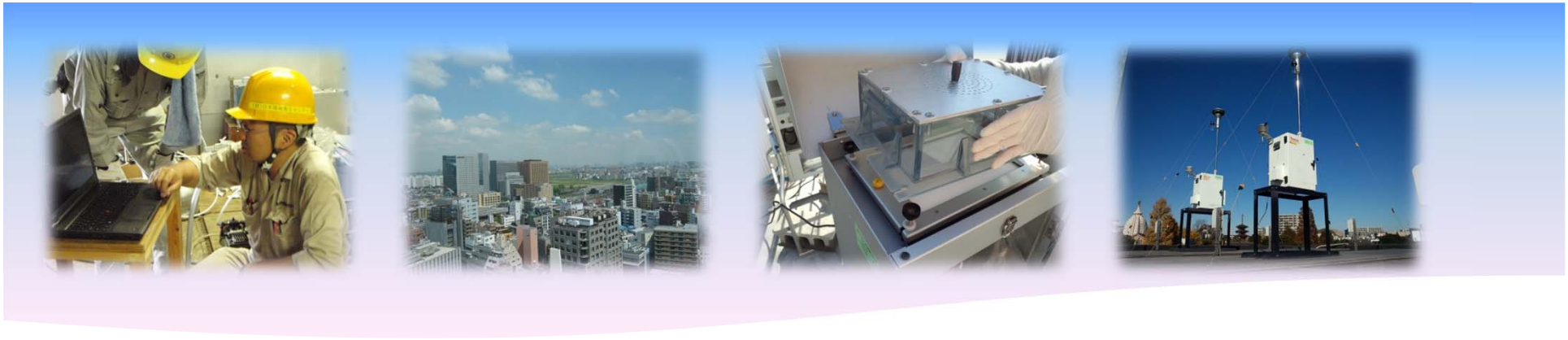


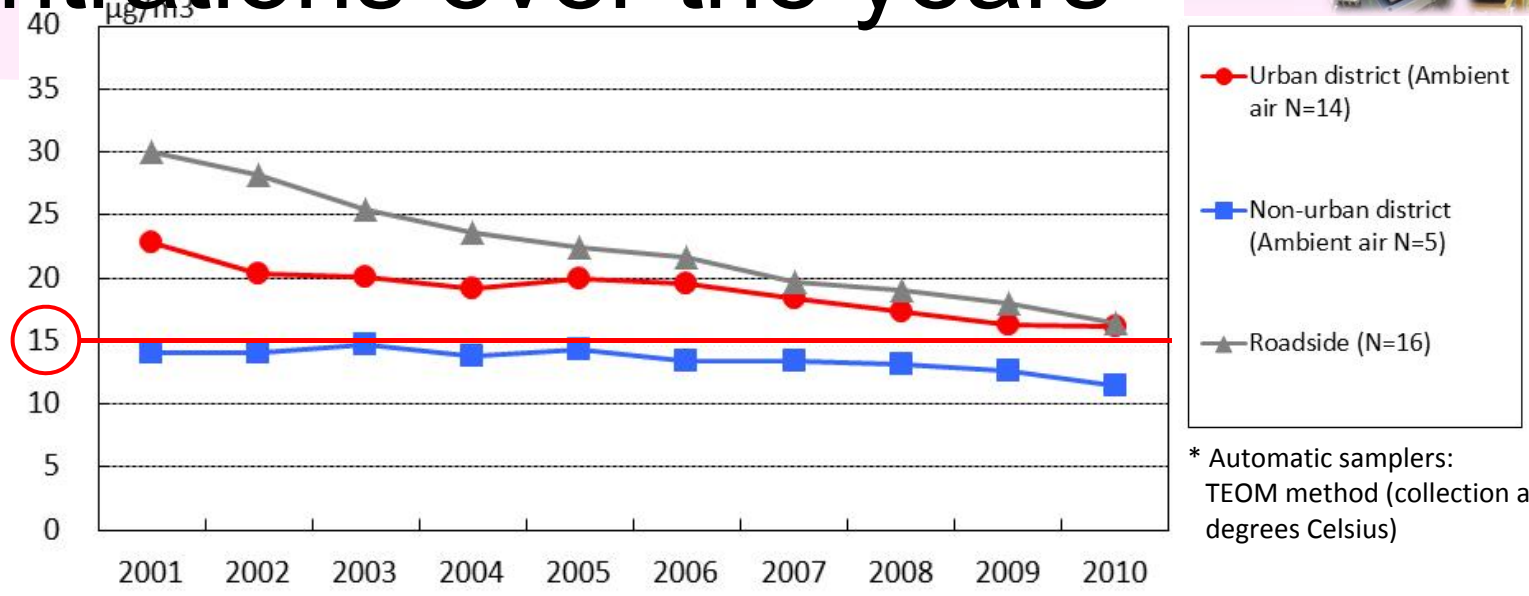
# Approach to air quality improvement by PM2.5 monitoring

Japan Environmental Sanitation Center
Katsuyuki TAKAHASHI

# Contents

- Current Status of PM2.5 in Japan
- Monitoring Method of PM2.5
- Chemical Component Analysis
- Source Apportionment of PM2.5
- Future Tasks

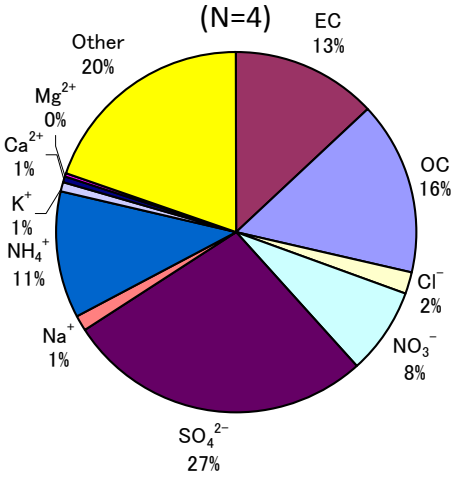
# Changes in PM2.5 concentrations over the years



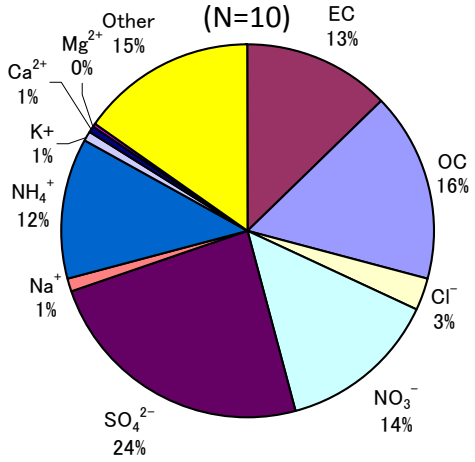

* Automatic samplers: TEOM method (collection at 50 degrees Celsius)

Component ratio of carbon and ion in PM2.5 (average for the 2001-2010 period)

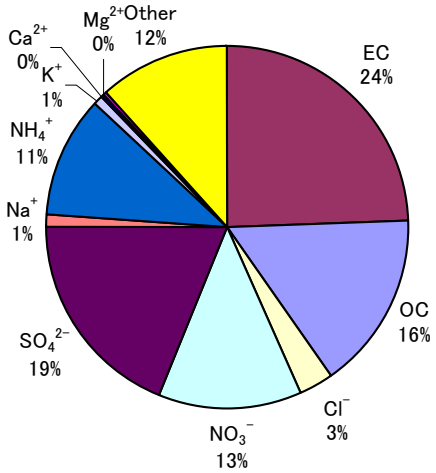
Non-urban district (N=4)




Urban district (N=10)



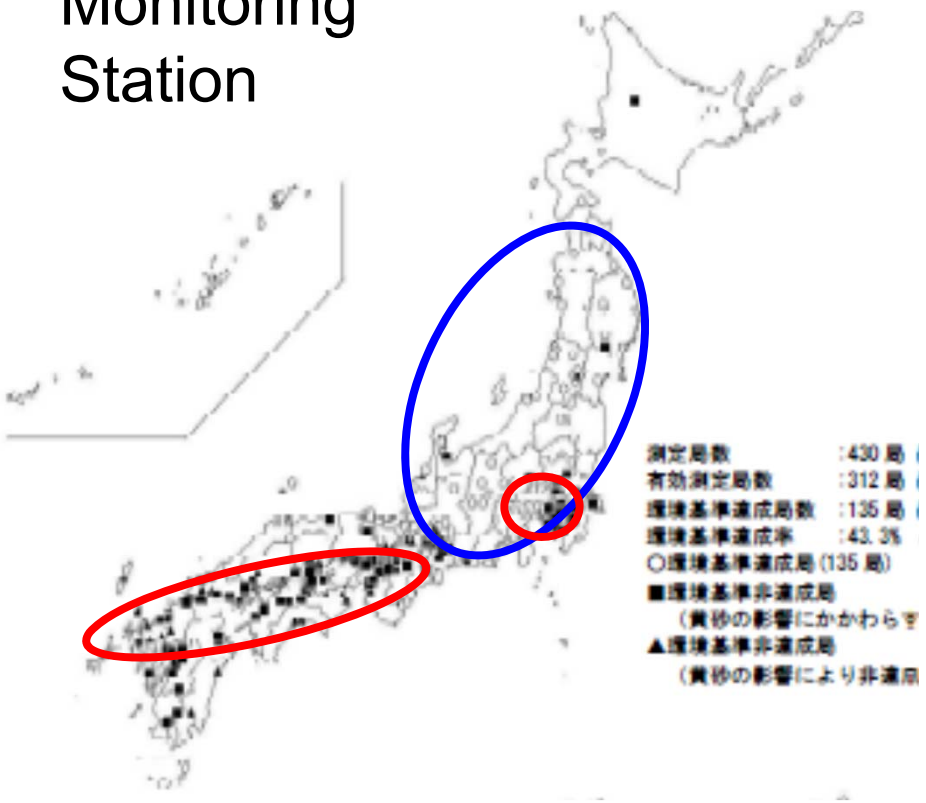

Roadside (N=5)



# The Results for Achievement of PM2.5 Standard FY2012

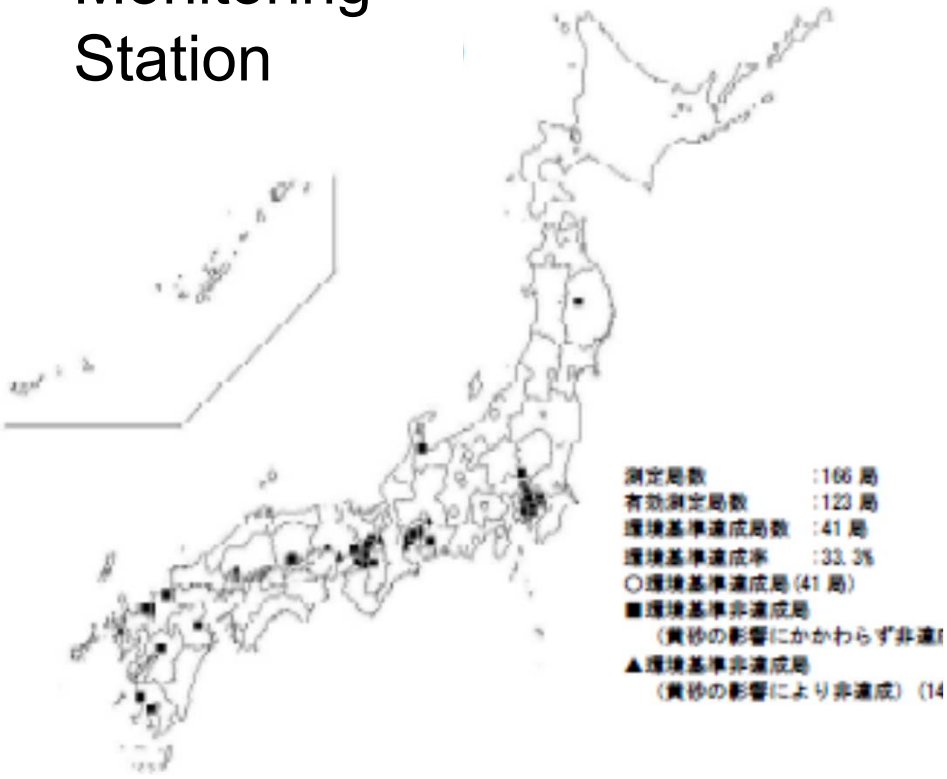
Ambient Air Monitoring Station

Achievement Ratio 43.3%



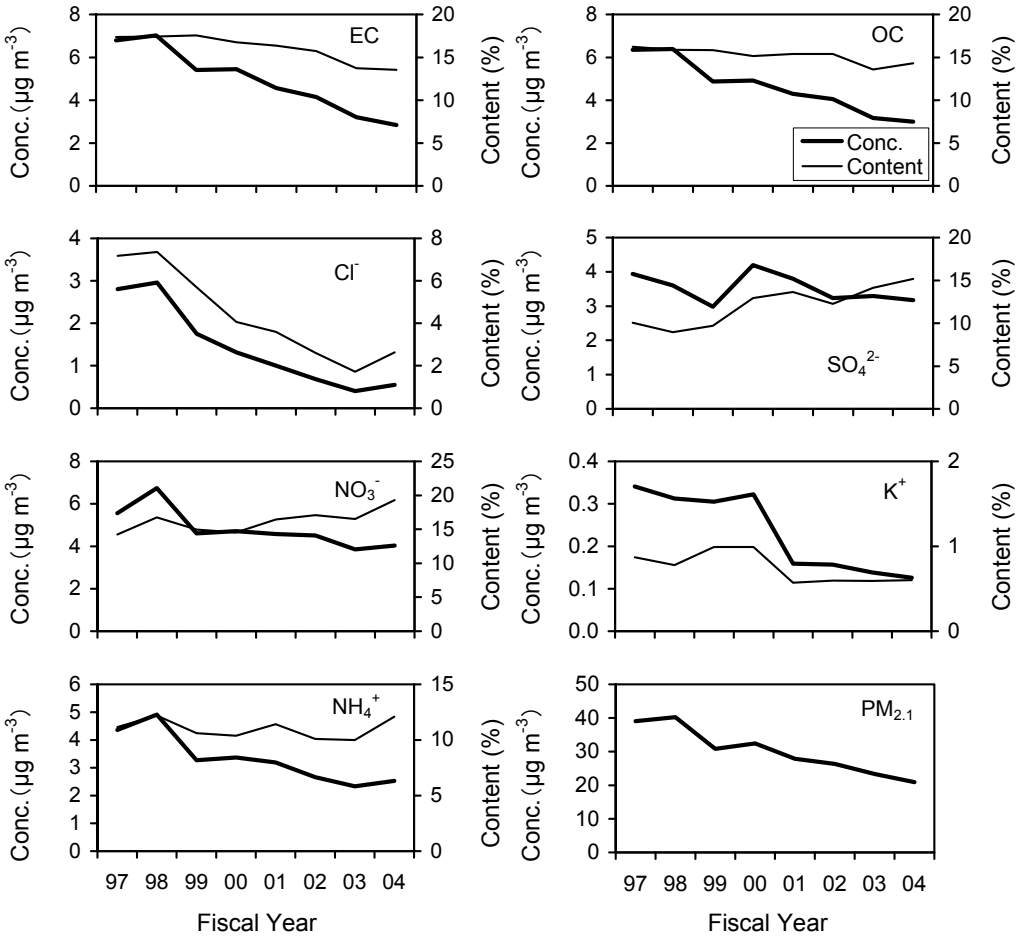

Roadside Air Monitoring Station

Achievement Ratio 33.3%



# Results of Long-term Observation of PM Components

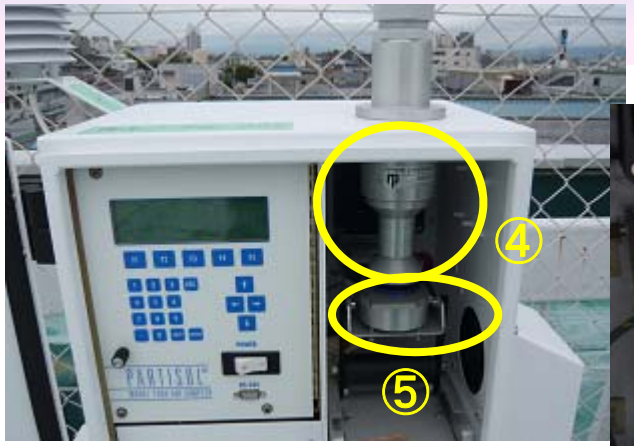
- Components whose concentration and content have decreased (1997 vs. 2004)
  - EC: 56%
  - $Cl^-$: 82%
- Lowering factor of EC
  - → Achievements of controlling of diesel emissions from automobiles
- Lowering factor of $Cl^-$
  - → Regulation on incinerators (Law Concerning Special Measures against Dioxins: 2000)



# Automatic Measurement and Measurement Using Filters

- Monitoring using automatic measuring instruments
- Advantages
  - Possible to obtain measured values hourly
  - Possible to perform continuous monitoring at a fixed point
  - Possible to know the concentration change in a day
- Requirements
  - Cost and labor for proper maintenance and management are required.
  - Not only expensive equipment but power supplies and a measuring station with necessary devices and instruments are required.
  - A supply system for consumables is required.

# Air Sampler Used for the Filter Method


Dimensions: W 410 × D 330 × H 610 mm / (The height when placed on the stand is approximately 2,000 mm.)

Weight: Approx. 32 kg

① PM10 inlet ･･･ Screens out particles whose size is 10 μm or larger.

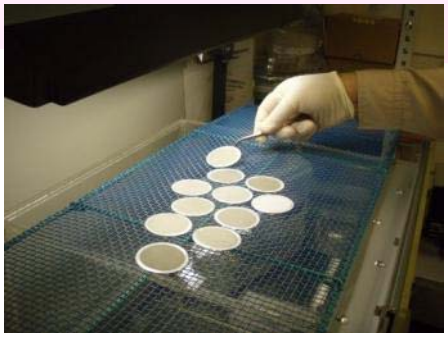
② Temperature sensor ･･･ Maintains the temperature difference between the outer air and filter section within 5°C.

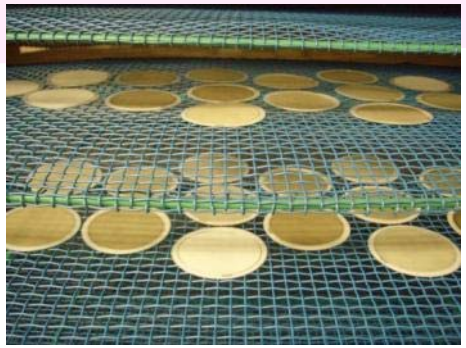
③ Weights for outdoor installation

④ PM2.5 impactor ･･･ Screens out particles whose size is 2.5 μm or larger.

⑤ Filter ･･･ Pull the handle to replace the filter.

# For Highly Accurate Weighing





Marble:
Placed on sand

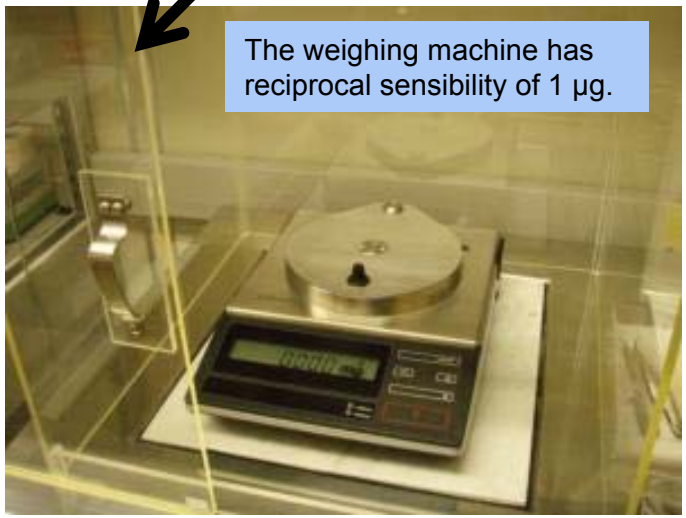
Vibration isolation table:
Sand is inside.

Rubber vibration insulator

Discharge mat

Conditioning for 24 hours with the temperature at 21.5°C ± 1.5°C and relative humidity at 35% ± 5%.

Windbreak cover




- ✓ **Accuracy of the weighing machine**
- ✓ **Constant weight of the filter**
- ✓ **Measures against wind**
- ✓ **Measures against static electricity**
- ✓ **Measures against vibration**

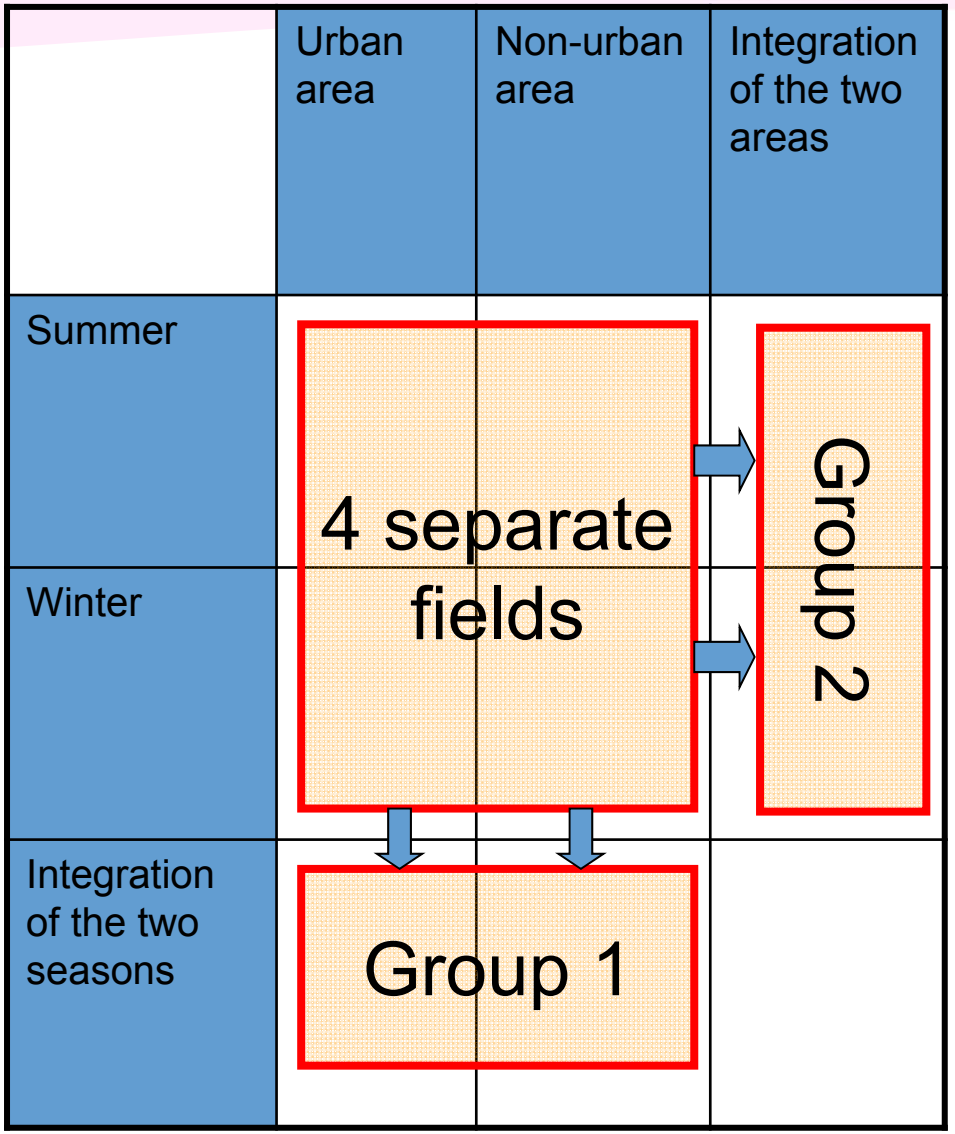
Ionizer
(for removing static electricity)

# Monitoring Using Automatic Measuring Instruments

- Sample commercially available PM2.5 automatic measuring instruments

# Equivalence Evaluation Test

- Round 1:
  - Winter from December 21, 2009 to February 2, 2010 (37 days excluding the period from December 28 to January 3)
  - Summer from July 20 to August 29, 2010 (40 days)
- Round 2:
  - Winter from December 20, 2010 to February 15, 2011 (50 days excluding the period from December 28 to January 3)
  - Summer from July 20 to August 29, 2010 (40 days)
- Testing area:
  - Urban area: 1 Daishikoen, Kawasaki-ku, Kawasaki, Kanagawa Prefecture
  - Non-urban area: 1182 Sowa, Nishi-ku, Niigata, Niigata Prefecture



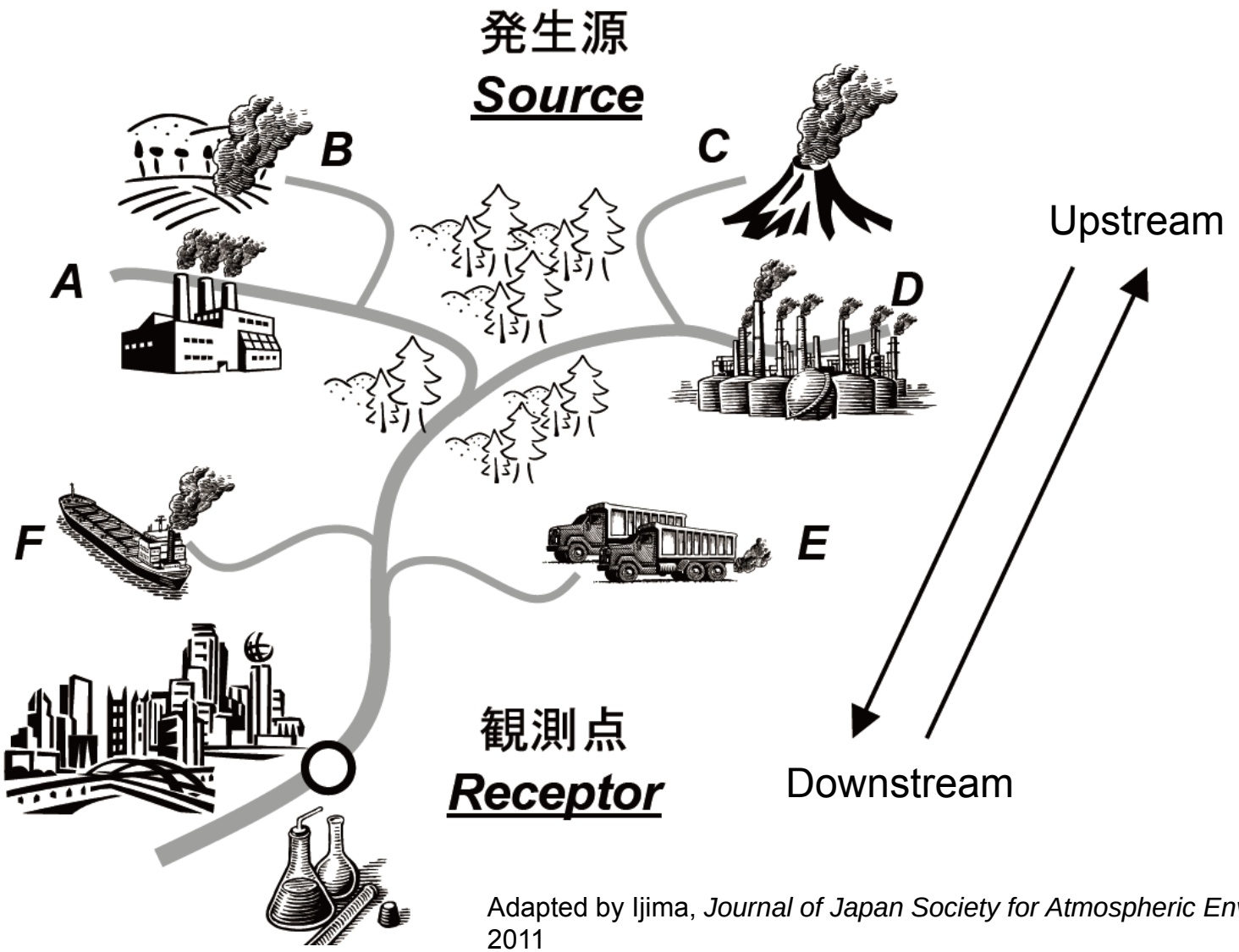
# Chemical Component Analysis: Purposes

- To examine effective measures against micro-particulate matters suitable for the characteristics by region
- To accumulate scientific knowledge, such as behaviors of micro-particulate matters and their precursors in the atmosphere, including the secondary generation mechanism of the micro-particulate matters
- To estimate the source contribution rate of micro-particulate matters
- To enrich the knowledge that contributes to health effects researches of micro-particulate matters
- To contribute to the establishment and verification of a simulation model
- To enhance the knowledge regarding the transition of generation sources over time and the verification of effects of measures

# Chemical Component Analysis: Analytical Method

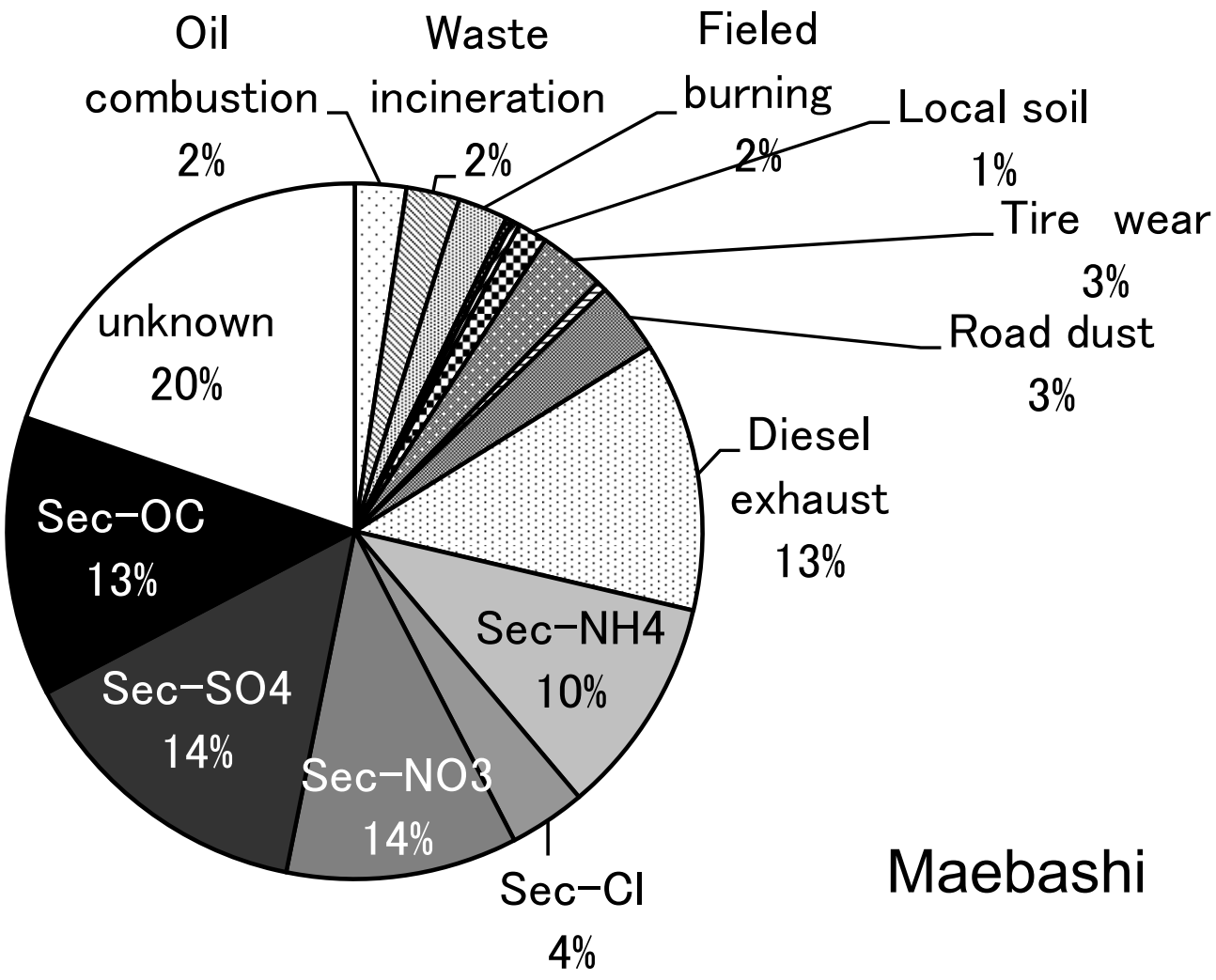
| Analysis item | Filter | Analytical method |
|---|---|---|
| Ion components | Quartz fiber filter or PTFE filter | Water extraction—Ion chromatography |
| Inorganic element components | PTFE filter | Acidic cleavage—Inductively-coupled plasma mass spectrometry (ICP/MS) or X-ray fluorescence (XRF) method |
| Carbon components | Quartz fiber filter | Thermal/optical reflectance method |
| Polycyclic aromatic hydrocarbons | Quartz fiber filter or PTFE filter | Solvent extraction—High performance liquid chromatography (HPLC) or Solvent extraction—Gas chromatography mass spectrometry (GC/MS) |

# Conceptual Diagram of Generation Source Analysis Using an Atmospheric Model




Adapted by Ijima, *Journal of Japan Society for Atmospheric Environment*, 2011

# Example of Source Apportionment by the CMB Method



# Necessity of Source Profile Data Accumulation

Steel Industry

District Heating & Cooling

Incineration Plant

Industrial Waste Incineration Plant

Heavy Oil Boiler

# In Conclusion

- Continuous monitoring at fixed points will let you know a lot of things.
  - Verification of the effects on measures against air pollution
  - Changes in generation source of air pollution
- Quality control is important
  - Dual measurement, Sampling low rate calibration
  - Traveling blank test, certified reference material
- Work around your mission with the intention of obtaining one data item spending a decade.