

Southern AER

Atmospheric Education Resource
Atmospheric Education Resource

Volume 10, Number 6

Summer 2003

Editor: Lauren Bell

Did you know?

- The same forested land area (749 million acres) that existed in 1900 supports 270 % more US citizens today.

(from the USDA Forest Service)



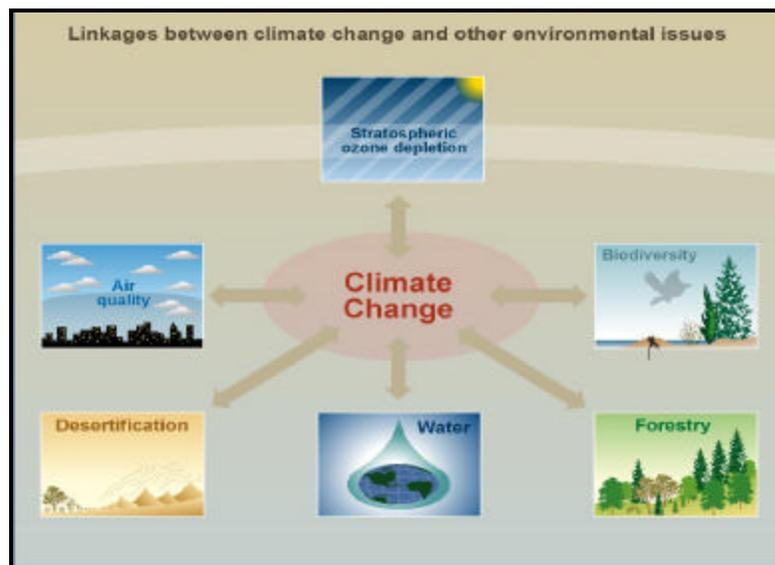
- In 1963, a massive smog episode occurred in New York City.

(from the EPA Journal - Jan-Feb 1991)

Climate Change and You:

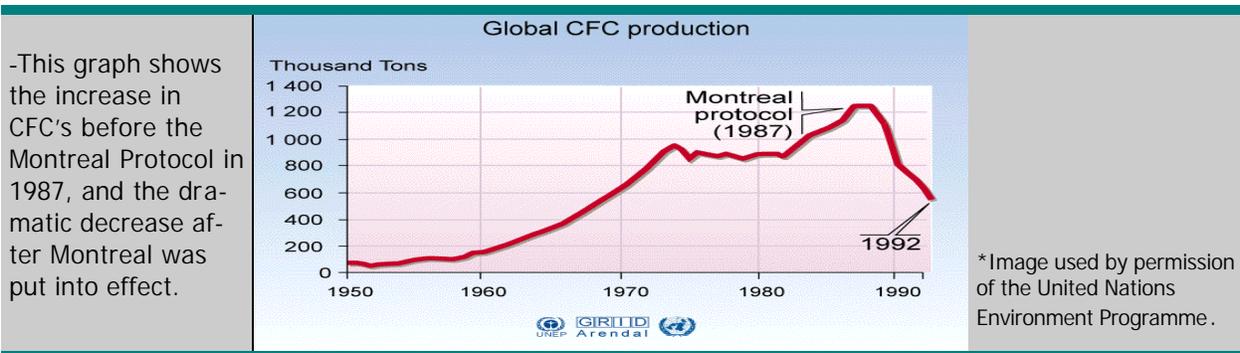
How human activities impact global and local climate, and how climate change affects the world around us

Have you ever considered how the climate in your area affects the way you live? For example, climate can determine whether or not you wear shorts year round, or if you need snow boots during the winter. Climate also affects the world around us: plants, animals, the atmosphere, and water. Some changes in climate, such as flood or drought, can be naturally occurring, while others, like global warming, are caused by human activity. Mankind, the environment, and climate constantly share a number of cause and effect relationships. To better understand these relationships, study the chart below. The chart highlights six major areas of interaction between climate change, land, water, atmosphere, plants, animals, and human activity. Read on to learn more about the changing and interactive world around you



Ozone is a gas that plays a vital role in our atmosphere. You may have heard of the *Ozone Layer*, the portion of the atmosphere where 90% of the earth's ozone is found. The Ozone layer is located in the stratosphere. The *stratosphere* begins 5-11 miles (8-18 kilometers) above the surface of the earth, and extends upward about 30 miles (50 kilometers). The important role of the Ozone Layer is its ability to block out harmful solar rays, known as ultraviolet (UV) rays. If not absorbed by ozone in the atmosphere, UV rays may damage human skin, causing skin cancer, and create growth problems in plants. Also, UV rays can damage the oceanic food chain by decreasing the survival rates of many sea creatures such as fish, shrimp, crab, and amphibians.

The problem here is that human activities like factories are producing chemical compounds that deplete or diminish the Ozone Layer (*Stratospheric Ozone Depletion*), allowing the harmful UV rays to pass through the atmosphere. One important type of these gases is called chlorofluorocarbons, or CFC's. CFC's are used in refrigeration, air conditioning, and cleaning electronic equipment. They escape into the stratosphere, where they deplete the Ozone Layer. Over time, CFC's have helped create a hole in the Ozone Layer. Before attempting to repair this hole, scientists asked themselves two questions: (1.) Can we repair the damage already done? (2.) How can we prevent damage in the future? The best answer came in a worldwide agreement called the Montreal Protocol. The *Montreal Protocol* is designed to increase ozone in the stratosphere by limiting the amount of CFC's produced by individual nations. The protocol was a success, and is working so well, the ozone layer is expected to recover over the next 50 years.



Just as human lives and communities are affected by climate change, so are those of plants and animals. A community of living organisms and its interactions with the surrounding environment is called an *ecosystem*. The variety or diversity of species within an ecosystem is called *biodiversity*. For example, an ecosystem in a tropical rainforest most likely has a high level of biodiversity, meaning there is a large variety of species in that environment.

One current trend in climate change is global warming, an increase in temperature worldwide. This warming has a great effect on plant and animal life. Unlike humans, plants and animals cannot simply go inside their homes and turn on their air conditioners. Global warming affects seasonal temperature change, growing seasons for plants, mating seasons, and migration patterns for some animals. As global climate grows warmer, many species have and will expand northward in search of a cooler, more suitable climate. The migrating species encounter two major problems: 1.) human civilization 2.) presence of pre-existing ecosystems. The migration of some plant or animal species may be hindered because of cities, neighborhoods, and freeways, leaving some plants and animals to extinction or severe population reduction. Another problem migrating species may encounter is competition for survival from native ecosystems already thriving in the cooler habitat. Animals are forced to compete for food in order to survive, while many plants compete for sunlight. As temperature increases on a global scale, many plants and animals are expected to migrate at different rates toward the poles in search of cooler habitats. Biodiversity is predicted to decrease with climate change as many ecosystems are destroyed.

Keep in mind that global warming is not the only factor affecting biodiversity.

Ecosystems are also influenced by human practices, such as water and air pollution, deforestation, and city growth/development, or *urbanization*. Humans are not the only living beings affected by climate change. Our reactions to our own impacts on the environment, including climate change, should be closely monitored in efforts to protect and maintain biodiversity globally.

Water is a vital part of almost all life on earth, and affects many aspects of our lives. With respect to weather and climate, we are influenced by water through the Hydrologic Cycle. The *Hydrologic Cycle*, also known as the Water Cycle, is the endless movement and exchange of water in all its states between the atmosphere, land surface, and underground. Changes in the Hydrologic Cycle over an area can influence changes in climate, such as drought or flooding.

Drought is an abnormal water shortage over time. It is in many cases a naturally occurring aspect of climate, and is not permanent. The impacts of drought can be devastating to economies, environments, and societies. Drought can reduce the productivity of crops, livestock, and forests, and increase the risk of forest fire, wind erosion, and insect infestation. One common side effect of drought, especially in developing regions such as South Africa, is famine. *Famine* is a severe shortage of food. Famine can lead to the eventual starvation of livestock and even people when governments do not have extra food or money to meet the nutritional needs of many people. In many third world countries, people are not equipped or prepared to cope with drought or famine. Migration becomes the solution for many in farming and herding communities when livestock die, food is scarce, and shallow wells only produce dirty, salty water. Migration only creates more problems, however. When people leave their homes in search of food and water, they are no longer a part of the production force that drives the economy.

The World Food Programme (WFP) is the world's largest humanitarian agency, and is dedicated to feeding hungry victims of natural or political disasters such as flooding, drought, or war. Provision of food by the WFP allows families to save their money for the future. In many cases, food is given in reward to those who help rebuild communities by cleaning irrigation canals or digging deeper wells. The WFP discourages migration by providing food locally. The WFP helps rehabilitate economies by enabling farmers to return to their crops after the drought. In 2002, the World Food Programme delivered 389 thousand tons of food to drought victims in Ethiopia.

Famine is just one of the destructive forces spawned by drought. The severe shortage of water creates a chain reaction, or snowball effect, as other problems arise, such as famine, forest fire, and insect infestation destroying economies and societies. In some cases, drought is actually brought on by human activity, such as desertification and deforestation, which you will read about later. Drought is a dreaded form of climate change, especially to those whose livelihoods depend completely on the availability of water for crops and cattle.



When the Dustbowl Drought plagued the Southwestern United States in the 1930's, a famine also occurred, and many farmers and their families became dependent on the government for food and money. As crops and ground cover died, there were no plants roots to hold the soil in place. Dust storms became common phenomena, and had disastrous effects—burying homes and barns, killing livestock and people (left: a farmer struggles to walk through a dust storm in the Dakotas. Middle: the aftermath of a dust storm reveals a mountain of dust blown against a barn. Right: a once fertile field transformed into a wasteland by the Dustbowl Drought.

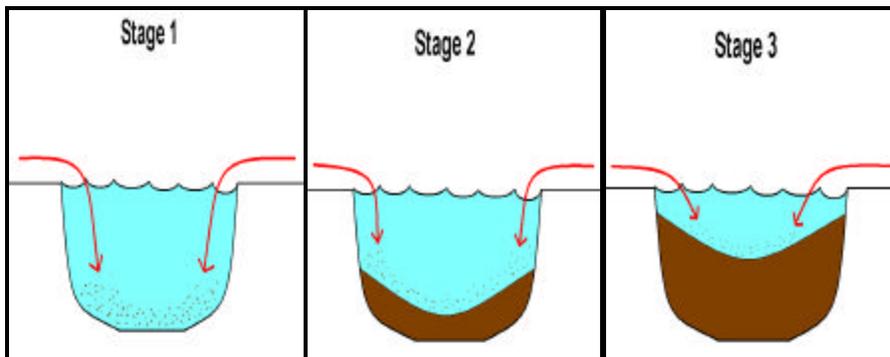
*Images courtesy of the NOAA Photo Gallery

Deforestation is an increasingly large environmental issue. It is defined as the removal of forest lands for virtually any purpose, including timber harvesting, fuel wood consumption, mining, and land clearing for construction. Tree removal began many hundreds of years ago as humans transitioned from hunters and gatherers to stationary farmers. Farm land was created by land clearing. Deforestation has since then grown into a massive problem worldwide, one which threatens the soil quality and natural habitat in all regions

The most popular region affected by deforestation is the tropical rainforest. In the tropics, like many other parts of the world, deforestation is caused primarily by three groups of people: farmers, ranchers, and loggers. Farmers and ranchers clear land in order to grow crops and graze cattle. In many third world (poor) countries, however, human population is growing at an extremely rapid rate, and there is less room for the farmers and ranchers. To make more room, they move outward, clearing land as they go. Many farmers in this situation practice slash and burn agriculture. *Slash and burn agriculture* is the removal of forests by fire for farming purposes. Farmers clear the land, and then farm on it for 5 to 10 years, or until the soil's nutrients are depleted. When crops will no longer grow on the land, the farmers move on by burning yet another parcel of land. This form of agriculture is damaging to the environment because it removes existing trees, and leaves behind infertile soils so that it will take a long time for re-growth of the forest. Cattle herders also move to new locations when their cattle have eaten all the vegetation in an area.

Loggers remove trees for purposes of timber harvesting and meeting fuel wood demands. Many rich countries have begun to import timber. Timber is a valuable resource to humans because it is useful in so many ways, but keep in mind that its most valuable role is held in the forest.

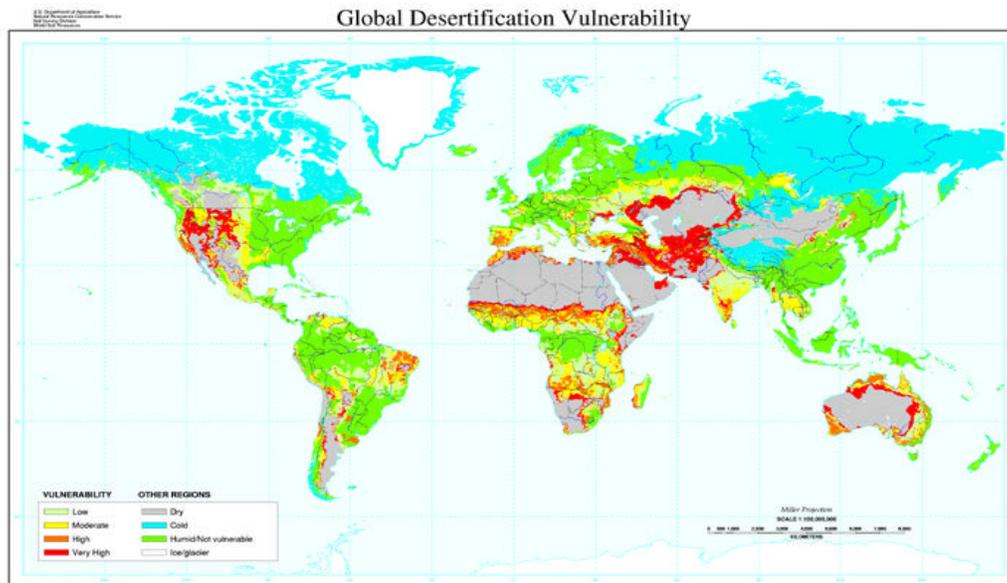
Aside from serving as homes and food sources for many animals in the tropical rainforest, trees also hold the soil in place with their roots. When the tree roots are no longer in place, the soil is quickly eroded away by wind and rain. This erosion is a form of *degradation*, or reduction in soil quality. An additional problem stemming from degradation is sediment buildup, known as *sedimentation*. As soil particles are carried away by wind or rain, they often end up in a river or stream in the form of sediment. More and more sediment builds up in the stream or river, and the amount of water allowed to pass through the stream is decreased, leaving shallow, slow-moving water systems. The figure below illustrates sedimentation.



* Images courtesy of the USDA Forestry Service Photo Gallery

Finally, the impacts of deforestation on climate could drastically decrease rainfall in the rainforests themselves. In the Amazon rainforest, almost half of the rainfall received at the surface is returned to the atmosphere through *evapotranspiration*, or water evaporated from the surface of a plant. With no trees to return moisture to the atmosphere, no moisture will fall to the earth in the form of rain. This process would prevent the growth of future forests or crops, and leave a dry, barren wasteland where a tropical rainforest used to be. Deforestation is a large and complex problem. Many people are combating deforestation with *reforestation*, or the replanting of trees. You can help by planting a tree in your yard at home, and by conserving and recycling paper.

Desertification is the process of making or expanding deserts. While most desertification occurs in areas that are already dry and difficult to cultivate, these regions are transformed into arid, unproductive environments by climate change and human influences. Humans initiate desertification through land degradation. Degradation, as you read in the section on deforestation, is the decrease in quality, or removal of nutrients from the land. Deforestation is just one form of land degradation which leads to desertification. Two primary forms of degradation that contribute to desertification are overgrazing and overcultivation. Overgrazing occurs when farmers or herders allow too many animals, or the wrong types of animals to graze in a pasture. The animals consume all the vegetation in the area, leaving bare soil vulnerable to erosion by wind and rain. The animals also trample the land, compacting the soil into a desert pavement where edible plants will not easily grow and rainwater will not be absorbed. Overcultivation is caused by an increase in intensity of farming, meaning farmers leave fields fallow (resting to regain nutrients) for shorter periods of time. As the same land is farmed over and over again, the soil structure actually begins to break down, and the smaller particles are more likely to be eroded by wind and rain. Desertification through overcultivation also occurs when large motorized ploughs are used. These ploughs dig much deeper into the soil, disturbing the soil structure so that soil particles are easily eroded. Through both overcultivation and overgrazing, the land is left dry and unproductive, just like the deserts you know of today.



The map above shows regions of the world that are vulnerable to desertification. Pay close attention to the highly vulnerable areas in red, and how they correspond to existing deserts: the Western United States near the North American Desert, Northern Africa near the Saharan Desert, and Central Asia near

Clues are in order of their appearance on the puzzle.

- a synonym for farming
- process of making or expanding deserts
- removal of helpful ozone from the stratosphere
- diversity/variety of species in an ecosystem
- growth and development of cities
- type of farming in which forests are cleared and burned first
- endless movement and exchange of water in all its states between the atmosphere, land surface, and underground
- occurs when too many animals or the wrong type of animals graze in a pasture
- severe food shortage (often accompanies drought)
- sediment build up in rivers and streams; a result of deforestation
- portion of the earth above the surface; composed of various gases, such as oxygen
- removal of forested land, often for timber harvesting, mining, and construction
- community of living organisms and its interactions with the surrounding environment
- the most abundant fluid resource on earth
- having to do with the management of forests
- abnormal water shortage
- characterized by increasing temperatures all over the world
- reduction in soil quality, often caused by deforestation
- water evaporated from the surface of a plant

For more information, check out the following websites:

Southeast Regional Climate Center—www.sercc.com
 Intergovernmental Panel on Climate Change – www.ipcc.ch/index.html
 U.S. Environmental Protection Agency – www.epa.gov
 United Nations Environment Programme – www.unep.org
 National Drought Mitigation Center – www.drought.unl.edu/index.htm
 World Food Program – www.wfp.org/index.html
 USDA Forest Service - <http://www.fs.fed.us/>
 National Resources Conservation Service— <http://www.nrcs.usda.gov/>



**Southern AER
 Southeast Regional Climate Center
 SC Department of Natural Resources
 2221 Devine Street, Suite 222
 Columbia, SC 29205**

The South Carolina Department of Natural Resources prohibits discrimination on the basis of race, color, sex, national origin, disability, religion, or age. Direct all inquiries to the Office of Human Resources, P.O. Box 167, Columbia, SC 29202.

Permission is granted for the reproduction of materials contained in this bulletin. Send comments or questions to: sercc@dnr.state.sc.us