How Dust Storms Work

http://science.howstuffworks.com/nature/climate-weather/storms/dust-storm.htm

by Vicki M. Giuggio

You step out onto the sun-drenched patio to enjoy what's left of yet another stellar summer day. But as you lazily take in the view of the horizon, you can't quite believe what you see. Instead of the clear blue Southwestern sky that usually backdrops the expansive desert landscape, a looming black wall towers miles above the ground, dwarfing the nearby town as if it were a child's LEGO project. You blink. With all due respect to Mother Nature, this thing looks more like the product of computer graphics from a science-fictionmovie than anything real. But it is real, and you realize it's moving toward you -- fast. Two minutes later, you're thrown into the dark of night, the wind is howling in your ears, and it feels like someone's repeatedly throwing a shovel full of fine sand in your face. As you fumble to make your way back inside for cover, your eyes, nose and mouth are full of fine gritty stuff. Your stunned brain can only think one thing: Is this what Armageddon feels like?

Often described with apocalyptic terms by the media, what you've just experienced is a **haboob**, a type of dust storm. Dust storms come in various shapes and sizes, but regardless of their variations, what they do is similar -- they carry dust and sediment from one place to another, regardless of who or what is in their path.

Dust storms are natural events. However, scientists believe human activity is causing them to occur more frequently in certain regions, and their impact can be devastating.

Ever wonder how all that dust gets airborne and why haboobs are the scene-stealers they are? Turns out, it takes more than a windy day.

Where Do Dust Storms Occur?

The erosion of soil in one area and deposition of it in another is a process that has played a role in our global ecosystem since time began. Although dust storms make headlines for the havoc they cause, their occurrence is not always a tale of destruction and mayhem. For instance, 20 million tons of dust are transported from the Bodele depression in the Sahara to the Amazon basin each year, supplying the rain forest with essential minerals and nutrients to keep it fertile and thriving [source: Koren].

From a small, cyclone-like burst of dust that only lasts for a few minutes to storms that blow dust for 50 days straight at near-hurricane speeds, dust storms result from a combination of climate, weather and wind. Central Asia, North America, Central Africa and Australia are home to the most dust storms, but they can kick up anywhere where the conditions are ripe.

The first element needed for any dust storm -- a source of dust -- depends largely on climate. Ideal dust sources occur in areas where the composition of the soil is very dry and loosely held on the surface. This most commonly occurs in arid and semi-arid regions, usually after a prolonged drought. Moisture keeps soil compact and helps maintain vegetation, which protects it from being swept up into passing winds. Not surprisingly, dust storms frequently occur in the desert. However, marginal dry lands are increasingly a

source of major dust storms. These areas have fragile, delicately balanced ecosystems. Their degradation, called **desertification**, makes the soil less resilient to wind during prolonged drought. Desertification sometimes happens naturally; the Bodele Depression, for instance, is a natural dry lake bed that was once a large freshwater lake in northern Chad. Now, an average of 0.7 tons of dust a day is blown up from the dried up lake each winter [source: Koren].

Increasingly, however, desertification results from human activity. Excessive animal grazing, timber cutting and farming methods strip and exhaust dry-land topsoil. When a drought occurs in these areas -- and eventually it will -- all you need is the right weather and you've got yourself a dust storm.

So how do dust storms form? First, we'll examine how wind gets dust into the air and later find out how weather patterns determine what happens to the dust once it's airborne.

The Impact of Dust Storms

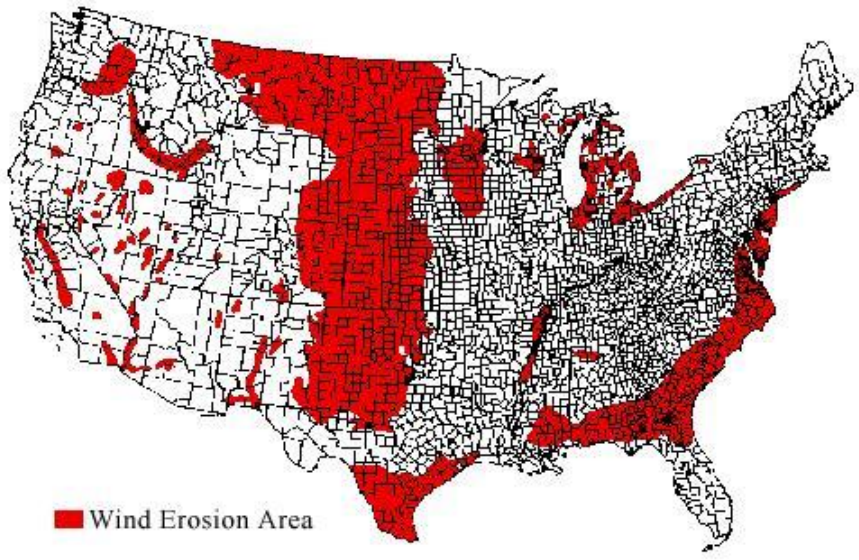
During major dust storms, the deposition of dust over populated areas can be wide reaching, often affecting multiple cities and towns. Dust storms can take down trees, bury equipment and cause damage to houses. In the final years of the Dust Bowl, farm animals were found dead in the fields and people started suffering from "dust pneumonia" [source: WGBH].

While the loss of human life during dust storms is relatively small when compared to other natural disasters, long-term health concerns have cropped up recently. This is primarily due to the increased number of storms originating from areas of desertification. The dust in these storms has been shown to contain pollutants and toxins, such as salt, sulfur, heavy metals, pesticides and carbon monoxide to name a few [sources: United Nations, Stewart]. The pollution-laden dust can be carried over hundreds of miles, affecting millions of people who might not necessarily suffer from the acute events of the storm.

The immediate economic impact of dust storms is significant, but it doesn't rival major natural disasters that destroy entire cities. For instance, the damage due to dust storms in China averages at about $6.5 billion per year [source: Ford]. A single major earthquake can do damage to the tune of five times that figure. However, experts argue that the real economic impact of dust storms, particularly those that originate in areas of desertification, is difficult to pin down because of the long-term consequences they have on the livelihood of people who live in the area[source: United Nations]. When dust storms kick up in agricultural dry lands that are degraded, they remove the topsoil, which causes further desertification. As a result, farmers are forced to watch the topsoil, and their livelihood, literally blow away. This cycle, if gone unchecked, threatens to displace whole communities in some regions.

Some dust storm activity can be prevented, but dust storms will always be an integral part of the natural ecosystem. Learn what we can do to prevent and live with dust storms in the next section.

The Problem of Wind Erosion



Wind erosion is a serious threat to food security and contributes to the degradation of a sustainable agriculture in the United States and throughout the world. In addition, dust storms affect air quality and airborne dust has significant economic, health, ecological, and hydrological impacts.

Soil erosion by wind is worse in arid and semiarid regions. Areas most susceptible to wind erosion on agricultural land include much of North Africa and the Near East; parts of southern, central, and eastern Asia; the Siberian Plains; Australia; northwest China; southern South America; and North America.

During the 1930's, a prolonged drought culminated in dust storms and soil destruction of disastrous proportions. The "black blizzards" of the resultingDust Bowl inflicted great hardships on the people and the land.

Over seventy years after the Dust Bowl ended, wind erosion continues to threaten the sustainability of our nations' natural resources. As recently as the spring of 1996, wind erosion severely damaged agricultural land throughout the Great Plains. On cropland, about 70 million hectares (171.8 million acres) are eroded by wind and water at rates that exceed twice the tolerance level for sustainable production (USDA, 1989). On average, wind erosion is responsible for about 40 percent of this loss (Hagen, 1994), and can increase markedly in drought years (Hagen and Woodruff, 1973). In the United States, wind erosion is the dominant problem on about 30 million hectares (73.6 million acres) and moderately to severely damages approximately 2 million hectares (4.9 million acres) annually (USDA, 1965). According to the 1992 National Resources Inventory (NRI), the estimated annual soil loss from wind erosion on nonfederal rural land in the United States was 2.5 tons per acre per year (SCS-USDA, 1994). This number is a decrease from 3.3 tons per acre per year in the 1982 NRI. However much of this reduction was a result of enrollment of land classified as highly erodible in the Conservation Reserve Program (CRP). The CRP enrollment for much of this acreage is scheduled to retire within the next few years.

Wind erosion physically removes the lighter, less dense soil constituents such as organic matter, clays, and silts. Thus it removes the most fertile part of the soil and lowers soil productivity (Lyles, 1975). Lyles (1975) estimated that top soil loss from wind erosion causes annual yield reductions of 339,000 bushels of wheat and 543,000 bushels of grain

sorghum on 0.5 million hectares (1.2 million acres) of sandy soils in southwestern Kansas. This loss in productivity has been masked or compensated for over the years by improved crop varieties and increased fertilization. Thus wind erosion reduces potential soil productivity and increases economic costs. Blowing soil impacting plants can also reduce seedling survival and growth, depress crop yields, lower the marketability of vegetable crops, increase the susceptibility of plants to certain types of stress, including diseases, and contribute to transmission to some plant pathogens (Armbrust, 1982 and 1984; Claflin, et al., 1973; Michels et al., 1995). In the long run, the cost of wind erosion control practices can offset the cost of replanting a blown out crop. Some soil from damaged land enters suspension and becomes part of the atmospheric dust load. Dust obscures visibility and pollutes the air, it fills road ditches where it can impact water quality, it causes automobile accidents, fouls machinery, and imperils animal and human health (Skidmore, 1988). In Seward County Kansas alone the state highway department spent over $15,000 in 1996 to remove 965 tons of sand from 500 feet of highway and ditch (Tri-County Area Proposal for EQIP, unpublished report). Wind erosion is a threat to the sustainability of the land as well as the viability and quality of life for rural as well as urban communities.

Wind erosion in the United States is most widespread on agricultural land in the Great Plains states. Wind erosion is also a serious problem on cultivated organic soils, sandy coastal areas, alluvial soils along river bottoms, and other areas in the United States. In addition it is a major cause of soil degradation in arid and semiarid areas around the world.

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Last modified: 09/02/2012
http://www.weru.ksu.edu/new_weru/problem/problem.shtml

What caused the Dust Bowl?

http://science.howstuffworks.com/environmental/green-science/dust-bowl-cause1.htm

by Maria Trimarchi

A father and son are slowed by a dust storm in their walk toward a shack.

Arthur Rothstein/Resettlement Administration/Time Life Pictures/Getty Images

Effects of the Dust Bowl

When the drought hit the Great Plains, roughly one-third of the farmers left their homes and headed to the mild climate of California in search of migrant work. Known as the **Okies** -- the nickname referred to any poor migrant from the American Southwest since only about 20 percent were from Oklahoma -- they left behind the parched lands and economic despair. Many were used to financial stability and home amenities such as indoor plumbing, but had become financially indebted after purchasing mechanized farming equipment and suffering crop failures. They faced foreclosure on home and farm.

California didn't welcome the influx of Okies. Since the number of migrant workers outnumbered the available jobs, tensions grew between Californians and laborers, and public health concerns rose as California's infrastructure became overtaxed.

In 1933, President Franklin D. Roosevelt enacted the first of several mortgage and farming relief acts under the New Deal aimed to reduce foreclosures and keep farms afloat during the drought. But by the end of 1934, roughly 35 million acres of farmland were ruined, and the topsoil covering 100 million acres had blown away [source: PBS].

Under the Taylor Grazing Act of 1934, the government reserved 140 million acres as protected federal lands. Grazing and planting would be monitored to encourage land rehabilitation and conservation. Additionally, in the early 1930s, the government launched the **Civil Conservation Corps** (**CCC**), one of the most successful New Deal programs. Three-million young men volunteered for forestry and conservation work for the CCC. They were called Roosevelt's "Forest Army," and they planted trees, dug ditches and built reservoirs -- work that would contribute to flood control, water conservation and prevent further soil erosion.

Additionally, between 1933 and 1935 many more programs and agencies were introduced specifically to help people affected by the Dust Bowl, including efforts like the Emergency Relief Appropriation Act, the

Resettlement Administration, the Farm Security Administration, the Land Utilization Program and the Drought Relief Service.

The **Works Progress Administration** (**WPA**), a program started under the Emergency Relief Appropriation Act, is one of the best-known New Deal programs. The WPA was a work relief program that employed more than 8.5 million people to build roads, bridges, airports, public parks and buildings [source: PBS].

It took millions of tons of dirt and debris blowing from the Plains all the way into Washington D.C., known as "Black Sunday," to move Congress to pass the Soil Conservation Act and establish the **Soil Conservation Service** (**SCS**) under the Department of Agriculture.

The SCS (now the Natural Resources Conservation Service) promoted healthy soil management and farming practices, and paid farmers to put such practices to work on their farms. The legacy of the Service's practices such as irrigation, crop diversity and no-till farming continue in the Plains today.

The 1930s Dust Bowl didn't inoculate the United States from another such ecological disaster, though. About 90 percent of the 450 million hectares of arid land in North America suffers from moderate to severe**desertification** [source: Center for International Earth Science Information Network]. Sustainable agriculture and soil conservation practices could help avoid another dust bowl, but experts aren't sure that such measures will be enough if extended and severe drought revisits the Great Plains.