Earth Gauge
A National Environmental Education Foundation Program

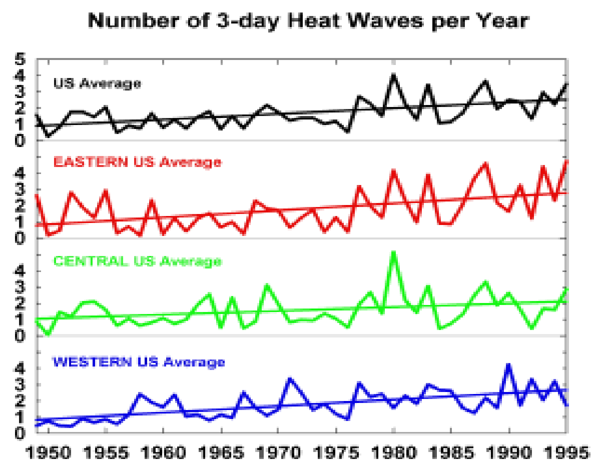
Climate and Public Health

Most public health trends are driven by complex interactions between many social and environmental factors, including climate. Although there are numerous ways that climate can affect human health indirectly – for example, through changes in crop ranges and food availability, or changes in water availability due to drought – there are also direct climate-health relationships. This fact sheet focuses on three climate topics that have displayed direct health effects: temperature extremes; airborne allergens; and diseases.

TEMPERATURE EXTREMES

Extreme temperatures increase mortality rates. In U.S. cities during extreme cold events, the death rate rises by an average of one to two percent, and during extreme heat events, the death rate rises by an average of six percent. Calculations based on extreme values in city-specific temperature distributions determine what constitutes an extreme event (i.e. a heat wave in Philadelphia would feel like average summer temperatures to residents of Atlanta who are acclimated to the hot weather). The increases in death rates during extreme cold events are similar across climate zones, indicating that the "shock" from a cold temperature is more important with regard to mortality rates than the absolute temperature. This means that a person is less likely to die from cold temperatures if they are acclimated. Heat-related deaths show a similar pattern, as there are significantly more mortalities during extreme heat events that occur early in the summer. Recent climate trends that have likely affected mortality rates include the following:

- In the U.S., summer nights between 2002 and 2006 were the warmest on record. Over the last 50 years, the Planet's diurnal temperature range has fallen by 0.72 degrees Fahrenheit, as the increases in daily maximum temperatures have been less (1.1 degrees Fahrenheit) than the increases in nighttime minimum temperatures (1.6 degrees Fahrenheit). Cool nights provide breaks from the heat, which helps to prevent heat-related illnesses.
- One of the best indicators of how hot the weather feels is the dewpoint. Over the past 50 years, the average dewpoint in the United States rose 2.7 degrees Fahrenheit.
- The average number of heat waves (three-day periods where apparent temperature is considered extreme) per year doubled over the second half of the 20th Century.



NOAA Air Resources Laboratory

It is important to note that while extreme hot weather events may result in a spike in mortality rates, during the weeks following these extreme events there is often a decline in mortality rates. This decline actually offsets the initial mortality spike, a phenomenon referred to as the "harvesting effect." The "harvesting effect" occurs when a heat wave kills many infirmed and elderly people that were likely to have died even if the heat wave had not occurred. After the heat wave mortality spike, the number of susceptible individuals is reduced and the mortality rate drops accordingly. Extreme cold temperatures may also result in a mortality spike, but these are not offset by a subsequent decrease. Cold-temperatures stimulate the onset of cardiovascular and respiratory diseases, so there is actually a rise in mortality after extreme cold events. By some estimates, the cumulative effect of one extreme cold event and the subsequent 30 days is a ten percent rise in mortality. In the North Atlantic Region (which includes the eastern U.S. and Europe), the frequency of extreme cold events have decreased or shown no trend.

AIRBORNE ALLERGENS

While there was a rise in global asthma rates and doubling of U.S. allergy and asthma related deaths in the 1980's and 1990's, numerous non-climate-related factors affect these rates. Some trends that are likely to have influenced airborne allergy concentrations are listed on the following page.

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- Over the last two centuries, carbon dioxide (CO_2) concentrations have increased from about 280 parts per million to 385 parts per million. Many plants have been found to produce more pollen when atmospheric CO_2 rises, including ragweed, which produces 50 percent more pollen under doubled CO_2 concentrations. More Americans are allergic to ragweed pollen than to any other allergen. Higher temperatures also appear to stimulate pollen production in ragweed.
- Between 1982 and 2005, at latitudes above 40 degrees north (which is where a line from Denver to Philadelphia would be), the average date of the onset of spring (defined here as the timing of leafing, flowering, and budburst) advanced by a week.


Ragweed Flowers: Photo Courtesy NPS

- In the second half of the 20th century in the U.S., the average length of the growing season, or the point between the last frost in winter or spring and the first frost in fall or winter, grew by ten days.
- In Europe, several pollen monitoring stations show long-term trends of increasing levels of hazel, birch and grass pollen.

DISEASES

Disease Range Expansion: As the Planet has warmed, higher latitude winters and alpine zone conditions have become milder, allowing diseases that were previously confined to specific climate zones to expand their ranges.

- Milder and shorter winters in Sweden since the late 1970's have stimulated an increase in tick populations. More ticks have corresponded to a three-fold increase in the number of cases of tick-borne encephalitis in that country.
- Two viruses that were once confined to Africa, Chikungunya fever and a cattle disease known as bluetongue, have recently made their way into Europe. Warmer European winters in recent decades have allowed the flies that transmit these viruses to thrive there in greater numbers.
- A wintertime rise in water temperatures off the East Coast of the U.S. has corresponded to a northward range expansion of the *Perkinsus marinus* oyster disease.

ENSO's Impact on Disease: During El Niño phases, epidemics of malaria are more common in India, Colombia, Venezuela, and Uganda; Rift Valley fever is more common in East Africa; and Dengue Fever is more common in Thailand. El Niño also appears to stimulate waterborne diarrheal diseases in Peru, as well as cholera (also a waterborne disease) epidemics in Bangladesh. Yellow Fever, which has been eliminated in the U.S. due to mosquito control efforts and a vaccine, seems to have been influenced by ENSO. El Niño years correspond to higher temperatures and above average rainfall in the Southeastern U.S. If this increased rainfall comes in frequent and steady showers instead of a few strong storms, then conditions for mosquito breeding are ideal, as they were during the strong El Niño events of 1878 and 1905. These years corresponded to the last two major outbreaks of Yellow Fever in the United States.

Salmonella in Europe: When the temperature rises above 40 degrees Fahrenheit, *Salmonella* bacteria, which is found in poultry products and causes the *Salmonellosis* sickness in humans, start to grow. The rate of this growth increases as it gets warmer, until the temperature reaches about 100 degrees Fahrenheit. Despite improvements in sanitation and refrigeration practices, there is still a relationship between outdoor air temperature and the number of *Salmonellosis* cases. In Europe, once the temperature exceeds 43 degrees Fahrenheit, the number of cases increases by about seven percent for each additional 1.8 degree Fahrenheit rise in temperature.

Plague in New Mexico: Plague (a.k.a. Hantavirus Pulmonary Syndrome), is a disease caused by a virus that fleas carry in their blood. Fleas are transported from one place to another, primarily by small mammals. New Mexico's climate is considered ideal for Plague transmission because the State's wet winters and early springs are conducive to the reproductive cycles of small mammals, and the dry periods that follow the wet seasons promote dispersion of small mammals, along with the fleas they carry. Increases in winter precipitation and soil moisture at the local level have been linked to subsequent increases in plant growth and fruit, seed, and nut production. This increase in plant/food production leads to an increase in small mammal populations. The increase in soil moisture also leads to an increase in flea populations that transmit the virus. During two separate drought spells (1952-1958 and 1962-1964) there were no cases of Plague reported in New Mexico. During the wet period of 1981-1986, however, the number of reported cases was especially high, and the year with the most reported cases (1983) followed an especially strong El Niño event. El Niño events typically bring above-average winter precipitation to the Southwest. Over the past 30 years, there has been a steady increase in wintertime precipitation in the American Southwest, and a delay in the arrival of the summertime monsoon rains.

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