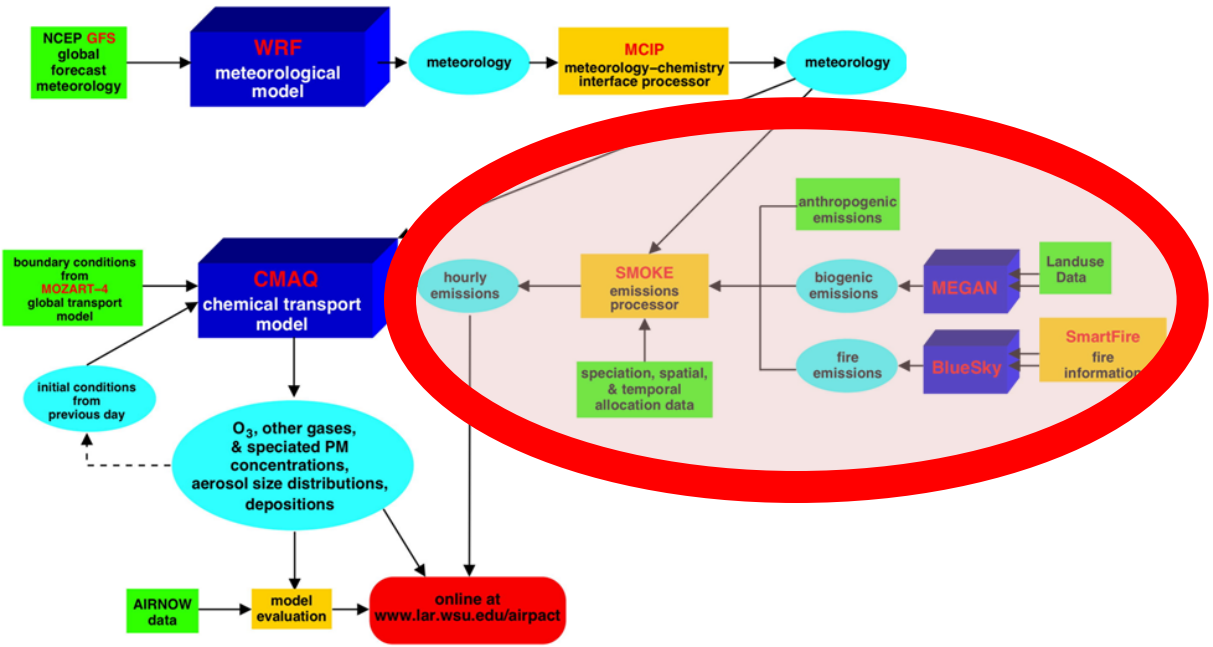
Laboratory for Atmospheric Research
Washington State University

Working Group report-outs:

1) **Emission Inventories:**
   - SMKREPORT project
   - Potential future projects
2) **Model Evaluation:**
   - Winter PM2.5
   - Kennewick Ozone



Presented by Farren Herron-Thorpe

NW-AIRQUEST Mtg.
June 15, 2016

Washington State Department of Ecology

Emissions Reporting

An emissions reporting tool was installed so that daily emissions could be compared to the annual inventory. This "SMKREPORT project" should help inform us of potential issues in the EI.

Emissions Reporting from SMOKE – Current Setup:

- Daily emissions reports are combined to make monthly summaries (avg. daily)
- All reporting done at the county level
- Sub-sector reporting by partial SCC (e.g 301xxxx or 2114xxxxxx)

Pollutants Included in Final Summary:

- CO, NH3, SO2, NOx, VOCs, PM2.5, PM10

Other Details:

- Fires from BlueSky not currently included (can be added)
- Biogenics (MEGAN) not included (would require separate methodology)
- MOVES process does not allow SCC-level reporting (diesel and gasoline combined)

Laboratory for Atmospheric Research
Washington State University

Emissions Reporting

Sectors for Emissions Reporting:

- Point Sources
  - "points" - includes large facilities, airports, railyard equipment, etc.
- On-Road Mobile Sources
  - "moves_rpd" – on roadway (driving)
  - "moves_rpv" – off-network (parked vehicles)
  - "moves_rpp" – evaporation from fuel tanks of parked vehicles
- Non-Road mobile sources
  - "nonroad" – off-road mobile vehicles, railroad equipment, pleasure craft
- Residential Wood Combustion
  - "rwc_tpy" – woodstoves, fireplaces, etc.
- Other area sources
  - "all_other" – roadways, fuel combustion, waste disposal, construction, mining, agricultural activity, open burning, railroad equipment, etc.
    - ❑ broken out separately in the upcoming samples

Upcoming Slides – smkreport samples for metropolitan areas:

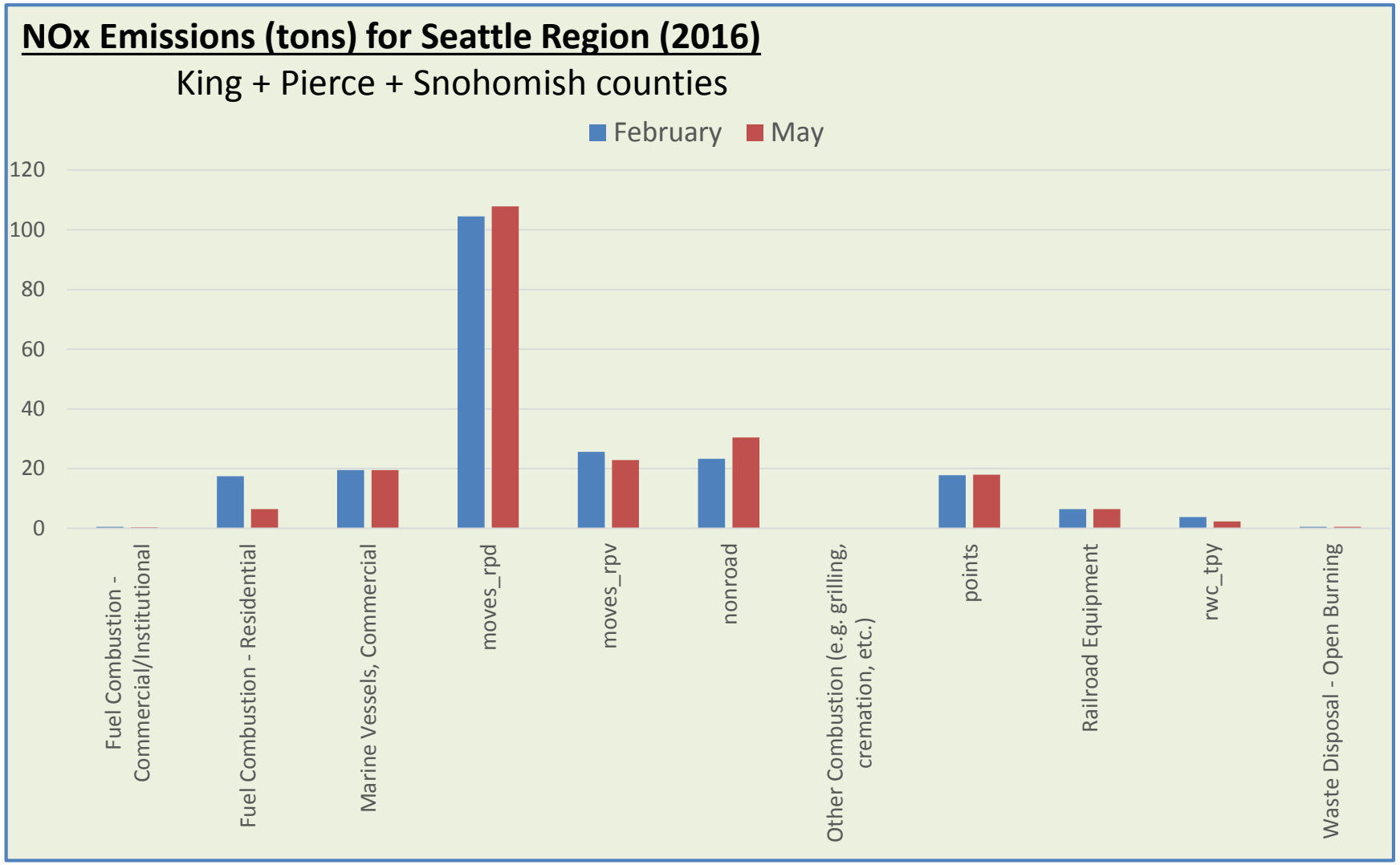
Seattle Region = King + Pierce + Snohomish counties

Portland Region = Multnomah + Marion + Washington + Clackamas + Yamhill counties

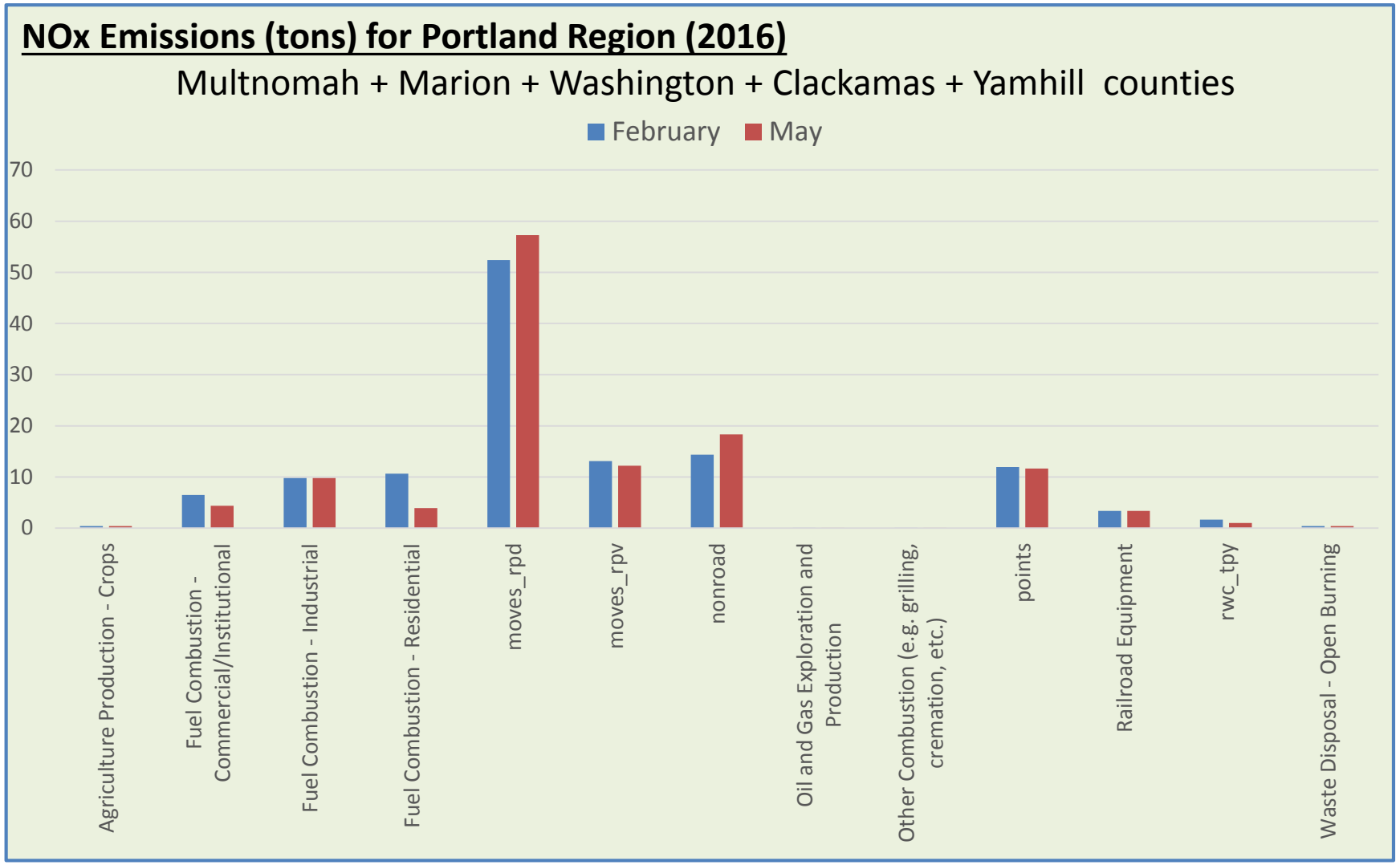
Boise Region = Ada + Boise + Canyon + Gem counties

Washington State Department of Ecology

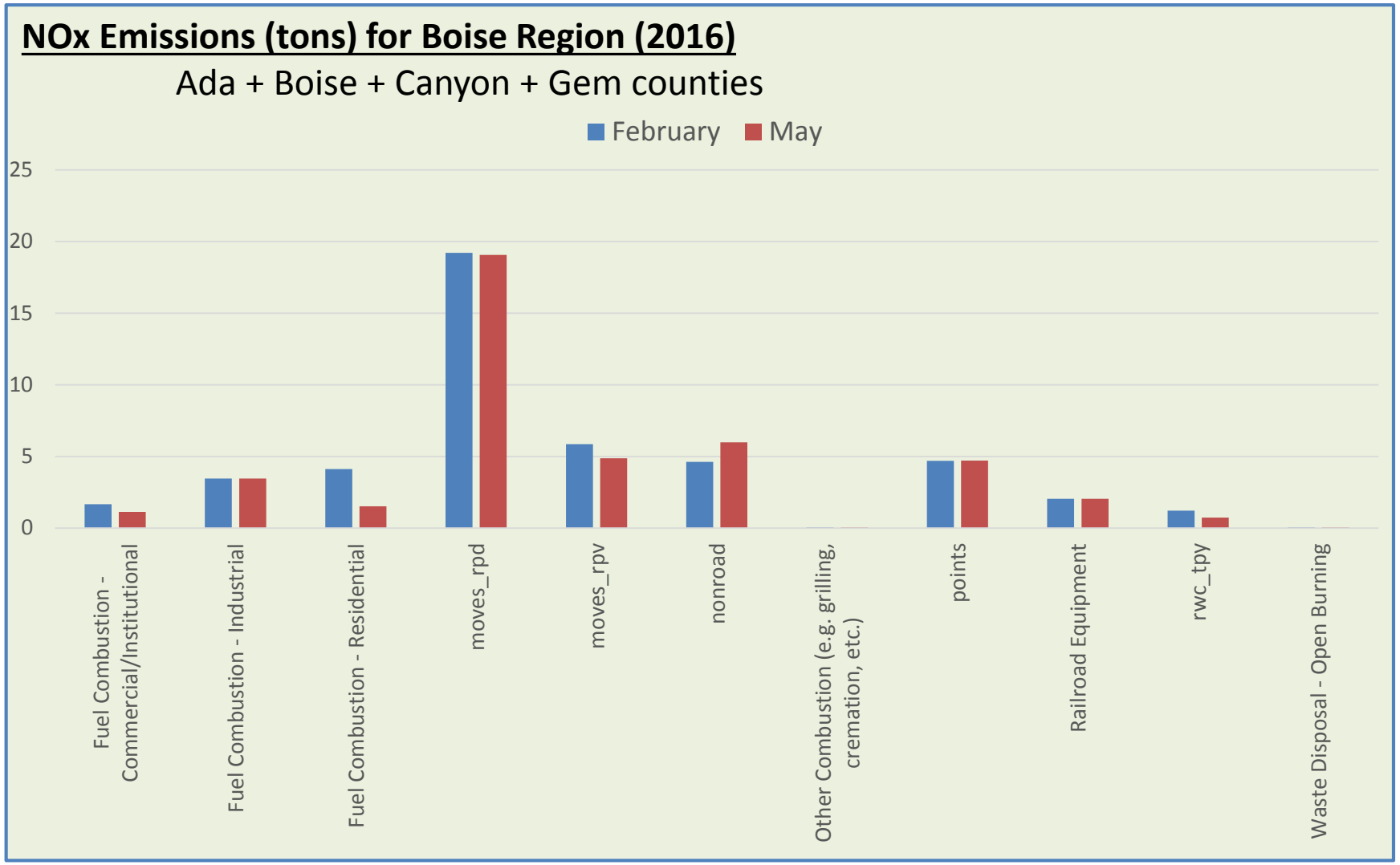
NOx Emissions Reporting



NOx Emissions Reporting



NOx Emissions Reporting



AIRPACT-5 PM2.5 Performance

PM2.5 Emissions (Feb. 2016):

Seattle Region:

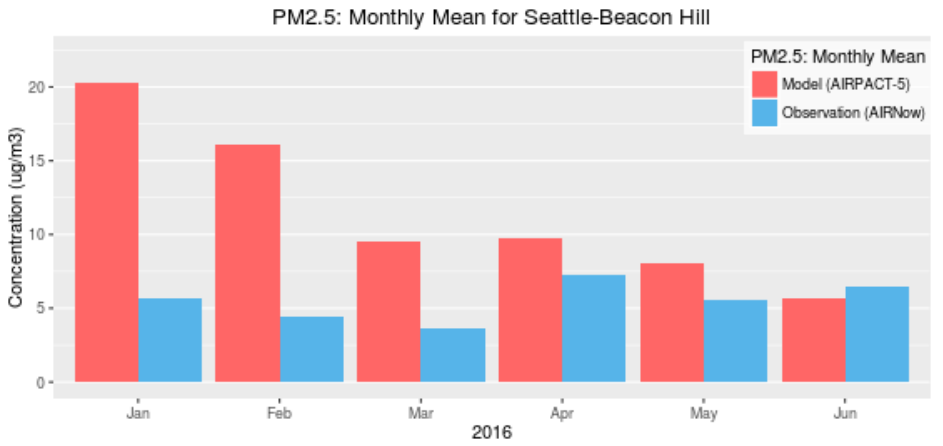
- RWC = 53% of PM2.5 emis
- dust was 20% of PM2.5 emis;

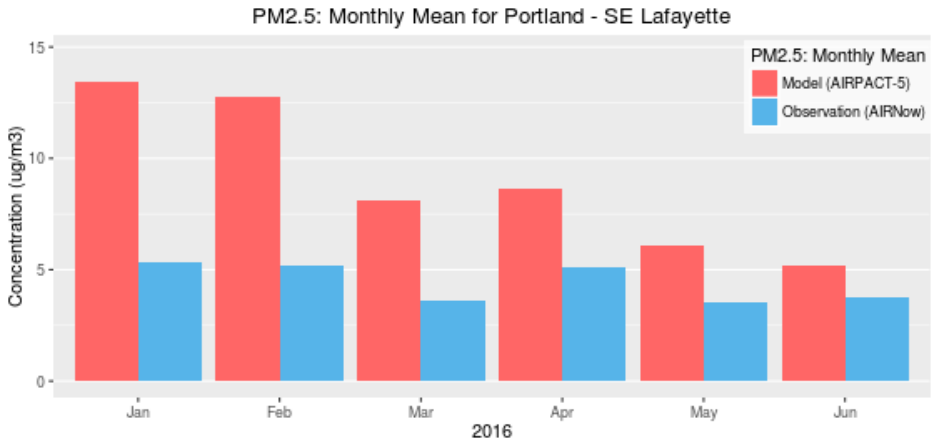
Portland Region:

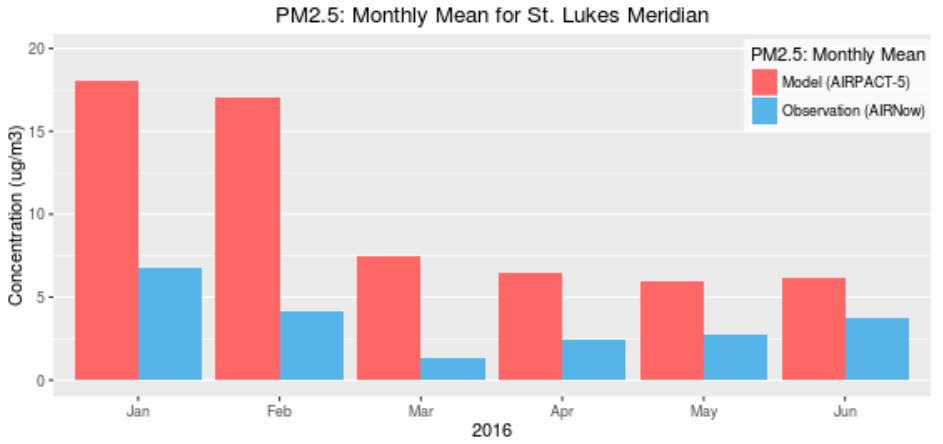
- RWC = 30% of PM2.5 emis
- dust sources were 32% of PM2.5

Boise Region:

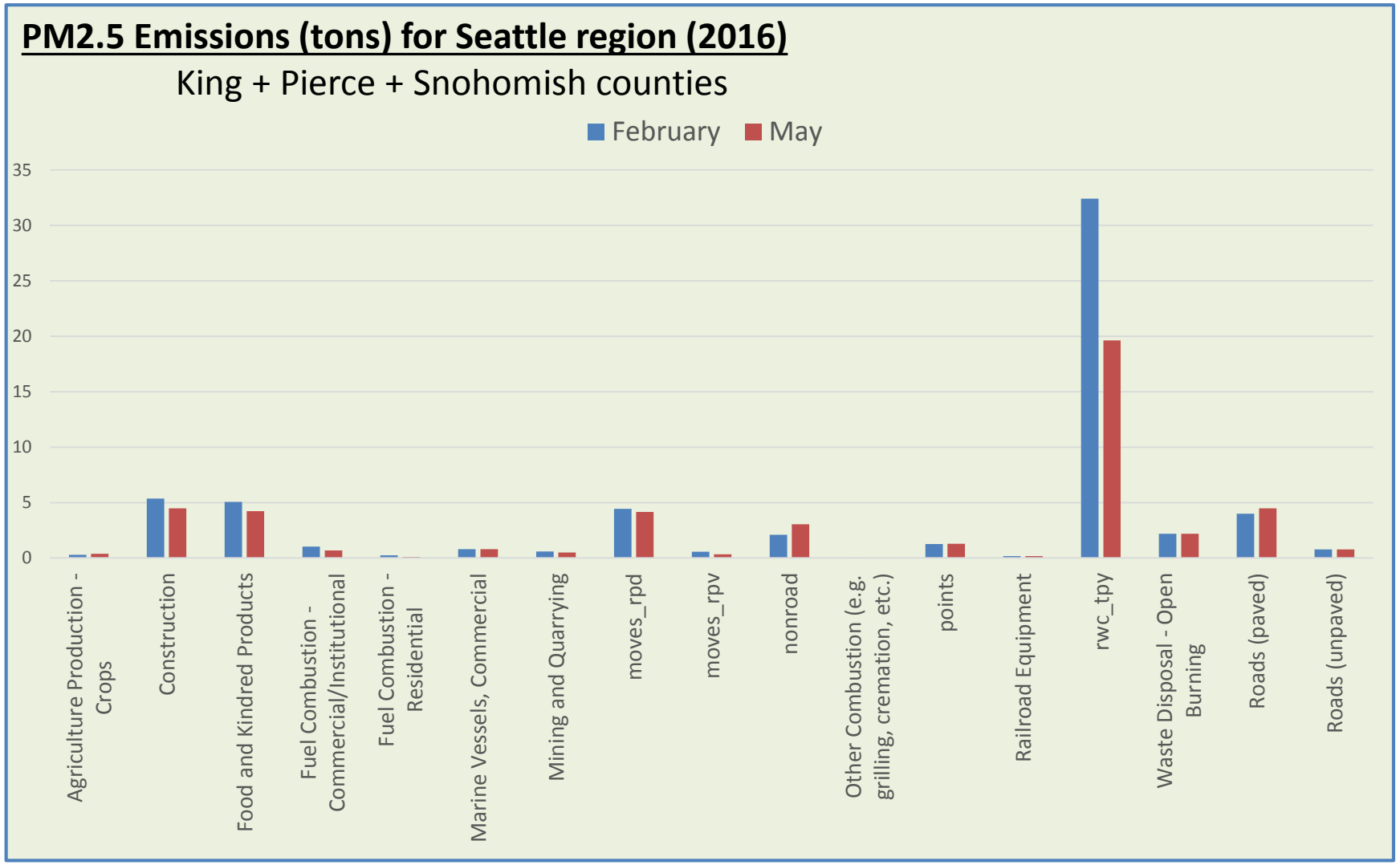
- RWC = 34% of PM2.5 emis
- dust was ~50% of PM2.5 emis



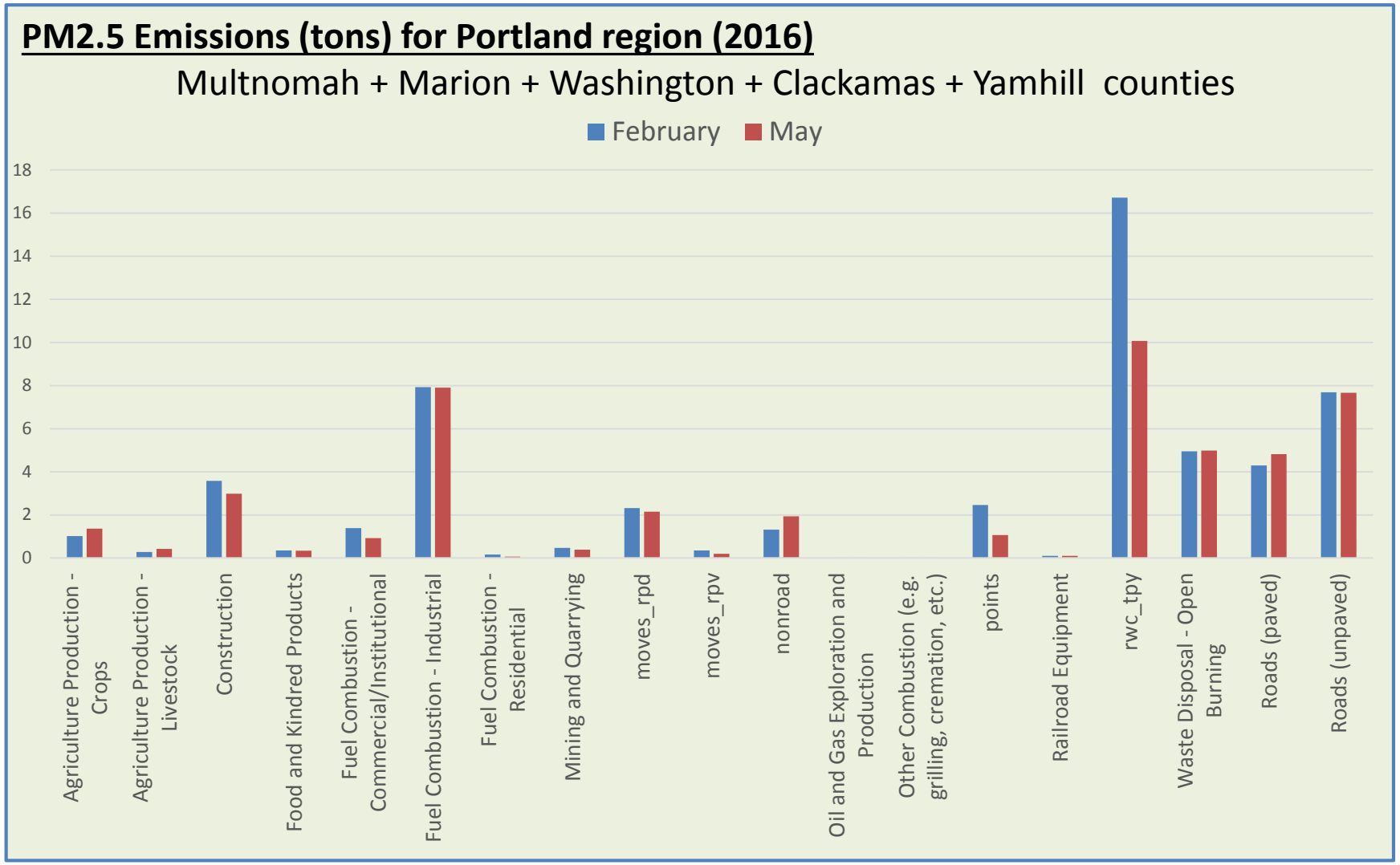




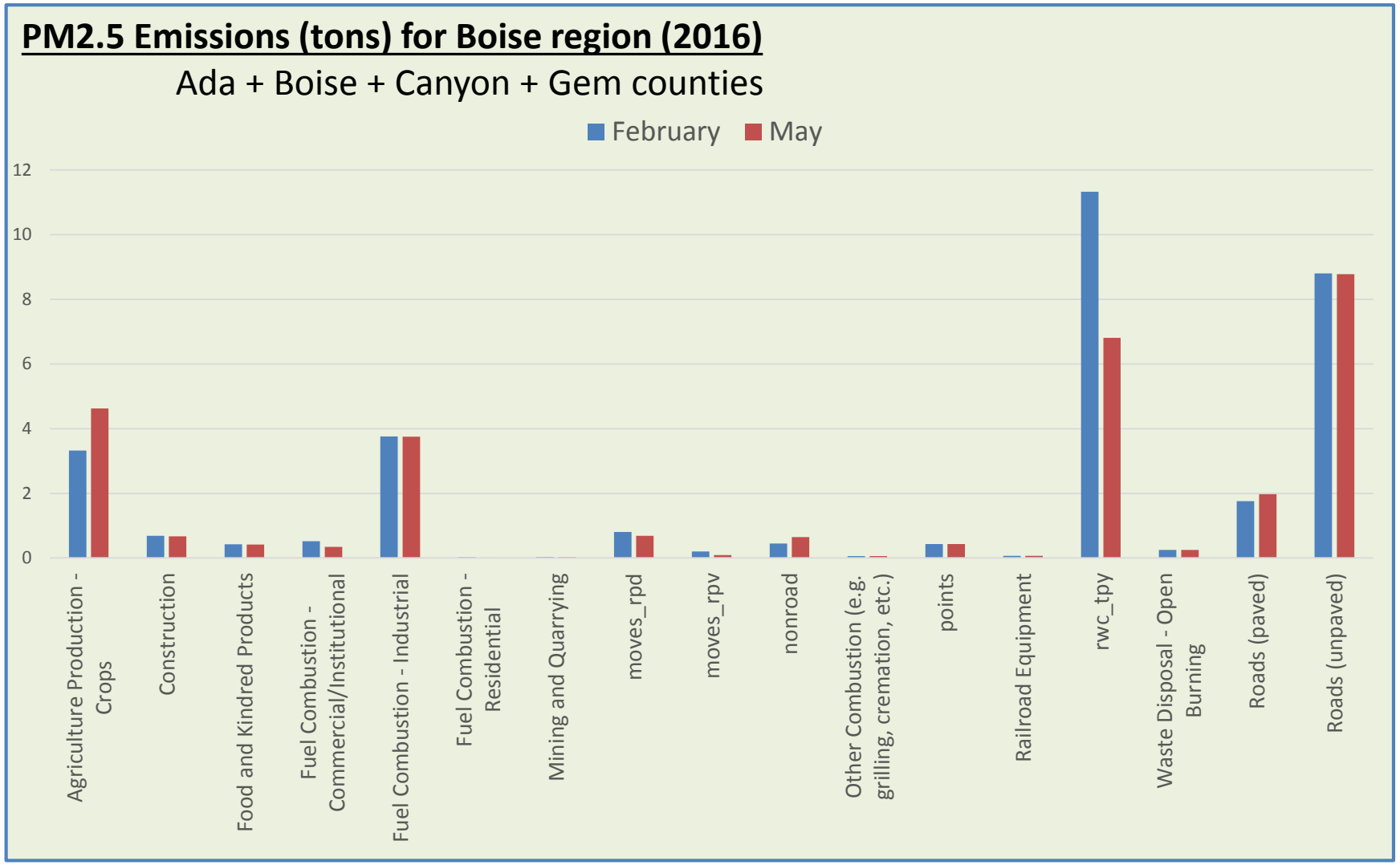
PM2.5 Emissions Reporting



PM2.5 Emissions Reporting



PM2.5 Emissions Reporting



Notes

SMOKE Reports:

- Jen will be setting up a webpage that allows users to query monthly reports by county, sector, pollutant, and month
- Annual summary will be compared to the EI inputs once 2016 is complete.
- "All Data" monthly csv tables can be posted too

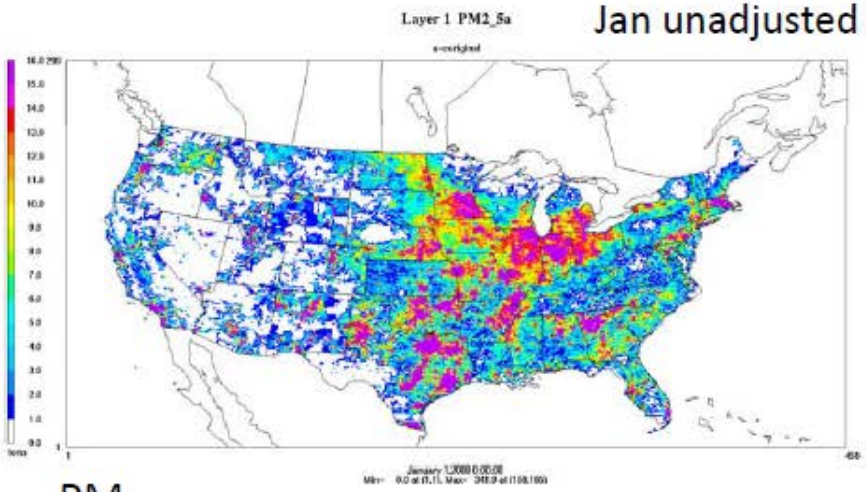
Dust Suppression:

- A "zero RWC" simulation for January 2016 still over-predicted PM2.5
  - Road dust identified as issue
- Area Fugitive Dust Module (AFDust) will require creation of a custom sector that only includes fugitive dust sources
  - paved and unpaved road dust, agricultural tilling, construction, etc.
  - New adjustments developed by George Pouliot (EPA ORD)
  - Transportable fraction
    - uses Biogenic Emissions Land-use Database v3 (BELD3; used by BEIS)
  - Meteorological adjustment
    - Snow and rain suppresses PM emissions
    - Snow on ground OR top 1cm of soil > 50 % saturated -> dust emissions = 0

New Methods: afdust met adjustment

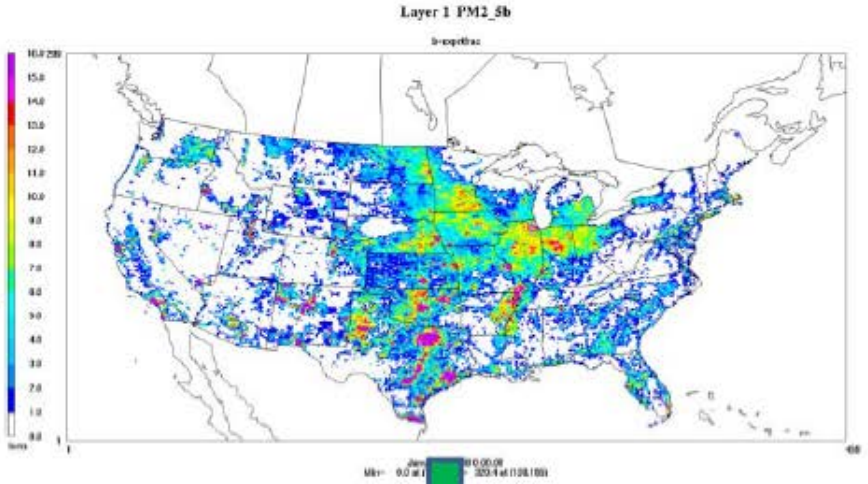
United States Environmental Protection Agency

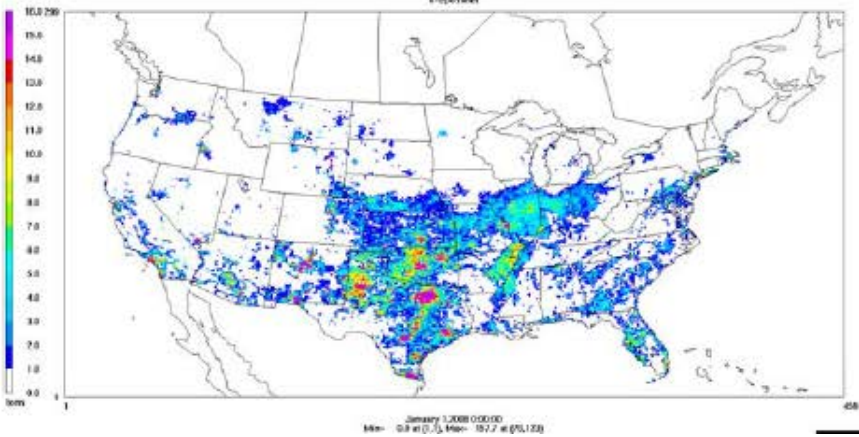
Jan unadjusted



$PM_{2.5}$

Jan transport fraction adj.





Jan transport fraction and met adj.

AIRPACT-5 PM2.5 Performance

PM2.5 Emissions (Feb. 2016):

Seattle Region:

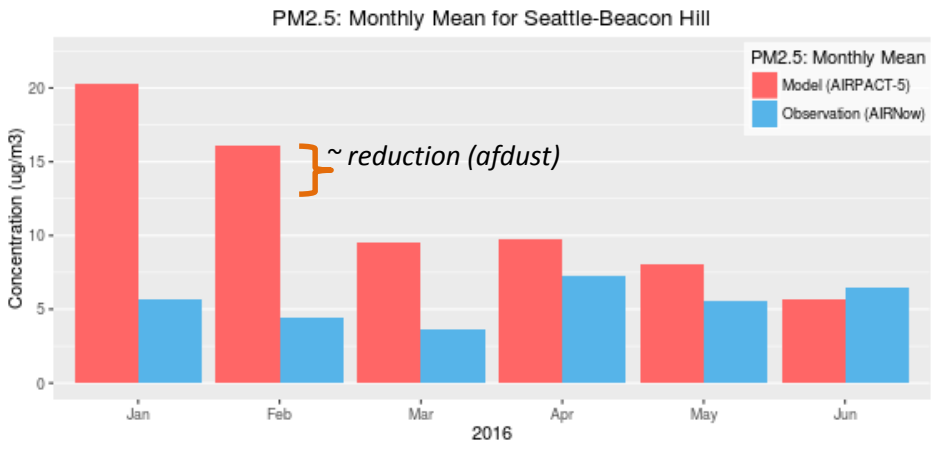
- RWC = 53% of PM2.5 emis
- dust was 20% of PM2.5 emis;
- dust suppression would be 100%
  - wet for whole month

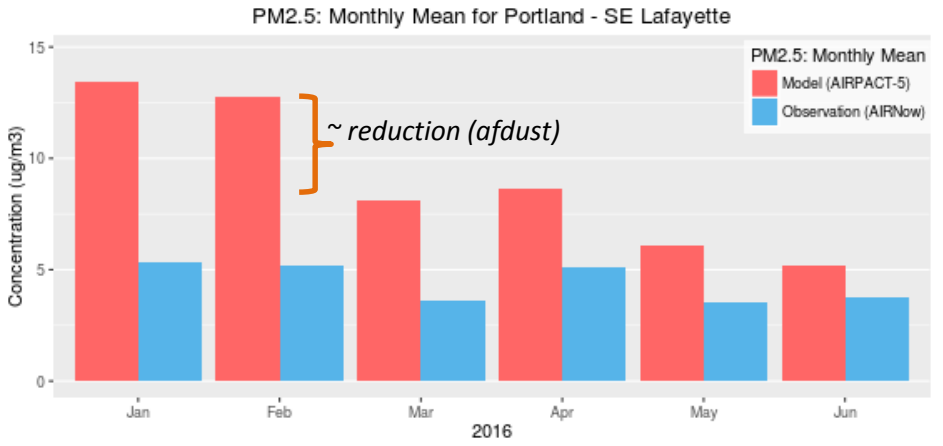
Portland Region:

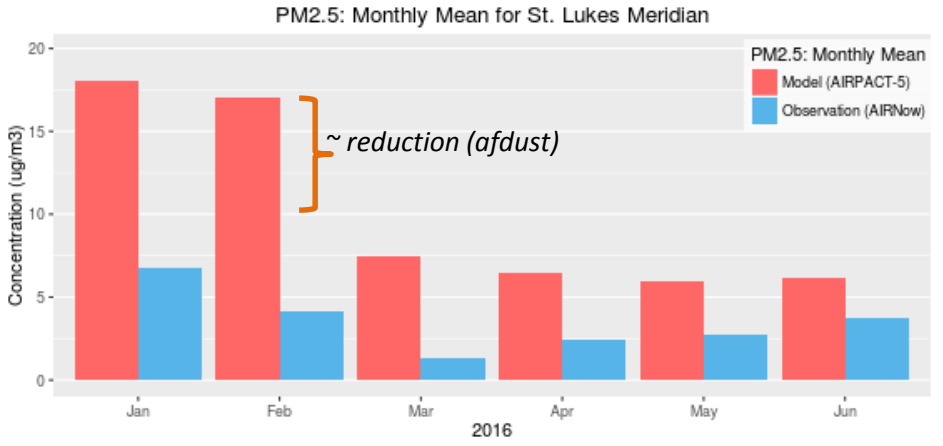
- RWC = 30% of PM2.5 emis
- dust sources were 32% of PM2.5
- dust suppression would be 100%
  - wet for whole month

Boise Region:

- RWC = 34% of PM2.5 emis
- dust was ~50% of PM2.5 emis
- dust suppression would be ~75%
  - wet or snow for most of month





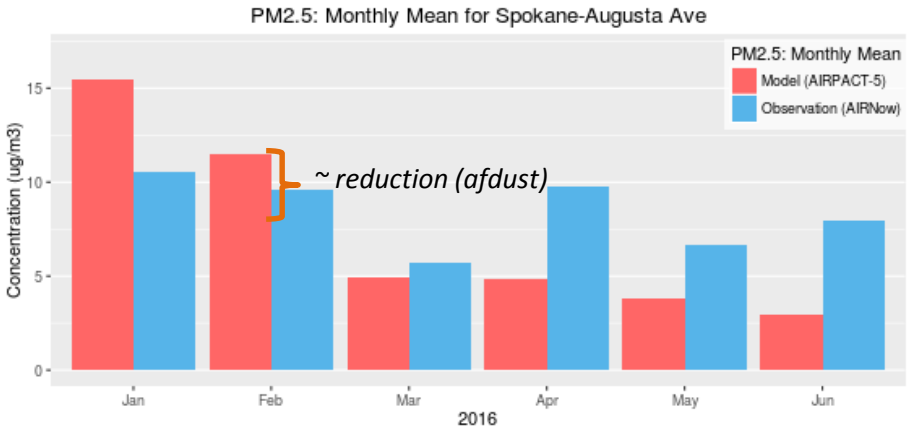


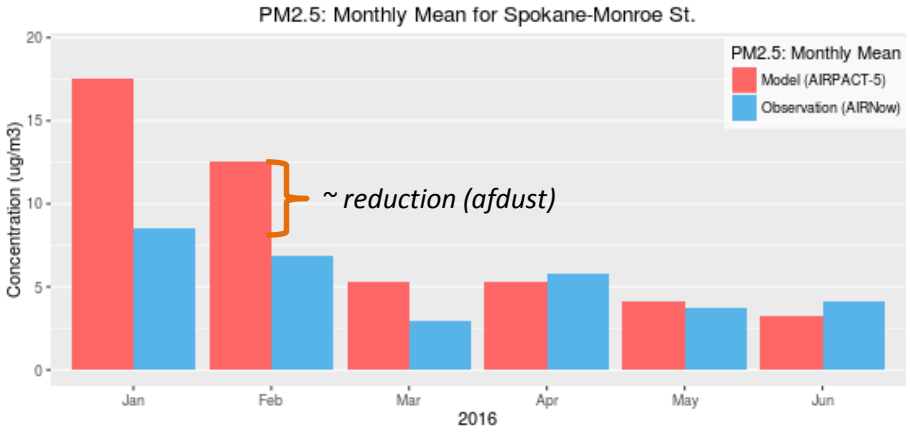
AIRPACT-5 PM2.5 Performance

PM2.5 Emissions (Feb. 2016):

Spokane County:

- RWC = 35% of PM2.5 emis
- dust was 47% of PM2.5 emis;
- dust suppression would be ~80%
  - wet or snow for most of month





Issues / Future Work

Dust Suppression:

- Area Fugitive Dust Module (AFDust) also requires new methodology for WRF/MCIP
  - Soil Type (STLYP) needed in WRF output (Dave Ovens made the change)
  - Soil temperature and moisture (SOIT1 and SOIM1) also need to be added to the MCIP process

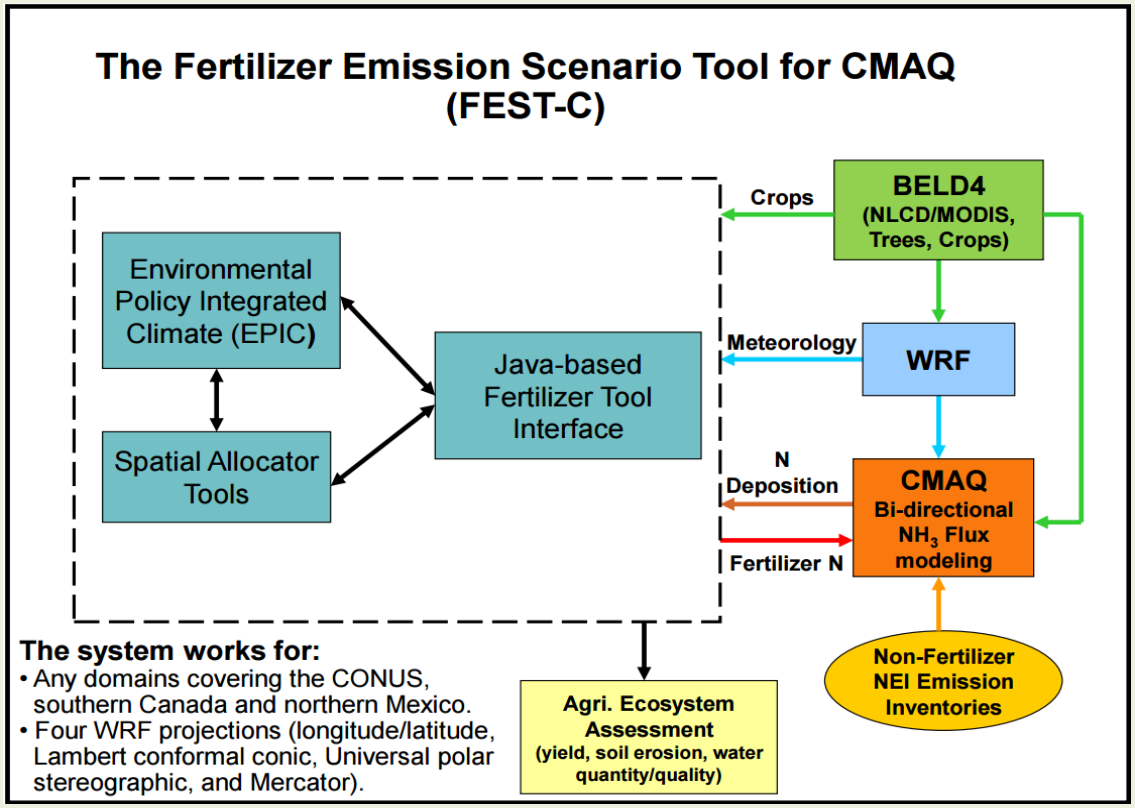
- If the dust suppression module is not running before our next cold season:
  - we could use temporal profile adjustments to zero out fugitive dust emissions

Laboratory for Atmospheric Research
Washington State University

Other EI Topics

Fertilizer Application (NH3 Emissions):

- EPA has an updated method to calculate fertilizer emissions of ammonia

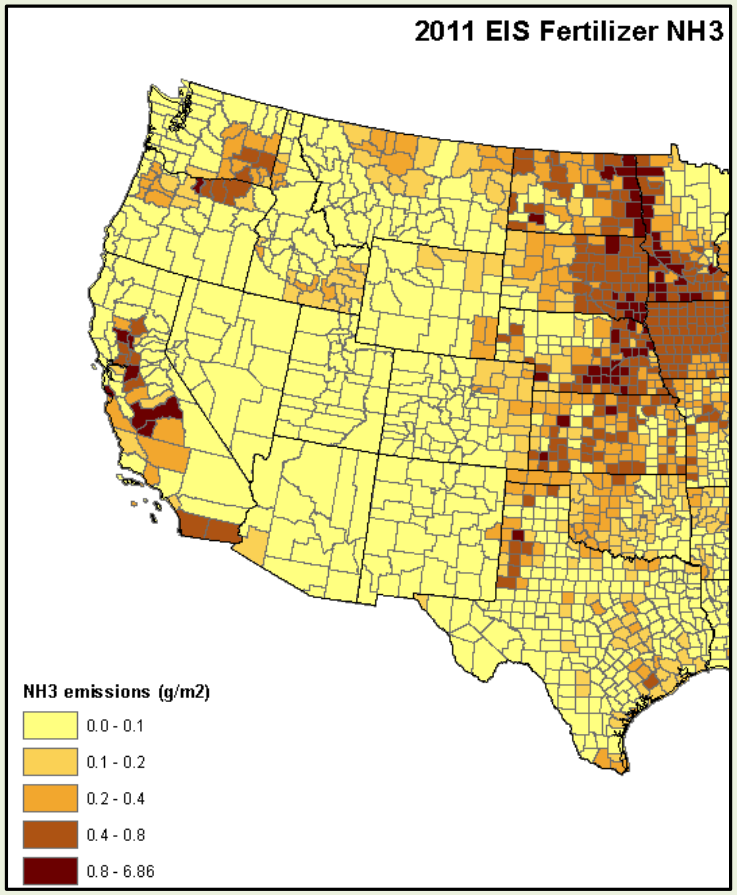


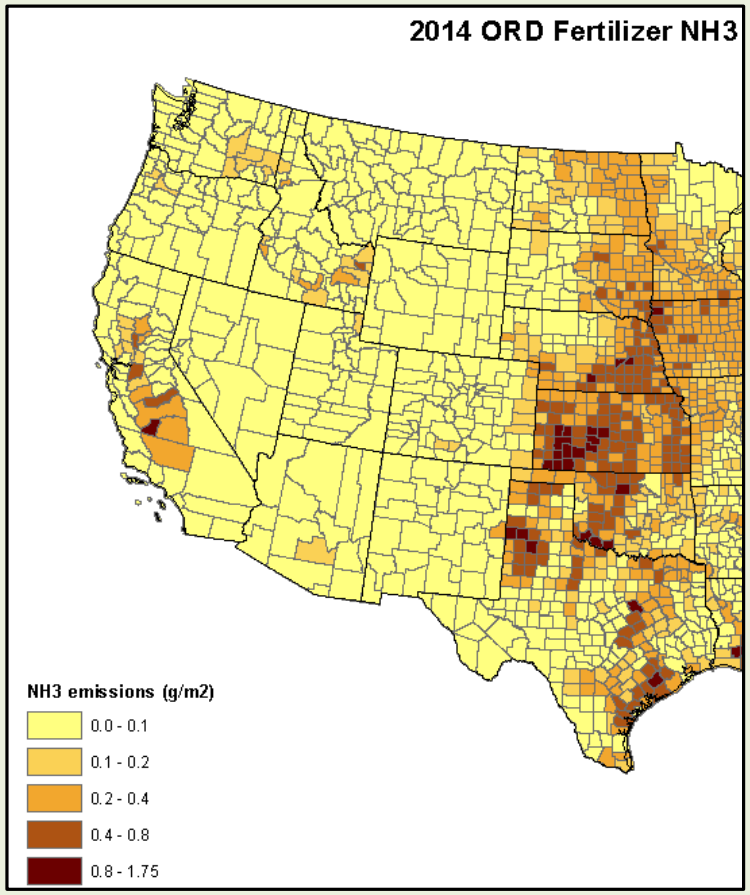
- Environmental Policy Integrated Climate (EPIC) modeling system produces NO_3, Ammonium (including Urea), and organic (manure) nitrogen fertilizer estimates.

Washington State Department of Ecology

Other EI Topics

Fertilizer Application (NH3 Emissions):





Is this something we want to pursue for AIRPACT5?

Laboratory for Atmospheric Research
Washington State University

Other EI Topics

Residential Wood Combustion (New EPA Method):

RWC Tool V3.0: Used for EPA Estimates for Version 1 of the 2014 NEI

- EPA used survey responses from across the nation
- Activity was surveyed by dwelling type
- State-level Results:

	2011 NEI v2 (tons)	EPA 2014 (tons)	Change (tons)	% Difference
Washington State	17,070	5,333	-11,737	-69%
Oregon State	15,034	3,502	-11,532	-77%
Idaho State	4,461	1,982	-2,479	-56%

Washington State Department of Ecology

Other EI Topics

Residential Wood Combustion (New EPA Method):

RWC Tool V3.0: Used for EPA Estimates for Version 1 of the 2014 NEI

Washington State

Description	2011 NEI v2 (tons)	EPA 2014 (tons)	Change (tons)	% Difference
Fireplace: general	4,578	513	-4,065	-89%
Woodstove: fireplace inserts; non-EPA certified	2,848	328	-2,519	-88%
Woodstove: fireplace inserts; EPA certified; non-catalytic	1,356	138	-1,218	-90%
Woodstove: fireplace inserts; EPA certified; catalytic	470	42	-428	-91%
Woodstove: freestanding, non-EPA certified	4,258	1,481	-2,777	-65%
Woodstove: freestanding, EPA certified, non-catalytic	2,075	1,176	-899	-43%
Woodstove: freestanding, EPA certified, catalytic	720	816	96	13%
Woodstove: pellet-fired, general	66	63	-3	-5%
Furnace: Indoor, cordwood-fired, non-EPA certified				
Hydronic heater: outdoor	27	80	53	198%
Outdoor wood burning device, NEC	483	483	0	0%
Residential Firelog Total: All Combustor Types	188	211	23	12%
TOTAL	17,070	5,333	-11,737	-69%

Is this something we want to test for AIRPACT-5?

Other EI Topics

Residential Wood Combustion (New EPA Method):

RWC Tool V3.0: Used for EPA Estimates for Version 1 of the 2014 NEI

Oregon State

Description	2011 NEI v2 (tons)	EPA 2014 (tons)	Change (tons)	% Difference
Fireplace: general	2,348	319	-2,029	-86%
Woodstove: fireplace inserts; non-EPA certified	2,327	204	-2,123	-91%
Woodstove: fireplace inserts; EPA certified; non-catalytic	728	86	-643	-88%
Woodstove: fireplace inserts; EPA certified; catalytic	317	26	-291	-92%
Woodstove: freestanding, non-EPA certified	3,564	976	-2,588	-73%
Woodstove: freestanding, EPA certified, non-catalytic	1,042	775	-267	-26%
Woodstove: freestanding, EPA certified, catalytic	1,697	538	-1,159	-68%
Woodstove: pellet-fired, general	173	41	-132	-76%
Furnace: Indoor, cordwood-fired, non-EPA certified	990	0	-990	-100%
Hydronic heater: outdoor	38	85	47	124%
Outdoor wood burning device, NEC	1,432	317	-1,116	-78%
Residential Firelog Total: All Combustor Types	377	135	-242	-64%
TOTAL	15,034	3,502	-11,532	-77%

Is this something we want to test for AIRPACT-5?

Other EI Topics

Residential Wood Combustion (New EPA Method):

RWC Tool V3.0: Used for EPA Estimates for Version 1 of the 2014 NEI

Idaho State

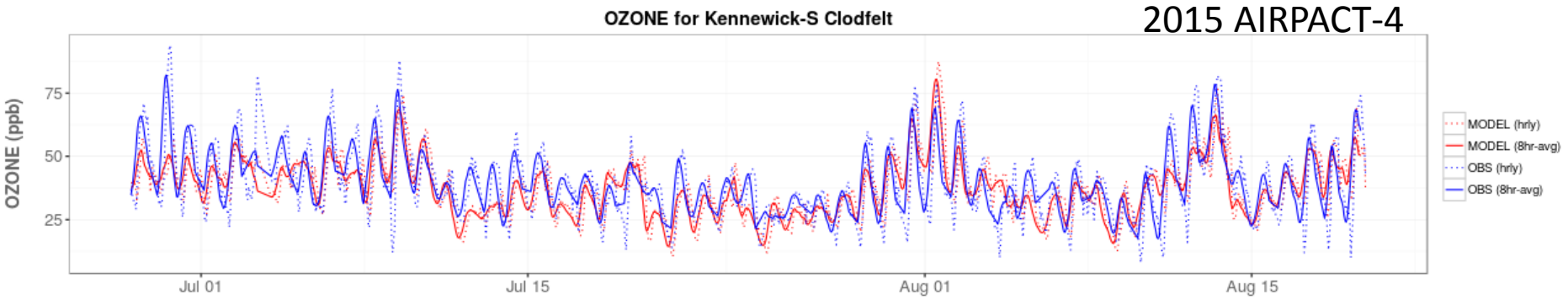
Description	2011 NEI v2 (tons)	EPA 2014 (tons)	Change (tons)	% Difference
Fireplace: general	773	115	-658	-85%
Woodstove: fireplace inserts; non-EPA certified	798	74	-724	-91%
Woodstove: fireplace inserts; EPA certified; non-catalytic	336	31	-305	-91%
Woodstove: fireplace inserts; EPA certified; catalytic	177	10	-167	-95%
Woodstove: freestanding, non-EPA certified	1,456	549	-906	-62%
Woodstove: freestanding, EPA certified, non-catalytic	325	436	112	34%
Woodstove: freestanding, EPA certified, catalytic	168	303	135	80%
Woodstove: pellet-fired, general	33	23	-9	-29%
Furnace: Indoor, cordwood-fired, non-EPA certified	91	42	-49	-54%
Hydronic heater: outdoor	36	130	94	263%
Outdoor wood burning device, NEC	270	270	0	0%
Residential Firelog Total: All Combustor Types				
TOTAL	4,461	1,982	-2,479	-56%

Is this something we want to test for AIRPACT-5?

Kennewick Ozone

Unclassifiable for ozone attainment:

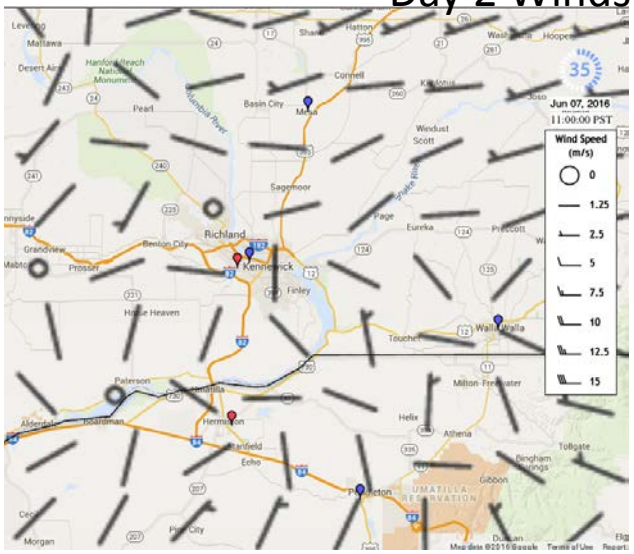
- Need 3 full years of ozone data
  - will have this in October 2017
- Attainment issues are a concern (Ranks #2 in WA after Enumclaw)
- AIRPACT-4 had some difficulty producing the peak ozone events
  - AIRPACT-5 typically produces less ozone (far less biogenic VOCs in AP5)



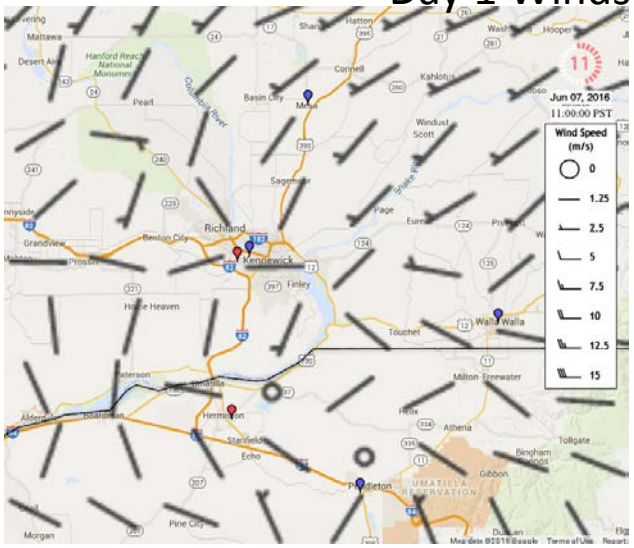
LABORATORY FOR ATMOSPHERIC RESEARCH
WASHINGTON STATE UNIVERSITY

Kennewick Ozone

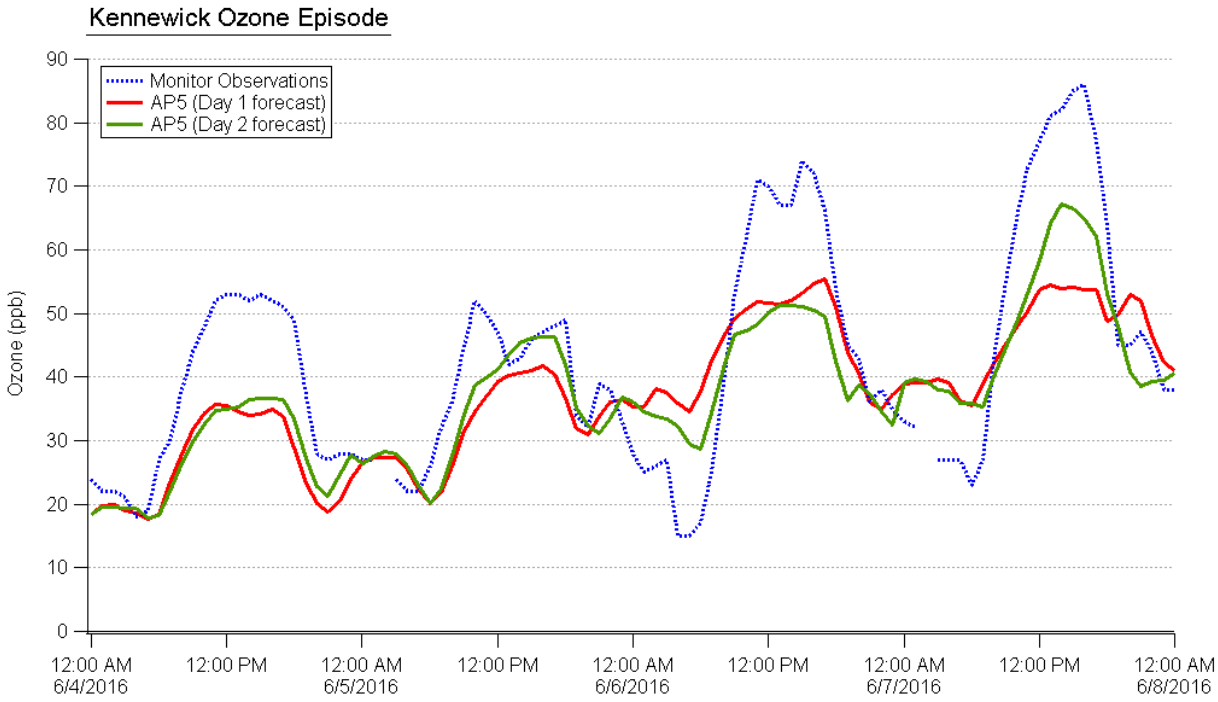
Day 2 Winds



Day 1 Winds

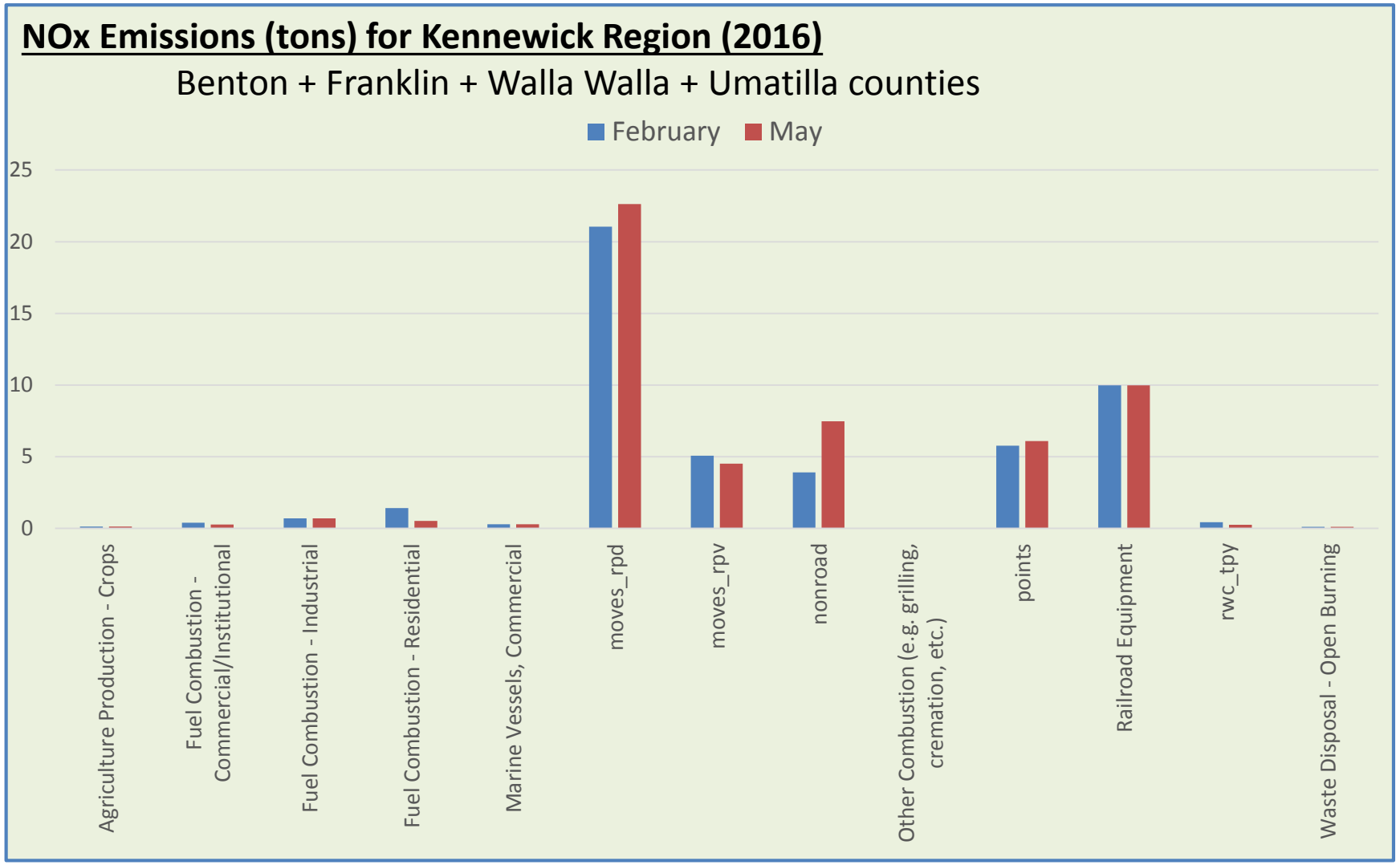


- One day with regulatory importance so far this year (June 7; MDA8O3 > 75 ppb).
- Extended forecast ("Day 2") from previous day performed better (but still under-predicted)
- Day 1 forecast included significantly more cloud cover
- Day 1 forecast had different wind fields

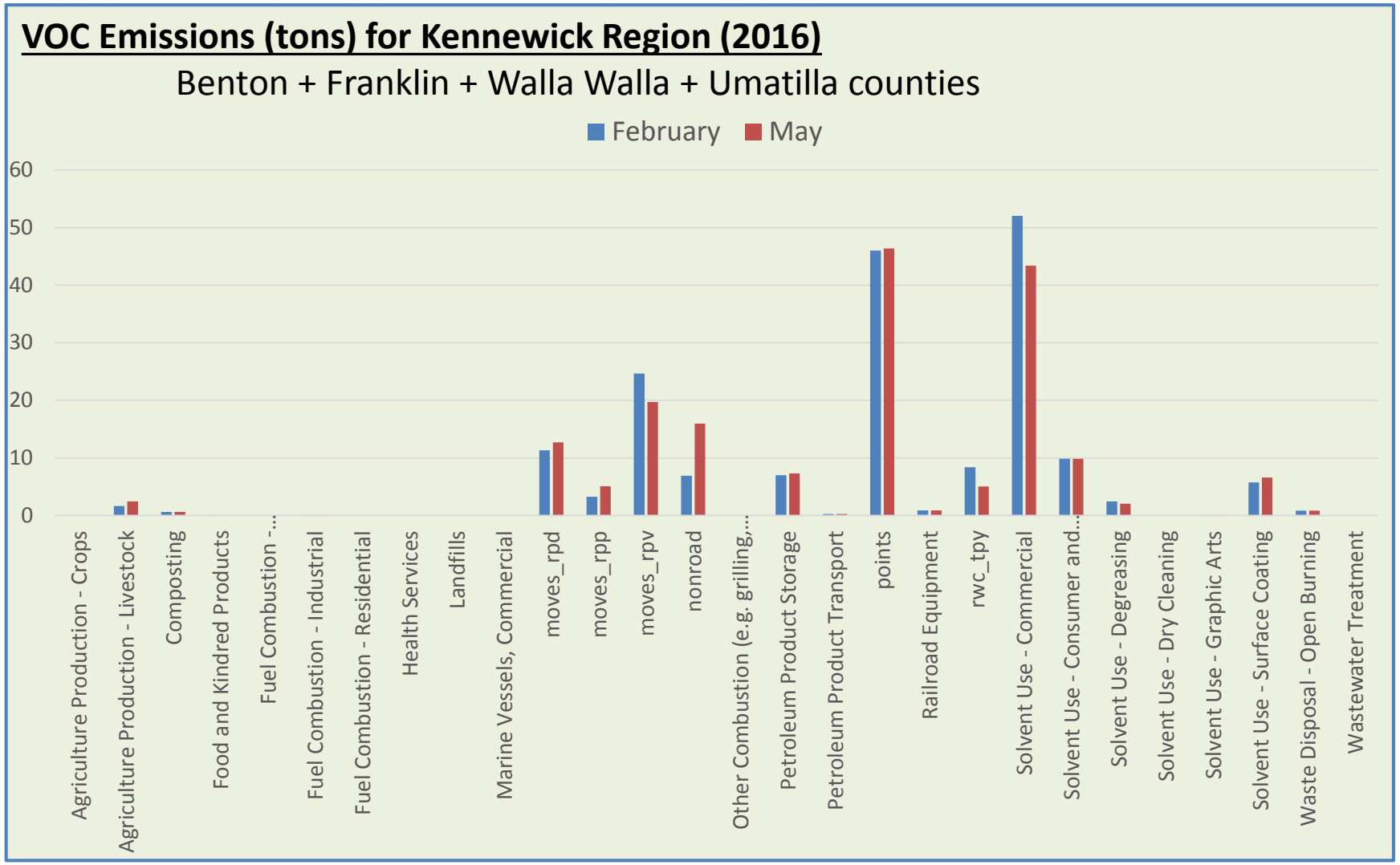


WASHINGTON STATE DEPARTMENT OF ECOLOGY

Kennewick Ozone



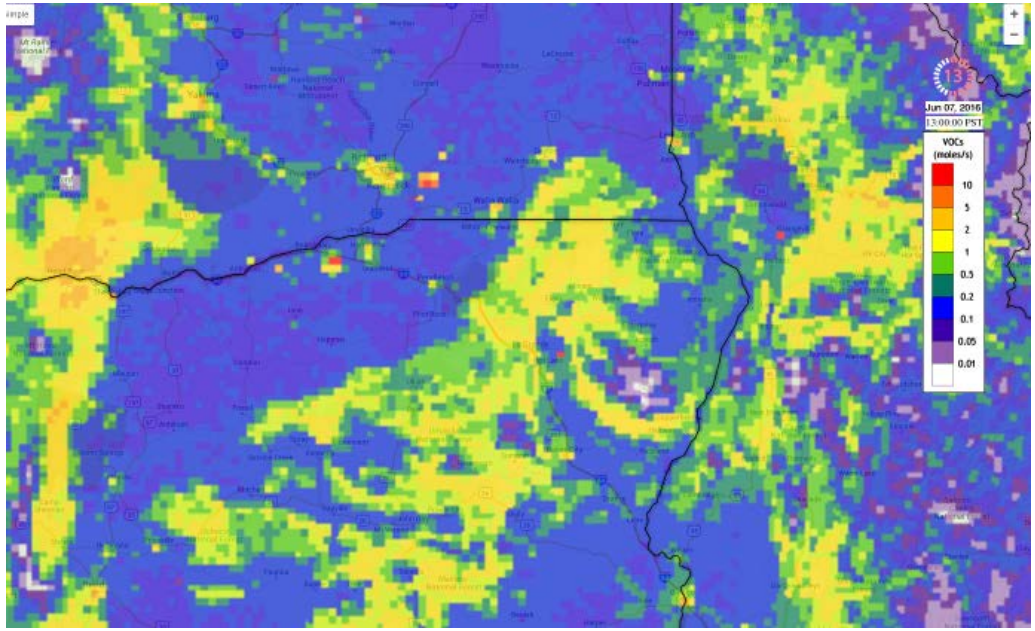
Kennewick Ozone



Laboratory for Atmospheric Research
Washington State University

AP4 VOC Emissions

AP5 VOC Emissions



Washington State Department of Ecology

Issues / Future Work

Kennewick Ozone:

- Model would benefit from evaluation of Agricultural VOCs (underpredicted?).
  - We've manually updated poplar farms nearby already
  - other crop-specific VOC emissions?
- Are Hanford NOx emissions underestimated significantly?
- What is the influence of fire emissions on observed ozone?
  - peak ozone events in 2015 coincided with nearby fires
  - this year's episode does not appear to be influenced by fire
- TCOPS – Tri-Cities Ozone Precursor Study to be conducted this summer
  - mobile monitoring with multi-pollutant capability

Working Group report-outs:

Done!

Questions? Comments? Other Ideas?

- ✓ 1) **Emission Inventories:**
  - ✓ SMKREPORT project
  - ✓ Potential future projects
- ✓ 2) **Model Evaluation:**
  - ✓ Winter PM2.5
  - ✓ Kennewick Ozone