

A Monte-Carlo method for summing modeled and background concentrations

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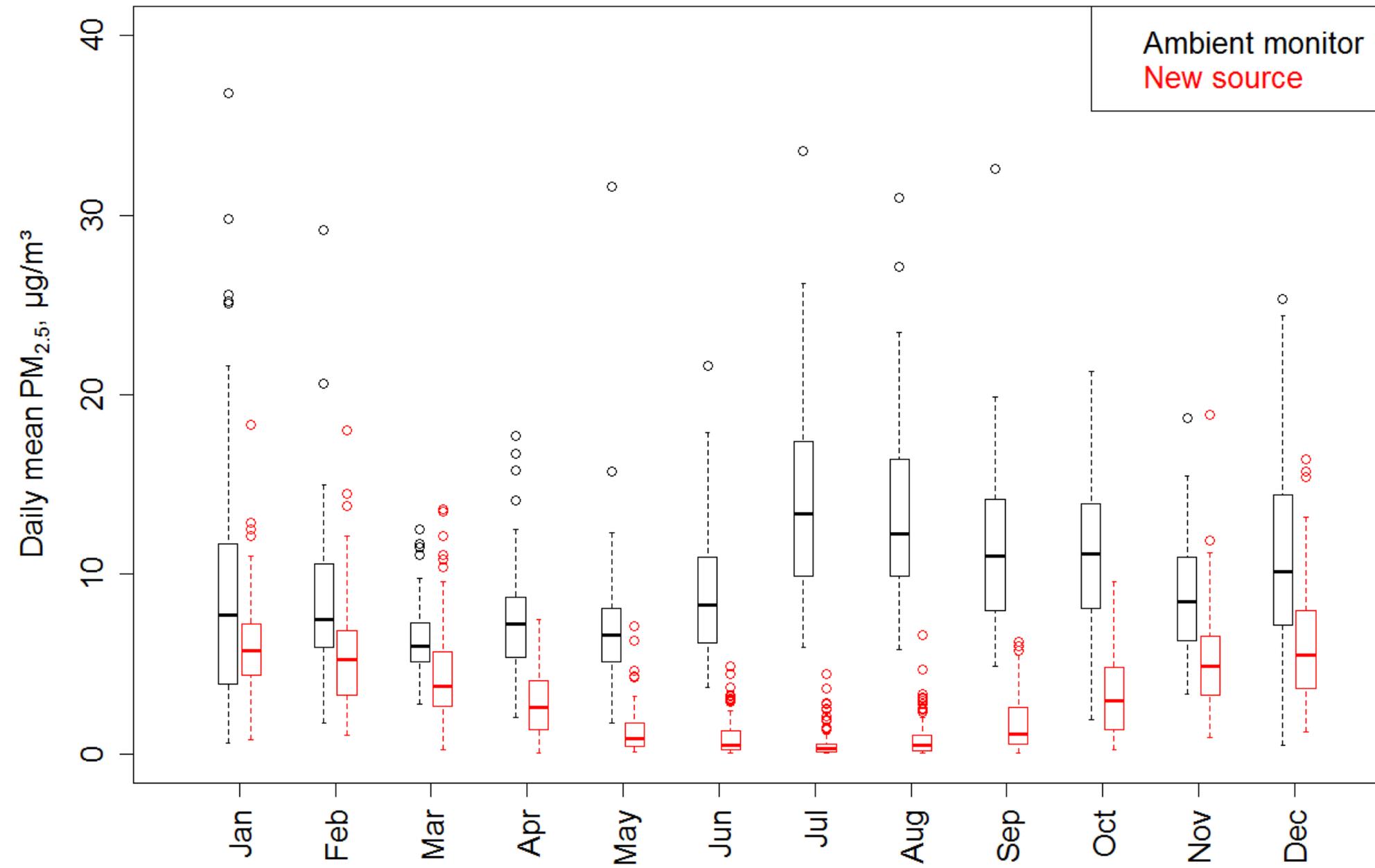
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Introduction

- In permitting, typically add AERMOD DVs values to background DVs
- Adding high ends of two independent distributions is very conservative
- More so if emissions from new source(s) and area background have different seasonality



PM _{2.5} , µg/m ³	Monit- or	New source
DVs	25.1	11.9
Sum DVs	37.0	
DV of day by day sum	30.7	

Suggested alternative approaches

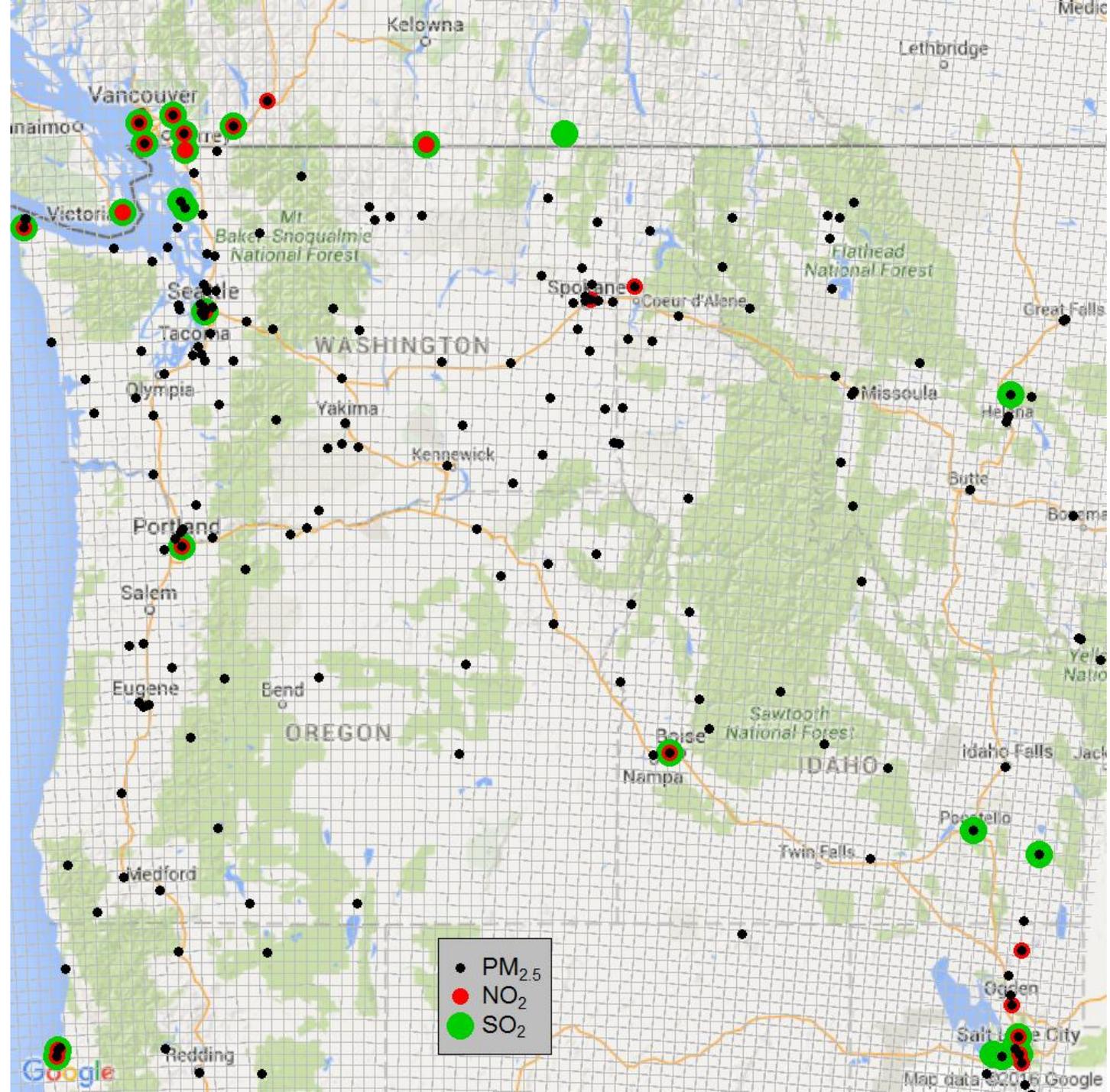
- Including nearby emissions in AERMOD
- Pairing AERMOD with a lower percentile of background data
- Pair AERMOD with direction or season- dependent background
- Probabilistic methods

Our suggested approach

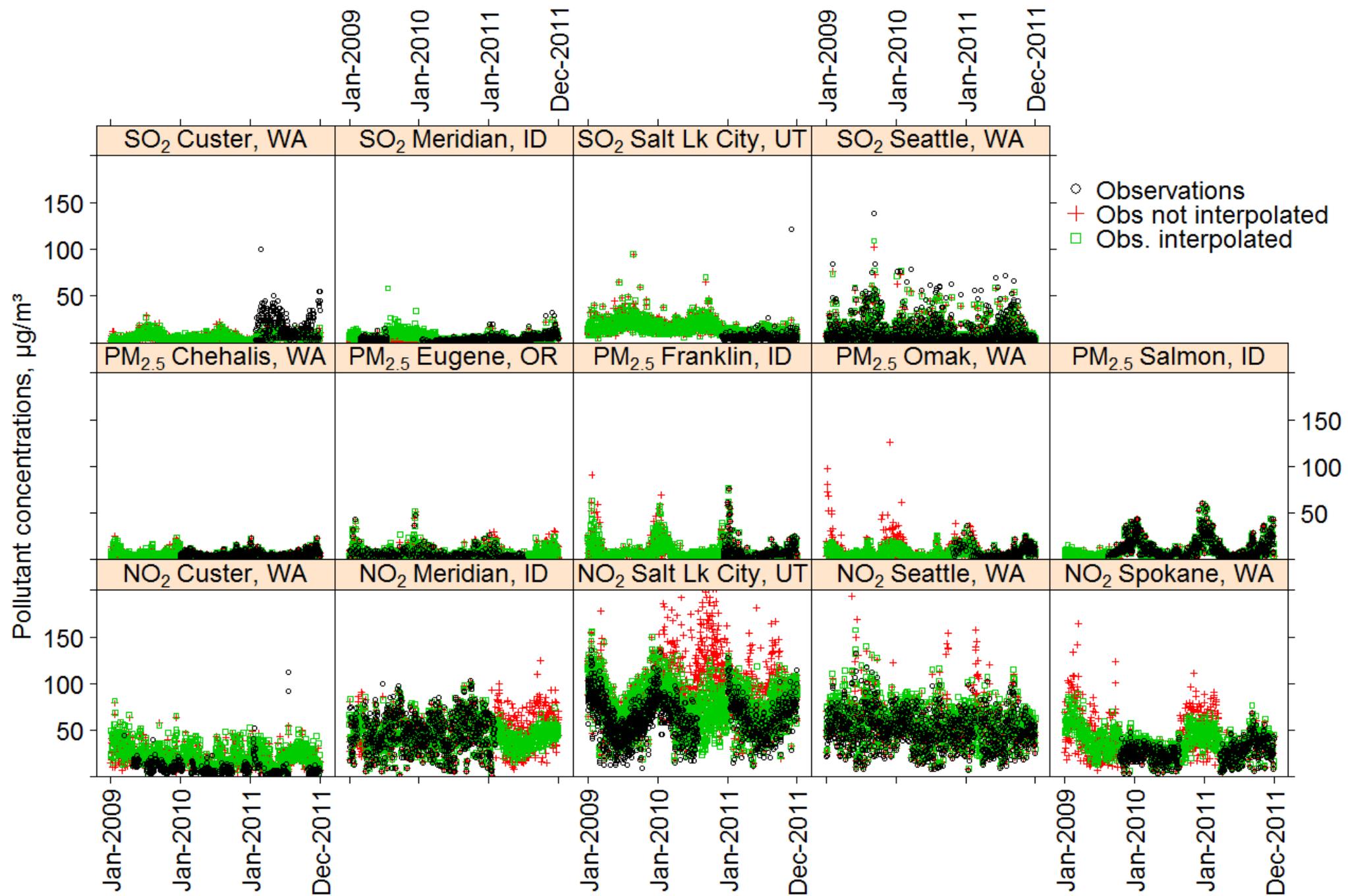
1. Spatially interpolate daily CMAQ and measured data.
 - PM_{2.5}, SO₂ and NO₂ data from 2009- 2011 interpolated with 12km CMAQ archives for Pacific NW
 - Used “idw” function in R package “gstat”
2. Web based daily background concs at user- selected locations
 - Can download date stamped CSV file containing interpolated data
3. Monte Carlo method to add AERMOD & background concs within same month



Interpolated data



All monitors used
in this work





Downloadable daily concentrations

For single point queries, click the map below to select a point, or manually enter coordinates in Lat/Long or UTM.

Latitude (decimal degrees) or UTM Northing (m):

47.87214362811194

Longitude (negative decimal degrees) or UTM Easting (m):

-118.66819901566487

UTM Zone (10-12; leave blank if entering Lat/Longs):

Download output in CSV file?: No ▾

Daily data?:

Yes ▾

Submit coordinates

For multiple point queries, upload a CSV file containing the coordinates (25 kB max): [See instructions for formatting the](#)

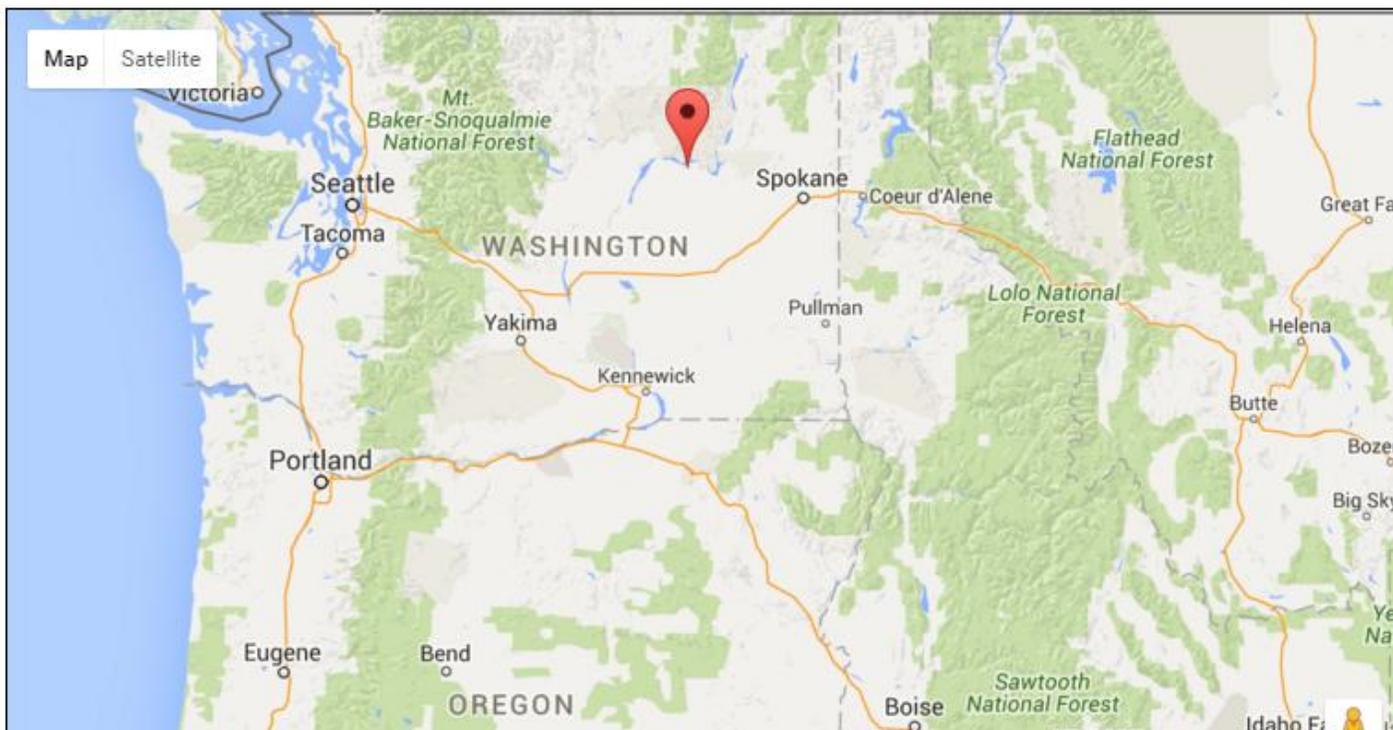
CSV file

Choose File No file chosen

Download output in CSV file?: No ▾

Daily data?: No ▾

Submit file



Lat or UTMN	47.87214
Lon or UTME	-118.6682
UTM zone	
In Washington Oregon or Idaho	YES
PM_{2.5} 24hr µg/m³	15
PM _{2.5} annual µg/m ³	5.5
O ₃ daily 8hr max ppb	54
O ₃ for PVMRM ppb	50
NO₂ 1hr ppb	7
NO ₂ annual ppb	0.7
SO₂ 1hr ppb	1.1
SO ₂ 3hr ppb	1
SO ₂ 24hr ppb	0.6
SO ₂ annual ppb	0.1
CO 1hr ppb	1034
CO 8hr ppb	566
PM ₁₀ 24hr µg/m ³	79
PM ₁₀ no extremes 24hr µg/m ³	60

	A	B
1	Date	SO2_1hr_ugm3
2	1/1/2009	14.094
3	1/2/2009	4.959
4	1/3/2009	12.528
5	1/4/2009	17.226
6	1/5/2009	8.613
7	1/6/2009	92.916
8	1/7/2009	18.27
9	1/8/2009	10.44
10	1/9/2009	14.877



Setting up AERMOD

Control Pathway

- Model: AERMOD
- Control Pathway
 - Dispersion Options
 - Pollutant / Averaging**
 - Terrain Options (Flat & Elevat
 - NOx to NO2 Options
 - Background Ozone
 - Optional Files
 - Re-Start/Multi-Year Files
 - Event/Error Files
 - Debug Files
 - Gas Deposition
 - Gas Deposition
 - Seasonal Categories
 - Land Use Categories

Pollutant

Type: SO2

Averaging Time Options

<input checked="" type="checkbox"/> 1-Hour (see below)	<input type="checkbox"/> 6-Hour
<input type="checkbox"/> 2-Hour	<input type="checkbox"/> 8-Hour
<input type="checkbox"/> 3-Hour	<input type="checkbox"/> 12-Hour
<input type="checkbox"/> 4-Hour	<input type="checkbox"/> 24-Hour

Dispersion Coefficient

Month
 Period
or
 Annual

Rural
 Urban

Urban dispersion option requires

Report Maximum Annual Average for Each Met

1-Hour Average Options

1-Hour SO2 Non-NAAQS
Disables US NAAQS special processing

1-Hour SO2 NAAQS
Based on a multi-year average of ranked maximum
Requires 99th Percentile (4th Highest) Daily Maximum

 Additional NAAQS options (MAXDAILY, MAXDCONT) available in the Output Pathway

Output Pathway

- Model: AERMOD
- Output Options
 - Tabular Outputs
 - Output Files
 - Output Settings
 - Contour Plot Files
 - Thresh. Violation Files
 - Post-Processing Files
 - TOXX Files
 - Season Hour Files
 - Rank Files
 - Evaluation Files
 - US EPA NAAQS Options**
 - Lakes Tools
 - Percentile / Rolling Average
 - Plume Animation

US EPA NAAQS Options

Max Daily | Max Daily By Year | Contributions

NAAQS Maximum Daily Files (MAXDAILY)

Source Group: ALCOA_BL

File Name: Four.dat

List of Output Files (Press the [Add] button to add to the List)

- BP_PLANT One.dat
- PHILLIPS Two.dat
- ALCOA_pt Three.dat
- ALCOA_BL Four.dat

Output Pathway

Model: AERMOD

Output Options

◆ Tabular Outputs

Output Files

◆ Output Settings

◆ Contour Plot Files

◆ Thresh. Violation Files

◆ **Post-Processing Files**

◆ TOXX Files

◆ Season Hour Files

◆ Rank Files

◆ Evaluation Files

◆ US EPA NAAQS Options

Lakes Tools

◆ Percentile / Rolling Average

◆ Plume Animation

Post-Processing Files (POSTFILE)

Averaging Period: 24

Format: UNFORMatted PLOT

Source Group ID: ALL

File Unit (Optional):

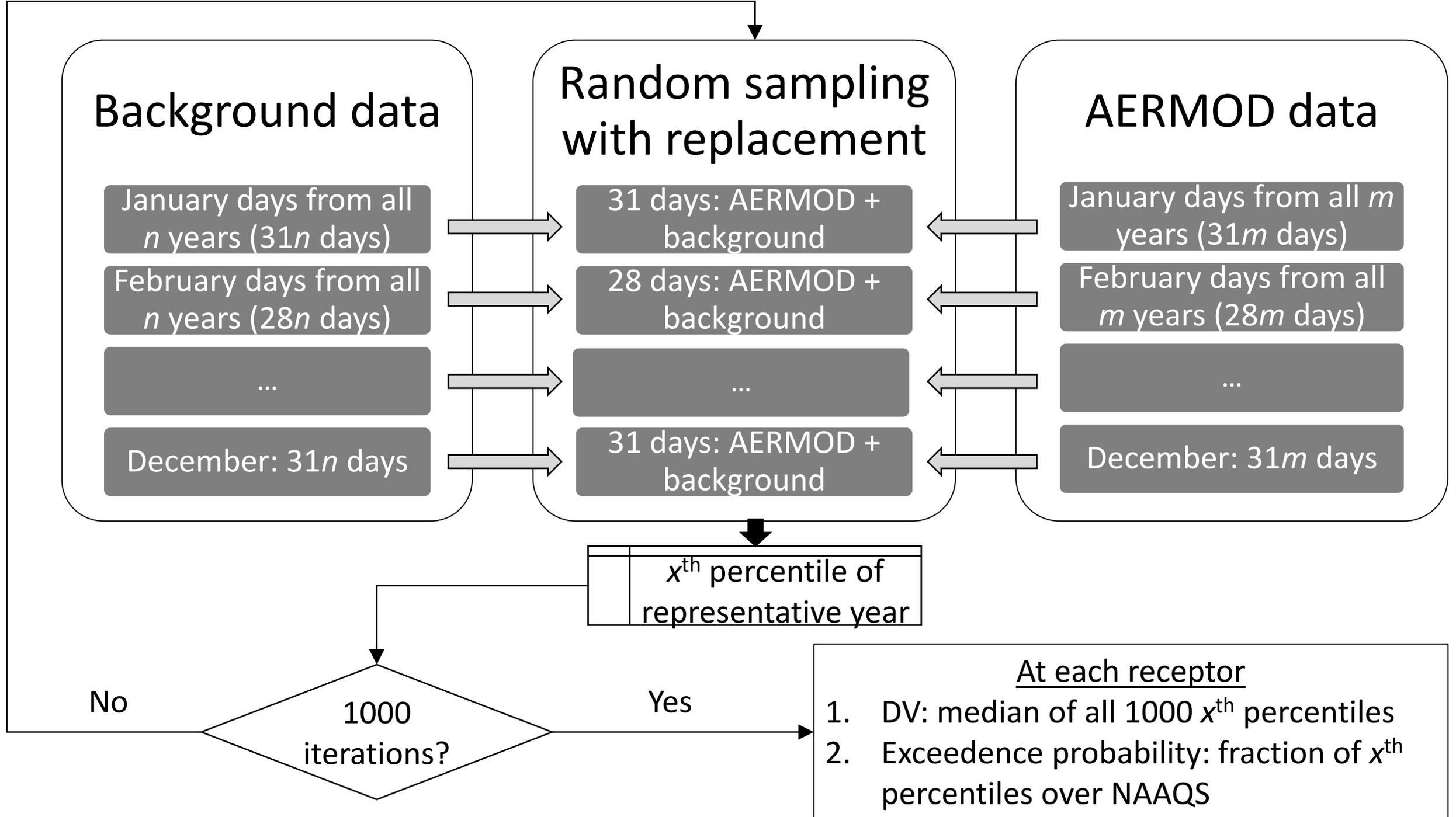
File Name: PM2.5_24HRMEAN_POSTFILE.POS

List of Output Files (Press the [Add] button to add to the List)

24 ALL PLOT PM2.5_24HRMEAN_POSTFILE.POS

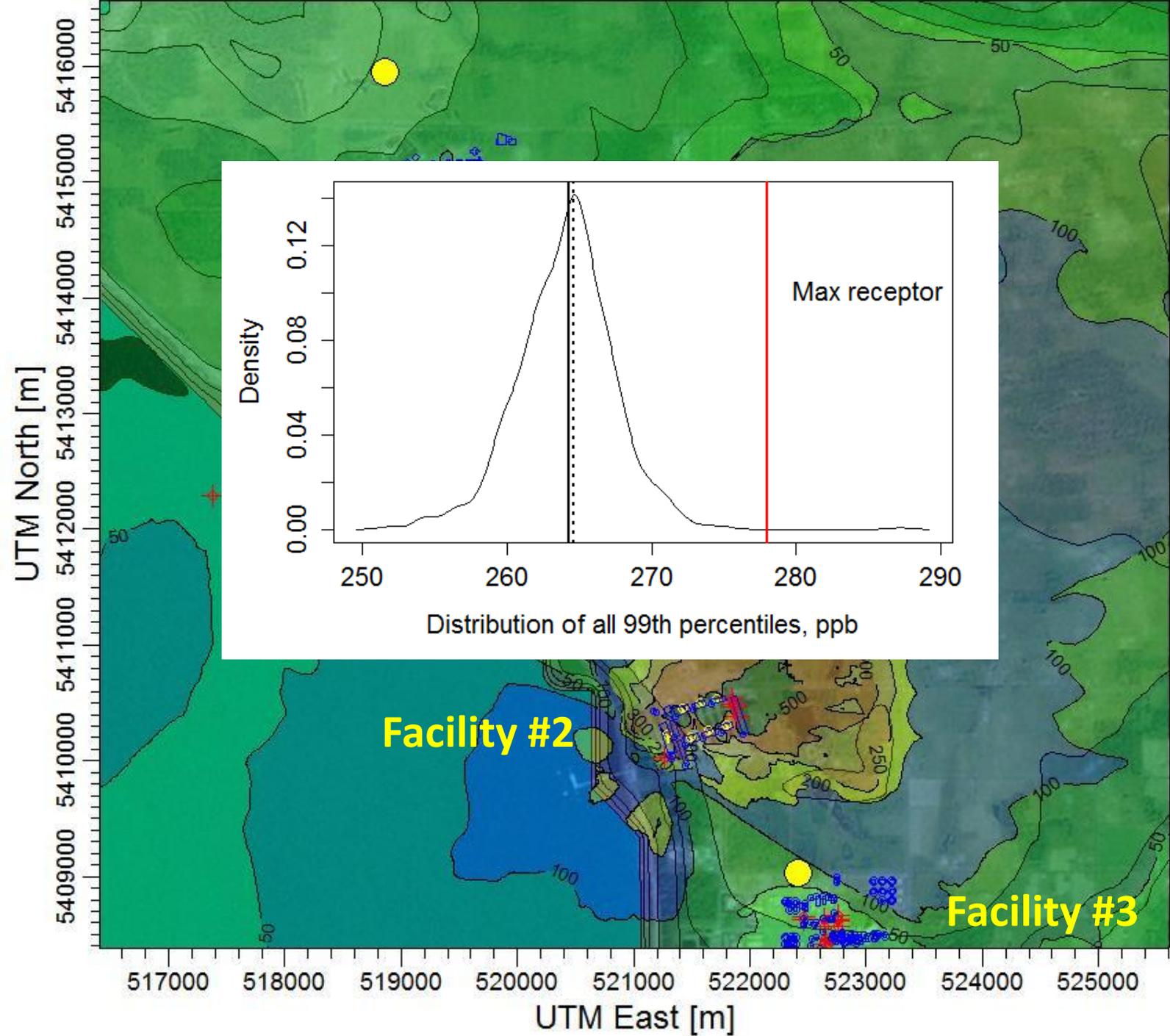


The Monte Carlo method

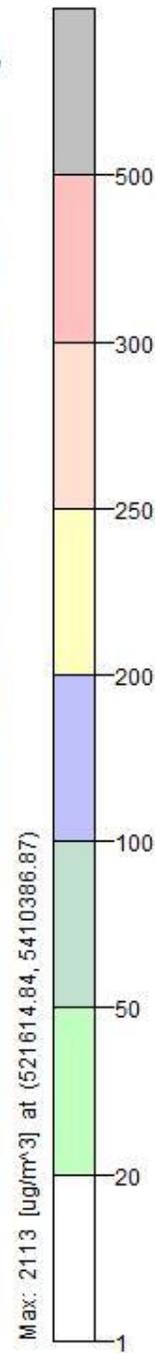




Testing it out



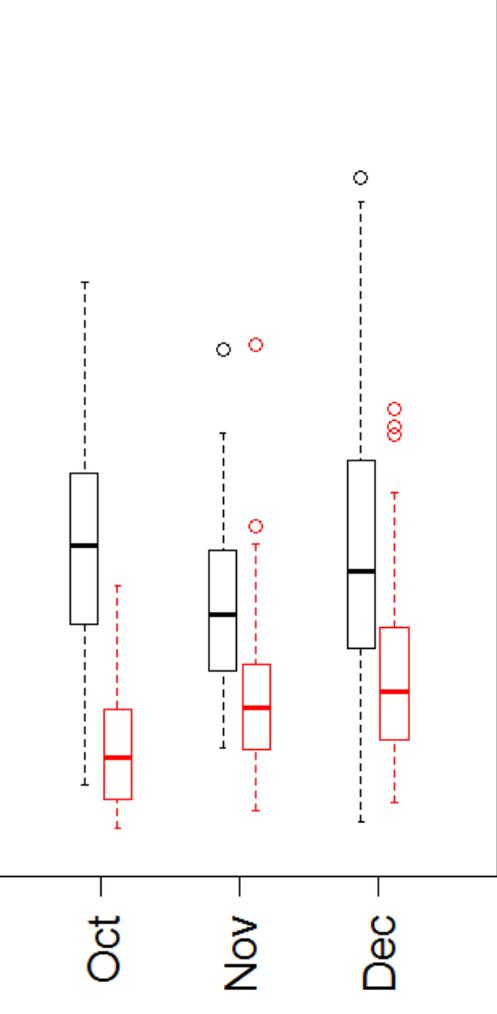
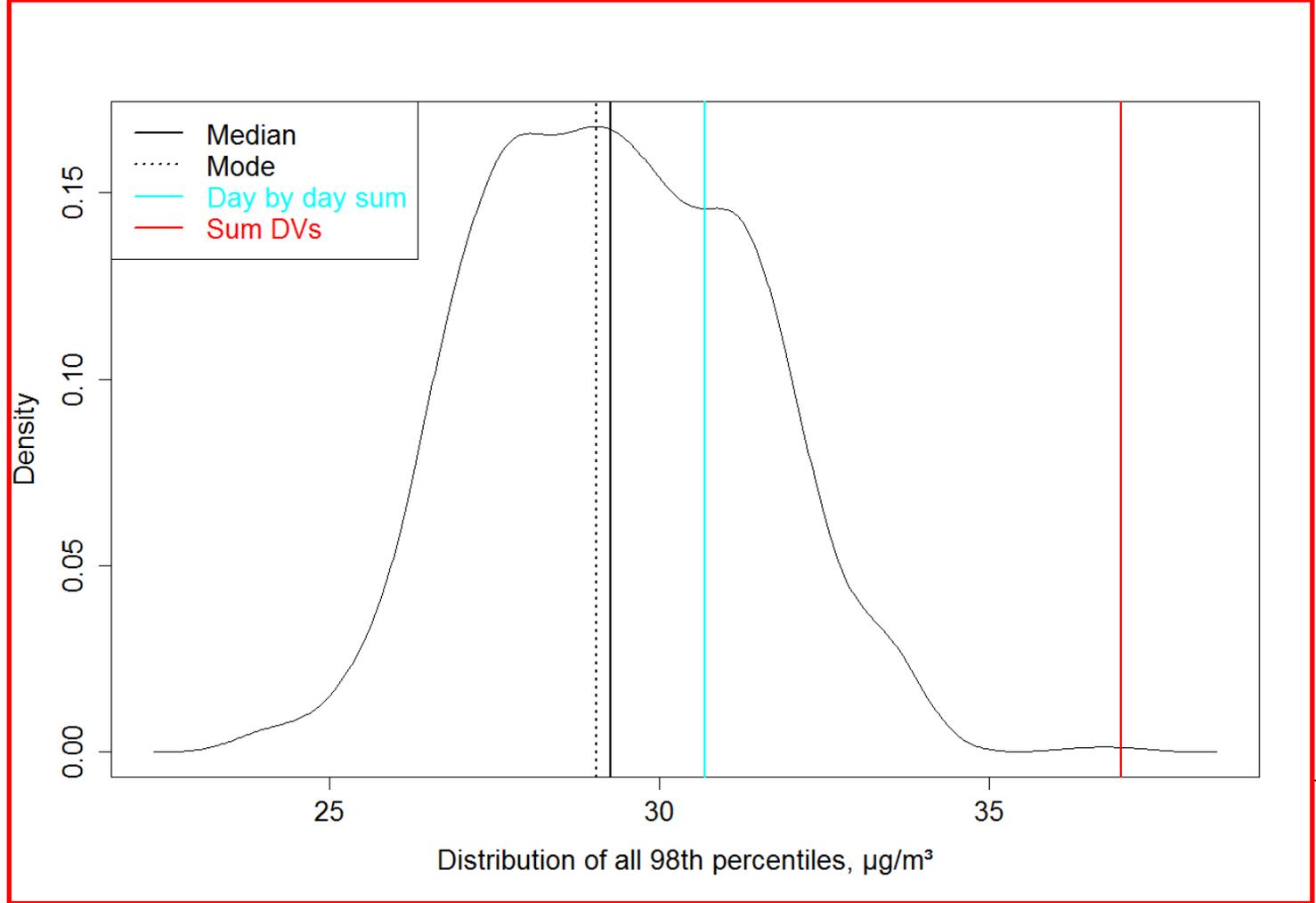
PLOT FILE OF 4TH-HIGHEST MAX DAILY 1-HR VALUES AVERAGED OVER 3 YEARS FOR SOURCE GROUP: ALLALBPP. ug/m³



All important SO₂ sources modeled with AERMOD v15181.

SO₂ 2012- 2014 DV

SO ₂ DVs, ppb	#1	#2	#3
AERMOD (own SrcGrp)	10 (8)	89 (88)	20 (3)
Background monitor	19		
AERMOD + background	29 (27)	108 (107)	39 (22)
This Monte Carlo method	22	95	28
Onsite monitor	16	81	27



PM _{2.5} , $\mu\text{g}/\text{m}^3$	Monitor	New source
DVs	25.1	11.9
Sum DVs	37.0	
DV of day by day sum	30.7	
This work	29.3	

Conclusions

- This Monte- Carlo method mimics reality more closely than AERMOD DV + background DV
- Some conservatism for NO₂ and SO₂- adds daily maxima even if hourly plumes don't overlap
- Calculates probability of exceedence
- In PNW, use <http://www.lar.wsu.edu/nw-airquest/lookup.html> for daily background concs
- Ready for use in WA, OR and ID (every1 on board?), for minor source NSR
- R code available on request.



Questions & discussion

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