

A satellite image of Earth showing a large hurricane over the Atlantic Ocean, with the eastern coast of North America visible on the left. The text is overlaid in red.

INCREASING HURRICANES, DROUGHTS, & WILDFIRES

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www.MirrorOfNature.org

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

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November 1, 2012

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>

**Bloomberg
Businessweek**
**IT'S 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

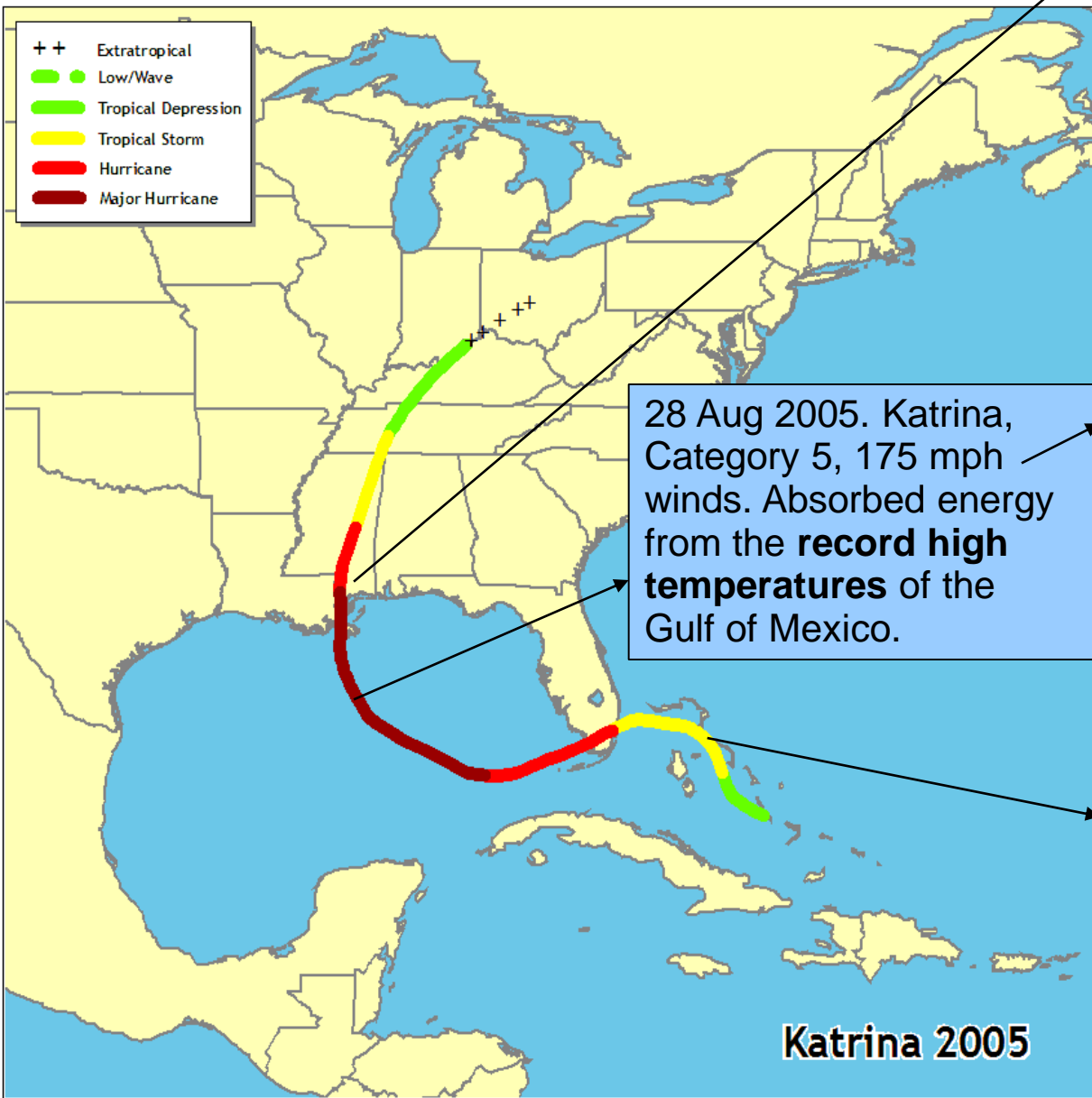
Ning Lin, Kerry Emanuel, et al MIT

Nature Climate Change 2, 462–467 (2012) doi:10.1038/nclimate1389

Published online 14 February 2012

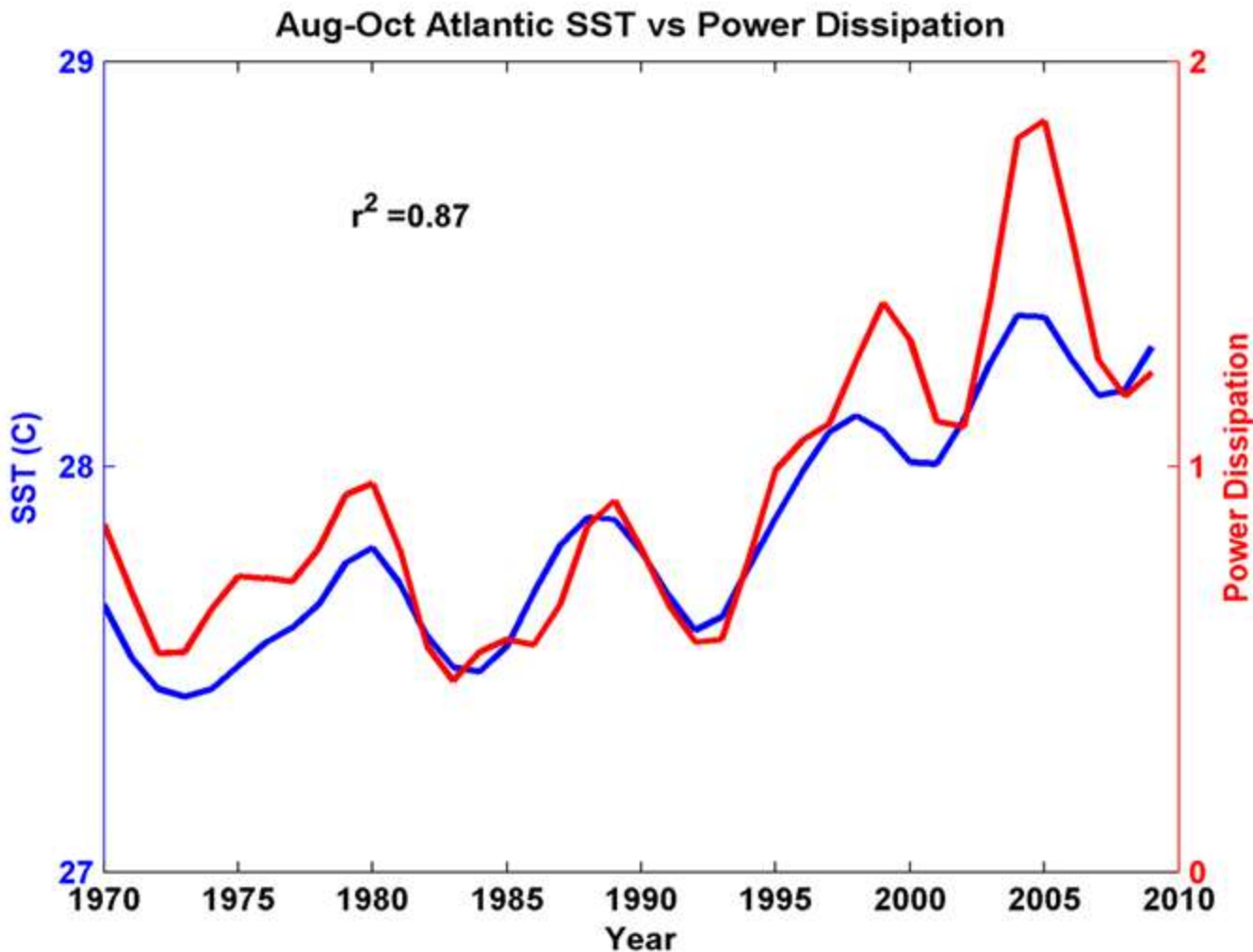
<http://www.nature.com/nclimate/journal/v2/n6/full/nclimate1389.html>

KATRINA: Tropical Storm to Hurricane



28 Aug 2005. Katrina, Category 5, 175 mph winds. Absorbed energy from the **record high temperatures** of the Gulf of Mexico.





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



Predicting and managing *extreme weather events*

Jane Lubchenco and Thomas R. Karl

Earth's climate is warming, and destructive weather is growing more prevalent. Coping with the changes will require collaborative science, forward-thinking policy, and an informed public.

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.**

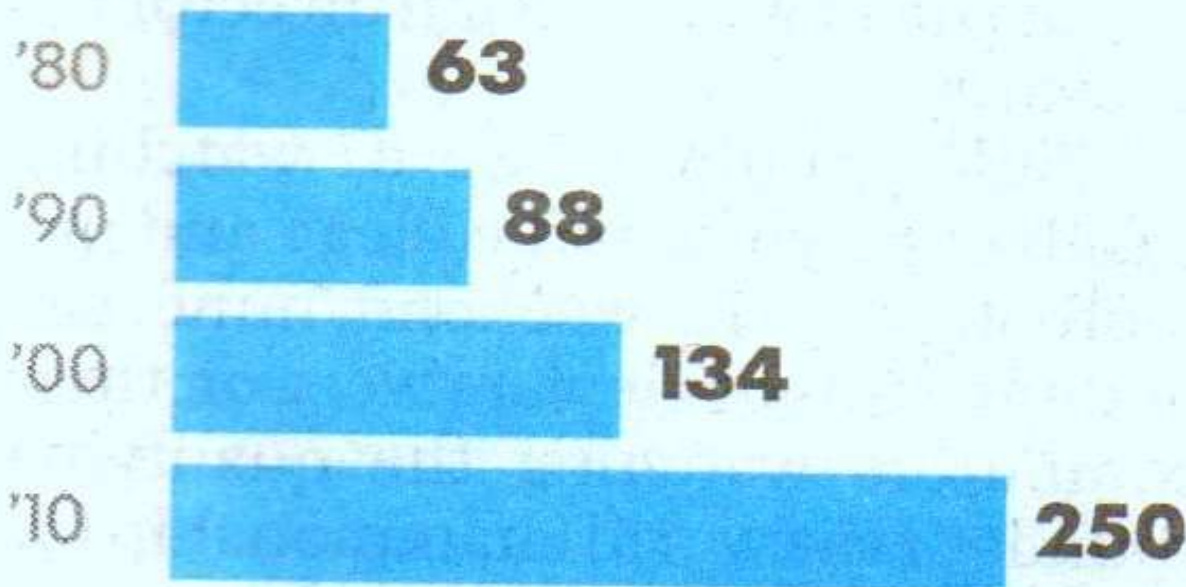
Hurricane Katrina 2005: \$146 B

Hurricane Irene 2011: \$15B

Hurricane Sandy 2012: \$50B

DISASTERS ON THE RISE

U.S. natural catastrophes have skyrocketed over several years.



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

Source Munich Re

Insured losses in US from thunderstorms alone in 2011 were highest on record: \$26 billion

-More than double the previous record set in 2010.

IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

November 2011

220 Authors from 62 countries.

http://www.ipcc.ch/news_and_events/docs/srex/SREX_fact_sheet.pdf





- **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.

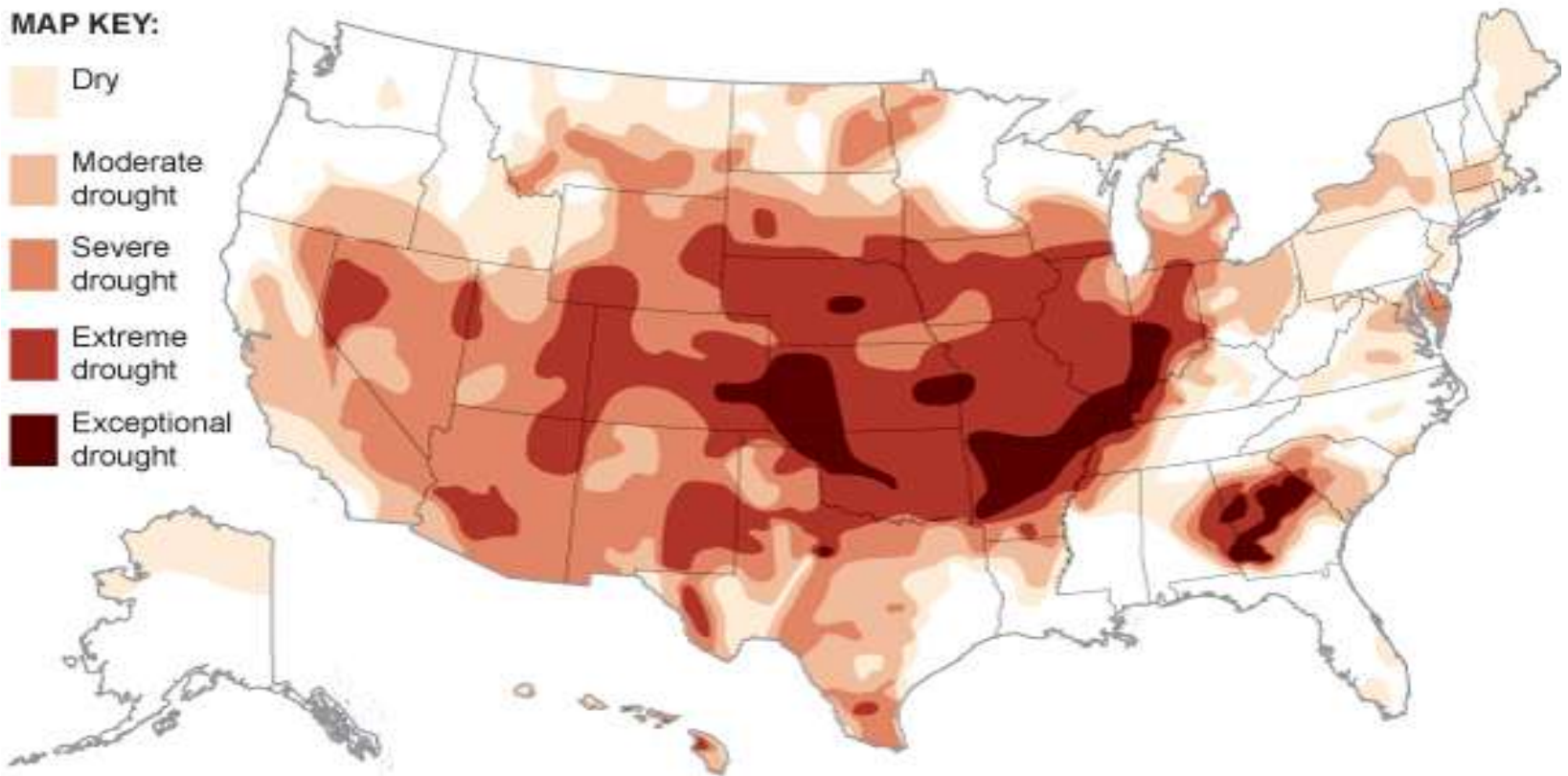
2012 DROUGHT: 52% OF U.S. \$ 20 -\$25 B loss in crop insurance.

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

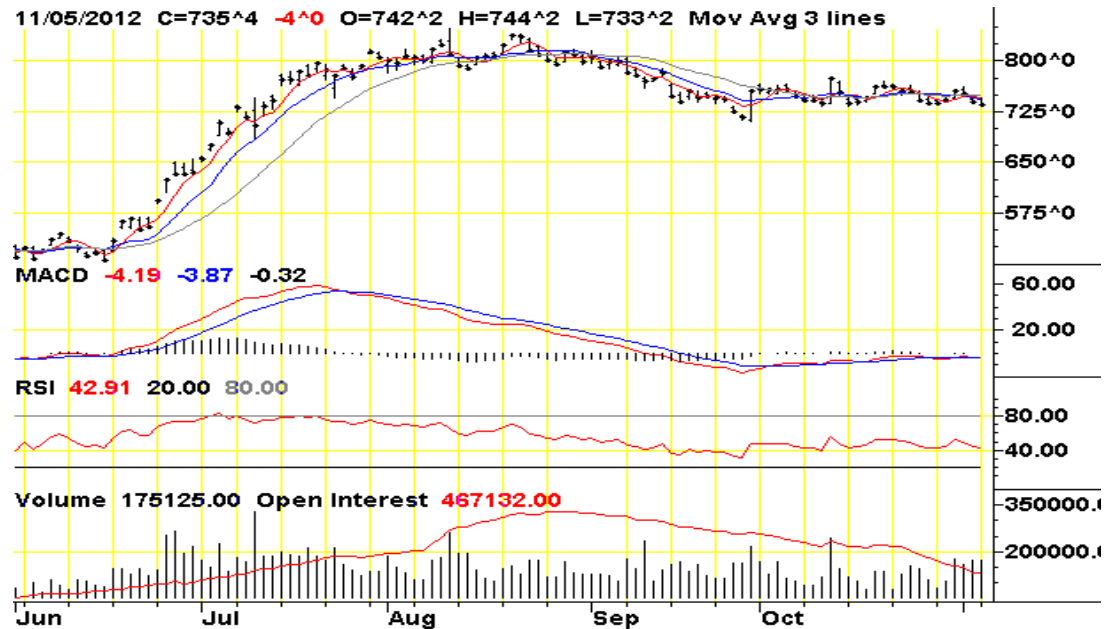
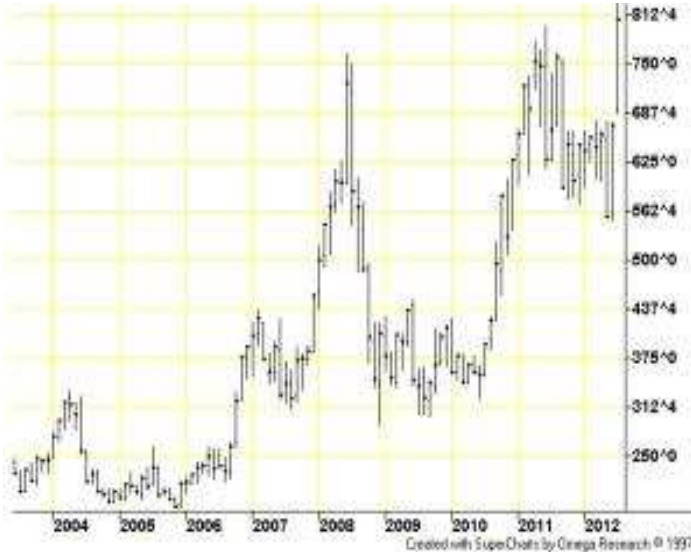


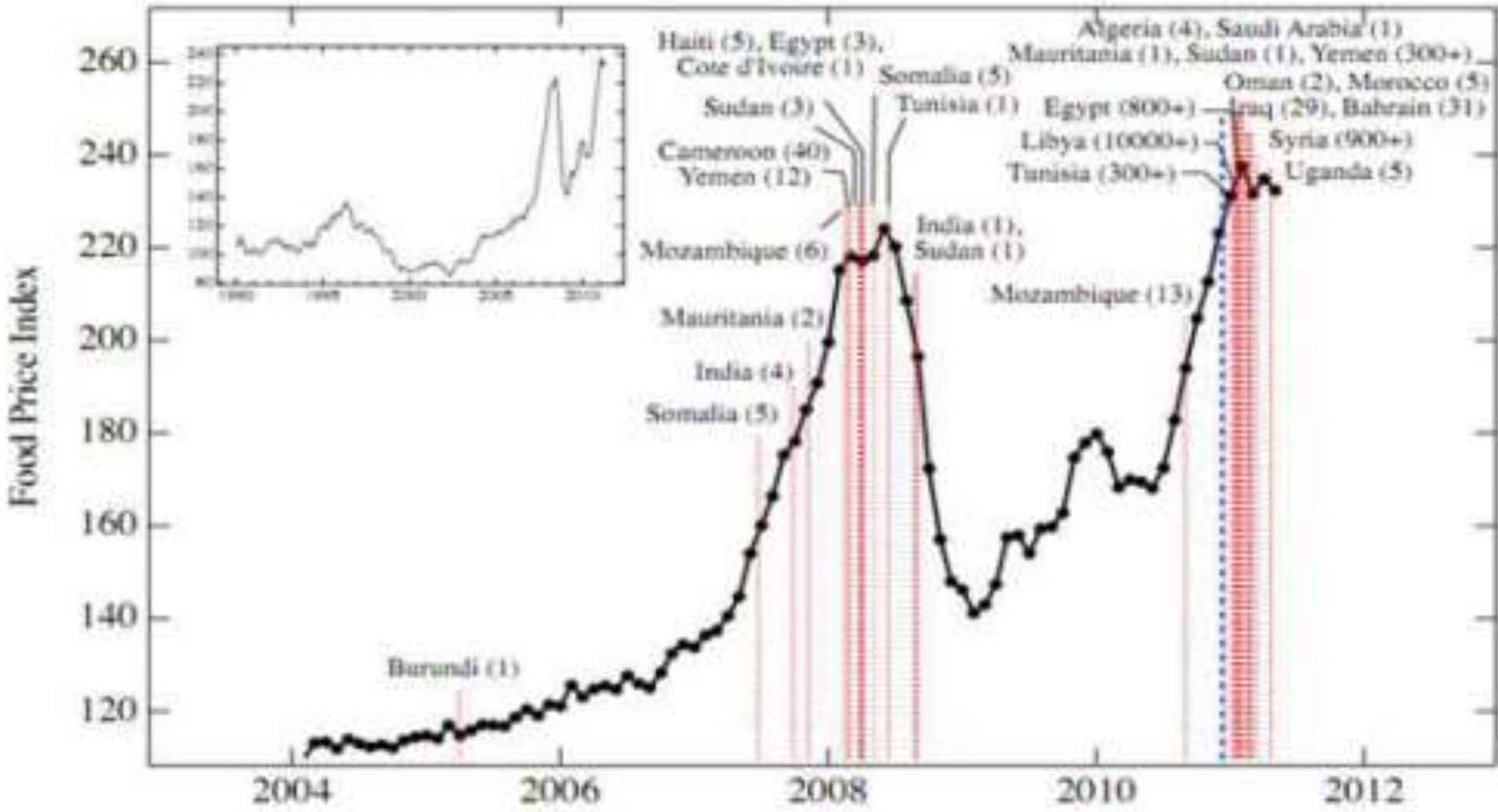
<http://www.nytimes.com/imagepages/2012/08/12/opinion/12drought-map.html?ref=sunday>

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.

Corn Futures Prices





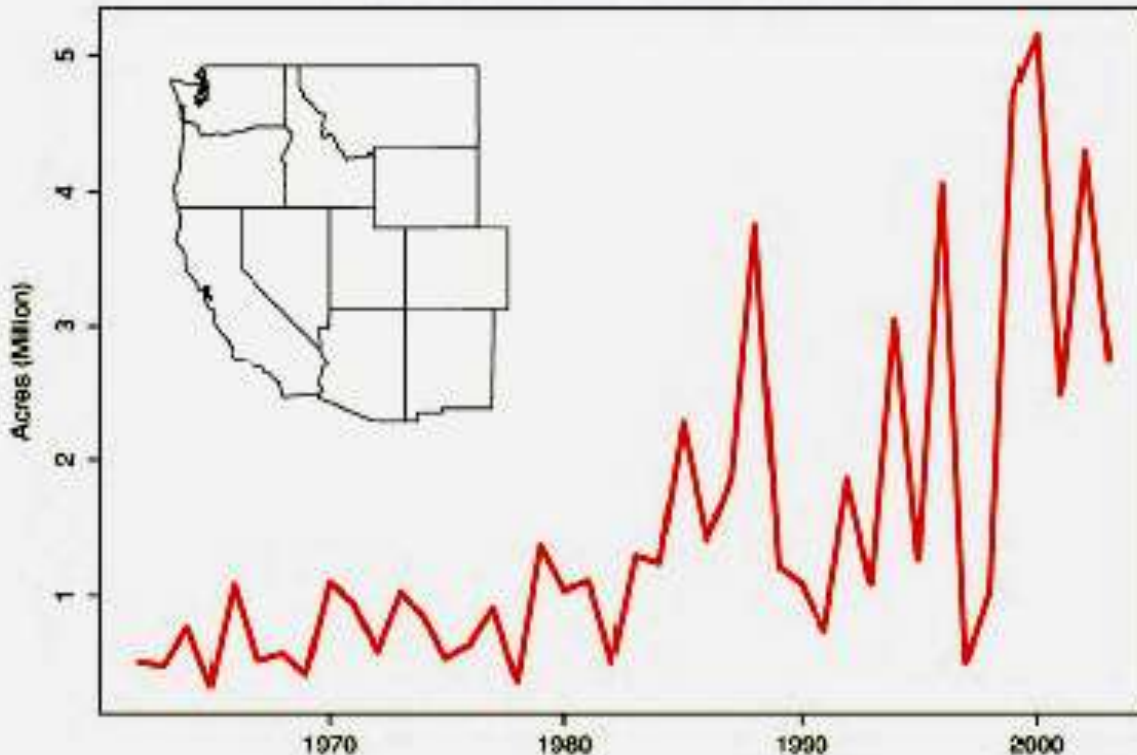
Social unrest accompanies food price increases.
 6 – 10 calories of fossil fuels are required for each calorie of food.
<http://www.zerohedge.com/news/deja-food-will-social-unrest-surge-corn-prices-soar>

Fires Are Increasing World-Wide

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

Western US area burned

Western U.S. Burned Area - All Sources



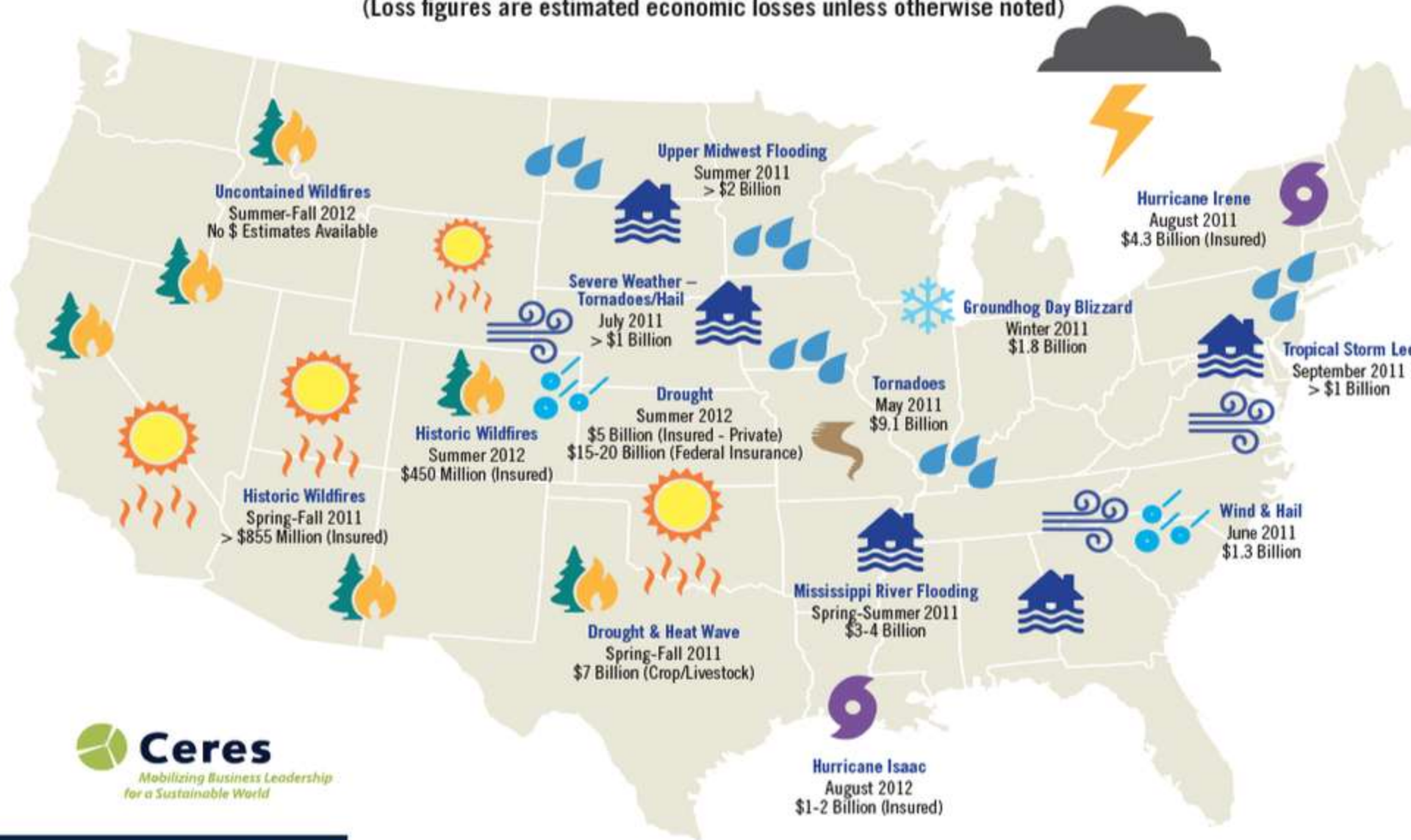
The effects of global warming on temperature, precipitation levels, soil moisture, and Western Pine beetles are turning many of our forests into kindling for more wildfires.

(Westerling, A.L, et al. (2006) Warming and Earlier Spring Increase Western U.S. Forest Wildfire. *Science* 313, 940 -943 DOI: 10.1126/science.11288340.)

STORMY FUTURE FOR U.S. INSURERS

Losses from U.S. Extreme Weather Disasters – 2011-2012

(Loss figures are estimated economic losses unless otherwise noted)



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
- **NUMBER OF EVENTS WITH DAMAGE OVER \$ 1 BILLION (NOAA)**
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China Carbon Debut Defies Emission Doubters

By Bloomberg News - Oct 12, 2012 5:09 AM ET

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.

<http://www.bloomberg.com/news/2012-10-12/china-carbon-debut-defies-emission-doubters-energy-markets.html>

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