



HYDROLOGY & ATMOSPHERIC SCIENCES

LIASCIENCE

Friction Velocities in the Picacho Peak Area

HAS Superfund Laboratory – 2019 Dust Workshop
2019

Presenter: Ruby O'Brien-Metzger

Authors: Dr. Eric Betterton, Dr. Eduardo Saez, Kyle Rine, Reman Almusawi, Tania Rodriguez, Jeremy Rine

Funded By: NIEHS Superfund Research Program, NASA Space Grant Program

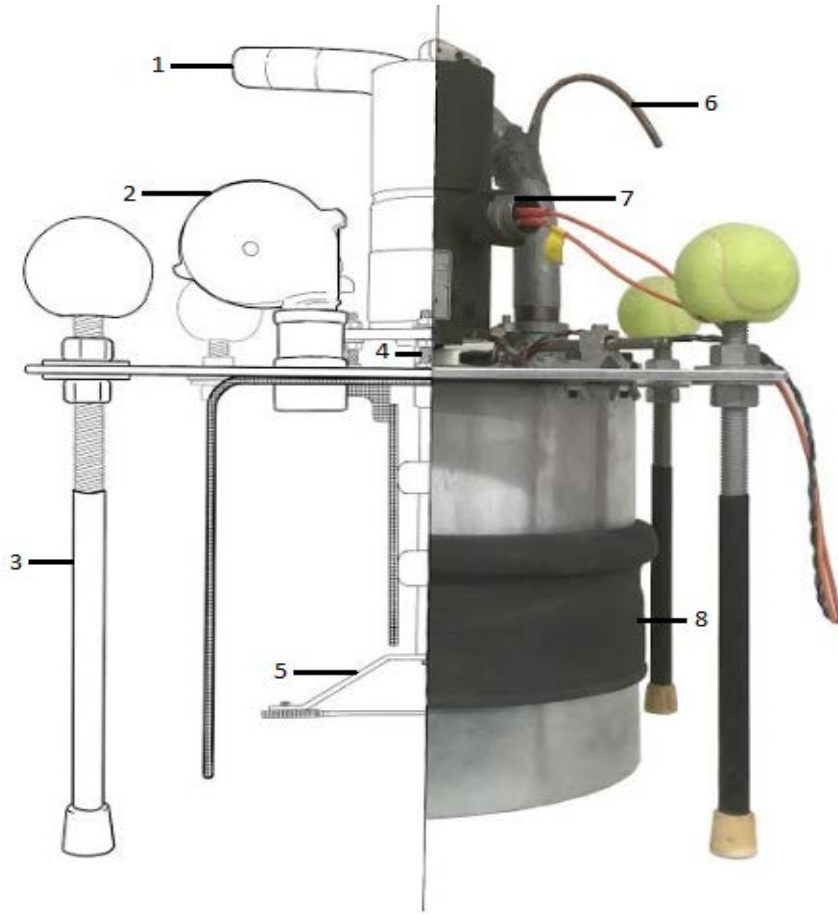


Research Objectives



- Question: What wind conditions create dust storms?
- Step 1) Create a known wind speed over a soil surface with portable wind tunnel
- Step 2) Track how much dust is created from that wind speed

Portable Dust Generator



1. Exhaust Tube 2. Blower 3. Adjustable legs 4. Hall Sensor 5. Annular Ring 6. Isokinetic Sampling Port 7. Motor 8. Adjustable Skirt

- (PDG)
- Based on PI-SWERL by DRI
- Produces a known wind speed
- Measures real time dust production
- Lightweight and Compact



Traditional Wind Tunnel

Photo Credit: Desert Research Institute

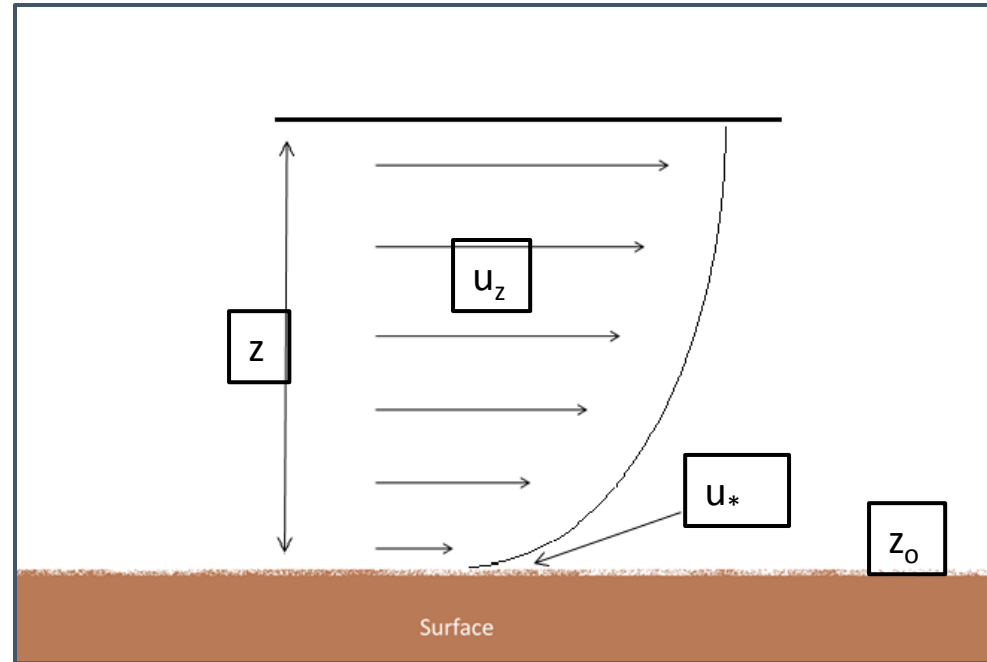
- Lower Cost**
- Lower maintenance**
- Less man power required**
- Smaller foot print**
- Ease of use**



Portable "Wind Tunnel"

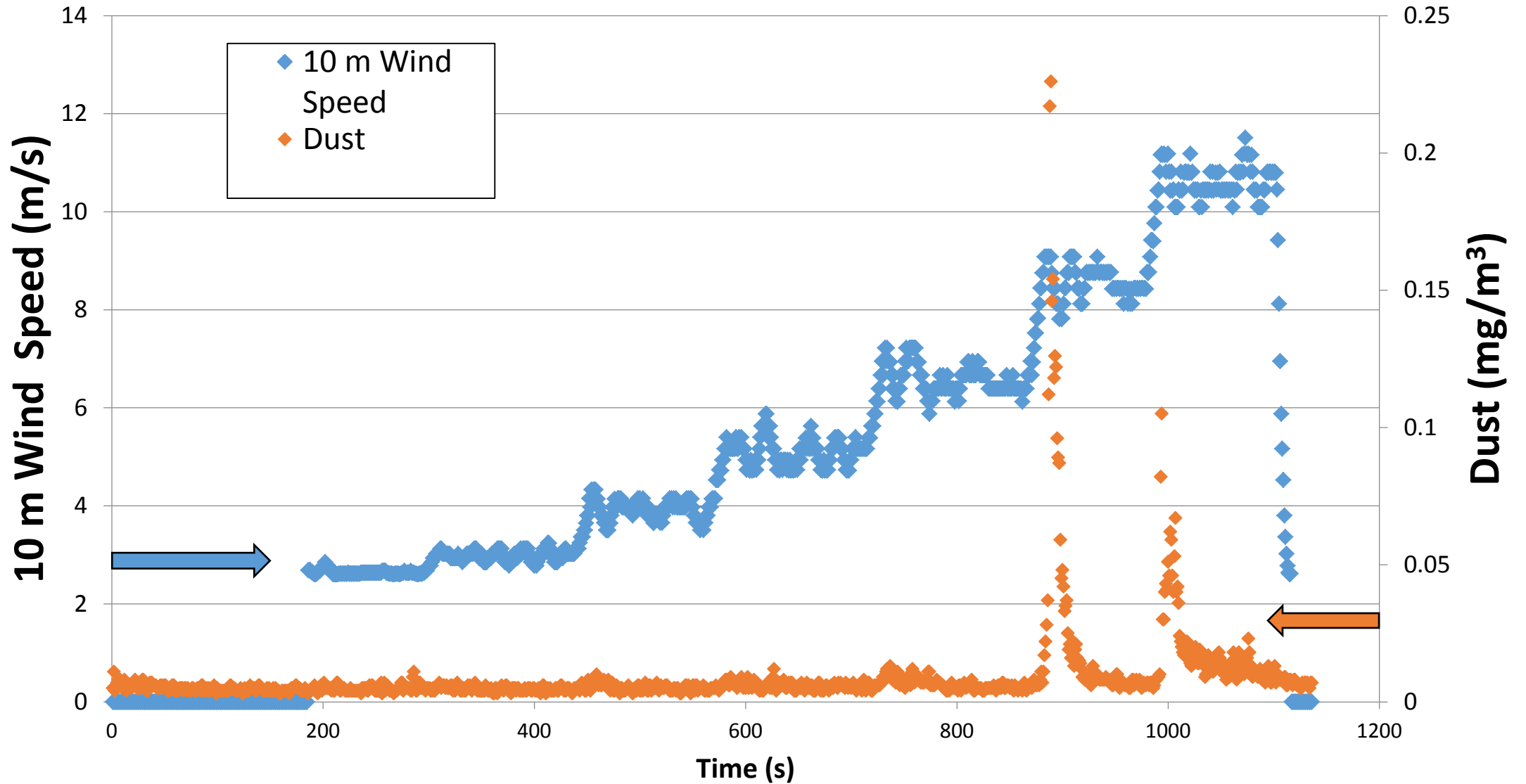
Theory

- Friction Velocity
 - Shear stress at the surface
 - Mechanical erosion
- Threshold Friction Velocity
 - Friction velocity that is needed for mechanical erosion
 - u_f
- Log-Wind Profile
 - u_z : Wind speed at height Z
 - κ : Von Kármán constant (0.4)
 - z_0 : Roughness length
 - u_* : Friction velocity



$$u_z = \frac{1}{\kappa} \ln \left(\frac{z}{z_0} \right) u_*$$

Dust and Wind Speed in Picacho Peak

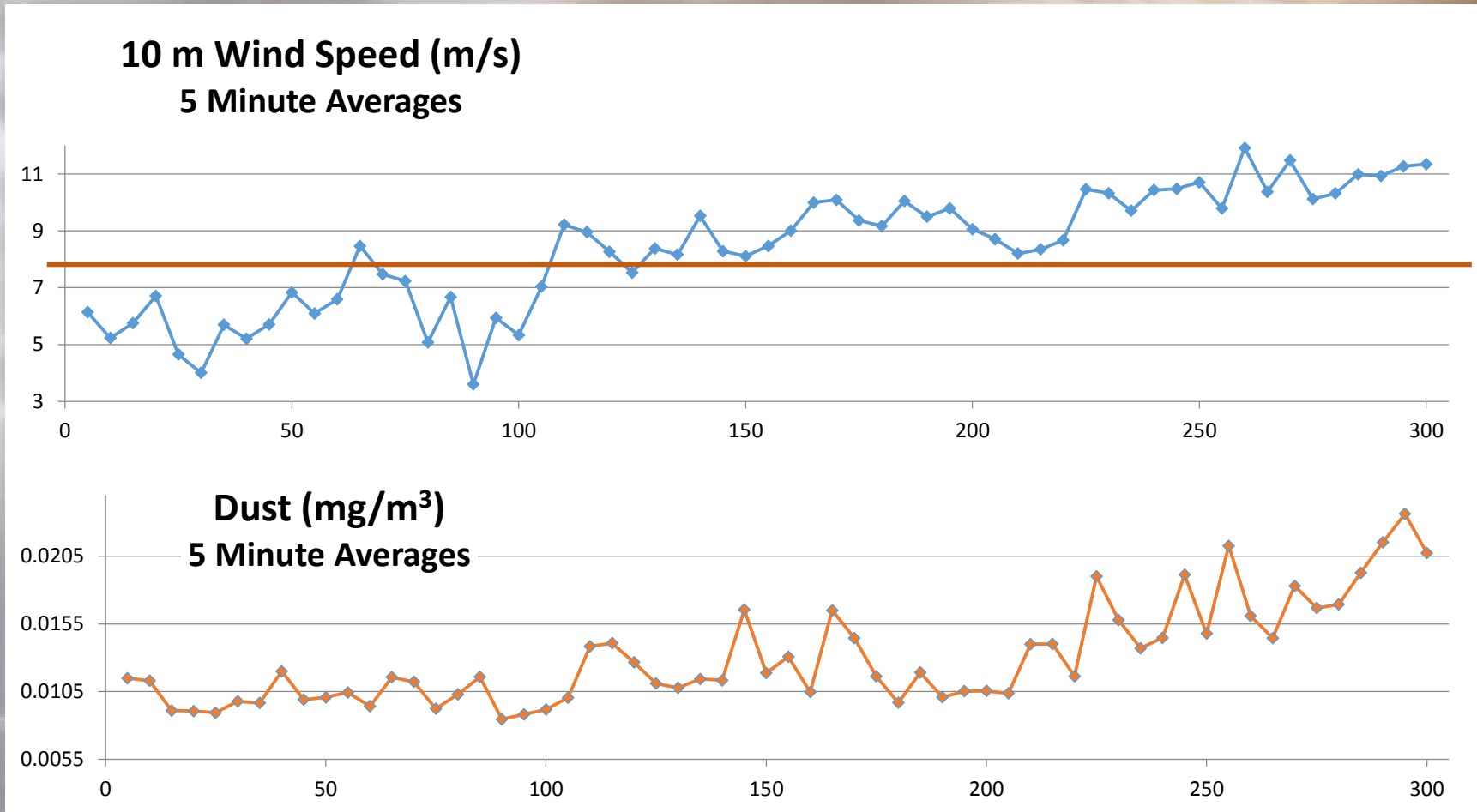


Picacho Peak 1-Day Study

Soil One (Crusted)	TFV (u_*) (m/s)	10-m Wind Speed (u_z) (m/s)
Run 1:	0.19 - 0.21	5.5 - 6.0
Run 2:	0.13 - 0.17	3.8 - 4.9
Run 5:	0.14 - 0.18	3.8 - 5.1
Soil Two (Rocky)	TFV (u_*) (m/s)	10-m Wind Speed (u_z) (m/s)
Run 3:	0.25 - 0.30	7.5 - 9.1
Run 4:	0.24 - 0.29	7.2 - 8.8

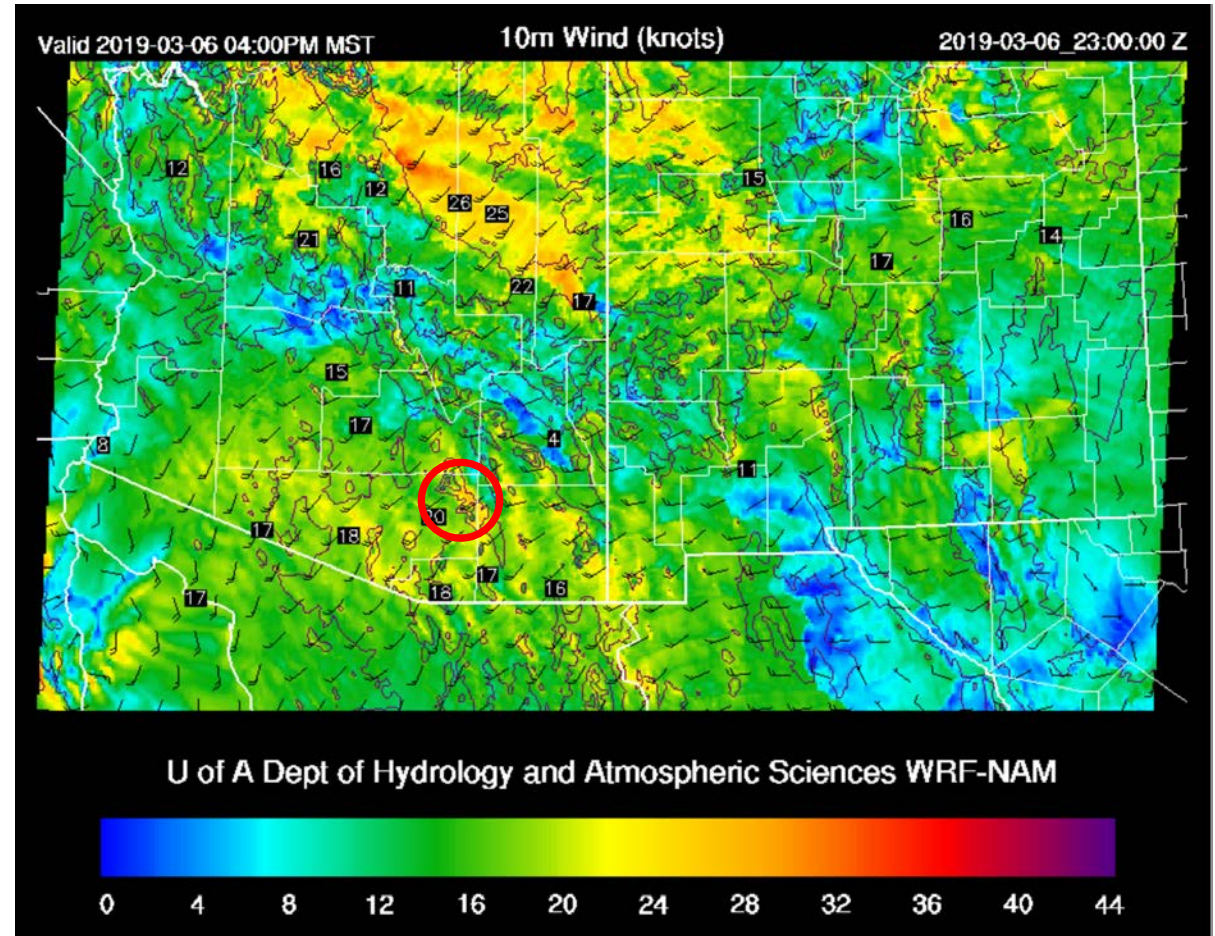


Ten Meter Wind Speed in Picacho Peak



Ten Meter Wind Speed Forecast

- Weather Research and Forecasting Model (WRF)
- 10 meter wind speed from <http://www.atmo.arizona.edu/?section=weather&id=wrf>
- Know what days are most dangerous to drive based on TFV research



Future Work

- More samples from Picacho Peak
- Undisturbed sites

- Wilcox area dust sources
- Effects of soil moisture

