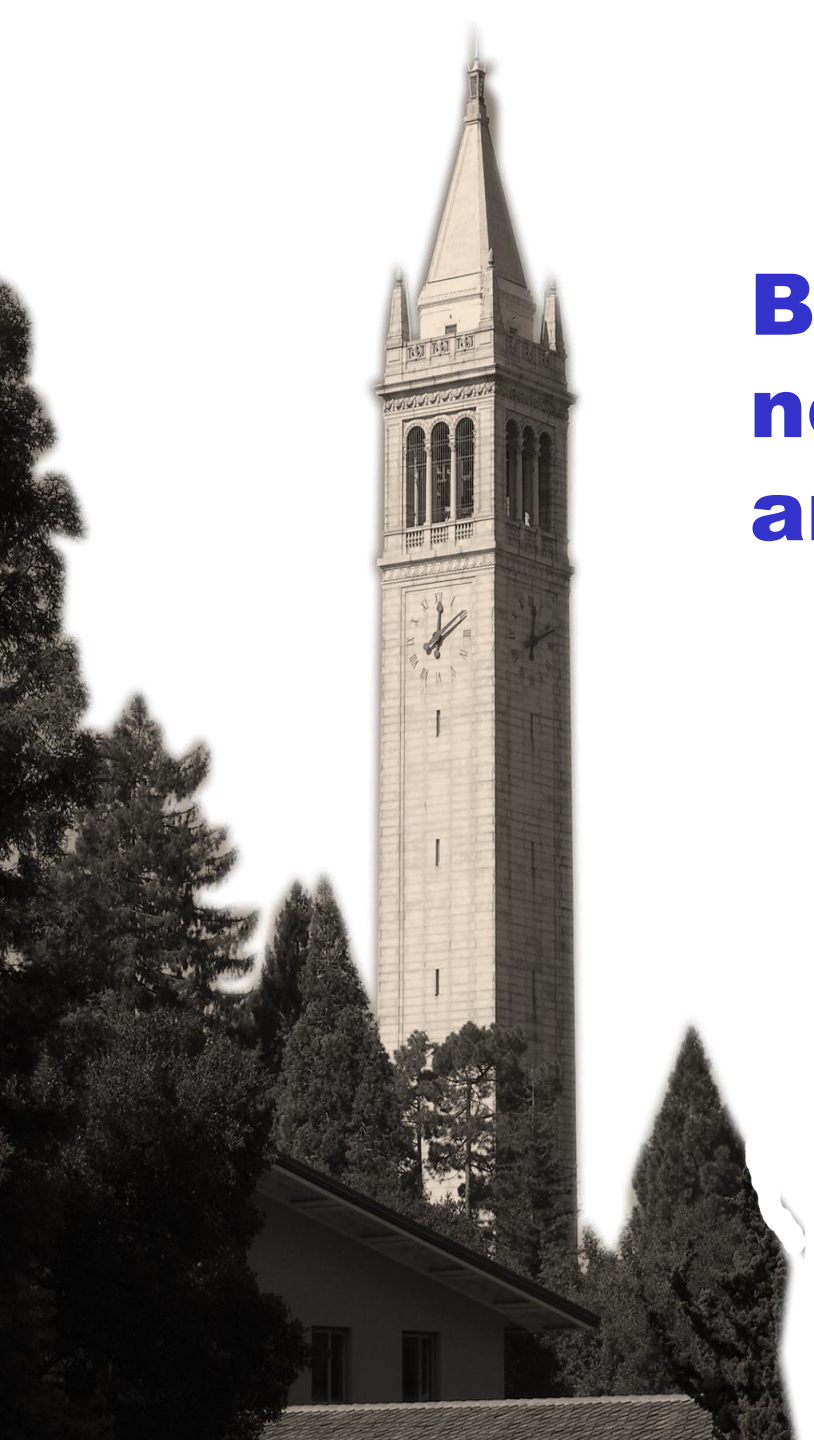


BEACO$_2$N: Dense networks for air quality and climate research

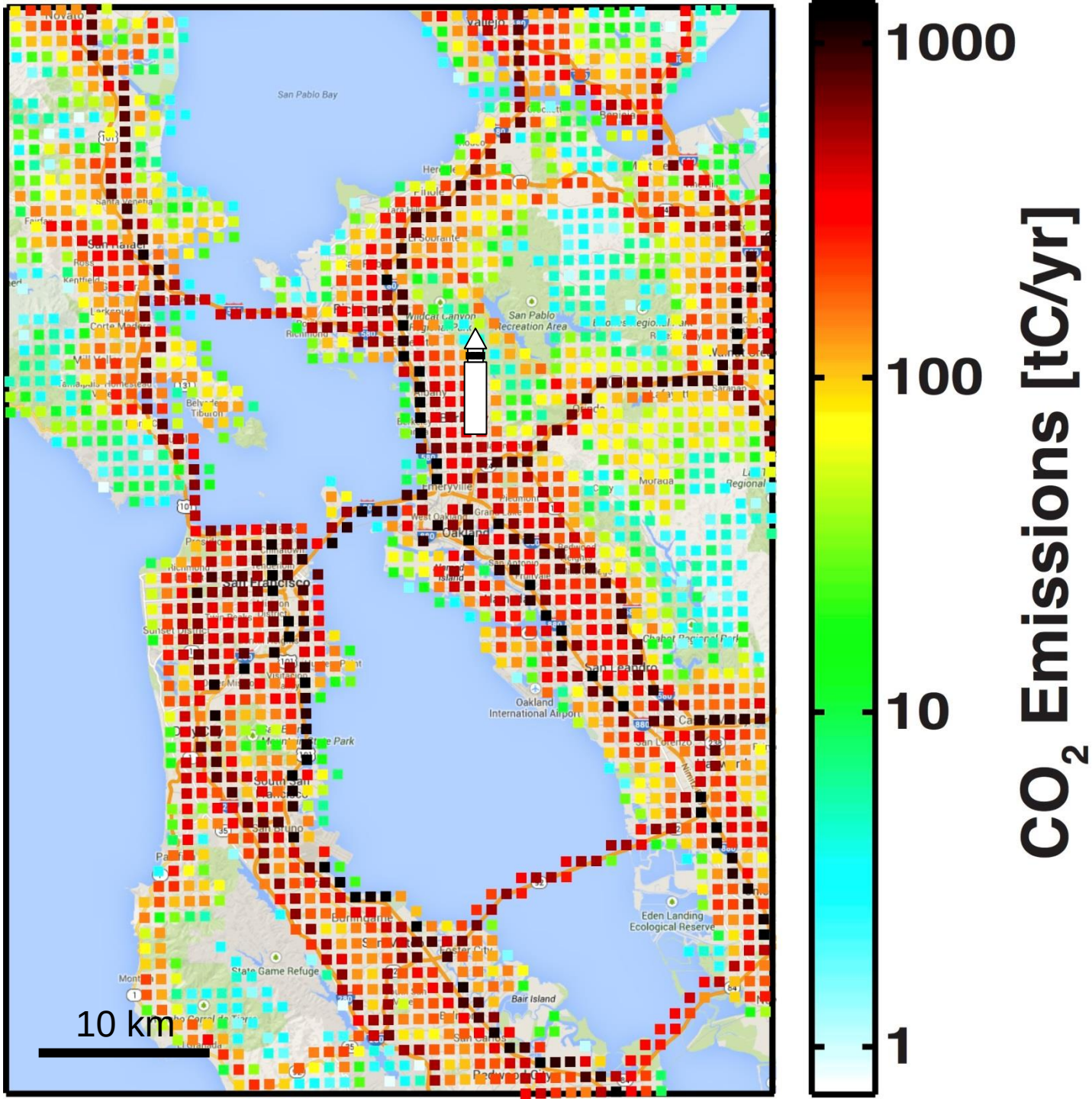
Ronald C. Cohen
Professor of Chemistry
Professor of Earth and Planetary Science
UC Berkeley

$NSF, BAAQMD, HEI, UC Berkeley

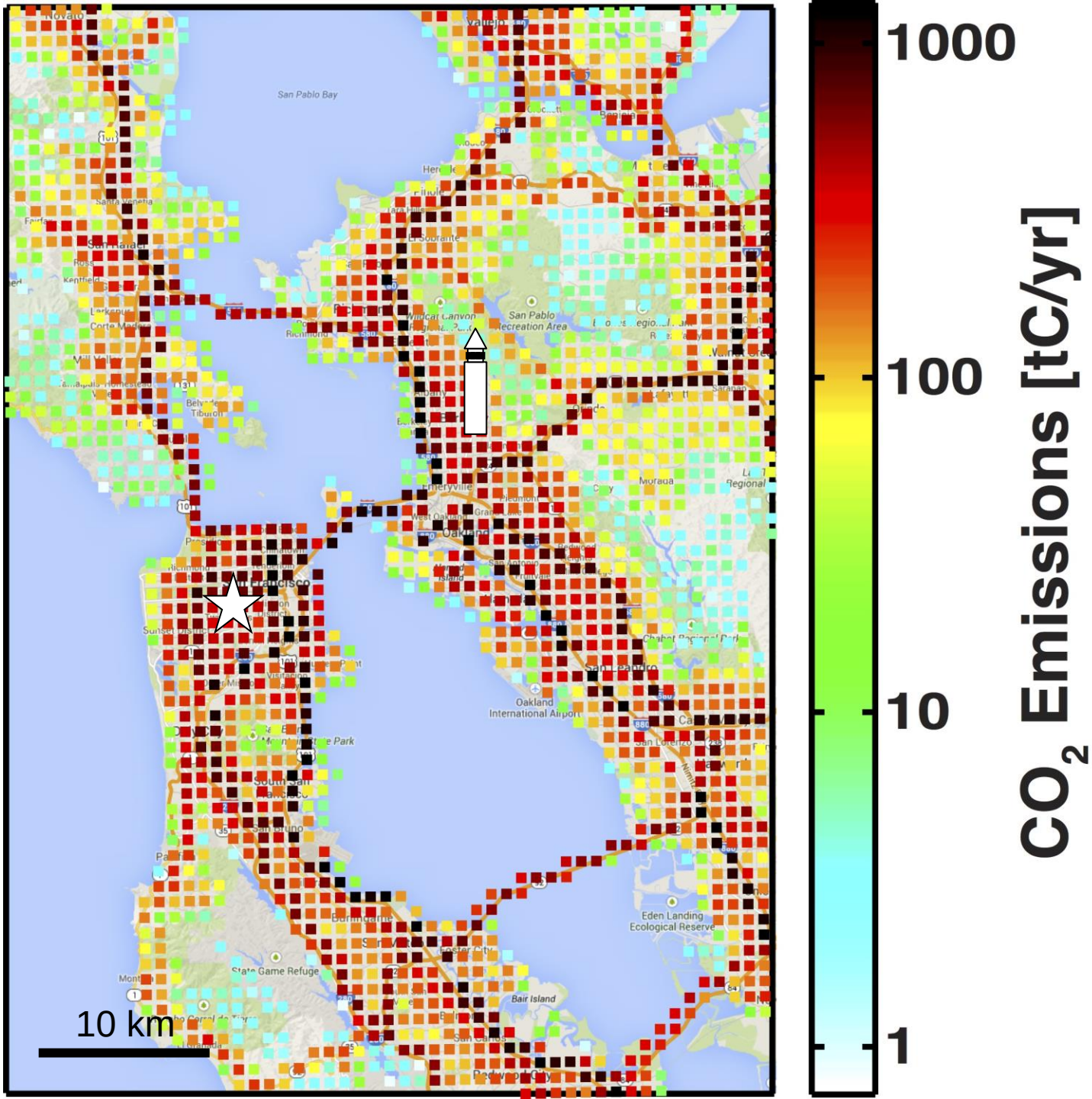
Climate

Illustration by John Heinly

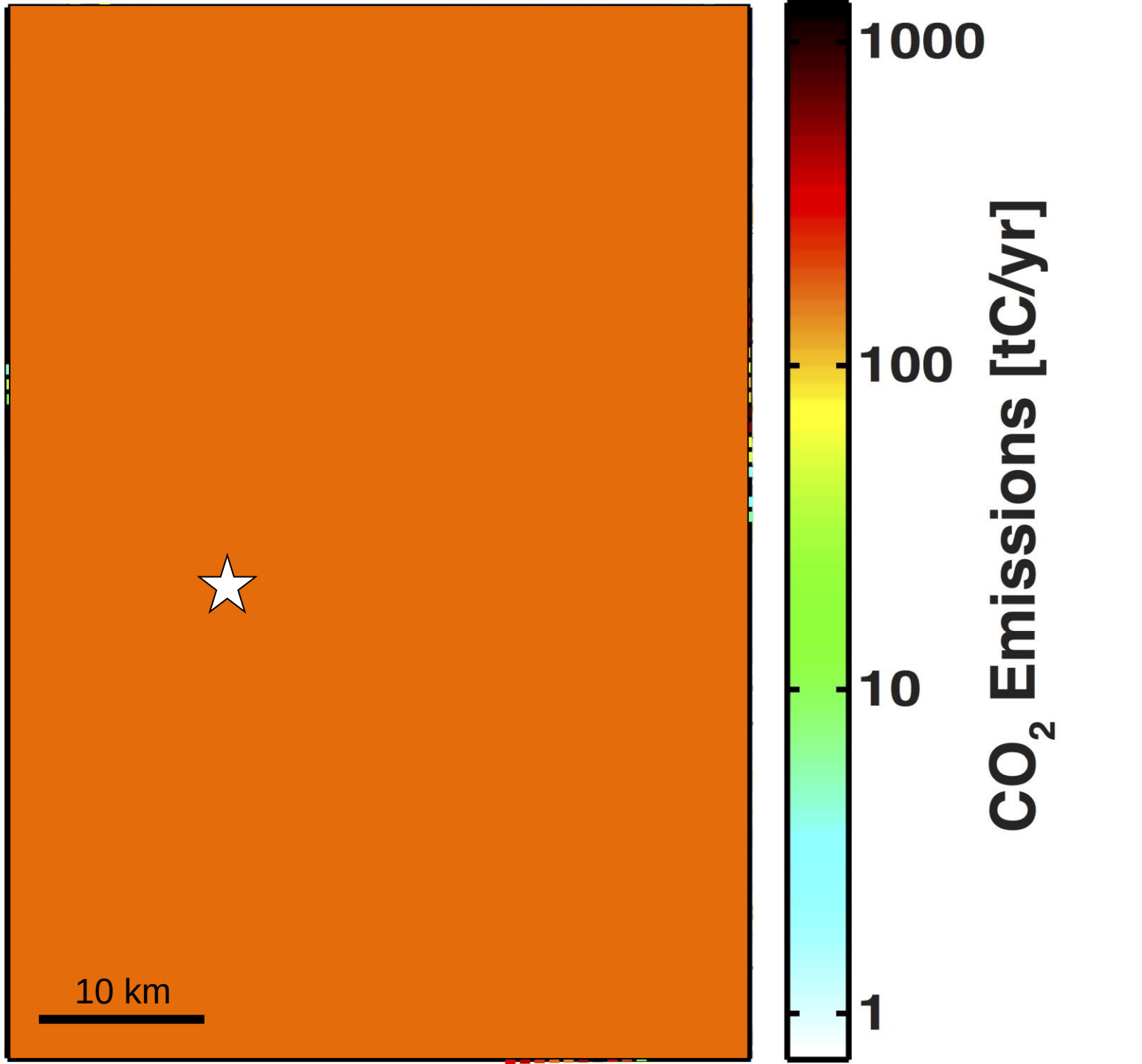
Air Quality



c/o Alex Turner

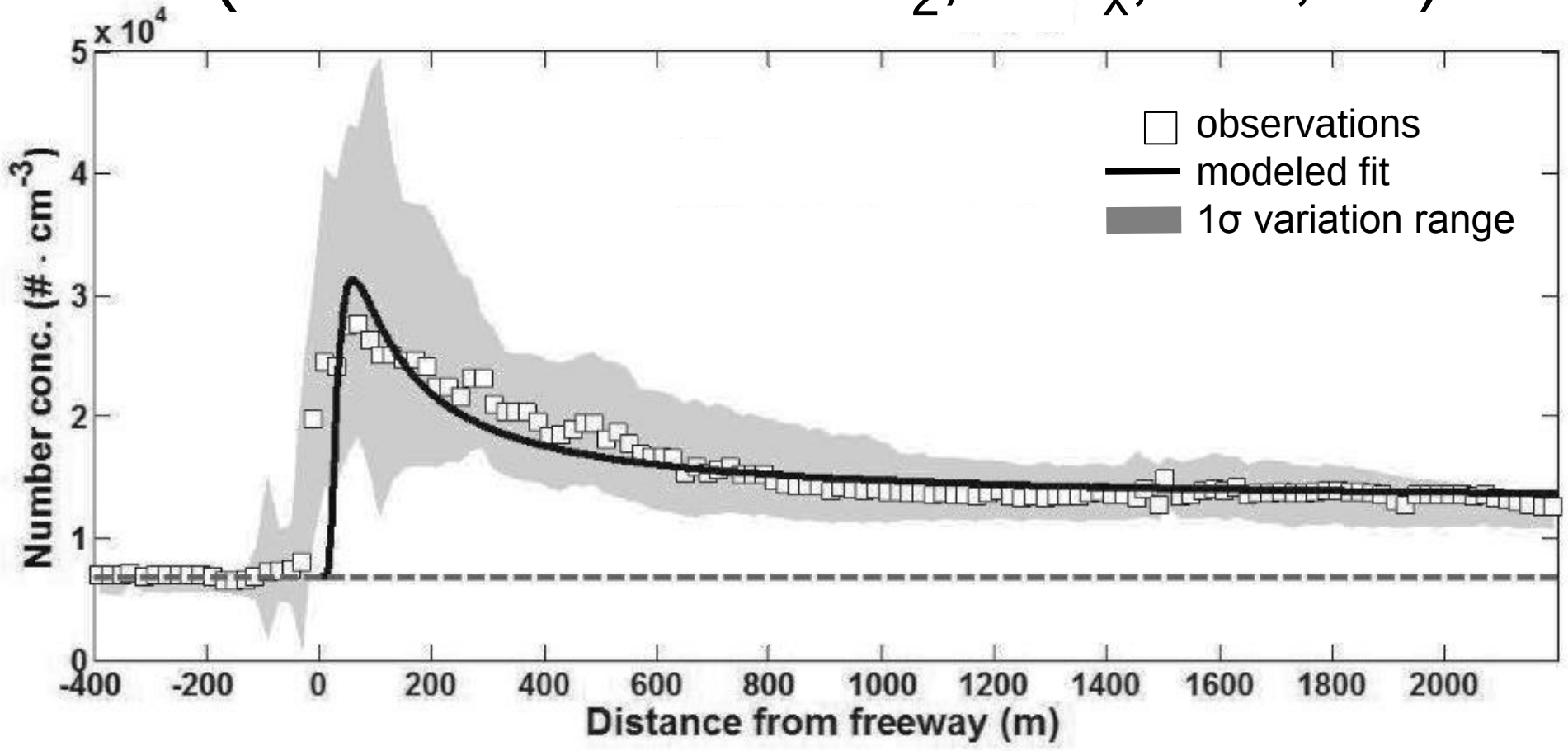


c/o Alex Turner

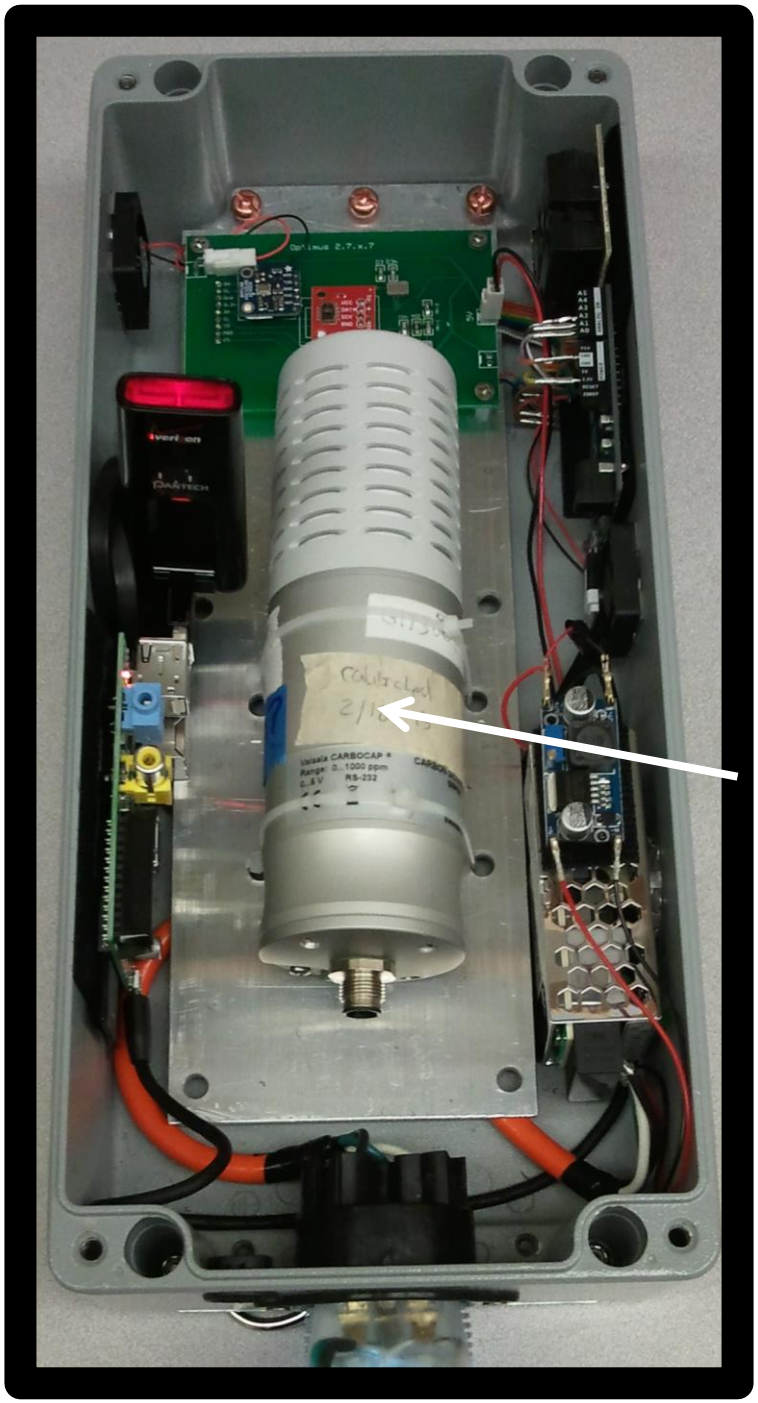


c/o Alex Turner

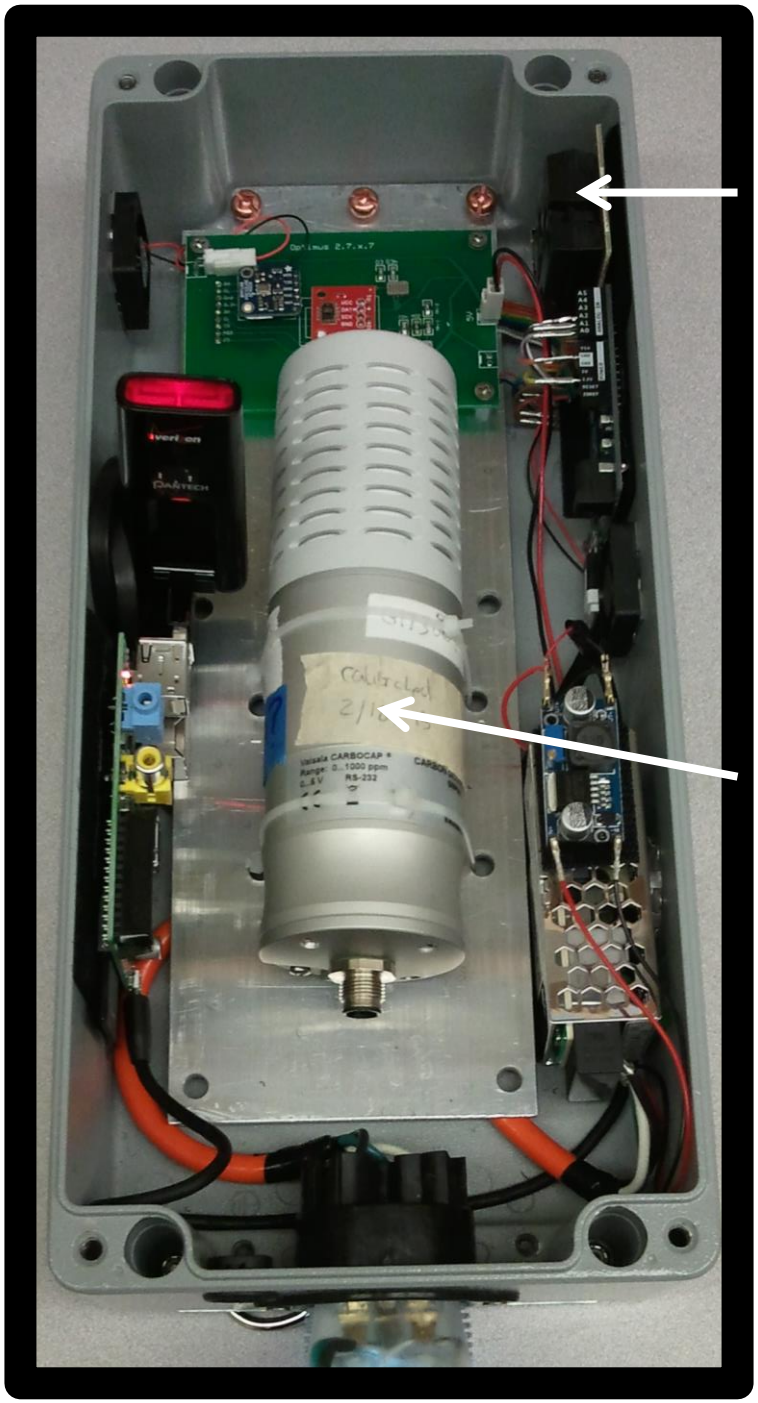
Particulate Matter (co-emitted with CO_2, NO_x, CO, …)



from Choi et al. 2014



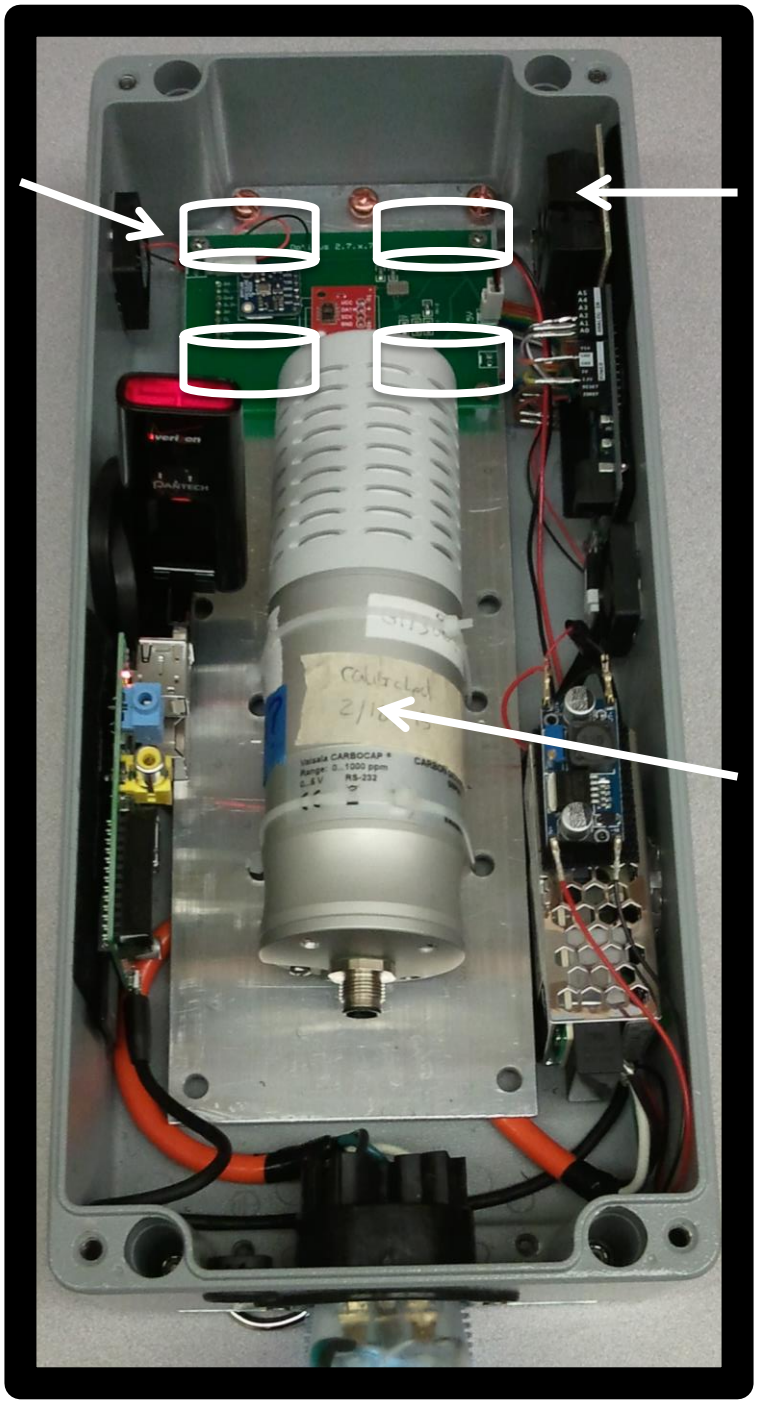
Vaisala
GMP343 NDIR
CO_2 Sensor



Shinyei Grove Particulate Sensor

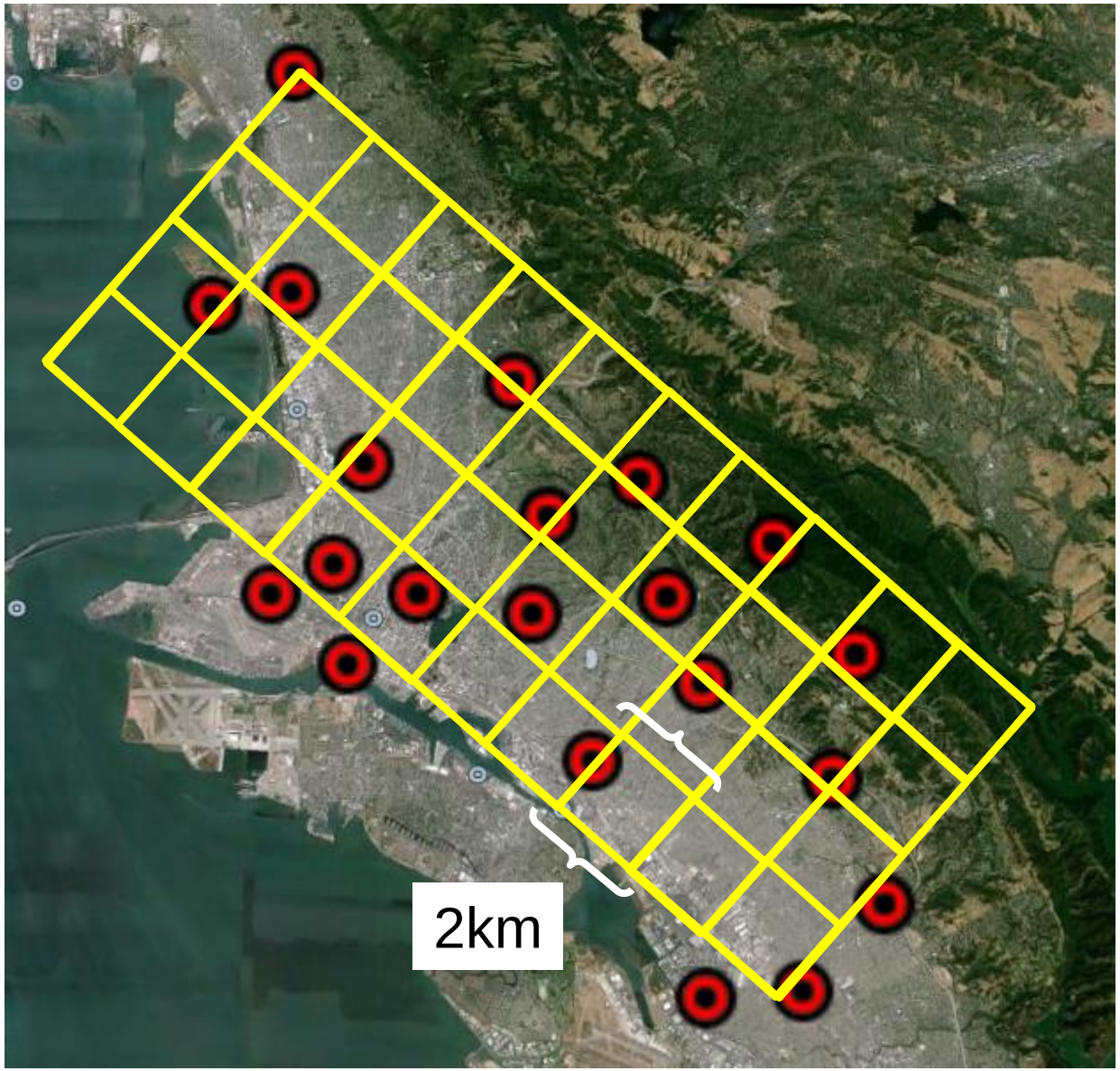
Vaisala GMP343 NDIR CO_2 Sensor

Electrochemical O_3, NO, NO_2 & CO Sensors



Shinyei Grove Particulate Sensor

Vaisala GMP343 NDIR CO_2 Sensor



BErkeley

Atmospheric

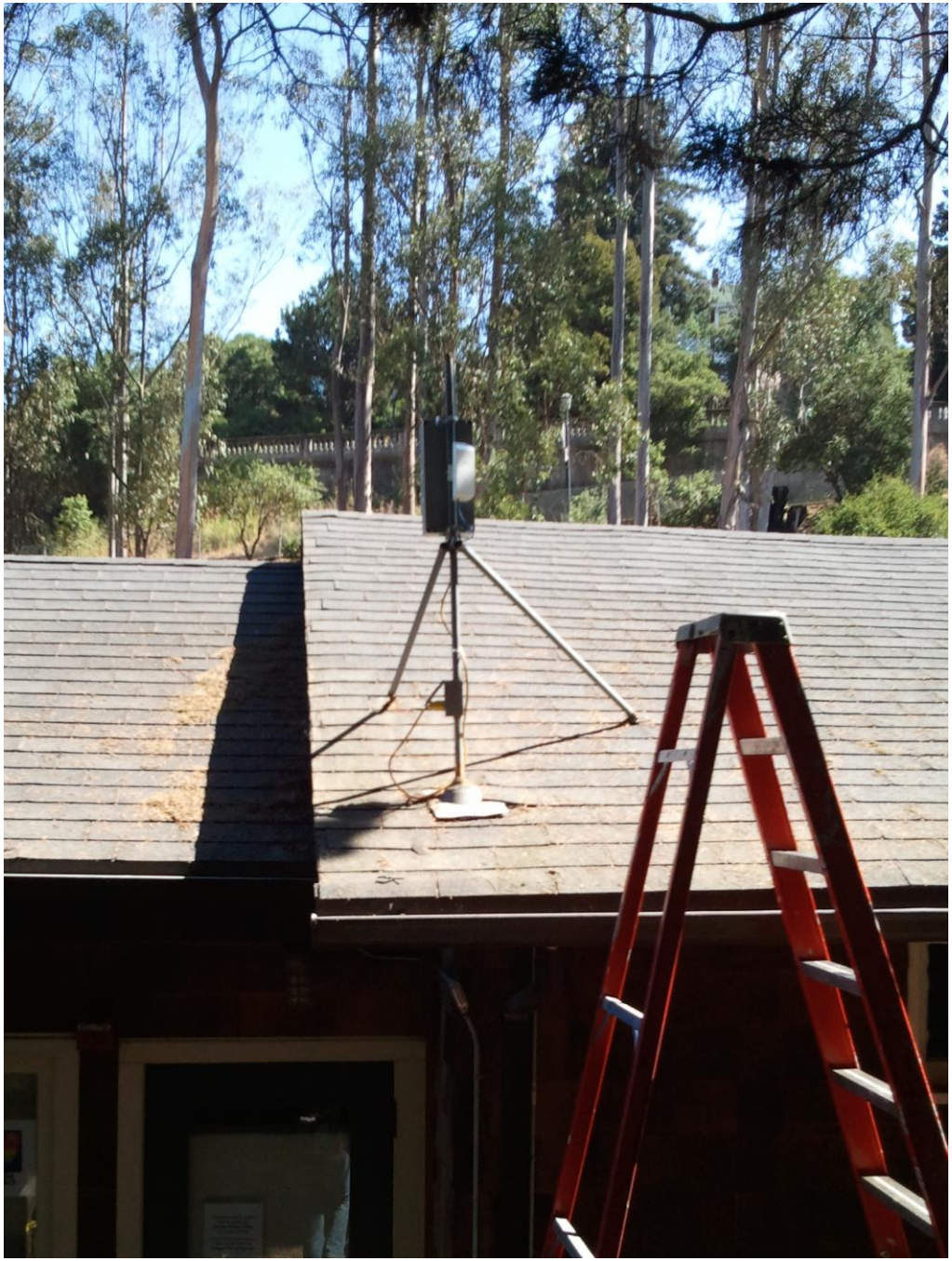
CO_2

Observation

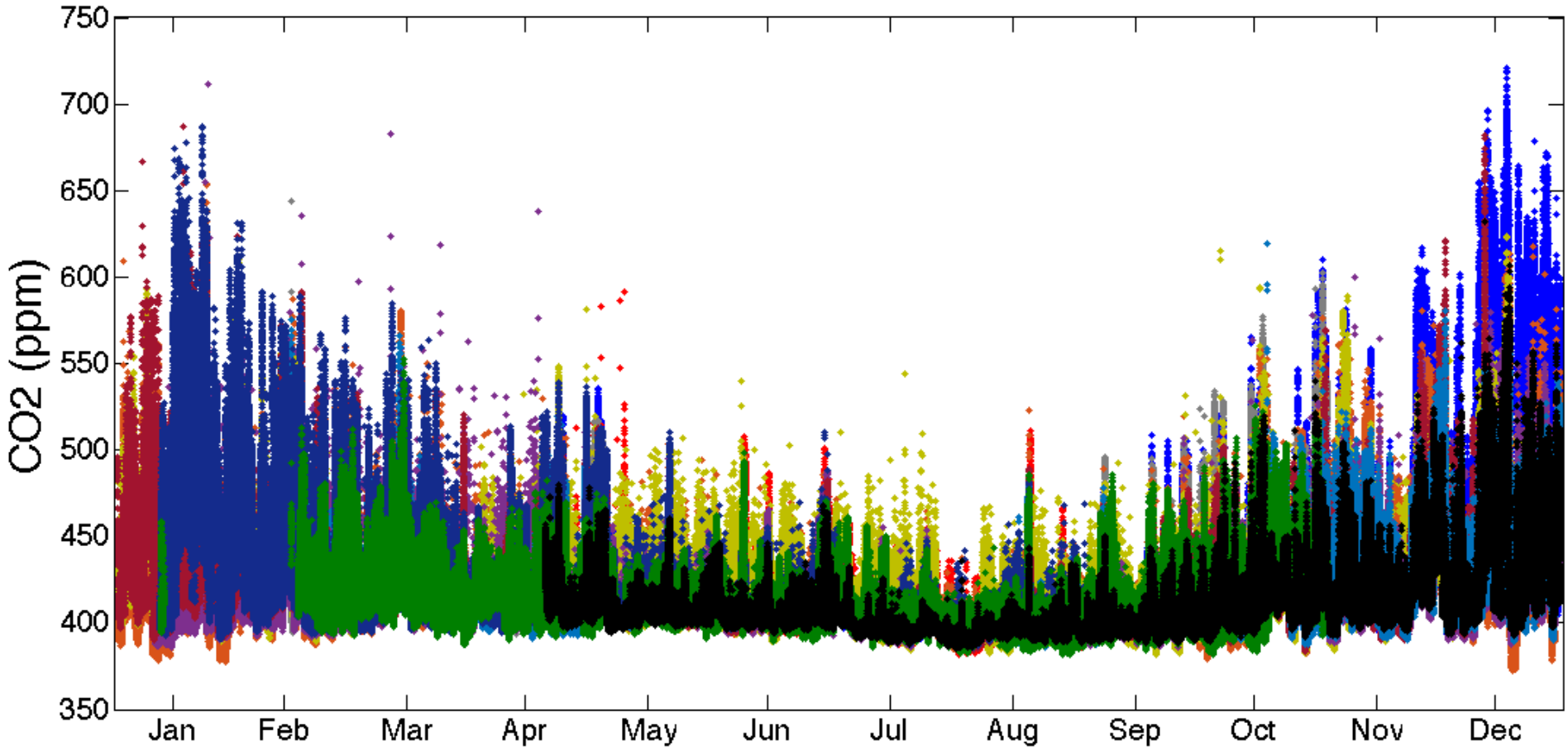
Network

Performance	Picarro G2301	Vaisala GMP343
Accuracy	± 1 ppm	± 7 ppm
Precision	± < 0.2 ppm (5s)	± 3 ppm (2s)
Drift	± 6 ppm/yr	± 8 ppm/yr
Weight	58 lbs	0.8 lbs
Price	$50,000-100,000	$3,000


San Francisco Bay Ferry



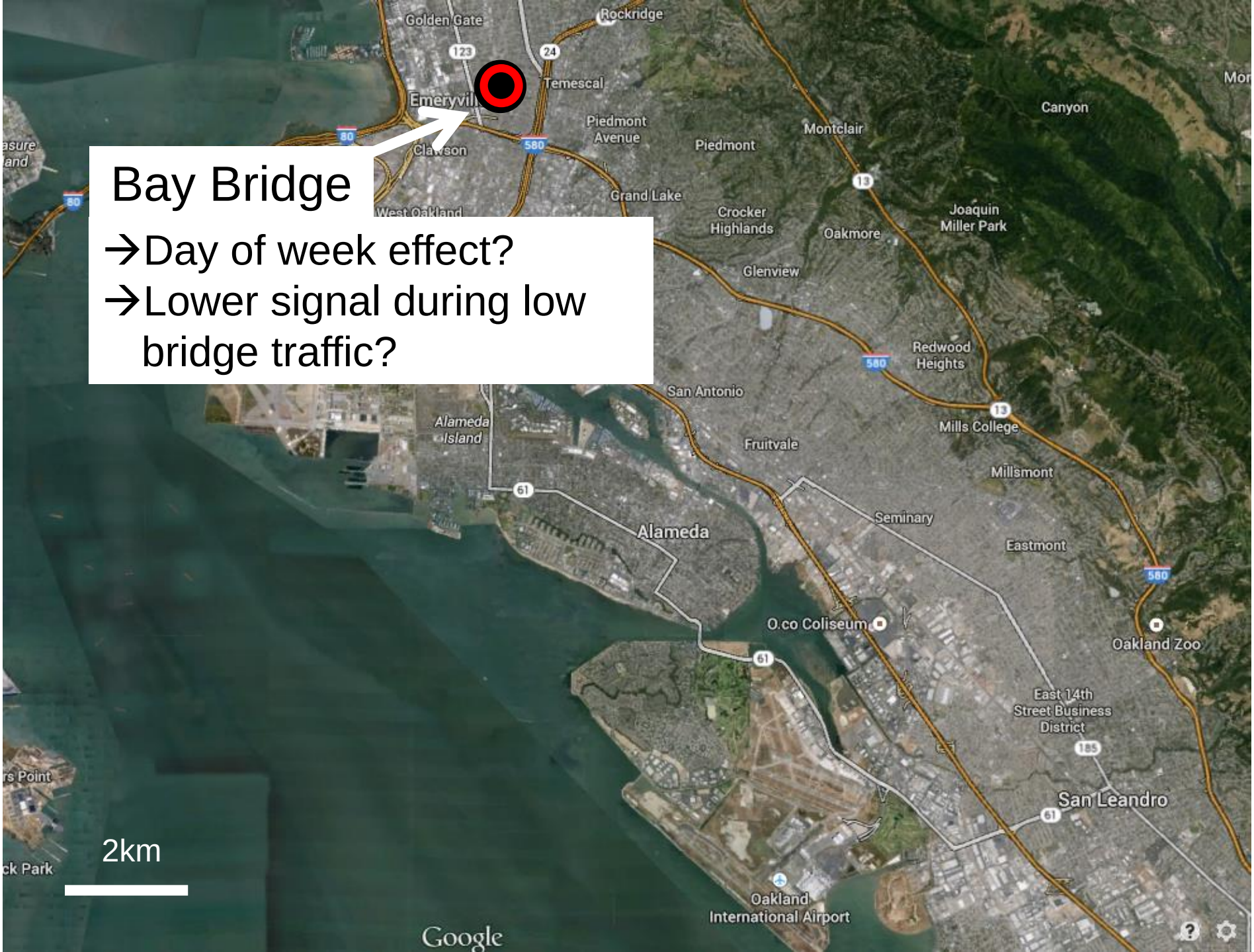
BEACO$_2$N CO$_2$ 2013



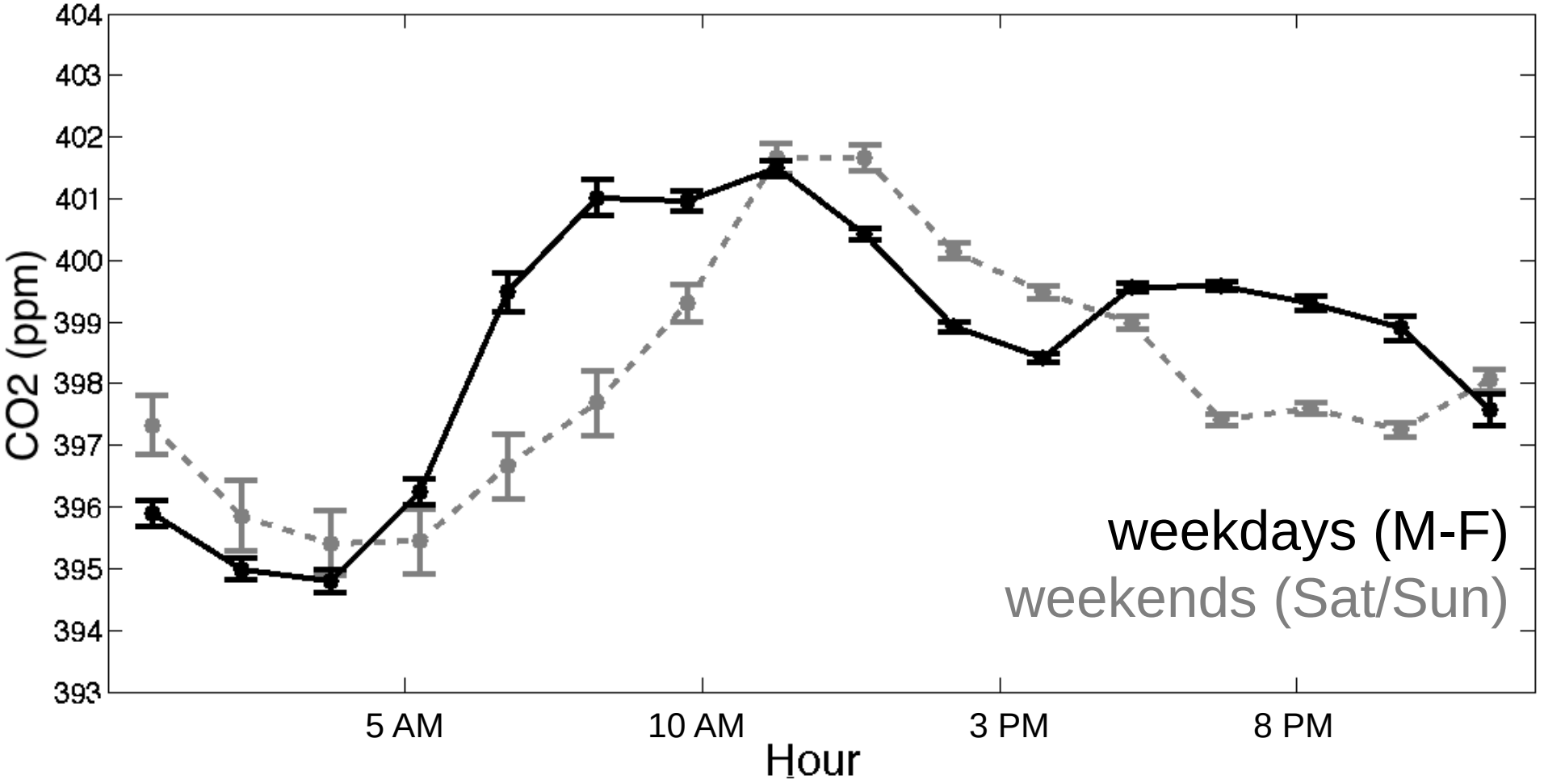
Sites:

Burckhalter
Prescott
Laurel
Kaiser
CollegePrep
Korematsu
ODowd
StLiz
HeadRoyce
ElCerrito
NOakland

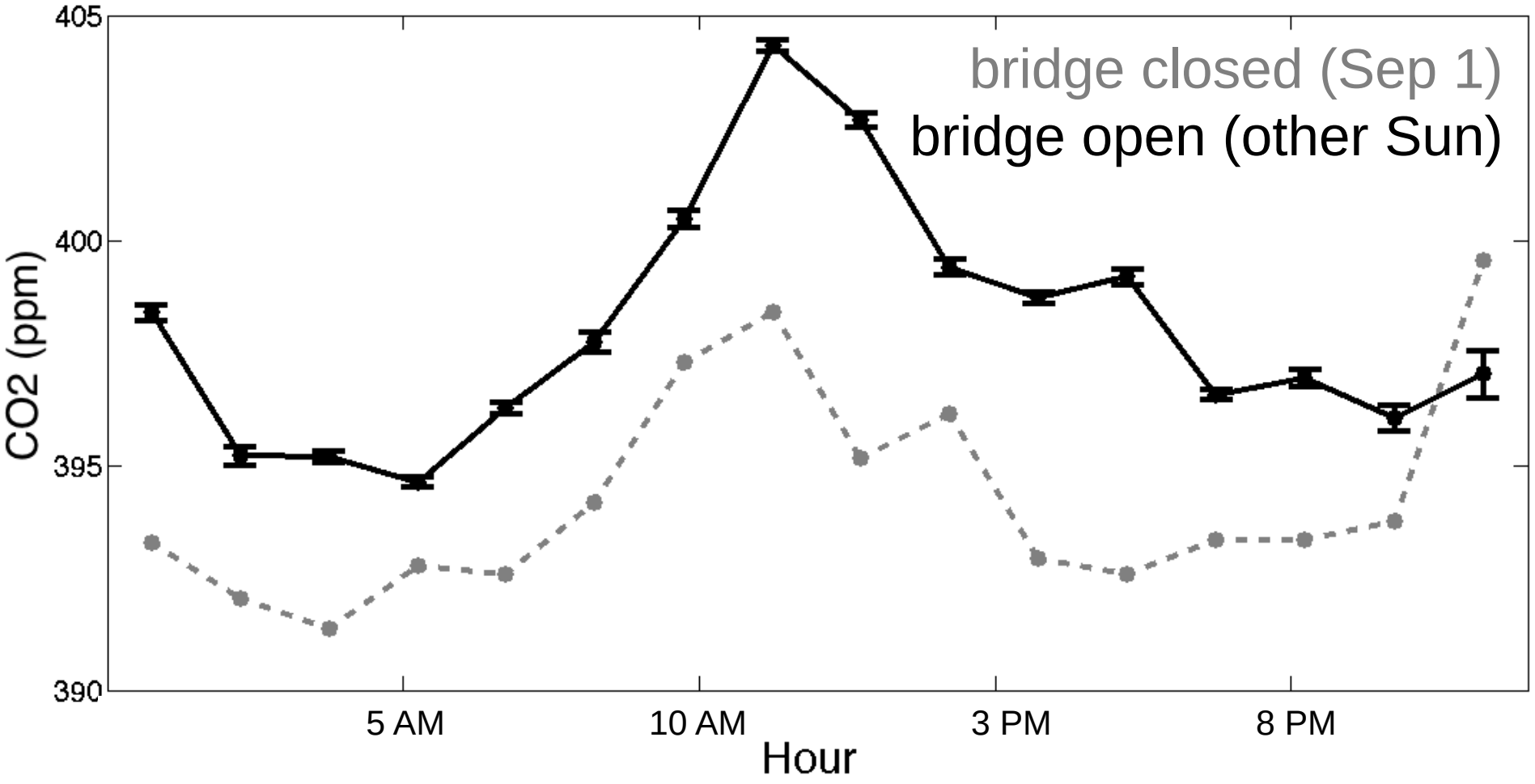

Downwind of Bay Bridge
Downwind of Port of Oakland
wind
2km
Google
Golden Gate
Rockridge
Emeryville
Clawson
West Oakland
Oakland
Canyon
Joaquin Miller Park
Oakmore
Glenview
Redwood Heights
Mills College
Millsmont
Seminary
Eastmont
Alameda
O.co Coliseum
Oakland Zoo
East 14th Street Business District
San Leandro
Oakland International Airport

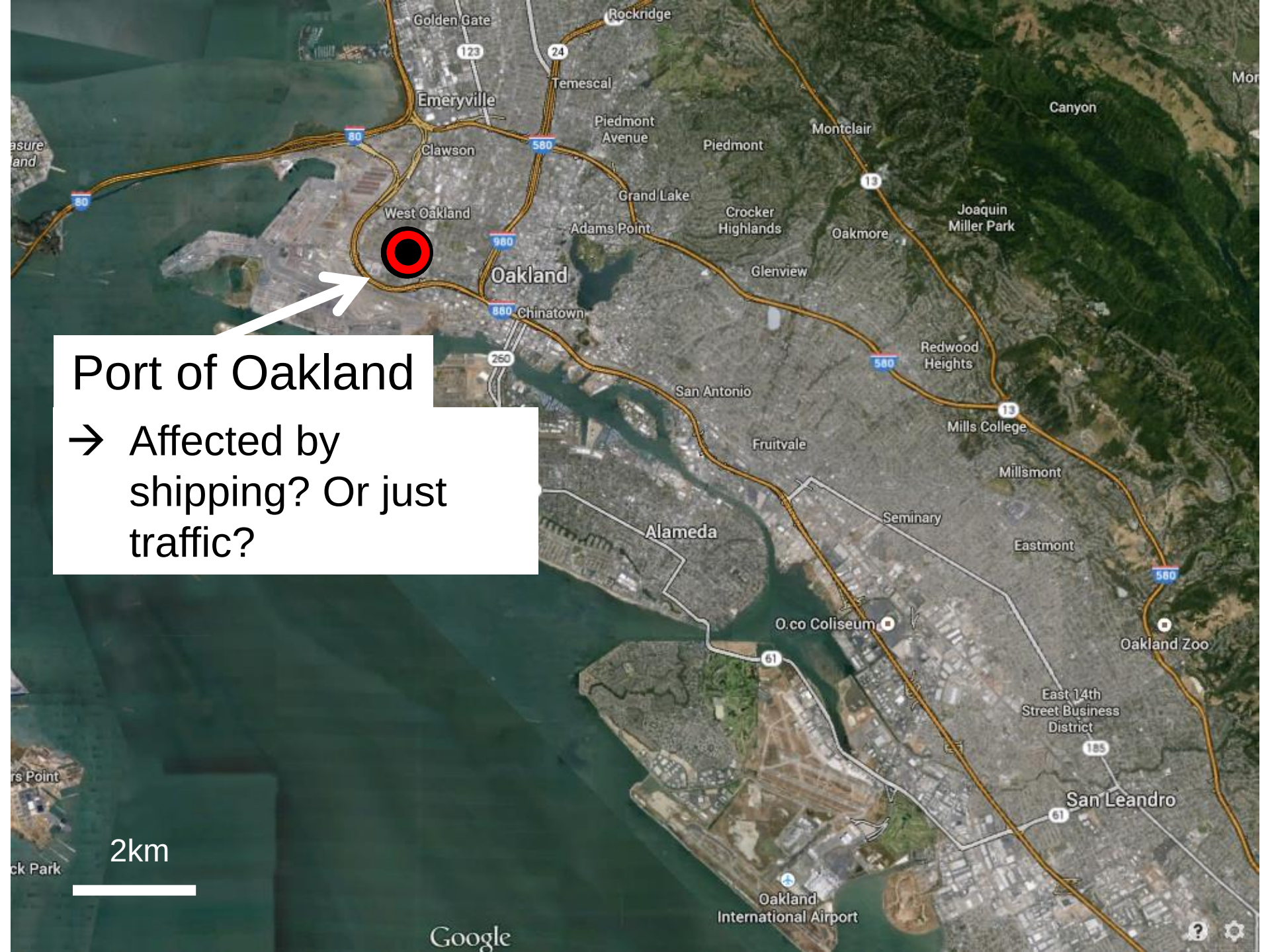

Bay Bridge
→Day of week effect?
→Lower signal during low bridge traffic?
Golden Gate
Rockridge
Temescal
Emeryville
Piedmont Avenue
Piedmont
Montclair
Canyon
Clawson
Grand Lake
West Oakland
Crocker Highlands
Oakmore
Joaquin Miller Park
Glenview
Redwood Heights
San Antonio
Alameda Island
Fruitvale
Mills College
Millsmont
Seminary
Alameda
Eastmont
O.co Coliseum
Oakland Zoo
East 14th Street Business District
San Leandro
Oakland International Airport
2km
Google

Bay Bridge Aug/Sept Diurnal Cycle

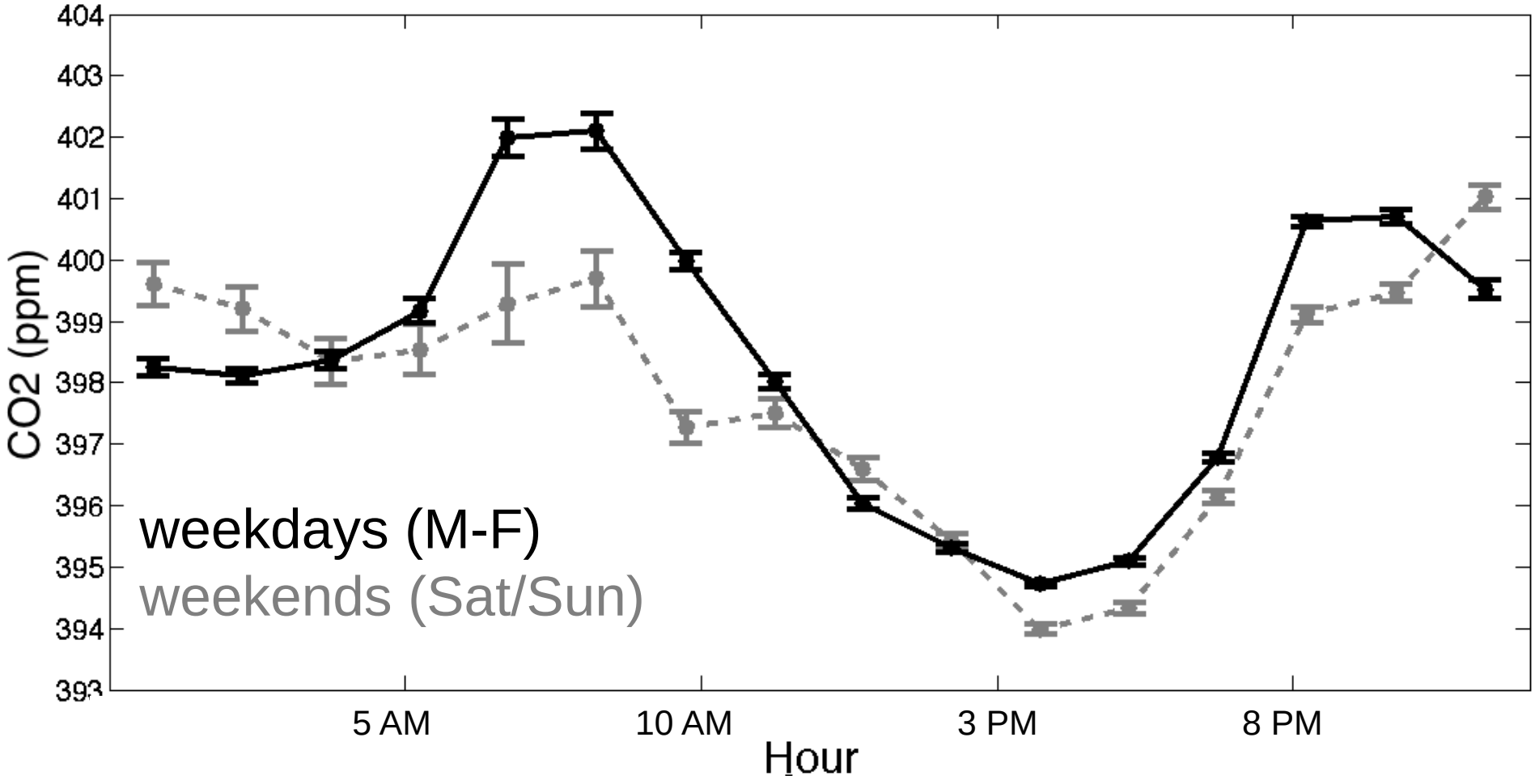


Bay Bridge Closure Diurnal Cycle

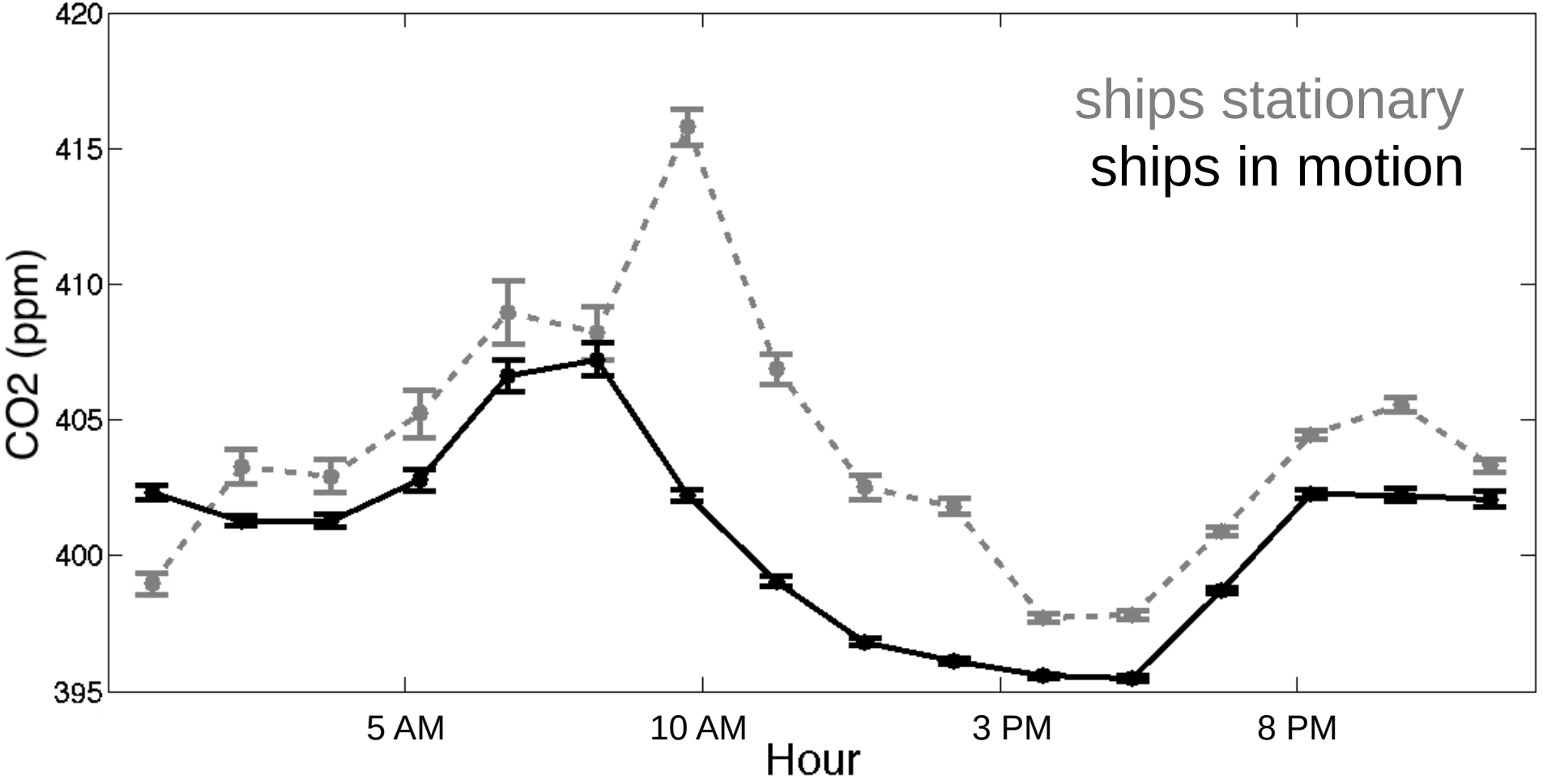



Port of Oakland
→ Affected by shipping? Or just traffic?
Golden Gate
Rockridge
Temescal
Emeryville
Piedmont Avenue
Piedmont
Montclair
Canyon
Clawson
Grand Lake
West Oakland
Adams Point
Crocker Highlands
Oakmore
Joaquin Miller Park
Oakland
Glenview
Chinatown
Redwood Heights
San Antonio
Mills College
Fruitvale
Millsmont
Seminary
Alameda
Eastmont
O.co Coliseum
Oakland Zoo
East 14th Street Business District
San Leandro
Oakland International Airport
2km
Google

Port Aug/Sept Diurnal Cycle



Port Diurnal Cycle by Ship Movement




☑ Sensitivity
☑ Spatial Resolution
☑ Temporal Resolution
2km
Google
Golden Gate
Rockridge
Temescal
Emeryville
Piedmont Avenue
Piedmont
Montclair
Canyon
Clawson
Grand Lake
West Oakland
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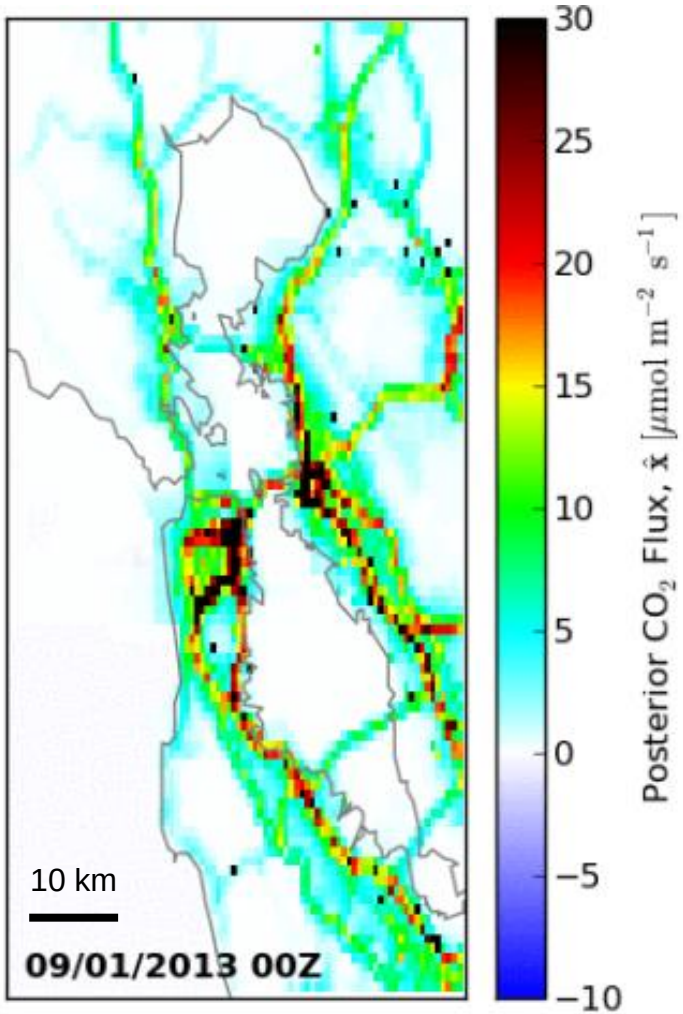
Seminary
Eastmont
O.co Coliseum
Oakland Zoo
East 14th Street Business District
San Leandro
Oakland International Airport

Interpreting the observations



c/o Alex Turner

WRF-STILT

$$Kx + \varepsilon = y$$

forward 

y = concentrations ($BEACO_2N$ observations)

x = emissions

K = “footprint” mapping from x to y

ε = error

WRF-STILT

$$Kx + \varepsilon = y$$

forward →

← inverse

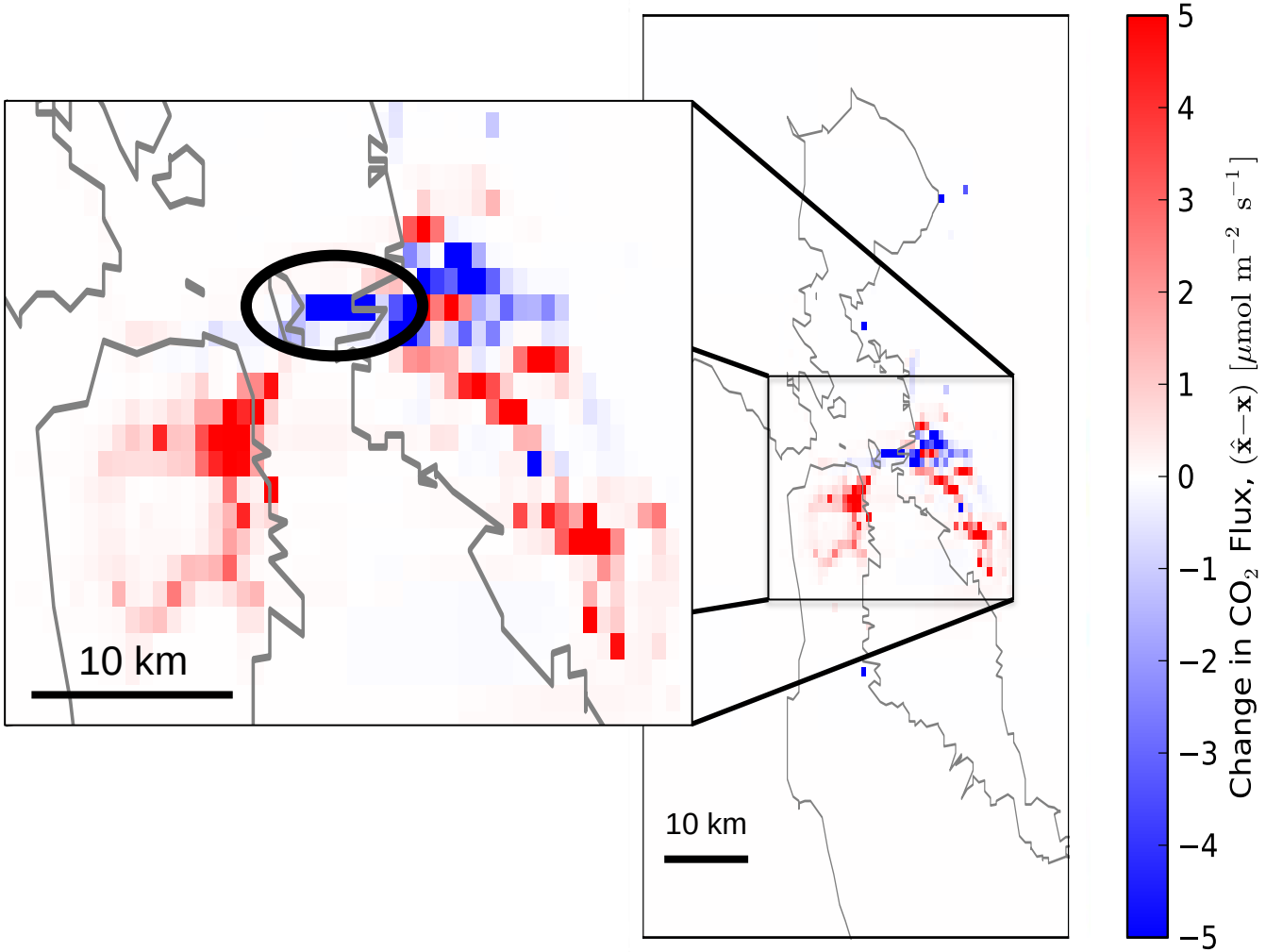
y = concentrations (BEACO$_2$N observations)

x = emissions

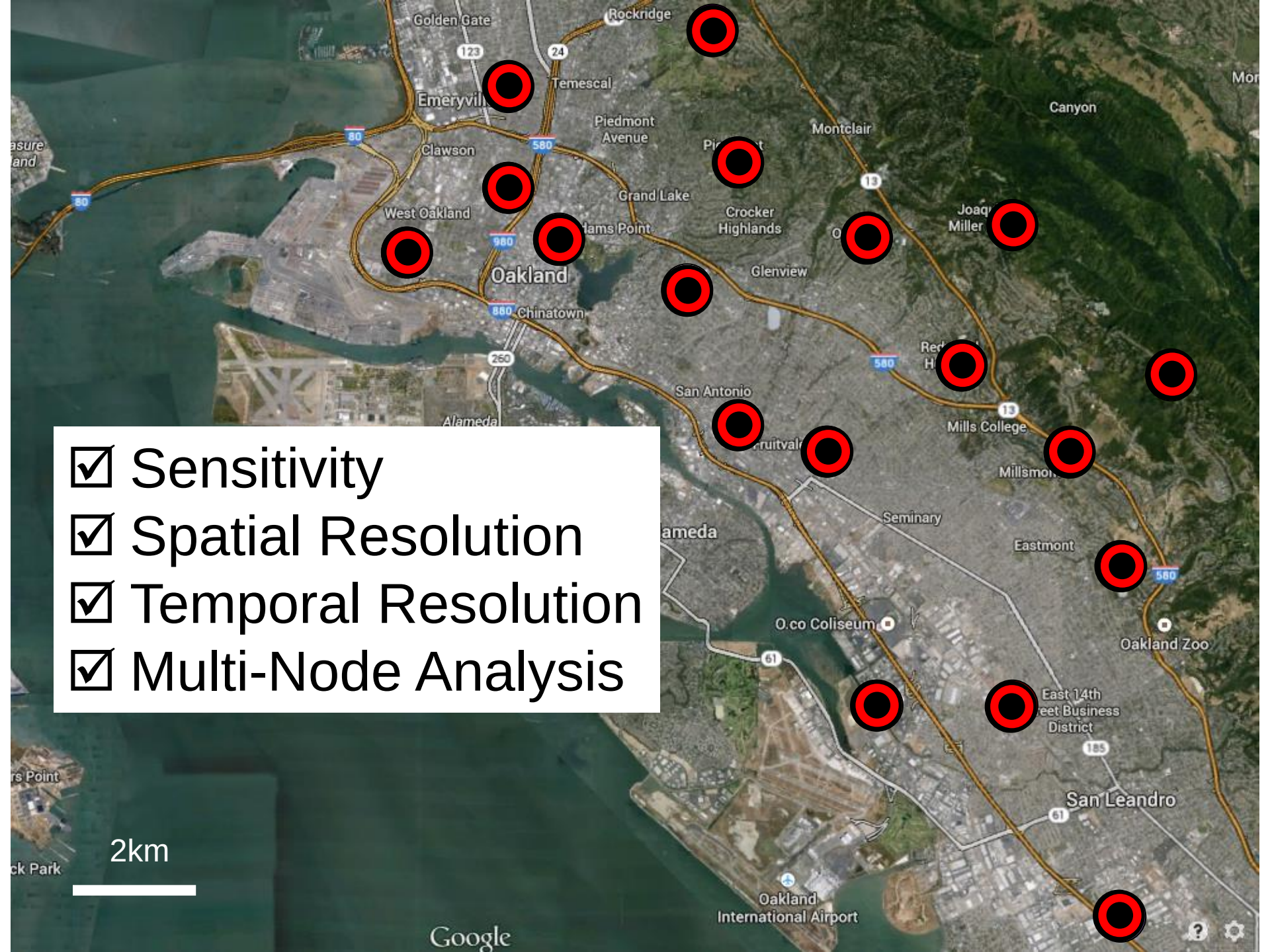
K = “footprint” mapping from x to y

ε = error

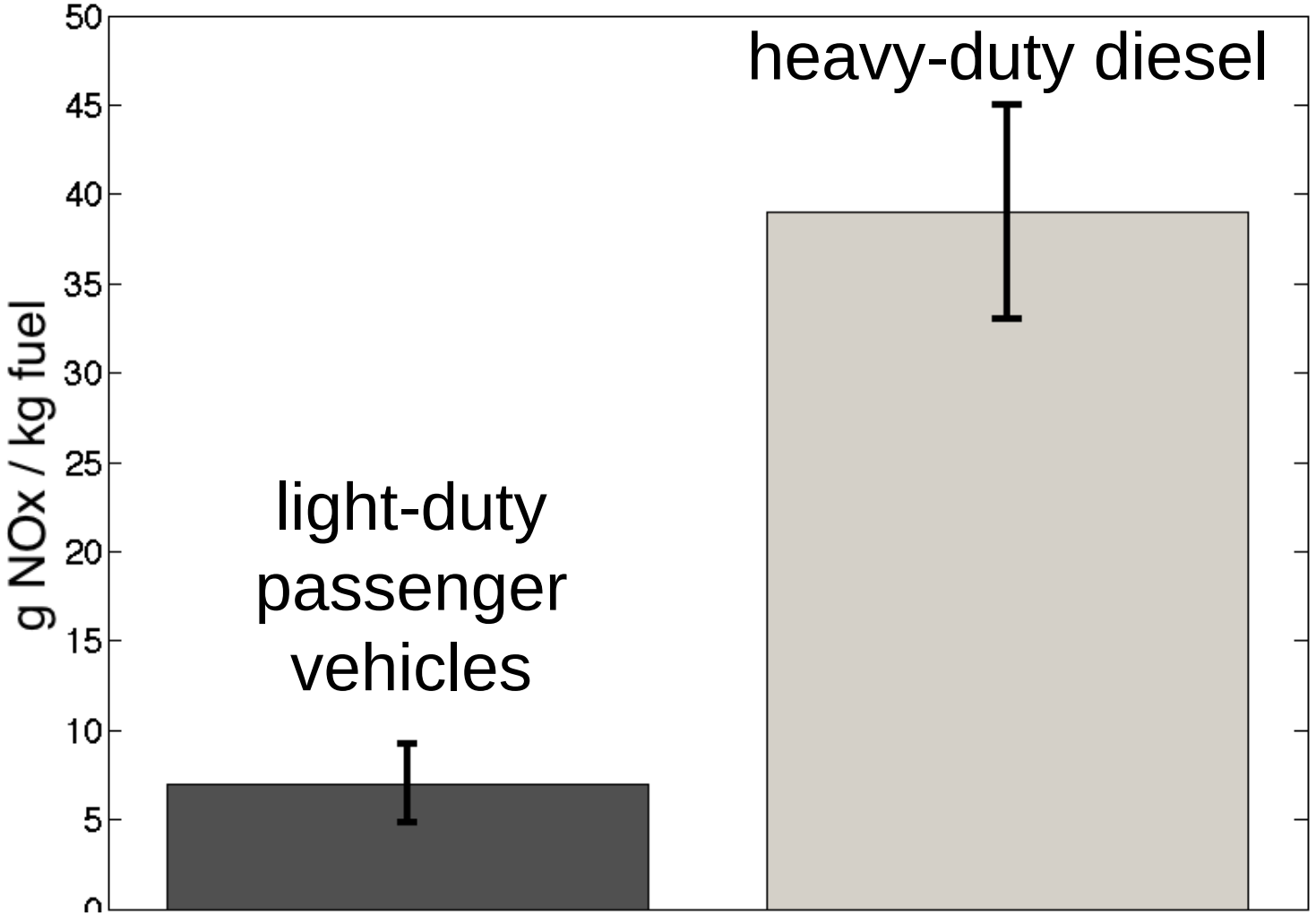
WRF-STILT for day bridge was closed



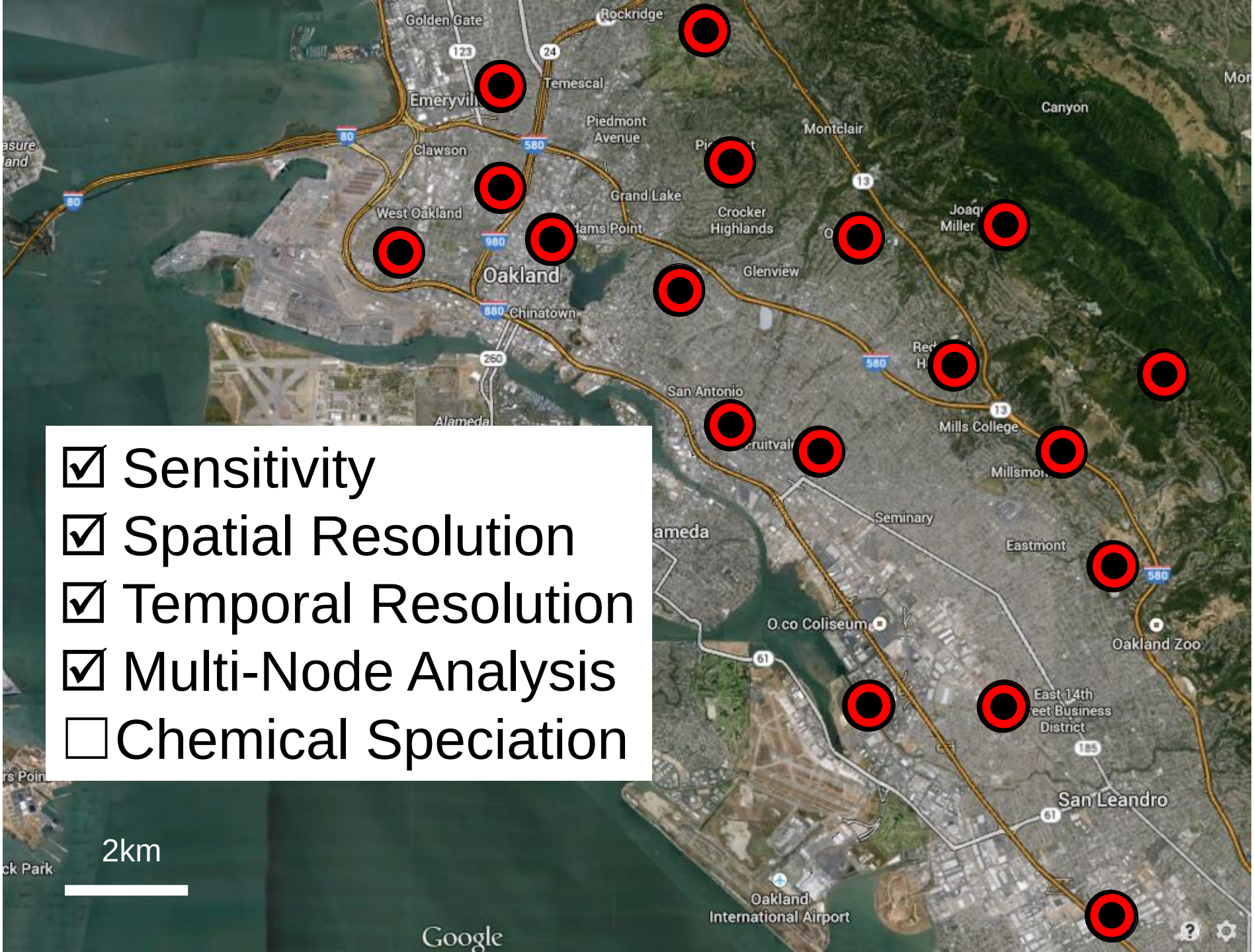
c/o Alex Turner


☑ Sensitivity
☑ Spatial Resolution
☑ Temporal Resolution
☑ Multi-Node Analysis
2km
Google

1999-2000 Emissions Factors



Harley et al. 2005


☑ Sensitivity
☑ Spatial Resolution
☑ Temporal Resolution
☑ Multi-Node Analysis
☐ Chemical Speciation
2km
Google
Golden Gate
Rockridge
Temescal
Emeryville
Piedmont Avenue
Montclair
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Clawson
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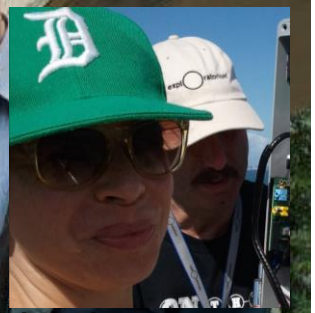
Eastmont
O.co Coliseum
Oakland Zoo
East 14th
District
San Leandro
Oakland International Airport

Thank you!

Jill Teige

Alex Turner



Catherine Newman

Alexis Shusterman David Holstius

Jill Teige

Alex Turner

Catherine Newman

Thank you!