

Potential Applications of μ PEMS and Remote Sensing Devices

7th Portable Emissions Measurement System (PEMS)
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Collaboration

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Background

- › Light duty vehicles... Significant progress has been made PFIs, but new technologies important.
- › Heavy duty (HD on-road). Programs are needed
- › Heavy duty (HD non-road). Construction, marine, locomotive...
- › Other

Light duty I/M with RSD methods

- › Failure Modes: Age, Off-cycle, Defeat device
- › I/M can capture, aging and defeat devices, but off cycle may be complex.
- › Combine with PEMS/PAMS for complete picture
- › Distributed EDAR may also be an option for off-cycle



Active Project: On-Road HD I/M

- HD vehicles represent 33% of NO_x, 26% of PM, and 8% of GHG emissions from motor vehicles.
- California has an existing heavy-duty vehicle Inspection and Maintenance program (HDVIP) and a Periodic Smoke Inspection Program (PSIP).
 - Snap-acceleration opacity testing (SAE J1667)
 - Vehicle and emission control label (ECL) inspections
- California needs a more comprehensive HD I/M program.
 - Updated for modern trucks with aftertreatment and on-board diagnostics
 - Test for multiple pollutants

On-road I/M Objective

- ▶ The objective of this study is to evaluate and assess various potential approaches and technologies for a more comprehensive HD I/M program that could be implemented in California.

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Overview of Project Tasks

- › Task 1: Perform a literature review
- › Task 2: Demonstration
- › Task 3: Cost, benefit, and emissions analysis



Pilot I/M Program – Chassis Dyno Testing

Test Sequence	
Vehicle 3 minutes warm up @ 60 mph	
Dyno 50 mph @ 200 hp	
1 minute @ 50 mph	Collect Emissions
Dyno 30 mph @ 100 hp	
1 minute @ 30 mph	Collect Emissions
2 minutes Idle @ 600 rpm	Collect Emissions
1 minute High Idle @ 1800 rpm	Collect Emissions
Opacity	Triplicate tests



Vehicle on the dyno

Pilot I/M Program – Instrumentation

Maha



Pegasor Mi3



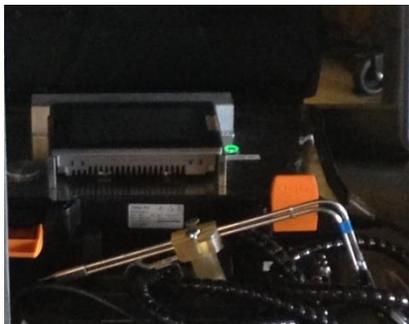
TSI NPET



Instrument List

Instrument	Measure
Maha	NO _x , CO ₂ , PM
Pegasor	PM
TSI NPET	Solid PN
Testo	PN
parSYNC	NO _x , CO ₂ , PM
NTK	NO _x , PM, AFR, PN

Testo



parSYNC



NTK



Note: Pegasor, NPET, and parSYNC were only used for the first two weeks of testing.

Pilot I/M Program: HEAT EDAR & CARB PEAQS*

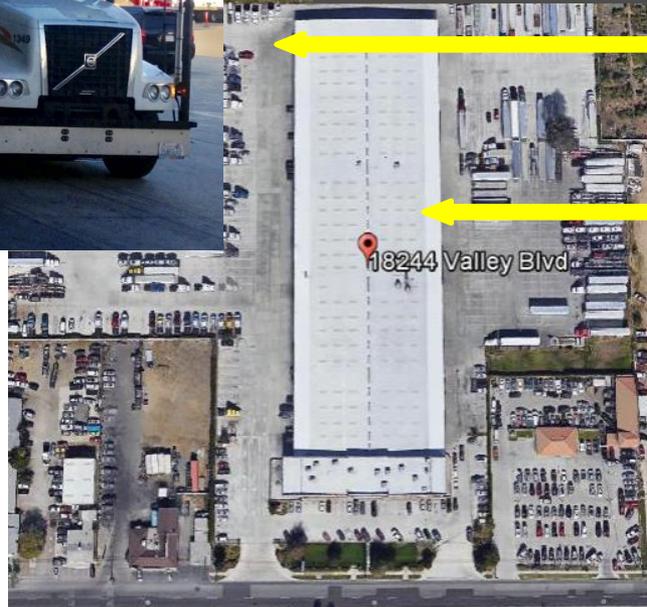
EDAR



PEAQS



Locations



PEAQS

EDAR

**CARB's Portable Emissions
Acquisition System (PEAQS)
evaluation will not be part of CE-CERT
report*

On-Road I/M Observations

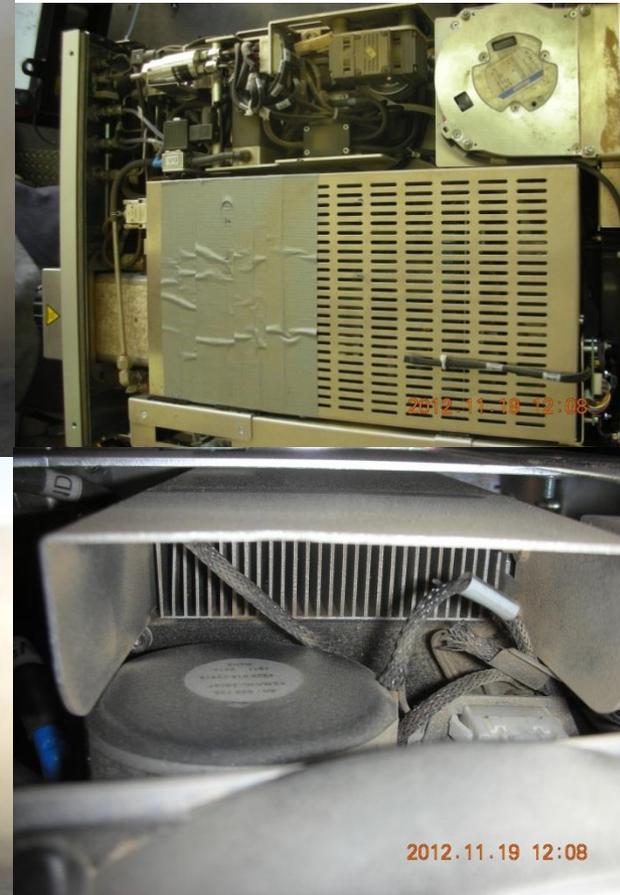
- ▶ Some truckers are declining diagnostic scans, even with an active MIL, based on cost.
- ▶ Some truckers are also declining emissions-related repairs, some even with active MILs.
- ▶ DPF cleaning is frequently conducted in conjunction with other repairs.
 - ▶ Many repairs involve more than one system/component

Non-Road I/M is Needed Also

- ▶ PEAKS or RSD would take the unit off line
- ▶ Construction works very demanding (tell them were to go?)
- ▶ Other options?



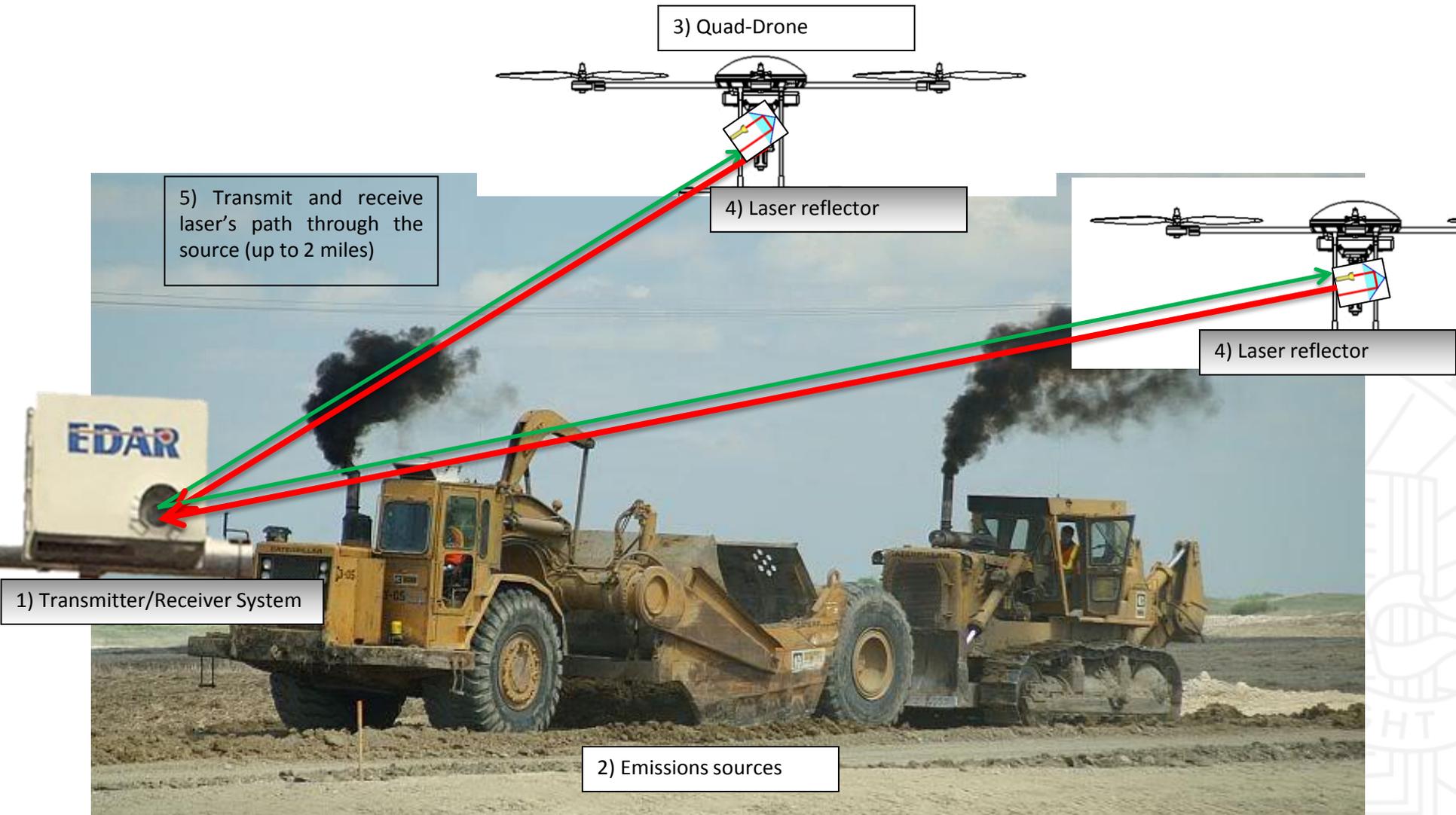
Non-Road Measurement Biases



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- Imagine the PM contamination on this test! Best I/M?

Non Road: Next Generation of I/M



Marine Testing Even More Complex

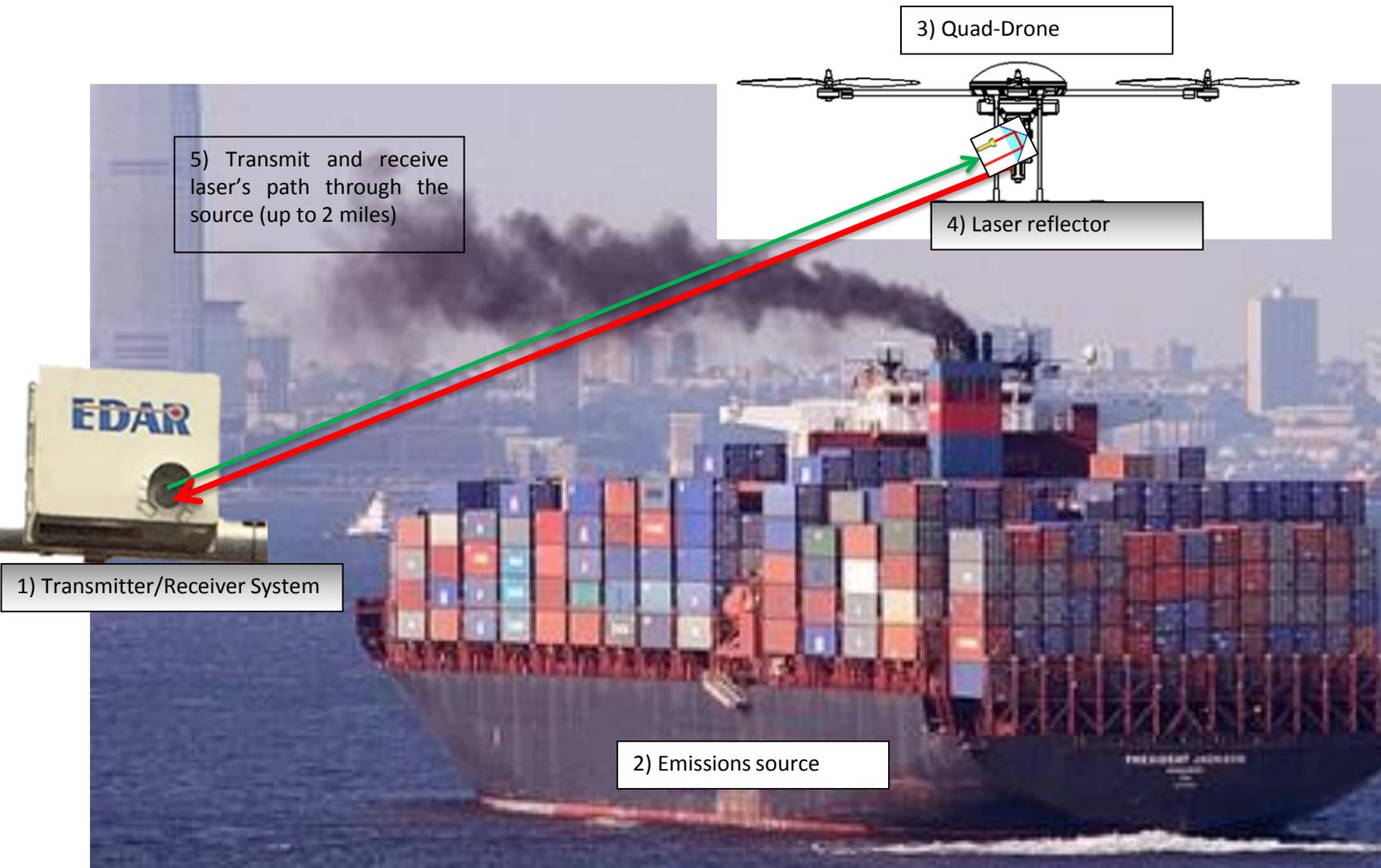


- ▶ Permissions to board
- ▶ Long routes
- ▶ Logistics complex
 - ▶ Homeland security
 - ▶ Customs
 - ▶ Combustible gases
- ▶ Setup very long

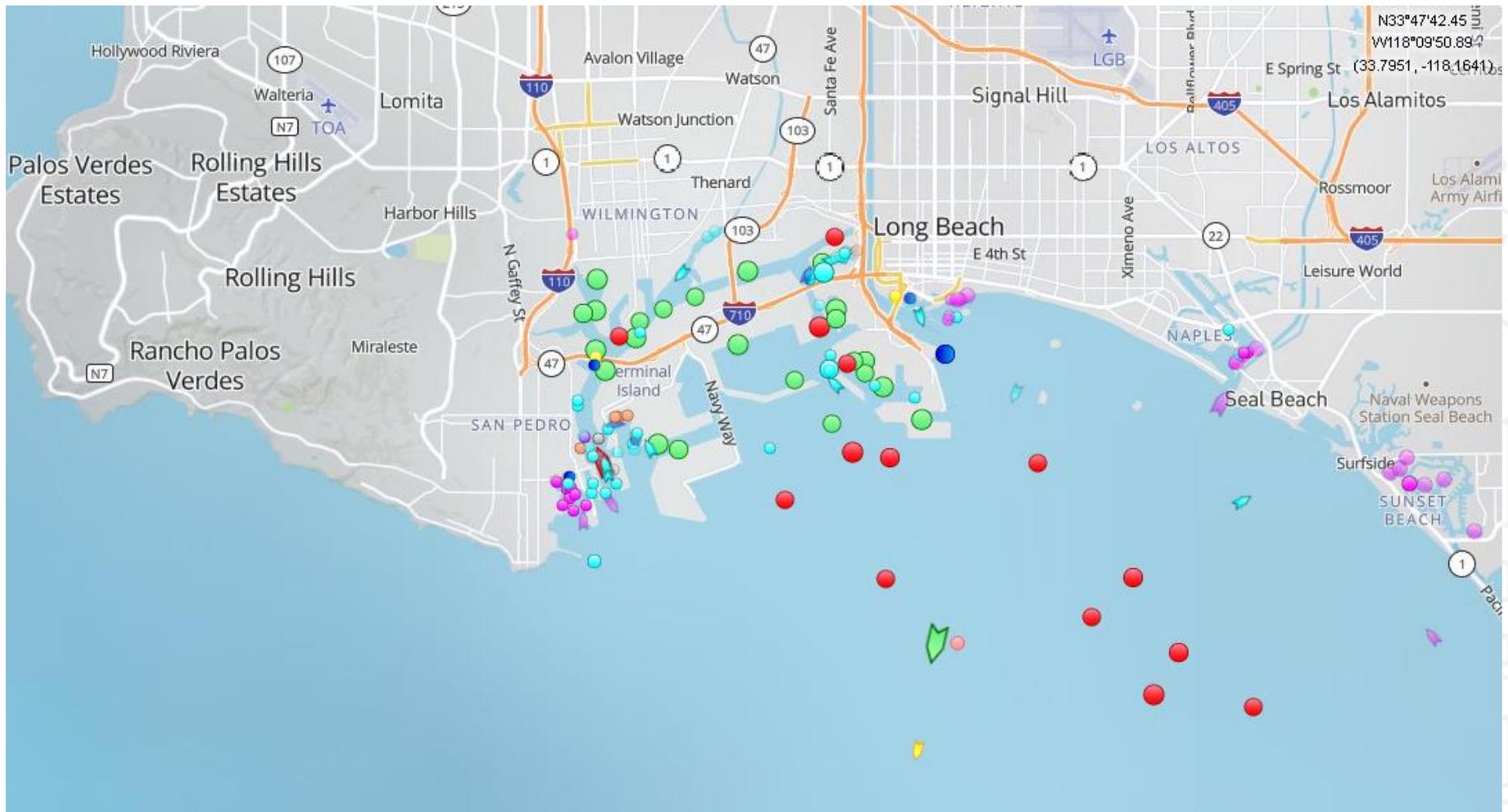


Simultaneous source sampling and plume sampling

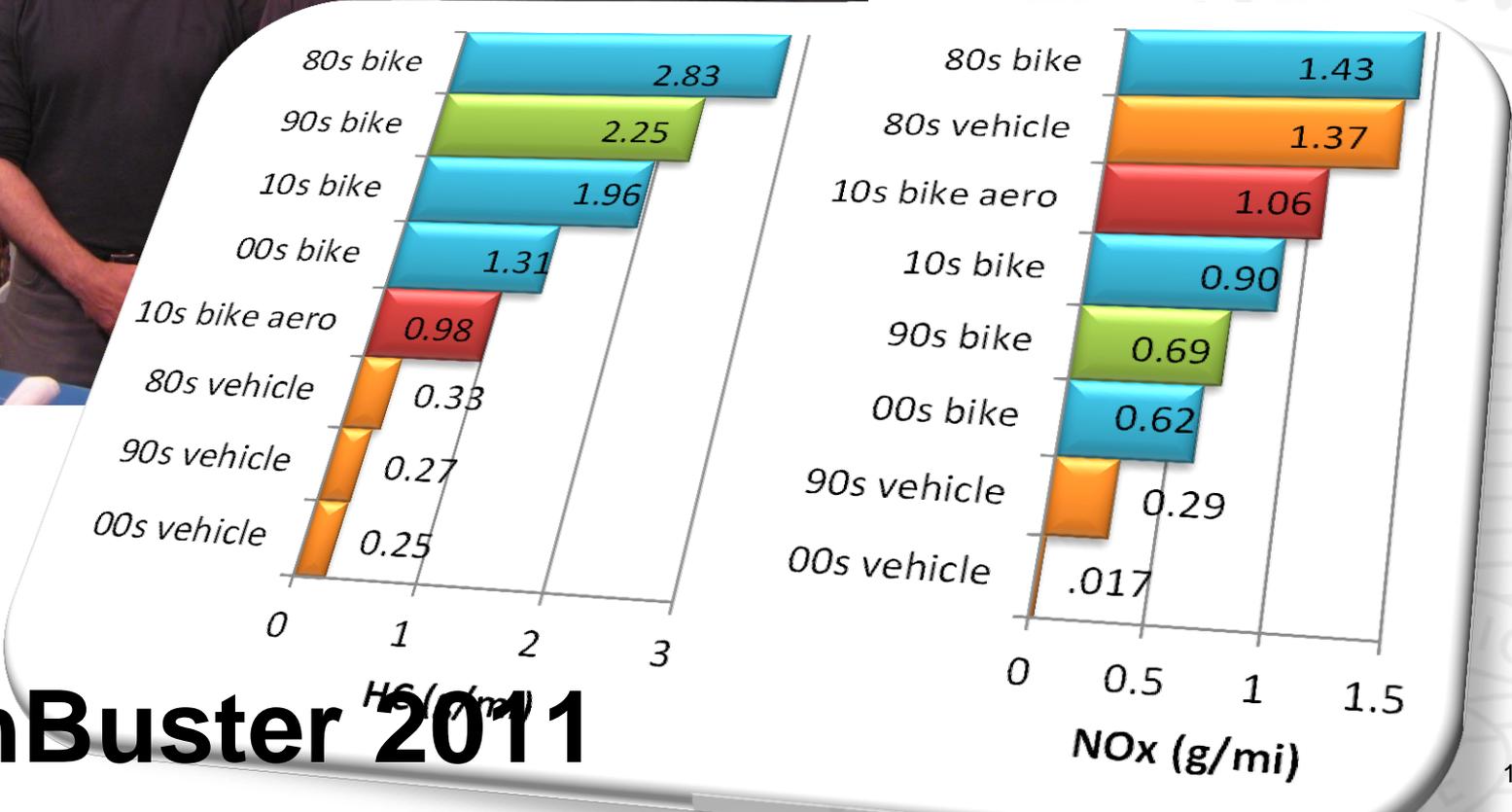
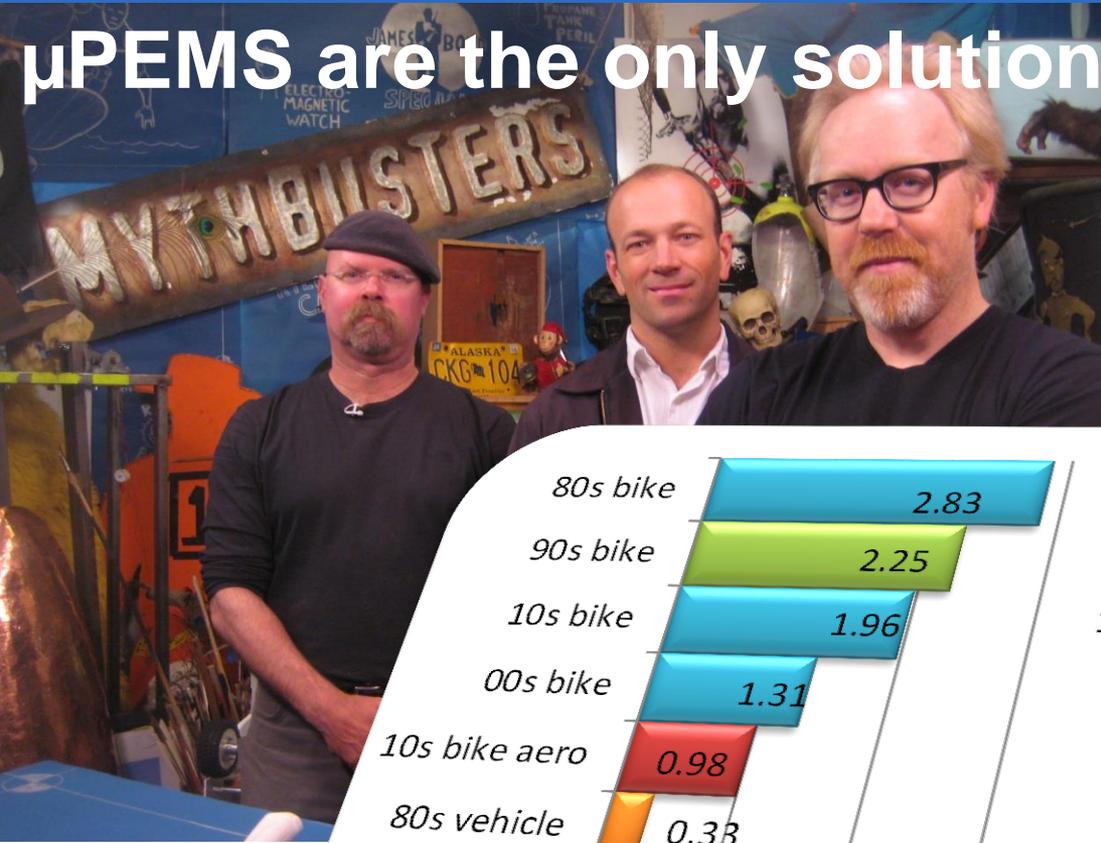
Marine: Next Generation of I/M



Marine Testing with Drones Could Cover Large Areas and Low Cost



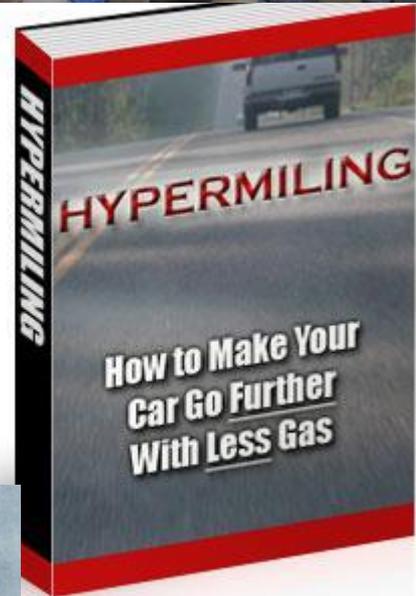
μ PEMS are the only solution here!



MythBuster 2011

uPEMS would not work well

Go around me
I'm
Hypermiling



MythBusters 2012

<http://www.cert.ucr.edu/events/pems2014/>



Summary

- › On-road many tools available
- › Non-road tools more limited
- › Marine even more complex and limited
- › Other: Aircraft, restaurants?

