

Modeling dry scrubber stacks as buoyant line sources in AERMOD

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Modeling Buoyant Line Sources

- Potlines in smelters release a lot of fugitive heat
- Emissions traditionally vented through roof ridges
- From ~1980, the BLP model was used to handle the xs heat & roof ridge vent emissions
- But emissions from reduction pots are now ducted to banks of dry scrubbers

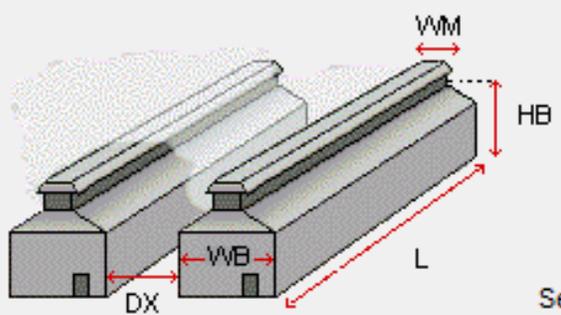


Modeling Buoyant Line Sources (contd.)

- Dry scrubbers can be modeled as point sources but this ignores fugitive heat nearby. Concs overpredicted.
- Old BLP model does not accept refined meteorological (e.g. AERMET) inputs.
- BLP ported to AERMOD v15181 but still Beta option
- To model SO₂ from Al smelters, we reconfigured potline dry scrubber stacks as buoyant line sources in AERMOD v15181
- Like this

Average Properties for All Buoyant Line Sources

Average Building Parameters



Specify Average Parameters:

Building Length (L):	<input type="text" value="33.0"/>	[m]
Building Height (HB):	<input type="text" value="18.0"/>	[m]
Building Width (WB):	<input type="text" value="15.0"/>	[m]
Line Source Width (WM):	<input type="text" value="1.52"/>	[m]
Separation Between Buildings (DX):	<input type="text" value="5.0"/>	[m]

Average Properties

Average Buoyancy Parameter (FPRIME):	<input type="text" value="400.0"/>	[m4/s3]
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Buttons: Help, Cancel, OK

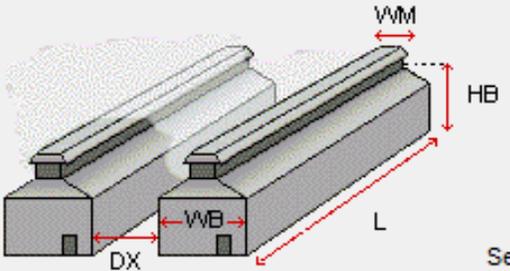
AERMOD- BLP assumes buoyant line source are continuous lines that run the length of the building.

Line of dry scrubbers shorter than the potline building



Average Properties for All Buoyant Line Sources

Average Building Parameters



Specify Average Parameters:

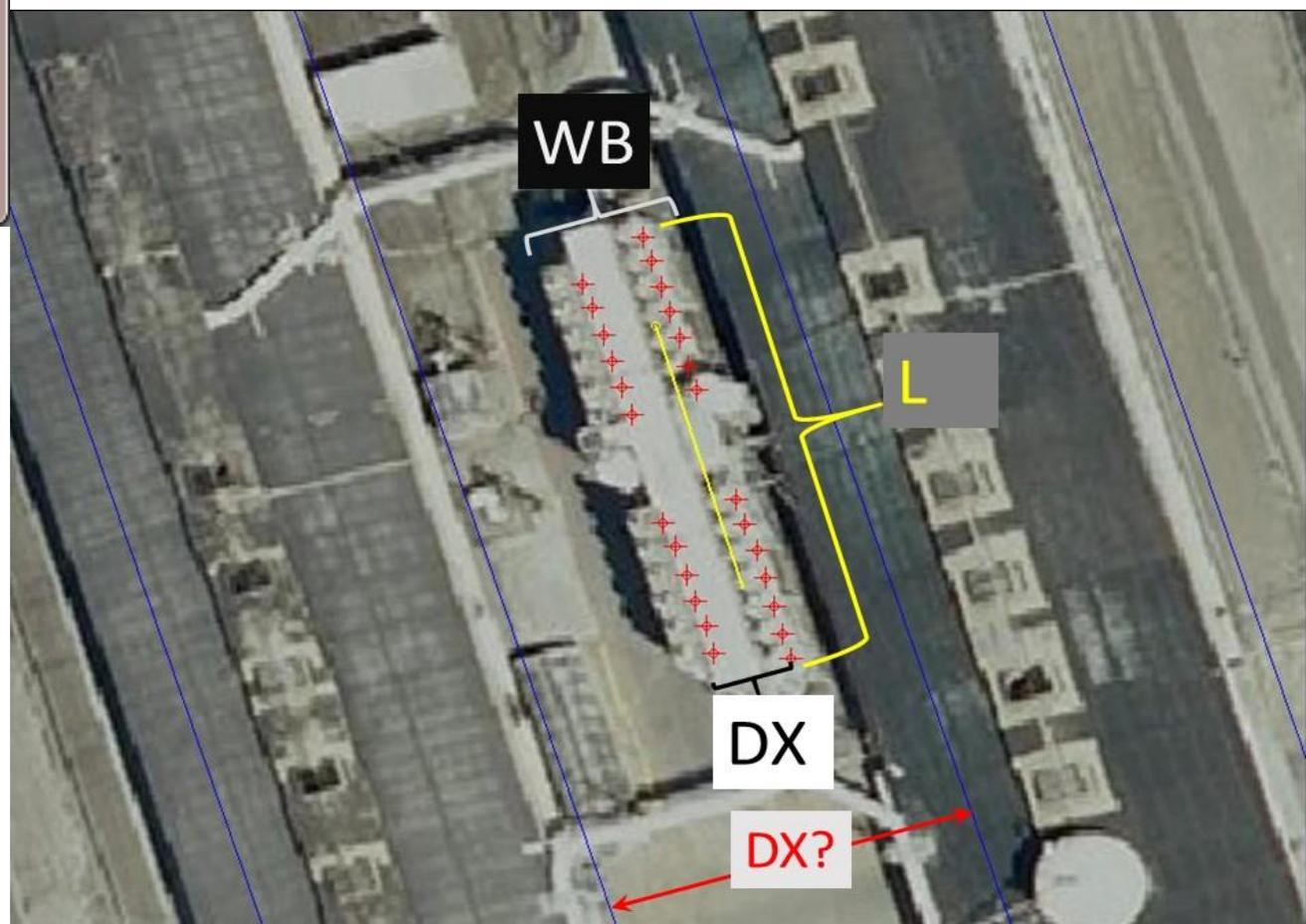
Building Length (L):	<input type="text" value="33.0"/>	[m]
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Building Width (WB):	<input type="text" value="15.0"/>	[m]
Line Source Width (WM):	<input type="text" value="1.52"/>	[m]
Separation Between Buildings (DX):	<input type="text" value="5.0"/>	[m]

Average Properties

Average Buoyancy Parameter (FPRIME): [m4/s3]

WM = dry scrubber stack diameter

DX= 40m gave slightly higher concs downwind

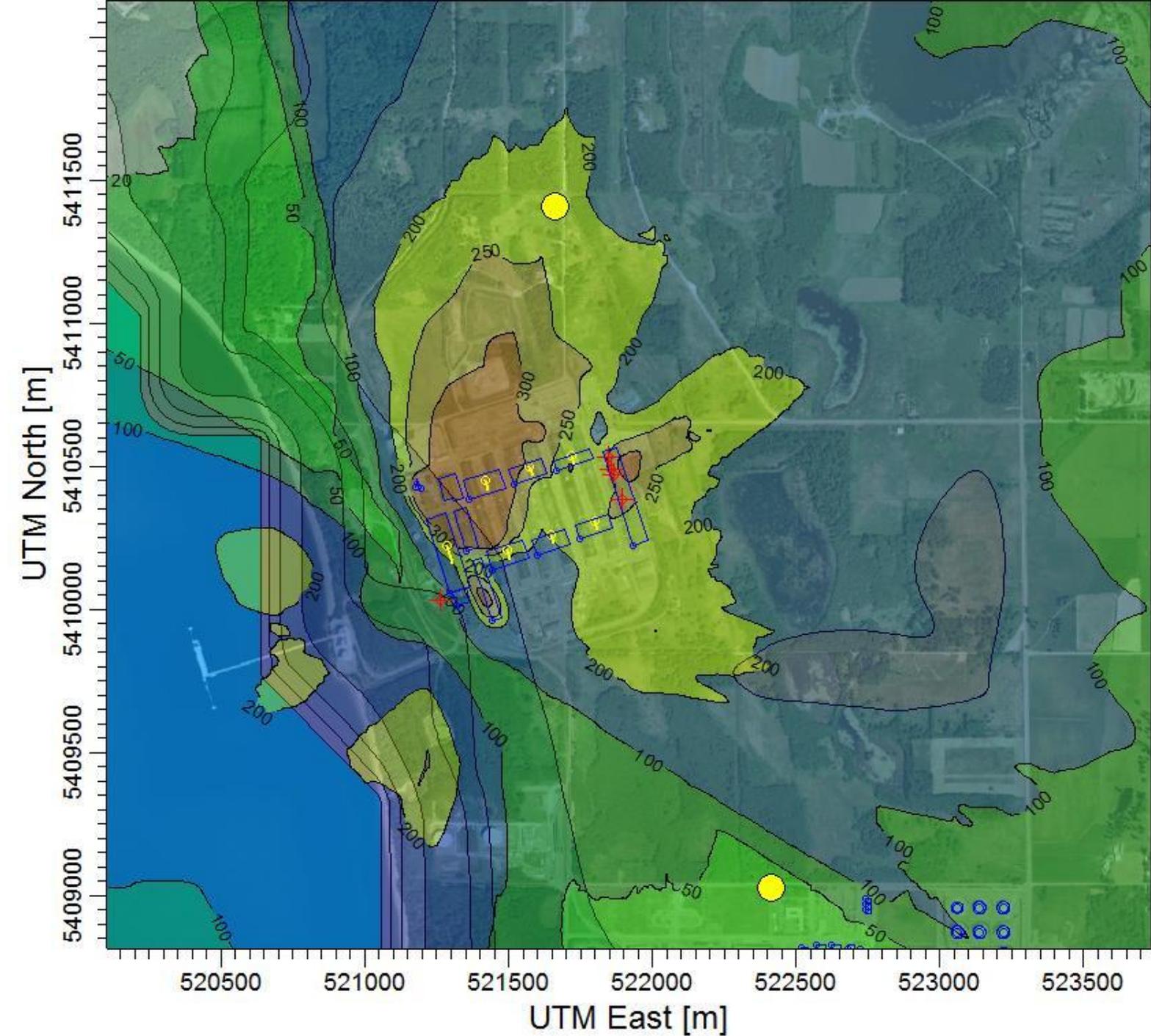


Average line source buoyancy parameter (F' , m^4/s^3)

- $F' = [g L W_m w (T_s - T_a)]/T_s$
- Where:
 - g = acceleration of gravity (9.81 m/s^2)
 - L = average line source length (m)
 - W_m = average line source width (m)
 - w = exit velocity (m/s)
 - T_s = exit temperature (K)
 - T_a = ambient air temperature (K)
- Stayed conservative. Used lowest w , T_s and high-balled T_a . Then halved F' value.

Running AERMOD

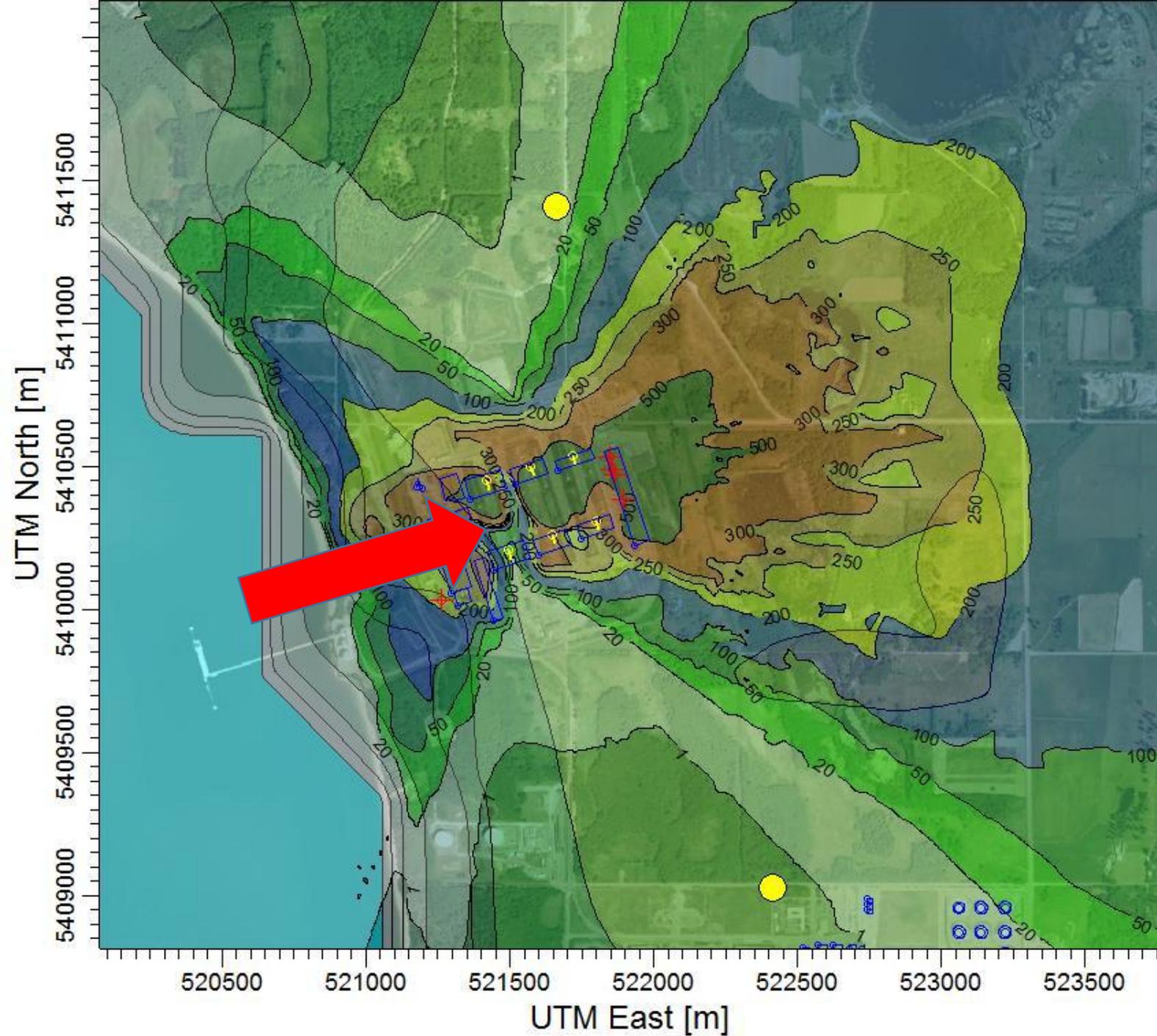
- Used 2012- 2014 on- site meteorology
- Actual emissions from the same years
- Separate source groups for different facilities
- Separate source groups for point and buoyant line sources at smelter



PLOT FILE OF 4TH-HIGHEST MAX DAILY 1-HR VALUES AVERAGED OVER 3 YEARS FOR SOURCE GROUP: ALCOA_PT ug/m³
Max: 465.0 [ug/m³] at (521218.82, 5410386.87)

Smelter point source
SO₂ emissions only; no
BLP or dry scrubber
emissions.

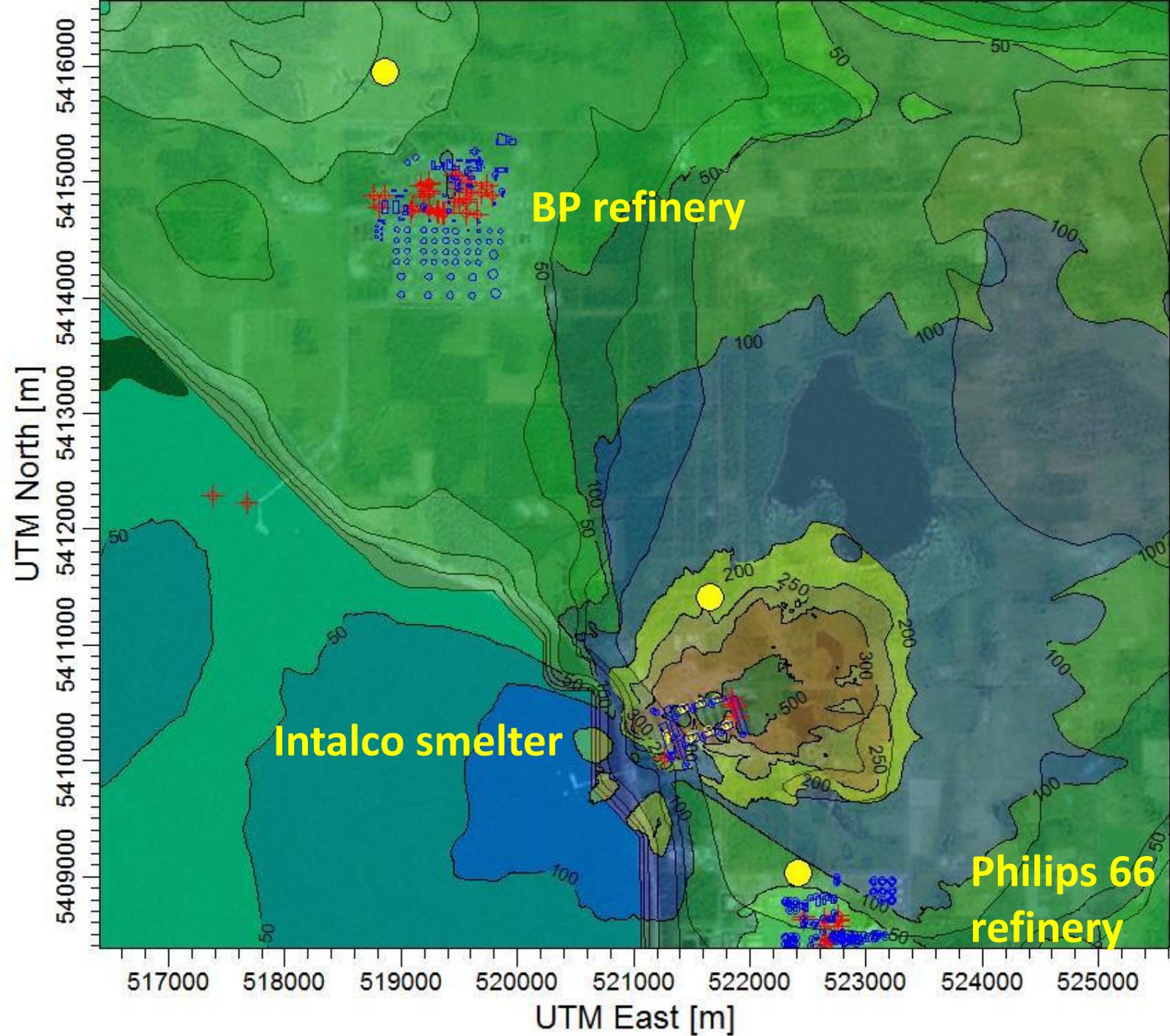
SO₂ 2012- 2014 DV



PLOT FILE OF 4TH-HIGHEST MAX DAILY 1-HR VALUES AVERAGED OVER 3 YEARS FOR SOURCE GROUP: ALCOA_BL ug/m³
Max: 2112 [ug/m³] at (521614.84, 5410386.87)

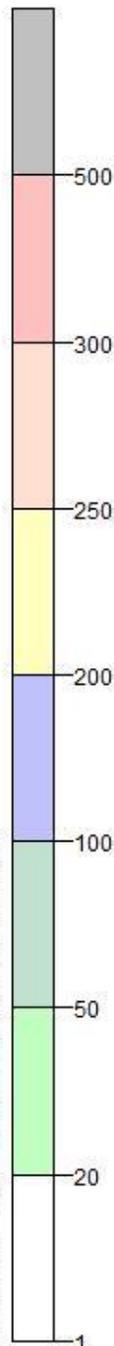
Smelter dry scrubber emissions (no point sources), modeled with AERMOD-BLP.

SO₂ 2012-2014 DV



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

Max: 2113 [ug/m³] at (521614.84, 5410386.87)

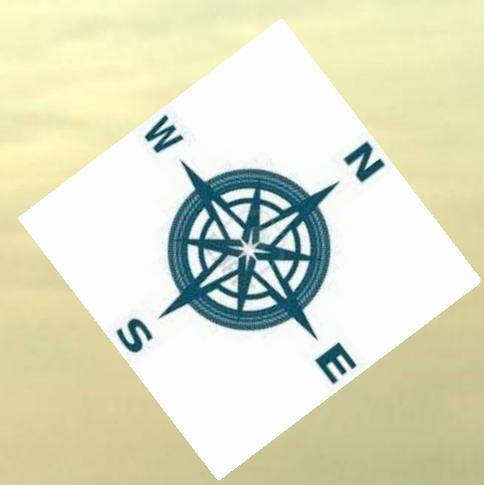


All Cherry Point SO₂ sources (BP, Philips 66 and Intalco emissions) modeled with AERMOD BLP

SO₂ 2012- 2014 DV

	BP*	Philips 66	Intalco
Monitor SO ₂ , ppb	16	27	81
Model + backgr. SO ₂ , ppb	29	39	108

* Excluding 2012 data- refinery fire closed facility



Intalco smelter

New
SO₂
monitor

**Philips 66
refinery**

Evening in May. Light winds.

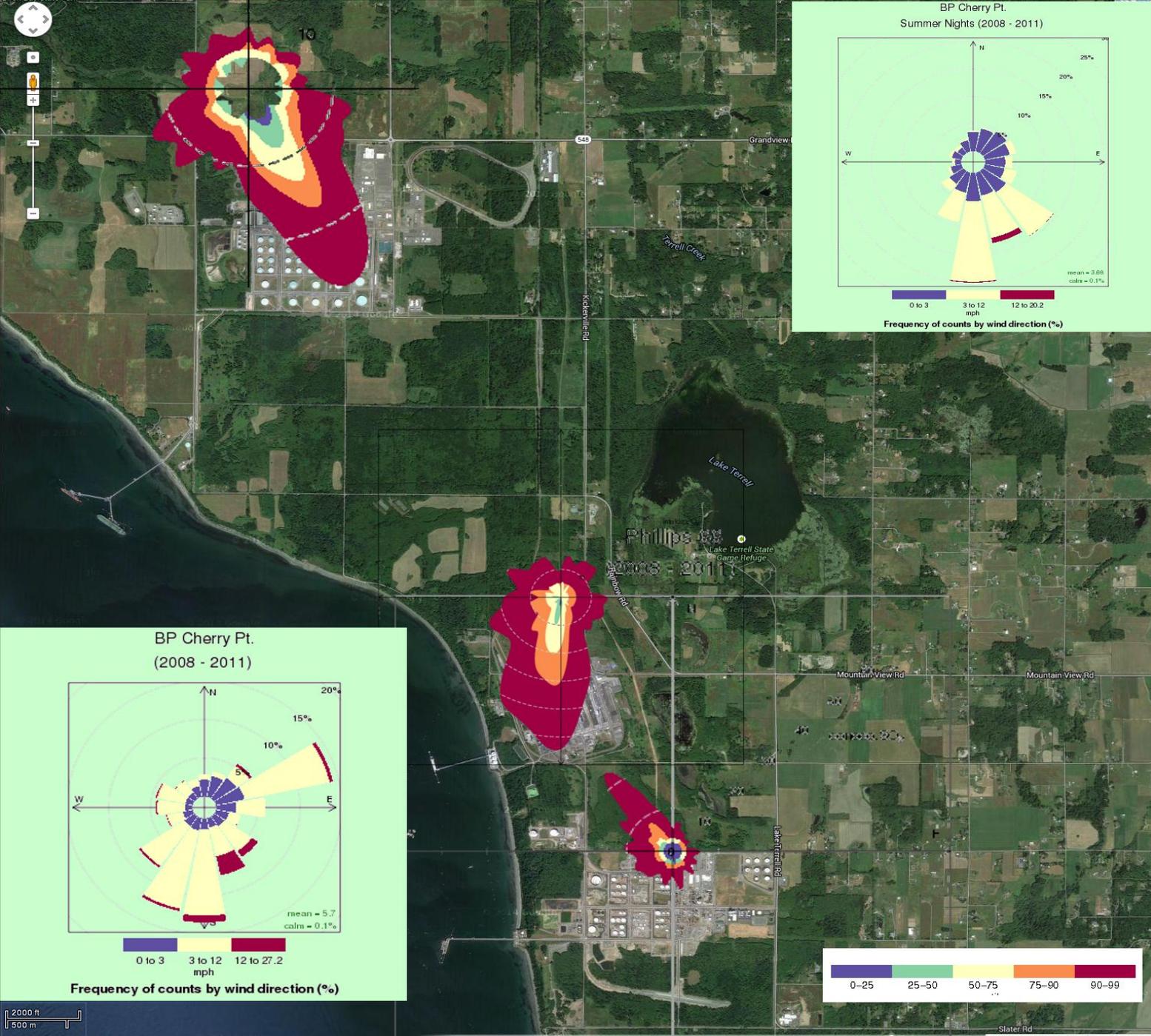
Philips 66 stacks taller and hotter. Escape evening inversion.

Intalco plume doesn't.

Conclusions

- Model- monitor comparison boosted our confidence in BLP in AERMOD v15181.
- The hotspot to the NE of Intalco (line source augmentation) cannot be ignored.
- BP and Philips66 emissions have minimal impact on the hotspot.
- Buoyant line sources have minimal impact at the on-site SO₂ monitor (used AERMOD SRCGRPS).
- Recommended one additional ambient SO₂ monitor in the area to the NE of Mountain View/ Rainbow road

From ECY analysis of Ferndale SO₂ monitoring data. Percentile roses are shown



4 th hi, ppb	BP	Philips 66	Intalco
2012	29	36	93
2013	16	27	78
2014	15	18	71
2012-2014 design value, ppb	20	27	81