

# Evaluation of Tire Road Wear Particles (TRWP) in PM2.5

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## Previous Measurement of TRWP in PM10

- TRWP contribution to PM10 was previously evaluated in the United States, Europe, and Japan.
- Levels were determined using Pyrolysis-GCMS technique.

Location	Average PM10 $\mu\text{g}/\text{m}^3$	Average TRWP (range of avg) $\mu\text{g}/\text{m}^3$	Maximum TRWP $\mu\text{g}/\text{m}^3$
France, Seine Watershed	28	0.24 (0.05-0.17)	1.34
United States, Chesapeake Bay Watershed	16	0.14 (0.1-0.24)	0.48
Japan, Yodo Watershed	32	0.1 (0.06-0.18)	0.32

Panko, J.M, J. Chu, M.L. Kreider, and K.M. Unice. 2013. Measurement of airborne concentrations of tire and road wear particles in urban and rural areas of France, Japan, and the United States. *Atmosph Environ.*72:192-199.

# Analytical Method – Pyrolysis GC/MS

- Quantification Approach
  - Passenger tire tread: Blend of BR and SBR
  - Truck tire tread: Blend of BR and NR
  - Pyrolysis fragmentation of SBR, BR and NR polymers in tire tread particles
  - Most abundant fragments: styrene (SBR), isoprene (NR), butadiene (BR, SBR), vinylcyclohexene (BR, SBR), dipentene (NR)
  - Monomers: abundant but generated by multiple sources
    - Secondary quantification
  - Dimers: specific to the polymeric source
    - Primary quantification

Unice, K.M., Marisa L. Kreider, Julie M. Panko (2012). Use of a Deuterated Internal Standard with Pyrolysis-GC/MS Dimeric Marker Analysis to Quantify Tire Tread Particles in the Environment. *International Journal of Environmental Research and Public Health*, **2012**, 9, 4033-4055.

# ISO TC 146 (SC3) – Proposed Technical Specification for TRWP in Ambient Air

- > On September 25, 2014, a proposal to create a Technical Specification (TS) to quantify tire wear particles in air using a deuterated standard was presented to the ISO TC 146 (SC3).
  - > resolution was taken to form a new SC3 working group that will focus on measurement of particulate matter in ambient air from transportation sources.



# Current Project – TRWP in PM2.5

## > Objectives:

- > Quantify TRWP in ambient PM2.5 to understand contribution to total PM2.5 and variability
- > Obtain TRWP PM2.5 measurements in various places around the world
  - U.S
  - Europe
  - Japan

## Criteria for City Selection

1. Annual average total PM2.5 greater than 20 ug/m<sup>3</sup>
  - At 20 ug/m<sup>3</sup>, 48-hr sampling duration will be required to achieve analytical limit of detection for polymers
2. Significant PM2.5 contribution from motor vehicles
3. Population >1M as indicator of high traffic density
4. Regulatory programs and/or specific interest in vehicle emission contributions
5. Epidemiology studies of health effects associated with PM2.5

# Final List of Recommended U.S. Cities

Common Cities	MSA Population >1 million <sup>1</sup>	24-hr PM2.5 Levels $\geq 20\mu\text{g}/\text{m}^3$ <sup>2</sup>	Annual Mean PM2.5 Levels $\geq 20\mu\text{g}/\text{m}^3$ <sup>3</sup>	Daily Vehicle Miles Traveled >50000 <sup>5</sup>	Percent PM 2.5 emissions from mobile Sources <sup>6</sup>	Sampling Decision
Atlanta, GA	Yes	23	13.6	129,641	20.13%	Yes
Baltimore, MD	Yes	25	12	52,741	20.35%	Maybe
Boston, MA	Yes	24	9.5	93,719	17.97%	Yes
Los Angeles, CA	Yes	44	20	270,807	25.21%	Yes
New York City, NY	Yes	26	13.9	286,101	26.28%	Maybe
Philadelphia, PA	Yes	31	16.5	99,190	20.22%	Maybe

1 = 2012 US Census

2 = USEPA Air Quality Statistics Report 2012, 24-hour 98th percentile

3 = USEPA Air Quality Statistics Report 2012, annual weighted mean with exceptional events

4 = American Lung Association State of the Air 2013

5 = 2011 US DOT Federal Highway Administration

6 = US EPA NEI

# Final List of Recommended European Cities

Common Cities	Regulatory Interest		Population >1 million <sup>3</sup>	PM2.5 ≥20µg/m <sup>3</sup> Annual Mean 2011 <sup>4</sup>	Recommend?
	Member of EU <sup>1</sup>	LEZ <sup>2</sup>			
Barcelona	Yes	No	1617393	24	Yes
London	Yes	Yes	8278251	49	Yes
Milan	Yes	Yes	1333670	33	Yes
Paris	Yes	No	2234105	23	Yes
Rome	Yes	Yes	2771584	26	Yes

1 = Subject to EU Standards

2 = Low Emission Zone Established within City Limits (<http://www.lowemissionzones.eu>)

3 = UN Data

4 = Annual Mean 2011, European Environment Agency, at least one site, ([http://www.eea.europa.eu/themes/air/interactive/pm2\\_5](http://www.eea.europa.eu/themes/air/interactive/pm2_5))

# Final List of Recommended Japanese Cities

Common Cities	Regulatory Interest <sup>1</sup>	Not on Western Coast	Population <sup>2</sup>	Indication of PM2.5 $\geq 20\mu\text{g}/\text{m}^3$	Sampling Decision
Nagoya	Yes	Yes	2263894	Yes	Yes
Osaka	Yes	Yes	2665314	Yes	Yes
Tokyo (Kanto; Greater Tokyo Area)	Yes	Yes	>9000000	Yes	Yes
Kyoto	Yes	Yes	1474015	Yes	Yes

1 = Japanese National Standard

2 = UN Data

3 = Various Literature Sources

4 = At Least One Data Point

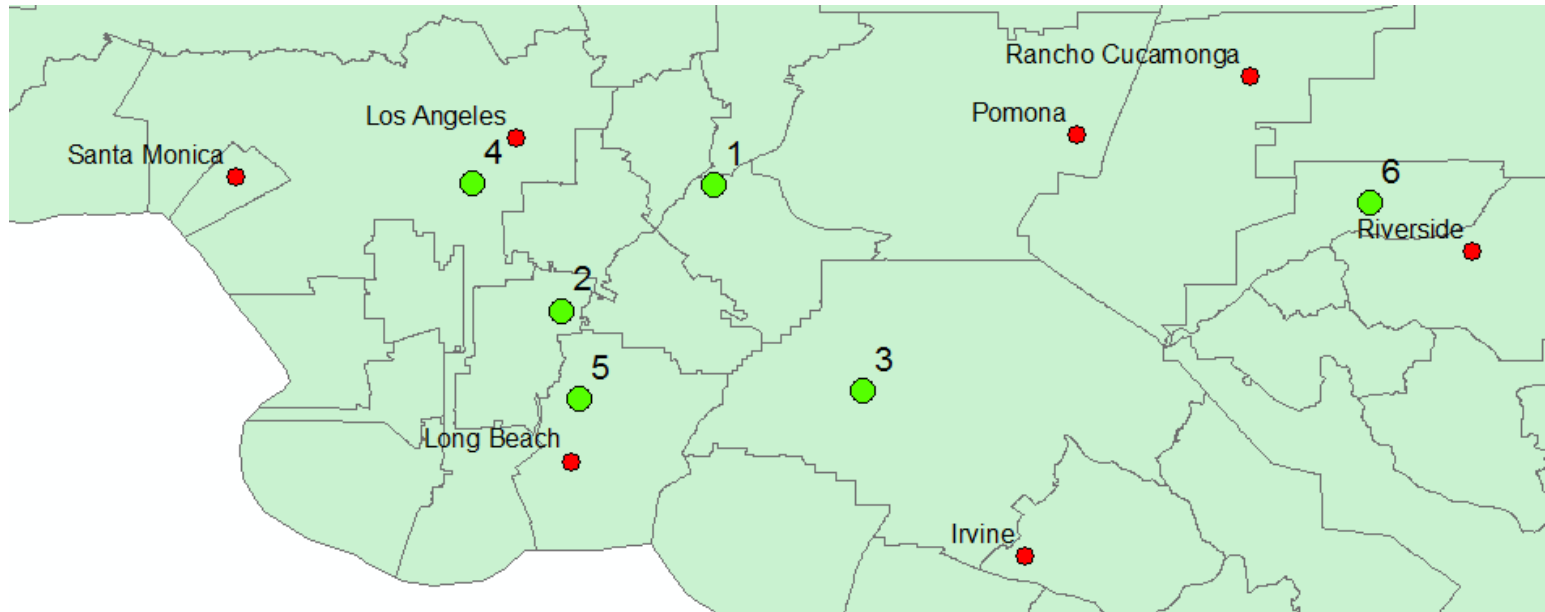
(Ministry of the Environment Air Pollutants Wide Area Monitoring System, <http://soramame.taiki.go.jp/Index.php>)

5 = News Reports



# PM2.5 Global Sampling Plan – Los Angeles

- > Sampling: July 15, 2014 to July 25, 2014
  - 6 near-road locations co-located with California South Coast Air Quality Management District PM sites



# Progress to Date

- > Los Angeles
  - > Sampling complete
    - 4 sampling events
    - 48-86 hrs/event
    - Total PM2.5: 3-15  $\mu\text{g}/\text{m}^3$
  - > TRWP analyses on-going

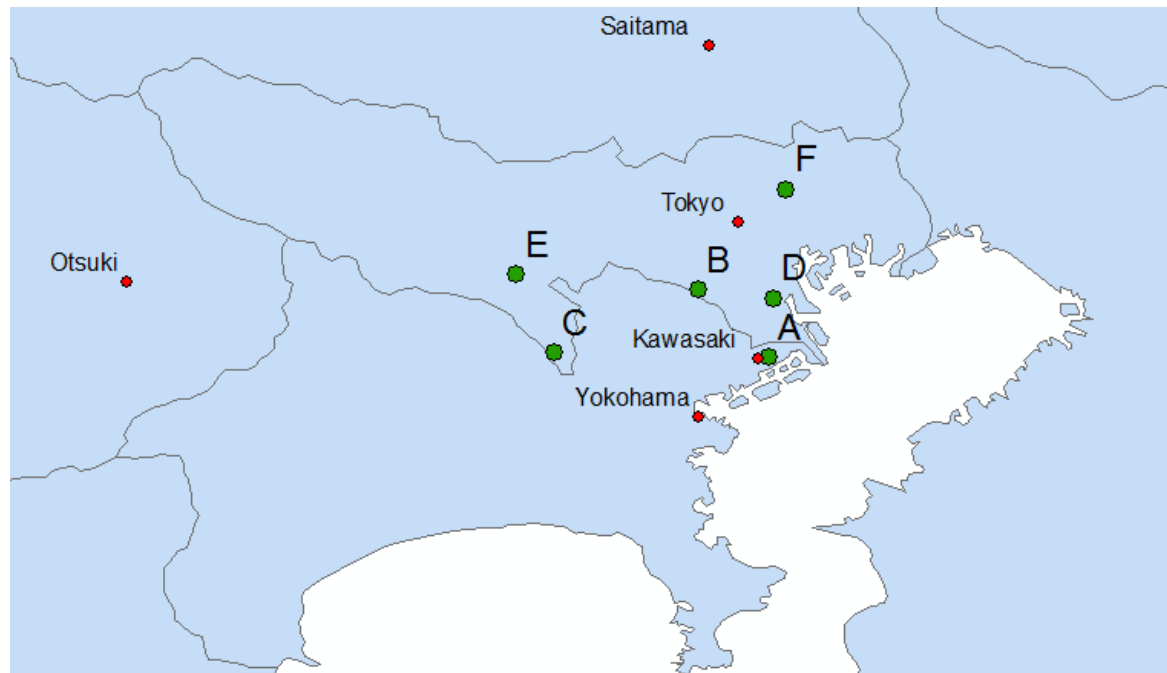


Exposition Park



# PM2.5 Global Sampling Plan – Japan

- > Sampling: September 10, 2014 to September 30, 2014
  - 6 roadside locations (~10 m)



# Progress to Date (continued)

- > Greater Tokyo
  - > Sampling completed September 2014
  - > 4 sampling events
    - 48-72 hr/event
    - Total PM<sub>2.5</sub> = 13 $\mu$ g/m<sup>3</sup>
  - > TRWP analyses ongoing



# Progress to Date (continued)

## > London

- > In discussions with Kings College regarding collaboration
- > Anticipate Spring 2015 sampling



Select a monitoring site to view:

PM2.5 Particulates  Include closed sites:

## Results from the study

- > Results from PM2.5 study should be available by October 2015
- > Goal for publication in a peer-reviewed journal in 2016.