Global Warming and Extreme Weather Events

The blockbuster movie of the summer of 2004, The Day After Tomorrow, popularised the public's conventional assumptions regarding how global warming will manifest – as a global increase in severe or even catastrophic weather.

By Benjamin Preston

DESPITE THE COMIC BOOK SCALE of catastrophe in the film, the potential for more extreme events in response to global warming does have some roots in hard science. For a number of years, scientific studies and assessments have been hinting at the potential for greater climate variability and, subsequently, extreme weather events. Substantial reinforcement of this perception has been provided by the media, which is quick to report on severe weather and increasingly interested in its relationship with global warming.

This fascination with extreme weather events and global warming is understandable. In the United States alone, disasters associated with weather inflict considerable economic costs averaging $23 billion per year, not to mention over 1,500 deaths (Table 1). Interestingly, temperature extremes, which would appear most directly relevant to global warming, cause negligible property damage, but are the leading cause of death. In contrast, the most violent extremes (e.g., hurricanes and tornadoes), cause catastrophic economic losses, but relatively few deaths in the developed world.

Annual averages mask considerable year-to-year variability associated with extreme weather events and their societal impact. For example, an average of 1.6 hurricanes strike the US coastline every year. In 2004, however, an active hurricane season resulted in four hurricane strikes and $56 billion in total economic losses, with $27 billion in insured losses, according to Swiss Re. When one considers that about 25% of the US economy is comprised of sectors that are sensitive to weather and climate, such as agriculture and tourism, any potential increase in the frequency or intensity of severe weather would have substantial implications. Yet, unraveling and clarifying the complex connection among global warming, extreme events and society is a challenging task.

Historical trends

Over the 20th century, average annual temperatures in the United States increased by approximately 0.56°C (1°F) and precipitation increased by 5-10%. These seemingly small changes have been accompanied by an apparent epidemic of climate catastrophes in recent decades. In 1992, Hurricane Andrew caused $35 billion in economic damages and 40 deaths. Atlantic hurricane activity, particularly the occurrence of large hurricanes (category 3 and above), has been above average since 1995. Similarly, 1998, 2003 and 2004 were record years for tornadoes as well. The 1993 flooding in the Midwest, caused approximately $15 billion in damages and 50 deaths. Chicago's heat wave during the summer of 1997 resulted in over 700 excess deaths.

Many have been quick to link such disasters with global warming, but these events must be placed in their long term context. The 2004 US hurricane season was undoubtedly unusual in its ferocity, yet since 1851 there have been 11 years with four or more hurricane landfalls. The record year was 1886, well before the human influence on the global climate began to appear. The active hurricane seasons in recent years appear to be attributable in large part to a cyclical pattern of climate variability known as the North Atlantic Oscillation (NAO). The 1940s-1960s also saw a period of elevated hurricane activity, which was followed by almost three decades of relative calm. Somewhere during the mid-1990s, the NAO flip-flopped once again and that period of calm came to an abrupt end.

Other indicators yield inconsistent trends with respect to long term change in extreme events. US temperature data indicate a decrease in low temperature extremes (e.g. frost days) over the 20th century, but also a decrease in high temperature extremes. US drought statistics show no long term trend, although the record is dominated by the Dust Bowl era mega-droughts of the 1930s-40s. Some evidence suggests that the observed increase in US precipitation has manifested itself largely as severe rainfall events. In any case, identifying a coherent signal of increasing frequency or severity in weather extremes amid the noise of natural variability is a challenging task. One should be quite cautious about attributing cause to any individual event or making assumptions about the likelihood of future events from observed data.

Climatology v. sociology

Although climate data portray a somewhat ambiguous picture of changes in climate extremes, economic data show a clear trend toward greater losses from severe weather. During the latter half of the 20th century, the

TABLE 1. AVERAGE ANNUAL IMPACT OF US EXTREME WEATHER EVENTS

EVENT	COST ($ BILLIONS)	DEATHS
Hurricanes[1]	$5.1	20
Tornadoes[1]	$1.1	50
Floods[1]	$5.9	80
Droughts[1]	$6-8	–
Lighting[2]	$1.0	175
Hail[2]	$2.3	–
Winter storms[2]	$1.0	47
Extreme cold[2]	–	770
Extreme heat[2]	–	384
TOTAL	$22-24	1526

1 Source: National Oceanic and Atmospheric Administration (NOAA), Economic Statistics, 2002.
2 Source: National Center for Atmospheric Research. Workshop on the Social and Economic Impacts of Weather, 1997.