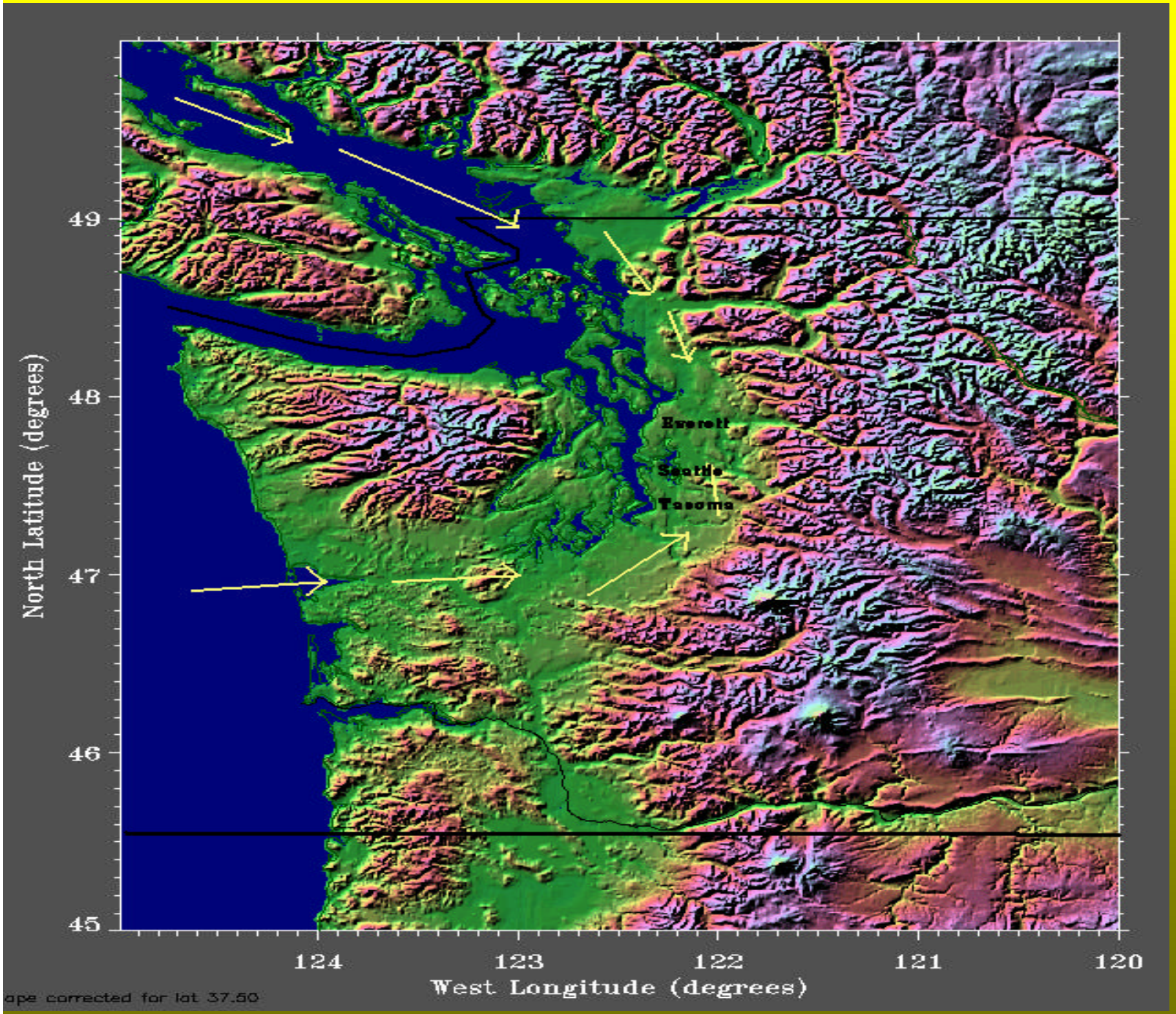
$PM_{2.5}$ Data Comparison

The Puget Sound Experience

www.pscleanair.org

Puget Sound Clean Air Agency



Puget Sound Clean Air Agency

Puget Sound Overview

- **Diverse air shed**
- **Particulate is the primary driver of AQI**
- **Summer ozone**
  - **Generally only an issue 5-7 days over the summer.**

Puget Sound Clean Air Agency

Our role in AQI & PM $^{2.5}$ programs

Operate 11 air monitoring sites that provide year round real-time data. (Pm_{10}, $pm_{2.5}$, Nephs)

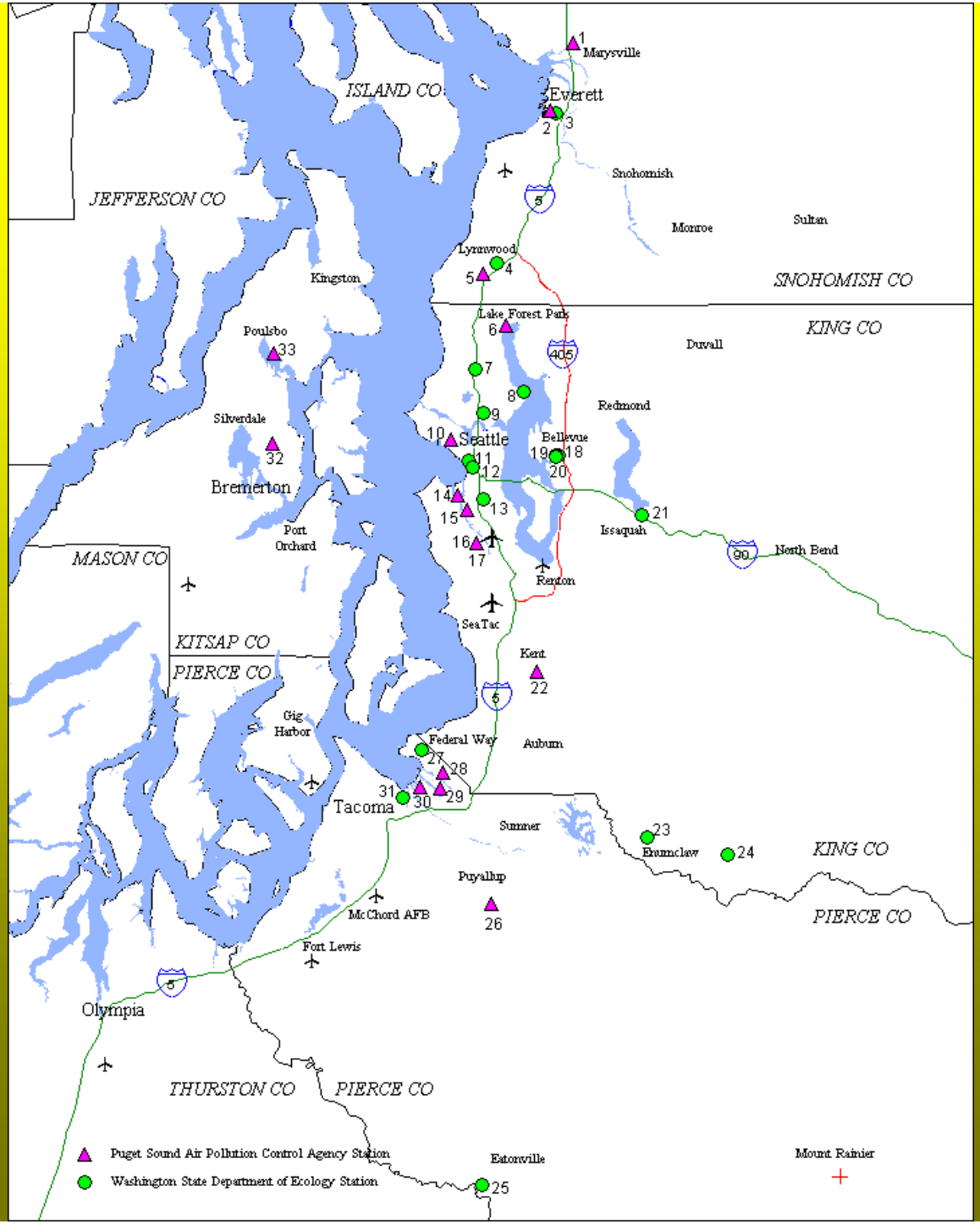
Provide AQI reporting/forecasting services for Seattle and Tacoma MSA's

Provide ~ 50 % of all Washington State Fine Particulate FRM Data.

Provide >50% of all Washington State

Real-time Pm2.5 data.

Puget Sound Clean Air Agency



Puget Sound Air Monitoring Network

Clean Air Agency

Equipment

EQUIP

R&P TEOM's

- a/b versions
- Both types of heads in use.
- Seasonal Temperature Adjustments made April and October.
- Flow 16.7 lpm

Neph's

- Radiance Research 903
- 7 lpm

Anderson Beta's

- Flow 16.7 lpm

Puget Sound Clean Air Agency

Staff Resources

- 3 FTE’s to Operation and Maintenance
- 2 FTE’s to Data and QA

- Management and Board Support

Puget Sound Clean Air Agency

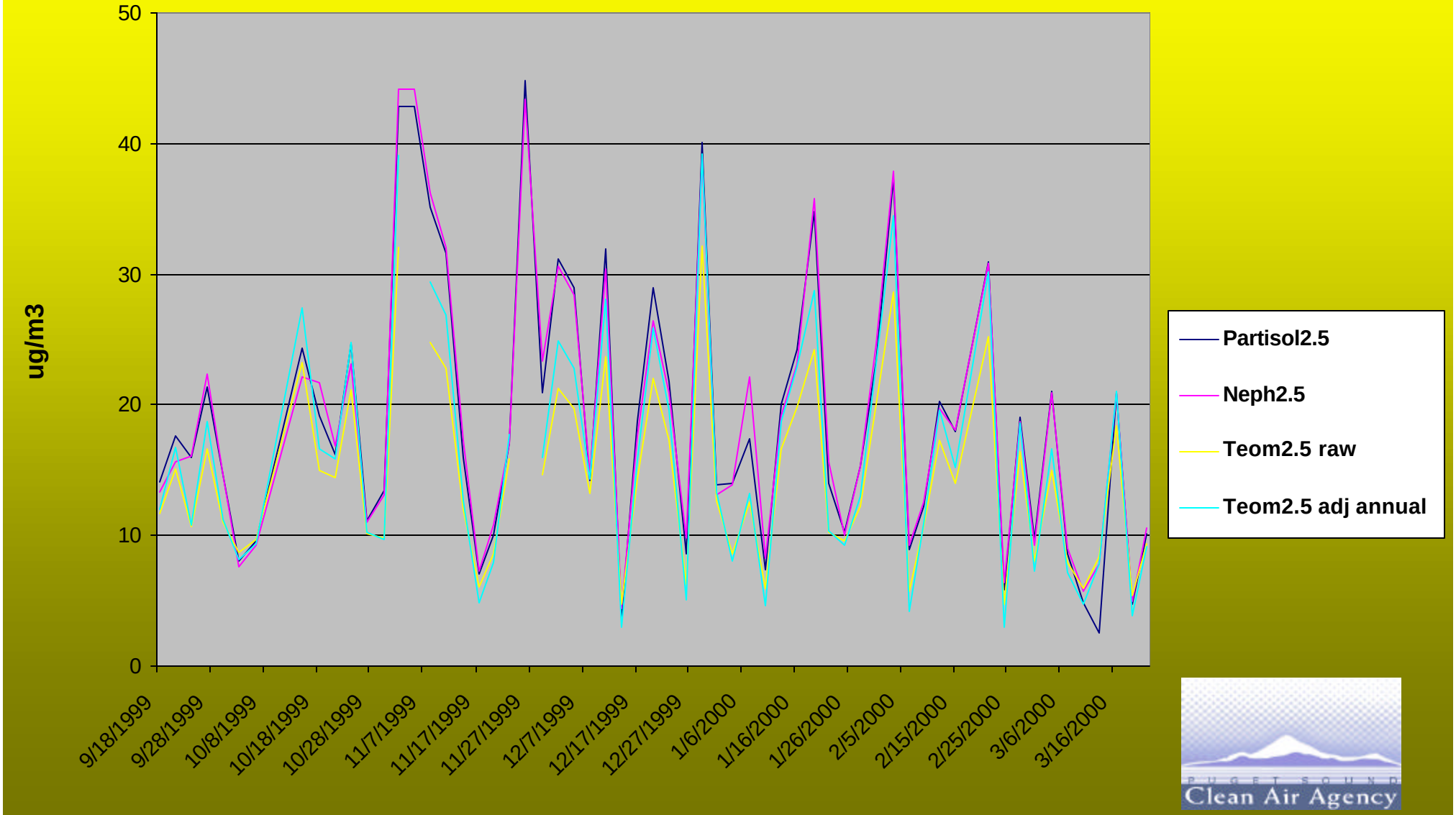
Question ?

With respect to real-time characterizations and predictions of PM $^{2.5}$ levels…

- **Can continuous monitors be effectively used in the AQI and Pm $^{2.5}$ programs?**

Puget Sound Clean Air Agency

Marysville
Partisol vs Neph & Teom
Wintertime 2000-01



Puget Sound Clean Air Agency

DRAFT

EPA Model Dev pub

Data Quality Objectives (DQOs) and Model Development for Relating Federal Reference Method (FRM) and Continuous $PM_{2.5}$ Measurements to Report an Air Quality Index (AQI)

Puget Sound Clean Air Agency

Table 2-2.Sample size requirements for model development by ", $, and) under a null hypothesis of H_0: R^2 # 0.6

Size of Gray Region ())	False Acceptance Decision Error ($)	False Rejection Decision Error (")			
		0.20	0.10	0.05	0.01
0.30	0.40		18	37	119
	0.30		31	61	176
	0.20	24	57	103	266
0.25	0.40	18	56	126	422
	0.30	36	104	213	628
	0.20	79	196	365	
0.20	0.40	53	196	454	
	0.30	124	373		
	0.20	282	709		

Clean Air Agency

Table 2-3.Lower bound on observed model R^2 value necessary for concluding model adequacy by ", $, and) under a null hypothesis of H_0: R^2 # 0.6

Size of Gray Region ())	False Acceptance Decision Error ($)	False Rejection Decision Error (")			
		0.20	0.10	0.05	0.01
0.30	0.40		0.87	0.88	0.88
	0.30		0.85	0.86	0.87
	0.20	0.79	0.82	0.84	0.85
0.25	0.40	0.81	0.82	0.83	0.83
	0.30	0.78	0.80	0.81	0.82
	0.20	0.75	0.77	0.79	
0.20	0.40	0.76	0.77	0.78	
	0.30	0.74	0.75		
	0.20	0.71	0.73		

Puget Sound Clean Air Agency

Site	Year	# pairs	Slope m	Intercept b	Correlation Coefficient r	Goodness of Fit r2	Predicted Partisol Pm2.5 @ Neph=1.0x10-4	Dataset Date Range
			x	y				
			Neph vs Partisol2.5					
			y=mx+b					
Seattle, Duwamish	1999	337	27.474	2.251	0.96	0.92	29.7	Jan - Dec 1999
	2000	354	31.158	0.992	0.97	0.94	32.2	Jan - Dec 2000
	All	796	29.611	1.689	0.96	0.93	31.3	Oct 1998 - Feb 2001
Kent	1999	108	23.022	1.369	0.96	0.92	24.4	Jan - Dec 1999
	2000	116	27.726	1.129	0.96	0.92	28.9	Jan - Dec 2000
	All	251	25.323	1.354	0.95	0.90	26.7	Nov 1998 - Feb 2001
Lk Forest Park	1999	67	24.279	0.428	0.97	0.94	24.7	Jun - Dec 1999
	2000	114	26.634	0.715	0.99	0.98	27.3	Jan - Jul 2000
	All	212	25.565	0.641	0.97	0.95	26.2	Jun 1999 - Mar 2001
Lynnwood	2000	119	27.356	0.319	0.98	0.96	27.7	Jan - Dec 2000
	All	154	26.448	0.621	0.98	0.96	27.1	Oct 1999 - Feb 2001
Marysville	2000	100	24.592	1.418	0.99	0.98	26.0	Jan - Dec 2000
	All	163	24.252	1.286	0.99	0.97	25.5	Sep 1999 - Mar 2001
Puyallup	All	51	26.699	0.070	0.98	0.97	26.8	Aug 2000 - Feb 2001
Tacoma, Alexander	1999	336	25.228	1.738	0.95	0.91	27.0	Jan - Dec 1999
	2000	350	28.150	1.317	0.96	0.93	29.5	Jan - Dec 2000
	All	752	27.119	1.423	0.96	0.93	28.5	Dec 1998 - Feb 2001
Tacoma, South L			27.0	0.0				
Seattle, Queen Anne			25.0	0.0				
Seattle, Beacon Hill	1999	93	22.682	1.957	0.95	0.91	24.6	Jan - Dec 1999
	2000	326	26.342	1.641	0.97	0.94	28.0	Jan - Dec 2000
	All	450	25.074	1.97	0.95	0.91	27.0	Jan 1999 - Feb 2001

Nephelometer vs. FRM Comparison 1999-2000

Puget Sound Clean Air Agency

x y

Continuous2.5 vs Partisol2.5

y=mx+b

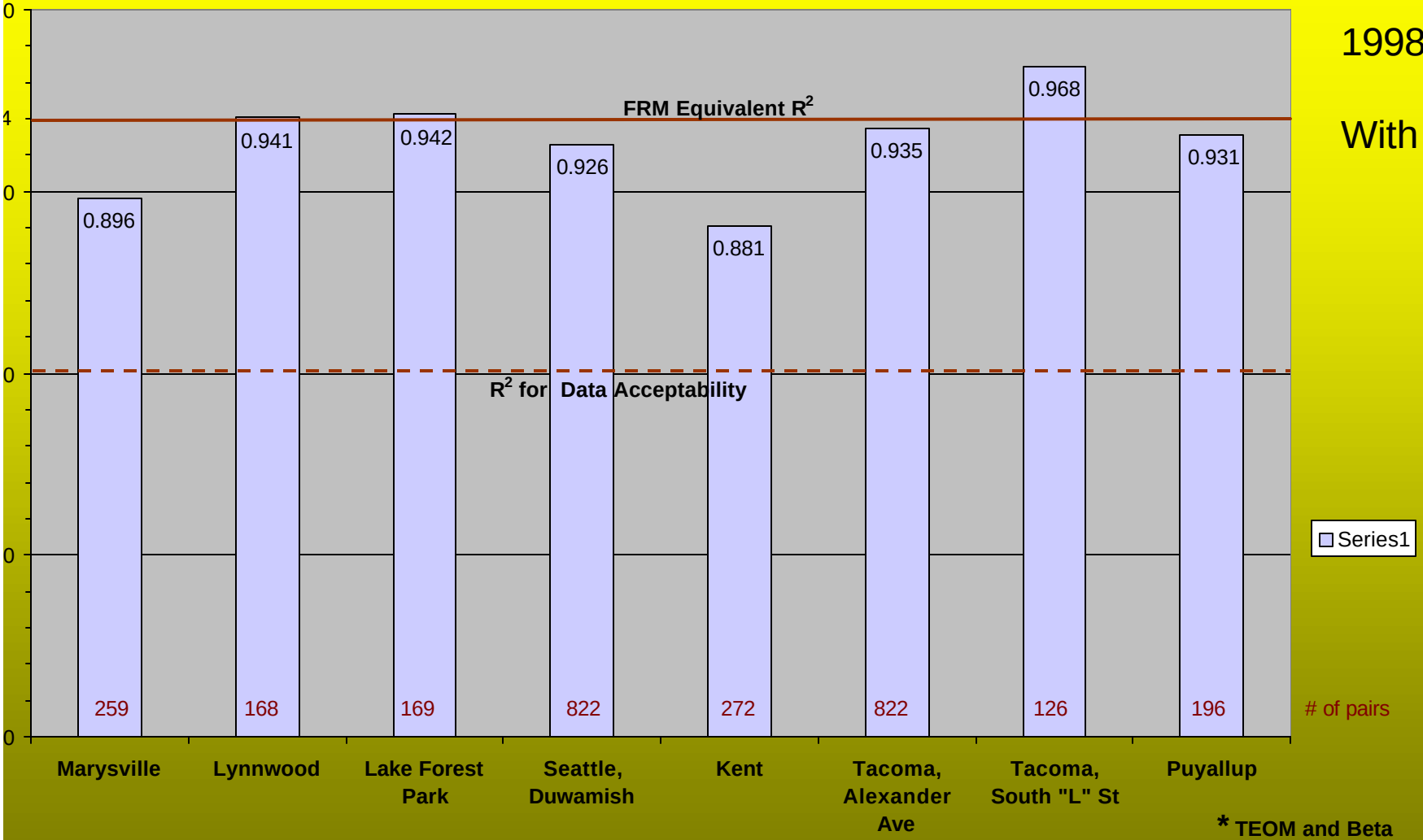
Site	Year	# pairs	Slope m	Intercept b	Correlation Coefficient r	Goodness of Fit r^2	Dataset Date Range
Seattle, Duwamish	1999	342	1.15	-2.0	0.96	0.91	Jan - Dec 1999
	2000	341	1.10	-2.0	0.97	0.95	Jan - Dec 2000
	All	822	1.12	-1.9	0.96	0.93	Nov 1998 - Mar 2001
Kent	1999	115	1.16	-1.8	0.96	0.92	Jan - Dec 1999
	2000	117	1.09	-0.8	0.91	0.83	Jan - Dec 2000
	All	272	1.16	-1.6	0.94	0.88	Nov 1998 - Mar 2001
Lk Forest Park	2000	111	1.23	-1.6	0.97	0.95	Jan - Dec 2000
	All	172	1.22	-1.5	0.97	0.94	Sep 1999 - Mar 2001
Lynnwood	2000	115	1.19	-2.4	0.97	0.94	Jan - Dec 2000
	All	168	1.17	-2.1	0.97	0.94	Oct 1999 - Mar 2001
Marysville	1999	114	1.22	-3.6	0.92	0.85	Jan - Dec 1999
	2000	100	1.25	-1.5	0.96	0.92	Jan - Dec 2000
	All	262	1.29	-2.9	0.95	0.90	Nov 1998 - Mar 2001
Puyallup	2000	109	1.23	-3.7	0.97	0.94	Jan - Dec 2000
	All	196	1.29	-3.7	0.96	0.93	Nov 1999 - Mar 2001
Tacoma, Alexander	1999	349	1.16	-2.9	0.97	0.94	Jan - Dec 1999
	2000	353	1.25	-3.7	0.96	0.93	Jan - Dec 2000
	All	822	1.22	-3.4	0.97	0.94	Nov 1998 - Mar 2001
Tacoma, South L	All	126	1.30	-1.3	0.98	0.97	Nov 2000 - Mar 2001

TEOM & BAM

PM 2.5 Comparison

Puget Sound Clean Air Agency

Puget Sound $PM_{2.5}$ Network
Correlations (FRM vs Continuous Monitiors*)



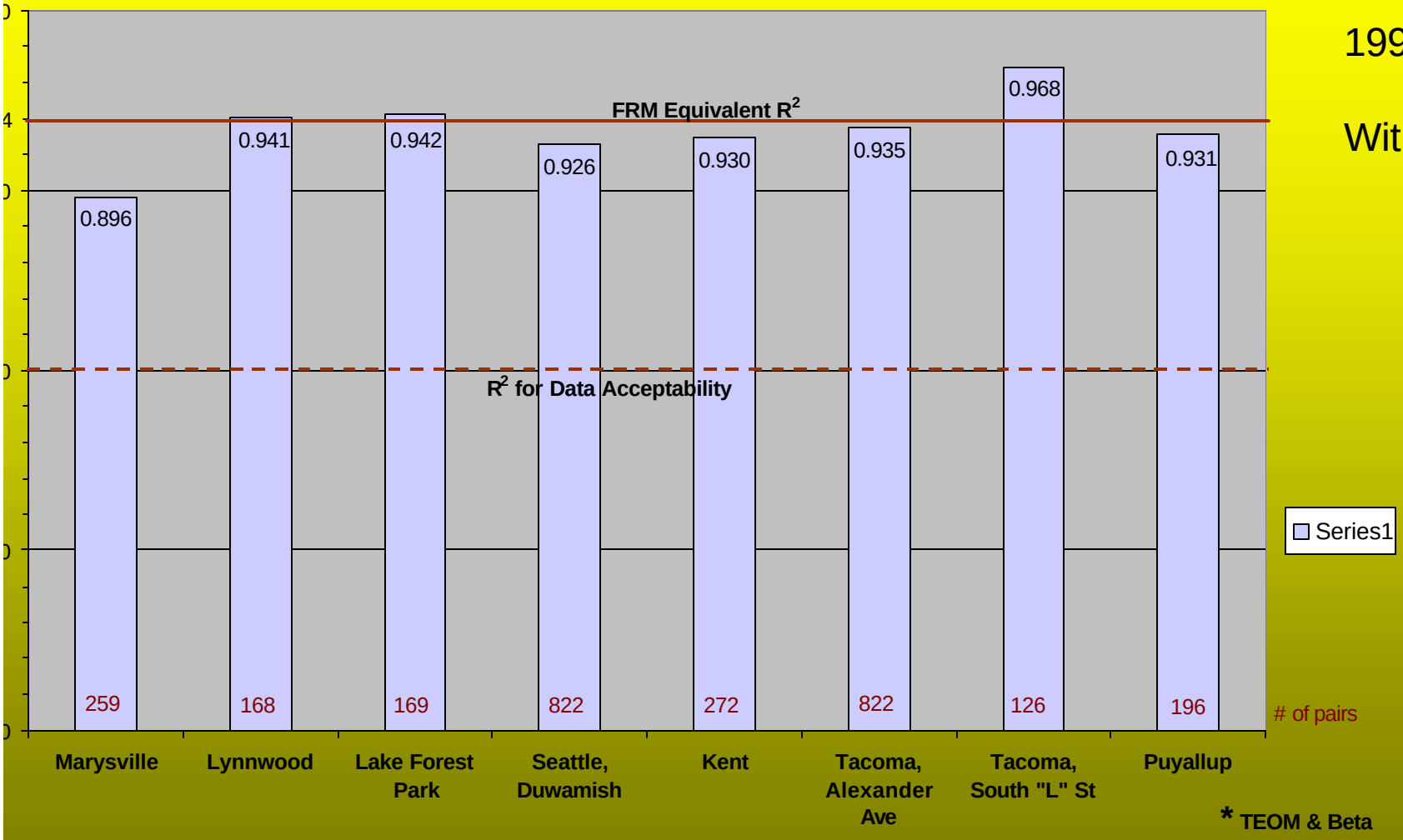
1998-2001

With Fireworks

* TEOM and Beta

Puget Sound Clean Air Agency

Puget Sound $PM_{2.5}$ Network
Correlations (FRM vs Continuous Monitors*)



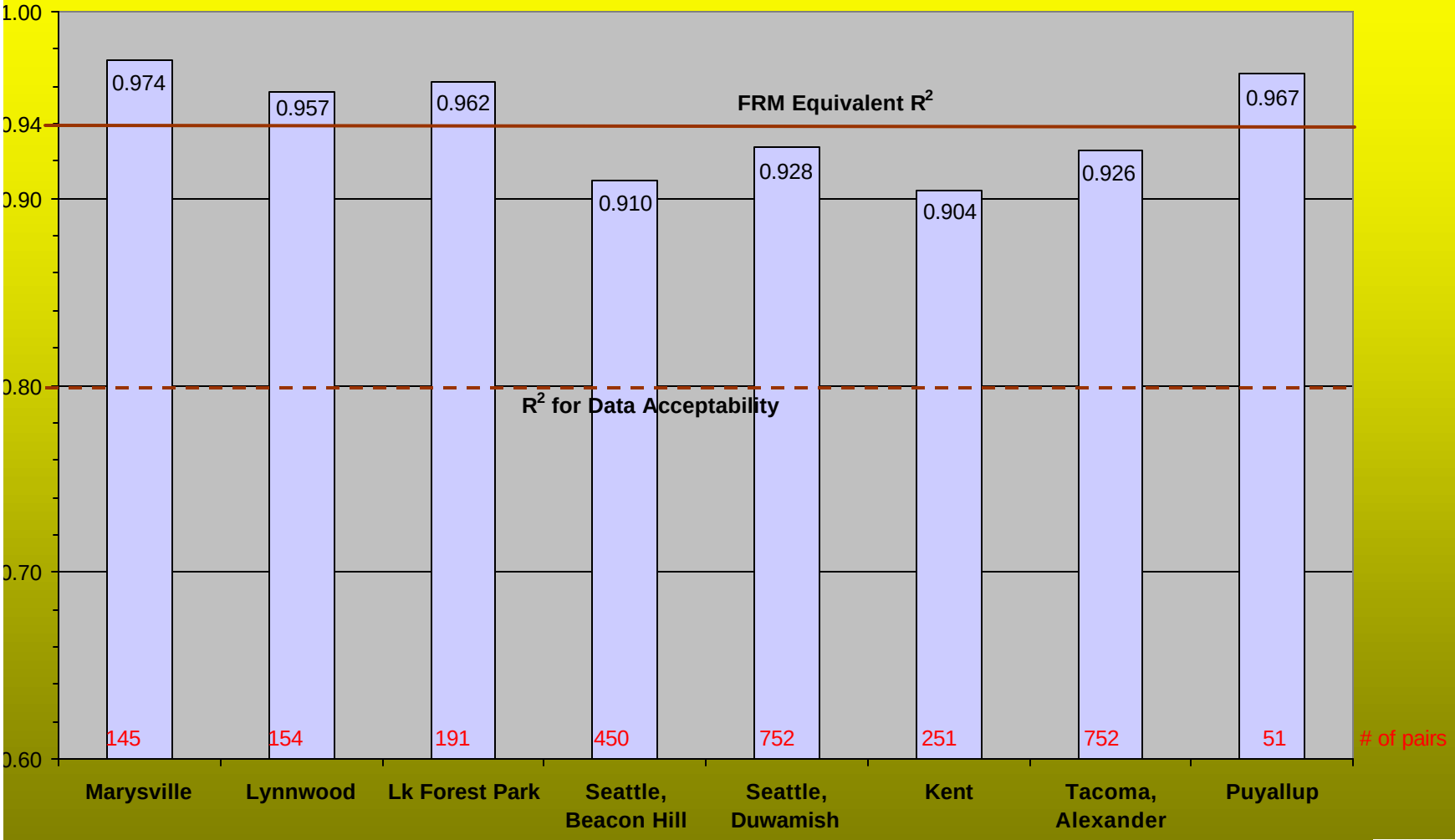
1998-2001

Without Fireworks

* TEOM & Beta

Clean Air Agency

Puget Sound $PM_{2.5}$ Network
Correlations (FRM vs Nephelometer)
1999 - 2000



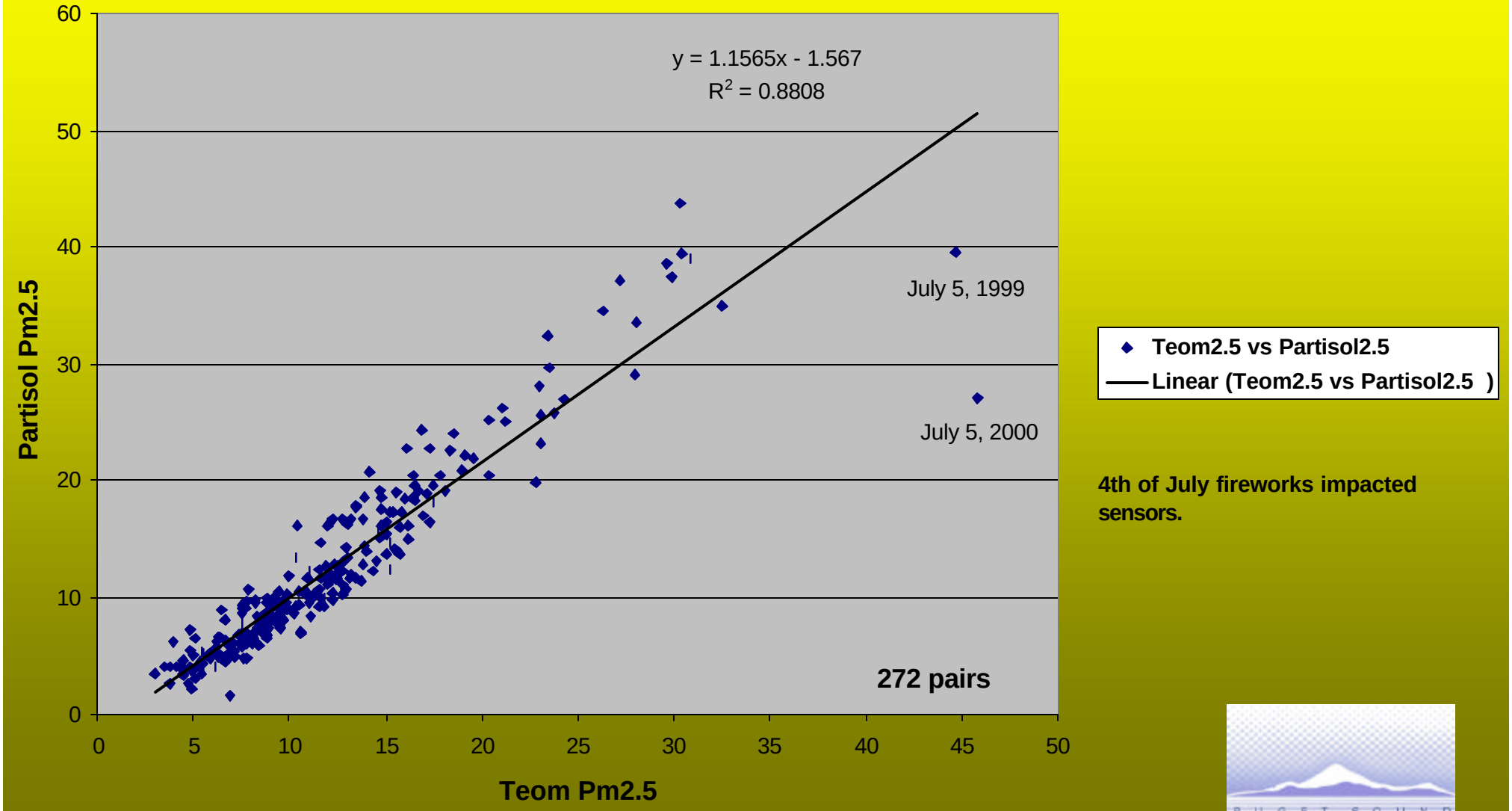
Clean Air Agency

Kent, Washington

- Mix use site. Residential and Commercial.
- In the Kent Valley.

Puget Sound Clean Air Agency

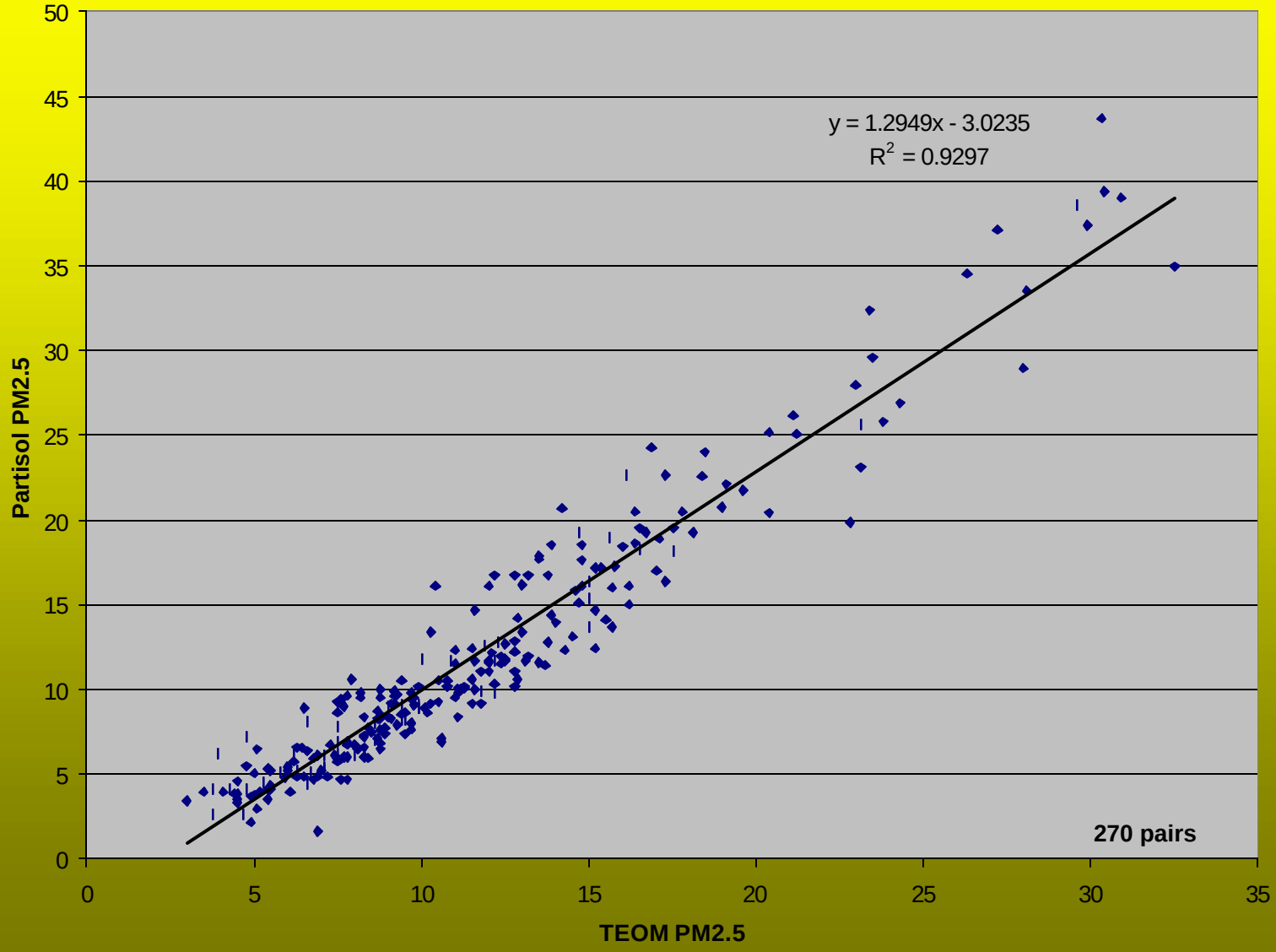
Kent
Nov 1998 - Mar 2001
Teom Pm2.5 vs Partisol Pm2.5



4th of July fireworks impacted sensors.

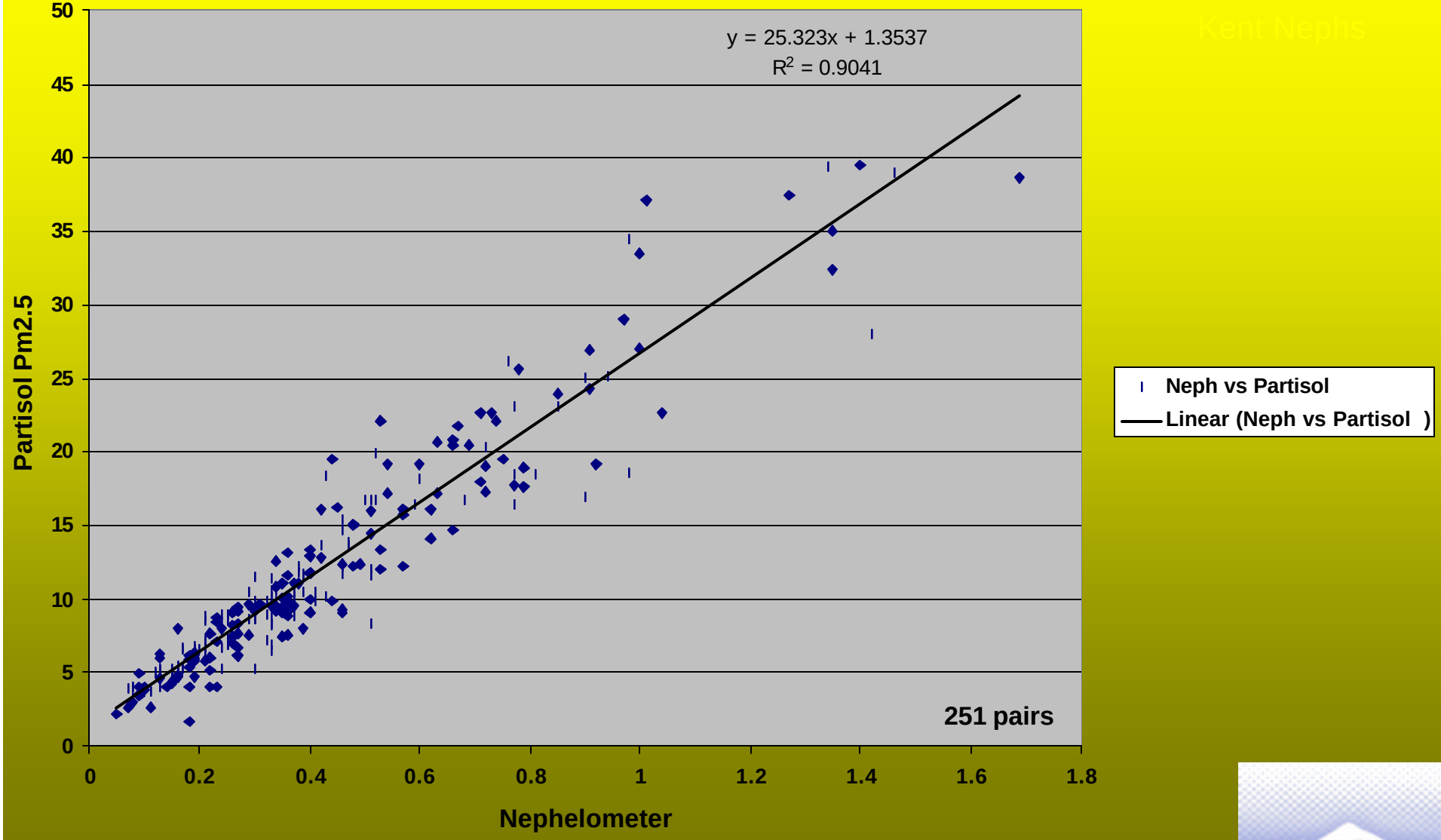
Clean Air Agency

Kent
Teom PM2.5 vs Partisol PM2.5
Nov 1998 - Mar 2001



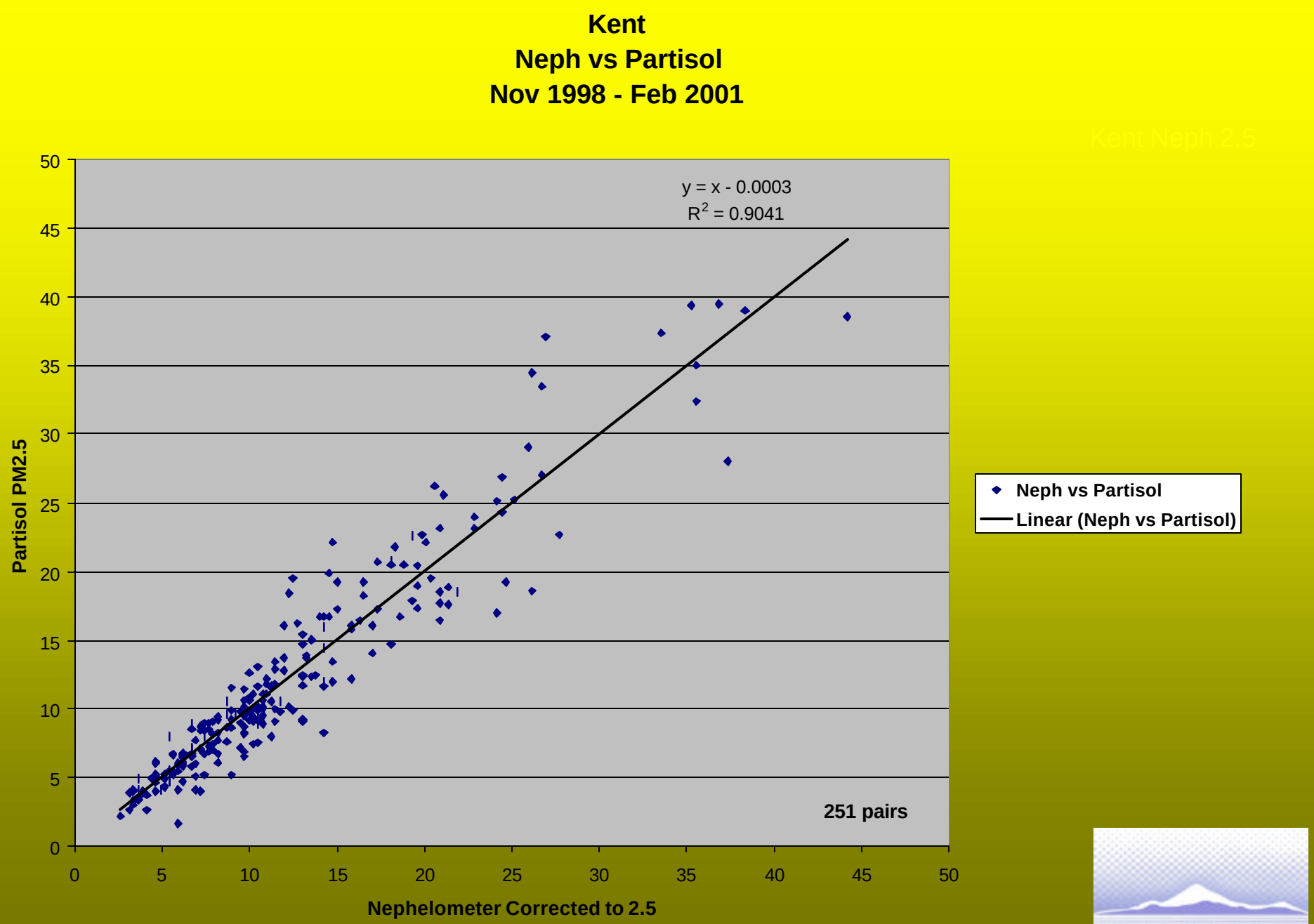
Clean Air Agency

Kent
Neph vs Partisol
Nov 1998 - Feb 2001



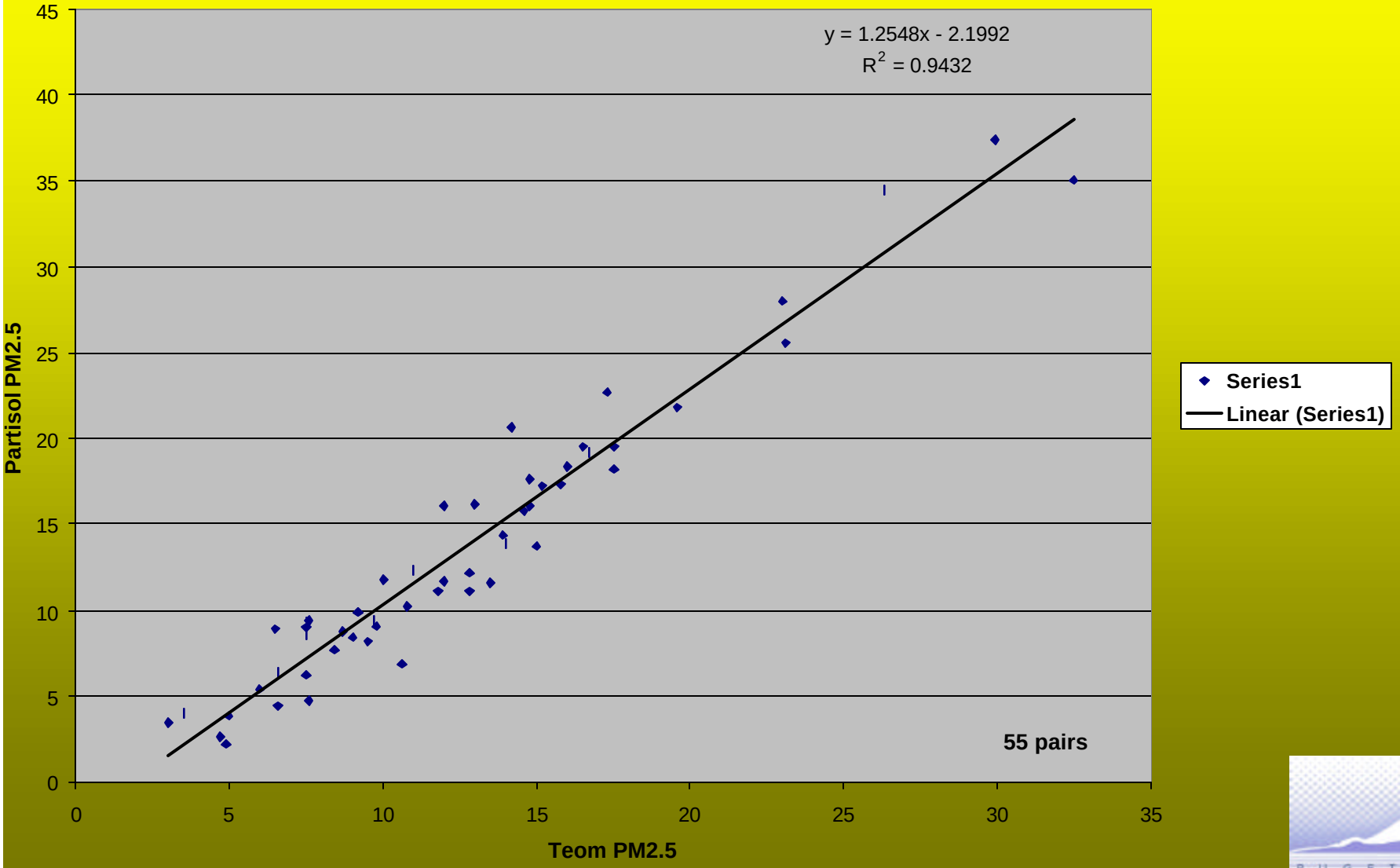
Kent Nephs

Clean Air Agency



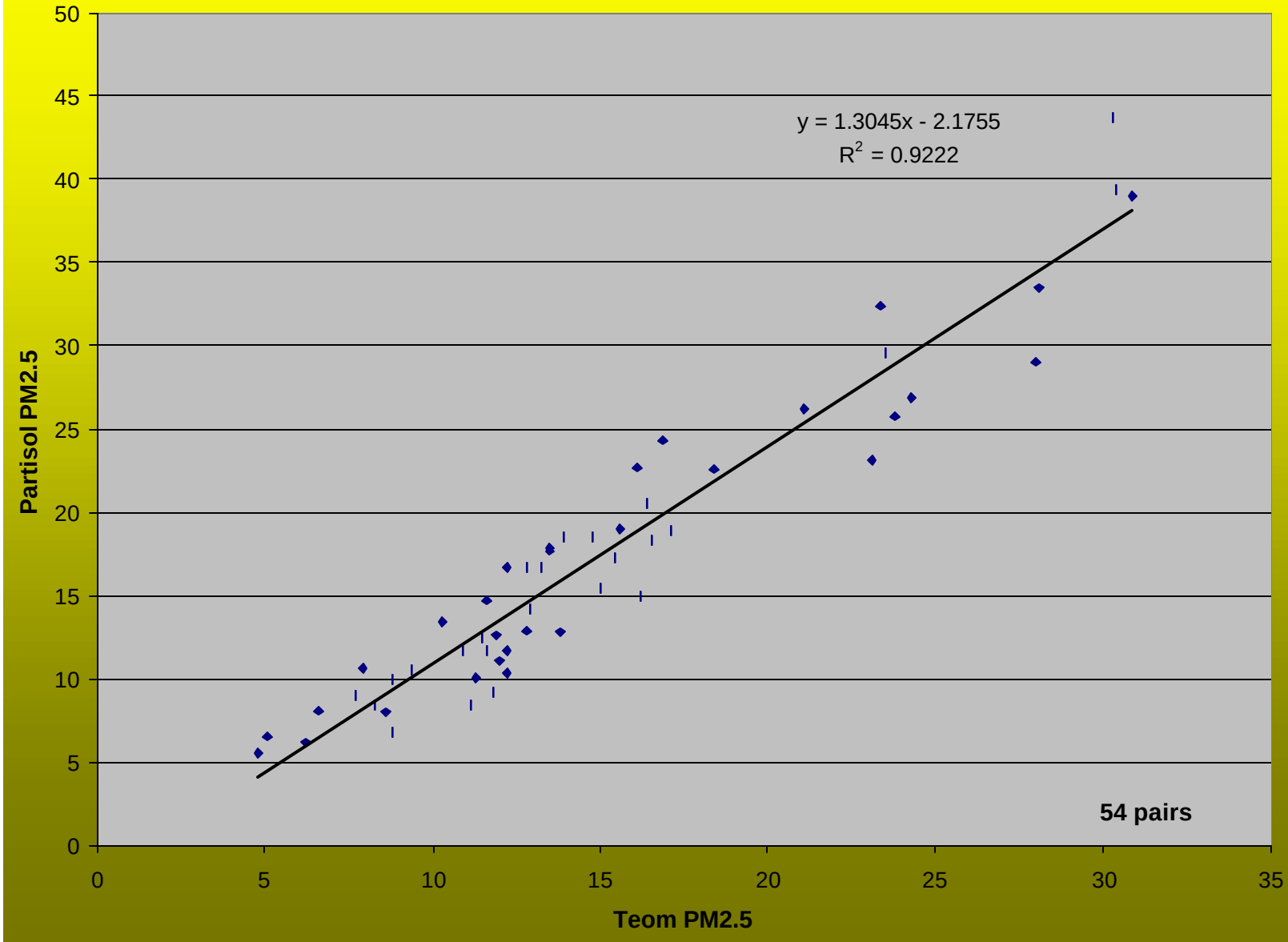
Clean Air Agency

Kent
Teom PM2.5 vs Partisol PM2.5
Wintertime Oct 1999 - Mar 2000



Clean Air Agency

Kent
Teom PM2.5 vs Partisol PM2.5
Wintertime Oct 2000 - Mar 2001



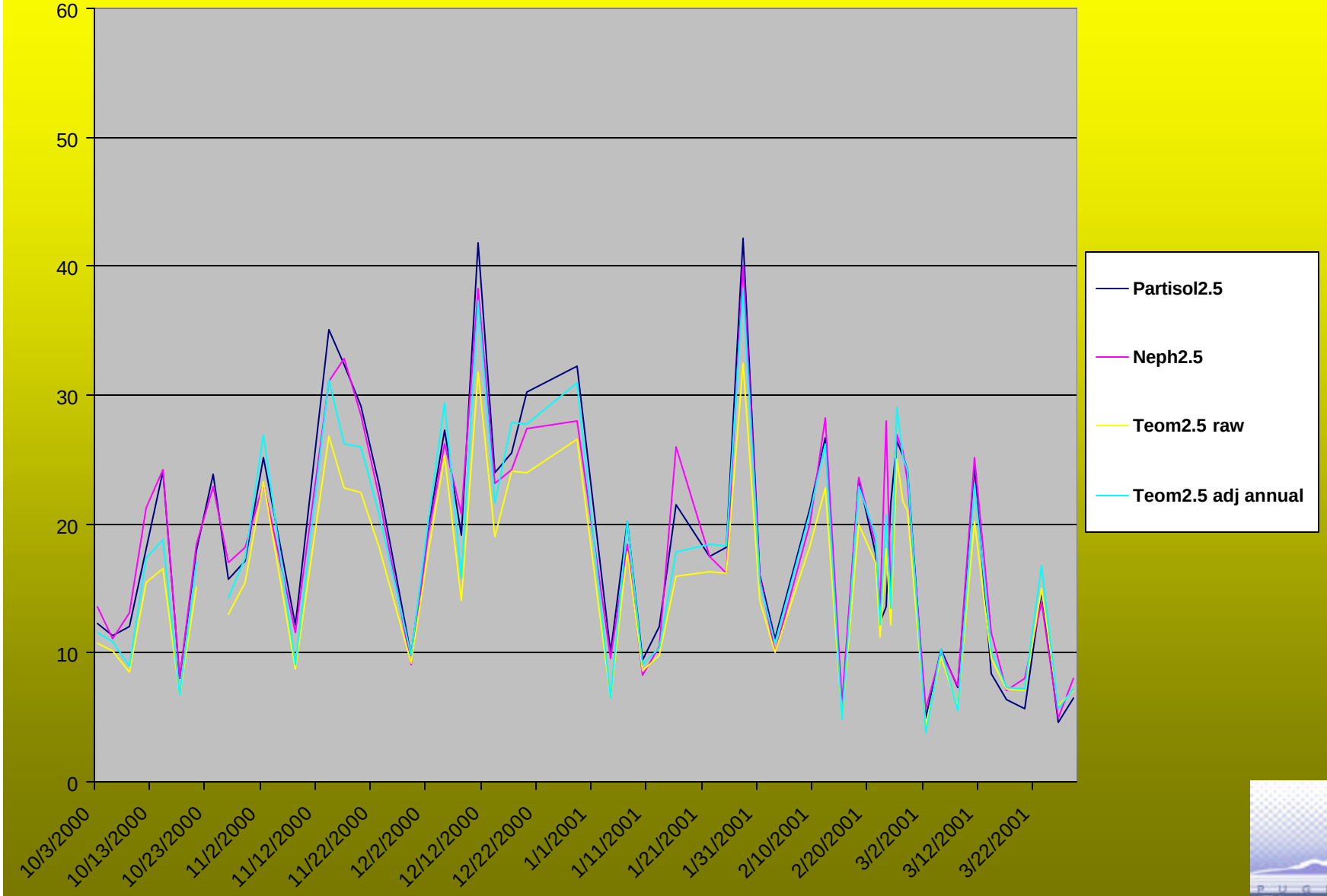
Clean Air Agency

Lake Forest Park, Washington

- North Seattle Area
- Residential, Commercial
- Wood smoke impacted.
- No natural gas for heating

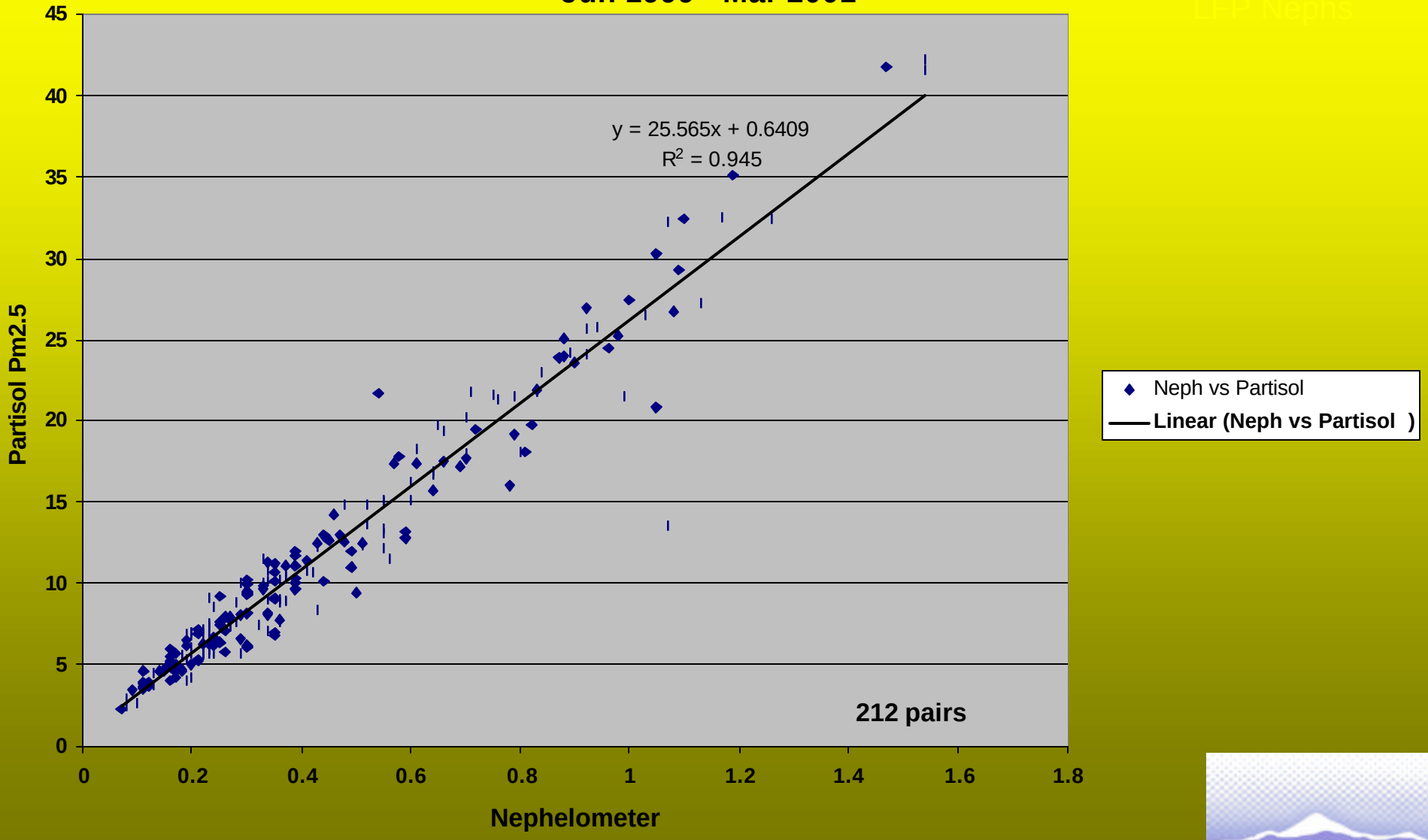
Puget Sound Clean Air Agency

Lake Forest Park
Partisol vs Neph & Teom
Wintertime 2000-01



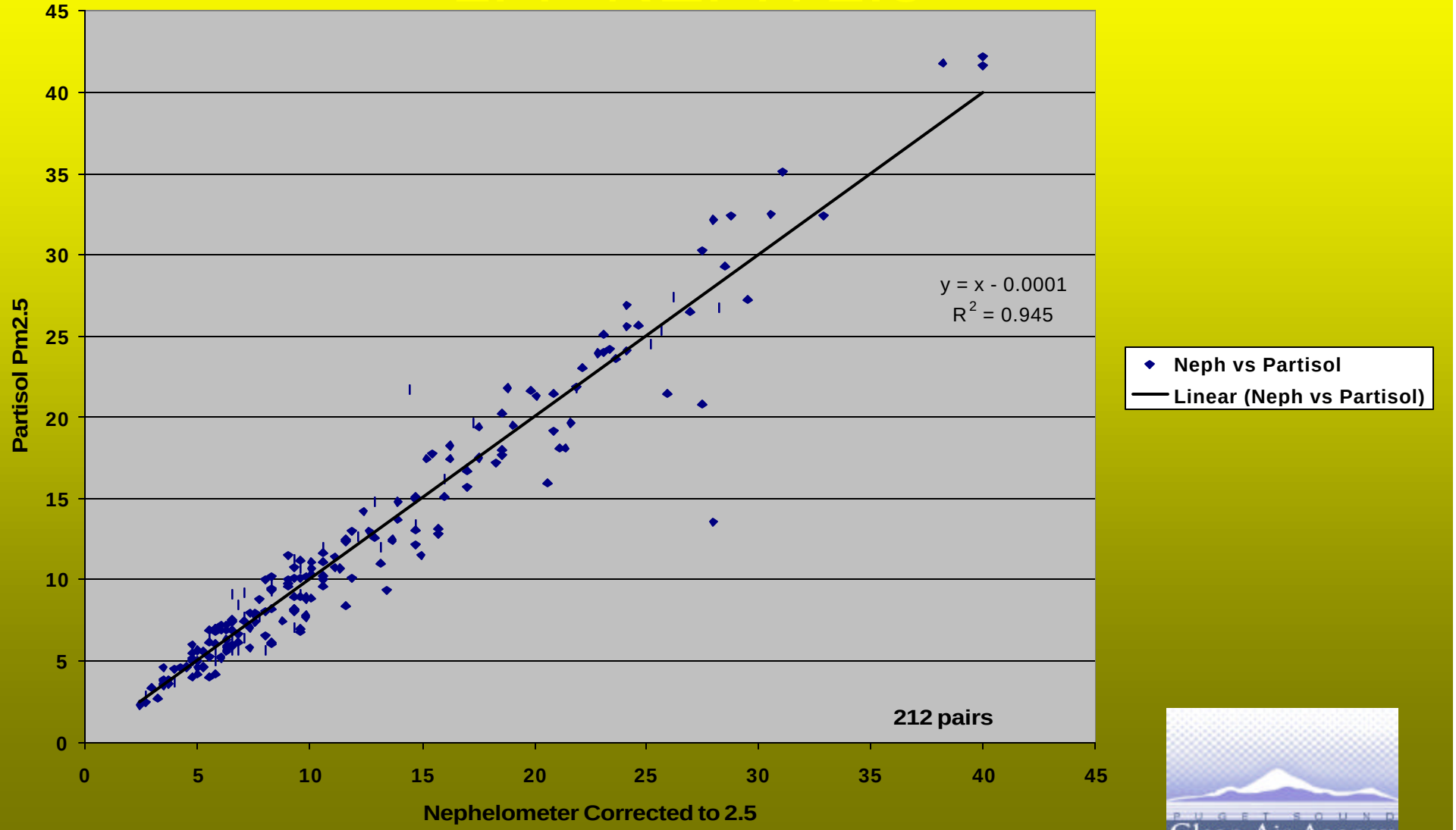
Clean Air Agency

Lake Forest Park
Neph vs Partisol
Jun 1999 - Mar 2001



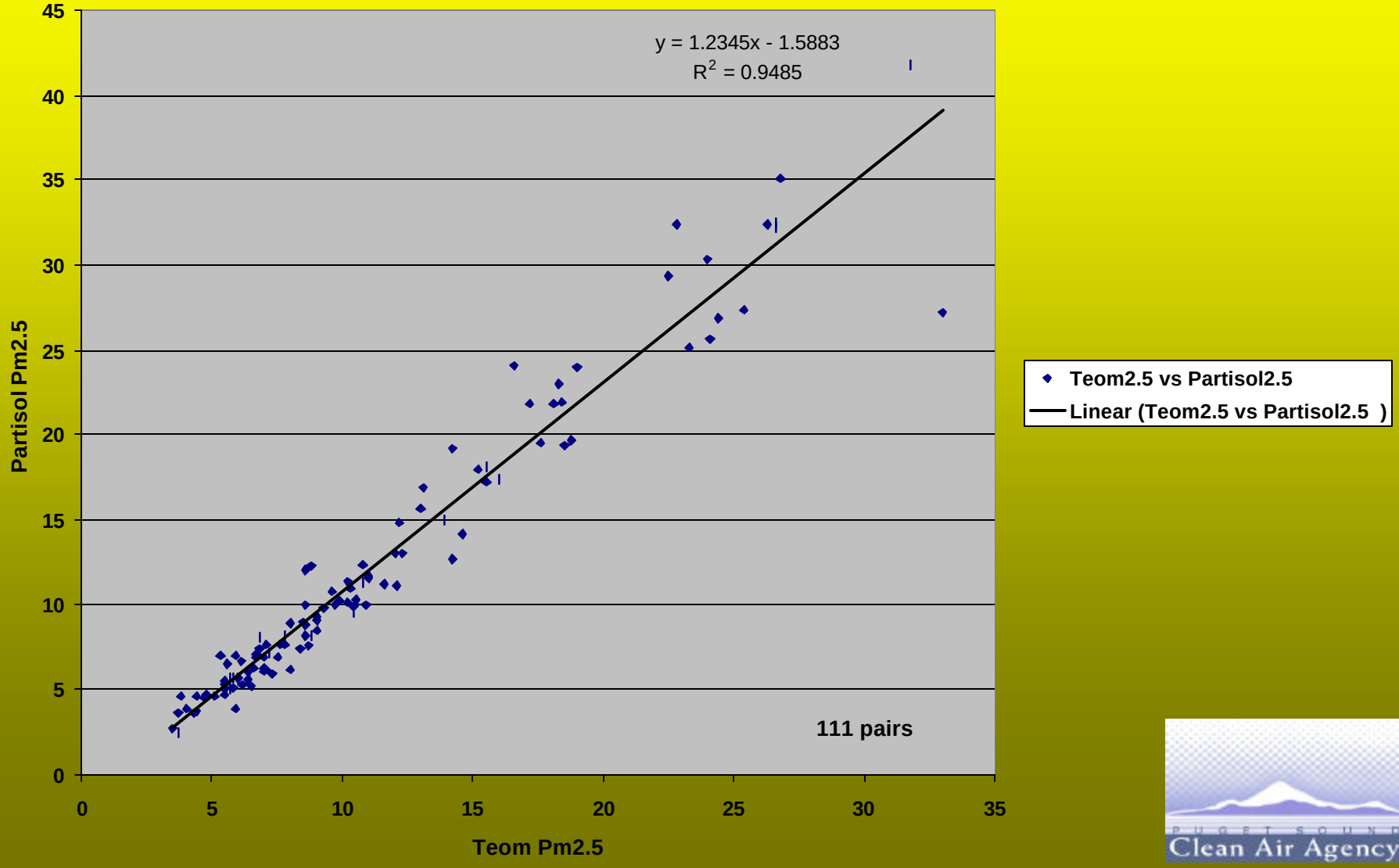
Clean Air Agency

Lake Forest Park
Neph vs Partisol
Jun 1999 - Mar 2001

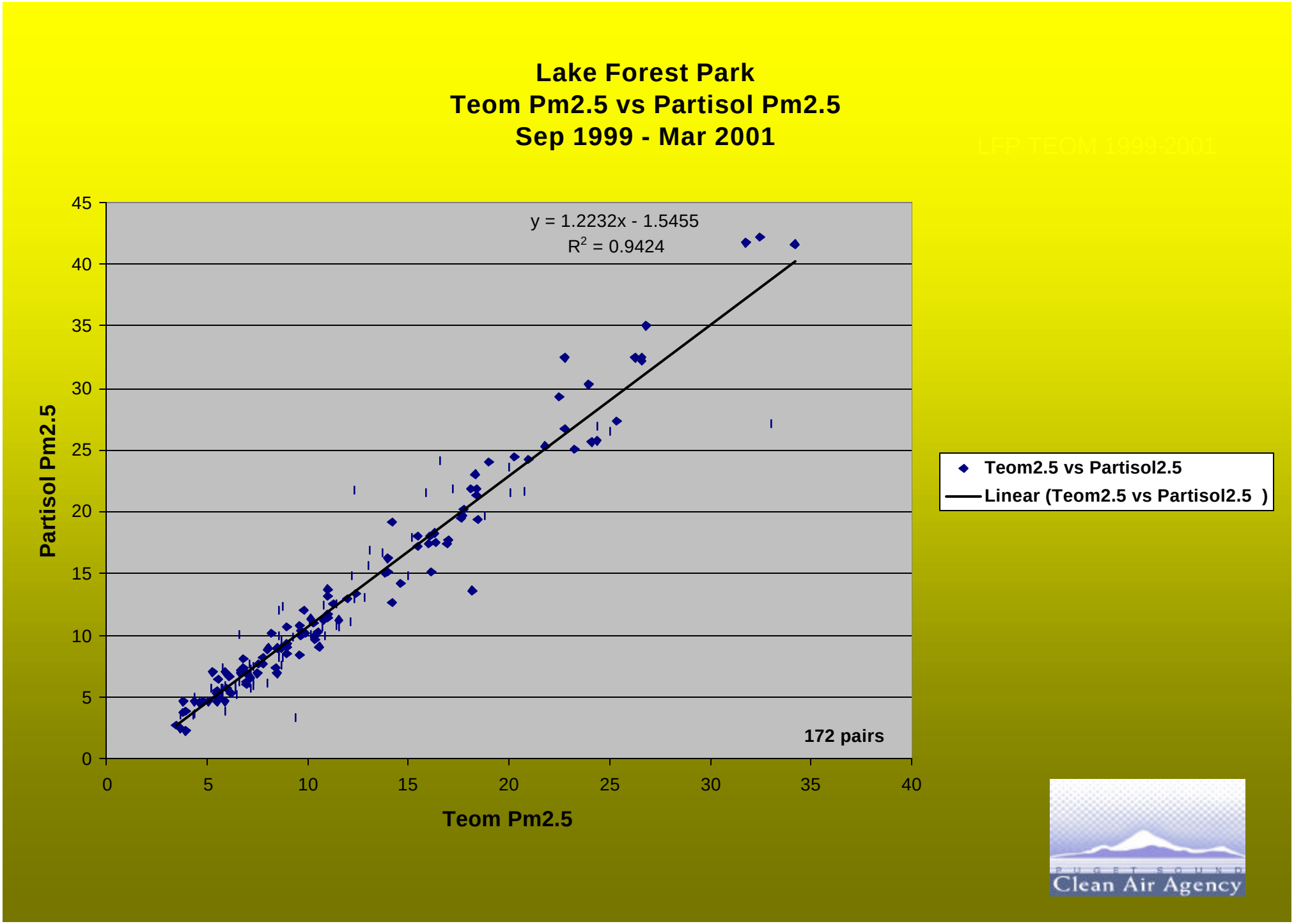


Clean Air Agency

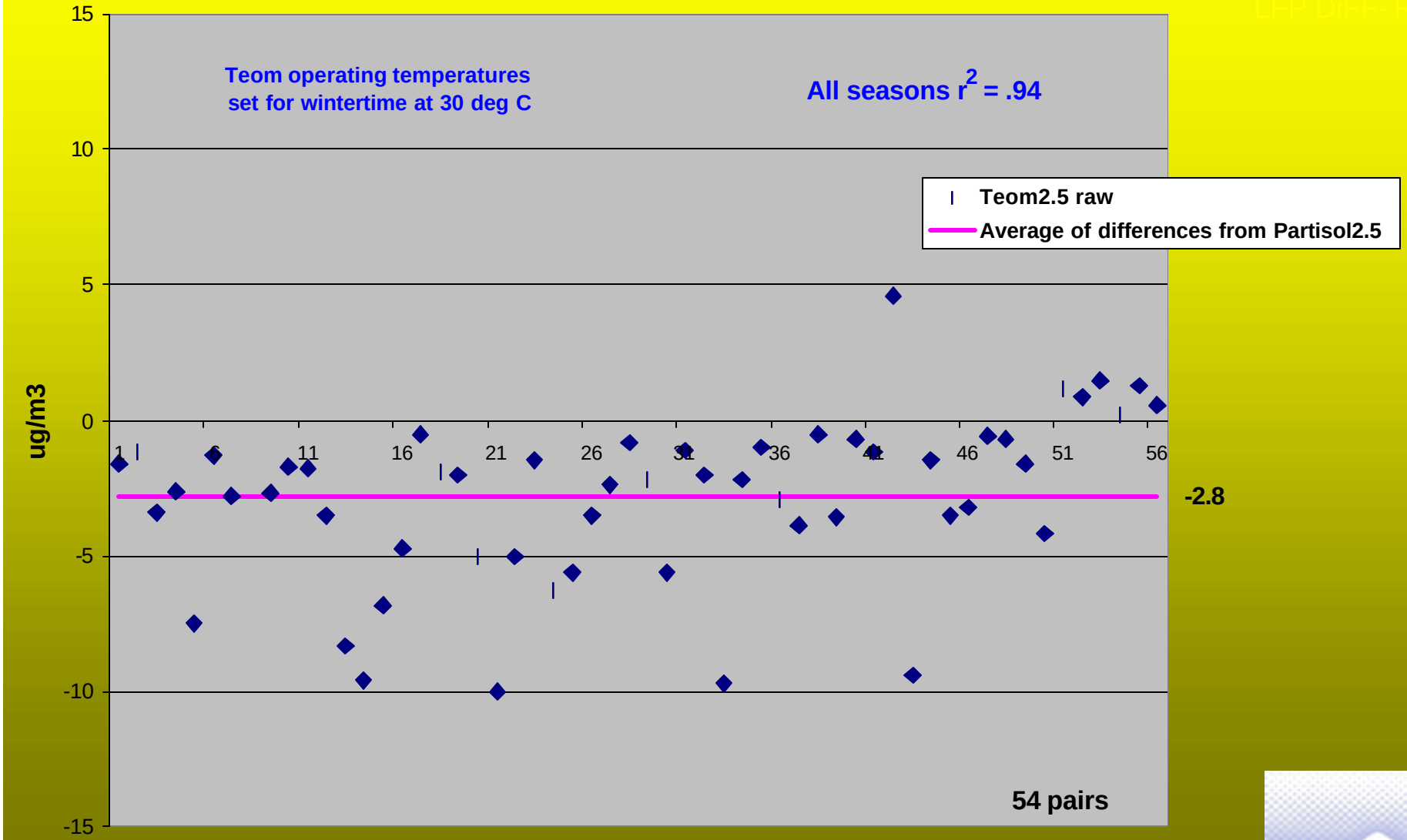
Lake Forest Park
2000
Teom Pm2.5 vs Partisol Pm2.5



Clean Air Agency

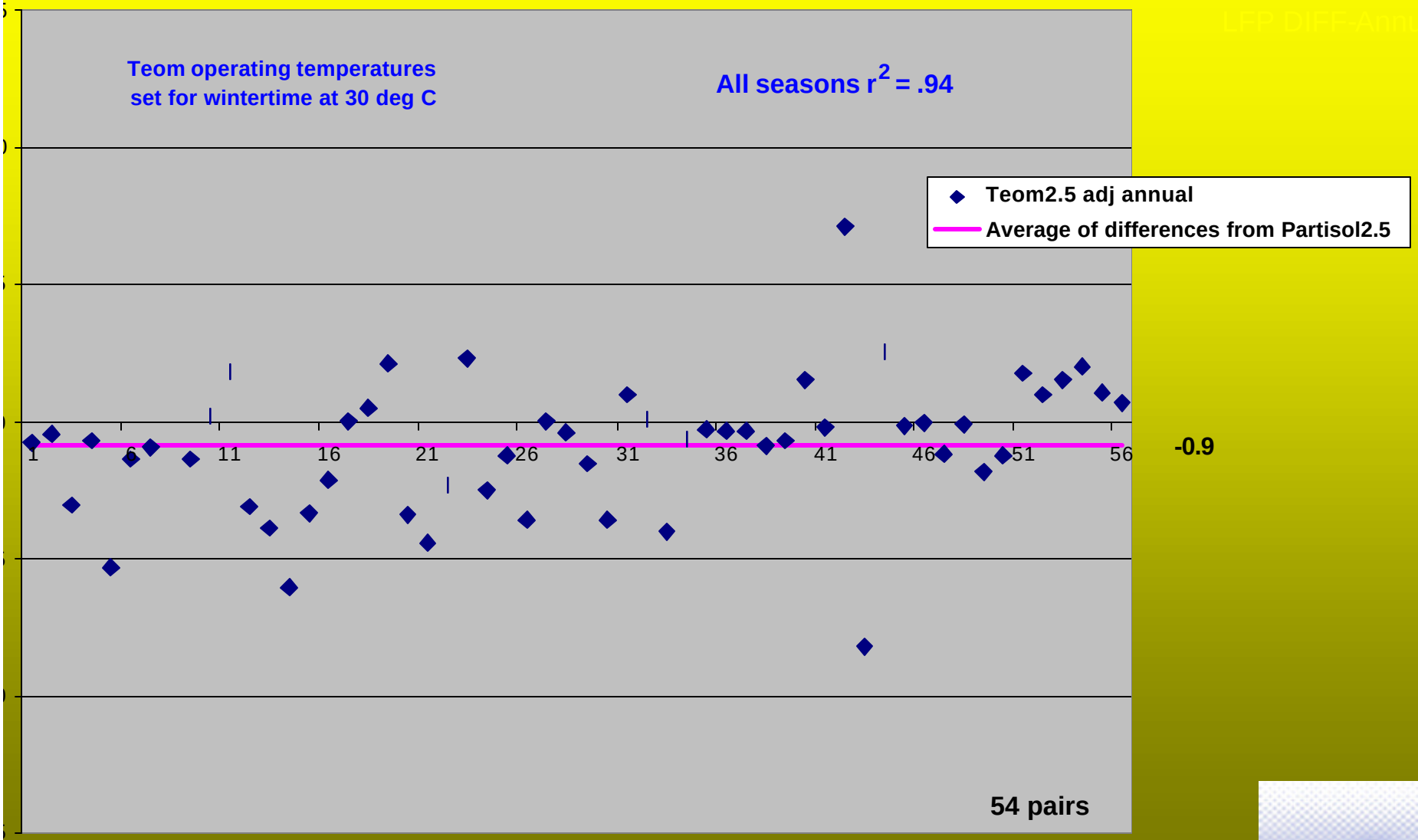

Lake Forest Park
Teom Pm2.5 vs Partisol Pm2.5
Sep 1999 - Mar 2001
LFP TEOM 1999-2001
y = 1.2232x - 1.5455
R2 = 0.9424
172 pairs
Partisol Pm2.5
Teom Pm2.5
0
5
10
15
20
25
30
35
40
45
Teom2.5 vs Partisol2.5
Linear (Teom2.5 vs Partisol2.5)
PUGET SOUND
Clean Air Agency

Lake Forest Park Oct 2000 - Mar 2001
Teom25 Difference from Partisol Pm2.5
Teom Raw Data



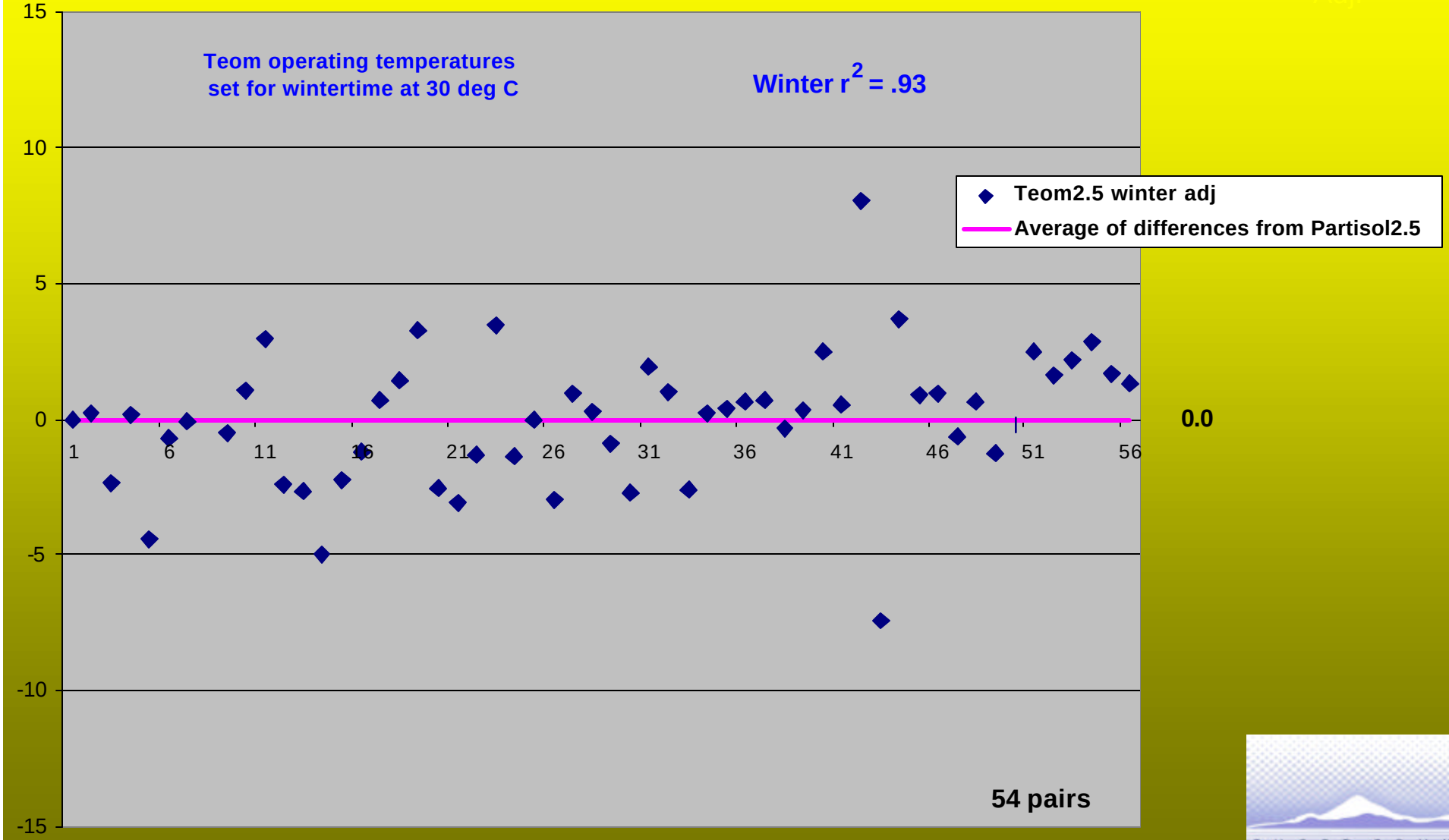
Clean Air Agency

Lake Forest Park Oct 2000 - Mar 2001
Teom25 Difference from Partisol Pm2.5
Teom Annual Adjustment

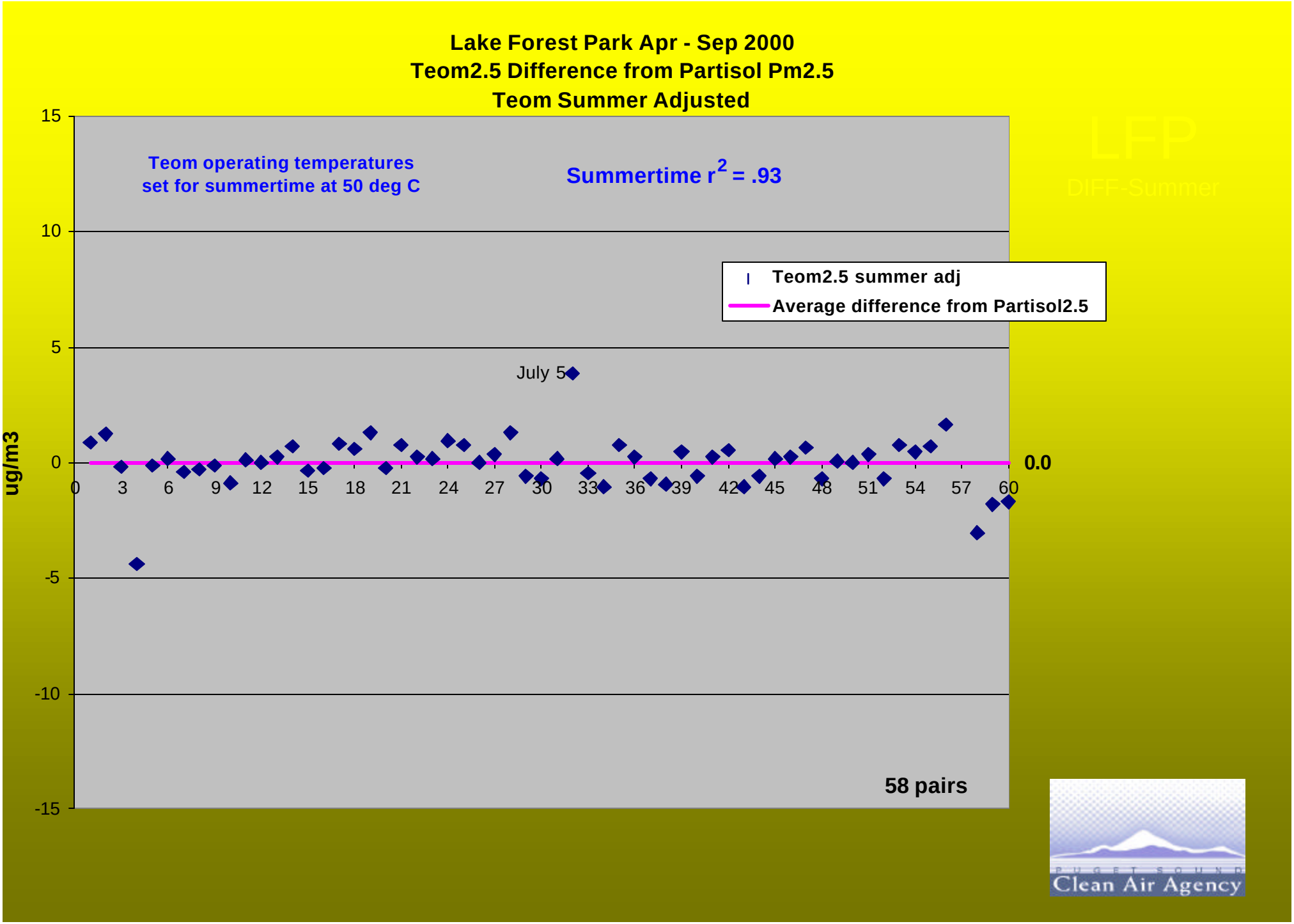


Clean Air Agency

Lake Forest Park Oct 2000 - Mar 2001
Teom25 Difference from Partisol Pm2.5
Teom Winter Adjustment



Clean Air Agency


Lake Forest Park Apr - Sep 2000
Teom2.5 Difference from Partisol Pm2.5
Teom Summer Adjusted
Teom operating temperatures
set for summertime at 50 deg C
Summertime r2 = .93
LFP
DIFF-Summer
Teom2.5 summer adj
Average difference from Partisol2.5
July 5
0.0
58 pairs
ug/m3
15
10
5
0
-5
-10
-15
0
3
6
9
12
15
18
21
24
27
30
33
36
39
42
45
48
51
54
57
60
Clean Air Agency

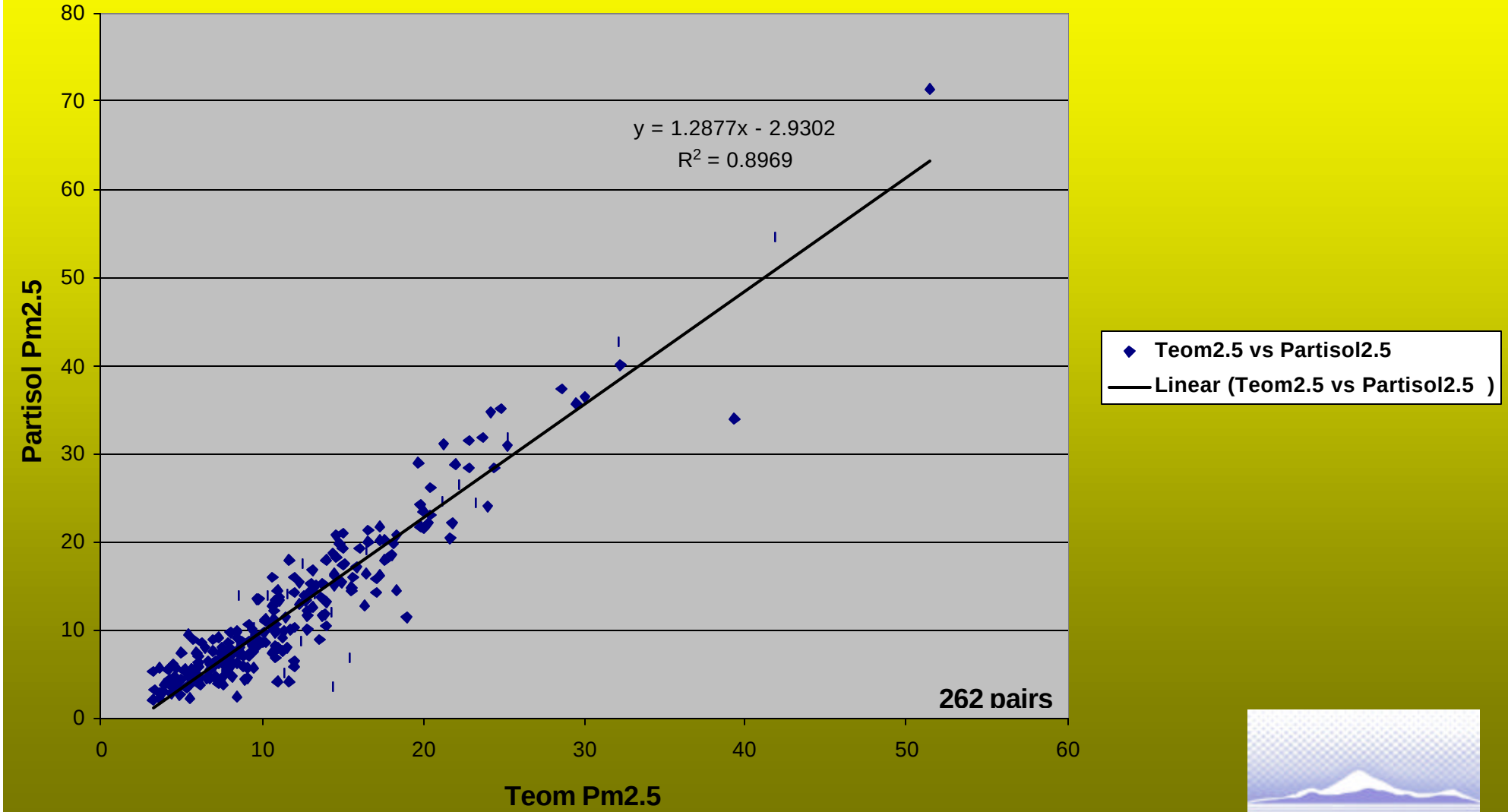
Marysville, Washington

- North of Everett in Snohomish County
- Located at Junior High School
- Wood Smoke site.
- May fit Environmental Justice model
- Adjacent to Tulalip Indian Reservation
- Has exceeded the 24hr NAAQS (1998)

Puget Sound Clean Air Agency

Marysville
Nov 1998 - Mar 2001
Teom Pm2.5 vs Partisol Pm2.5

MSVL TEOM 98-01



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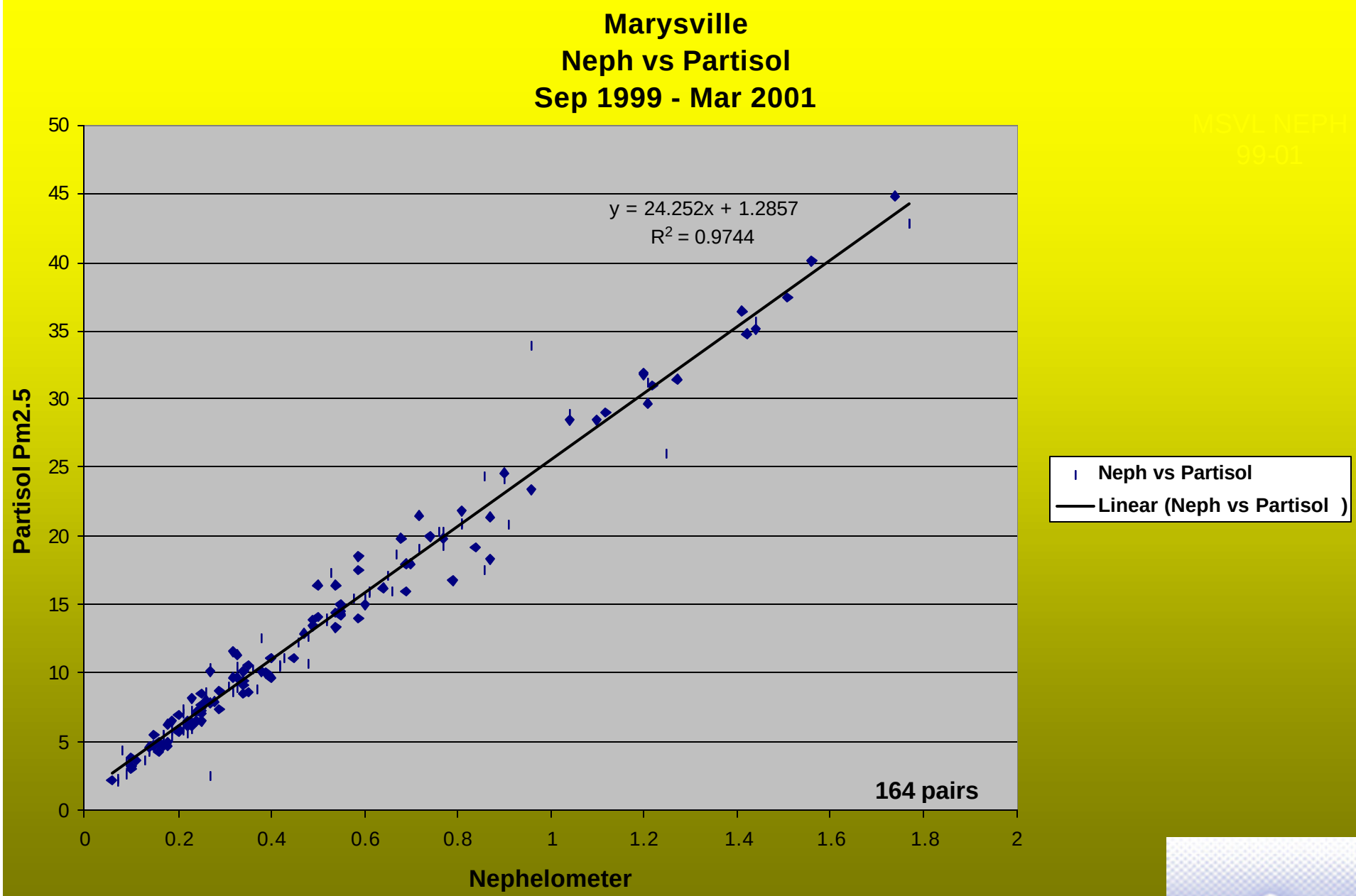
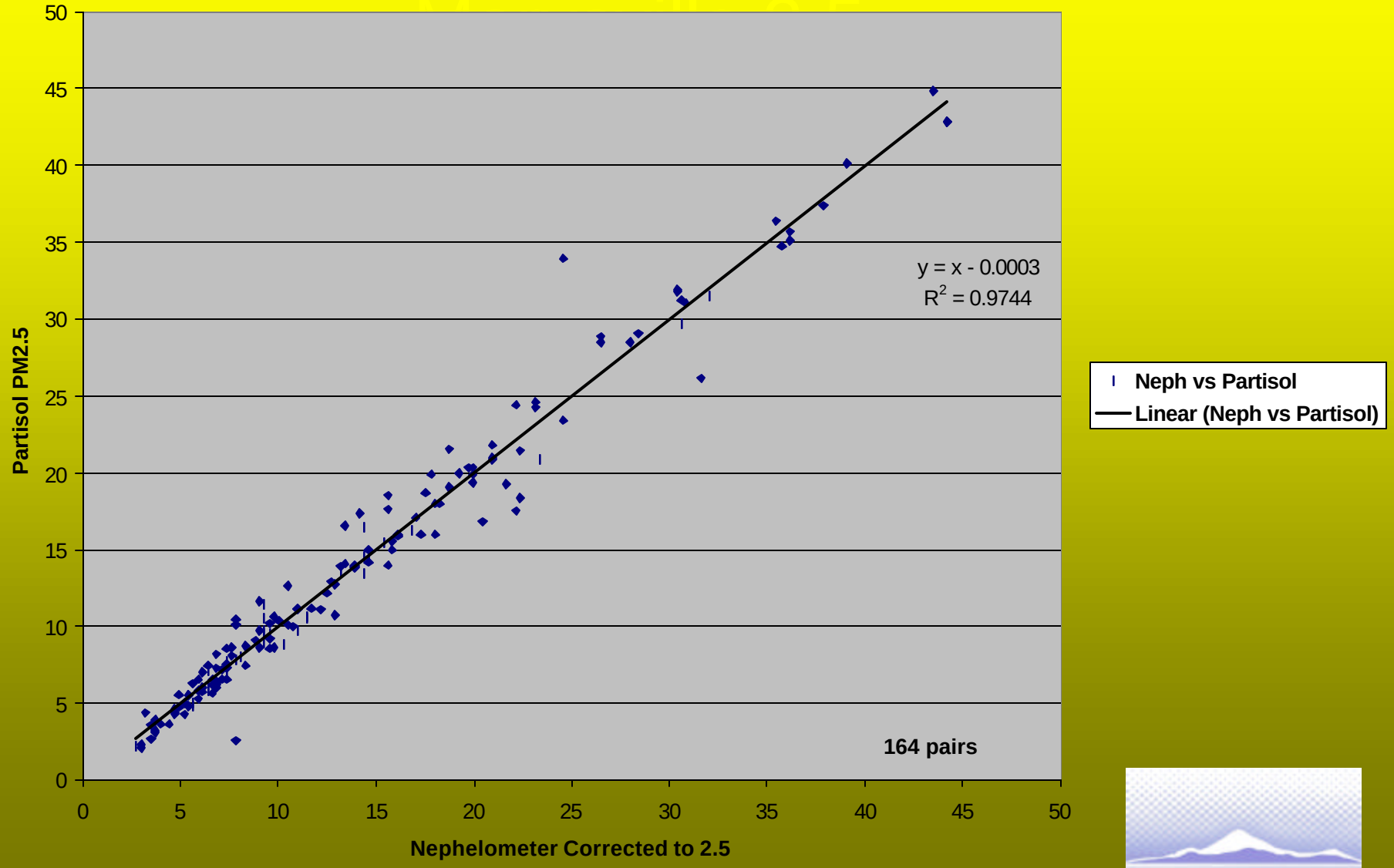


MSVL NEPH
99-01

Puget Sound Clean Air Agency

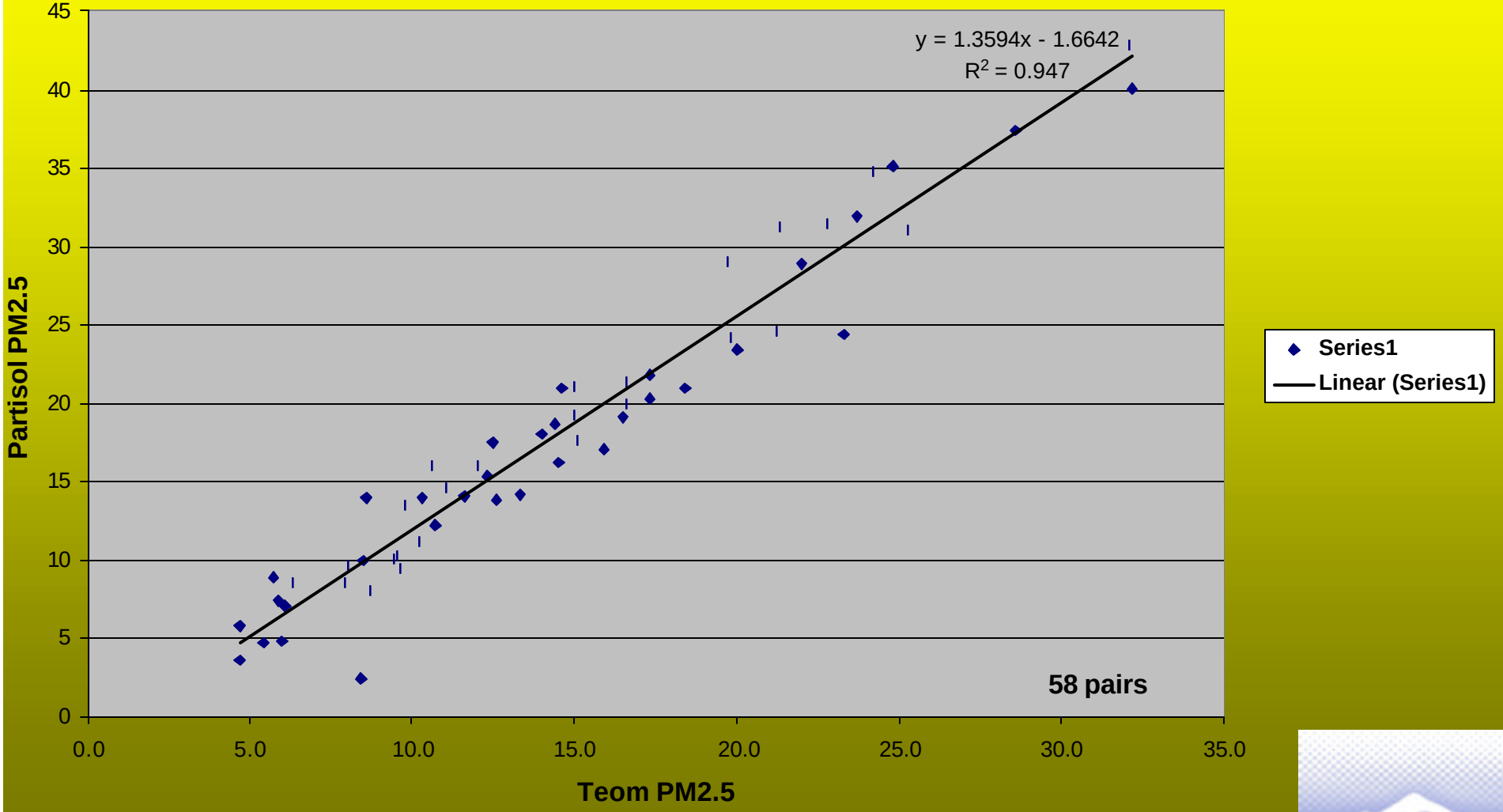
Marysville
Neph vs Partisol
Sep 1999 - Mar 2001



Clean Air Agency

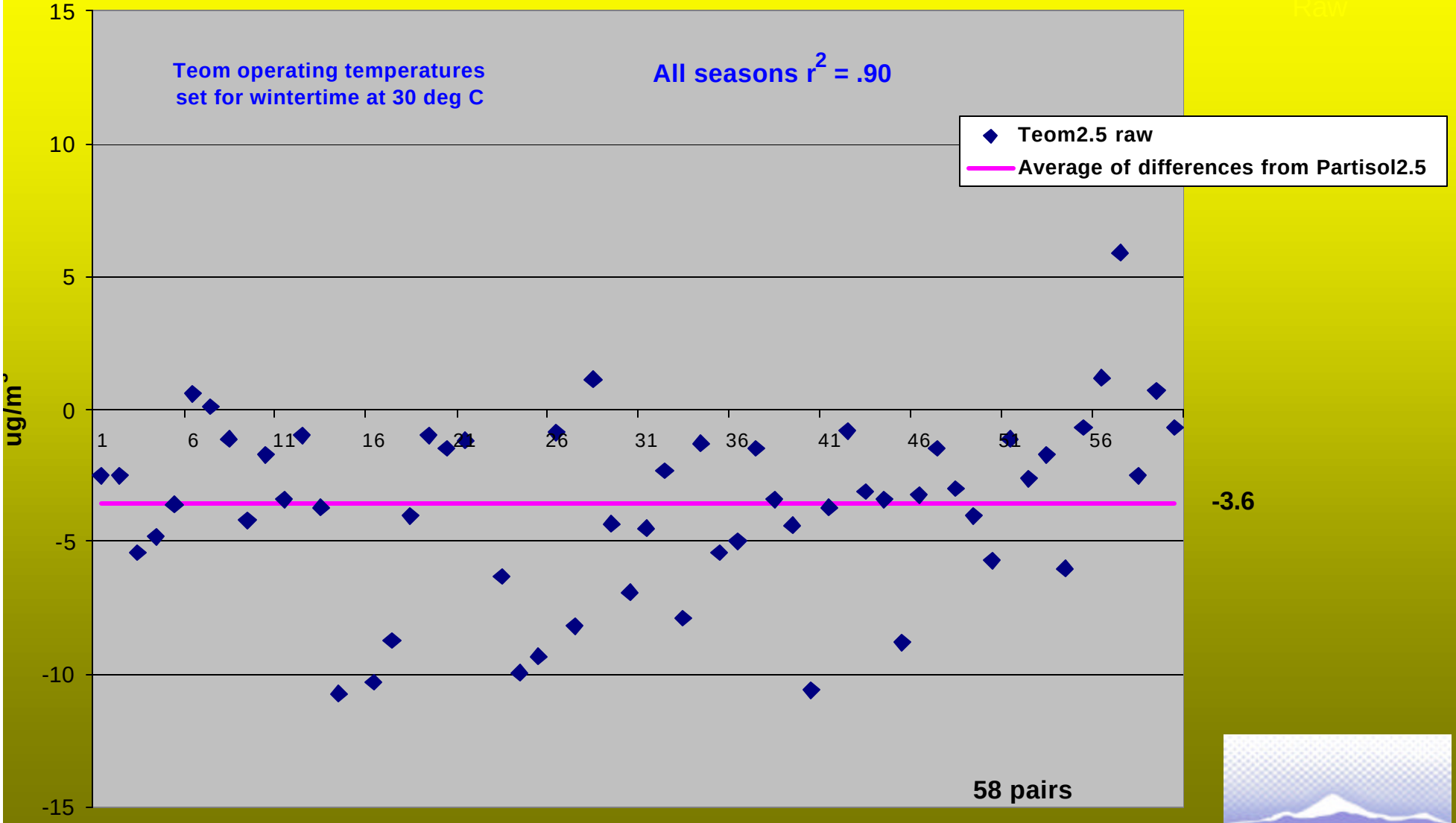
Marysville
Oct 2000 - Mar 2001
Teom PM2.5 vs Partisol PM2.5

MSVL TEOM - Winter

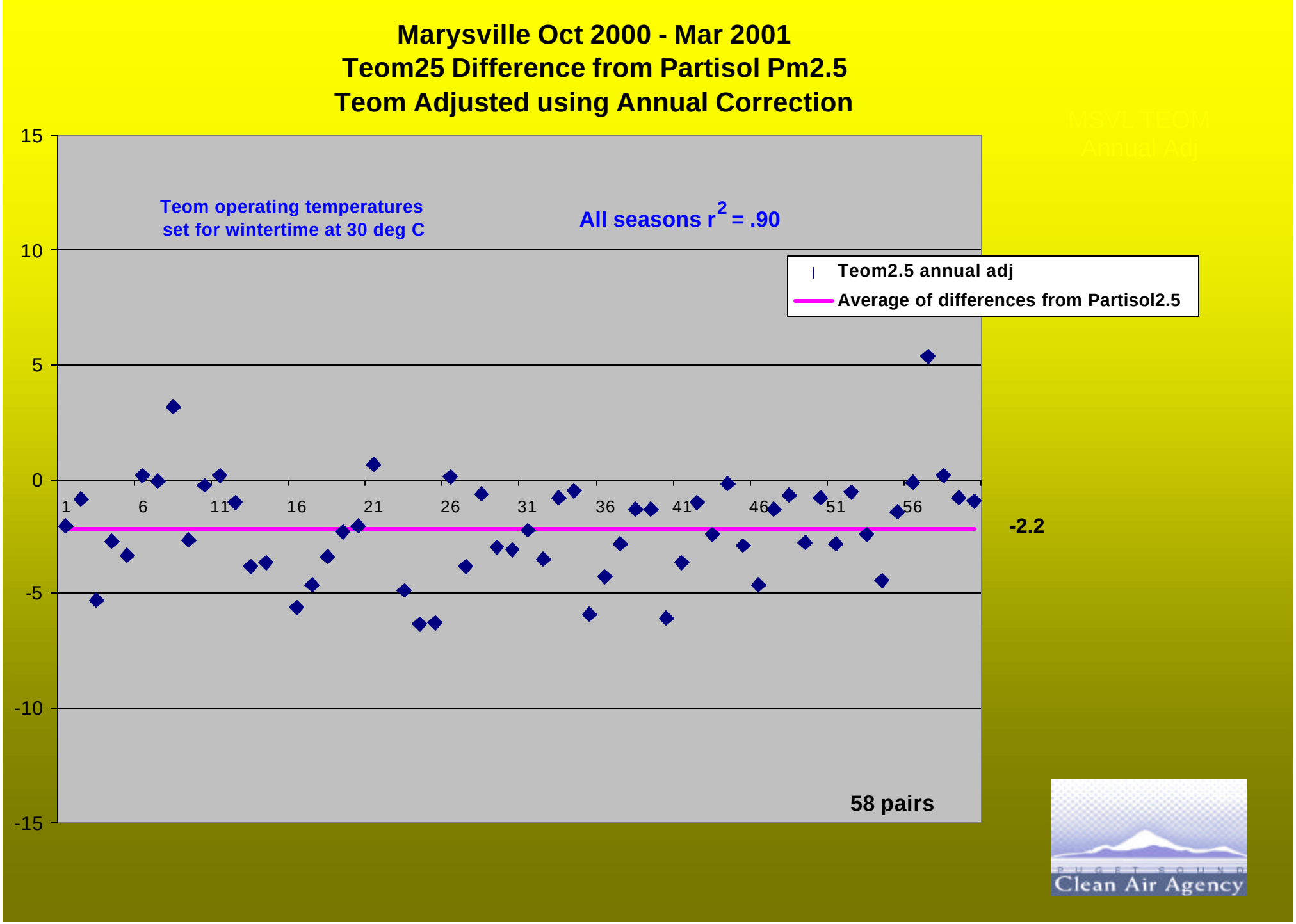


Puget Sound Clean Air Agency

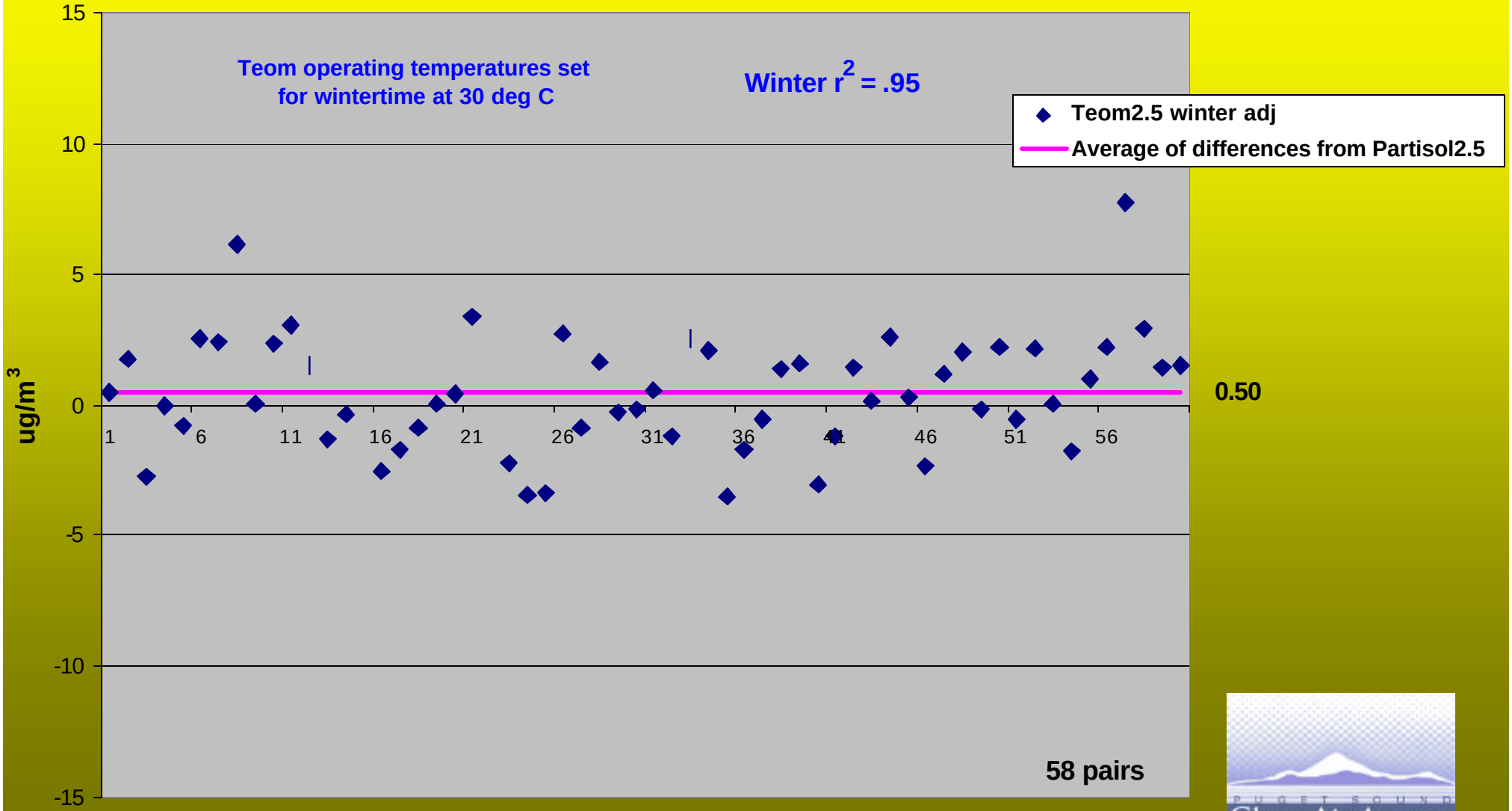
Marysville Oct 2000 - Mar 2001
Teom2.5 Difference from Partisol2.5
Teom Raw Data



Clean Air Agency


Marysville Oct 2000 - Mar 2001
Teom25 Difference from Partisol Pm2.5
Teom Adjusted using Annual Correction
Teom operating temperatures
set for wintertime at 30 deg C
All seasons r2 = .90
Teom2.5 annual adj
Average of differences from Partisol2.5
-2.2
58 pairs
15
10
5
0
-5
-10
-15
1
6
11
16
21
26
31
36
41
46
51
56
Clean Air Agency

Marysville Oct 2000 - Mar 2001
Teom2.5 Difference from Partisol Pm2.5
(Teom Adjusted using Wintertime Correction)

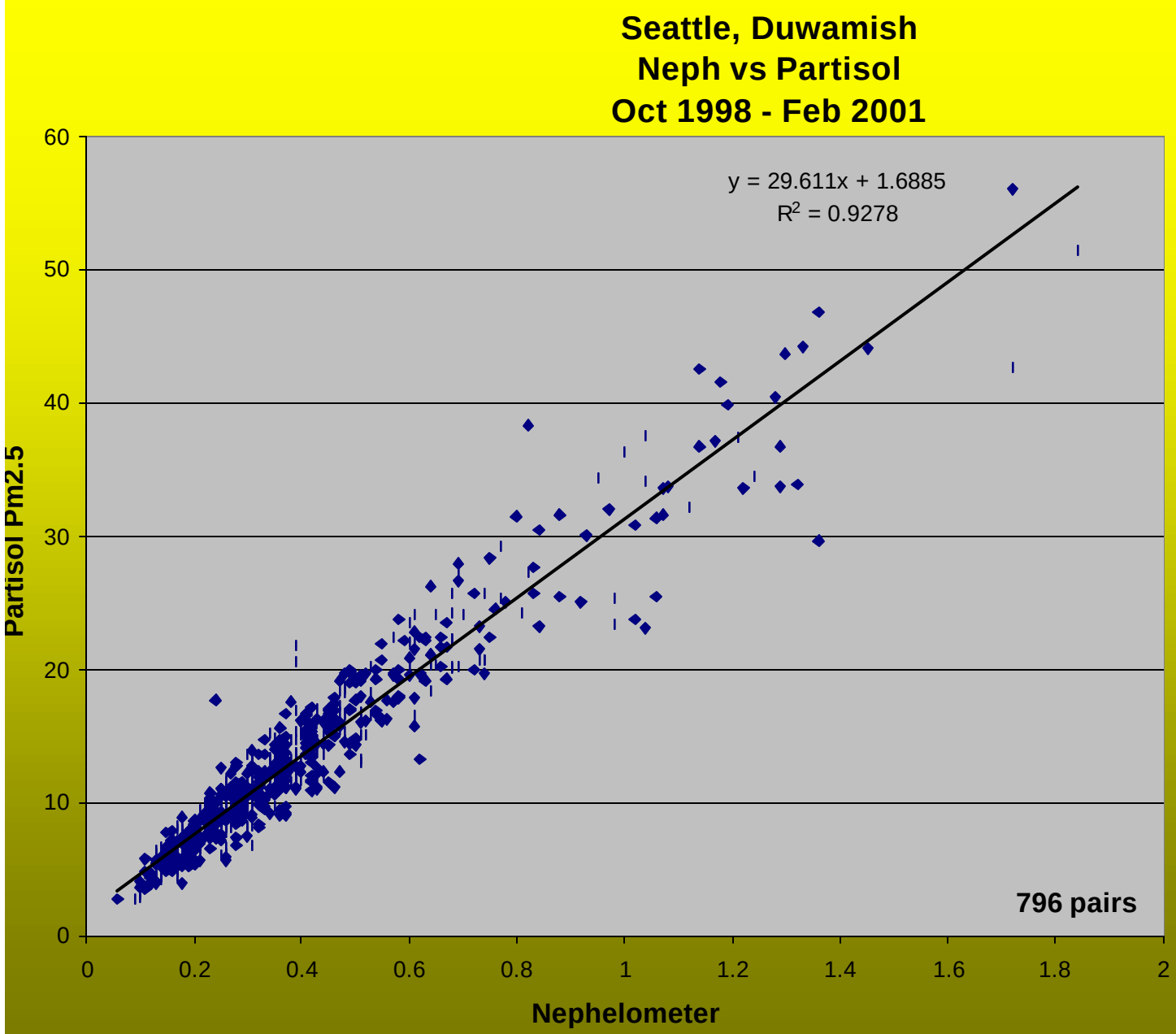


Clean Air Agency

Industrial Sites

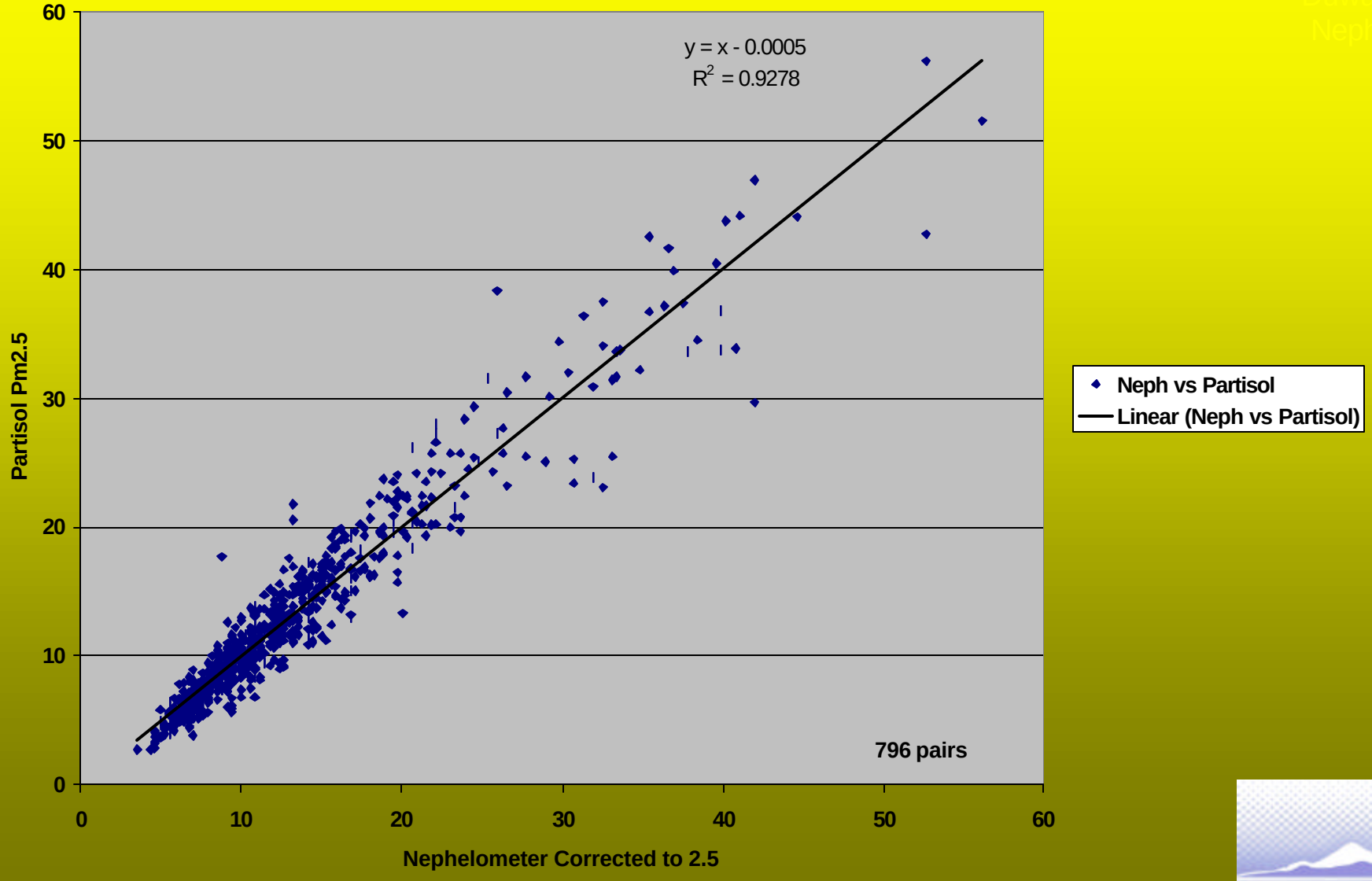
- Located in the heart of the Seattle and Tacoma Industrial areas.
- Max PM Concentration Sites.

Puget Sound Clean Air Agency



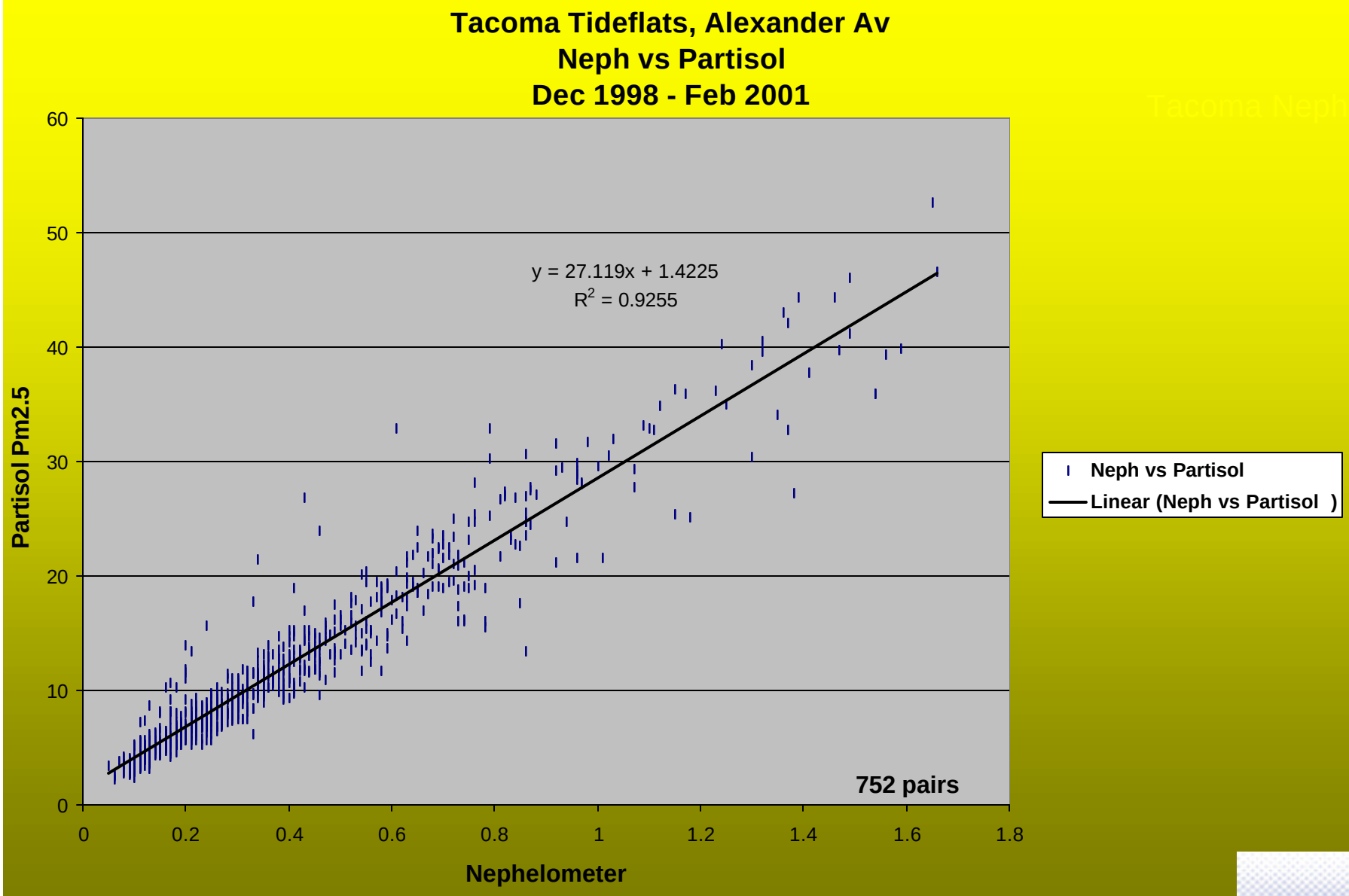
Clean Air Agency

Seattle, Duwamish
Neph vs Partisol
Oct 1998 - Feb 2001



Duwamish
Neph 2.5

Clean Air Agency

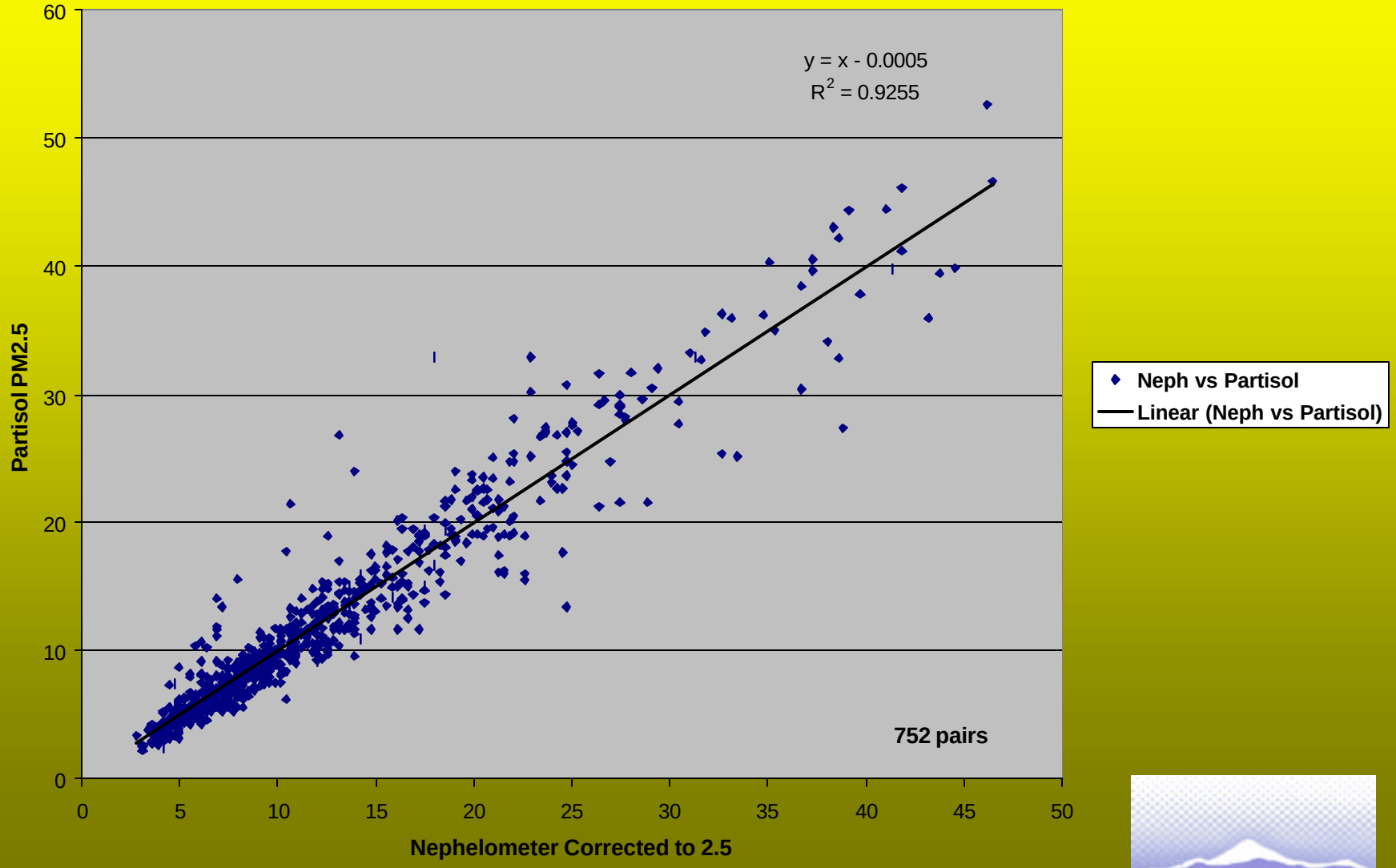


Tacoma Nephs

Clean Air Agency

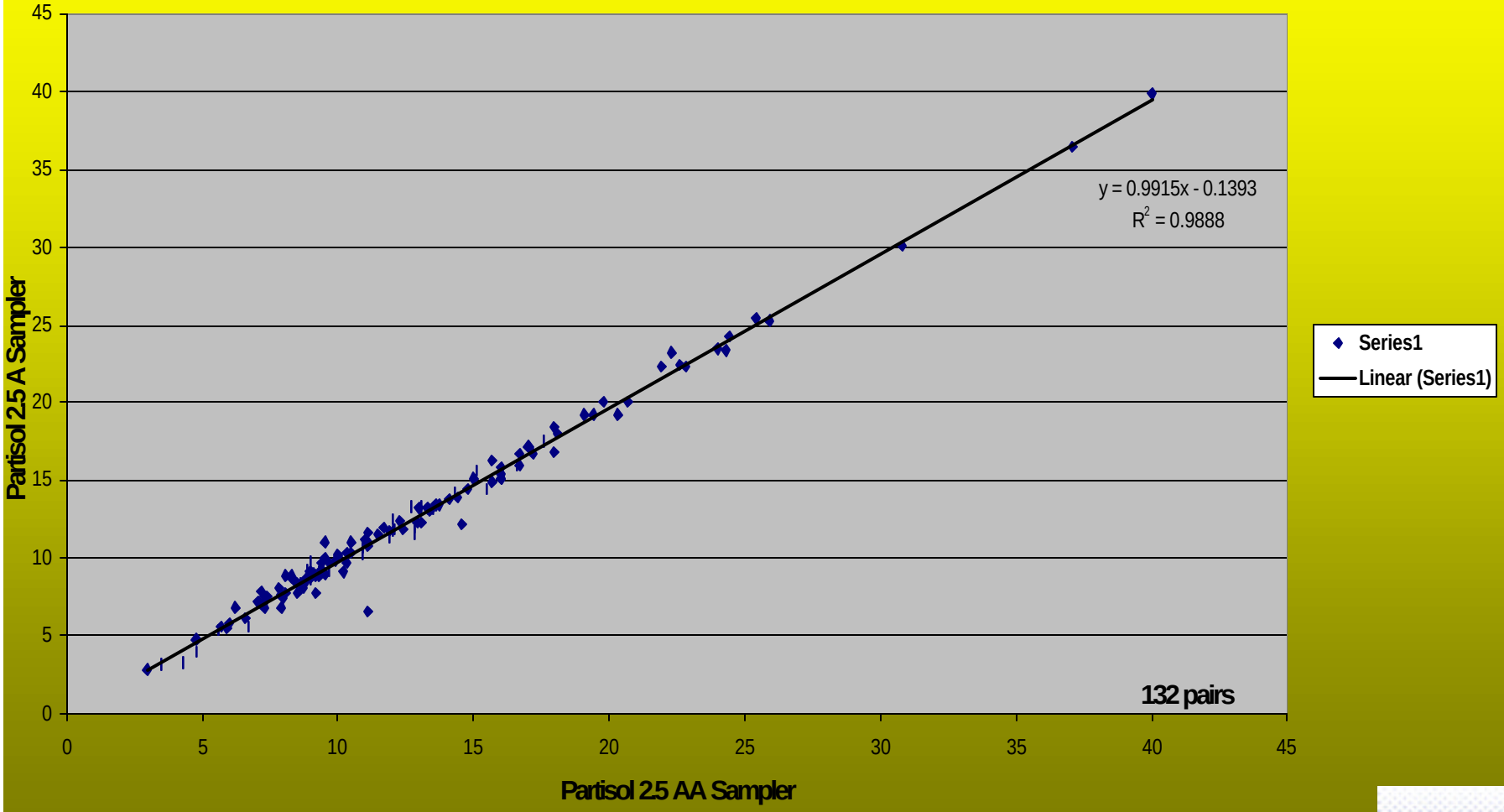
Neph 2.5
Tacoma

Tacoma Tideflats, Alexander Ave
Neph vs Partisol
Dec 1998 - Feb 2001

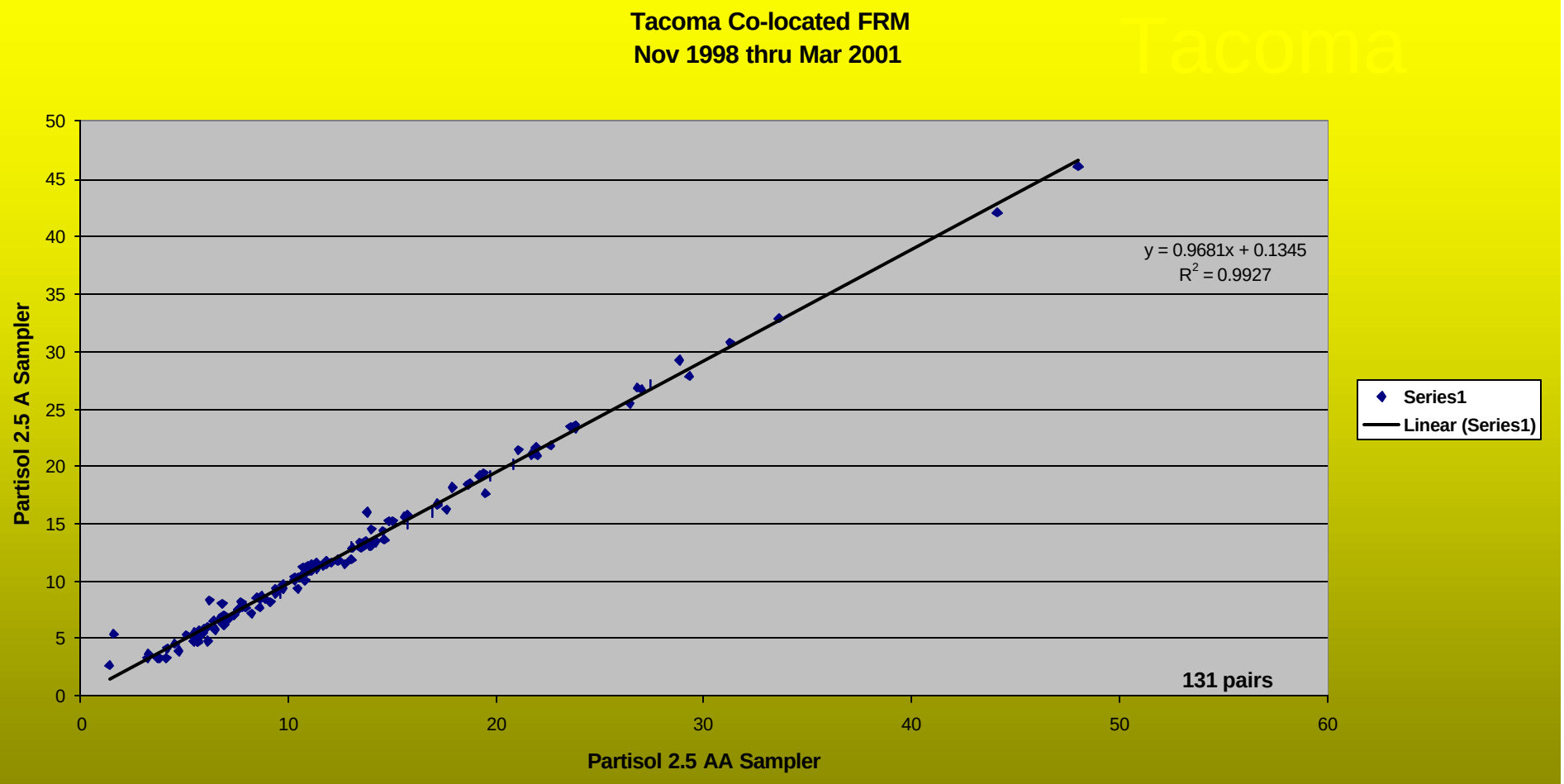


Puget Sound Clean Air Agency

Duwamish Co-located FRM
Nov 1998 thru Mar 2001

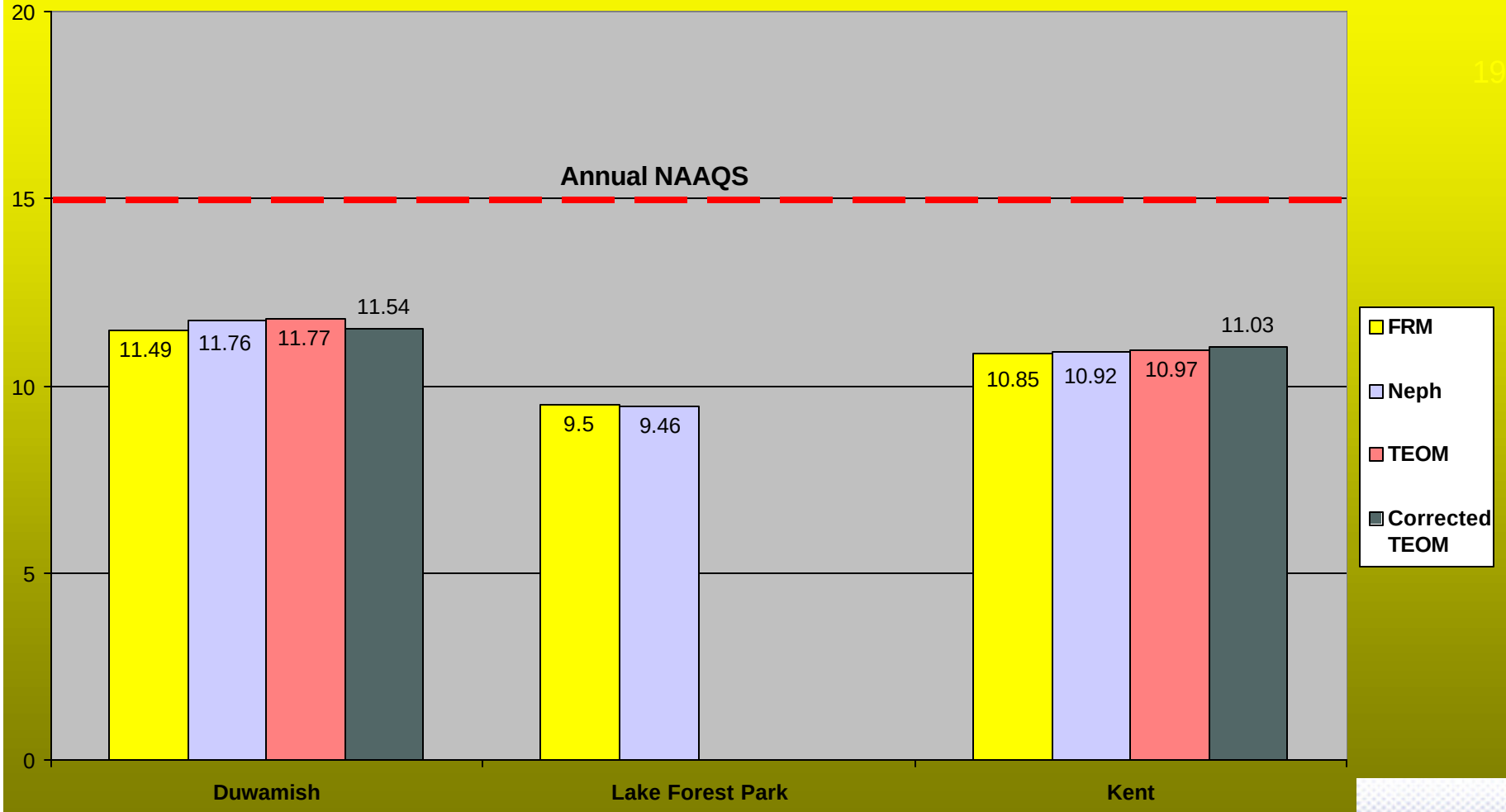


Clean Air Agency



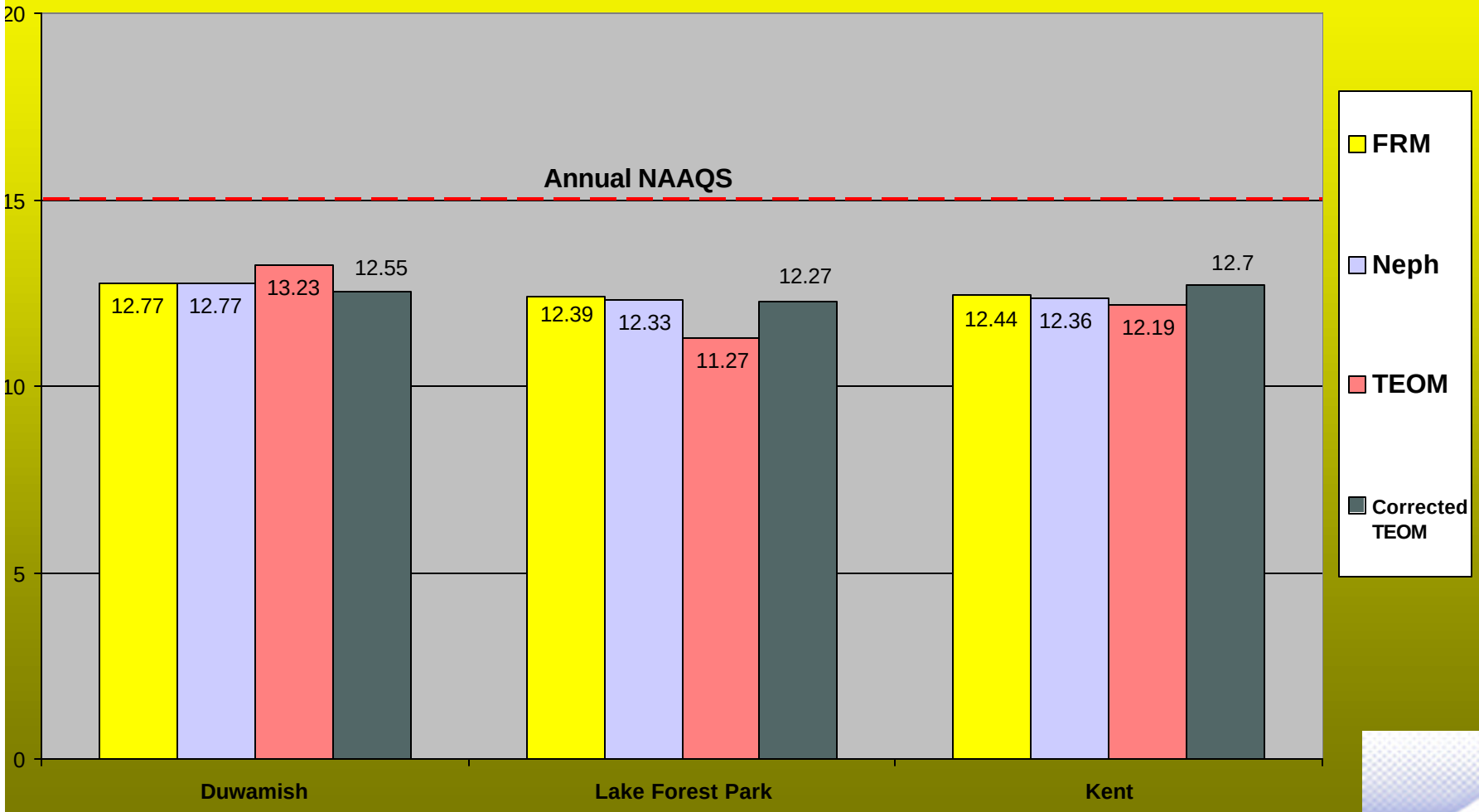
Clean Air Agency

Puget Sound $PM_{2.5}$ Network
Method Comparison
1999 Annual Averages



Clean Air Agency

Puget Sound $PM_{2.5}$ Network
Method Comparison
2000 Annual Averages



Puget Sound Clean Air Agency

Daily Air Quaity Index - Netscape

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Bookmarks Location: http://www.pscleanair.org/dailyaq1.htm What's Related

Puget Sound Clean Air Agency

Daily Air Quality Index

Updated at 25 minutes past every hour

This is the Air Quality Index representing current conditions for the areas listed below. Click on the name of your area to see an air quality trend chart for the previous 3 days. You can also view the latest air quality forecasts for our region.

Area	AQI Value	Descriptor						Pollutant	
		G	M	USG	U	VU	H	PM	CO
EVERETT/MARYSVILLE	102			✓				✓	
LYNNWOOD	112			✓				✓	
BELLEVUE	62		✓					✓	
SEATTLE	112			✓				✓	
KENT	95		✓					✓	
TACOMA	89		✓					✓	
PUYALLUP	87		✓					✓	
BREMERTON	66		✓					✓	
SILVERDALE	48	✓						✓	
1/28/2001 11AM PACIFIC									

Check Marks ✓ indicate applicable AQI descriptor and prevalent pollutant at each monitoring area
Descriptors: G=Good, M=Moderate, USG=Unhealthy for Sensitive Groups, U=Unhealthy, VU=Very Unhealthy, H=Hazardous
Pollutants: PM=Particulate Matter, CO=Carbon Monoxide

Document: Done

Current AQI

With Links To EPA/Ecology

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Why we do this.

- **Public Information Products**

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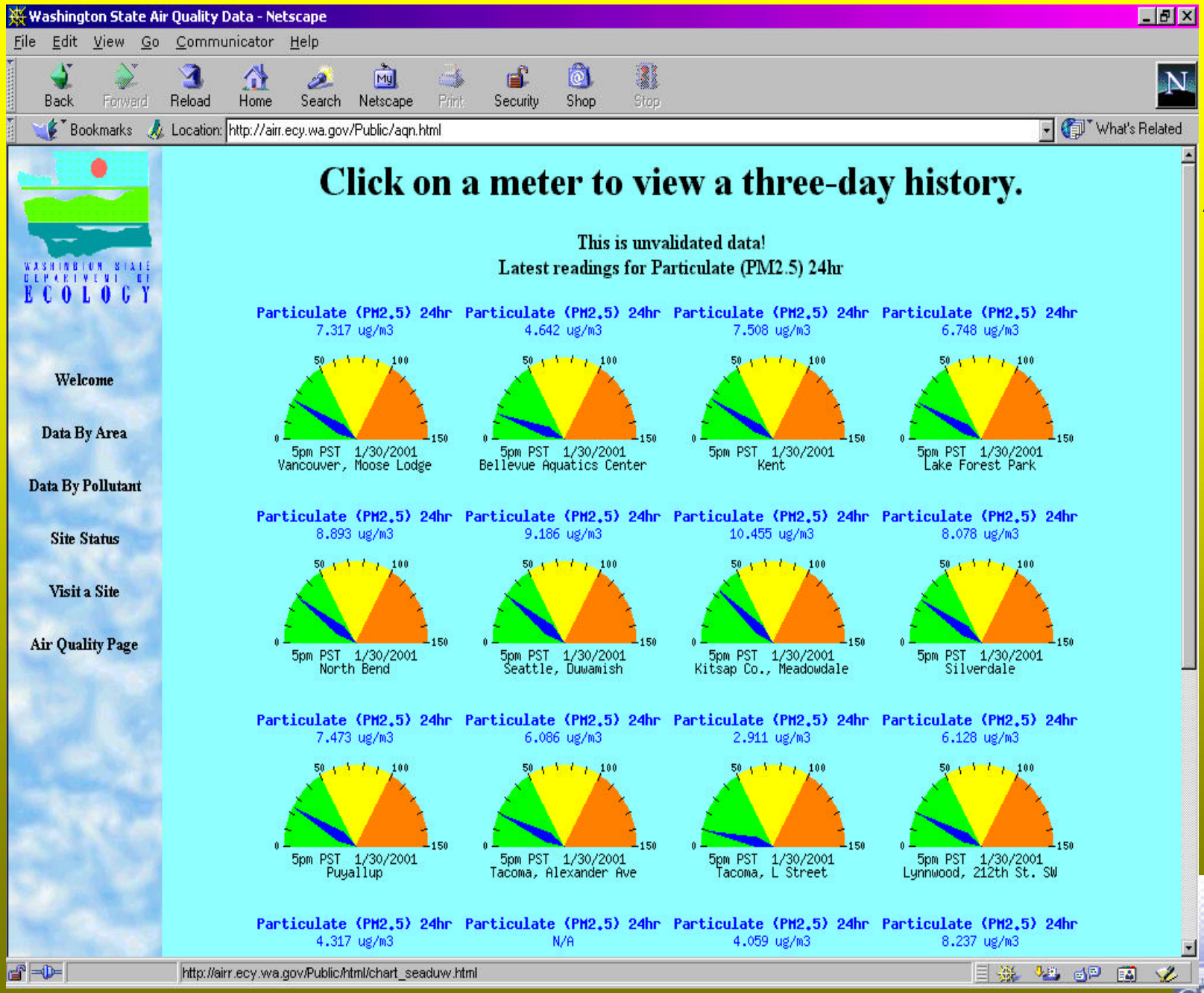
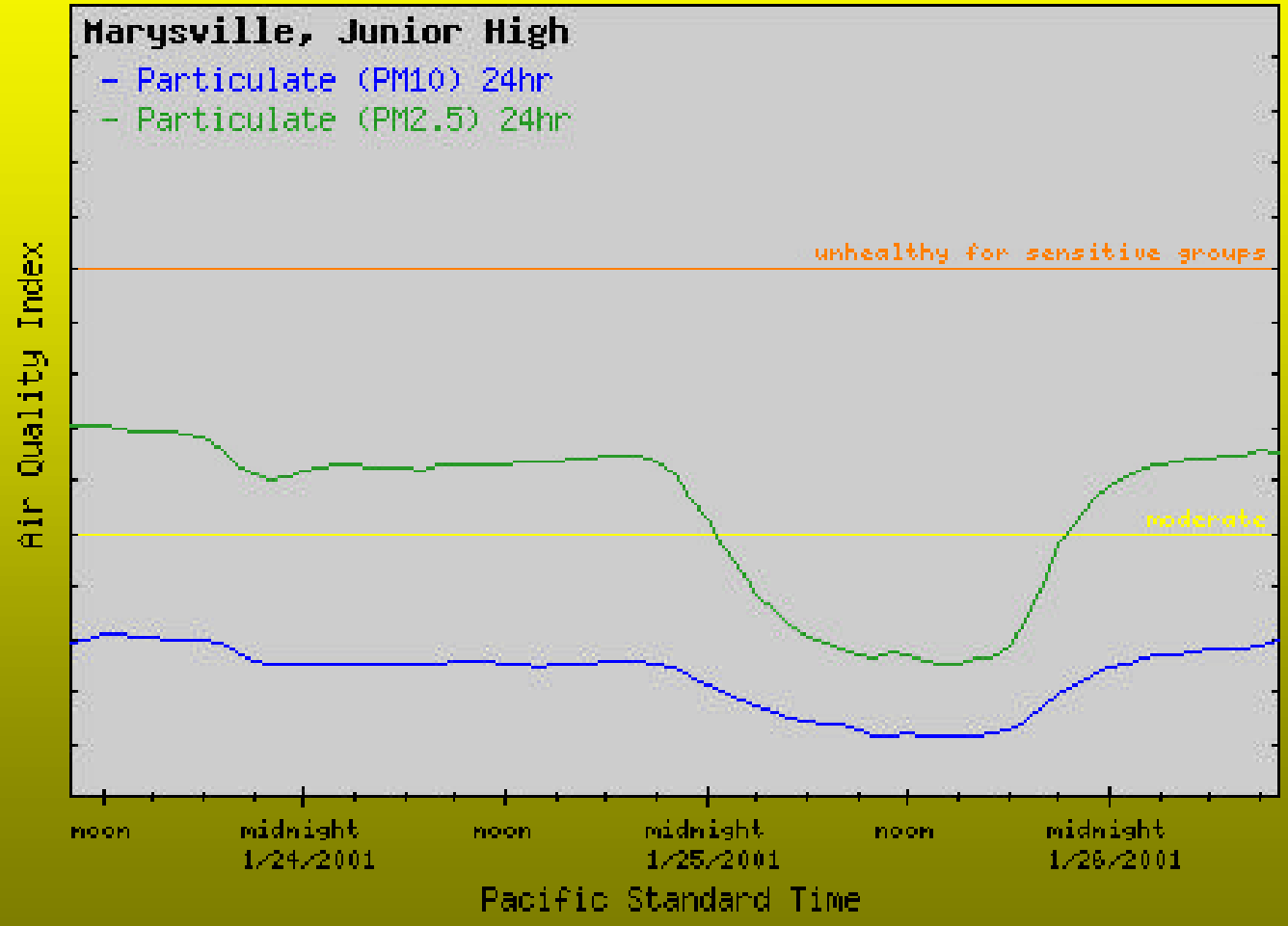


Real-time AQI & PM levels (24hr

Clean Air Agency

Ecology Air Quality Network



Real-time Monitoring trends

Puget Sound Clean Air Agency

Air Now Forecast

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Bookmarks Netsite: http://www.epa.gov/cgi-bin/airnow.cgi?MapDisplay=WHEREILIVE&MapDomain=IenIPWA What's Related

AK ID OR WA

This page contains Air Quality links to State and Local Webpages, State and Local Air Quality Forecasts for Today and Tomorrow and links to the AIRNow Ozone Maps for Alaska, Idaho, Oregon, and Washington.

Area	Today's Forecast	Tomorrow's Forecast	Ozone Maps	State/Local Air Quality Links
Alaska			Ozone maps not available.	
Idaho			Ozone maps not available.	
Pocatello/Chubbuck				AQI
Treasure Valley (Boise)				AQI
Area	**Today's Forecast**	**Tomorrow's Forecast**	**Ozone Maps**	**State/Local Air Quality Links**
Oregon			Ozone maps not available.	AQI
Portland	Not Available	Not Available		AQI
Area	**Today's Forecast**	**Tomorrow's Forecast**	**Ozone Maps**	**State/Local Air Quality Links**
Washington			Ozone maps not available.	
Bremerton- Silverdale- Bainbridge Island	Particulate Matter Good	Particulate Matter Good		AQI
Everett- Marysville- Lynnwood	Particulate Matter Moderate	Particulate Matter Moderate		AQI
Seattle-Bellevue-Kent Valley	Particulate Matter Moderate	Particulate Matter Moderate		AQI
Tacoma-Puyallup	Particulate Matter Moderate	Particulate Matter Moderate		AQI

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http://www.epa.gov/airnow/

Search | Comments?

data unavailable

Puget Sound Clean Air Agency

TV Weather and Air Quality Forecasts

Puget Sound Clean Air Agency

Conclusions:

Continuous monitors can perform very well in the characterization of PM $^{2.5}$ for:

- **AQI Reporting**
- **Short Term Events**
- **Predicting PM 2.5 concentrations**
- **Annual Averages**
- **An efficient alternative to traditional NAMS monitoring**

Puget Sound Clean Air Agency

Recommendations:

- Create new guidelines to support and expand the collection of Fine Particulate with continuous monitors while refining the FRM Network.

Puget Sound Clean Air Agency

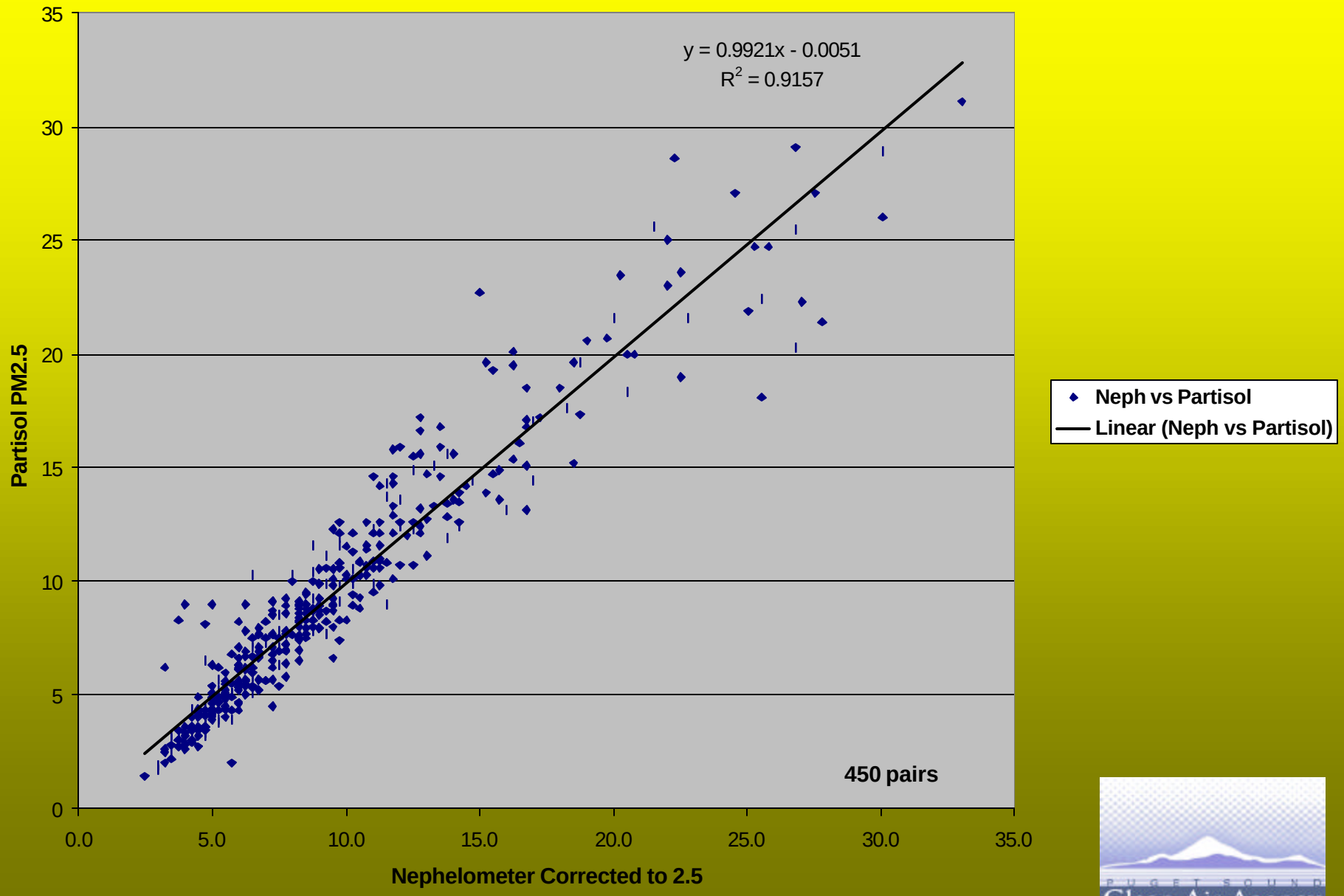
Additional Data

Puget Sound Clean Air Agency

Beacon Hill, Seattle Washington

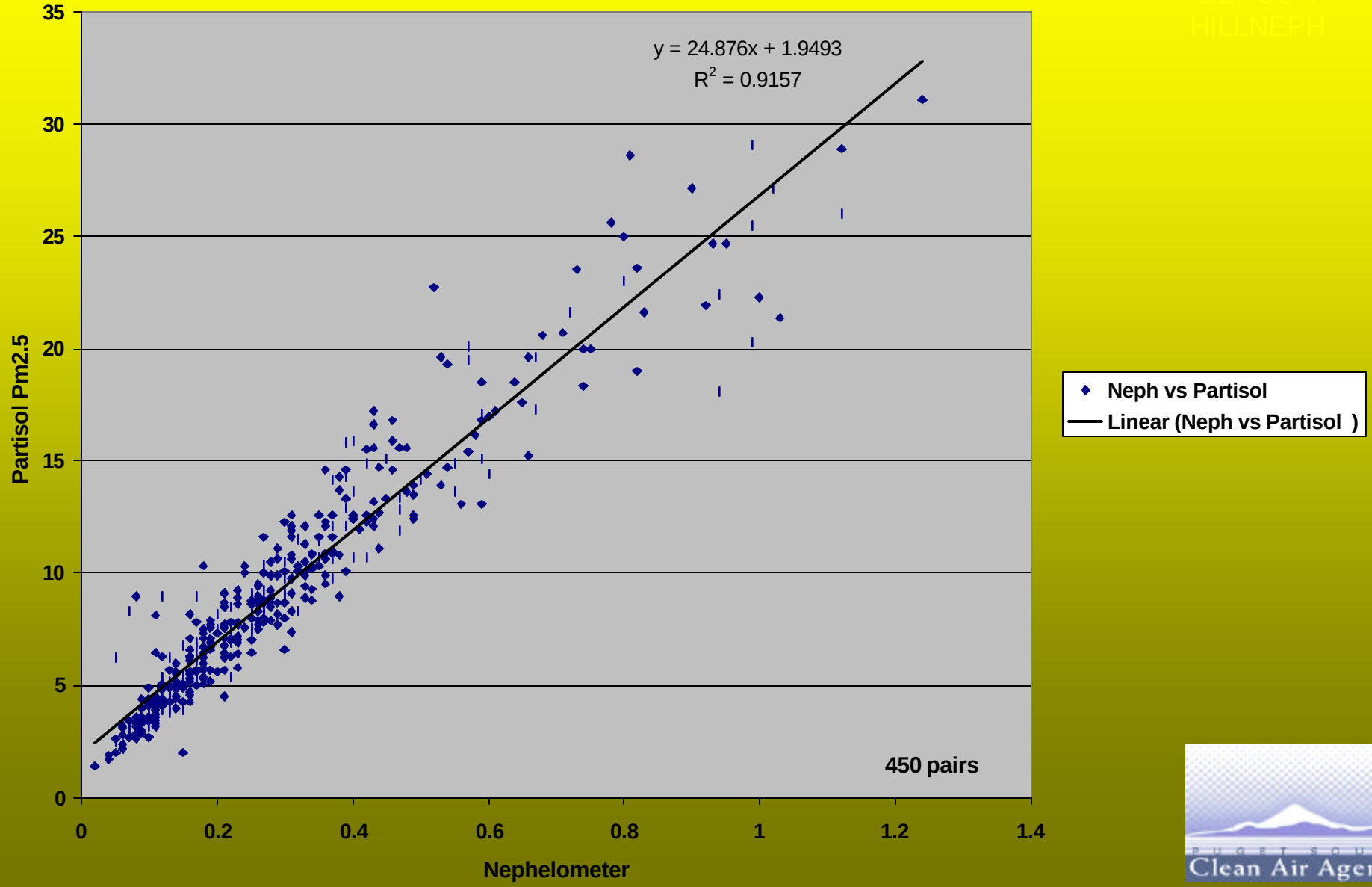
- Residential Community in Central Seattle Urban Core
- Elevation ~ 325FT. On a hill.
- Low Concentrations. Urban scale site.
- Operated by Washington State Dept. of Ecology

Puget Sound Clean Air Agency



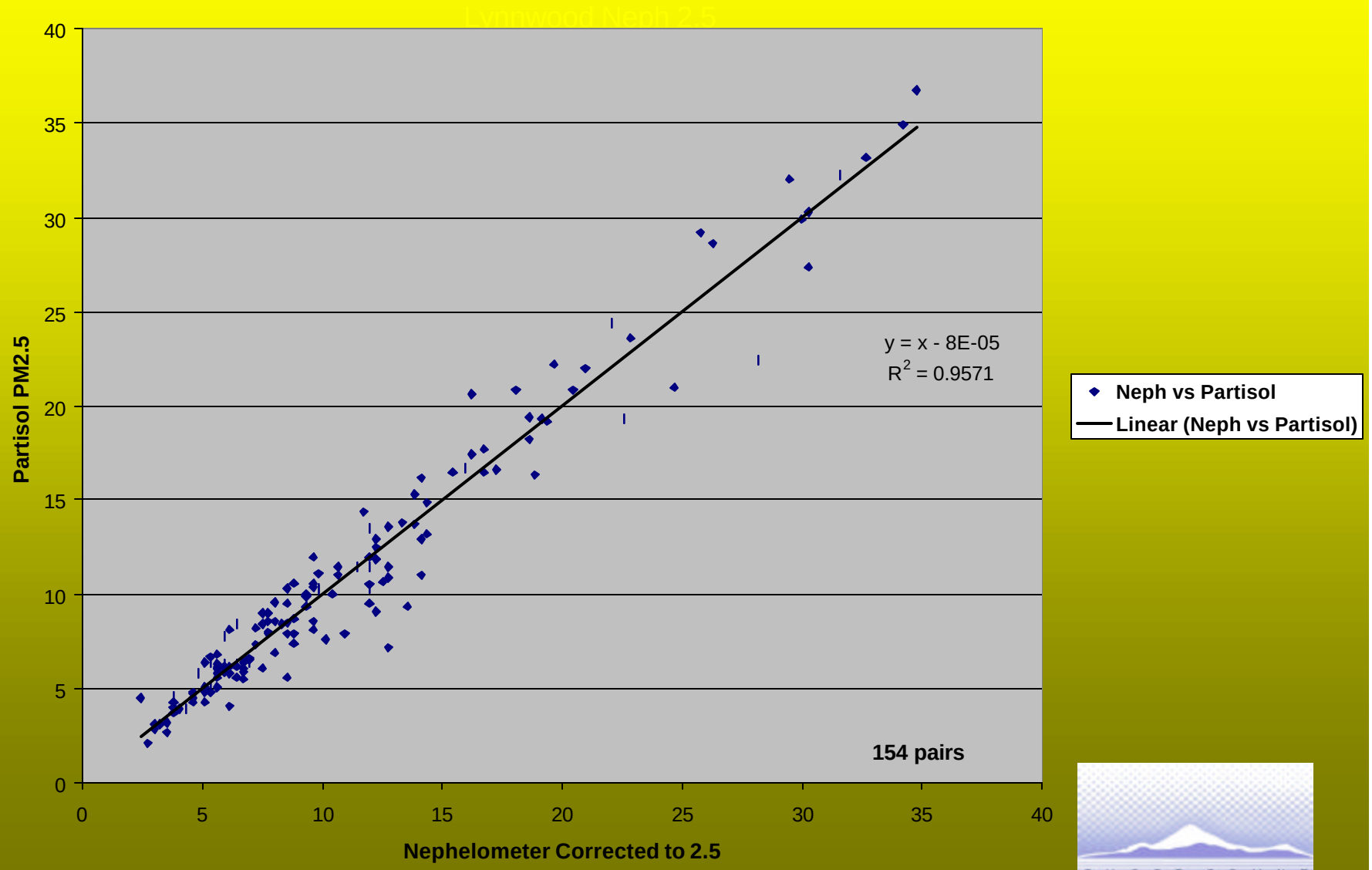
Puget Sound Clean Air Agency

Beacon Hill
Nephelometer vs Partisol Pm2.5



Clean Air Agency

Lynnwood
Neph vs Partisol
Nov 1999 - Jan 2001



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Lynnwood, Washington

- Located in South Snohomish County
- Residential/Light Industrial.
- May see impacts from I-5.

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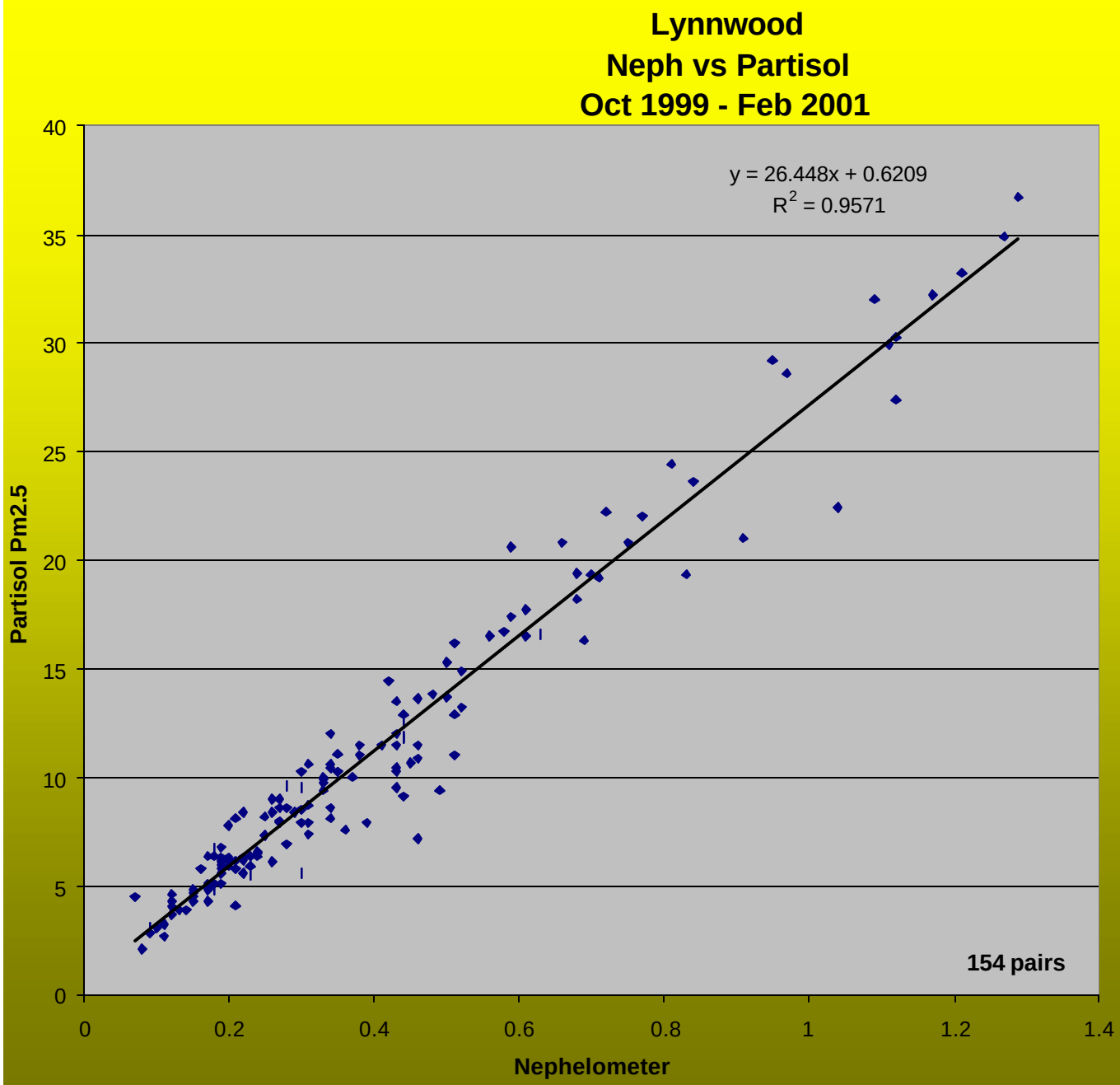
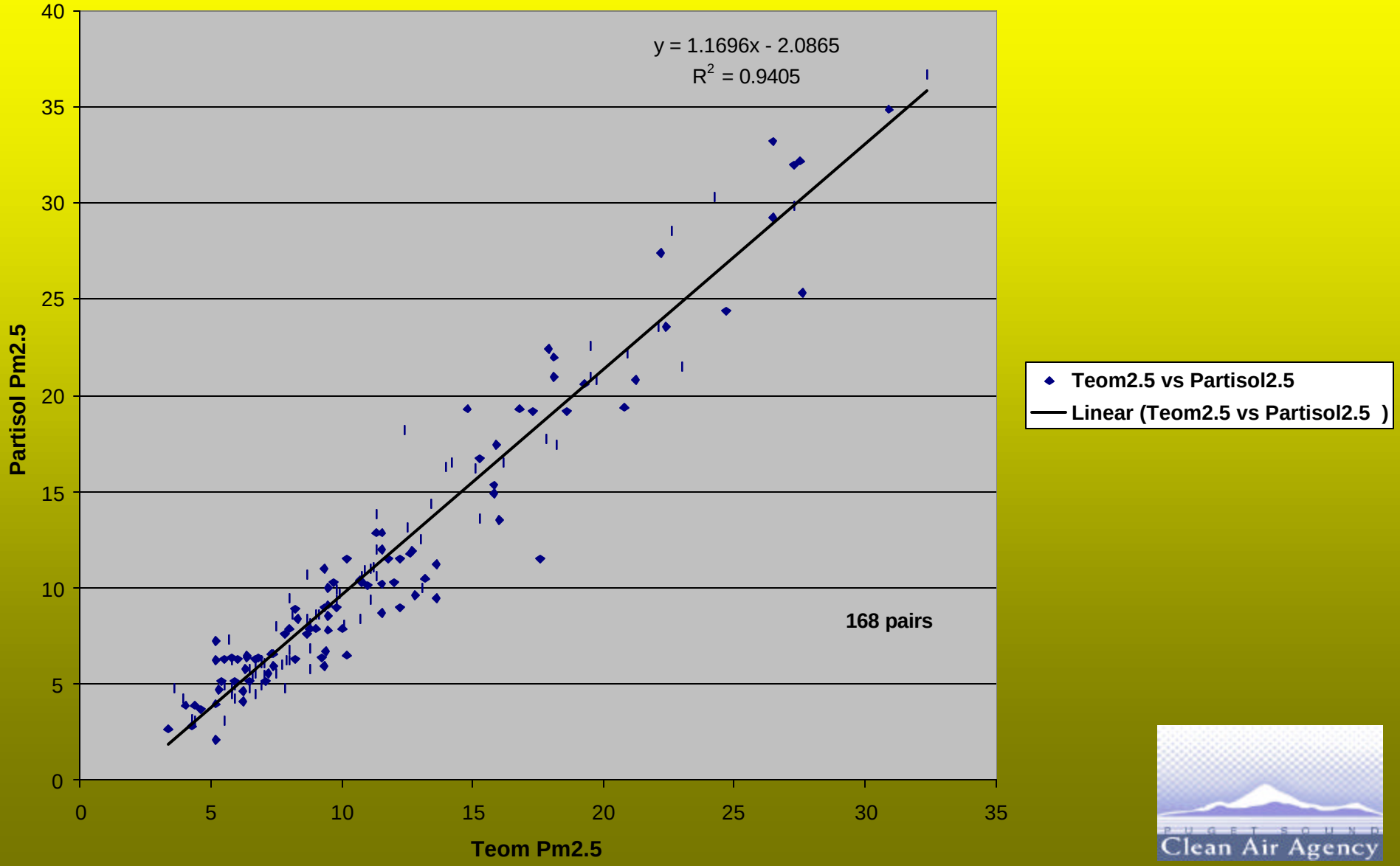


LYNNWOOD NEPH

Clean Air Agency

Lynnwood
Oct 1999 - Mar 2001
Teom Pm2.5 vs Partisol Pm2.5



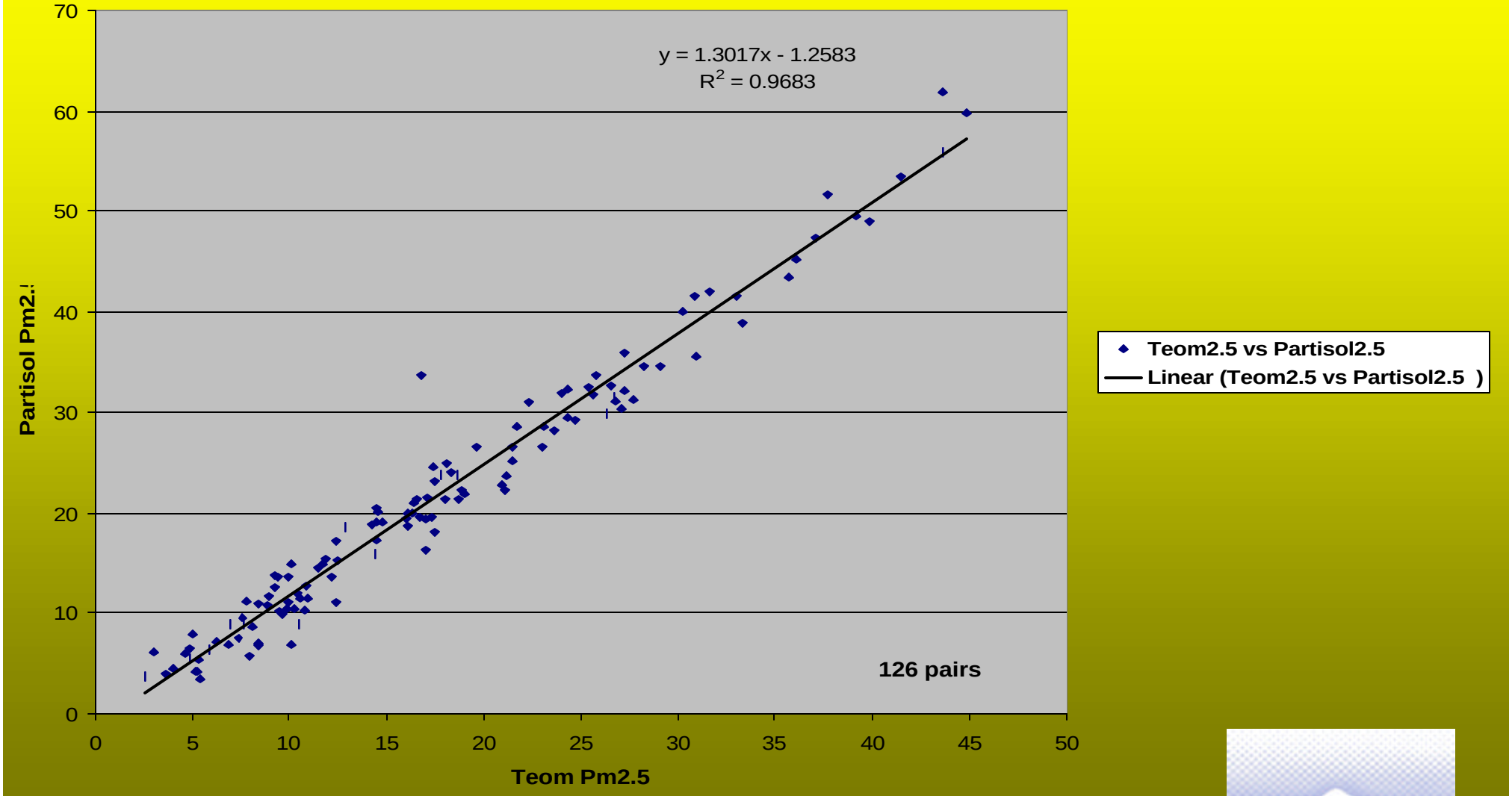
Clean Air Agency

South Tacoma,Washington

- Located on a community center in a residential area.
- Adjacent to schools.
- Environmental Justice.
- High Pm 2.5 Concentrations from wood smoke.

Puget Sound Clean Air Agency

Tacoma, South L Street
Nov 2000 - Mar 2001
Teom Pm2.5 vs Partisol Pm2.5



Clean Air Agency

Puyallup, Washington

- Located in Pierce County.
- Residential
- Wood smoke Impacts

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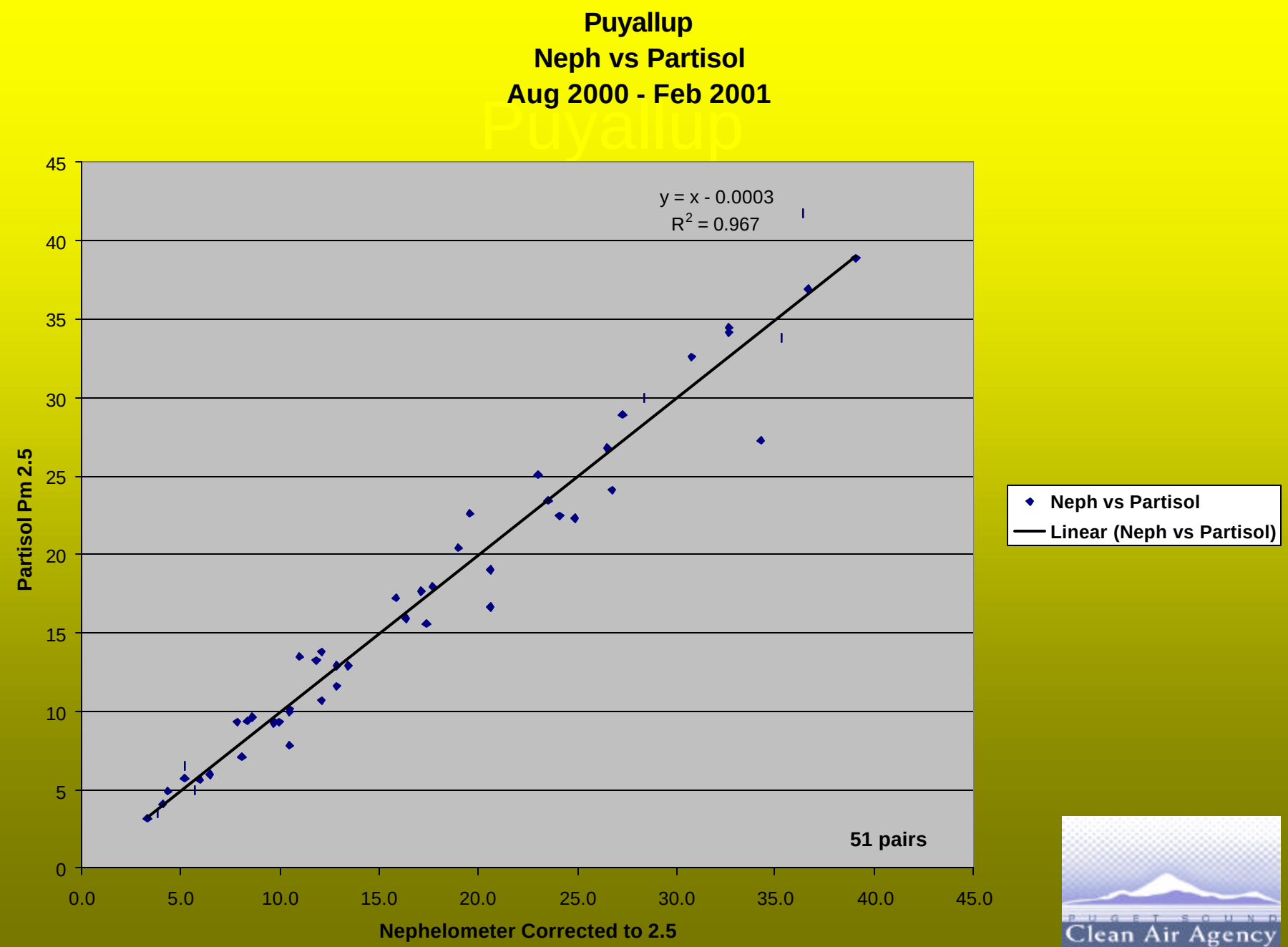
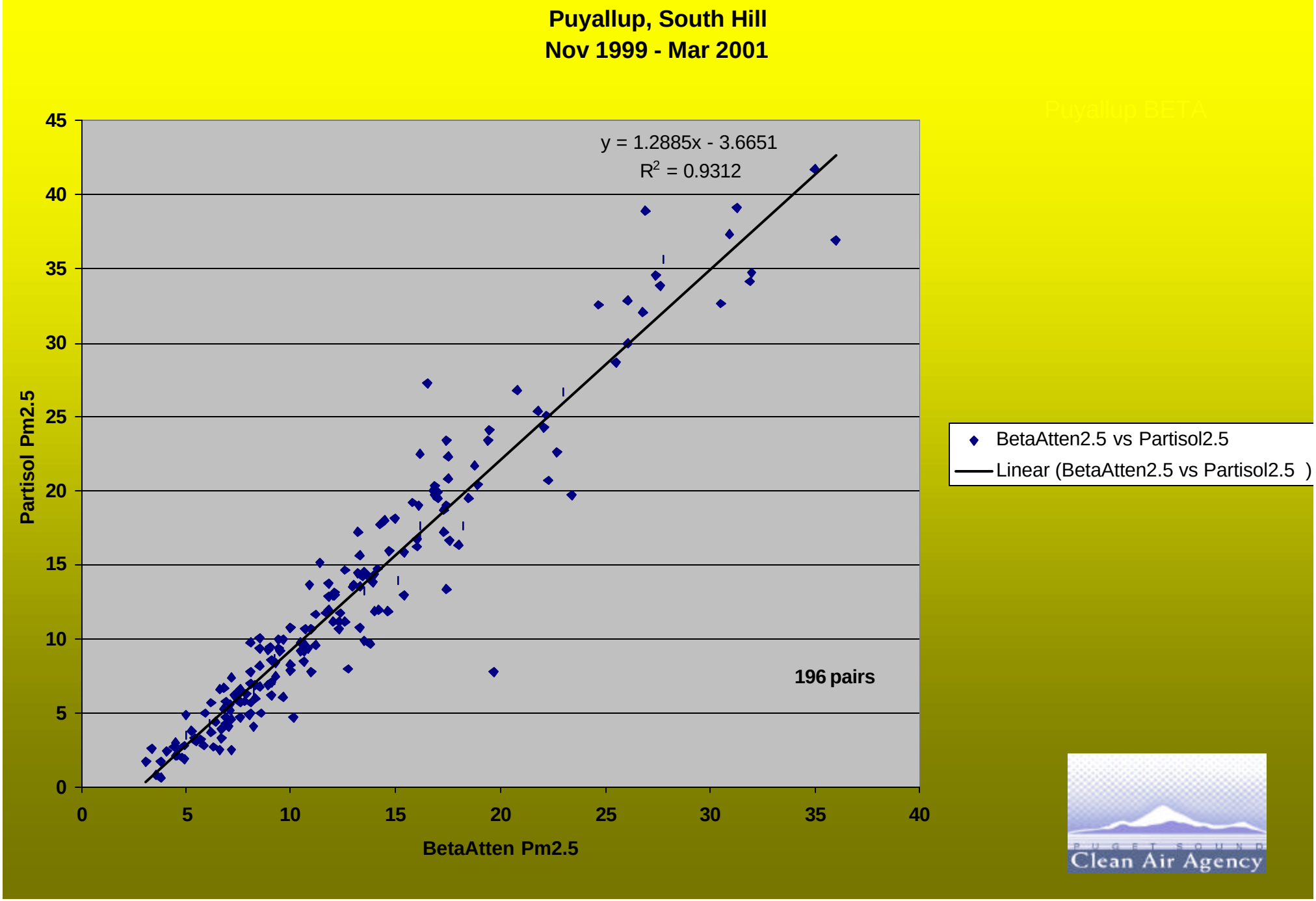

Puyallup
Neph vs Partisol
Aug 2000 - Feb 2001
Puyallup
y = x - 0.0003
R2 = 0.967
51 pairs
Partisol Pm 2.5
Nephelometer Corrected to 2.5
0
5
10
15
20
25
30
35
40
45
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Neph vs Partisol
Linear (Neph vs Partisol)
PUGET SOUND
Clean Air Agency


Puyallup, South Hill
Nov 1999 - Mar 2001
y = 1.2885x - 3.6651
R2 = 0.9312
196 pairs
Partisol Pm2.5
BetaAtten Pm2.5
0
5
10
15
20
25
30
35
40
45
BetaAtten2.5 vs Partisol2.5
Linear (BetaAtten2.5 vs Partisol2.5)
Puyallup BETA
Clean Air Agency