Climate Facts – Weather Related Disasters

Environmental Information for Broadcast Meteorologists

Read on for information on recent climate changes and patterns that may affect the frequency and severity of weather related disasters.

Rainfall Trends and Floods

A one degree Fahrenheit increase in temperature increases the atmosphere's water holding capacity by four percent. The warming trend over the lower 48 states during the last three decades has been accompanied by a ten percent increase in the amount of water vapor that is available for rainfall and the following changes in rainfall patterns:

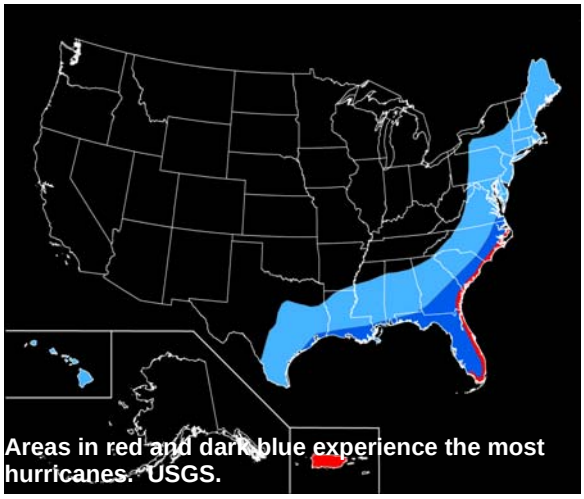
- Total precipitation has increased by seven percent, and the frequency of heavy rains has increased by 14 percent.
- The occurrence of extreme one-day precipitation events has increased nationally by seven percent, with some areas experiencing up to a 12 percent increase. The number of moderate precipitation events has declined slightly.
- The average time between rainfall events has grown as the lengths of both wet and dry spells have grown by over a week. The longer soil goes without water, the harder it is for the water to infiltrate the soil when the rains do come. Heavy rains and hard soil make flooding more likely.

Visit NOAA's Climate Prediction Center for a map of U.S. rainfall trends: http://www.cpc.noaa.gov/anltrend.gif

Tropical Storms

Tropical cyclones are one of Earth's mechanisms for distributing heat from the sweltering tropical regions to the frigid poles. Warm ocean water is necessary to power these cyclones, and records from the twentieth century show that high sea surface temperatures (SSTs) correspond to more tropical cyclone activity. There have been the following trends in tropical storm behavior:

- Global SSTs are the warmest they have been since at least 1870.
- During the last thirty-five years, there has been an increase the number of tropical cyclones in the North Atlantic.
- Globally, the number of hurricanes, or typhoons depending on where the cyclone originates, that fall into categories four and five has nearly doubled. Category four and five storms produce winds that exceed 136 miles per hour.



Areas in red and dark blue experience the most hurricanes. USGS.

Additionally, the Atlantic Multidecadal Oscillation (AMO), which is a 65-80 year cycle during which sea-surface temperatures in the North Atlantic alternate between warm (positive) and cool (negative) phases, affects hurricane formation. Warmer ocean temperatures in the North Atlantic generally correspond to less vertical wind shear, which favors tropical storm development. The AMO entered the positive (warm) phase in about 1995 where it will probably stay for several decades.

Earth Gauge
A National Environmental Education Foundation Program

4301 Connecticut Avenue, NW, Suite 160
Washington, DC 20008
www.neefusa.org www.earthgauge.net

Extreme Heat

The increase of water vapor in the atmosphere has led to a 0.4 percent global decline in the diurnal temperature range, or the difference between the hottest part of the day and the coolest, over the last 40 years. In the United States, the summer nights over the last five years have been the hottest on record. Because cooler nights give the body a break from the heat, this nighttime warming helps to explain why the number of heat related deaths in U.S. cities has gone up by 5.74 percent since 1989. The Southeast and Intermountain West are two regions where trends in exteme heat have been particularly noticeable.

- **Southeast:** Over the last fifty years, the amount of time during the summer when a moist tropical air mass sits over the Southeastern United States has been growing by an average of two to four percent per decade. This air mass brings the hot and humid weather that is most often linked to heat related deaths. This trend is related to the rise in the Southeast's average relative humidity, or the amount of moisture that is present in the air at a given temperature, which has been growing at a rate of three percent per decade. Recent years have also brought record dewpoints to the Region.
- **Intermountain West:** During much of the summer, a dry tropical air mass, which is usually further south during the winter months, covers much of the Intermountain West. Almost all of the area covered by this air mass during the summer has increased in temperature during this period. The temperature increase associated with this air mass has averaged 0.2 degrees Celsius per decade, and temperatures are rising faster in this region than anywhere else in the lower 48 states.

Extreme Cold

While the general warming trend is predicted to decrease the number of cold related deaths during the winter months, the number of extremely cold days during winters in the mid-latitudes of the Northern Hemisphere is strongly correlated with the phase of the North Atlantic Oscillation (NAO). The NAO is a cyclical change in the difference in atmospheric pressure between a low pressure center around Iceland and a high pressure center around the Azores Islands in the North Atlantic. When this difference in pressure is larger (i.e. the low pressure center is especially low and the high pressure center is especially high), the NAO is in a "positive" phase, whereas when the difference in pressure is smaller, the NAO is in a "negative" phase. This oscillation influences the sub-polar westerly winds that flow between 35 and 55 degrees north. When the NAO is in a positive phase, as it was during the last thirty years, these westerlies are relatively strong and "block" the polar air masses from invading the lower latitudes. This tends to keep winter weather in the mid-latitudes relatively mild and reduce the occurrence of extremely cold days.

- NAO positive phase winter days in the mid-latitudes are on average five degrees warmer than NAO negative phase days.
- In Chicago, IL days when the temperature dips below zero degrees Fahrenheit occur nearly three times more often during negative phases as they do during positive phases.
- In Portland, OR days when the temperature dips below 27 degrees Fahrenheit occur nearly three times more often during negative phases as they do during positive phases.

The NAO is currently trending toward a negative phase.

Wildfires

Researchers found that since the mid-1980's, the length of the wildfire season (the period of the year when it is dry and hot enough for fires to happen) in the forests of the Western United States has grown 78 days longer as a result of earlier snowmelt and increased spring and summer temperatures. Also, positive phases of the Atantic Multidecadal Oscillation correspond to warmer and drier conditions in the west. Tree ring records that go back almost 500 years show that the entire Western Region consistently experiences more wildfires during positive phases of the cycle.

Sources:

1. *Trenberth, K et al. "The Changing Character of Precipitation." Bulletin of the American Meteorological Society, September 2003, pp. 1205-1217.*

2.*Easterling, D et al. "Observed climate variability and change of relevance to the biosphere." Journal of Geophysical Research, vol. 105, No. D15, pages 20, 101-20, 114. Augugst 16, 2000.*

3.*National Weather Service: Climate Prediction Center. U.S. Temperature and Precipitation Trends: Annual. Accessed Online 3 July 2007 http://www.cpc.noaa.gov/anltrend.gif.*

4.*Baldocchi, Dennis. Climate Change and Agriculture: Trends and Bi-Directional Impacts. University of California - Berkely. 2006. Accessed Online 29 January 2007 http://www.climatechange.ca.gov/events/2006_conference/presentations/2006-09-14/2006-09-14_BALDOCCHI.PDF>*

5. *Trenberth, K et al. "Trends and variability in column-integrated water vapor." Climate Dynamics, January 7, 2005.*

6. *Kitzberger, T et al. "Contingent Pacific-Atlantic Ocean influence on multicentury wildfire synchrony over western North America." Proceedings of the National Academy of Sciences: January 9, 2007, vol. 104, no. 2. pps 543-548.*

7. *Zhang R and Delworth T. "Impact of Atlantic multidecadal oscillations on India/Sahel rainfall and Atlantic hurricanes." Geophysical Research Letters, Vol. 33, L17712, 2006.*

8. *Webster PJ, et al. 2005: Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment. Science 309, 1844-1846.*

9. *Hoyos CD, et al. 2006: Deconvolution of the Factors Contributing to the Increase in Global Hurricane Intensity. Science 312, 94-97.*

10. *Is Global Warming Impacting or Expected to Impact Hurricanes. October 20, 2007. United States Senate.*

11. *"Extreme Weather and Climate Events." 2006. U.S. Department of Commerce. National Climatic Data Center. November 3, 2006 http://www.ncdc.noaa.gov/oa/climate/severeweather/extremes.html>*

12. *Quinn, Ben. "Report Warns on Desertification." Telegraph: 6 June 2007. Accessed Online 2 July 2007 http://www.telegraph.co.uk/earth/main.jhtml?view=DETAILS&grid=&xml=/earth/2007/06/28/eades28.xml>*

13. *Kalkstein, LS and Greene, JS. "An Evaluation of Climate/Mortality Relationships in Large U.S. Cities and the Possible Impacts of a Climate Change." Environmental Health Perspectives Volume 105, Number 1, January 1997.*

14. *Sources: Kalkstein, L et al. "A Determination of Character and Frequency Changes in Air Masses Using a Spatial Synoptic Classification." International Journal of Climatology. 18: 1223–1236 (1998).*

15. *Braganza, K. "Diurnal temperature range as an index of global climate change during the twentieth century." Geophysical Research Letters: vol 31, L13217.*

16. *Westerling, A.L. "Warming and Earlier Spring Influence Western U.S. Forest Wildfire Activity." Science. 313 (18 August 2006): 940-943.*