AMBIENT AIR MONITORING

Objectives and Monitoring Devices

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Content of this presentation

- *Monitoring objectives*
- *Advantages and disadvantages of different types of instrumentation*
- *Quality assurance and quality control*

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Planning and design considerations

- Objectives of the monitoring program
- Resource availability
- Spatial and temporal coverage
- Performance specifications of the monitoring devices (precision, accuracy, and response time)

Monitoring Objectives

- *To provide the data required for rational air quality management*

Monitoring Objectives

- *Activate air pollution alert*
- *Assess accuracy of air quality models*
- *Assess impacts of air pollution on health and the environment*
- *Assess accumulation of persistent pollutants*

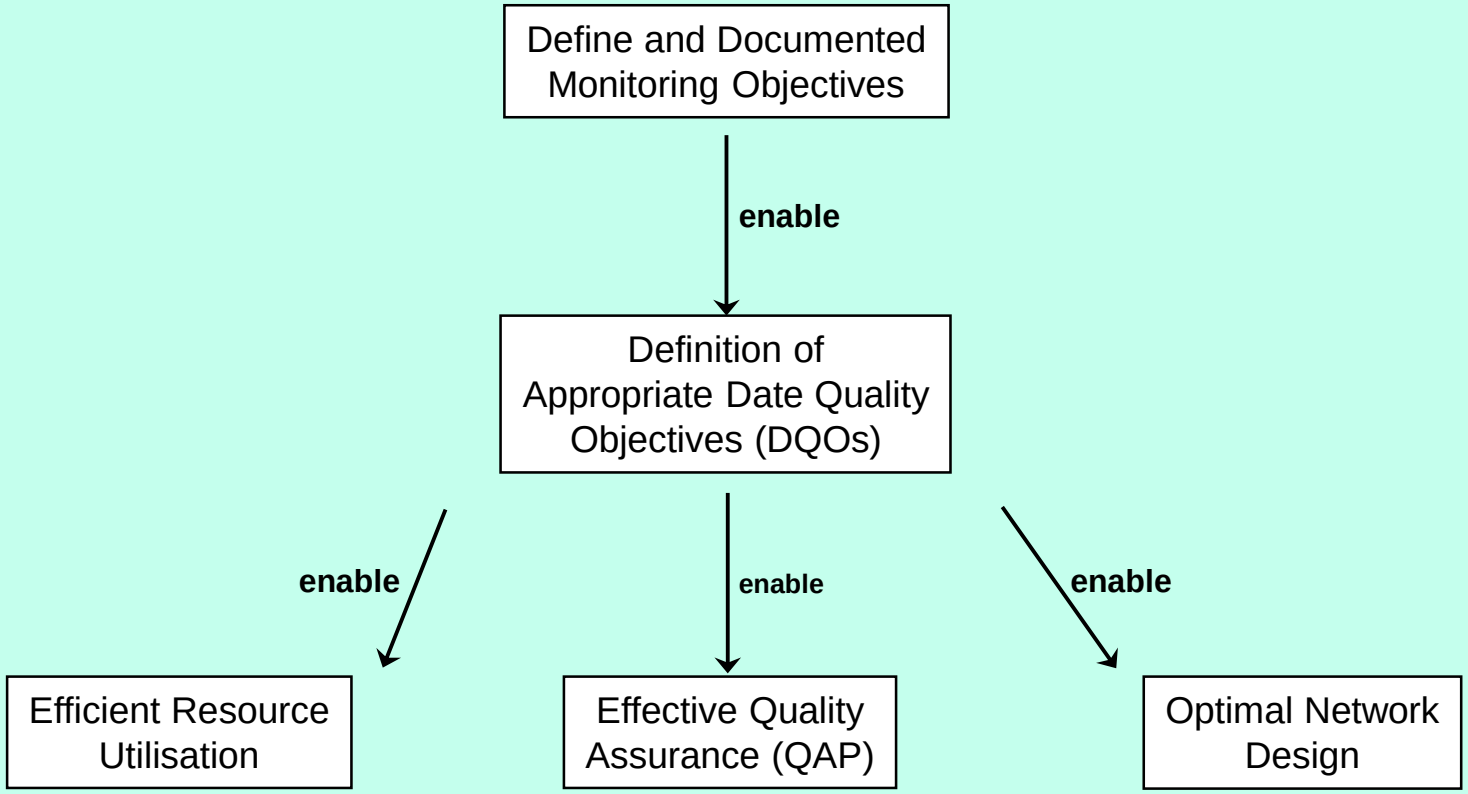
Monitoring Objectives

- *Inform the public through reporting*
- *Assess need for pollution control at*
  - ***current emission levels***
  - ***future emission levels***
- *Assess effectiveness of pollution control*
- *Assess compliance with regulations*

Why measure indoor air pollution

- To determine
  - Level of exposures
  - Distribution of exposure
  - Demographics of exposure
- To evaluate if interventions achieved the objectives
- To relate indoor air quality to health outcomes

The importance of objective-setting



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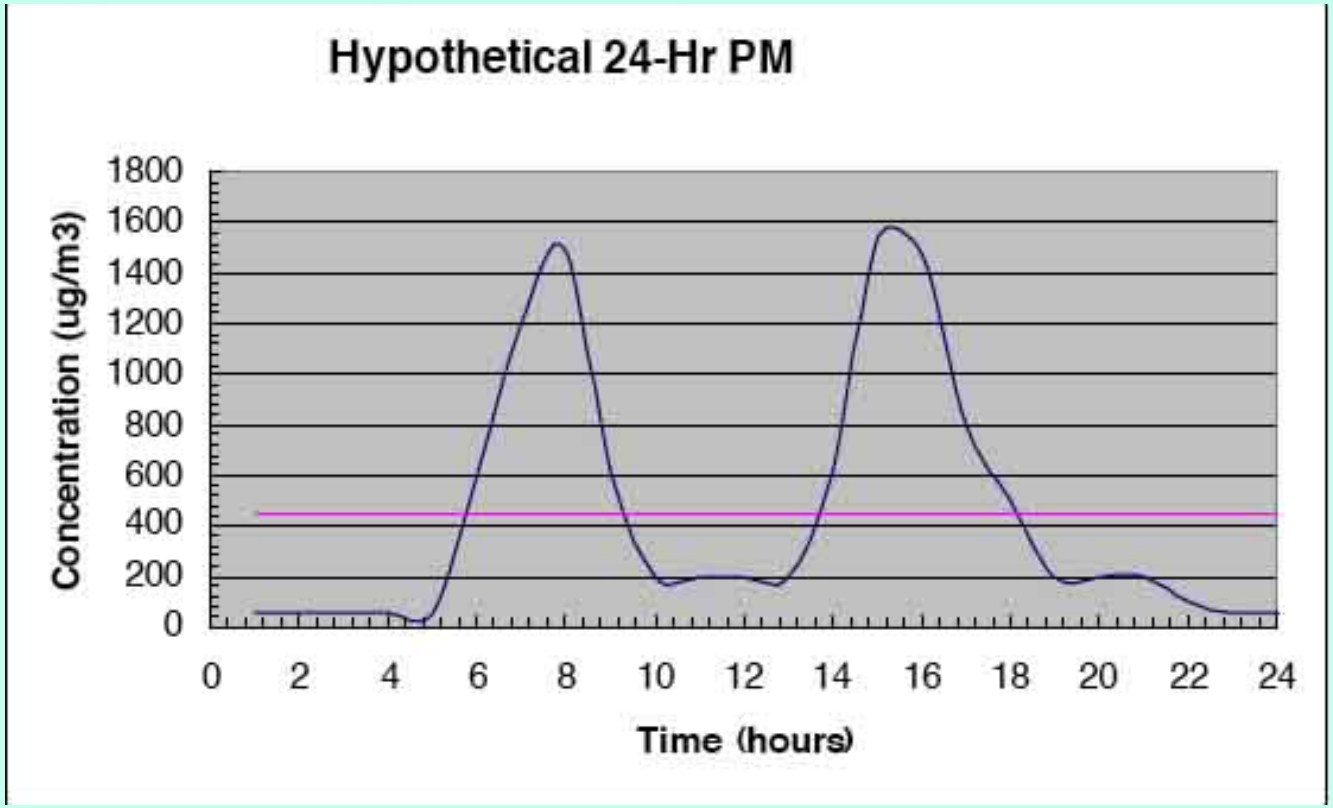
Which Air Pollutants?

- *Most commonly: suspended particulate matter, PM_{10}, $PM_{2.5,}$ Pb, SO_2, NO_2, NO, O_3, CO, non-methane hydrocarbons,*
- *HF, other heavy metals, benzene, polycyclic aromatic hydrocarbons, and other air toxics.*

Sampling intervals

- Grab samples
- Integrated sampling (averaging)
- Continuous (provides peak information)



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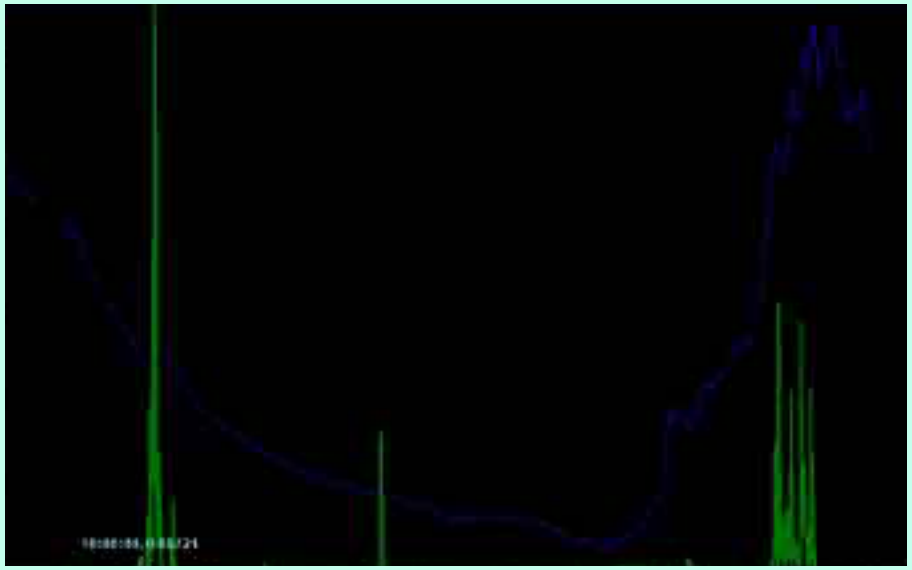
When to measure?

- When cooking
- Morning to evening
- 24 hr
- 48 hr
- 7 day
- Different seasons



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Samplers

- *Passive samplers - very cheap, no services needed, used for surveys, remote uses*
- *Active samplers - worldwide most widely used, cheap, simple, long averaging times, accuracy ?*
- *Biological accumulation (eg accumulation in plants, soil)*

Passive Samplers - Advantages

- *Simple and inexpensive*
- *Can provide large scale simultaneous measurements of concentrations at many locations for long time periods, eg surveys*
- *No need for electricity*
- *Standardised production and measurement from one well equipped laboratory*

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Canisters for sampling indoor air

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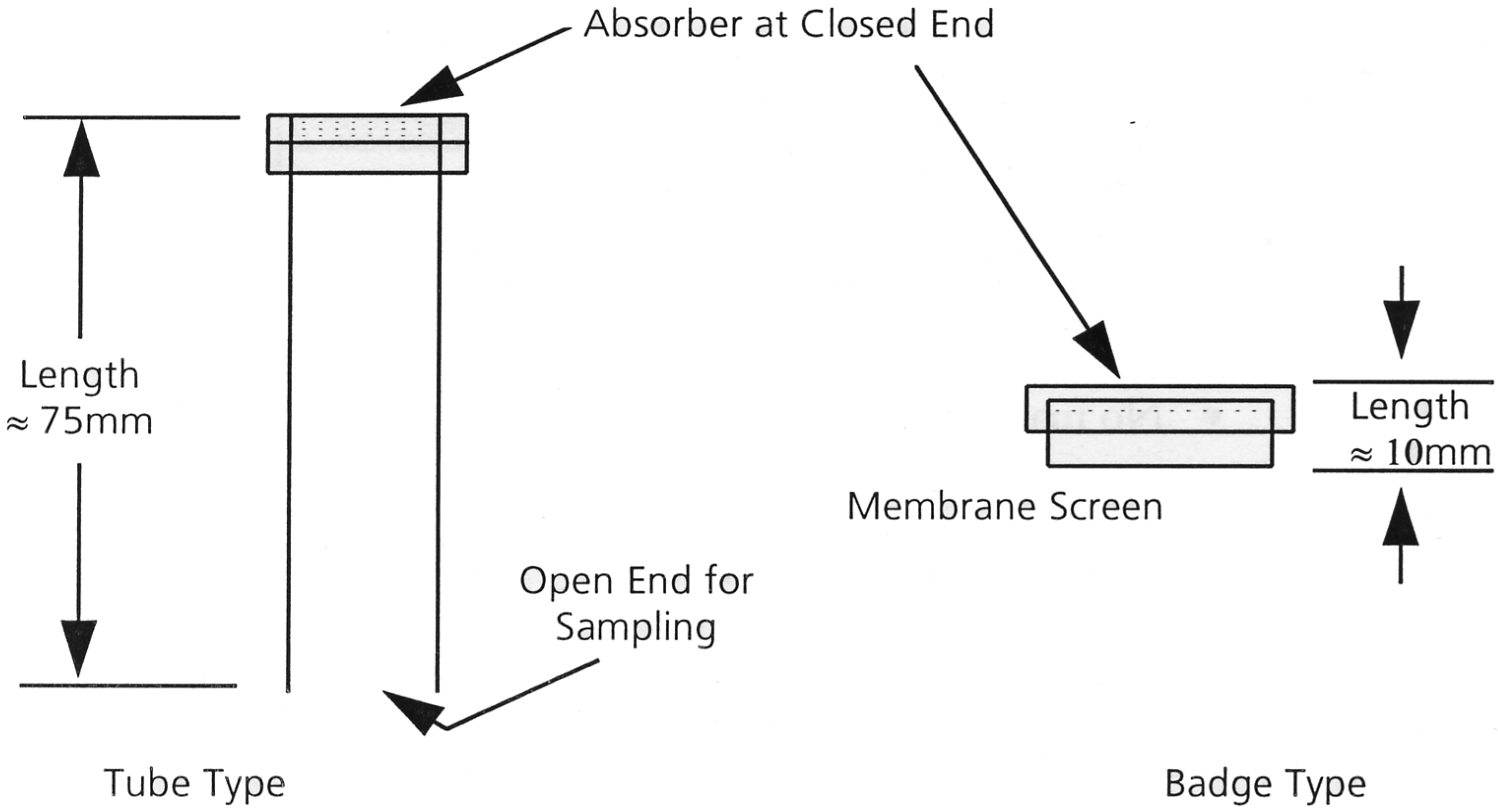
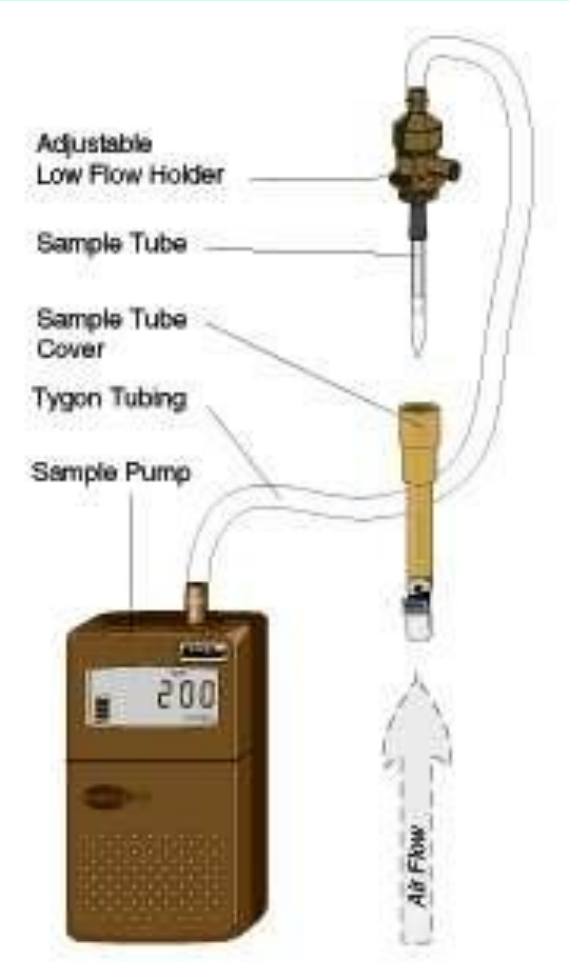
Passive Sampler

Diffusion Tube Sampler



Badge-type Sampler

Passive Samplers - Disadvantages

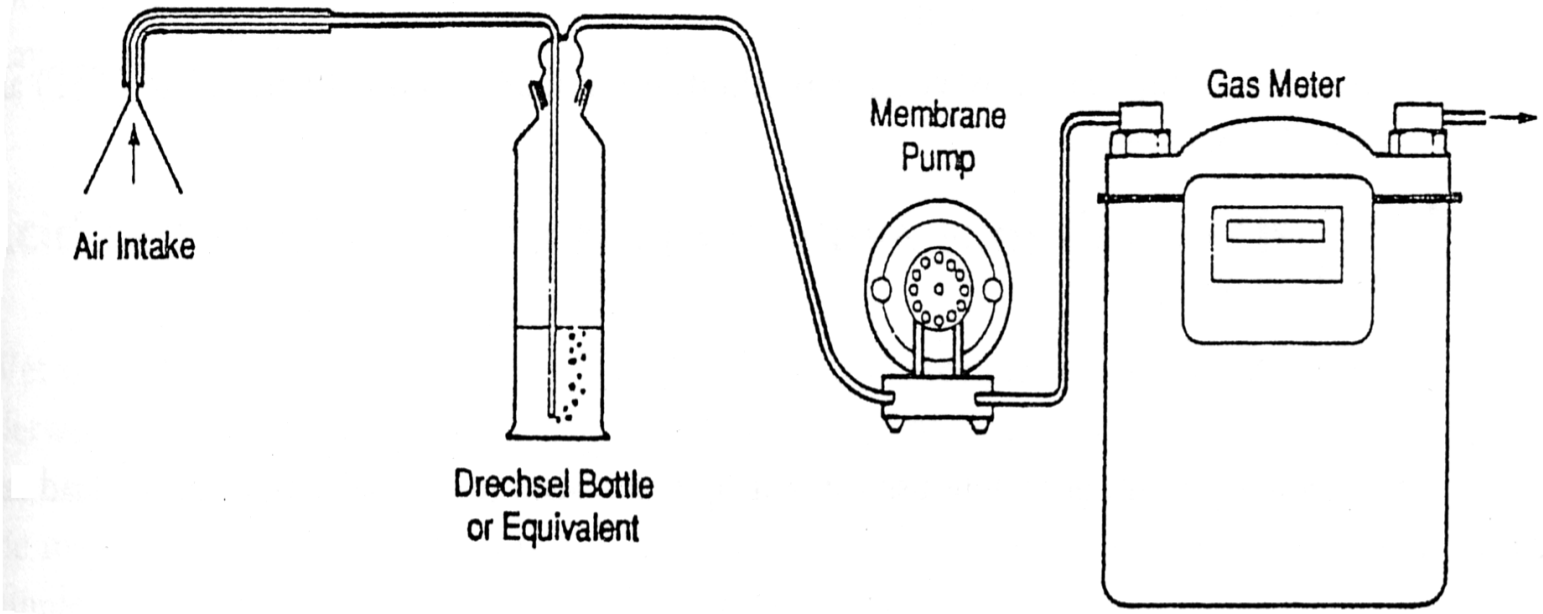


- *ACCURACY - less accurate than other samplers and analysers, but good for an overview of an area*

Active Samplers - Advantages

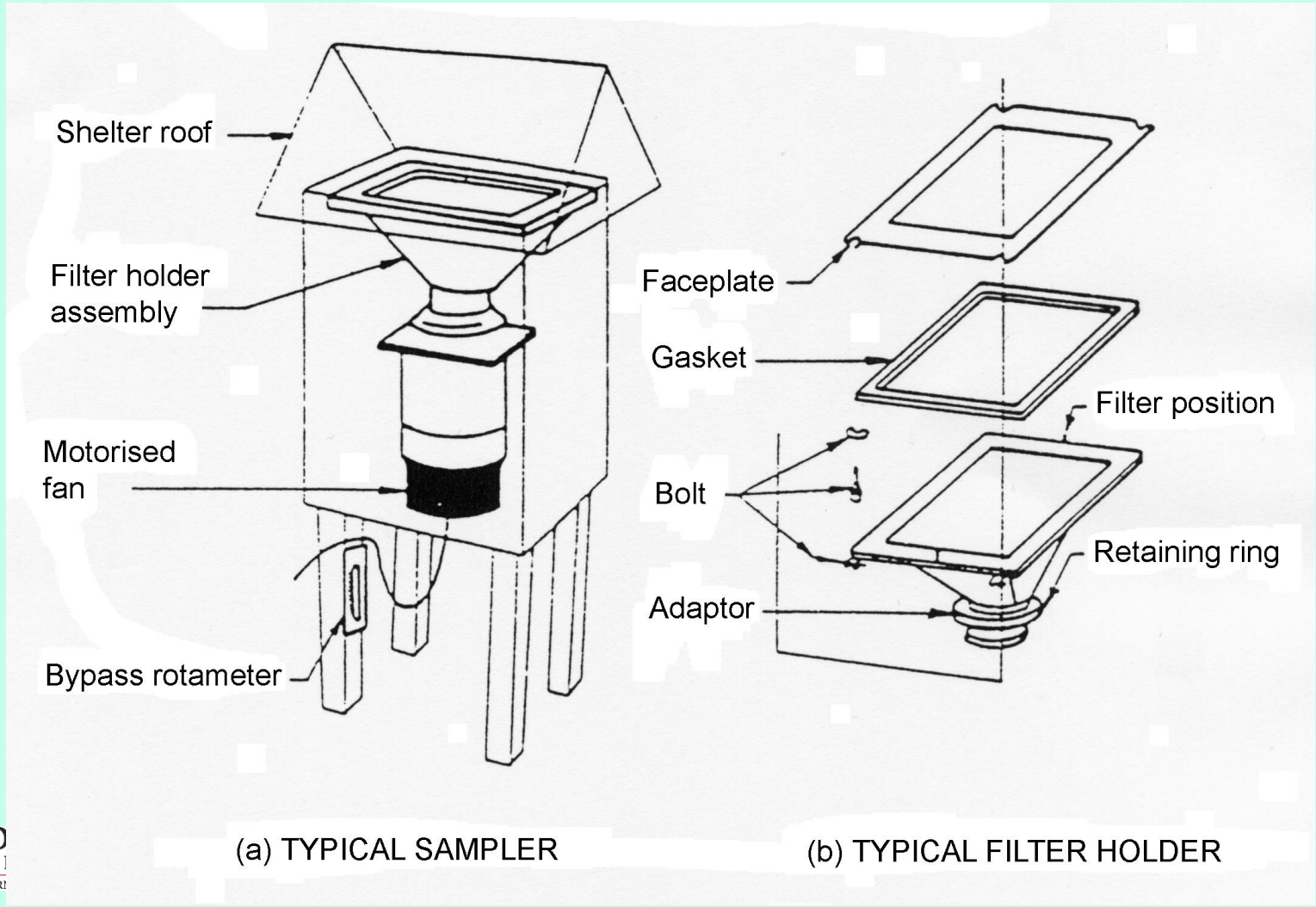
- *Relatively cheap*
- *Technically simple and sustainable*
- *Moderately accurate - more accurate than passive samplers*
- *Established technology*
- *Shorter averaging times than passive samplers*

Active Sampler

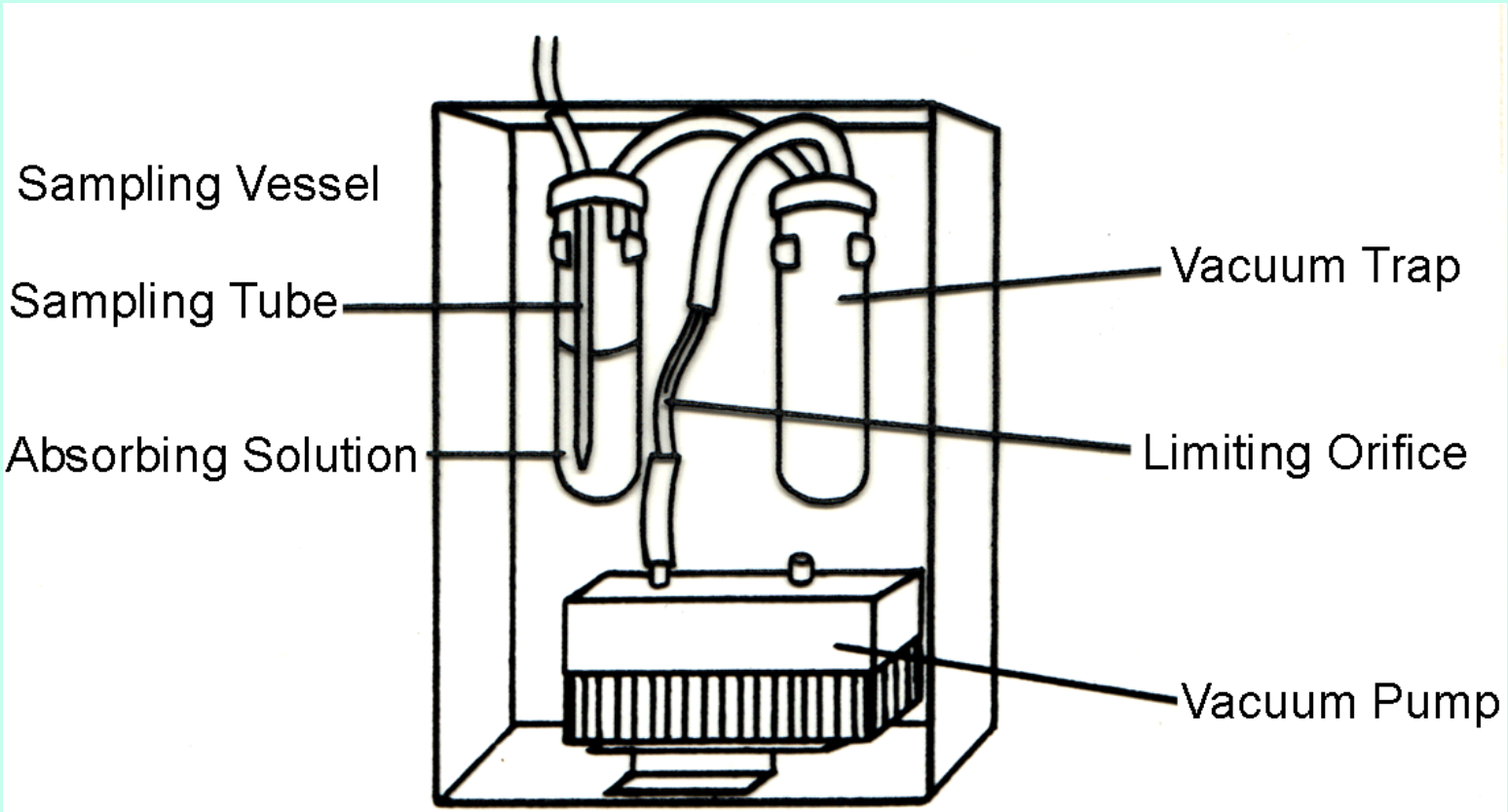


Equipment for sampling of SO2 in an absorbing solution

Active sampler for particulates



Active samplers for water soluble gases



A gas sampling train

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High volume RSP and TSP samplers

Solar radiation detector

Wind anemometer

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Acid rain collector

tapered element oscillating microbalance - continuous RSP

Active Samplers - Disadvantages

- *Require electricity*
- *Require careful maintenance and analytical procedures for satisfactory results*

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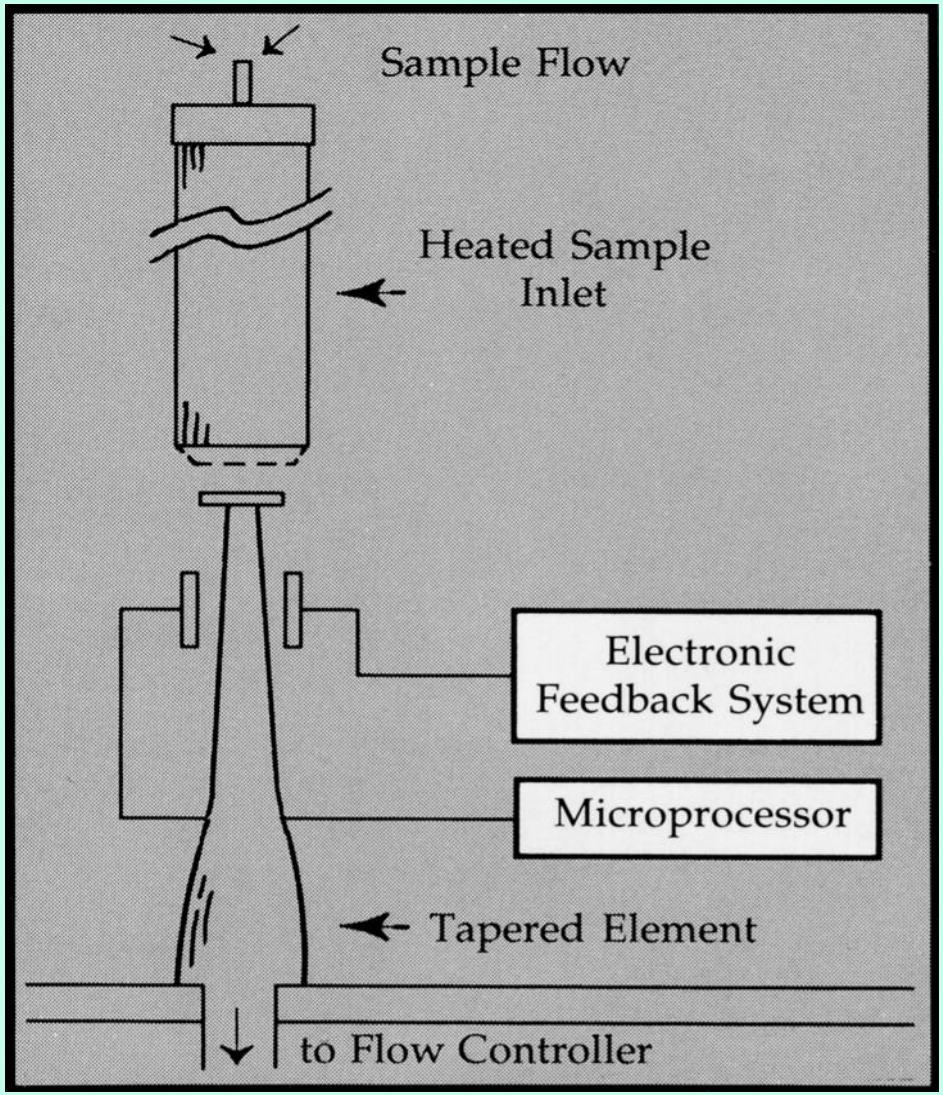
Analysers

- *Automatic analysers - real-time, short averaging times, complex, provide excellent data if well-operated*
- *Interactive monitoring/modelling (eg Airtrak)*

TEOM Ambient Particulate Monitor

Schematic diagram of the TEOM Ambient Particulate Monitor



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Photometer: DustTrak

FEATURES
Cheaper, simple, Mass size selection: PM_1, $PM_{2.5}$ and PM_{10} real time results
result is not a gravimetric mass, needs calibration

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Gaseous pollutants analyzer

Mobile air sampler

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Continuous methods of air pollutant measurement

POLLUTANT	TECHNIQUE	RESPONSE TIME	DETECTION LIMIT
SO_2	H_2O_2/conductivity	3 min	10 ppbv
	Flame photometric	25 sec	0.5 ppbv
	Pulsed fluorescence	2 min	0.5 ppbv
NO	Chemiluminescence with O_3	1 sec	0.5 ppbv
NO_2	Reduction / Chemiluminescence	1 sec	0.5 ppbv
O_3	KI oxidation / electrolysis	1 min	10 ppbv
	Chemiluminescence	3 sec	1 ppbv
	UV spectroscopy	30 sec	3 ppbv
CO	Electrochemical	25 sec	1 ppmv
	Non-dispersive infrared	5 sec	0.5 ppmv
Hydrocarbons	Flame ionisation	0.5 sec	10 ppbv
	Non-dispersive infrared	5 sec	1 ppmv

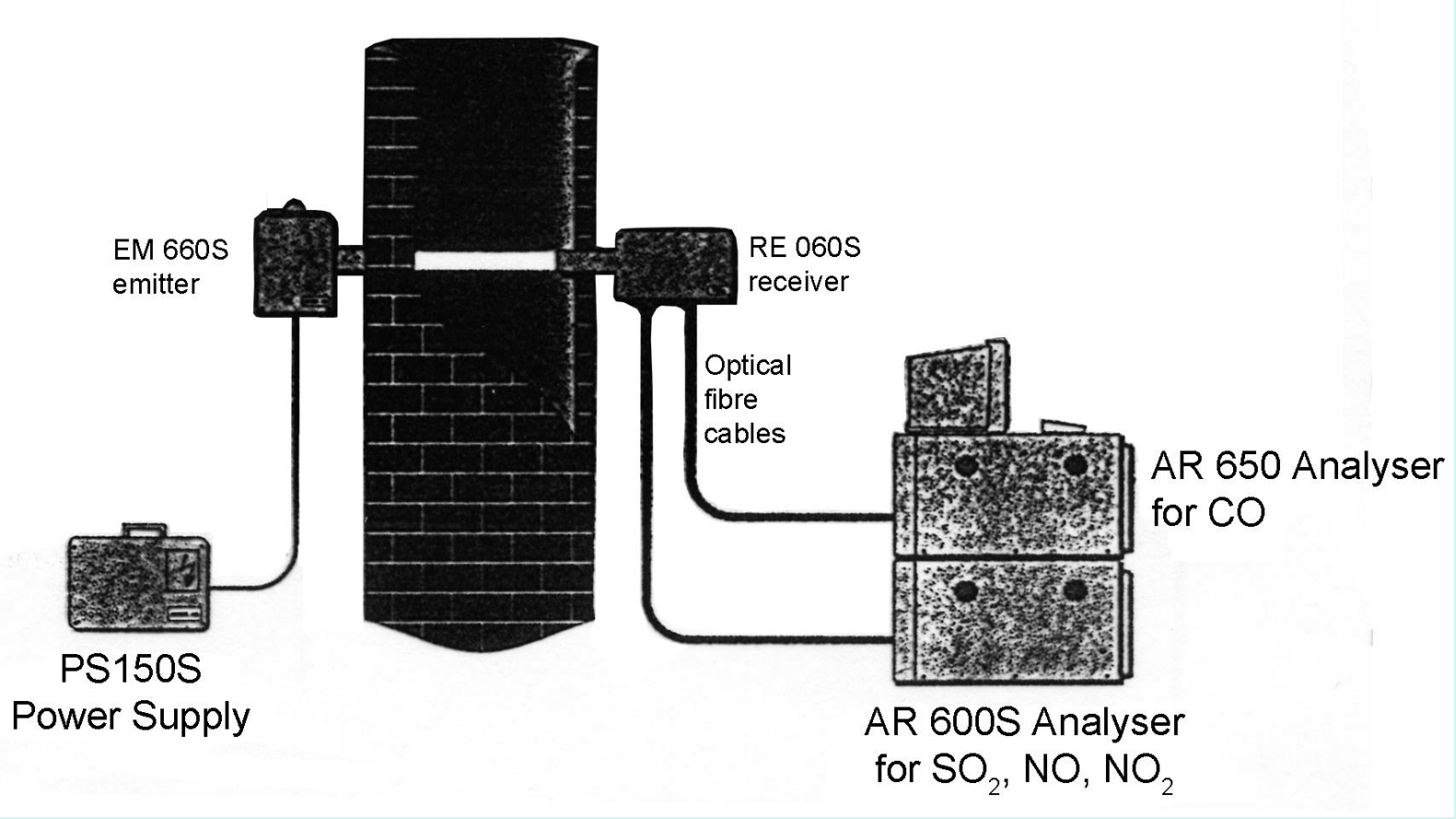
Analysers - Disadvantages

- *Expensive to purchase and service*
- *Can be technically difficult to maintain - spare parts and service not always available*
- *May require sophisticated infrastructure*

Remote Sensing

- *Multiple pollutant automatic analysis, remote sensing (eg Opsis)*
- *Automated analysis - real-time instant data, short averaging times, very visible, provide excellent data if well-operated*

Remote sensors



Remote Sensing - Disadvantages

- *Extremely expensive to purchase and service*
- *Technically difficult to calibrate and maintain - spare parts and service not always available*
- *Require sophisticated infrastructure*
- *Data may not be fully comparable with other techniques*

Instrumented Air Monitoring Techniques

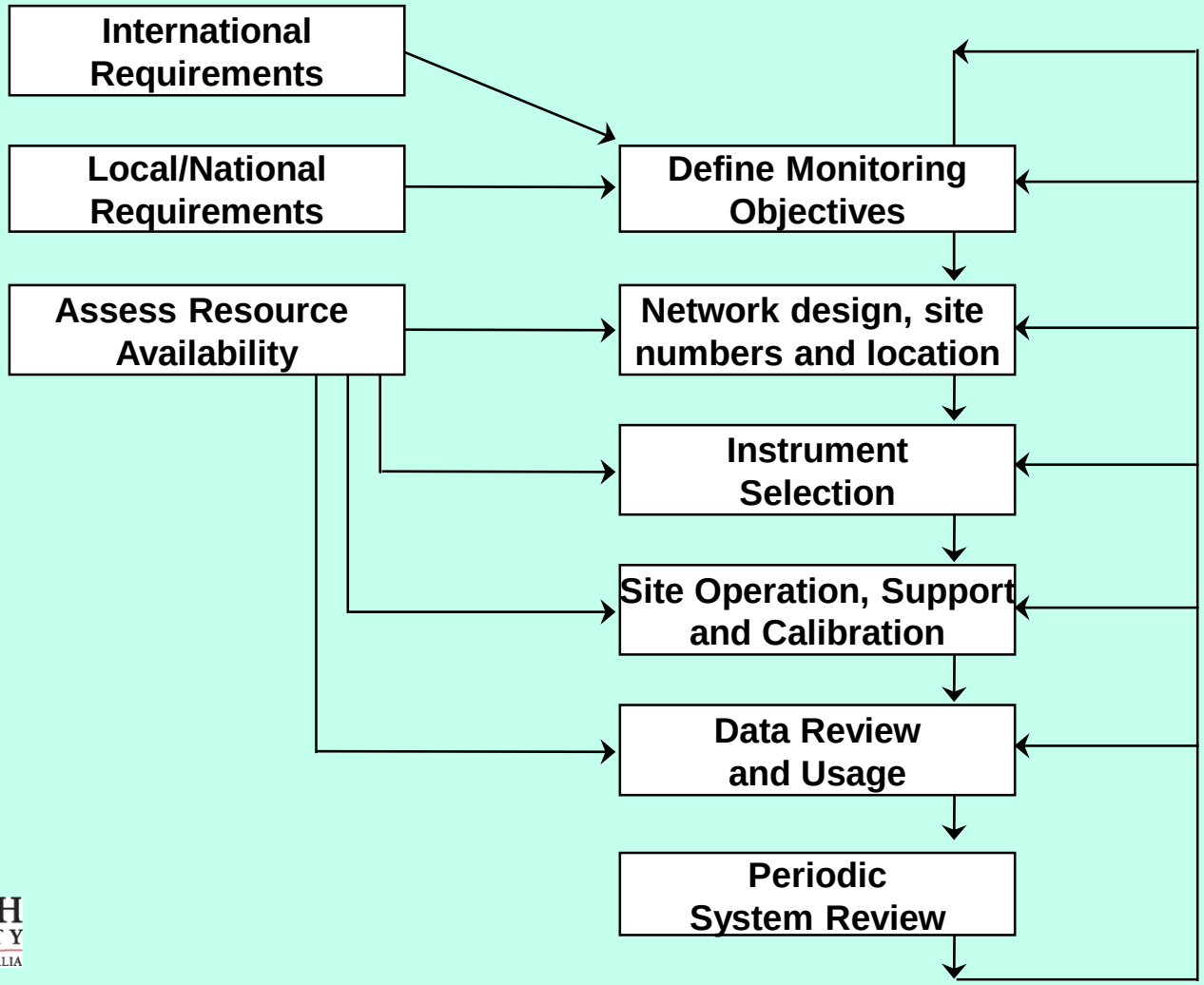
METHOD	ADVANTAGES	DISADVANTAGES	CAPITAL COST
Passive Samplers	Very low cost Very simple Useful for screening and baseline studies	Unproven for some pollutants Often only provides monthly and weekly averages	$2 - 4 per sample
Active Samplers	Low cost Easy to operate Reliable performance Historical dataset	Provide daily averages Labour intensive Laboratory analysis required	$2 - 4K per unit
Automatic Analysers	Proven High performance Hourly data On-line information and low direct costs	Complex and expensive High skill required High recurrent costs	$10 - 20K per analyser
Remote Sensors	Provide path or range-resolved data Useful near sources and vertical measurements in the atmosphere Multi-component measurements	Very complex and expensive Difficult to support, operate, calibrate and validate Not always comparable with conventional analysers	> $200K per sensor

Bio-indicators

Bioindication methods include use of:

- *Surface of plants as receptors of air pollutants*
- *Plant capacity for accumulating some air pollutants over a period of time*
- *Estimation of the effects of air pollutants on plant metabolism, growth, appearance, or marketable products*
- *Surveys of the distribution of effects on plants as indicators of air quality in a region, or resolve compensation claims*

QA/QC for Air Monitoring: A step-by-step approach



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Conclusions

- *Be clear about the objectives of monitoring, preferably in writing*
- *Define data quality objectives*
- *Choose monitoring methods and instrumentation suitable to achieve the objectives*
- *Ensure quality control and quality assurance*
- *These are especially important in monitoring of controversial projects subject to close public scrutiny*