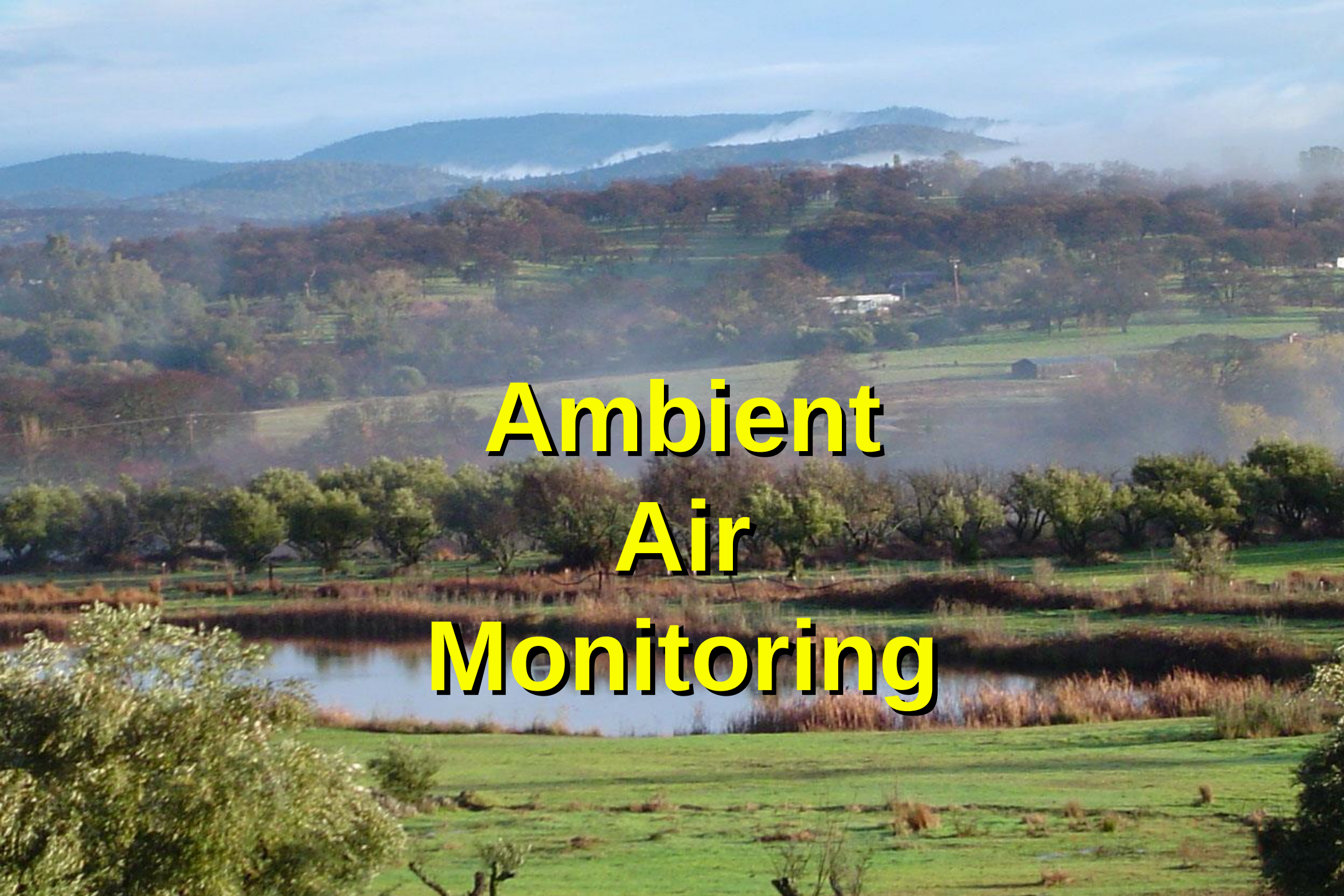
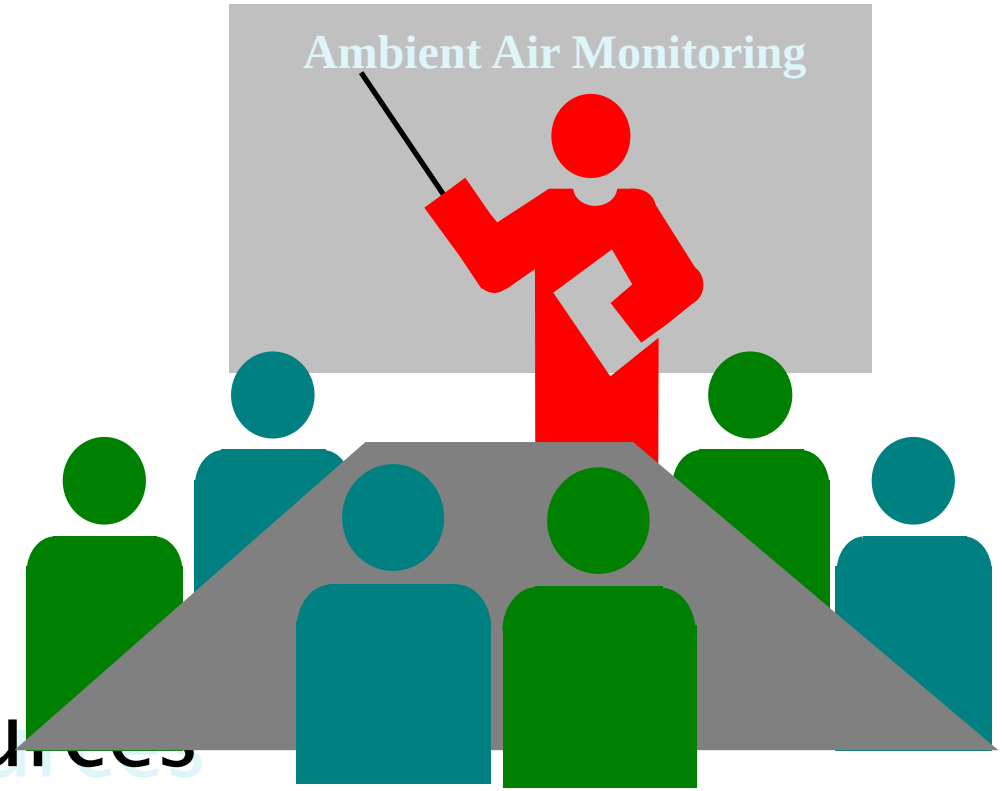

Ambient
Air
Monitoring

Course Overview

- Regulations and Standards
- Monitoring Networks
- Station Siting
- Instrumentation
- Documentation
- Data Handling
- Quality Assurance
- References and Resources




Standards and Regulations

EPA Responsibilities Under CAA

- National Ambient Air Quality Standards (NAAQS)
  - Identification
  - Attainment
- Toxic air pollutants
  - Identification
  - Control
- Acid Rain
- Pollution Index
- PSD

Monitoring

- Attainment
- Progress Toward Attainment
- Pollution Trends
- Emergency Control Procedures
- Database.

Regulations

- U.S. EPA
  - 40 CFR 50 – NAAQS
  - 40 CFR 53 – Methods
  - 40 CFR 58 – Monitoring criteria
  - 40 CFR 51.24 – PSD
- State and Local Regs

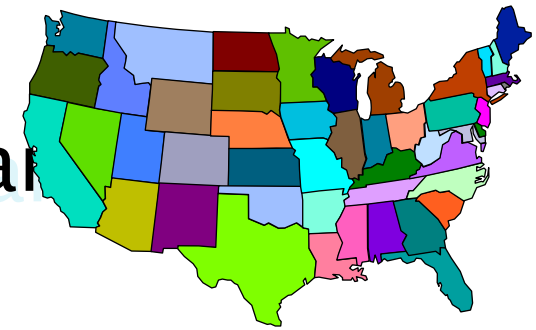
Monitoring Networks

SLAMS -- State and Local Air Monitoring Station

NAMS -- National Air Monitoring Station

PAMS -- Photochemical Assessment Monitoring Station

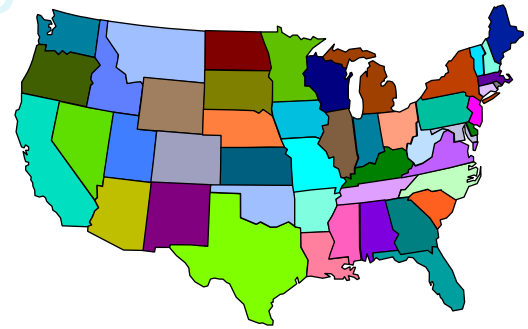
NCore—National Core Multipollutant Network



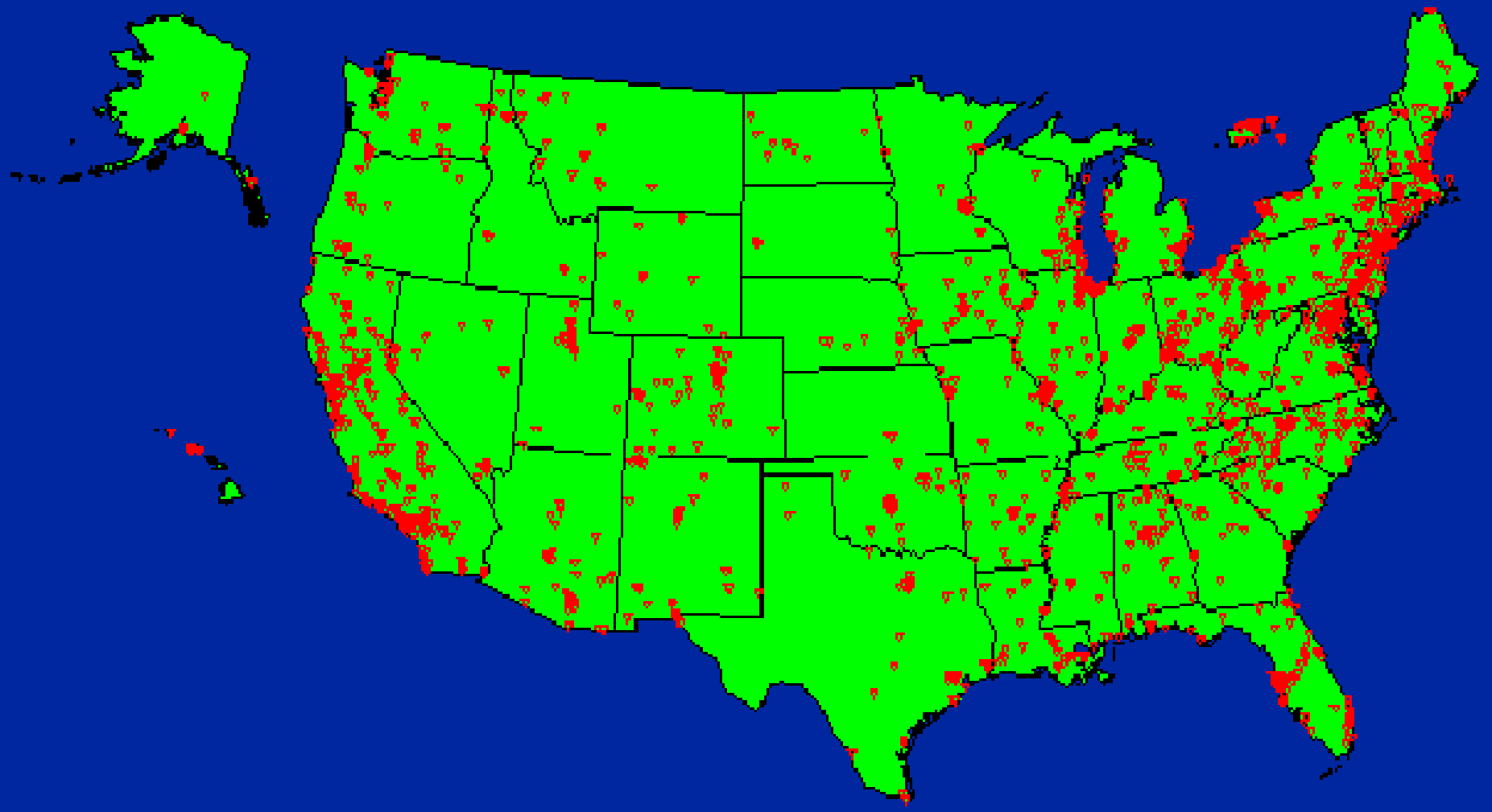
Monitoring Networks

- PSD -- Prevention of Significant Deterioration
- SPM -- Special Purpose Monitoring
- IMPROVE -- Interagency Monitoring of Protected Visual Environments

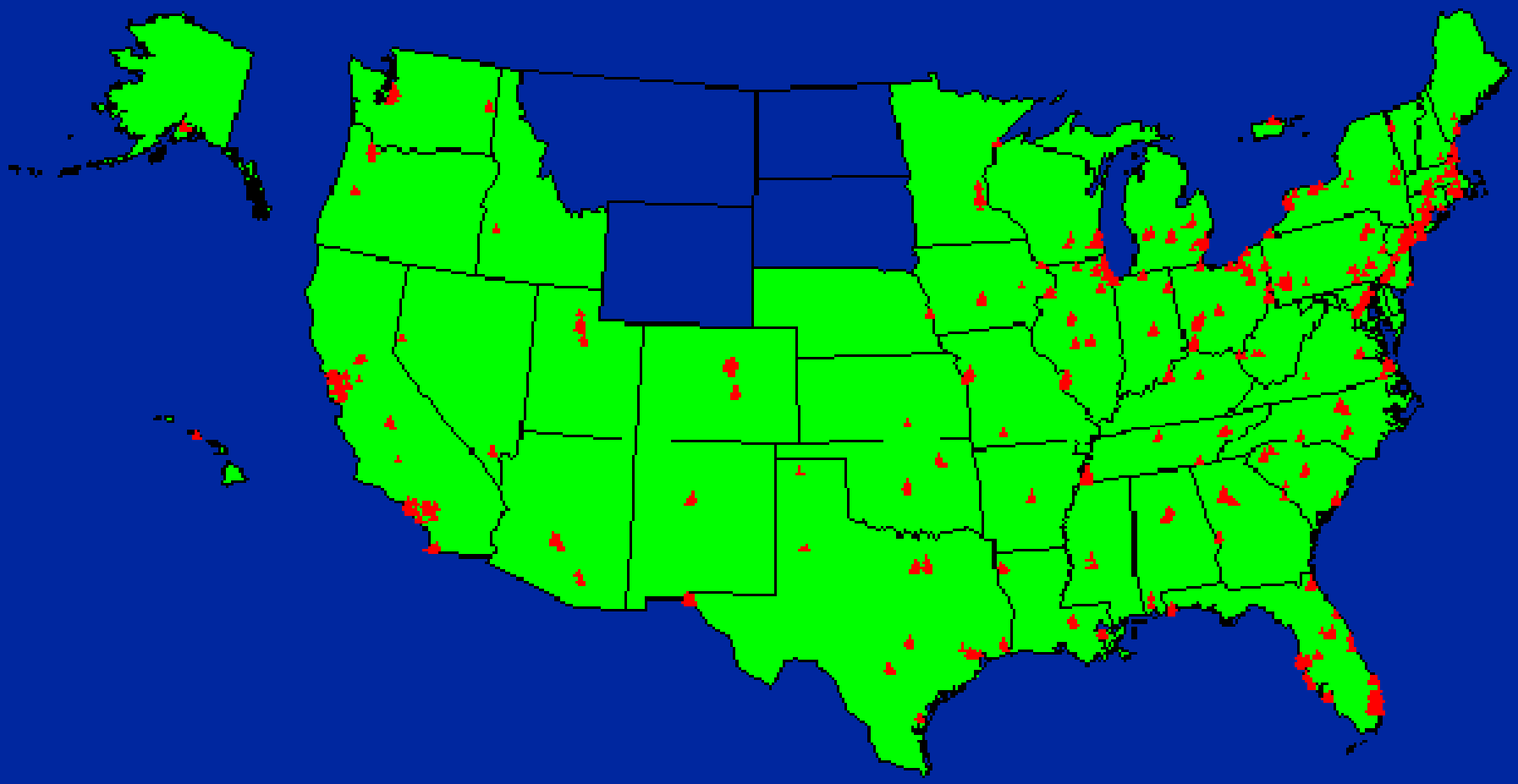
Acid Rain Network



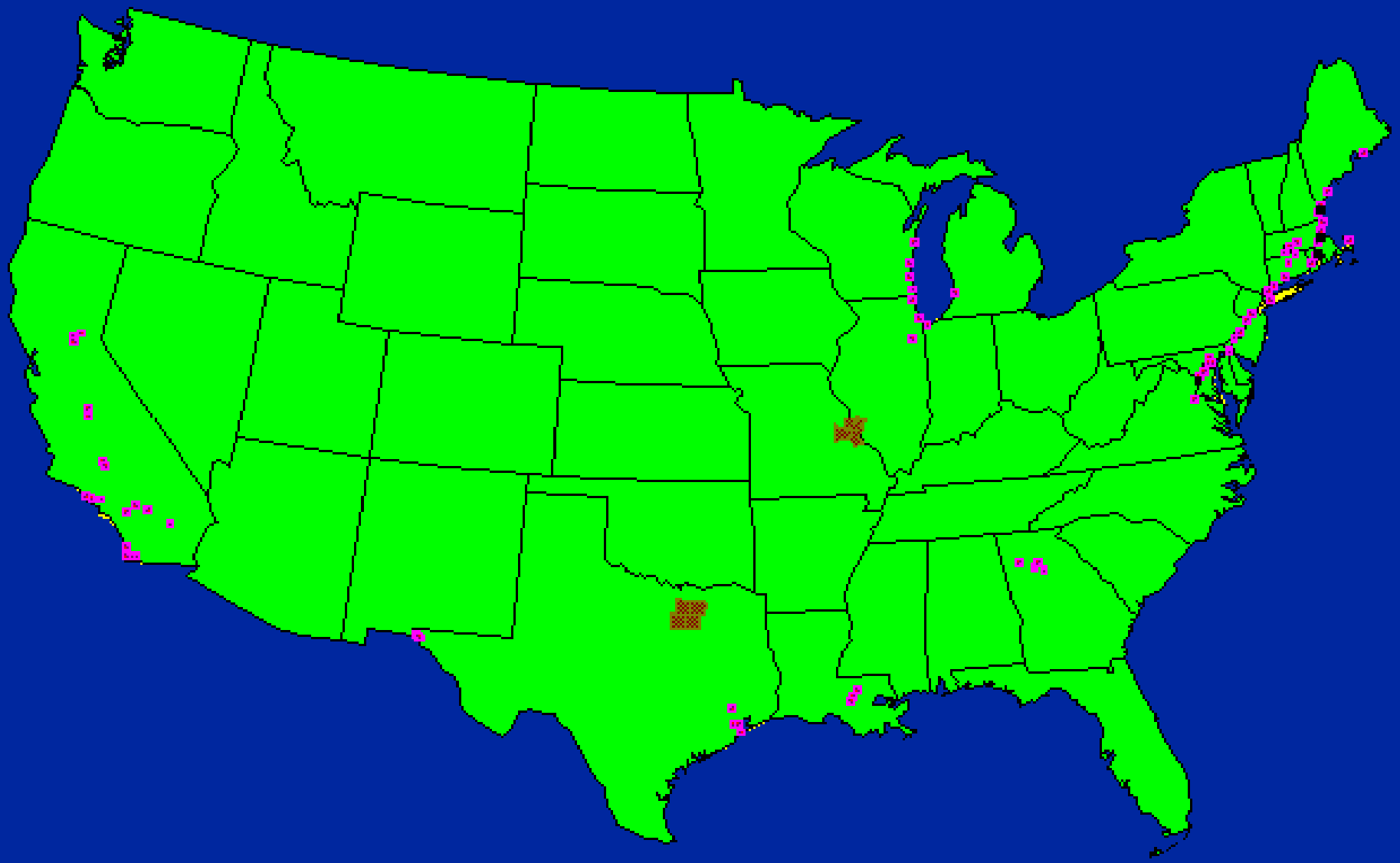
State and Local Monitoring (SLAMS) Network

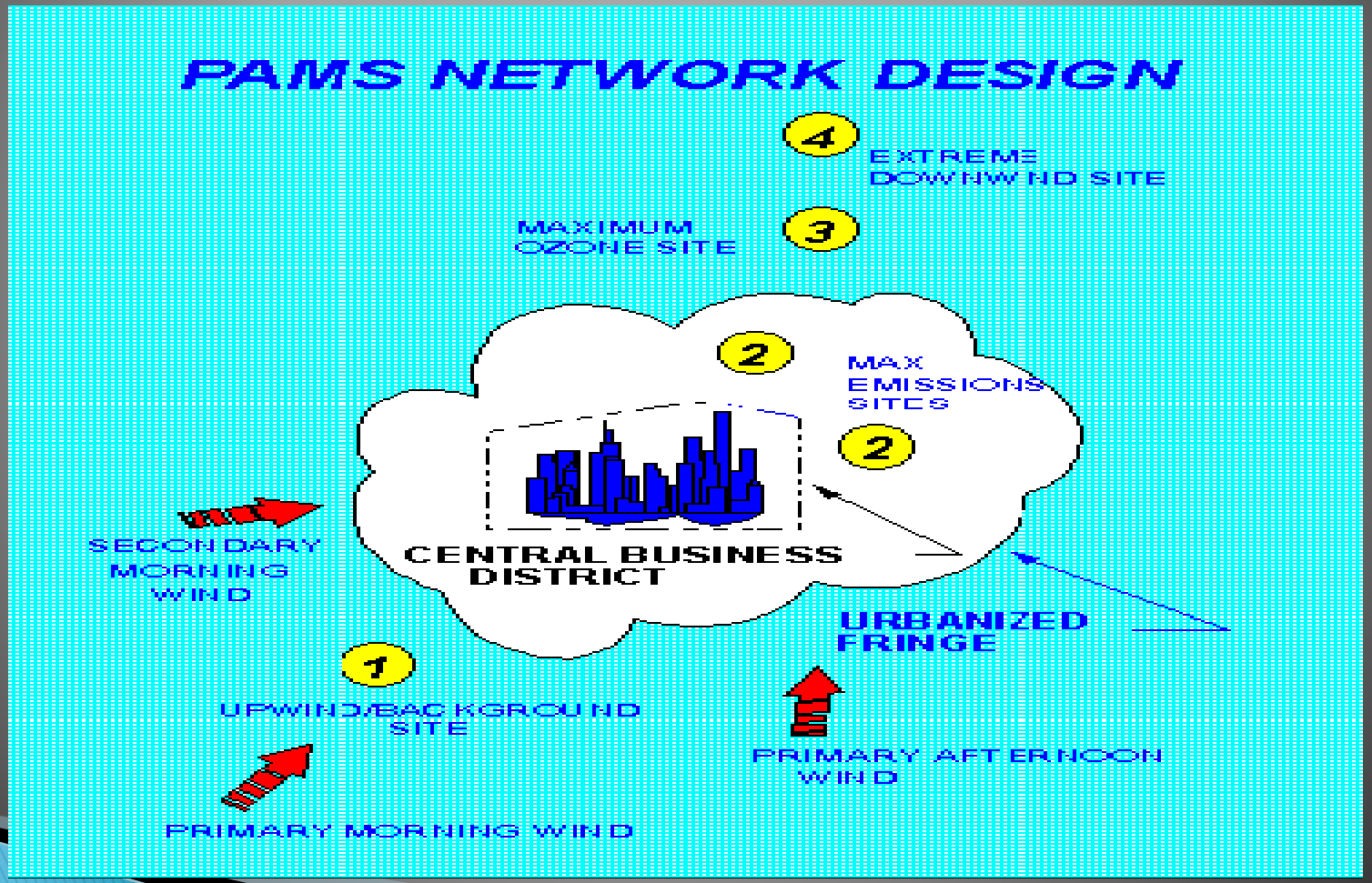


National Air Monitoring (NAMS) Network

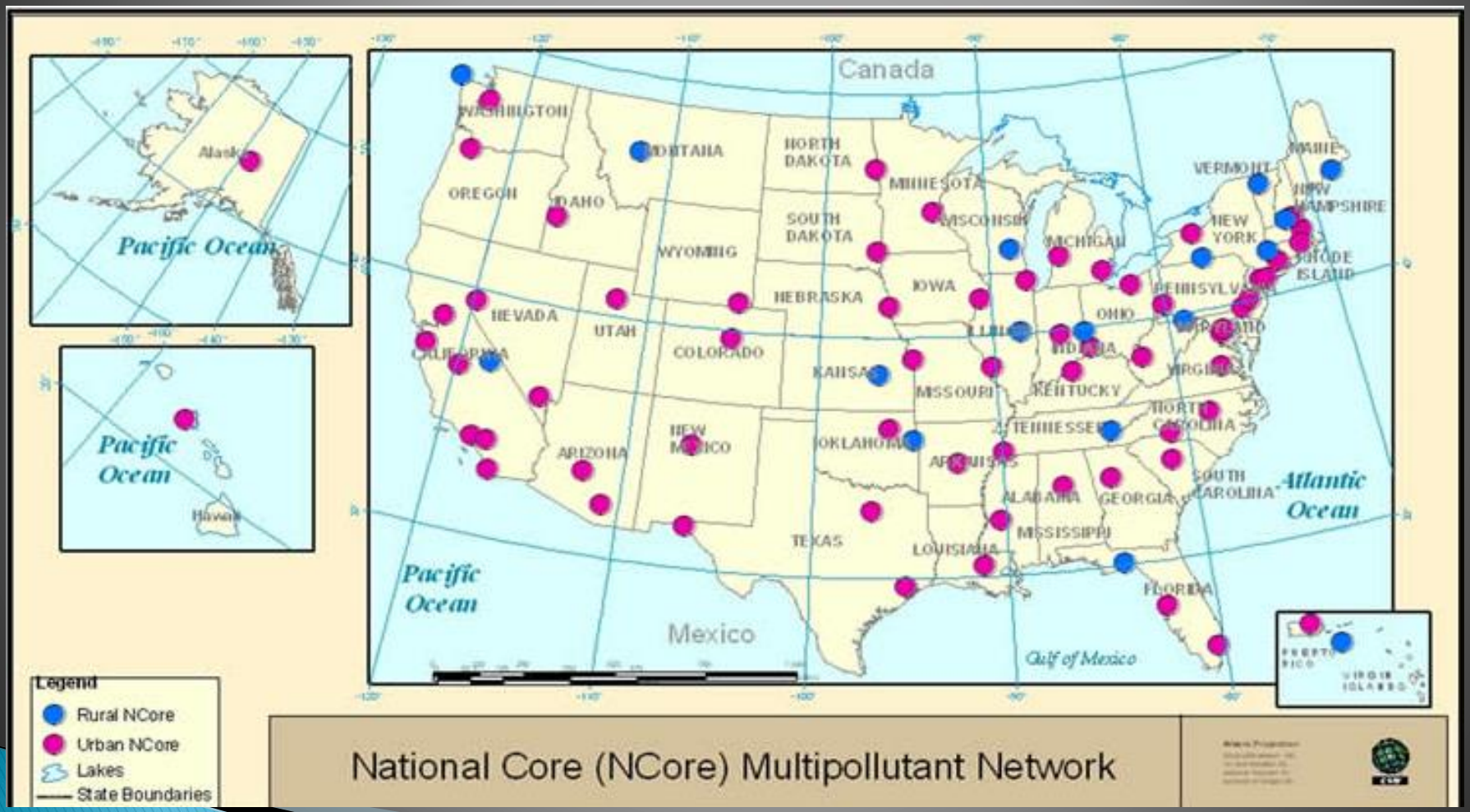


Photochemical Assessment Monitoring (PAMS) Network




PAMS NETWORK DESIGN
4
EXTREME DOWNWIND SITE
MAXIMUM OZONE SITE
3
2
MAX EMISSIONS SITES
2
SECONDARY MORNING WIND
CENTRAL BUSINESS DISTRICT
URBANIZED FRINGE
1
UPWIND/BACKGROUND SITE
PRIMARY AFTERNOON WIND
PRIMARY MORNING WIND

NCore Network



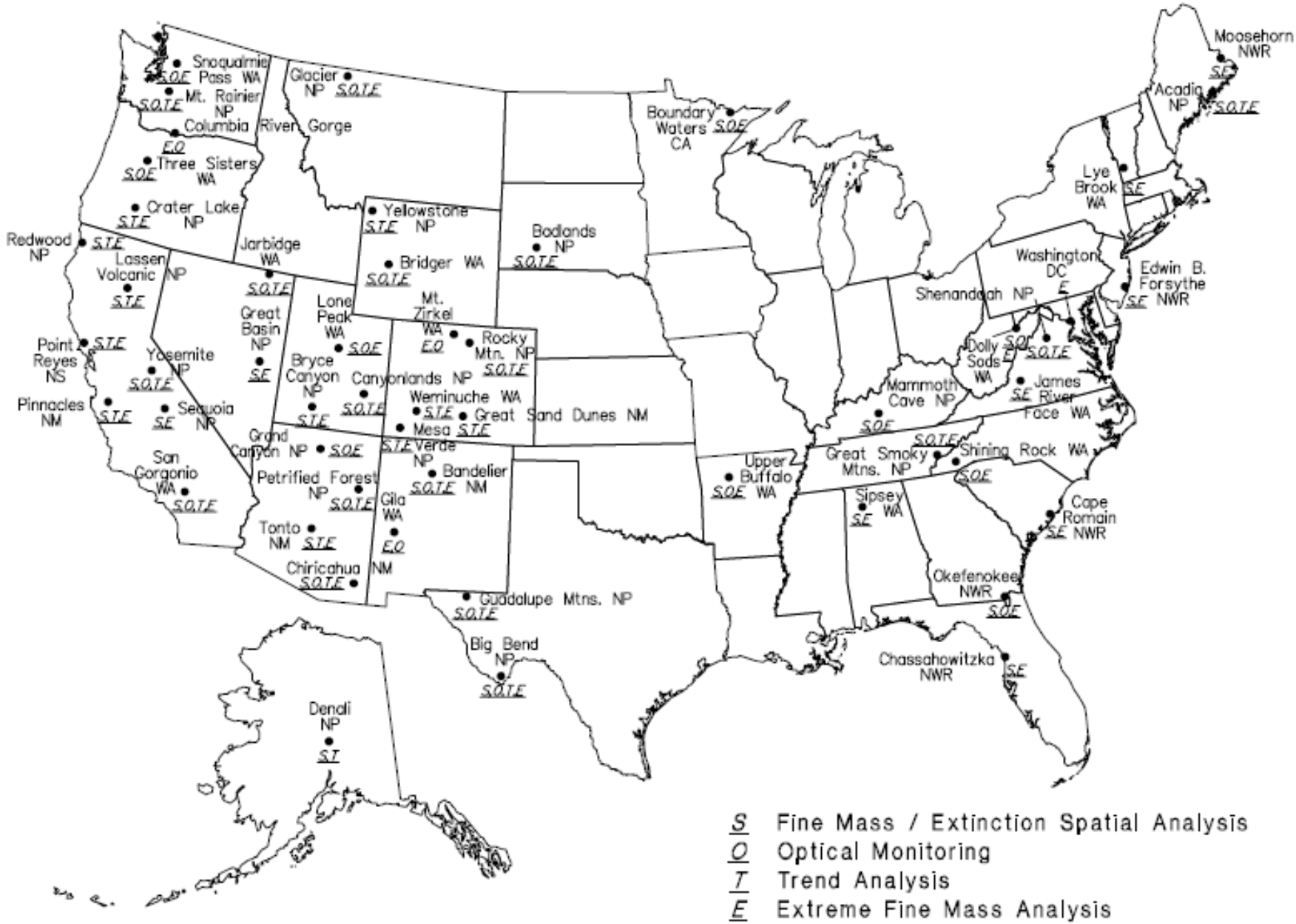
NCore Objectives

- Timely reporting of air quality data to public
- Support for development of emission strategies
- Long-term tracking of emission strategies
- Long-term health assessment for NAAQS reviews
- Establish Attainment/Nonattainment areas
- Support for scientific studies in technical, health & atmospheric disciplines
- Support to ecosystem assessment

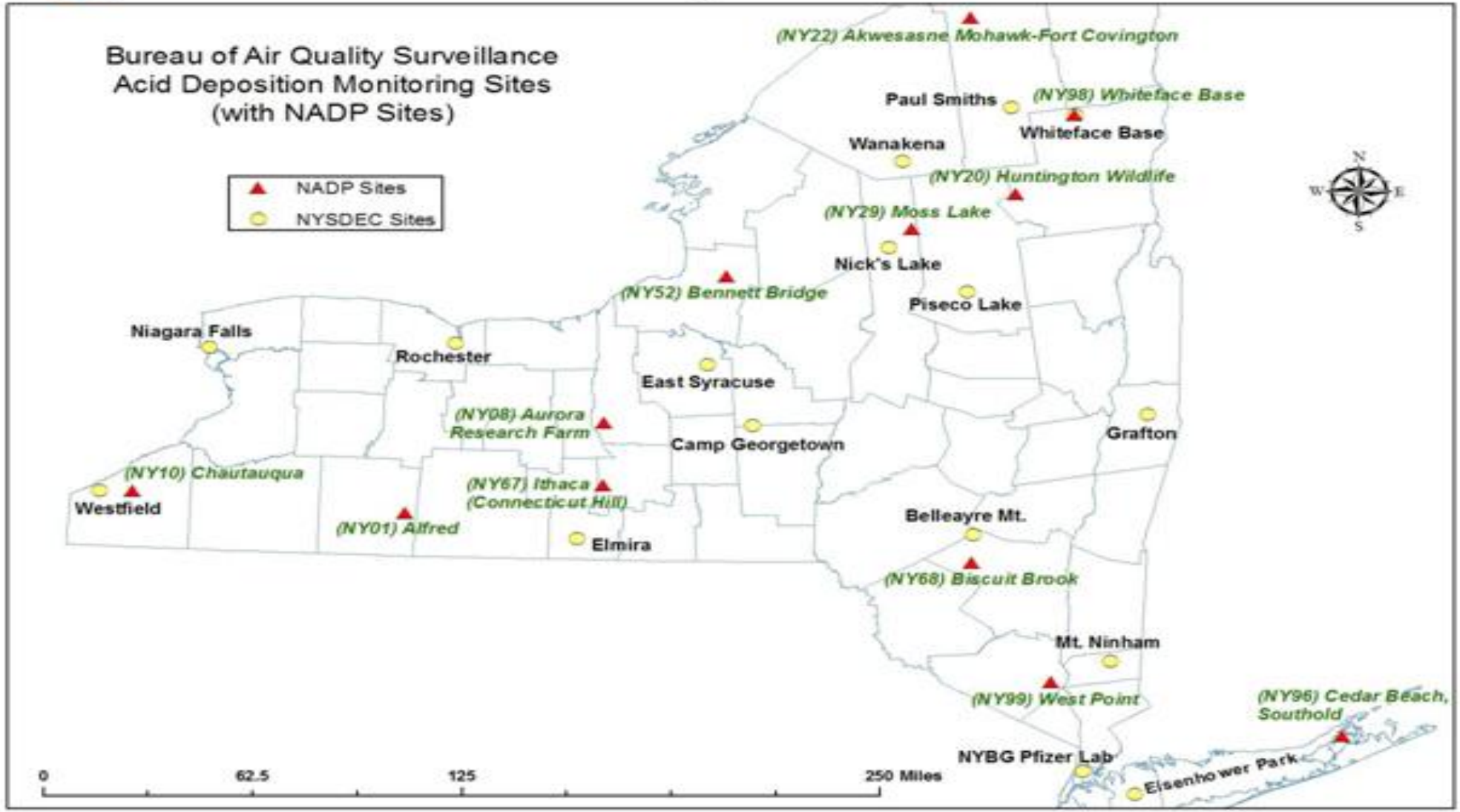
NCore pollutants

Parameter	Comments
PM2.5 speciation	Organic and elemental carbon, major ions and trace metals (24 hour average; every 3rd day); IMPROVE or CSN
PM2.5 FRM mass	24 hr. average at least every 3rd day
continuous PM2.5 mass	1 hour reporting interval; FEM or pre-FEM monitors
PM(10-2.5) mass	Filter-based or continuous
ozone (O3)	all gases through continuous monitors
carbon monoxide (CO)	capable of trace levels (low ppm and below) where needed
sulfur dioxide (SO2)	capable of trace levels (low ppb and below) where needed
nitrogen oxide (NO)	capable of trace levels (low ppb and below) where needed
total reactive nitrogen (NOy)	capable of trace levels (low ppb and below) where needed
surface meteorology	wind speed and direction (reported as "Resultant"), temperature, RH

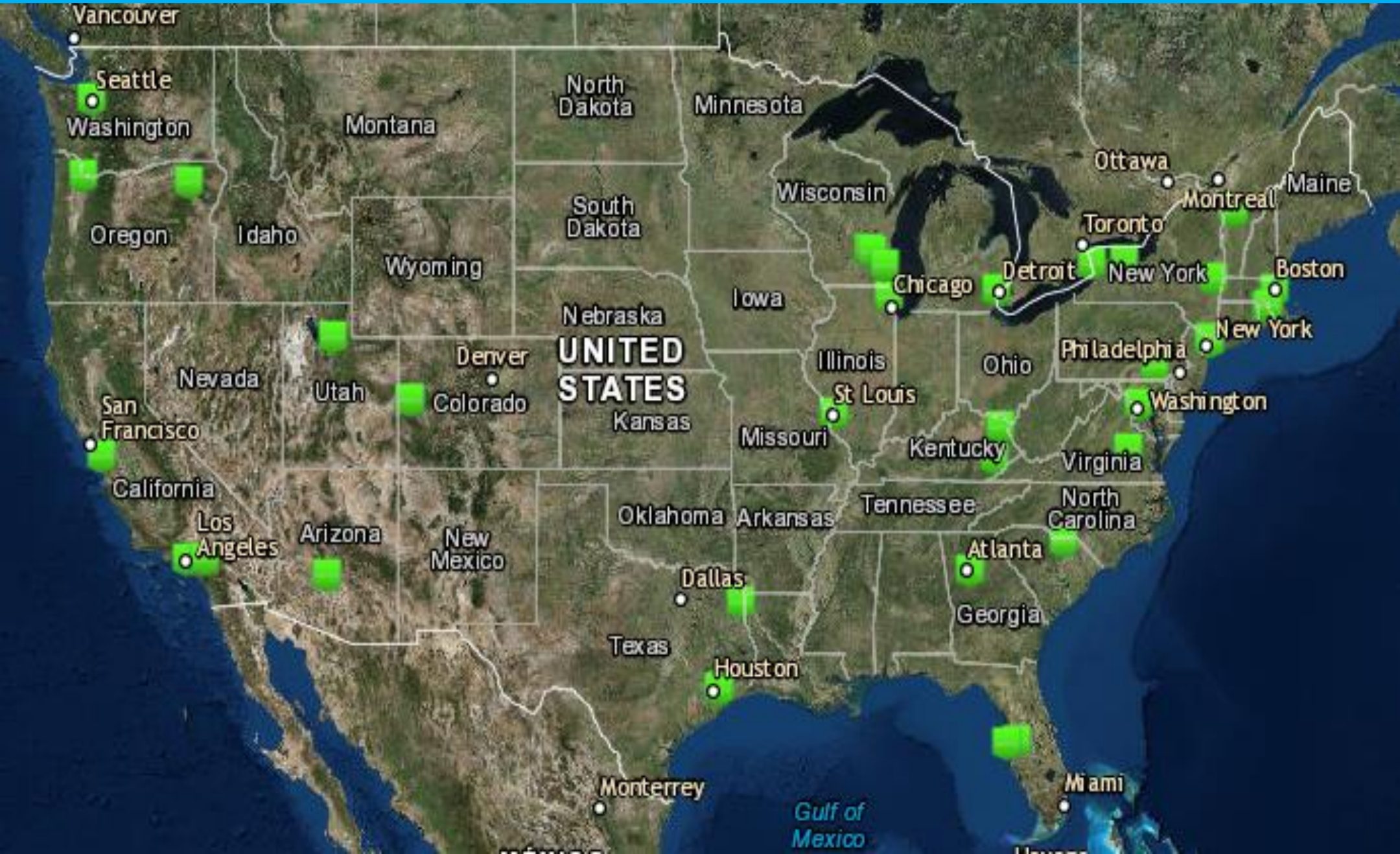
IMPROVE Sites



New York State Dept of Environmental Conservation
2012 Ambient Air Monitoring Network



Current NATTS monitors



Criteria Pollutants

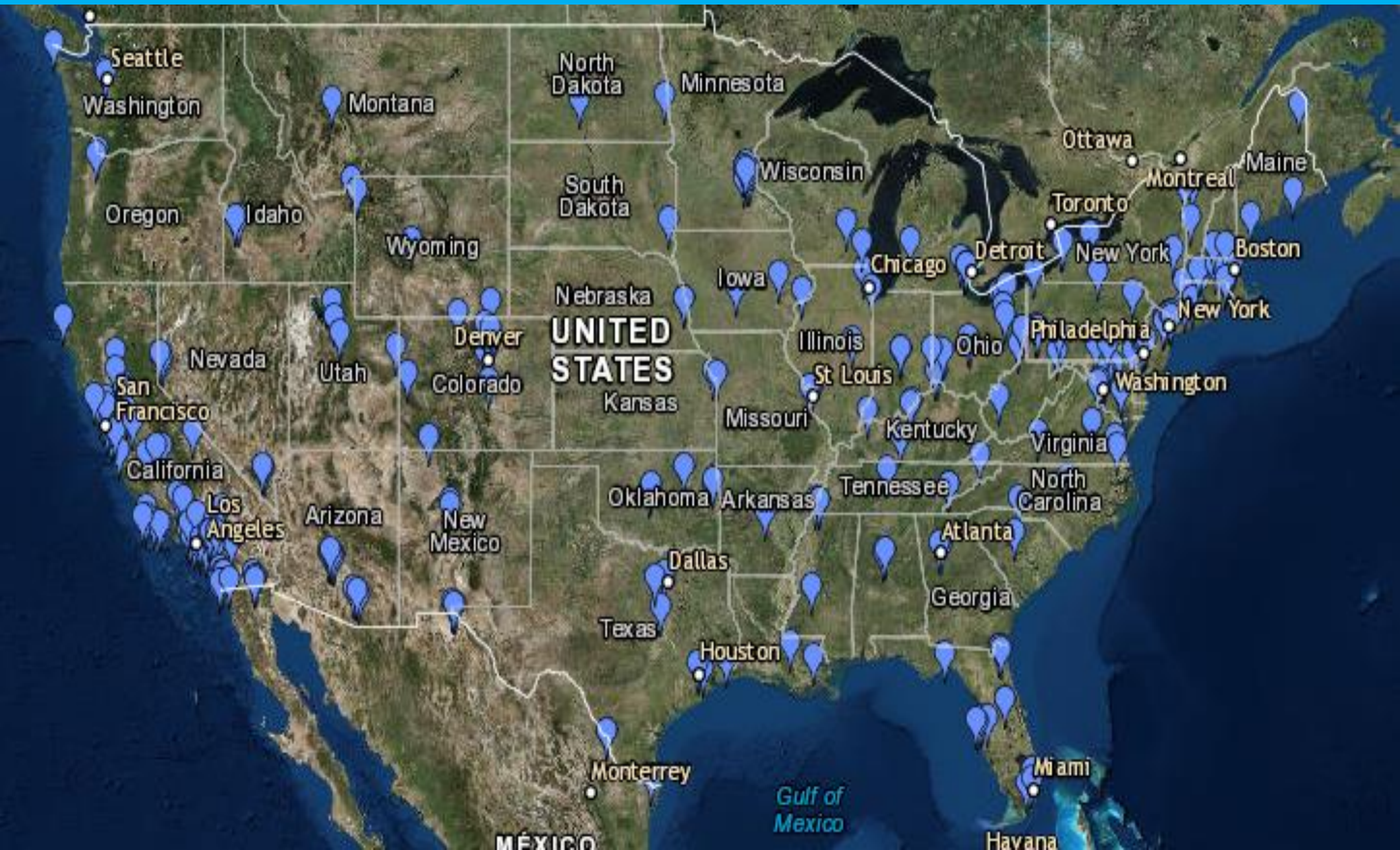
CURRENT NAAQS

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 µg/m^3 (1)	Not to be exceeded
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb (2)	Annual Mean
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 µg/m^3	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m^3	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

Carbon Monoxide(CO) Standards–Table of Historical CO NAAQS

Final Rule/Decision	Primary/ Secondary	Indicator	Averaging Time	Level [2]	Form
1971 36 FR 8186 Apr 30, 1971	Primary and Secondary	CO [1]	1–hour period	35 ppm	Maximum, not to be exceeded more than once in a year
			8–hour period	9 ppm	Maximum, not to be exceeded more than once in a year [3]
1985 50 FR 37484 Sept 13, 1985	Primary standards retained, without revision; secondary standards revoked.				
1994 59 FR 38906 Aug 1, 1994	Primary standards retained, without revision.				
2011 76 FR 54294 Aug 31, 2011	Primary standards retained, without revision.				

Current CO monitors



Nitrogen Dioxide (NO_2) Standards– Table of Historical NO_2 NAAQS

Final Rule/Decision	Primary/ Secondary	Indicator [1]	Averaging Time	Level [2]	Form
1971 36 FR 8186 Apr 30, 1971	Primary and Secondary	NO_2	Annual	53 ppb [3]	Annual arithmetic average
1985 50 FR 25532 Jun 19, 1985	Primary and secondary NO_2 standards retained, without revision.				
1996 61 FR 52852 Oct 8, 1996	Primary and secondary NO_2 standards retained, without revision.				
2010 75 FR 6474 Feb 9, 2010 [4]	Primary	NO_2	1-hour	100 ppb	98th percentile, averaged over 3 years [5]
		Primary annual NO_2 standard retained, without revision.			

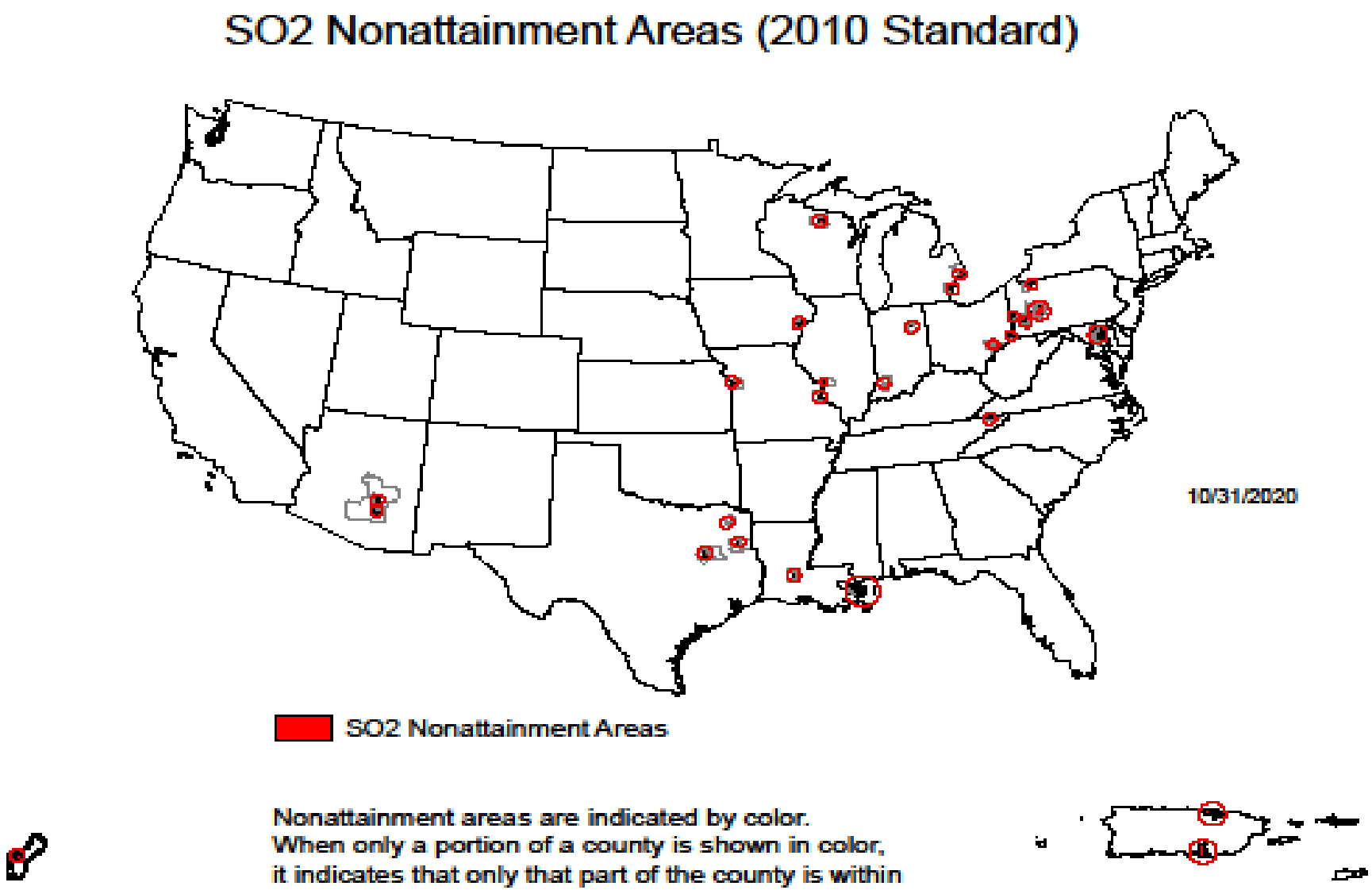
Current NO_2 monitors

Oxides of Sulfur (SO2) Standards–Table of Historical SO2 NAAQS

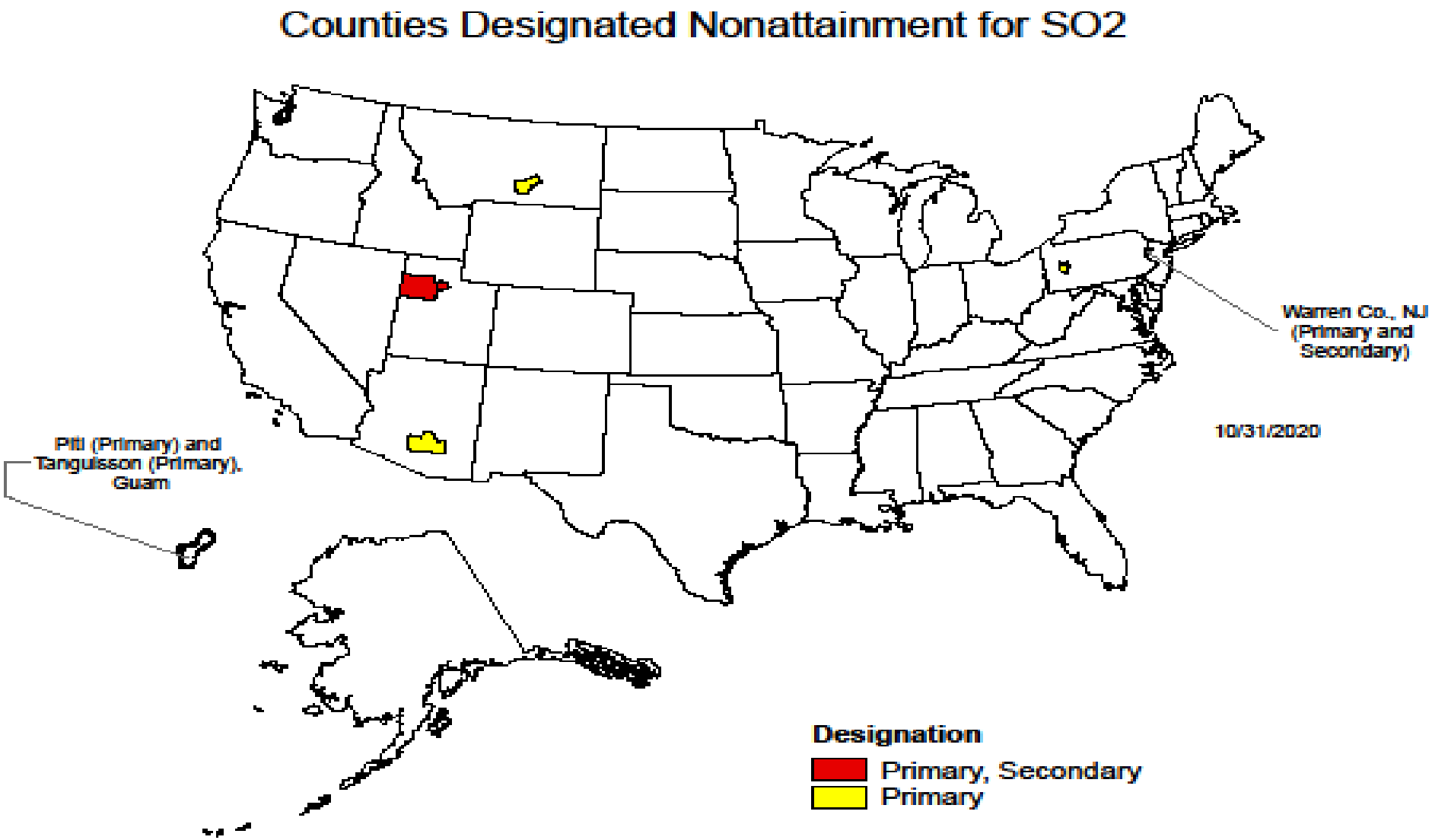
Final Rule/Decision	Primary/ Secondary	Indicator [1]	Averaging Time	Level [2]	Form
1971 36 FR 8186 Apr 30, 1971	Primary	SO_2	24–Hour	0.14 ppm	Not to be exceeded more than once per year
			Annual	0.03 ppm	Annual arithmetic average
	Secondary		3–Hour	0.5 ppm	Not to be exceeded more than once per year
			Annual [3]	0.02 ppm	Annual arithmetic average
1973 38 FR 25678 Sept 14, 1973	Secondary	Secondary 3–hour SO_2 standard retained, without revision; secondary annual SO_2 standard revoked.			
1996 61 FR 25566 May 22, 1996	Primary	Existing primary SO_2 standards retained, without revision.			
2010 75 FR 35520 Jun 22, 2010 [4]	Primary	SO_2	1–hour	75 ppb	99th percentile, averaged over 3 years [5]
		Primary annual and 24–hour SO_2 standards revoked.			

Current SO_2 monitors

SO_2 Nonattainment areas



SO_2 Nonattainment areas

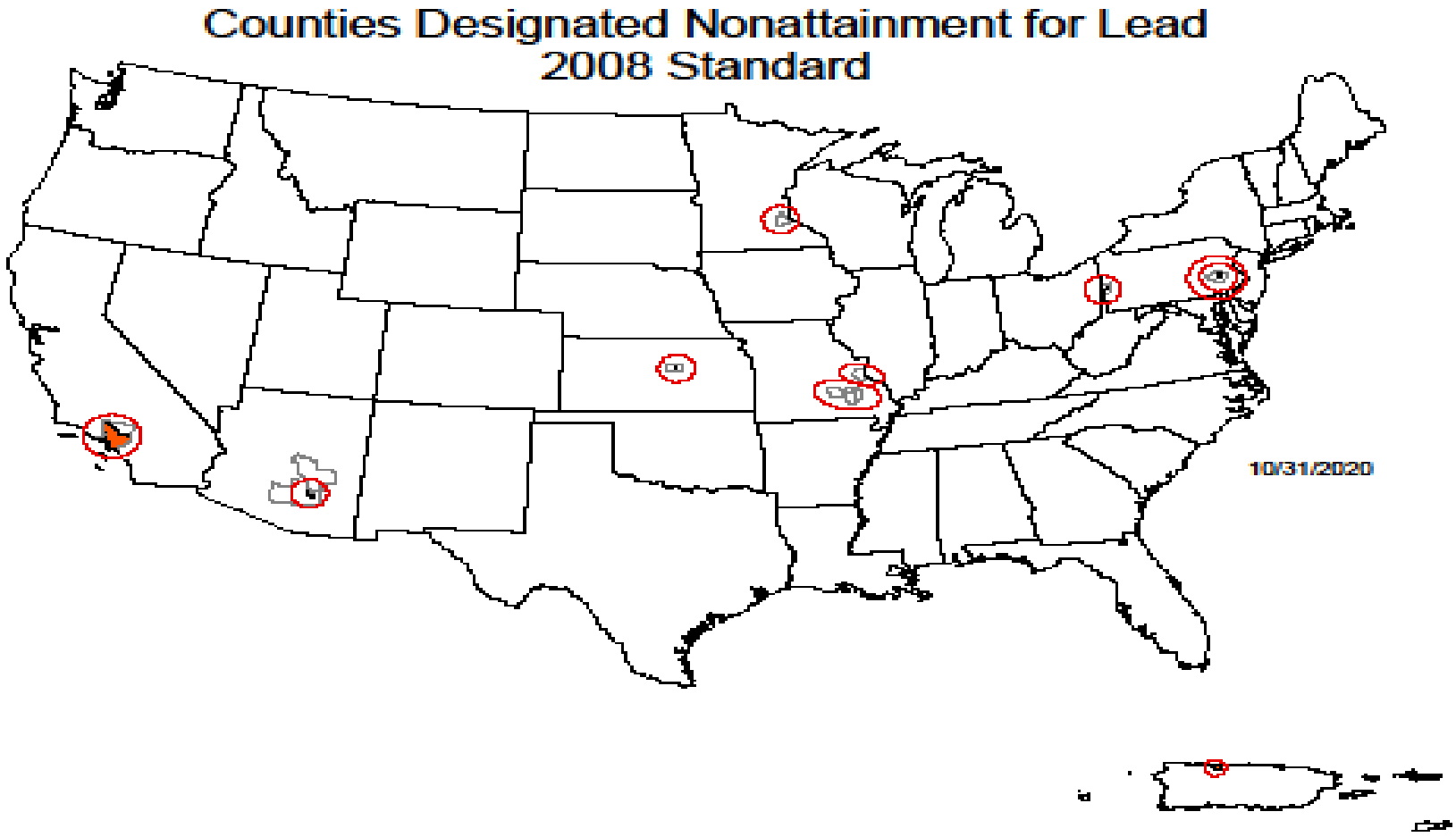


Lead (Pb) Standards– Table of Historical Pb NAAQS

Final Rule/Decision	Primary/ Secondary	Indicator	Averaging Time	Level [1]	Form
1978 43 FR 46246 Oct 5, 1978	Primary and Secondary	Pb–TSP [2]	Calendar Quarter	1.5 μg/m^3	Not to be exceeded
Feb 21, 1991 – Agency released multimedia "Strategy for Reducing Lead Exposures" [3]					
2008 73 FR 66964 Nov 12, 2008	Primary and Secondary	Pb–TSP	3–month period	0.15 μg/m^3	Not to be exceeded

Current Lead monitors

Lead Nonattainment areas



The portions of a county designated nonattainment are indicated by color on this national map. The counties with nonattainment areas are circled. The double circles indicate that there are two nonattainment areas within the same county. The State maps provide details of the smaller nonattainment areas within the county boundaries.

UNITED STATES FACILITIES WITH LEAD EMISSIONS GE 5 TPY

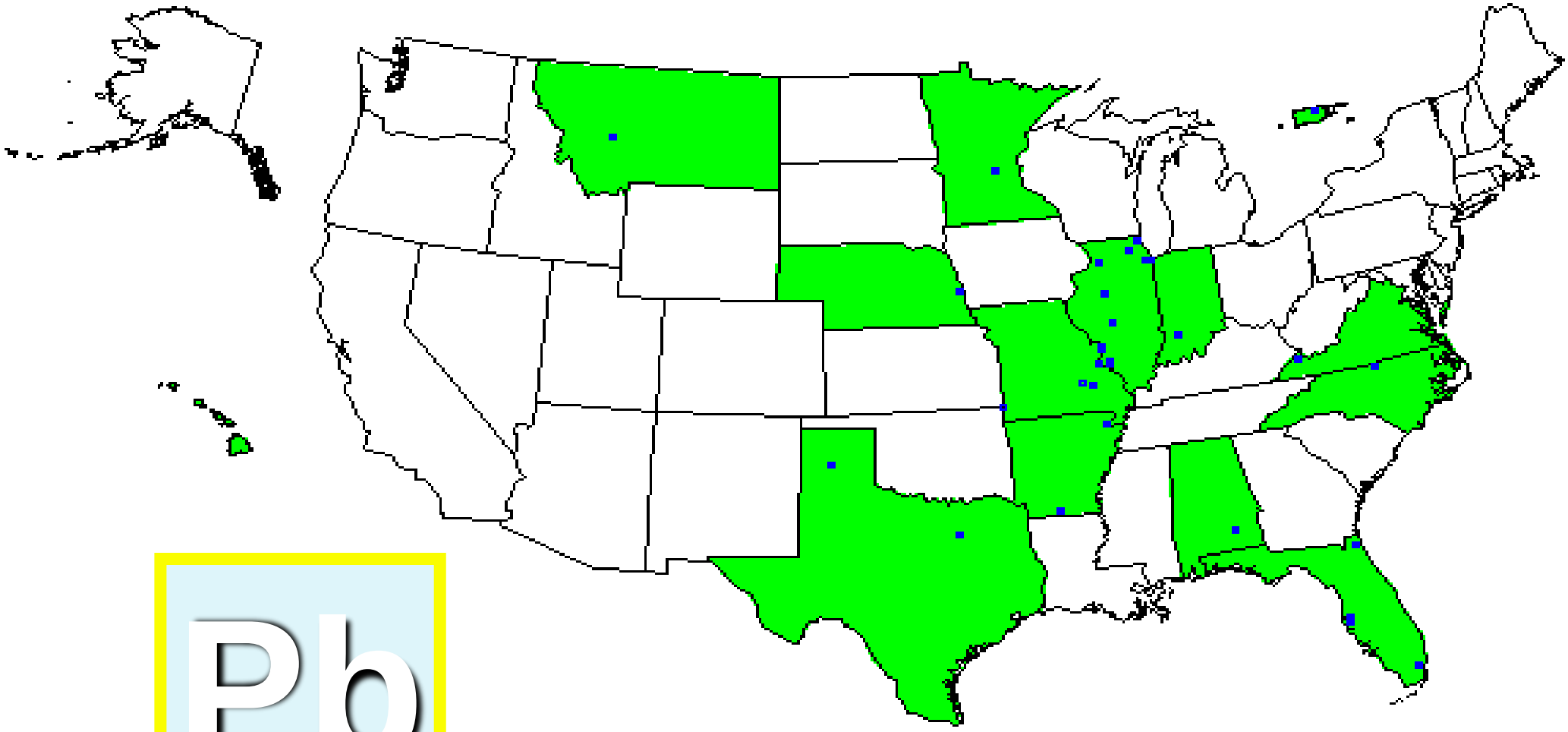
OPERATING STATUS: OPERATING, SEASONAL, UNSPECIFIED

YEAR OF RECORD: (All) SIC: (All)

AIRS Graphics

EPA

Shaded states have facilities



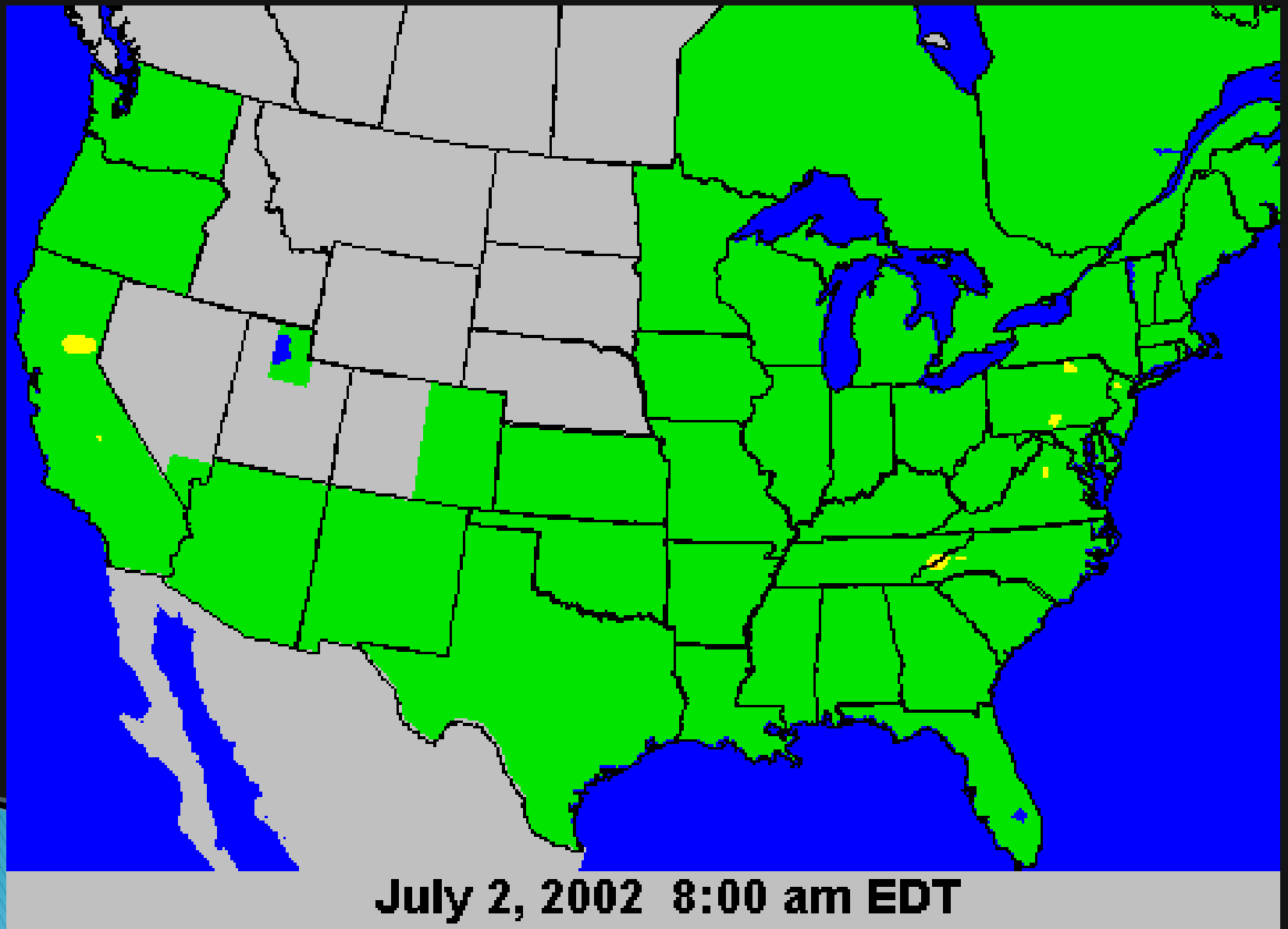
USEPA, OAQPS, ITPID, INFORMATION TRANSFER GROUP

11/31/98

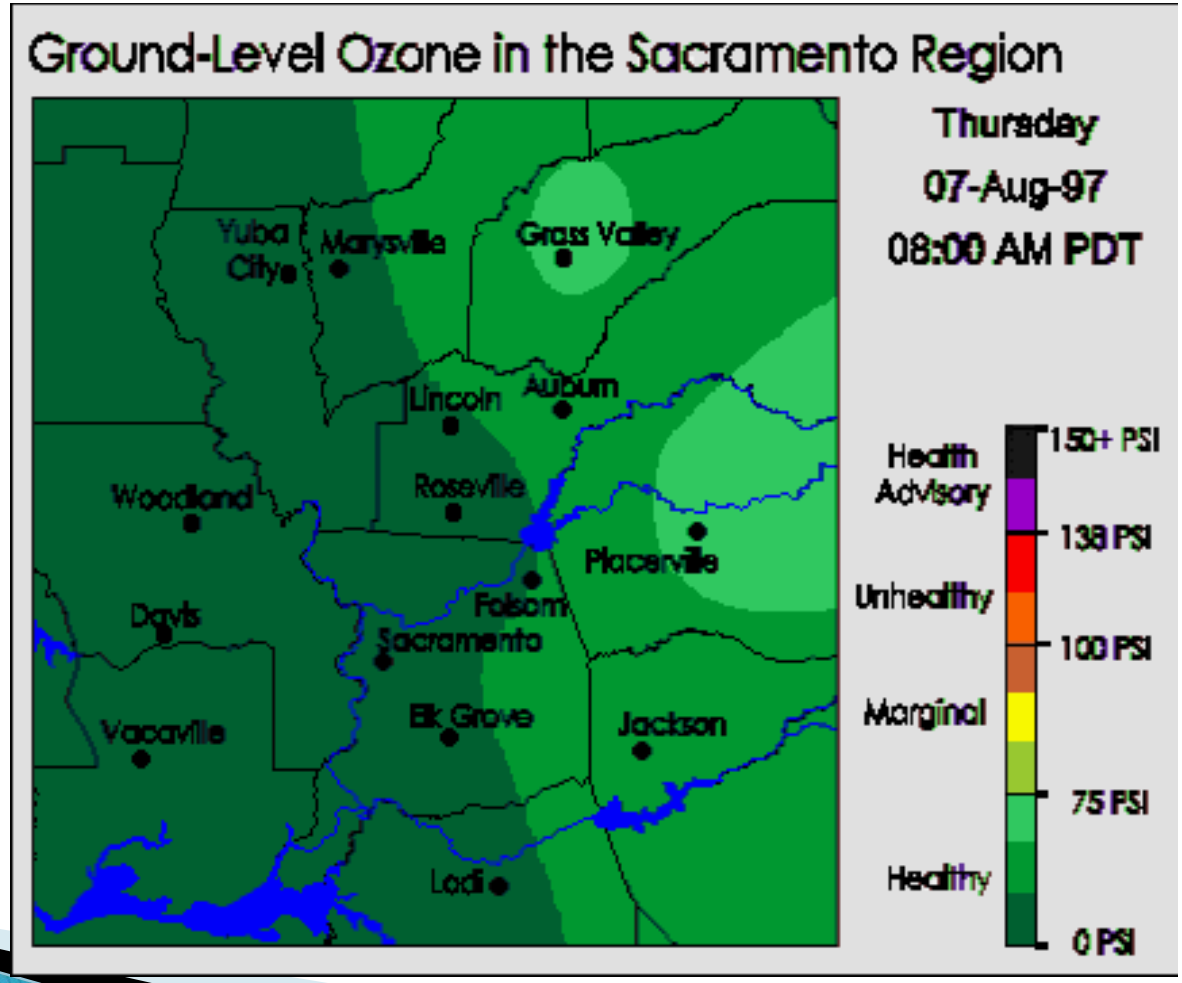
History of the NAAQS for Ozone, from 1971 to 2015

Final Rule/Decision	Primary/Secondary	Indicator[1]	Averaging Time	Level[2]	Form
1971 36 FR 8186 Apr 30, 1971	Primary and Secondary	Total photochemical oxidants	1 hour	0.08 ppm	Not to be exceeded more than one hour per year
1979 44 FR 8202 Feb 8, 1979	Primary and Secondary	O_3	1 hour	0.12 ppm	Attainment is defined when the expected number of days per calendar year, with maximum hourly average concentration greater than 0.12 ppm, is equal to or less than 1
1993 58 FR 13008 Mar 9, 1993	EPA decided that revisions to the standards were not warranted at the time				
1997 62 FR 38856 Jul 18, 1997	Primary and Secondary	O_3	8 hours	0.08 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
2008 73 FR 16483 Mar 27, 2008	Primary and Secondary	O_3	8 hours	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
2015 80 FR 65292 Oct 26, 2015	Primary and Secondary	O_3	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8 hour average concentration, averaged over 3 years

OZONE Formation

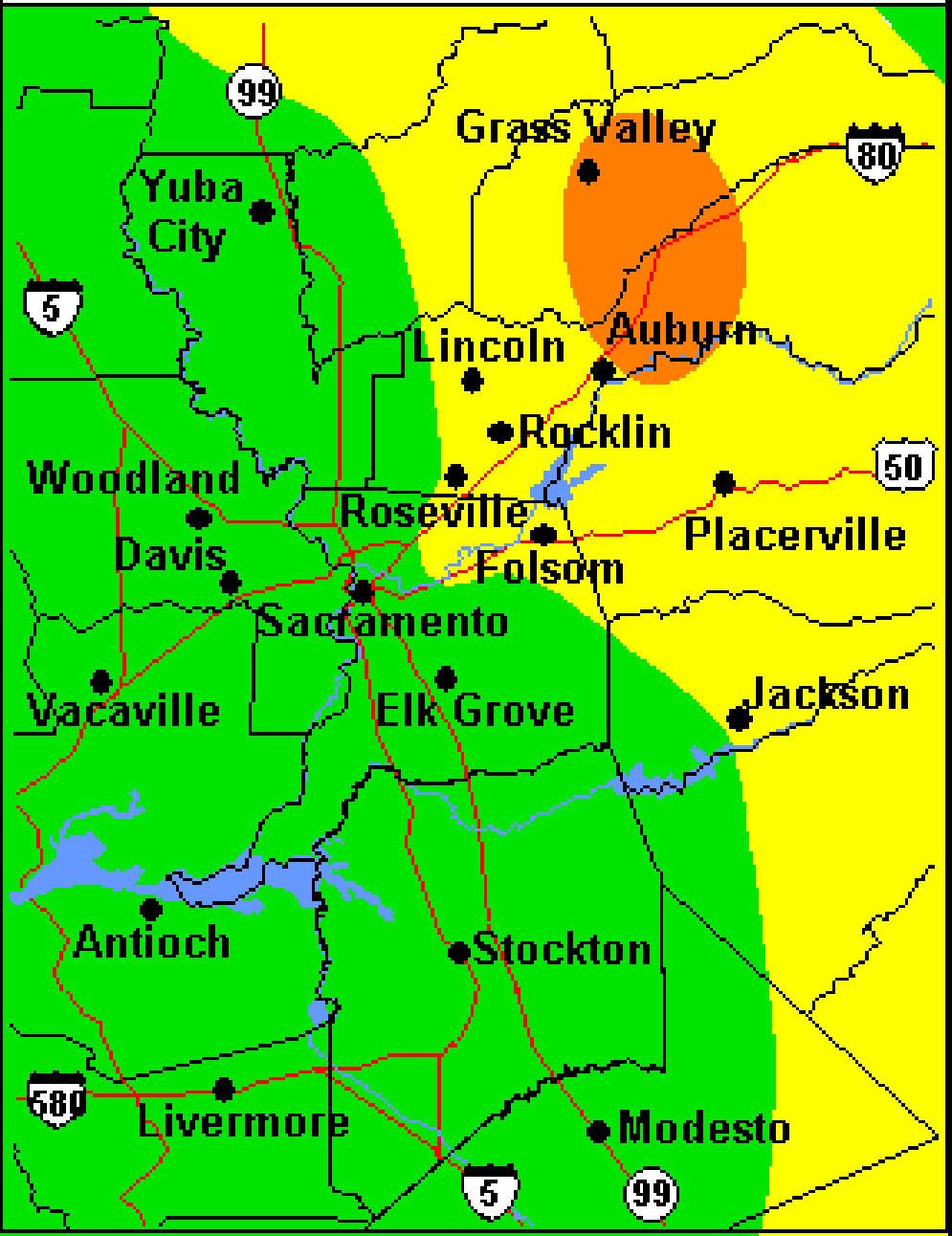


Ground-Level Ozone



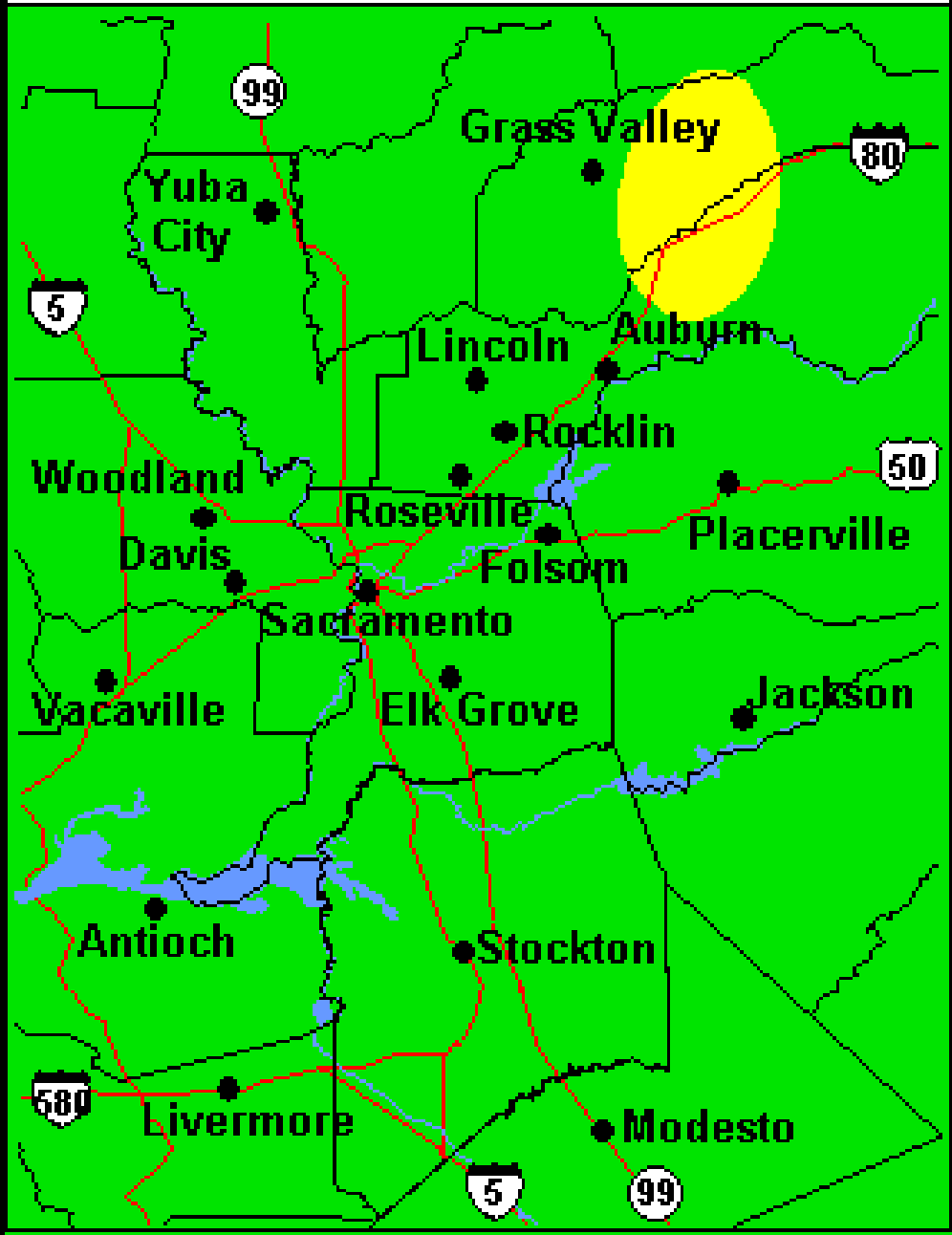
Sacramento Region
Ground-Level Ozone

July 31, 2002
5:00 pm PDT

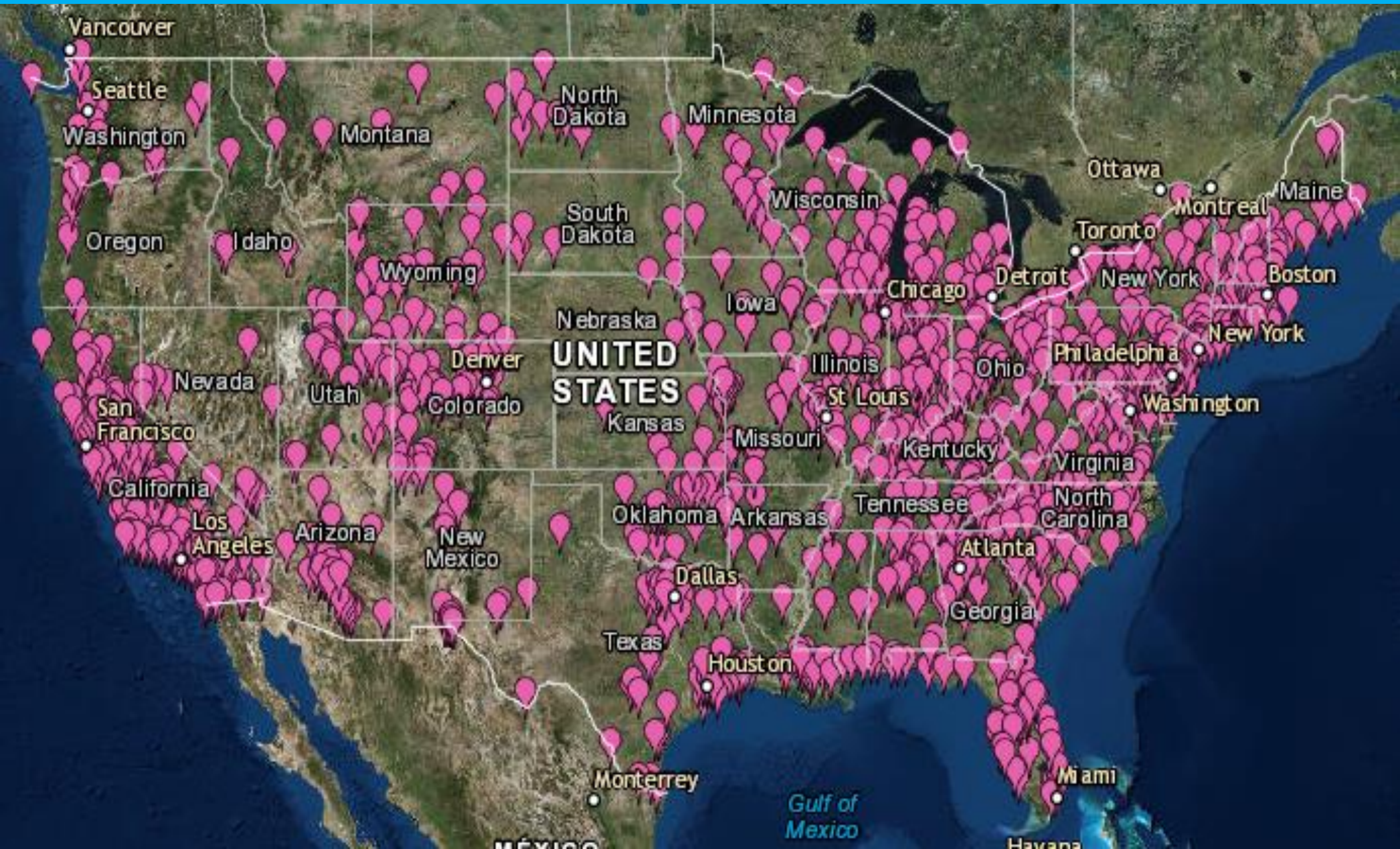


Sacramento Region
Ground-Level Ozone

August 1, 2002
11:00 am PDT

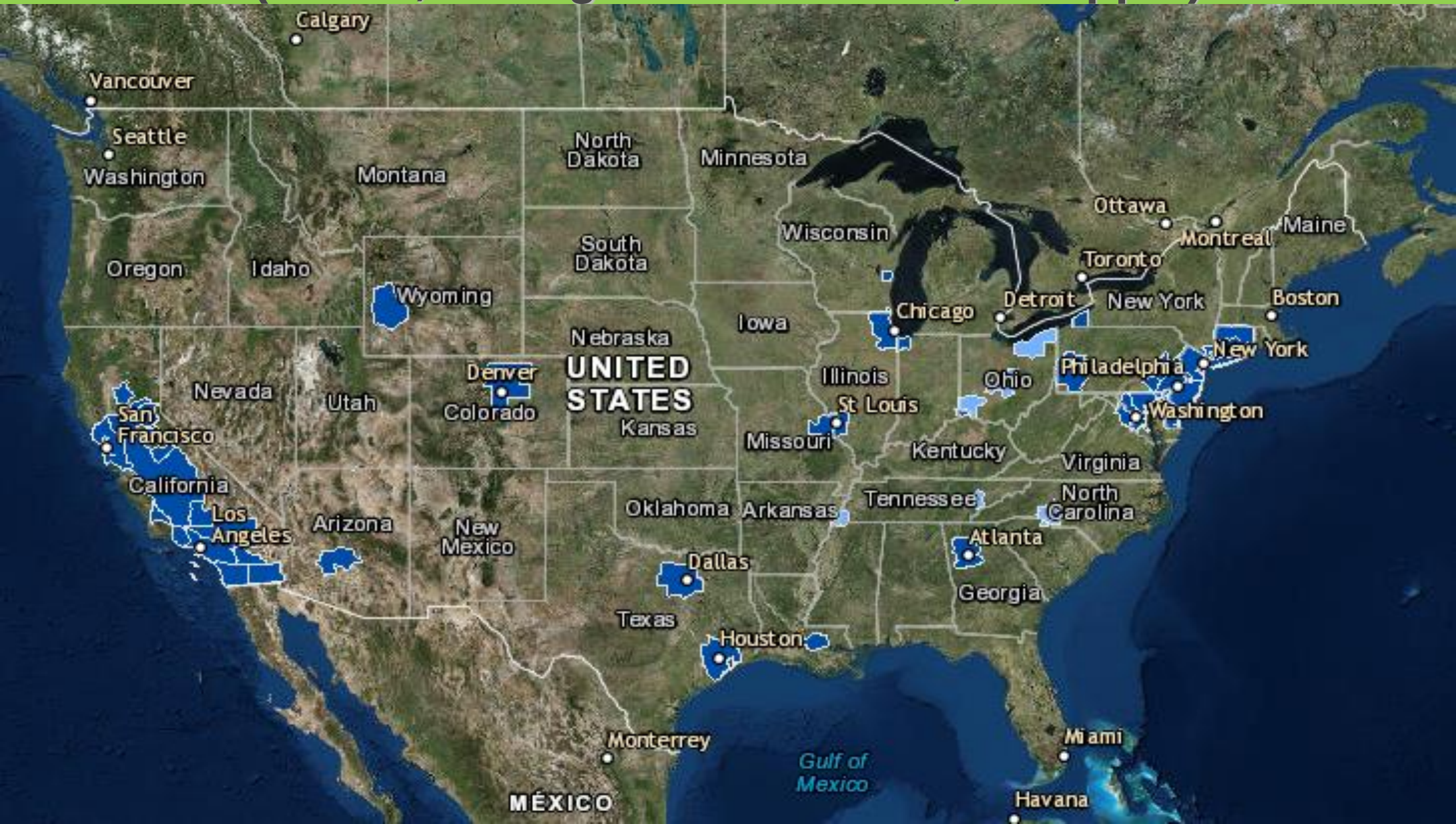


Current Ozone monitors

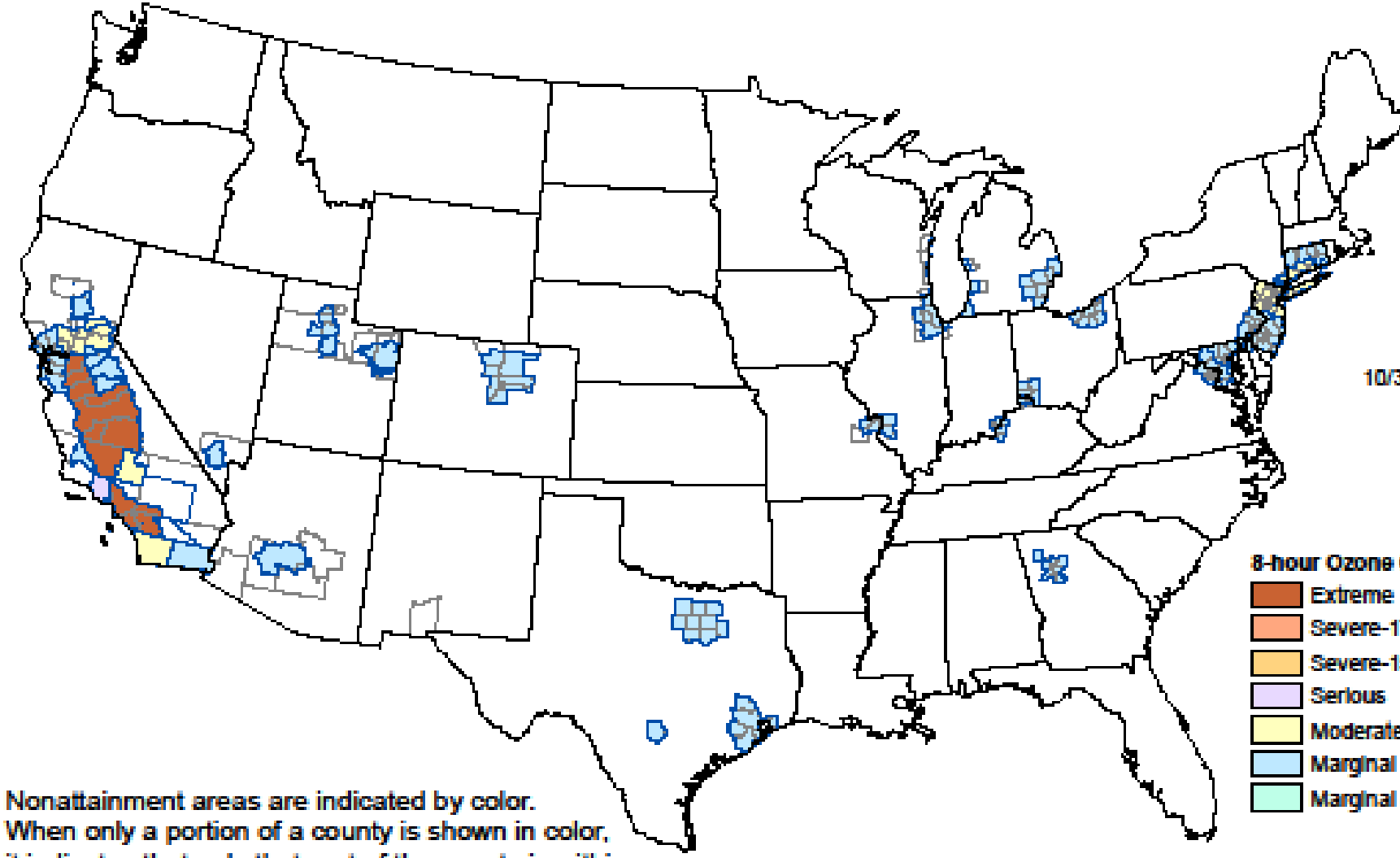


Ozone Nonattainment areas

(8 hour, average 4th maximum, 0.75 ppm)



8-Hour Ozone Nonattainment Areas (2015 Standard)



Nonattainment areas are indicated by color.
When only a portion of a county is shown in color, it indicates that only that part of the county is within a nonattainment area boundary.

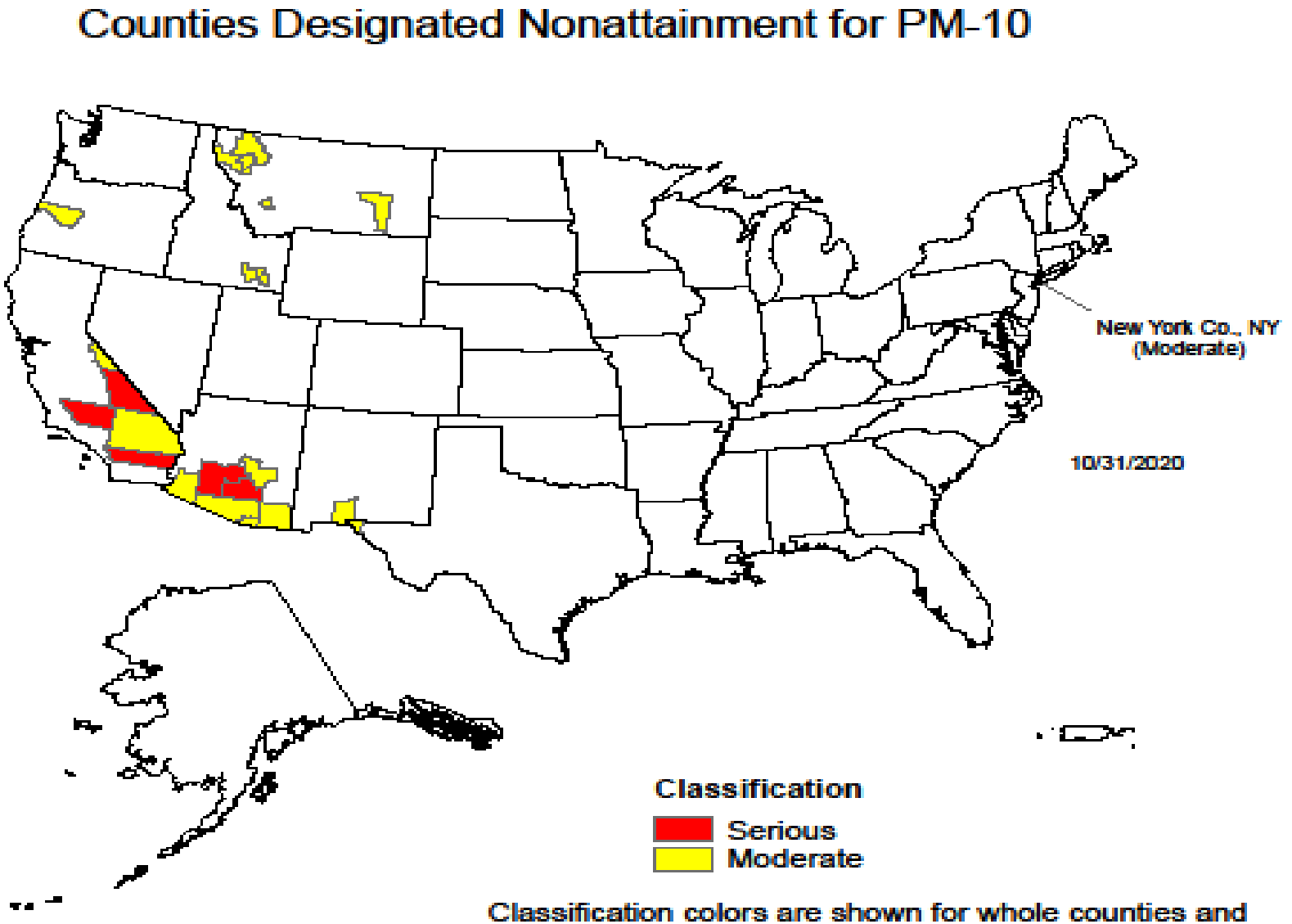
O_3

Particulate Matter (PM) Standards–Table of Historical PM NAAQS

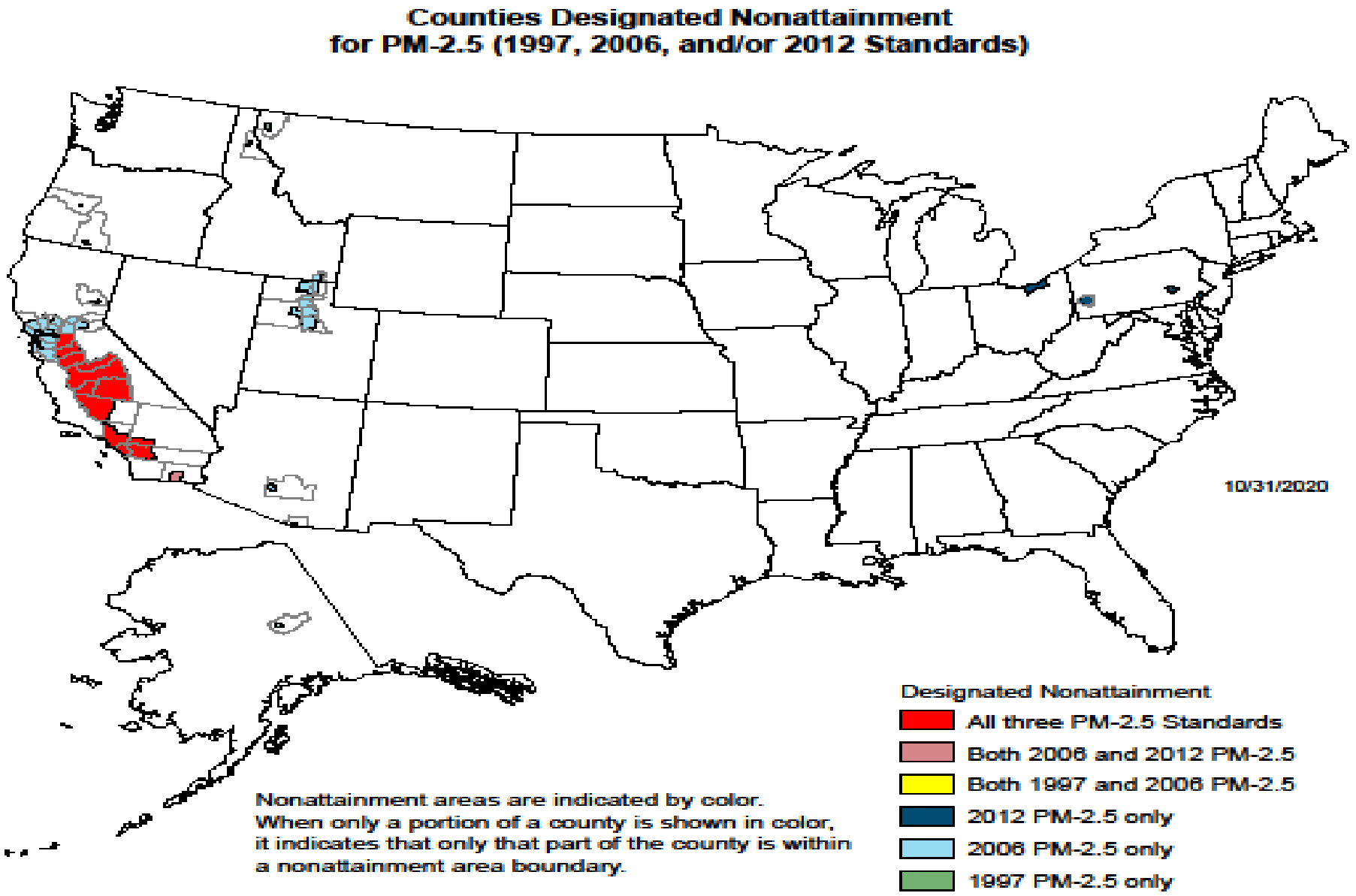
Final Rule	Primary/ Secondary	Indicator	Averaging Time	Level [1]	Form
1971 36 FR 8186 Apr 30, 1971	Primary	TSP [2]	24-hour	260 µg/m³	Not to be exceeded more than once per year
			Annual	75 µg/m³	Annual Average
	Secondary	TSP	24-hour	150 µg/m³	Not to be exceeded more than once per year
1987 52 FR 24634 Jul 1, 1987	Primary and Secondary	PM_{10}	24-hour	150 µg/m³	Not to be exceeded more than once per year on average over a 3-year period
			Annual	50 µg/m³	Annual arithmetic mean, averaged over 3 years
1997 62 FR 38652 Jul 18, 1997	Primary and Secondary	$PM_{2.5}$	24-hour	65 µg/m³	98th percentile, averaged over 3 years
			Annual	15.0 µg/m³	Annual arithmetic mean, averaged over 3 years [3],[4]
		PM_{10}	24-hour	150 µg/m³	Initially promulgated 99th percentile, averaged over 3 years; when 1997 standards for PM10 were vacated, the form of 1987 standards remained in place (not to be exceeded more than once per year on average over a 3-year period) [5]
			Annual	50 µg/m³	Annual arithmetic mean, averaged over 3 years
2006 71 FR 61144 Oct 17, 2006	Primary and Secondary	$PM_{2.5}$	24-hour	35 µg/m³	98th percentile, averaged over 3 years [6]
			Annual	15.0 µg/m³	Annual arithmetic mean, averaged over 3 years [2], [7]
		PM_{10}	24-hour	150 µg/m³	Not to be exceeded more than once per year on average over a 3-year period
2012	Primary	$PM_{2.5}$	Annual	12.0 µg/m³	Annual arithmetic mean, averaged over 3 years
	Secondary		Annual	15.0 µg/m³	Annual arithmetic mean, averaged over 3 years
	Primary and Secondary		24-hour	35 µg/m³	98th percentile, averaged over 3 years
	Primary and Secondary	PM_{10}	24-hour	150 µg/m³	Not to be exceeded more than once per year on average over a 3-year period

Current PM 10 and 2.5 monitors

PM-10 Nonattainment areas

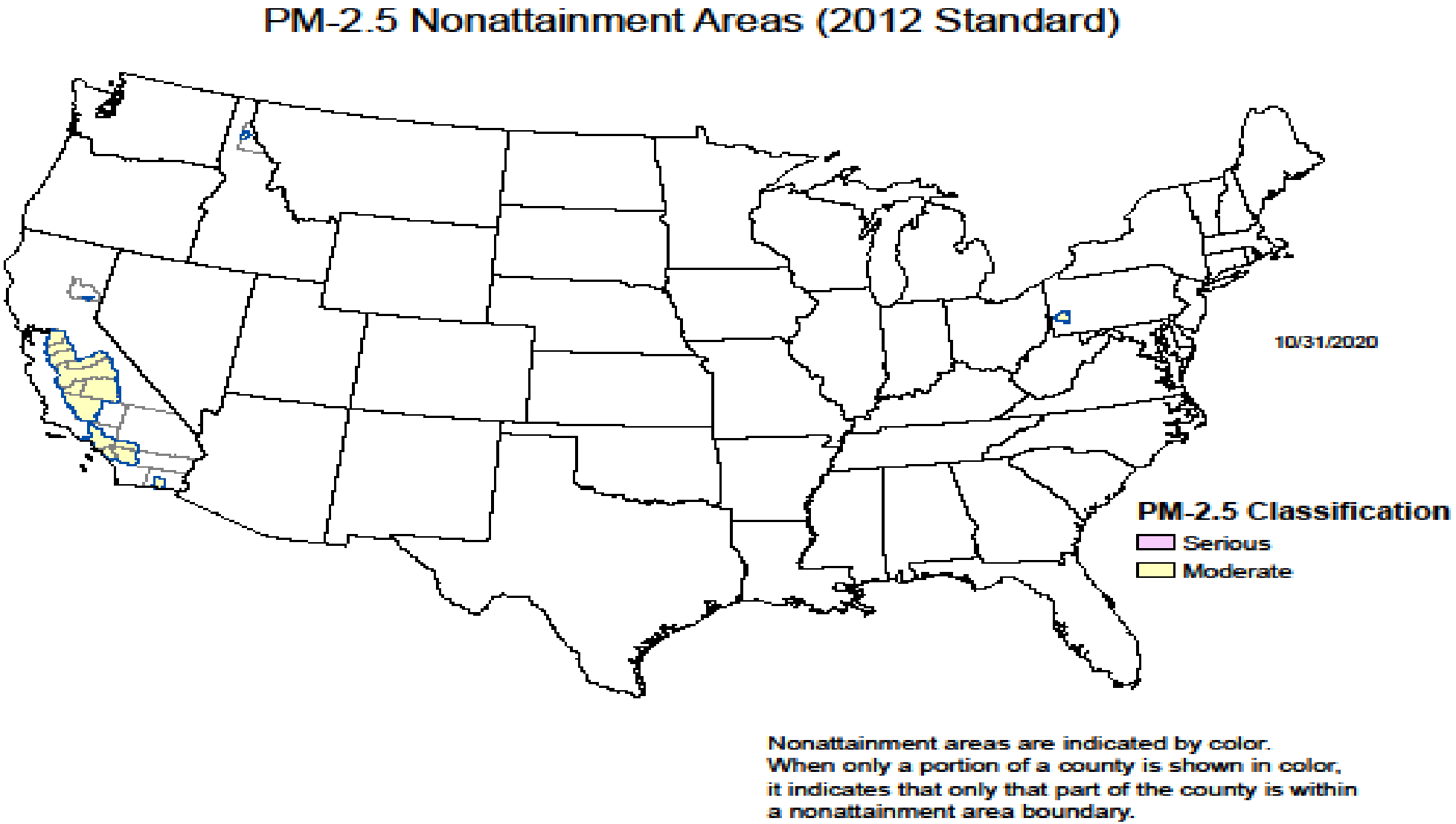


PM-2.5 Nonattainment areas



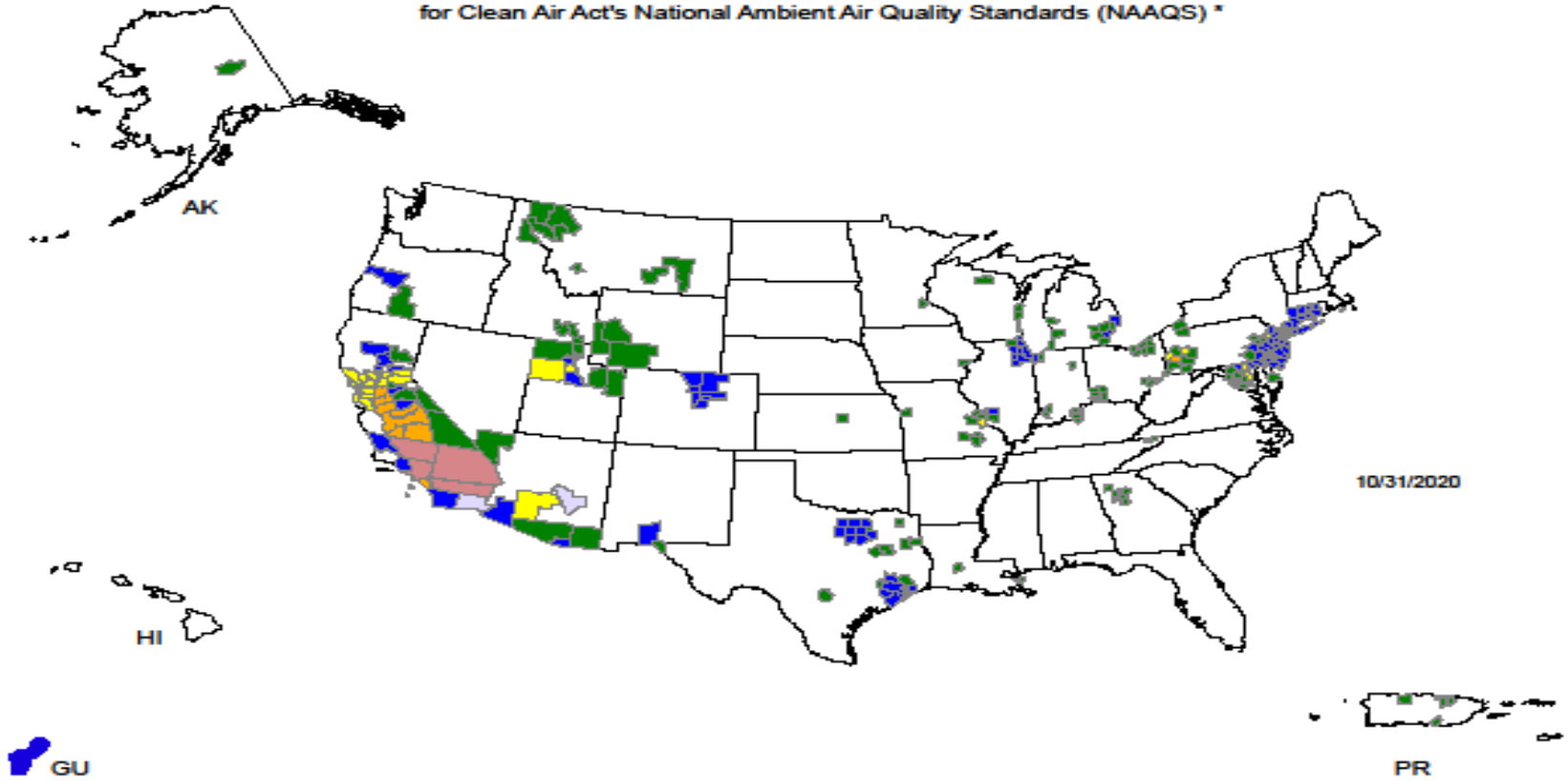
PM-2.5 Nonattainment areas

For standards of different years



Counties Designated "Nonattainment"

for Clean Air Act's National Ambient Air Quality Standards (NAAQS) *

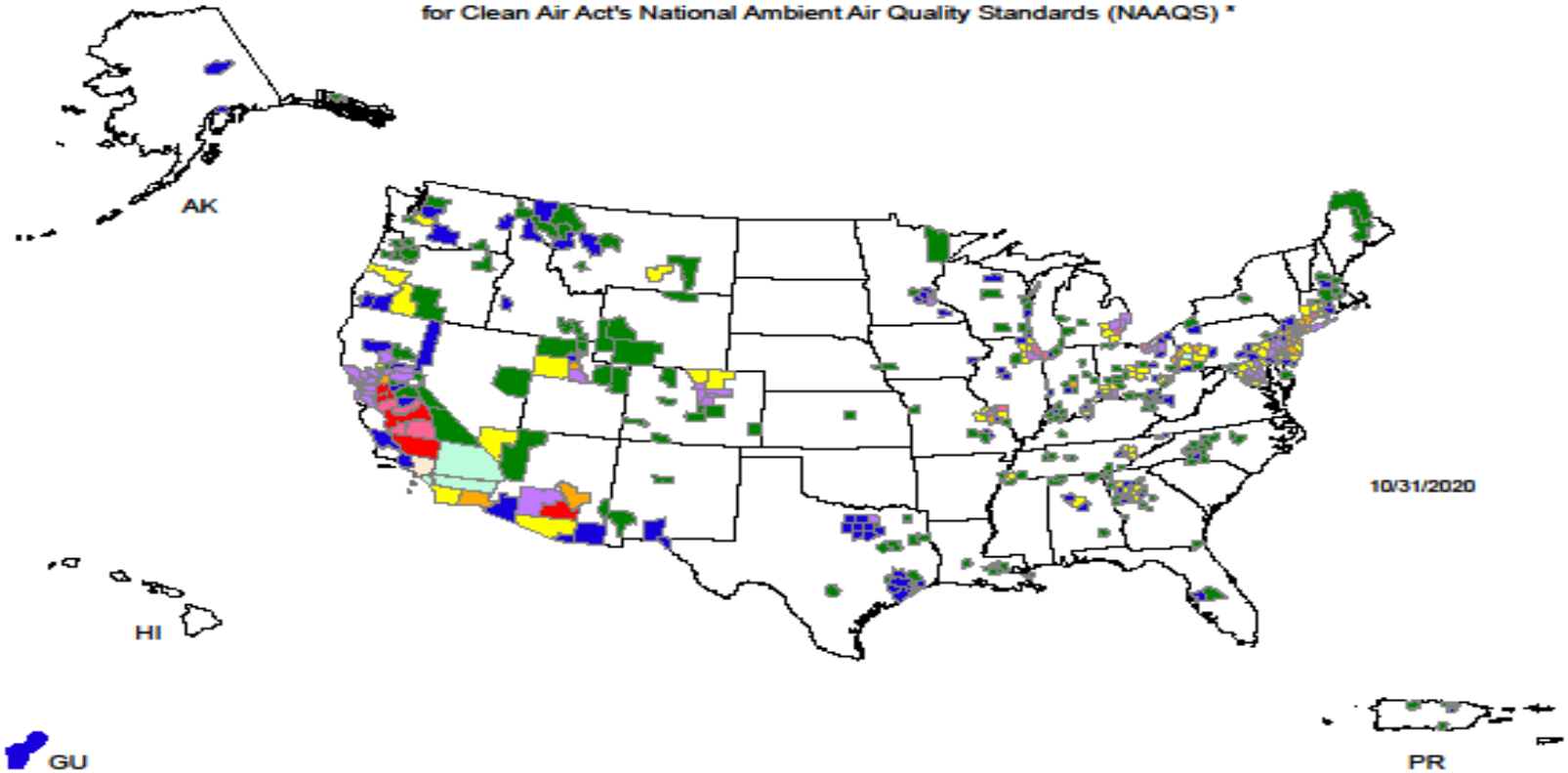


* The National Ambient Air Quality Standards (NAAQS) are health standards for Carbon Monoxide, Lead (1978 and 2008), Nitrogen Dioxide, 8-hour Ozone (2008), Particulate Matter (PM-10 and PM-2.5 (1997, 2006 and 2012), and Sulfur Dioxide.(1971 and 2010)

** Included in the counts are counties designated for NAAQS and revised NAAQS pollutants. Revoked 1-hour (1979) and 8-hour Ozone (1997) are excluded. Partial counties, those with part of the county designated nonattainment and part attainment, are shown as full counties on the map.

Counties Designated "Nonattainment" or "Maintenance"

for Clean Air Act's National Ambient Air Quality Standards (NAAQS) *



Legend **

- County Designated Nonattainment or Maintenance for 9 NAAQS Pollutants
- County Designated Nonattainment or Maintenance for 8 NAAQS Pollutants
- County Designated Nonattainment or Maintenance for 7 NAAQS Pollutants
- County Designated Nonattainment or Maintenance for 6 NAAQS Pollutants
- County Designated Nonattainment or Maintenance for 5 NAAQS Pollutants
- County Designated Nonattainment or Maintenance for 4 NAAQS Pollutants
- County Designated Nonattainment or Maintenance for 3 NAAQS Pollutants
- County Designated Nonattainment or Maintenance for 2 NAAQS Pollutants
- County Designated Nonattainment or Maintenance for 1 NAAQS Pollutants

* The National Ambient Air Quality Standards (NAAQS) are health standards for Carbon Monoxide, Lead (1978 and 2008), Nitrogen Dioxide, 8-hour Ozone (2008), Particulate Matter (PM-10 and PM-2.5 (1997, 2006 and 2012), and Sulfur Dioxide.(1971 and 2010)

** Included in the counts are counties designated for NAAQS and revised NAAQS pollutants. Revoked 1-hour (1979) and 8-hour Ozone (1997) are excluded. Partial counties, those with part of the county designated nonattainment and part attainment, are shown as full counties on the map.


Siting Criteria

Network Design Considerations

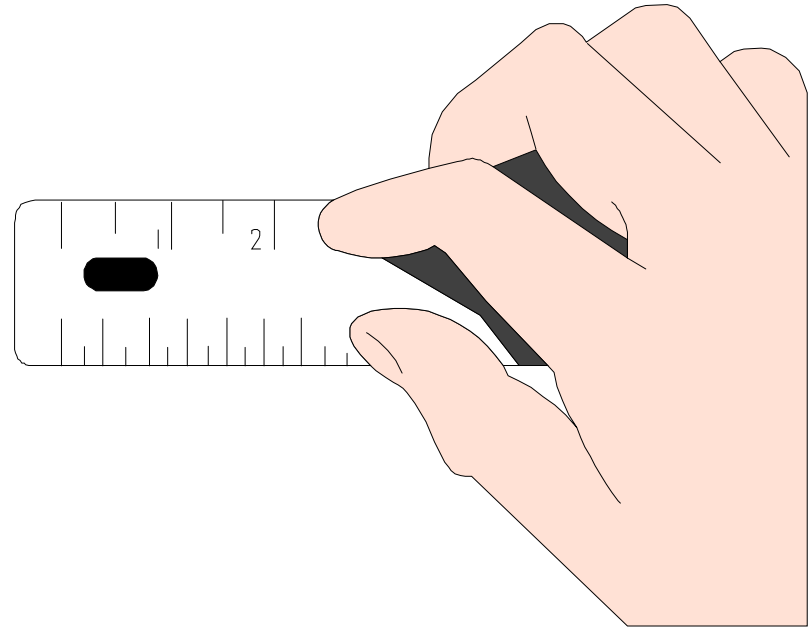
- Concentration Expected
- Representative Concentrations
- Significant Sources or Source Categories

Network Design Conciderations

- Background Concentrations
- Regional Transport
- Welfare-Related Impacts for Rural Areas

Scales of Monitoring

- Micro
- Middle
- Neighborhood



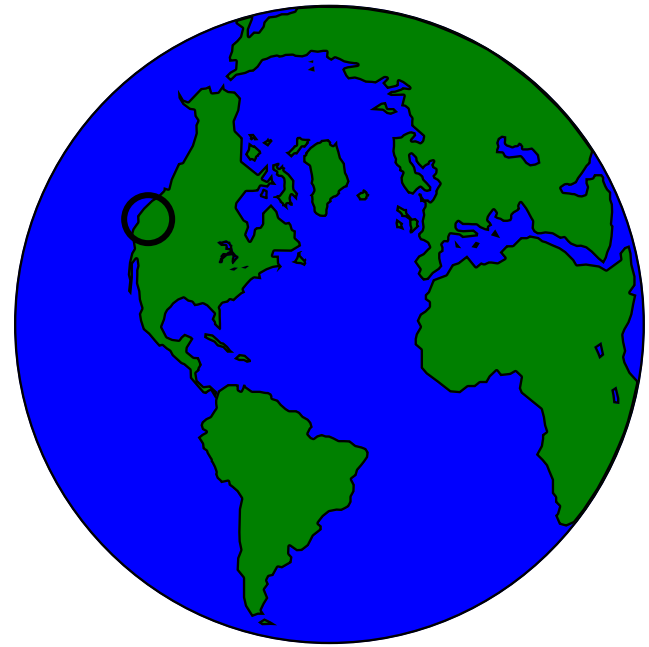

Micro
Scale
Site
Up
to
100 m
1001 i st Sacramento ca
© 2006 Europa Technologies
Image © 2006 Sanborn
© 2005 Google
Pointer 38°34'54.66" N 121°29'32.31" W elev 26 ft
Streaming 100%
Eye alt 483 ft

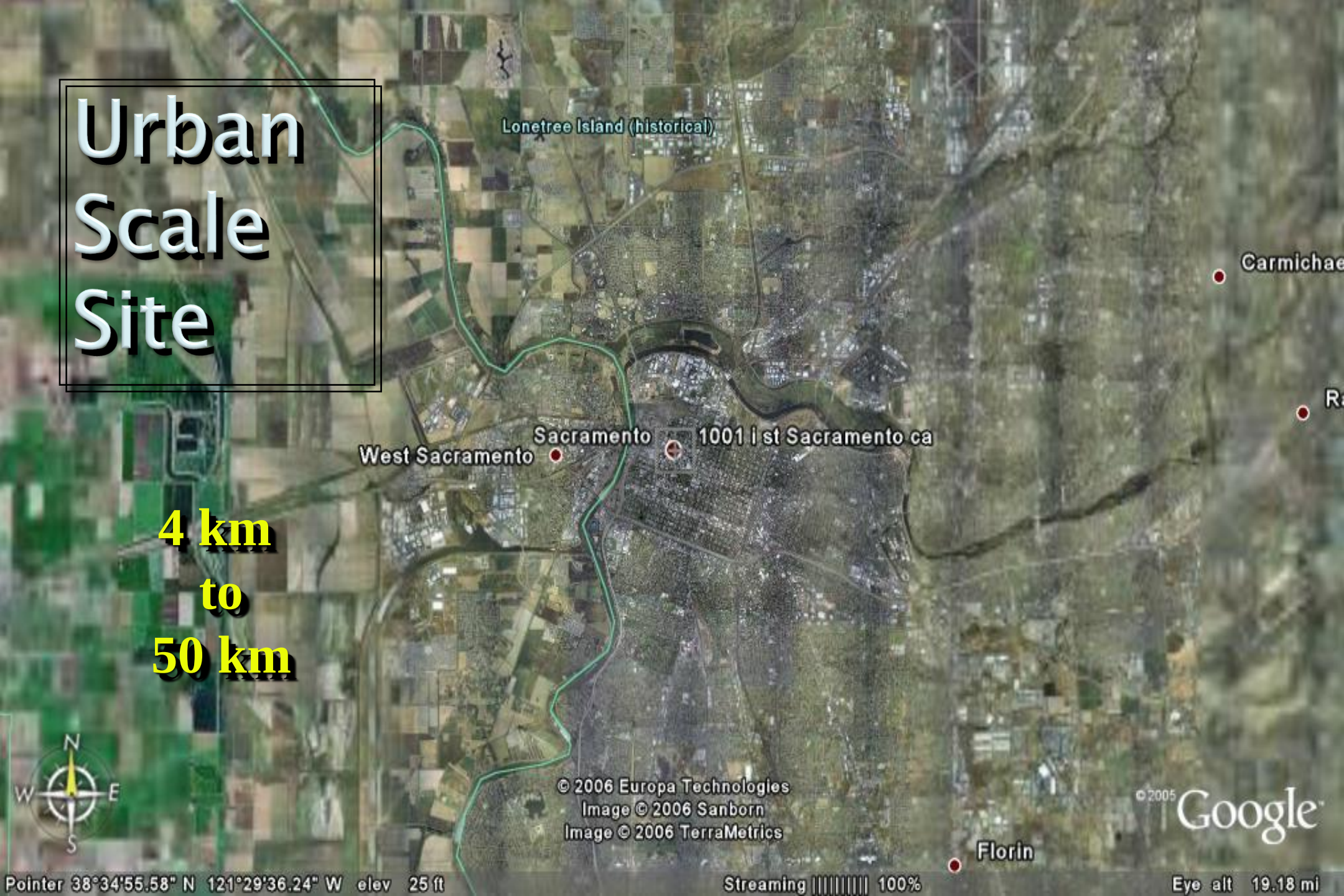

Middle
Scale
Site
100 m
to
0.5 km
Sacramento
1001 i st Sacramento ca
© 2006 Europa Technologies
Image © 2006 Sanborn
©2005 Google
Pointer 38°34'55.58" N 121°29'36.24" W elev 26 ft
Streaming 100%
Eye alt 3509 ft


Neighbor
-hood
Scale
Site
Sacramento
1001 I st Sacramento ca
0.5 km
to
4 km
N
W
E
S
© 2006 Europa Technologies
Image © 2006 Sanborn

Additional Scales of Monitoring

- Urban
- Regional
- National and Global




Urban
Scale
Site
4 km
to
50 km
Lonetree Island (historical)
Sacramento
1001 I st Sacramento ca
West Sacramento
Carmichae
Florin
© 2006 Europa Technologies
Image © 2006 Sanborn
Image © 2006 TerraMetrics
©2005 Google
Pointer 38°34'55.58" N 121°29'36.24" W elev 25 ft
Streaming 100%
Eye alt 19.18 mi


Regional Scale Site
10s km to 100s km
Sacramento
1001 i st Sacramento ca
Stockton
Angel Island
San Francisco
Oakland
Fremont
Google Campus
San Jose
California
© 2006 Europa Technologies
Image © 2006 NASA
Image © 2006 TerraMetrics
©2005 Google
Pointer 38°05'42.81" N 121°29'35.10" W elev -8 ft
Streaming 100%
Fresno Eye alt 273.18 mi

National and Global Scale Site

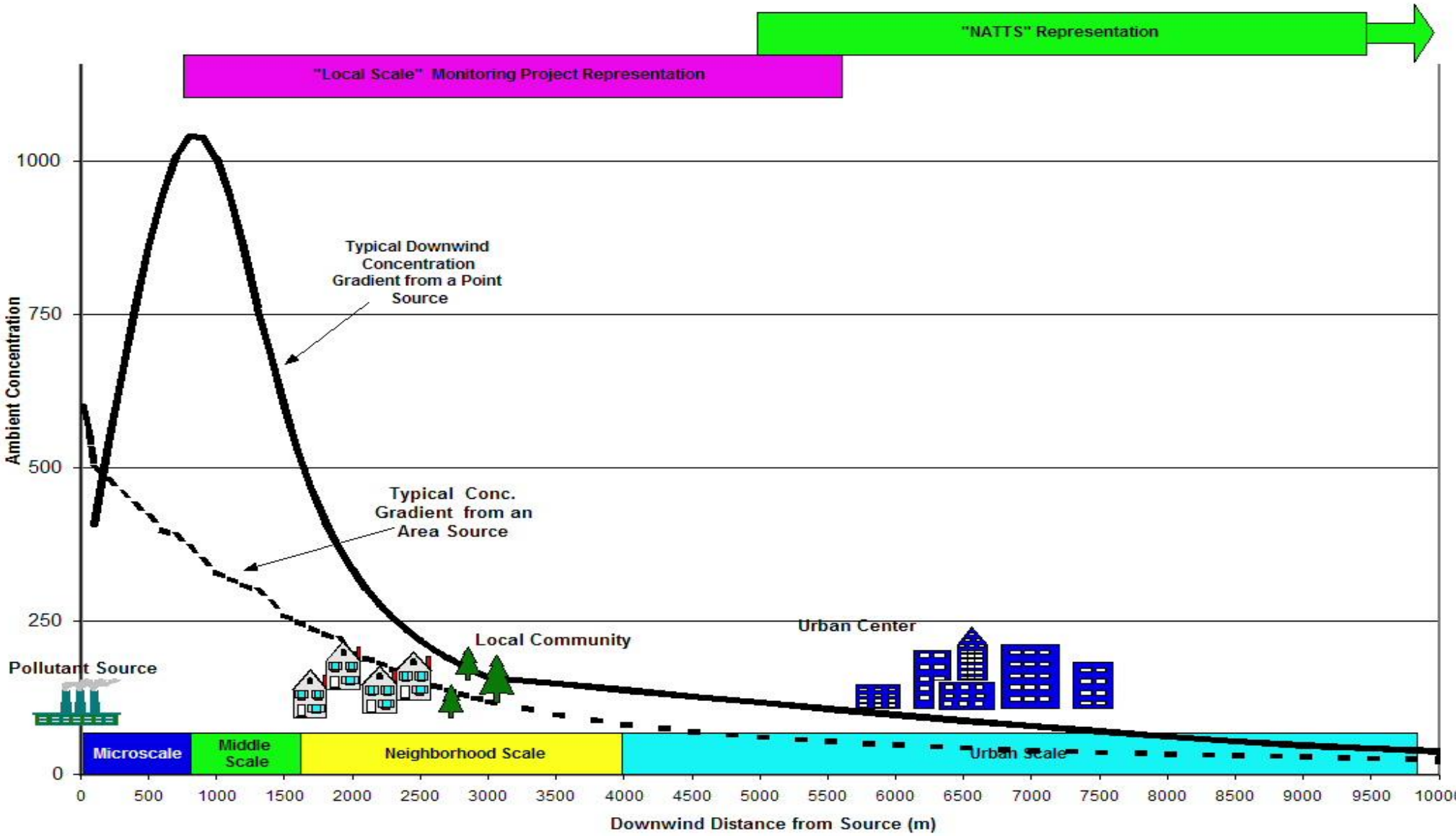
100s to 1,000s km

(On the Scale of a Nation or the World as a Whole)

Monitoring Objectives & Scale

Monitoring Objective	Appropriate Siting Scales
Highest concentration	Micro, middle, neighborhood (sometimes urban)
Source impact	Micro, middle, neighborhood
Population	Neighborhood, urban
General / Background	Neighborhood, regional, global

National Monitoring Projects Scales of Representation



Network Design Considerations

- Priority area (zone of highest pollution conc.)
- Air Transport
- Evaluation

Network Design Considerations

- Population Areas
- Future development
- Full Representation

Number of Stations – PM_{10}

Population	Expected Maximum Concentration		
	High[1]	Medium[2]	Low[3]
> 1,000,000	6 - 10	4 - 8	2 - 4
500,000 - 1,000,000	4 - 8	2 - 4	1 - 2
250,000 - 500,000	3 - 4	1 - 2	0 - 1
100,000 - 250,000	1 - 2	0 - 1	0

[1] Exceeding NAAQS by 20% or more, or 95% Probability of PM_{10} Nonattainment

[2] Exceeding 80% of NAAQS, or 20% to 95% Probability of PM_{10} Nonattainment

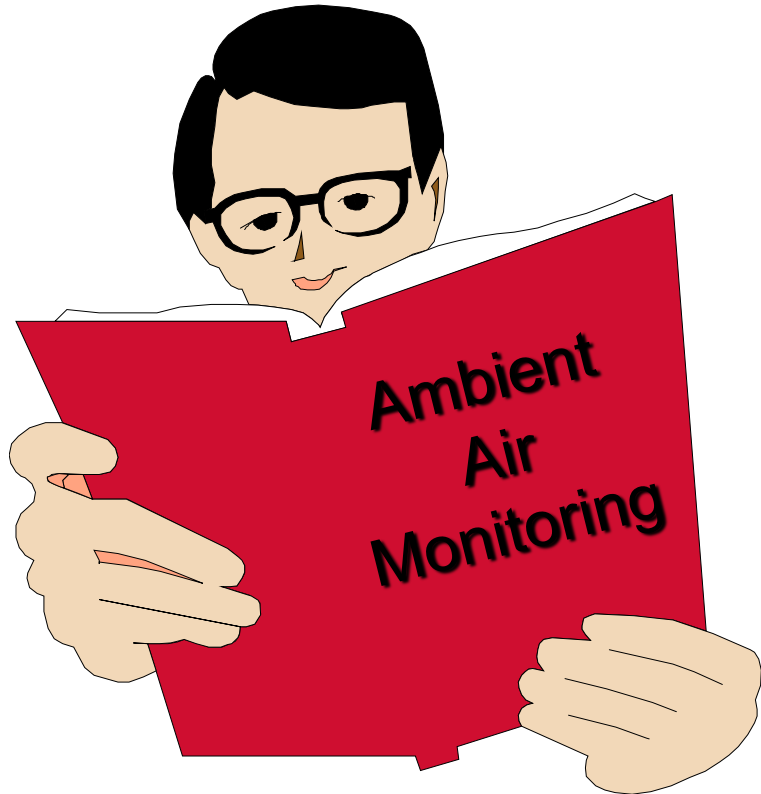
[3] Less than 80% NAAQS, or < 20% Probability of PM_{10} Nonattainment

Station Siting Considerations

- Available sites
- Start-up costs
  - Equipment
  - Facility improvements
- Operation costs
  - Equipment operation and maintenance
  - Station costs (lease payments, heating, etc.)
  - Expendables (calibration gases, chart paper, etc.)
  - Personnel

Station Siting Considerations

- Types of Pollutants
- Topography
- Air flow

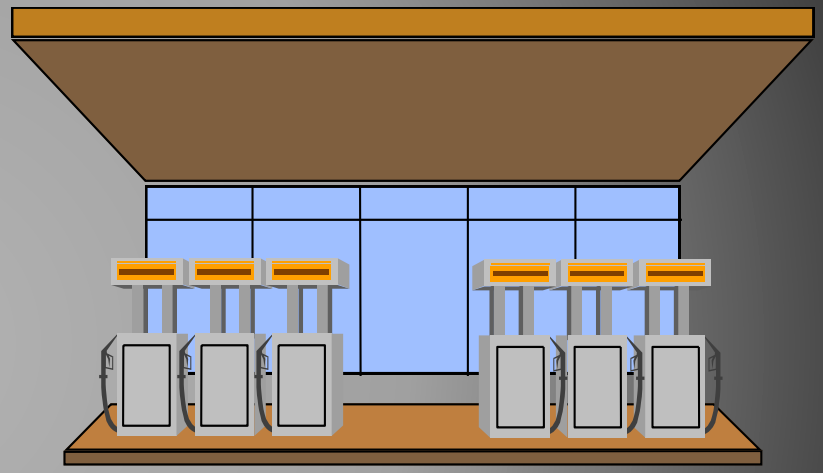


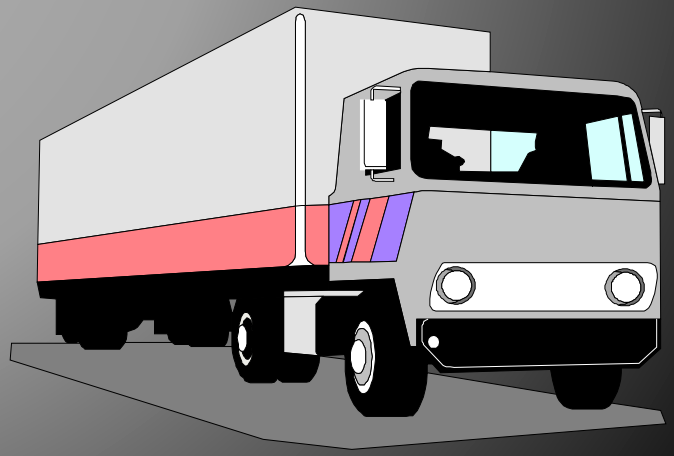
Station Categories

A (Ground Level)	Heavy pollutant concentration, high potential for pollutant buildup
B (Ground Level)	Heavy pollutant concentration, minimal potential for buildup
C (Ground Level)	Moderate pollution concentration
D (Ground Level)	Low pollutant concentration
E (Air Mass)	Sampler probe that is between 6-45m (20-150 ft) above ground
F (Source-Oriented)	Sampler that is adjacent to a point source

Site Information

- Local Sources
  - Flues & Vents by Inlet
  - Non-Vehicular/Local Industry
  - Traffic
- Dominant Influence Category
  - Industrial
  - Residential
  - Commercial
  - Vehicular
  - Urbanization
  - Near Urban
  - Agricultural
  - Recreational Area






Local Sources Near Monitoring Stations

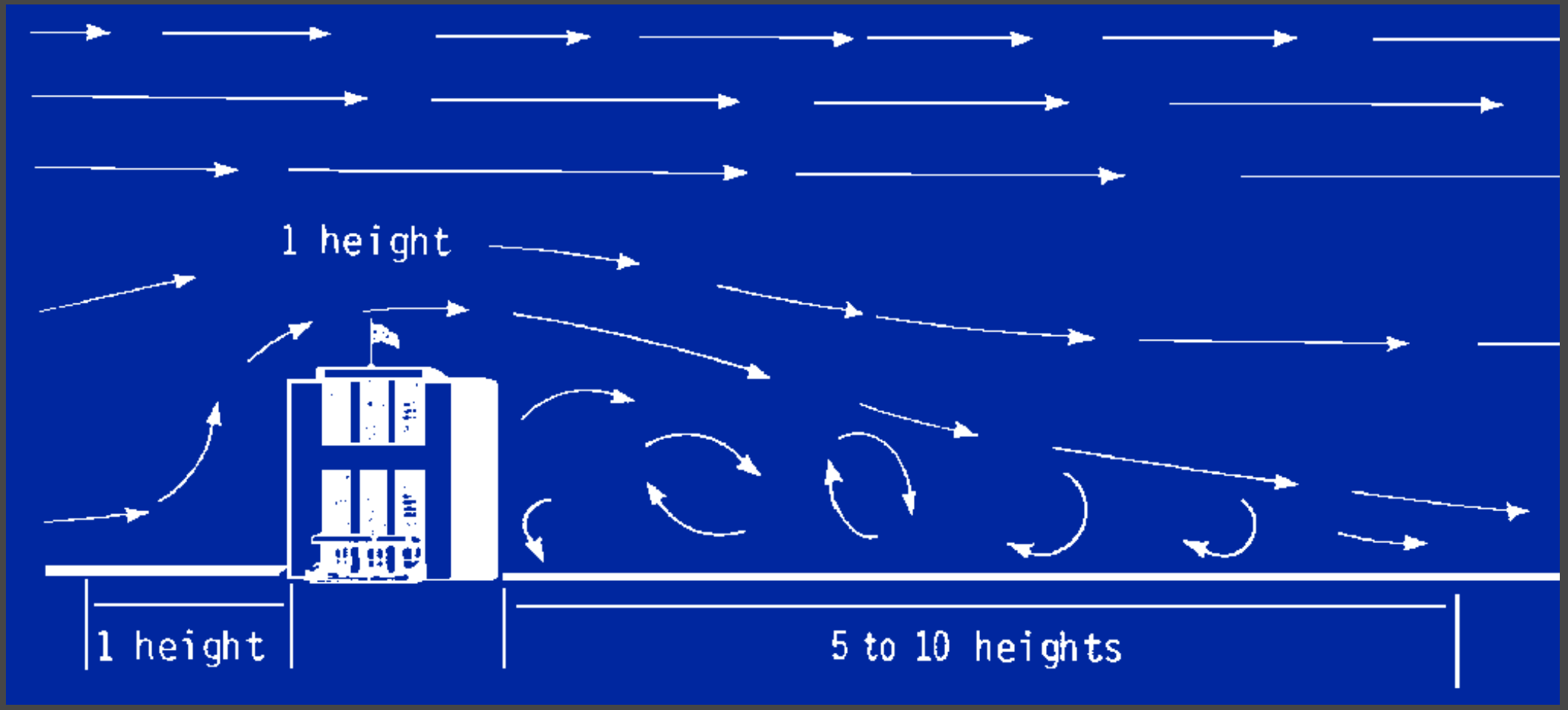
Site Information

- Data Acquisition Objective
- Station Type
- Spatial Scale
- Instrumentation
- Sampling System
- Influential Pollutant Sources
- Topography
- Atmospheric Exposure

Site Information

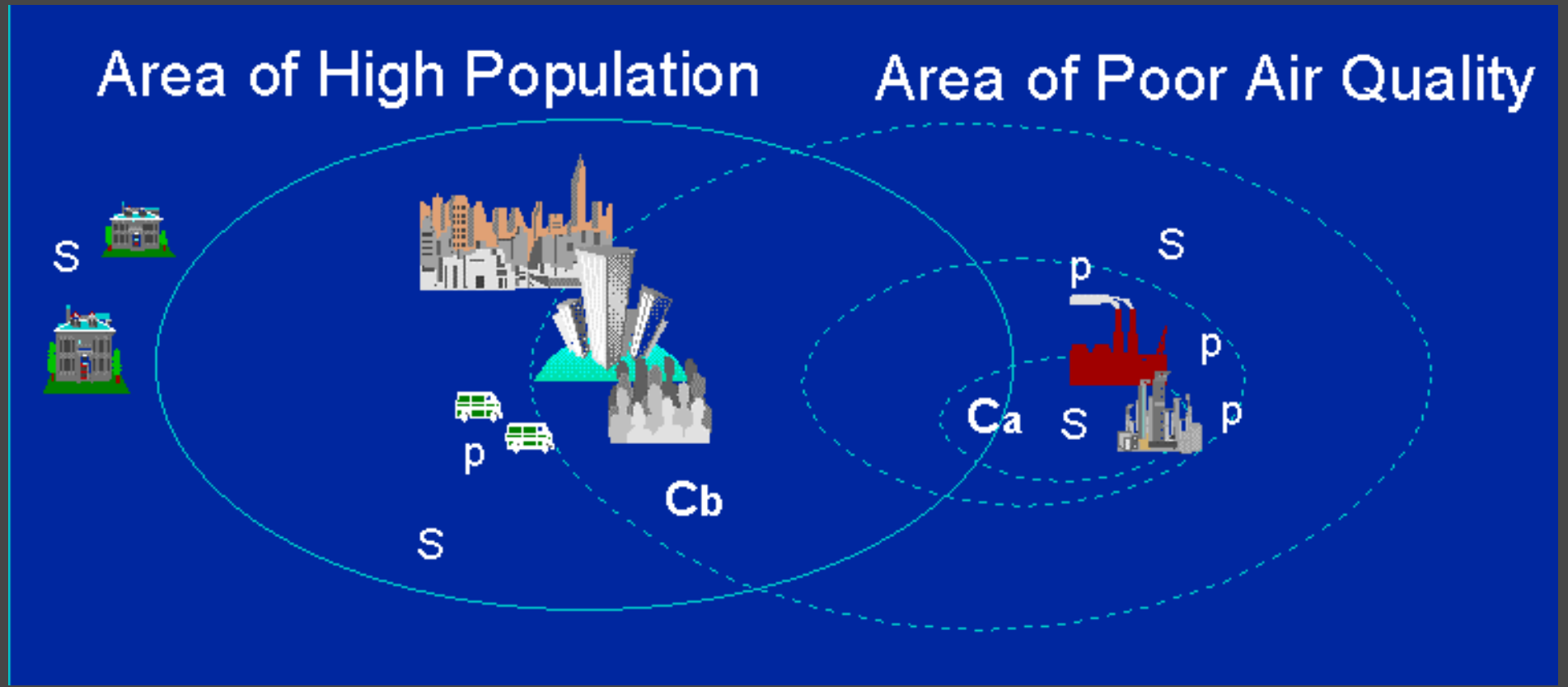
- Obstacles
  - Description
  - Distance
  - Height above inlet
  - Walls
  - Air flow arc
- Trees
  - As obstacles
  - As interferants

Obstacle Effects



Location of Monitors

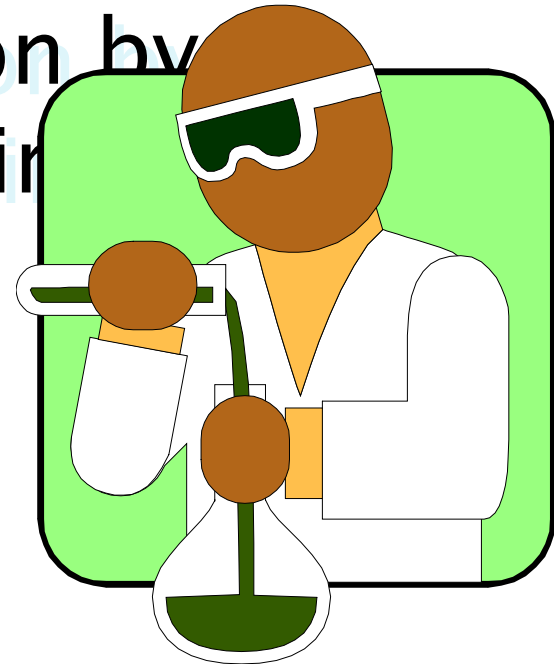
- C = Core site
- S = SLAMS site
- p = Special Purpose Monitor




Measurement Process

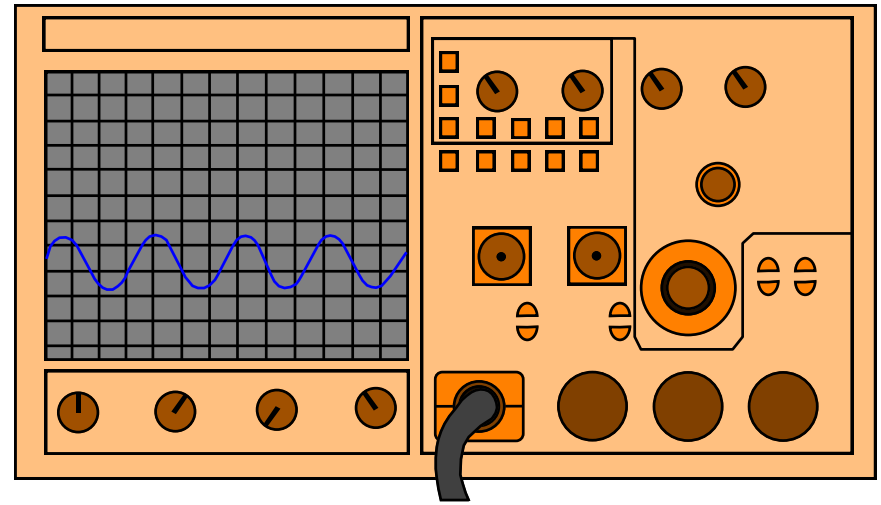
Air Pollutant Measurement Process

- Separate pollutant from air
- Determine pollutant quantity and air volume
- Calculate pollution concentration by dividing pollutant quantity by air volume
- Analyze data

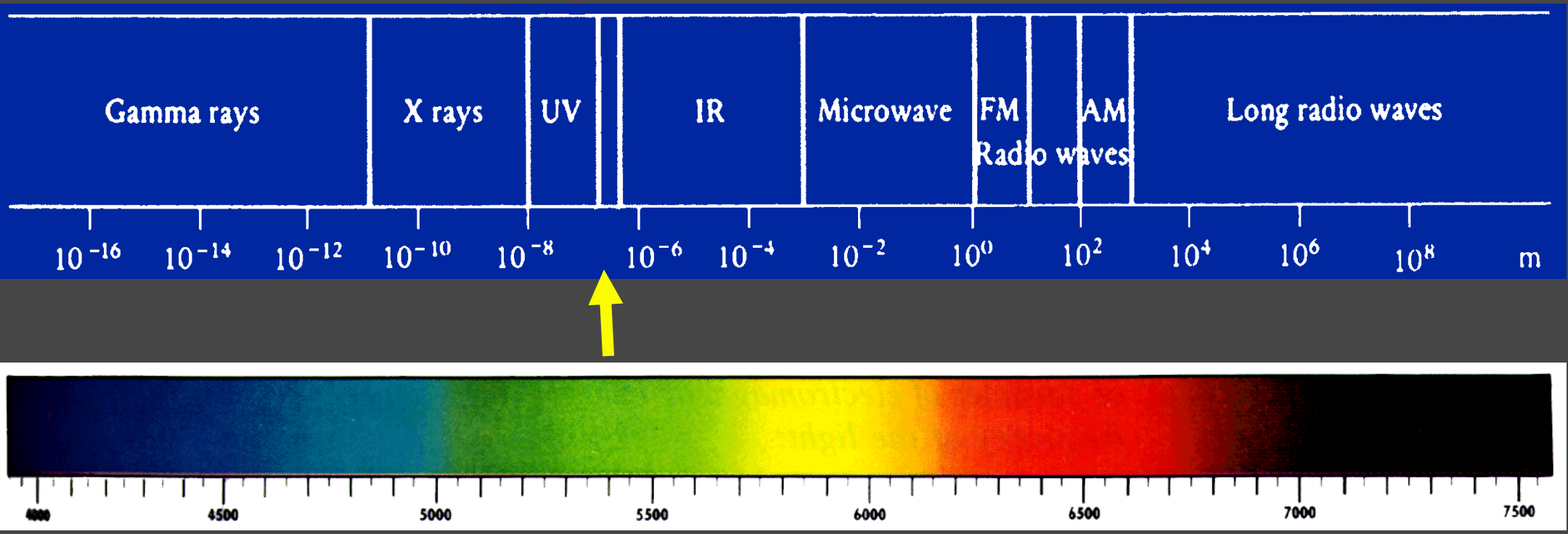


Types of Monitoring

- Automated analytical methods
  - Point analyzers
  - Open path analyzers
- Time averaged samplers
  - Manual methods
  - Filter (ex. PM_{10}) samples



Electromagnetic Spectrum



400 nm

Visible Range

700 nm

Beer-Lambert Law

- Absorption of light related to:
  - Absorption coefficient dependencies
    - Wavelength of light
    - Properties of the pollutant molecule
  - Number of molecules in light path
    - Concentration
    - Path length

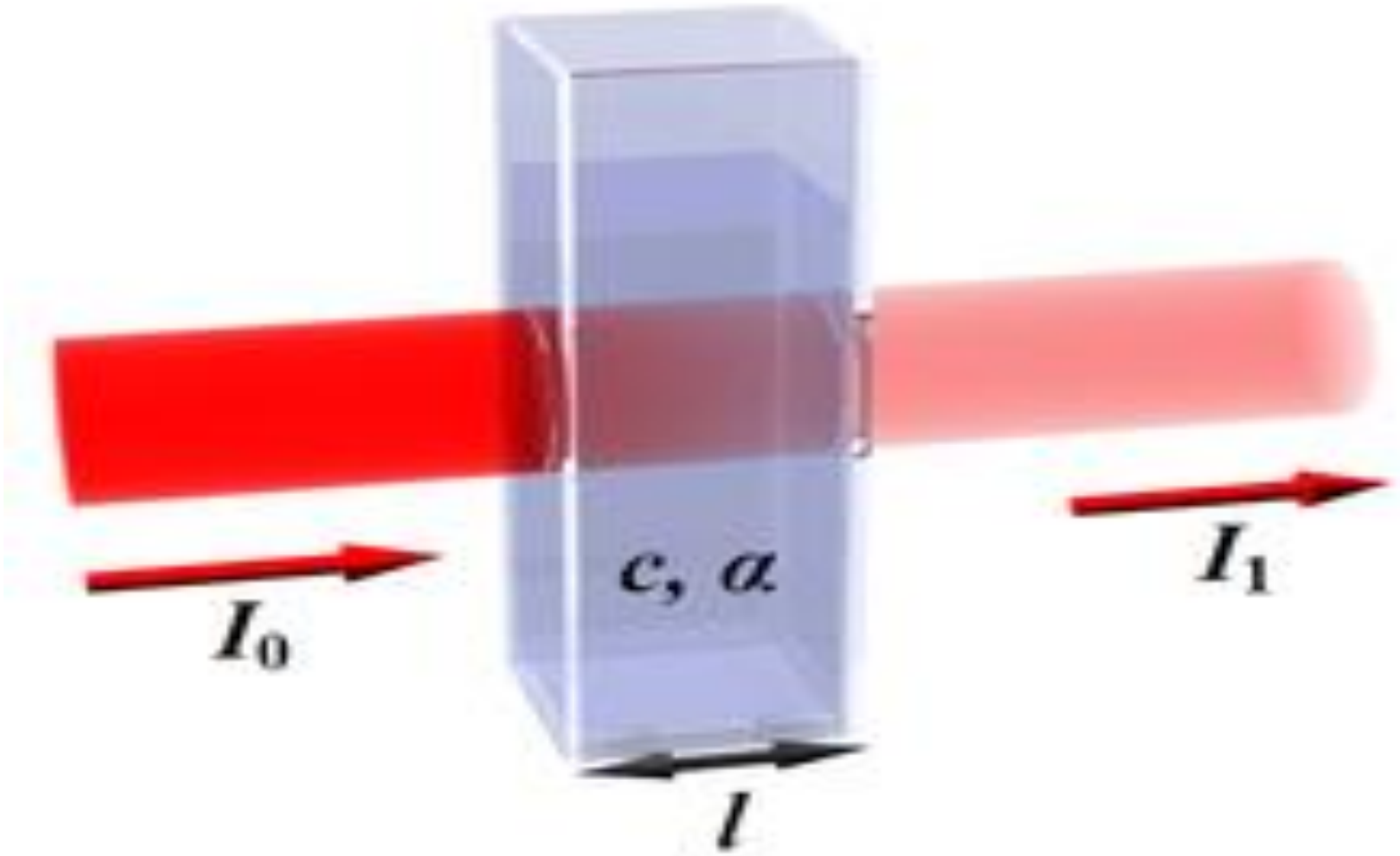
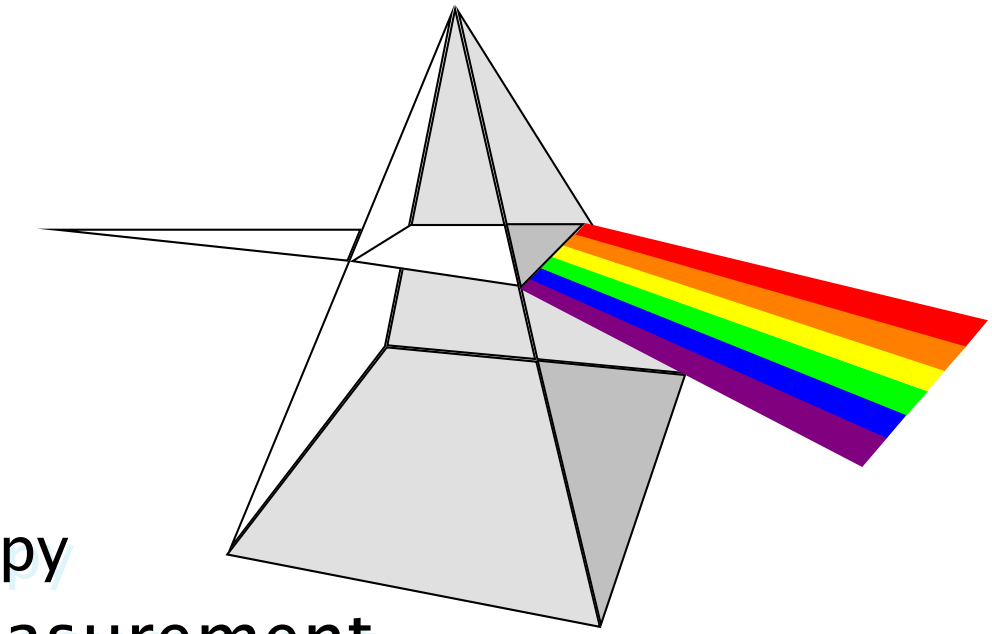


Diagram of Beer–Lambert absorption of a beam of light as it travels through a cuvette of width ℓ.

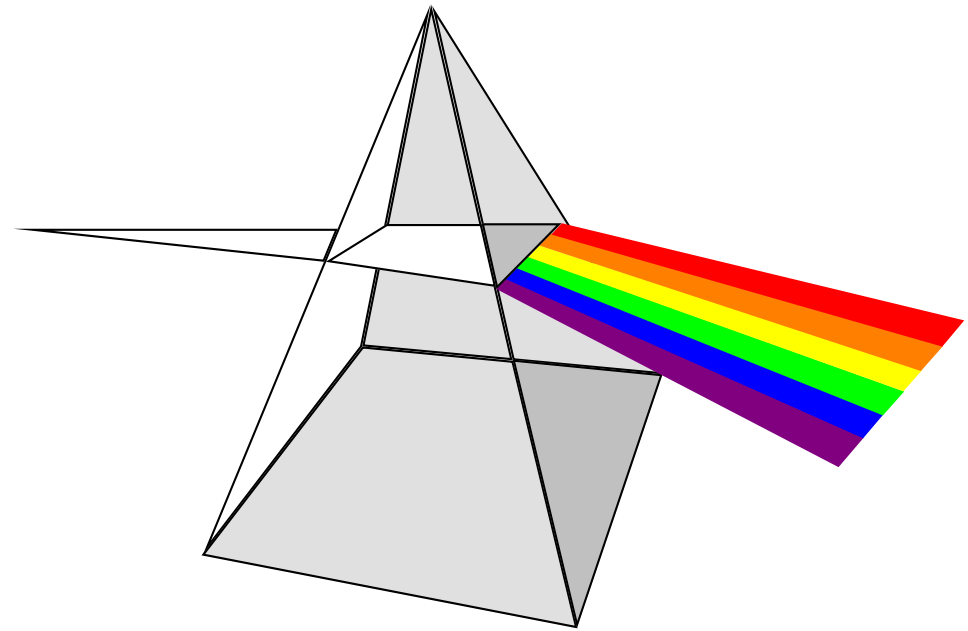
Analytical Techniques

- Infrared Methods
  - Differential Absorption
  - Gas Filter Correlation
  - Fourier Transform Infrared
- Ultraviolet Methods
  - Differential Absorption
  - Second Derivative Spectroscopy
- Visible Light - Opacity Measurement
  - Scattering & Absorption



Analytical Techniques

- Luminescence Methods
  - Fluorescence
  - Chemiluminescence
  - Flame Photometry
- Electroanalytical Methods
  - Polarography
  - Electrocatalytic
  - Paramagnetism
  - Conductivity



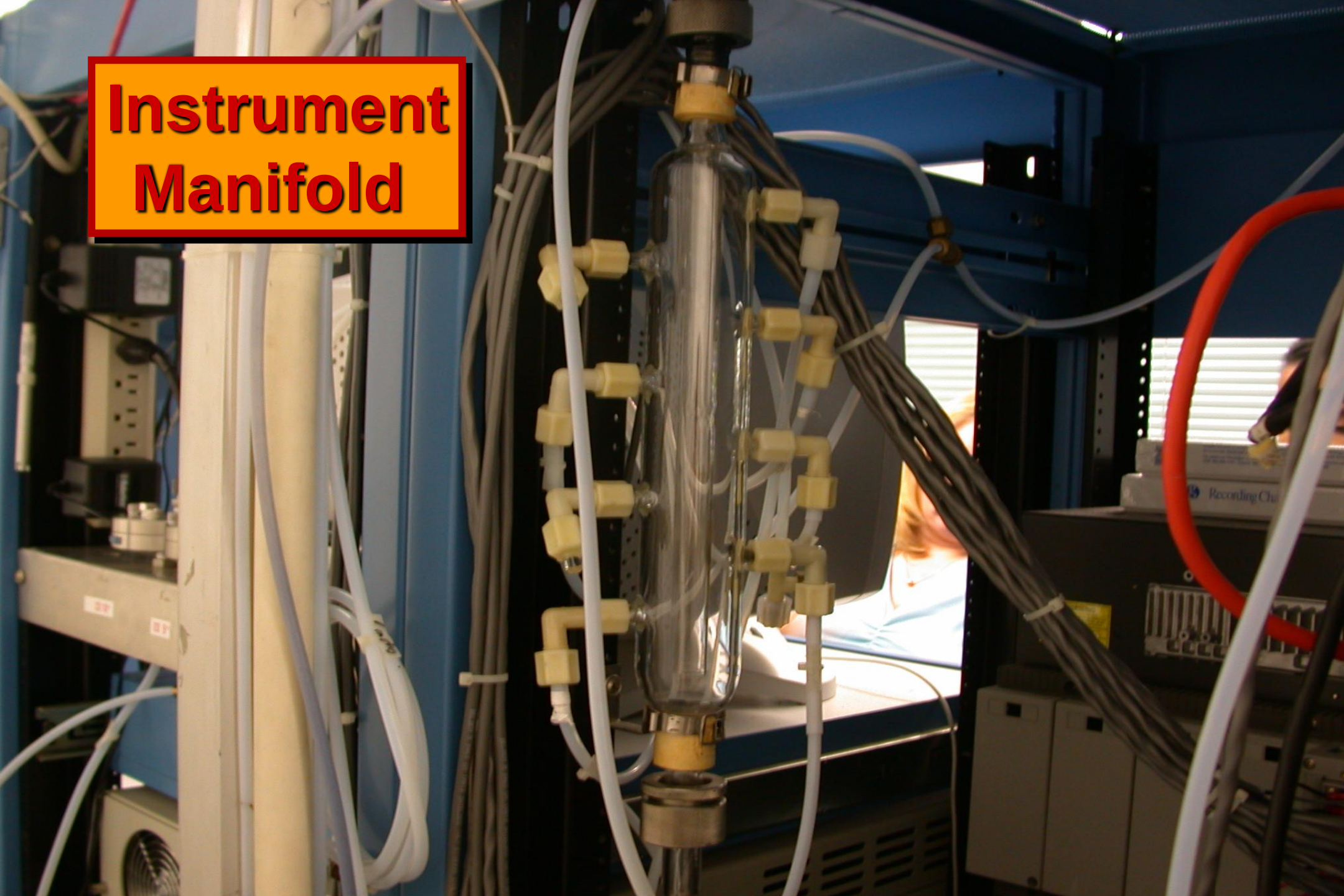
Site Information

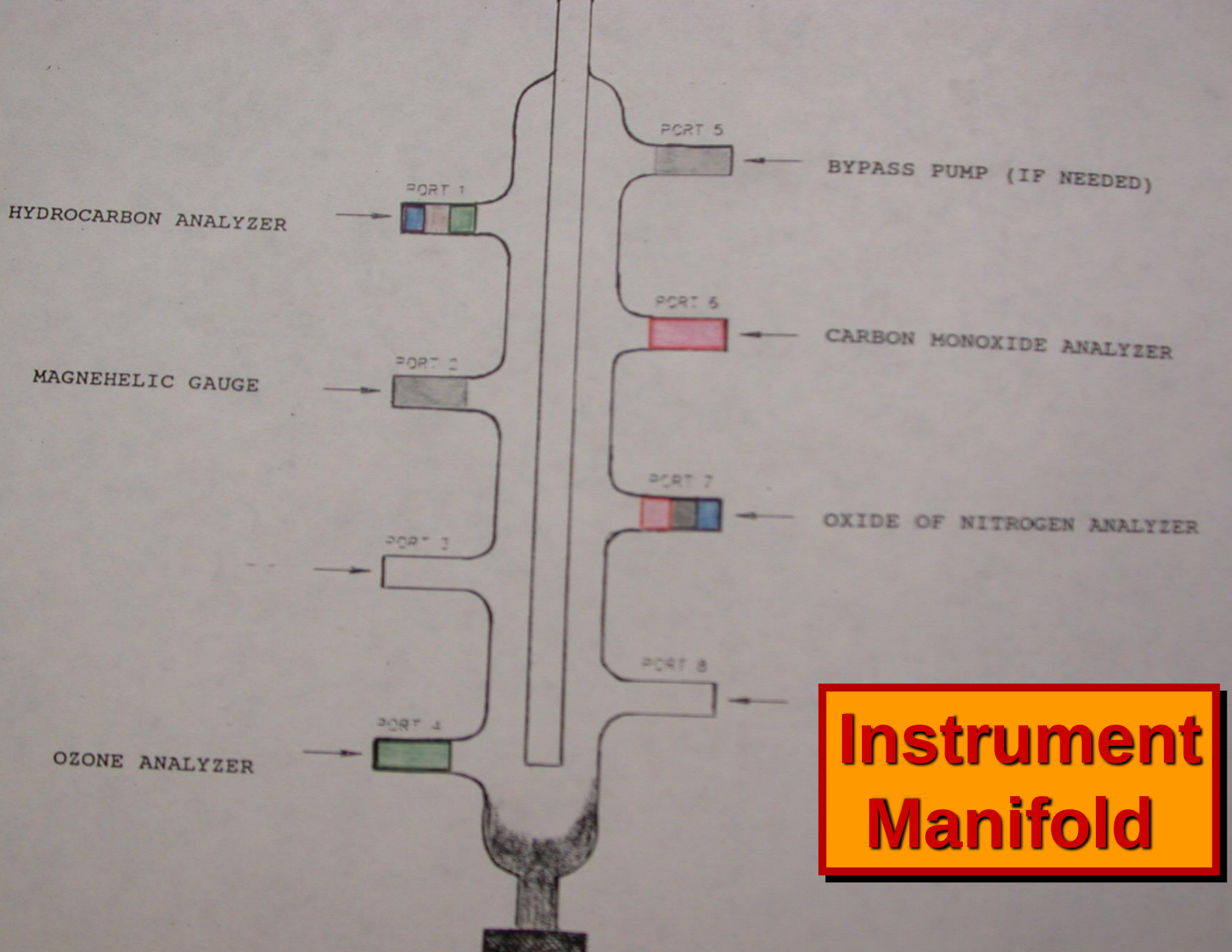
- Site Description
  - Ground Cover
  - Height of Inlet
  - Type of Samplers
  - Spacing Between Samplers
  - Inlet Boom Description and Orientation
  - Meteorological Instrument Tower Description
  - Meteorological Instrument Radiation Shield

Site Information

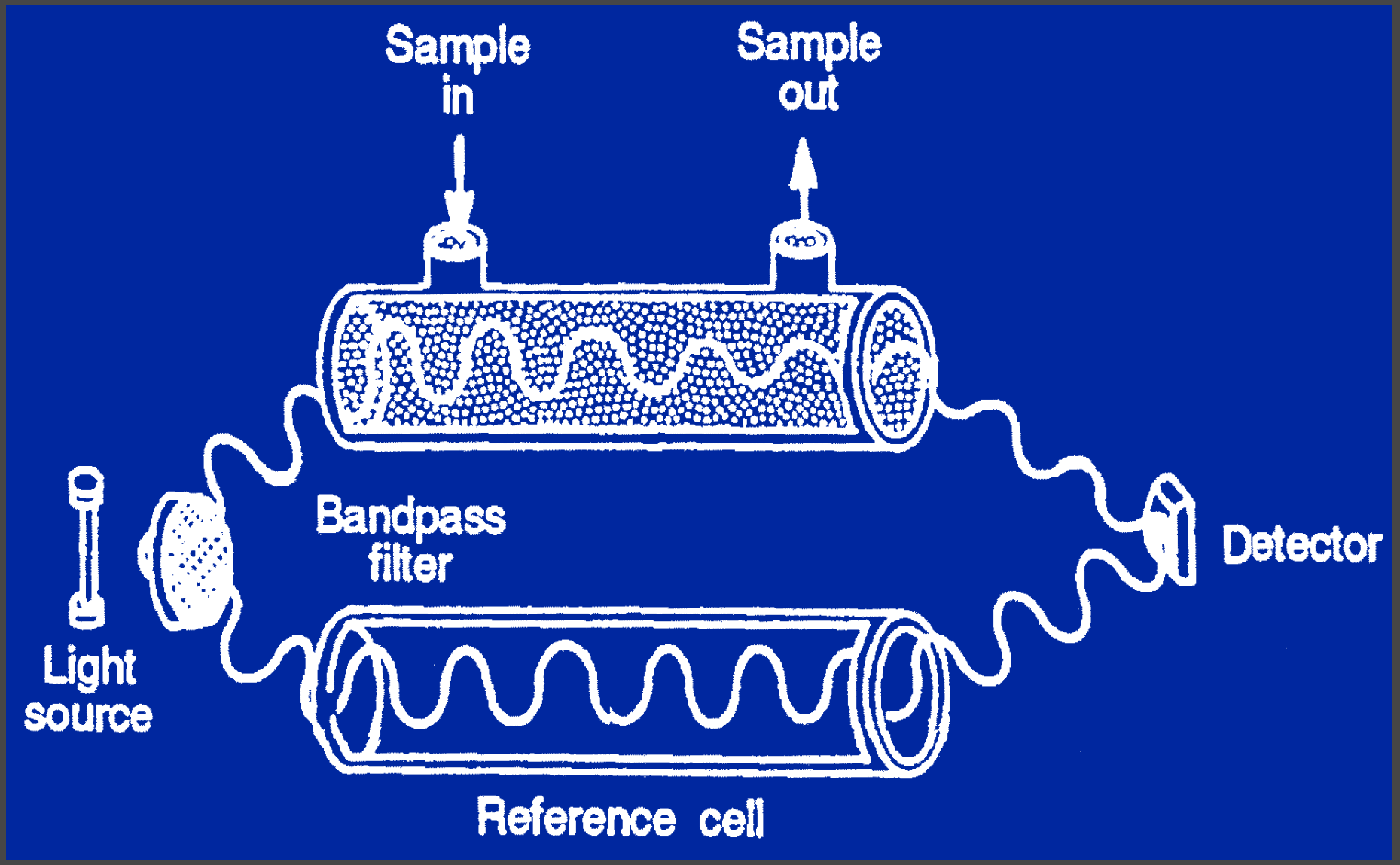
- Probe Information
  - Probe Material
  - Probe Dimensions
  - Manifold Description
  - Manifold Dimensions
  - Tubing Material
  - Tubing Dimensions
  - Residence Time
    - Probe, Manifold, Tubing, Total


Gas Inlet

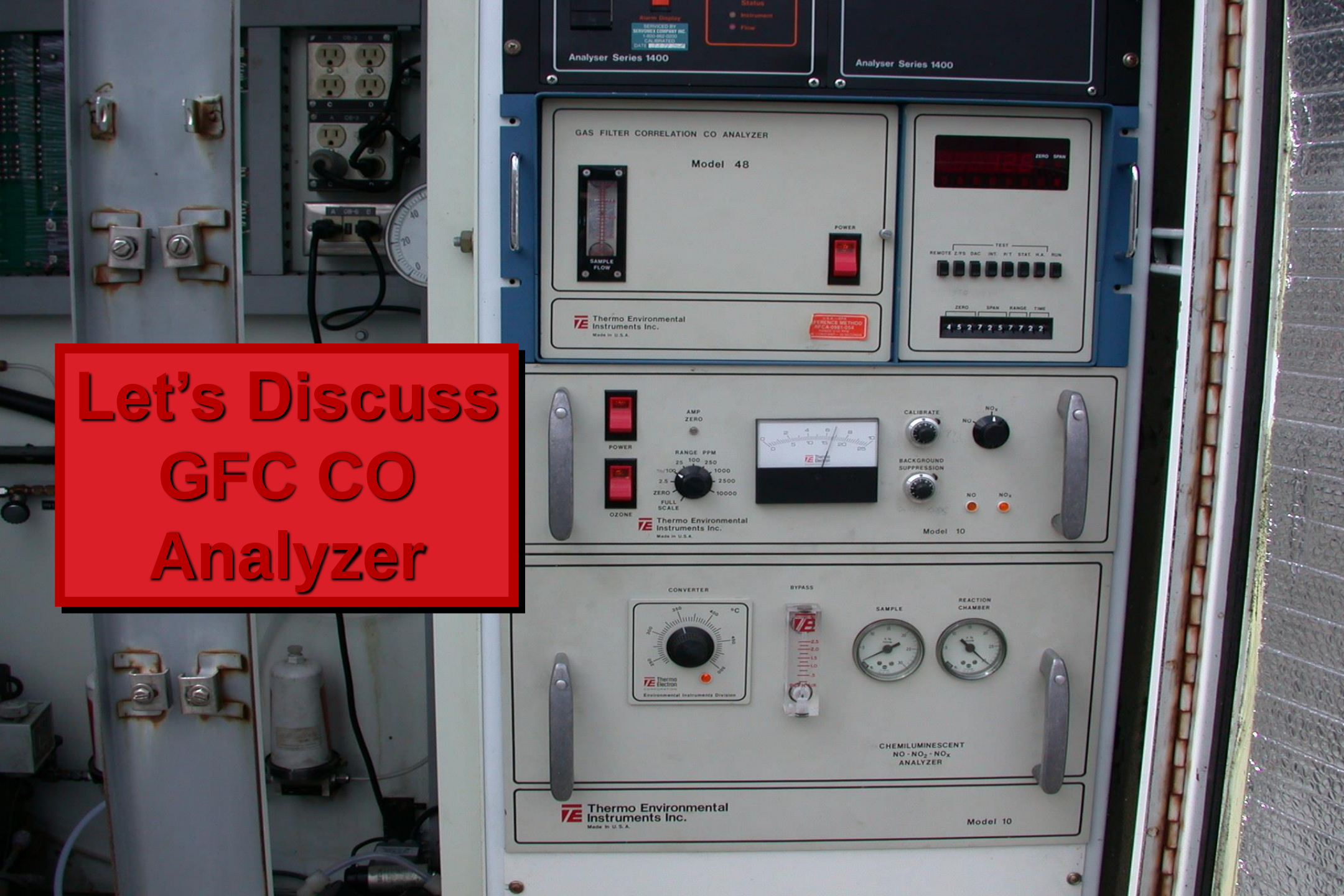

Instrument
Manifold


PORT 5
BYPASS PUMP (IF NEEDED)
PORT 1
HYDROCARBON ANALYZER
PORT 6
CARBON MONOXIDE ANALYZER
PORT 2
MAGNEHELIC GAUGE
PORT 7
OXIDE OF NITROGEN ANALYZER
PORT 3
PORT 8
PORT 4
OZONE ANALYZER
Instrument Manifold

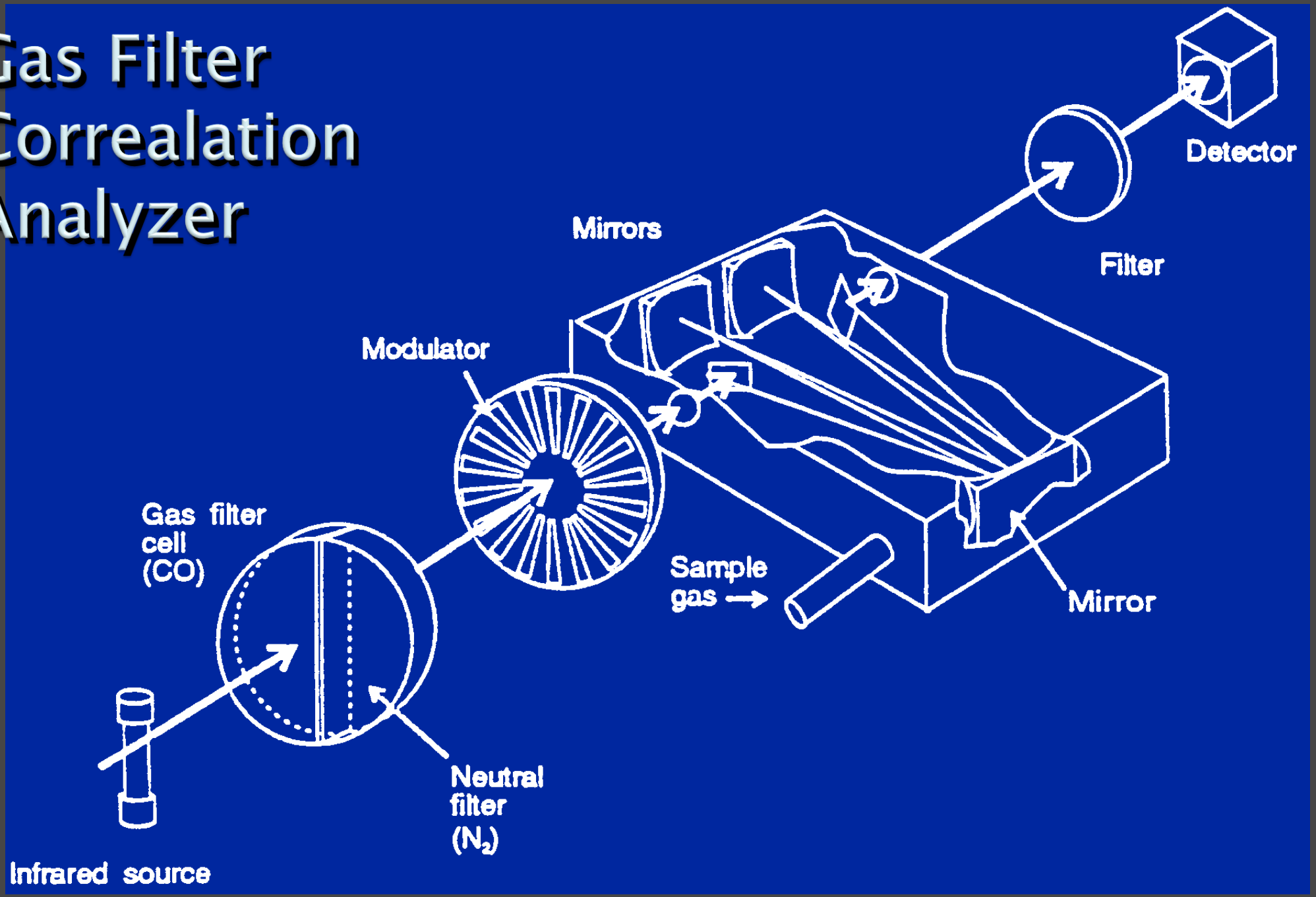
Non-Dispersive IR Analyzer




CHEMILUMINESCENCE NOx ANALYZER
POWER
Thermo Environmental Instruments Inc.
Made in U.S.A.
Model 42D
A-0.001
REM ENT Z/FS DISP CAL STAT MAN AUTO
GAS FILTER CORRELATION CO ANALYZER
SAMPLE FLOW
POWER
Thermo Environmental Instruments Inc.
Made in U.S.A.
Model 48
ZERO SPAN
TEST
REMOTE Z/FS DAC INT. P/T STAT. H.A. RUN
ZERO LO SPAN HI SPAN T
NOx & CO Analyzer

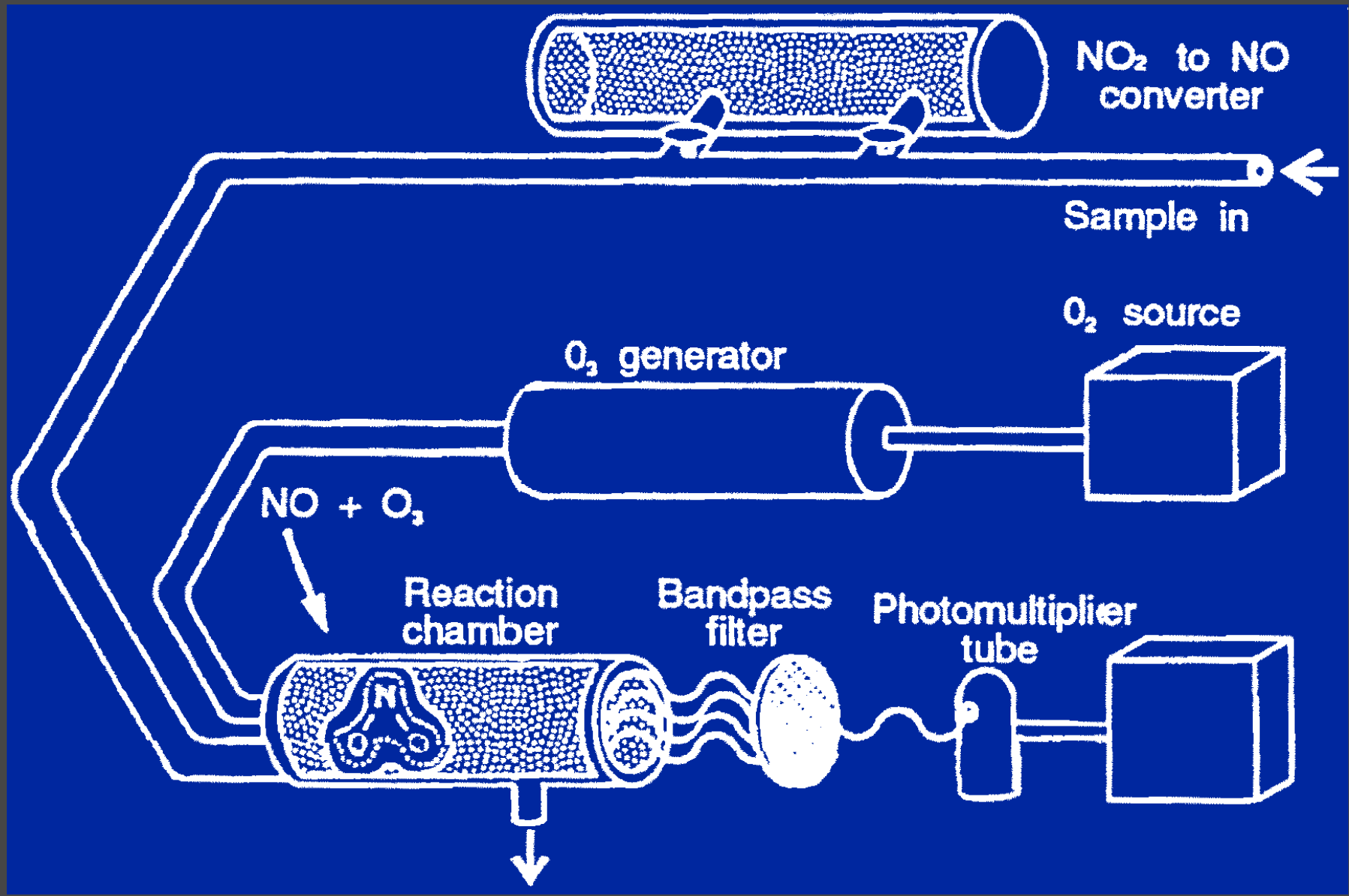

Let's Discuss
GFC CO
Analyzer
Analyser Series 1400
Analyser Series 1400
GAS FILTER CORRELATION CO ANALYZER
Model 48
SAMPLE FLOW
POWER
Thermo Environmental Instruments Inc.
Made in U.S.A.
ZERO SPAN
TEST
REMOTE
ZERO
SPAN
RANGE
TIME
POWER
OZONE
AMP ZERO
RANGE PPM
ZERO
FULL SCALE
CALIBRATE
BACKGROUND SUPPRESSION
NO
NOx
Thermo Environmental Instruments Inc.
Model 10
CONVERTER
BYPASS
SAMPLE
REACTION CHAMBER
Thermo Electron
Environmental Instruments Division
CHEMILUMINESCENT
NO - NO2 - NOx
ANALYZER
Thermo Environmental Instruments Inc.
Made in U.S.A.
Model 10

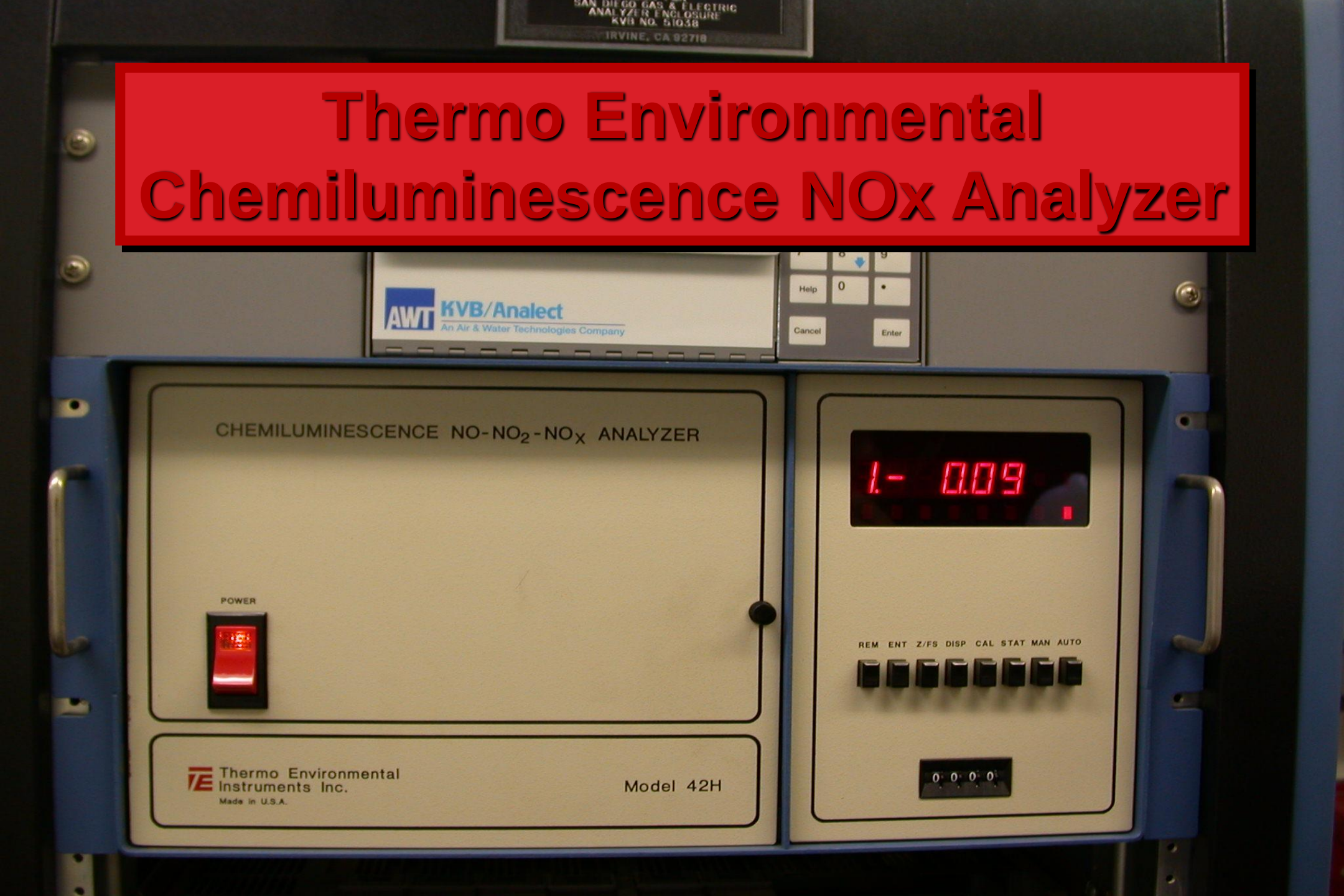
Gas Filter Correalation Analyzer

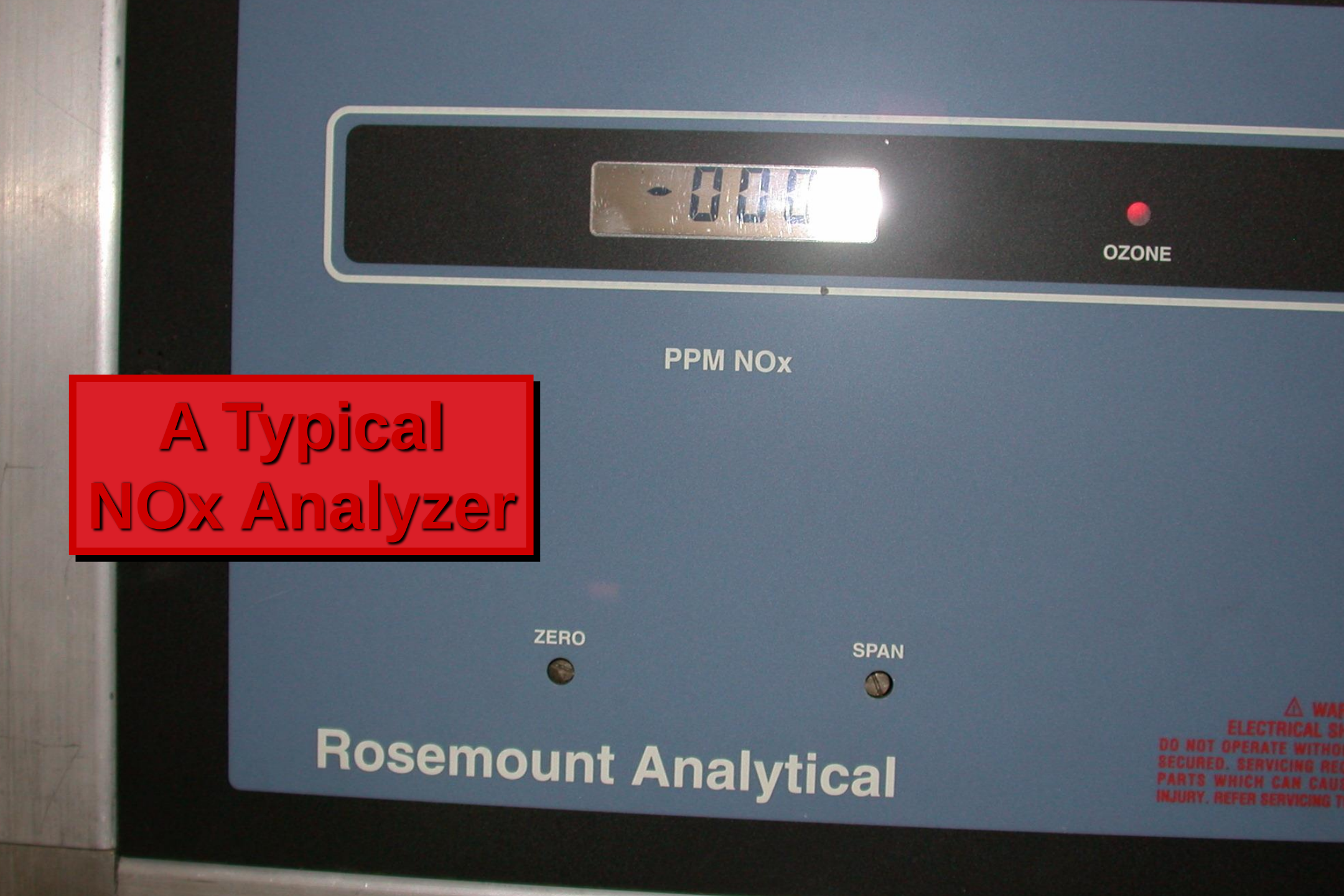



Looking Inside
a GFC CO
Analyzer

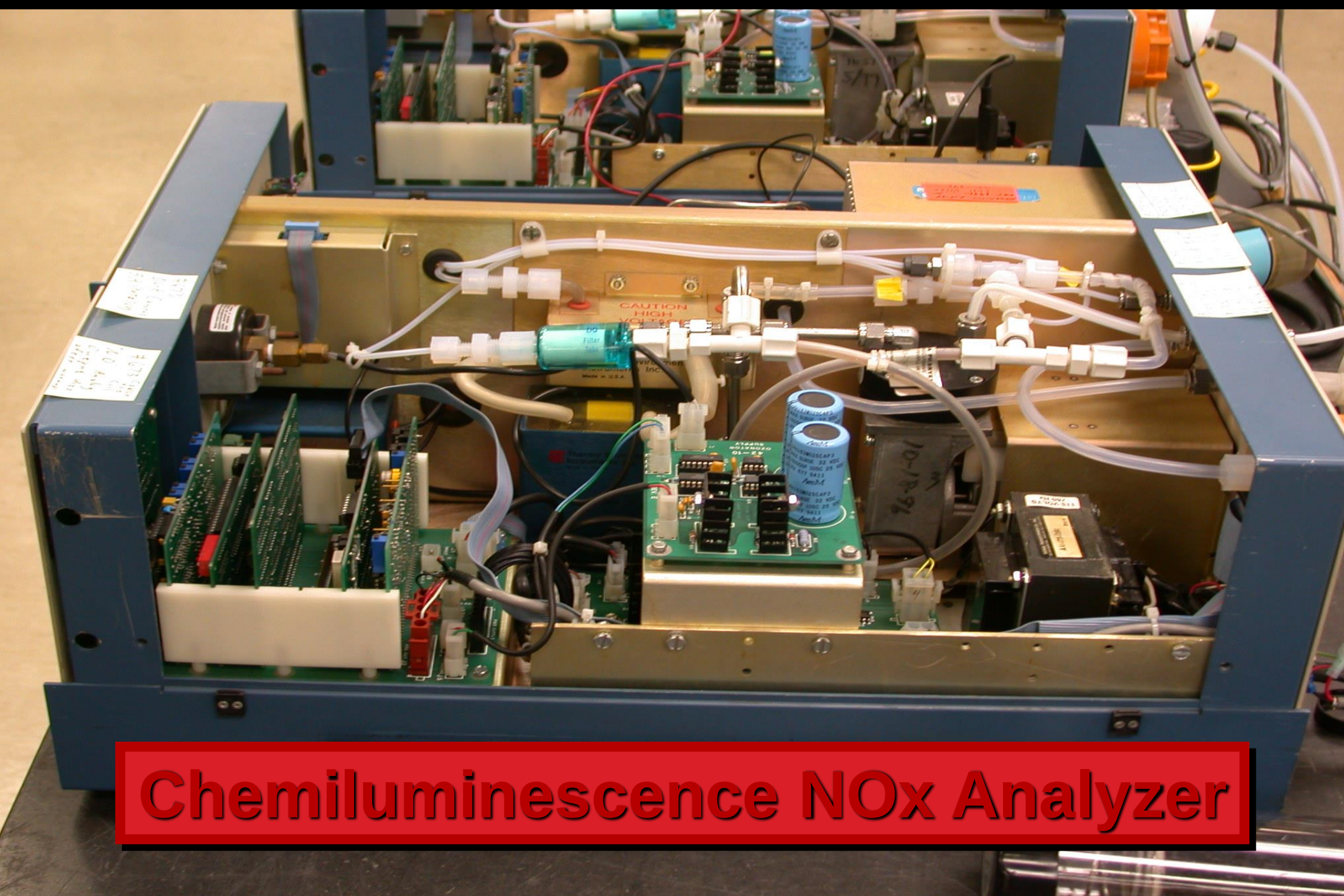
Chemiluminescence NO_x Analyzer



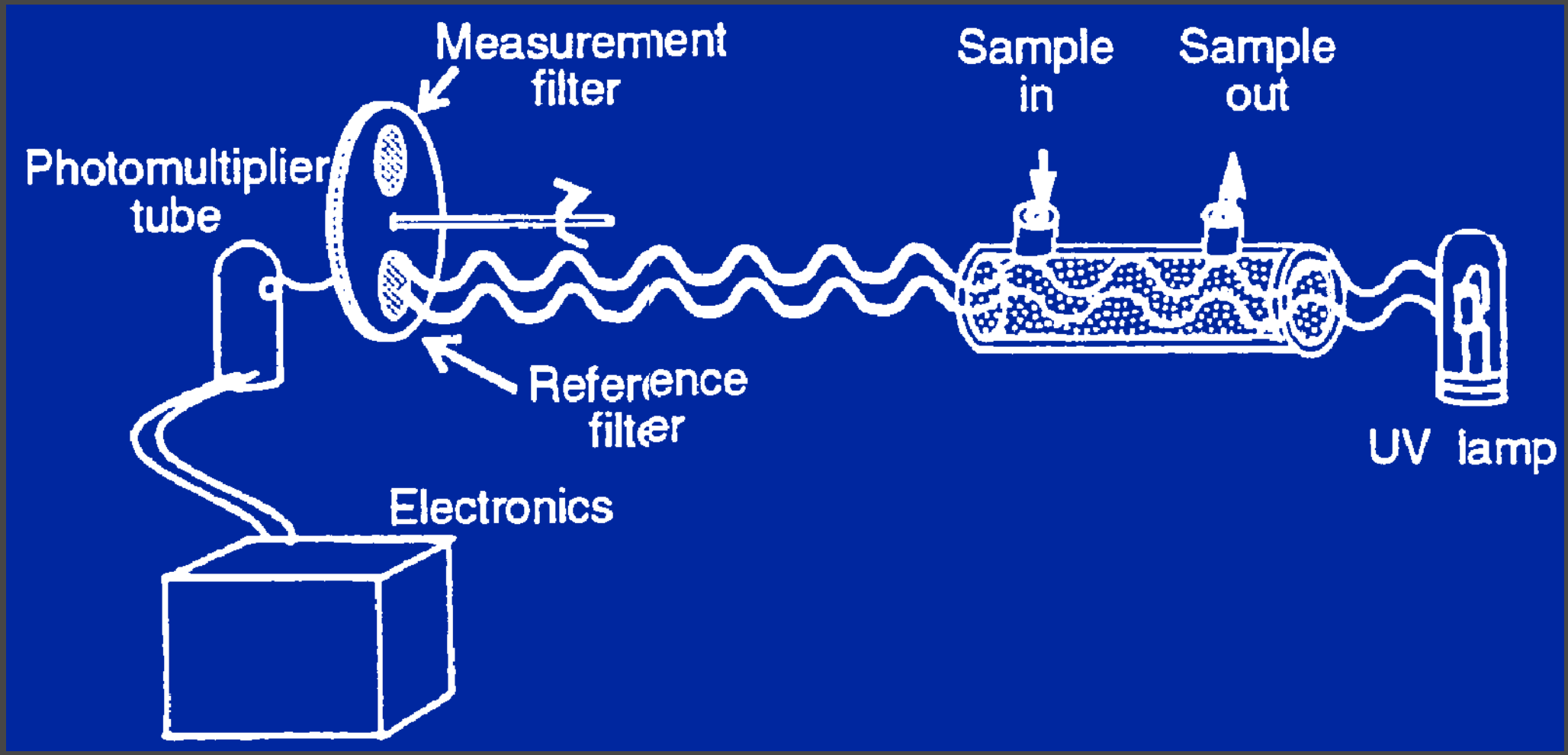

SAN DIEGO GAS & ELECTRIC
ANALYZER ENCLOSURE
KVB NO. 51038
IRVINE, CA 92718
Thermo Environmental
Chemiluminescence NOx Analyzer
AWT KVB/Analect
An Air & Water Technologies Company
Help
0
Cancel
Enter
CHEMILUMINESCENCE NO-NO2-NOX ANALYZER
POWER
1.- 0.09
REM ENT Z/FS DISP CAL STAT MAN AUTO
0 0 0 0
Thermo Environmental
Instruments Inc.
Made in U.S.A.
Model 42H



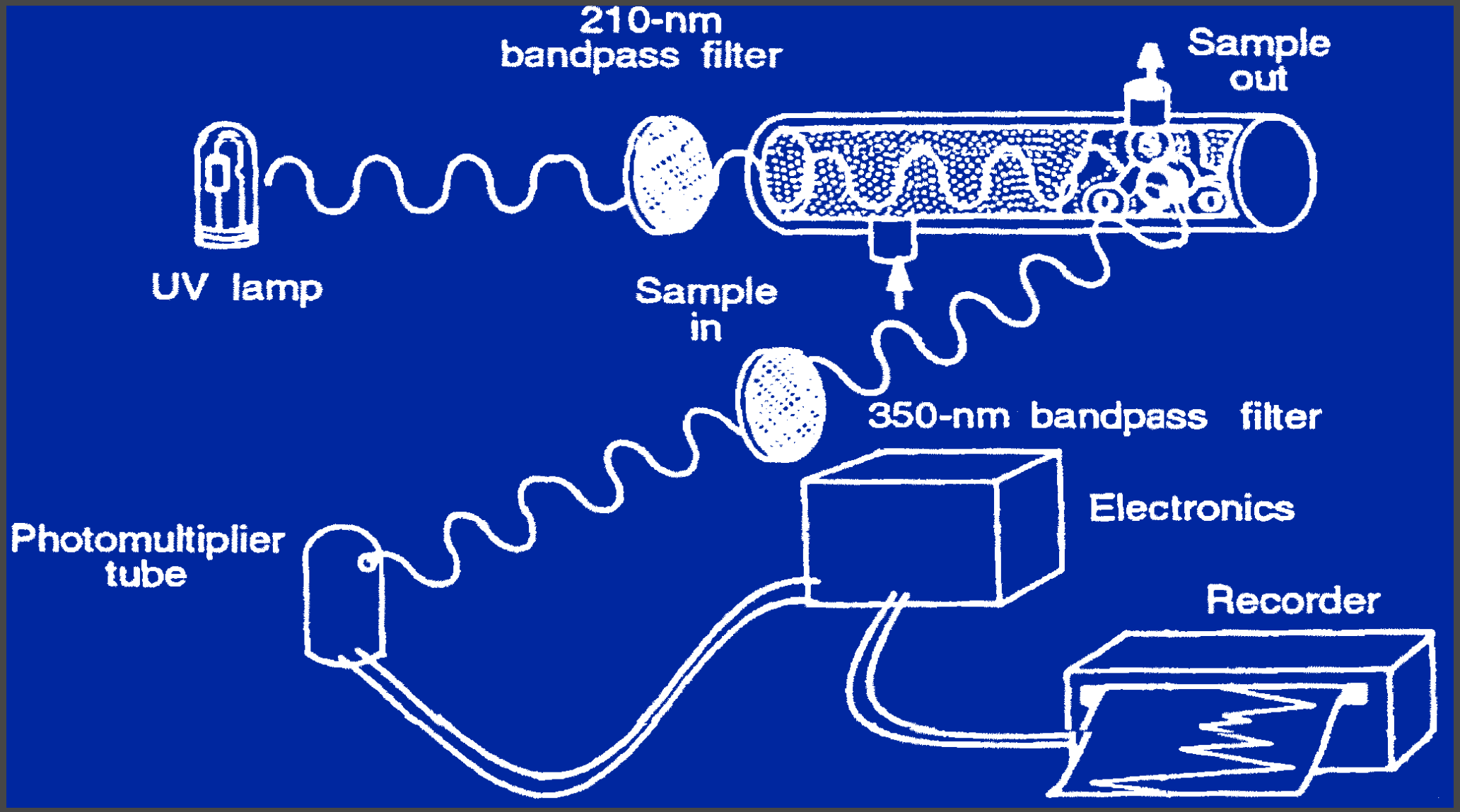
A Typical NOx Analyzer

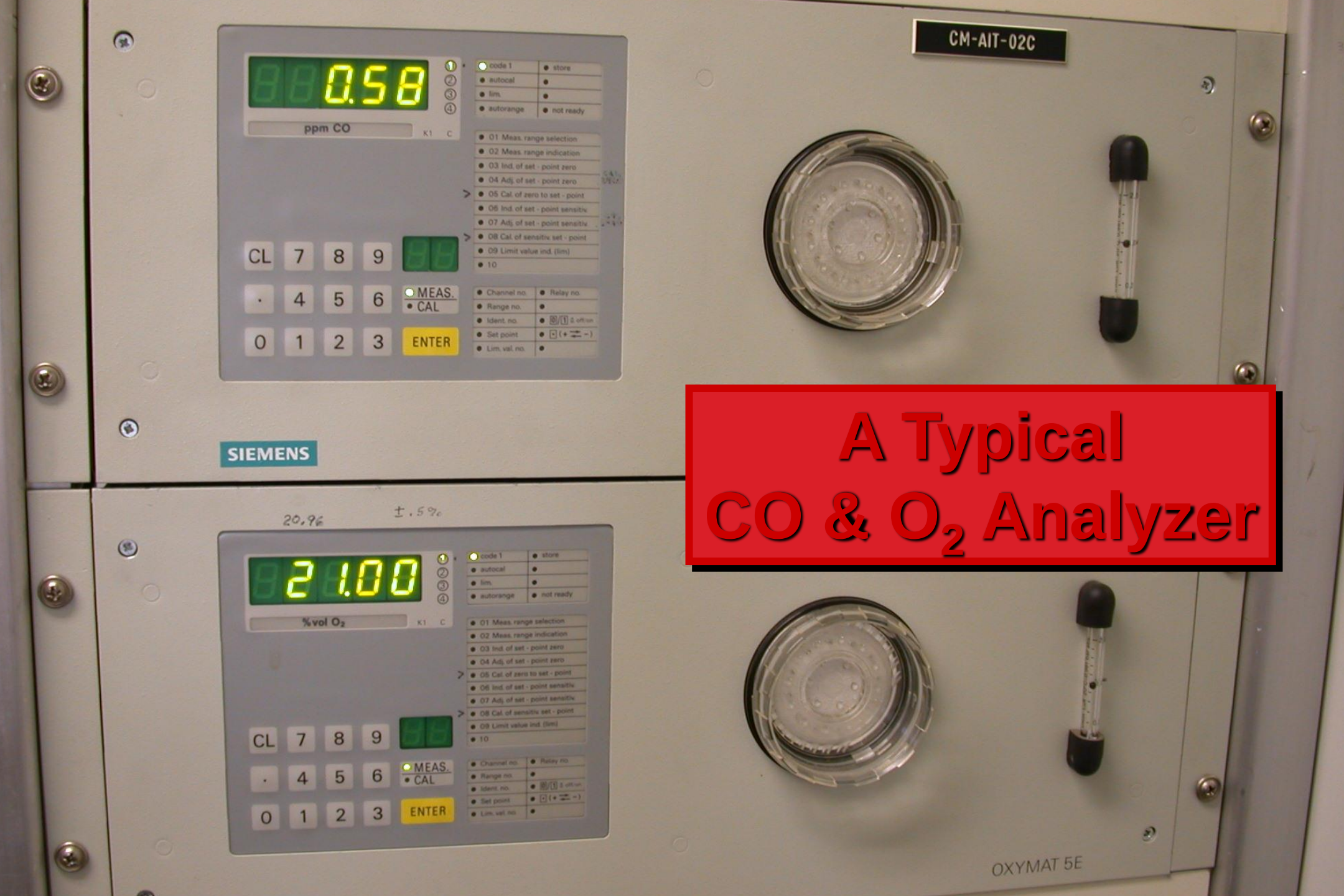

Chemiluminescence NOx Analyzer

Non-Dispersive UV Analyzer



Fluorescence SO_2 Analyzer

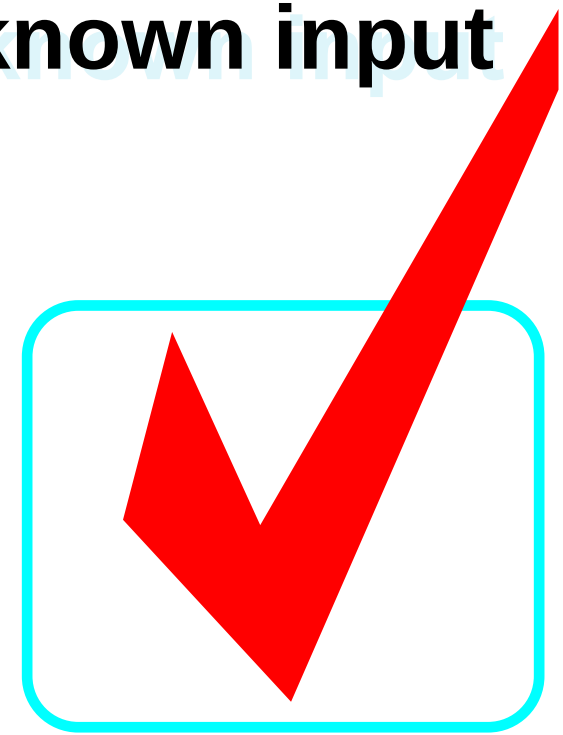



CM-AIT-02C
0.58
ppm CO
SIEMENS
20.96
±.5%
21.00
%vol O2
OXYMAT 5E
A Typical
CO & O2 Analyzer

Calibrations and Zero Air

Calibration is the process of establishing the relationship between the output of a measurement process and a known input

- Pure (zero) air generators
- Certified cylinder gases
- Dilution calibration systems




Calibration
Gases


Calibration Gases

EPA 600/R-12/531 | May 2012 | www.epa.gov/ord

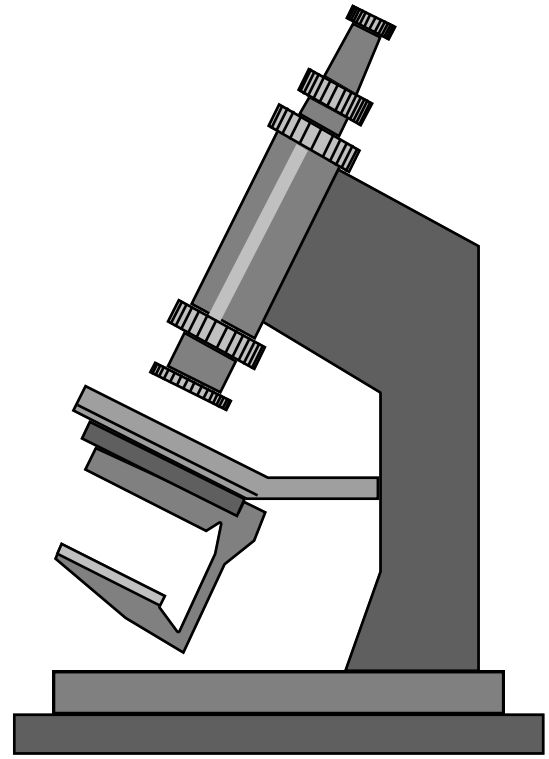
EPA
United States
Environmental Protection
Agency

EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards

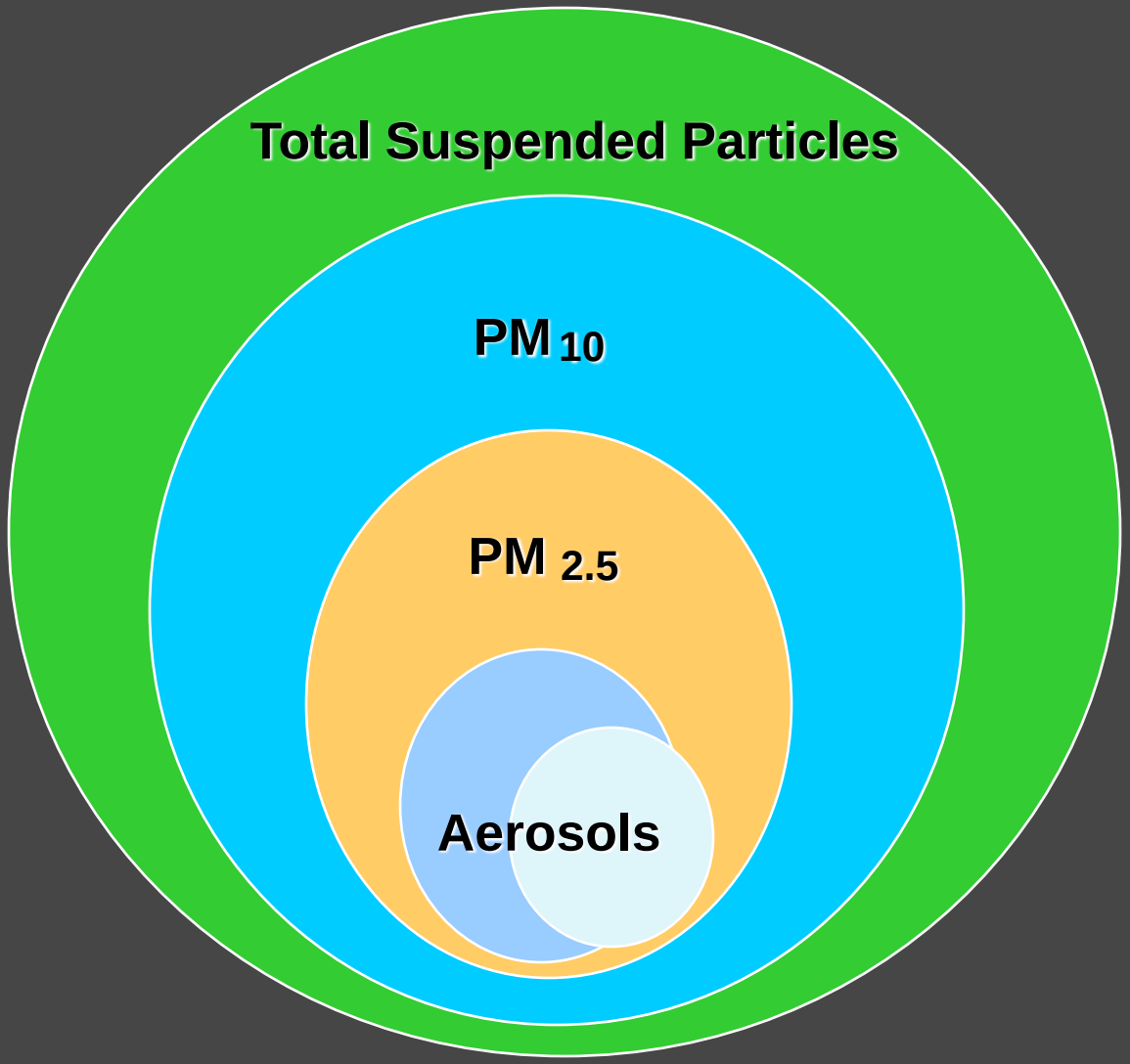
SCIENCE

Particulate Properties

- Collected Mass
- Inertial Properties
- Particle Size
- Optical Density
  - Haze and Opacity in the Air
  - Density of Collected Deposit



Measures of Particulate Matter in the Atmosphere

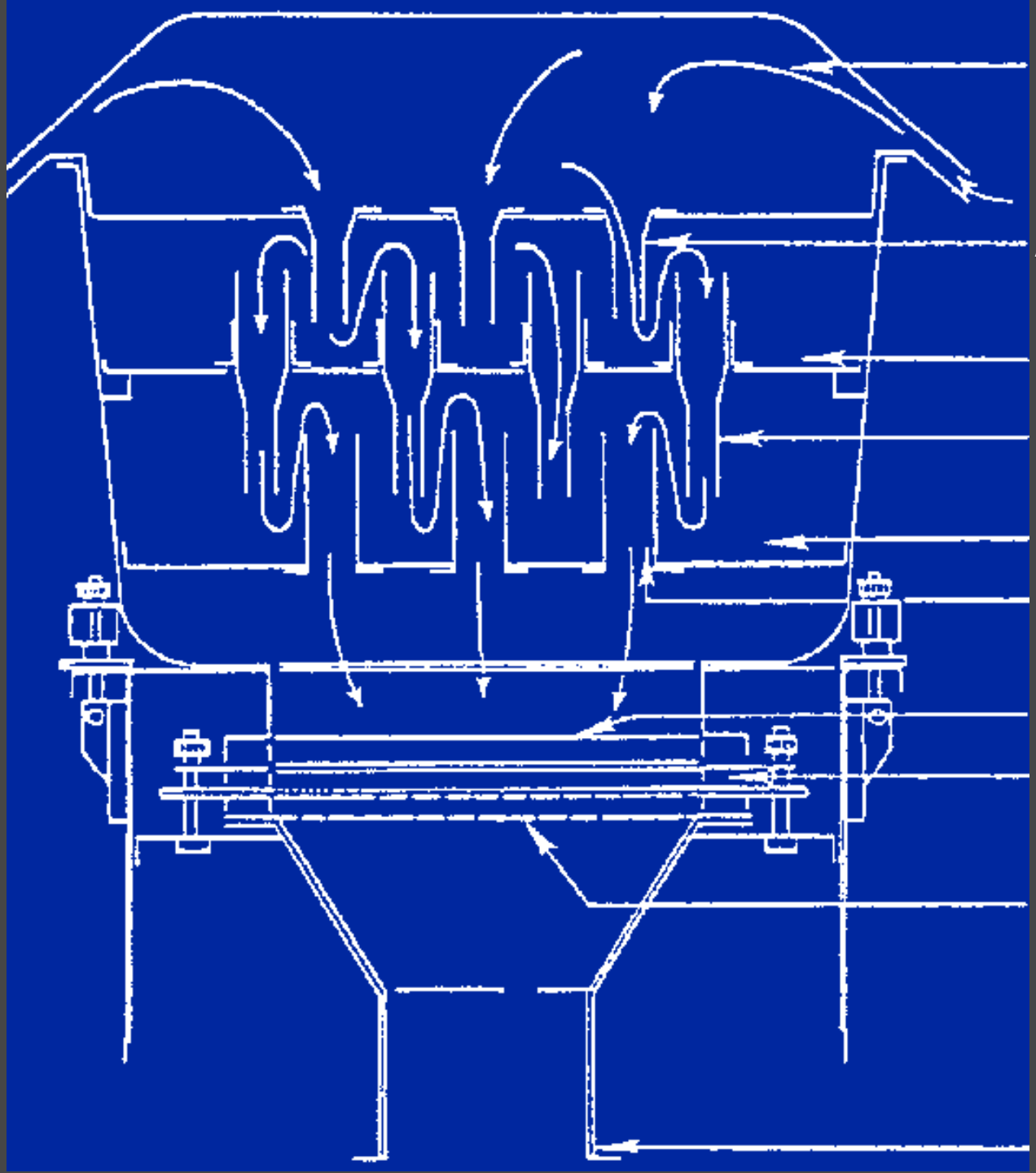


Particulate

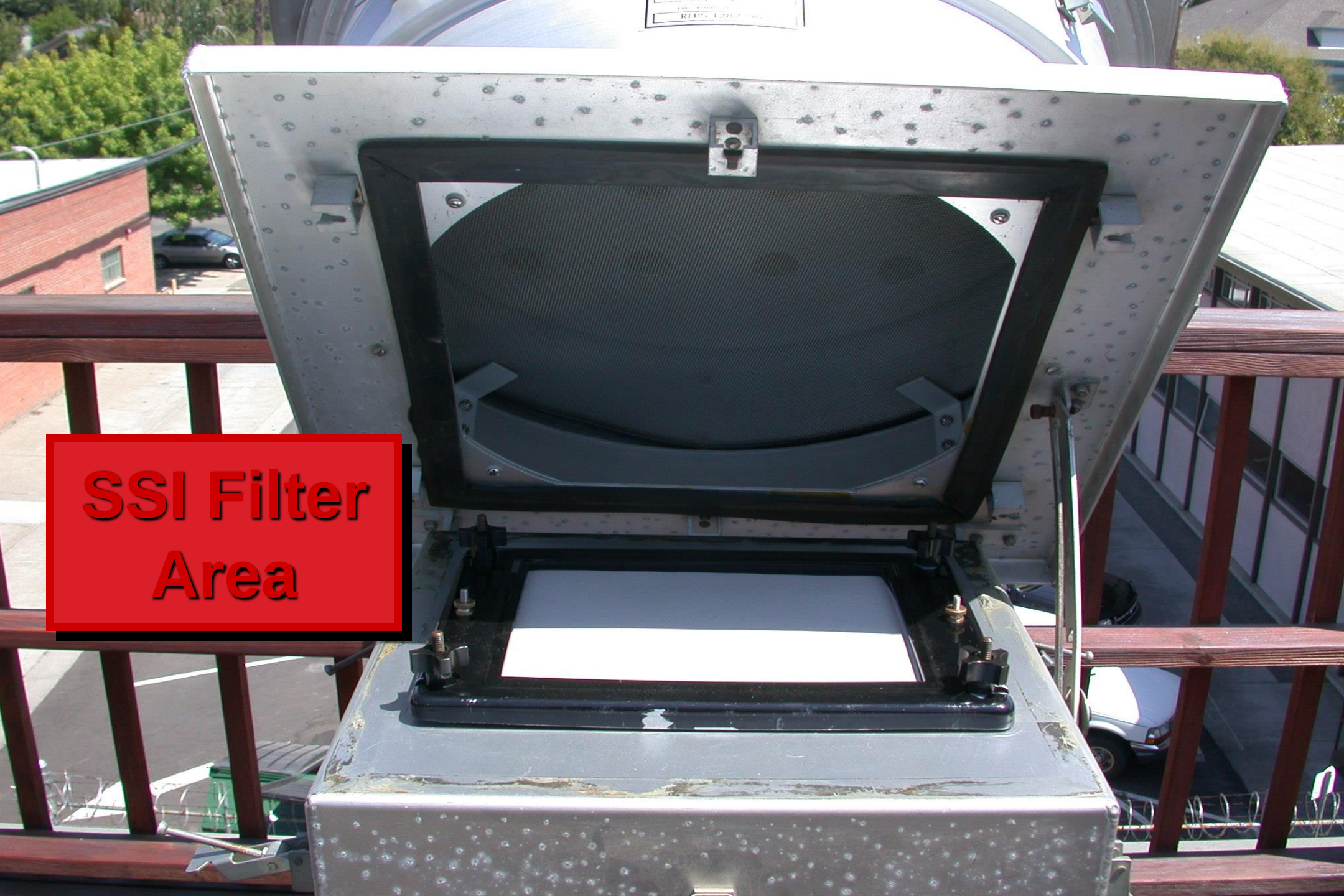
- Total Suspended Particulate (TSP) Samplers
  - Lead
- PM10 and/or PM2.5 samplers
  - Size Selective Inlet
  - BAM
  - TEOM
- Visibility Samplers
  - Nephelometer
  - Optical Test Tape Sampler


Size
Selective
Inlet (SSI)
Sampler

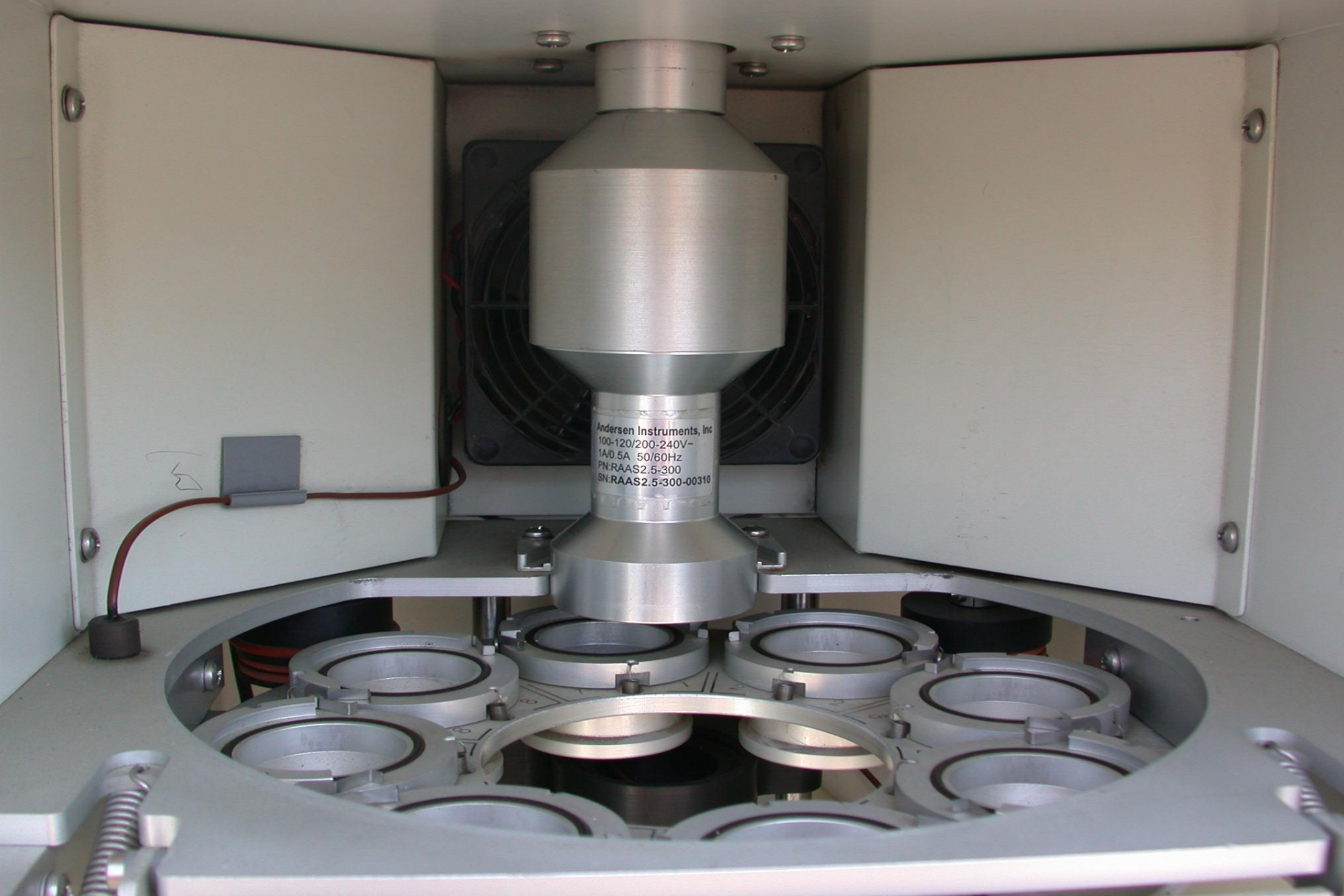
PM_{10} – Size Selective Inlet (SSI)



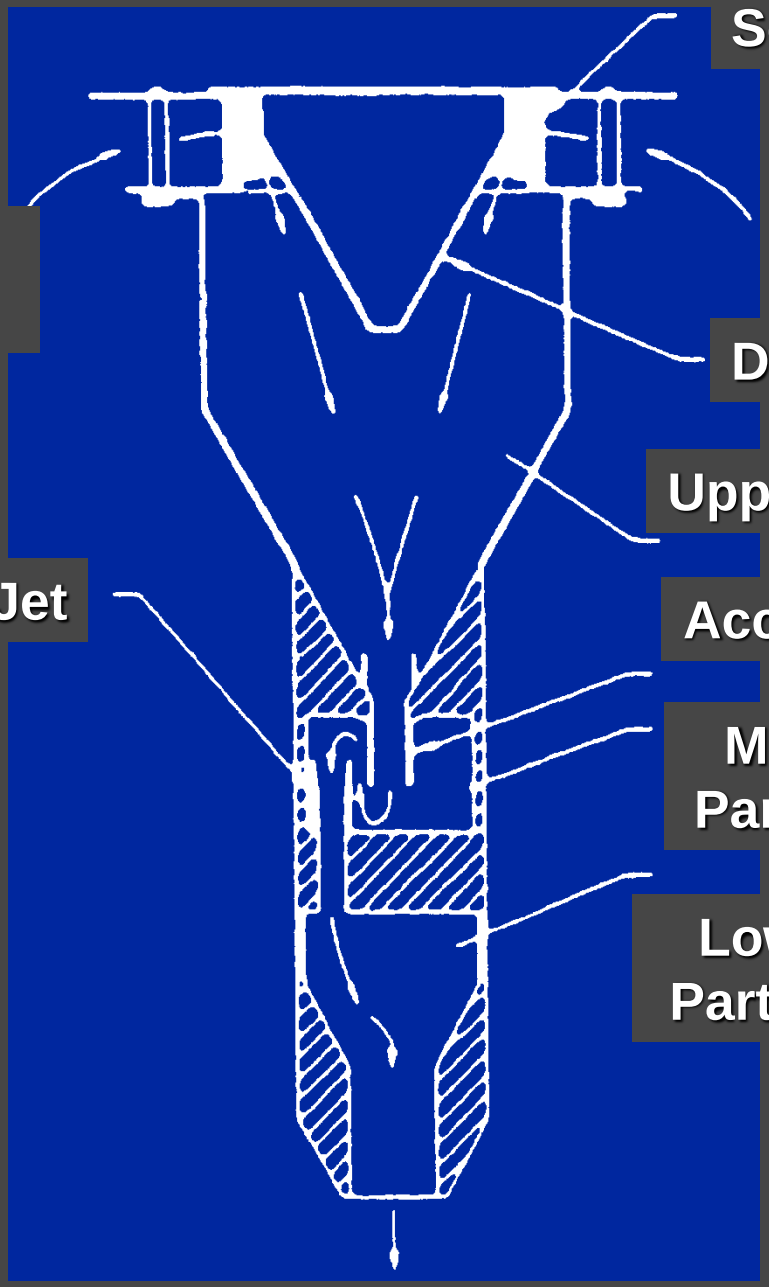

Inside SSI Head


SSI Filter
Area

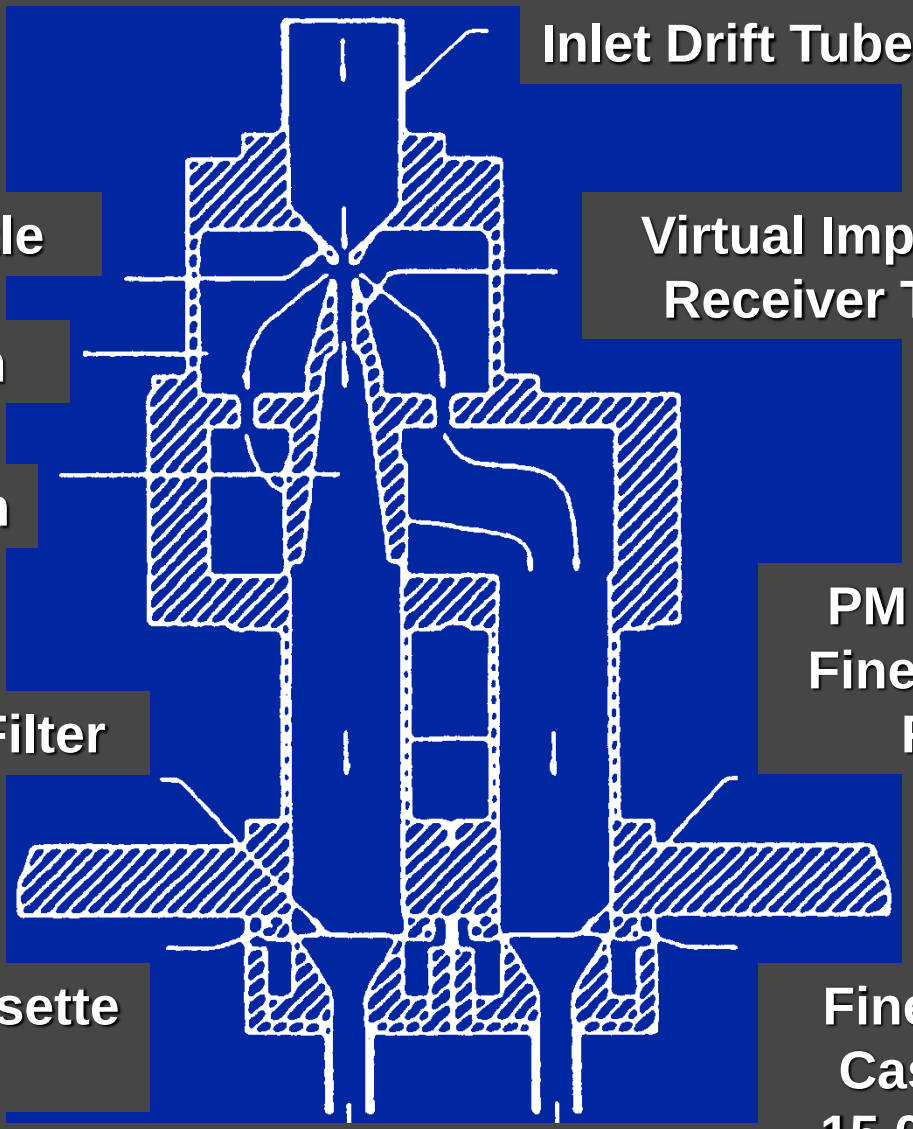

PM2.5
Sampler


Andersen Instruments, Inc
100-120/200-240V~
1A/0.5A 50/60Hz
PN:RAAS2.5-300
SN:RAAS2.5-300-00310

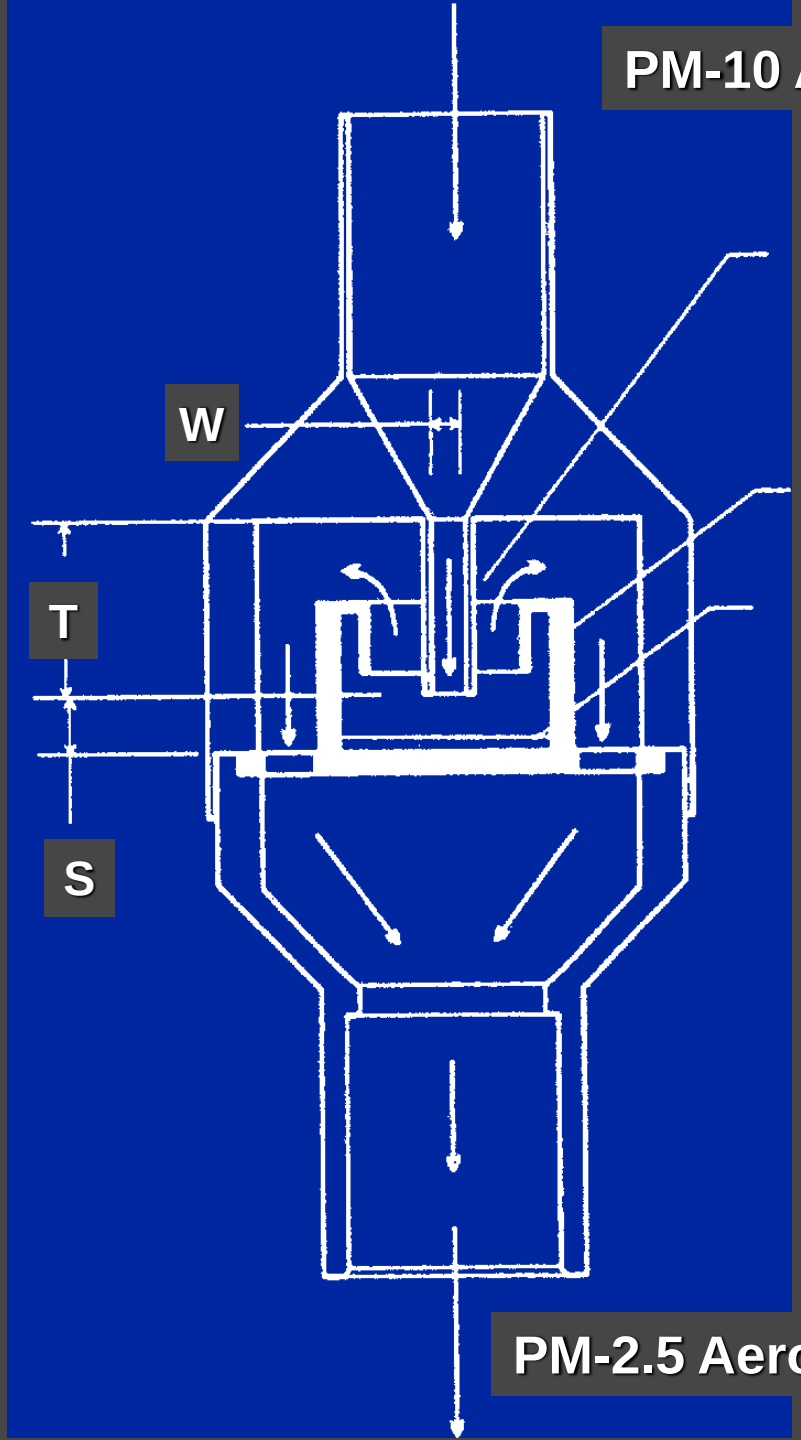
PM_{10} Size Selective Inlet



Virtual Impactor



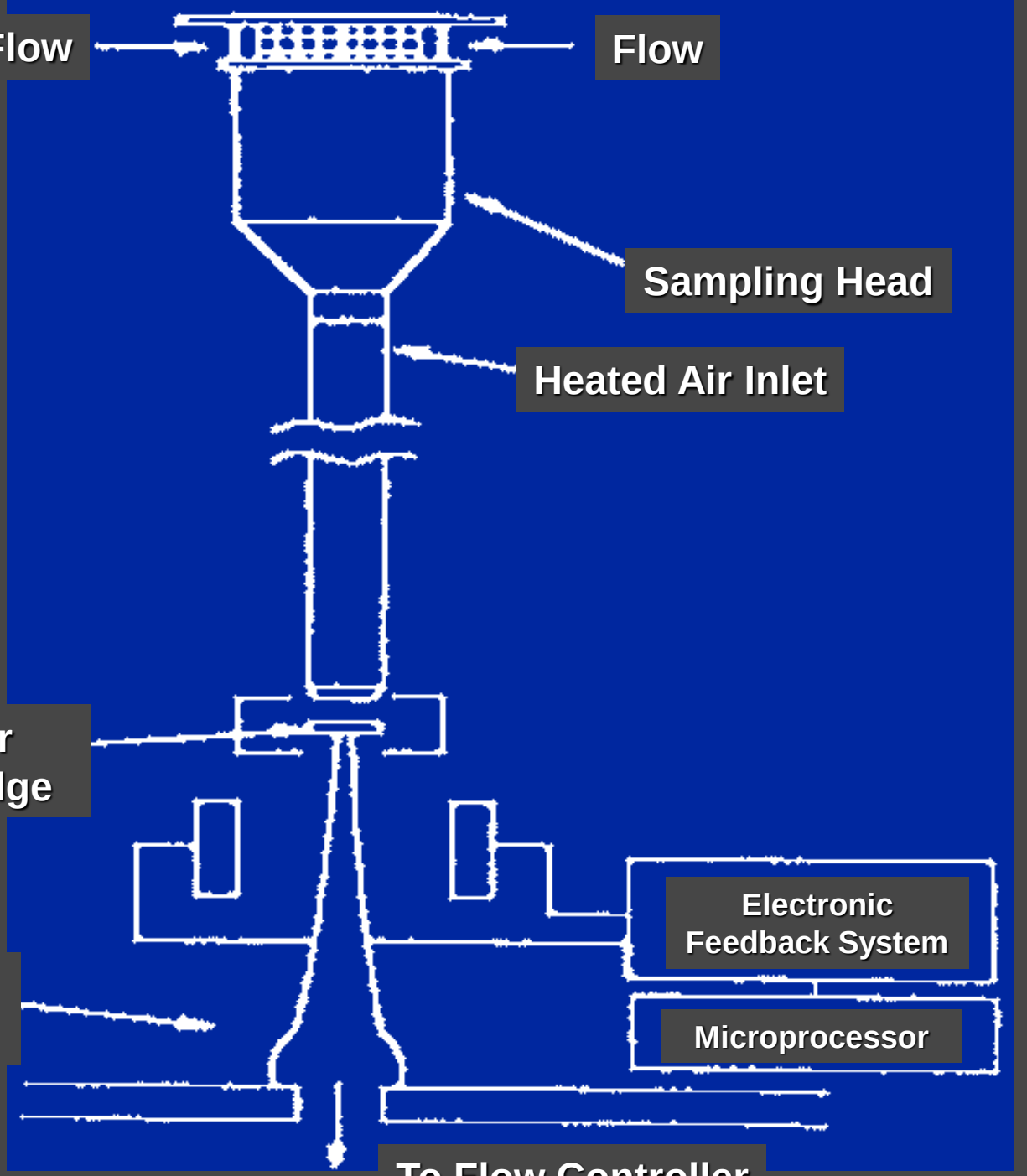
EPA–WINS $PM_{2.5}$ Impactor



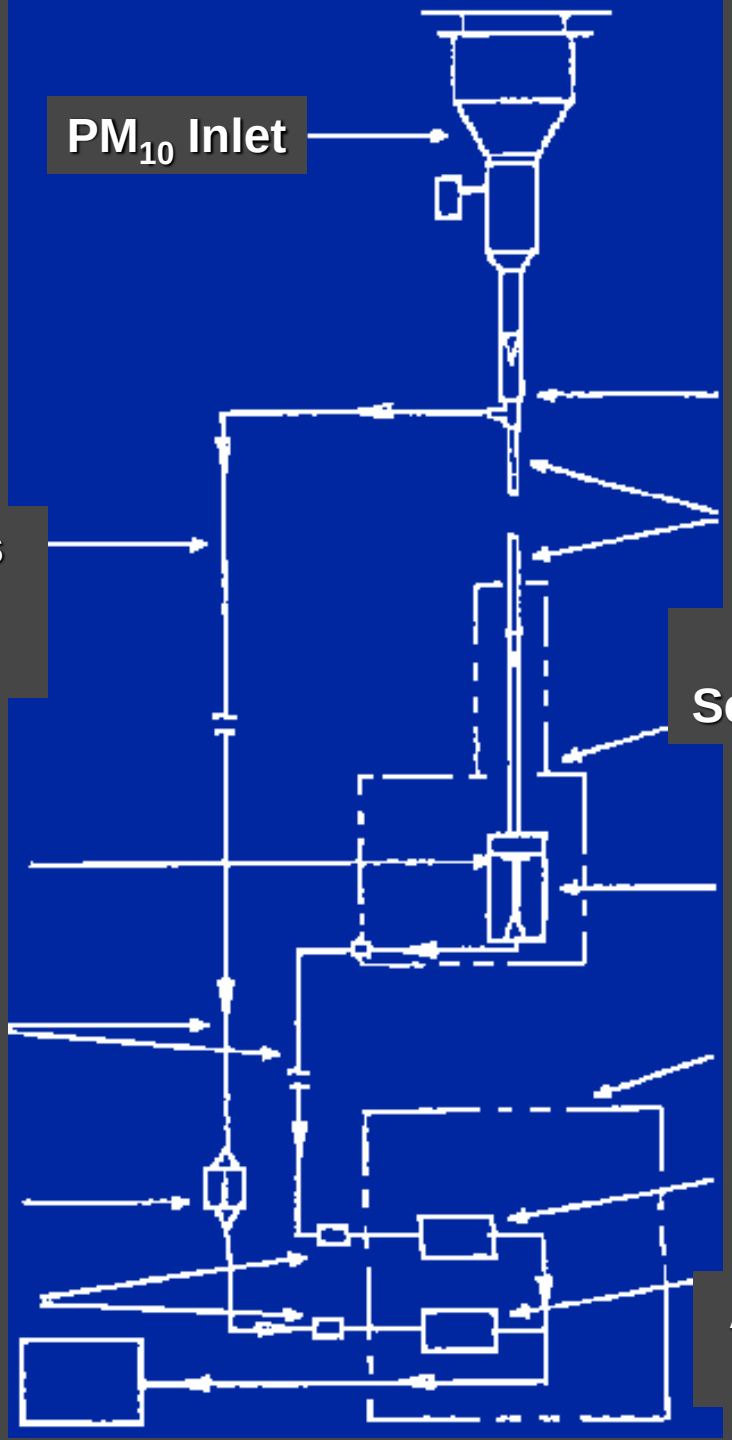
Tapered Element Oscillating Microbalance (TEOM) Inlet

PM_{10} – TEOM

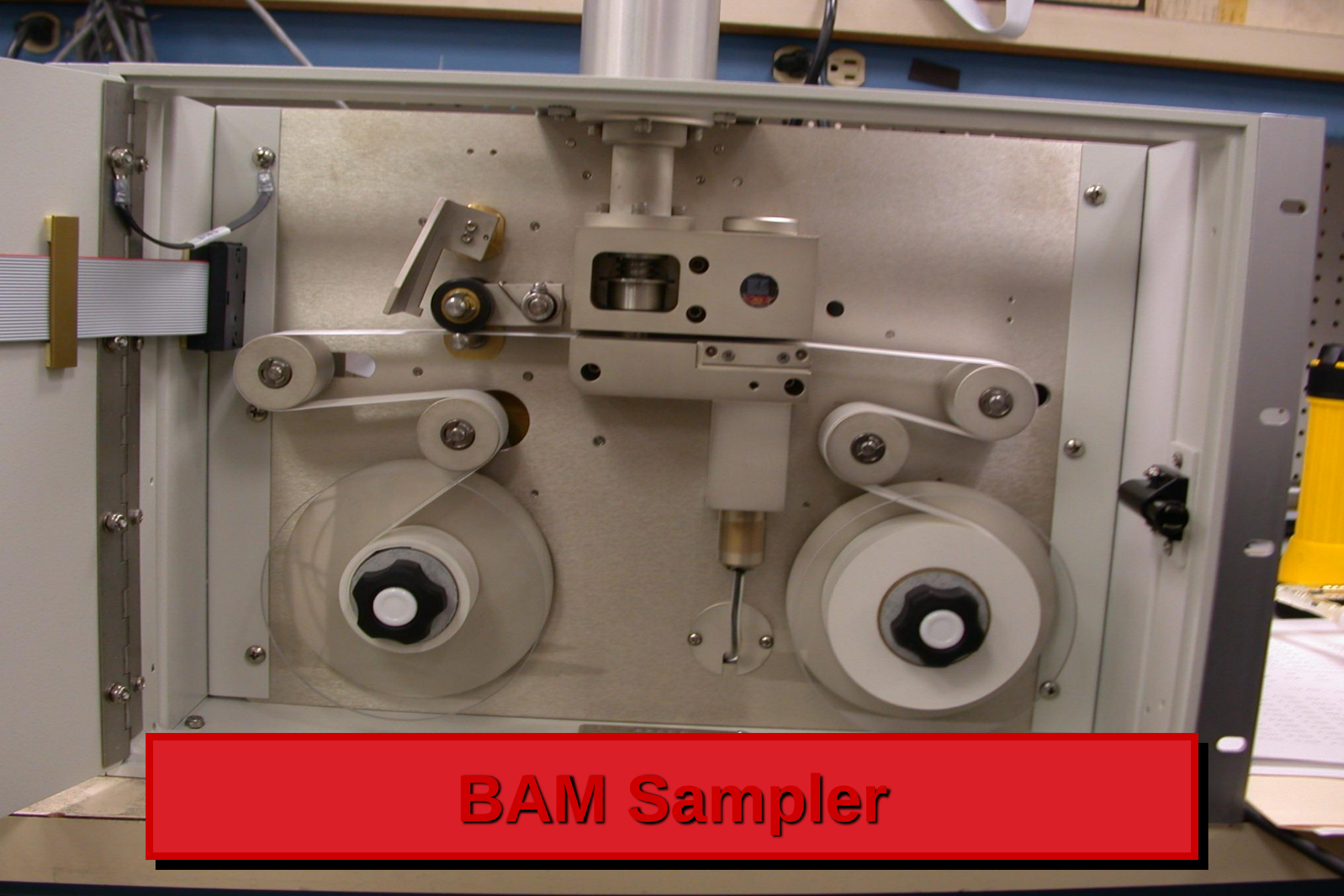
Tapered Element



PM_{10} – TEOM


PM_{10} Inlet
Flow Splitter
Sample Tube
Bypass Flow Line
TEOM Sensor Unit
TEOM Filter
Mass Transducer
Air Tubes
TEOM Control Unit
Bypass Fine Particle Filter Assembly
Main Flow Controller
Inline Filters
Auxiliary Flow Controller
Vacuum Pump

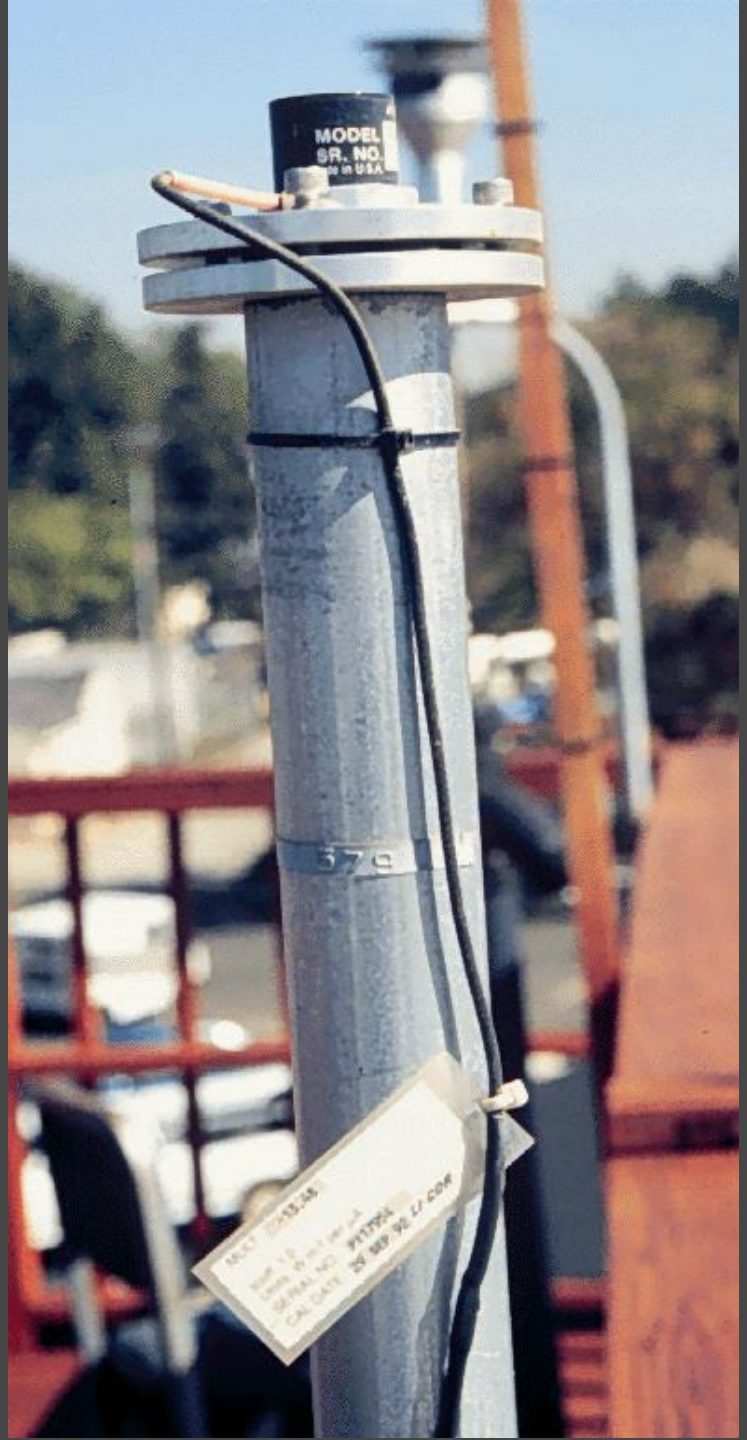

MAX 85%
Series 1400a
TEOM® Control Unit
TEOM Series 1400 PM-10 Monitor
U.S. EPA Designated Equivalent Method
EQPM-1090-079
20003848
OK 66% NU 12:59
Mass Conc> 44.0
30-Min MC 38.1
01-Hr MC 39.6
POWER
CHECK STATUS
RS-232
ANALOG I/O
Rupprecht & Patashnick Co., Inc.


BAM Sampler

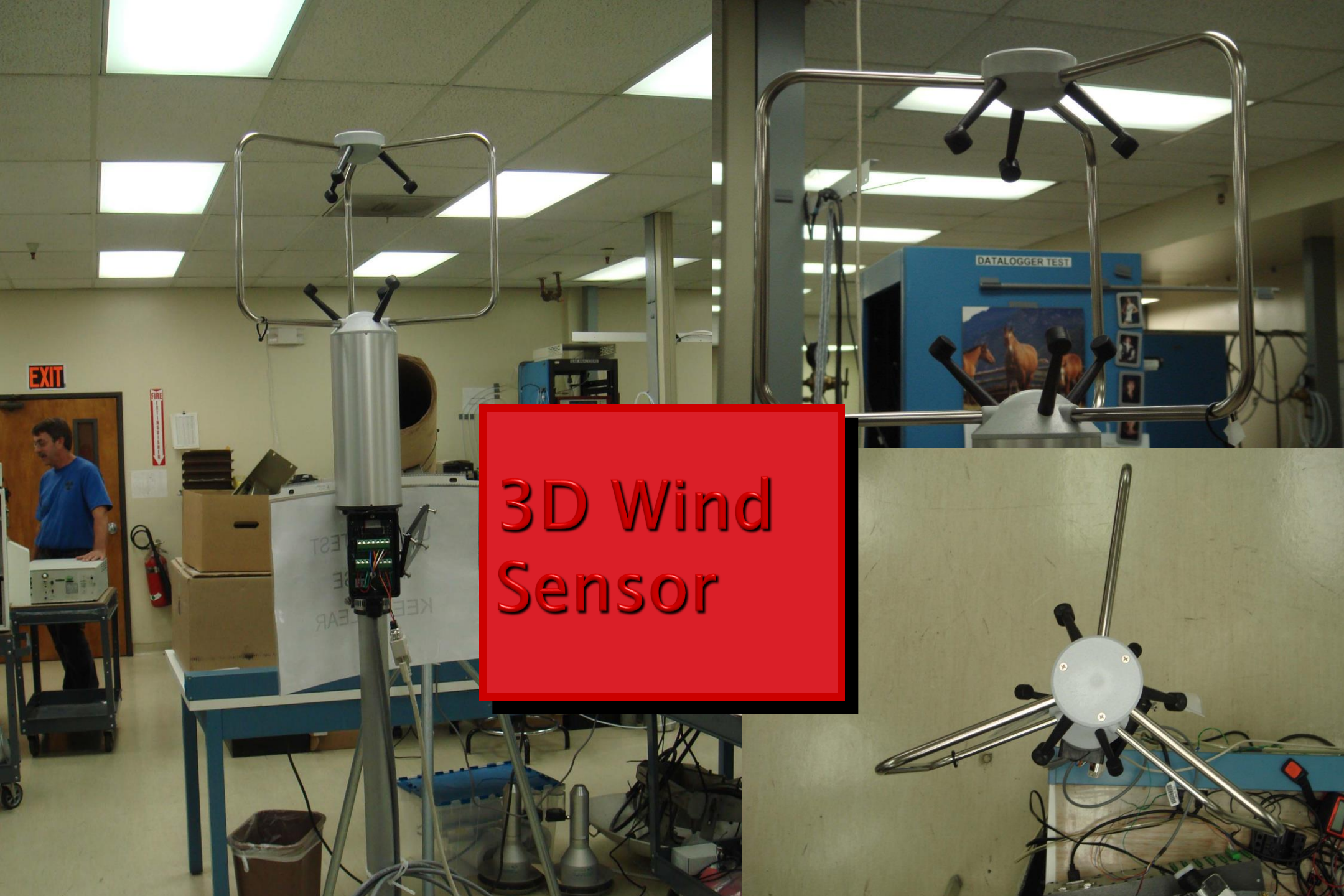

Meteorological
Instruments

Meteorological Instruments

- Wind speed
- Wind direction
- Atmospheric pressure
- Temperature
- Relative humidity, dew pt
- Solar radiation



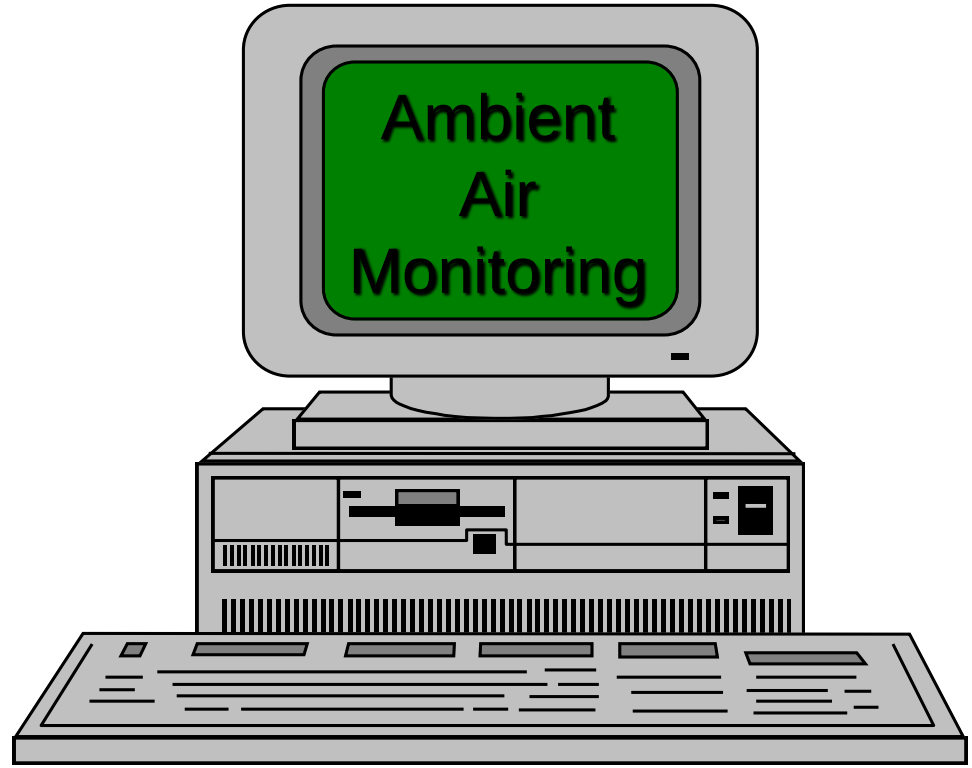
Meteorological Instruments

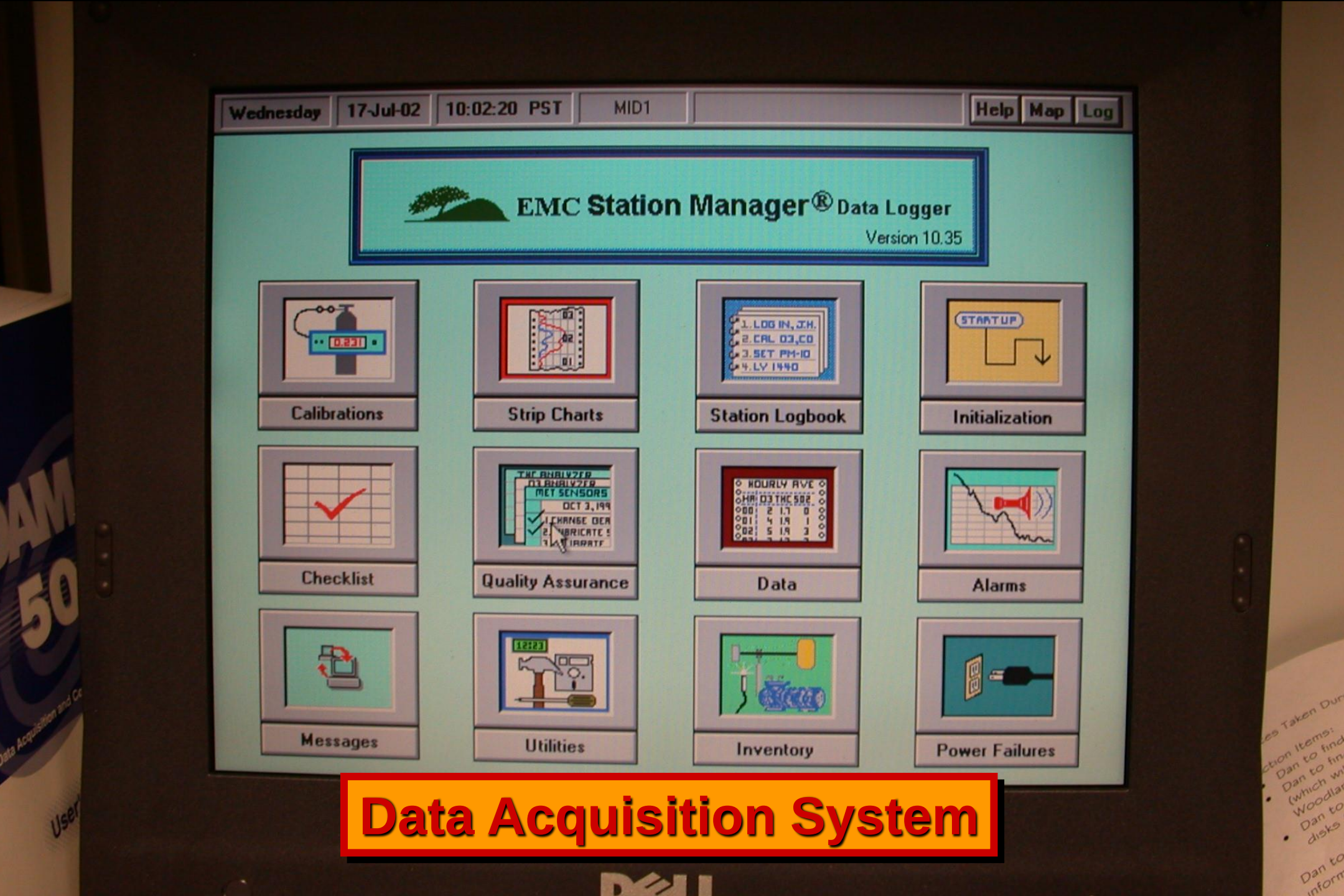

EXIT
FIRE
DATALOGGER TEST
3D Wind Sensor


DATA

Data Handling

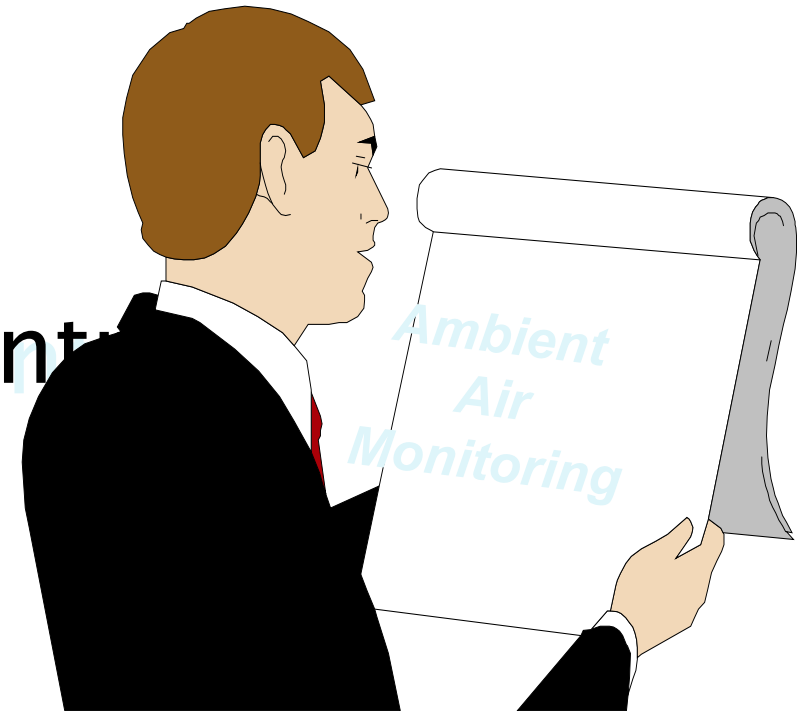
- Data loggers
  - Strip charts
  - Computers
  - Temporary data storage
  - On-line data retrieval




Wednesday
17-Jul-02
10:02:20 PST
MID1
Help
Map
Log
EMC Station Manager® Data Logger
Version 10.35
Calibrations
Strip Charts
Station Logbook
Initialization
Checklist
Quality Assurance
Data
Alarms
Messages
Utilities
Inventory
Power Failures
Data Acquisition System

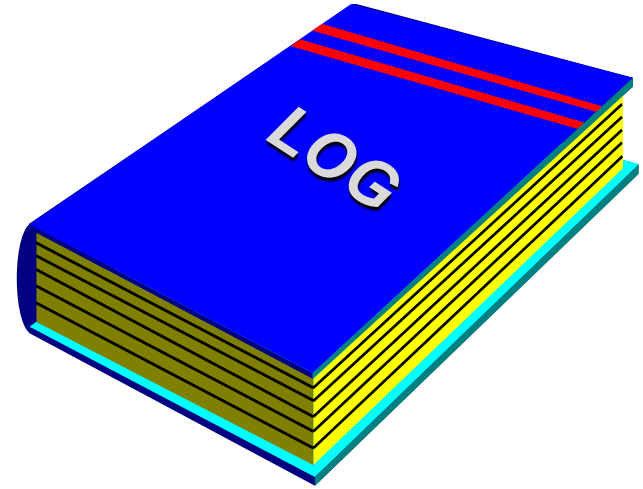
Site Survey Data

- Quality Assurance Procedures and Plans
- Cleaning Schedule
- Calibrations
- Station Temperature Cont
- In-Line Filters



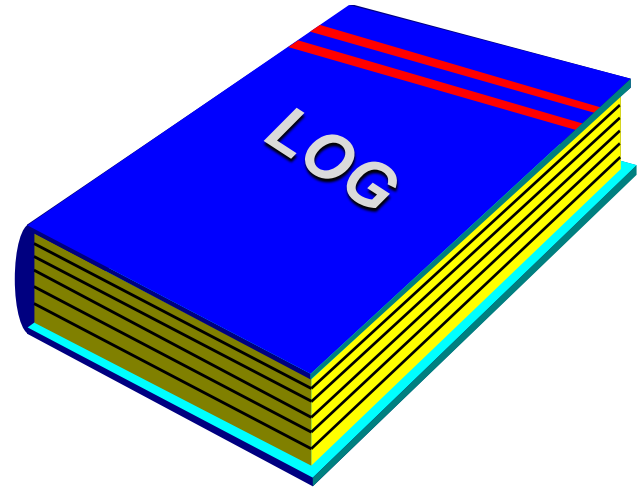
Documentation

- Instrument Log
  - Stays with Instrument
  - Documents Acceptance Tests
  - Documents Routine Maintenance
  - Documents Repairs
  - Documents Calibrations
  - Other Instrument Specific Information
    - i.e. Location, History, etc.



Documentation

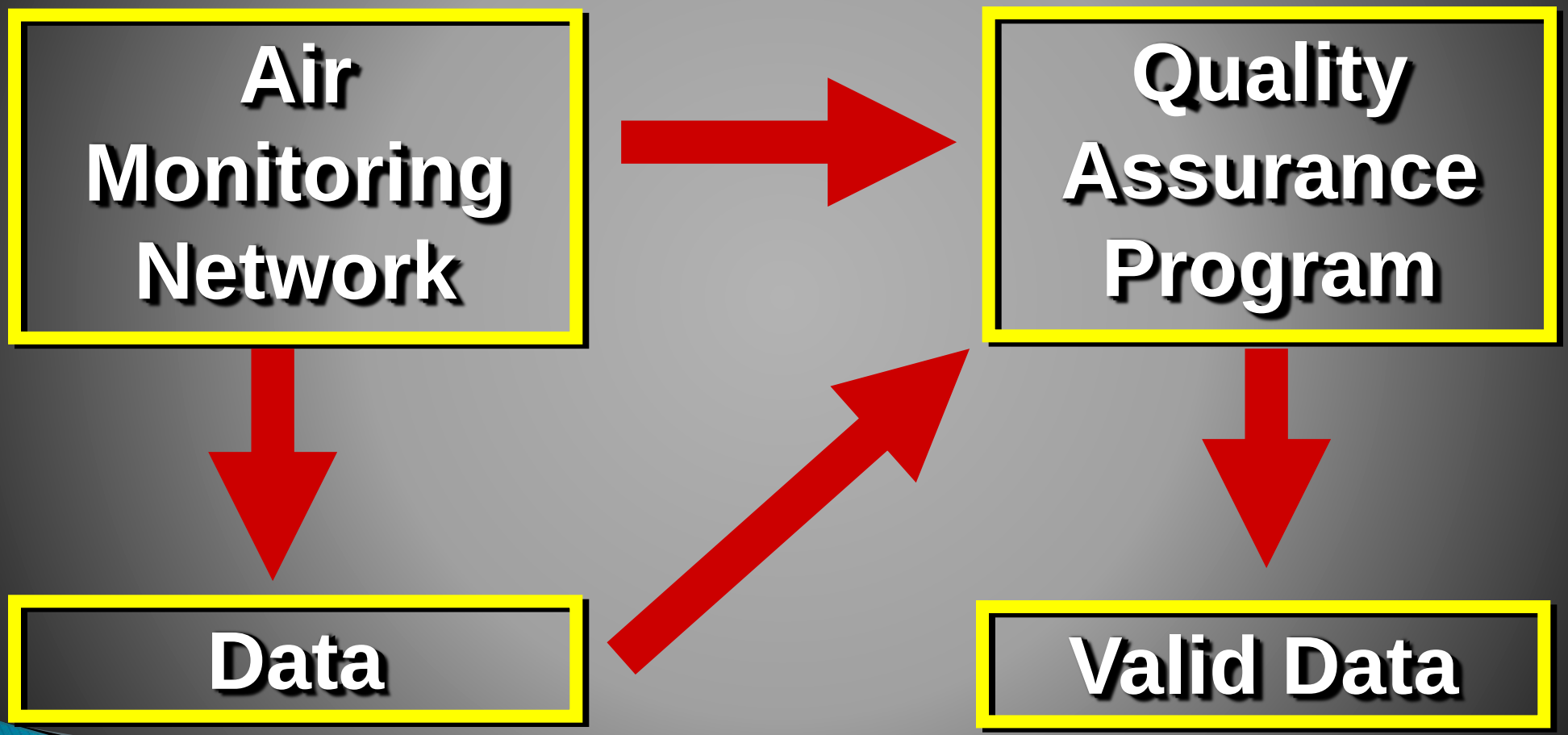
- Station Log
  - Stays at Station
  - Documents Conditions that may Influence Data
    - Nearby Construction
    - Changes in Traffic Patterns and Flow
  - Documents Alterations of Sampling Train
    - Probe and Equipment Changes
  - Contains Completed Site Reports



Typical Monitoring Station


Quality Assurance

Quality Assurance



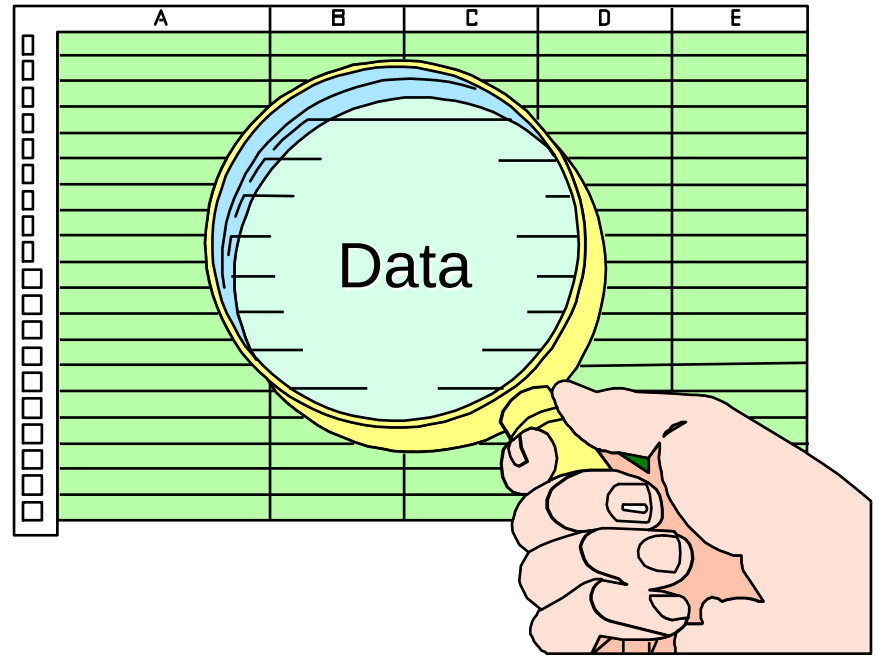
Quality Assurance

- Field QA
  - Daily and Weekly Zero and Span Checks
  - Semi-Annual Multipoint Calibrations
  - External Audits
    - Agency Audits
    - EPA NPAP (National Pollutant Audit Program)

Data Handling

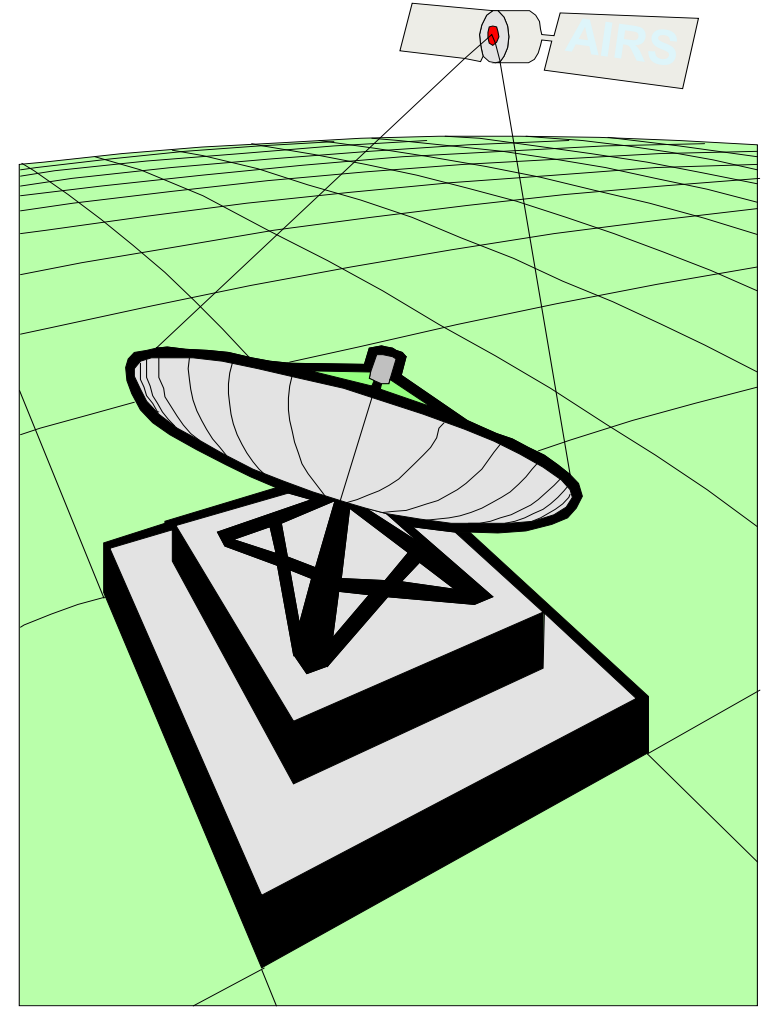
- Data review and editing
  - Complete data set
  - Reviewed for accuracy
  - Reviewed for consistency

QA



Data Handling

- Data Processing
  - Upload to AQS (formerly AIRS)
  - Air Quality Data Actions
    - Data Deletion
    - Data Correction
    - Links Data to Field QA



Station Inspection

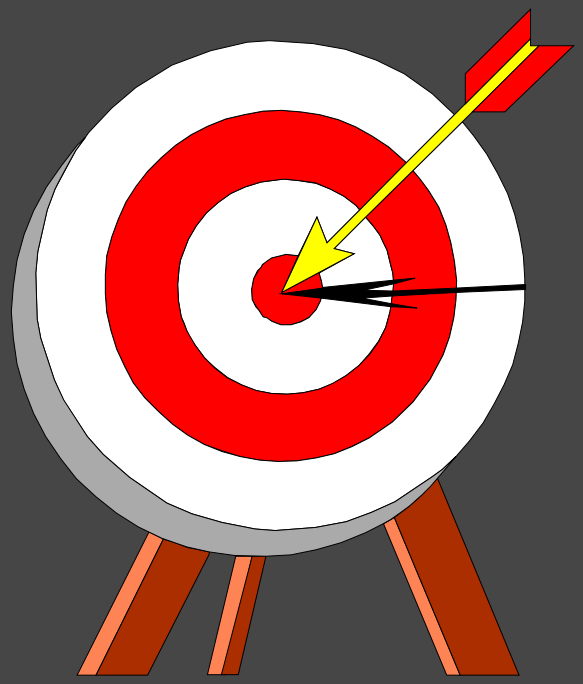
- Review Siting
- Examine Instruments
  - Condition, Zero/Spans, Calibration, Audit Results
- Examine Gases
  - Certification
- Review Logs
- Evaluate Overall Station Cleanliness and Operation

QA

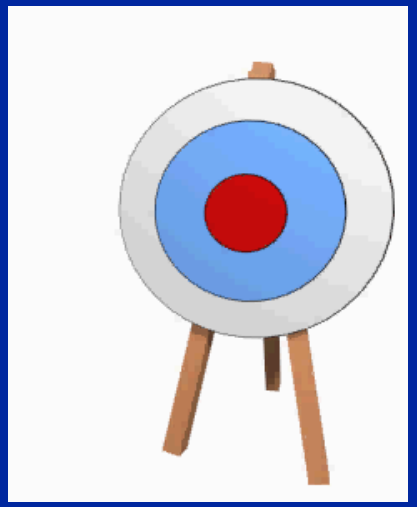
ARB Audit Van

ARB Audit Van Instrumentation

Accuracy & Precision



Accurate and Precise



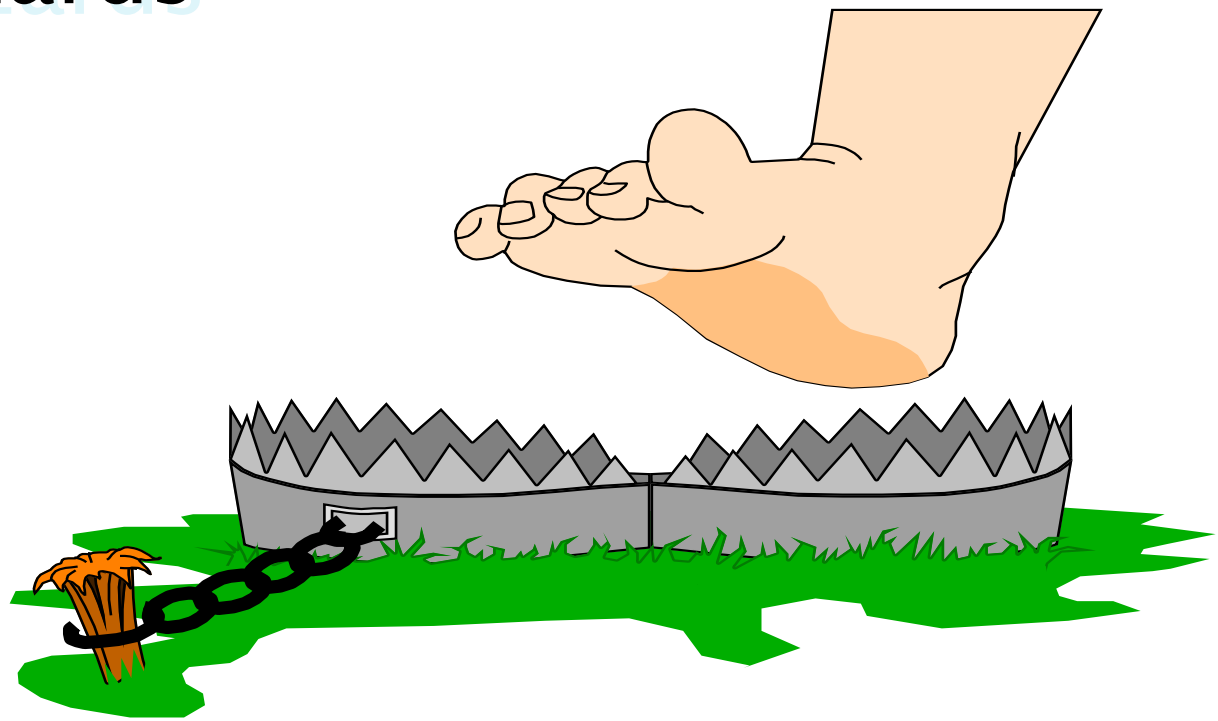
Neither Accurate nor Precise

Accurate but not Precise

Precise but not Accurate

Safety

- Compressed Gas Cylinders
- Hazardous Gases
- Electrical Hazards
- Heights



AIRNow - Homepage

airnow.gov

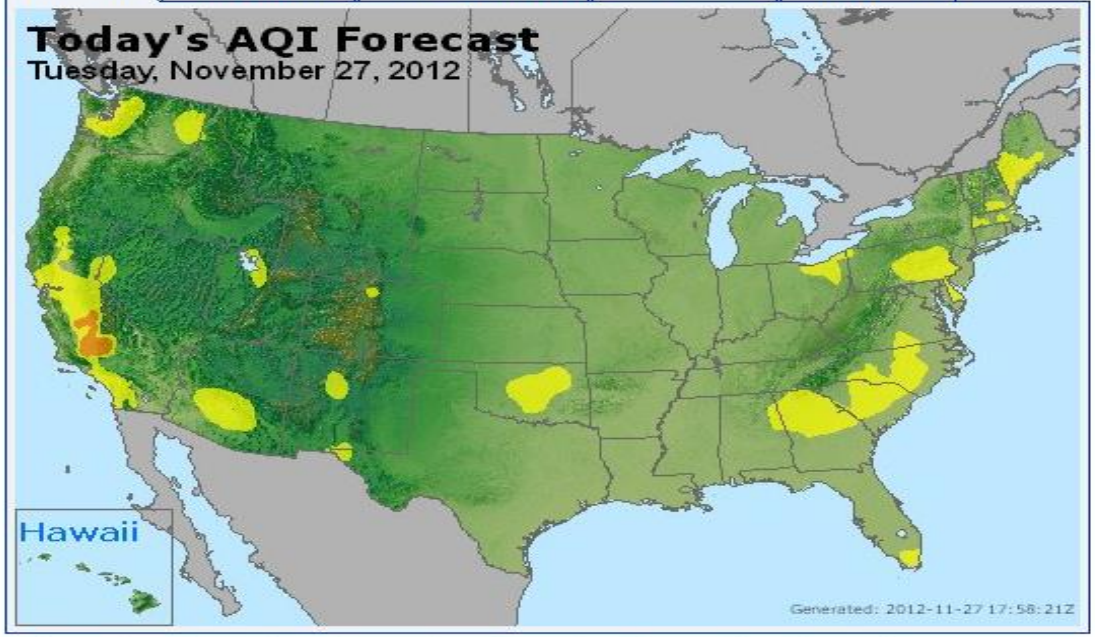
AIRNOW

Zip Code: Go State: Alabama Go

U.S. Air Quality Summary (text)

Click on a state for more information

Forecast | Current AQI | AQI Animation | Current Ozone | Current $PM_{2.5}$



Good | Moderate | USG | Unhealthy | Very Unhealthy | Hazardous | ! Action Day

Highest 5:

U.S. Air Quality Summary | Canada Air Quality

Today's Forecasts | Tomorrow's Forecasts | Current AQI

Cowtown, AZ		110
Bakersfield, CA	!	108
Fresno, CA	!	106
Visalia, CA	!	104
Tacoma-Puyallup, WA		102

Wildfire Smoke Advisories and Forecasts

For more information

Announcements

11/13/12: State of Nuevo León first to benefit from improved nationwide air quality information system

10/3/12: UPDATED - Technical Assistance Document for the Reporting of Daily Air Quality (PDF)

Free AIRNow EnviroFlash Android and iPhone Apps Now Available. Download Android App. | Download iPhone App.

more announcements

E-Mail Notification

EnviroFlash **EnviroFlash** provides air quality information such as forecasts and action day notifications via email for your area of interest. Sign-Up

Follow Us on Twitter

AQI in Google Earth

AirCompare

Publications | Publicaciones (en español)

Air Quality Maps: Monitoring Locations and Archives

BP Spill Information

AIR QUALITY BASICS

Air Quality Index | Ozone | Particle Pollution | UV | Smoke from Fires | What You Can Do

HEALTH

Your Health | Health Providers | Wildfire Smoke

LEARNING CENTER

Health Providers | Kids | Students | Teachers | Older Adults | Weathercasters | School Flag Program | Picture Book

www.epa.gov/outdoor-air-quality-data

EPA United States Environmental Protection Agency

Environmental Topics | Laws & Regulations | About EPA | Search EPA.gov

Air Data: Air Quality Data Collected at Outdoor Monitors Across the US

Contact Us | Share

Your Access to Outdoor Air Quality Data

The tools below are connected directly to EPA's Air Quality System Data Mart.

Basic Information

Frequent Questions

This website provides access to outdoor air quality data collected from state, local and tribal monitoring agencies across the United States.

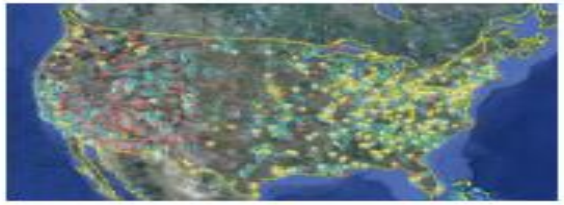
Download Data

Pre-generated Data Files

Download Daily Data

Download Raw Data

Explore Monitor Locations



Get Air Data Updates

Subscribe to our RSS feed to keep up with the latest news, including scheduled system downtime, major data updates, etc.

Generate Summary Reports

Visualize Data

Tile Plot - Multiyear

Generate Technical Reports

www.epa.gov/outdoor-air-quality-data

Geographic Area: Seattle-Tacoma-Bellevue, WA

Summary: by CBSA

Year: 2016 (Annual statistics for 2016 are not final until May 1, 2017)

Exceptional Events: Included (if any)

About this report

EPA Air Quality Standards:

Carbon Monoxide: 35 ppm (1-hour), 9 ppm (8-hour)

Nitrogen Dioxide: 100 ppb (1-hour), 53 ppb (annual)

Ozone: 0.12 ppm (1-hour), 0.070 ppm (8-hour)

Sulfur Dioxide: 75 ppb (1-hour), 140 ppb (24-hour), 30 ppb (annual)

PM2.5: 35 ug/m3 (24-hour), 12.0 ug/m3 (annual)

PM10: 150 ug/m3 (24-hour)

Lead: 0.15 ug/m3 (3-month avg)

Statistics in red are above the level of the respective air quality standard.

The following data links are active for the next 10 minutes, after which you must resubmit your query.

Download PDF (printable page)

Download CSV (spreadsheet)

To sort a column in the table below, click on the column heading.

CBSA	CO 1-hr 2nd Max	CO 8-hr 2nd Max	NO2 98th %ile	NO2 Annual Mean	O3 1-hr 2nd Max	O3 8-hr 4th Max	SO2 99th %ile	SO2 24-hr 2nd Max	SO2 Annual Mean	PM2.5 98th %ile	PM2.5 Wtd. Mean	PM10 24-hr 2nd Max	PM10 Annual Mean	Lead Max 3-Mo. Avg
Seattle-Tacoma-Bellevue, WA	1.9	1.4	60	21	0.08	0.061	5	2	1	59	8.7	.	.	0

AirData reports are produced from a direct query of the AQS Data Mart. The data represent the best and most recent information available to EPA from state agencies. However, some values may be absent due to incomplete reporting, and some values may change due to quality assurance activities. The AQS database is updated by state, local, and tribal organizations who own and submit the data.

Readers are cautioned not to rank order geographic areas based on AirData reports. Air pollution levels measured at a particular monitoring site are not necessarily representative of the air quality for an entire county or urban area.

This report is based on monitor-level summary statistics. Air quality standards for some pollutants (PM2.5 and Pb) allow for combining data from multiple monitors into a site-level summary statistic that can be compared to the standard. In those cases, the site-level statistics may differ from the monitor-level statistics upon which this report is based.

Outdoor Air Quality Data

Monitor Values Report

This report displays criteria pollutant summary data for individual monitoring sites. Read more about what's in this report.

1. Pollutant

   PM2.5

2. Year

   2016

3. Geographic Area

   Select a State ...

   -- or --

   Seattle-Tacoma-Bellevue, WA

   -- or --

   Select a County ...

4. Exceptional Events

   - (●) Include exceptional events data
   - ( ) Exclude exceptional events data

Geographic Area: Seattle-Tacoma-Bellevue, WA
Pollutant: PM2.5
Year: 2016 (Annual statistics for 2016 are not final until May 1, 2017)
Exceptional Events: Included (if any)
About this report

EPA Air Quality Standards:
PM2.5: 35 ug/m3 (24-hour), 12.0 ug/m3 (annual)

The following data links are active for the next 10 minutes, after which you must resubmit your query.
Download PDF (printable page)
Download CSV (spreadsheet)

To sort a column in the table below, click on the column heading.

Obs	First Max	Second Max	Third Max	Fourth Max	98th Percentile	Weighted Annual Mean	Exc Events	Monitor Number	Site ID	Address	City	County	State	EPA Region
230	20.6	19.9	18.9	18.1	17	8.3*	None	3	530330030	10th & Weller	Seattle	King	WA	10
274	30.2	27	22.4	22.3	22	6.6*	None	3	530330057	4700 East Marginal Way South	Seattle	King	WA	10
88	13.7	11.8	11.3	10.7	12	5.6*	None	1	530330080	4103 Beacon Hill S	Seattle	King	WA	10
271	16.2	15.7	15.6	14.8	12	5.2*	None	3	530330080	4103 Beacon Hill S	Seattle	King	WA	10
263	32.8	23.7	21.4	18.5	18	5.5*	None	3	530332004	614 Railroad Ave N, Kent	Kent	King	WA	10
238	17.6	15.5	15.1	15	15	6.8*	None	5	530530024	1802 S 36th St	Tacoma	Pierce	WA	10
250	60.7	31.7	28.8	27.2	23	6.8*	None	1	530530029	7802 South L Street	Tacoma	Pierce	WA	10
20	59.1	11.6	9.6	9.3	59	8.7*	None	2	530530029	7802 South L Street	Tacoma	Pierce	WA	10
267	62.3	30.6	27.7	25.4	21	6.4*	None	3	530530029	7802 South L Street	Tacoma	Pierce	WA	10
273	22.4	22.2	21.9	19	18	3.8*	None	3	530610005	6120 212th St Sw, Mountlake Terrace, Wa	Mountlake Terrace	Snohomish	WA	10
251	43.1	42	35.9	33.3	31	4.8*	None	3	530610020	1085 Fir St	Darrington	Snohomish	WA	10
253	37.7	30	28.6	28.1	22	6.4*	None	3	530611007	1799 7th S	Marysville	Snohomish	WA	10
274	38.7	31	29.8	29.4	23	6.3*	None	4	530611007	1799 7th S	Marysville	Snohomish	WA	10

The future

- Greenhouse Gases
- Real time Particulate Speciation
- Satellite Stations
- ???????

The Web

- https://www.epa.gov/outdoor-air-quality-data
  Monitoring data

- http://www.airnow.gov
  - AQI

- https://www.epa.gov/technical-air-pollution-resources
  - NAAQS
  - Air monitoring regulations and information

- https://www.epa.gov/green-book
  - Non attainment Areas


Questions???