

Comparison of the measured values from the same emission source obtained by using various measurement instruments

Tetsuya Yamashita
Hiroyuki Fukui
JCAP Promotion Department

What is JCAP?

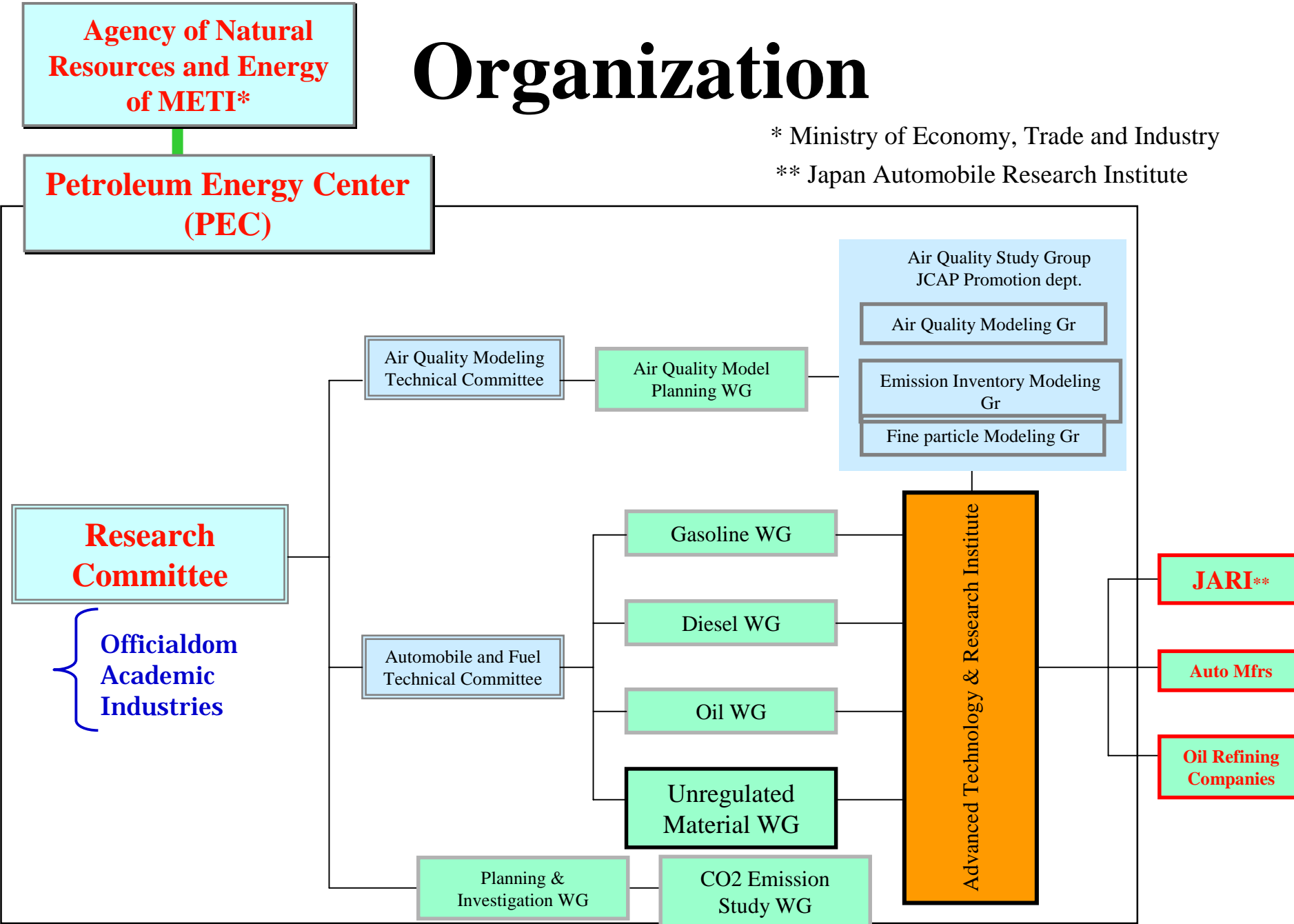
(Japan Clean Air Program)

- Collaborative study by automobile industry and petroleum industry
(Supported by METI's subsidy)
- JCAP I has been conducted for 5-years from 1997 to 2001
(Budget: Approx. 5.4 billion yen)
- JCAP II has been launched as another 5-years program from 2002
(Budget : Approx. 5.6 billion yen)

Organization

* Ministry of Economy, Trade and Industry

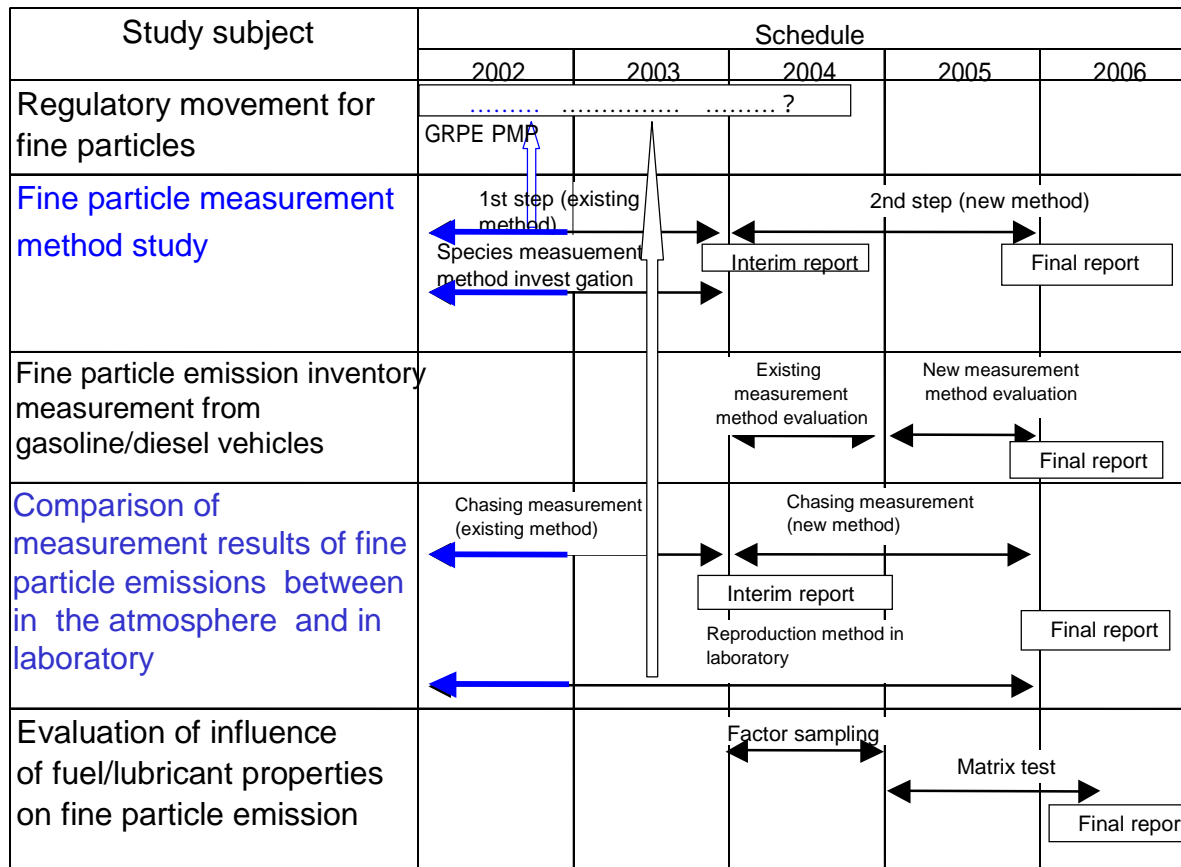
** Japan Automobile Research Institute



Purpose of Unregulated Material WG

For fine particles

- Evaluate engine and fuel technologies aiming at realizing near Zero Emissions
- Clarify appropriate measurement methods to reproduce fine particle emission into the air through measurement method comparison



Cross-check test

Purpose

Figuring out of measurement accuracy: SMPS, ELPI, Nanomet

Repeatability of particle measurement instruments

Variation between several instruments of the same type

Number of participating institutes and measuring instruments

Number of participating institutes: 15

SMPS: 16 units

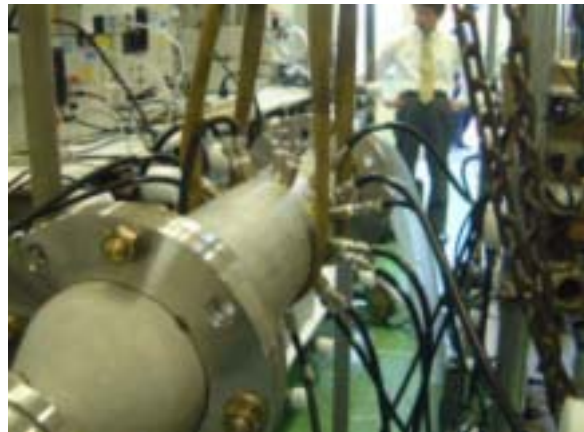
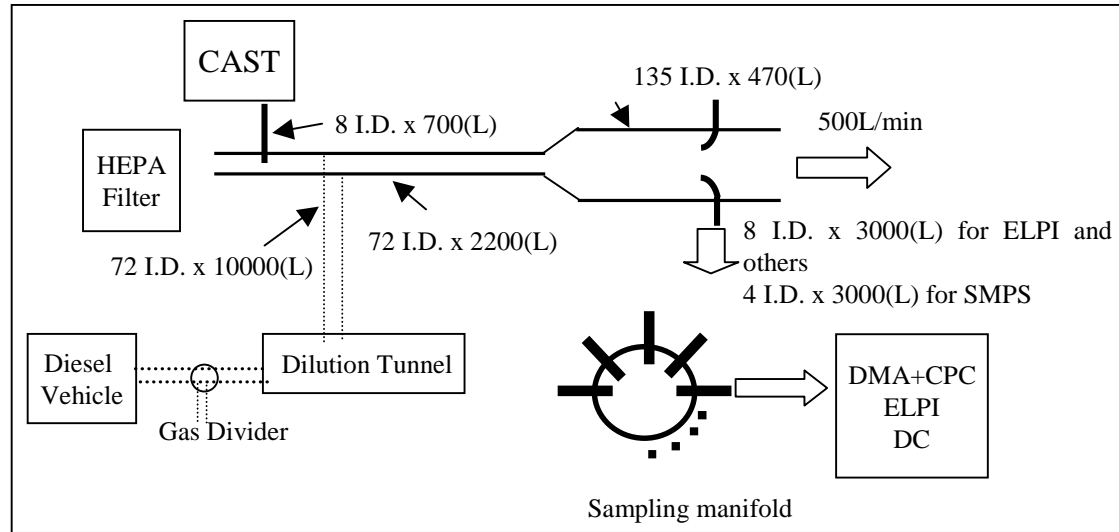
ELPI: 9 units

Nanomet (DC and PAS): 6 units

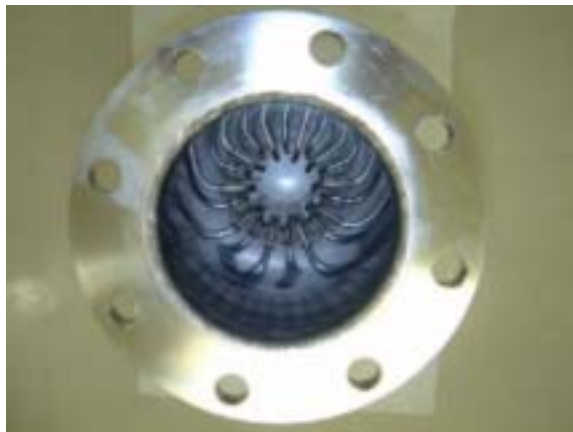
Test equipment



Test vehicle and Dilution tunnel



Overall view of distributor



Inside of distributor (probe)



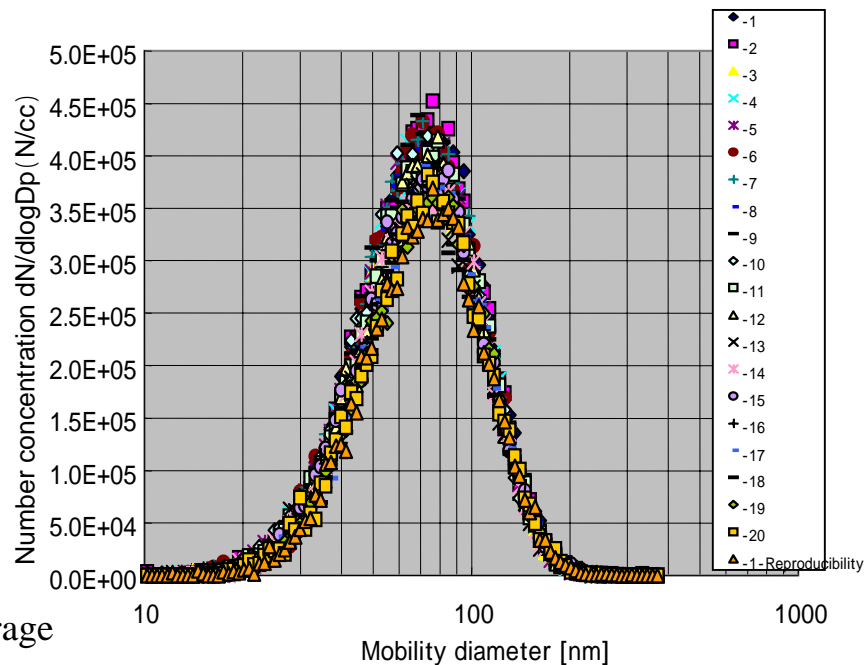
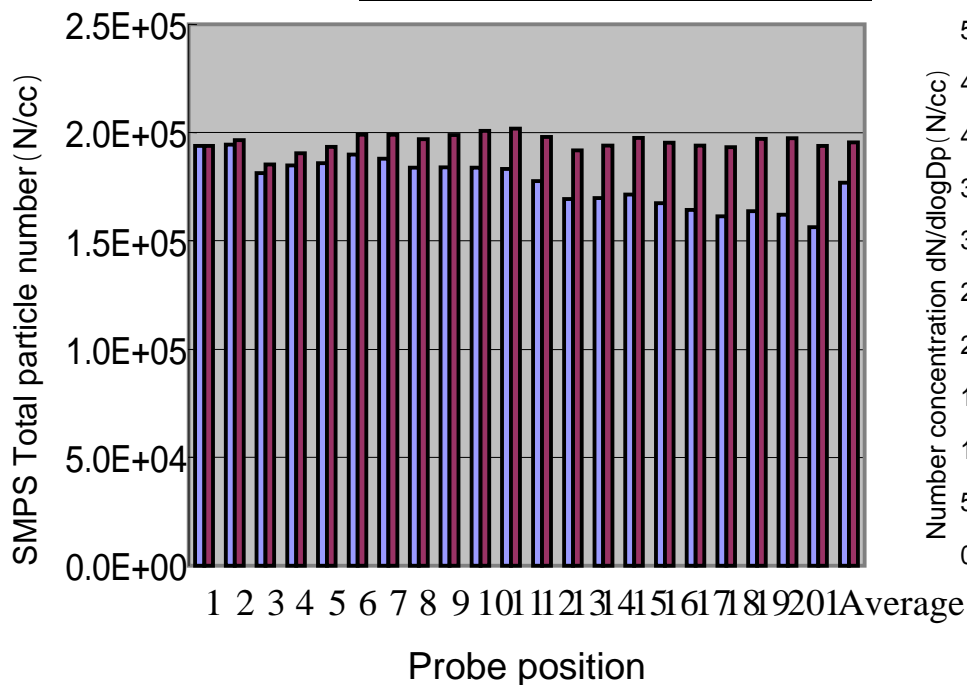
SMPS Test conditions

Fluctuation by Sampling probe position

Cross-check: distributor pre-check (CAST-MP6)

Probe position difference

	Measured value	Corrected value
Average	176968	195638
S D	11584	3800
CV(%)	6.55	1.94



■ Measured value
 ■ Corrected value

Correction method: Assuming that values linearly decrease in order of probe position, correction is made using ratio of probe position #1 value to value at each position, respectively.

Fluctuation of repeated measurement for SMPS

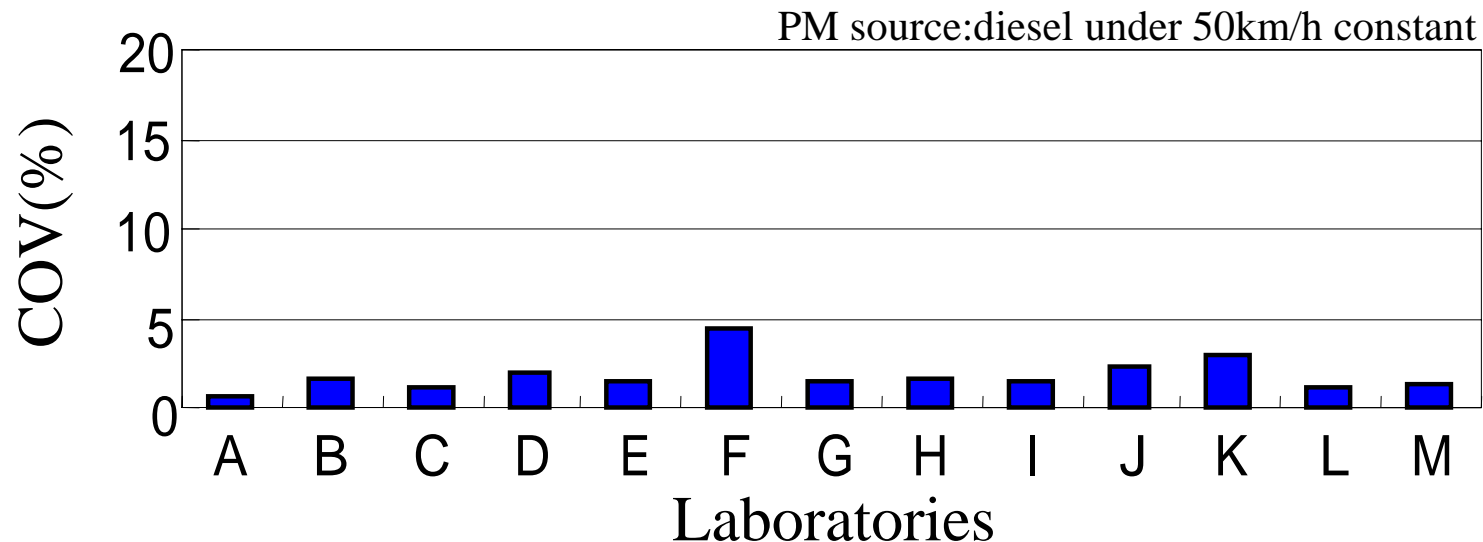
SMPS specifications list

	A	B	C	D	E	F	G	H	I	J	K	L	O	M	N	P
DMA Type	3080	3081	3080	3081	3081	3081	3081	3081	3071	3081	3081	3080	Model5.5-900	3081	3081	Model5.5-900
CPC Model Number	3026A	3025	3022A	3025A	3025	3025A	3022A	3022A	3022A	3022A	3025A-S	3025A	Model5.401	3022A	3022A	Model5.401

Instrument setting conditions

CPC Flow	Rate(L/min.) Sheath, Sample	Scan Time Up,Down(sec.)	Inter Sample Delay(min.)	Impactor Type(cm)	Size Range Bounds(nm)	Charge Collection
High	6.0, 0.6	90, 30	1	0.0457	9.65-406	on

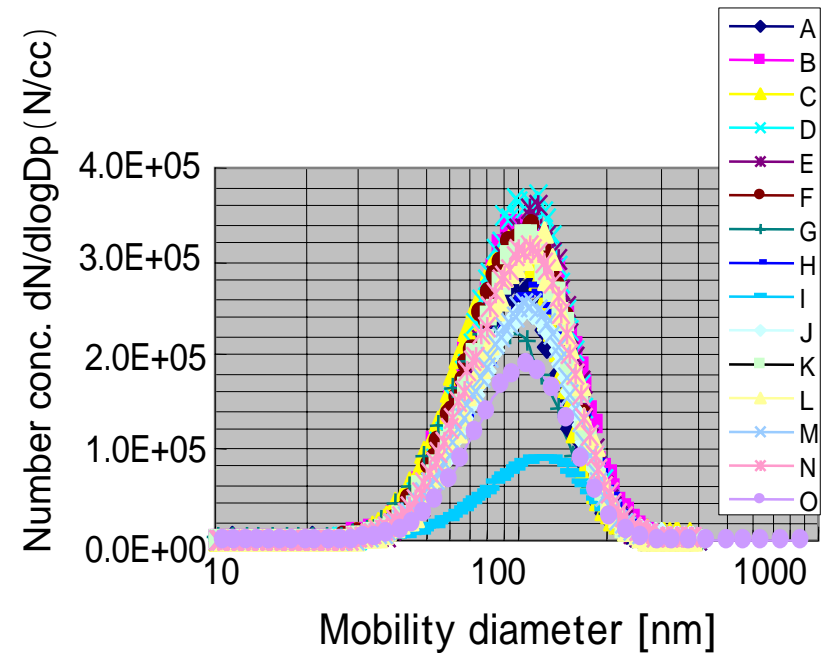
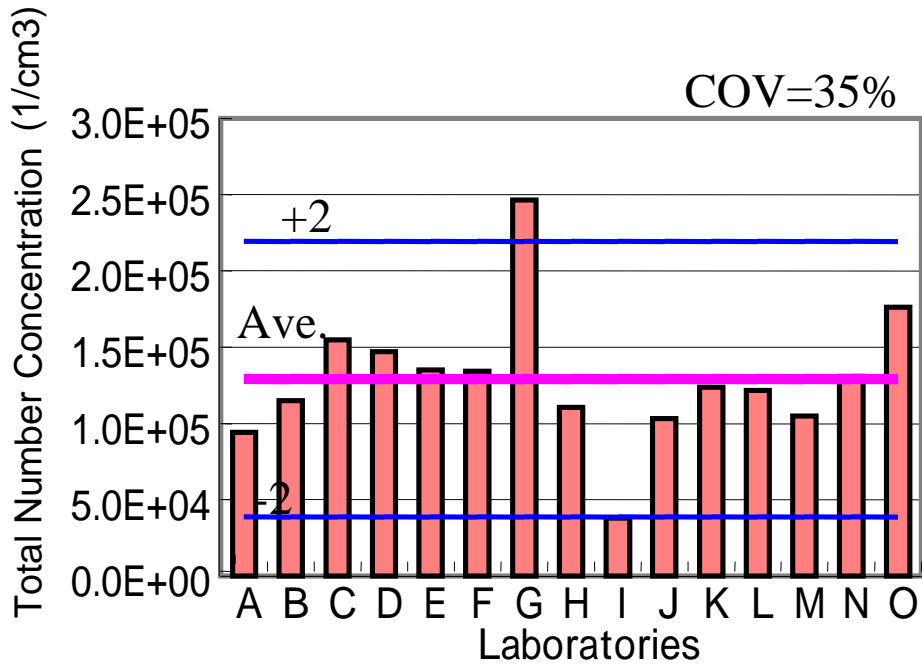
Fluctuation of repeated measurement for each SMPS (N=5)



COV in SMPS (1)

Particle number concentration and size distribution

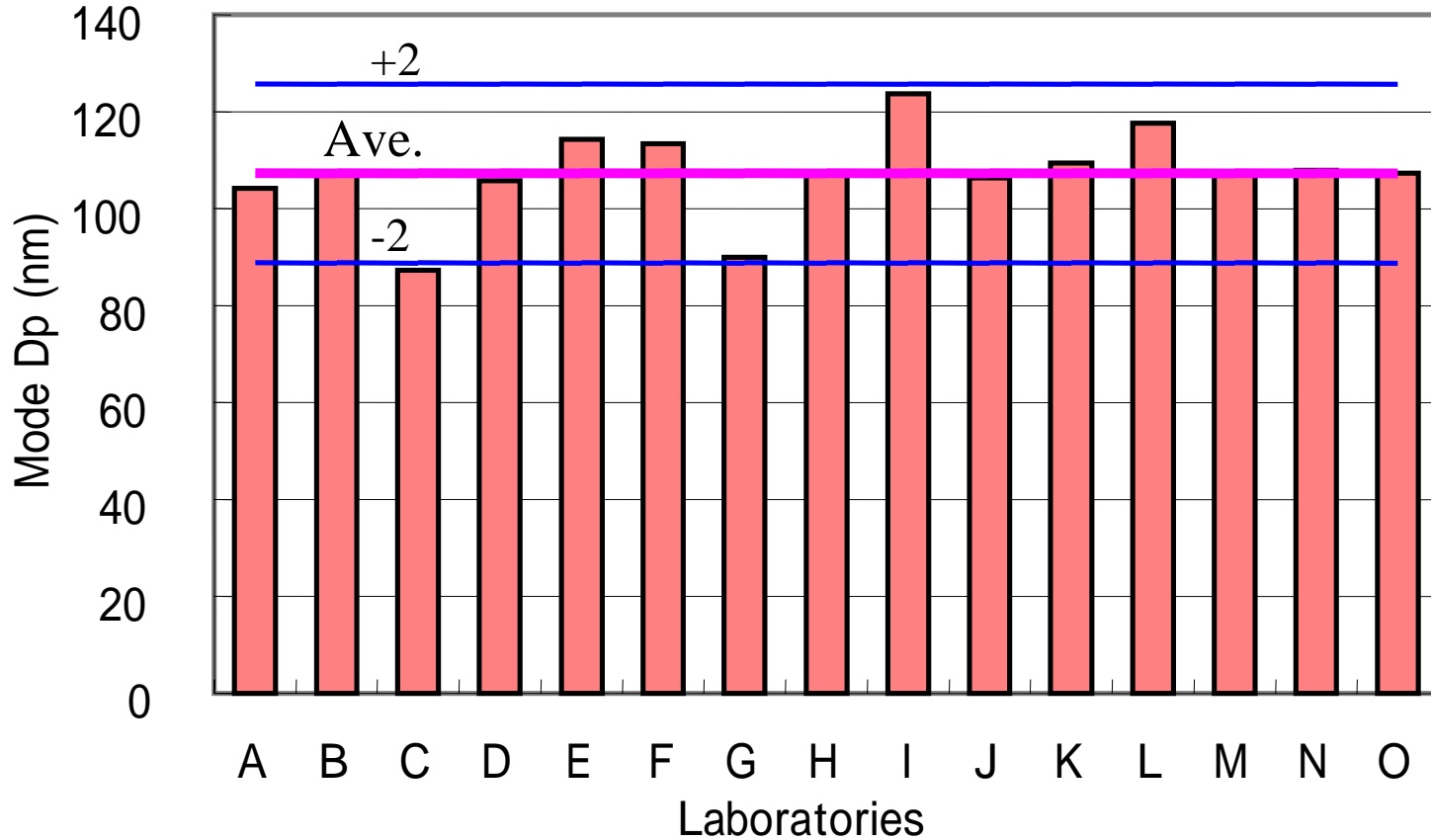
PM source:diesel under 50km/h constant



COV in SMPS (2)

Mode diameter

PM source:diesel under 50km/h constant COV=9%

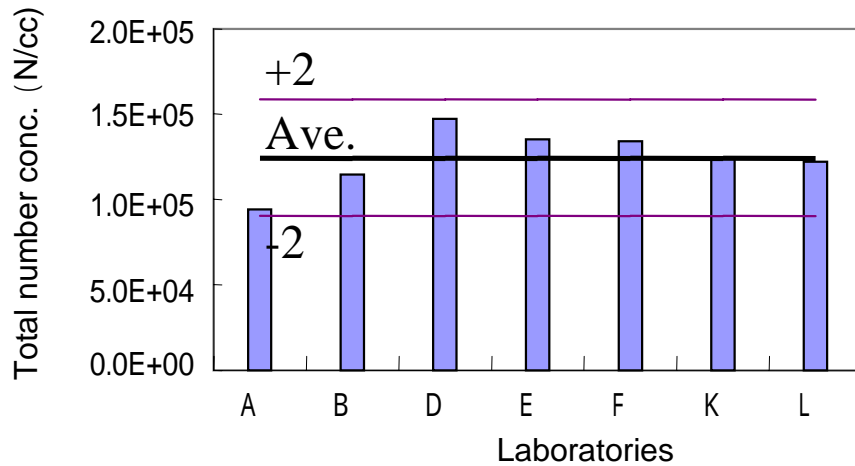


COV by SMPS specifications (1)

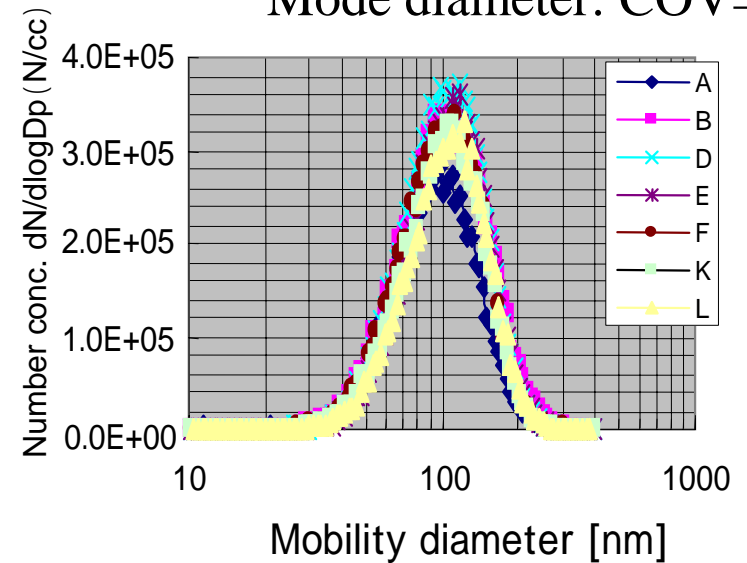
CPC: 3025

PM source:diesel under 50km/h constant

COV=14%



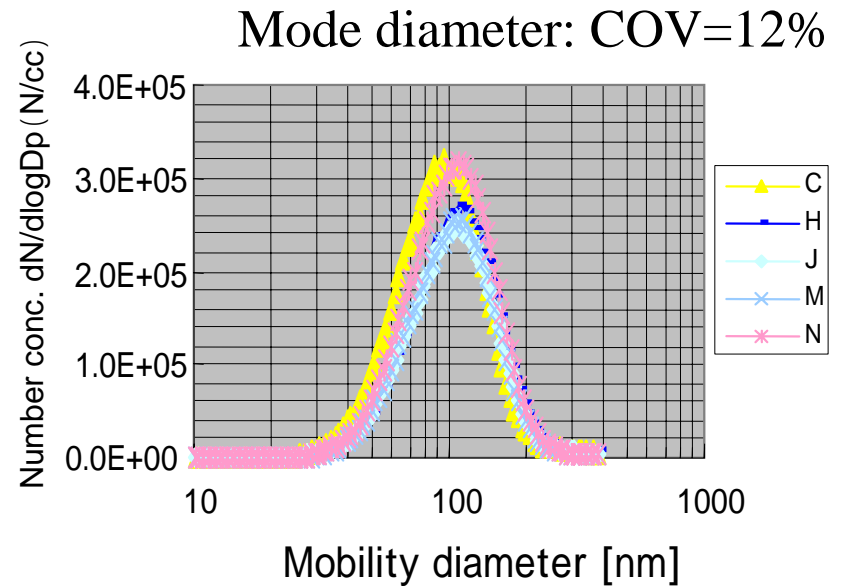
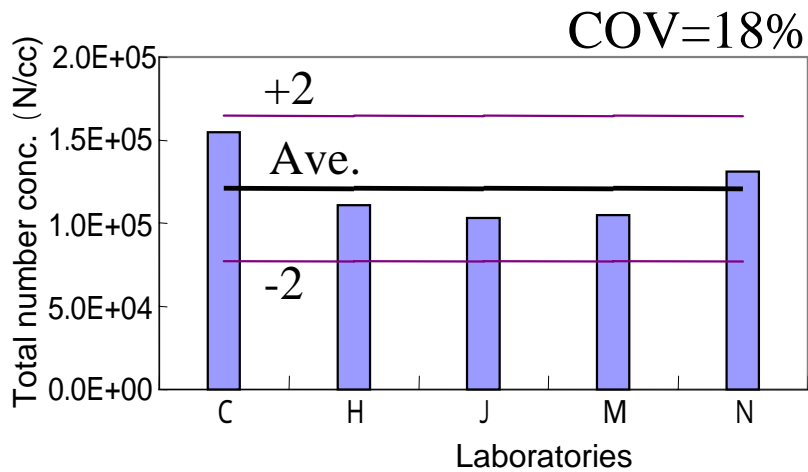
Mode diameter: COV=12%



COV by SMPS specifications (2)

CPC: 3022

PM source:diesel under 50km/h constant



COV in ELPI

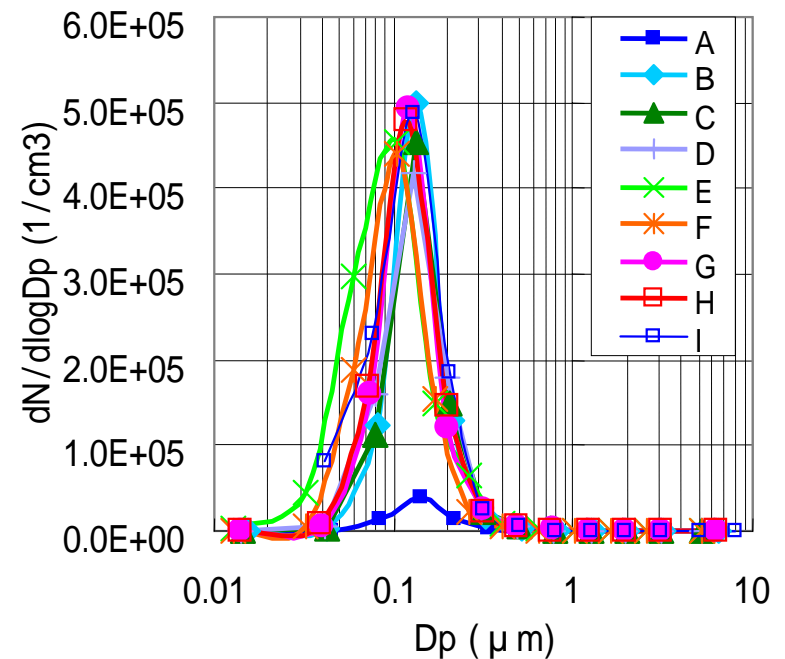
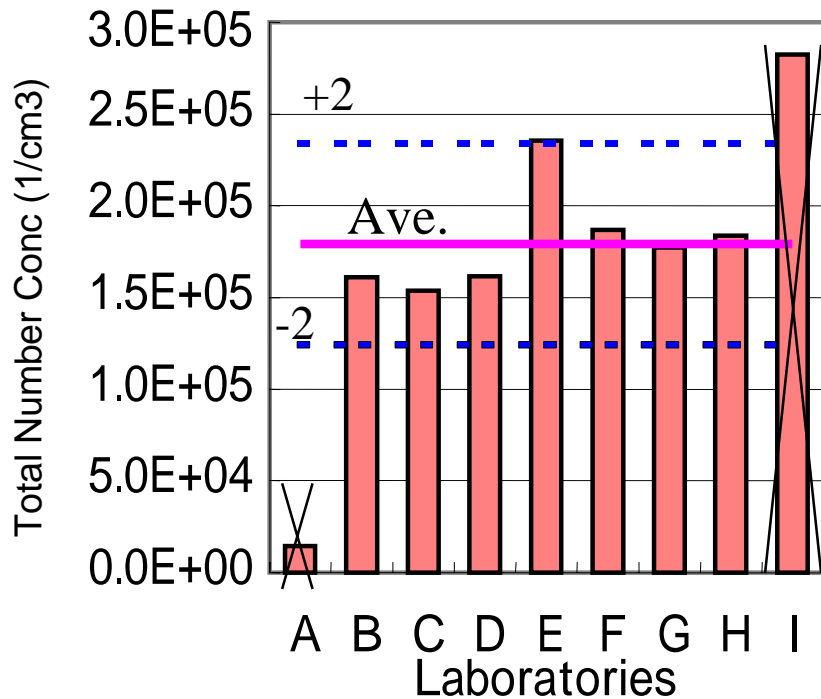
PM source:diesel under 50km/h constant

Particle number concentration COV

42% in all 15% for instruments with same specifications

A: failure

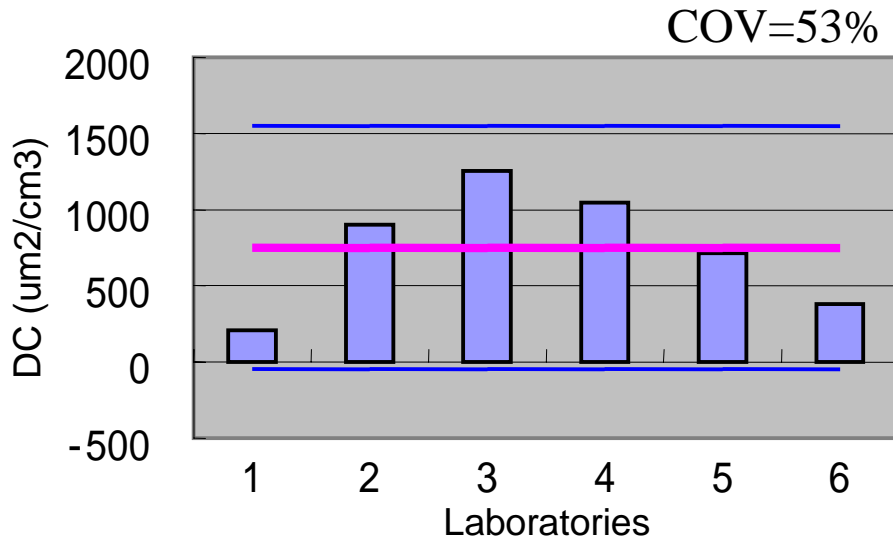
I: without filter stage



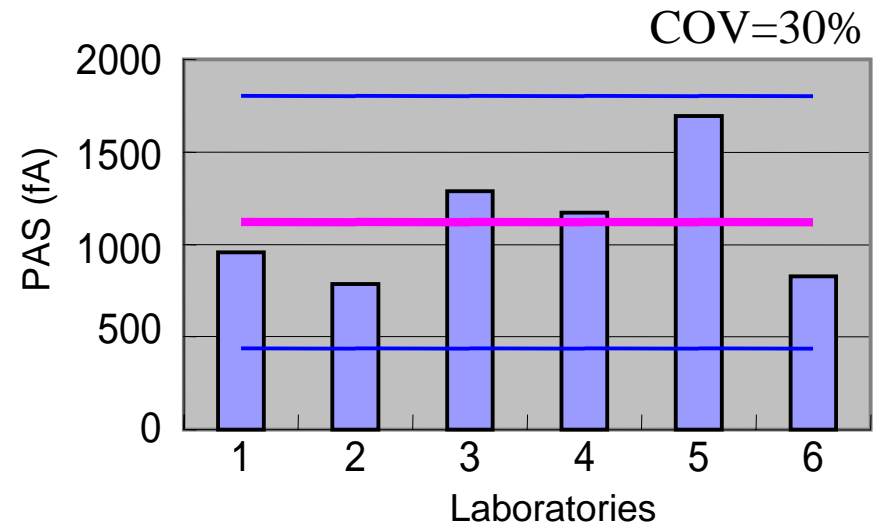
COV in DC and PAS

PM source:diesel under 50km/h constant

DC



PAS



Conclusion

- For every measuring instrument model, as of particle number concentration, COV of each instruments is approximately 30~50%.
- As for SMPS and ELPI, Using same specification models decreases variation in measurement accuracy.
(COV : about 40% 15%)
- Variation of particle size measurement is smaller than that of particle number measurement.
(size: about 10%, number: about 30~40%)
- Variation of fine particle measurement instruments are larger than measurement instruments for regulated emissions of automobile exhaust.
- Maintenance and calibration methods for the instruments are required for measurement accuracy improvement.