REDUCING HEALTH IMPACT OF DIESEL EXHAUST
Challenge and Opportunities

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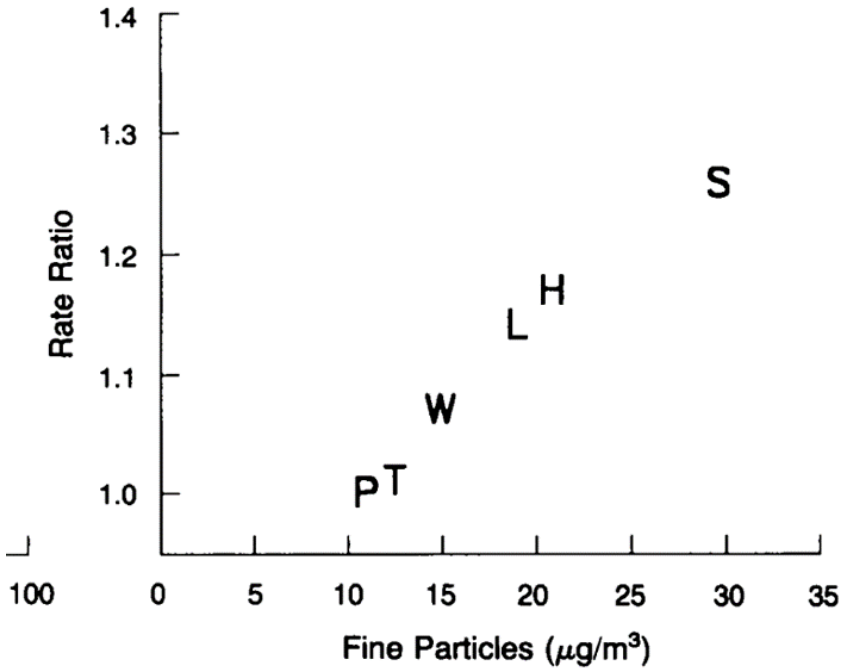
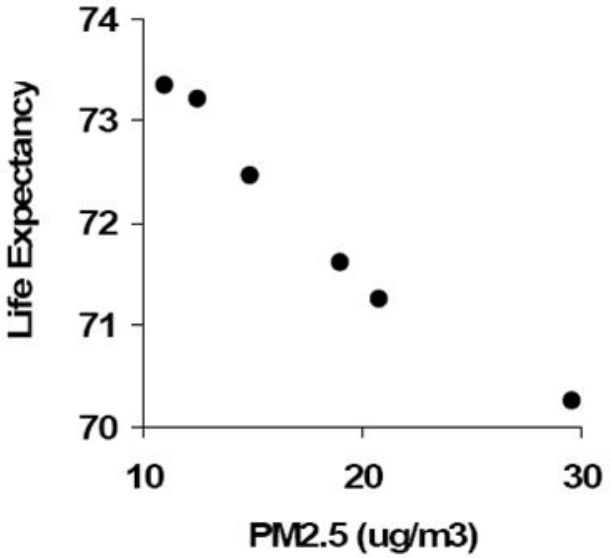
Why is it difficult to assess health benchmarks for diesel particulate matter?



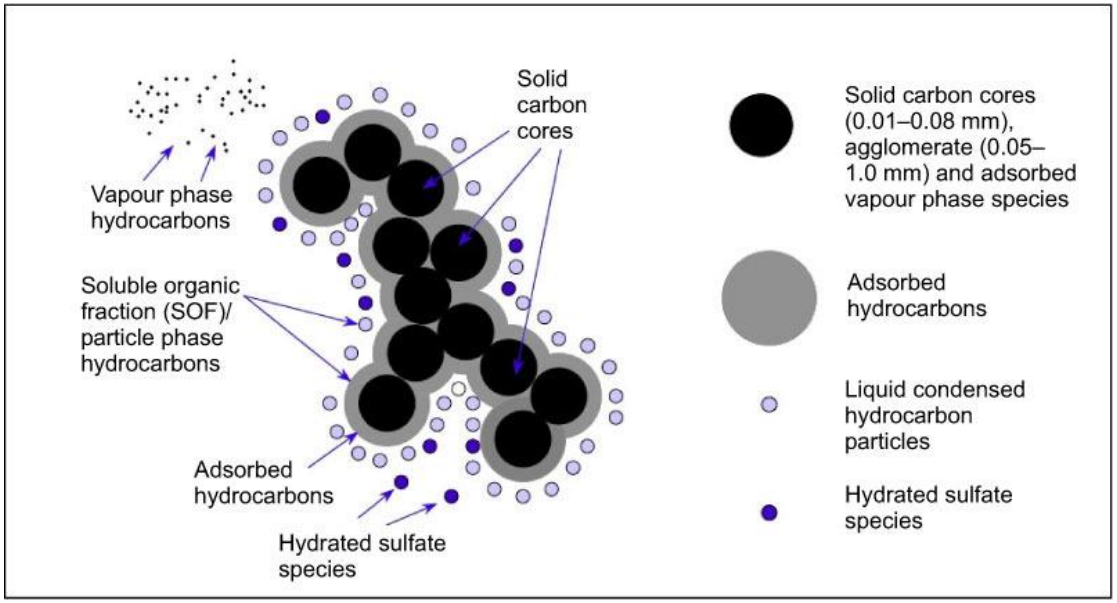


The New England
Journal of Medicine

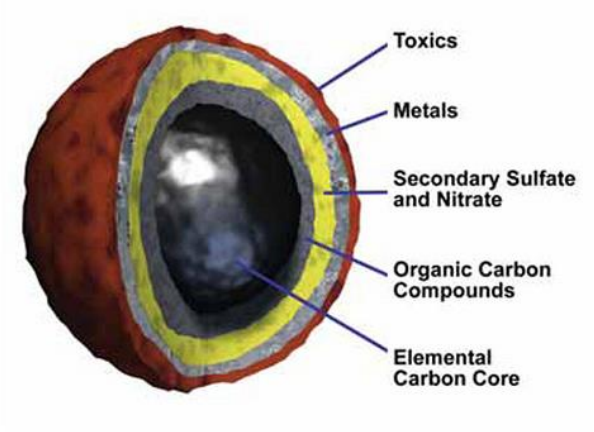
Volume 329 DECEMBER 9, 1993 Number 24

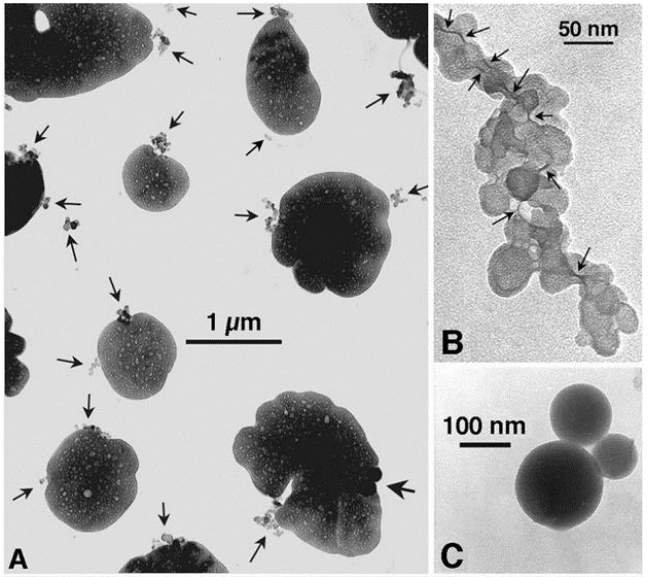
AN ASSOCIATION BETWEEN AIR POLLUTION AND MORTALITY IN SIX U.S. CITIES

Douglas W. Dockery, Sc.D., C. Arden Pope III, Ph.D., Xiping Xu, M.D., Ph.D.,
John D. Spengler, Ph.D., James H. Ware, Ph.D., Martha E. Fay, M.P.H.,
Benjamin G. Ferris, Jr., M.D., and Frank E. Speizer, M.D.



Nitrogen oxides
Numerous hydrocarbons
Particles < 1um





Complexities of Diesel Exhaust for Health Impact Assessment

- **Diesel exhaust is a complex mixture of gases and suspended particles. Composition depends on vehicle type, fuel, load, lubricant, etc.**

- **Each potential components carries with it their own health impact.**

- **Components are not necessarily unique to diesel but perhaps the combination is.**

- **Health impact studies:**
    - **Animal studies and cell lines - exposure to diesel exhaust directly**
    - **Human exposure studies**
    - **Occupational exposure to diesel**

Journal of Allergy and Clinical Immunology
Volume 115, Issue 2, February 2005, Pages 221–228

Biology of diesel exhaust effects on respiratory function

Marc Riedl, MD, and David Diaz-Sanchez, PhD *Los Angeles, Calif*

TABLE I. Direct effects of DEPs and their extracts on multiple cell types

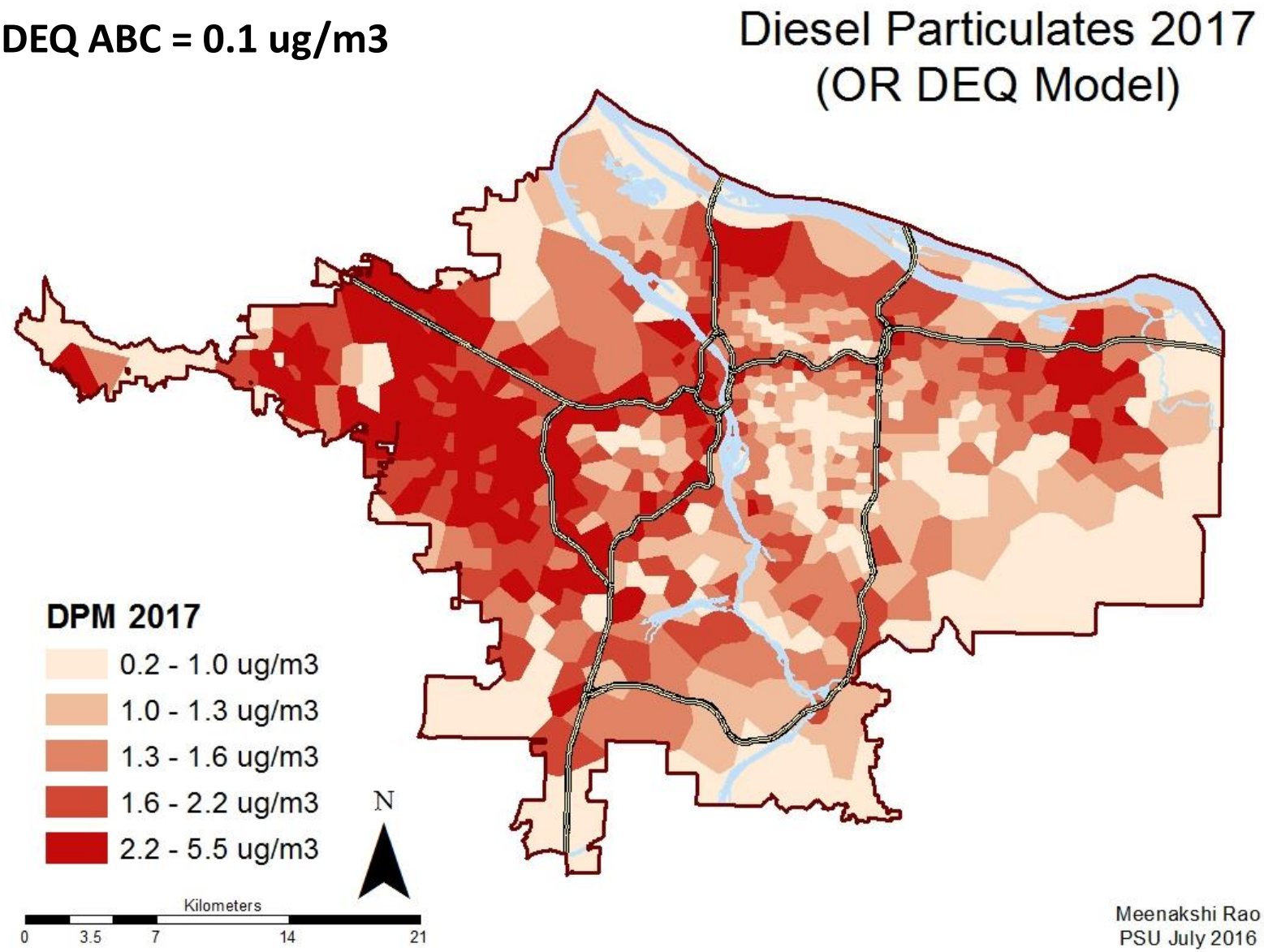
A. Bronchial and nasal epithelial and endothelial cells:
Increase expression of chemokines and cytokines (IL-8, eotaxin, RANTES, GM-CSF, and IL-6)
Increase expression of histamine 1 receptor
Upregulate expression of adhesion molecules (ICAM-1)
Increase phase 2 enzyme expression
B. Eosinophils
Enhance adhesion to nasal epithelial cells
Induce eosinophil degranulation
C. Mast cells
Enhance IgE-mediated histamine release
Enhance cytokine production (IL-4, IL-6)
D. Basophils
Induce histamine release in the absence of IgE
Enhance cytokine production (IL-4)
E. PBMCs
Induce chemokine production (IL-8, RANTES)
Synergize with allergen to increases in IL-8, RANTES, and TNF-α production
F. B cells
Enhance IgE production after IL-4 and anti-CD40 stimulation
G. Monocytes-macrophages
Modulate cytokine production (eg, inhibits IL-12p40 production)
Inhibit prostaglandin E_2 release
Increase phase 2 enzyme expression

TABLE II. Clinical effects of diesel exhaust in human controlled exposure studies

A. Diesel exhaust effects on healthy subjects
Increased number of inflammatory cells (neutrophils, B cells, T cells, mast cells) in the airways
Increased circulating neutrophils and platelets
Increased histamine levels
Increased cytokines (IL-6) and CXC chemokines (IL-8 and GrO-α)
Increased expression of adhesion molecules ICAM-1 and VCAM-1
Decreased macrophage function
Increased airway resistance
B. Diesel exhaust effects on subjects with mild asthma
Increased hyperresponsiveness to methacholine
Increased airway resistance
Increased sputum IL-6 levels
No apparent airway inflammation
Increased epithelial staining for IL-10

VCAM-1, Vascular cell adhesion molecule 1.

ORDEQ ABC = 0.1 ug/m3



ESTIMATES OF HEALTH COSTS OF DPM IN PORTLAND METRO DUE TO LUNG CANCER

24	Estimated annual incidence of lung cancer for Portland metro due to DPM exposure
$150,088,000	Assuming 90% mortality from lung cancer (Brown et al, 2001). Assuming VSL $7.18 million 2005 USD (EPA VSL)
$17,520,000	At $50,000/per QALY Assuming 14.6 QALYs reduction due to lung cancer (Brown et al 2001)
$45,760,838	WHO rule of 3x per capita GDP per QALY Assuming 14.6 QALYs reduction due to lung cancer (Brown et al 2001) US 2005 GDP $43,532 USD per capita (World Bank)

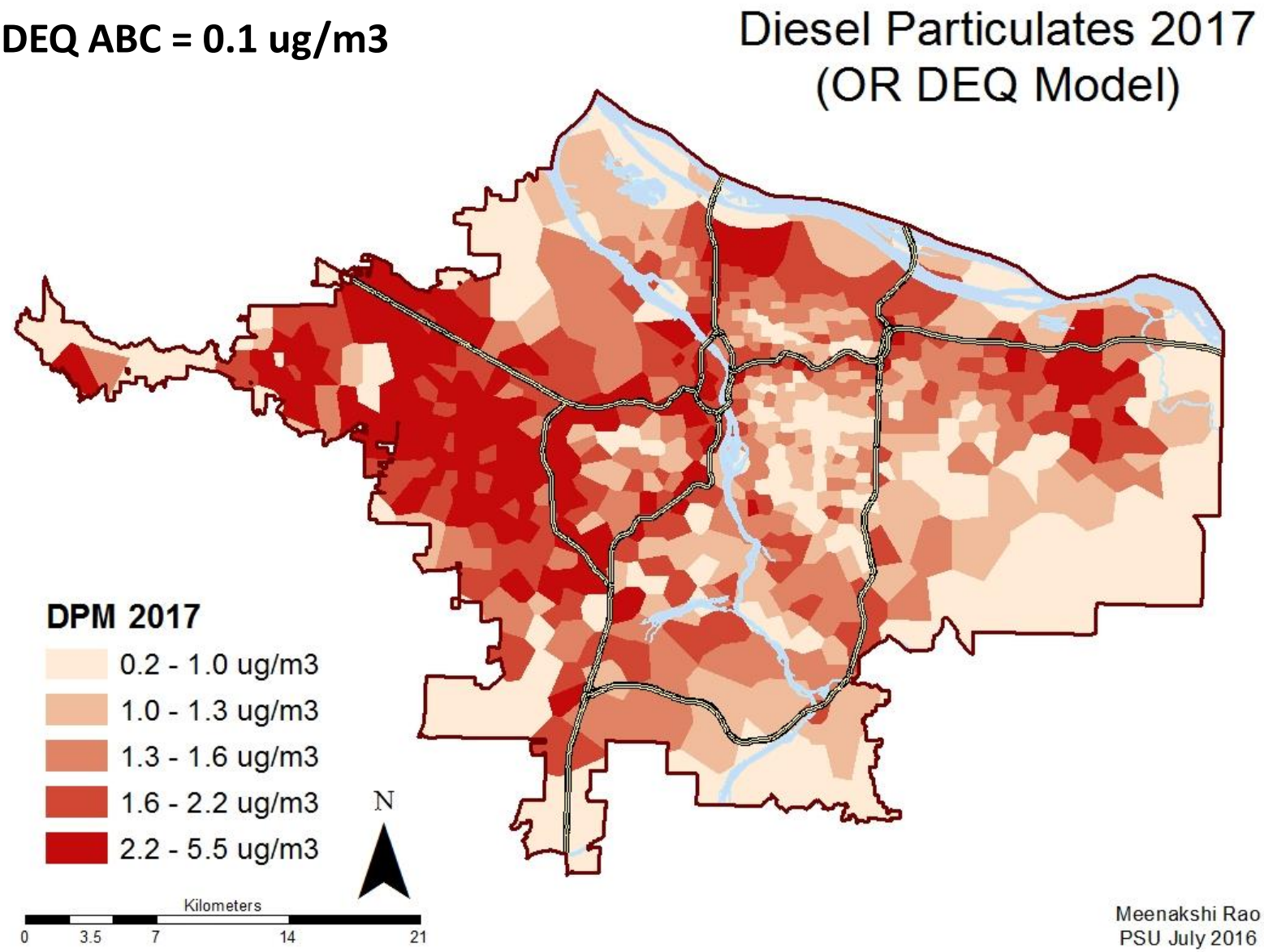
California Air Resources Board – California incidence

Health Effect	Estimated Annual Number of Cases*
Cardiopulmonary Death	1,400 (1,100 – 1,800)
Cardiovascular Hospitalization	100 (0 – 250)
Respiratory Hospitalization	120 (30 – 250)
Respiratory Emergency Room Visits (Including Asthma)	600 (400 – 800)

DPM is estimated to increase statewide cancer risk by 520 cancers per million residents exposed over a lifetime.

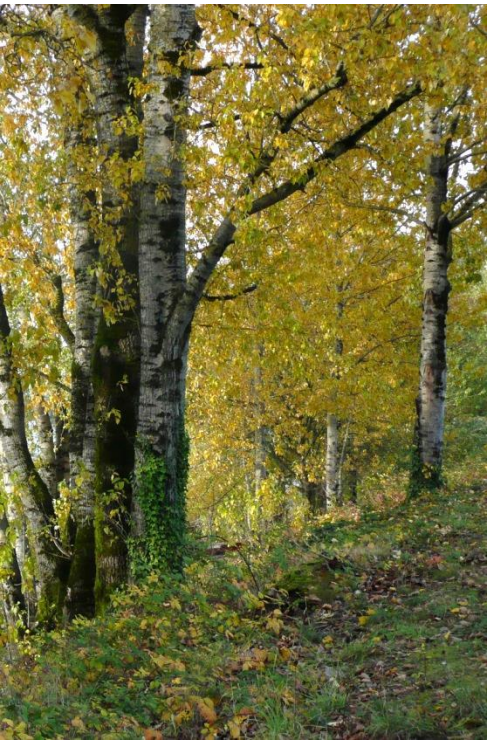
http://www.arb.ca.gov/research/diesel/diesel-health.htm

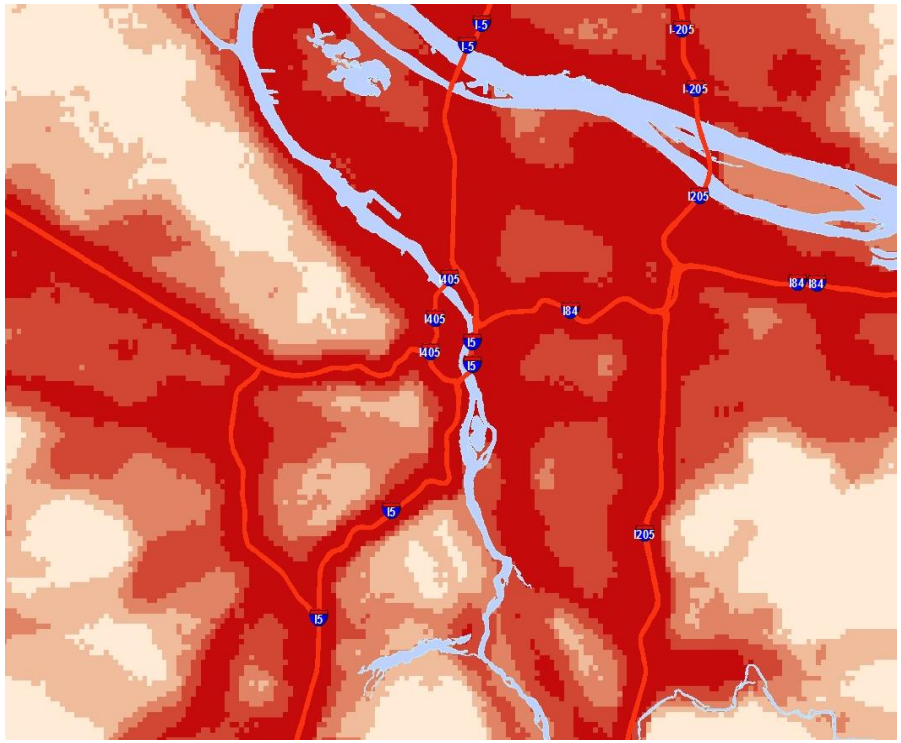
ORDEQ ABC = 0.1 ug/m3



Investigating the potential of land use modifications to mitigate the respiratory health impacts of NO_2

A case study in the Portland-Vancouver metropolitan area

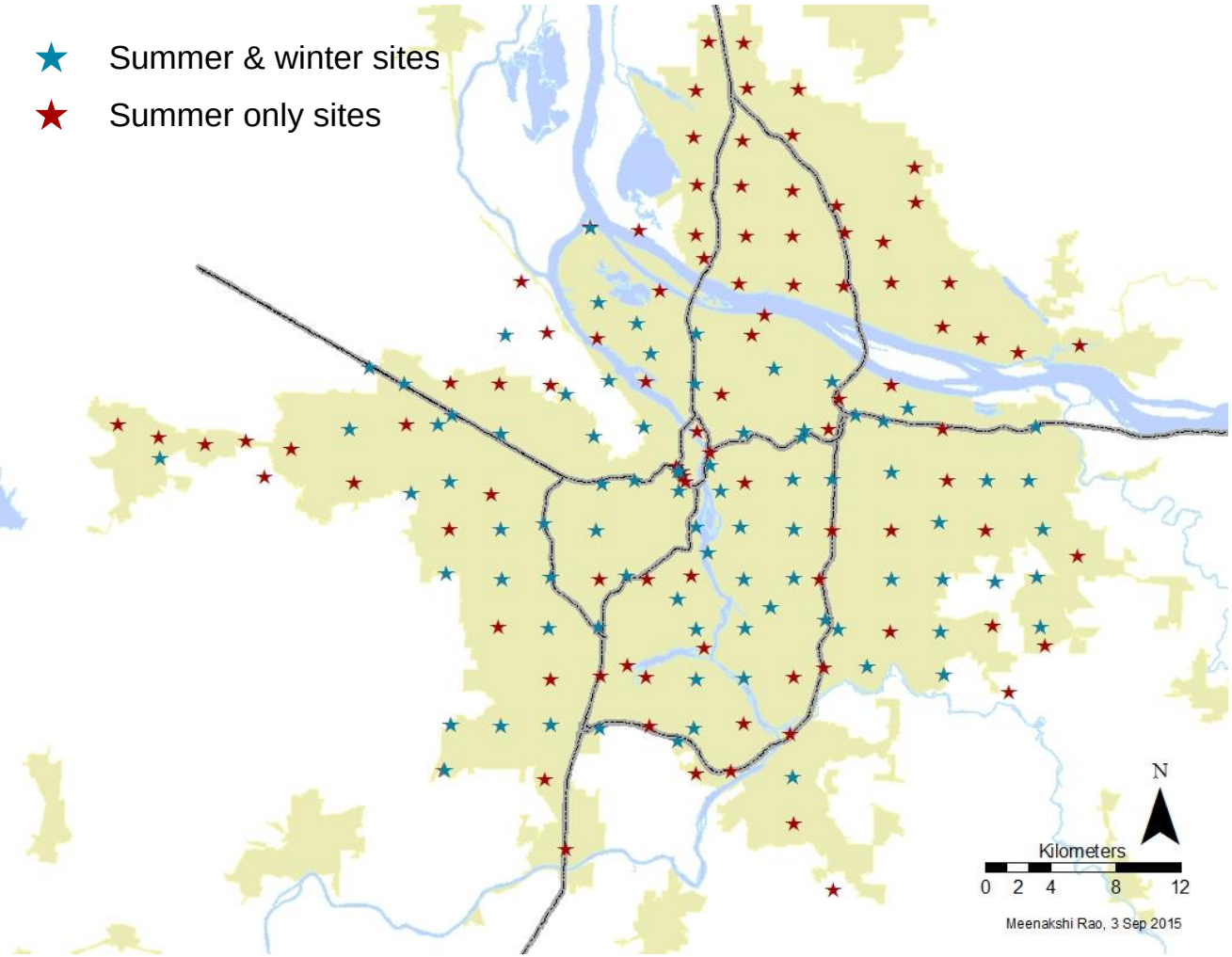


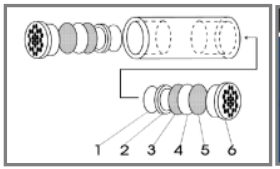


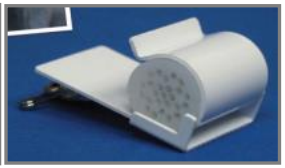
Meenakshi Rao, PhD
School of the Environment

Portland State University

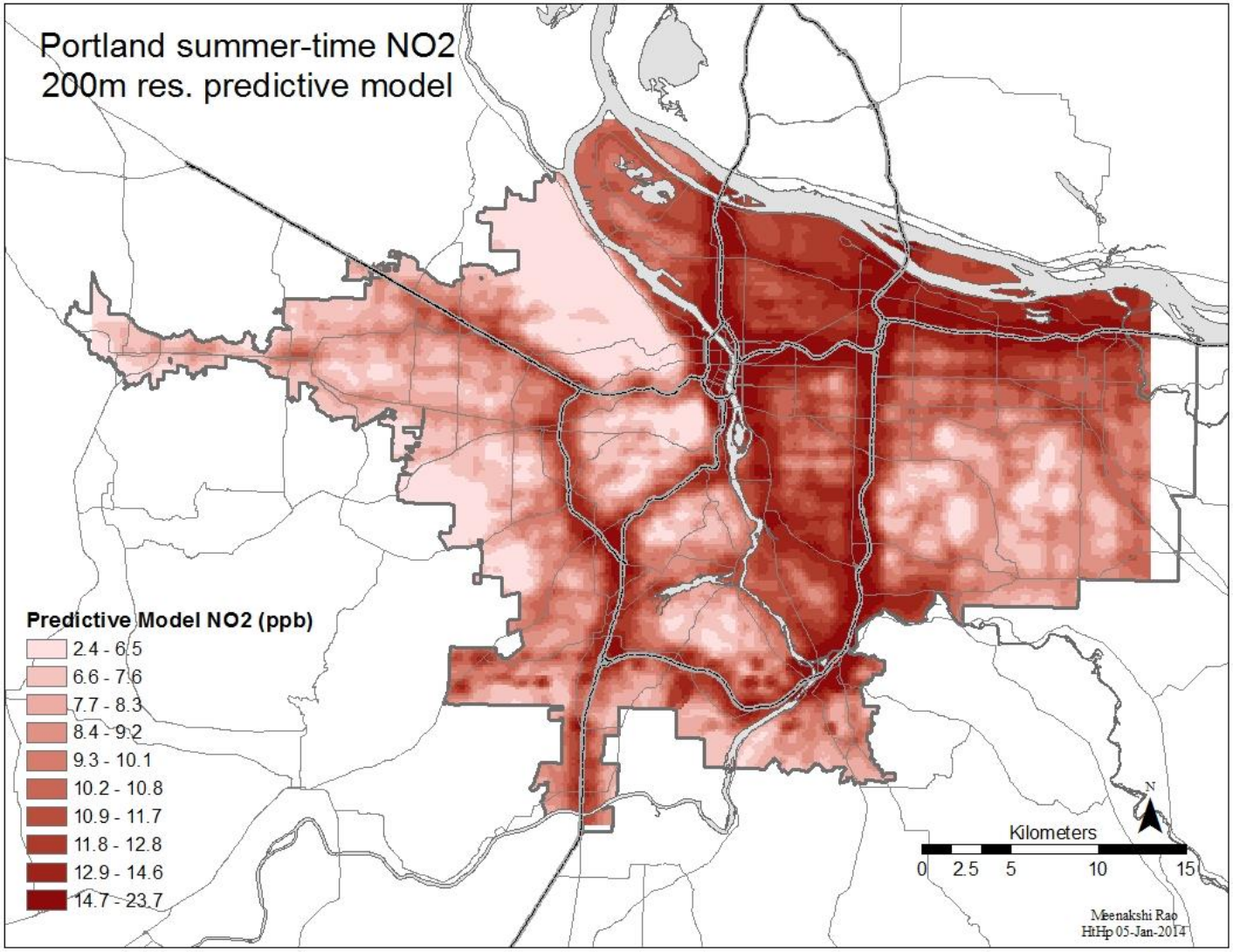
Research: NO_2 in Portland-Vancouver





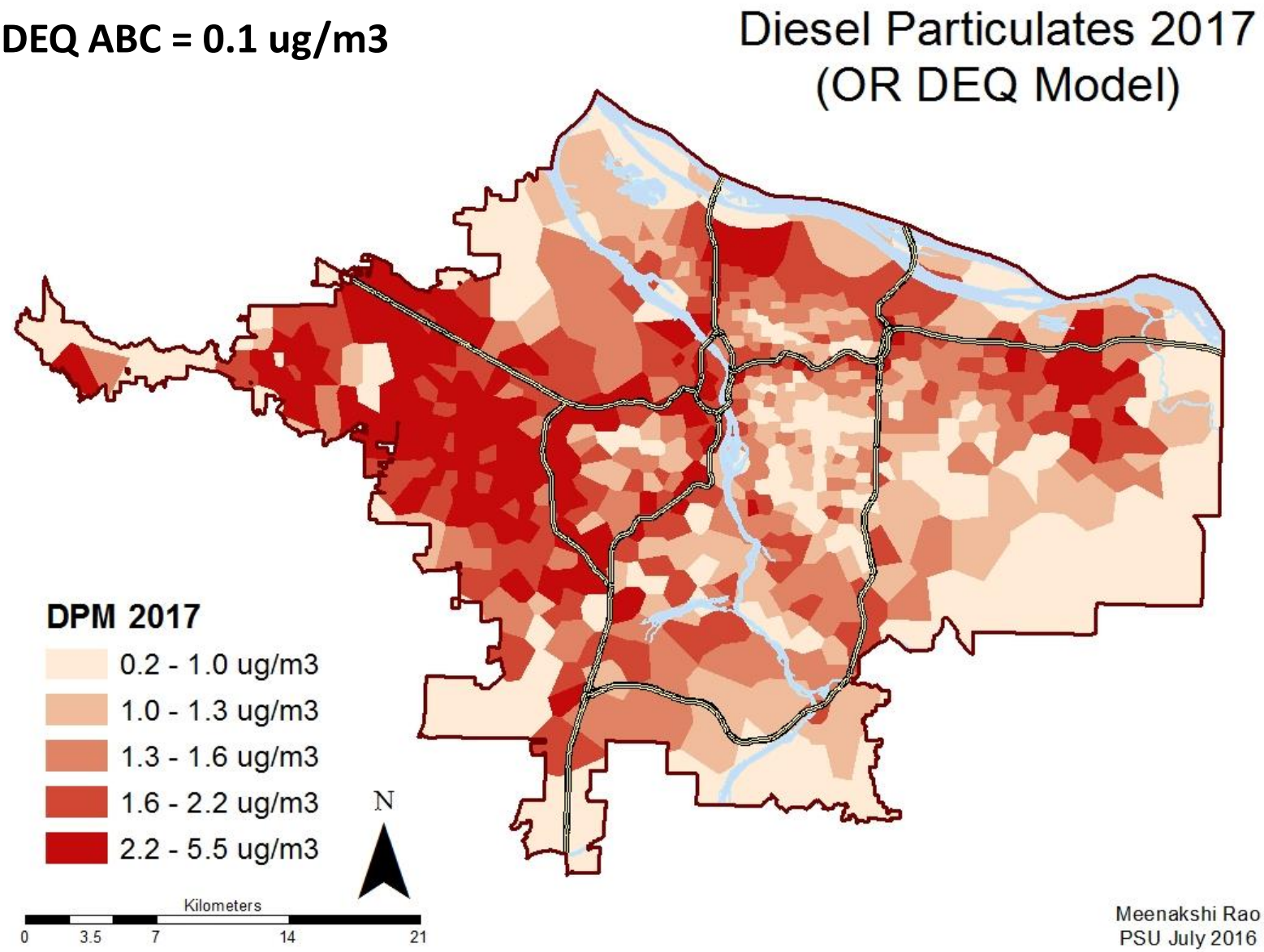


Winter (82 sites): 13th – 27th Feb 2014
Summer (174 sites) : 23rd Aug – 6th Sep 2013


Portland summer-time NO2
200m res. predictive model
Predictive Model NO2 (ppb)
2.4 - 6.5
6.6 - 7.6
7.7 - 8.3
8.4 - 9.2
9.3 - 10.1
10.2 - 10.8
10.9 - 11.7
11.8 - 12.8
12.9 - 14.6
14.7 - 23.7
N
Kilometers
0 2.5 5 10 15
Meenakshi Rao
HtHp 05-Jan-2014

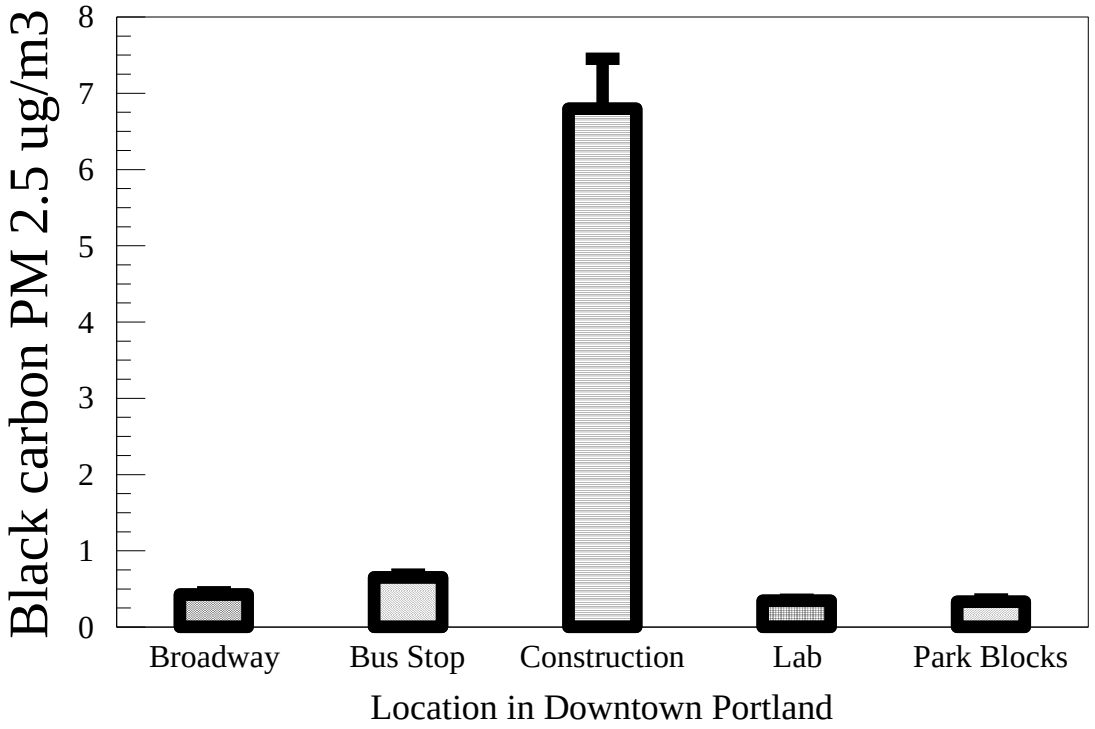
Health Impact	Compared to 7 ppb baseline		
	Incidence	Incidence rate (per 100,000)	Valuation (2013 USD)
Asthma Exacerbation, Missed school days (4 -12 year olds)	34,189	14,455	$7,289,729
Asthma Exacerbation, One or More Symptoms (4 -12 year olds)	99,740	42,171	$21,266,297
Cough (7 -14 year olds)	24,134	12,070	$3,219,017
Emergency Room Visits, Asthma (75 years and older)	20	22	$7,171
HA, Asthma (younger than 30 years)	6	1	$64,785
HA, Asthma (30 years and older)	7	1	$76,749
HA, Chronic Lung Disease (less Asthma) (65 years and older)	143	64	$2,633,286
HA, All Respiratory (65 years and older)	307	137	$7,752,000
Total:			*$39,598,999*

ORDEQ ABC = 0.1 ug/m3



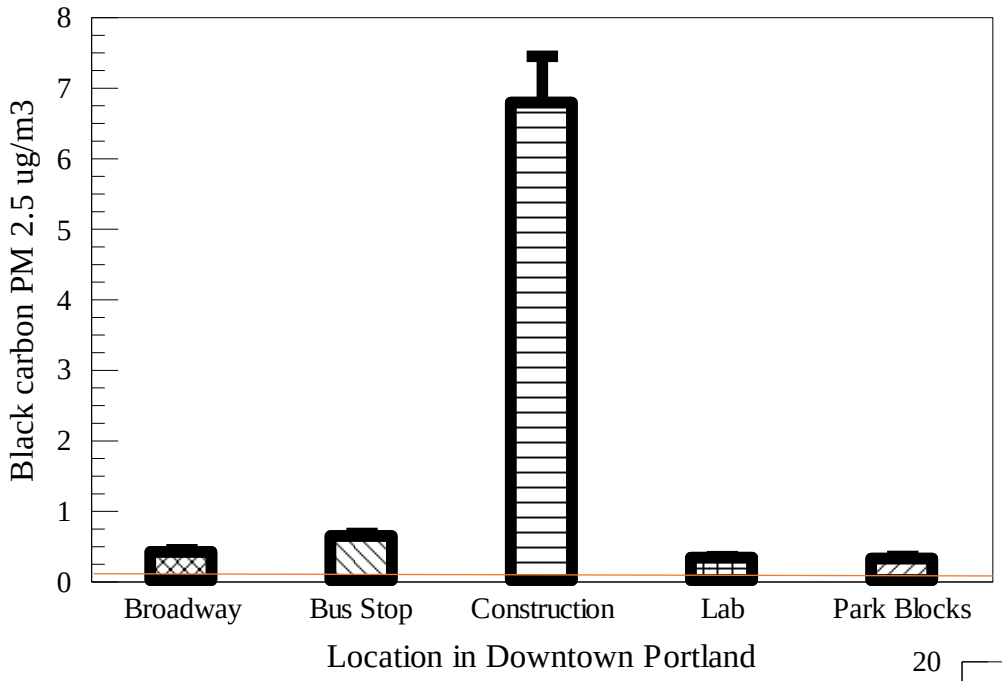
Diesel particulate matter assessment in Portland

(partially funded by METRO grant to NCA)



Aethalometer
PM 2.5 Particulate Monitor
Ultrafine particle counter
Filter EC/OC

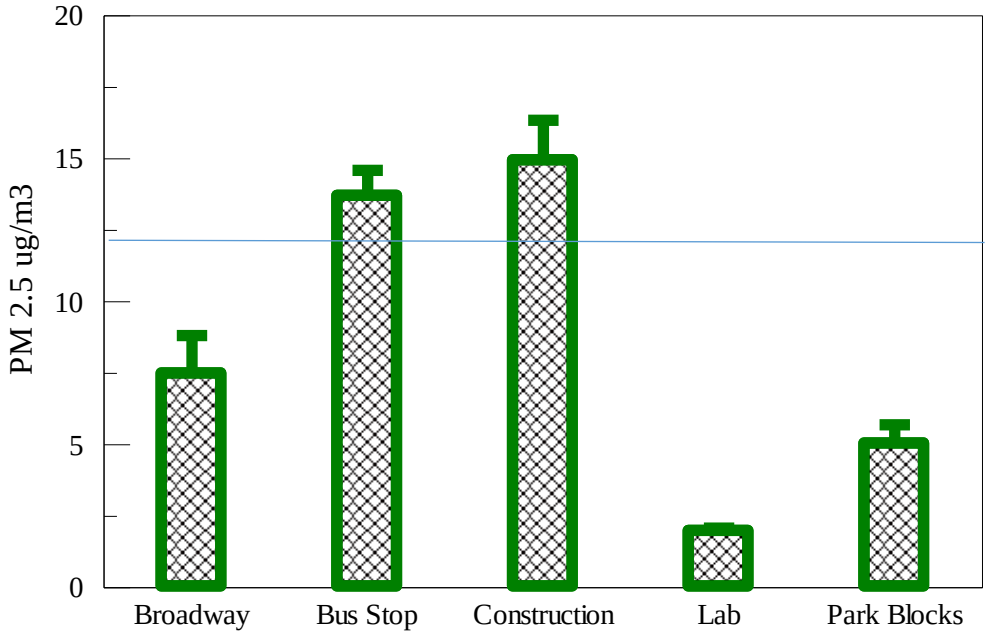
Preliminary data



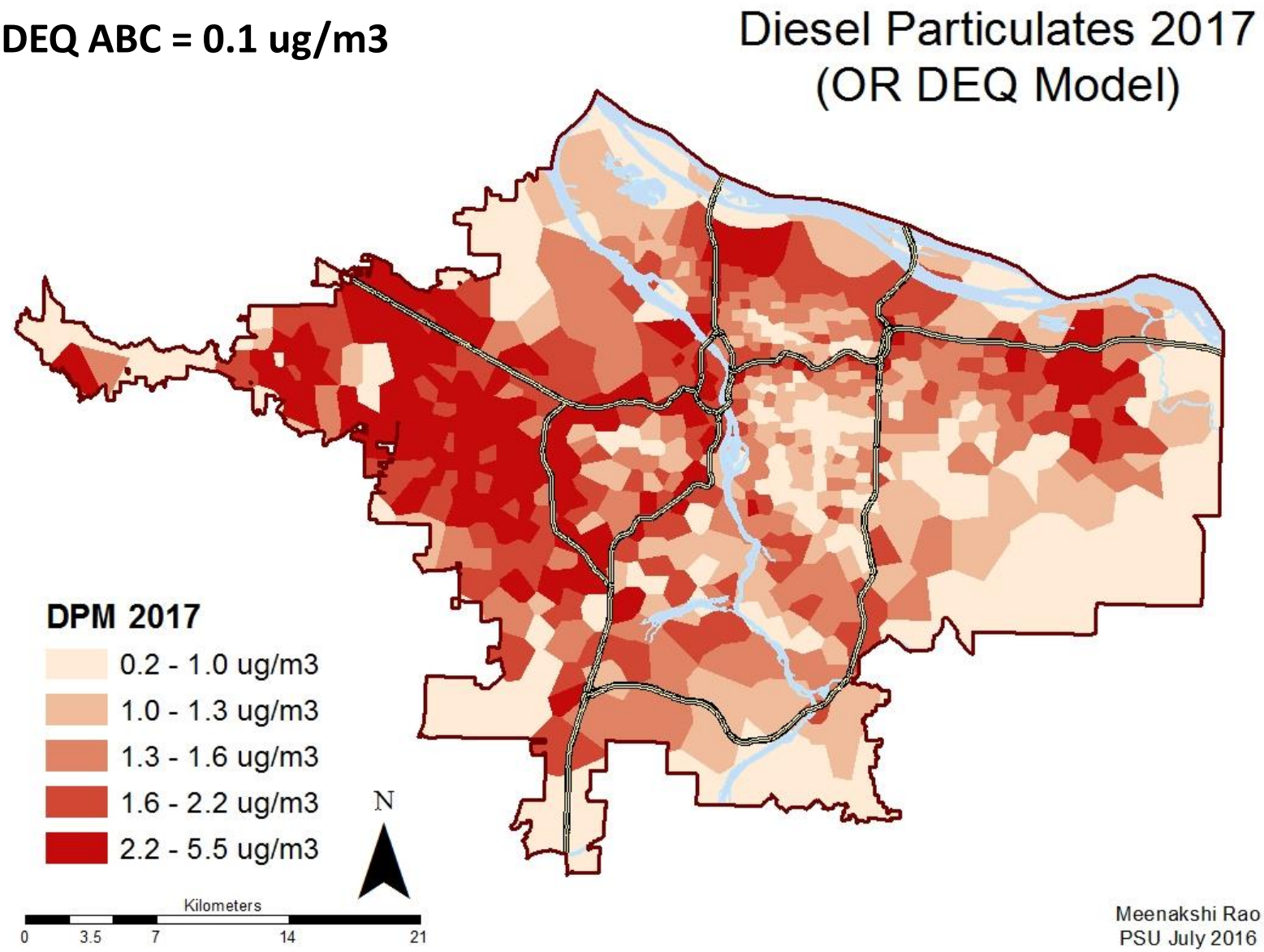
Black carbon PM assessment , preliminary data, P.Orlando, B. Bennett & L. George July 2016

DPM ABC = 0.1 ug/m3

NAAQS standard



ORDEQ ABC = 0.1 ug/m3



January 2015

RESEARCH REPORT

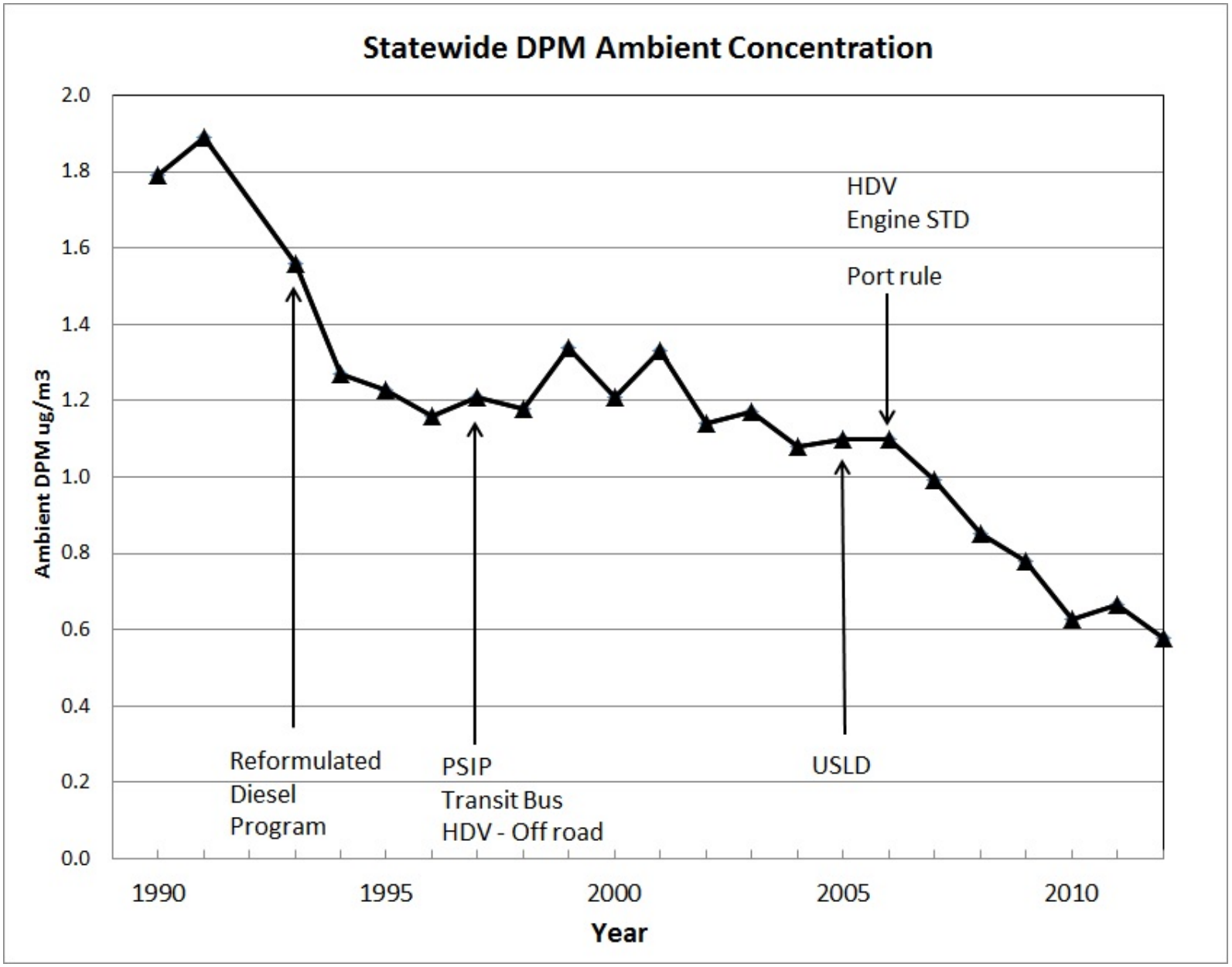
HEALTH EFFECTS INSTITUTE

Number 184
January 2015

Advanced Collaborative Emissions Study (ACES): Lifetime Cancer and Non-Cancer Assessment in Rats Exposed to New-Technology Diesel Exhaust

"Overall, these results indicate that rats exposed to one of three levels of NTDE [new technology diesel exhaust] from a 2007-compliant engine for up to 30 months, for 16 hours per day, 5 days a week, with use of a strenuous operating cycle that more accurately reflected the real-world operation of a modern engine than cycles used in previous studies, showed few exposure-related biologic effects. **In contrast to the findings in rats chronically exposed to TDE [traditional technology diesel exhaust], there was no induction of tumors or pre-cancerous changes in the lung and no increase in tumors that were considered to be related to NTDE in any other tissue."**

CALIFORNIA


Statewide DPM Ambient Concentration
Ambient DPM ug/m3
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1990
1995
2000
2005
2010
Year
HDV
Engine STD
Port rule
Reformulated
Diesel
Program
PSIP
Transit Bus
HDV - Off road
USLD