DoD Natural Resources Program

Enabling the Mission, Defending the Resources

Mapping, Optimization of Controls, and Reduction of Fenceline Impacts of Fugitive Dust Emissions from DoD Roads, Trails, and Training Areas: Demonstration of Tools in Practical Applications

November 18, 2021

Please mute your phones.

Audio Dial-In: 800-300-3070

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www.denix.osd.mil/nr/

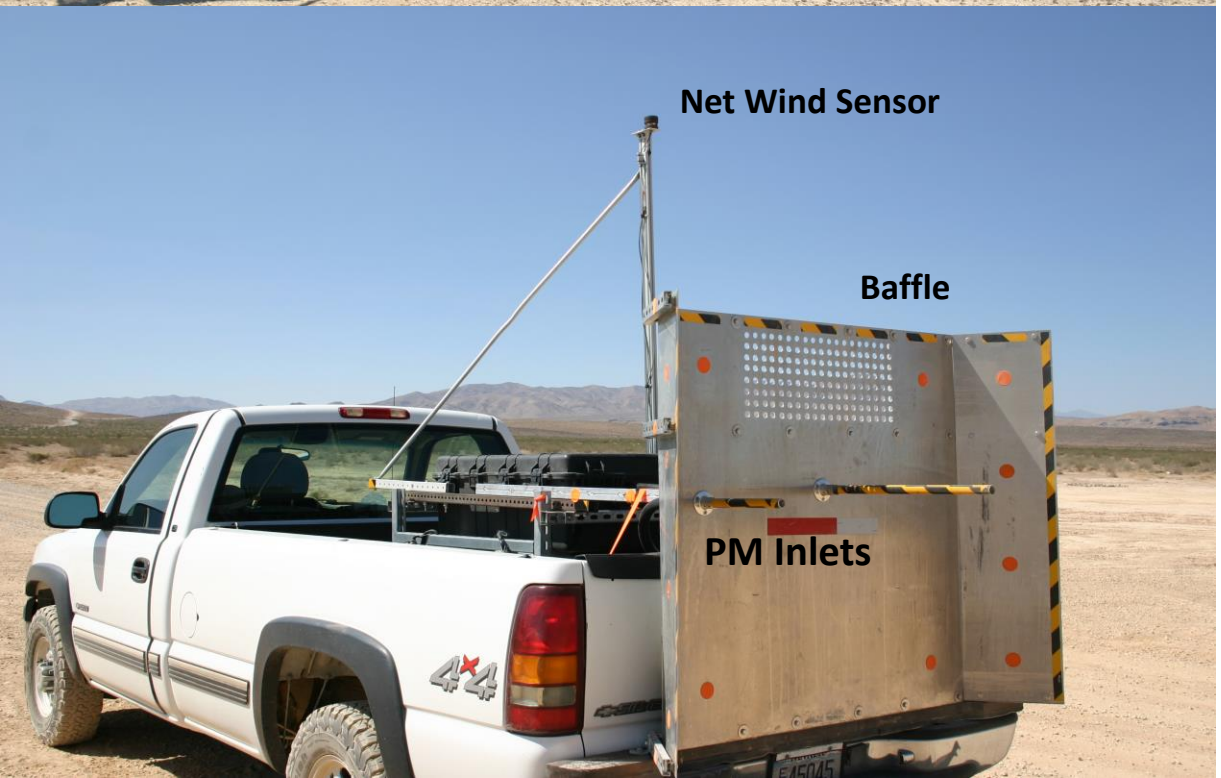
Twitter: @DoDNatRes

Environmental Security Technology Certification Program (ESTCP)

Project Team

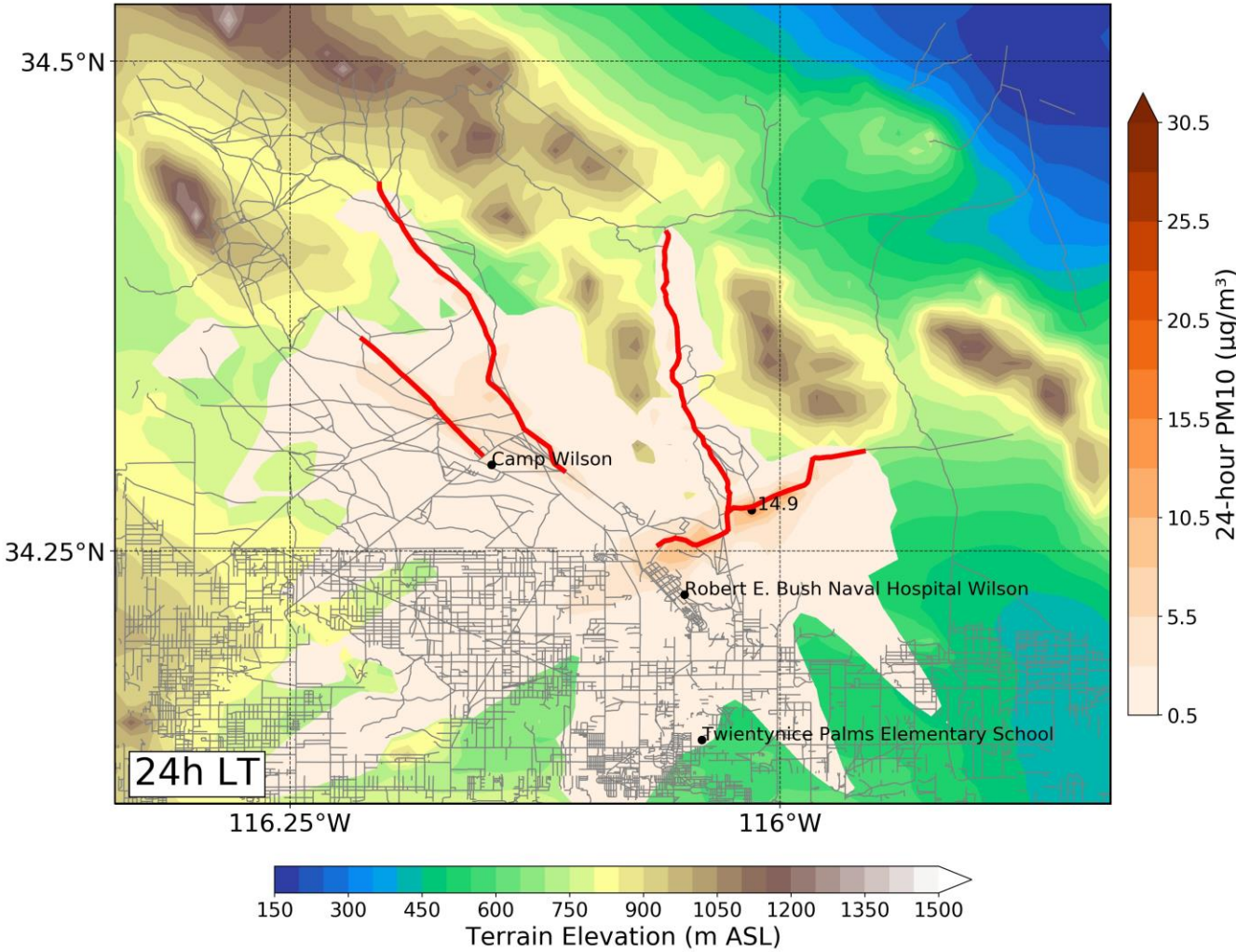
- **Dust-Solve LLC, Henderson, Nevada**
  - **Lead organization**
  - **Nevada Limited Liability Company**
- **DRI: Desert Research Institute, Reno & Las Vegas, Nevada**
  - **Non-profit research institute**
  - **Part of the Nevada System of Higher Education**

TRAKER®



Practical Application:

Mapping PM_{10} created by testing/training vehicle activity



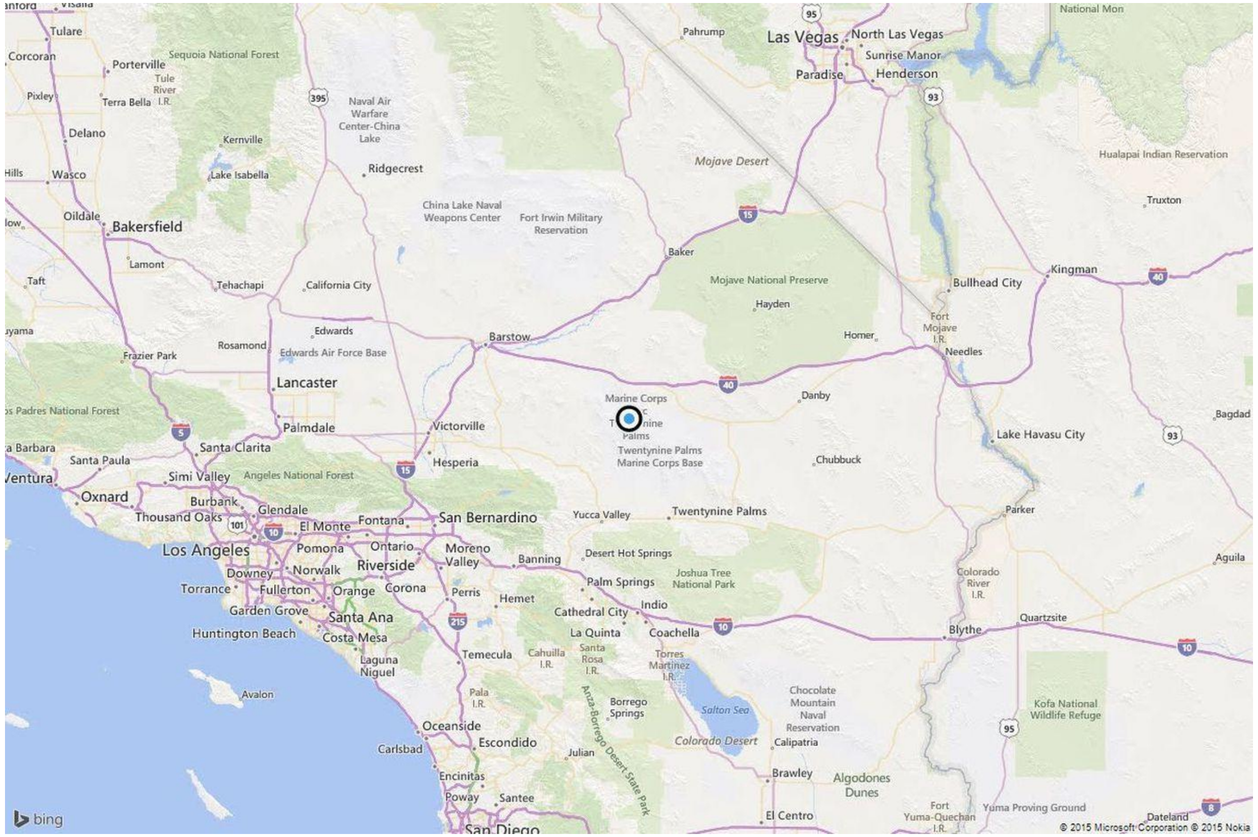
Technical Objectives

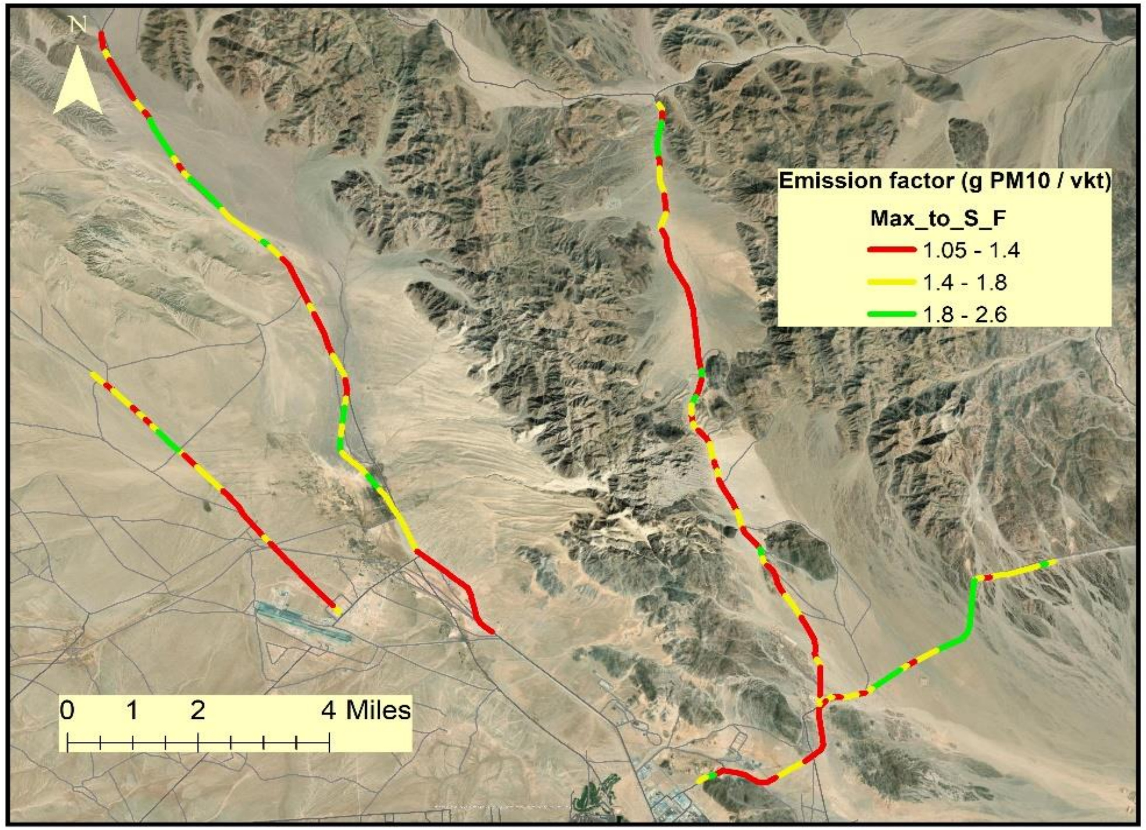
- **Demonstrate practicality of patented TRAKER technology for DoD installations where fugitive dust is a concern.**
- **Upgrade TRAKER platform for improved operability, real-time data quality assurance metrics, and data analysis.**
- **Quantify measurement repeatability.**
- **Standardize the TRAKER measurement format for consistent use across DoD facilities.**
- **Demonstrate TRAKER linked with AERMOD can be used to identify source area impacts at other locations (e.g., residences, offices, fence-line, downwind populations).**

Performance Objectives

- **Demonstrate repeatability of TRAKER measurements – 20% target.**
- **TRAKER engineering – DC power, integrated filter sampling, real-time quality control algorithms during data collection**
- **Assess environmental bias effects on measurements.**
- **Demonstrate TRAKER can quantify applied dust control effectiveness.**
- **AERMOD dispersion model accepts TRAKER data, incorporates meteorological data, outputs data on PM generated by vehicle activity**

Test Site: Marine Corps Air Ground Combat Center (MCAGCC), Twentynine Palms, CA





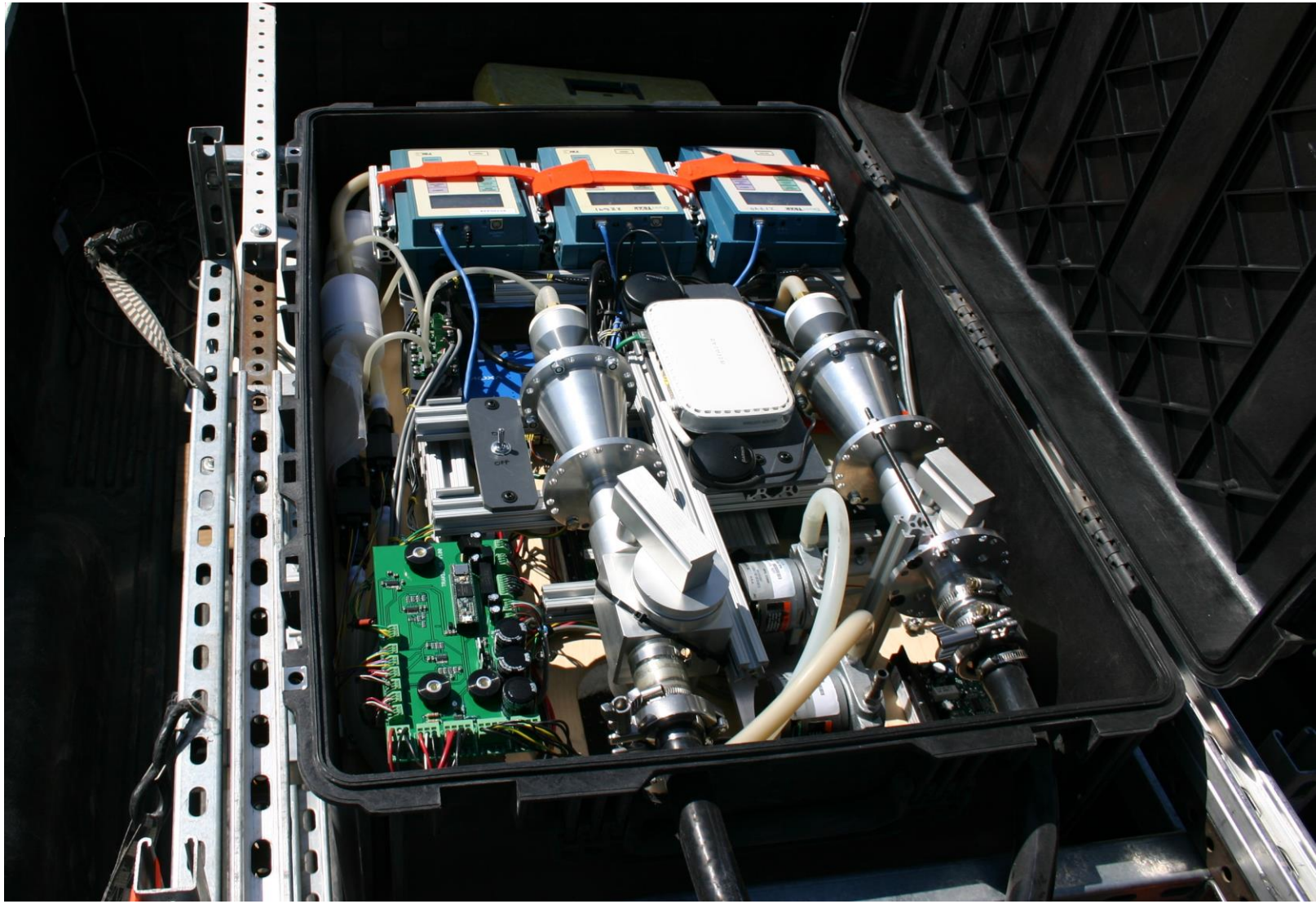
55 km unpaved roads
Range of conditions and road surface characteristics
Roads divided in 253 test segments (200-240 m in length)

TRAKER Engineering

- **Instrument package fits within standard pick up**
- **Wake conditioning baffle**
- **User interface:**
  - ❖ **Turn-key startup**
  - ❖ **Preloaded maps and instructions**
  - ❖ **On-the-fly data quality checking and information**

TRAKER Engineering

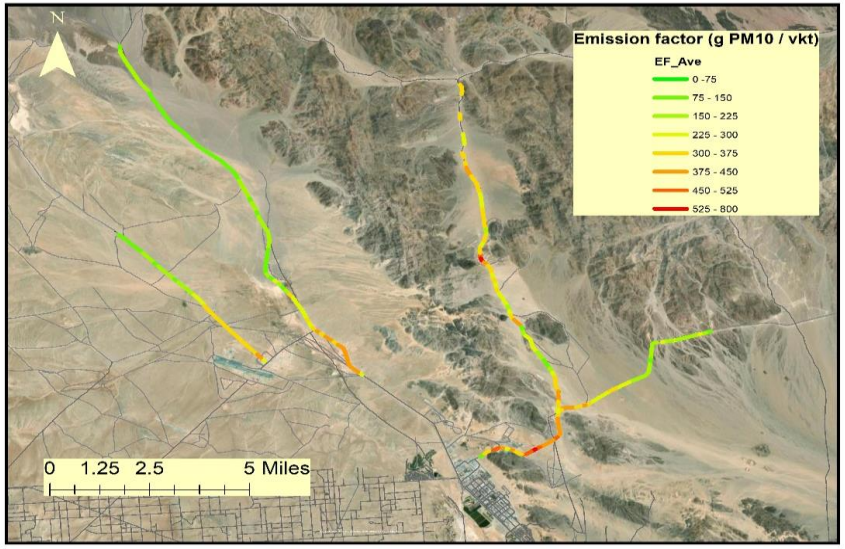
- **DC Power management**
- **Real-time mass flow controls**
- **Instruments in travel-hardened case**
- **Fast assembly**
- **Federal Reference Method PM_{10} and $PM_{2.5}$ sampler for collecting physical samples**



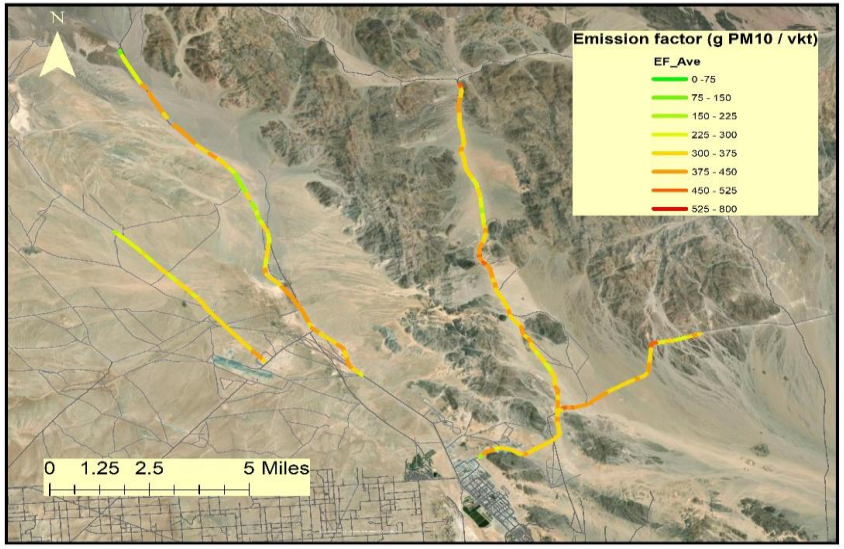
On Site Testing: Emission Factor Variability

- ❖ **October 2018 - September 2020**
- ❖ **Traversed 4 times (2 Roundtrips) per site visit**
- ❖ **Seven site visits 2018-2020 (total travel distance≈1540 km)**

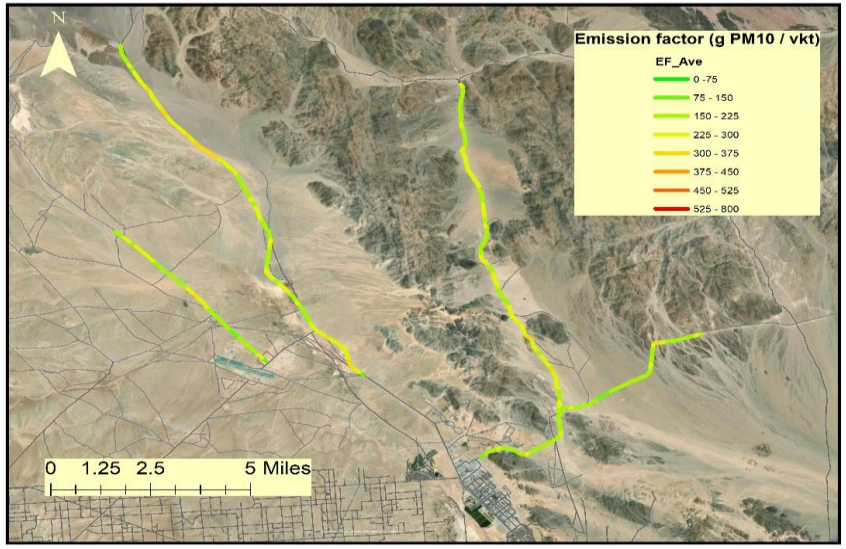
May 1-2, 2019



July 17-18, 2019

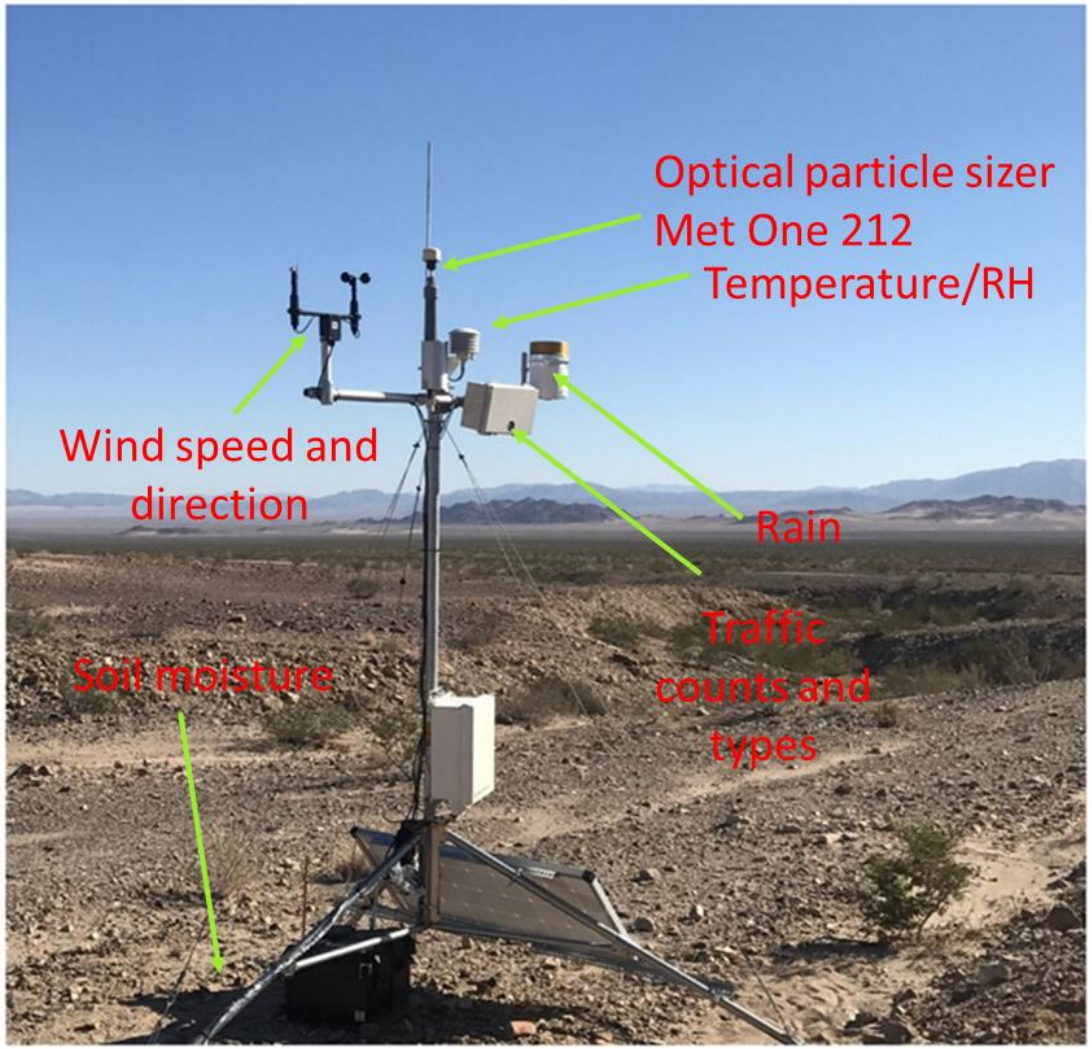


September 9-10, 2020



Emission Factor Variability & Environmental Bias Effect

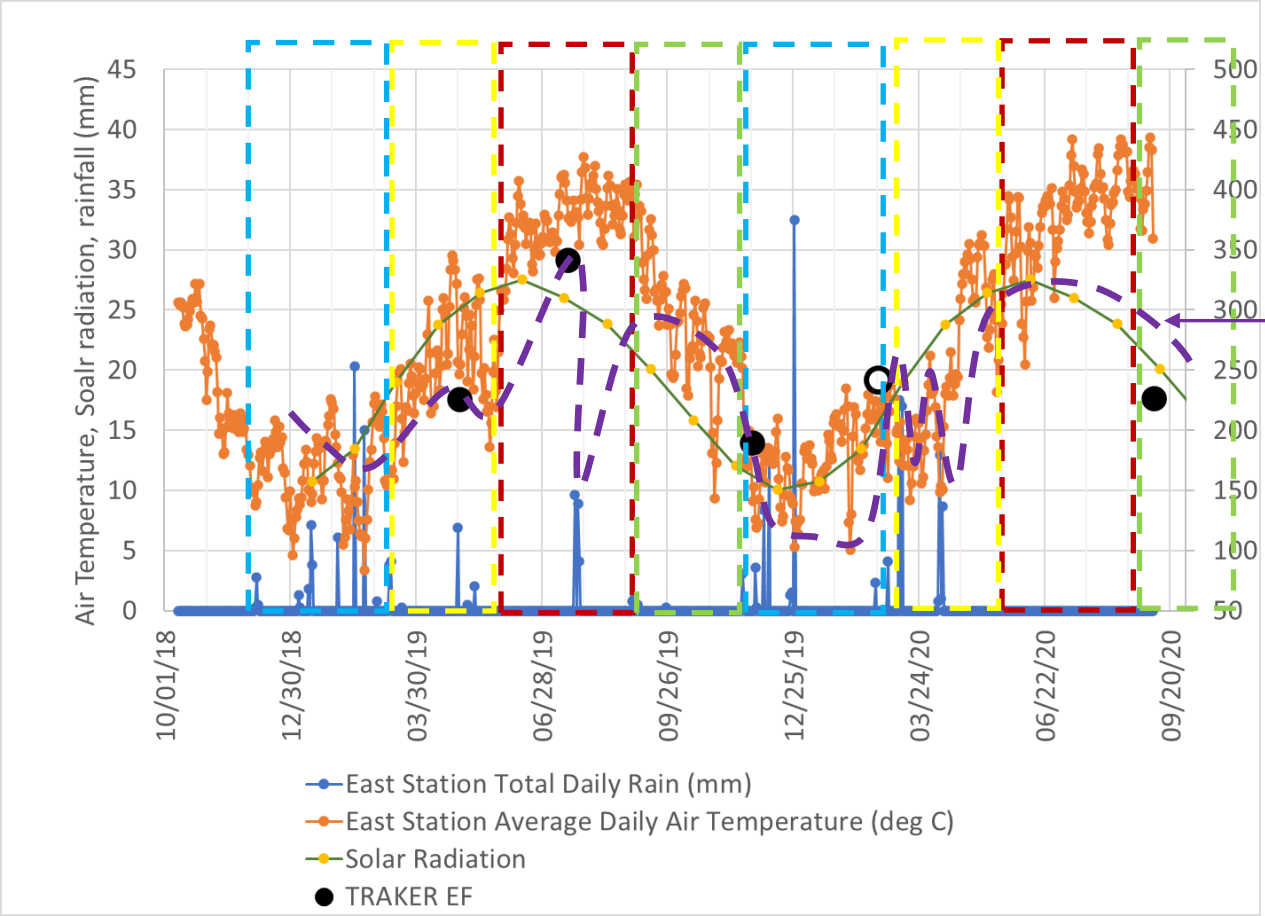
- **Environmental Monitoring to detect seasonal bias in EF (2 stations, 2 years of continuous monitoring)**



Meteorology, Dust Concentration, and Vehicle Activity Monitoring (Credit: Eddie Valls)

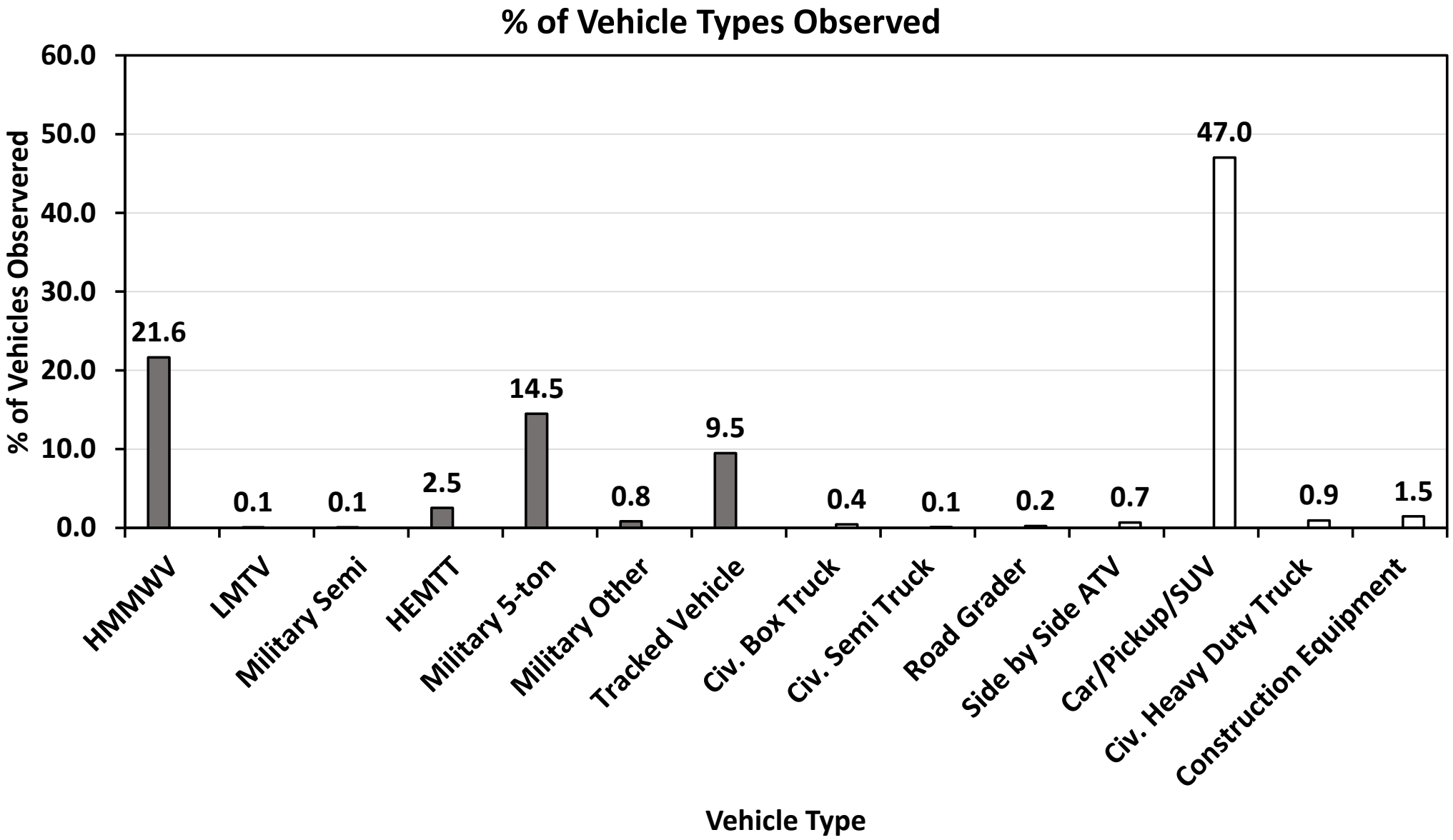
Emission Factor Variability & Environmental Bias Effect

- **Emission factors can be modified by season using multi-season TRAKER data**
- **Or correction factors developed based on meteorological data (requires on-site data and sampling around rain events)**



Seasonal + shorter-term environmental factors

Vehicle Fleet Characteristics – 29 Palms



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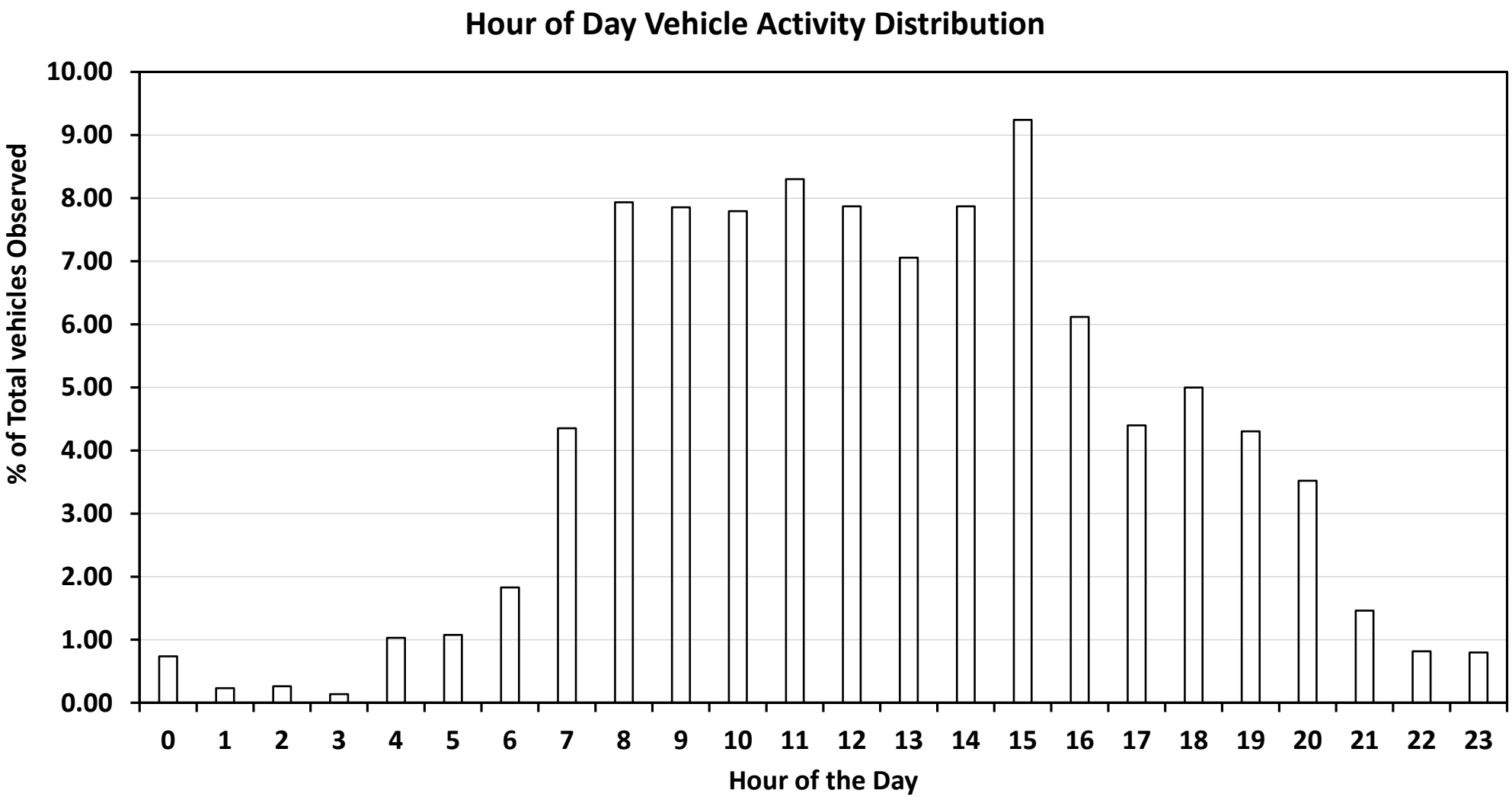

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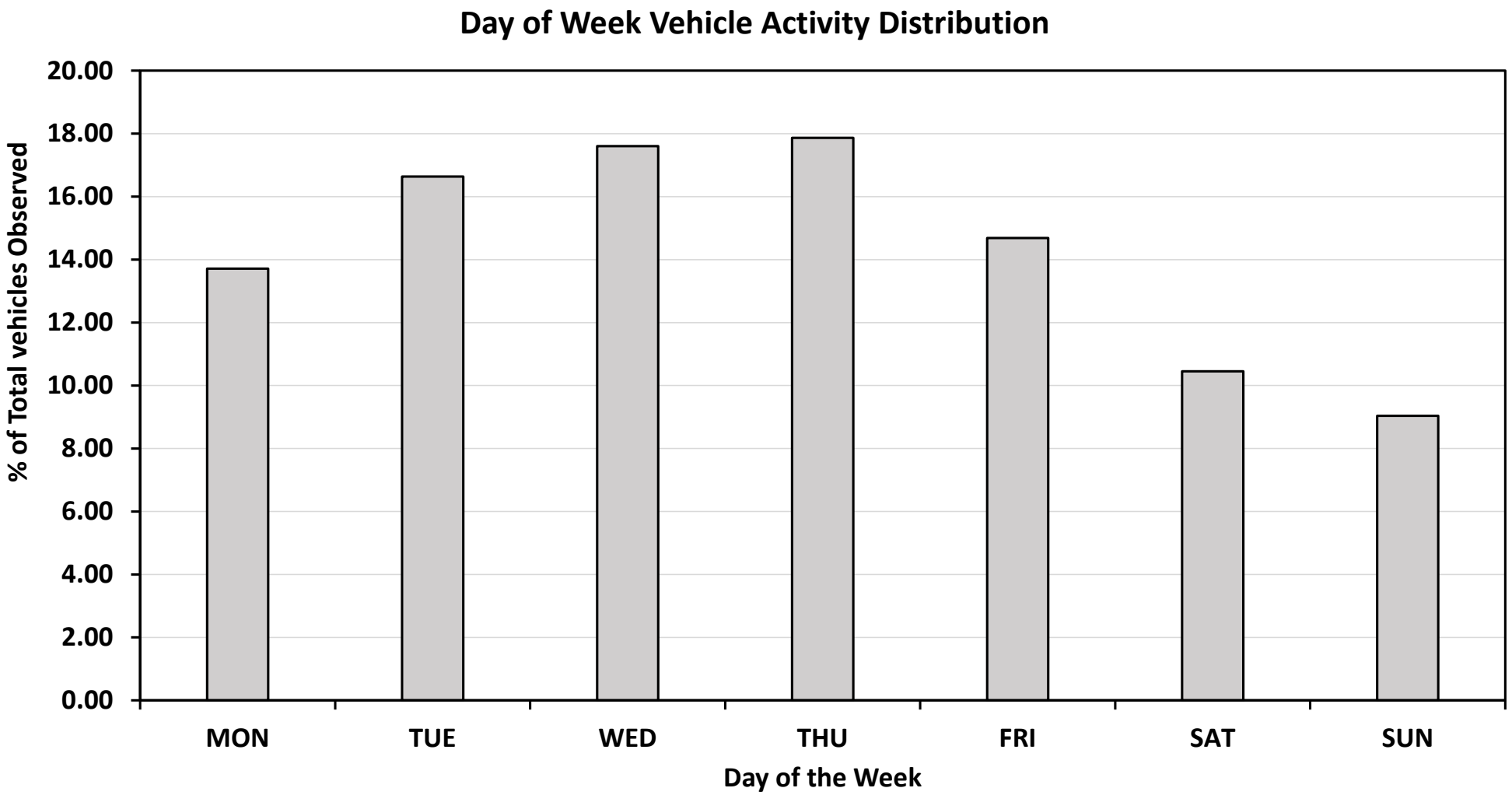

Linking Emission with Dispersion Modeling

Emission potential (*TRAKER*)

Emission potential (*TRAKER*) + Vehicle Activity = Emissions Inventory

Emission potential (*TRAKER*) + Vehicle Activity + Meteorology + AERMOD Dispersion Model- (*EPA Approved; DRI interfase*) = Air Quality Impacts and Planning

TRAKER data

- **Georeferenced emissivity data for an installation**
- **TRAKER scaling factors for other vehicles**
- **Seasonal bias factors**

Category	TRAKER Multiplier	Vehicles in Category	Gross Vehicle Weight Class (kg)
Civilian	0.8	car/pickup/SUV	<4000
Heavy Payload	11.5	Semi-trucks, HEMMT	35000-55000
Medium Payload	4.2	LMTV, 5-ton, road construction	19000-35000
Light Payload	1.2	HMMVW, heavy duty service truck, box truck	4000-10000
Heavy Tracked	19	M1 Abrams	>50000
Medium Tracked	9.5	Tracked	<50000
Side-by-Side	0.33	ATV	<2000

Vehicle Activity Data

		Overnight 1	Overnight 2	Overnight 3	Morning 1	Morning 2	Midday 1	Afternoon 1	Afternoon 2
	Acticity times	21-0 LT	0-3 LT	3-6 LT	6-9 LT	9-11 LT	11-14 LT	14-17 LT	17-21 LT
Category (Number Vehicles)	Civilian	0	0	0	0	14	0	0	0
	Heavy payload Transport	0	0	0	0	12	0	0	0
	Medium payload Transport	0	0	0	0	4	0	0	0
	Light payload Transport	0	0	0	0	6	0	0	0
	Heavy Tracked	0	0	0	0	2	0	0	0
	Medium tarcked vehicle	0	0	0	0	8	0	0	0
	SideBySide	0	0	0	0	5	0	0	0

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"""
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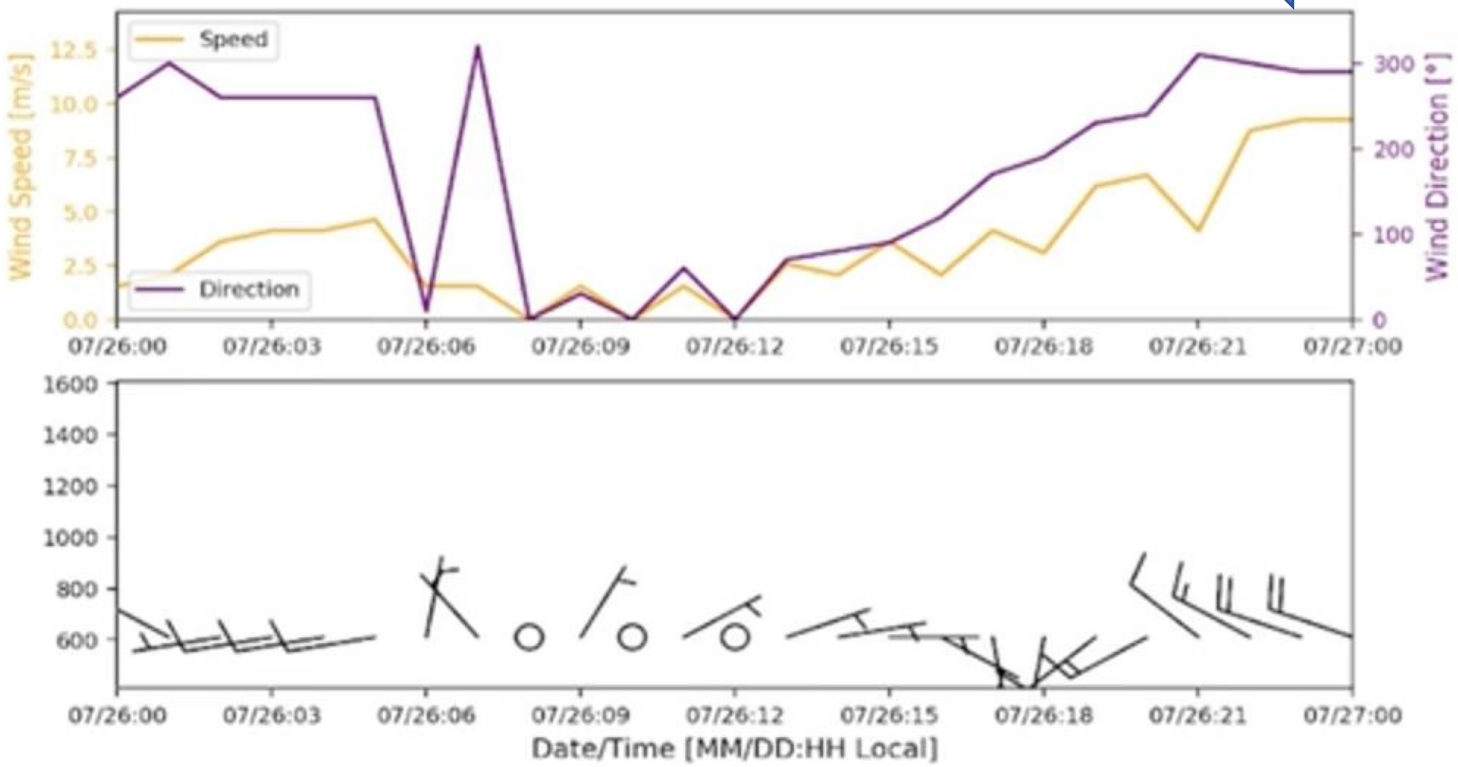
"""
Period='    STARTEND 19 07 26 19 07 26'   # YY MM DD (start, end); Diagnostic for Jan-Nov, 2019
UTCtoLocal=7#
#Prepare surface and upper-air station data (run only once! Set to False after first run to same time')
diagnostic=True
prognostic=False
#Vehicule Distribution; everytime one changes from Normal to Scenario one needs to set RemakeEmissionsFile to True and rerun AERMOD (runAERMOD=True)
NormalVehicleDistribution=True
EmissionScenario=False
EmissionScenarioName='Vic.ShiftedMorning1'
```

Meteorological Data

- **Airports, on-site, upper-air soundings (nearby is best, but can be estimated)**

Historic Diagnostic

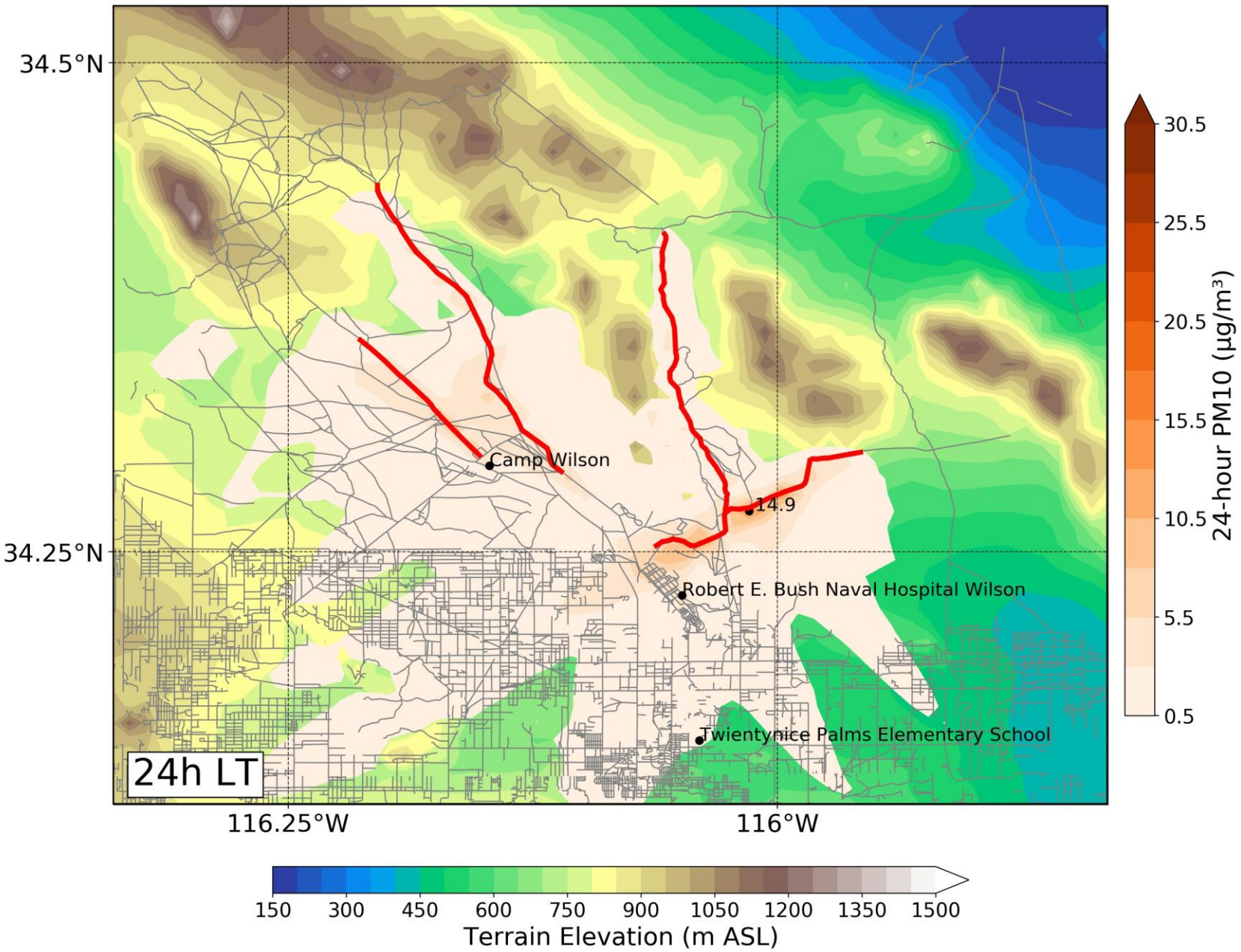
Future Prognostic



Real-time forecast
NCEP GFS, NAM or WRF-based DRI products

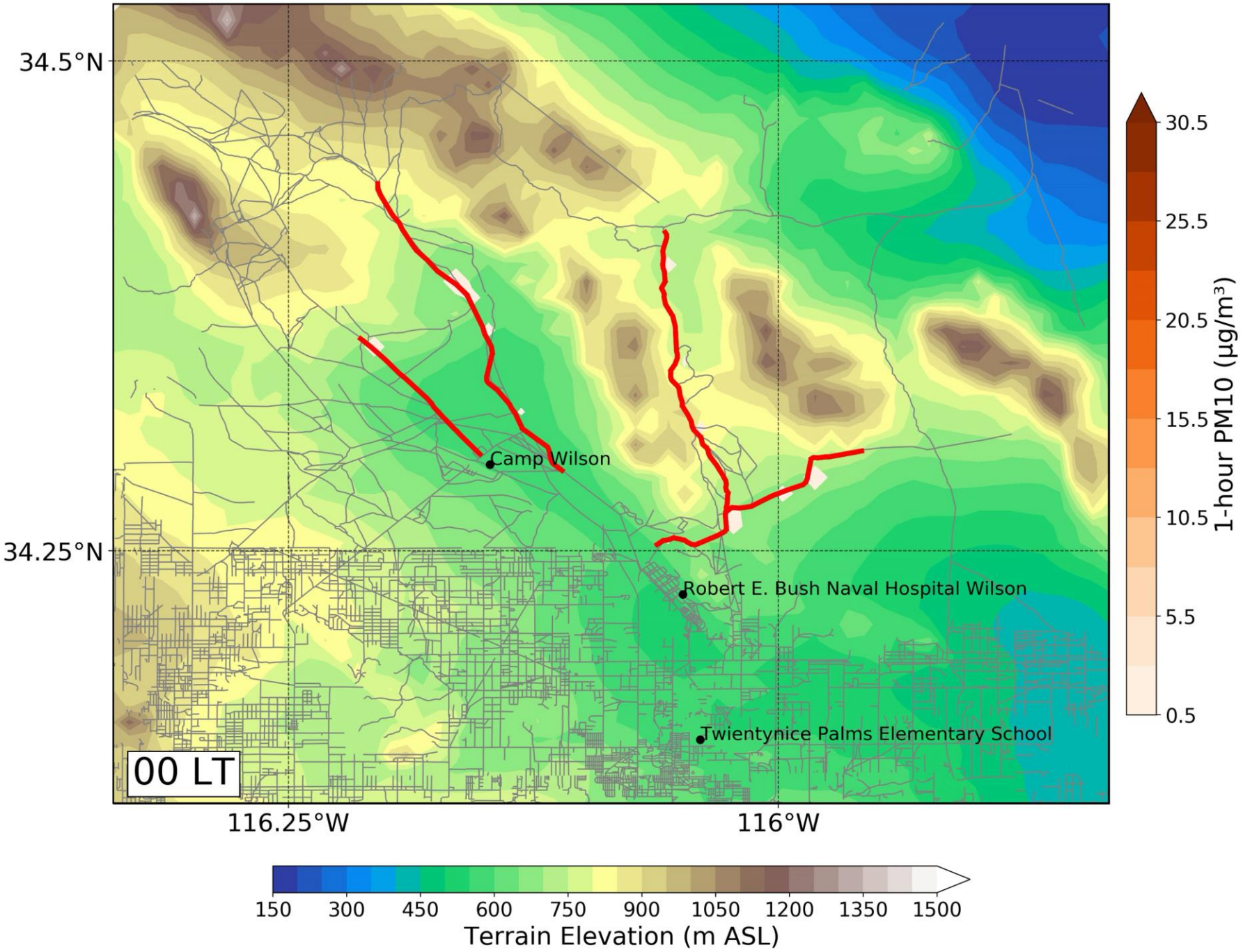
Model Products

24-hour PM_{10}
July 26, 2019



Model Products

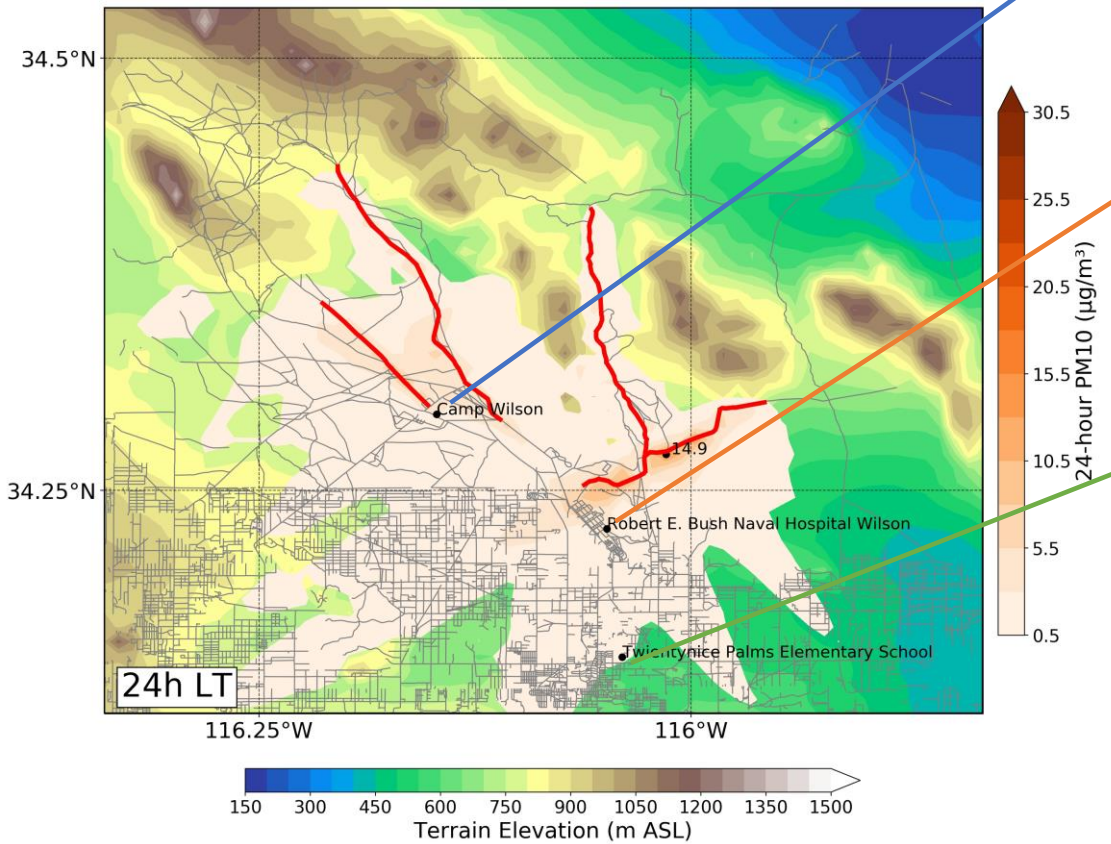
Hourly PM_{10}

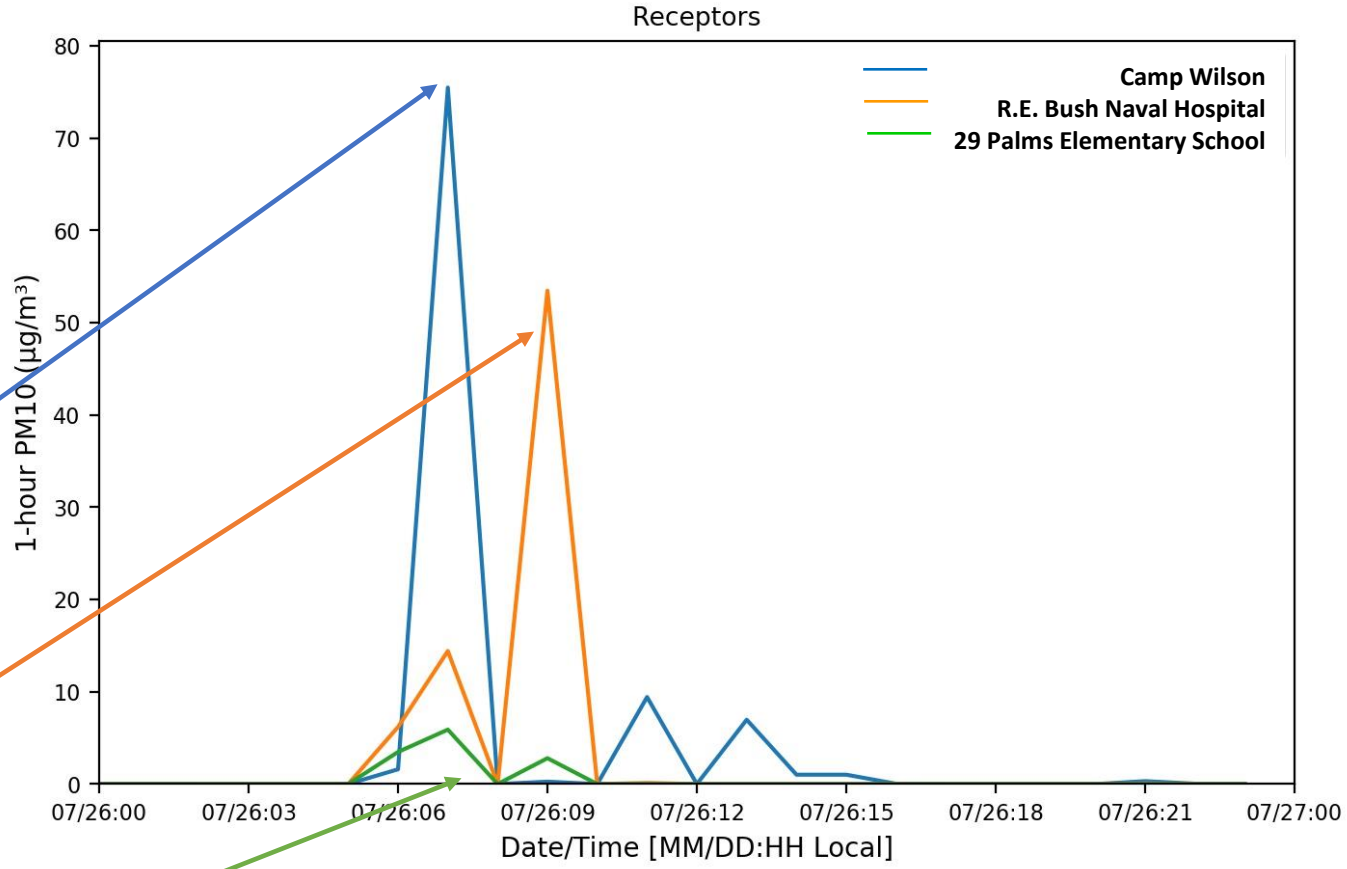


Model Products

Hourly PM_{10} at receptors of interest

July 26, 2019, 0-23:59 (Local Time)



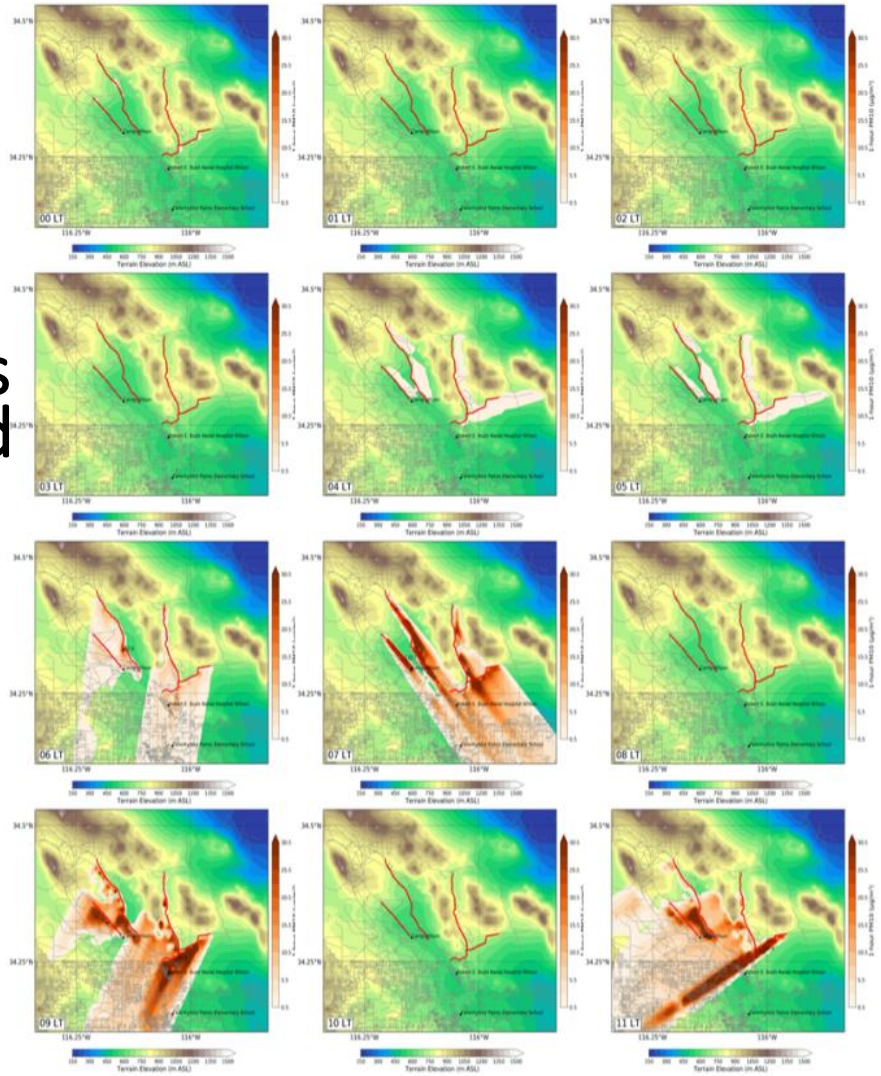


Model Products

PDF Report Function produces maps as requested

ESTCP Project
Dispersion modeling: AERMOD - VERSION 18081
Emissions unpaved roads and PM10 concentrations

(IV) HOURLY RECEPTOR MAPS:



ESTCP Project
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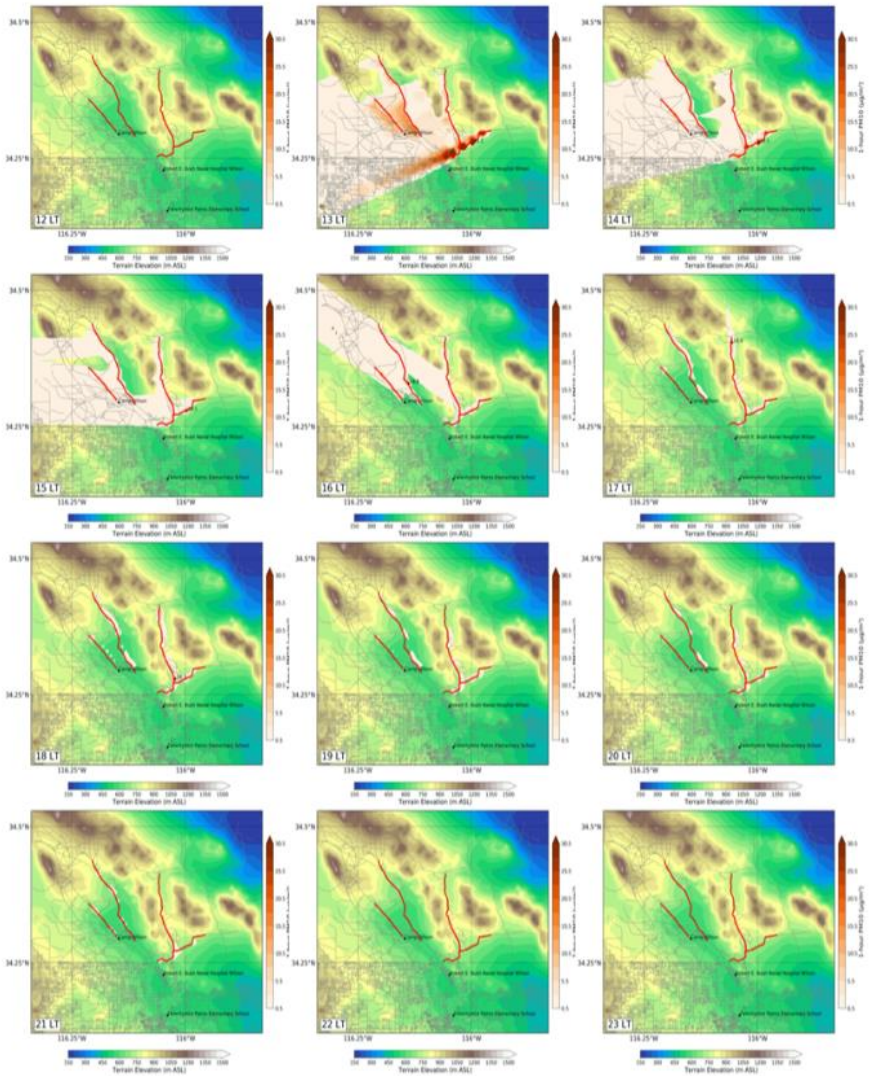
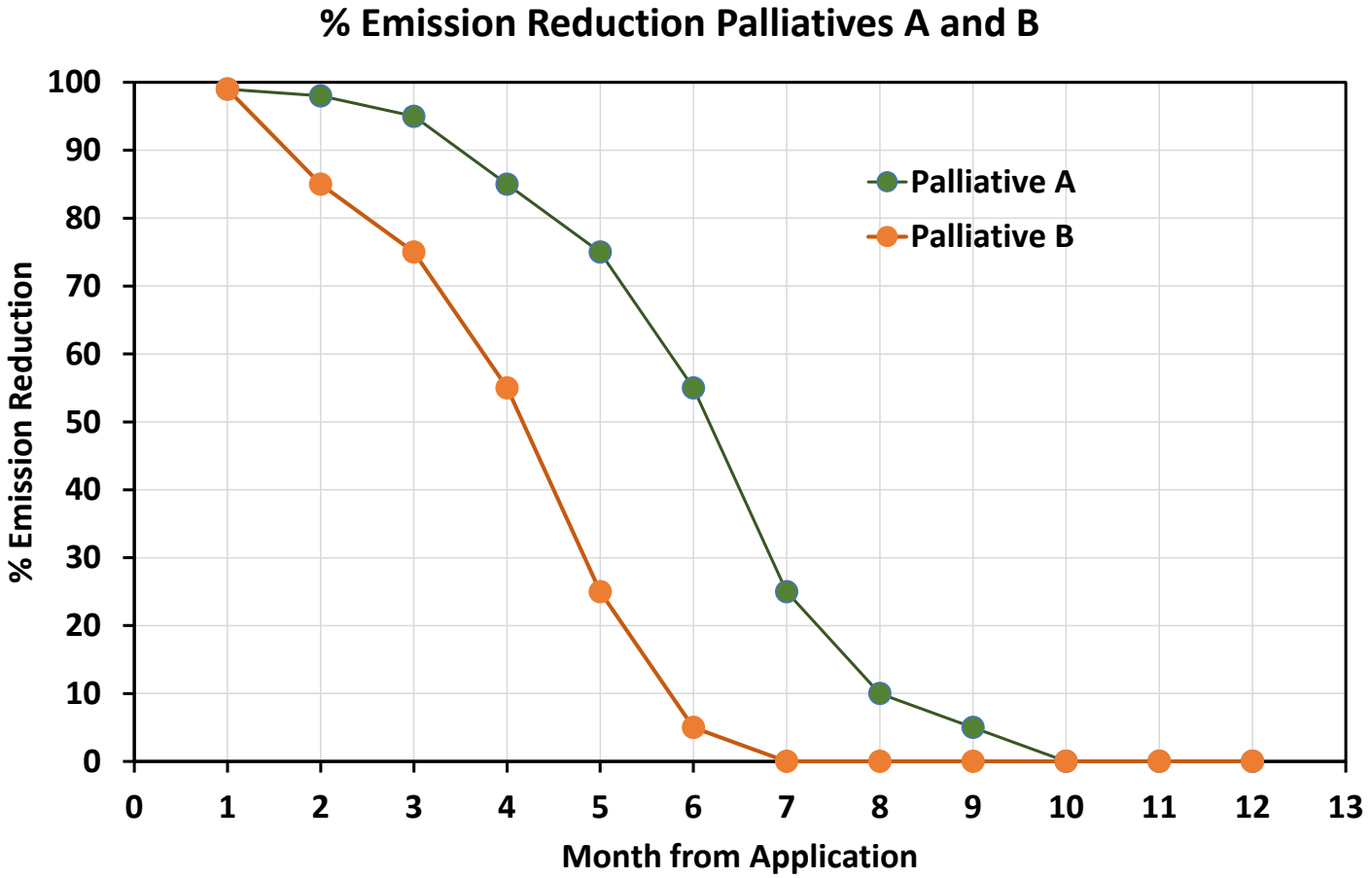
(IV) HOURLY RECEPTOR MAPS (cont...):



Dust Palliative Effectiveness Evaluation

- **Repeat measurements of emissivity, treated and untreated are used to define an effectiveness curve through time**

$$\%ER = \left(1 - \left[\frac{Treated\ EF}{Untreated\ EF}\right]\right) \times 100$$



Cost Model for TRAKER – Based on 29 Palms experience

Cost Element	Data Tracked During Demonstration	Costs
Initial Planning/Training/Site Visit	Hours of labor	**$25K**
	Travel/per diem	
Daily Usage Rate (DUR)	Usage days	**$5K**
	Hours of labor	
	Vehicle Maintenance	
Meteorological/PM/Vehicle Monitoring	Instrument costs/maintenance	$50K
(2 years)	Communications	
	Hours of labor (QA/QC, analysis)	
Vehicle Classification Inventory	Hours of labor (QA/QC, analysis)	$30-$50K
Emission Inventory	Hours of labor (QA/QC, analysis)	$25K
(PM emitted by installation)		
Model Set Up	Hours of labor	$40-$50K
(estimating effects of emissions)		
Modeling runs for requested scenarios	Hours of labor	$20-$40K
Evaluating dust control effectiveness	DUR	$20-$80K
	Hours of labor (QA/QC, analysis)	
Annual support (following initial year)	Hours of labor (QA/QC, analysis)	$15-$20K
(e.g., update model inputs and runs)		
In Depth Training	Hours of labor	$35K
	Travel/per diem	

- Except items in red, all activities can be performed by trained installation personnel (additional training: $35K)
- In practice, cost to installation would vary between $135K - $420 depending on suite of services, with typical cost of $200K for initial characterization/modeling + $25K annually.

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Vic Etyemezian	Dust-Solve, LLC 326 Quiet Harbor Dr. Henderson NV 89052-2346	702-862-1952 702-862-5569 Vic.Etyemezian@dri.edu	Co-PI
George Nikolich	Dust-Solve, LLC 326 Quiet Harbor Dr. Henderson NV 89052-2346	702-739-4439 702-862-5413 George.Nikolich@dri.edu	Co-PI and principal engineer
John Mejia	Desert Research Institute 2215 Raggio Parkway, Reno NV 89512	405-863-2842 775-673-7667 John.Mejia@dri.edu	TRAKER/AERMOD Python model development