Modeling Dust Generation and Deposition

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Motivation: The Iron King Site

Iron King tailings impoundment
- Superfund site since 2008
- Directly adjacent to the town of Dewey-Humboldt
- Highly contaminated (As, Pb)
Field site: Instrumentation

Eddy flux towers
- TSI DUSTTRAKs
- Anemometers
- Wind vanes
- Thermometers
- Hygrometers
- Soil moisture probe
- Soil radiometer

MOUDI
- Micro-Orifice Uniform-Deposit Impactor
- Particle Size Fractionation
Dust Generation

Effect of wind speed (10-m height)
Effect of relative humidity

Dust Generation
Initialization Weather Forecast

- Operational WRF model
  - 1.8-km spatial resolution (inner domain)
  - Hourly temporal resolution
- Analysis of WRF surface output
  - 10-m Wind Velocity
  - 2-m Temperature
  - 2-m Specific Humidity
  - Surface Pressure
Equations of motion for individual particles coupled to WRF model predictions allow for determination of particle trajectories. Example: 10-µm particle
In situ verification

- Inverted-disc (Frisbee) samplers
  - Weight
  - Chemical composition
  - Lead isotopes

- Month long sampling campaigns
  - May and June, 2014

DFM results for May 2014
Model (DFM PM27) vs Observed (lead concentration)
Conclusions

1. The deposition forecasting model can be used to predict transport and deposition of PM$_{2.7}$ tailings dust.

2. Arsenic and lead contaminants can be used as tailings dust tracers.

3. DFM captured the spatial variations of the deposition patterns up to 1 km distance from the tailings.

Portable Dust Generator

- Based on PI-SWERL (Etyemezian et al., 2007)
- A rotating annular ring provides shear to generate dust
- Wind speeds measured by a calibrated Irwin sensor
- Objective: to measure threshold friction velocities for dust generation
Picacho Peak

- Measured RPM
- TSP Concentration
- PM10 Concentration
- PM2.5 Concentration

$u^* = 0.27 \text{ m/s}$