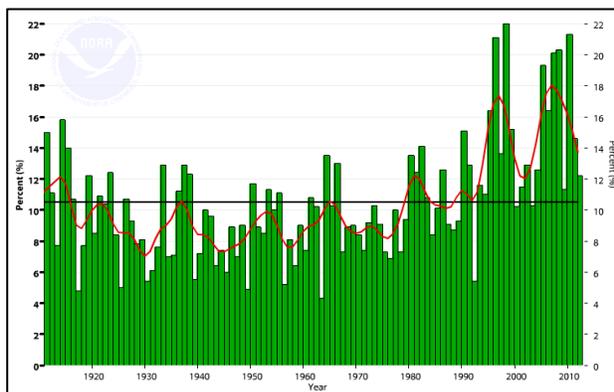


Wild weather: the new normal?

By Sonia Aggarwal and Hallie Kennan

In 2012, a drought throughout the U.S. severely impacted over 1,000 counties across 26 states. Economists estimate that this drought will cost over \$12 billion to cover crop insurance, disaster-relief loans, and other economic costs.ⁱ As climate change alters rainfall patterns, droughts like this will likely become much more common, and will be interspersed with equally extreme precipitation leading to floods of similar magnitudes. These changing rainfall patterns will profoundly affect global food security, health, and water access.

The strength and frequency of precipitation has already increased in several flood-prone regions over the last several decades. The number of extreme one-day precipitation events has increased in the last



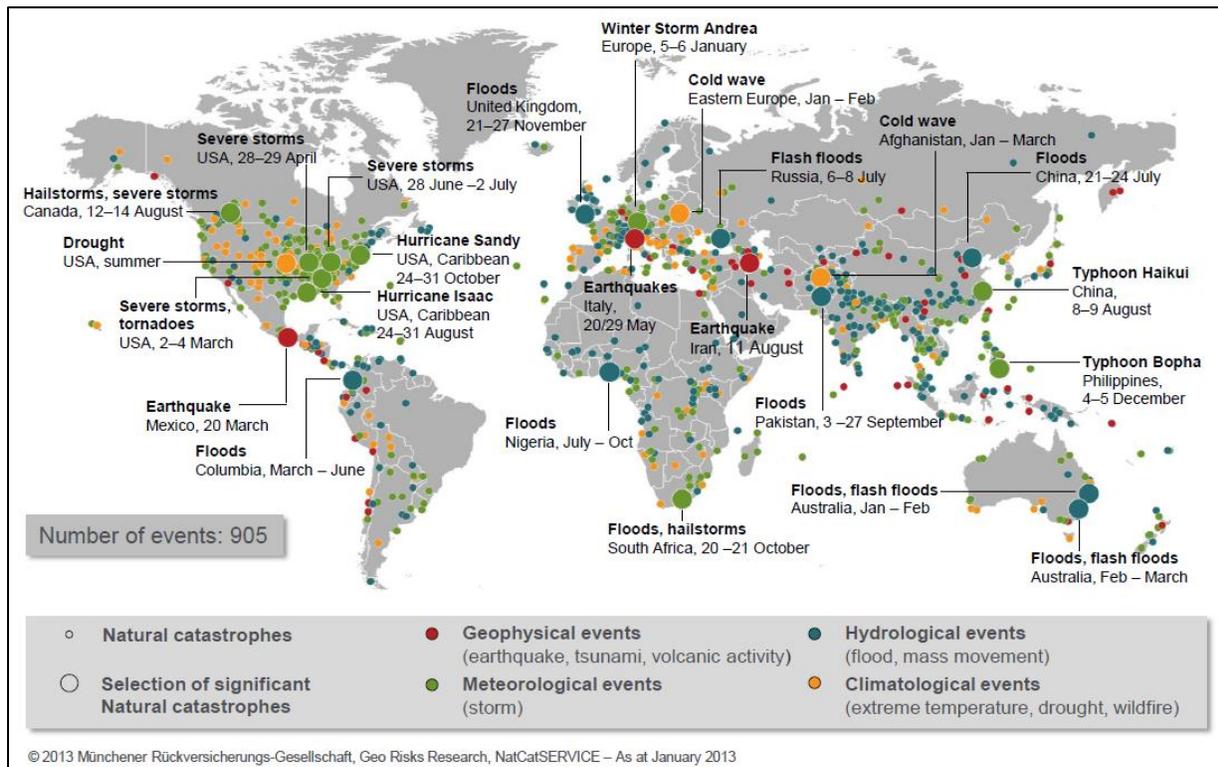
Extreme One-Day Precipitation Events in the Contiguous 48 States, 1910-2012 (NOAA; 2012).

century, with nine of the top ten years with extreme one-day precipitation events occurring since 1990.ⁱⁱ Global climate models predict that the rainfall probability curve is shifting to the right, meaning there's a higher likelihood of more rainfall in future years. The rainfall probability curve is also likely to flatten as the climate changes. This makes both ends of the probability curve, the "tails," become thicker in the future; which means that extreme weather events, major droughts and floods, will occur much more frequently.

The growing prevalence of extreme weather events, like droughts and floods or extreme high temperatures, will significantly impact our ability to plan for crops and harvests—in the U.S. and beyond (the U.S. alone experienced more than 3,500 record-breaking extreme weather events for heat, rain, and snow last year).ⁱⁱⁱ As a result, food scarcity is likely to become an even larger global problem. For example, catastrophic precipitation events occurred throughout the world in 2010, which was both the hottest and wettest year on record.^{iv} Russia experienced a record heat wave that killed thousands of people and destroyed a quarter of the country's crop yield.^v That same year, flooding overtook an area in Queensland the size of Germany and France combined, devastating the country's agriculture and mining sectors.^{vi}

These anomalous events affected millions of people and cost billions of dollars in damages. As the climate continues to shift, the "100 year drought" will become the "5 year drought," while floods that used to merit international attention will become commonplace. Munich RE's natural catastrophe database demonstrates that the frequency of natural catastrophes has nearly tripled since 1980, with the greatest increase in weather-related climatological (extreme temperatures, drought, fire) and

hydrological (flood, mass movement) events.^{vii} In 2012, the world experienced more than 900 natural disaster events, many of which occurred in densely populated, coastal regions.



World Map of Natural Catastrophes, 2012 (Munich RE)

Are humans to blame for these extremes?

The composition of gases in Earth’s atmosphere is one of the primary factors of climate change. Throughout history, there have been periods of severe heat as well as severe cold, as atmospheric gas concentrations have fluctuated over time. Carbon dioxide is a well-known example of one of these gases. “Sources” of carbon dioxide, such as burning organic material, release this gas into the atmosphere. At the same time, oceans and forests act as “sinks” and absorb the emitted carbon dioxide, thus maintaining a steady concentration.^{viii} For all of human history, the earth has played this balancing act, which has kept carbon dioxide concentrations between approximately 170 and 300 parts per million (ppm).^{ix}

However, changes in human activity since the Industrial Revolution have increased carbon dioxide emissions. Recent human activities have not only *increased* carbon dioxide sources through the combustion of long-buried gas and oil, but have also *decreased* carbon dioxide sinks through logging and agriculture, which eliminate CO₂-absorbing forests. As more carbon dioxide enters and remains in the atmosphere, it absorbs heat and reflects it back to the earth’s surface, causing the planet to warm. In the last 150 years, carbon dioxide concentrations have increased by nearly 40 percent and, this May, surpassed 400 ppm for the first time in human history.^x The Fourth Assessment Report by the Intergovernmental Panel on Climate Change attributes 90 percent of global warming to human activity

throughout the last 250 years and states that this rate of warming is likely unprecedented in the last 10,000 years—since before the end of the stone age.^{xi}

Extremes will continue to cost us, but there are solutions

As history and experience have shown, the damages from isolated extreme weather events can be massive. However, as Earth's climate continues to change, we will begin to experience these kinds of events more often: a record heat wave, a prolonged drought, a deadly flood. In combination, these weather events present immense economic, social, and political risk.

We have the potential to lessen the impact of these extreme weather events by cutting emissions now. If we aggressively deploy emissions-reduction technologies today, we still have the potential to slow the effects of climate change and minimize the increase in global average temperature. Starting now—and starting fast—can minimize our risk exposure.^{xii} Of course, this will not prevent all statistical anomalies, but building resilience to extreme climate events now will help us in the future, regardless of how many extreme events we end up facing. We can also reduce our vulnerability by investing now in climate adaptation measures such as water-use efficiency, disaster preparedness, and appropriate building codes.

If you would like to learn more about how extreme weather events are becoming the norm, please see Energy Innovation's more detailed treatment of the subject in [Extremes Become the Norm](#).

ⁱ Rice, Doyle and Chuck Raasch. "Drought could cost \$12 billion, most since 1988." *USA Today*. 7/26/12.

<<http://usatoday30.usatoday.com/weather/drought/story/2012-07-25/drought-crops-loss-costs/56491296/1>>.

ⁱⁱ NOAA. "Contiguous U.S. Extremes in 1-Day Precipitation (Step 4*) Annual (January-December) 1910-2012." *U.S. Climate Extremes Index (CEI)*. 2012. <<http://www.ncdc.noaa.gov/extremes/cei/graph/4/01-12>>.

ⁱⁱⁱ "Extreme Weather Map 2012." *Natural Resources Defense Council*. 2012. <

<http://www.nrdc.org/health/extremeweather/#ref1>>.

^{iv} "2010 Wettest Year, Tied for Hottest - NOAA." Weblog post. *The Carbon Brief*. N.p., Jan. 2011. Web.

<<http://www.carbonbrief.org/blog/2011/01/noaa-2010-tied-for-hottest-year-on-record>>.

^v Jha, 2010.

^{vi} Harwood, Jonathan. "Queensland Floods: The Effects Could Go Global." *The Week*. N.p., Jan. 2011. Web.

<<http://www.theweek.co.uk/politics/8617/queensland-floods-effects-could-go-global#>>.

^{vii} "The GENI-us Letter: Climate Change - Connecting the Dots." *GENI*. Global Energy Network Institute, Apr. 2012.

Web. <<http://www.geni.org/globalenergy/library/GENI-us/2012/geni-us-letter-2012-04.shtml>>.

^{viii} "Sources and Sinks." Environmental Literacy Council, 2002. Web.

<<http://www.enviroliteracy.org/article.php/439.html>>.

^{ix} Karl, Thomas R., Jerry M. Melillo, and Thomas C. Peterson. *Global Climate Change Impacts in the United States*.

Publication. U.S. Global Change Research Program, 2009. Web.

<<http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>>.

^x Gerken, James. "Atmospheric CO2 Concentrations Surpass 400 PPM Milestone." *The Huffington Post*. 5/10/13. <

http://www.huffingtonpost.com/2013/05/10/atmospheric-co2-concentrations_n_3253757.html>.

^{xi} "Causes." *Global Climate Change*. Ed. Amber Jenkins. National Aeronautics and Space Administration, n.d. Web.

<<http://climate.nasa.gov/causes/>>.

^{xii} Aggarwal, Sonia and Hal Harvey. *Costs of Delay*. ClimateWorks Foundation, 2011.

<<http://www.climateworks.org/news/item/delayed-action-on-climate-to-result-in-irreversible-change-and-high-costs>>