Inter-pollutant trading ratios from AIRPACT-3

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Background

- Mostly concerns Nonattainment NSR
  - An existing source can increases $PM_{2.5}$ emissions by <u>*X*</u> tons in exchange for reducing SO_2 or NO_x emissions by <u>*Y*</u> tons
  - Technical demonstration, usually photochemical grid modeling needed.
  - Spatial and seasonal variability must be considered.

- These ratios can also be used to account for secondary inorganic components of $PM_{2.5}$

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IPTRs from Airpact-3 archives

- IPTRs are based on emissions of NO_x (or SO_2) to primary $PM_{2.5}$.
- Can we use gridded ambient concentrations to approximate this?
- Conversion of SO_2 or NO_x from new sources in the area to $PM_{2.5}$ might mimic ambient concentration ratios, assuming all available NH_3 is not used up.
- So… lets mine the AP3 archives from 2006- 2013

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But wait… how did the model perform?

- Compared NO_2 and SO_2 in 2009-2011
- Compared SO_4^{2-} and NO_3^- from CSN and IMPROVE sites in 2007- 2013.
- No easy way to correct for poor model performance

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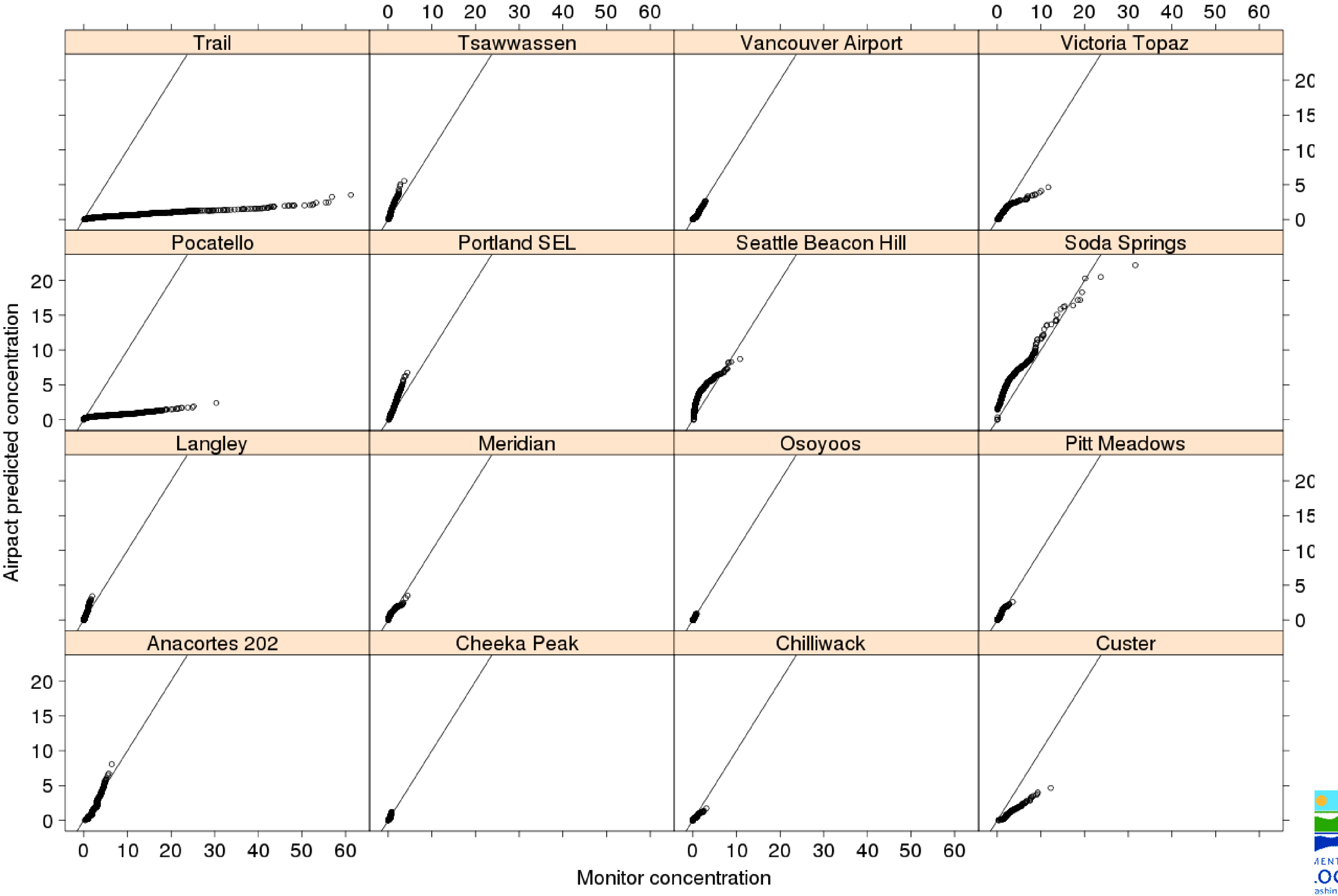
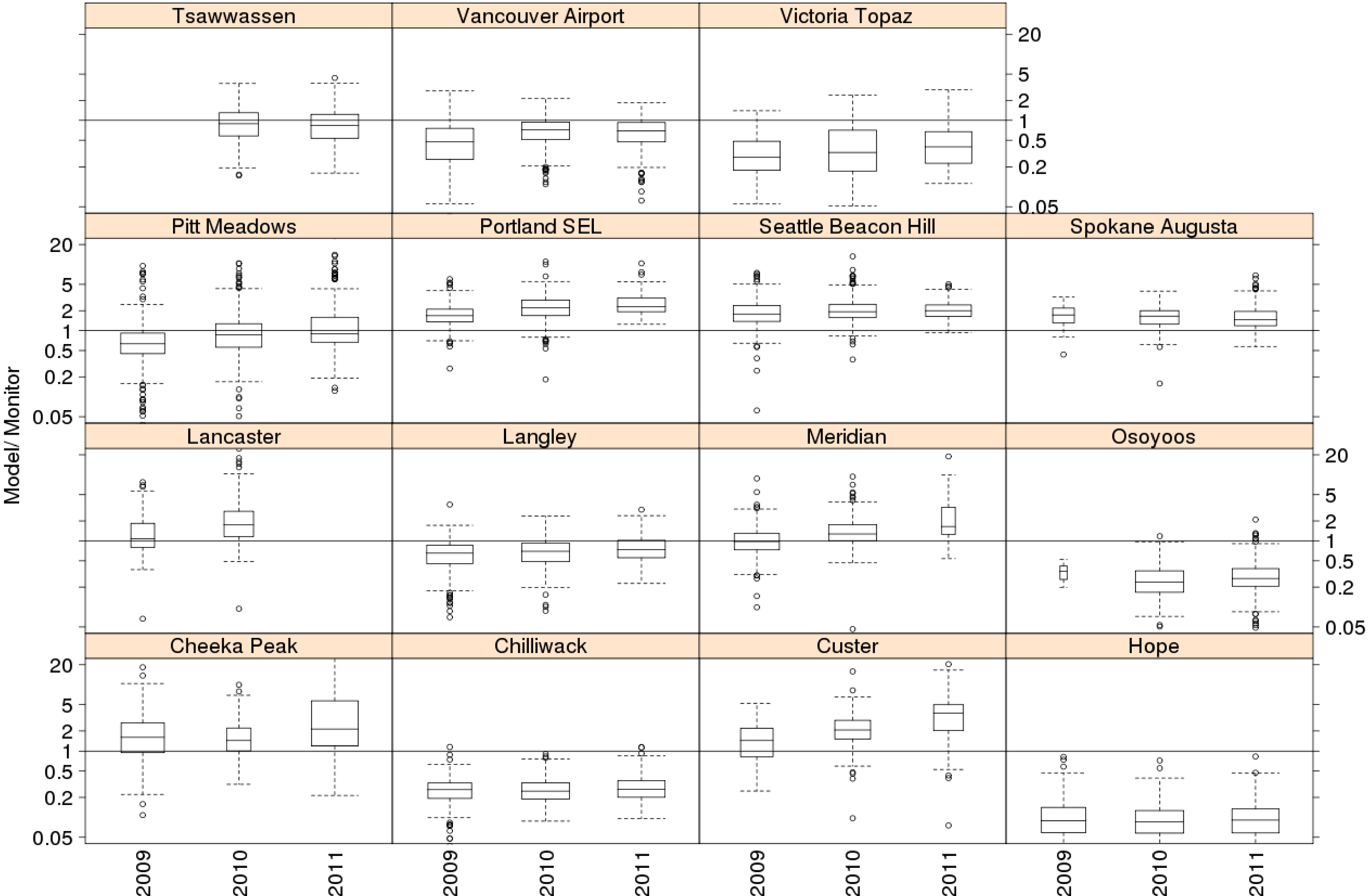
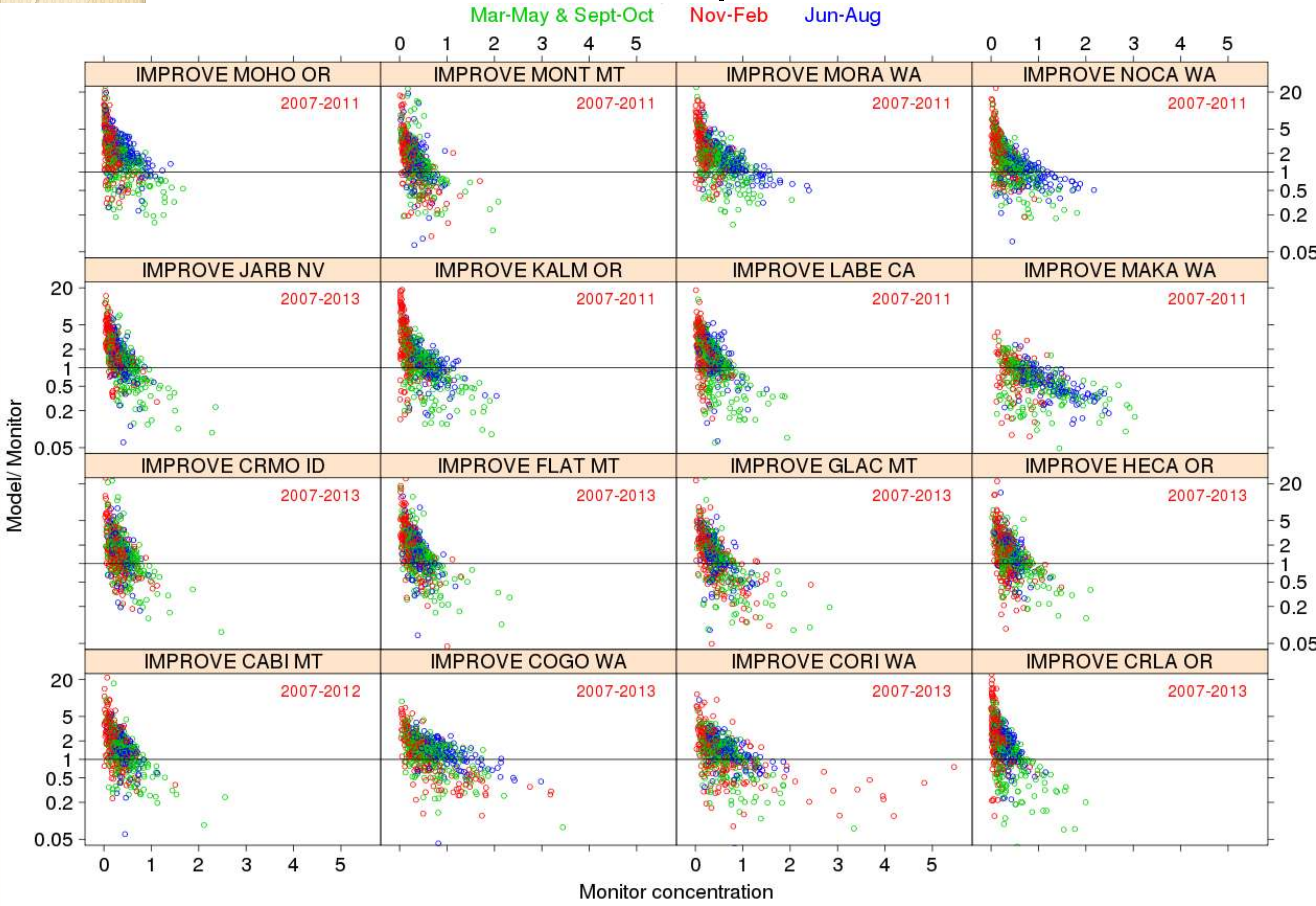
QQ-plot of AP3 performance of SO_2 daily means: 2009- 2011



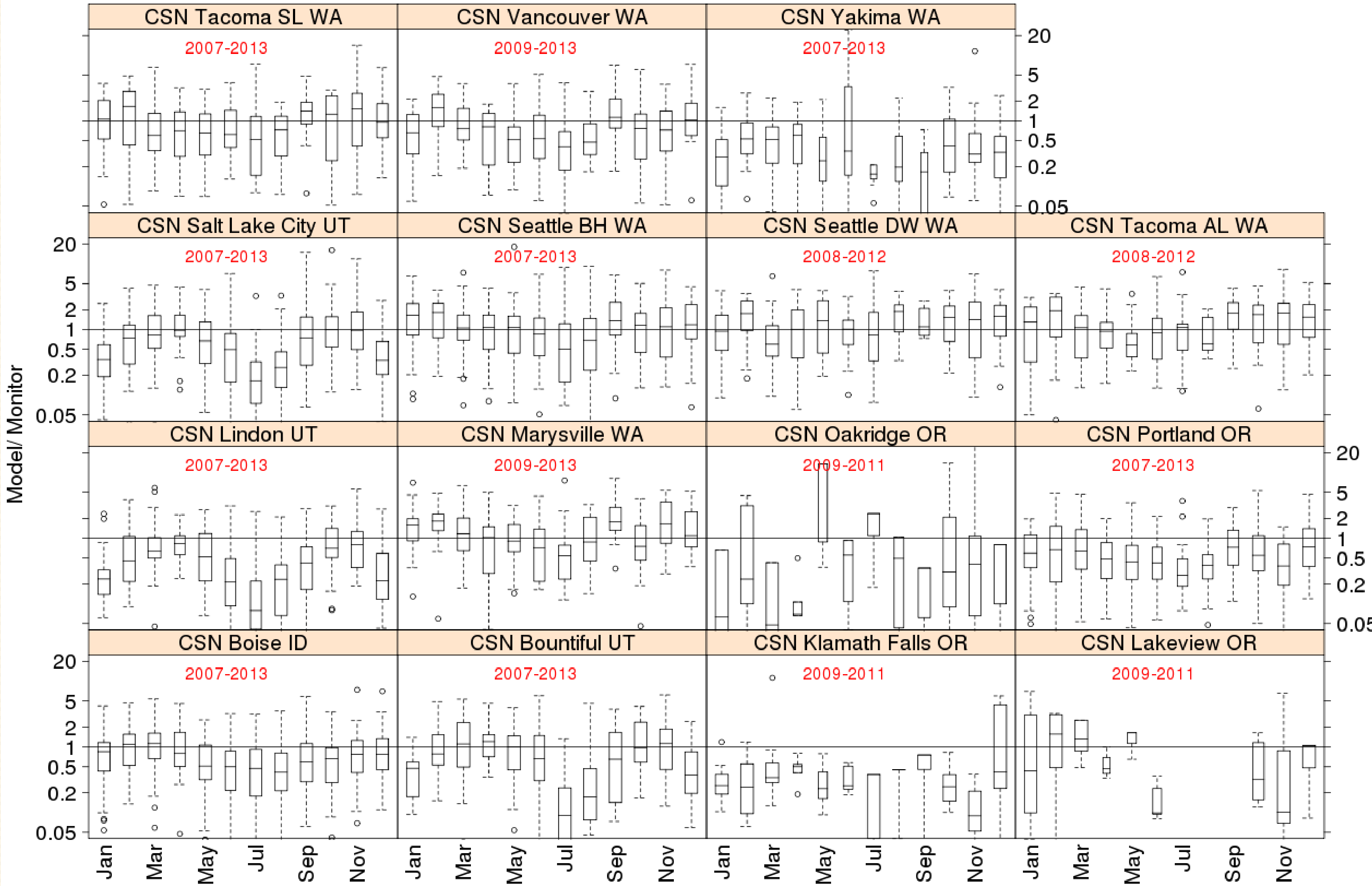
Annual AP3 performance of NO_2 daily means: 2009- 2011



AP3 performance of SO_4^{-2} at IMPROVE sites

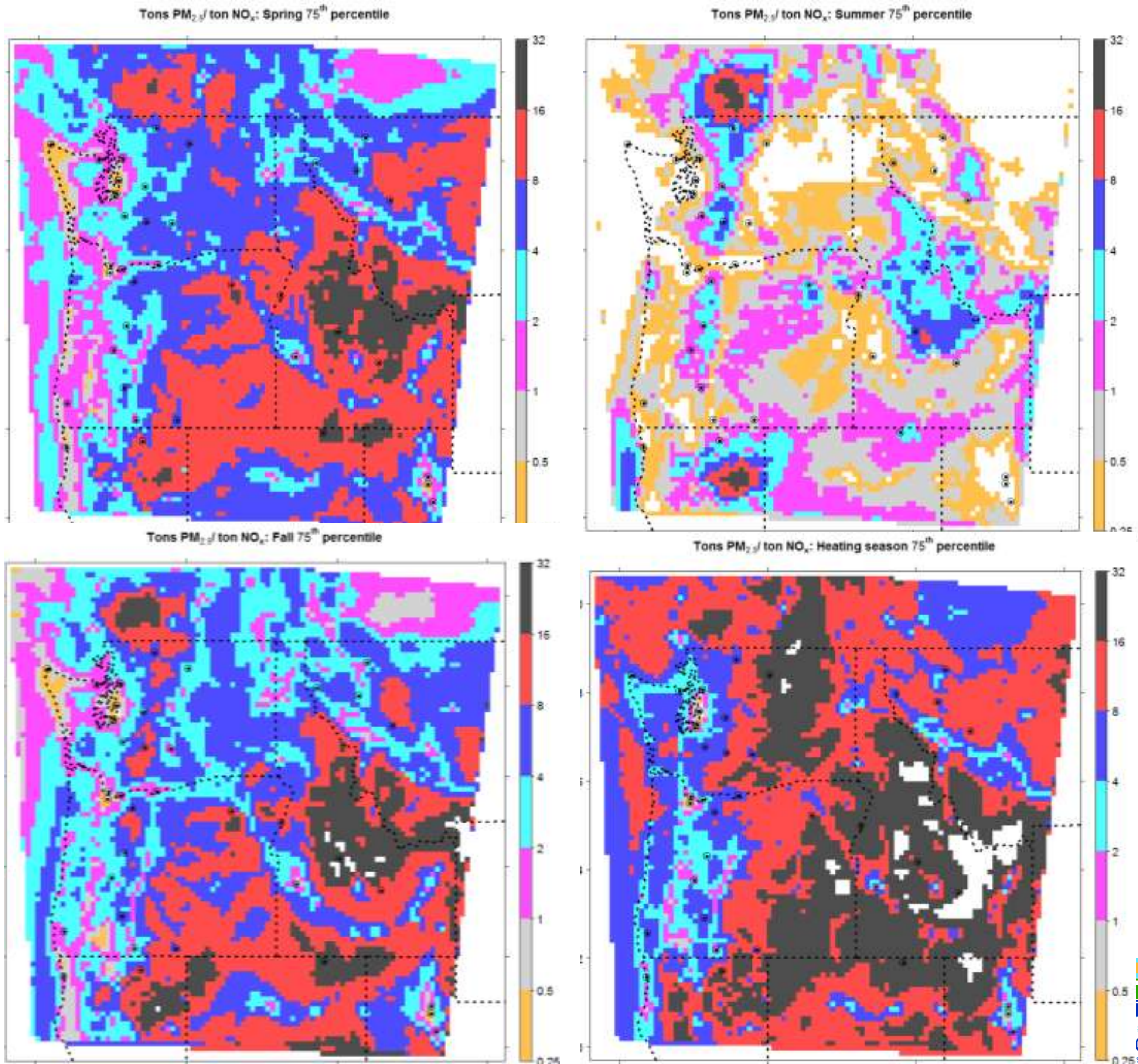


Monthly AP3 performance of NO_3^- at CSN sites

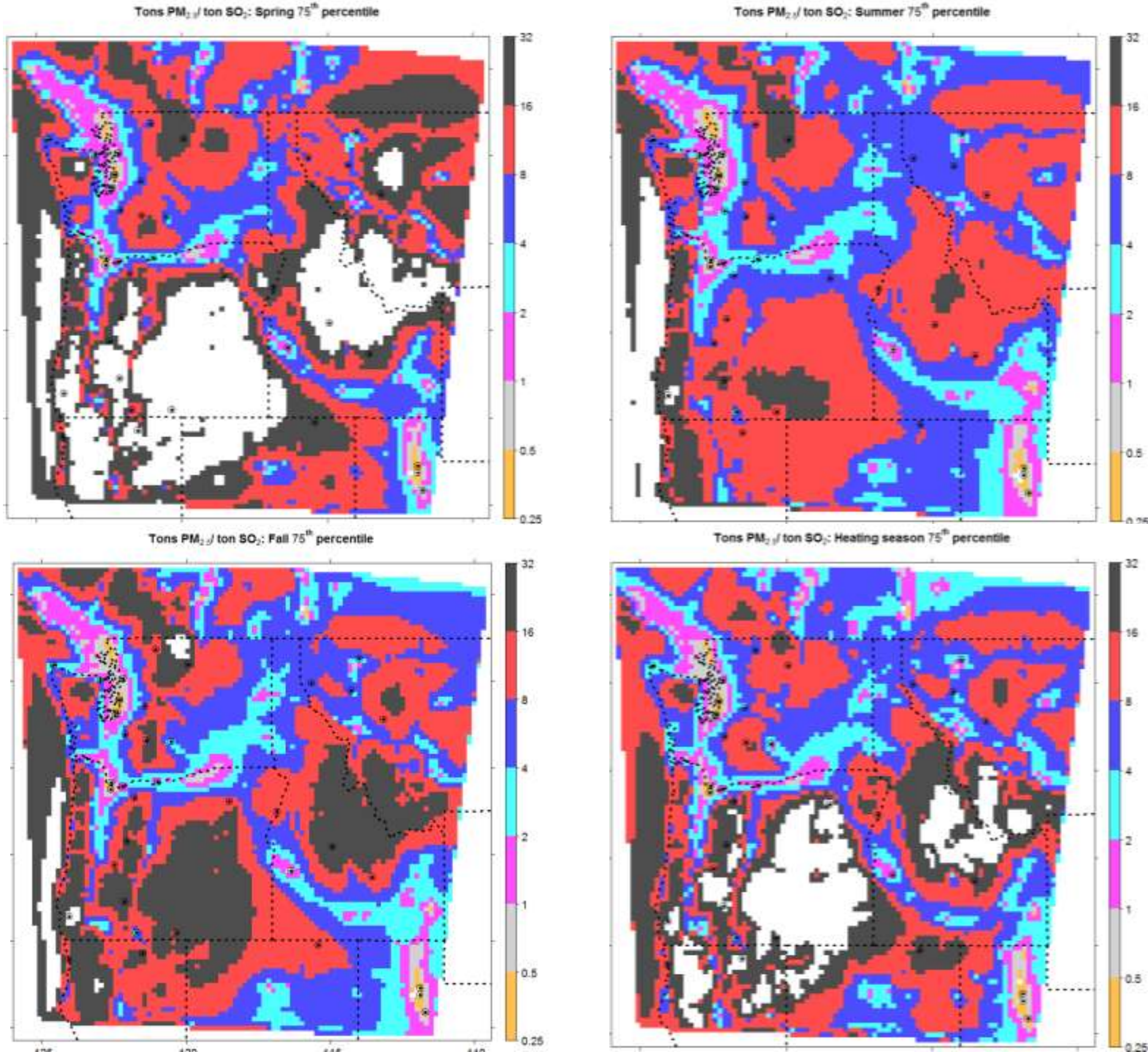


- Agreed on seasonal 75th percentile.
  - Heating season = Nov- Feb
  - Spring= Apr- May
  - Summer= June- Aug
  - Fall = Sept & Oct
- Reported as mass ratios

NO_3/NO_x IPTRs by season



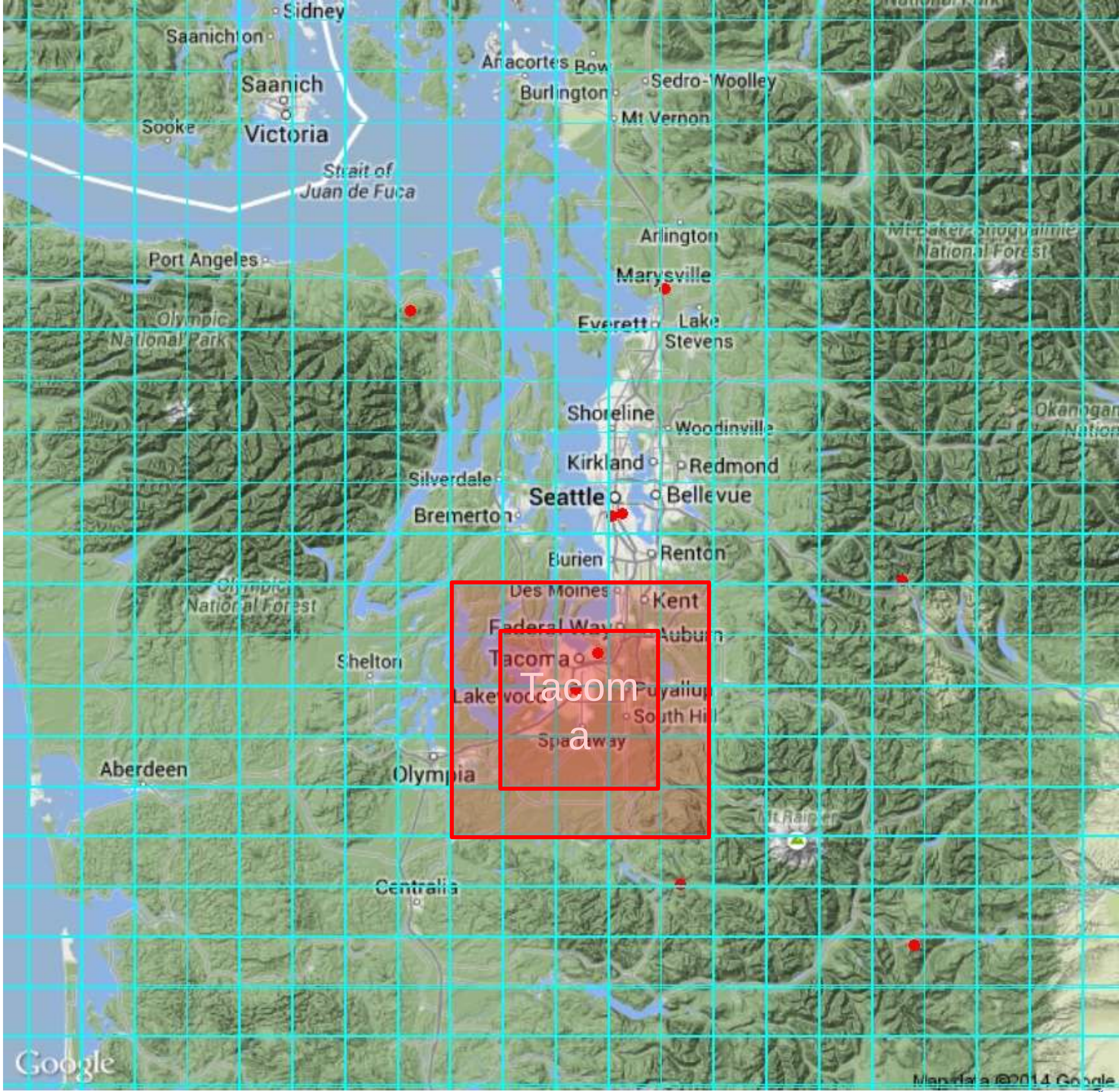
SO_4/SO_2 IPTRs by season



Weaknesses and workaround

- SO_2 and NO_x are released at the source but SO_4^{2-} and NO_3^- form in grids further downwind.
- PM SO_4/ SO_2 ratios within grid do not allow for $SO_2 \rightarrow SO_4^{2-}$ and NOx $\rightarrow NO_3^-$ conversion time
- Suggestion: aggregate grids. Average concs over 36 or 60km resolution.

How does grid aggregation look like in WA's only NAA?



Effect of aggregating grids around Tacoma

Mass ratio, season	Single grid	3 x 3	5 x 5
PM NO_3/NO_x, Spring	0.37	0.42	0.51
PM NO_3/NO_x, Summer	0.087	0.1	0.12
PM NO_3/NO_x, Fall	0.29	0.38	0.47
PM NO_3/NO_x, Heating season	0.38	0.49	0.62
PM SO_4/SO_2, Spring	0.82	0.88	0.94
PM SO_4/SO_2, Summer	0.82	0.86	0.89
PM SO_4/SO_2, Fall	0.67	0.75	0.79
PM SO_4/SO_2, Heating season	0.69	0.67	0.71

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Effect of aggregating grids around Klamath Falls, OR

Mass ratio, season	Single grid	3 x 3	5 x 5
PM NO_3/NO_x, Spring	0.98	1.6	2.0
PM NO_3/NO_x, Summer	0.19	0.38	0.52
PM NO_3/NO_x, Fall	0.8	1.6	2.0
PM NO_3/NO_x, Heating season	0.93	1.9	2.6
PM SO_4/SO_2, Spring	3.8	8.7	12
PM SO_4/SO_2, Summer	3.3	5.1	6.0
PM SO_4/SO_2, Fall	3.0	6.1	8.0
PM SO_4/SO_2, Heating season	2.1	4.6	6.9

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Conclusions

- Not IPTRs per-se but close. Scalable?
- Seasonal 75th percentile metric: an attempt at accounting for wildfires and their sporadic inclusion in AP3
- Model performance is a mixed bag
- Web lookup tool for IPTRs (not ready for prime time): http://lnxtst.cee.wsu.edu/iptr.html

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