



Colors, Future!

いろいろって、未来。

川崎市

Report on Findings from the PM2.5 Collaborative Research in Kawasaki City and Shengyang City

- Overview of Enterprise and Research Results -

February 7, 2019 (Thursday)

Kawasaki Environment Research Institute



Today's Agenda



Friendly Relations with Shenyang City

○ Overview of Shenyang City



	Shenyang City	Kawasaki City (For Reference)
Population	Approx. 8.3 million people	Approx. 1.51 million people
Area	Approx. 12,900 Km ²	Approx. 144 Km ²

This is the largest industrial city in the northeast district of China. It is centered on government, economics and culture, and is a vital Chinese city.

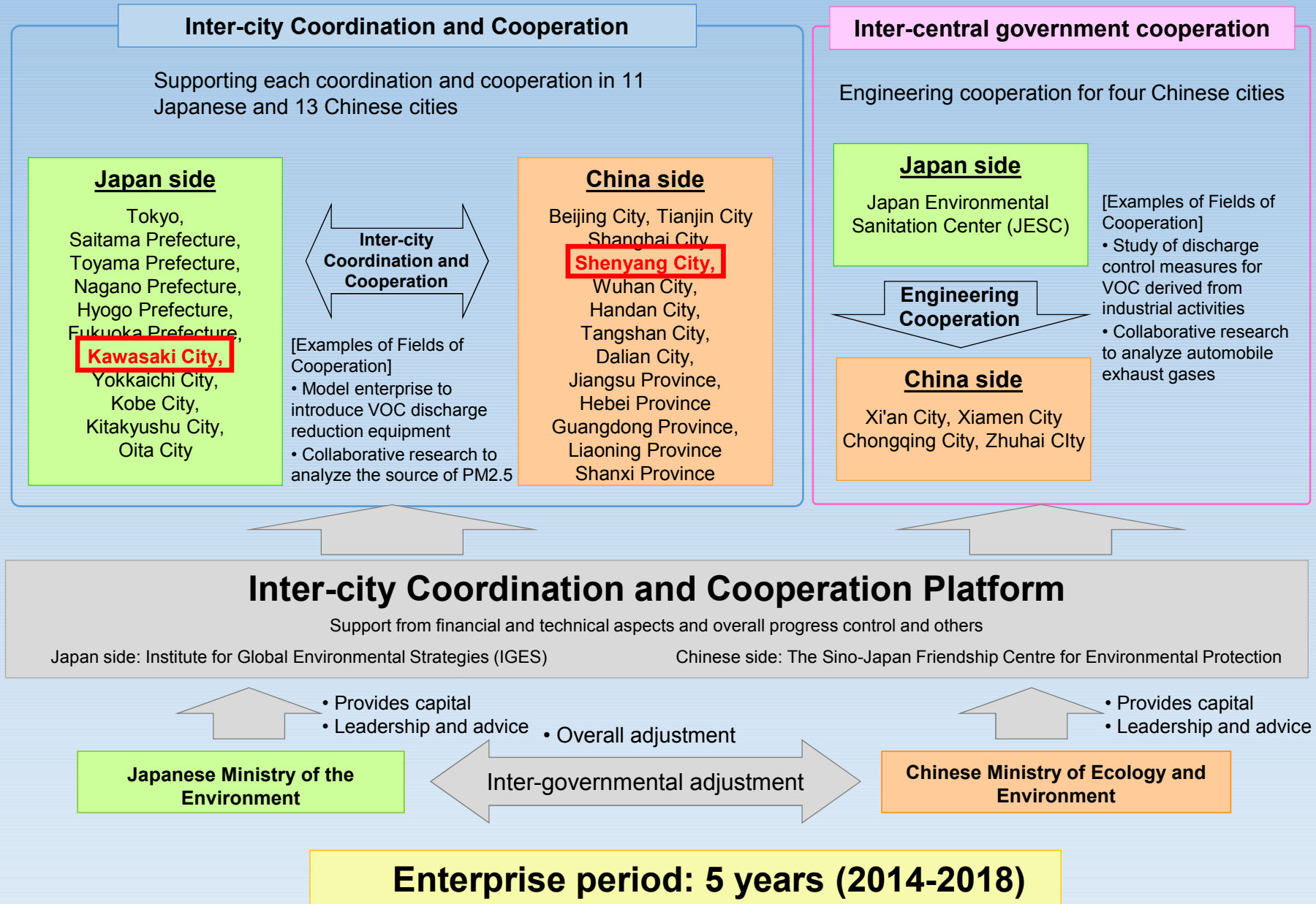
○ Main background to links

August, 1981	Concluded a friendly relationship
May, 1997	Concluded protocols for environment engineering exchange cooperation (started accepting environment engineering students)
February, 2009	Concluded letter of agreement for environment economic expansion cooperation
May, 2012	Concluded memorandum for five organizations relating to the environment between Kawasaki City and Shenyang City
April, 2014	Ministry of the Environment started Inter-city Coordination and Cooperation Enterprise to Improve the Atmosphere and Environment in China (2014 to 2018)

<Results>

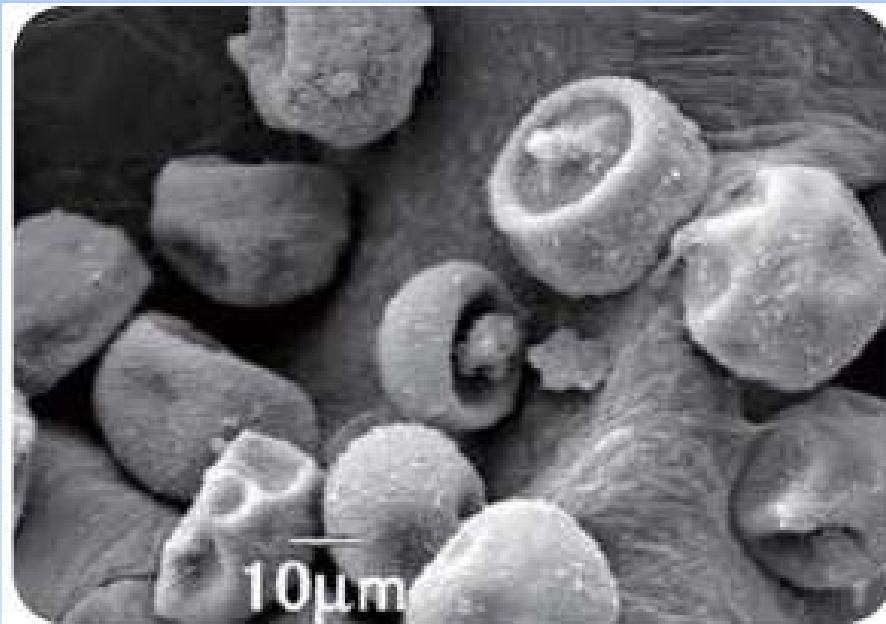
- Accepted environment engineering students (Started in 1997; total of 49 students)
- Participated in eco-business forum (have been participating since 2008 (1st forum))

Ministry of the Environment started Inter-city Coordination and Cooperation Enterprise to Improve the Atmosphere and Environment in China

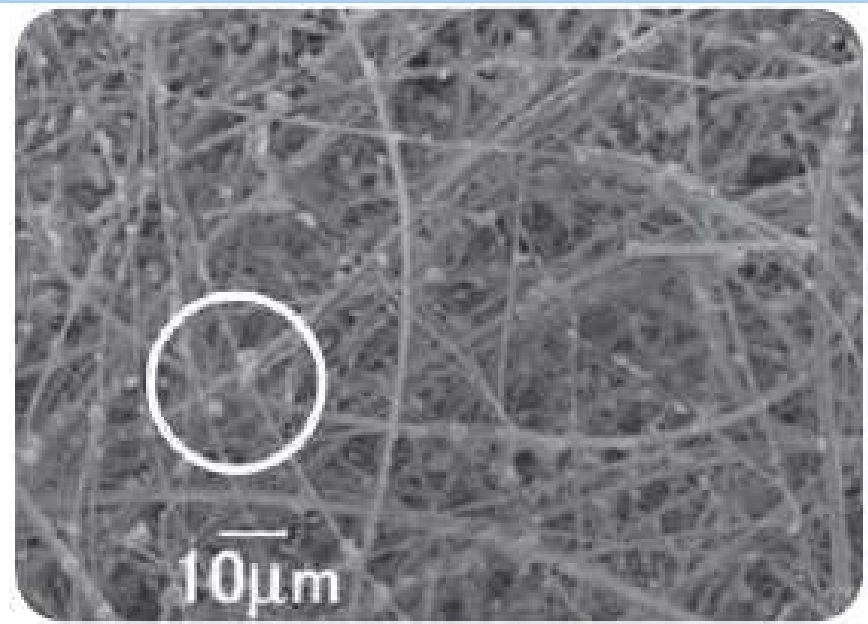


What is fine particulate matter (PM2.5)?

Airborne particles smaller than a grain size of 2.5 μm



Cedar Pollen

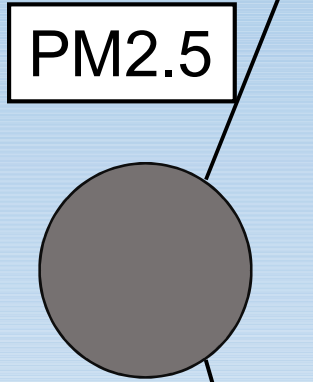


PM2.5

* 1 μm = 1/1000 mm

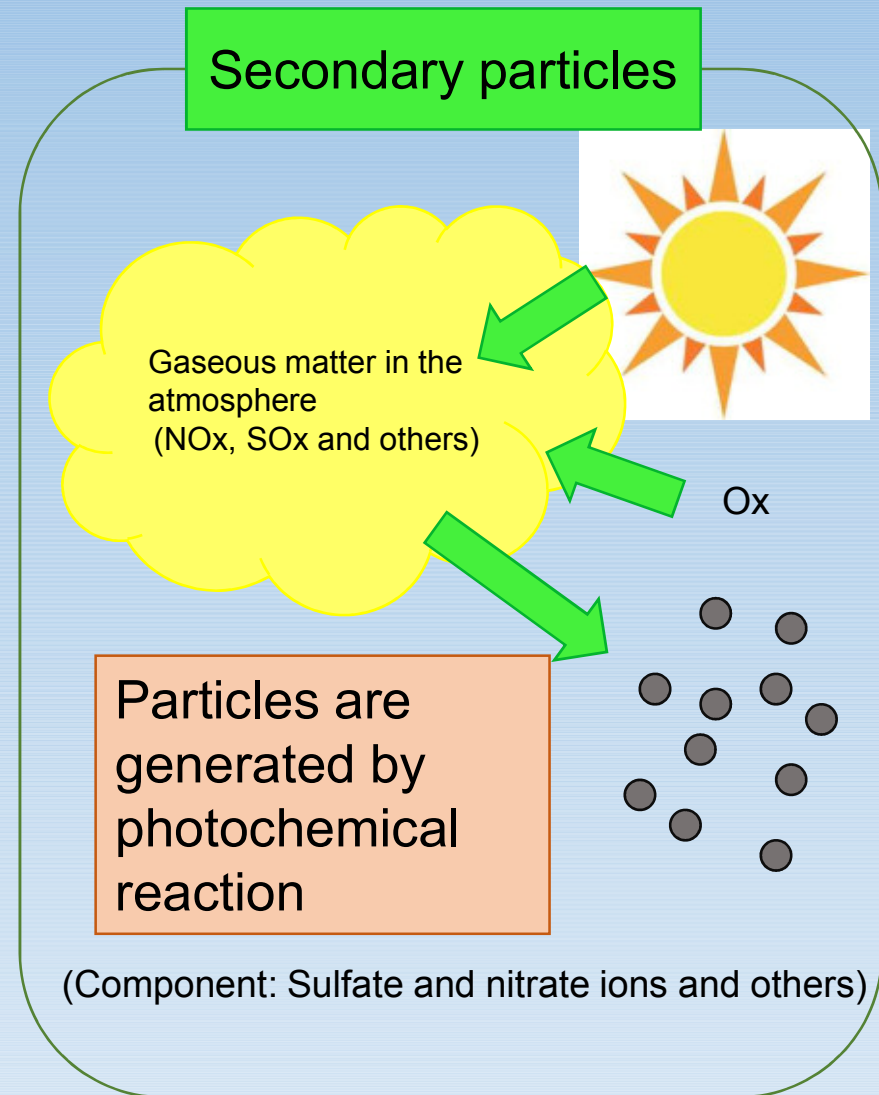
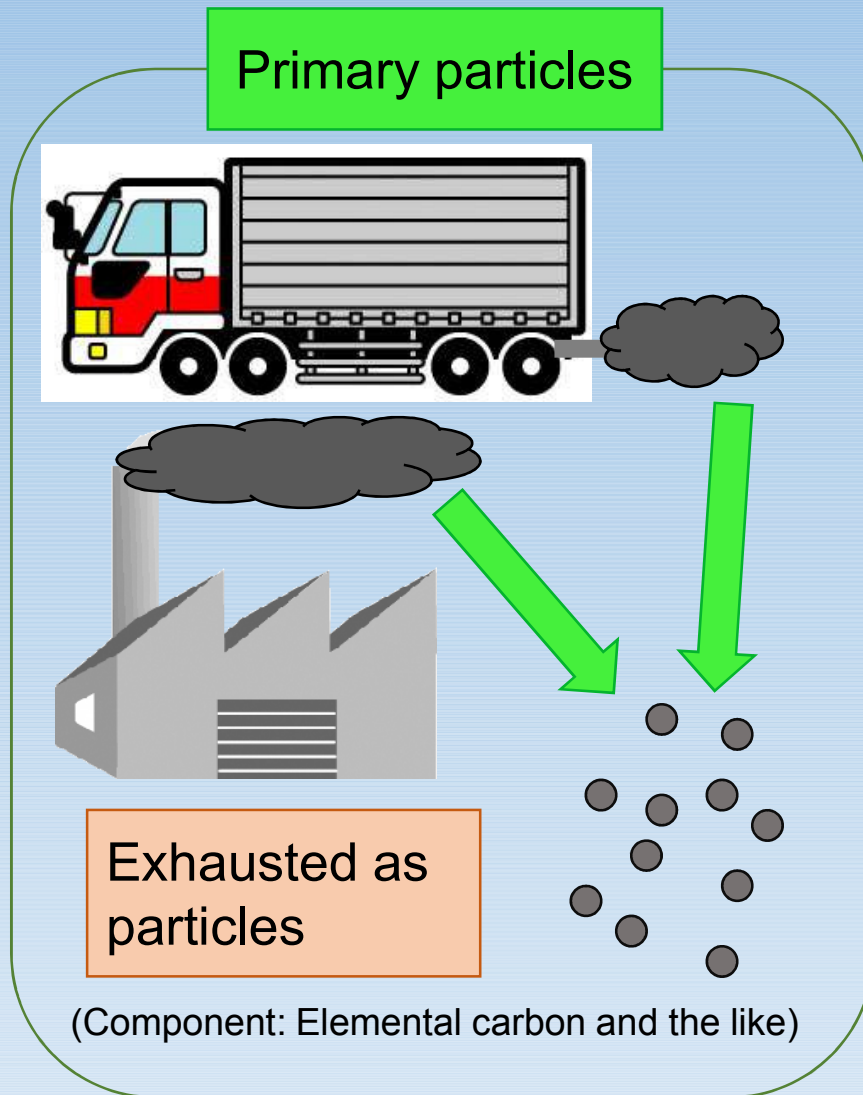
Component content in PM2.5

- PM2.5 is an extremely fine particle, but **it is composed of a variety of matter.**



Carbon	Elemental carbon (EC: so-called soot) Organic carbon (OC: Chain compounds such as C_nH_{n+2} and others, polycyclic aromatics, levoglucosan and others)
Ions	Sulfate ion (SO_4^{2-}), nitrate ion (NO_3^-), chloride ion (Cl^-), ammonium ion (NH_4^+), sodium ion (Na^+) and others
Inorganic elements (Metals)	Aluminum (Al), calcium (Ca), iron (Fe), vanadium (V) manganese (Mn), lead (Pb) and others

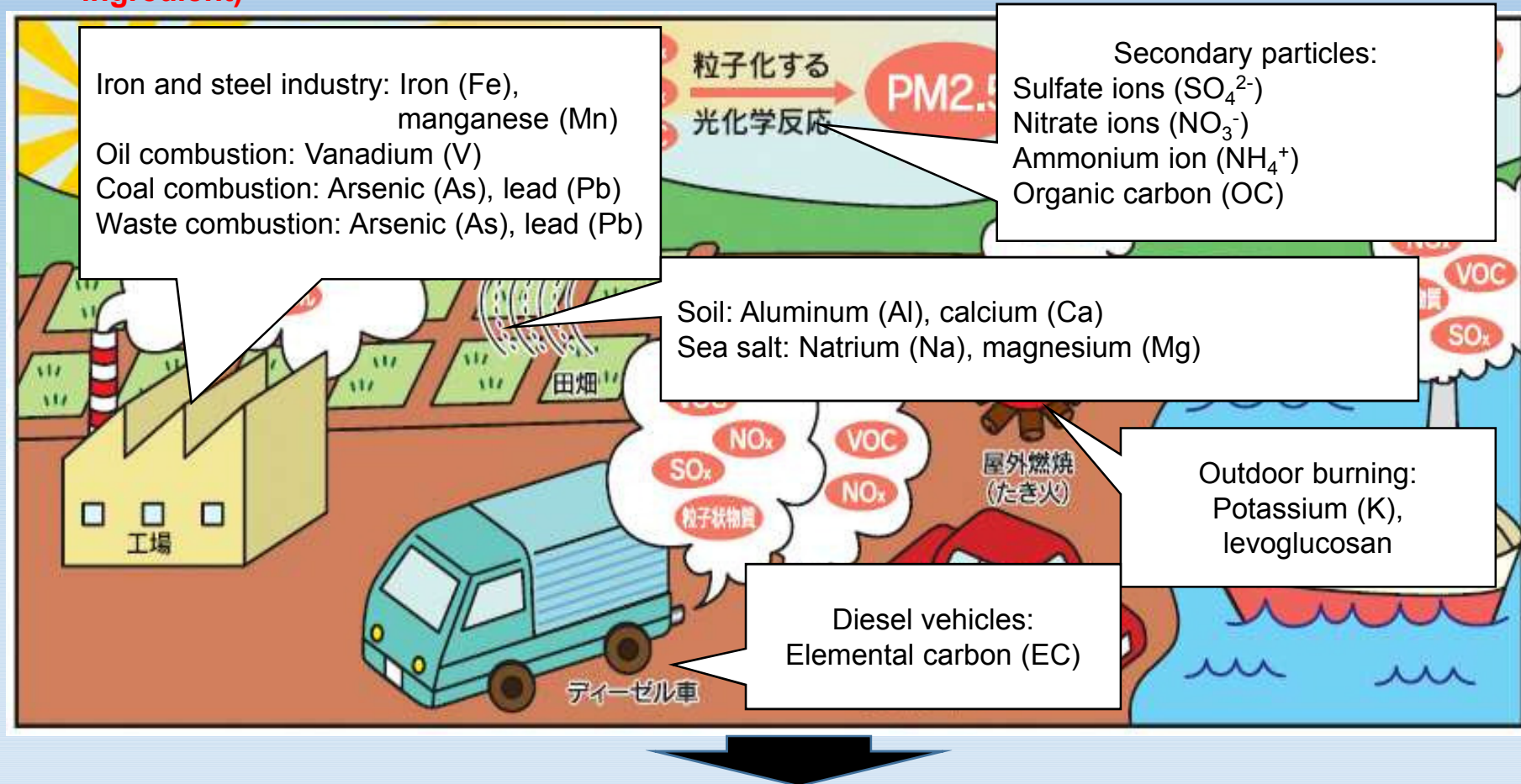
Generating mechanism of PM2.5



- PM2.5 is generated in two ways, namely the **primary particles** that are discharged into the environment as particles from the source, and **secondary particles** of which gaseous matter becomes particulate through a photochemical reaction.

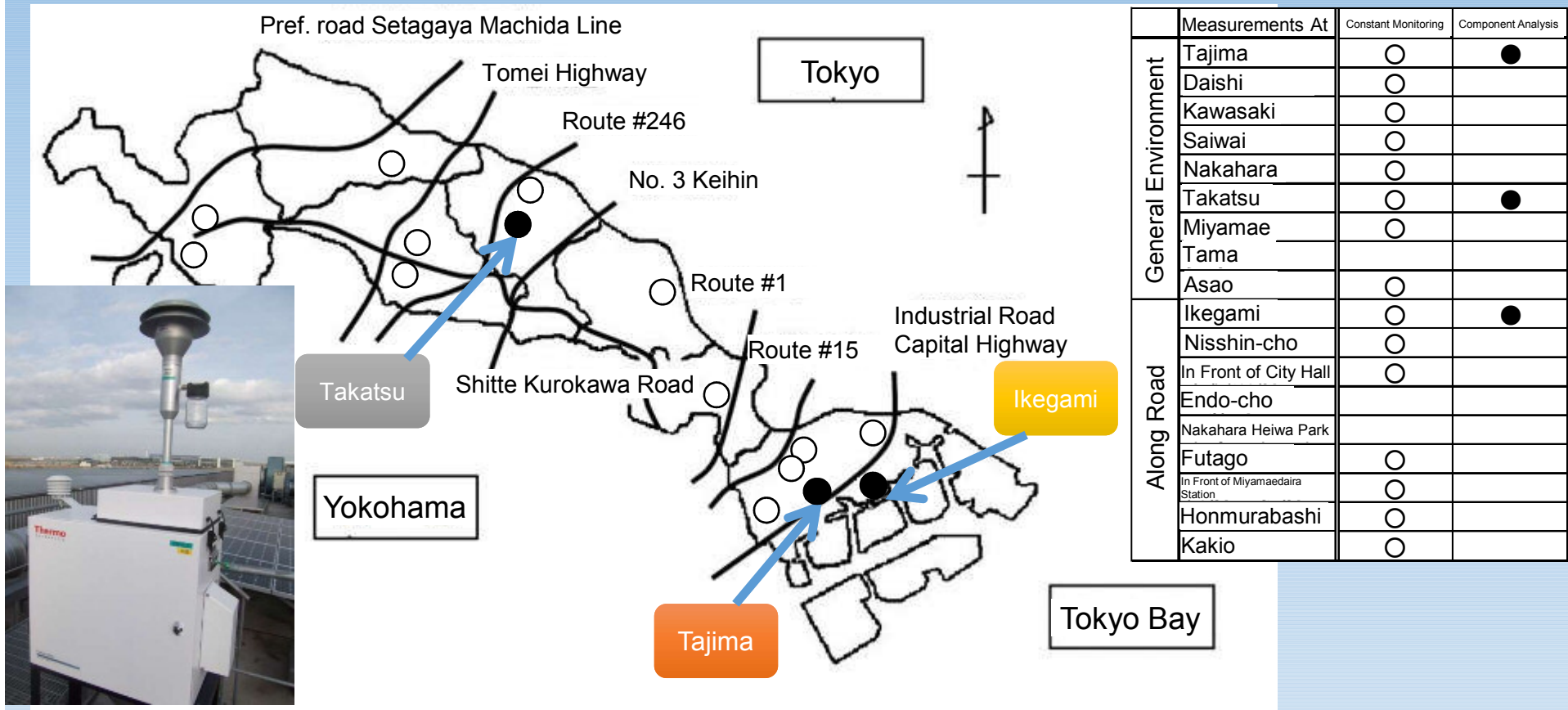
The sources of PM2.5

- ▶ There are many sources of particulates including industrial plants, automobiles, ships, soil and the oceans, and others.
- ▶ **There are characteristics in exhausted components depending on the source. (indicator ingredient)**



PM2.5 has characteristics in exhausted components depending on the source. For that reason, it is possible to estimate a rate of contribution of each source by analyzing the components and their sources.

Survey sites and survey period



Season	Survey period	Survey times
Spring	May 10 - 24, 2017	10.00 AM - 10:00 AM the next morning; 24-hour sampling
Summer	July 20 - August 3, 2017	
Fall	October 19 - November 2, 2017	
Winter	January 18 - February 1, 2018	

Implementation of the Inter-city (Shenyang - Kawasaki) Coordination and Cooperation Enterprise to Improve the Atmosphere and Environment



Collaborative research to analyze the source of PM2.5 in Shenyang City

PM2.5 Period and site for taking samples



Spring: 2017.05.08 - 2017.05.26



Summer: 2017.07.17 - 2017.08.04



Fall: 2017.10.16 - 2017.11.03



Winter: 2017.12.04 - 2017.12.22



Component Analysis Items

○ PM2.5 mass concentration

○ Ion component (8 items)

- Cl^- , NO_3^- , SO_4^{2-} , Na^+ , NH_4^+ , K^+ , Mg^{2+} , Ca^{2+}

○ Carbon component

- Elemental carbon (EC)
- Organic carbon (OC)

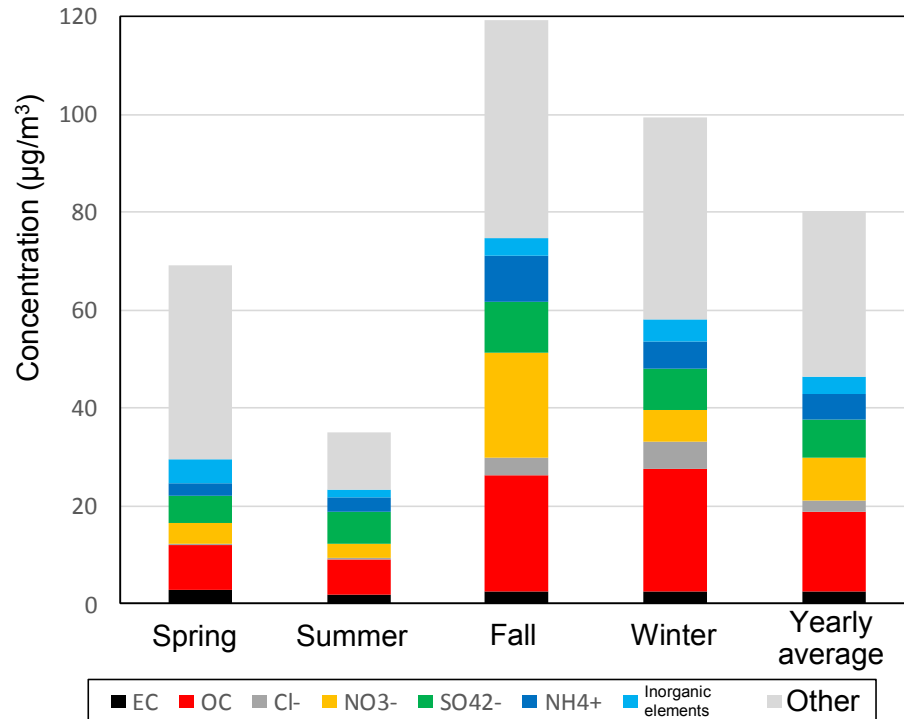
(Water-soluble organic carbon, water-insoluble organic carbon)

○ Metal component (29 items)

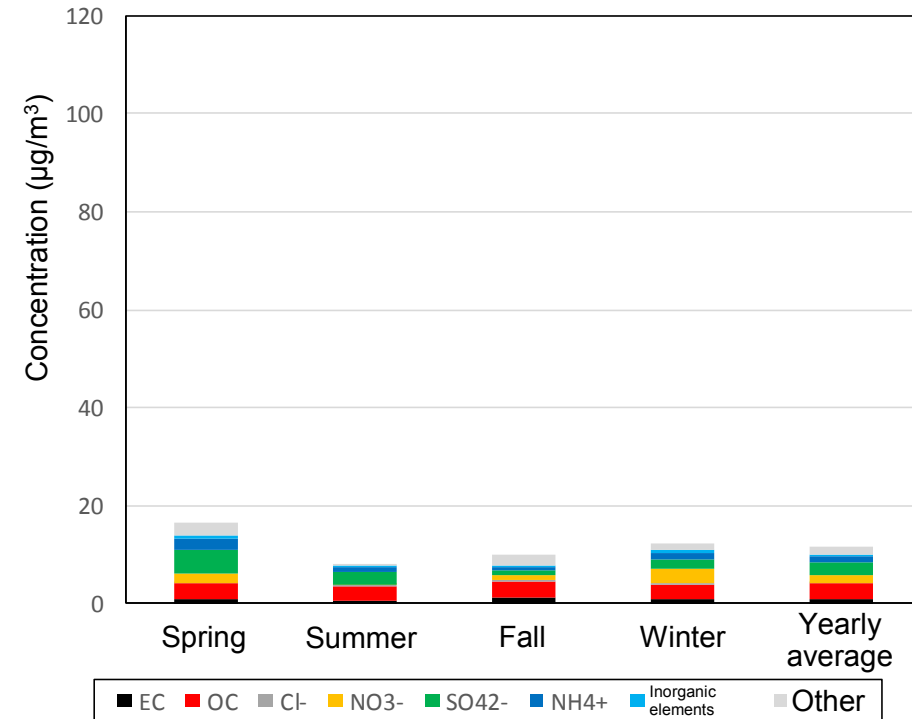
- Na, Al, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn ,
As, Se, Rb, Mo, Sb, Cs, Ba, La, Ce, Sm, Hf, Ta, W, Pb, Th

PM2.5 collaborative research results comparison (component analysis)

Shenyang City



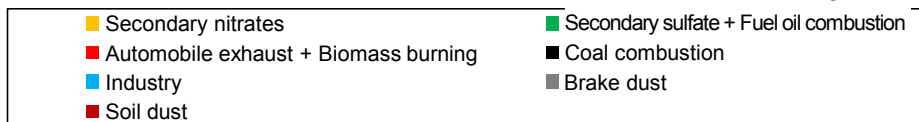
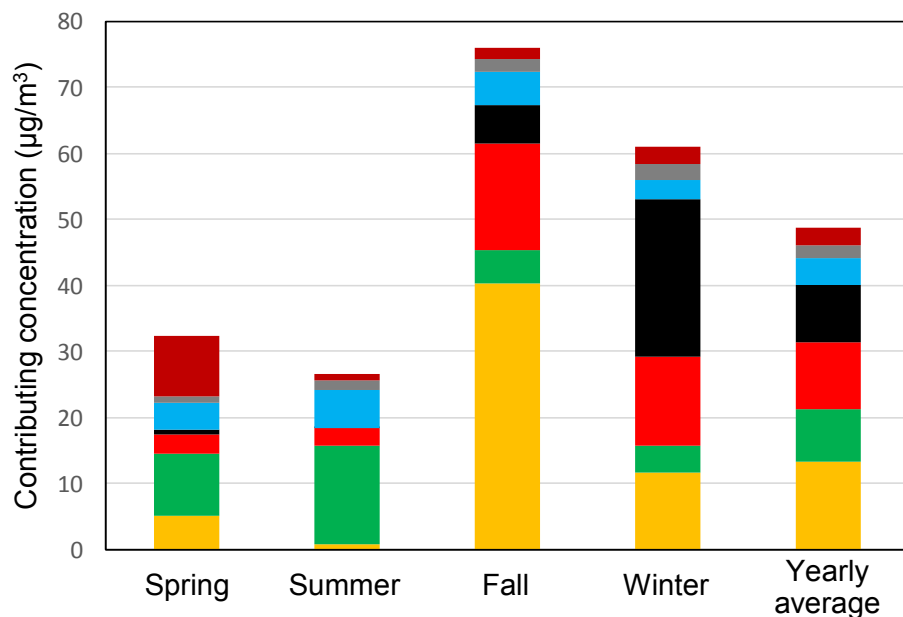
Kawasaki City



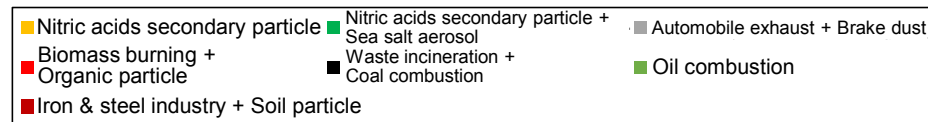
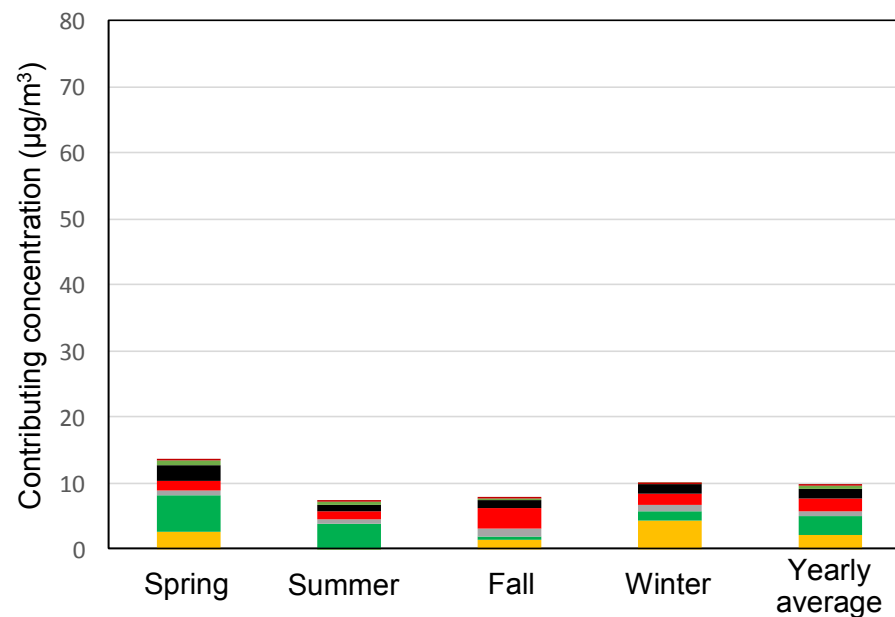
- Annual average values for PM_{2.5}: Shenyang City: 80.3 $\mu\text{g}/\text{m}^3$; Kawasaki City: 11.6 $\mu\text{g}/\text{m}^3$
This shows that Shenyang City is approximately 7 times higher than Kawasaki City in terms of particulates.
- Components that showed a high ratio in Shenyang City were in the order of OC, NO₃⁻, and SO₄²⁻; OC was high in the fall, and winter; NO₃⁻ was high in the fall.
- Components that showed a high ratio in Kawasaki City were in the order of OC, SO₄²⁻, and NO₃⁻.

PM2.5 collaborative research results comparison (source analysis)

Shenyang City



Kawasaki City



- For the PM2.5 source analysis results, the contributing concentration of identified sources was compared.
- In Shenyang City, the highest contributor during the fall and winter seasons in which PM2.5 was high, were secondary nitrates, automobile exhaust + biomass burning, and oil combustion. Improvements can be expected in the colder seasons by promoting countermeasures for these.
- Primary particles greatly contributed to PM2.5 in Shenyang City, through direct discharge from their sources. The atmospheric environment can be expected to be improved by promoting the same kinds of countermeasures used for Japan and Kawasaki City in the past.

Conclusion

Started Inter-city Coordination and Cooperation Enterprise to Improve the Atmosphere and Environment in China

- A total of 43 employees from Kawasaki City visited Shenyang City to get involved in training and research.
- A total of 37 employees from Shenyang City visited Kawasaki City to get involved in training and research.
- Engineering and knowledge about countermeasures for atmospheric contamination including PM2.5 in Kawasaki City was useful in improving the atmosphere and environment in Shenyang City.

Thank you for listening.



Kawasaki Environment Research Institute

- **Address**
3-25-13 Tonomachi, Kawasaki-Ku, Kawasaki City
- **Directions**
 - Airport:** 15 minutes by car from Haneda Airport
 - Train:** 15 minutes on foot from Kojimashinden Station on the Keikyu Daishi Line
 - Bus:** City bus from Yokohama Station, or Kawasaki Station, 10 minutes by bus from Sangyōdōro Station on the Keikyu Daishi Line
 - Car:** 1 minute by car from the Tonomachi exit on the Metropolitan Expressway