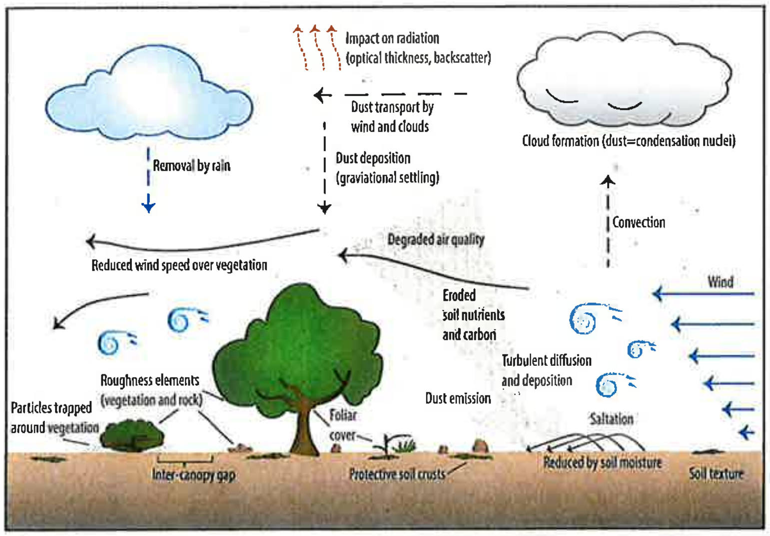
Wind erosion, blowing dust, and agroecosystem change

National Wind Erosion Research Network
http://winderosionnetwork.org



More than an air quality issue...

Wind erosion of soils is a national problem exacerbated by disturbance and land cover change. An estimated 60% of dust emissions in the US originate from areas where vegetation and soils are affected by land management.

The 1930s Dust Bowl is a dramatic example of how inappropriate management practices, unchecked during intense drought, can result in massive regional wind erosion.

Agriculture, energy development, livestock grazing, off-road vehicle use, and wildfires all contribute to increased wind erosion in the west.

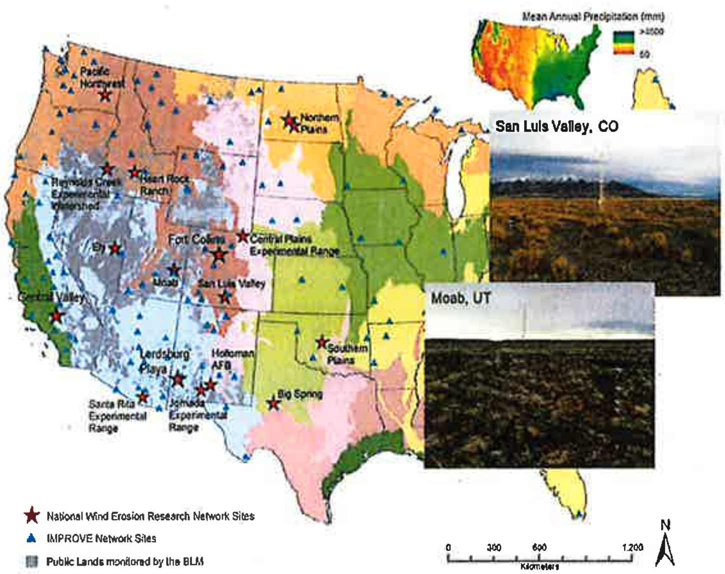
While high dust concentrations are often regarded as an air quality problem, reducing wind erosion and dust emissions is critical for maintaining healthy lands and resilient agroecological systems.

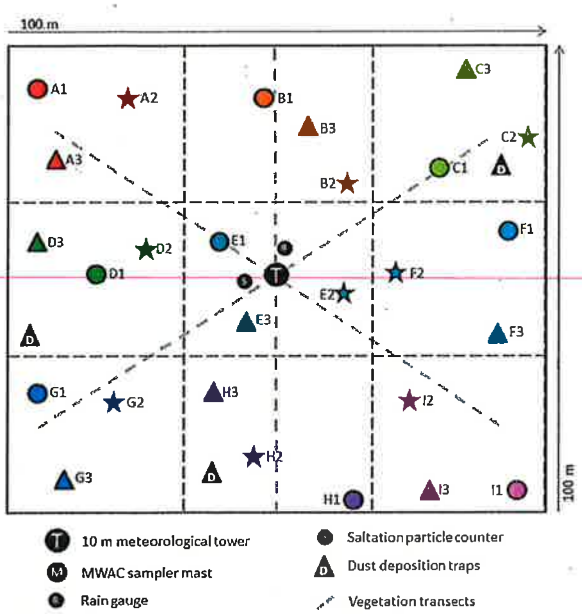
A multi-partner research network

The National Wind Erosion Research Network is a multi-partner collaboration, established to improve wind erosion monitoring, assessment and management in the US.

The Network: (1) collects standardized data to support understanding of wind erosion processes across land cover types, (2) supports the development of new technologies for assessing wind erosion that integrate existing monitoring data from the BLM, NRCS and air quality monitoring networks, and (3) facilitates collaborations to enhance monitoring, assessment, and management strategies.

Network sites are operated and/or supported by the USDA ARS, NRCS, BLM, Department of Defense, US Geological Survey and The Nature Conservancy.





Supporting national monitoring programs

Network sites monitor sediment transport rates and their controlling factors across agroecological systems. 27 MWAC samplers measure sediment mass flux. DustTrak aerosol samplers monitor fine dust concentrations. Meteorological and phenocam data are collected at a central 10 m tower. Vegetation is monitored using the core methods adopted by the BLM AIM and NRCS NRI monitoring programs.

New models developed by the network can be applied directly to AIM and NRI monitoring data, enabling wind erosion assessments across local to national scales.

Model outputs are being linked to ecological site descriptions and NPS and EPA air quality monitoring data, enabling identification of management benchmarks for wind erosion control and to improve air quality over public and private lands.

AIM Core Methods provide essential information about wind erosion

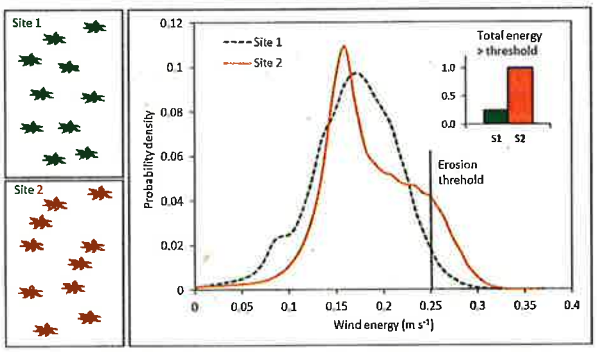
The BLM's Assessment, Inventory and Monitoring (AIM) program collects data that can be used to evaluate land health, including the susceptibility of landscapes to wind erosion.

The AIM Core Methods generate indicators of soil erodibility and vegetation cover and structure that influence where, when, and how much wind erosion may occur.

Soil Texture determines how loose and mobile soils may be and their tendency to form physical crusts that reduce the erodible sediment supply and protect soils from abrasion.

Bare Ground determines where soils are exposed to potentially erosive winds. However, knowing **Vegetation Cover** is not sufficient to assess wind erosion; **Canopy Gap** and **Vegetation Height** are also needed.

Canopy Gap Size is key to wind erosion assessment



Canopy gap size describes the spatial distribution of foliar cover, which affects the probability of erosive winds at the soil surface. The main graph shows differences in the probability density of wind energy for two sites with different vegetation arrangements[4]. At Site 2 (S2–Inset bar graph), there is significantly more wind energy above the erosion threshold (see page 1), which could lead to much larger wind erosion rates.

Vegetation structure, including **Canopy Gap Size** and **Vegetation Height** determine how much wind energy can access an exposed soil surface.

Vegetation absorbs wind energy and shelters exposed soil immediately downwind. Tall vegetation and small canopy gaps therefore afford the most soil protection.

As wind speeds increase, the sheltering benefit of vegetation typically decreases.

Vegetation that is short has significantly less sheltering benefit than taller vegetation with the same foliar cover.

Foliar cover that is evenly distributed in a landscape will have a significantly different effect on wind erosion than foliar cover that is clumped or patchy.

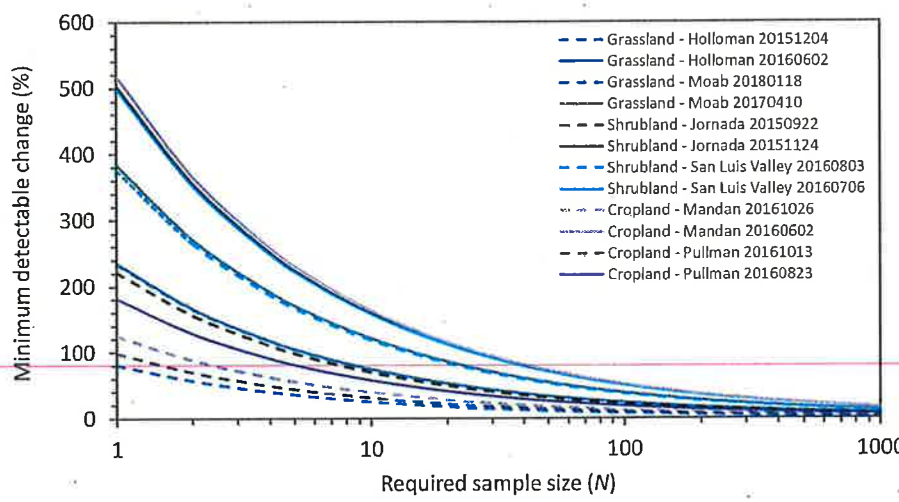
Canopy Gap data, part of the AIM Core Methods, quantifies these effects and greatly improves the accuracy of wind erosion assessments.

Robust monitoring underpins model development and applications

Wind erosion and dust emission have large spatial and temporal variability due to interactions between land surface and atmospheric drivers at different scales.

Sampling the spatial and temporal variability in sediment transport is critical for having confidence that the Network sites can detect differences in transport among land use and land cover types.

The Network sample design provides the most robust available data (globally) for evaluating sediment transport rates among sites, in response to management, and for parameterizing wind erosion and dust emission models that can be applied to inform management.



Paying attention to sample design is critical for monitoring aeolian sediment transport. The above graph shows the effect of sample size for a simple random sample on the minimum amount of change in sediment transport that could be detected at the 95% confidence level. Small sample sizes commonly used in wind erosion research ($n < 3$) are inadequate for detecting change

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