Large Wildfires in the Pacific Northwest (Summers 2007 & 2008): Evaluation of AIRPACT-3

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[1] Laboratory for Atmospheric Research, Washington State University, USA
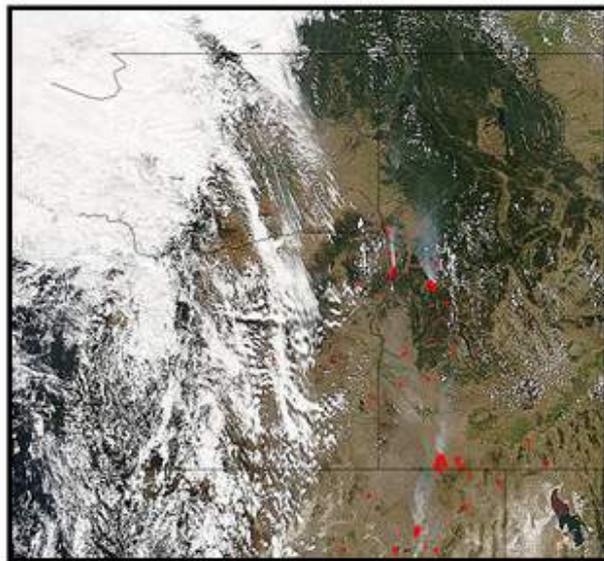[2] National Center for Atmospheric Research, Boulder, CO, USA
[3] University of Washington, Seattle, WA, USA

Dates Presented:
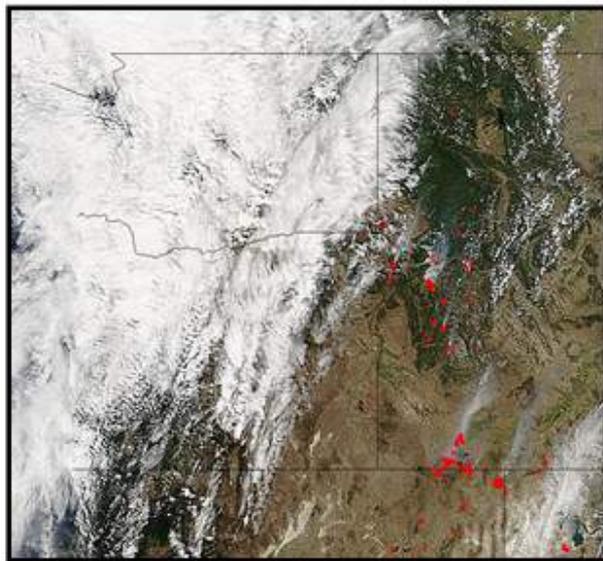July 3 to Aug 22, 2007
June 22 to Aug 27, 2008
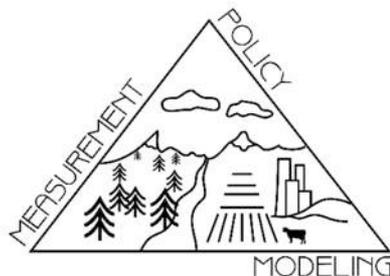
Laboratory for Atmospheric Research
Washington State University

MODIS/Aqua Visible Imagery with hot-spot fire detects (http://lance-modis.eosdis.nasa.gov)
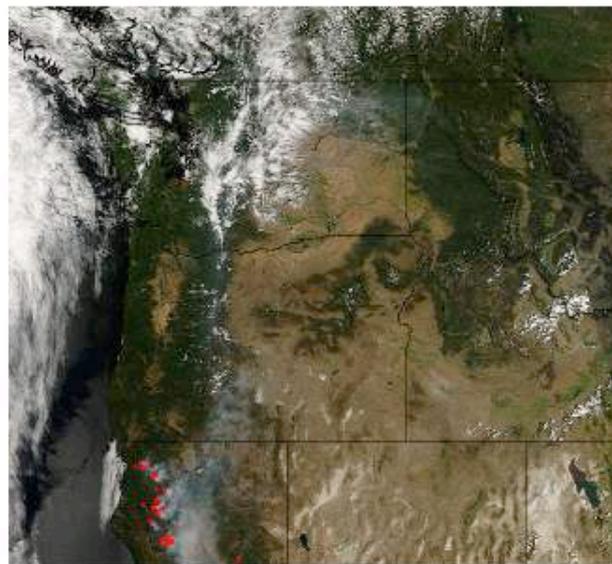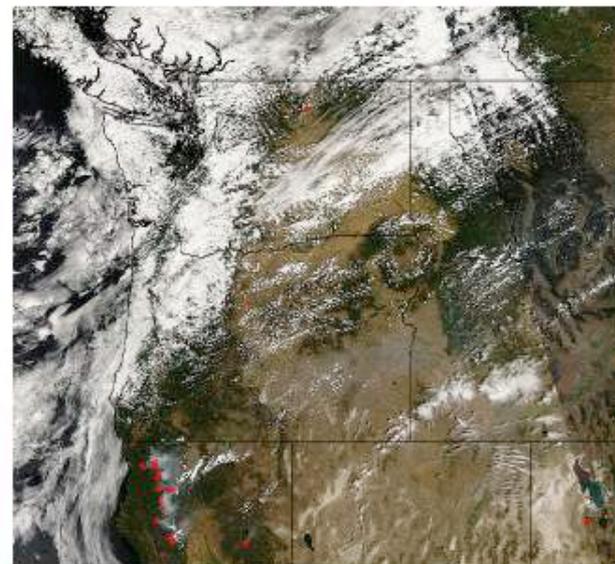

July 18, 2007
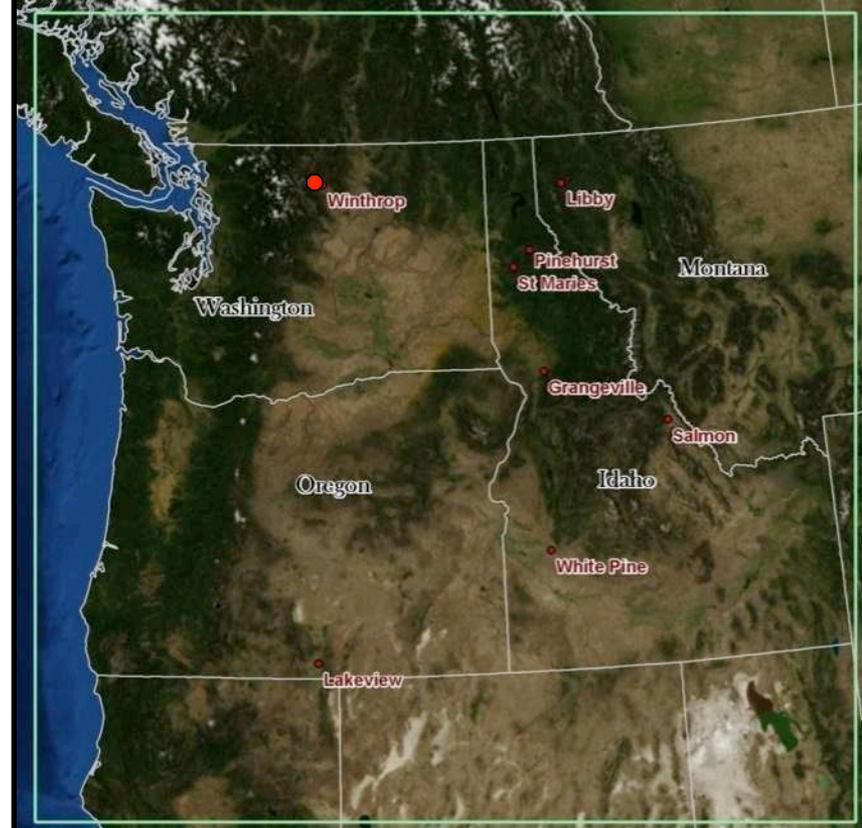
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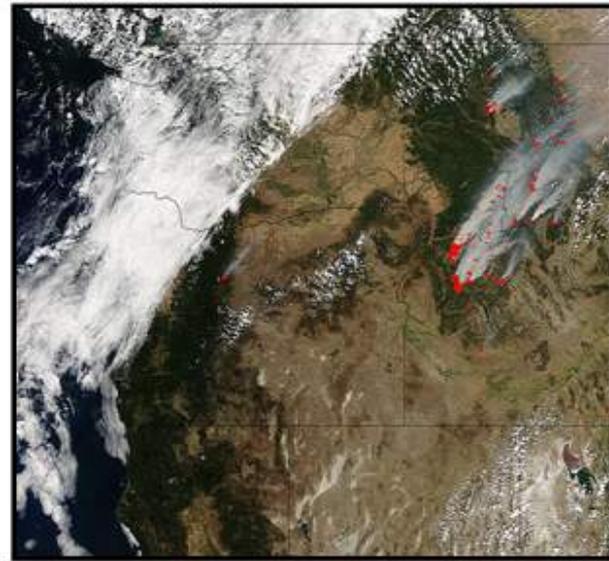
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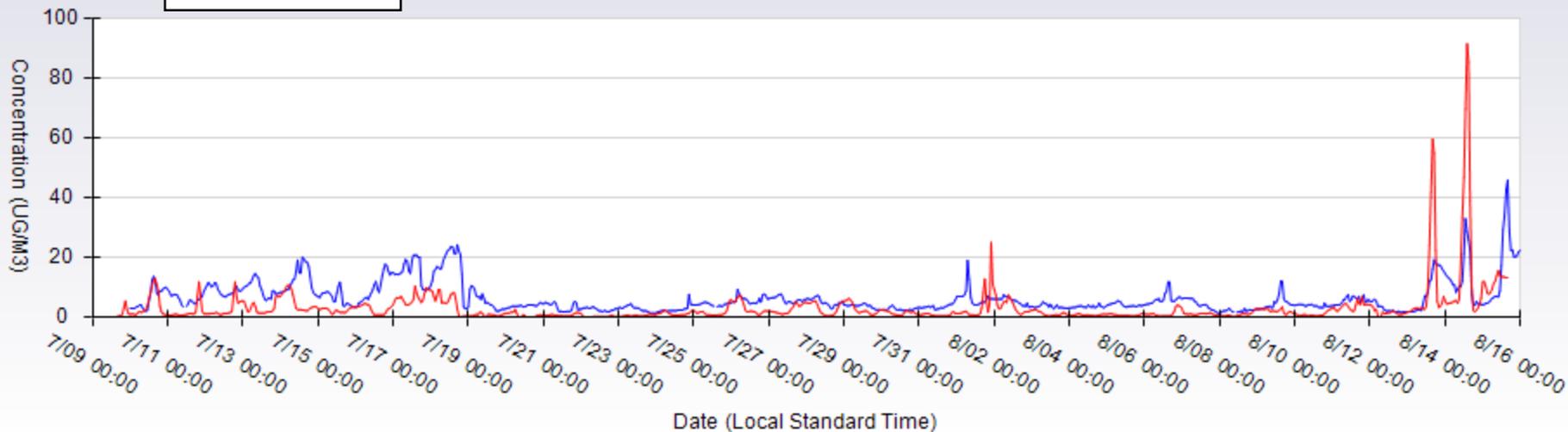
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July 25, 2008

August 1, 2008
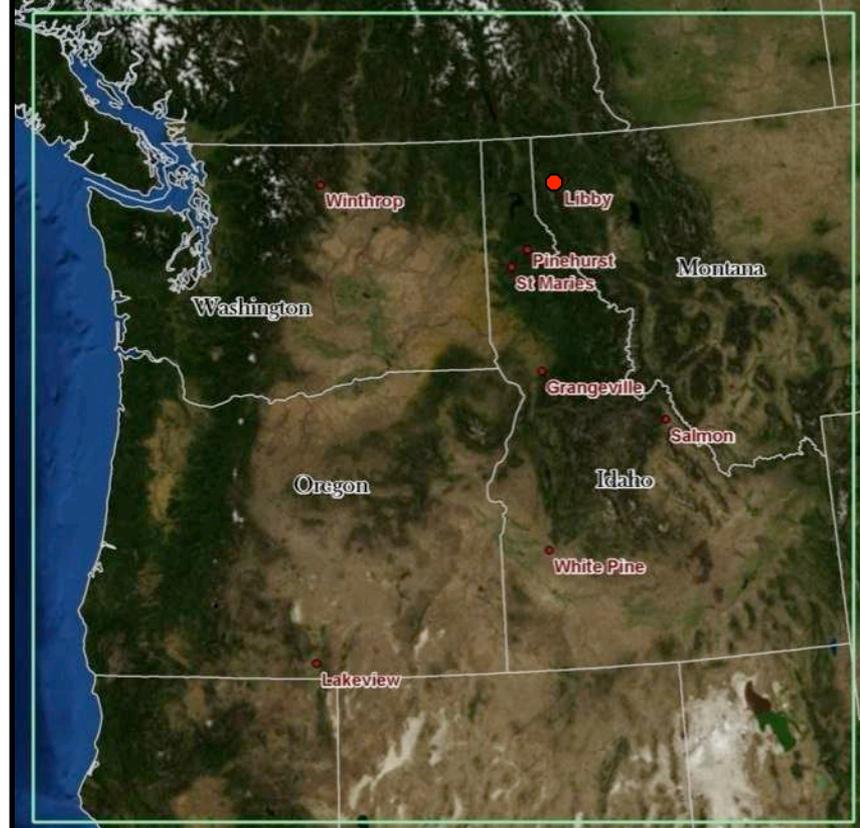
Surface PM2.5 results (2007) (Winthrop, WA)

R²=0.24

Winthrop-Chewuch Rd (PM2.5)

AIRPACT3 hourly PM2.5 — Monitor hourly PM2.5

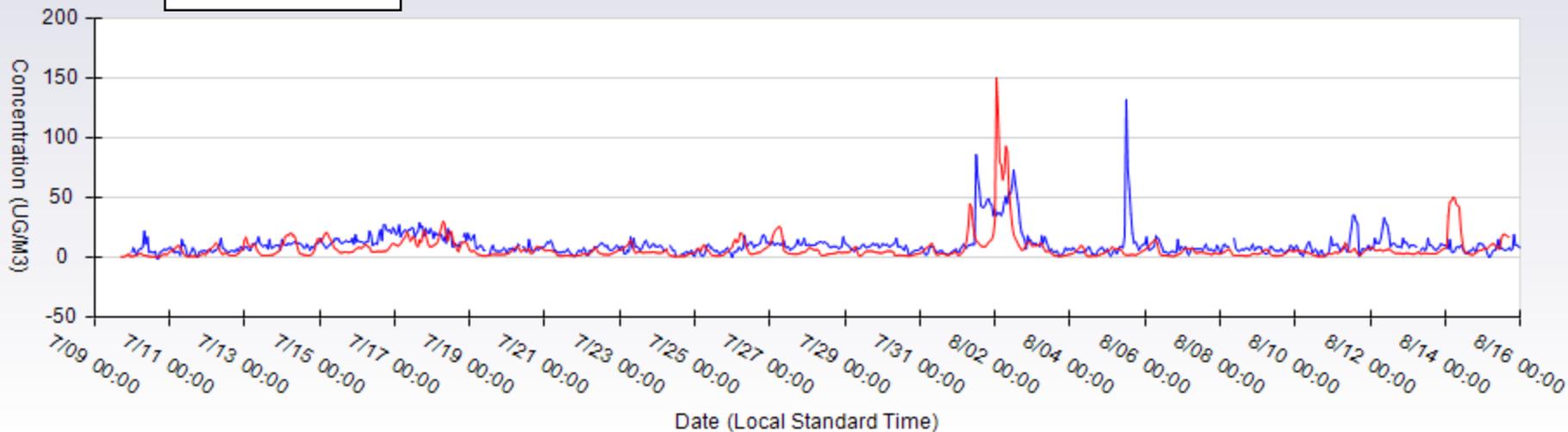# Surface PM2.5 results (2007) (Libby, MT)

R²=0.14

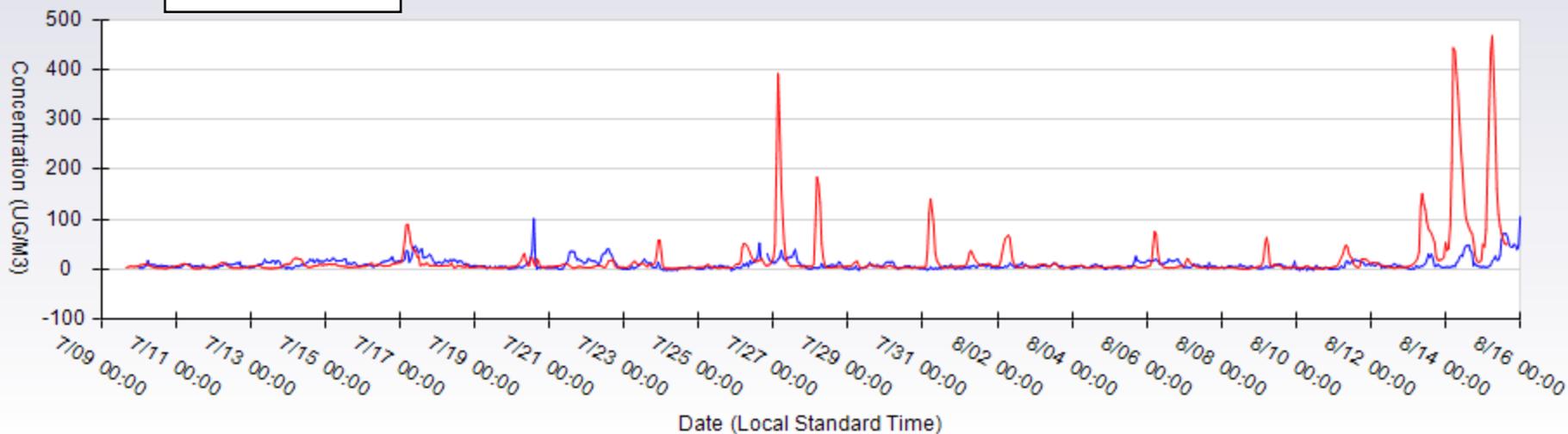Libby Courthouse (PM2.5)

AIRPACT3 hourly PM2.5 — Monitor hourly PM2.5
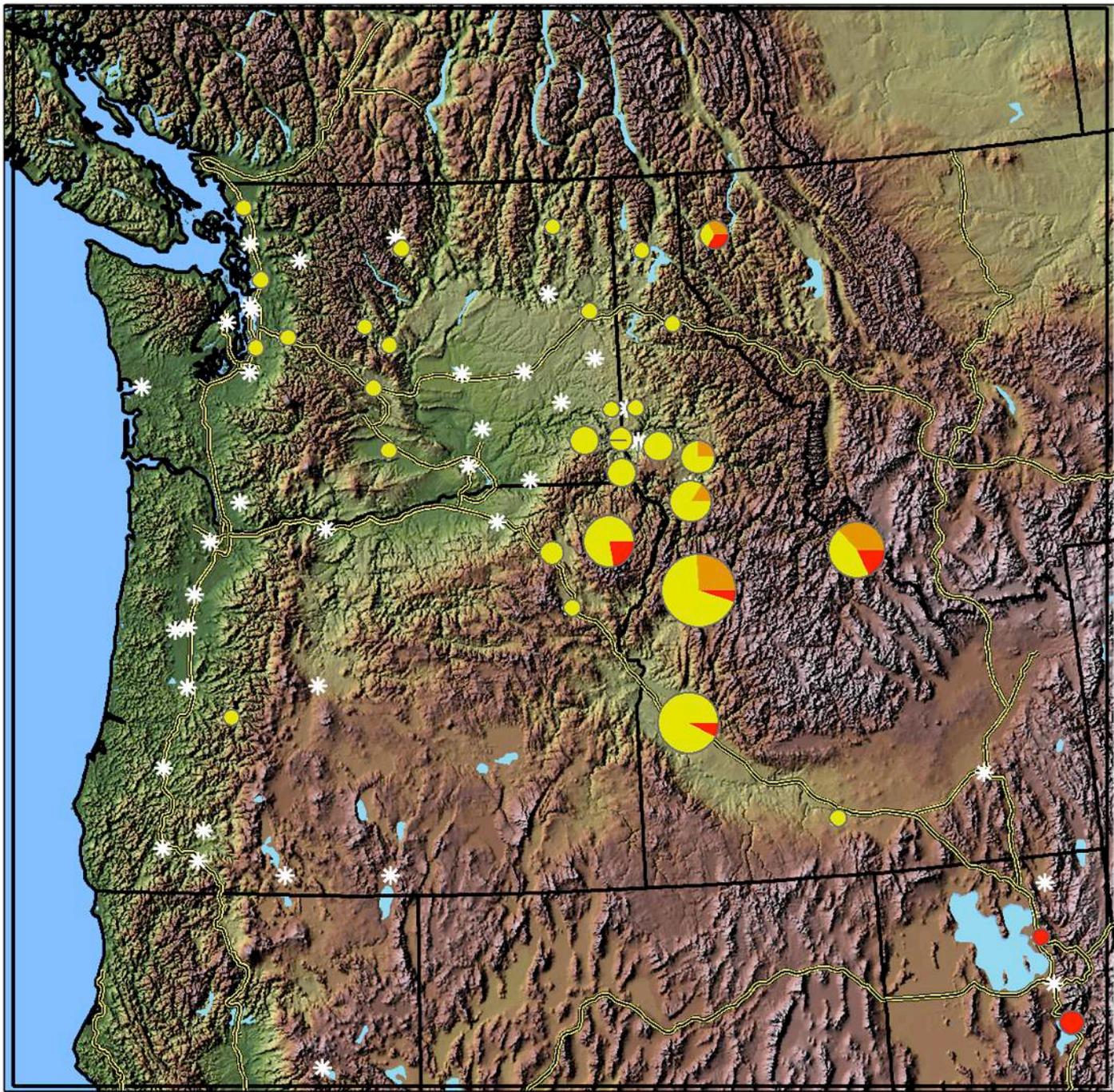
Surface PM2.5 results (2007) (Grangeville, ID)
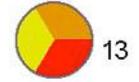

R²=0.03

Grangeville (PM2.5)

AIRPACT3 hourly PM2.5 — Monitor hourly PM2.5

Sum of Fields

13

Both
AIRPACT
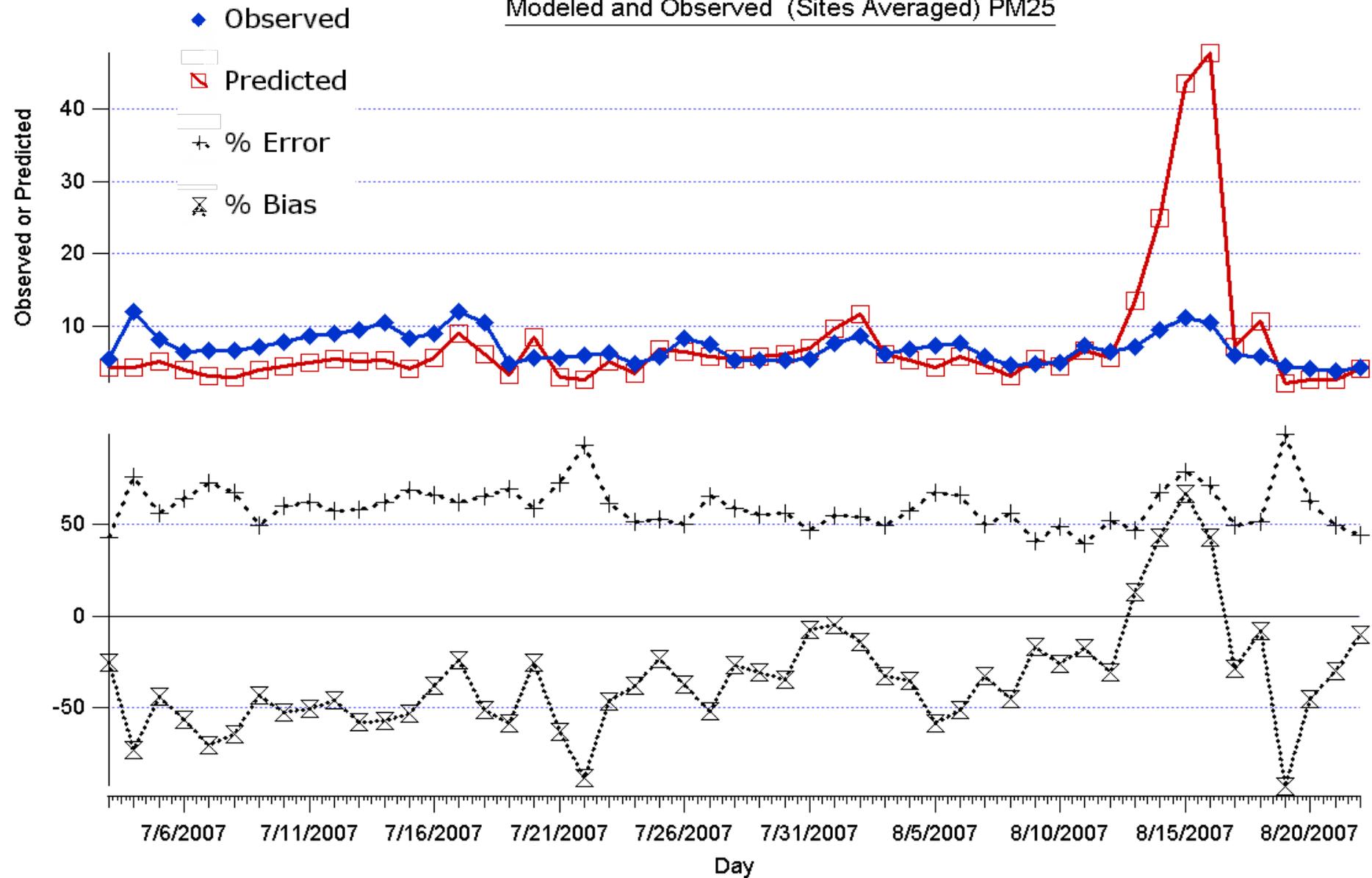Observed

AIRPACT-3 vs Surface PM$_{2.5}$

Number of Daily NAAQS Exceedances in PM2.5 (24-hr avg)

Surface 24-hr PM$_{2.5}$ evaluation for 2007

Sum of Fields

13
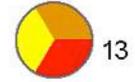
Both
AIRPACT
Observed

Number of Daily NAAQS Exceedances in PM2.5 (24-hr avg)
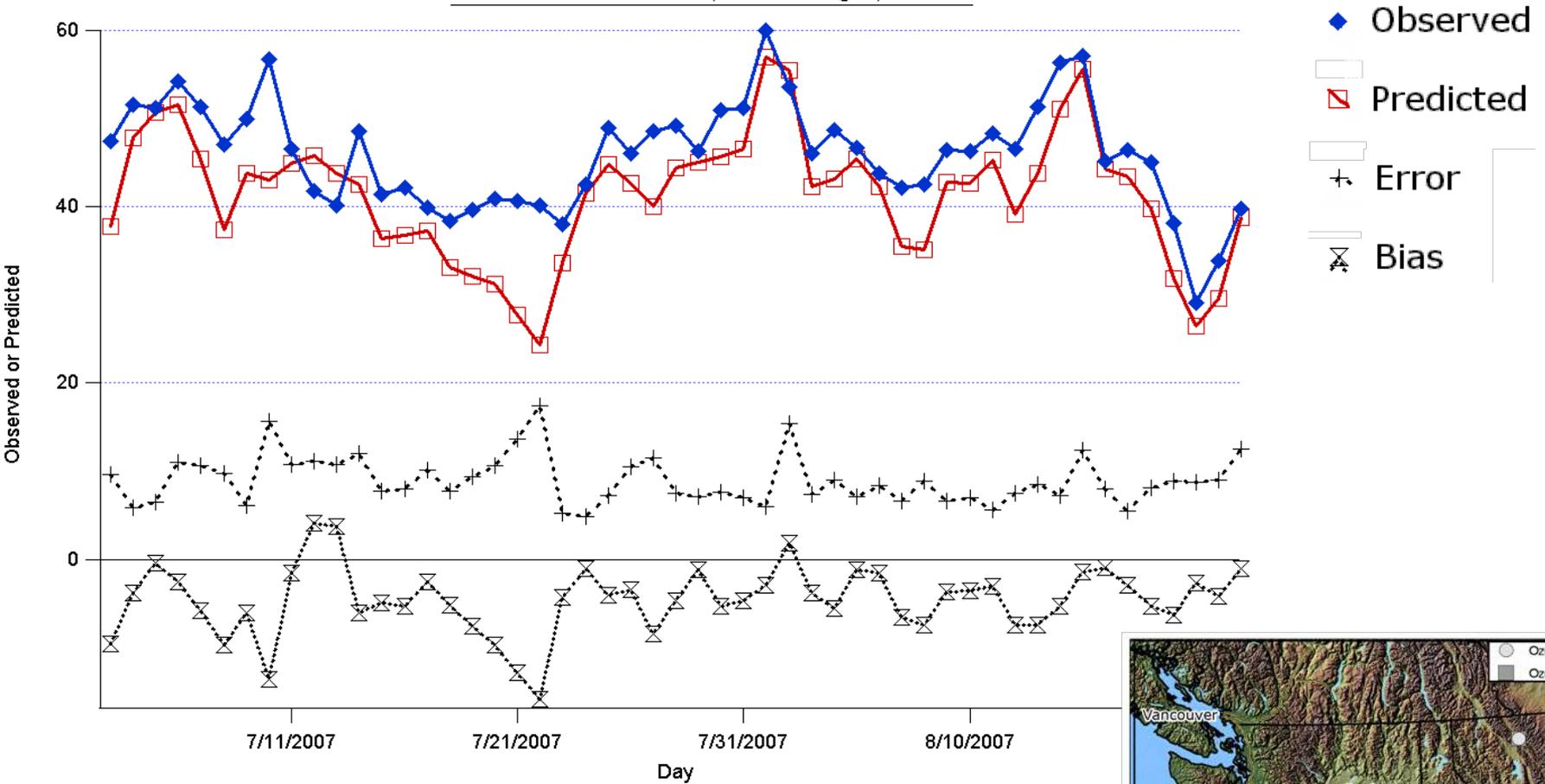
Surface 24-hr PM$_{2.5}$ evaluation for 2008

Modeled and Observed (Sites Averaged) OZONE

Surface 8-hr ozone evaluation for 2007
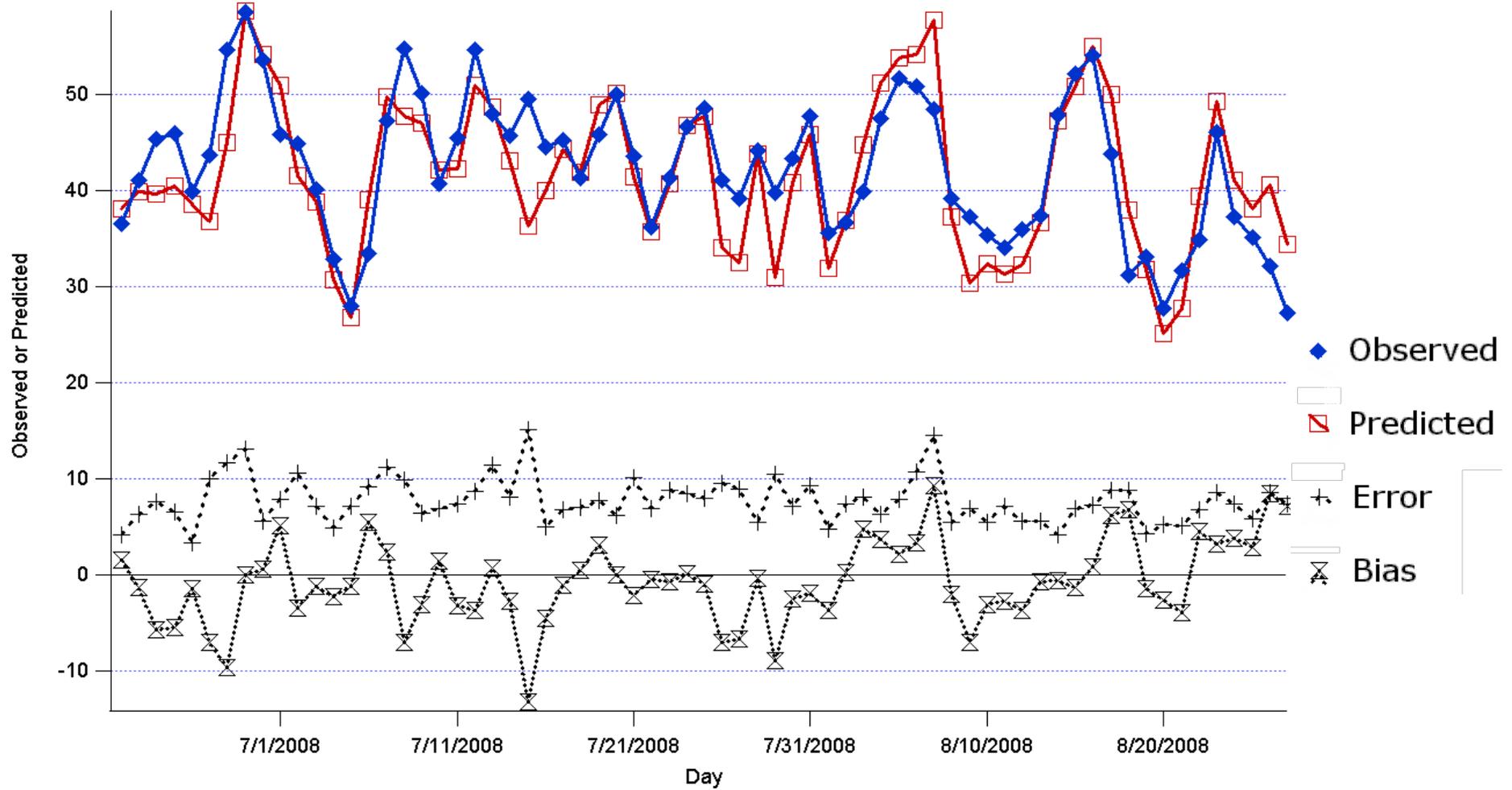
Surface 8-hr ozone evaluation for 2008

Aug 14, 2007: MODIS AOD (left) AIRPACT AOD (right)
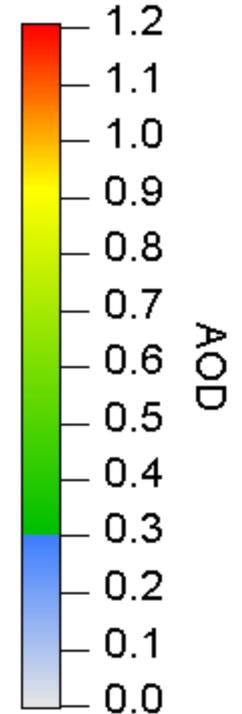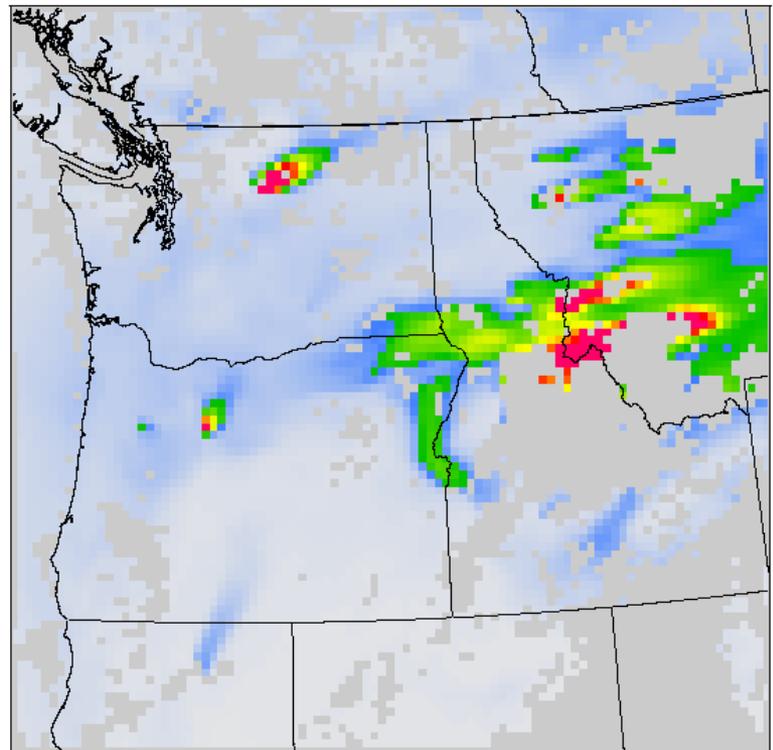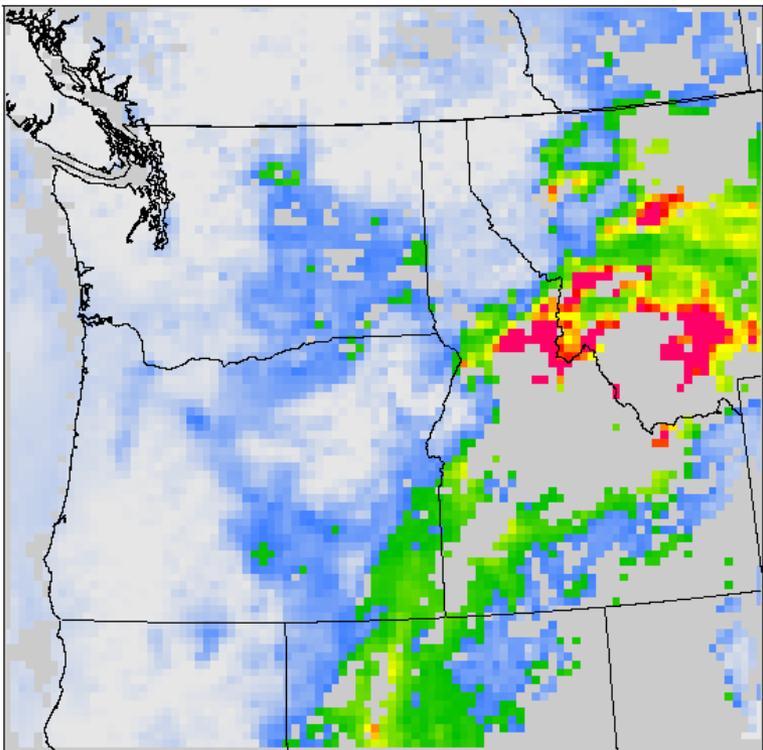
MODIS AOD vs AIRPACT-3
Aqua/MODIS co-located AOD pixels vs
Binkowski-Roselle method for model AOD
(no stratosphere aerosols included)
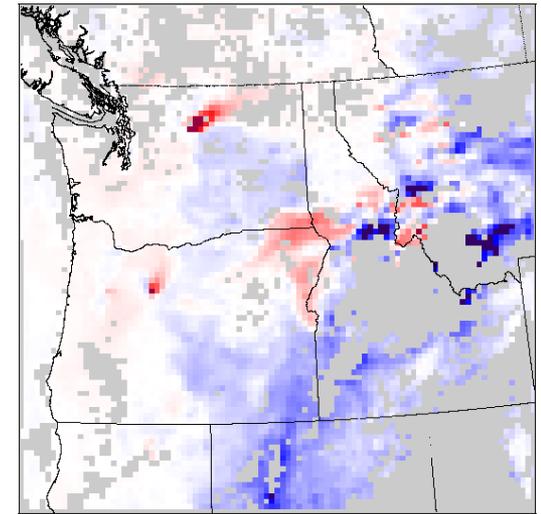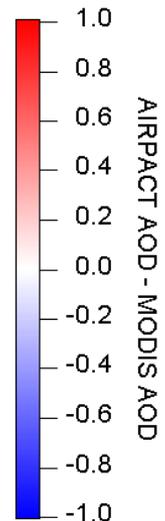
July 15, 2008: MODIS AOD (left) AIRPACT AOD (right)
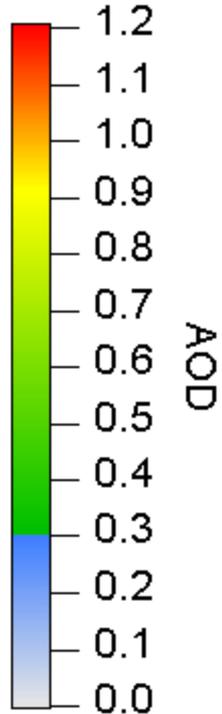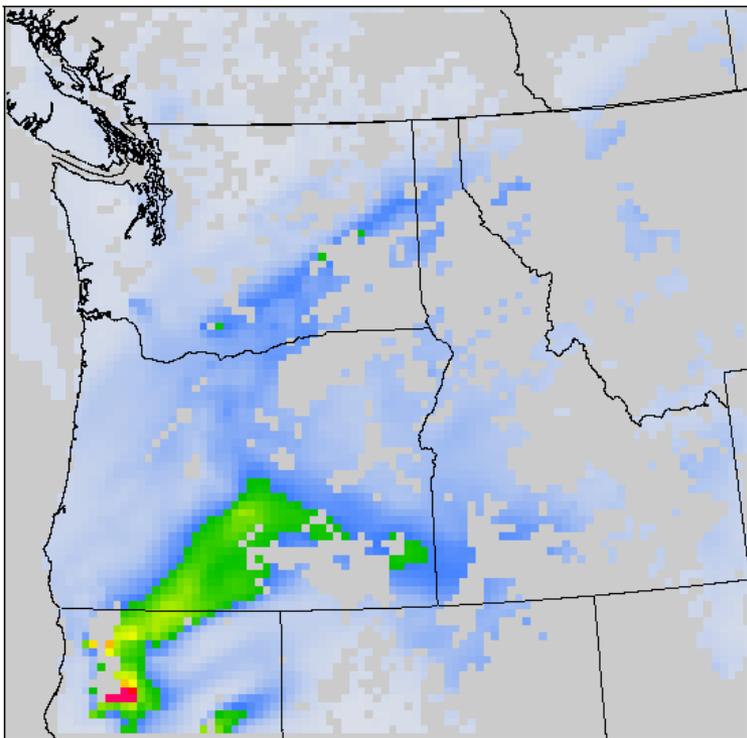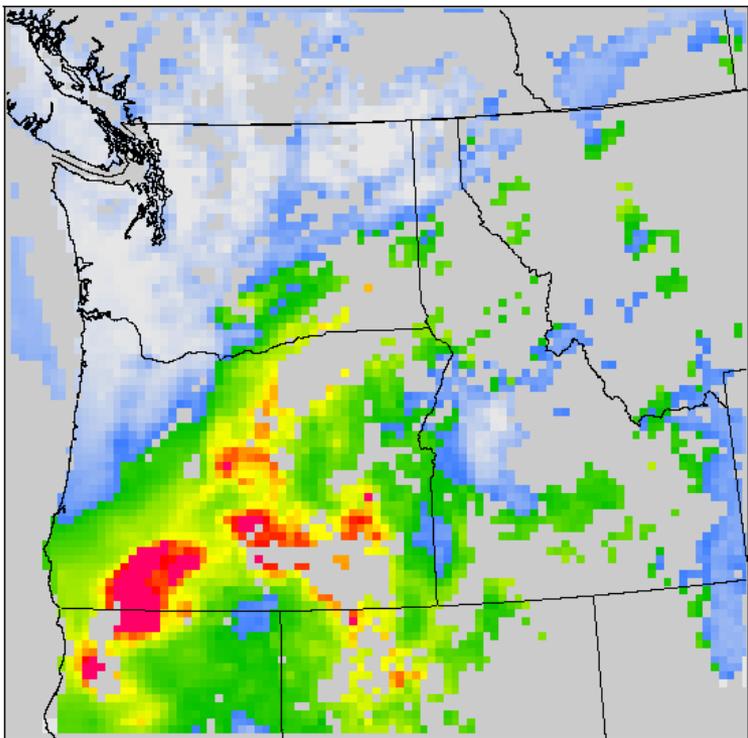
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Aqua/MODIS co-located AOD pixels vs
Binkowski-Roselle method for model AOD
(no stratosphere aerosols included)
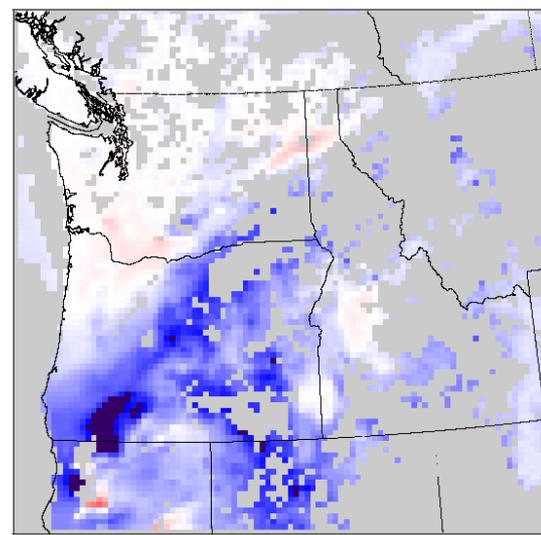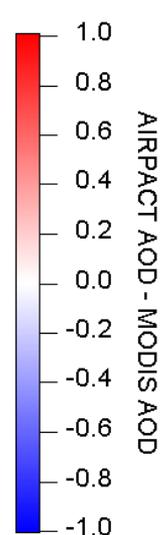
Aug. 18, 2007:   AIRS CO (left) AIRPACT CO (right)
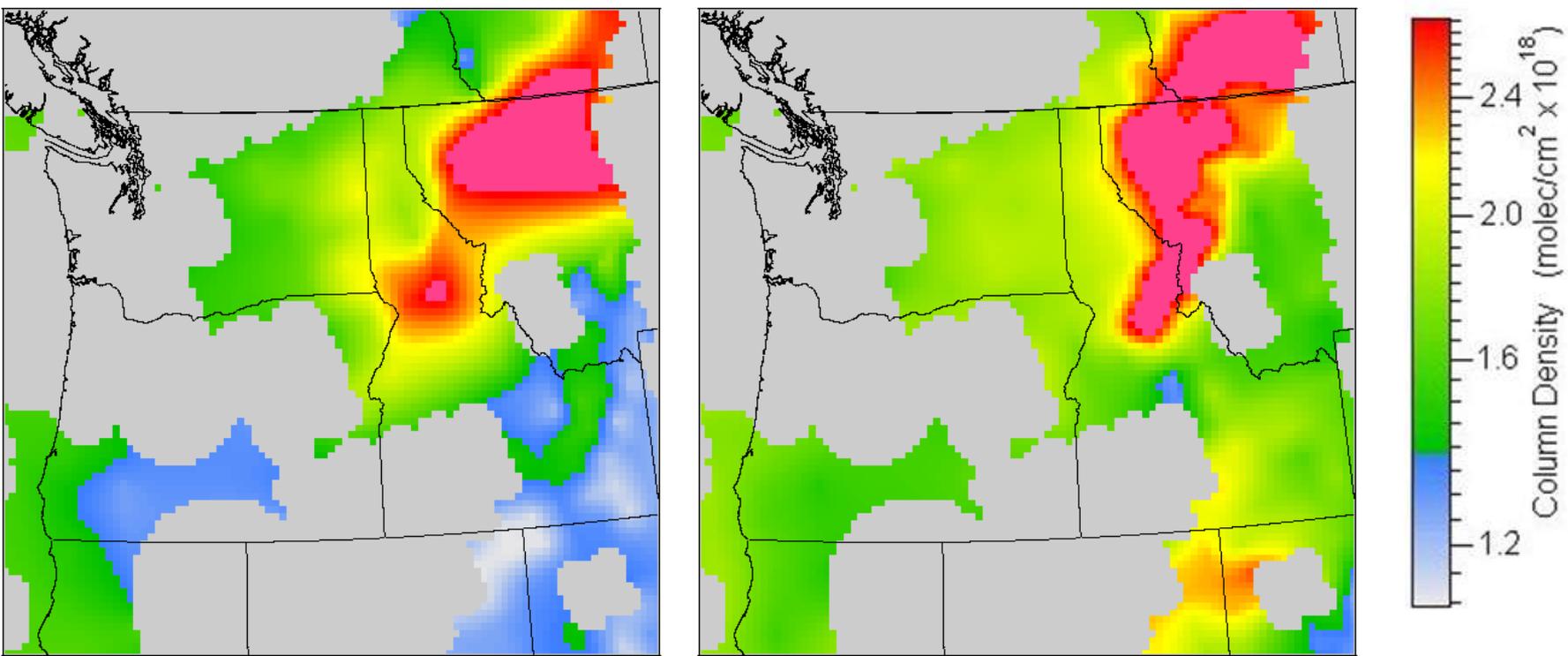
AIRS CO vs AIRPACT-3
Aqua/AIRS co-located CO pixels vs model columns (re-gridded w/ avg. kernel)
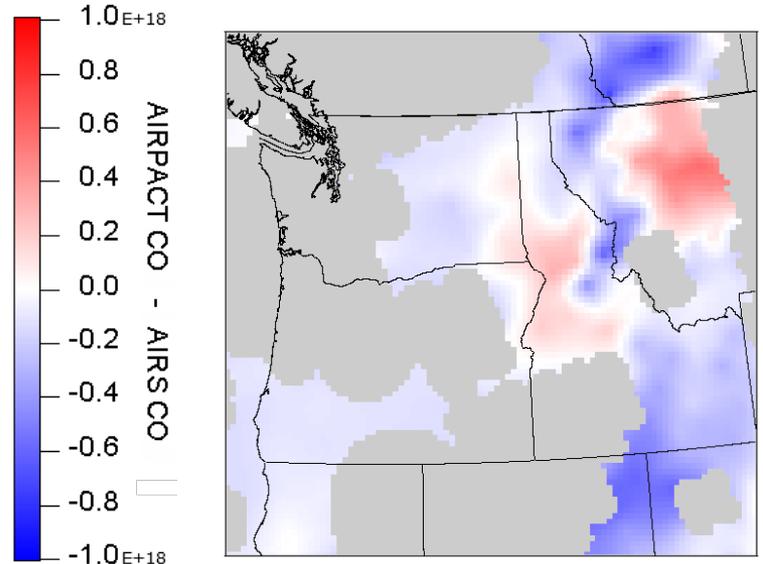
August 7, 2008:   AIRS CO (left) AIRPACT CO (right)

AIRS CO vs AIRPACT-3
Aqua/AIRS co-located CO pixels vs model columns (re-gridded w/ avg. kernel)

OMI NO2 vs AIRPACT-3
Aura/OMI co-located trop. NO2 pixels vs
model columns (re-gridded w/ avg. kernel)

July 11, 2008:   OMI Trop. NO2 (left) AIRPACT Trop. NO2 (right)

OMI NO2 vs AIRPACT-3
Aura/OMI co-located trop. NO2 pixels vs
model columns (re-gridded w/ avg. kernel)

AIRPACT-3 Evaluation Summary Matched Threshold

Daily "All Sites" Matched Threshold Values Analysis

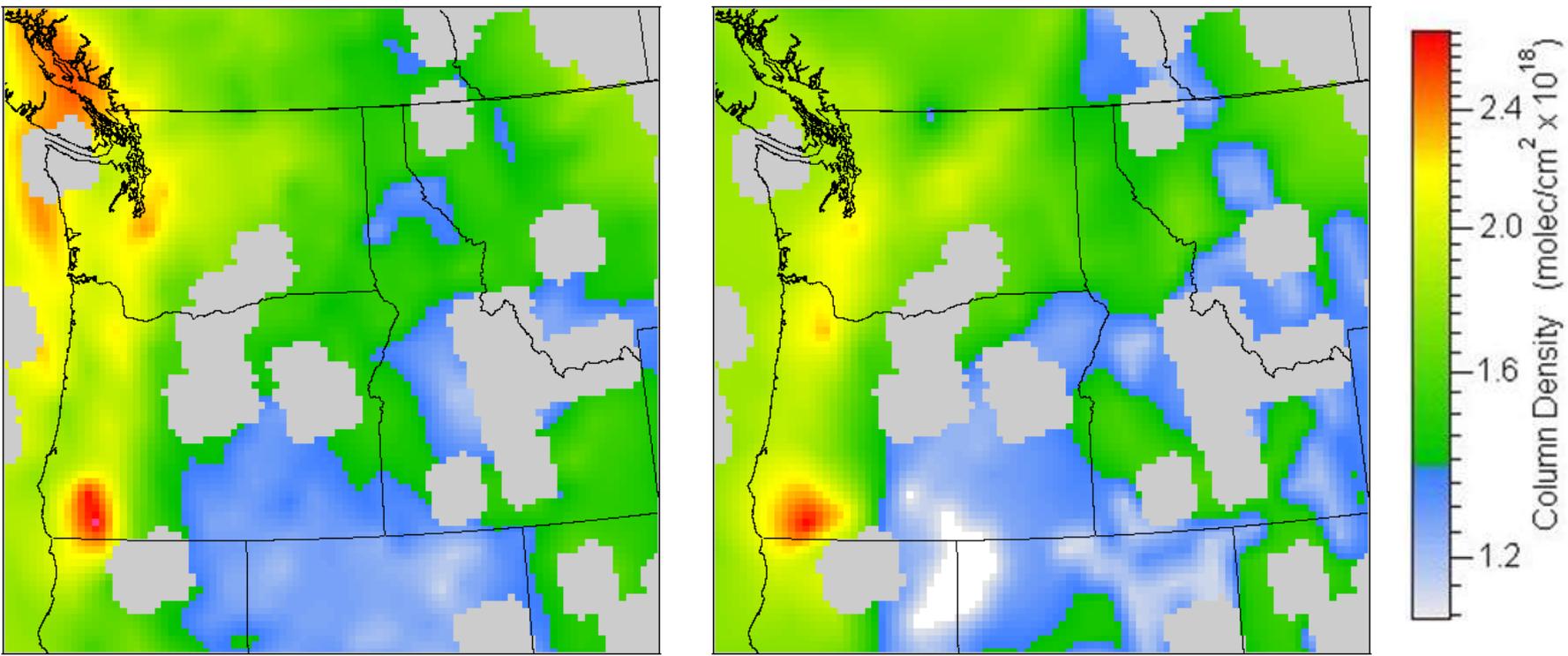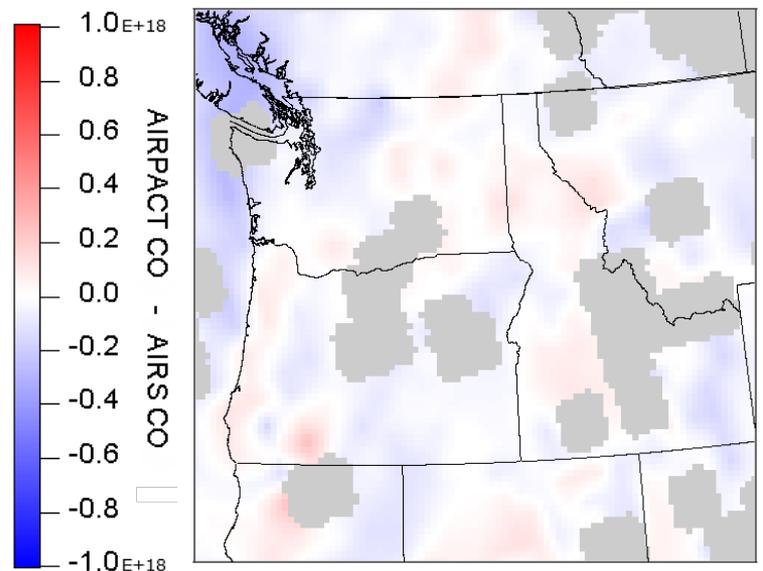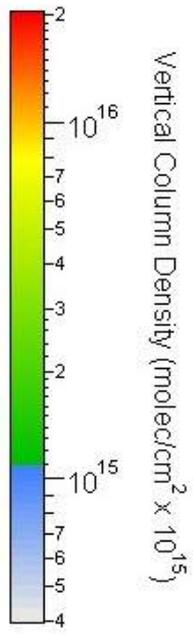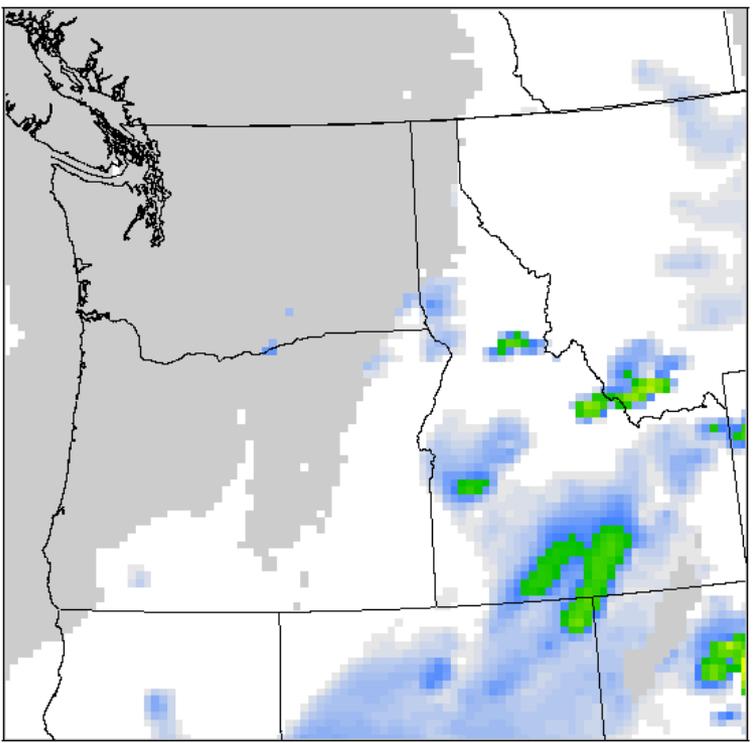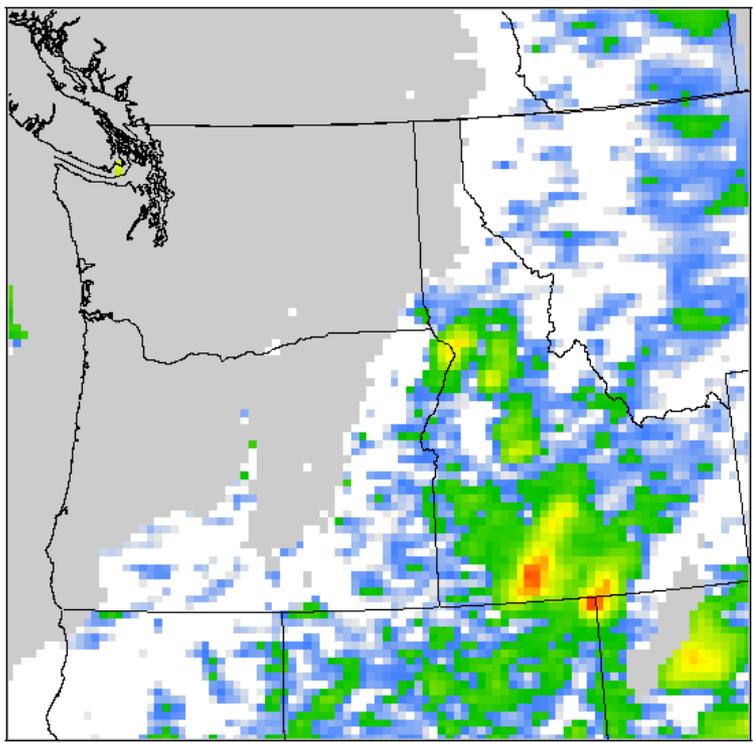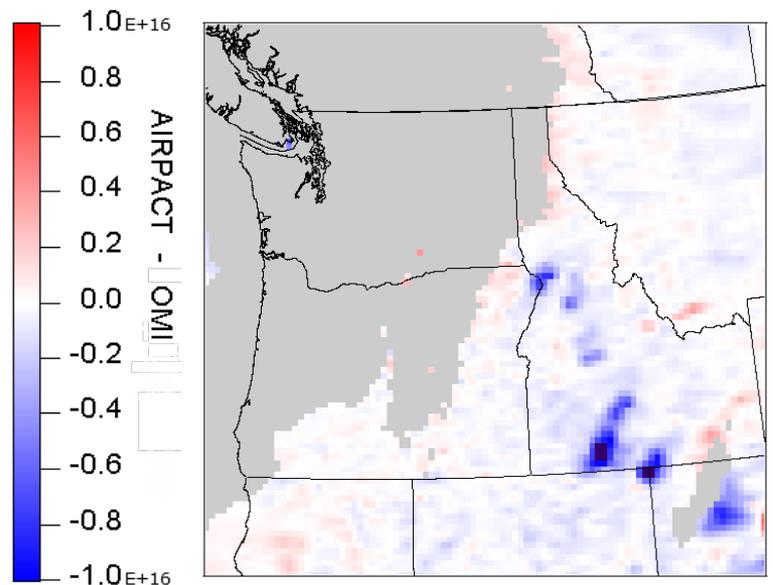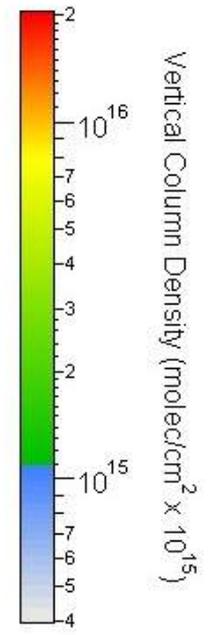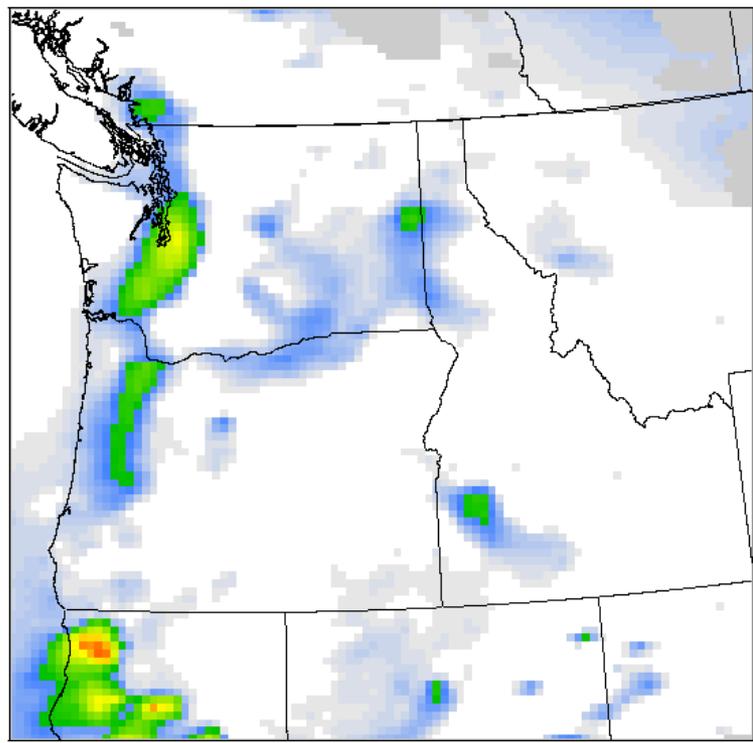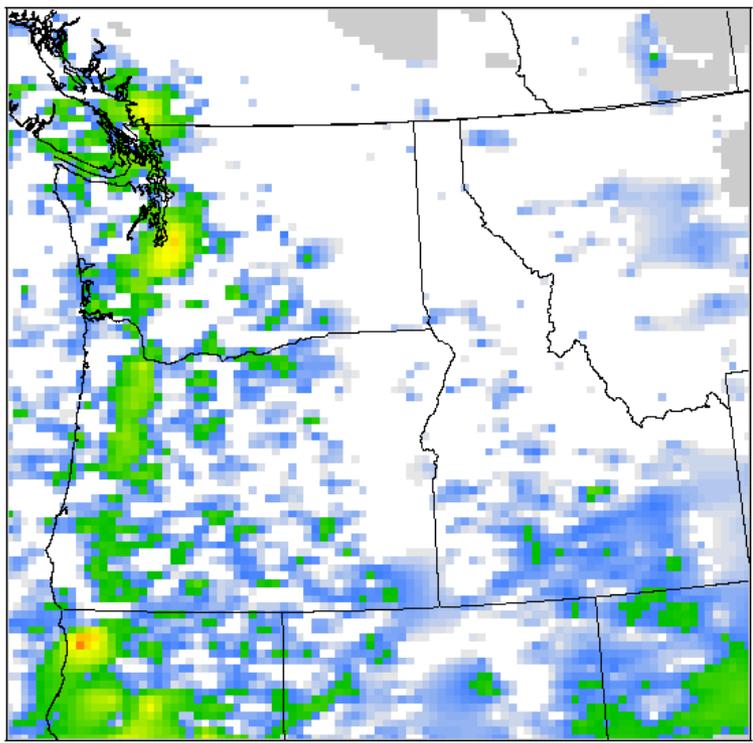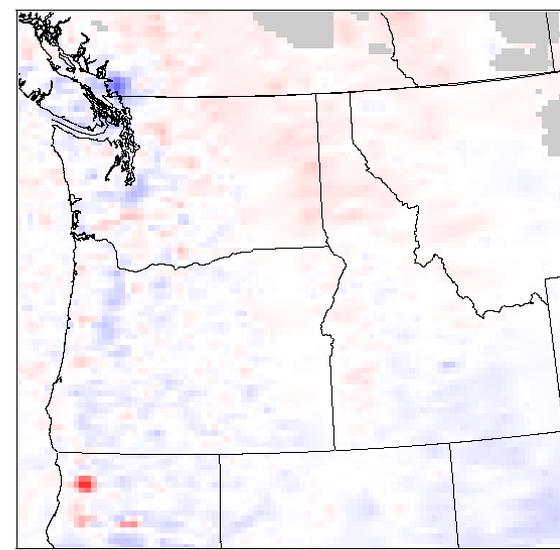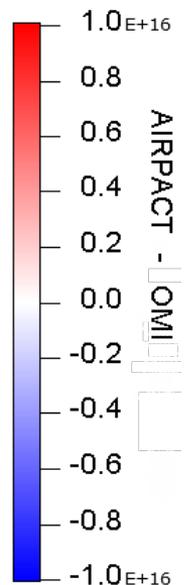| 7/3 to 8/22	2007	Aqua/MODIS	AIRS	OMI
Species	A24-hr PM2.5	AOD	Column CO	Trop. Col. NO2
Threshold	10 µg/m³	0.3	1.9E+18 VCD	1.0E+15 VCD
Paired Points	555	150	356	599
Correlation (r)	0.41	0.03	0.28	0.19
Measured Mean	16.8	0.49	2.05E+18	1.7E+15
Mean Bias	5.9	-0.34	-0.32E+18	-1.1E+15
Mean Error	19.1	0.39	0.36E+18	1.2E+15
Normalized Mean Bias	0.24	-0.66	-0.15	-0.59
Normalized Mean Error	1.04	0.77	0.17	0.68
Fractional Bias (%)	-38.3	-117.3	-17.6	-96.5
Fractional Error (%)	79.6	122.9	19.2	100.8

6/22 to 8/27	2008	Aqua/MODIS	AIRS	OMI
Species	A24-hr PM2.5	AOD	Column CO	Trop. Col. NO2
Threshold	10 µg/m³	0.3	1.9E+18 VCD	1.0E+15 VCD
Paired Points	872	260	521	755
Correlation (r)	0.39	0.14	0.29	0.29
Measured Mean	15.9	0.51	2.14E+18	1.6E+15
Mean Bias	-6.5	-0.38	-0.25E+18	-0.9E+15
Mean Error	9.0	0.40	0.29E+18	1.1E+15
Normalized Mean Bias	-0.35	-0.73	-0.11	-0.54
Normalized Mean Error	0.56	0.77	0.12	0.66
Fractional Bias (%)	-66.4	-125.3	-12.0	-90.4
Fractional Error (%)	77.1	128.3	13.6	95.3

* Note "Matched Threshold" refers to both model and observation values being removed from the analysis if either is below the threshold

BlueSky (FEPS Plume Top) vs MISR (Median Plume Top)
2008 Wildfires Analysis:

Paired Points = 66

r = 0.042139

Mean Bias = 705 meters

Mean Error = 953 meters

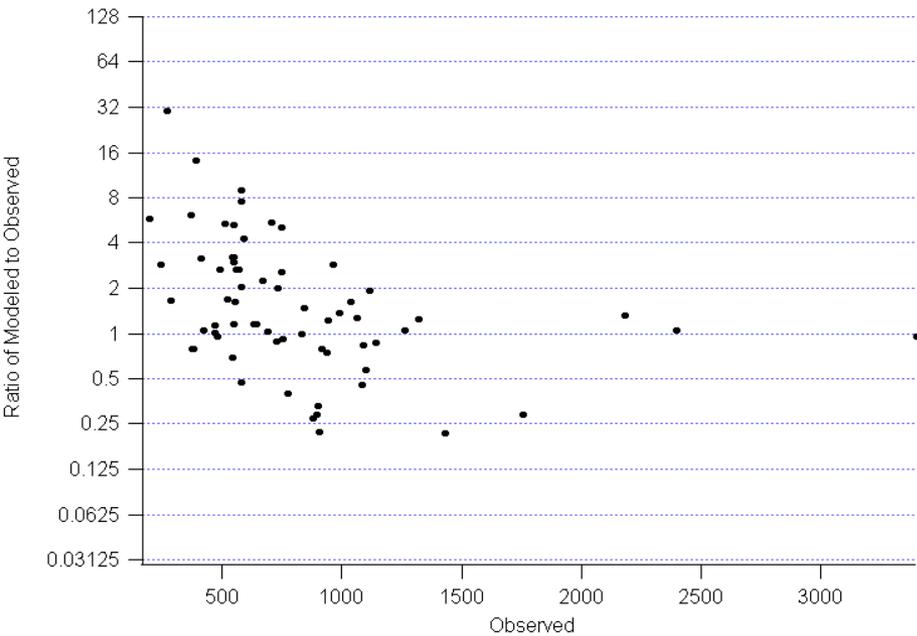Measured Mean = 806 meters

Predicted Mean = 1511 meters

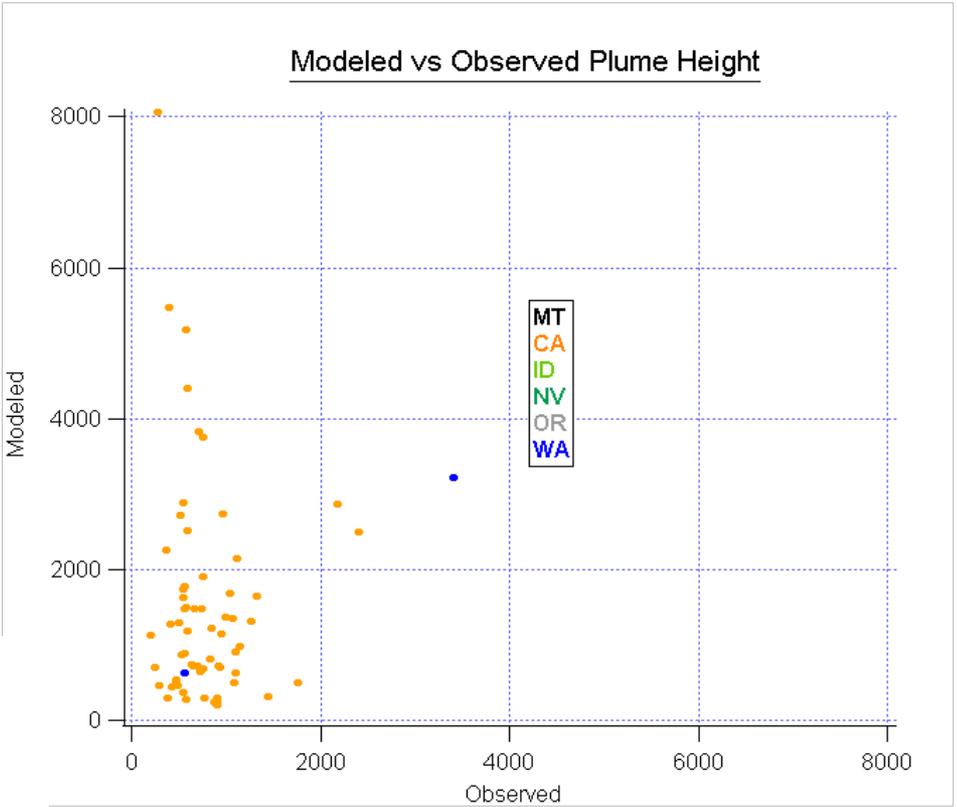Normalized Mean Bias = 1.6

Normalized Mean Error = 1.9

Fractional Bias = 32 %

Fractional Error = 68 %

Modeled vs Observed Plume Height

Ratio of Modeled to Observed vs Observed Plume Height

Conclusions:

- BCON misses fire influence (affects 2008 case significantly)

- AOD transport under-represented in model (partly due to deposition issues?)
    - Transport is further exacerbated by the lack of fire influence on meteorology.

- Some fires completely missed by BlueSky (or grossly underestimated)

- AIRPACT sometimes over-estimates near-source emissions and often puts a fire where one wasn't observed, but overall tends to under-predict fire emissions. Despite this, AIRPACT tends to predict NAAQS PM2.5 exceedances too often.

- Plume rise is un-realistically treated in locations where many fire centers are reported in close proximity (no merged plumes), large fire (predicted) plume top is often overestimated.
    - Potential issue with large number of small fires emitting all emissions into layer 1