INCREASING HURRICANES, DROUGHTS, & WILDFIRES

By Paul H. Carr, NES American Physical Society, Williams College, Nov 9, 2012

The last 12 months were the warmest on record: hurricanes, draughts, and wildfires continue to increase.

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Hurricane physics is that of a Carnot cycle. The heat source, the high-temperature sea surface, $T = 300K$ (27°C), transfers wind energy to the hurricane. The heat sink is the cooler upper atmosphere, $T = 200 K$ (-73°C). Hurricane Katrina in 2005 is an example. It caused $146 billion dollars of damage to New Orleans.

**Droughts**: This year’s drought in our Midwest, the worst since the dustbowl, is raising corn prices to the highest level in history. Food riots are linked to food price increases.

**Wildfires**: The effects of global warming on temperature, precipitation levels, soil moisture, and Western Pine beetles are turning many of our forests into kindling for more wildfires. Western Pine beetles can now survive the warmer winters.

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Hurricane Sandy

• At least 100 U.S. deaths.
• Economic losses expected to climb as high as $50 billion.
• Eight million homes without power.

The broadening scientific consensus:

*Climate change amps up other basic factors that contribute to big storms.

*The oceans have warmed, providing more energy for storms.

*The Earth’s atmosphere has warmed, so it retains more moisture, which is drawn into storms and is then dumped on us.

http://www.businessweek.com/articles/2012-11-01/its-global-warming-stupid
NY City is highly vulnerable to storm surges.

Storm surges are responsible for much of the damage and loss of life associated with land falling hurricanes.

The combined effects of storm climatology change and a 1 m Sea Level Rise may cause the present NYC 100-yr surge flooding to occur every 3–20 yr.

Reference:
Physically based assessment of hurricane surge threat under climate change
Ning Lin, Kerry Emanuel, et al  MIT
*Nature Climate Change*  2, 462–467 (2012) doi:10.1038/nclimate1389
Published online 14 February 2012

http://www.nature.com/nclimate/journal/v2/n6/full/nclimate1389.html


29 Aug 2005. Katrina causes $100Bs damage to New Orleans, LA.

KATRINA: Tropical Storm to Hurricane
Kerry Emanuel, MIT Prof. of Atmospheric Science, showing how both the hurricane dissipation (damage) and sea surface temperature (SST) have increased since 1995.

Physics Today, March 2012, pg. 31

NUMBER OF EVENTS WITH DAMAGE OVER $1 BILLION (NOAA)

2008: 9  2011: 14  Average since 1980: 3 to 4

• Since 1996 over $1 billion damage doubled compared with the previous 15-year period.

Hurricane Katrina 2005: $146 B
Hurricane Irene 2011: $15B
Hurricane Sandy 2012: $50B
Insured losses in US from thunderstorms alone in 2011 were highest on record: $26 billion - More than double the previous record set in 2010.

Note: This includes events that cost at least $1 million.

Source: Munich Re
Economic losses from weather & climate-related disasters vary from year to year and place to place, but overall have increased.

The frequency of heavy precipitation will increase in the 21st century from more moisture in the atmosphere.

Heat waves & droughts will increase in length, frequency, and/or intensity from higher temperatures.

The average maximum wind speed of hurricanes will increase from higher water temperatures.

The Current Disaster
National drought conditions as of last week. About 52 percent of the United States was in moderate drought, or worse; 20 percent was in extreme or exceptional drought.

MAP KEY:
- Dry
- Moderate drought
- Severe drought
- Extreme drought
- Exceptional drought

http://www.nytimes.com/imagepages/2012/08/12/opinion/12drought-map.html?ref=sunday
Droughts: Rising Food Prices

- 2007-08: Grain and soybean prices more than doubled, leading to food riots and unrest in some 60 countries.
- 2010-11: Another price spike helped fuel the Arab Spring.
- 2012: Drought in our Midwest, the worst since the dustbowl, is raising corn prices to the highest level in history.
Social unrest accompanies food price increases.

6 – 10 calories of fossil fuels are required for each calorie of food.

Fires Are Increasing World-Wide

Wildfires in Western US have increased 4-fold in 30 years.

The effects of global warming on temperature, precipitation levels, soil moisture, and Western Pine beetles are turning many of our forests into kindling for more wildfires.

STORMY FUTURE FOR U.S. INSURERS
Losses from U.S. Extreme Weather Disasters – 2011-2012
(Loss figures are estimated economic losses unless otherwise noted)

- Uncontained Wildfires
  Summer-Fall 2012
  No $ Estimates Available

- Historic Wildfires
  Summer 2011
  $450 Million (Insured)

- Historic Wildfires
  Spring-Fall 2011
  > $855 Million (Insured)

- Drought
  Summer 2012
  $5 Billion (Insured - Private)
  $15-20 Billion (Federal Insurance)

- Drought & Heat Wave
  Spring-Fall 2011
  $7 Billion (Crop/Livestock)

- Severe Weather – Tornadoes/Hail
  July 2011
  > $1 Billion

- Upper Midwest Flooding
  Summer 2011
  > $2 Billion

- Groundhog Day Blizzard
  Winter 2011
  $1.8 Billion

- Tornadoes
  May 2011
  $9.1 Billion

- Wind & Hail
  June 2011
  > $1 Billion

- Mississippi River Flooding
  Spring-Summer 2011
  $3-4 Billion

- Hurricane Irene
  August 2011
  $4.3 Billion (Insured)

- Tropical Storm Lee
  September 2011
  > $1 Billion

- Hurricane Isaac
  August 2012
  $1-2 Billion (Insured)

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www.ceres.org
HUMAN INFLUENCE ON GLOBAL WARMING & WEATHER

- Correlation of CO2 and temperature increases since 1880.
- Carbon dioxide, CO2, is from burning fossil fuels (Carbon Dating).
- Solar irradiance has not increased since 1940 (sunspot cycles).
- CO2 level of 390 ppm is 30% higher than in the last 600,000 yrs.
  - Extrapolates to 900 ppm by 2100.
  - Present sea levels projected to increase 2.5 – 6 ft by 2100.
- In the next millennia, sea levels could be 100s of feet higher, as it was 51 M yrs ago, when earth was ice-free, & CO2 was 1000 ppm

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- Average since 1980: 3 to 4

[http://mirrorofnature.org/GlobalWarmingDebateNESAPS.pdf]
China’s first steps to build what is destined to be the world’s second-biggest emissions market are boosting the prospects for fledgling programs from Australia to California.

Four cement makers in China, the world’s biggest emitter, bought 1.3 million pollution permits for 60 yuan ($9.55) a metric ton last month in Guangdong.

The province plans the largest of seven pilot programs for a proposed national market within three years.

Exchanges will trade permits to emit an estimated 1 billion metric tons of greenhouse gases a year by 2015, close to half the volume in the European Union system.

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