokane-E Broadway Ave	6.0	8.5	11.9	14.4	2.6	2.9	30%	33%
Lancaster	5.5	6.0	9.7	9.2	0.5	1.3	9%	22%
Airway Heights-West 12th	4.9	5.7	7.5	9.2	0.7	1.9	13%	34%
Wellpinit-Spokane Tribe	4.3	2.3	8.0	3.7	-1.9	2.0	-82%	84%
Plummer CDA Tribe	3.8	1.4	6.7	1.9	-2.5	2.5	-178%	183%
Rosalia-Josephine St	1.7	1.5	3.4	2.3	-0.2	1.0	-14%	68%
	5.4	6.1	20.0	19.1	0.8	2.5	12%	40%

$PM_{2.5}$ Model Performance for the 1.33 km Domain, Jan 11-22, 2018

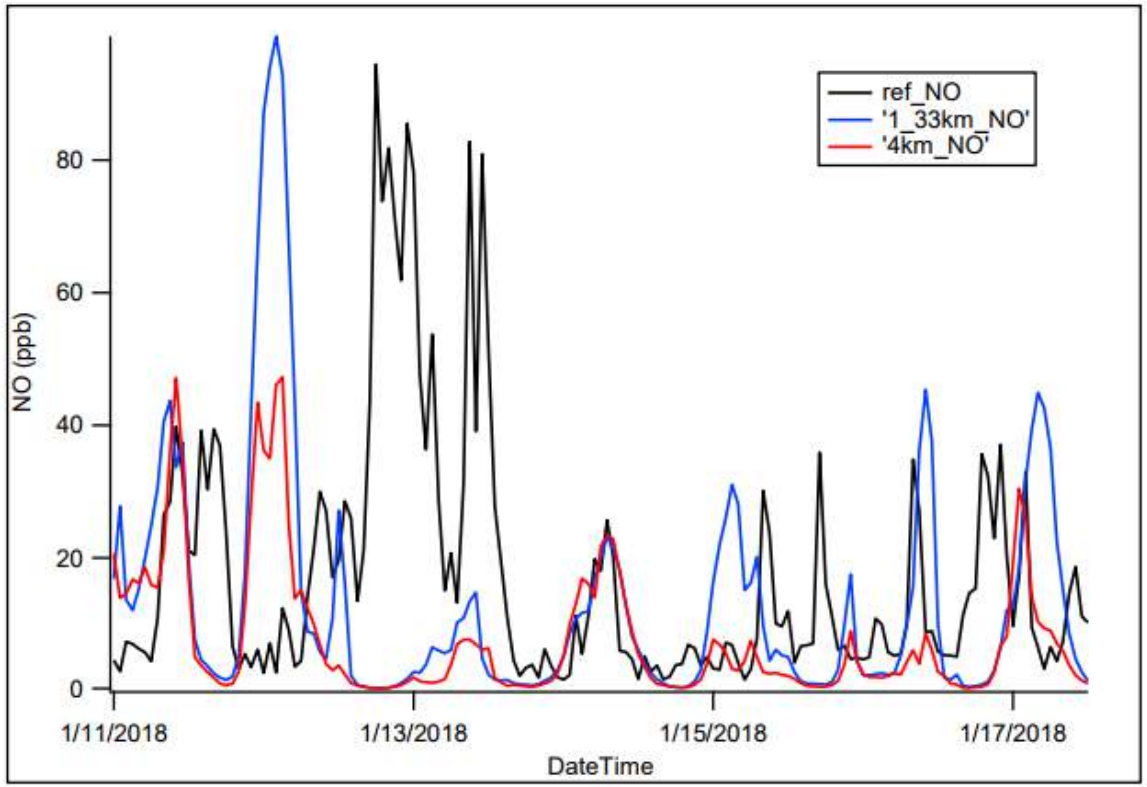
1.33 km Domain	Mean obs (ug/m^3)	Mean (ug/m^3)	Max Obs (ug/m^3)	Max (ug/m^3)	mean bias (ug/m^3)	mean error (ug/m^3)	% bias	% error
Spokane-Augusta Ave	9.1	11.0	20.0	18.8	1.9	3.0	17%	27%
Spokane-Monroe St.	6.8	13.1	15.6	22.8	6.3	6.3	48%	48%
Colbert-Greenbluff	6.1	12.1	10.3	18.1	6.0	6.0	50%	50%
Spokane-E Broadway Ave	6.0	10.1	11.9	19.3	4.2	4.2	41%	41%
Lancaster	5.5	5.7	9.7	8.8	0.2	1.5	3%	27%
Airway Heights-West 12th	4.9	7.6	7.5	12.8	2.7	3.0	35%	39%
Wellpinit-Spokane Tribe	4.3	2.4	8.0	3.9	-1.9	1.9	-79%	82%
Plummer CDA Tribe	3.8	1.7	6.7	2.4	-2.2	2.2	-129%	135%
Rosalia-Josephine St	1.7	1.5	3.4	2.3	-0.2	1.0	-11%	64%
OVERALL	5.4	7.2	20.0	22.8	1.9	3.2	26%	45%

$PM_{2.5}$ 24 hr ave, all sites, Spokane domain, Jan 11-22, 2018



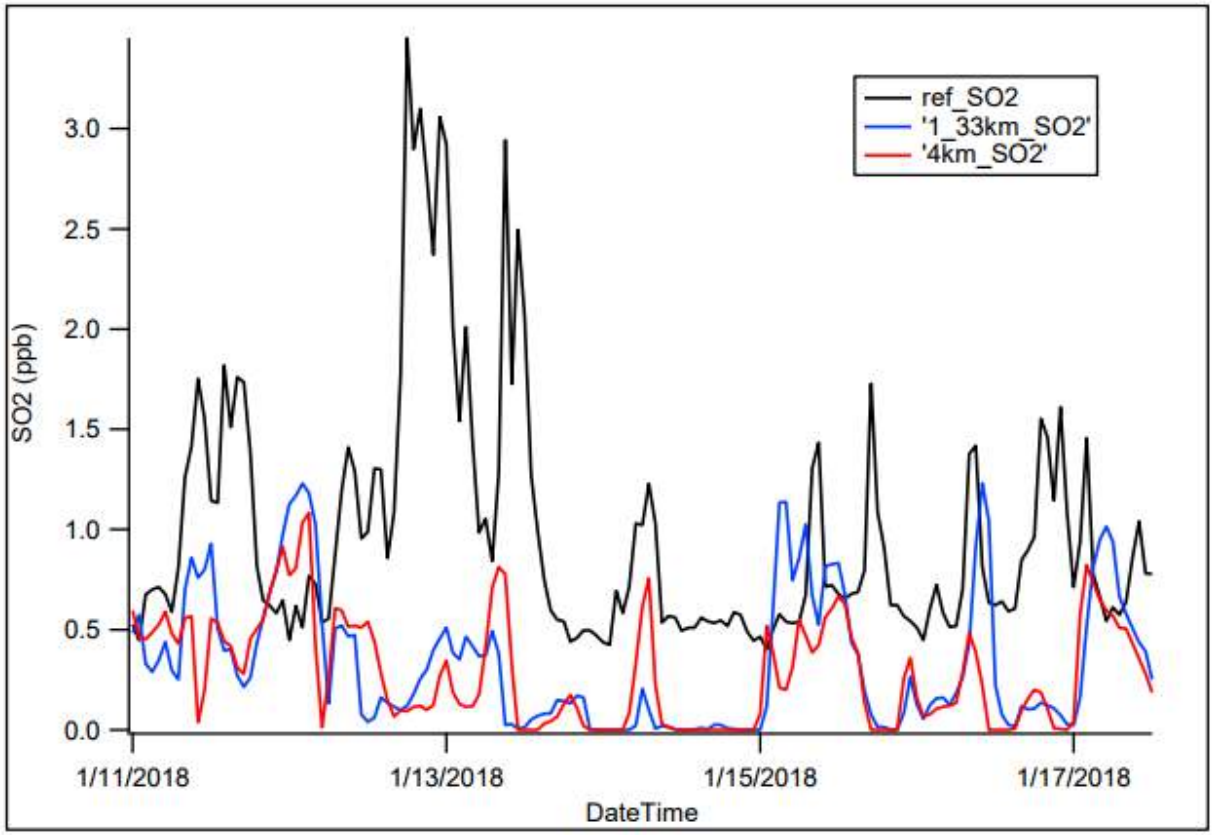
Performance Statistics for $PM_{2.5}$ in Spokane January 11-22, 2018

24 hr ave	4 km	1.33 km
	ug/m3	ug/m3
mean obs	5.4	5.4
mean model	6.1	7.3
mean bias	0.8	1.9
mean error	2.5	3.3
max obs	20.0	20.0
max model	19.1	22.8
stdev obs	3.1	3.1
stdev model	4.3	5.4

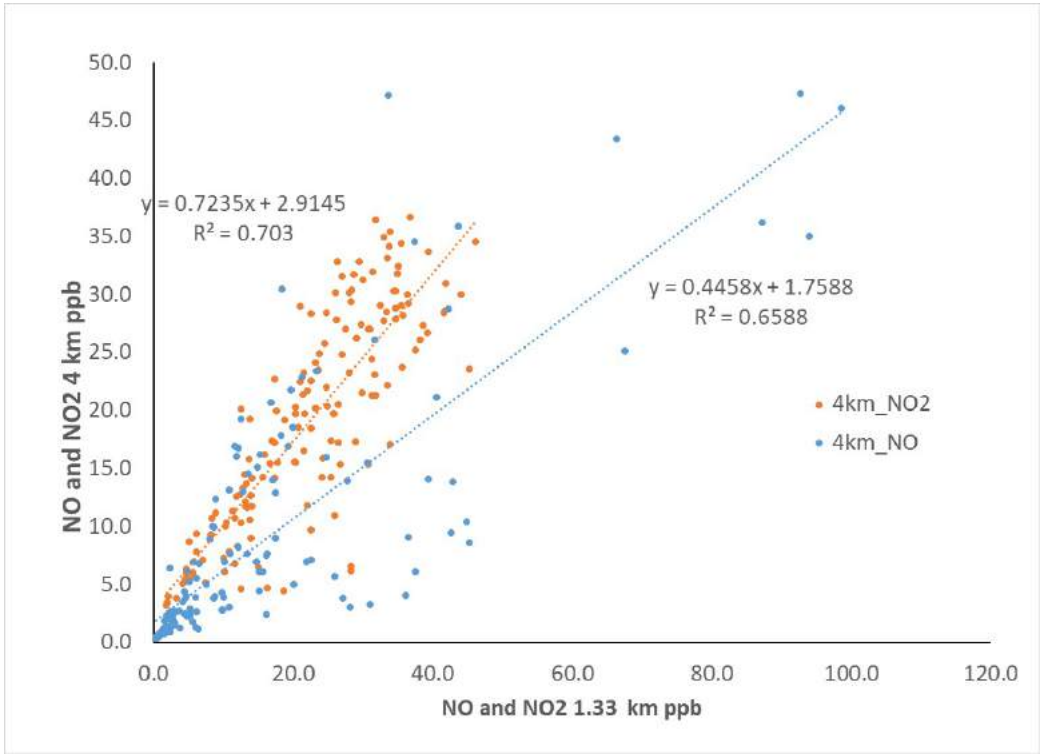


Reference site time series

- Apparent large plume hits from a NO/SO_2 source on 1/13/18
- Maximum NO magnitude is similar, but timing is off
- Other plume hits are sometimes captured and sometimes not

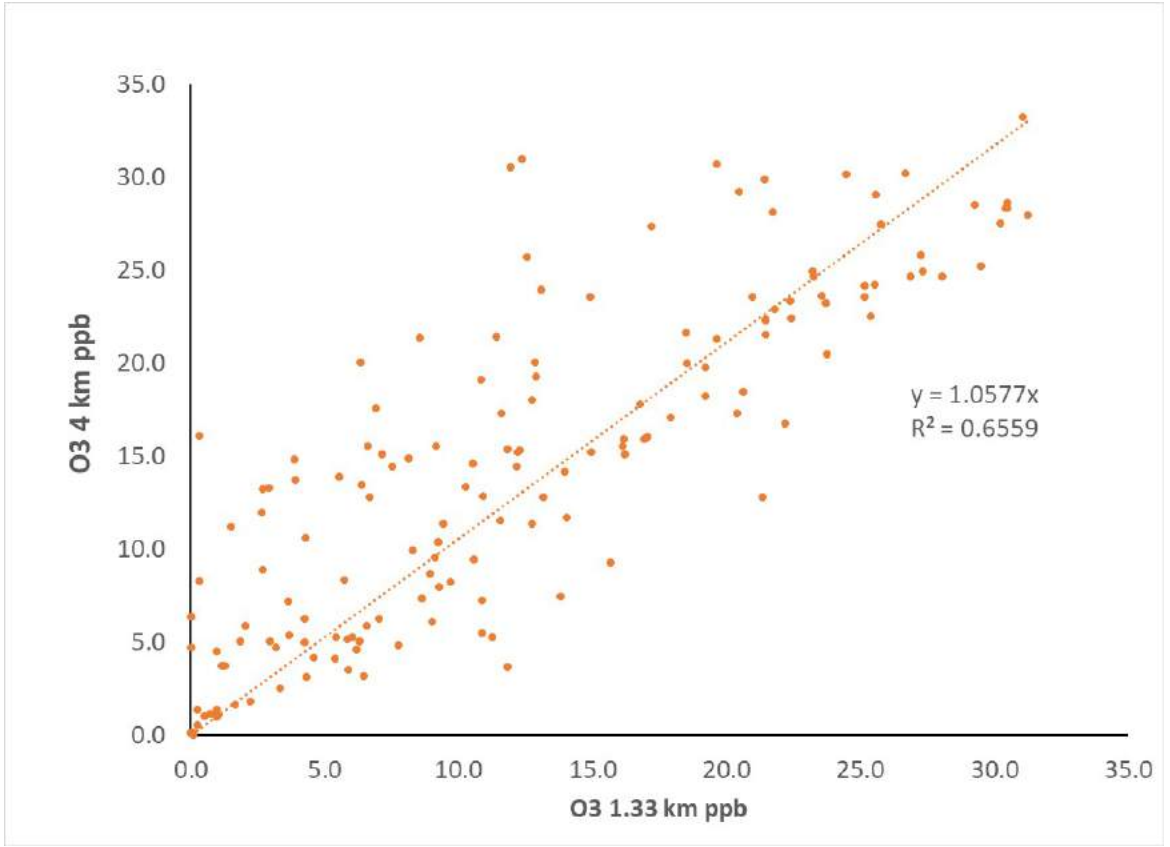


NO, NO_2 and O_3 at 4 km and 1.33 km at the reference site



Primary NO emissions are diluted more in the 4 km grid cells compared to 1.33 km grid cells.

Secondary NO_2 and O_3 are similar between the two grid size simulations



Looking Ahead

- Moving to 1.33 km hasn't changed the PM issues with overestimation in urban areas and underestimation in rural areas—we continue to have problems with PM emission inventories
- A new 1.33 km forecast web site will be implemented
- We are just beginning discussions about how to compile the required urban data layers for using WRF-Urban (NUDAPT—building footprints, heights, etc)
- New sensors will be deployed this spring within the Urbanova domain
- NSF proposal on Smart & Connected Cities is in preparation—due Feb 28

Questions?

What is Urbanova?

urbanova
rethinking cities

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

urbanova
rethinking cities

AVISTA

CITY OF SPOKANE

Itron

McKinstry
For The Life Of Your Building

University District

WASHINGTON STATE UNIVERSITY

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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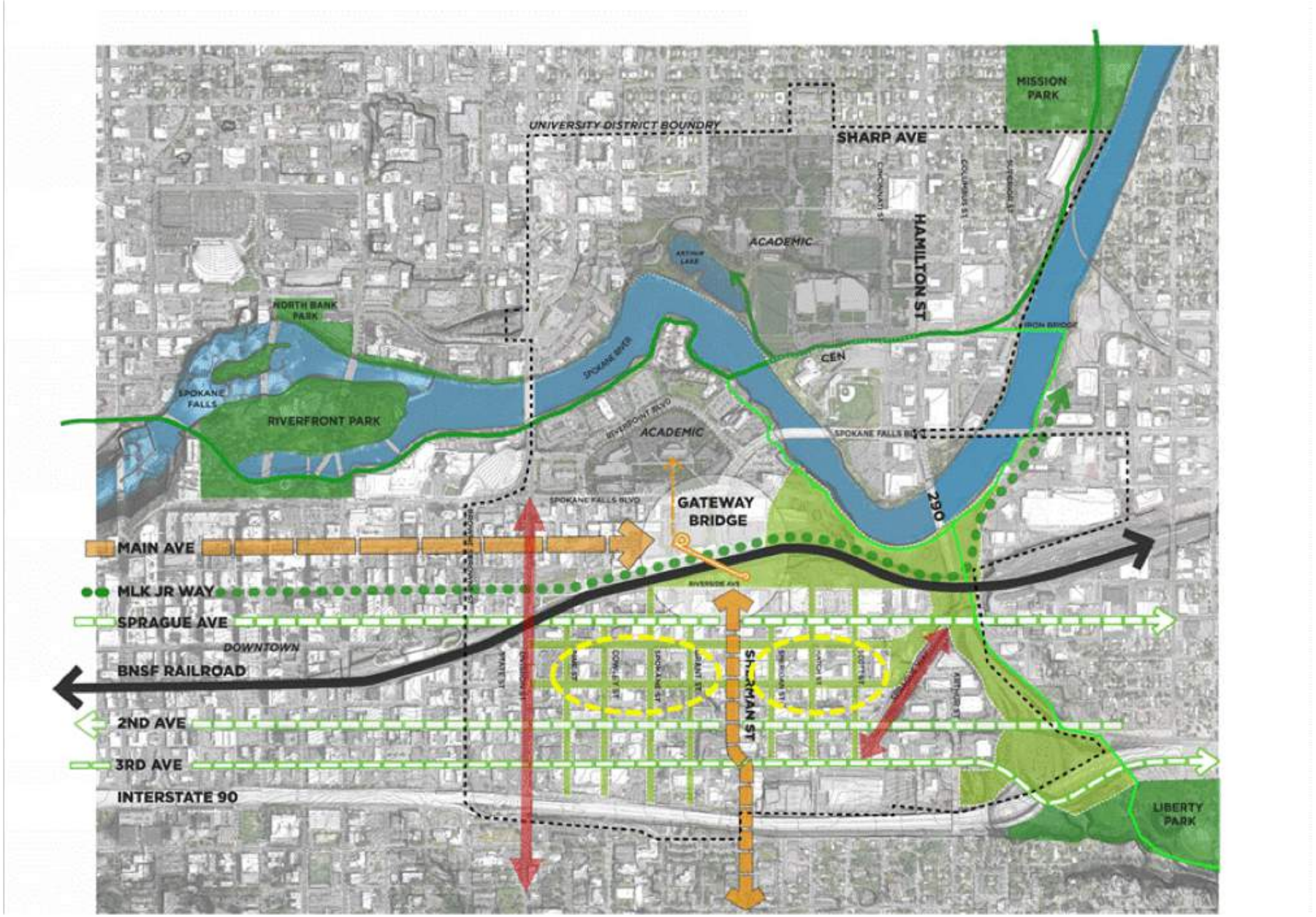
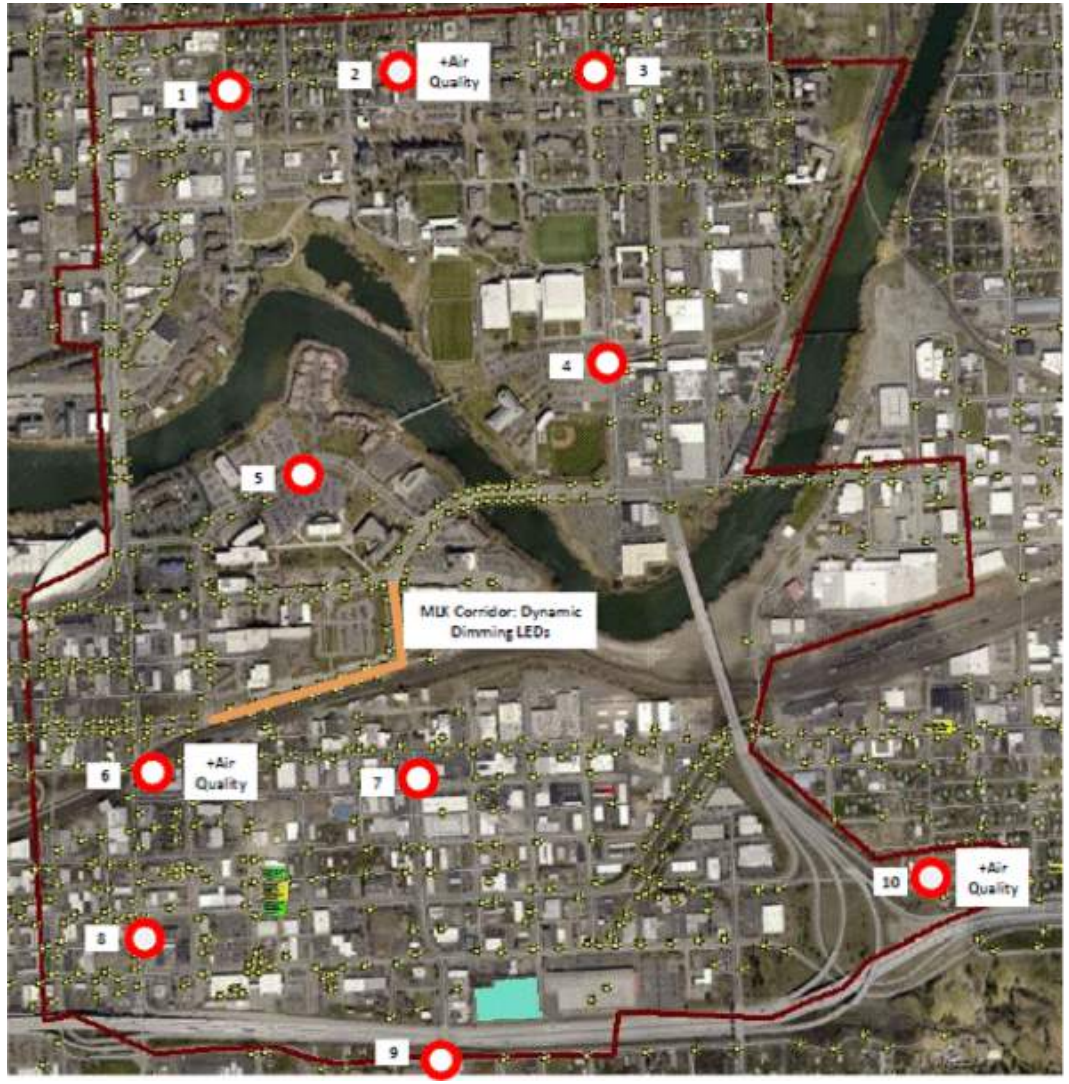
Spokane University District

- 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

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



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