Researcher studies near-surface wind effects on landscape evolution

January 7 2020

Zachary Lebo. Credit: University of Wyoming

The accurate characterization of near-surface winds is critical to understanding past and modern climate. Dust lifted by these winds has the potential to modify surface and atmospheric conditions, according to a University of Wyoming researcher who was part of a study on the subject.

"This study demonstrates an intricate coupling between land surface changes and wind speeds. Specifically, the wind acts to erode sandy deserts," says Zachary Lebo, a UW assistant professor of atmospheric science. "As a result, the surface transitions from a sandy surface to one composed of large rocks that tend to be darker and, thus, absorb more sunlight or decrease the albedo on the surface. This causes the ground to warm."

Surface albedo is the fraction of sunlight reflected off a surface, Lebo says. For example, snow has a really high albedo because it reflects a lot of light from the sun. On the other hand, asphalt has a very low albedo because it reflects very little light and, thus, absorbs a lot of sunlight, which causes it to be quite warm in many instances.

"Why is this important? Temperature gradients can ultimately impact wind speeds," Lebo continues. "So, changing the temperature over the desert changes the temperature gradient, which changes the wind speeds—in this case causing them to increase."

Lebo was a contributing author of a paper, titled "A Wind-Albedo-Wind Feedback Driven by Landscape Evolution," published Jan. 3 in *Nature Communications*.

Jordan Abell, a graduate student at Columbia University, was the paper's lead author. Other contributors to the paper included researchers from Clemson University, the University of Arizona and Lanzhou University in Lanzhou, China.

Numerical simulations were conducted for the period Feb. 1-June 1, 2011. The simulations spanned the climatological peak in wind speeds in the Turpan-Hami depression, located along the western fringe of the Gobi Desert in northwestern China, which was the focus region for this study.

Lebo and Alex Pullen, an assistant professor in the Department of Environmental Engineering and Earth Sciences at Clemson University, discussed the potential for surface wind speeds to have increased over the region of interest, due to the erosion of the sandy land, thus darkening of the surface. This led to the hypothesis that recent increases in wind speeds in the Turpan-Hami depression were related to the darkening of the surface from erosion and, thus, increased temperature gradients.

Lebo says the Weather Resource and Forecasting model, which produced controlled simulations, performed "quite well" in replicating the surface winds at most observation stations in the western part of the Gobi Desert.

"My role was developing a model configuration that could test the hypothesis as well as running the simulations," Lebo explains. "I worked very closely with the lead author with regard to interpreting and analyzing the results as well as the model-observation comparison."

The study's results show that altered surface thermal properties—through the winnowing of fine-grained sediments and formation of low-albedo gravel-mantled surfaces—lead to an increase in near-surface winds by up to 25 percent. Paradoxically, wind erosion leads to faster winds regionally.

The East Asian dust-producing regions are located upwind of a prominent high-nutrient, low-chlorophyll area in the North Pacific where the productivity of photosynthetic organisms is limited.

"This work, albeit focused on a single basin in western China, has implications that may extend to other similar sandy deserts around the world, including the Sahara and the Arabian Peninsula," Lebo says. "Another real-world implication of the wind-albedo-wind impacts is on the supply of nutrients from dust around the world. Dust from sandy deserts, such as the Gobi, provide key nutrients for plant growth that extend far beyond the deserts themselves. The ever-evolving surface, impact on winds and subsequent feedback on dust emissions could affect nutrient supplies downwind."

More information: Jordan T. Abell et al. A wind-albedo-wind feedback driven by landscape evolution, *Nature Communications* (2020). DOI: 10.1038/s41467-019-13661-w

Provided by University of Wyoming

Citation: Researcher studies near-surface wind effects on landscape evolution (2020, January 7) retrieved 26 April 2024 from https://phys.org/news/2020-01-near-surface-effects-landscape-evolution.html