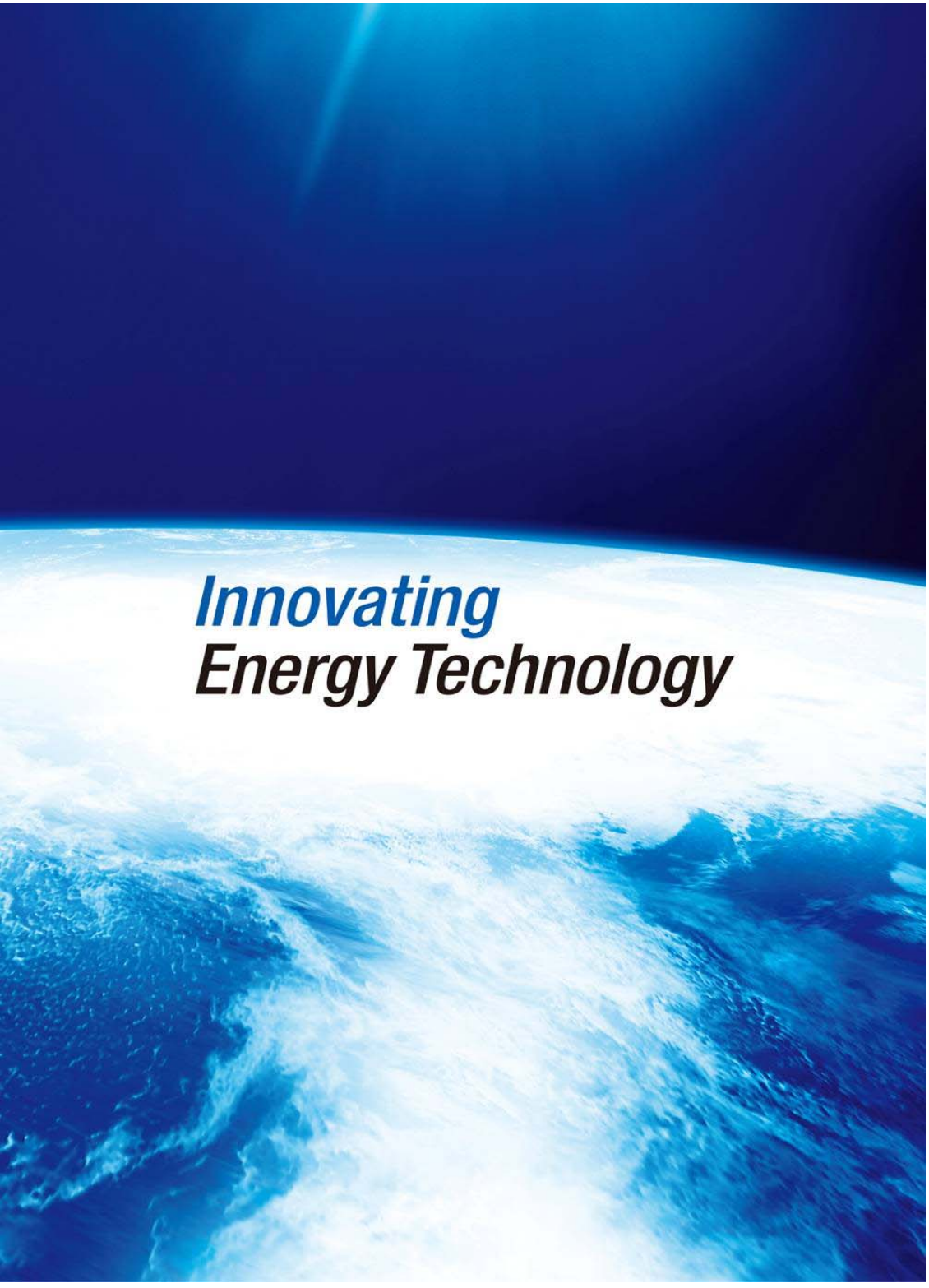


Fuji Electric
Innovating Energy Technology

Field test of the aerosol particle combined analyzer

- A new PM2.5 analyzer-

February 4, 2015

Fuji Electric Co., Ltd.

About Fuji Electric

Fuji Electric
Innovating Energy Technology

In energy management

■Cluster Energy Management System

In automobiles

■System for EV

In railways

■Traction converter

In power stations

■Steam turbines

In factories

■Industrial inverters

In shops

■Freezer and refrigerated showcases

In office buildings

■IDC

Fuji Electric's sensors

Fuji Electric
Innovating Energy Technology

Valuable components and services creator
Customer satisfaction provider

Improving infrastructures, industry and transportation.

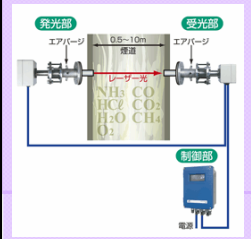
FA components providing business.

Most Valuable Service Provider ⟷ ***Most Valuable Components Provider***

For system solutions

・Specific sensors, high sensitivity sensors (for plant control).

Plant equipment



Gas analyzer

Particle sensor

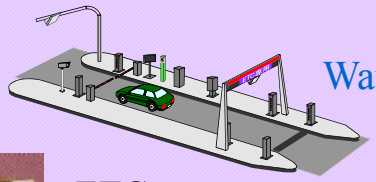
Flow meter

Power meter

Transmitter

Radiation equipment

Traffic systems



ETC car sensors

Water treatment

Water quality monitor

Personal monitors, environmental monitors

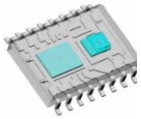
Sensor components

・MEMS technology applied sensors.

Pressure sensor

Gas alarm (sensor)

FA sensors



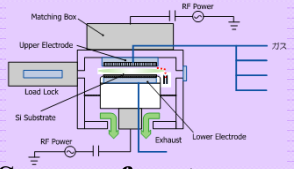
Acceleration sensor

Auto focus sensor

Coin and banknote recycler

New sensors

Aerosol analysis



Sensors for stepper

About PM2.5

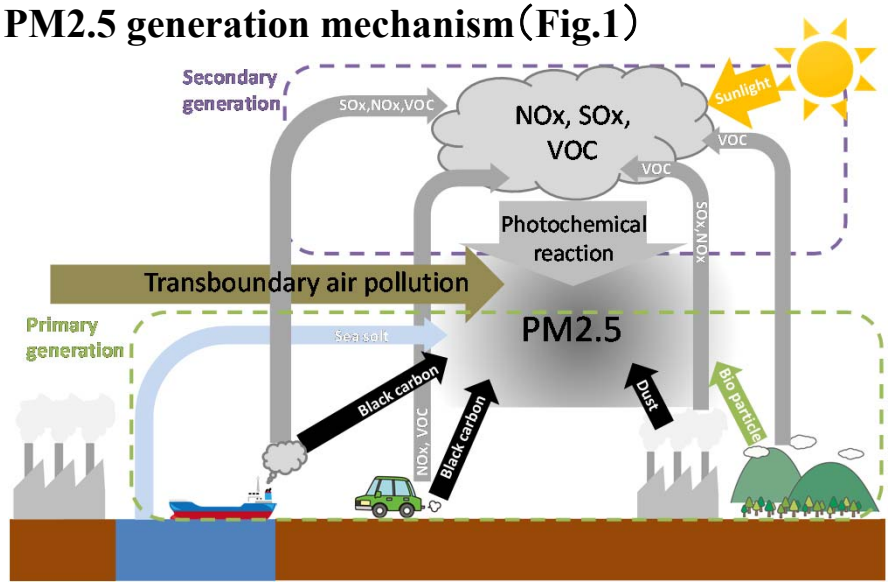
Fuji Electric
Innovating Energy Technology

●PM2.5 has various origins, sizes and chemical compositions（Fig.1, Fig.2）

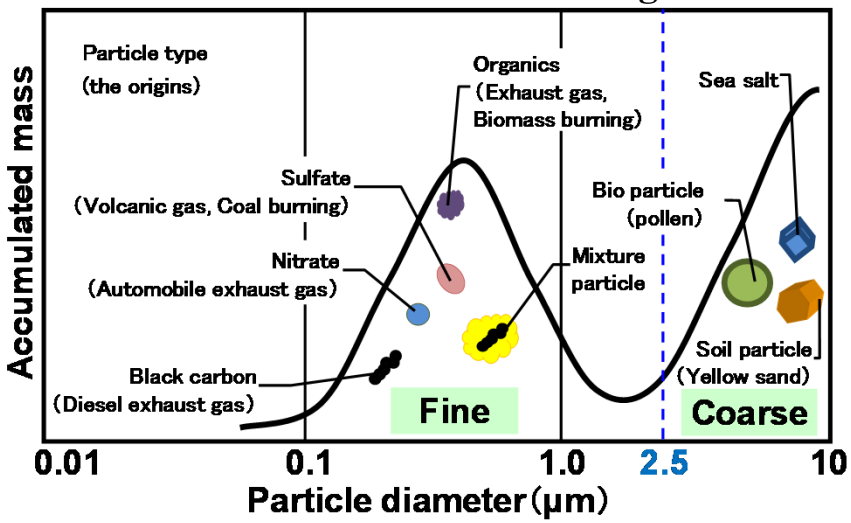
●There are growing concerns about Health effects (Fig.3) and meteorological effects (Fig.4).

●Reducing PM2.5 requests more detailed information (sizes, origins...) .

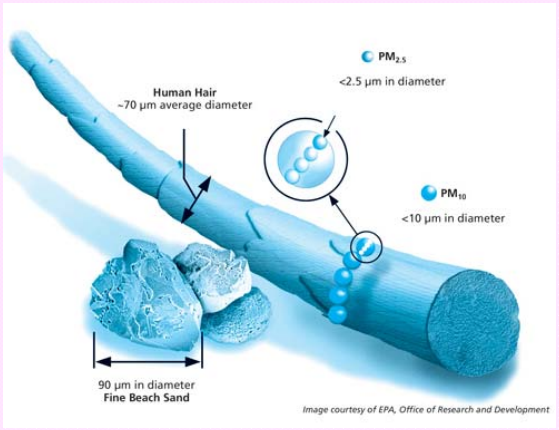
■PM2.5 generation mechanism（Fig.1）

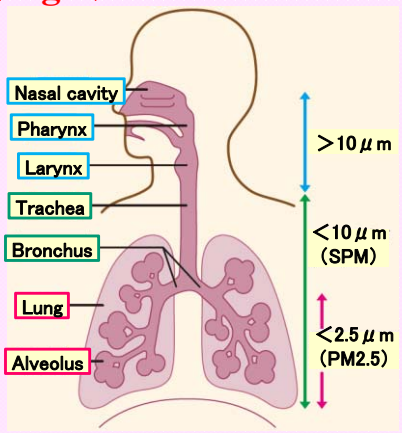


■Aerosol Particle Size distribution（Fig.2）

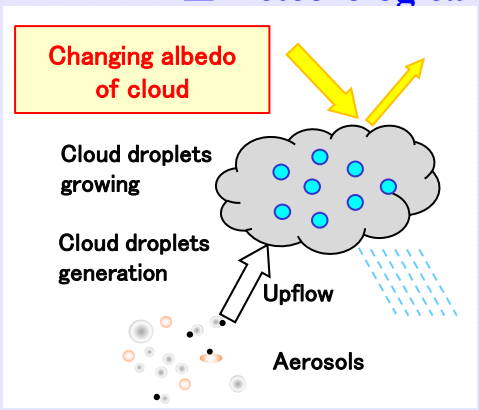


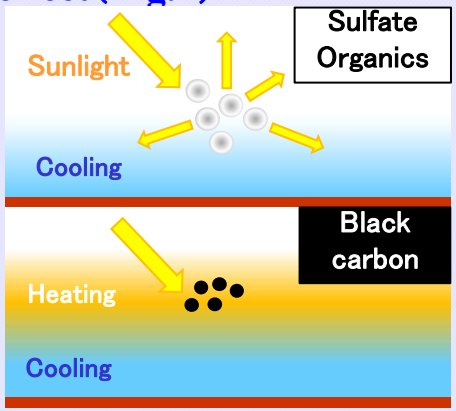
■Health effect （Fig.3）





■Meteorological effect（Fig.4）





©Kondo Lab. The University of Tokyo

Aerosol particle combined analyzer

Fuji Electric
Innovating Energy Technology

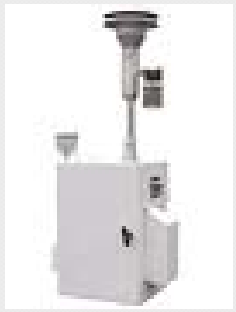
Hourly mass concentration monitoring only

Particle size, number and composition real-time (every 15min) analysis.
Possible applications : Inferring PM2.5 origins, Improving PM2.5 forecast

Existing method

■PM2.5 monitor

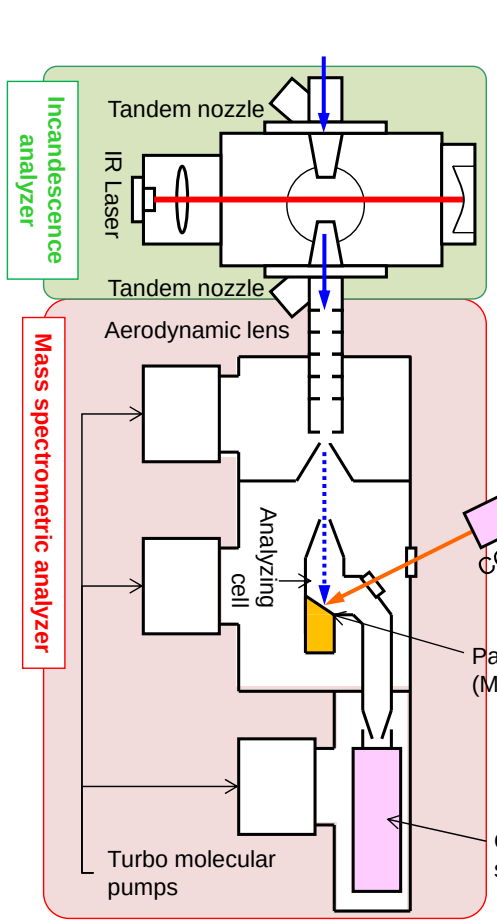
Mass concentration monitoring only,
Composition analysis is impossible.



■PM2.5 manual analysis

8–12 hours per analysis
Real-time measurement is impossible.

Fuji Electric's aerosol particle combined analyzer



Loading aerosol particles

Introduce particles into IR Laser cavity

Detecting particle diameter with scattering
Detecting black carbon with incandescence

Producing particle beam with aerodynamic lens

Particle collection on the particle trap and vaporizing CO_2 Laser

Analyzing particle chemical compositions with QMS

This research was supported by Japan Science and Technology agency (2008～2012). The member of the joint research are The University of Tokyo, Japan Agency for Marine-Earth Science and Technology and Fuji Electric Co., Ltd.

Field test at Kawasaki city

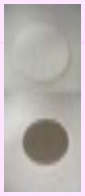
Fuji Electric
Innovating Energy Technology

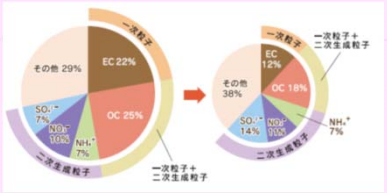
Joint study between Kawasaki city and Fuji Electric (since 2013)

Kawasaki city

Takatsu general station

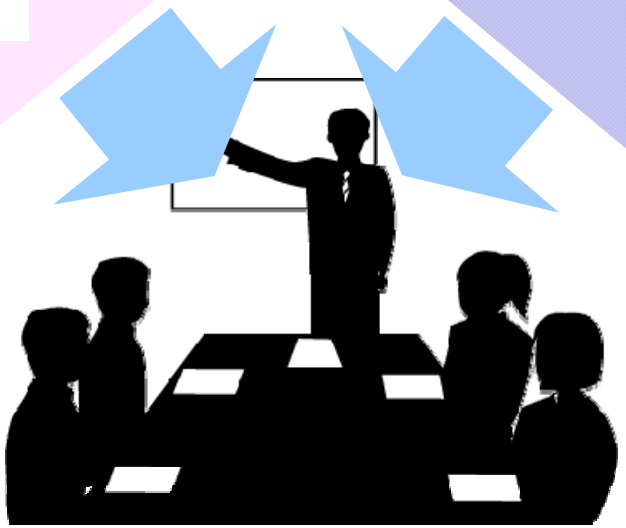
PM2.5 monitoring





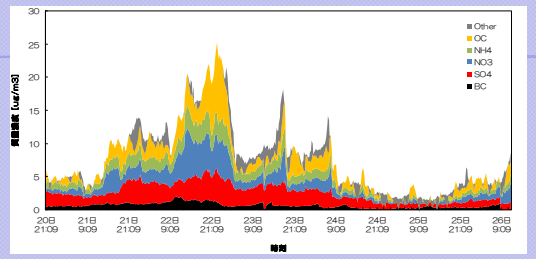
Manual analysis

【Resources】
- PM2.5 monitoring data
- PM2.5 manual analysis data
- Weather data
- Air pollutant data



Fuji Electric

Aerosol combined analyzer (prototype)



Field observation

【Resources】
- PM2.5 mass concentration data
- PM2.5 real-time analysis data (particle chemical composition, size and number)

Example – Field test at Kawasaki general station

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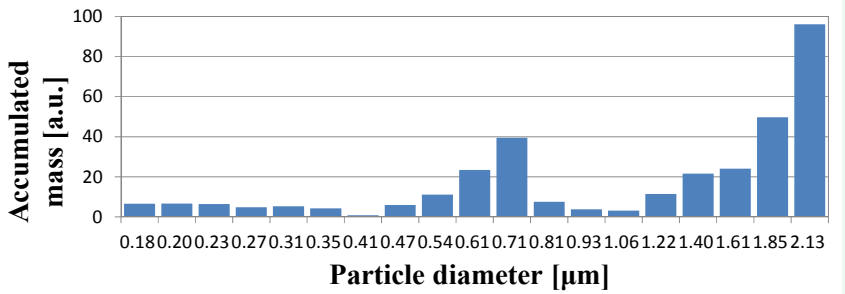
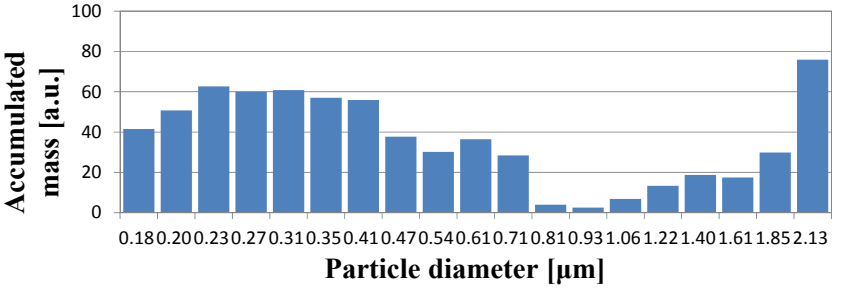
Particle size distribution

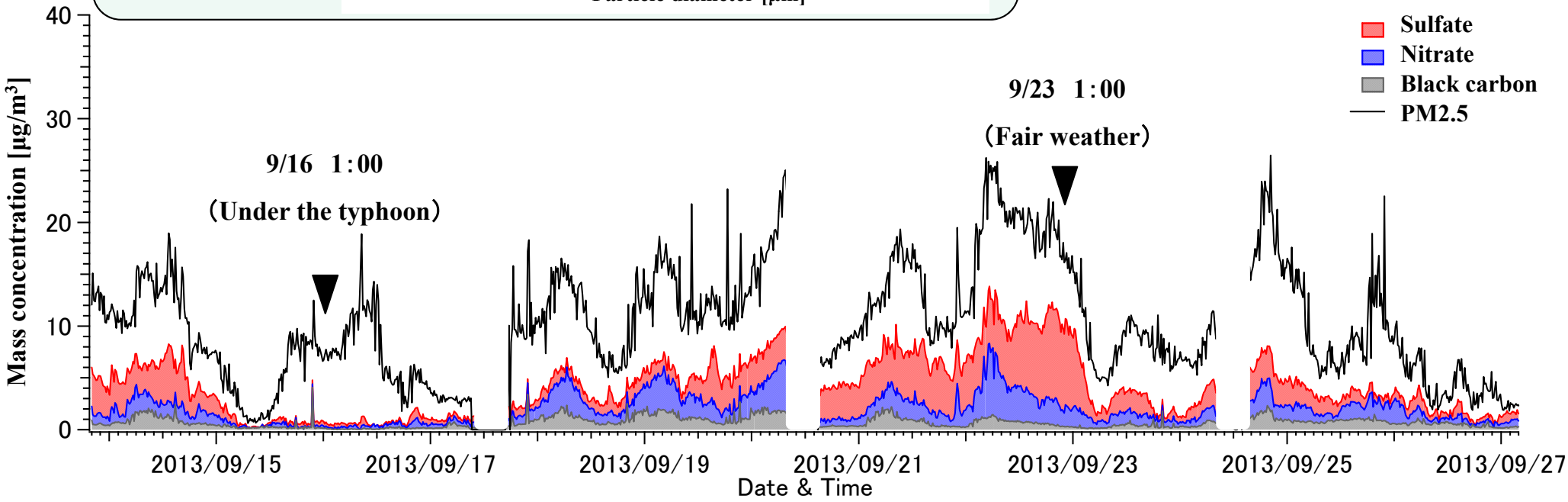
9/16 1:00
(Under the typhoon)



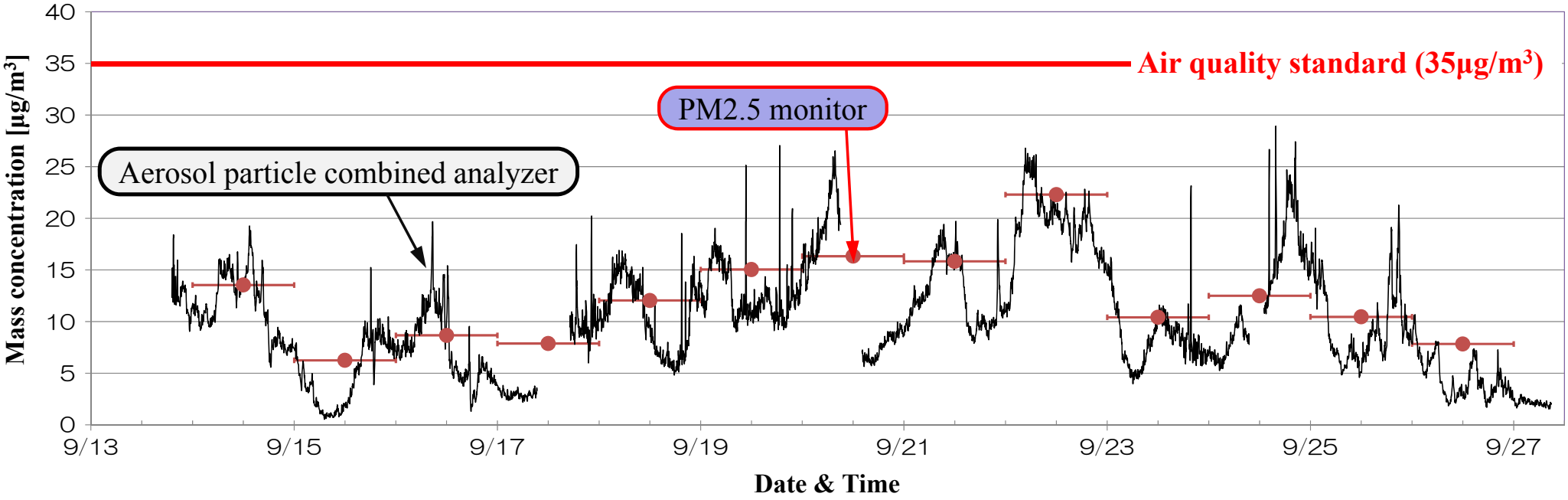
9/23 1:00
(Fair weather)

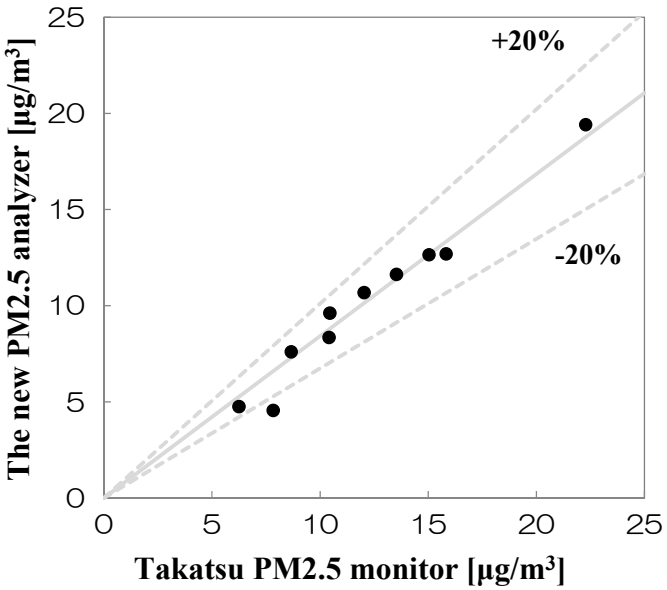


The prototype of aerosol particle combined analyzer in the Takatsu general station



Intercomparison





Intercomparison between results of PM2.5 monitor and results of aerosol particle combined analyzer (daily data).

Trends show good correlation (approximately±20%)

Data analysis1—Nitrate vs NOx

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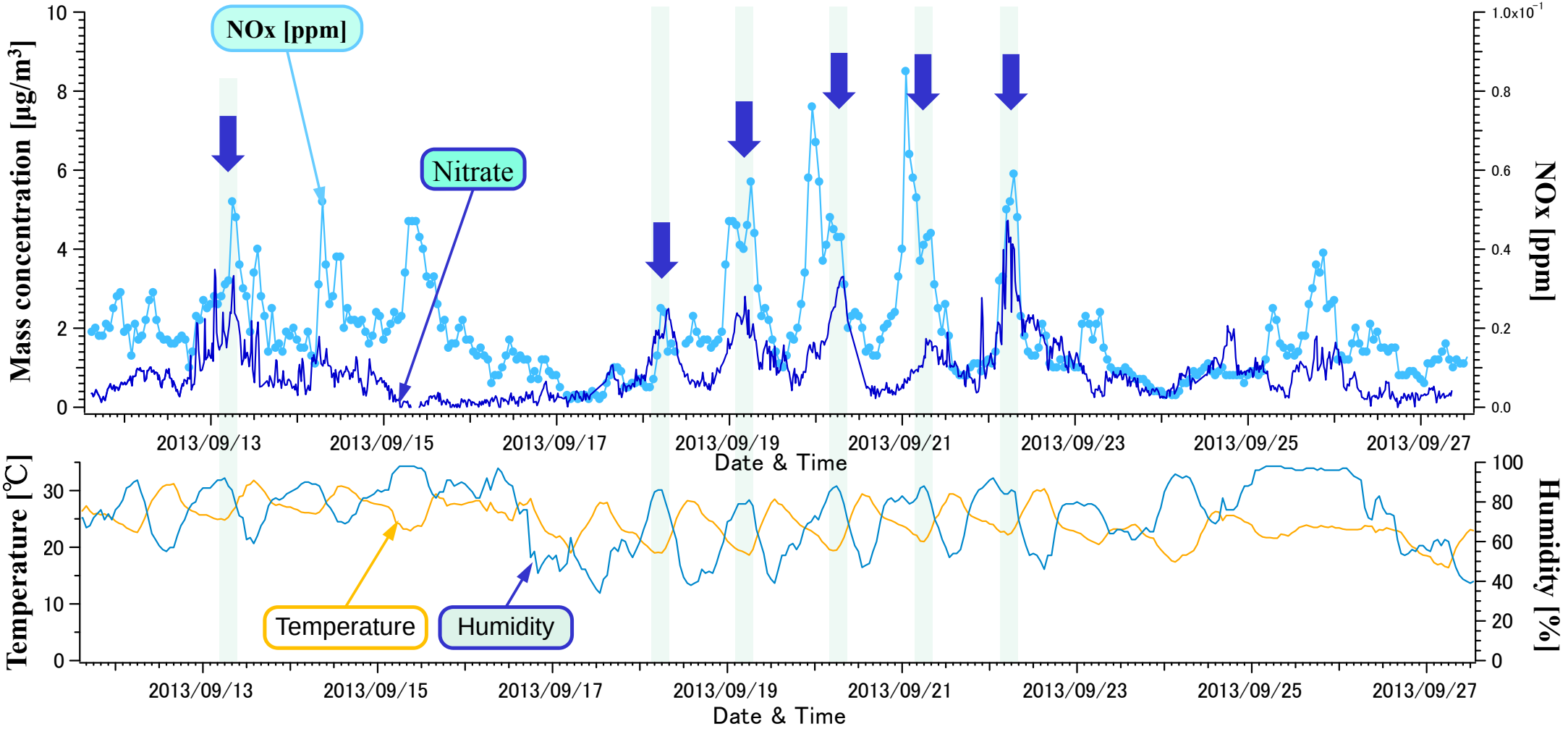
- There is a correlation between nitrate and NOx gas.
- NOx gas rapidly changes into nitrate.

The origin of nitrate could be around here.



Data analysis2—Nitrate vs black carbon

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Innovating Energy Technology

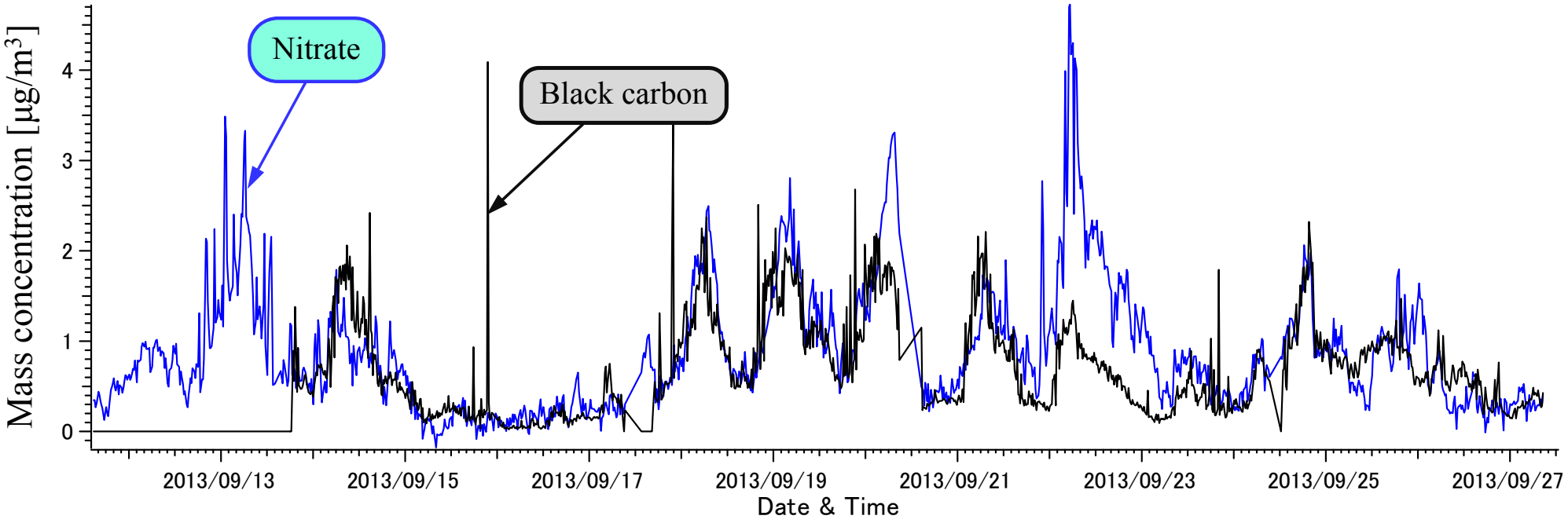
Measurement results of nitrate

- **There is a correlation between nitrate and NOx gas.**
- **NOx gas rapidly changes into nitrate.**

Measurement results of black carbon

- **There is a correlation between nitrate and black carbon.**

The origin of nitrate could be automobiles around here.



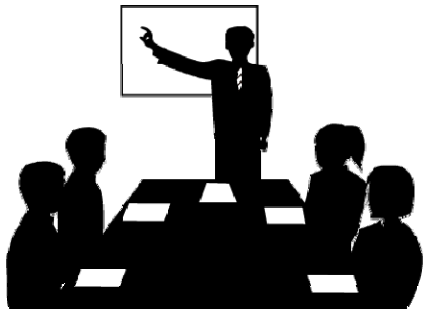
Aerosol particle combined analyzer can provide PM2.5 origin information.

Joint study 2014

Fuji Electric
Innovating Energy Technology

Long term field measurement (more than 3 months)

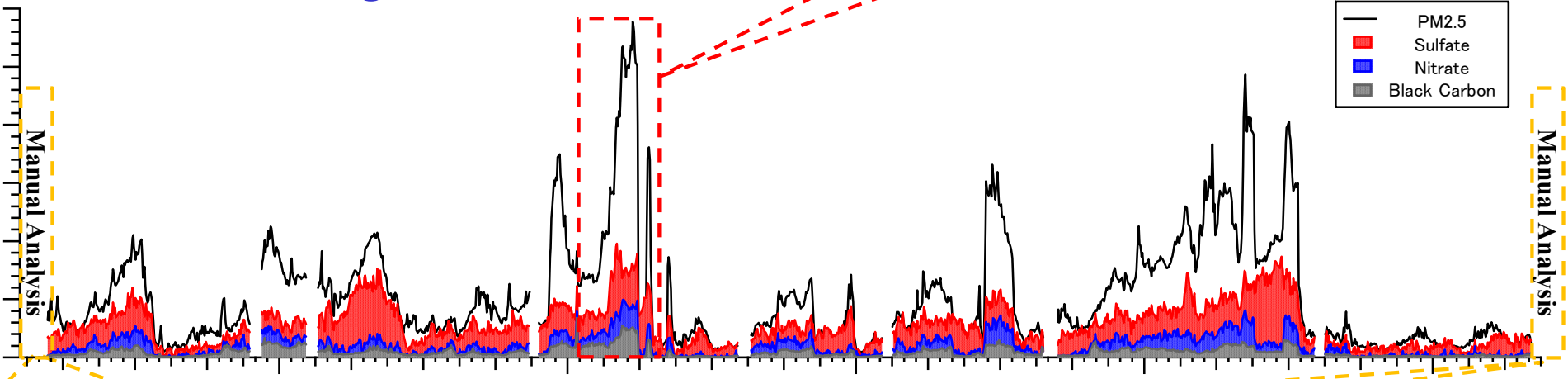
- Studying PM2.5 component dynamics
  Peculiar case analysis, macro trend …
- Developing the analyzer for commercialization
  Improving reliability, maintenance methods …

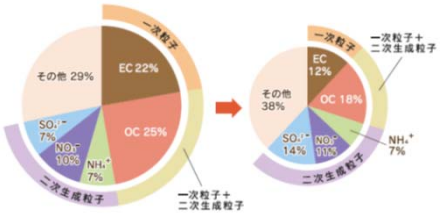


Kawasaki city & FE Joint analysis

Measurement image

Peculiar case





Verification of long term stability

We will contribute to reduce PM2.5.

空気の、テイスティング。

それぞれどんな成分がふくまれているのか、空気中のPM2.5の特性を
リアルタイム分析。微小粒子の生まれた場所と原因の特定に、道を拓きます。

PM2.5発生源特定を可能にする
富士電機のエアロゾル複合分析技術
【第27回独創性を拓く先端技術大賞】企業・産学部門 特別賞受賞