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SERDP and ESTCP Webinar Series

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Quantifying and Modeling Fugitive Dust Emissions from DoD Activities

March 8, 2018



Welcome and Introductions

Jennifer Nyman, Ph.D., P.E.
Webinar Facilitator



Webinar Agenda

- **Webinar Logistics** (5 minutes)
Dr. Jennifer Nyman, Geosyntec Consultants
- **Overview of SERDP and ESTCP** (5 minutes)
Dr. Kurt Preston, SERDP and ESTCP
- **Measurement and Modeling of Fugitive Dust from Off-Road DoD Activities** (25 minutes + Q&A)
Dr. Larry Wagner, USDA Agricultural Research Service
- **Characterizing and Quantifying Dust Emissions Due to DoD Activities** (25 minutes + Q&A)
Dr. Jack Gillies, Desert Research Institute
- **Final Q&A session**

How to Ask Questions

Type and send questions at any time using the Q&A panel

Chat with Presenter:

In Case of Technical Difficulties

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SERDP and ESTCP Overview

Kurt Preston, Ph.D.
Resource Conservation and
Resiliency Program Manager



SERDP

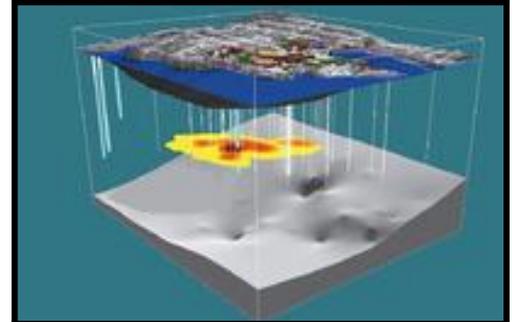
- Strategic Environmental Research and Development Program
- Established by Congress in FY 1991
 - DoD, DOE and EPA partnership
- SERDP is a requirements driven program which identifies high-priority environmental science and technology investment opportunities that address DoD requirements
 - Advanced technology development to address near term needs
 - Fundamental research to impact real world environmental management

ESTCP

- Environmental Security Technology Certification Program
- Demonstrate innovative cost-effective environmental and energy technologies
 - Capitalize on past investments
 - Transition technology out of the lab
- Promote implementation
 - Facilitate regulatory acceptance

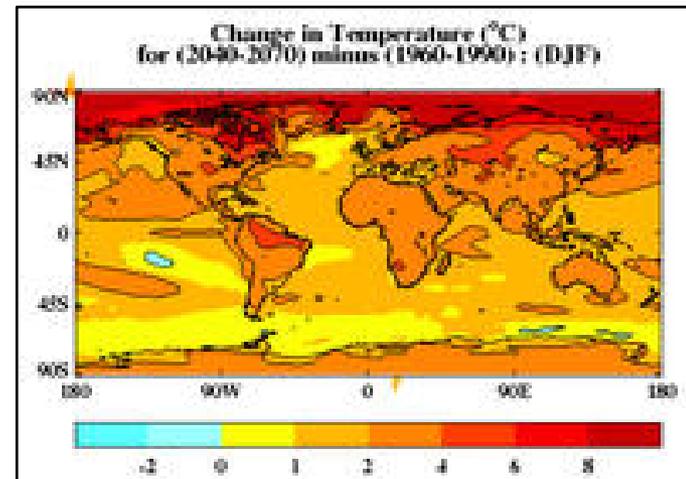
Program Areas

1. Energy and Water
2. Environmental Restoration
3. Munitions Response
4. Resource Conservation and Resiliency
5. Weapons Systems and Platforms



Resource Conservation and Resiliency

- **Natural resources**
 - Ecological forestry
 - Arid lands ecology and management
 - Cold regions ecology and management
 - Pacific island ecology and management
 - Coastal and estuarine ecology and management
 - Living marine resources ecology and management
 - Species ecology and management
 - Watershed processes and management
- **Climate change**
 - Vulnerability and impact assessment
 - Adaptation science
 - Land use and carbon management
- **Air quality**
 - Fugitive dust
 - Fire emissions



SERDP and ESTCP Webinar Series

Date	Topic
March 22, 2018	Cloud Computing Services for DoD - We Are Going To The Cloud!
April 5, 2018	Advanced Nanocrystalline Cobalt Alloys and Composites as Alternatives for Chromium and Nickel Plating in Repair Operations
April 19, 2018	Sediment Volume Search Sonar
May 3, 2018	Overview of the Defense Coastal/Estuarine Research Program (DCERP)
May 17, 2018	Environmental Restoration Program Area Webinar
May 31, 2018	Resonant Acoustic Mixing of Energetic Material Formulations

For upcoming webinars, please visit

<http://serdp-estcp.org/Tools-and-Training/Webinar-Series>



Save the Date

SERDP • ESTCP
SYMPOSIUM
2018 | Enhancing DoD's Mission Effectiveness

A three-day symposium showcasing the latest technologies that enhance DoD's mission through improved environmental and energy performance

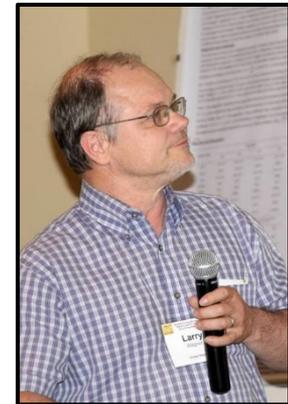
November 27 - 29, 2018

Washington Hilton Hotel

Registration is coming soon

Measurement and Modeling of Fugitive Dust from Off-Road DoD Activities

Dr. Larry Wagner
U.S. Department of Agriculture



Agenda

- Background
- Technical approach
 - Off-road trafficking
 - CELiS
- Results/DoD benefits
- Conclusions
- Acknowledgements

Background

- DoD military training and testing on ~12 million ha
 - Wheeled and tracked military vehicles
 - Particulate emissions from off-road trafficking and subsequent elevated wind erosion risk



Background

- Concern regarding particulate emissions drifting across installation boundaries
 - Need for measuring and monitoring particulate emissions at installation boundaries



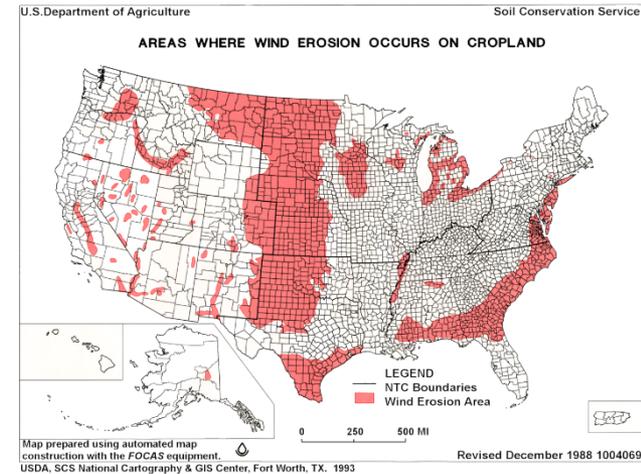
Dust plume generated while conducting trafficking experiments at White Sands Missile Range

Technical Approach

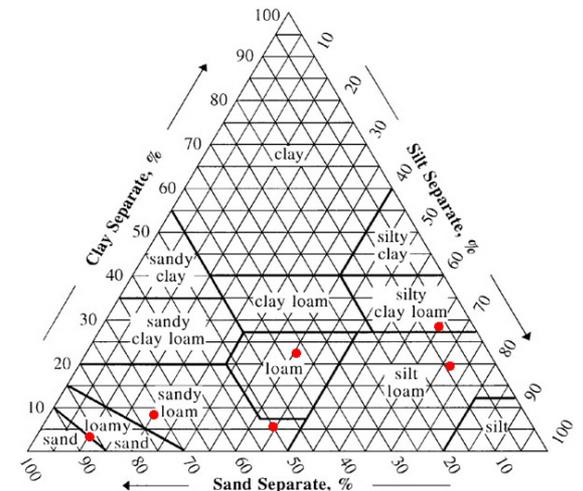
- Conducted off-road trafficking experiments at four military installations



Map of military installations where trafficking experiments were conducted



Map of wind erosion prone regions



Soil texture triangle – red dots denoting soils types trafficked

Technical Approach

- Figure-8 plots used to simulate multi-pass straight and curved trafficking



Vehicles trafficking in Figure-8 plots

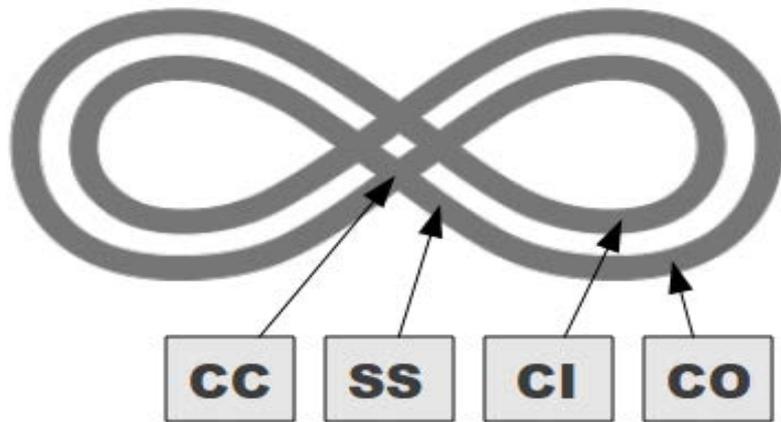


Figure-8 plot sampling locations



Trafficked Figure-8 plots at Yakima Training Center

Technical Approach

- Collected suite of wind erosion relevant data before and after trafficking events

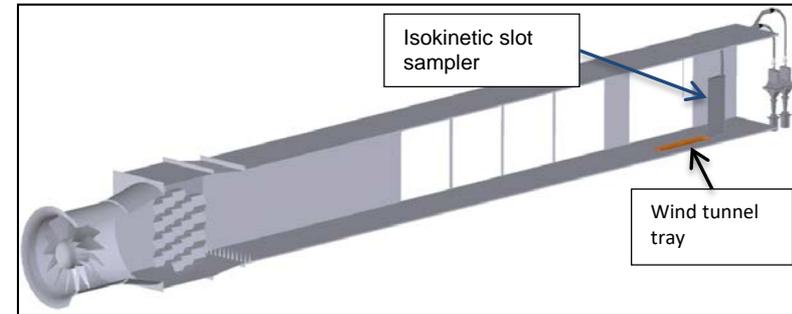


Diagram of laboratory wind tunnel used for testing



Soil extraction process for laboratory wind tunnel tray testing

Technical Approach

- Collected suite of wind erosion relevant data before and after trafficking events



Vegetation sampling



Aggregate samples collected for determining their size distribution with a rotary sieve



Technical Approach

- Collected suite of wind erosion relevant data before and after trafficking events



Obtaining surface roughness data with pin meter



PI-SWERL measuring generated particulate matter emissions from the surface

Technical Approach

- Collected additional vegetation and other site data ~1 year after trafficking experiments



Over-winter climatic effects



Before and after photos of Figure-8 plots at White Sands Missile Range



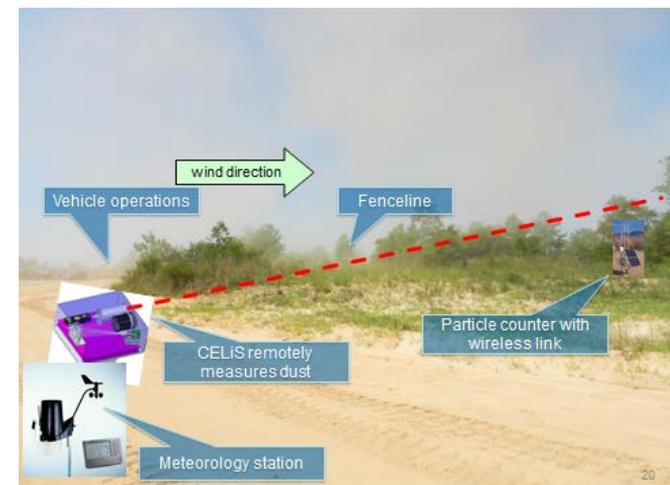
Surface puddling and crusting

Technical Approach

- Develop and test CELiS (Compact Eye-safe Lidar System)
 - Prototype eye-safe aerosol sensing lidar system
 - Real time measurement of fugitive dust concentrations
 - Suitable for monitoring installation fence-line particulate matter (PM) levels



CELiS with weather station



CELiS deployment concept

Results

- Trafficking obviously destructive
 - Removes vegetation
 - Pulverizes soil surface aggregates
 - Disturbs protective crusts
 - Destroys “desert pavement”



Results

- Trafficking obviously destructive
 - Tracked > Wheeled
 - Heavier > Lighter
 - Turns > Straight
 - Multiple passes > Single pass



Results

- Multi-pass trafficking response (tracked)
 - Vegetation regrowth
 - Increased animal activity



Results

- Multi-pass trafficking response (wheeled)
 - Vegetation regrowth
 - Erasure of original tracks



Results

- Multi-pass Trafficking Response
 - Can enrich vegetation growth/regrowth



Before and after photos showing enhanced gamma grass regrowth following tracked tank retriever (M88-A1) trafficking on a Figure-8 plot at White Sands Missile Range

Trafficking Results (Benefits to DoD)

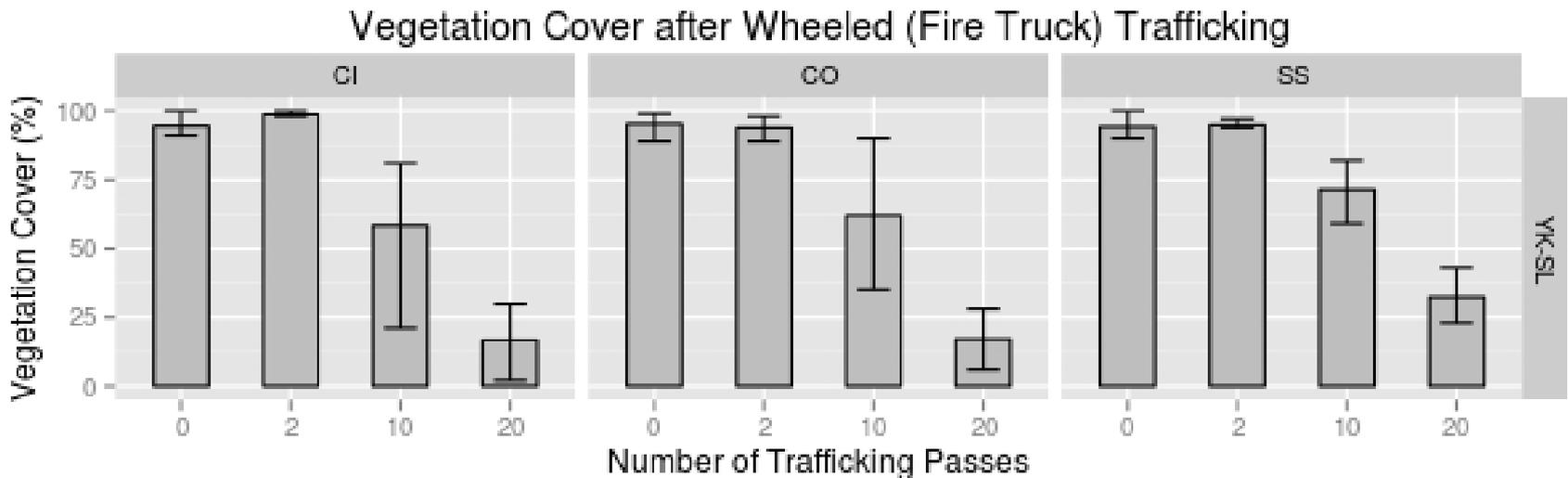
- Measured and analyzed erosion relevant soil and vegetation data on a variety of DoD sites using military vehicles



Crew sampling before and after each Figure-8 multi-trafficking experiment at Fort Riley, KS

Trafficking Results (Benefits to DoD)

- Developed relationships and algorithms to show type and degree of degradation with increased trafficking



Trafficking Results (Benefits to DoD)

- Proposed potential remediation options for off-road trafficking

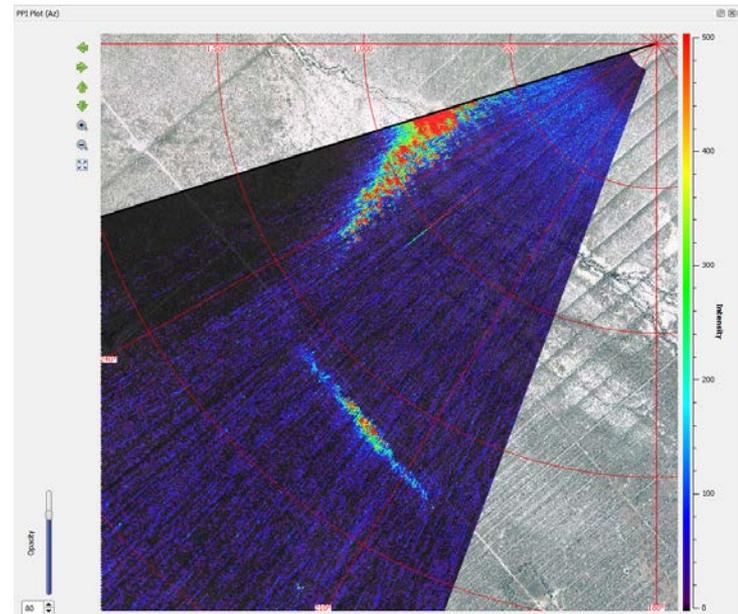


Lidar Testing Results: Tracking

- Plume detection and tracking
 - Initial field testing on open range at Dugway Proving Ground (DPG)
 - CELiS detects and tracks dust plumes



CELiS deployed in desert



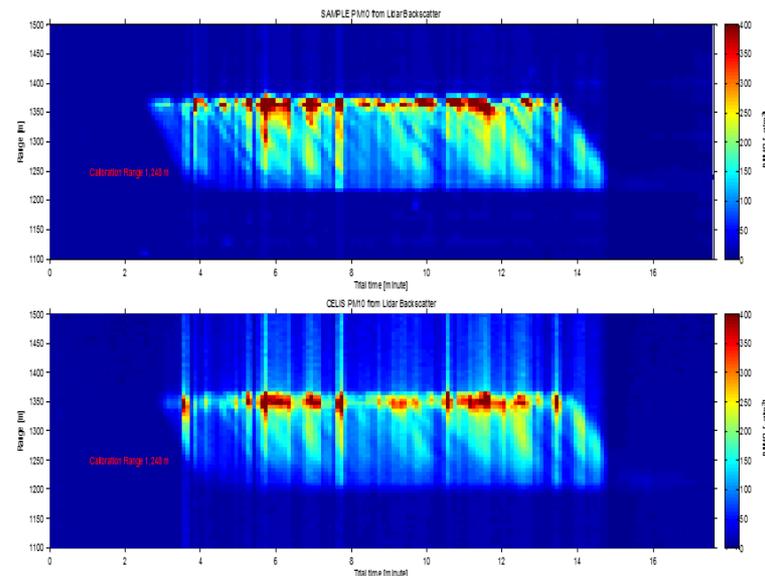
CELiS data from horizontal scan

Lidar Testing Results: PM

- Fence-line Plume Monitoring
 - Final testing at the JABT on DPG
 - With reference PM and lidar instruments
 - CELiS compared well to reference systems



CELiS deployed at Joint Ambient Breeze Tunnel (JABT) at Dugway Proving Grounds



PM derived from SAMPLE and CELiS lidar data

CELiS Implementation/Benefit to DoD

- Eye-safe fence-line monitoring lidar systems are available for purchase
 - Built on-demand, 6+ month lead time
 - Not yet tested for continuous monitoring
- DPG purchased two
 - CELiS Next Gen twice as sensitive and has a greater maximum range
 - Software improvements



CELiS Next Gen

Conclusions

- Limit non-essential off-road trafficking
- Limit turns during off-road trafficking
- Keep vehicles on the same “path” as much as possible to reduce the total area impacted
- Perform post-trafficking management remedial practices to encourage faster re-vegetation on off-road trafficked paths
- CELiS is a capable system for fence-line dust concentration monitoring

Acknowledgements

- Co-PI's: Dr. John Tatarko, Dr. Michael Wojcik and Dr. Ronaldo Maghirang
- Former ITAM (Integrated Training Area Management) coordinator, Dr. Phillip Woodford (retired) and Christopher Otto at Fort Riley; Shannon (Tannis) Danley at Fort Benning; Peter Nissen at the Yakima Training Center; Joel (Brian) Wilson at White Sands Missile Range; and William Brown at Dugway Proving Ground
- Neil Baker, Max Erdwien, Fred Fox, Jincheng Gao, Lawrence Hagen, Michelle (Bush) Hilburn, Michael Jurgensmeier, Laura Kemp, Matthew Kucharski, Hubert Lagae, Joseph Levin, Ben Li Liu, Jeremy Meeks, Kori Moore, Amare Retta, William Rust, Christopher Shultz, Abigail Stedry, Timothy Todd, Quincy Tuttle, Christy Wagner, Youjie Xu, Jonathan Zeller, and Jiaqiong Zhang

SERDP & ESTCP Webinar Series

For additional information, please visit
<https://www.serdp-estcp.org/Program-Areas/Resource-Conservation-and-Resiliency/Air-Quality/RC-1767>

Speaker Contact Information

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Q&A Session 1



Characterizing and Quantifying Dust Emissions Due to DoD Activities

Dr. Jack Gillies
Desert Research Institute



Agenda

- Introduction: Rationale for project
- Key project results and outcomes
- Research to application
- Demonstration/certification opportunities
- Benefits to DoD
- Conclusions

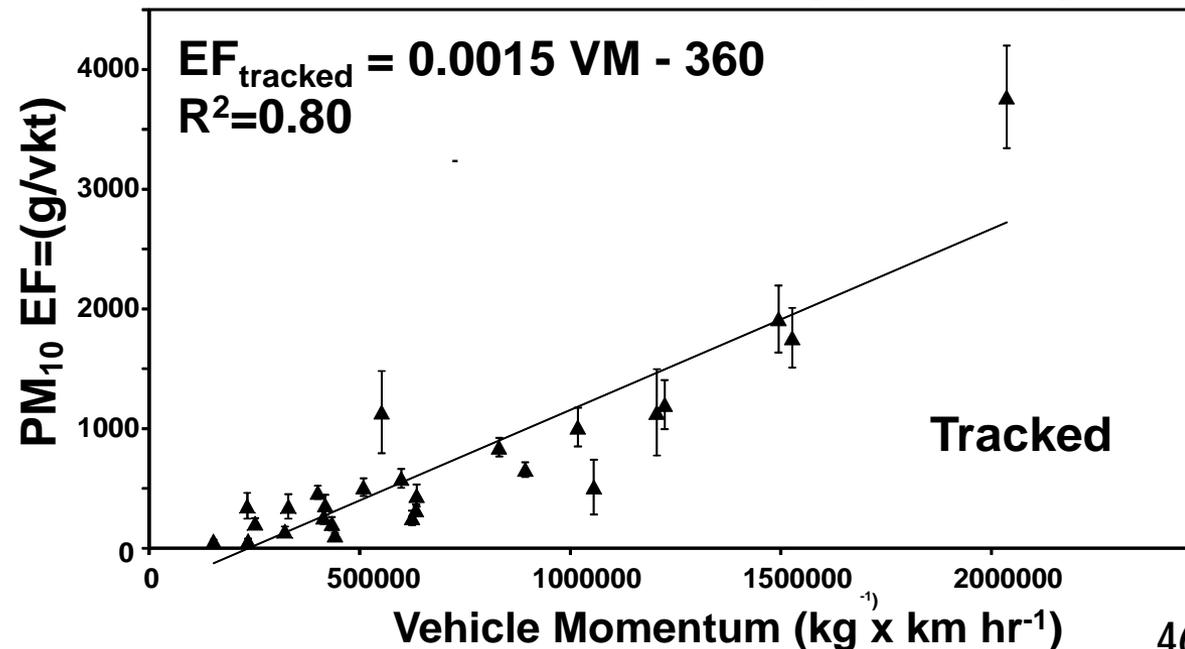
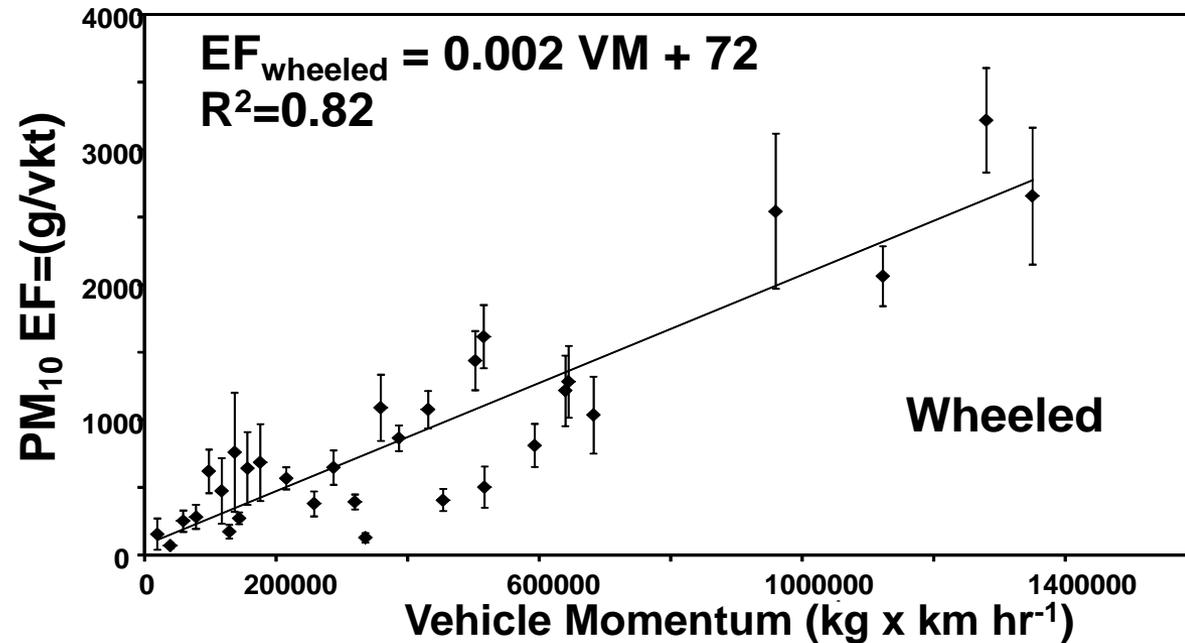
Project Rationale

- Mineral dust from DoD testing and training activities has the potential to:
 1. Impact detrimentally the biophysical and human environment
 2. Reach levels that exceed air quality standards
 3. Modify or curtail DoD activities

Key Project Result #1

- Identified critical source characteristics that influence dust emissions and developed emission factors for DoD vehicles/activities

Vehicle speed and weight are the most important characteristics influencing emissions



Key Project Result #2

- Developed two dust emission potential measurement systems
 - TRAKER™ for unpaved roads
 - PI-SWERL® for wind blown dust

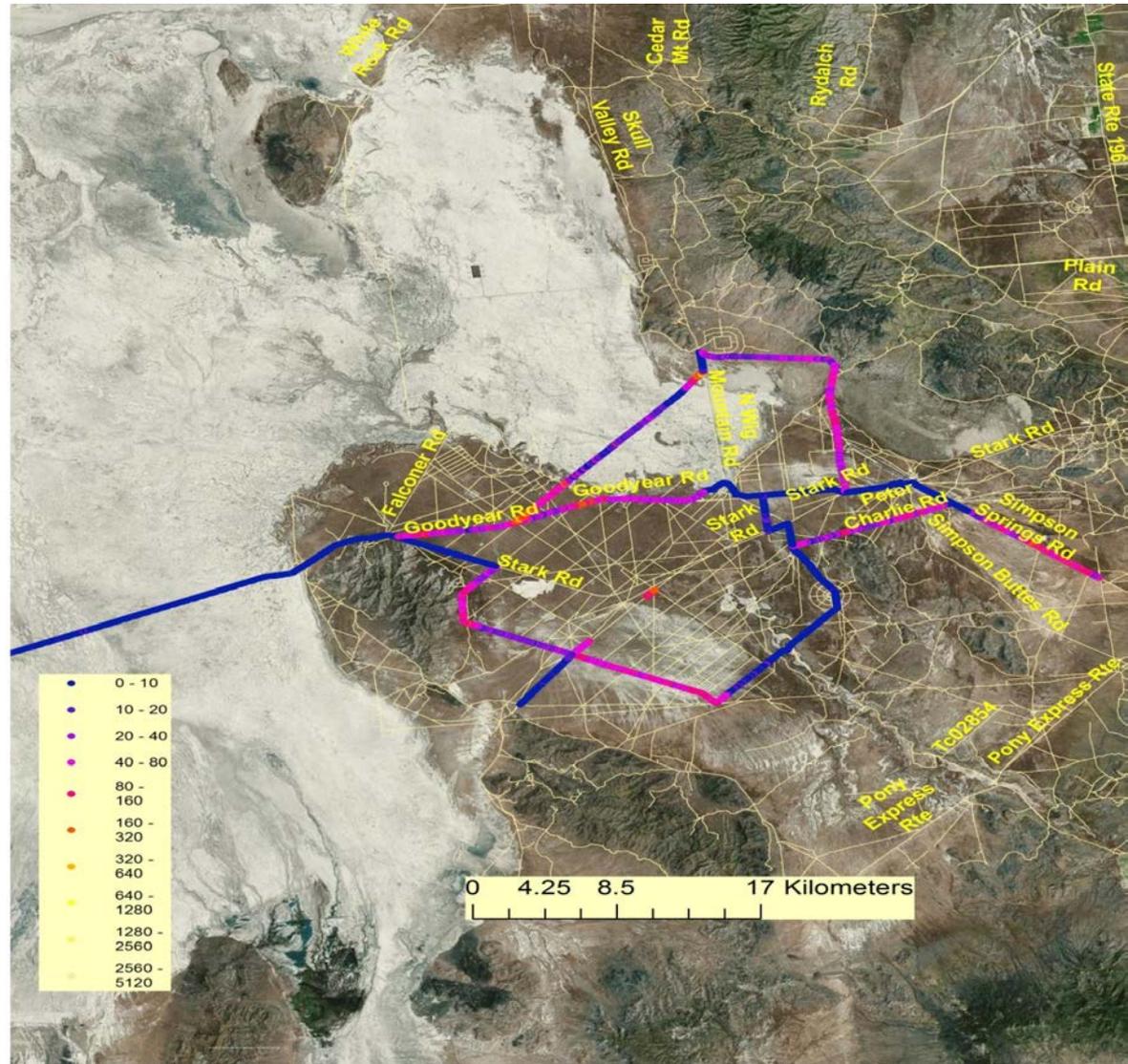
TRAKER™

- Measures/maps potential PM10 emissions across space (road networks)
- Scales emissions to represent DoD wheeled and tracked vehicles
- US EPA OTM-34



TRAKER™

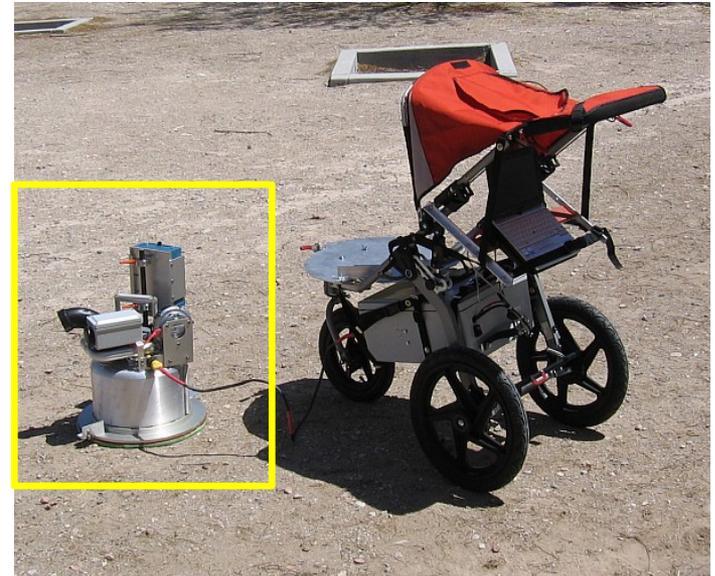
- Integrates emission factor relationships and measurement method to simplify quantification of road dust emission inventories



TRAKER™-derived road dust potential map, Dugway Proving Ground, UT

PI-SWERL[®]

- Portable device for measuring threshold wind speed for dust entrainment and emission vs. wind speed relationships

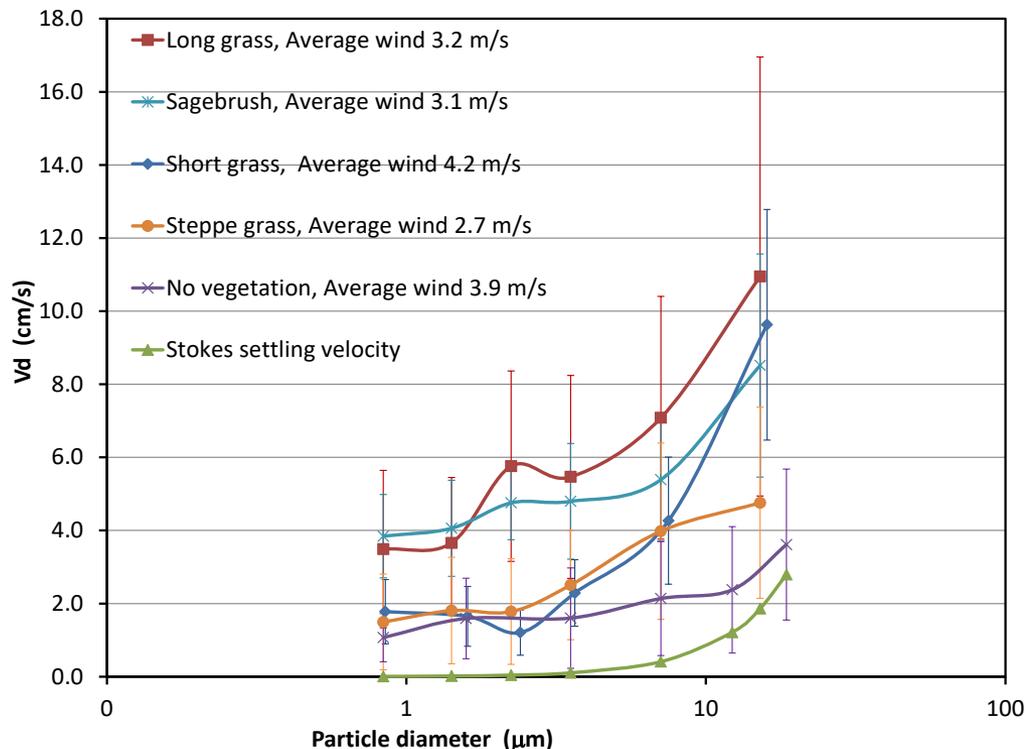


Key Project Results #3

- Identified and quantified terrain properties that attenuate emissions by near-field deposition processes

Key Project Results #3

- Deposition velocity increases with surface roughness
 - Over the range tested, deposition velocity is enhanced by up to a factor of ≈ 3 (bare vs. long grass)
 - 0-200 meters from source

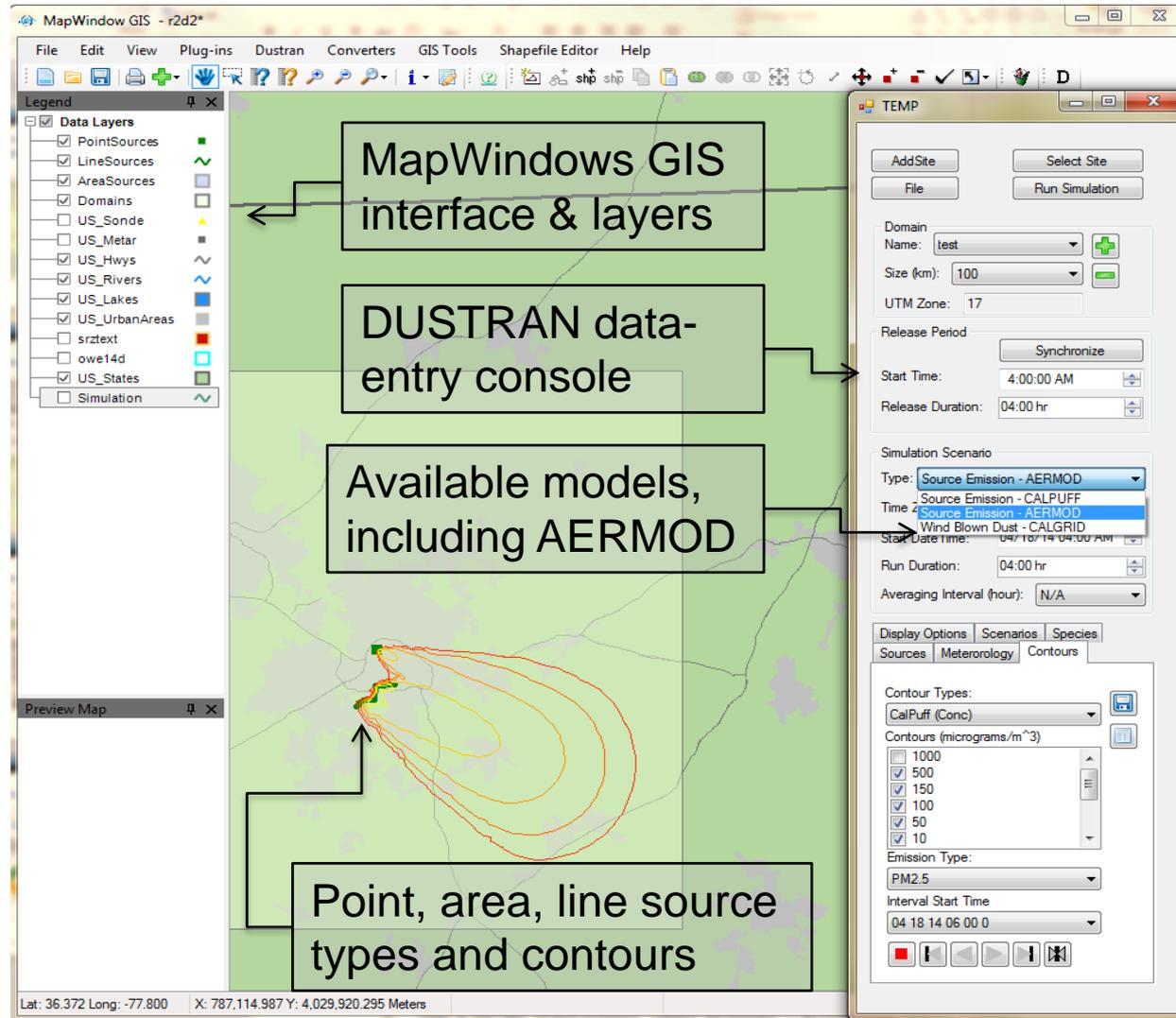


Key Project Result #4

- DUSTRAN 2.0 (PNNL developed)
 - Open-source GIS-based emission and dispersion model
 - For use by DoD personnel and air quality managers

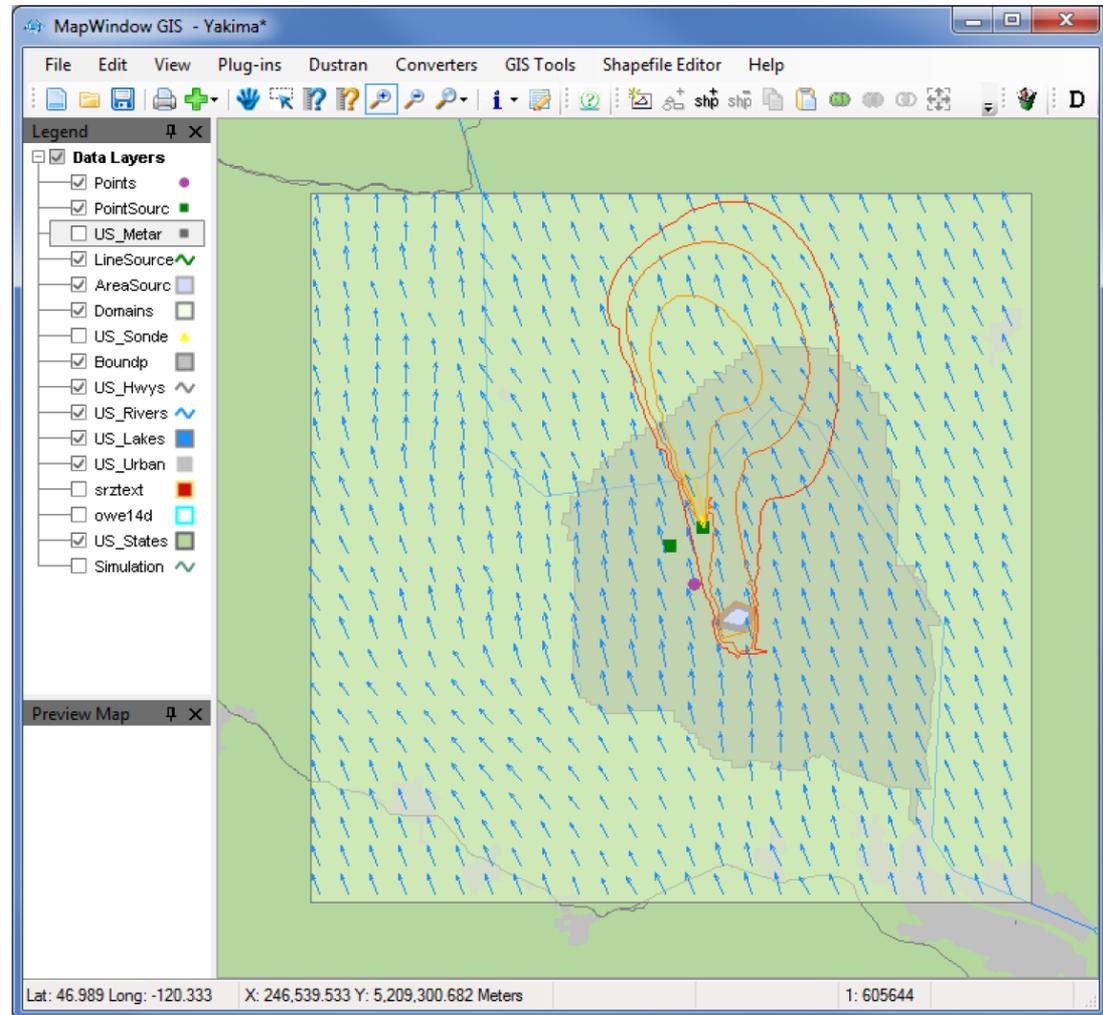
DUSTRAN 2.0

- Predicts PM concentrations based on:
 1. Known testing/training activities, meteorology, and surface characteristics
 2. Wind erosion events based on meteorology, and surface characteristics



DUSTRAN 2.0

- Display of PM10 concentration contours and wind vectors for one hour for an area and point source at the Yakima Training Center



Research to Application

- TRAKER used to
 1. Evaluate road dust PM10 emissions
 2. Dust control effectiveness on roadways/tracks
- PI-SWERL used to
 1. Evaluate wind-blown dust PM10 emissions
 2. Dust control effectiveness on area sources

Research to Application

- Quantified terrain properties that attenuate emissions provide more accurate estimates of dust emissions
- DUSTRAN 2.0 with integrated TRAKER, PI-SWERL, and Terrain Properties used to evaluate air quality impact of testing/training: 1) within installation 2) exterior to installation

Research to Application

- Easy-to-use methods for high quality characterization of dust emission using EPA recognized methods (e.g., for emission inventory reporting)
- Easy-to-use methods to assess dust suppressant effectiveness ensuring best-quality performance and cost savings

Research to Application

- DUSTRAN 2.0 used to evaluate off-site impacts of testing/training (e.g., large convoys of vehicles)
- Developed products allow development of effective dust management plans

Demonstration/Certification Opportunities

- TRAKER is advancing towards certification through ESTCP project RC-201700
 - “Mapping, Optimization of Controls, and Reduction of Fence line Impacts of Fugitive Dust Emissions from DoD Roads, Trails, and Training Areas”

Conclusions

- DoD-specific emission sources of dust have been characterized
- Effective tools to measure dust emission potential at any installation have been developed and follow US EPA recognized methods
- Model developed provides environmental managers a means to evaluate testing/training emission on local/regional air quality
- New tools are available to develop better informed dust management plans

SERDP & ESTCP Webinar Series

For additional information, please visit
<https://www.serdp-estcp.org/Program-Areas/Resource-Conservation-and-Resiliency/Air-Quality/RC-1729>

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Q&A Session 2



The next webinar is on
March 22, 2018

*Cloud Computing Services for DoD:
We Are Going To The Cloud!*



Survey Reminder

Please take a moment to complete the survey that will pop up on your screen when the webinar ends

