Investigation of the simplified measurement technique of the secondary aerosols formed from gaseous emissions of vehicle exhaust (2)

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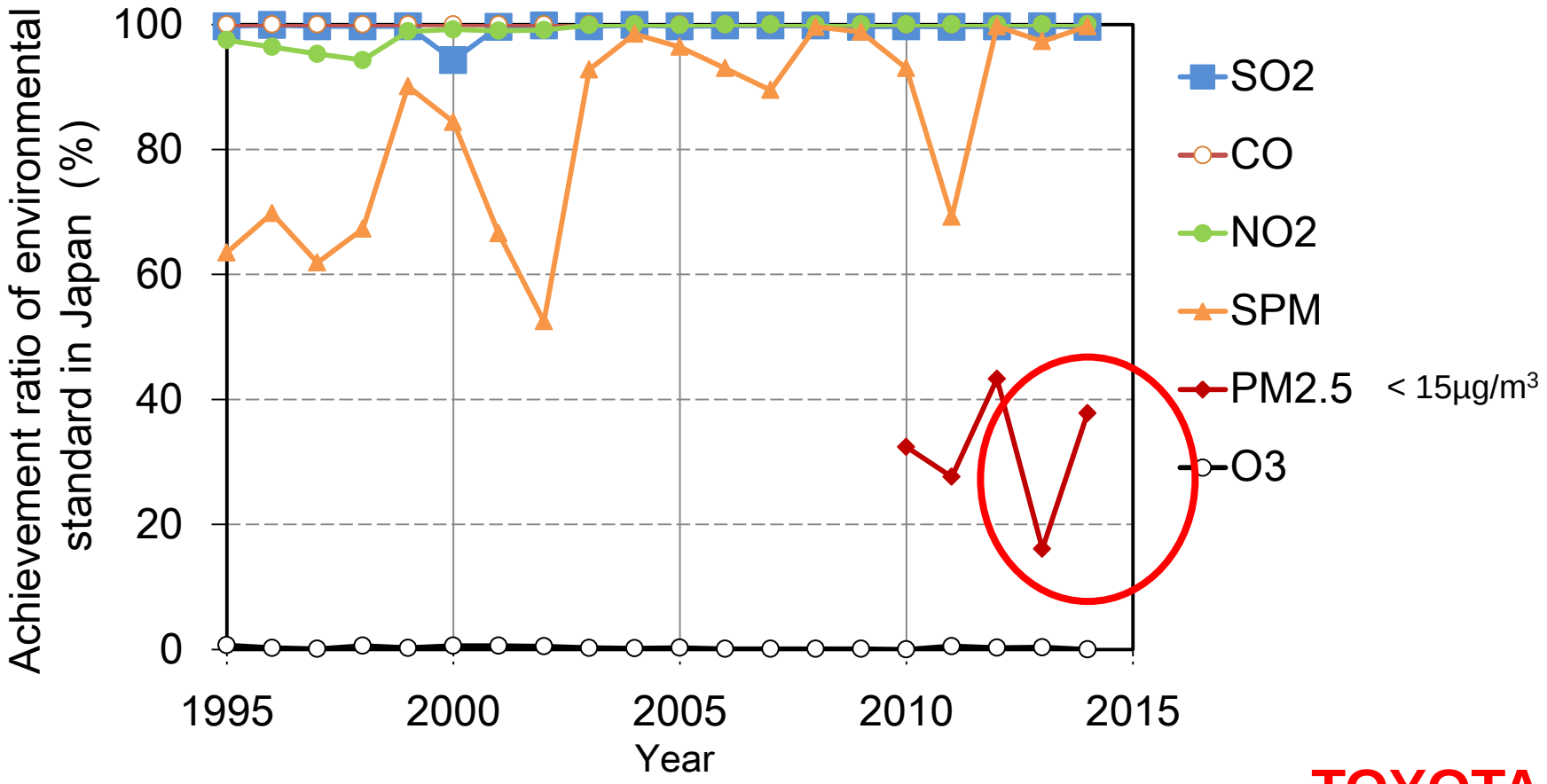
Content

1. Background
2. Reactivity of the secondary aerosol generation to hydrocarbon
3. Evaluation of transiently secondary aerosol from exhaust gas
4. Conclusion

Background

- The achievement ratio of $PM_{2.5}$ environmental standard is low in Japan.

Achievement of environmental standard in Japan

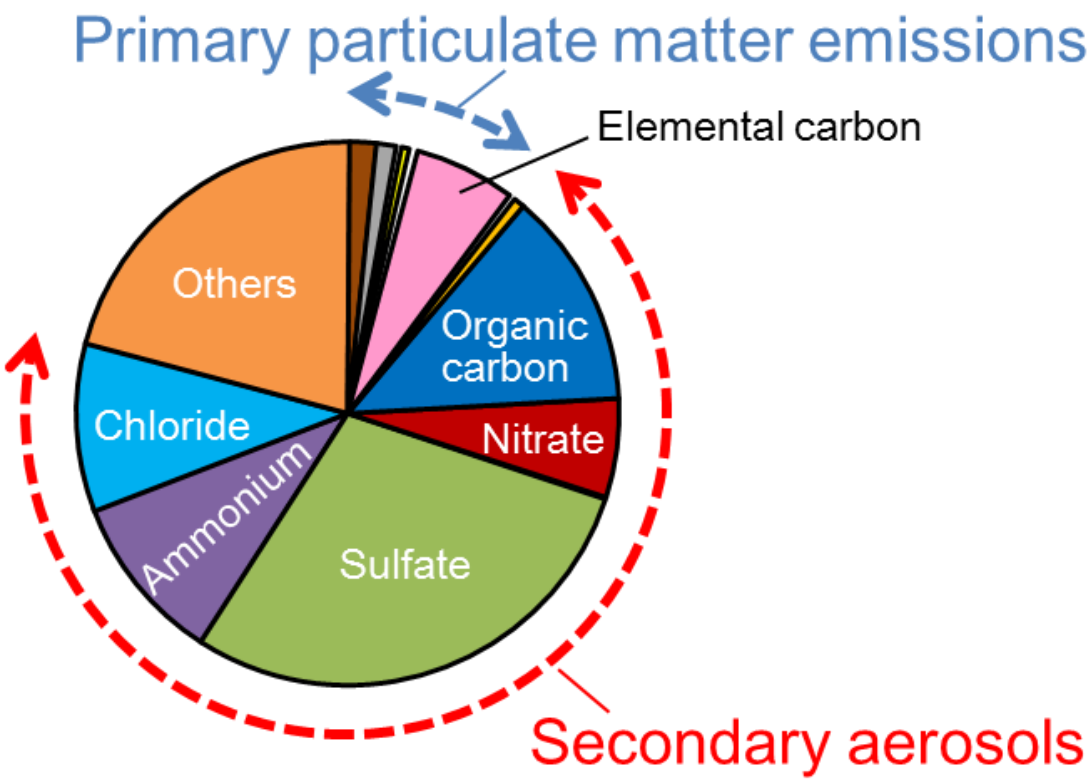


Ref. 2015 Ministry of the Environment, Japan

Background 2

- The ratio of secondary aerosols in $PM_{2.5}$ is high in Japan.
- The contribution of emission source including automobiles to the secondary aerosols is unidentified.

An example of $PM_{2.5}$ composition in recent Japan



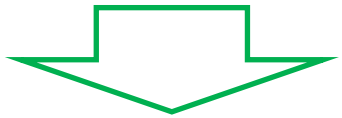
Ref. 2015 Ministry of the Environment, Japan

Motivation

Needs(1)

Understanding the actual atmospheric situation of the secondary aerosols derived from automobile exhaust.

- Generation of the secondary aerosols
- Contribution ratio to the $PM_{2.5}$

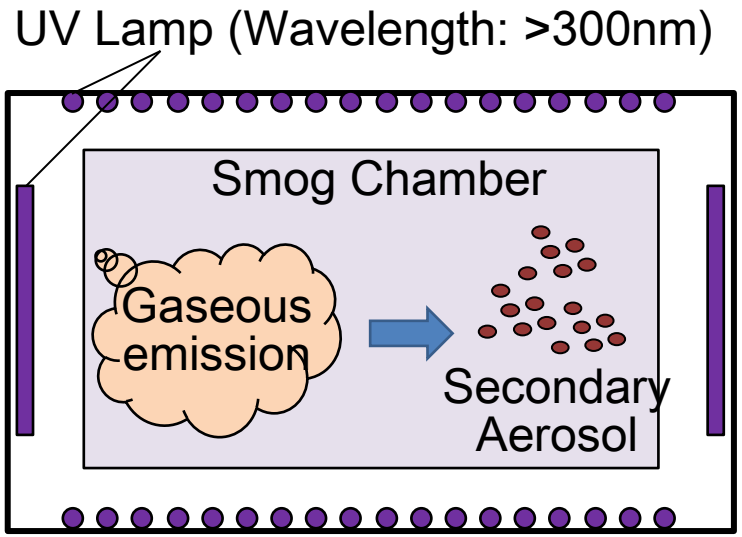
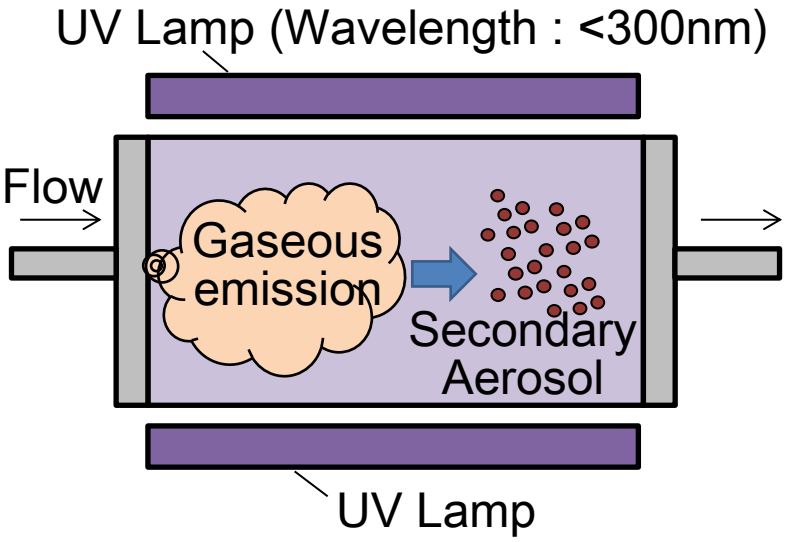


Needs(2)

The measurement technique of the secondary aerosols.
[**Small**, **Simple**, **Swift**]

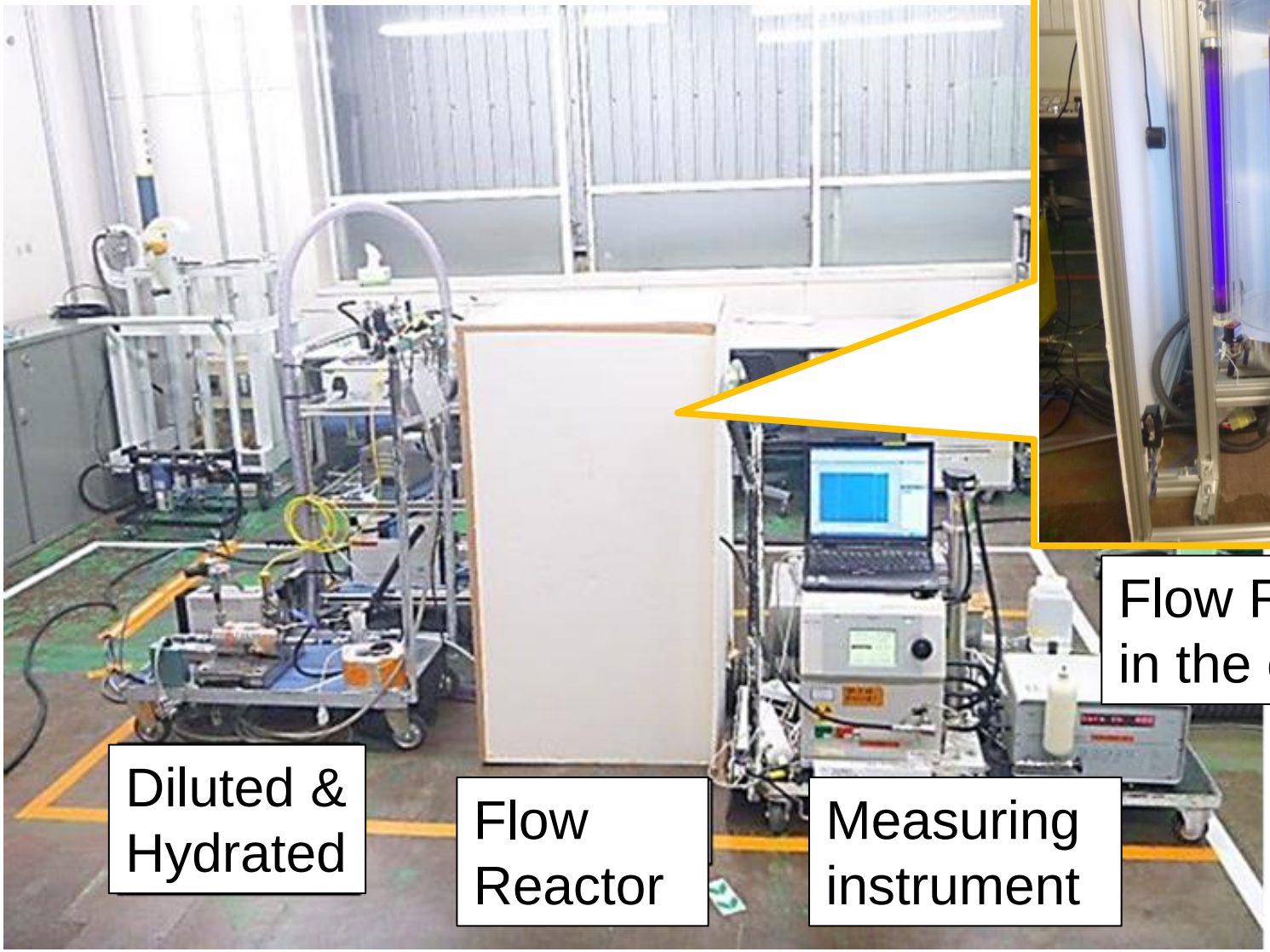
- Application to engine bench and chassis dynamometer
- Survey of various vehicle systems

Standard Tools

	Smog Chamber	Flow Reactor Potential Aerosol Mass chamber / Micro Smog Chamber *etc.*
Outline	 Volume: more than $1m^3$	 Volume: about $0.02m^3$
Advantage	· Can simulate the reaction in atmosphere	· **Portability** (Small, Simple) · **Short reaction time**
Weak Point	· Complicated handling · Long reaction time (>1hr)	· High wall loss · Different from the atmospheric reaction

Our Flow Reactor System

500mm x 225mm i.d.



Flow Reactor
in the cover

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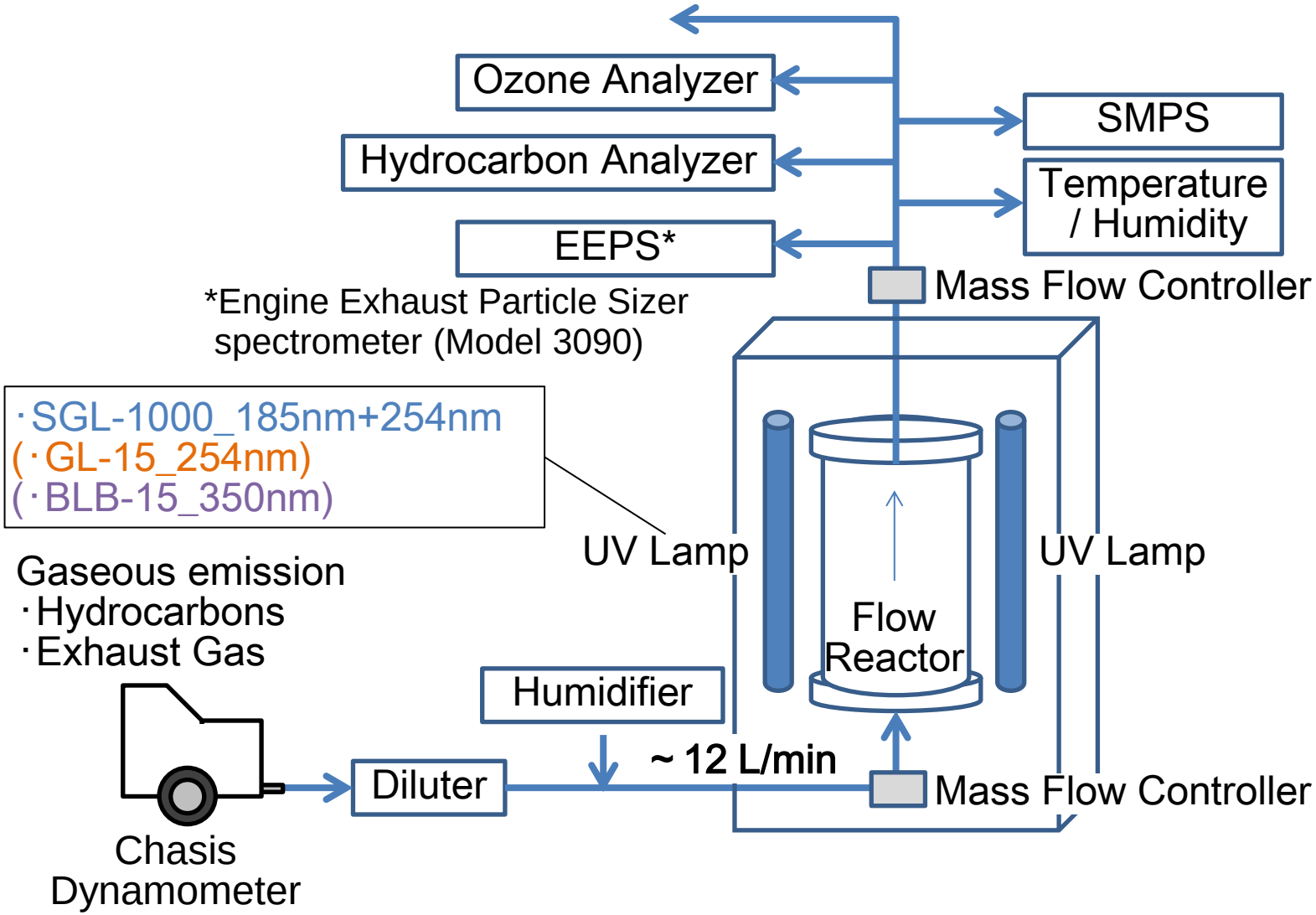
Our Flow Reactor System

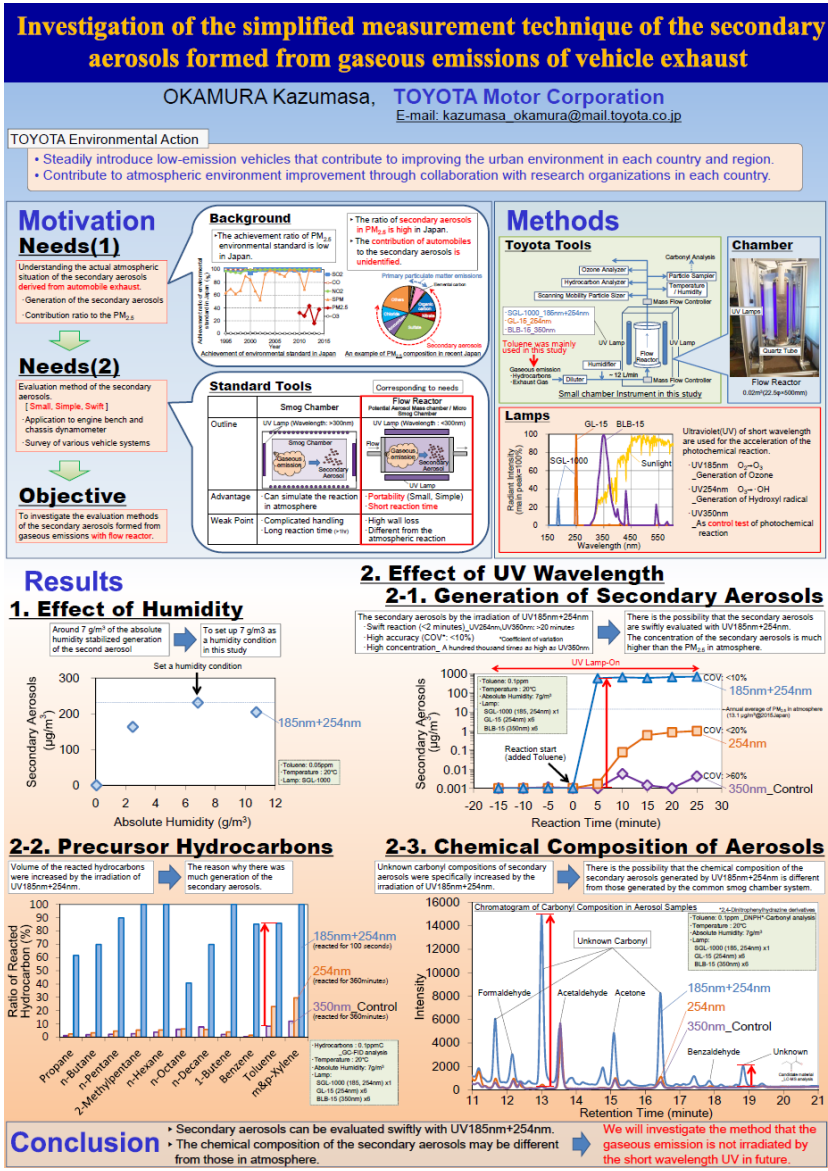


Objective

(Ref.)PosterNo.57@2017 ETH conference

[Last year]
We reported the effect of UV wavelength and humidity of the flow reactor.

[This study]
We examined the application to evaluate transient generation of secondary aerosols from the exhaust gas.



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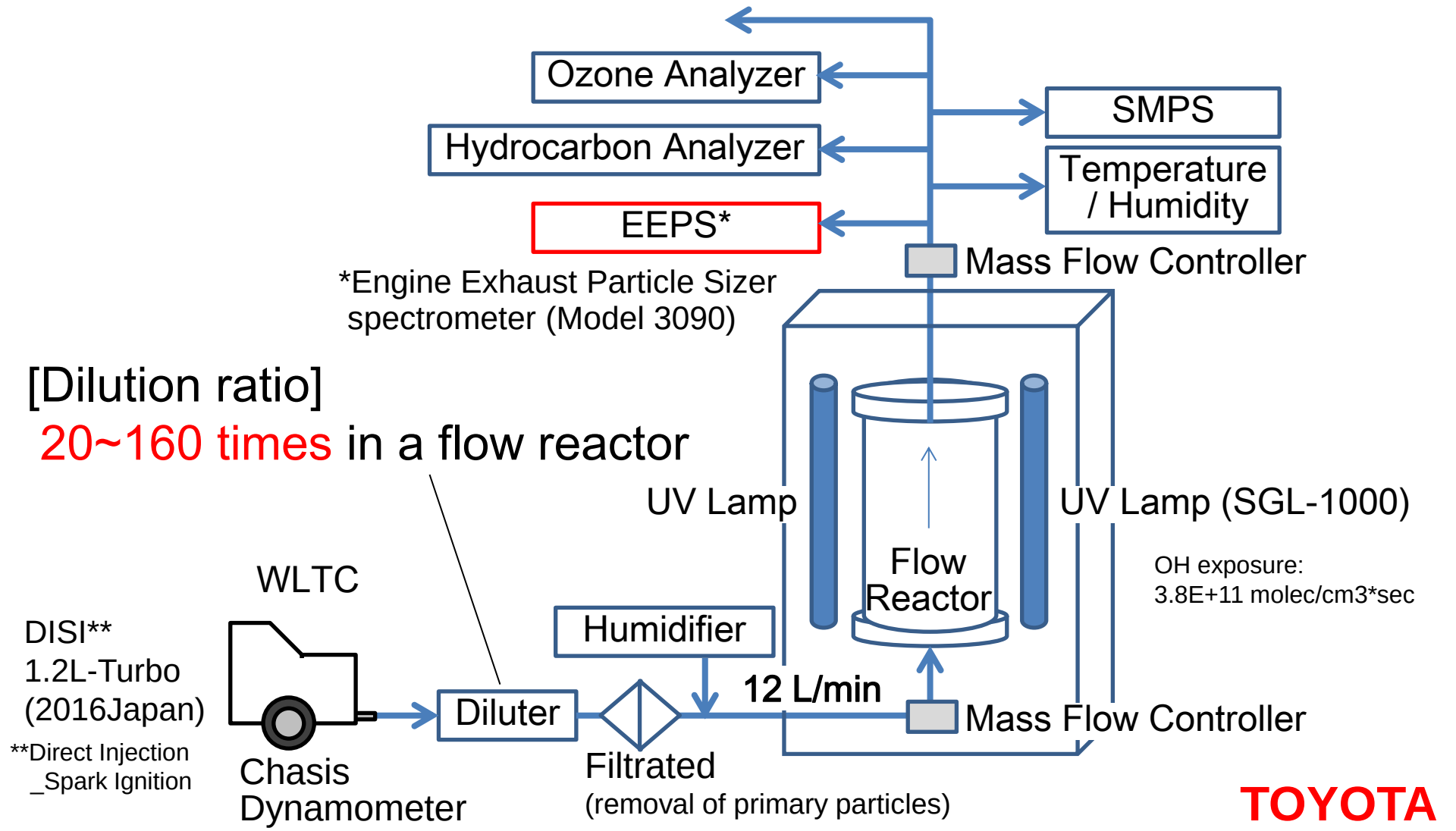
Content

Method

We evaluate the reactivity of secondary aerosol generation to hydrocarbon by being changed the dilution ratio of exhaust gas.



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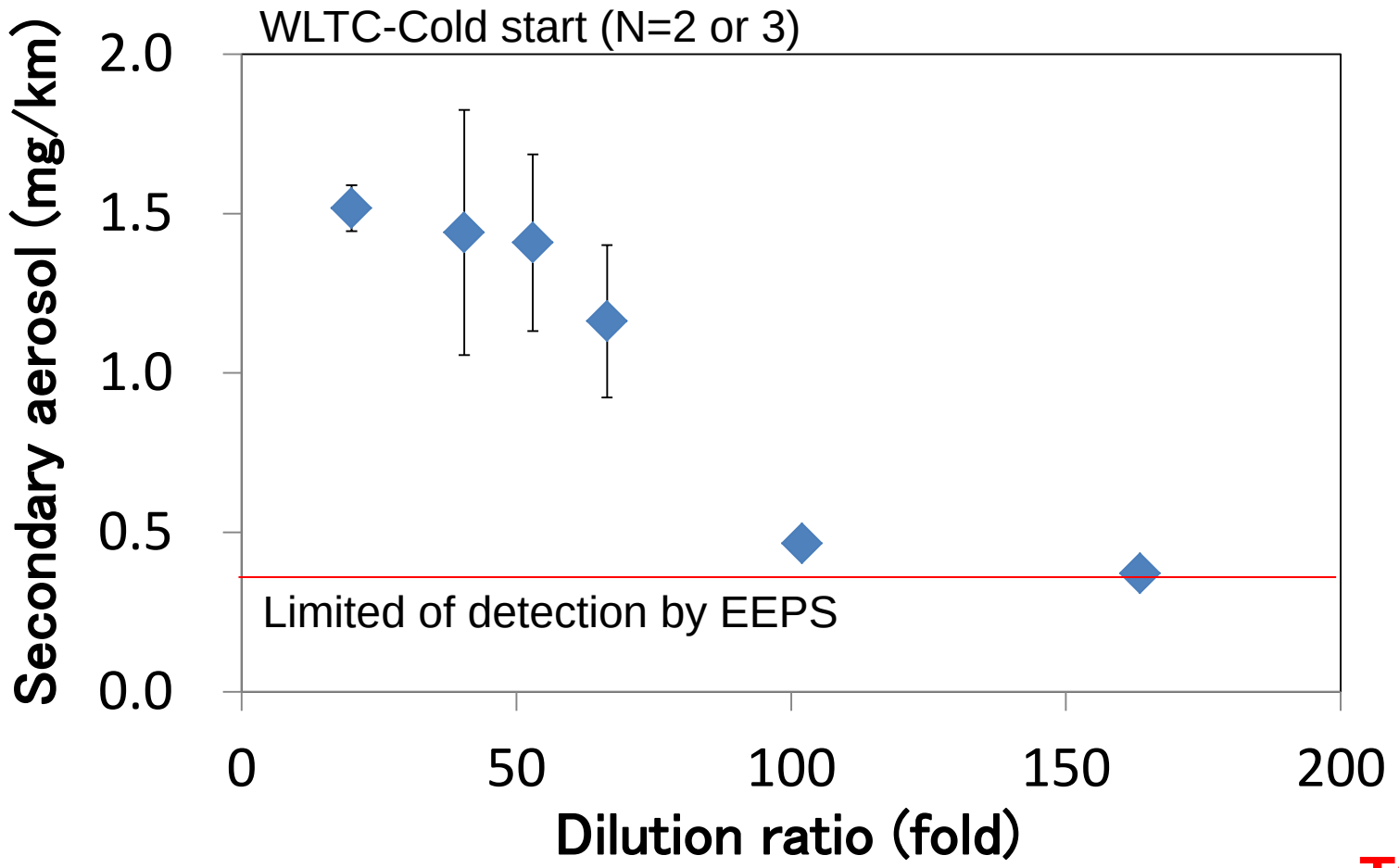
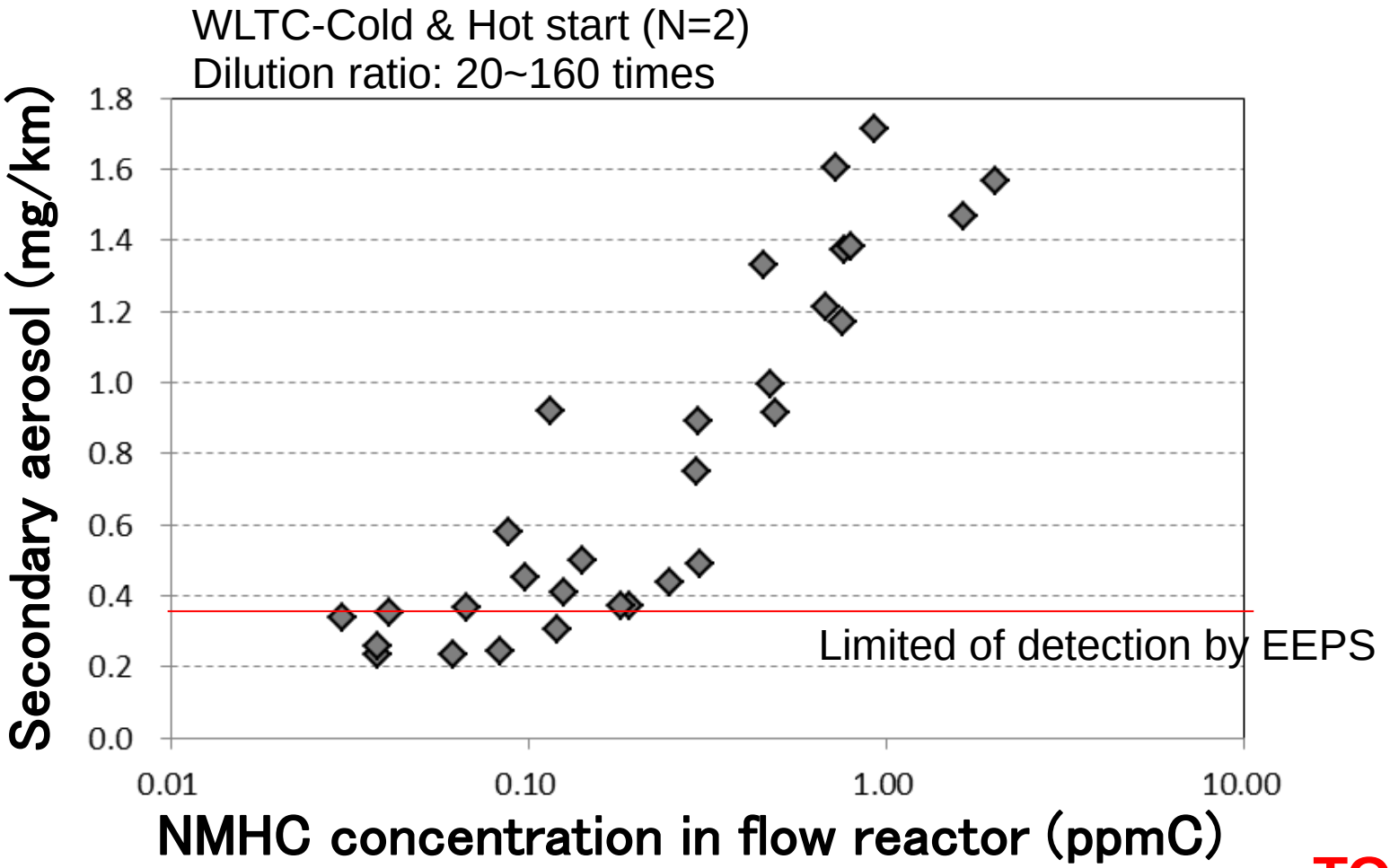
Effect of Dilution Ratio of Exhaust

The generation per kilometer of the secondary aerosols varies according to the dilution ratio of the exhaust gas.



Contribution of Hydrocarbon

Our flow reactor system can detect the secondary aerosols generated from NMHC* of more than about 0.1 ppmC.



*Non-Methane HydroCarbons

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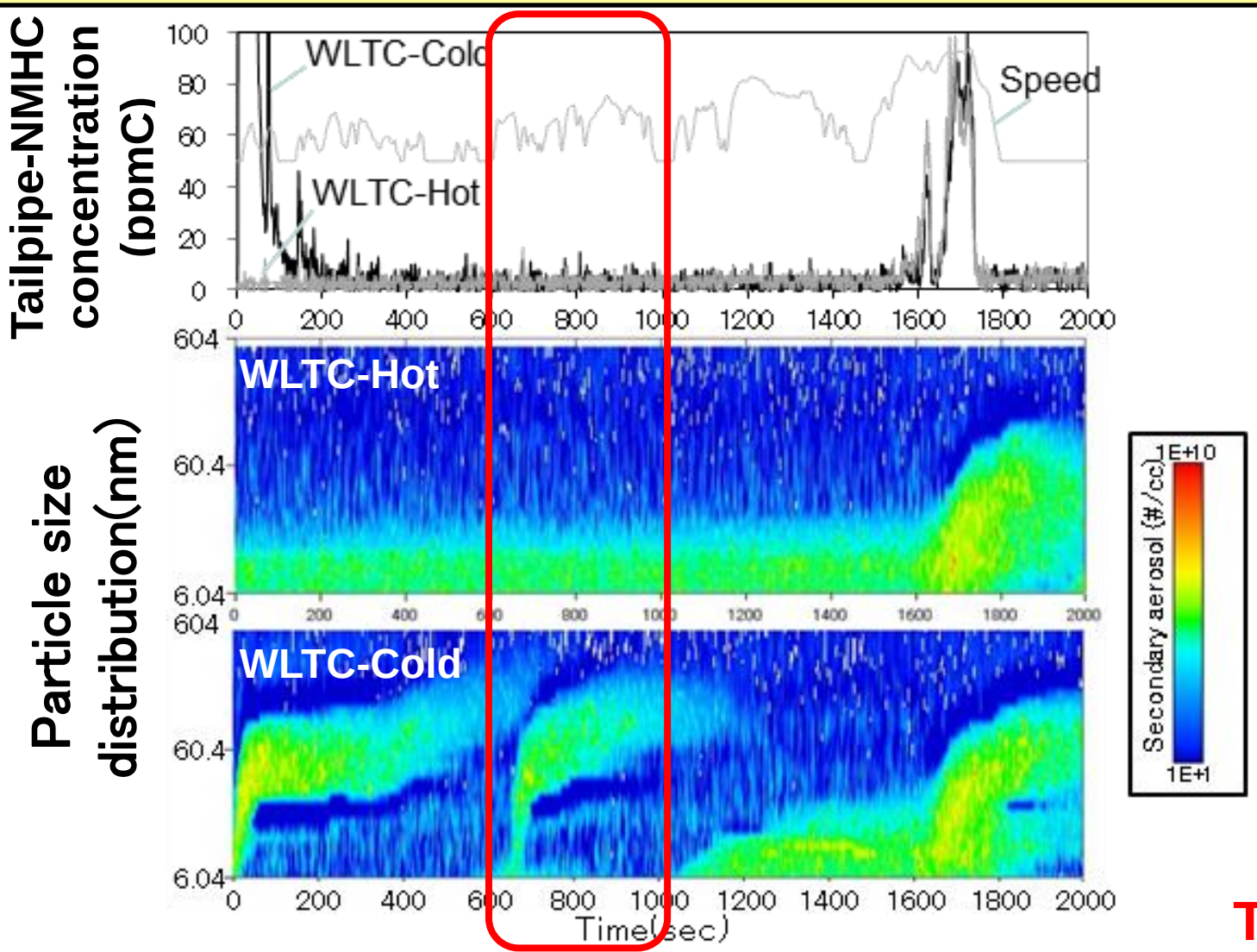
WLTC Cold vs. Hot Start

Even if NMHC are the same level, the generation of secondary aerosol are different between WLTC-Cold and Hot start.



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Contribution of Hydrocarbon

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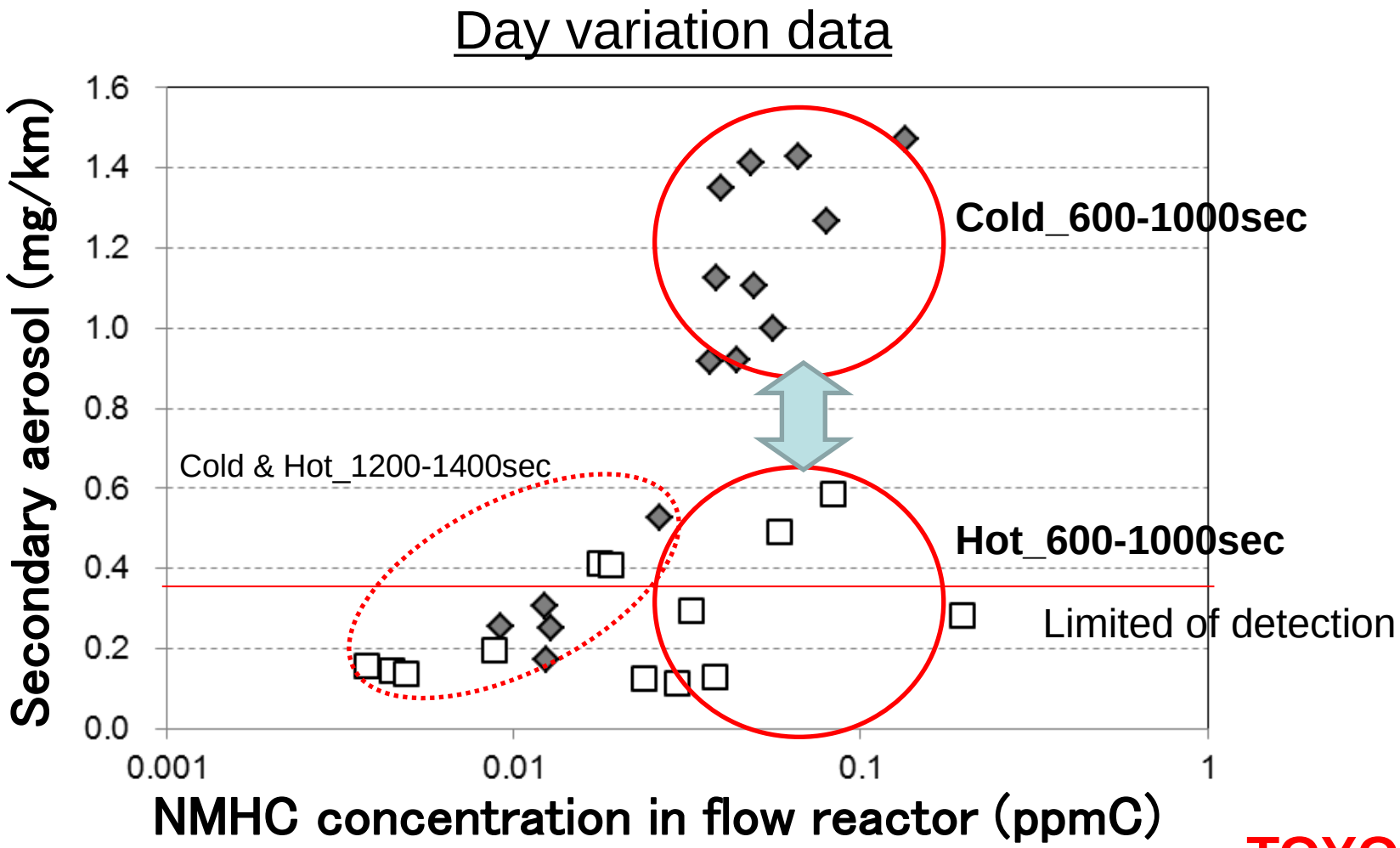
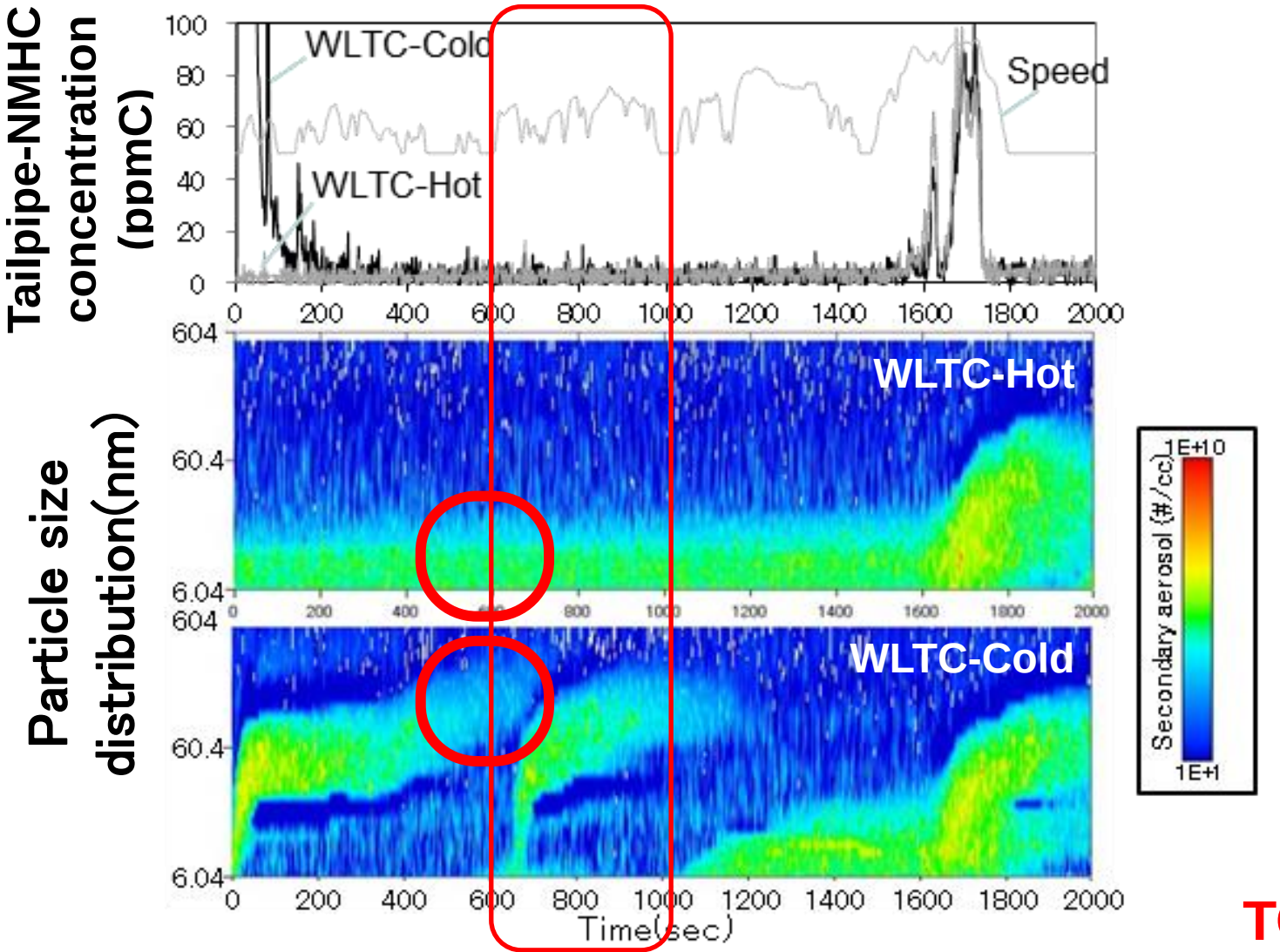


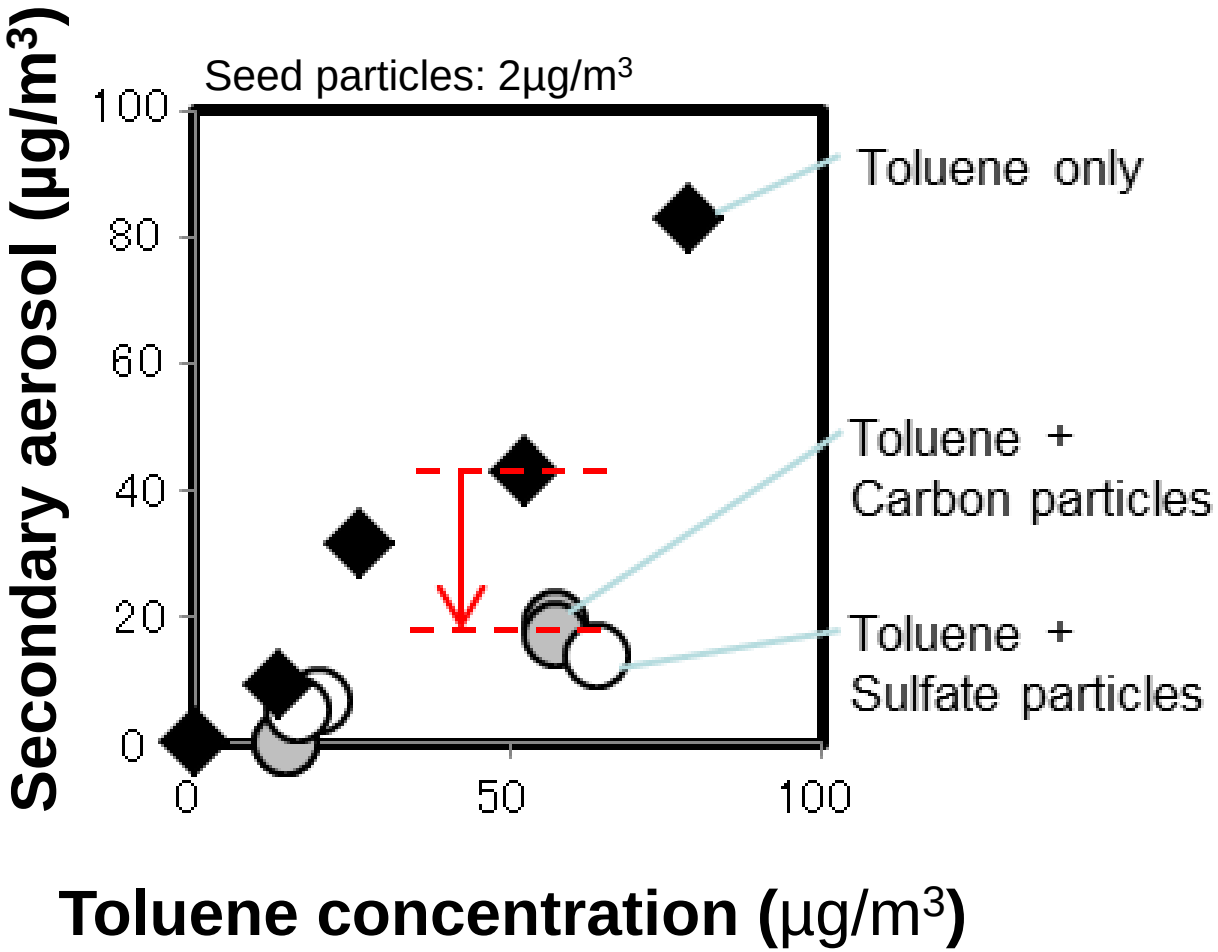
Hypothesis

We supposed that the seed particles in a flow reactor affect the generation of secondary aerosols.



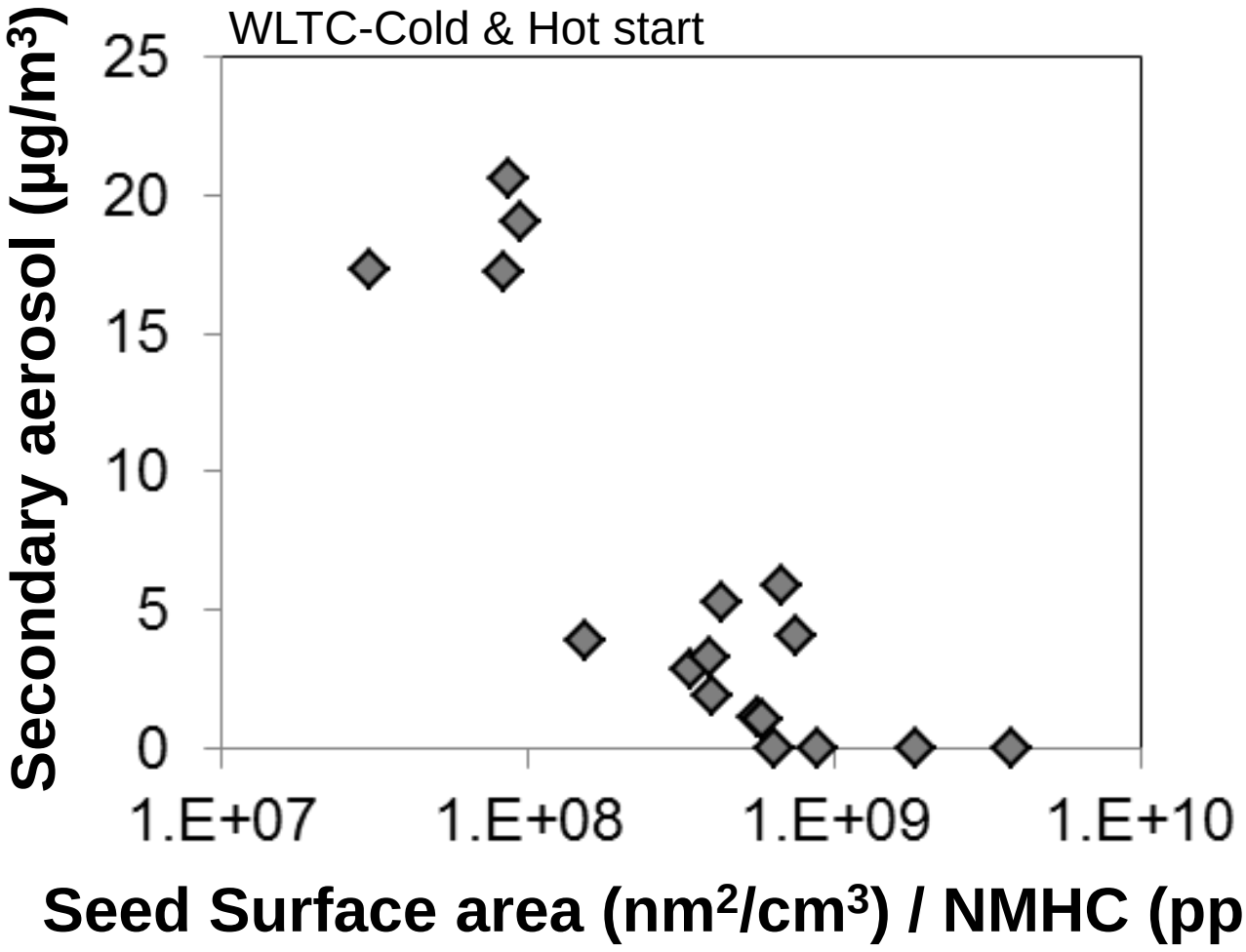
Effect of Seed Particles

Each seed particle decreases the secondary aerosol generated from toluene.



Effect of Seed Surface Area

The secondary aerosol generate in a flow reactor when seed surface area per NMHC is less than 1.0E+9.



Content

Conclusion

- Even if NMHC are the same level after engine warmed up, the generation of secondary aerosols by a flow reactor are different between WLTC-Cold and Hot start.

- The generation of secondary aerosols are decreased by seed particles in a flow reactor.

- It is necessary to remove the seed particles from a flow reactor to evaluate the transient generation of secondary aerosols.

  ⇒But it is very difficult, because the countermeasure mentioned above includes many problems.

Thank you for your attention