Motivation: An All-Lands Wind Erosion Model

Public concern about wind erosion in the United States is increasing. This concern has arisen as a consequence of changing and intensifying land use pressures, which can lead to increased soil loss and dust emissions and impacts on bio-geochemical cycles, agricultural productivity and human health. However, there are few available tools to support improved management.

To address the issue a new wind erosion model is being developed to assess net wind erosion across all land uses, including rangelands and croplands. The model development, led by the United States Department of Agriculture (USDA), will provide a tool for land managers and scientists to evaluate the impacts of land management and land use change on rates of wind erosion and dust emission. The model will provide estimates of net horizontal and vertical aeolian sediment fluxes, enabling assessments of management impacts on wind erosion from the plot to regional scales.

Objective

A significant constraint to the development of wind erosion models is limited and non-standard data for model calibration and testing. In response, a National Wind Erosion Monitoring Network is being established. The Network is a partnership between the USDA Long Term Agro-ecosystem Research (LTAR) Network, the Bureau of Land Management (BLM) and the Department of Defense (DoD).

The objective of the Network is to develop a national (US) dataset of standardized measurements of wind erosion and its controlling factors needed for the calibration, testing and application of an all-lands wind erosion model.

Development of a Standard Methods Protocol

A standard methods protocol is being developed to direct the measurement of wind erosion and its controlling factors at Network sites. The document provides a set of core methods that will be used at all Network sites, in rangelands and croplands, and a set of supplementary methods that can be used to collect additional data in support of soil erodibility assessments and the measurement of sediment transport rates.

Data and Model

Data collected at Network sites will be transmitted and stored centrally at the Jornada Experimental Range. Data will then be processed to evaluate dynamic soil erodibility ($\theta_1$) and aerodynamic roughness ($z_0$) changes at the sites and prepared for input to the model calibration and testing procedures.

These procedures will enable the development of a open-source all-lands wind erosion model and management decision support tools.

National Wind Erosion Monitoring Network

Site Locations

Network calibration sites will be established across the western United States at locations that represent the diversity of soils, vegetation, climate and land use and management practices in areas susceptible to wind erosion. It is expected that the Network will initially involve 9 USDA stations, 4 BLM stations and 1 DoD station (14 total).

Figure right shows prospective Network locations, marked with a red star.

Equipment at Network Sites

Each Network site will be instrumented with sensors and samplers to measure the meteorological controls on sediment transport, and sediment transport rates. A 10 m instrument tower (shown left) will be located in the centre of rangeland sites, or at the downwind edge of cropland sites. The tower will provide a platform to measure the wind velocity profile (6 heights), air temperature profile (3 heights), relative humidity, precipitation, and saltating particle counts (Sensit).

Data will be measured at a frequency of 1 Hz and logged at 1 min interval before transmission via mobile data network to a centralized database maintained at the Jornada Experimental Range in Las Cruces, NM.

Sampling – Vegetation, Soil and Management

Data on site management practices, vegetation and soil properties will be collected to describe the soil erodibility and surface roughness at sites. Measurements of the fractional cover of vegetation and soil crusts, the canopy gap size distribution, and canopy height will be made along three 100 m transects. The vegetation and soils data can be used to parameterize wind erosion models for calibration and testing.

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