EANET/IG28/6/2

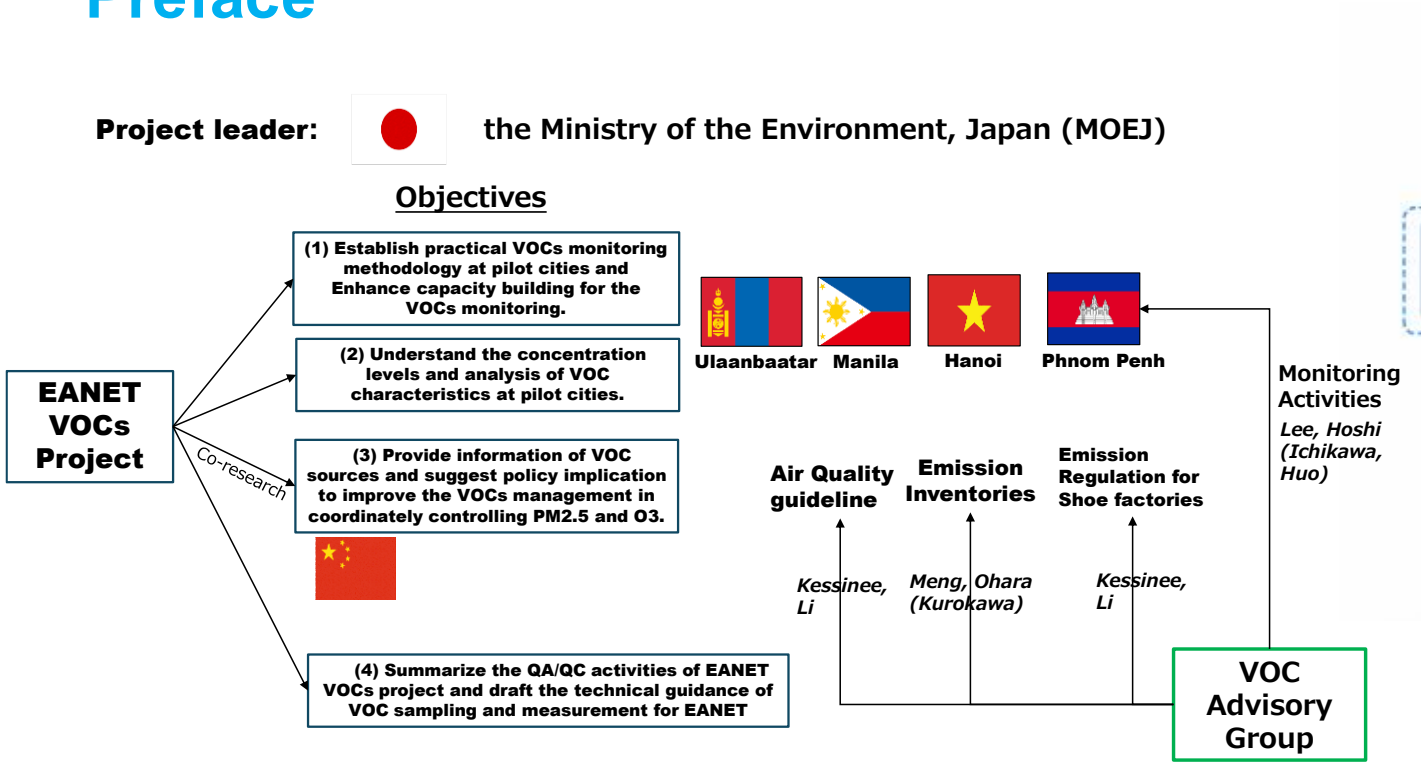
Technical Training Guidance for Ambient VOC Monitoring under EANET

The Twenty-eighth Session of the Intergovernmental Meeting (IG28)
on the Acid Deposition Monitoring Network in East Asia (EANET)
24-26 November 2026, Niigata, Japan

OUTLINE

Preface	**Overview**	EANET VOCs Project, Appreciation, Declaimer
1.	**Introduction**	Background, Challenge, Objective of VOC monitoring
2.	**Off-line Method**	Site selection, Active/Passive, Analytic, Calculation, QA/QC
3.	**On-line Method**	Site selection, Calibration, Monitoring Purpose
4.	**Data Analysis Method**	Data Screen, Data analysis and evaluation
5.	**Conclusion**	Summary and Recommendations
6.	**Annex**	Principle of methods, Methodologies comparison test

Preface



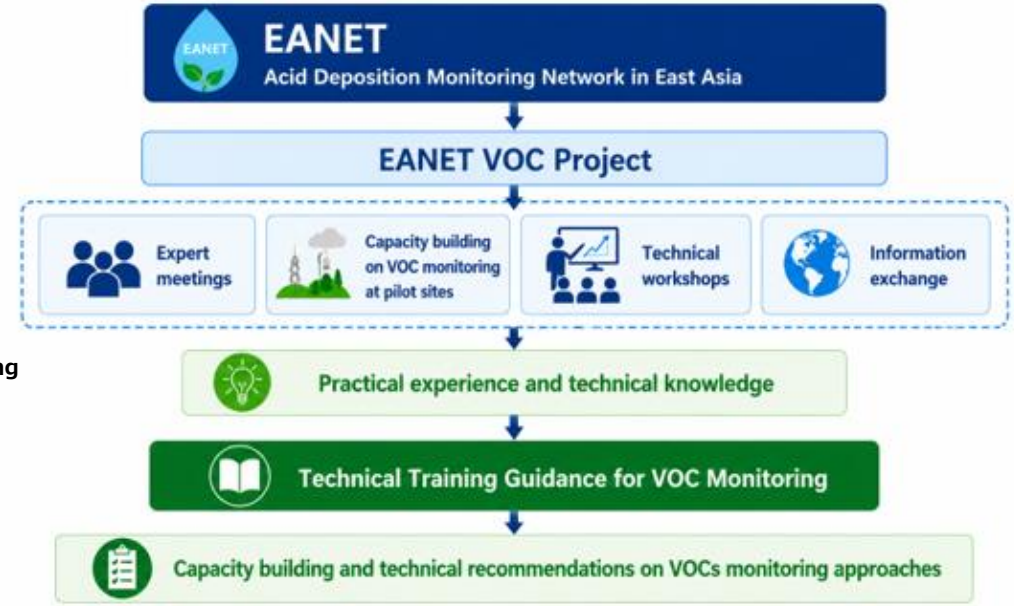


Figure 1 Development Framework of the Technical Training Guidance for Ambient VOCs Monitoring under the EANET

EANET launched the VOC Project to address the growing challenge of O_3 and $PM_{2.5}$ pollution driven by VOC and other precursors since 2023. Recognizing diverse regional technical capacities, this guidance provides a flexible, practical information covering off-line sampling, online monitoring, and methodology on data analysis. It serves as a comprehensive technical reference for scientists, engineers, and environmental agencies within and beyond the EANET region to support effective air quality management.

1. Introduction

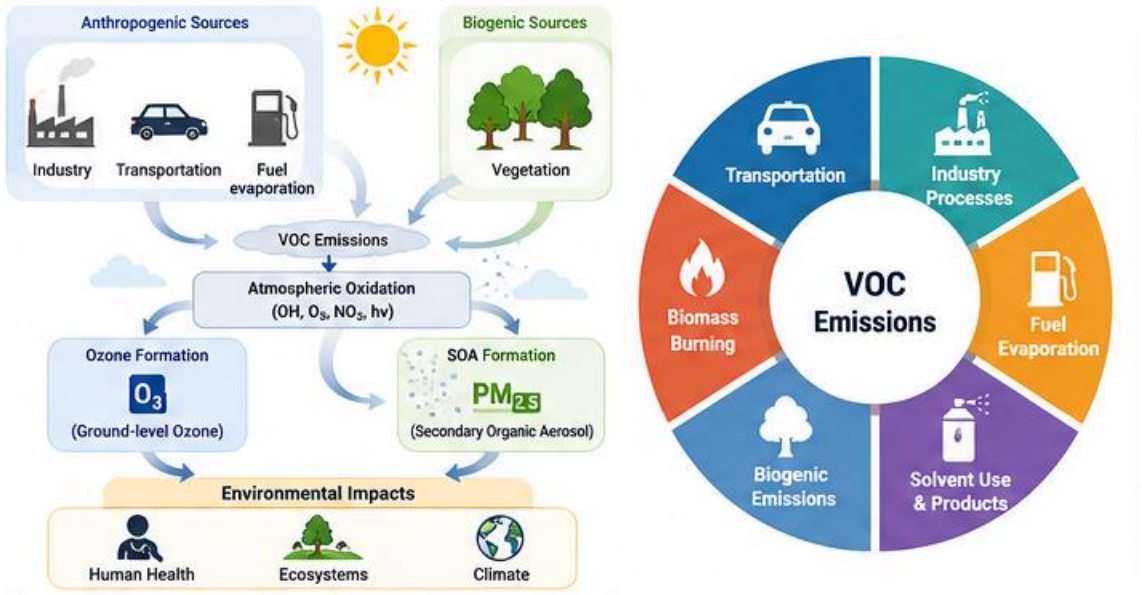


Figure 1.1 Atmospheric Chemistry and Sources of VOCs



Figure 1.2.1 Challenges of VOC monitoring

Volatile Organic Compounds (VOCs) are organic chemicals that easily evaporate at ambient temperature. Carbon-based chemicals with high vapor pressure.

Environmental impacts: Contributes to smog and air pollution, Precursors of $PM_{2.5}$ and Ozone

Challenge and Difficulty of VOCs measurement

Objectives: Understand the feasible VOC sampling techniques, and analytical methods. Apply knowledge for field and laboratory work

2. Offline method

2.1 Canister sampling method

2.2 Active Sorbent Tube Sampling

2.3 Active Charcoal Tube Sampling

2.4 Passive Charcoal-Based Diffusive Sampling

2.5 Passive Sorbent-Based Diffusive Sampling

2.6 Analytical Methods

2.7 Data Calculation

2.8 QA/QC process

3. On-line Method

3.1 PID detector

3.2 DOAS

Table 1.3.1. Summary of VOC Sampling and Measurement Methods

Method	Type / Time Resolution	Target VOCs	Main Advantages	Main Limitations
Canister Sampling + GC/MS	Off-line Minutes to 24 hours	Broad range of NMVOCs	Comprehensive VOC speciation; high sensitivity; suitable for source apportionment and photochemical studies	High cost; requires specialized equipment and laboratory analysis
Sorbent Tube + GC/MS	Off-line Hours to days	Wide range of VOCs depending on sorbent type	Good analytical performance; flexible sampling duration; lower cost than canisters	Potential breakthrough and sorbent limitations; requires thermal desorption and laboratory analysis
Charcoal Tube + Solvent Extraction (GC/FID or GC/MS)	Off-line Hours	Selected VOCs	Simple and widely used; relatively low cost	Limited compound range; possible solvent-related uncertainties
Passive Sampler (Charcoal or Sorbent Based)	Off-line Days to weeks	Selected VOCs	Low cost; no power requirement; suitable for large monitoring networks	Low temporal resolution; limited species coverage
PID	Online / Real Time Seconds	Total VOCs (TVOCs)	Rapid response; portable; useful for field screening	Cannot identify individual compounds; susceptible to interference
Online GC-FID	Online / Continuous Minutes to hourly	Hydrocarbons and selected NMVOCs	Continuous measurements; good quantification of hydrocarbon species; widely used in O_3 precursor monitoring	Limited compound identification capability compared with GC/MS
Online GC-MS	Online / Continuous Minutes to hourly	Broad range of VOCs	Continuous speciation data; high analytical capability	High cost and maintenance requirements
Proton-transfer-reaction Mass Spectrometry (PTR-MS)	Online / Continuous Seconds to minutes	Many oxygenated and reactive VOCs	Very high time resolution; highly sensitive	Expensive; limited compound separation
DOAS	Online / Continuous	Selected gases (e.g., formaldehyde, aromatic VOCs)	Open-path monitoring; no sample collection required	Limited target compounds; complex operation

2. Off-line Method

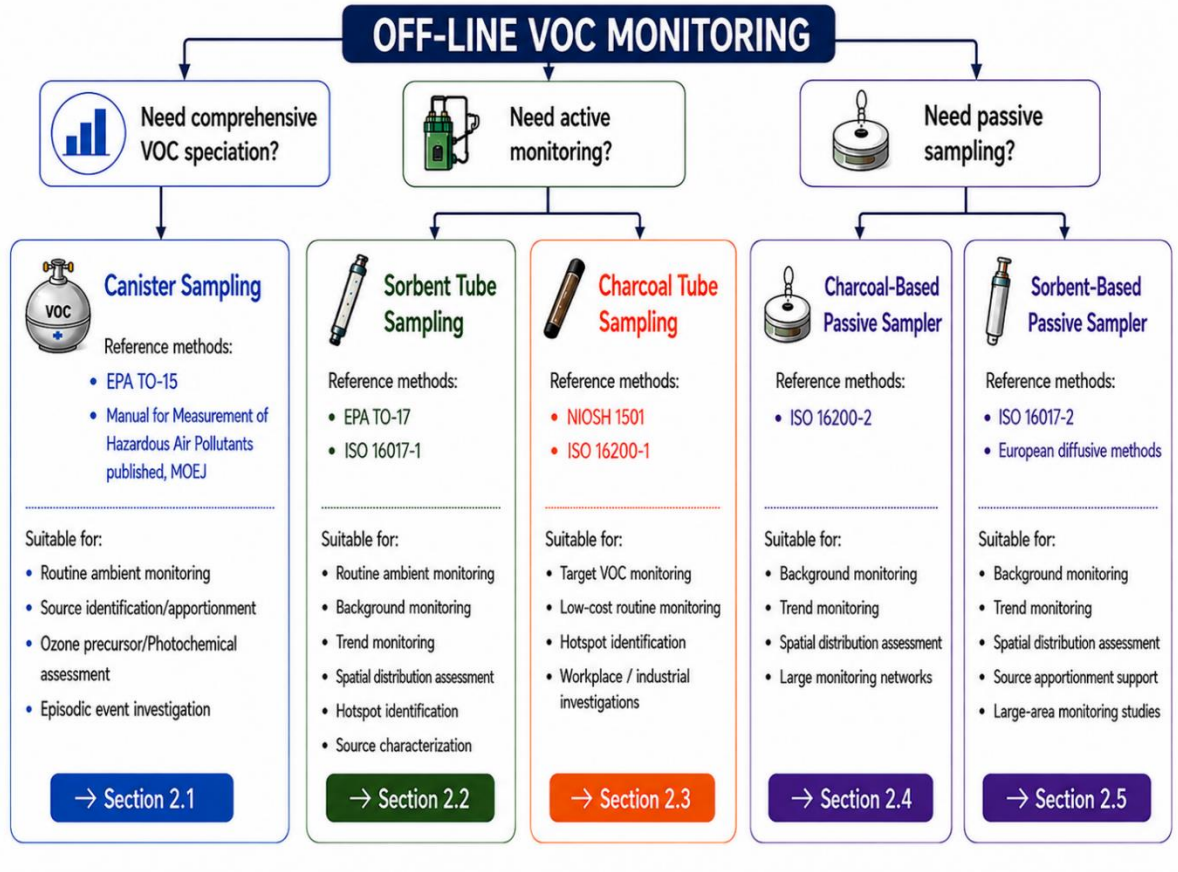


Figure 1.3.1 Decision Framework for Selecting Off-line VOC Monitoring Methods

Table 2.1.1 Comparison of off-line sampling methods for ambient VOC monitoring

Off-line Method	Pump	Sampling period	Precision*	VOC coverage**	Key advantages	Key limitations	Cost***
Canister sampling	No	12 h to 3 weeks	★★★★★	Very broad	Multi-component suitable for highly volatile VOCs	High cost; limited large-scale deployment	$$$$$
Active (sorbent-based)	Yes	Several hours (1–20 L total sampling volume)	★★★★★	Broad	High sensitivity; flexible sorbents	Breakthrough; moisture effects	$$$$
Active (charcoal-based)	Yes	Approximately 24 h	★★★☆☆	Moderate	Simple; low cost; re-analysis possible	Solvent extraction; blank/recover tests	$$
Passive (charcoal-based)	No	Several weeks	★★☆☆☆	Limited-moderate	Simple; long-term, multi-site use	TWA only; extraction; uptake rate validation required	$
Passive (sorbent-based)	No	Several weeks	★★★☆☆	Moderate–broad	Flexible sorbents; long-term monitoring	Uptake rate validation required	$$$

* Precision: qualitative relative comparison under QA/QC conditions.
** VOC coverage: qualitative range of measurable VOCs.
*** Cost: relative scale ($ to $$$$$).

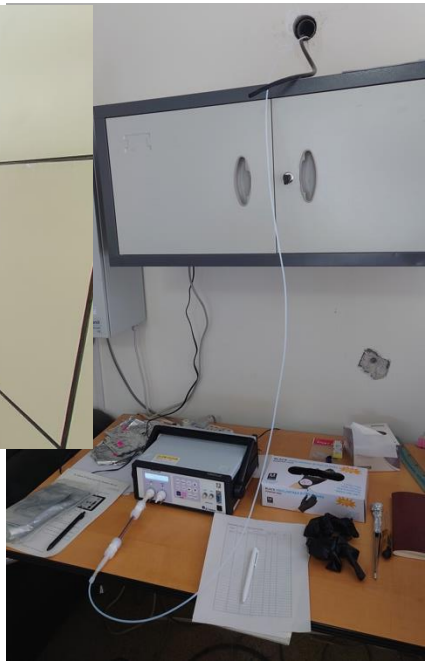
2. Off-line Method



Capacity building of VOCs sampling campaign using canister and tubes held at Manila, Philippines, Feb. 2025



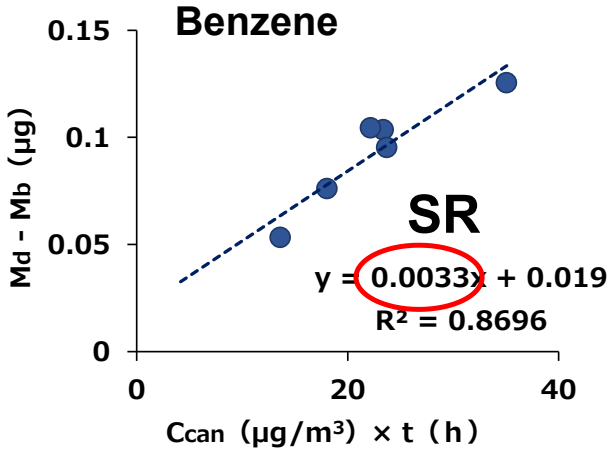




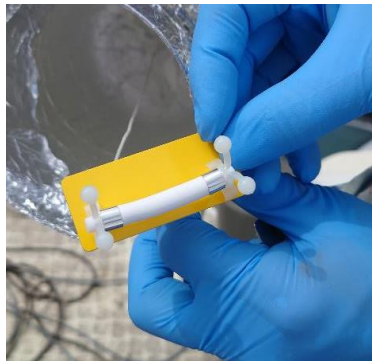




Installation and Training on sorbent/charcoal tube sampling at Ulaanbaatar, Mongolia 2024 (right) and Phnom Penh, Cambodia 2025 (left)



Install the passive sampler for VOC monitoring at Ulaanbaatar site for summer campaign, 2024





Junya Hoshi
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2.6 Analytical Methods

GC/MS Analysis of Canister Samples

Steps:

- Pre-concentration (cryogenic trap or sorbent trap)
- Injection into GC/MS system

Strengths:

- Multi-component detection (C2–C12 VOCs)
- High sensitivity (ppt–ppb range)
- Well-established QA/QC procedures

Quality control: canister cleaning, blank checks, calibration standards



On-site Training for the canister measurement by GC-MS at EMB Environment laboratory, the Philippines.

GC/MS Analysis of Sorbent/Charcoal Tubes

Sample preparation:

- Solvent extraction (e.g., CS2 for charcoal tubes)
- Thermal desorption for sorbent tubes

Analysis: GC/MS for identification and quantification

Strengths:

- Good for target VOCs
- Cost-effective compared with canisters

Limitations:

- Variable desorption efficiency
- Risk of contamination during preparation



3. On-line Method

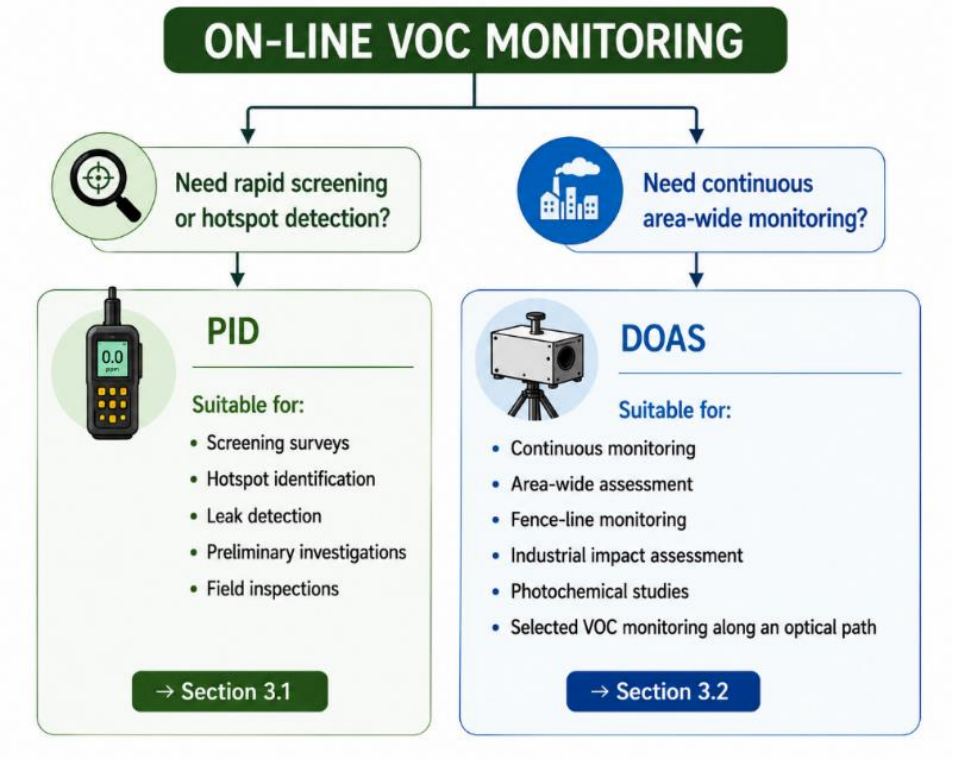
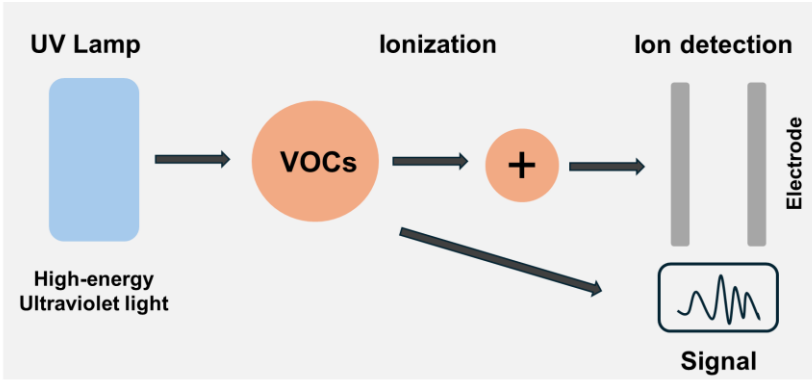


Figure 1.3.2 Decision Framework for Selecting On-line VOC Monitoring Methods

PID Detector





DOAS

	
Sampling station (rural site)	Four sampling methods

Capacity building of VOCs sampling campaign using canister and tubes held at Manila, Philippines, Feb. 2025

2.8 Quality Assurance and Quality Control (QA/QC)

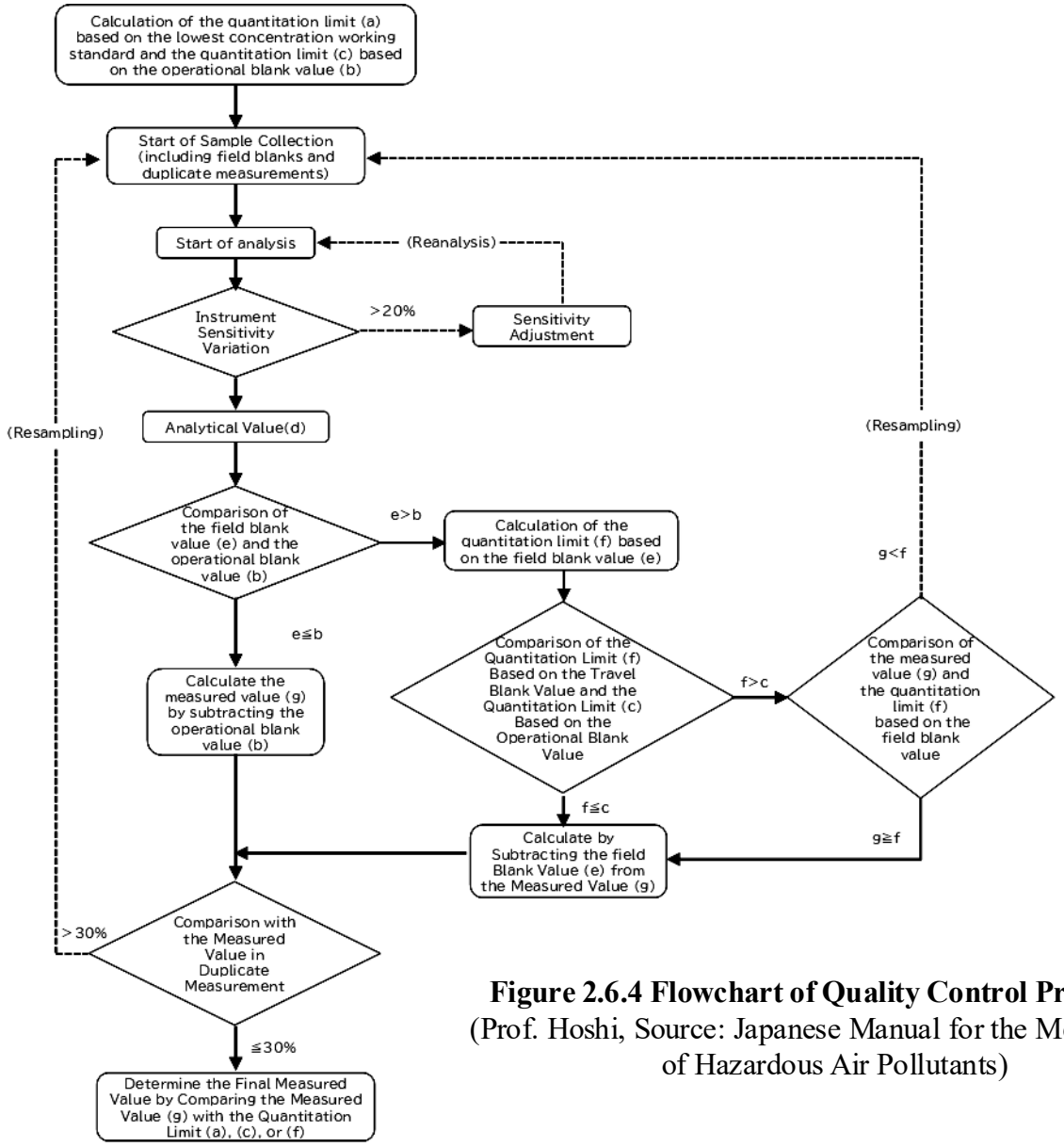


Figure 2.6.4 Flowchart of Quality Control Procedures
(Prof. Hoshi, Source: Japanese Manual for the Measurement of Hazardous Air Pollutants)

4. Data Analysis Methods for Ambient Air VOCs

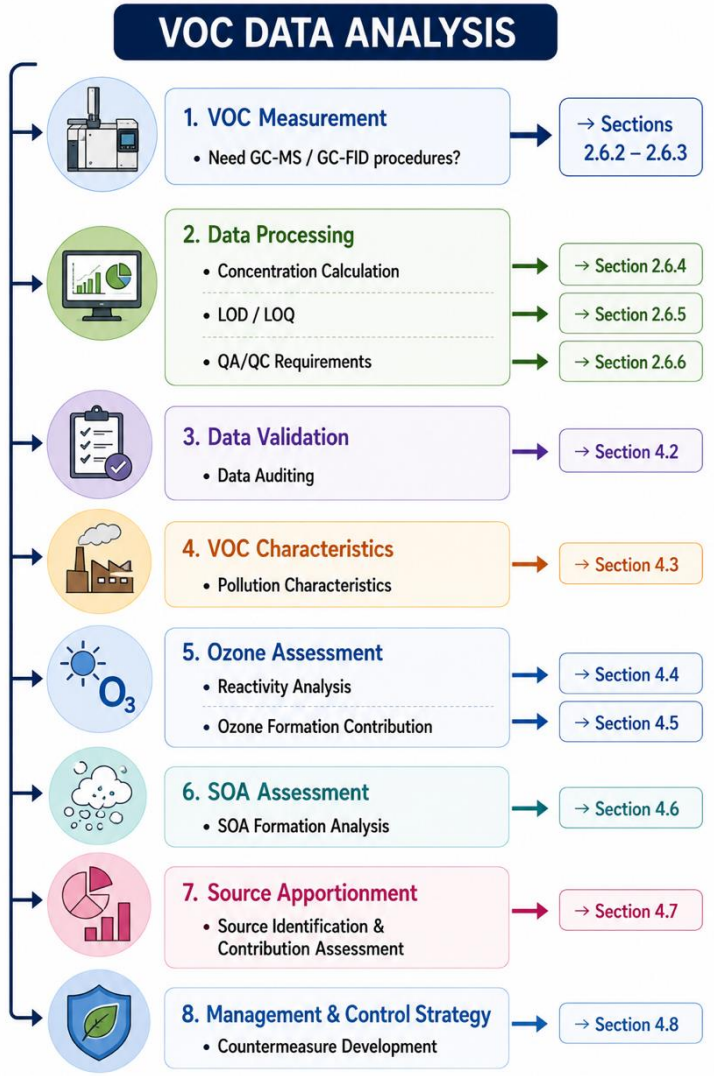


Figure 1.3.3 Roadmap for VOC Data Analysis and Interpretation

5. Conclusion

- Through continued technical cooperation, capacity building, and methodology comparison, EANET will continue to strengthen regional monitoring capabilities for VOCs and contribute to a better scientific understanding of O_3 and $PM_{2.5}$ pollution across East Asia.
- Emphasizing that monitoring objectives and available budgets vary across countries, this guidance does not prescribe a single standardized approach; instead, it recommends selecting appropriate methods based on specific monitoring goals and resource conditions.

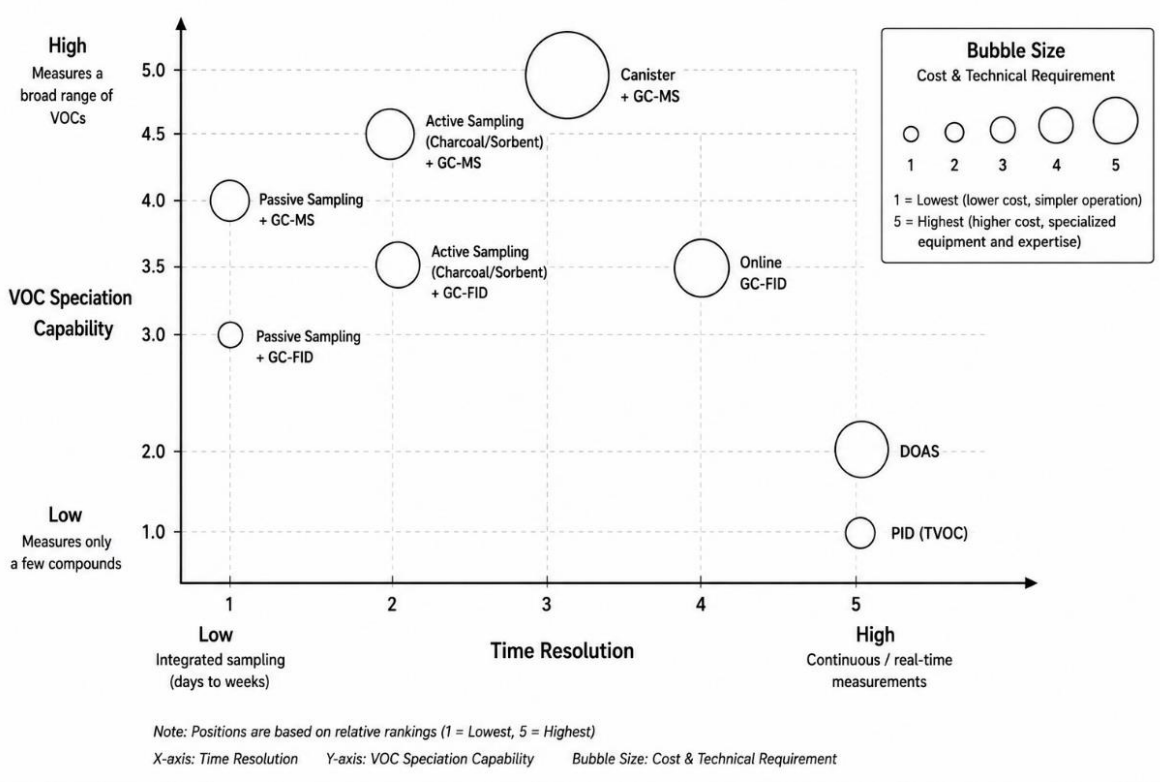


Figure 5.1 Comparison of VOC Monitoring Methods

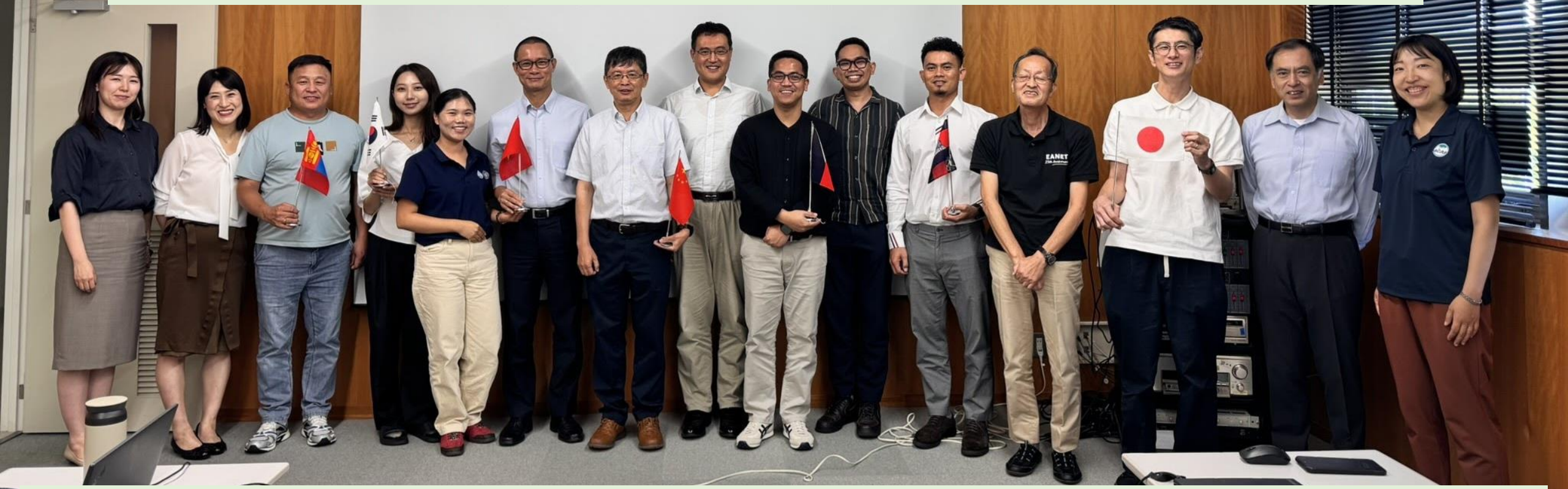
Table 5.1 Comparison of VOC Monitoring Methods

Monitoring Method	Typical Cost	Target Compounds	Time Resolution	Technical Requirement	Typical Application
Canister	High	Comprehensive VOCs	Hour–Day	High	Routine monitoring /Photochemical studies
Sorbent tube	Medium	Wide range	Hour–Day	Medium	Routine monitoring
Charcoal tube	Medium	Selected VOCs	Hour–Day	Medium	Routine/Occupational monitoring
Passive sampler	Low	Selected VOCs	Weekly–Monthly	Low	Background monitoring
PID	Low	TVOCs	Real-time	Low	Rapid data screening
DOAS	High	Specific gases	Continuous	High	Routine monitoring

Drafting Committee Meeting on the Technical Training Guidance for VOC Sampling under EANET

Period: 3–7 August 2026

Venue: Asia Center for Air Pollution Research (ACAP), Niigata, Japan



Sincerely appreciate the valuable contributions of all Advisory Group members, Drafting Committee members, and experts from participating countries of EANET VOC Project, the international collaboration project of CRAES, who contributed to the technical discussions, pilot monitoring activities, field training, and review process. Their constructive comments, continuous support, and commitment have greatly enhanced the scientific quality, technical value, and practical applicability of this guidance.

Action required

The Session of SAC26 adopted the Technical Training Guidance for Ambient VOCs Monitoring under EANET from the scientific and technical viewpoint and to be further endorsed at IG28.