Measurements of Threshold Friction Velocities on Abandoned Agriculture Fields near Picacho Peak using a Portable Dust Generator

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Our jobs would be a lot easier if there were a simple linear relation between dust and wind speed. We'd be done!!!
In The Real World

- Wind Speed
- Soil Moisture
- Soil Particle Shape and Size
- Soil Content
- Presence of Crust
- Presence of Vegetation
- Relative Humidity
- Presence of Aerosolizable Particles
- Soil Disturbance Level
- Current Amount of Dust in the Air

All Factor into Dust Production
Portable Dust Generator

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

Inlet

Exhaust/Sampling outlet

Chamber

Weighted Skirt
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 $Z$
  - $\kappa$: Von Kármán constant (0.4)
  - $z_0$: Roughness length
  - $u_*$: Friction velocity

$$\frac{u_Z}{u_*} = \frac{1}{\kappa} \ln \left( \frac{Z}{Z_0} \right)$$
Advantages over traditional wind tunnel

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

Traditional Wind Tunnel

Portable “Wind Tunnel”

Photo Credit: Desert Research Institute
Threshold Friction Velocity data

<table>
<thead>
<tr>
<th>Location</th>
<th>$U_*$ (m s$^{-1}$)</th>
<th>$U_{10}$ (m s$^{-1}$)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santa Cruz</td>
<td>(0.48-0.56) ± 0.03</td>
<td>(12.96-15.12) ± 0.81</td>
<td>4</td>
</tr>
<tr>
<td>Antelope Ravine U.</td>
<td>(0.58-0.61) ± 0.03</td>
<td>(15.98-16.81) ± 0.83</td>
<td>5</td>
</tr>
<tr>
<td>I.K. Lower Tailings</td>
<td>(0.39) ± 0.03</td>
<td>(10.89) ± 0.84</td>
<td>1</td>
</tr>
<tr>
<td>I.K. Upper Tailings</td>
<td>(0.35-0.40) ± 0.03</td>
<td>(9.77-11.17) ± 0.84</td>
<td>5</td>
</tr>
<tr>
<td>Antelope Ravine D.</td>
<td>(0.40) ± 0.04</td>
<td>(9.47) ± 0.95</td>
<td>1</td>
</tr>
<tr>
<td>Picacho Peak</td>
<td>(0.32-0.37) ± 0.02</td>
<td>(9.53-11.02) ± 0.89</td>
<td>3</td>
</tr>
</tbody>
</table>
Dust Observations in Iron King

June 2012 to May 2013 (8 AM to 8 PM)

1-m dust [10 minute average]
10-m winds [10 minute average]
What’s next?

- Picacho Peak Area
- Dewey-Humboldt
- Wilcox Playa
Thank You