Working together for clean air

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New source apportionment approaches to estimate diesel

Puget Sound Clean Air Agency
Erik Saganic

Two EPA Funded Studies

- Grant #1: To understand air toxics in Tacoma and Seattle
- Grant #2: To better understand sources of diesel (focused on Seattle)

Partnered with the University of Washington

- Tim Larson
- Mike Yost
- Chris Simpson

- Final reports submitted October 2010:
  - http://epa.gov/ttnamti1/files/20072008csatam/PSCAA_CommunityAssessment_FR.pdf
  - http://www.epa.gov/ttnamti1/files/20072008csatam/PSCAA_Methods_FR.pdf


Beacon Hill Site
Duwamish Site
SR-99
I-5
Study Area

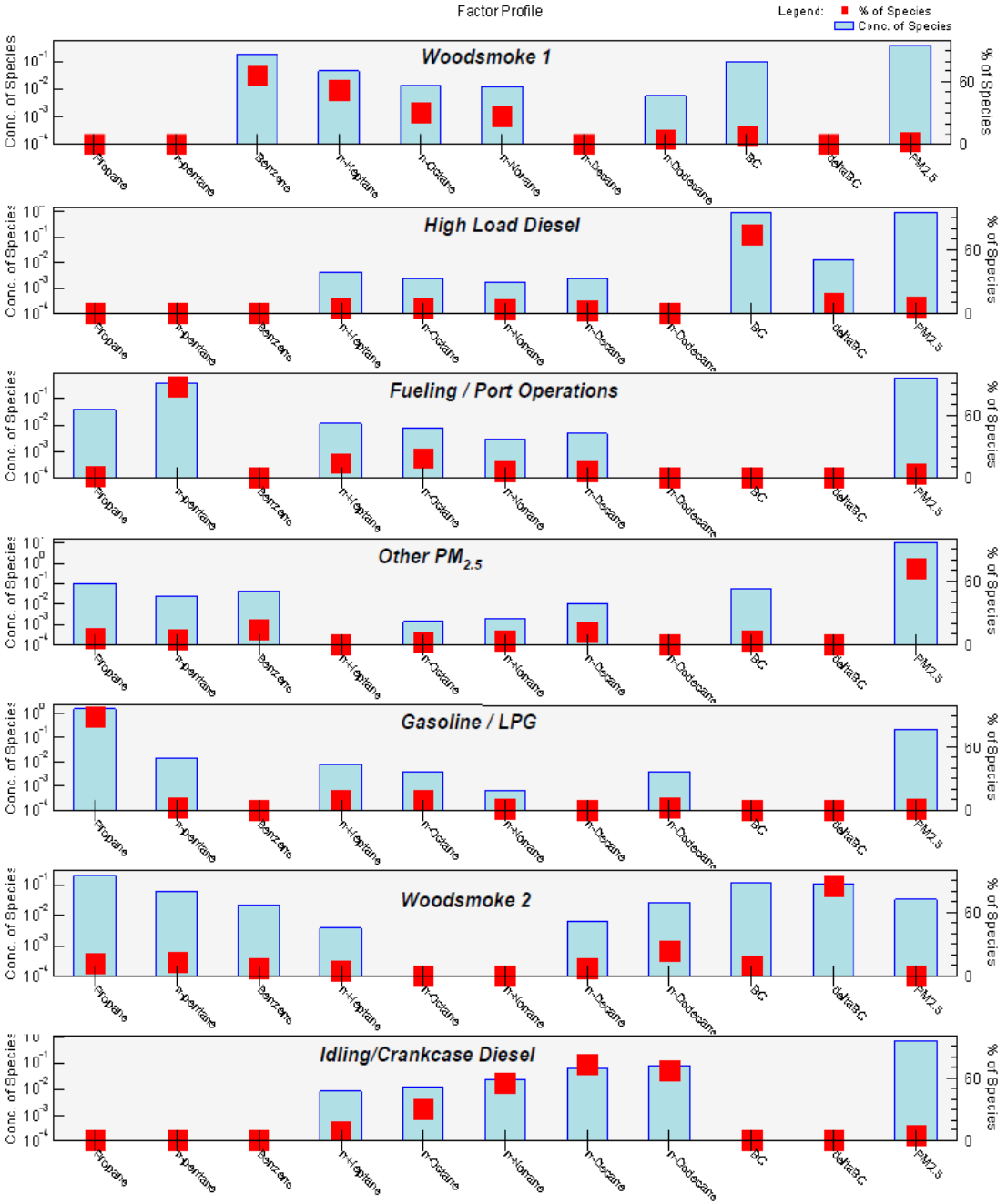
Data Collection

- 1-Nitropyrene filter collection and analysis
- GC-FID operation for hourly VOC's (54/hr)
- AIS ship tracking
- Truck Traffic data collection
- FTIR operation for Hydrocarbons and Toxics
- Speciation Sampling
- Continuous sampling: aethalometer, $PM_{2.5}$, meteorology

Table 2.2.1: Compounds measured hourly by the GC-FID. Items labeled with (*) were used in the source apportionment analysis.

PLOT Column Compounds (C2-C6)	BP-1 Column Compounds (C6-C12)
Propane*	n-Hexane
Propylene	3-Methylpentane
Isobutane	Methylcyclopentane
n-Butane*	2,4-Dimethylpentane
t-2-Butene	Benzene*
1-Butene	Cyclohexane
c-2-Butene	2-Methylhexane*
Isopentane	2,3-Dimethylpentane
n-Pentane*	3-Methylhexane
t-2-Pentene	2,2,4-Trimethylpentane
1-Pentene	n-Heptane*
c-2-Pentene	Methylcyclohexane
2,2-Dimethylbutane	2,3,4-Trimethylpentane
Isoprene	Toluene*
	2-Methylheptane
	3-Methylheptane
	n-Octane*
	Ethylbenzene*
	m & p-Xylene*
	Styrene
	o-Xylene
	n-Nonane*
	Isopropylbenzene
	n-Propylbenzene
	1,3,5-Trimethylbenzene
	o-Ethyltoluene
	1,2,4-Trimethylbenzene
	n-Decane*
	1,2,3-Trimethylbenzene*
	m-Diethylbenzene
	p-Diethylbenzene
	n-Undecane
	n-Dodecane*

Source-related factors at the Seattle Duwamish site derived from PMF 3.0 based on hourly measurements of n-alkanes and selected fine particle metrics.



The 1057 hourly measurements were collected over four different sampling periods in 2009: 1/28–2/6, 3/29–4/9, 5/6-5/26, and 7/30-8/11.

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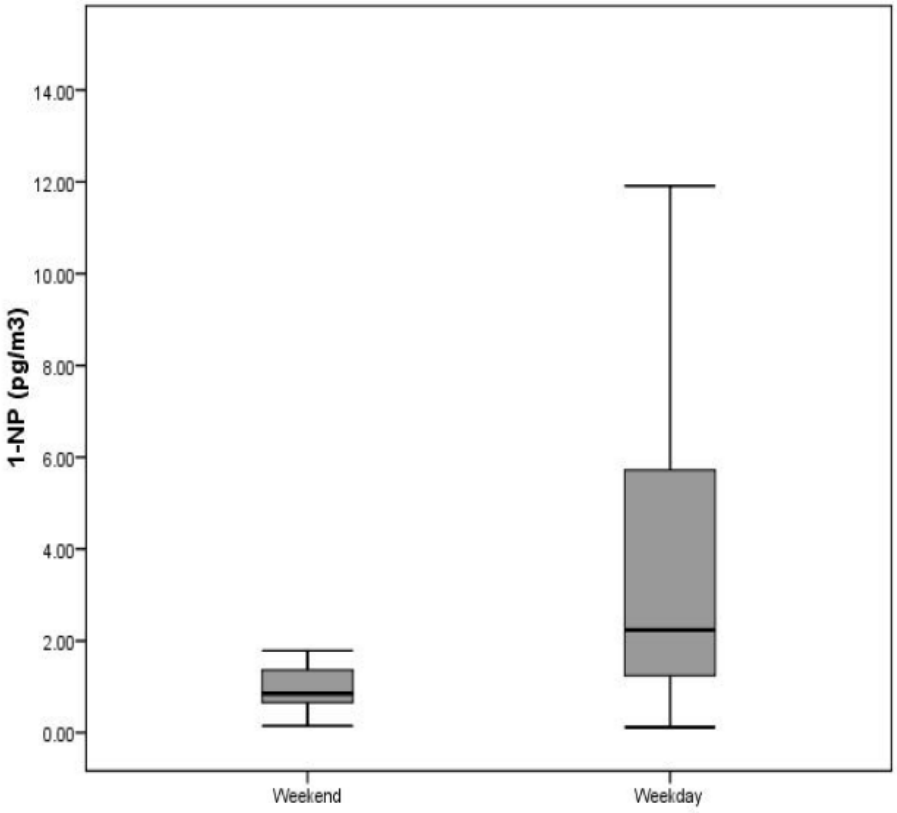
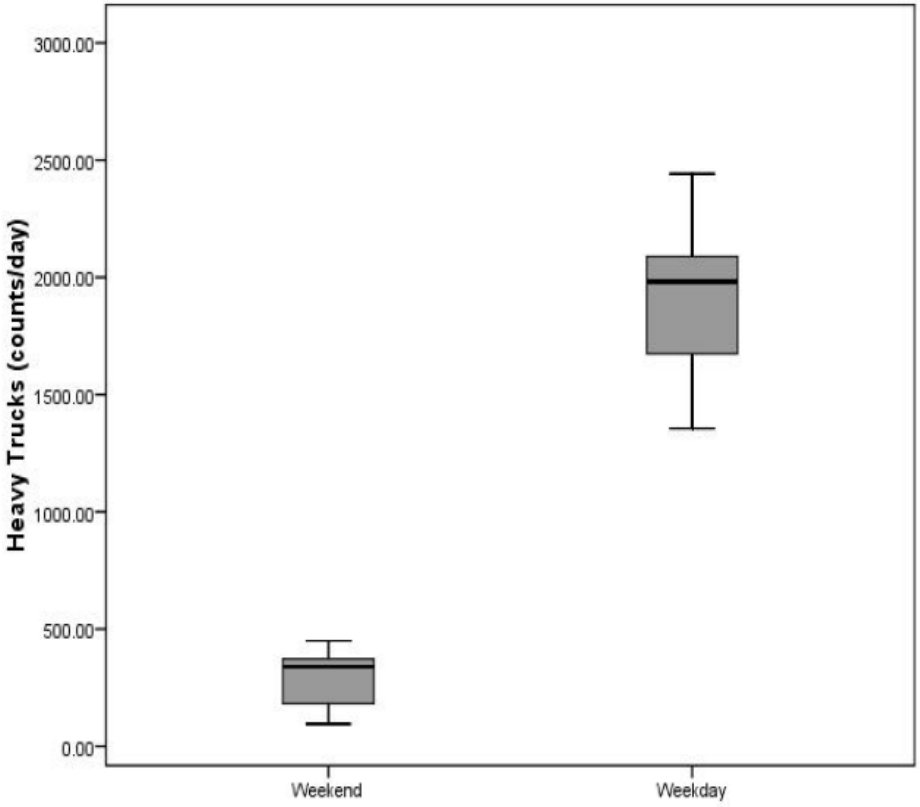
Box Plots of 1-nitropyrene (pg/m^3) and "Heavy Trucks" on Weekends versus Weekdays





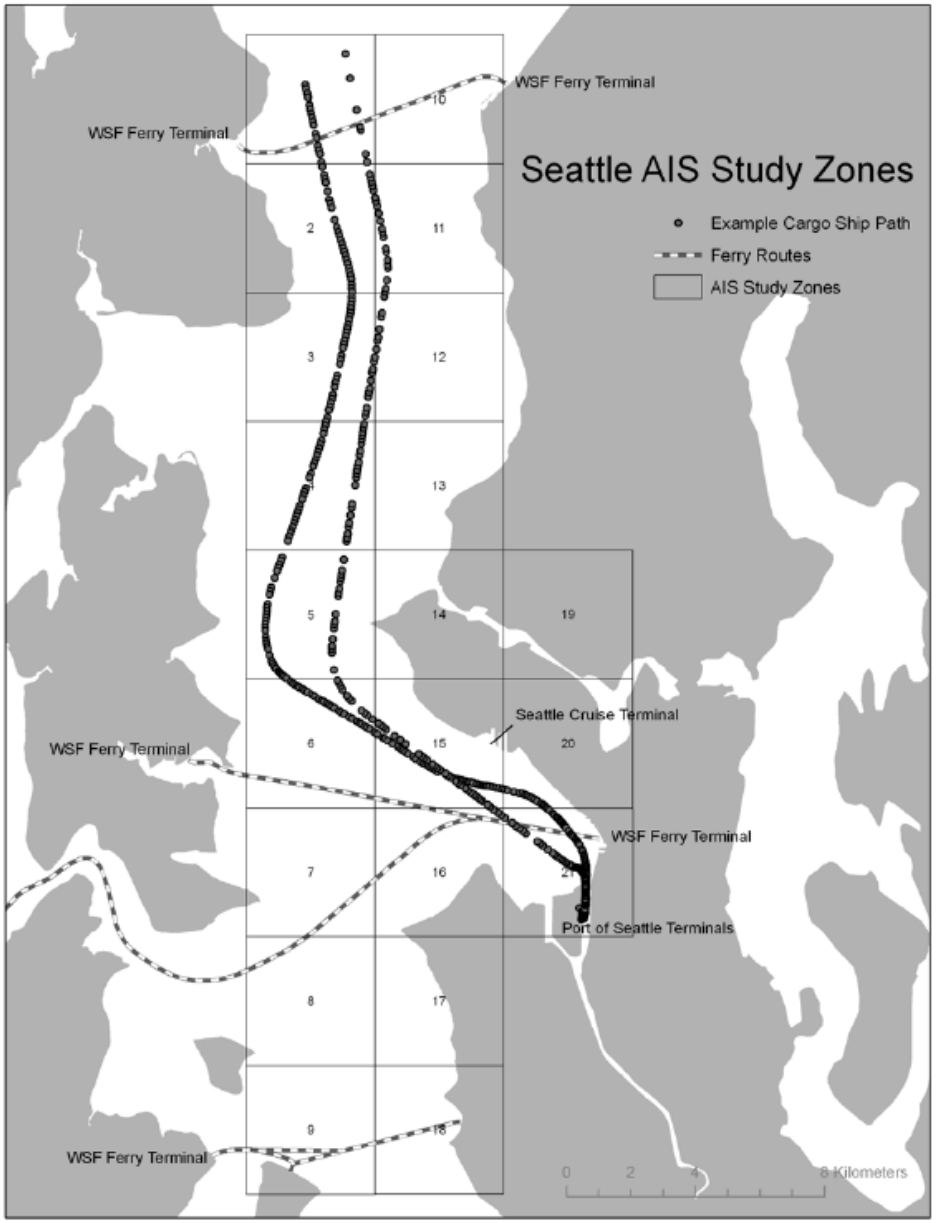


Figure 2.2.2: Seattle AIS Marine Emission Study Zone

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Table 7.2.1: AIS data provided by transponders

Data Broadcast Every 20 seconds	Data Broadcast Every 6 Minutes
Maritime Mobile Service Identity (MMSI) number	IMO ship identification number
Navigation status: "at anchor", "under way " etc.	Radio call sign
Rate of turn: right or left, 0 to 720 deg/minute	Vessel name
Speed over ground: 0 to 102 knots (0.1- resolution)	Type of ship/cargo
Position: Latitude/Longitude to 1/10000 minute	Dimensions of ship – to nearest meter
Course over ground: relative true north to 0.1 deg.	Location of GPS antenna on the vessel
True Heading: 0 to 359 degrees	Draught of ship – 0.1 meter to 25.5 meters
UTC time stamp to the nearest second	Destination – max 20 characters
	ETA at destination

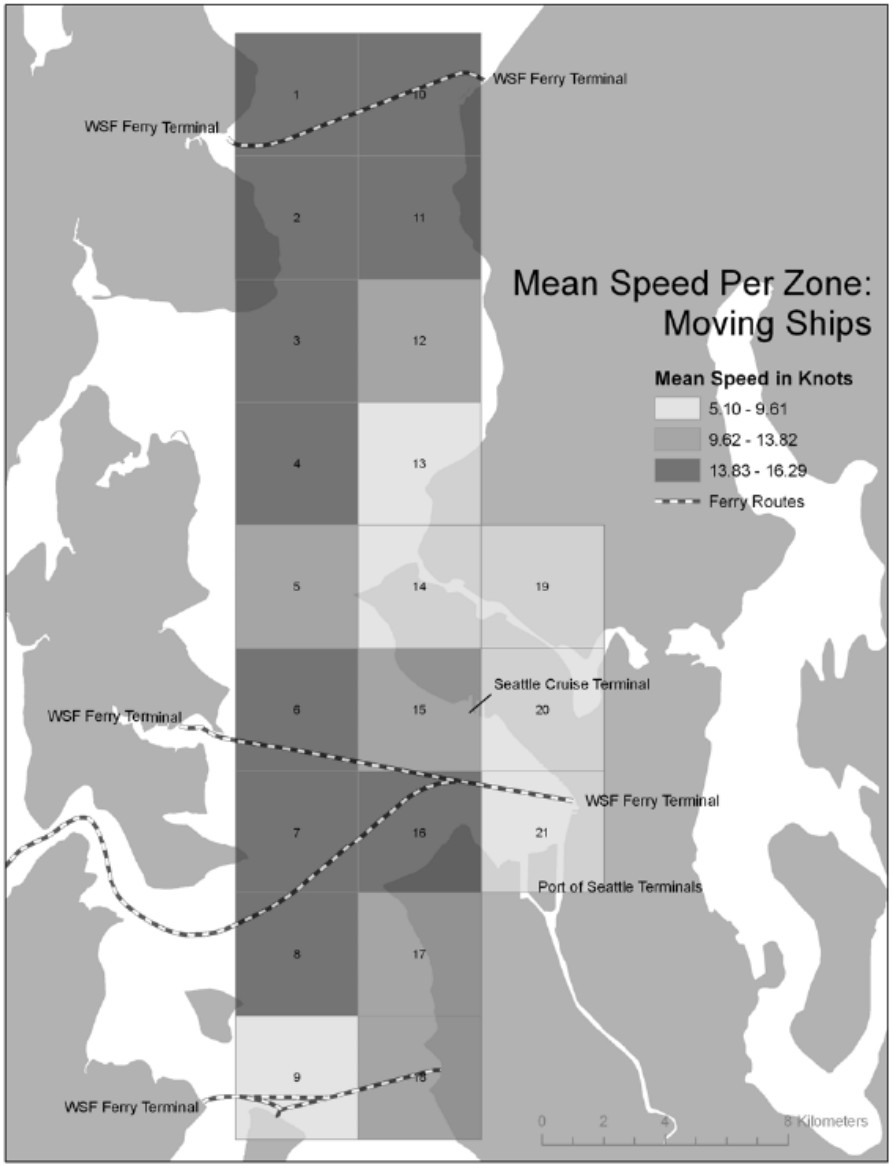

Figure 7.2.2: Mean Speed in Zones for Moving Ships (> 0.5 knots) over 1 Year (January – December 2009)

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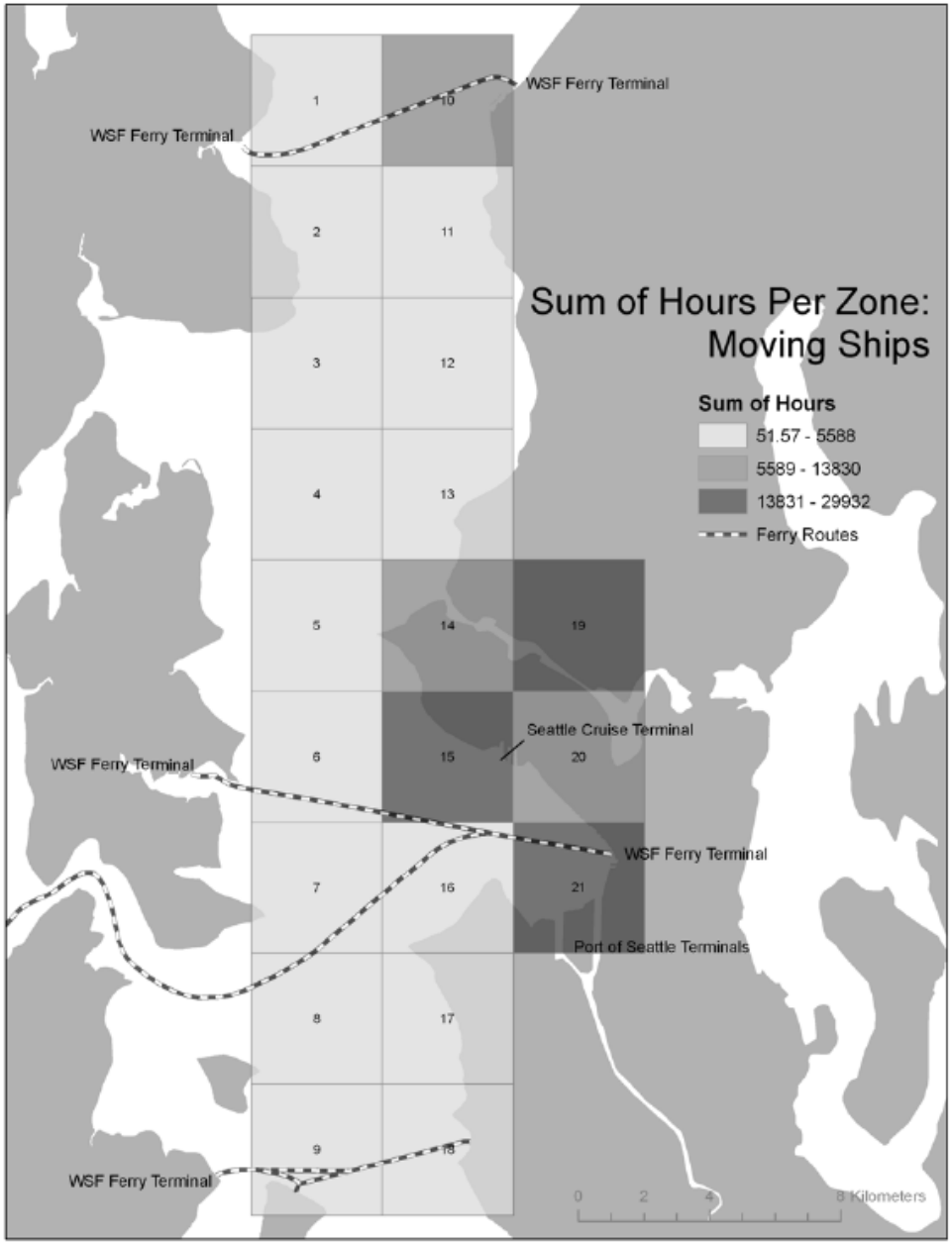

Figure 7.2.3: Sum of Hours per Zone for Moving Ships over 1 Year (January – December 2009)

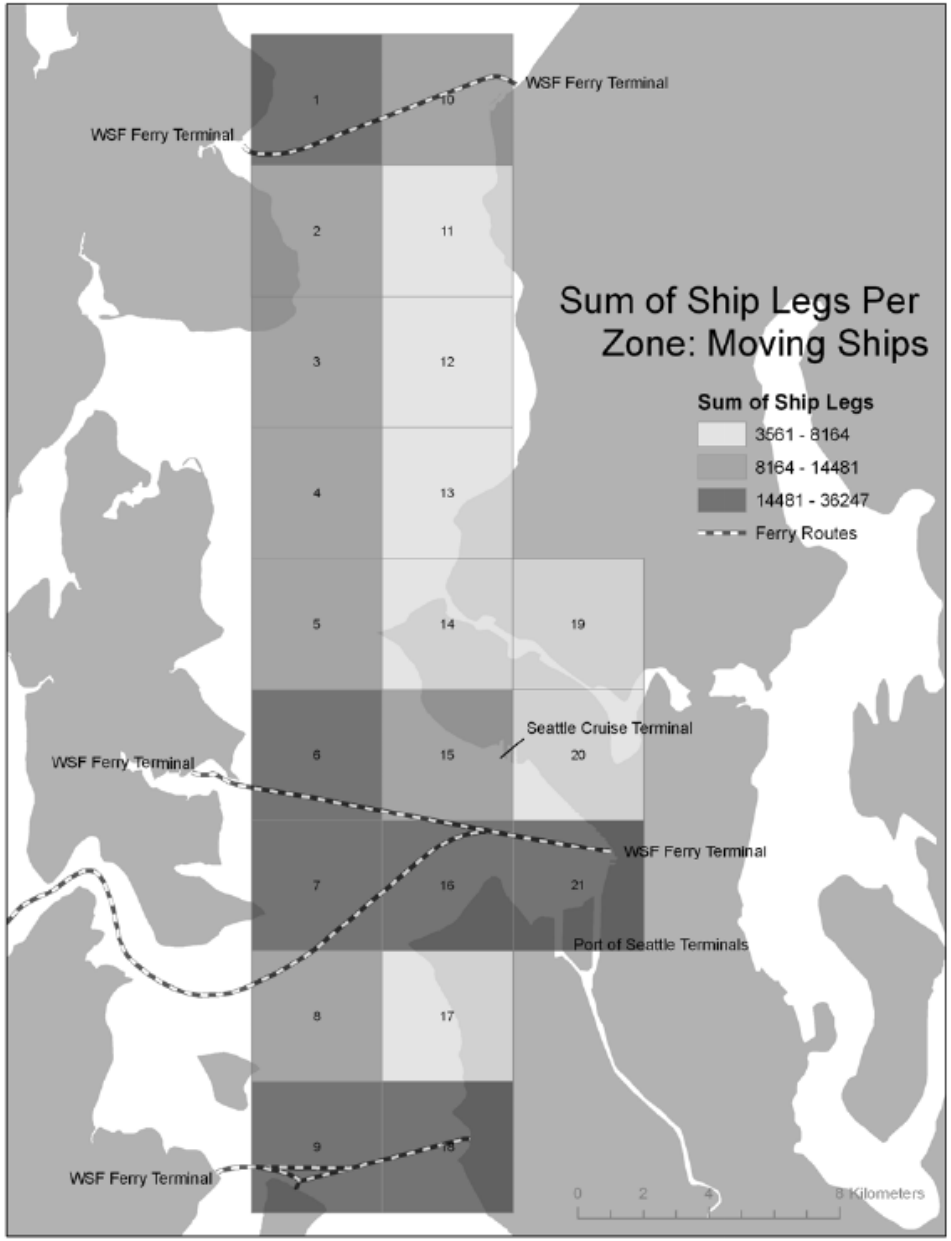

Figure 7.2.4: Sum of Ship Legs per Zone for Moving Ships over 1 Year (January – December 2009)

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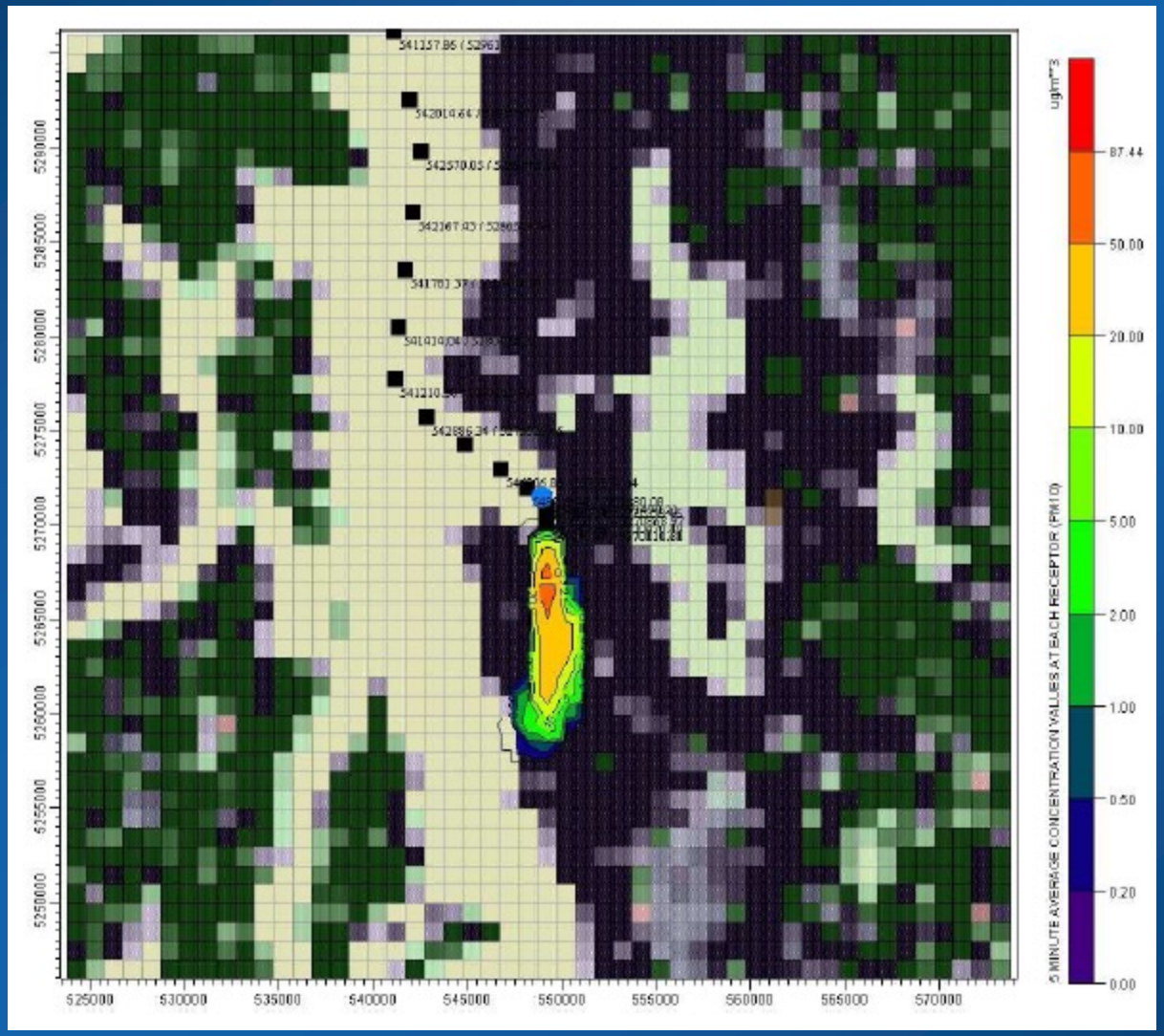
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ug/m**3
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20.00
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2.00
1.00
0.50
0.20
0.00
5 MINUTE AVERAGE CONCENTRATION VALUES AT EACH RECEPTOR (PM10)

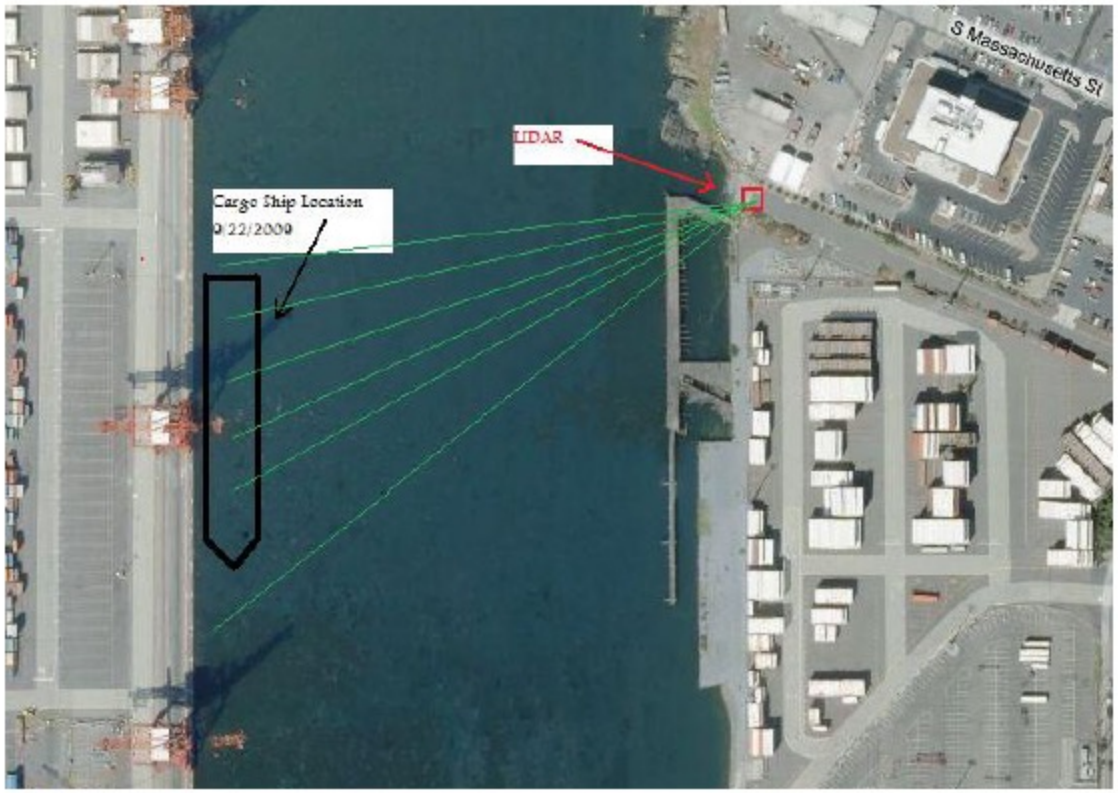
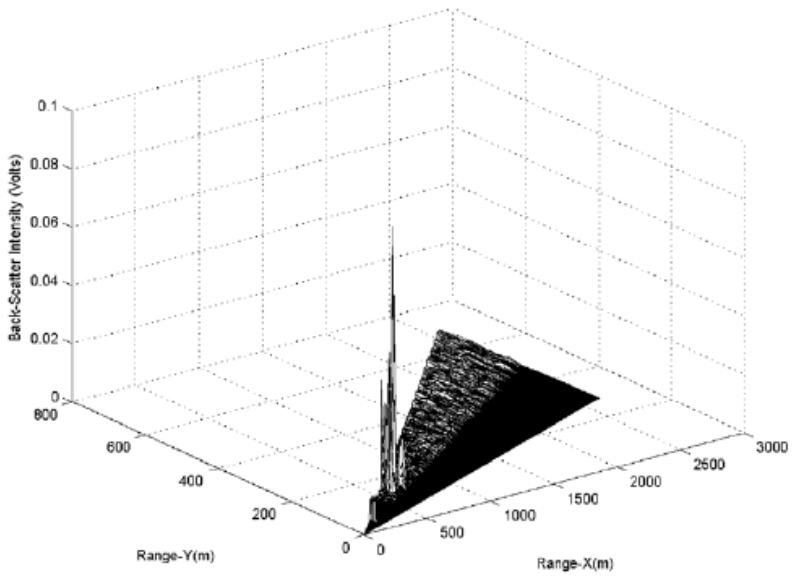
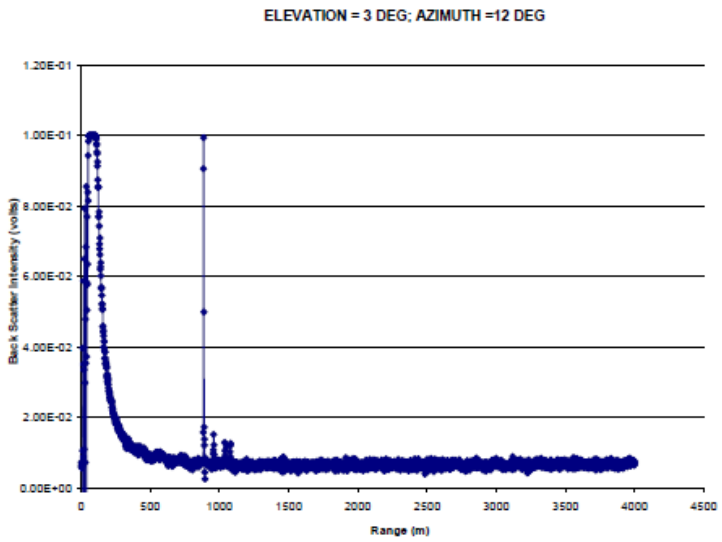


Figure 7.3.1: LIDAR monitoring placement across from Harbor Island, Port of Seattle



(A)



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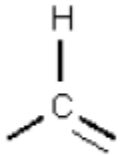
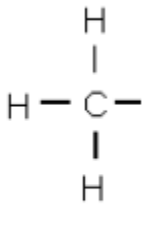
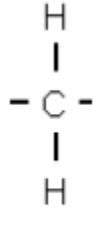


(C-H Absorption ~ 3000 cm^{-1})



and



(C-H Absorption ~ 2850cm^{-1})

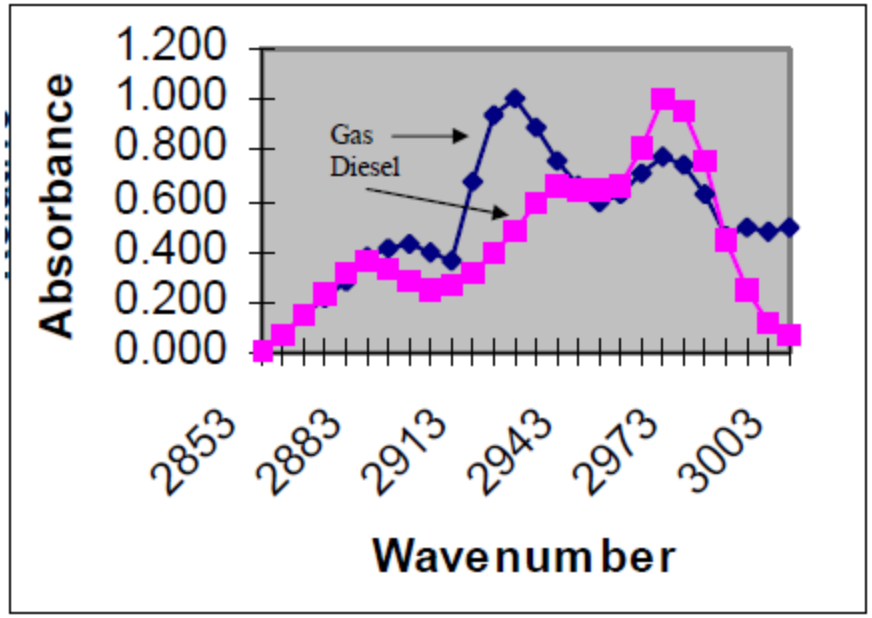


Figure 2.2.1: Gas vs. Diesel Normalized Peak Height

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