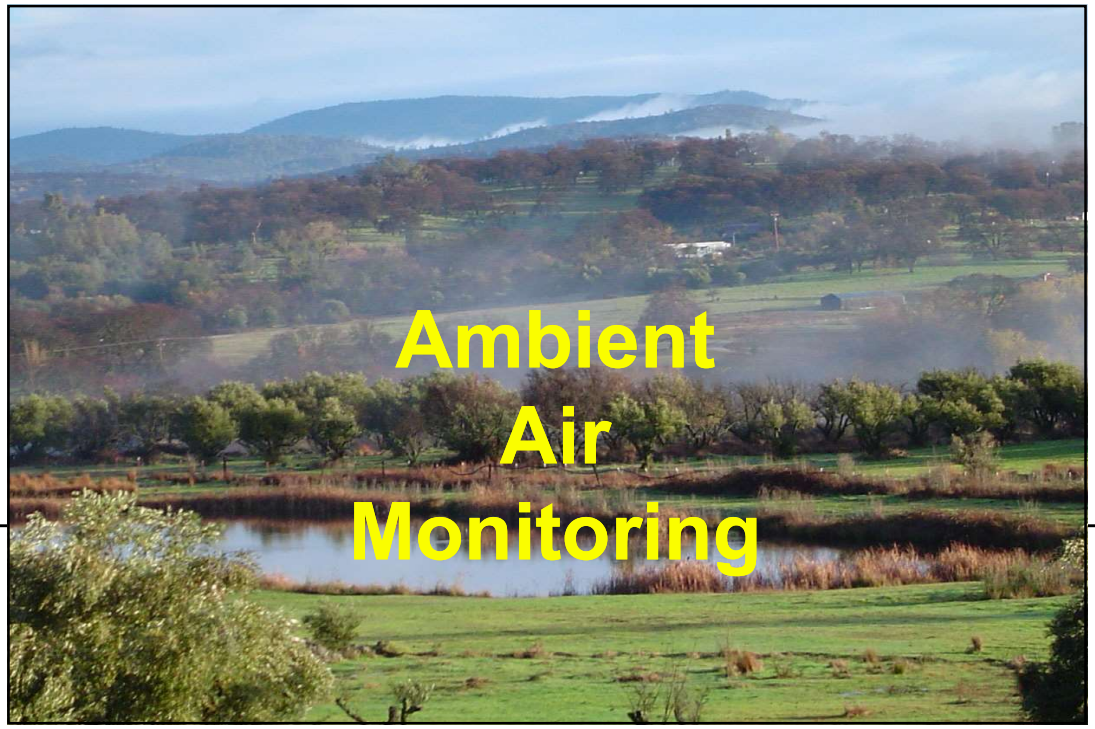
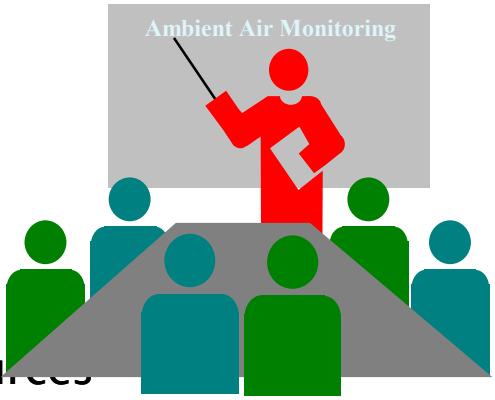


1

Course Overview

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



2

3

EPA Responsibilities Under CAA

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

4

Monitoring

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

5

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

6

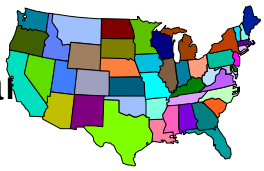
Monitoring Networks

SLAMS -- State and Local Air Monitoring Station

NAMS -- National Air Monitoring Station

PAMS -- Photochemical Assessment Monitoring Station

NCore—National Core Multipollutant Network

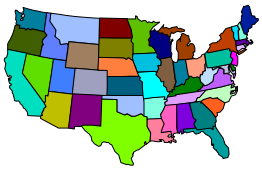


7

Monitoring Networks

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

Acid Rain Network



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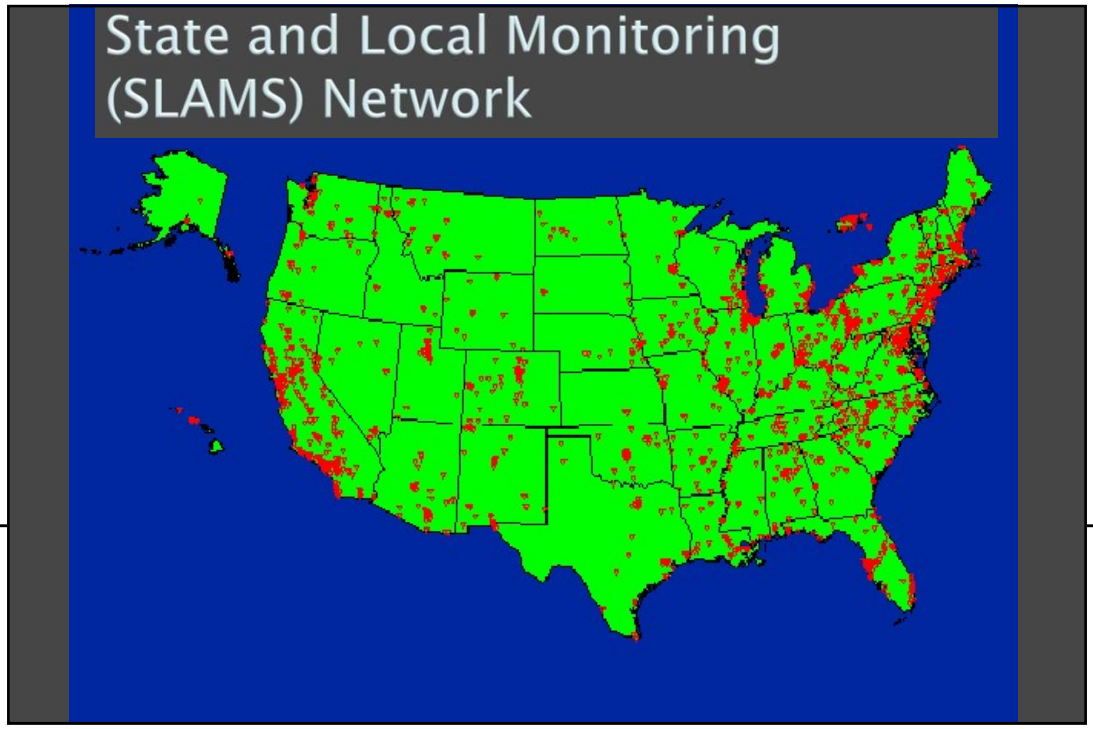
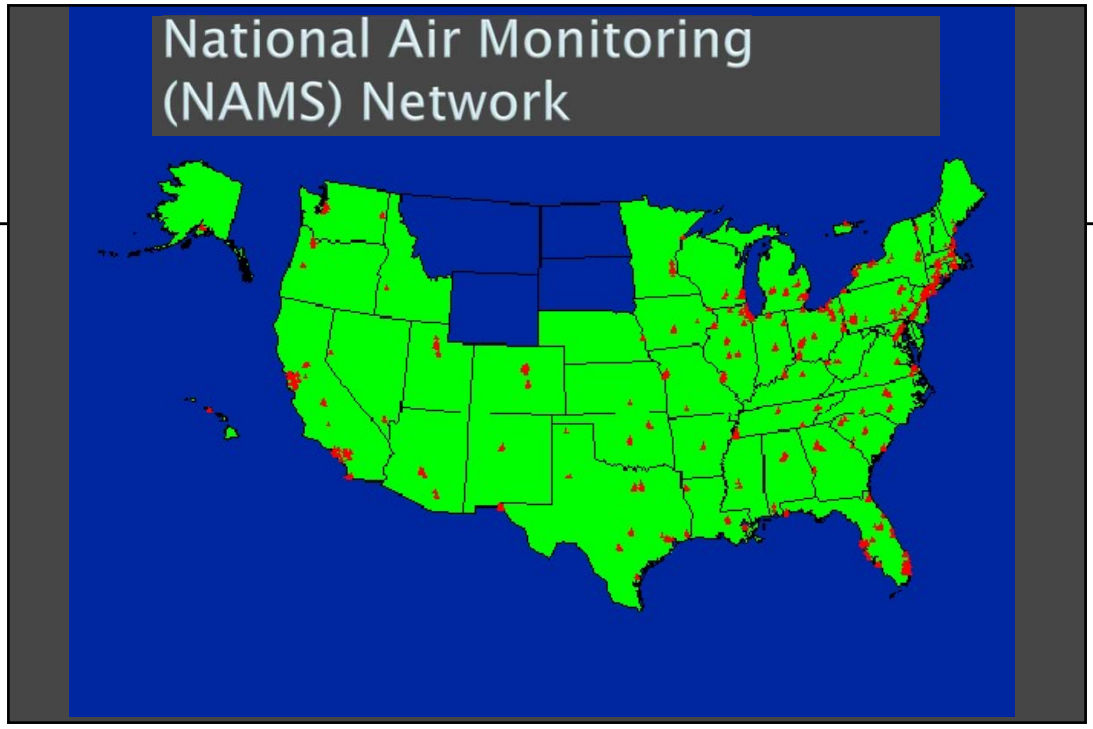
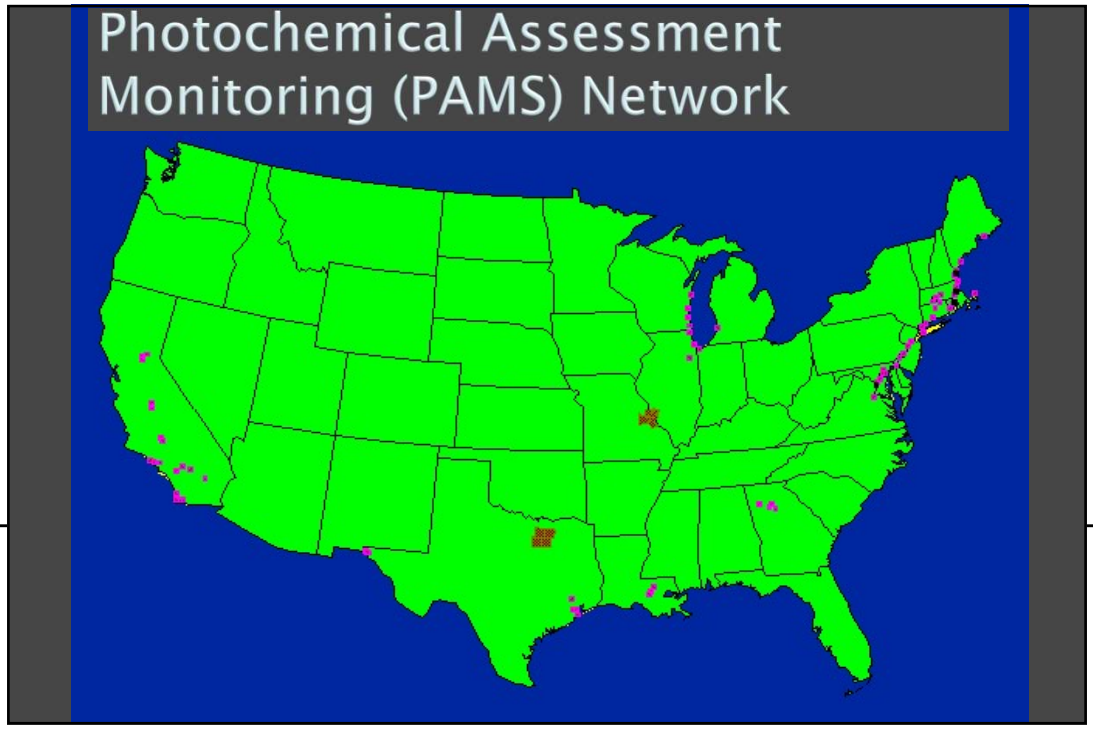

State and Local Monitoring
(SLAMS) Network

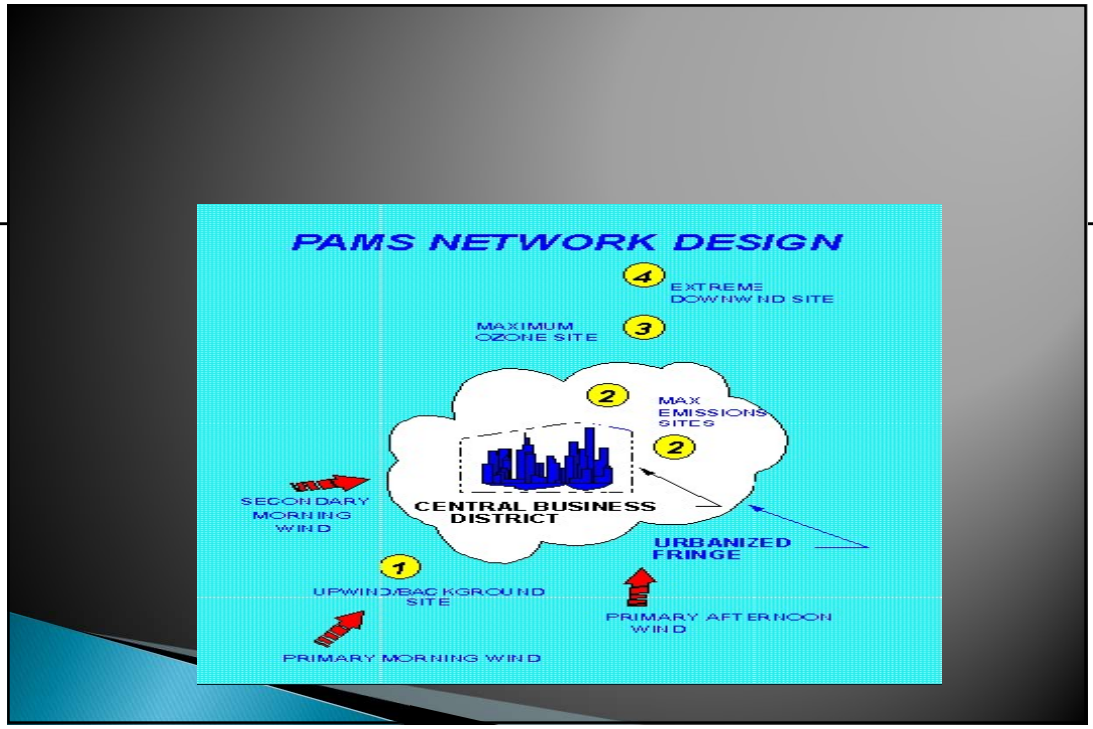
9


National Air Monitoring
(NAMS) Network

10

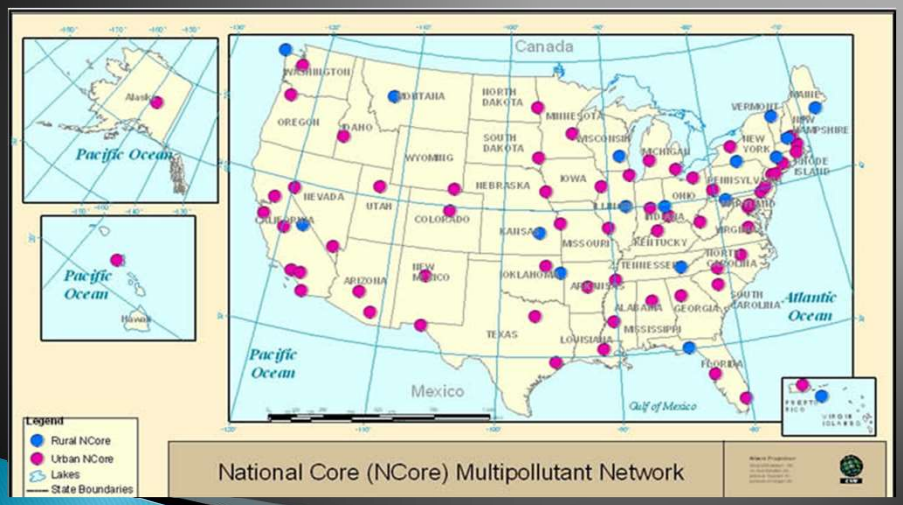

Photochemical Assessment
Monitoring (PAMS) Network

11


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

12

NCore Network



13

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

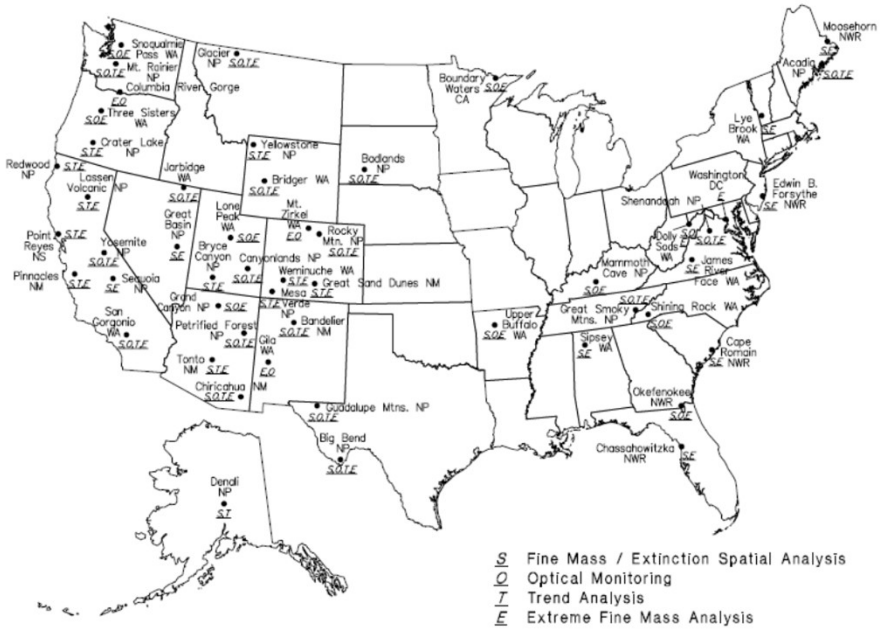
14

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

15

IMPROVE Sites



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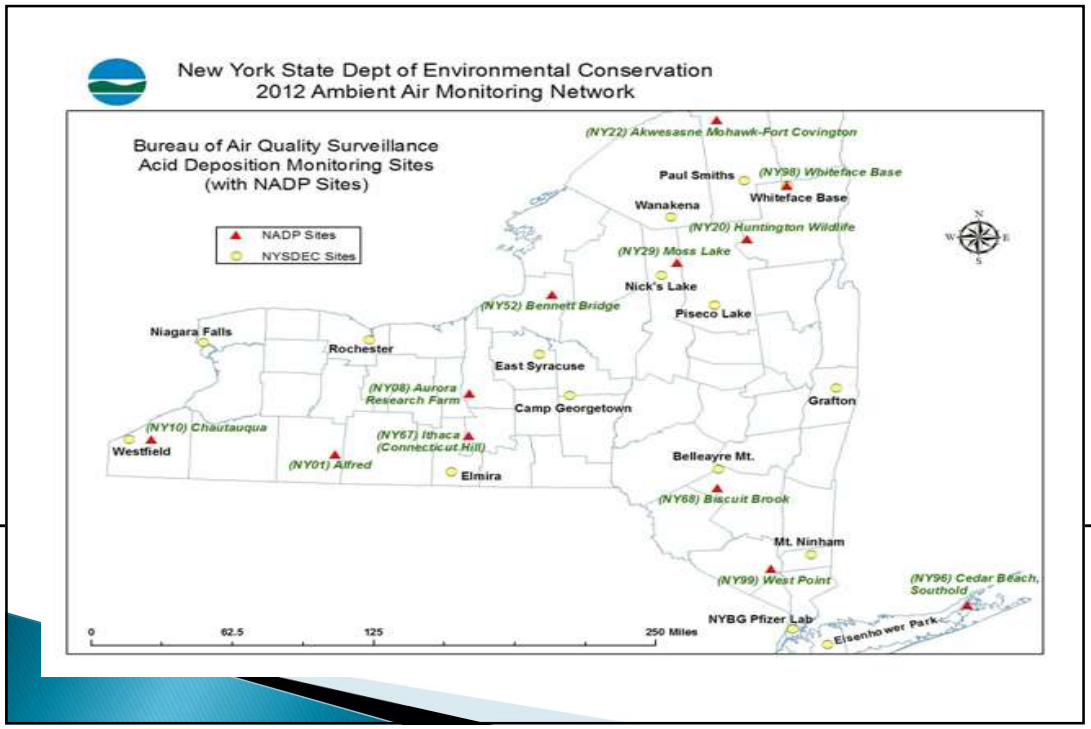
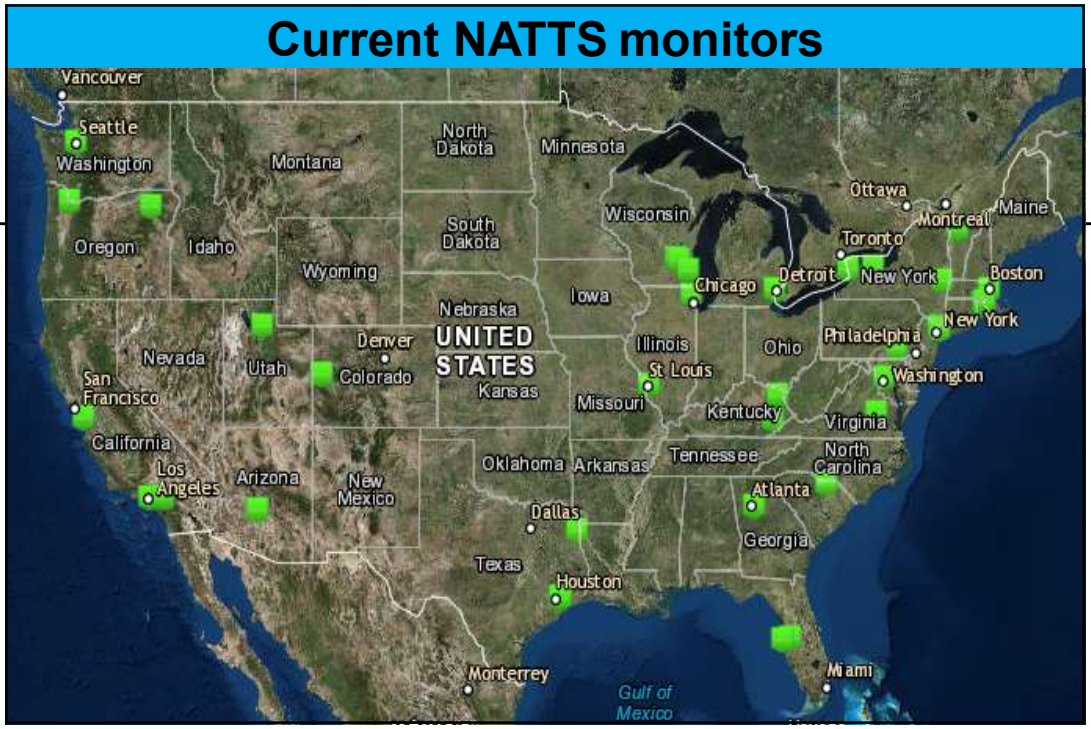

New York State Dept of Environmental Conservation
2012 Ambient Air Monitoring Network
Bureau of Air Quality Surveillance
Acid Deposition Monitoring Sites
(with NADP Sites)
NADP Sites
NYSDEC Sites
(NY22) Akwesasne Mohawk-Fort Covington
Paul Smiths
(NY98) Whiteface Base
Whiteface Base
Wanakena
(NY20) Huntington Wildlife
(NY29) Moss Lake
Nick's Lake
Piseco Lake
(NY52) Bennett Bridge
Niagara Falls
Rochester
East Syracuse
(NY08) Aurora Research Farm
Camp Georgetown
Grafton
(NY10) Chautauqua
Westfield
(NY67) Ithaca (Connecticut Hill)
(NY01) Alfred
Elmira
Belleayre Mt.
(NY68) Biscuit Brook
Mt. Ninham
(NY99) West Point
(NY96) Cedar Beach, Southold
NYBG Pfizer Lab
Eisenhower Park
0
62.5
125
250 Miles

17


Current NATTS monitors
Vancouver
Seattle
Washington
Montana
North Dakota
Minnesota
Ottawa
Montreal
Maine
Wisconsin
Toronto
Oregon
Idaho
South Dakota
Wyoming
Chicago
Detroit
New York
Boston
Iowa
Nebraska
UNITED STATES
Denver
Nevada
Utah
Colorado
Illinois
Ohio
Philadelphia
New York
San Francisco
Kansas
St Louis
Washington
Missouri
Kentucky
Virginia
California
Los Angeles
Arizona
New Mexico
Oklahoma
Arkansas
Tennessee
North Carolina
Atlanta
Dallas
Georgia
Texas
Houston
Monterrey
Gulf of Mexico
Miami

18

19

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

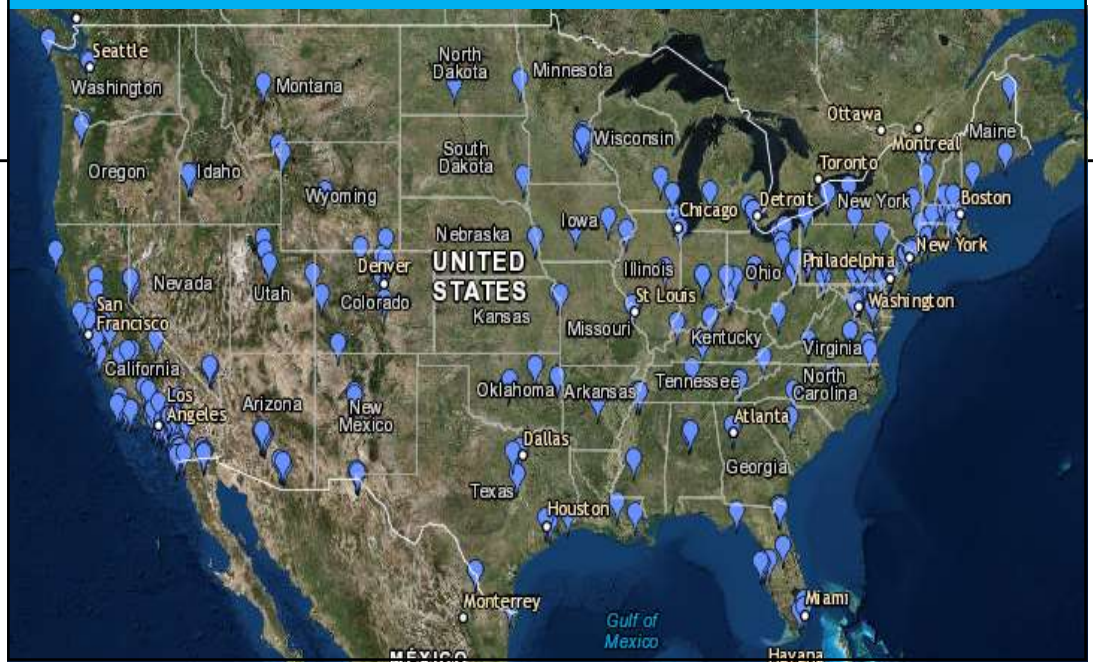
20

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

Final Rule/Decision	Primary/ Secondary	Indicator	Averaging Time	Level [1]	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 [1]
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.				

21

Current CO monitors



22

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.			

23

Current NO_2 monitors

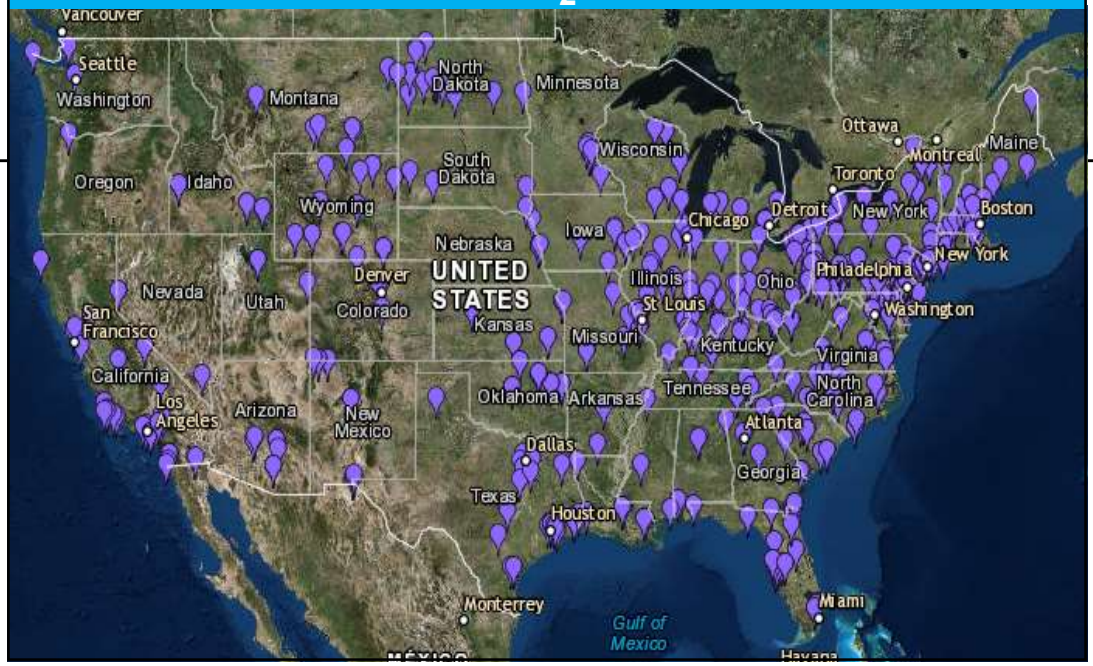
24

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

Final Rule/Decision	Primary/ Secondary	Indicator [(2)]	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.			

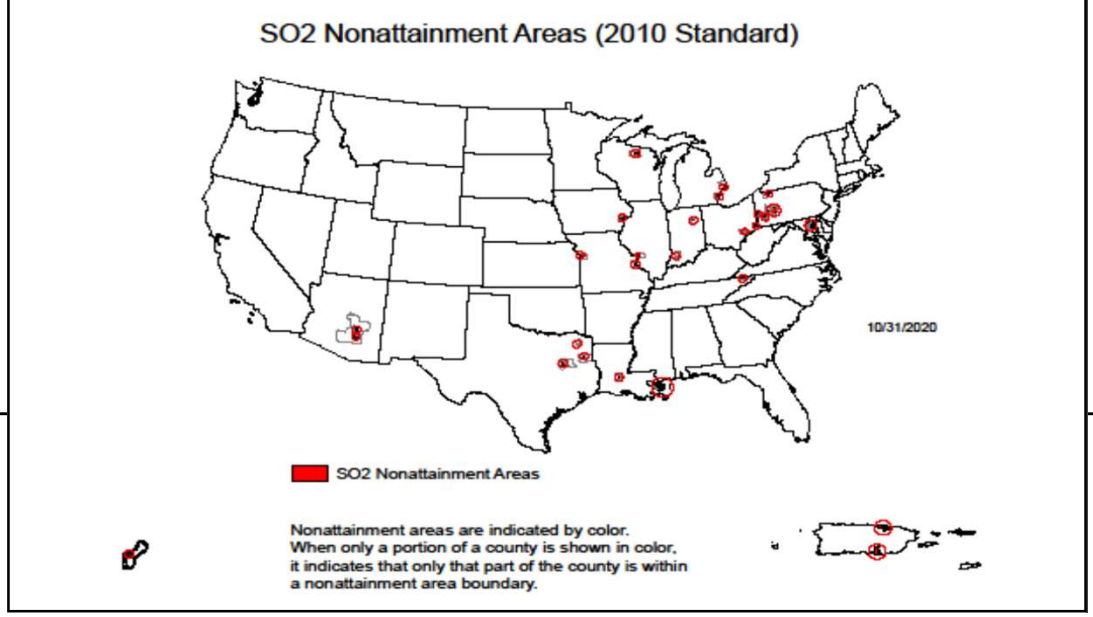
25

Current SO_2 monitors



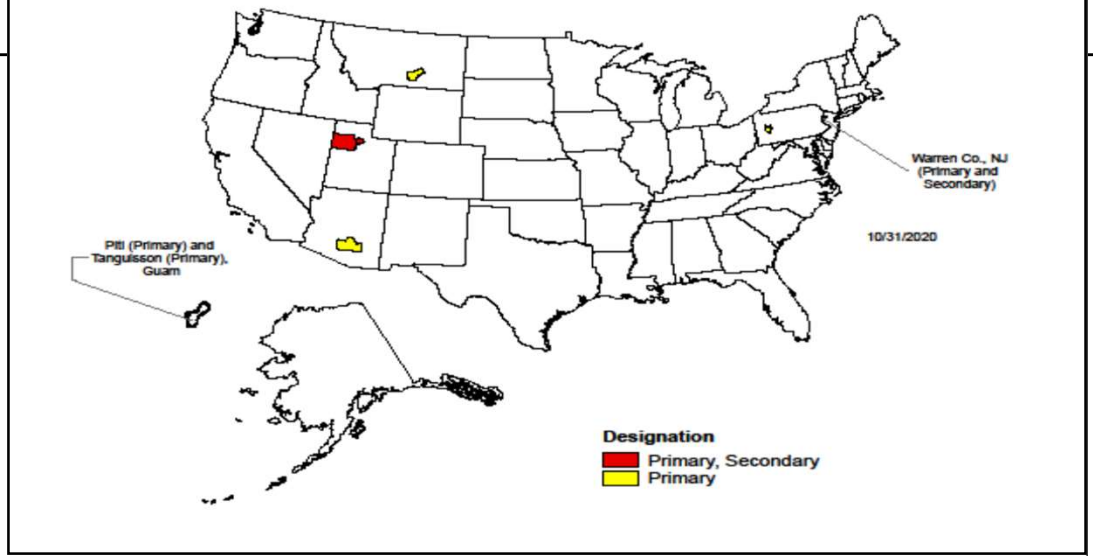
26

SO_2 Nonattainment areas



27

SO_2 Nonattainment areas



28

Lead (Pb) Standards– Table of Historical Pb NAAQS

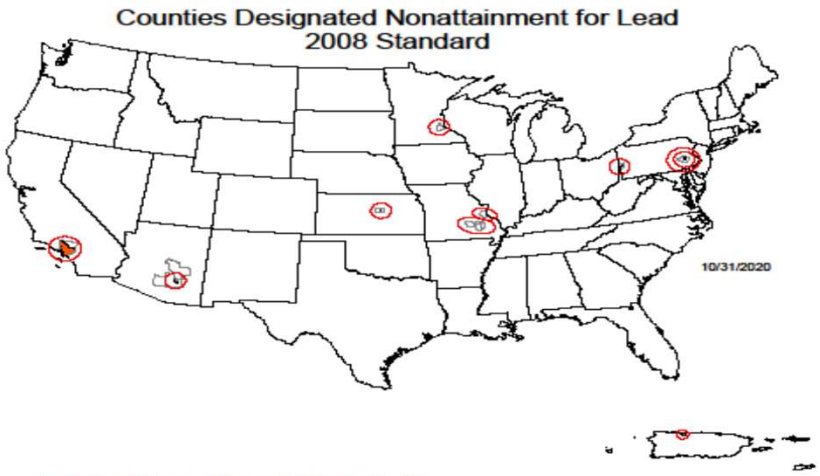
Final Rule/Decision	Primary/ Secondary	Indicator	Averaging Time	Level [1]	Form
1978 43 FR 46246 Oct 5, 1978	Primary and Secondary	Pb–TSP [2]	Calendar Quarter	1.5 µg/m^3	Not to be exceeded
Feb 21, 1991 – Agency released multimedia "Strategy for Reducing Lead Exposures" [3]					
2008 73 FR 66964 Nov 12,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

29

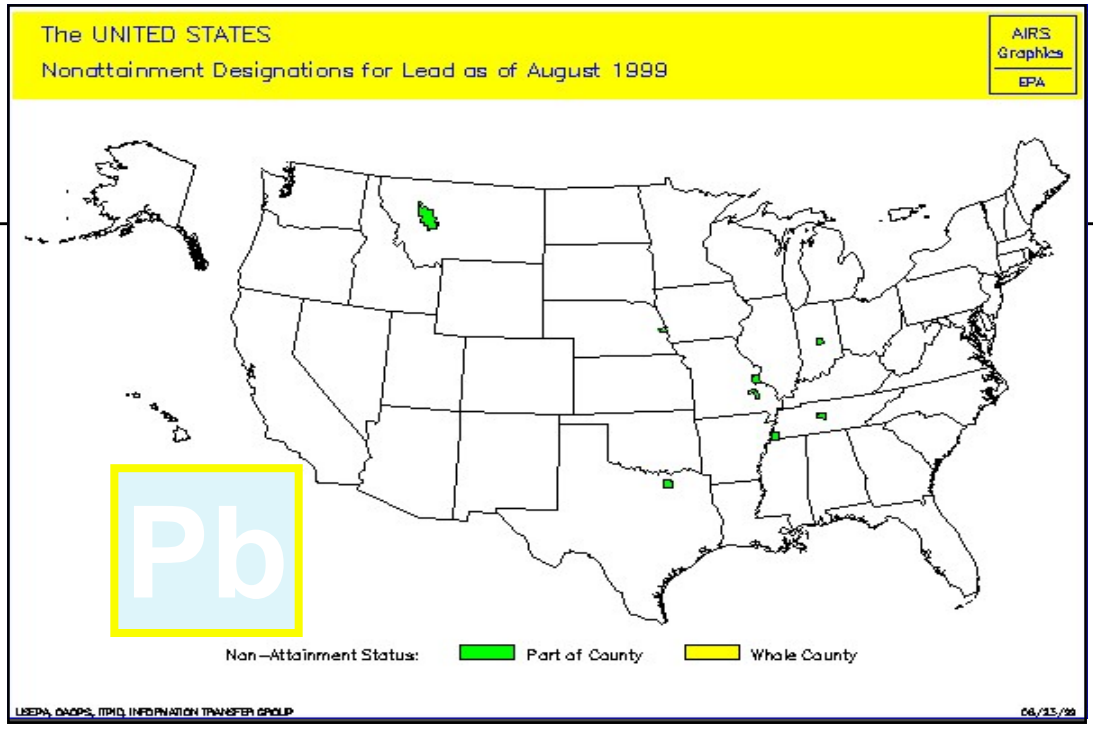
Current Lead monitors

30

Lead Nonattainment areas



31



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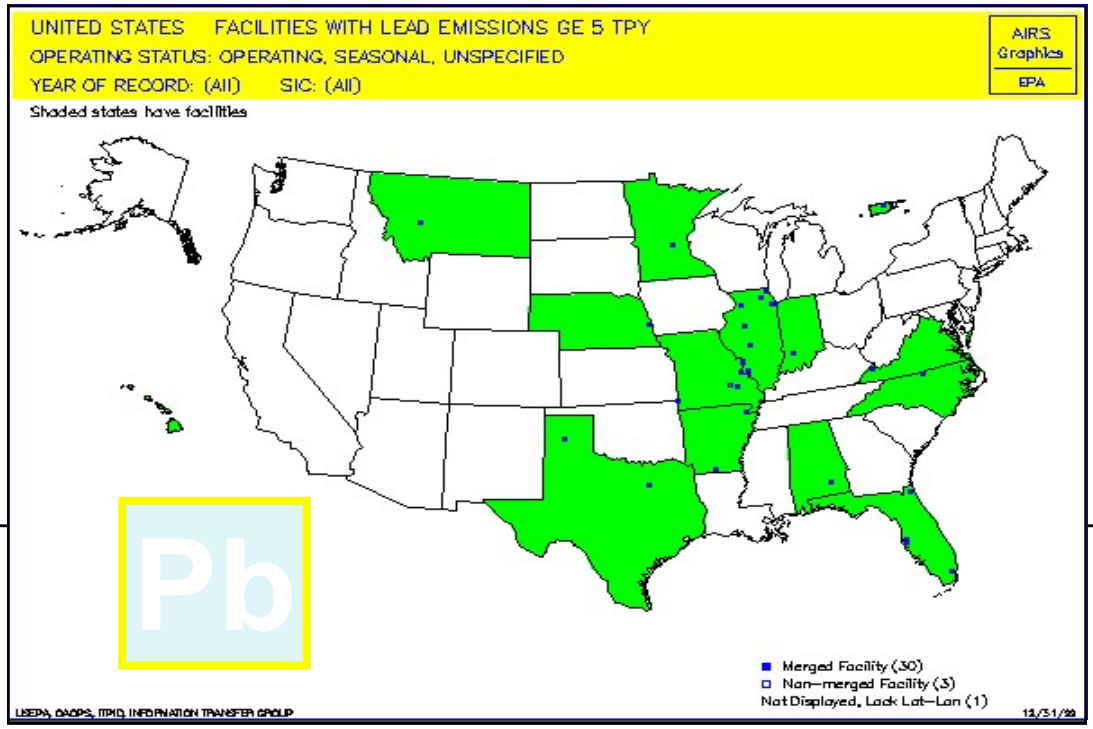


33

Ozone (O3) Standards- Table of Historic O3 NAAQS

Final Rule/Decision	Primary/ Secondary	Indicator[3]	Averaging Time	Level[4]	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-hour	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-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years

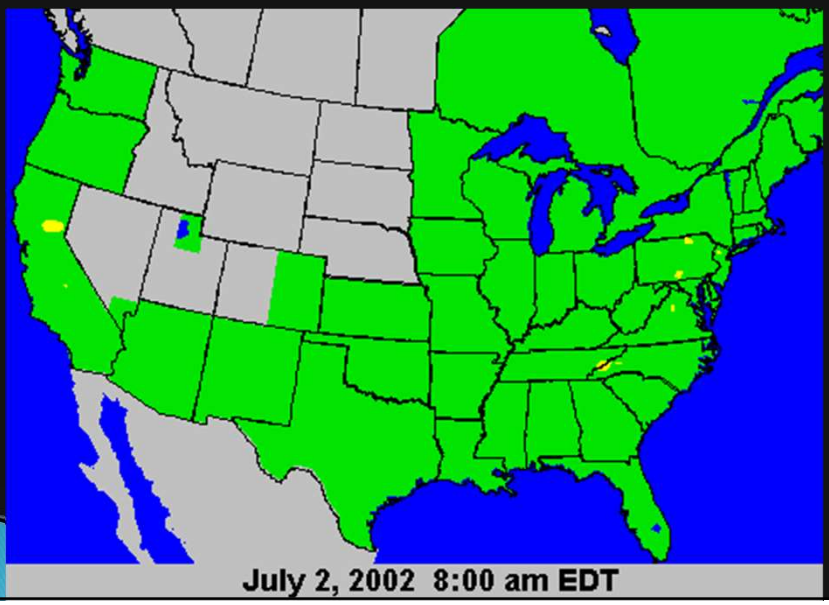
34

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

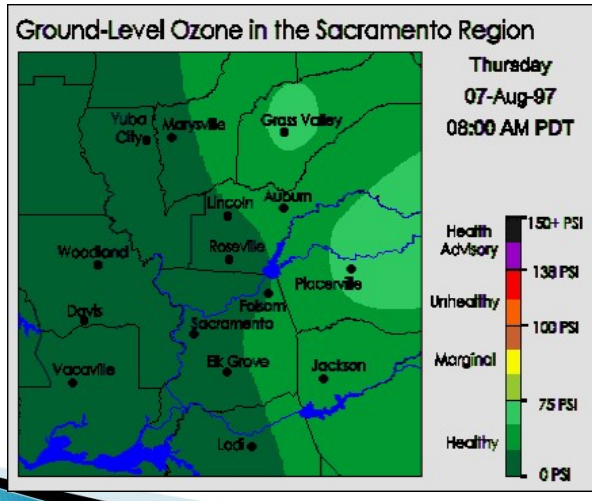
35

OZONE Formation



36

Ground-Level Ozone



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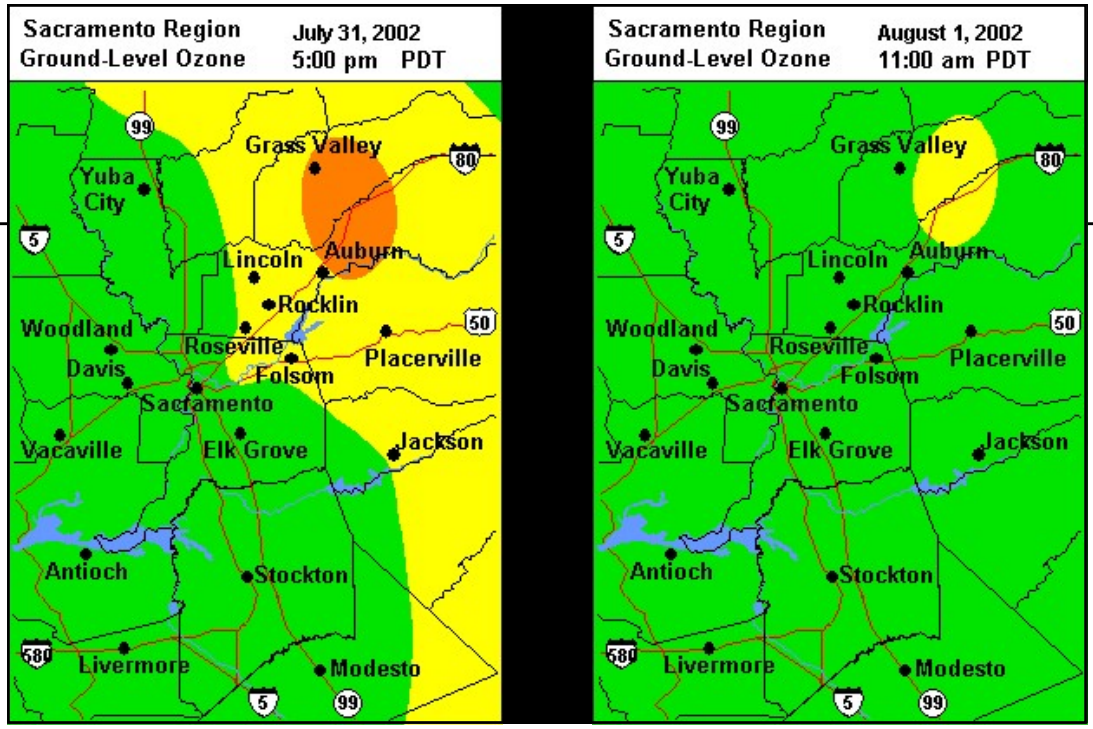
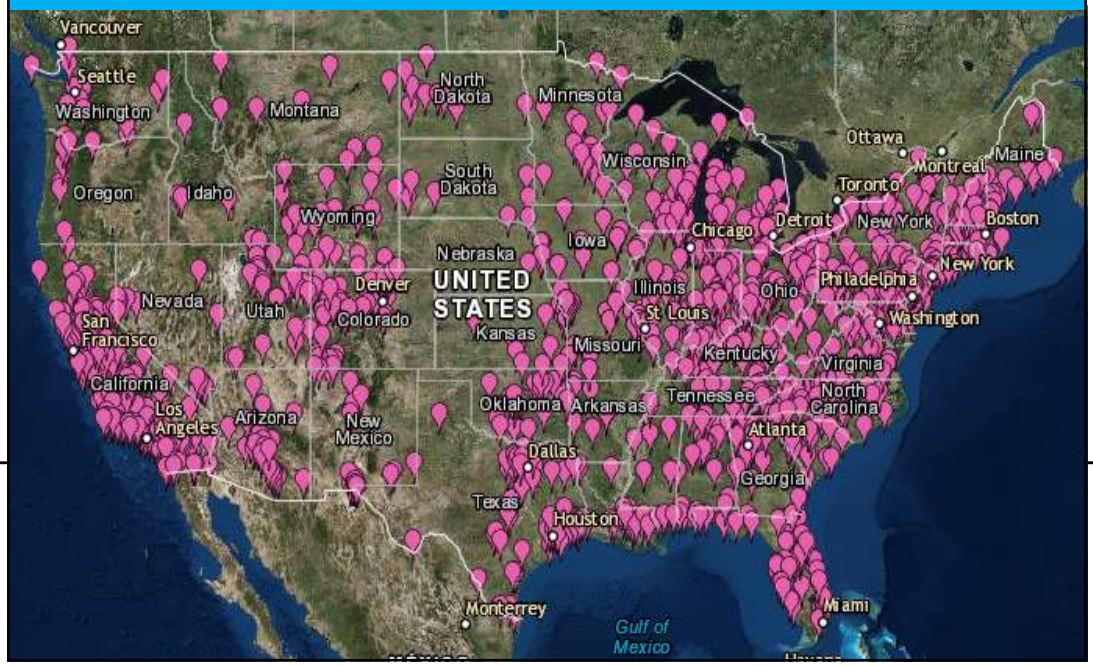


38

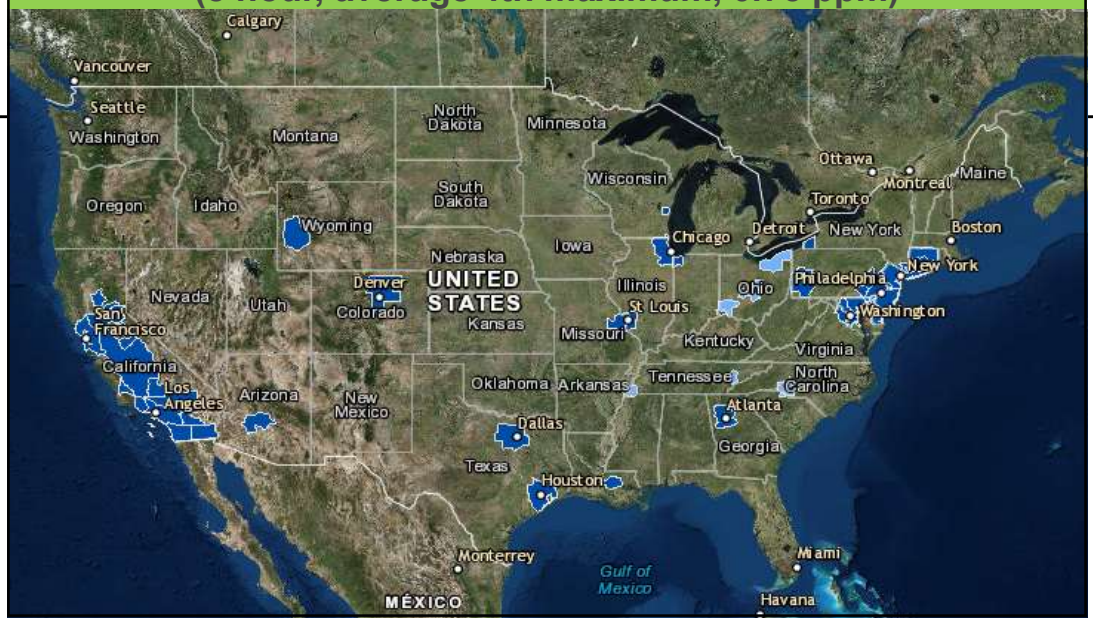
Current Ozone monitors



39

Ozone Nonattainment areas

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



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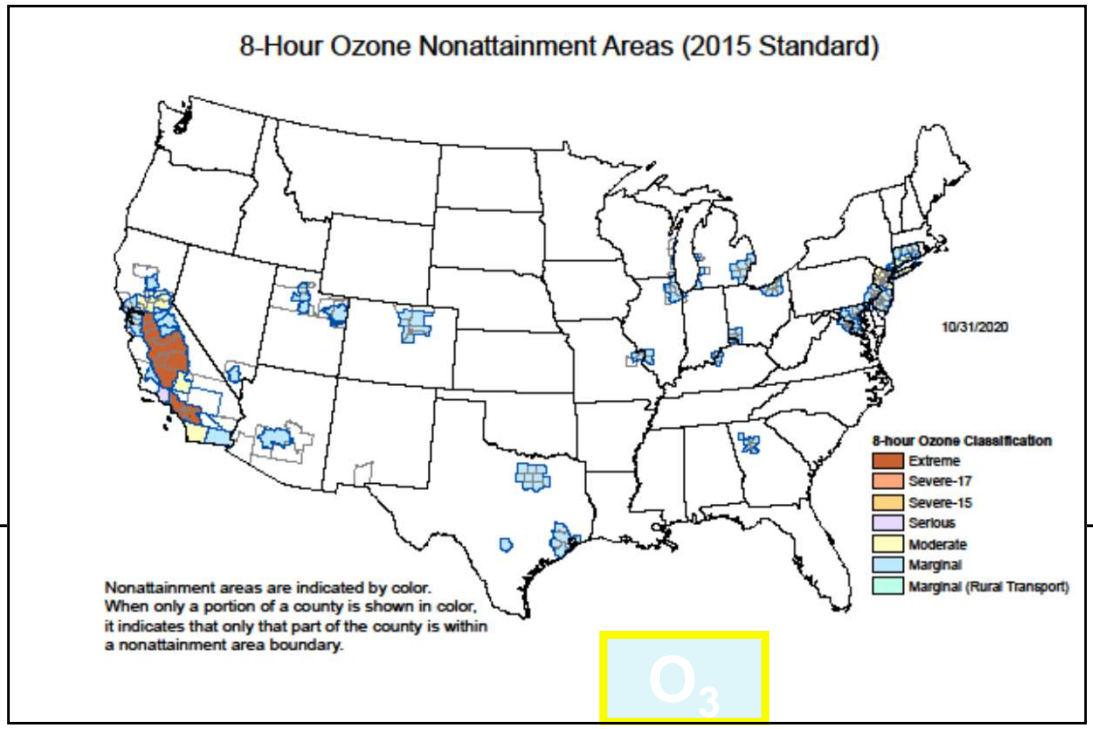


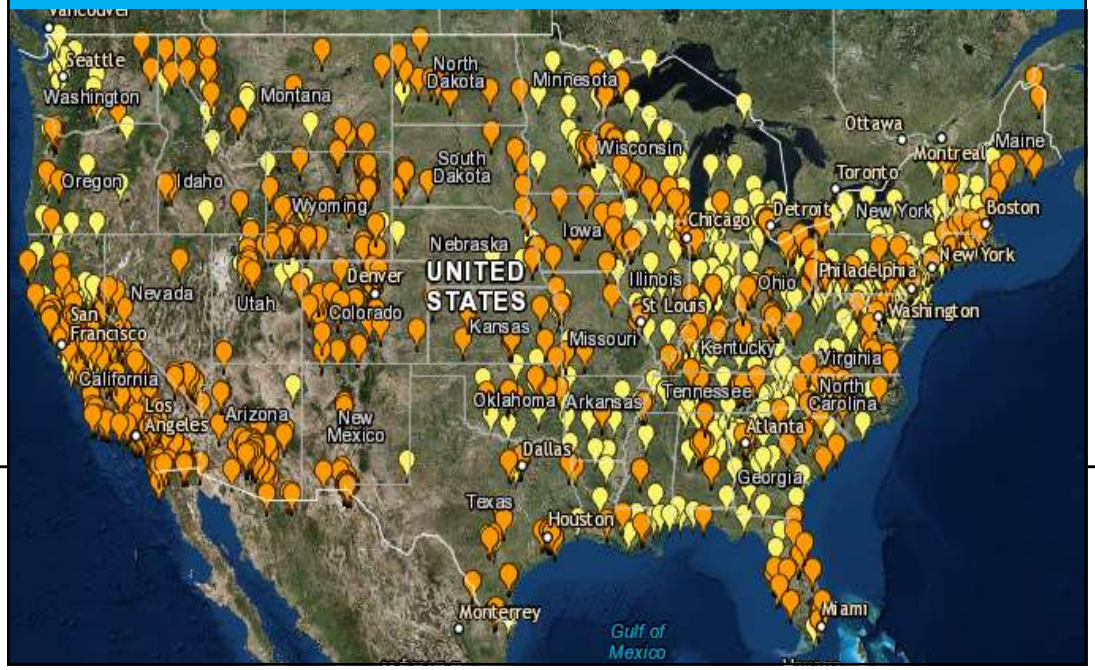
41

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 [3], [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

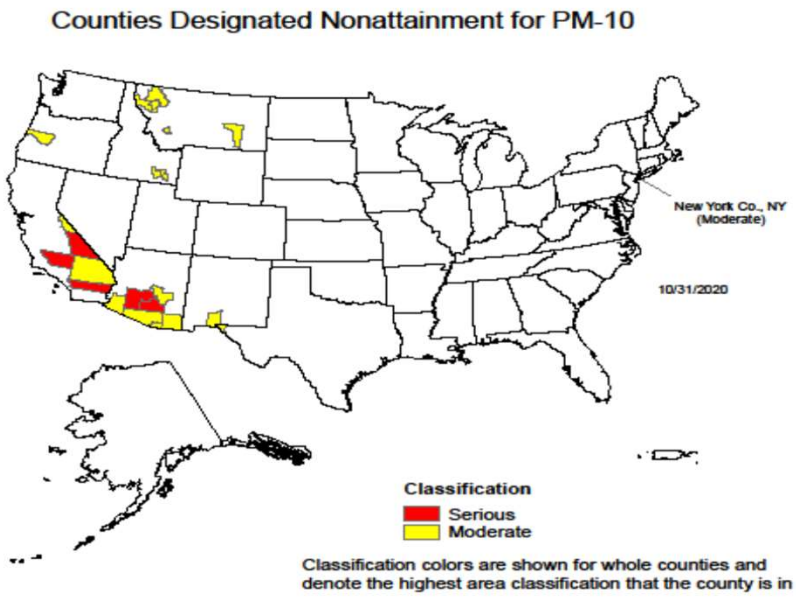
42

Current PM 10 and 2.5 monitors



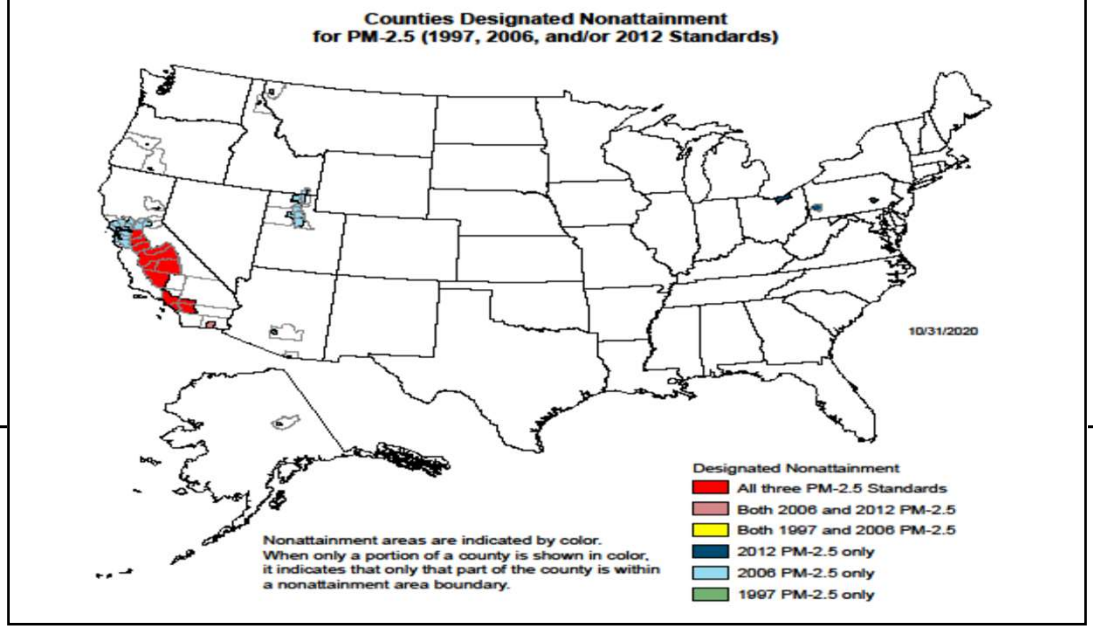
43

PM-10 Nonattainment areas



44

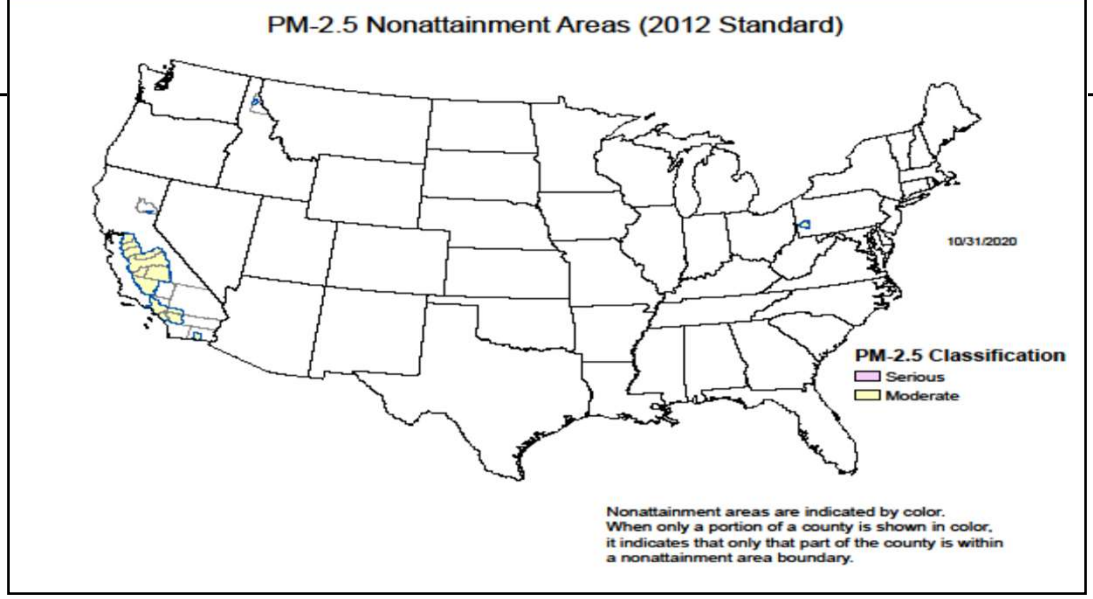
PM-2.5 Nonattainment areas



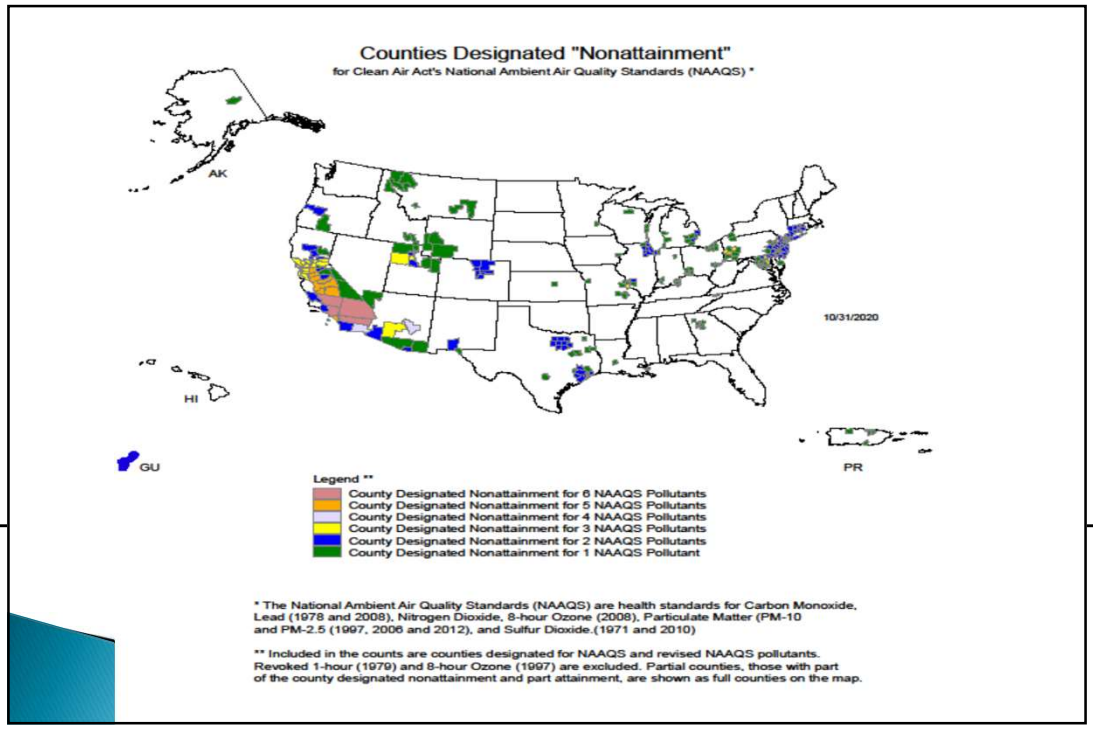
45

PM-2.5 Nonattainment areas

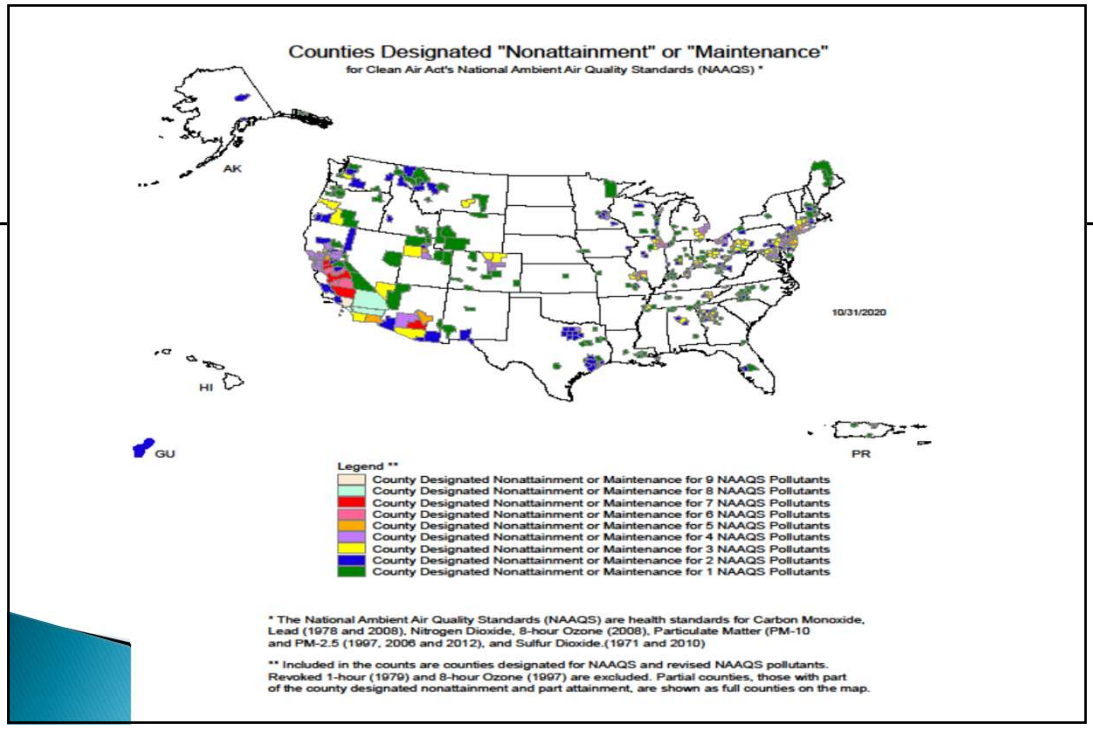
For standards of different years



46


Counties Designated "Nonattainment"
for Clean Air Act's National Ambient Air Quality Standards (NAAQS) *
AK
HI
GU
PR
10/31/2020
Legend **
County Designated Nonattainment for 6 NAAQS Pollutants
County Designated Nonattainment for 5 NAAQS Pollutants
County Designated Nonattainment for 4 NAAQS Pollutants
County Designated Nonattainment for 3 NAAQS Pollutants
County Designated Nonattainment for 2 NAAQS Pollutants
County Designated Nonattainment for 1 NAAQS Pollutant
* 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.

47


Counties Designated "Nonattainment" or "Maintenance"
for Clean Air Act's National Ambient Air Quality Standards (NAAQS) *
AK
HI
GU
PR
10/31/2020
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.

48

49

Network Design Considerations

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

50

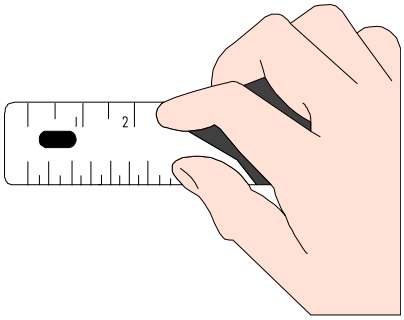
Network Design Conciderations

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

51

Scales of Monitoring

- Micro
- Middle
- Neighborhood



52


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

53

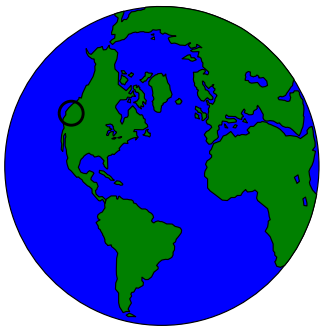

Middle
Scale
Site
100 m
to
0.5 km
Sacramento
1001 i st Sacramento ca
© 2006 Europa Technologies
Image © 2006 Sanborn
Google
Pointer 38°34'55.58" N 121°29'36.24" W elev 26 ft
Streaming 100%
Eye alt 3509 ft

54

55

Additional Scales of Monitoring

- Urban
- Regional
- National and Global



56


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

57


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
Google
Pointer 38°05'42.81" N 121°29'35.10" W elev -8 ft
Streaming 100%
Fresno
Eye alt 273.18 mi

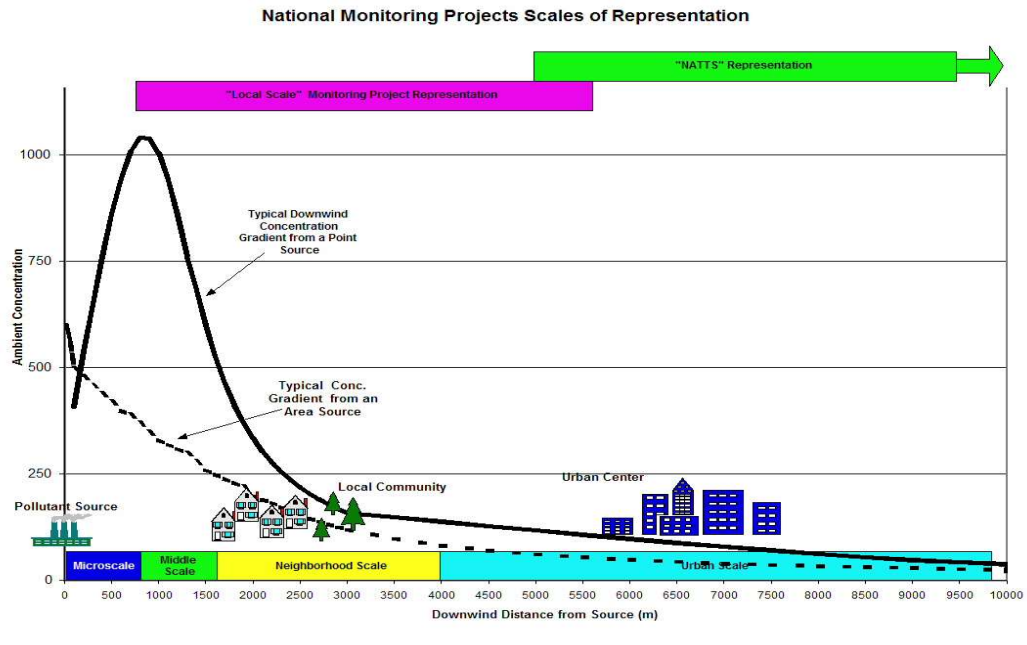
58

59

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

60



61

Network Design Considerations

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

62

Network Design Considerations

- Population Areas
- Future development
- Full Representation

63

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

64

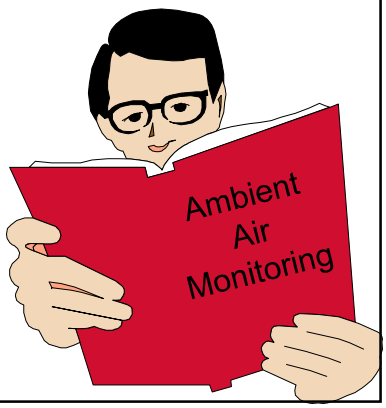
Station Siting Considerations

- 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

65

Station Siting Considerations

- Types of Pollutants
- Topography
- Air flow



66

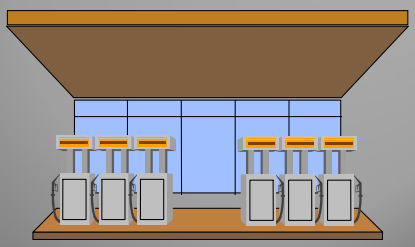
Station Categories

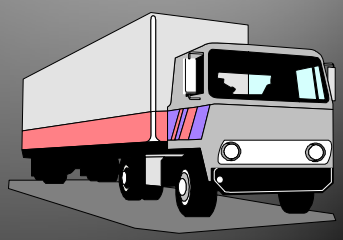
A (Ground Level)	Heavy pollutant concentration, high potential for pollutant buildup
B (Ground Level)	Heavy pollutant concentration, minimal potential for buildup
C (Ground Level)	Moderate pollution concentration
D (Ground Level)	Low pollutant concentration
E (Air Mass)	Sampler probe that is between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

67

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





68

69

Site Information

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

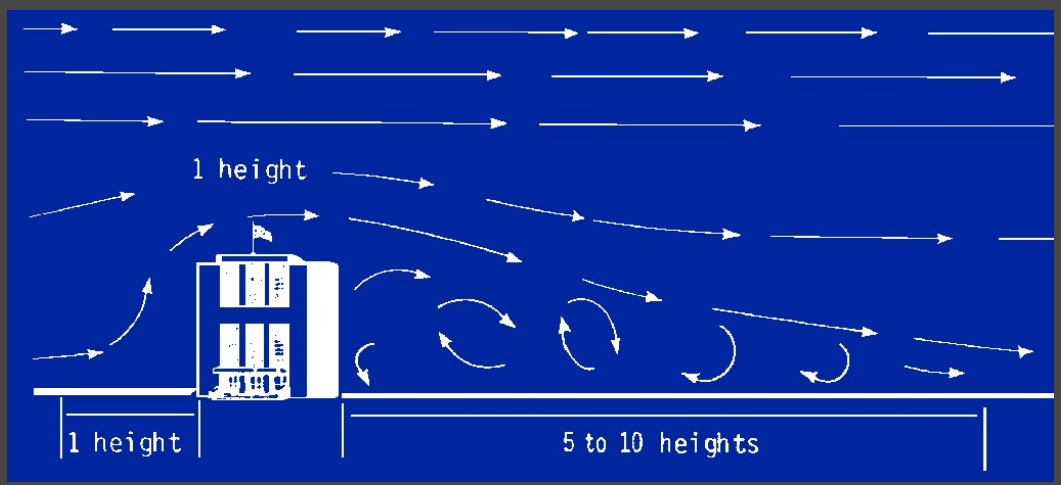
70

Site Information

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

71

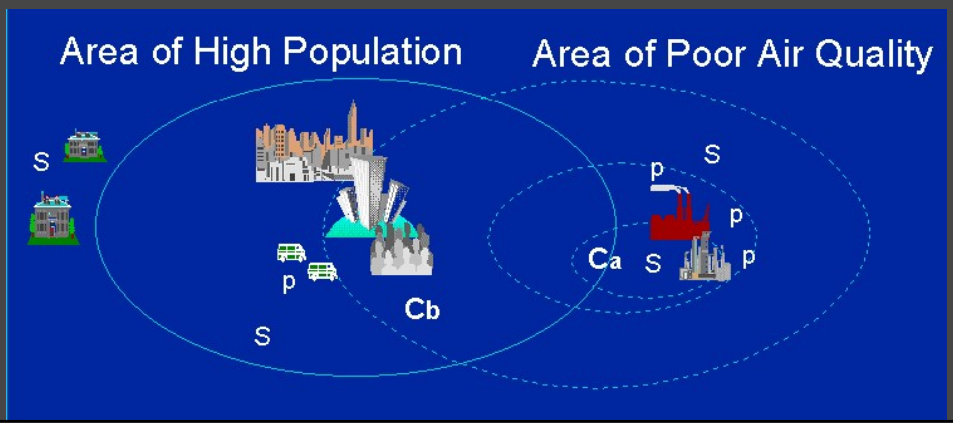
Obstacle Effects



72

Location of Monitors

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

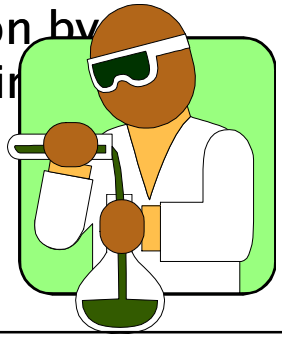


73

74

Air Pollutant Measurement Process

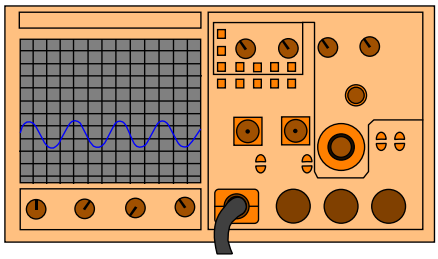
- Separate pollutant from air
- Determine pollutant quantity and air volume
- Calculate pollution concentration by dividing pollutant quantity by air volume
- Analyze data



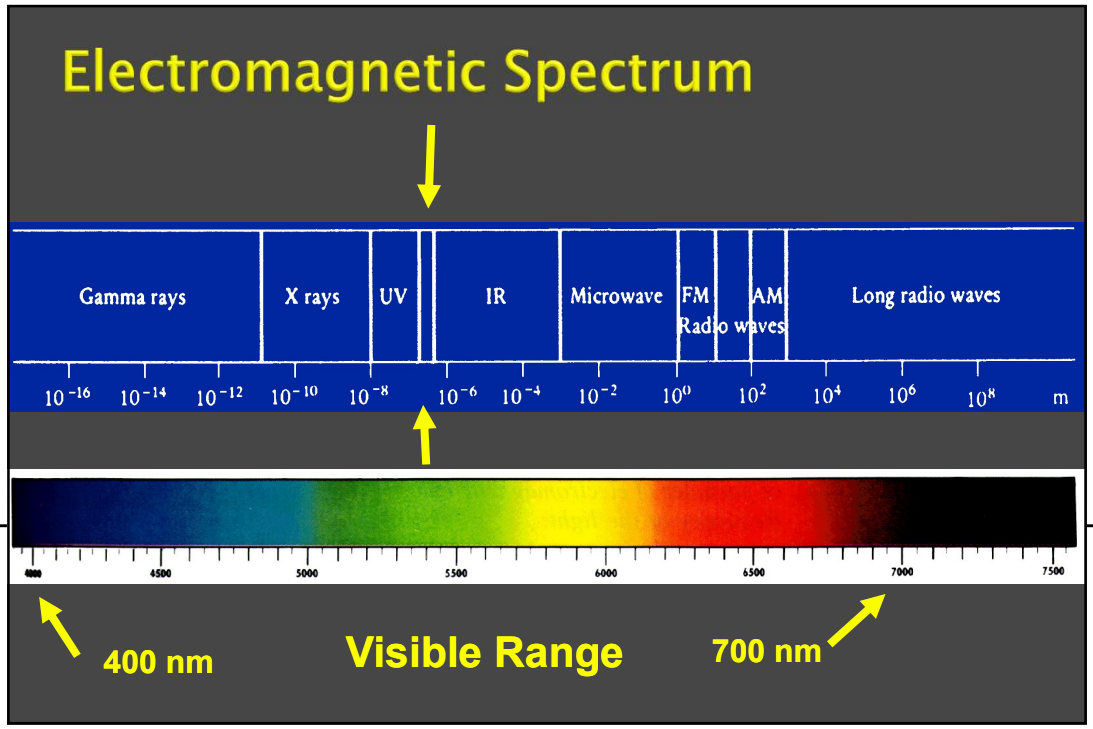
75

Types of Monitoring

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



76



77

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

78

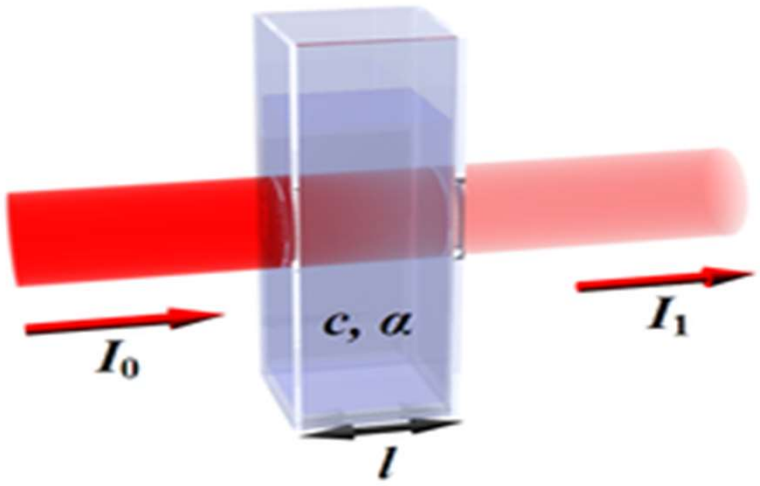
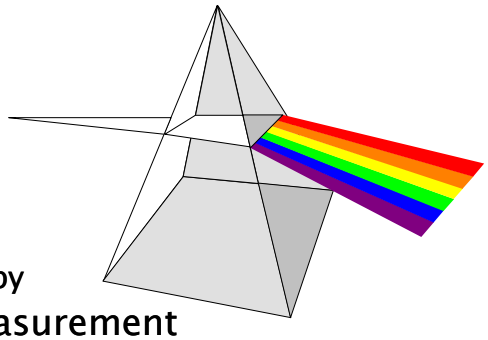


Diagram of Beer–Lambert absorption of a beam of light as it travels through a cuvette of width ℓ.

79

Analytical Techniques

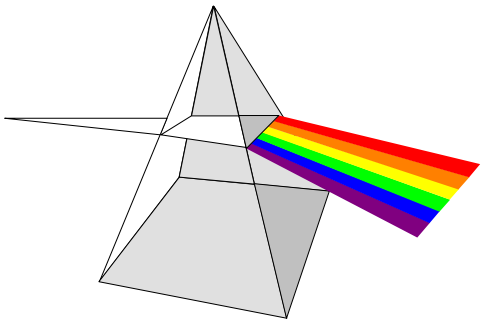
- Infrared Methods
  - Differential Absorption
  - Gas Filter Correlation
  - Fourier Transform Infrared
- Ultraviolet Methods
  - Differential Absorption
  - Second Derivative Spectroscopy
- Visible Light – Opacity Measurement
  - Scattering & Absorption



80

Analytical Techniques

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



81

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

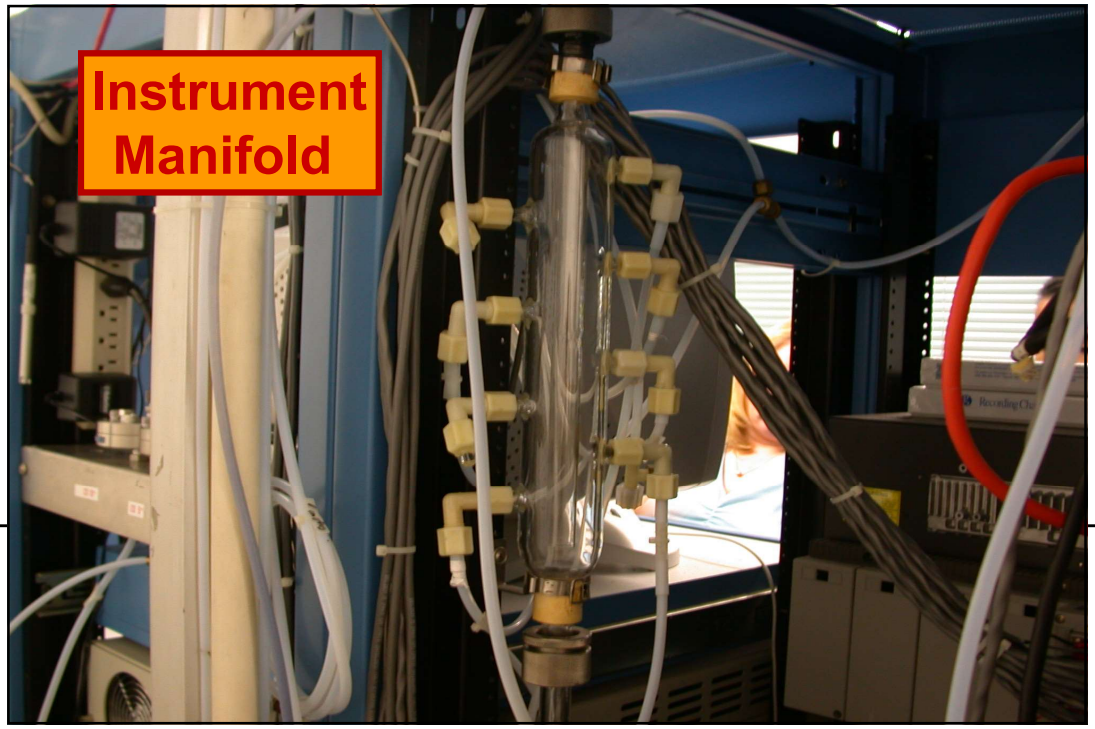
82

Site Information

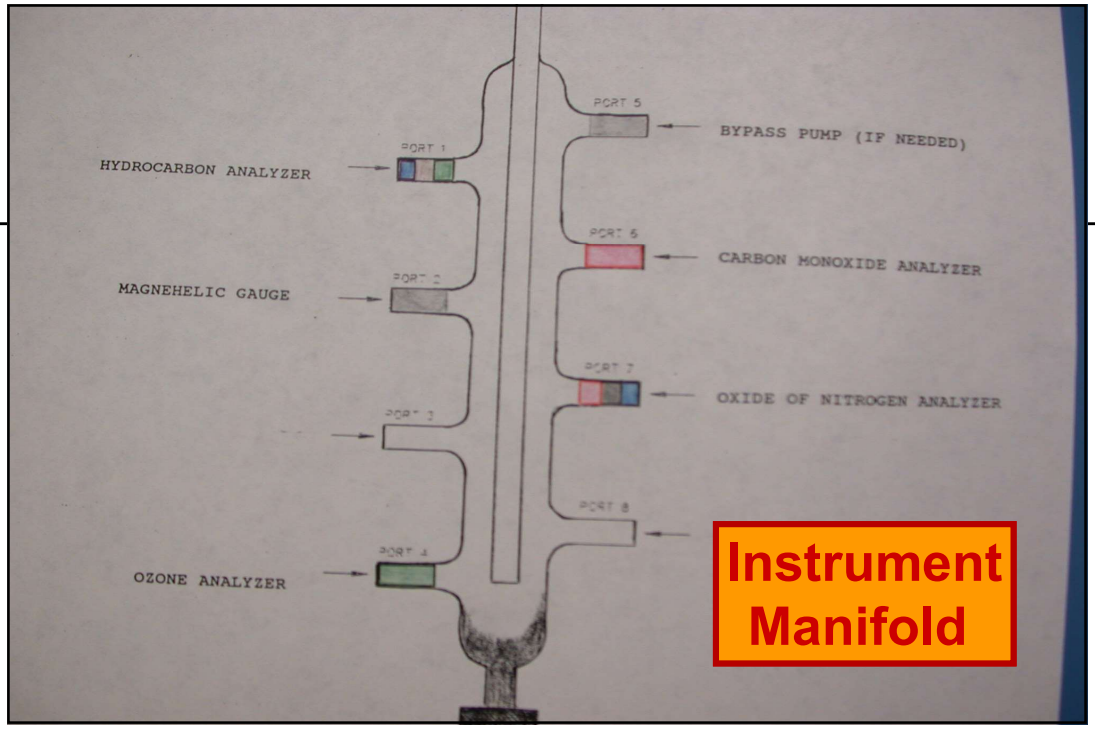
- Probe Information
  - Probe Material
  - Probe Dimensions
  - Manifold Description
  - Manifold Dimensions
  - Tubing Material
  - Tubing Dimensions
  - Residence Time
    - Probe, Manifold, Tubing, Total

83

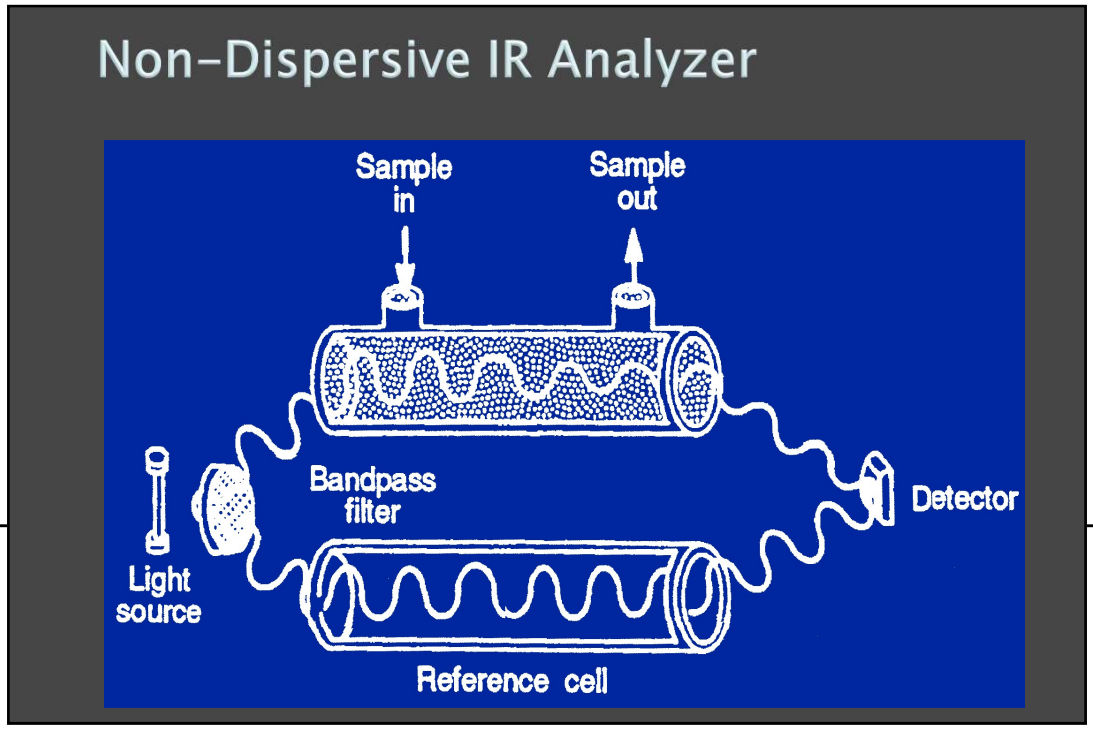
84


Instrument
Manifold

85


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

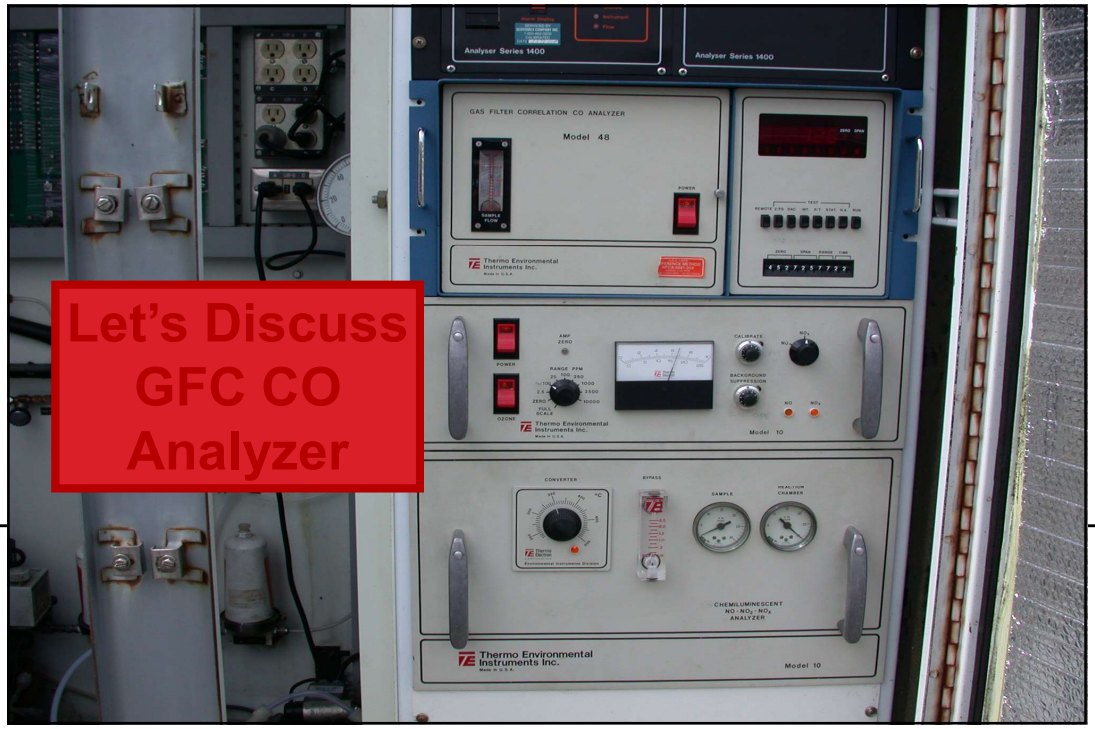
86


Non-Dispersive IR Analyzer
Sample in
Sample out
Bandpass filter
Detector
Light source
Reference cell

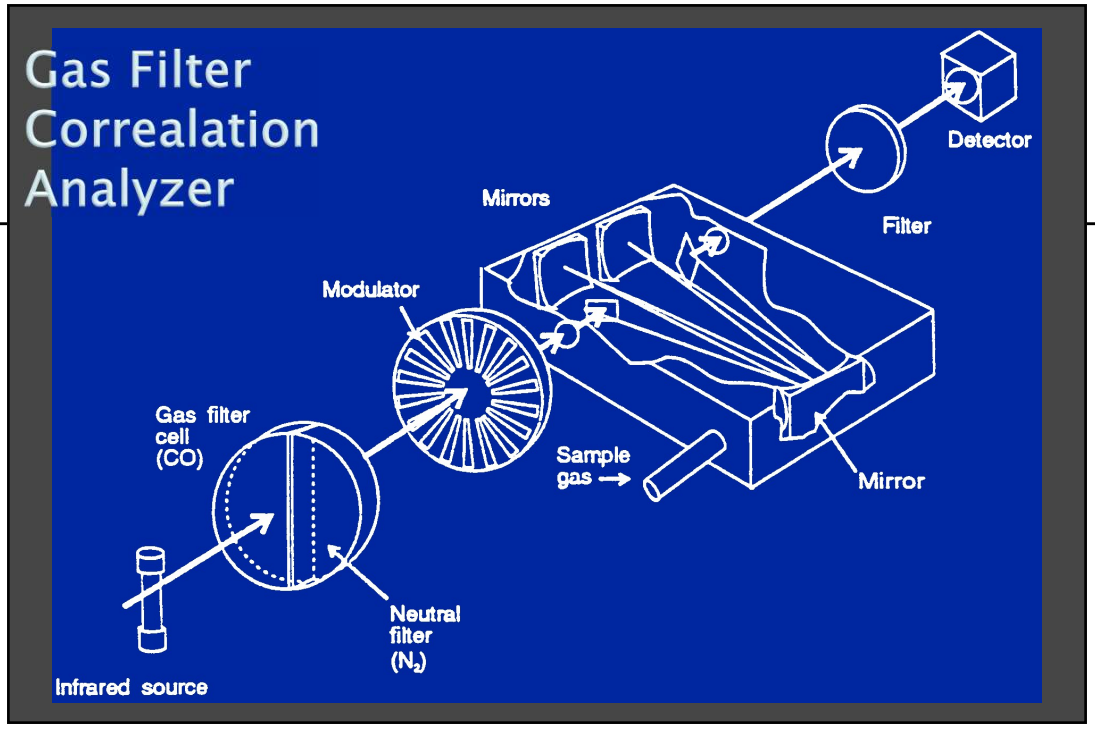
87


CHEMILUMINESCENCE NOx ANALYZER
Thermo Environmental Instruments Inc.
Model 42D
GAS FILTER CORRELATION CO ANALYZER
Thermo Environmental Instruments Inc.
Model 48
NOx & CO Analyzer

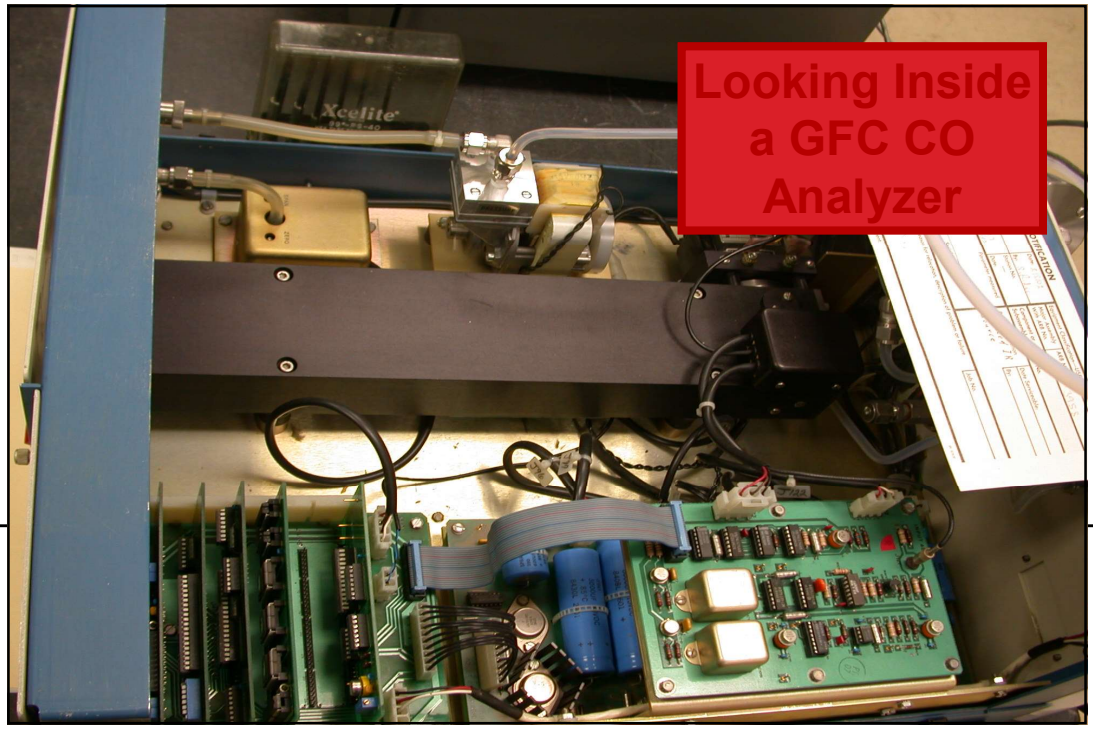
88


Let's Discuss
GFC CO
Analyzer
Analyser Series 1400
GAS FILTER CORRELATION CO ANALYZER
Model 48
Thermo Environmental Instruments Inc.
Model 10

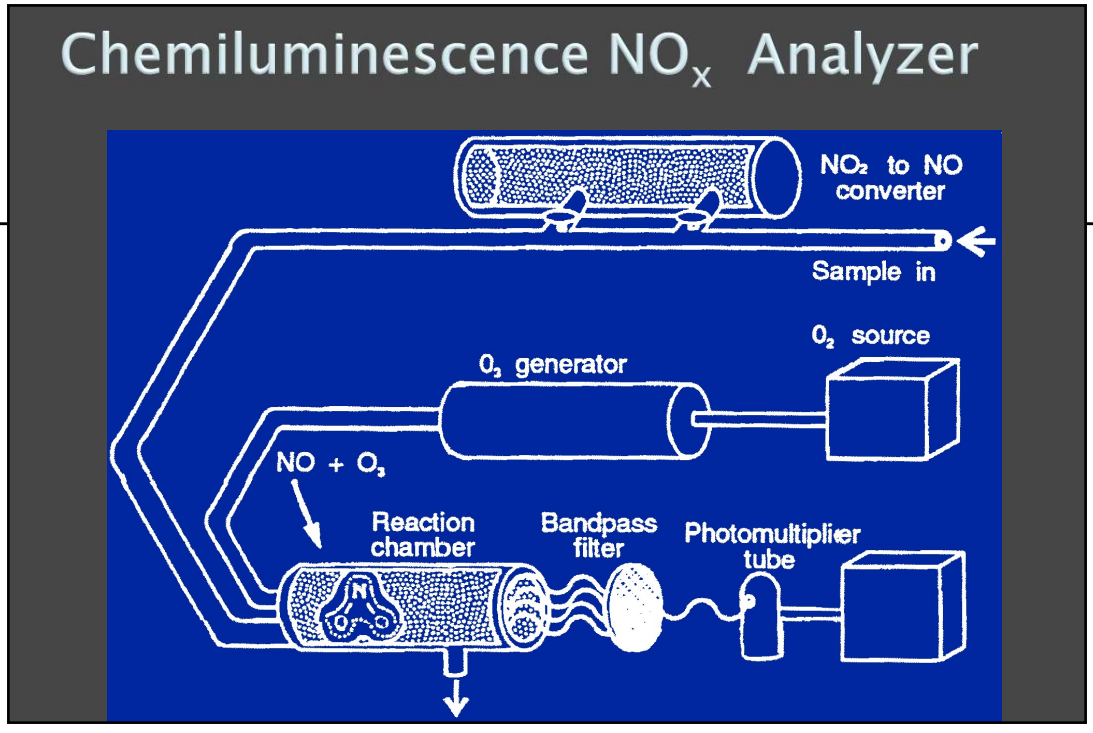
89


Gas Filter
Correalation
Analyzer
Detector
Mirrors
Filter
Modulator
Gas filter
cell
(CO)
Sample
gas
Mirror
Neutral
filter
(N2)
Infrared source

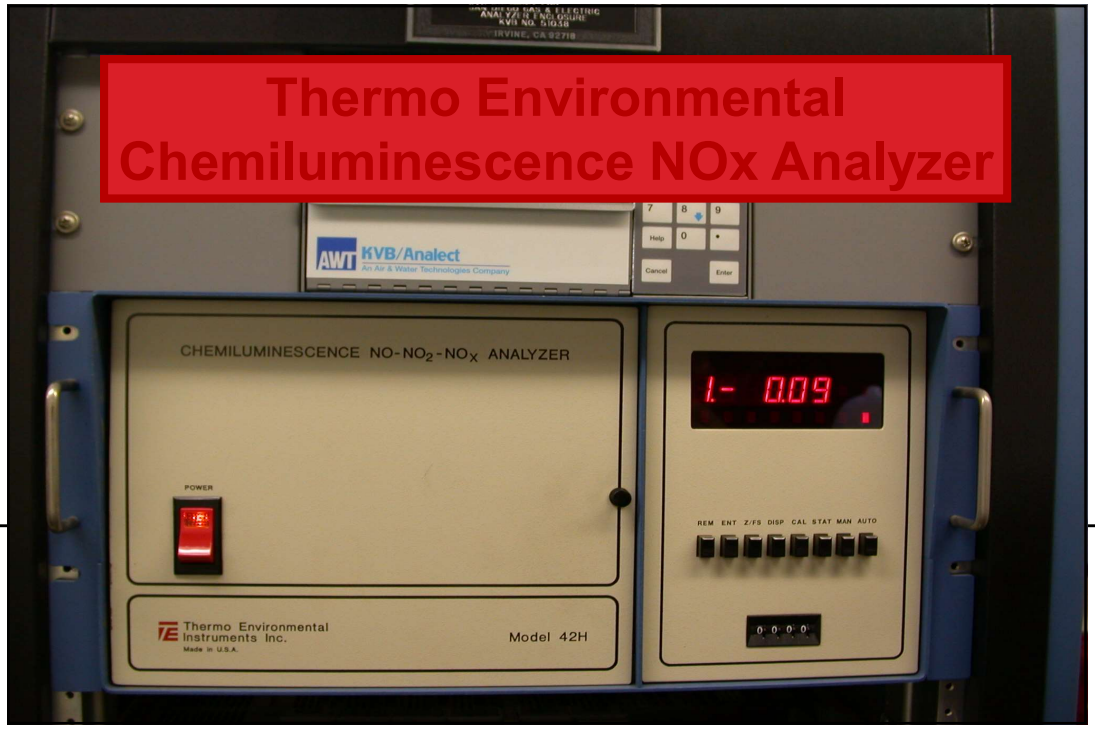
90


Looking Inside a GFC CO Analyzer

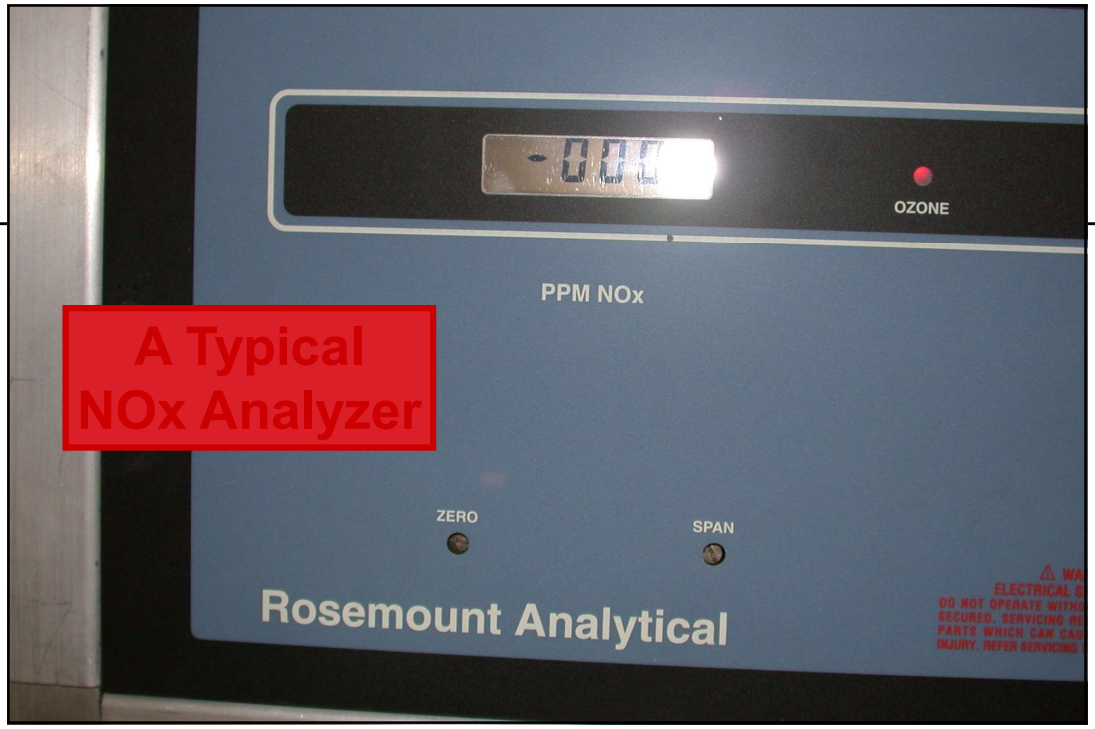
91


Chemiluminescence NO_x Analyzer
NO_2 to NO converter
Sample in
O_2 source
O_3 generator
NO + O_3
Reaction chamber
Bandpass filter
Photomultiplier tube

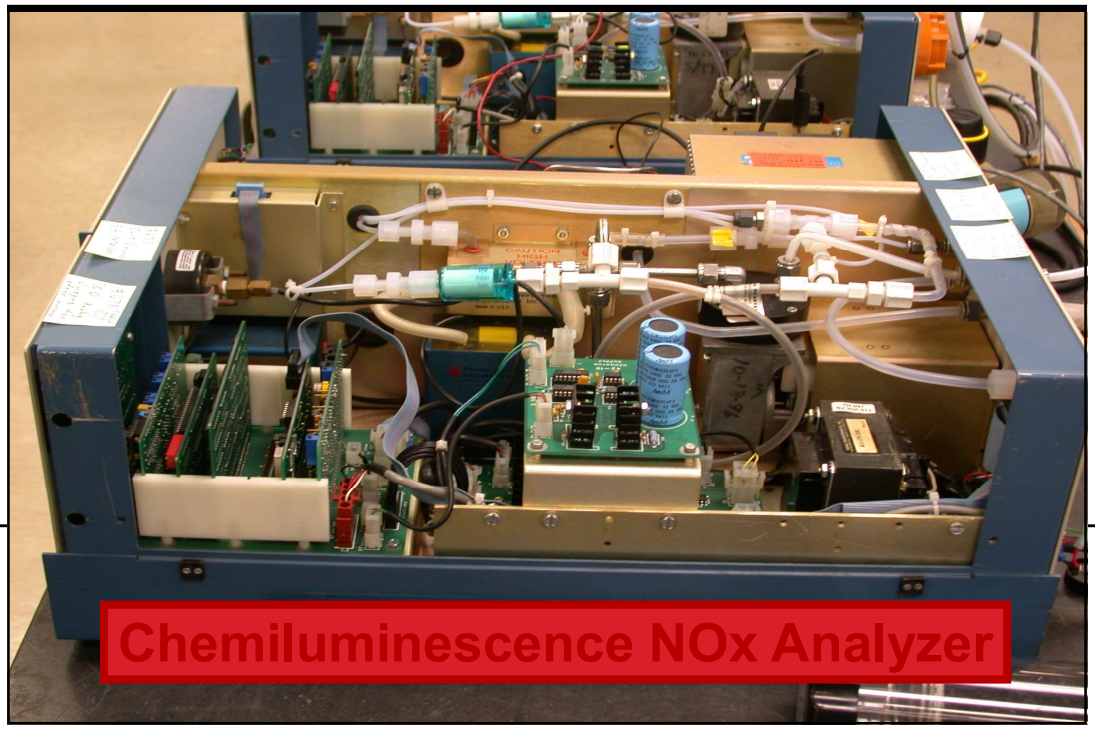
92


Thermo Environmental
Chemiluminescence NOx Analyzer
KVB/Analect
CHEMILUMINESCENCE NO-NO2-NOX ANALYZER
POWER
Thermo Environmental Instruments Inc.
Model 42H
REM ENT Z/FS DISP CAL STAT MAN AUTO

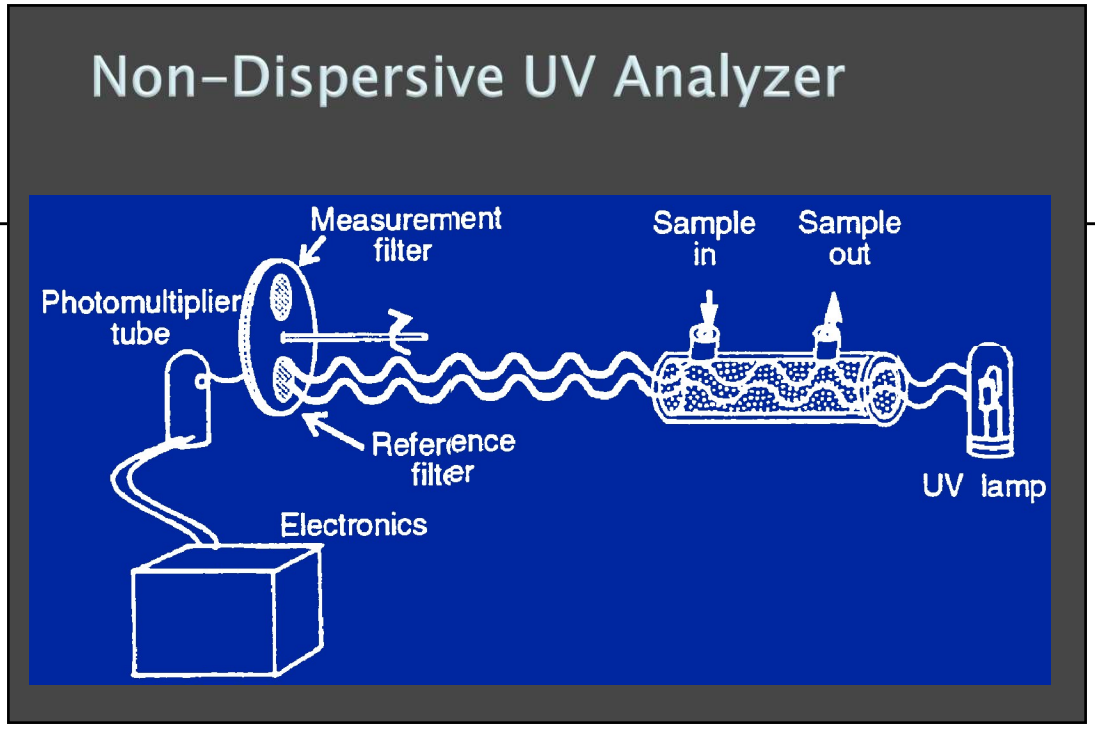
93


A Typical
NOx Analyzer
OZONE
PPM NOx
ZERO
SPAN
Rosemount Analytical

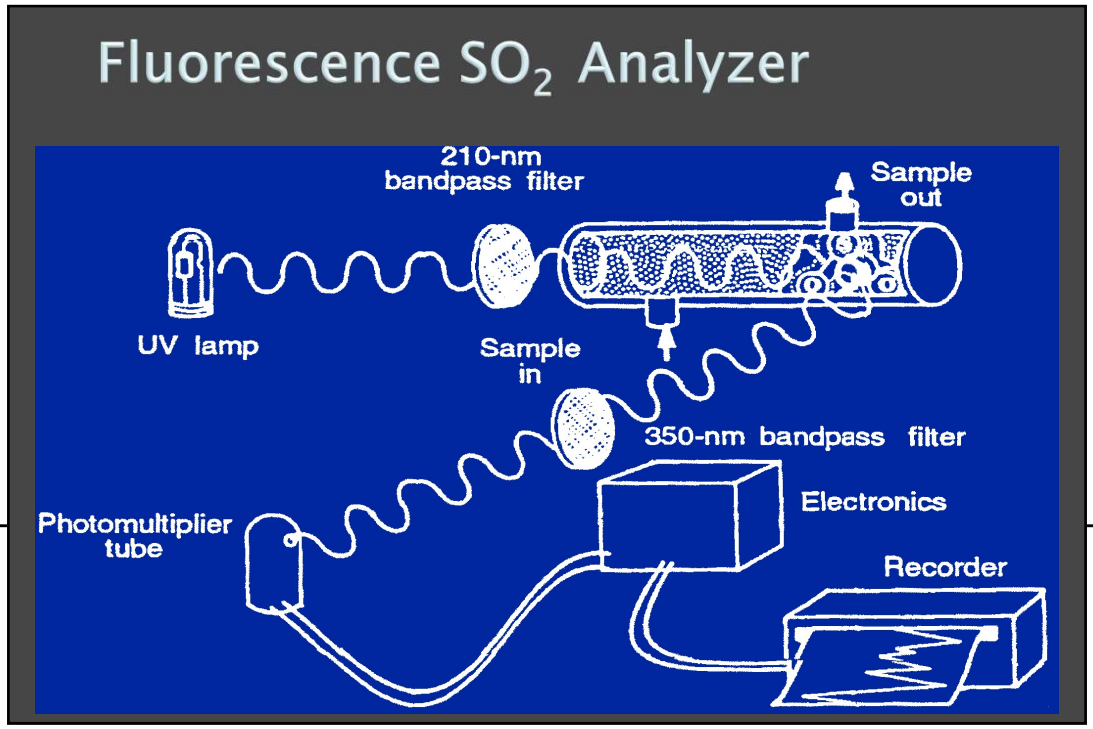
94


Chemiluminescence NOx Analyzer

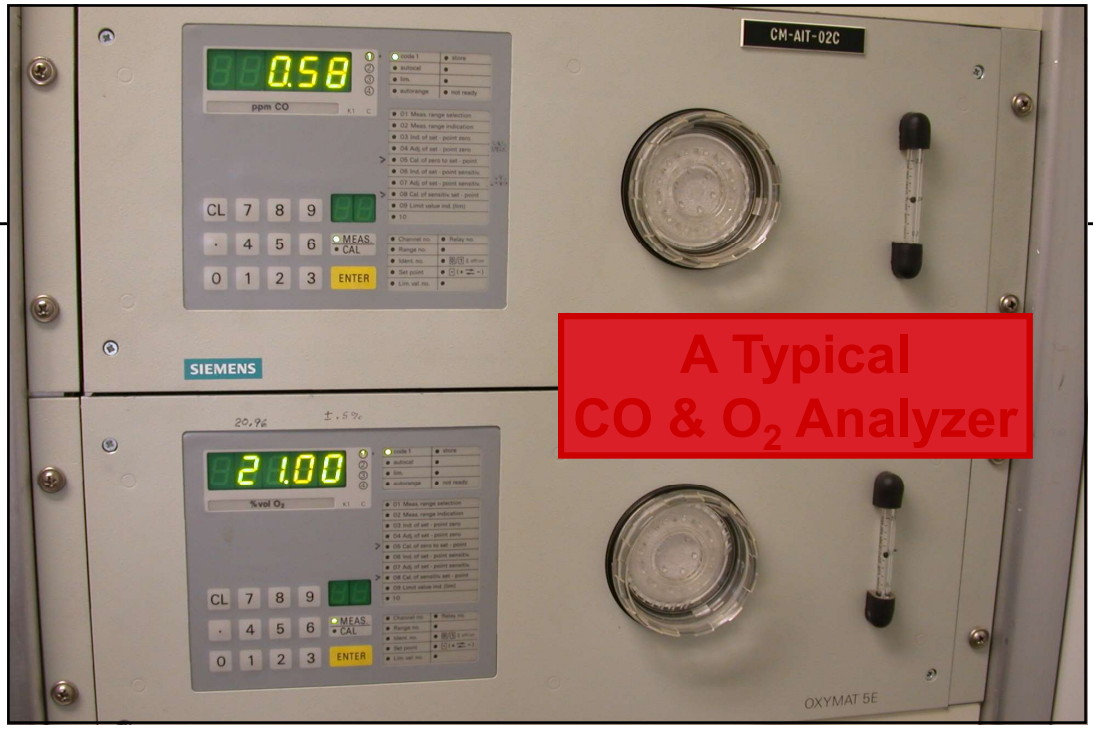
95


Non-Dispersive UV Analyzer
Measurement filter
Sample in
Sample out
Photomultiplier tube
Reference filter
UV lamp
Electronics

96


Fluorescence SO_2 Analyzer
210-nm bandpass filter
Sample out
UV lamp
Sample in
350-nm bandpass filter
Electronics
Photomultiplier tube
Recorder

97

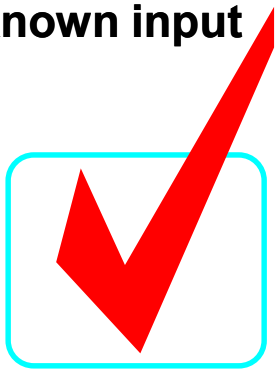

CM-AIT-02C
0.58
ppm CO
21.00
%vol O2
SIEMENS
OXYMAT 5E
A Typical
CO & O_2 Analyzer

98

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

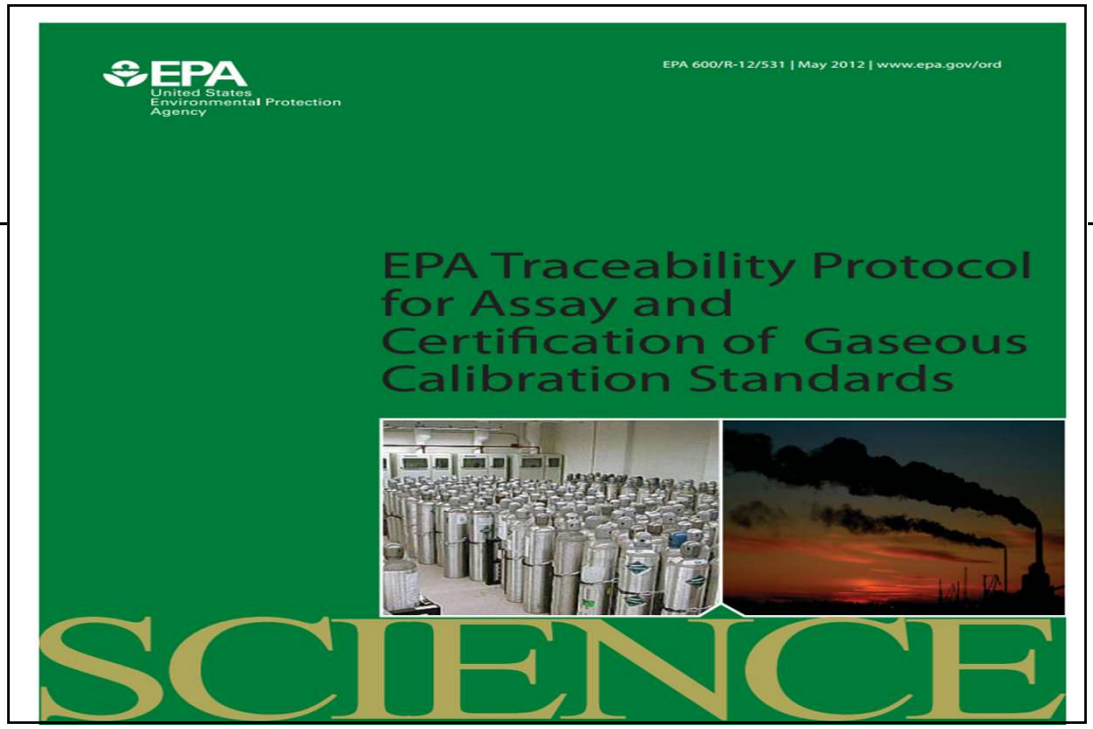


99

100


Calibration Gases

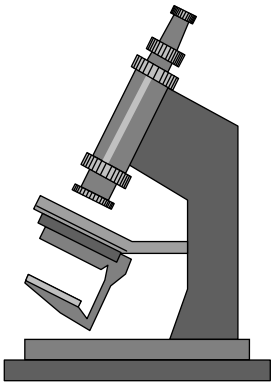
101


EPA
United States
Environmental Protection
Agency
EPA 600/R-12/531 | May 2012 | www.epa.gov/ord
EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards
SCIENCE

102

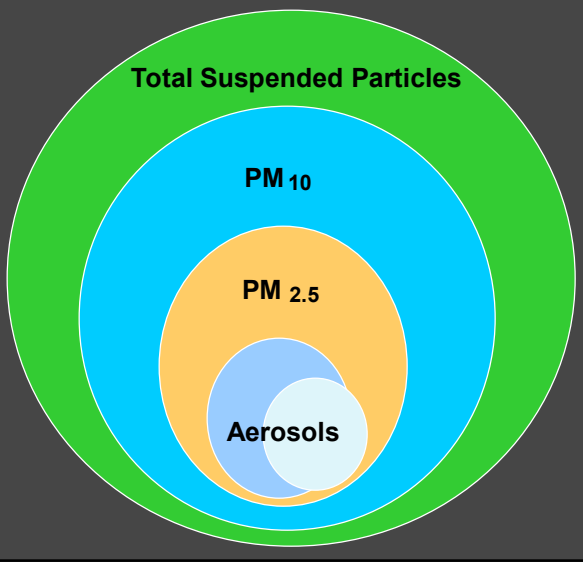
Particulate Properties

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



103

Measures of Particulate Matter in the Atmosphere



104

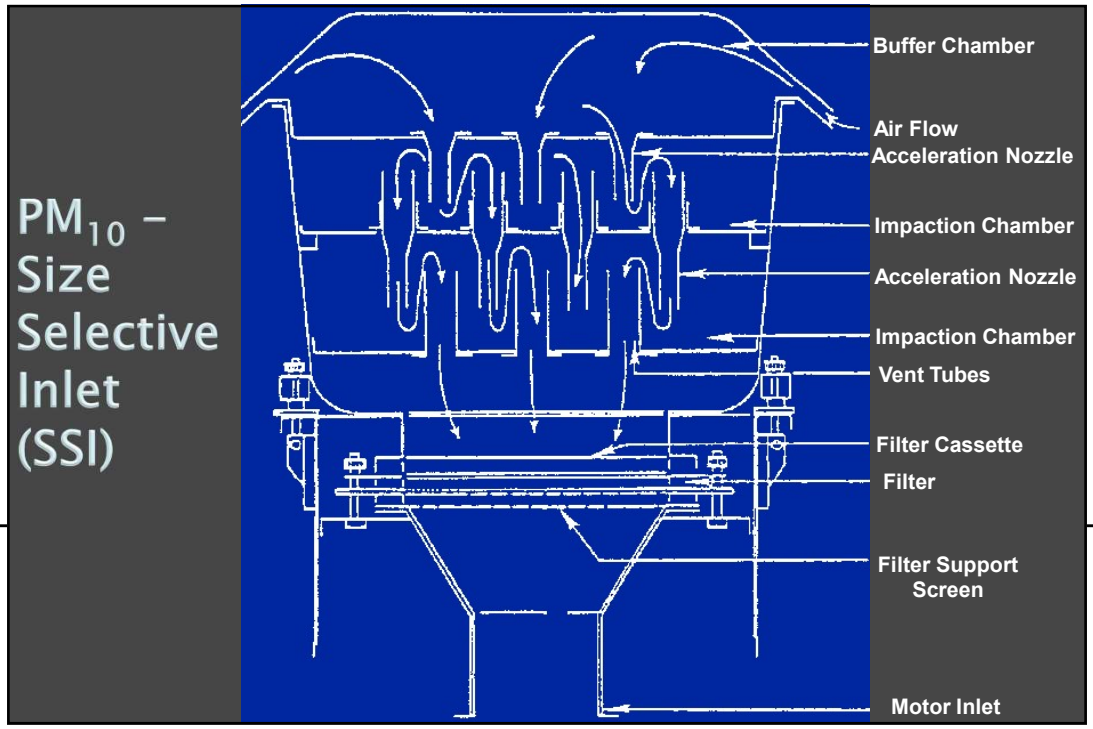
Particulate

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

PM

105

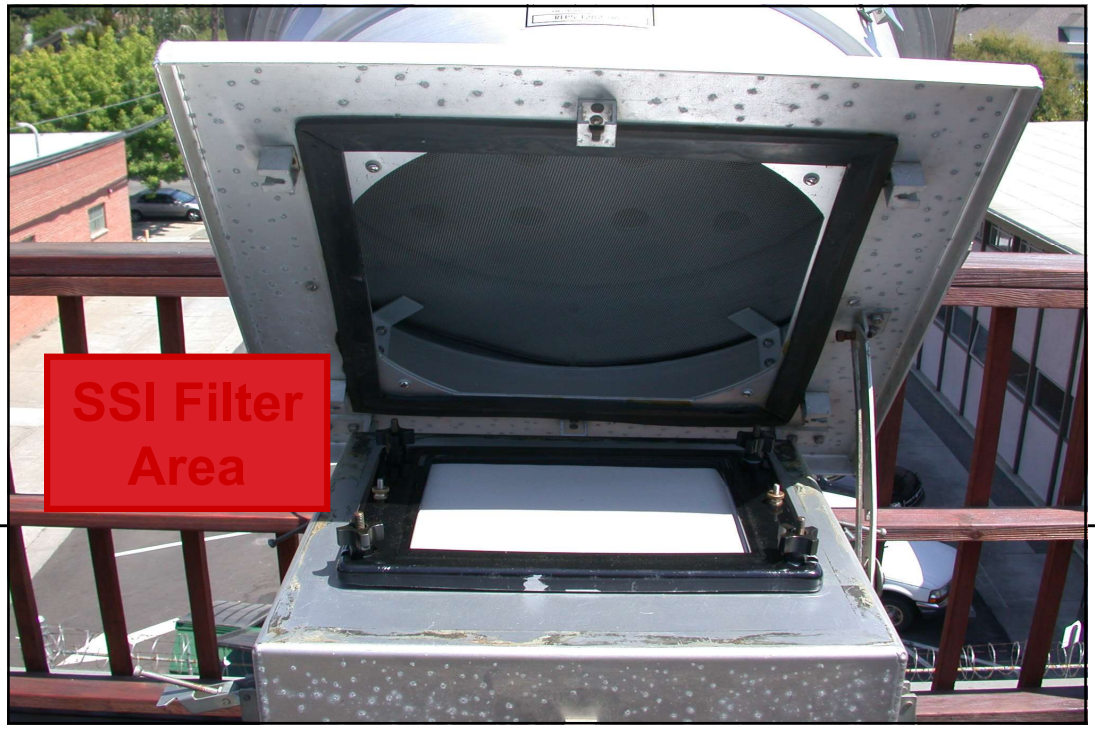
106


PM_{10} – Size Selective Inlet (SSI)
Buffer Chamber
Air Flow
Acceleration Nozzle
Impaction Chamber
Acceleration Nozzle
Impaction Chamber
Vent Tubes
Filter Cassette
Filter
Filter Support Screen
Motor Inlet

107

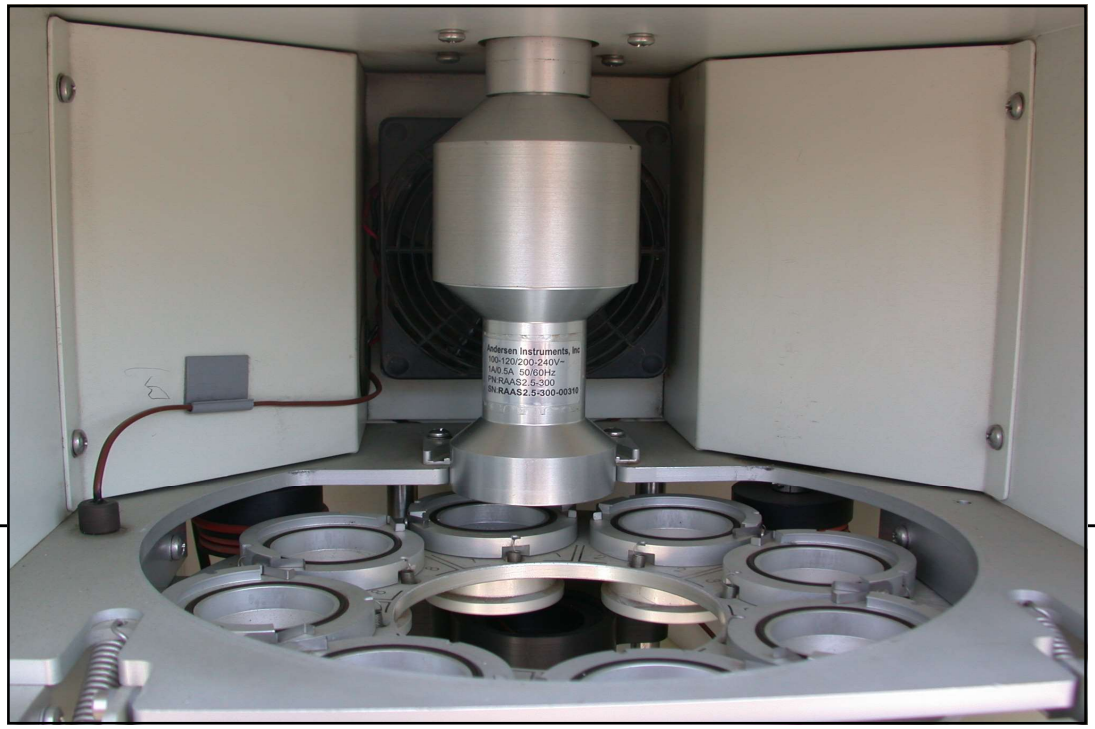

Inside SSI Head

108

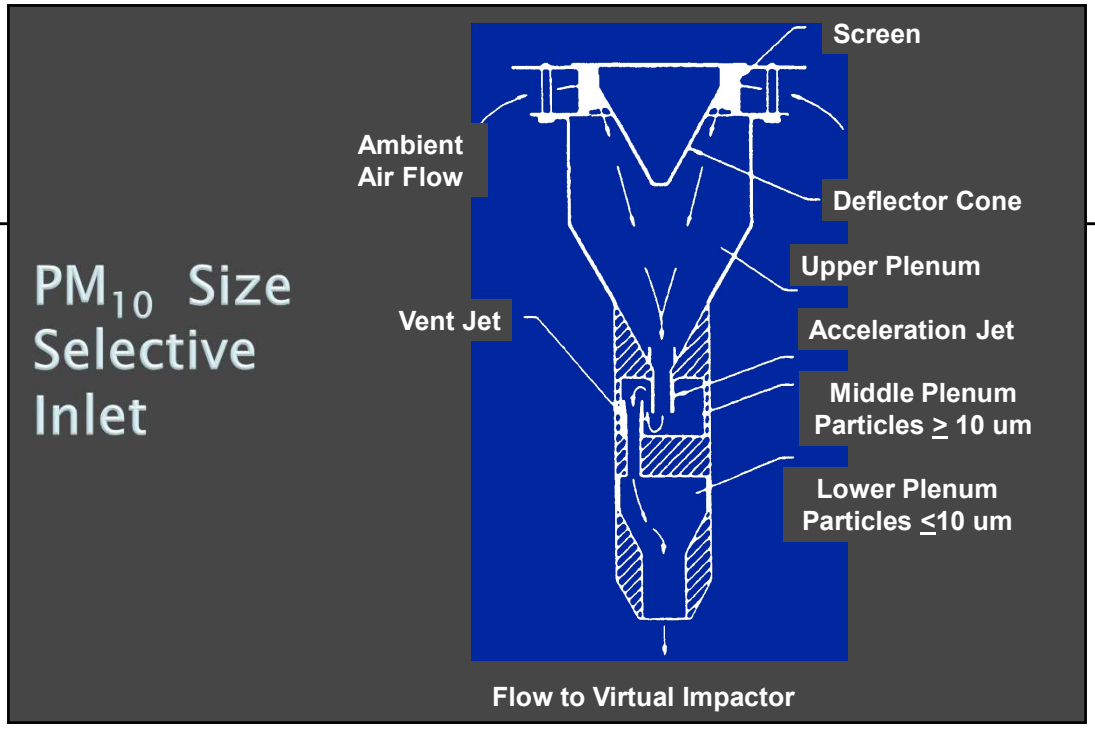


109

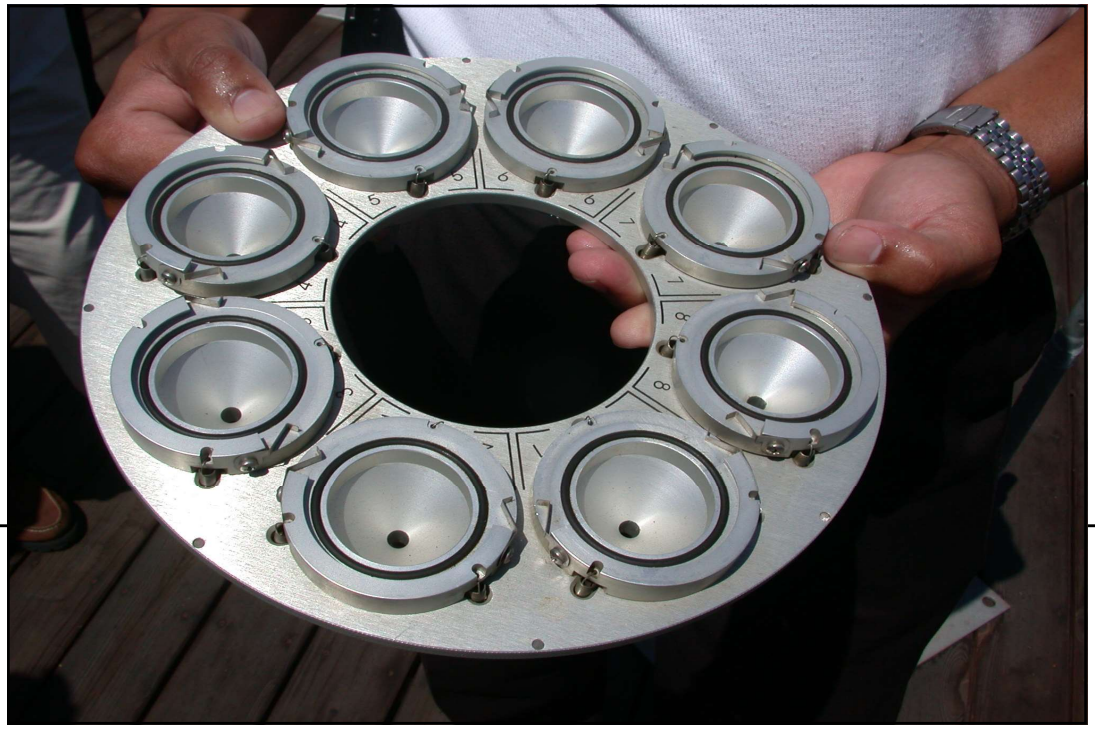
110


Andersen Instruments, Inc
100-120/200-240V~
1A/9.5A 50/60Hz
P/N:RAAS2.5-300
SN:RAAS2.5-300-00310

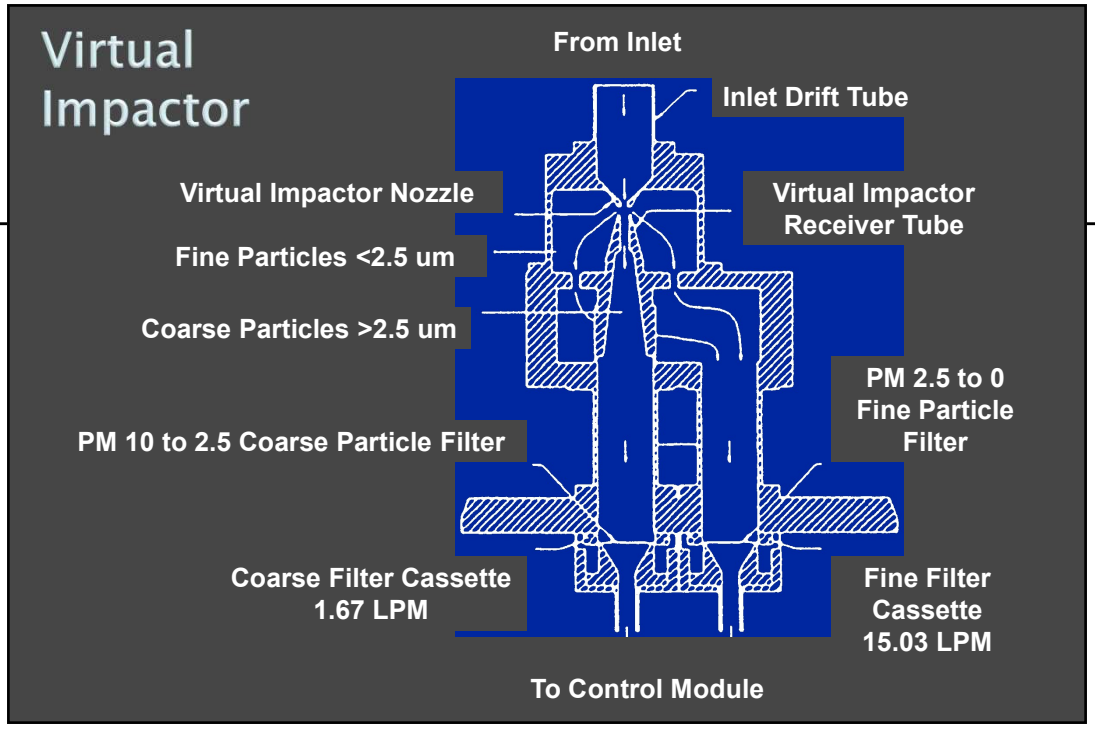
111


PM10 Size Selective Inlet
Screen
Ambient Air Flow
Deflector Cone
Upper Plenum
Vent Jet
Acceleration Jet
Middle Plenum
Particles ≥ 10 um
Lower Plenum
Particles ≤10 um
Flow to Virtual Impactor

112

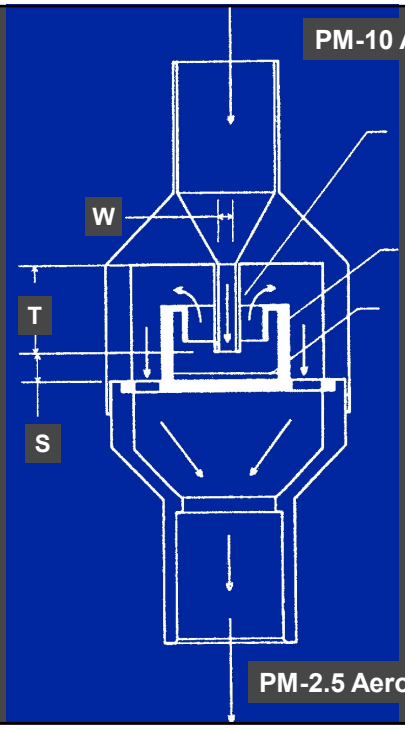


113


Virtual Impactor
From Inlet
Inlet Drift Tube
Virtual Impactor Nozzle
Virtual Impactor Receiver Tube
Fine Particles <2.5 um
Coarse Particles >2.5 um
PM 2.5 to 0 Fine Particle Filter
PM 10 to 2.5 Coarse Particle Filter
Coarse Filter Cassette 1.67 LPM
Fine Filter Cassette 15.03 LPM
To Control Module

114

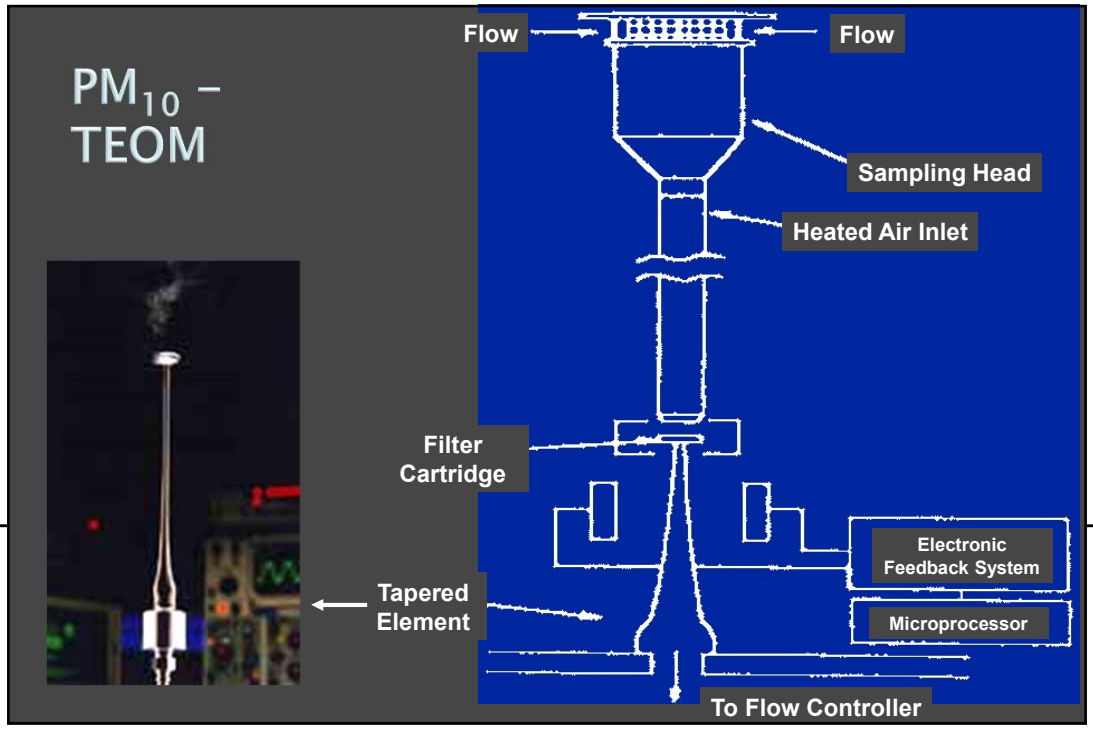
EPA–WINS
$PM_{2.5}$
Impactor



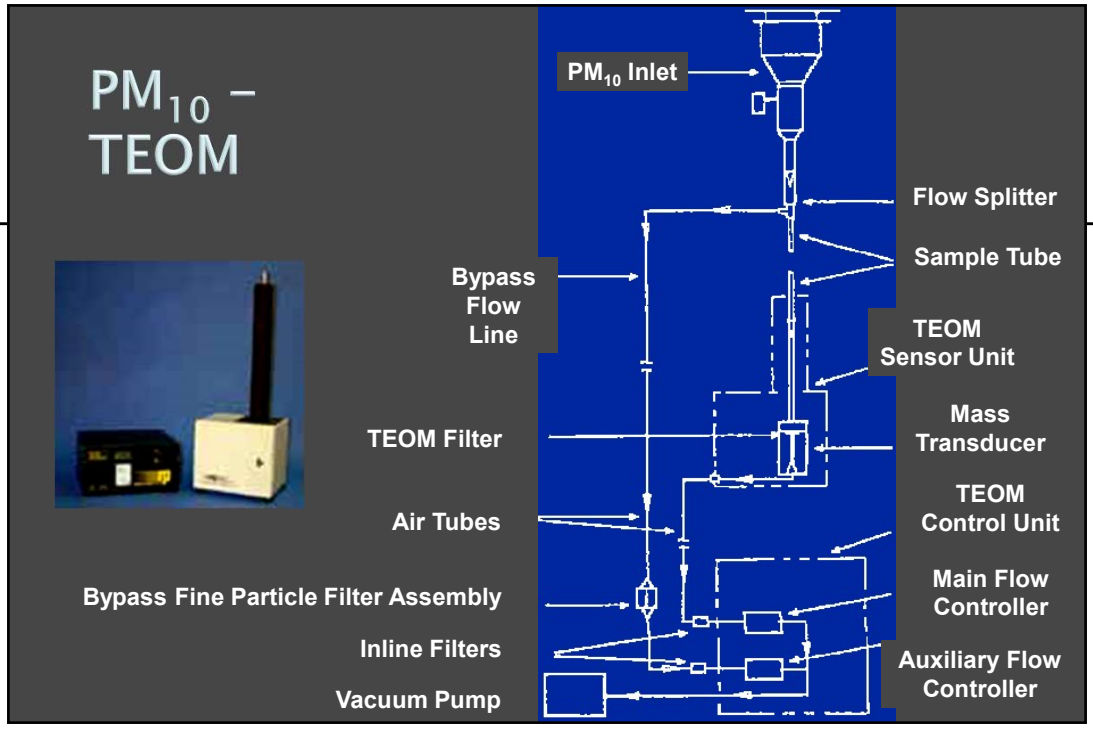
115

Tapered
Element
Oscillating
Microbalance
(TEOM) Inlet

116


PM10 – TEOM
Flow
Flow
Sampling Head
Heated Air Inlet
Filter Cartridge
Tapered Element
Electronic Feedback System
Microprocessor
To Flow Controller

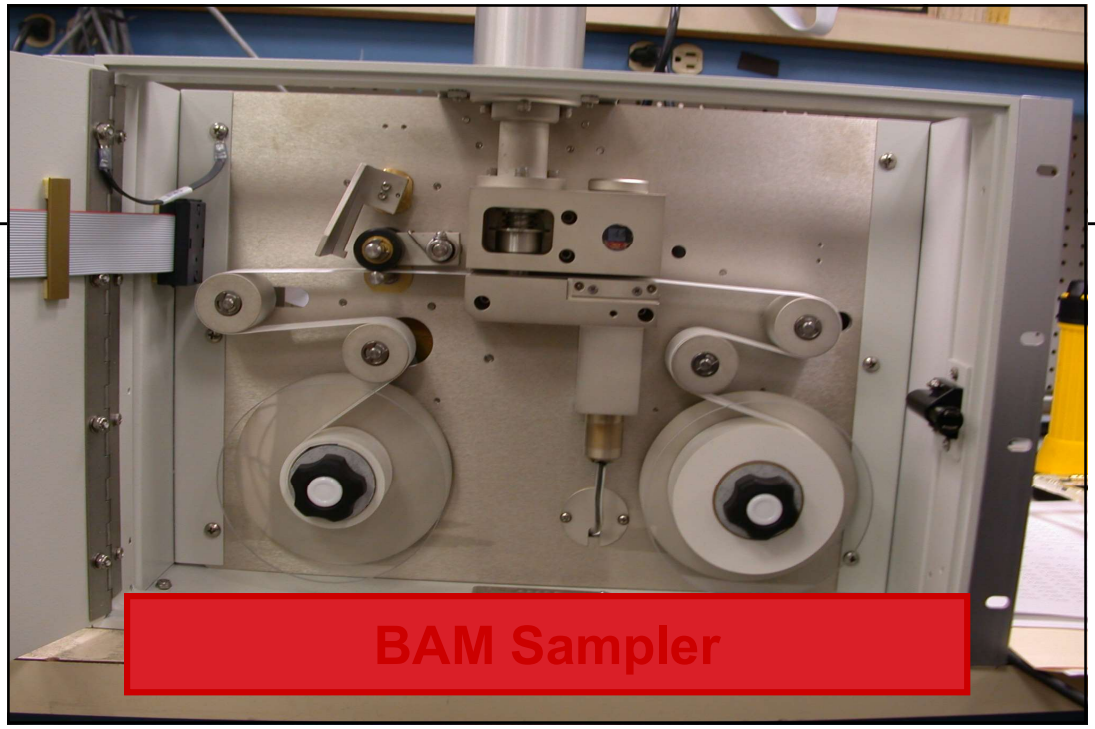
117


PM10 – TEOM
PM10 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

118


MAX 85%
Series 1400a
TEOM® Control Unit
TEOM Series 1400 PM-10 Monitor
U.S. EPA Designated Equivalent Method
EQPM-1090-079
POWER
CHECK STATUS
RS-232
ANALOG I/O
Rupprecht & Patashnick Co., Inc.

119


BAM Sampler

120

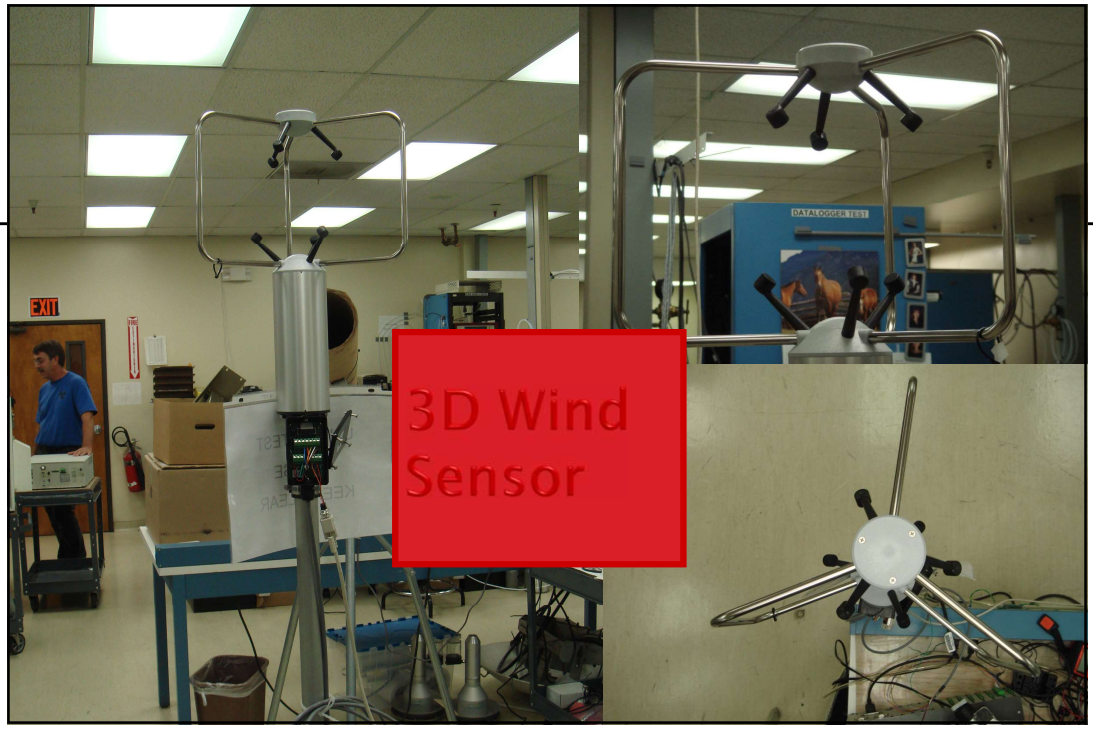
121

Meteorological Instruments

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

122

123

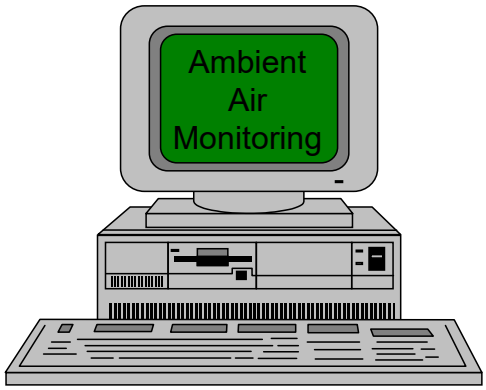


124

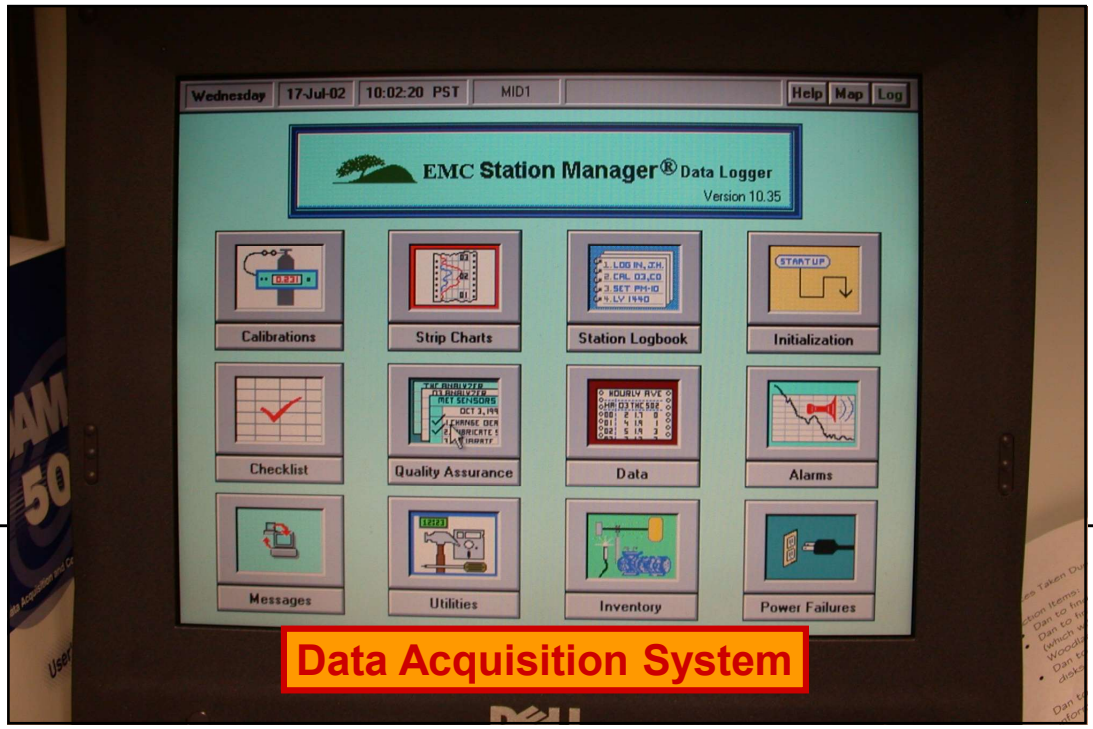
125

Data Handling

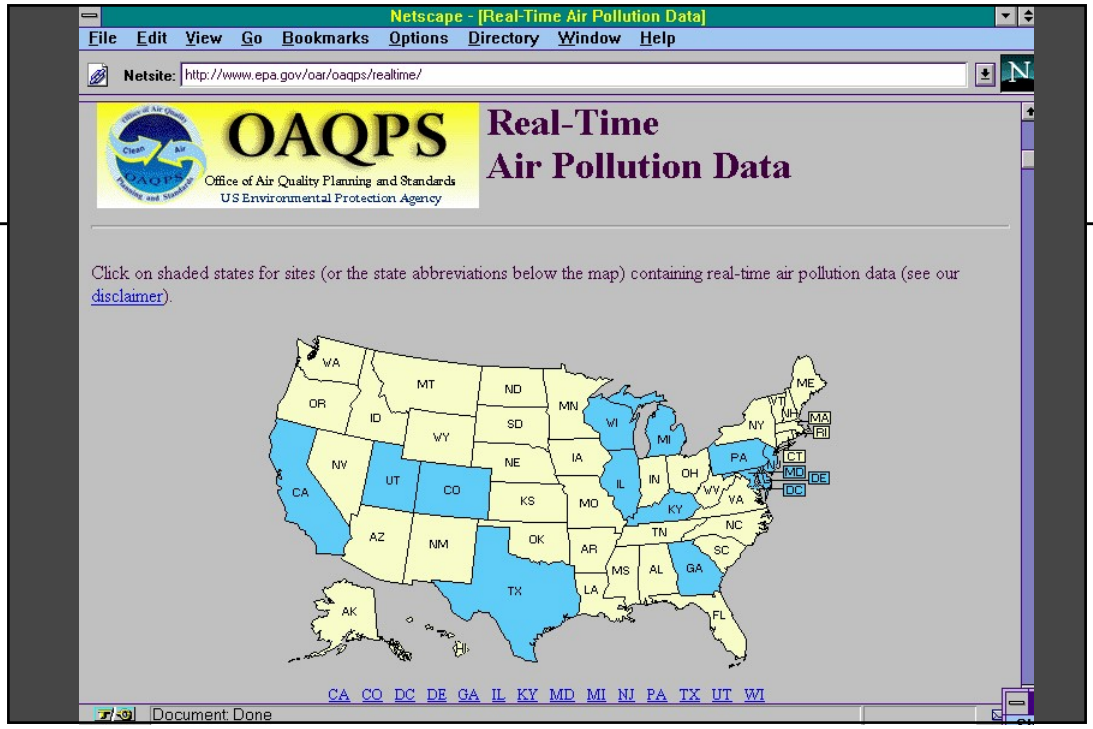
- Data loggers
  - Strip charts
  - Computers
  - Temporary data storage
  - On-line data retrieval



126


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

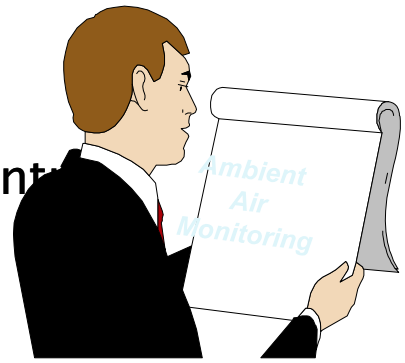
127


Netscape - [Real-Time Air Pollution Data]
File Edit View Go Bookmarks Options Directory Window Help
Netsite: http://www.epa.gov/oar/oaqps/realtime/
OAQPS
Office of Air Quality Planning and Standards
US Environmental Protection Agency
Real-Time
Air Pollution Data
Click on shaded states for sites (or the state abbreviations below the map) containing real-time air pollution data (see our disclaimer).
CA CO DC DE GA IL KY MD MI NJ PA TX UT WI
Document: Done

128

Site Survey Data

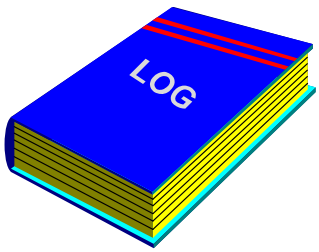
- Quality Assurance Procedures and Plans
- Cleaning Schedule
- Calibrations
- Station Temperature Cont
- In-Line Filters



129

Documentation

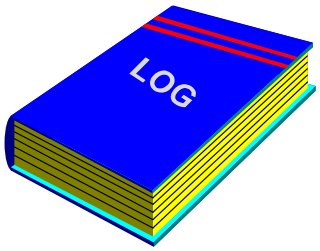
- Instrument Log
  - Stays with Instrument
  - Documents Acceptance Tests
  - Documents Routine Maintenance
  - Documents Repairs
  - Documents Calibrations
  - Other Instrument Specific Information
    - i.e. Location, History, etc.



130

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



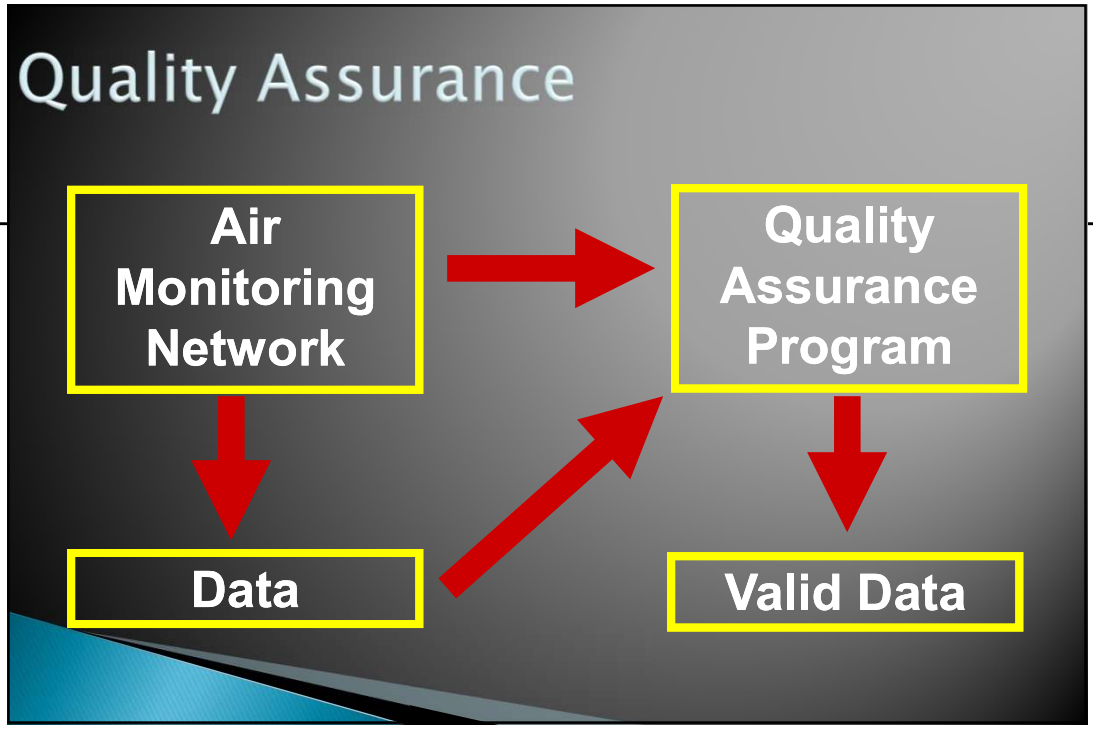
131

Typical Monitoring Station

132


Quality Assurance

133


Quality Assurance
Air Monitoring Network
Quality Assurance Program
Data
Valid Data

134

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)

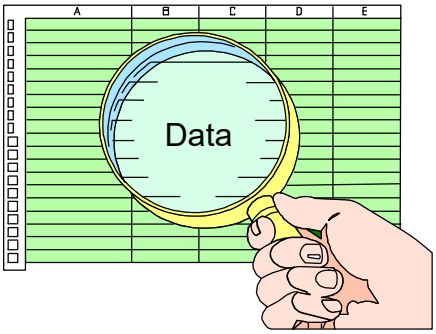
QA

135

Data Handling

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

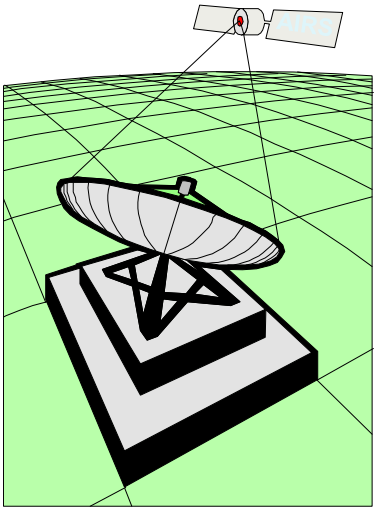
QA



136

Data Handling

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



137

Station Inspection

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

QA

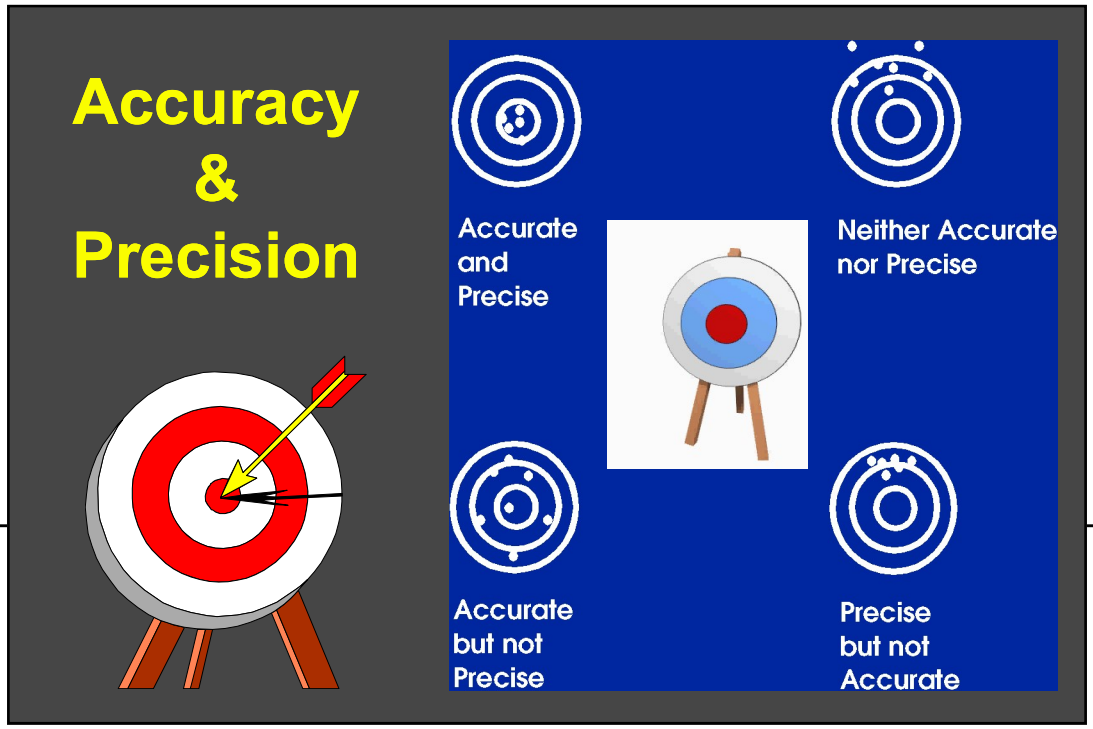
138

ARB Audit Van

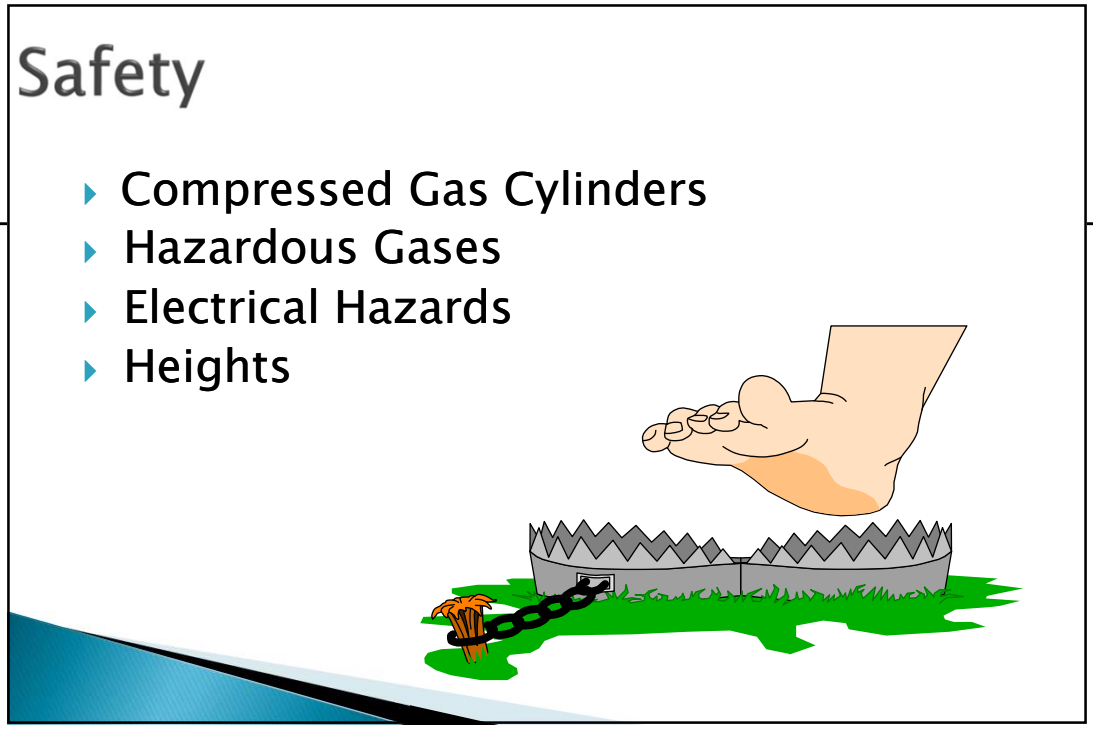
139

ARB Audit Van Instrumentation

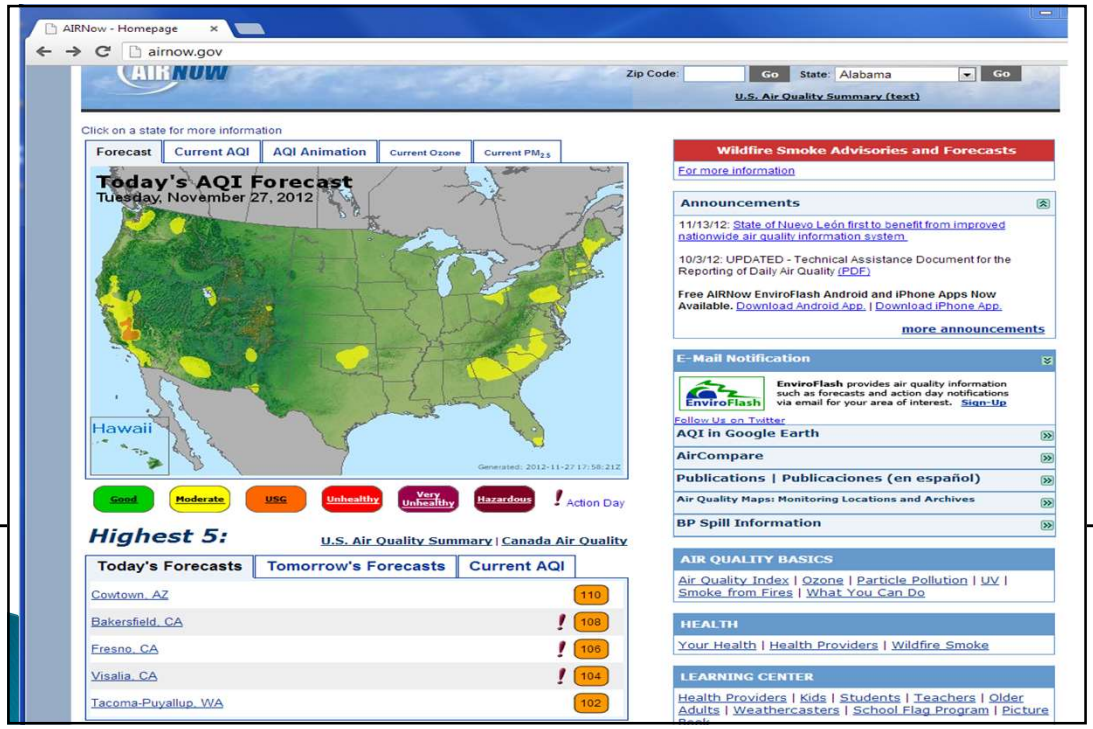
140


Accuracy
&
Precision
Accurate and Precise
Neither Accurate nor Precise
Accurate but not Precise
Precise but not Accurate

141


Safety
Compressed Gas Cylinders
Hazardous Gases
Electrical Hazards
Heights

142


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 PM2.5
Today's AQI Forecast
Tuesday, November 27, 2012
Hawaii
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 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

143


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

144

145

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.

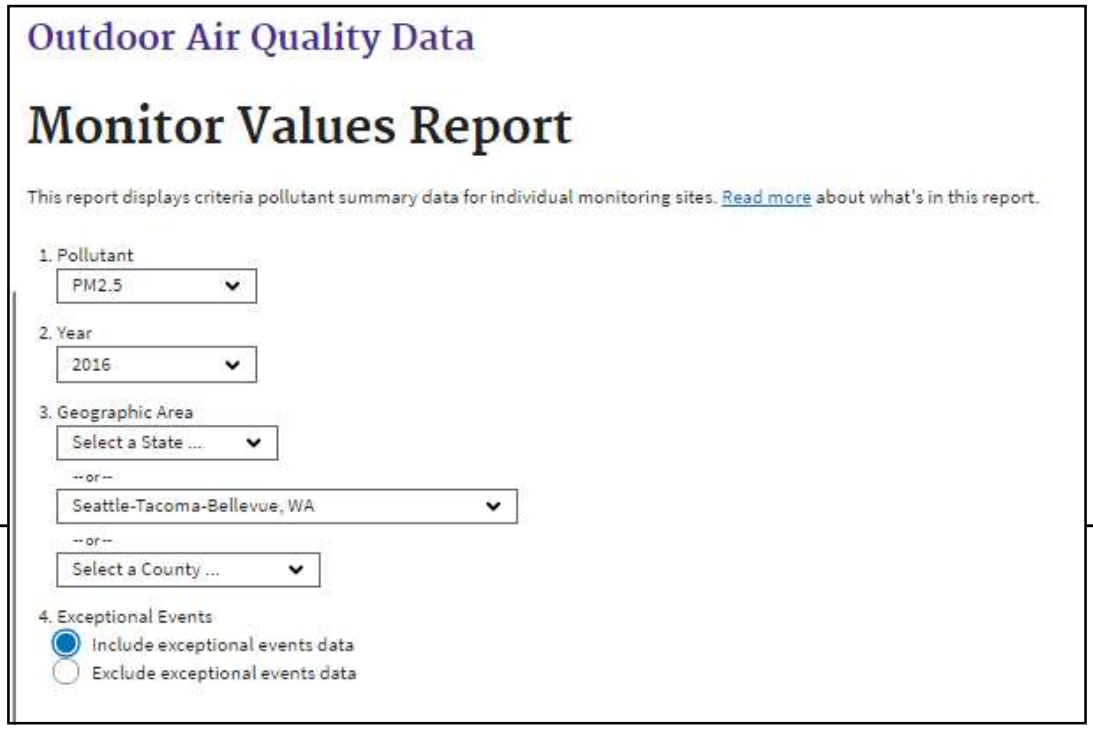
◊ CBSA	CO ◊ 1-hr 2nd Max	CO ◊ 8-hr 2nd Max	NO2 ◊ 98th %ile	NO2 ◊ Annual Mean	O3 ◊ 1-hr 2nd Max	O3 ◊ 8-hr 4th Max	SO2 ◊ 99th %ile	SO2 ◊ 24-hr 2nd Max	SO2 ◊ Annual Mean	PM2.5 ◊ 98th %ile	PM2.5 ◊ Wtd. Mean	PM10 ◊ 24-hr 2nd Max	PM10 ◊ Annual Mean	Lead ◊ Max 3-Mo. Avg
Seattle-Tacoma-Bellevue, WA	1.9	1.4	60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

146



147

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
174	30.2	27	22.4	22.3	22	6.9*	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
171	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	19.5	18	5.9*	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 38th 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	11.8	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
173	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	4.9*	None	3	530610020	1085 Fir St	Darrington	Snohomish	WA	10
259	37.7	30	28.6	28.1	22	6.4*	None	3	530611007	1709 7th S	Marysville	Snohomish	WA	10
174	38.7	31	29.8	29.4	23	6.3*	None	4	530611007	1709 7th S	Marysville	Snohomish	WA	10

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The future

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

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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

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