

U.S. GEOLOGICAL SURVEY, FLAGSTAFF, ARIZONA  
(OFFICE OF WESTERN REGIONAL GEOLOGY - ASTROGEOLOGY BRANCH)

DESERT WINDS PROJECT

PURPOSE: TO DEFINE THE GEOLOGIC AND METEOROLOGIC CONTROLS ON PROCESSES -- PRIMARILY WIND EROSION AND DEPOSITION -- THAT SHAPE SURFACES IN DESERTS OF DIFFERENT TYPES (CHARACTERIZED BY DIFFERENT ROCK TYPES, TOPOGRAPHY, VEGETATION, RAINFALL, AND WIND PATTERNS)

METHOD: SELECT TYPE AREAS IN SOUTHWEST U.S. DESERTS FOR REMOTE MONITORING OF BOUNDARY LAYER CONDITIONS, USING AUTOMATED "GEOMET STATIONS."  
DO DETAILED SURVEYS OF SITES -- SURFICIAL GEOLOGY, TOPOGRAPHY, AND VEGETATIVE COVER -- MAPPING, SAMPLING, AND REPEAT PHOTOGRAPHY.

OBJECTIVE: TO OBTAIN QUANTITATIVE, BASELINE DATA ON WIND EROSION AND DEPOSITION, IN ORDER TO ASSESS VULNERABILITY TO CHANGES THAT MAY RESULT FROM HUMAN IMPACT, AND TO COMPARE OBSERVED SURFACE CHANGES WITH THOSE PREDICTED BY THEORY.

EFFECTS OF EOLIAN (WIND) PROCESSES  
ON SEMI-ARID LANDS

WHO? U.S. GEOLOGICAL SURVEY, FLAGSTAFF, ARIZONA AND CO-INVESTIGATORS OR COLLABORATORS AT TAC - UNIV. OF NEW MEXICO; U.S. ARMY ENGINEER TOPO LAB - VIRGINIA; NOAA - BOULDER COLO.; USDA - LAS CRUCES AND OTHERS

WHERE? YUMA, ARIZONA  
JORNADA DEL MUERTO, NEW MEXICO

WHY? WIND EROSION TODAY IS PRESENT-DAY SIGNAL OF INCREASED ARIDITY OR DESERTIFICATION - AFFECTS SOIL EXPOSURE (ALBEDO), VEGETATION, ETC.

WIND EROSION IN PAST HAS LEFT RECORD OF QUATERNARY CLIMATIC EPISODES - A FRAMEWORK OF VULNERABLE LAND SURFACES SUBJECT TO NEW PULSES OF EOLIAN ACTIVITY.

CLIMATOLOGICAL AND GEOLOGICAL CONTROLS ON WIND EROSION ON NATURAL LANDS ARE POORLY KNOWN -- BASELINE DATA ARE NEEDED TO DEFINE CONDITIONS AND PREDICT VULNERABILITY TO CHANGE.

HOW? OBTAIN BASELINE DATA ON BOUNDARY LAYER METEOROLOGY, SURFICIAL GEOLOGY, AND VEGETATION COVER FROM INSTRUMENTED FIELD SITES ("GEOMET" STATIONS) IN TYPE AREAS OF U.S. SOUTHWEST DESERTS. DETERMINE THRESHOLD CONDITIONS FOR WIND EROSION ON VARIOUS NATURAL SURFACES FROM THESE DATA. ANALYZE TRENDS IN THESE DATA AND RELATE TO SURFACE CHANGES RECORDED ON LANDSAT MSS RETROSPECTIVE IMAGE DATA. USE RESULTS TO TEST MODELS FOR WIND EROSION UNDER GIVEN CONDITIONS AND TO PREDICT VULNERABILITY OF SURFACES TO DESERTIFICATION DUE TO CLIMATE CHANGE OR HUMAN IMPACT.

*Instrumentation*

DATA COLLECTED BY JORNADA AND YUMA GEOMET STATIONS

6-MINUTE DATA

WIND DIRECTION  
WIND SPEED (1.2, 2.7, 6.1m)  
AVERAGE  
PEAK GUST  
SAND FLUX - BAGNOLD CATCHER WITH PIEZOELECTRIC WEIGHING DEVICE (MACKINNON-  
USGS)  
SAND FLUX - SENSIT PIEZOELECTRIC MOMENTUM FLUX SENSOR (STOCKTON/GILLETTE -  
NOAA)

12-MINUTE DATA

PRECIPITATION  
RADIATION  
INCOMING SHORTWAVE  
OUTGOING SHORTWAVE  
INCOMING LONGWAVE  
OUTGOING LONGWAVE

THERMAL BRIGHTNESS TEMPERATURE - FOUR TARGETS  
SOIL HEAT FLUX (1 cm depth) - FOUR SENSORS

HOURLY DATA

HUMIDITY  
BAROMETRIC PRESSURE  
SOIL MOISTURE (4 cm)  
SOIL TEMPERATURE (4, 10, 20 cm)

ALSO - FRYREAR SAND CATCHER - SAMPLES COLLECTED MANUALLY AFTER WIND EVENTS.  
REPEAT PHOTOGRAPHY, VEGETATION TRANSECTS, SOIL SAMPLING.

The Desert Winds Project is a long-term study of surface processes, particularly wind erosion and deposition, that shape the local surficial geology of different deserts. The study uses data from satellite-relay, automated "Geomet" stations, combining meteorologic and geologic sensors, in a network that monitors localities representative of the Great Basin, Upper and Lower Sonoran, and Mohave Deserts in Arizona, and at the Jornada Experimental Range in Chihuahuan Desert of New Mexico. The Geomet data are used with repeat photography and detailed site studies to determine sediment transport (windblown sand and dust) under monitored geometeorological conditions. Results of the field studies will be used to test erosion equations based on theory. The long-term goal is to obtain data suitable for quantitative evaluation of wind processes as agents of surface geologic change.

The Eolian Processes-Landsat Retrospective Project expands the scope of Desert Winds to include the development and deployment of state-of-the-art experimental sensors, including sand flux and radiation sensors, at Geomet sites in the Yuma Desert and on the Jornada Experimental Range. This project, in collaboration with the U.S. Army Engineer Topographic Lab. and U.S. Department of Agriculture, is designed to test the effects of long-term wind erosion on desert surface characteristics that can be monitored by satellite remote sensing. The Geomet data are used in concert with retrospective and current Landsat and airborne remote sensing data to test the linkage between the meso- and microscale geometeorological parameters measured on the ground and the macroscale surface effects observed by remote sensing. The objectives are (1) to determine what kinds and scale of remotely-sensed data are useful for detecting, monitoring, and predicting effects of eolian processes on the surface properties of arid regions (mostly erodibility of soils and changes in type and amount of vegetation); (2) to study relations of eolian processes and effects to changes in surface energy budgets; and (3) to study local feedback effects of eolian processes on climate.

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