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Introduction

• Long-term: comparison of passive and FRM samplers for NO$_2$ in El Paso; published online 10/3/06 in journal *Environmental Monitoring and Assessment*.

• Short-term: comparison of passive, photolytic, and FRM samplers for NO, NO$_2$, NO$_x$ in El Paso and Houston; published 5/06 in *Journal of Environmental Monitoring*.
Many Thanks

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- TCEQ El Paso – Jon Williams, Joe Saenz, Kevin Smith
- City of Houston – Patricia Beltz
- EPA Region 6 – Dr. Doug Lipka, Rick McMillin, Dr. Melvin Ritter, Donna Ascenzi, John Lay, Nghia Nguyen
- EPA ORD – Dr. Jerry Varns and Jim Mulik
Long-term Study in El Paso

2002 NO$_2$ Annual Means in Parentheses
NO$_2$ PSD pole setup at the Ascarate Site
Two, three, and four week integrated sampling
Interlab [NO2] Comparison

[NO2] ppb

sample

utep1 skyline1 santa teresa1 ascarate1 desert view1 socorro1

RTP Houston lab Cont. mon.
NO2 method comparison in El Paso Area

\[ y = 0.8622x + 1.7139 \]

\[ R^2 = 0.9458 \]

- passive data (ppb)
- continuous data (ppb)
Annual NO$_2$ Standard Comparisons

- Skyline 2-week: 9 ppb for psd and frm
- Ascarate 3-week: 18 ppb for psd and frm
- Socorro 4-week: 13 ppb for psd and frm
- UTEP 2-week: 18 ppb for psd, 17 ppb for frm
- Santa Teresa 3-week: 3 ppb for psd, 4 ppb for frm
- Desert View 4-week: 10 ppb for psd, 11 ppb for frm
# Potential Cost Savings for New Site (Using Contractor Laboratory)

<table>
<thead>
<tr>
<th>Sampling Duration</th>
<th>( \text{NO}_2 \text{ FRM Cost} )</th>
<th>( \text{NO}_2 \text{ PSD Cost} )</th>
<th>Cost Savings with ( \text{NO}_2 \text{ PSD} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>$69,000</td>
<td>$6,000</td>
<td>91%</td>
</tr>
<tr>
<td>5 years</td>
<td>$89,000</td>
<td>$30,000</td>
<td>66%</td>
</tr>
<tr>
<td>10 years</td>
<td>$137,000</td>
<td>$60,000</td>
<td>56%</td>
</tr>
</tbody>
</table>
### Potential Cost Savings for New Site (Using Local Laboratory)

<table>
<thead>
<tr>
<th>Sampling Duration</th>
<th>NO$_2$ FRM Cost</th>
<th>NO$_2$ PSD Cost</th>
<th>Cost Savings with NO$_2$ PSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>$69,000</td>
<td>$1,000</td>
<td>99%</td>
</tr>
<tr>
<td>5 years</td>
<td>$89,000</td>
<td>$5,000</td>
<td>94%</td>
</tr>
<tr>
<td>10 years</td>
<td>$137,000</td>
<td>$10,000</td>
<td>93%</td>
</tr>
</tbody>
</table>

Potential Cost Savings for using NO$_2$ PSD in place of continuous NO$_2$ box at existing site: Around 50%, assuming PSD annual cost of $1,000, and assuming annual outlays of $1,000 for gas cylinders/regulators/shipping/postage and $1,000 for air technician salary (2 hours/80 hours at $40,000/yr).
Opportunity with New National Monitoring Regulations

- No longer required minimum # of monitors for NO$_2$ outside of serious and above ozone nonattainment areas (PAMS areas) and NCore requirements.

- States/Locals/Tribes could site long-term NO$_2$ PSDs as SPM monitors as a cheaper alternative method for annual ambient NO$_2$ monitoring in attainment areas after satisfying NCore requirements.
Short-term Study in El Paso and Houston

El Paso: Jan. 18-Feb. 28, 2005

Houston: Nov. 1-Dec. 17, 2004
## Precision Results (24-hour Sampling)

<table>
<thead>
<tr>
<th>Site</th>
<th>Pollutant</th>
<th>Mean of the absolute difference between duplicates</th>
<th>Standard Deviation</th>
<th>% &lt; 4 ppb difference between duplicates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascarate</td>
<td>NO₂</td>
<td>1.6 ppb</td>
<td>2.2 ppb</td>
<td>91%</td>
</tr>
<tr>
<td>Clinton</td>
<td>NO₂</td>
<td>1.9 ppb</td>
<td>3.7 ppb</td>
<td>88%</td>
</tr>
<tr>
<td>Ascarate</td>
<td>NO</td>
<td>3.9 ppb</td>
<td>3.7 ppb</td>
<td>59%</td>
</tr>
<tr>
<td>Clinton</td>
<td>NO</td>
<td>8.5 ppb</td>
<td>17.1 ppb</td>
<td>54%</td>
</tr>
<tr>
<td>Ascarate</td>
<td>NOₓ</td>
<td>2.6 ppb</td>
<td>3.6 ppb</td>
<td>77%</td>
</tr>
<tr>
<td>Clinton</td>
<td>NOₓ</td>
<td>8.9 ppb</td>
<td>17.7 ppb</td>
<td>58%</td>
</tr>
</tbody>
</table>
## El Paso Correlations

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Sampling duration</th>
<th>pass/frm $r^2$</th>
<th>pass/photo $r^2$</th>
<th>frm/photo $r^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>96-hours</td>
<td>0.98</td>
<td>0.98</td>
<td>0.97</td>
</tr>
<tr>
<td>NO₂</td>
<td>96-hours</td>
<td>0.97</td>
<td>0.96</td>
<td>0.98</td>
</tr>
<tr>
<td>NO₃</td>
<td>96-hours</td>
<td>0.98</td>
<td>0.98</td>
<td>0.97</td>
</tr>
<tr>
<td>NO</td>
<td>24-hours</td>
<td>0.94</td>
<td>0.93</td>
<td>0.93</td>
</tr>
<tr>
<td>NO₂</td>
<td>24-hours</td>
<td>0.92</td>
<td>0.78</td>
<td>0.93</td>
</tr>
<tr>
<td>NO₃</td>
<td>24-hours</td>
<td>0.96</td>
<td>0.95</td>
<td>0.93</td>
</tr>
</tbody>
</table>
El Paso Ascarate Site
Passive/FRM/Photolytic NO/NO2/NOx Comparison
96-hour Samples (Mon. 10 AM - Fri. 10 AM LST); January-February, 2005

NO
pass=35 ppb, frm=43 ppb, photo=37 ppb

NO2
pass=28 ppb, frm=23 ppb, photo=25 ppb

NOx
pass=62 ppb, frm=65 ppb, photo=62 ppb
El Paso Ascarate Site
Passive/FRM/Photolytic NO/NO2/NOx Comparison
24-hour Samples (10 AM - 10 AM LST); January-February, 2005

NO
pass=29 ppb, frm=38 ppb, photo=34 ppb

NO2
pass=26 ppb, frm=22 ppb, photo=24 ppb

NOx
pass=56 ppb, frm=60 ppb, photo=58 ppb
### Houston Correlations

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Sampling duration</th>
<th>pass/frm $r^2$</th>
<th>pass/photo $r^2$</th>
<th>frm/photo $r^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>96-hours</td>
<td>0.91</td>
<td>0.91</td>
<td>0.996</td>
</tr>
<tr>
<td>NO₂</td>
<td>96-hours</td>
<td>0.50</td>
<td>0.36</td>
<td>0.35</td>
</tr>
<tr>
<td>NOₓ</td>
<td>96-hours</td>
<td>0.89</td>
<td>0.93</td>
<td>0.98</td>
</tr>
<tr>
<td>NO</td>
<td>24-hours</td>
<td>0.86</td>
<td>0.84</td>
<td>0.996</td>
</tr>
<tr>
<td>NO₂</td>
<td>24-hours</td>
<td>0.37</td>
<td>0.35</td>
<td>0.79</td>
</tr>
<tr>
<td>NOₓ</td>
<td>24-hours</td>
<td>0.89</td>
<td>0.89</td>
<td>0.99</td>
</tr>
</tbody>
</table>
Houston Clinton Site
Passive/FRM/Photolytic NO/NO2/NOx Comparison
96-hour Samples (Mon. 10 AM - Fri. 10 AM LST); November-December, 2004

NO
pass=25 ppb, frm=22 ppb, photo=22 ppb

NO2
pass=25 ppb, frm=16 ppb, photo=22 ppb

NOx
pass=50 ppb, frm=37 ppb, photo=44 ppb
Houston Clinton Site
Passive/FRM/Photolytic NO/NO2/NOx Comparison
24-hour Samples (10 AM - 10 AM LST); November-December, 2004

NO
pass=24 ppb, frm=21 ppb, photo=22 ppb

NO2
pass=25 ppb, frm=16 ppb, photo=22 ppb

NOx
pass=48 ppb, frm=37 ppb, photo=44 ppb
FRM/Photolytic NO$_x$ Comparison in El Paso

Mean NO$_x$ Diurnal Profiles
El Paso Ascarate Site
January 18 - February 28, 2005

![Graph showing diurnal profile of NO$_x$ concentrations with peak values at midday and troughs at night.]
Short-term NO/NO$_2$/NO$_x$ Study Conclusions

- Good agreement between all three monitor types for 96-hour and 24-hour sampling.
- Less costly large multi-site episodic saturation screening studies for NO/NO$_2$/NO$_x$ could be done using PSDs.