California-Mexico 2030 Summit

Freight Mobility Living Laboratory (FML2)

For Truck Identification, Classification & Activity Monitoring

April 19, 2023

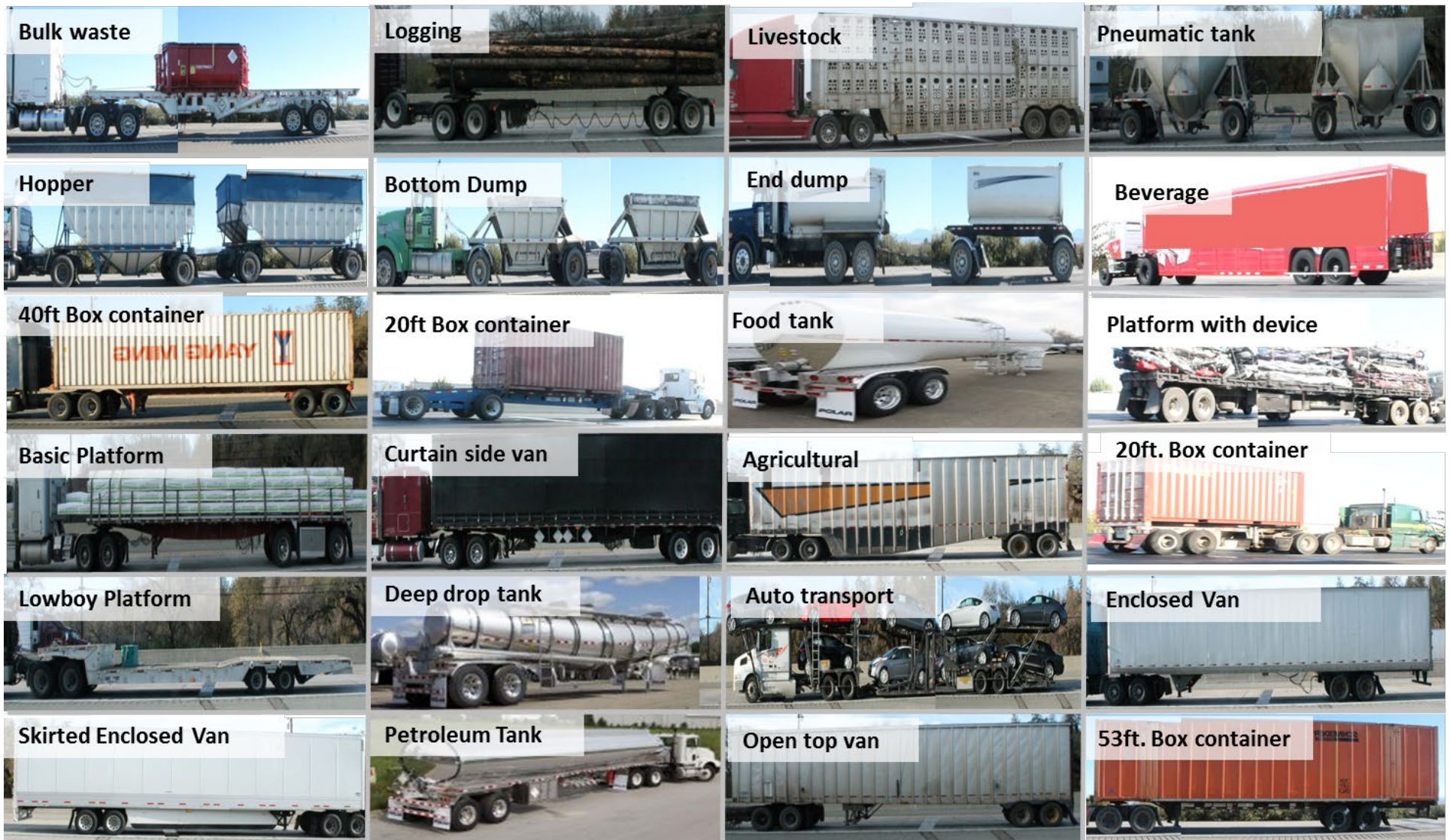
Stephen Ritchie
Director, Institute of Transportation Studies and
Professor of Civil and Environmental Engineering
University of California, Irvine

Sample of Our Truck Freight Transport Research

- FML2 – Freight Mobility Living Laboratory
- TAMS – Truck Activity Monitoring System
- FLEET – Fleet Electrification and Energy Technology model (for grid interactions)
- Alternative Fuel Choice and Adoption Behavior in Heavy-Duty Vehicle Fleets
- Low-Carbon Transportation Incentive Strategies Using Performance Evaluation Tools for Heavy-Duty Trucks and Off-Road Equipment
- Impacts of zero emission connected & autonomous drayage trucks on I-710 (Prof Saphores & Dr Monica Ibarra)
- Monitoring Out-of-State Trucks Entering California at Major Gateways
- Truck Data Collection Using LiDAR Sensing Technology
- California Truck Data Collection Improvement Project
- Air pollution & health impacts of shifting San Pedro Bay Port's freight from truck to rail in Southern California
- California Natural Gas Vehicle Incentive Project
- Initial pilot for California heavy duty vehicle inventory and use survey (Cal-VIUS)
- California Statewide Freight Forecasting Model

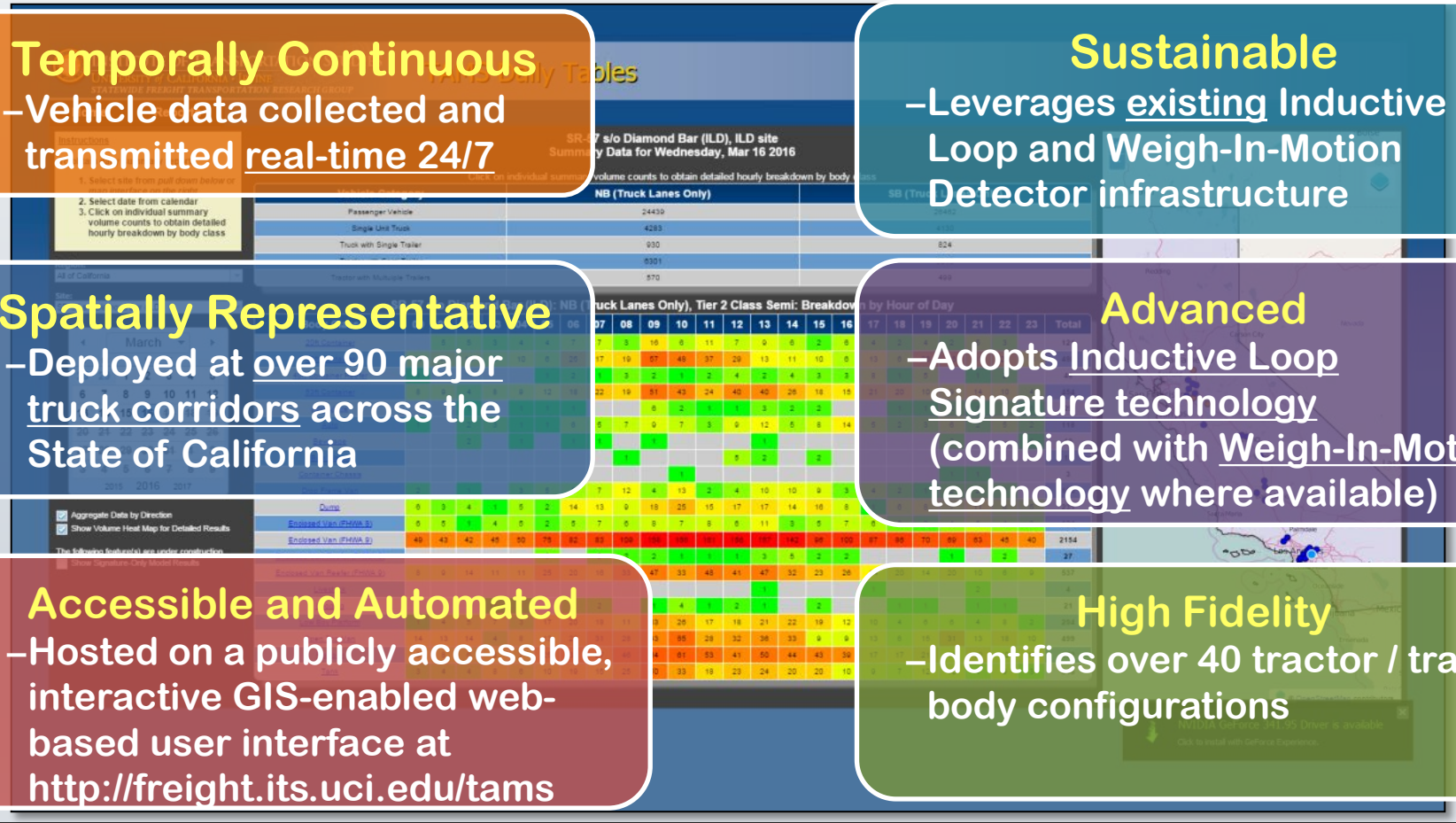
Truck Configurations

Trailer Configurations



Truck Activity Monitoring System (TAMS)

A heavy duty vehicle classification & counting system that is…



Temporally Continuous
–Vehicle data collected and transmitted real-time 24/7

Sustainable
–Leverages existing Inductive Loop and Weigh-In-Motion Detector infrastructure

Spatially Representative
–Deployed at over 90 major truck corridors across the State of California

Advanced
–Adopts Inductive Loop Signature technology (combined with Weigh-In-Motion technology where available)

Accessible and Automated
–Hosted on a publicly accessible, interactive GIS-enabled web-based user interface at http://freight.its.uci.edu/tams

High Fidelity
–Identifies over 40 tractor / trailer body configurations

The Next Generation of TAMS:
Freight Mobility Living Laboratory (FML2)

FML2 is an open innovation ecosystem for exploring field deployment of innovative technologies for freight data collection

Real-time, scalable system

Provides tractor/trailer body type, axle class, GVWR class, and truck counts, speeds, and weights (at WIM stations), and Automated License Plate Recognition (ALPR) and LiDAR analytics

- Freight planning & policy
- Environmental analysis (truck model, year, fuel type, emission characteristics)
- Freight system management & operations
- Federal & state reporting
- Pavement design

FML2 Deployment

126 total sites (95 = original TAMS sites)

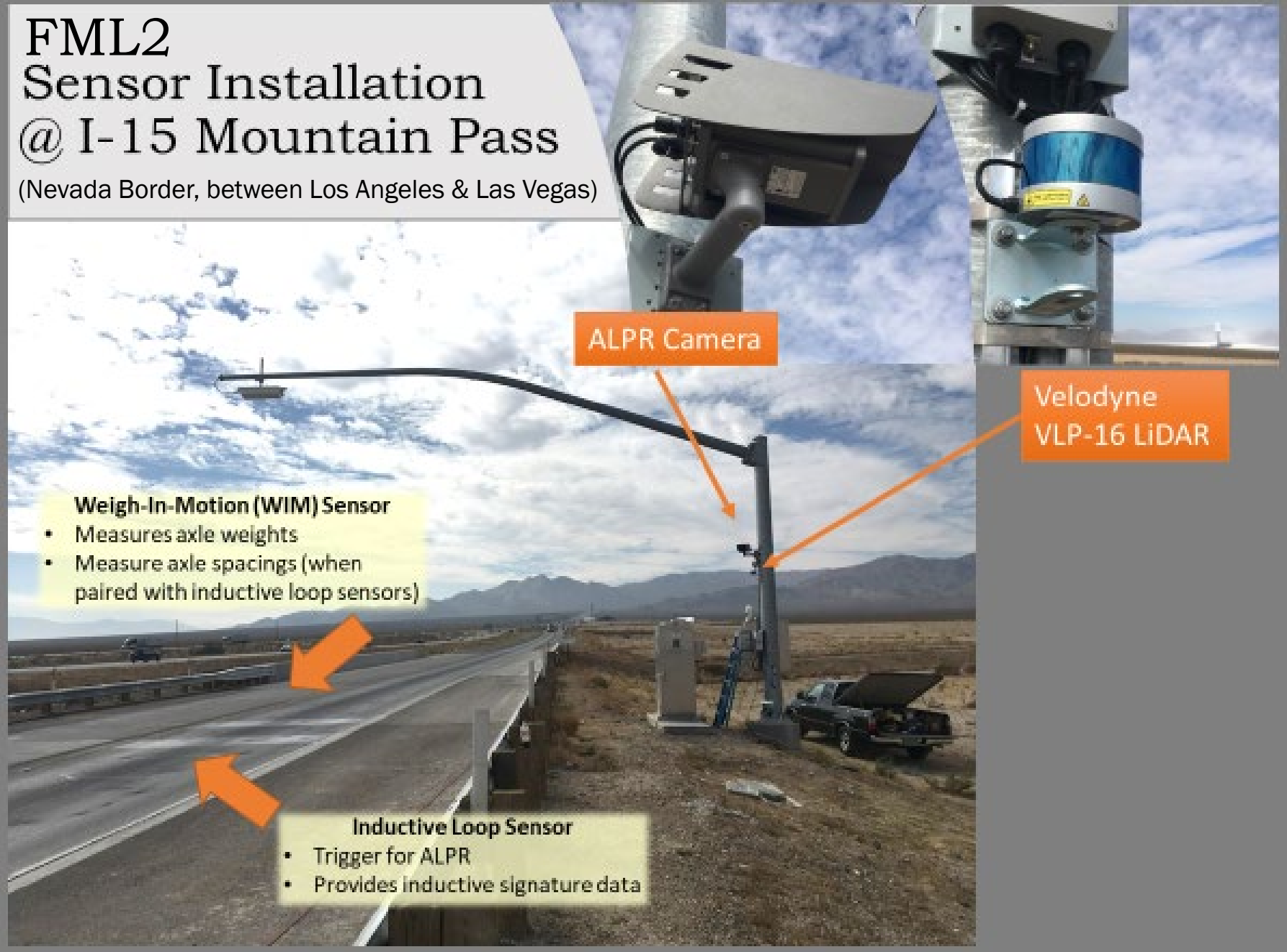
Currently: 36 active sites
- 4 with stationary side-fire LiDAR
- 10 with ALPR

Spans 7 counties mostly in S CA

In 2023:
- Caltrans District 8 (“Inland Empire”) deploying about 80 new sites, serving as operational sites for D8, and research sites for ITS
- ITS will deploy additional TAMS & ALPR & LiDAR sites in Central Valley, and near the Ports of Los Angeles/Long Beach (in new Caltrans and CARB research projects)
- ITS also now expanding FML2 to rail freight and incoming locomotive identification at border gateways

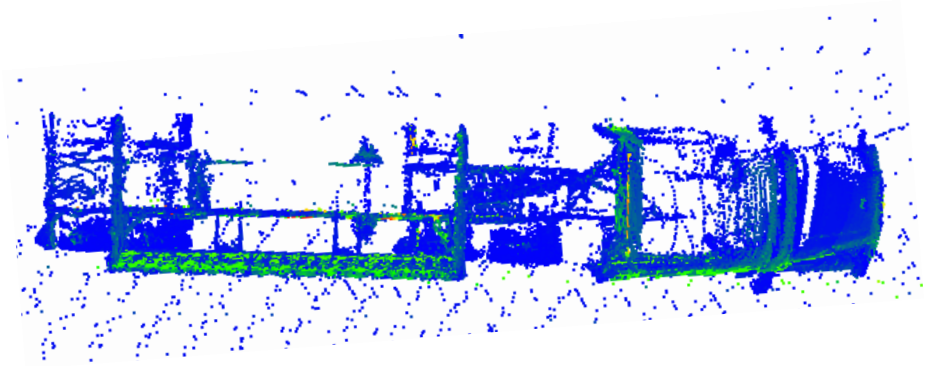
FML2
Sensor Installation @ I-15 Mountain Pass

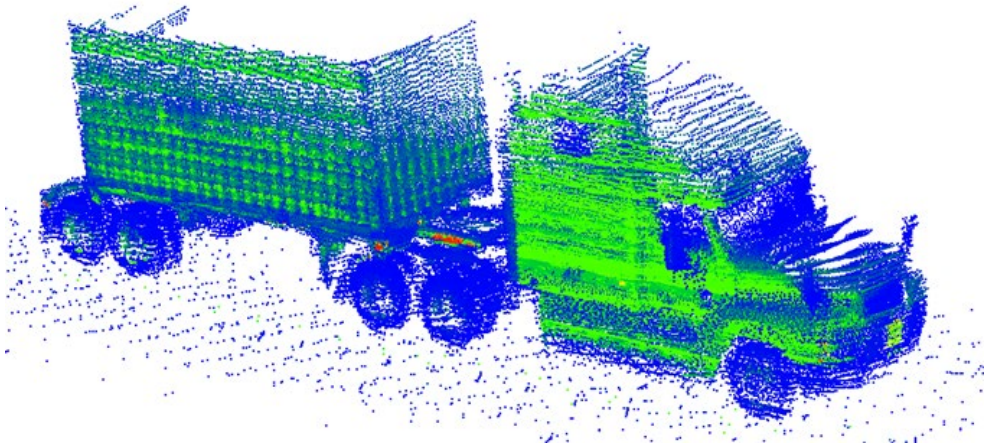
(Nevada Border, between Los Angeles & Las Vegas)



Example FML2 LiDAR Truck Images

(least costly, relatively low resolution LiDAR)





Mexico-California Border Annual Truck Crossings

(from US DOT, and US Customs & Border Protection)

https://explore.dot.gov/views/BorderCrossingData/Annual?%3Aembed=y&%3AisGuestRedirectFromVizportal=y

Border Crossing Entry Data | Annual Data

Year
Multiple values

Border
US-Mexico Border

State
California

Port Name
Multiple values

Measure
Trucks

Measure	Port Name	2009	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Trucks	Calexico East	276,894	312,973	322,424	325,690	325,243	337,474	349,727	360,833	376,079	389,046	393,849	435,253	453,776
	Otay Mesa	684,425	744,929	778,929	769,886	810,193	829,581	899,336	929,614	962,577	948,630	927,714	936,628	1,052,286
	Tecate	65,039	51,930	43,245	47,762	52,239	52,090	56,269	59,128	61,778	65,212	64,587	69,125	65,991

Total = 1,026,358

Total = 1,572,053

65% increase

- Since Global Financial Crisis - 65% increase overall
  - 2022 totals exceed pre-pandemic levels
- FML2 has:
  - Active site & LiDAR testbed on SR-7 at Calexico East
  - TAMS site near Otay Mesa

ALPR Truck Data Summary at Calexico

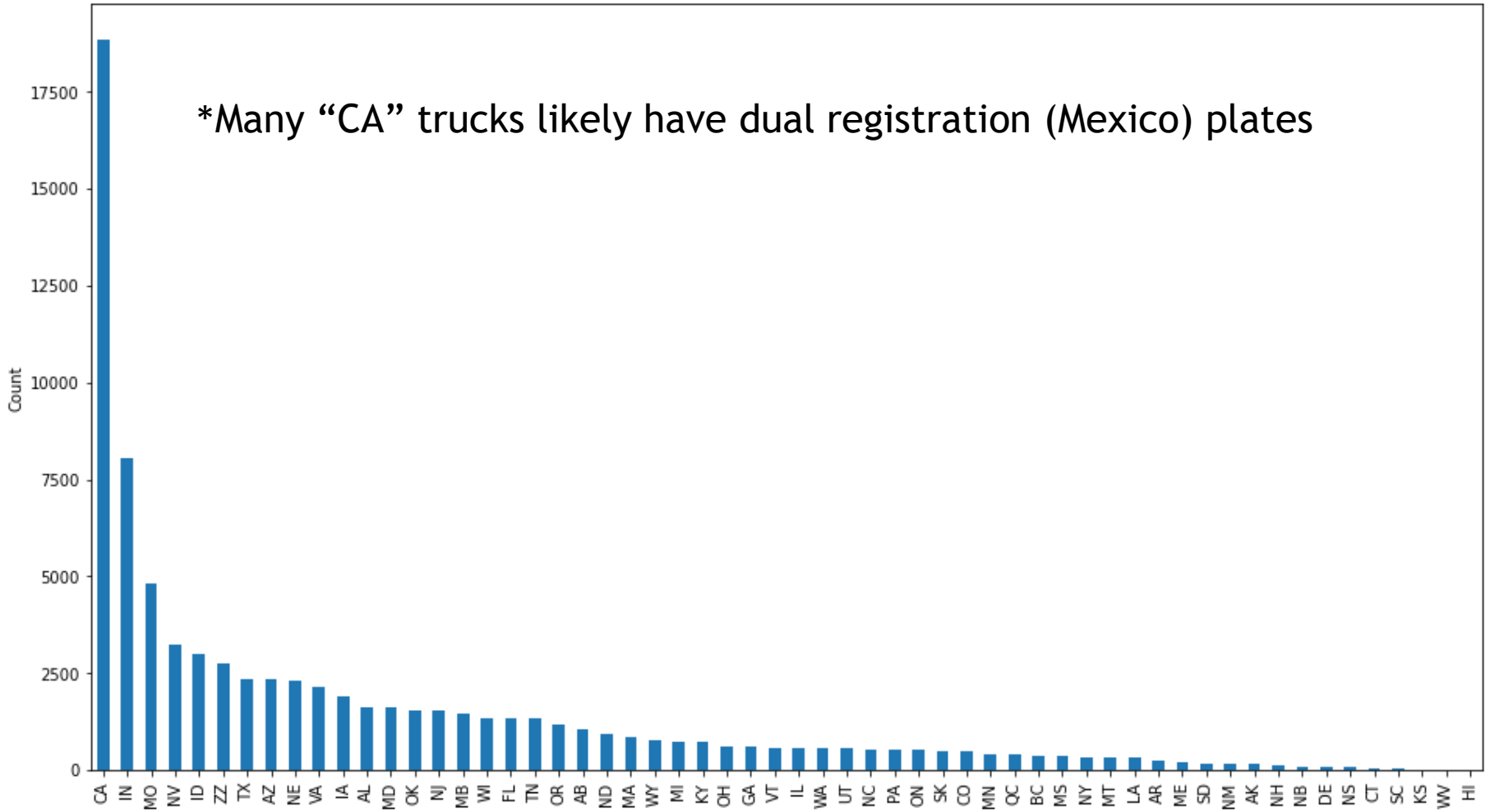
2022 Month	US CBP Truck Count	FML2 Calexico ALPR Total Vehicle Count	FML2 Calexico ALPR Truck Count	FML2 Calexico ALPR Truck Count %
January	35,430	85105	27483	77.6%
February	35,481	81207	29852	84.1%
March	41,547	95659	36213	87.2%
April	36,667	47122	23325	63.6%
May	38,791	90592	32591	84.0%
June	39,269	86271	32149	81.9%
July	37,174	84025	30735	82.7%
August	40,649	76286	27083	66.6%
September	37,682	49717	17461	46.3%
October	37,932	38934	13038	34.4%
November	37,071	71164	25567	69.0%
December	36,083	75028	26926	74.6%
Total	453,776	881,110	322,423	71.0%

- Of the 322,423 reads 79,688 are unique truck reads

2022 Distribution of the Jurisdiction of Trucks at Calexico (for uniquely identified trucks)

- Top 5 Jurisdictions: CA*, IN, MO, NV and ID
- Sixth Largest share = Unknown (ZZ)*
- Country Share:
  - USA – 91%*
  - Canada – 5.5%
  - Unknown – 3.5%*

* many are likely Mexican plated trucks



Concluding Comments

- Relatively inexpensive advanced technology exists to obtain automated, real-time detailed heavy duty truck characteristics and activity patterns, including HD ZEVs (for CA trucks), necessary for policy and planning
- However, while FML2 is expanding, additional installations are needed to more comprehensively monitor California, Mexico and other Out-of-State trucks
- With respect to HD truck border crossings and activity patterns, a strategic California-Mexico collaboration would help to identify key bilateral challenges, data needs, current data availability (especially on the Mexico side), data sharing possibilities, & most beneficial future research & development.