Climate Change and Human Health

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EDITORIAL

Lessons From Dr Strangelove
Human health depends on a safe environment and stable climate...
Last year...
“Up until now, the criticism has been that climate science is like a house of cards, and if you pull out one or two sets of data, it all collapses. That narrative has been refuted. [AR5] shows that...the observational evidence for human-caused warming is overwhelming, compelling, and irrefutable.”

--Former IPCC chair Bob Watson
ENERGY, CLIMATE CHANGE, AND OUR ENVIRONMENT

The President has taken unprecedented action to build the foundation for a clean energy economy, tackle the issue of climate change, and protect our environment.

JOINT ANNOUNCEMENT WITH CHINA

In a historic move, the U.S. and China came together and announced new targets to reduce carbon pollution.
June 2015
2015 & 2016

Anni mirabiles?
Last Winter
Editorial: Worst winter ever?
July Chill Brought Record Cold Temperatures
By Greg Sargent  June 2, 2014  Never mind 2014. Climate change will be big issue in 2016.
2015 warmest year on record to date. July 2015 was hottest month ever recorded.

-NOAA
The first six months of 2016 have been the warmest half-year on record.
To what extent do you agree or disagree?

The climate change we are currently seeing is largely the extent of human activity

Economist, 12/15
AR5 (9/27/2013)

physical science basis for CC
95-100% confidence that human activity is the principle cause of climate change since the Industrial Revolution in the 1850s.
Greenhouse Gasses:

The Last 500,000 years and the last 200 years

Carbon Dioxide, Methane, and Temperature
Carbon limit:

IPCC has defined an *upper limit for carbon dioxide emissions*—3.6°F—since the Industrial Revolution

we have already spent over half of our “budget.”
Each of the last three decades has been successively warmer at the Earth’s surface than any preceding decade since 1850. In the Northern Hemisphere, 1983–2012 was likely the warmest 30-year period of the last 1400 years.
Record Low Sea Ice Extent

Summer Arctic Sea Ice Boundary in 1979

NASA/Goddard Space Flight Center Scientific Visualization Studio; thanks to Rob Gerston (GSFC) for providing the data
Albedo refractive effect
The global ocean will continue to warm and heat will penetrate from the surface to the deep ocean and affect ocean circulation.

Global glacier volume will further decrease.
Increasing Ocean Heat Content

Ocean Heat Content, 0-700 m (1950-2003)

- Best estimate
- Uncertainty range (1 standard deviation)
The ocean has absorbed about 30% of the emitted anthropogenic carbon dioxide, causing ocean acidification.
Changes in the global water cycle in response to the warming over the 21st century will not be uniform.

The contrast in precipitation between wet and dry regions and between wet and dry seasons will increase, although there may be regional exceptions.
The challenge of science communication
The challenge of science communication

Complex system + energy = unpredictability
The challenge of science communication

Complex system + energy = unpredictability

Global Warming
The challenge of science communication

Complex system + energy = unpredictability

Global Warming

Global Energizing
A Complex System
+ Energy
Health Effects
5th Assessment Report (AR5)

Working Group II

March 2014

Impact on Human Health
Until mid-century= **exacerbating health problems that already exist** (*very high confidence*).

Throughout the 21st century= **increases in ill-health** in many regions...

**especially in developing countries** with low income, compared to baseline (*high confidence*)
Increase in the frequency of Extreme Weather

Not only changes in Mean (temp & precip)
But also increases in Extremes
Some Extreme Events will be well beyond historical experience

**Confirmed Mortality**

<table>
<thead>
<tr>
<th>Country</th>
<th>Confirmed Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>2,091</td>
</tr>
<tr>
<td>Italy</td>
<td>3,134</td>
</tr>
<tr>
<td>France</td>
<td>14,802</td>
</tr>
<tr>
<td>Portugal</td>
<td>1,854</td>
</tr>
<tr>
<td>Spain</td>
<td>4,151</td>
</tr>
<tr>
<td>Switzerland</td>
<td>975</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1,400-2,200</td>
</tr>
<tr>
<td>Germany</td>
<td>1,410</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>29,817-30,617</strong></td>
</tr>
</tbody>
</table>

Haines et al. *Public Health* 2006;120:585-96.
Heat and Elderly Mortality (Harvard School of Public Health, 2012)

- Medicare data from 1985 to 2006 to follow the long-term health of 3.7 million chronically ill people over age 65 living in 135 U.S. cities.
- Each 1°C increase in summer temperature variability increased the death rate for elderly with chronic conditions between 2.8% and 4.0% depending on the condition.
  - 4.0% for those with diabetes;
  - 3.8% for those who’d had a previous heart attack;
  - 3.7% for those with chronic lung disease;
  - 2.8% for those with heart failure.
- Greater summer temperature variability in the U.S. could result in more than 10,000 additional deaths per year.
Urban Heat Island can add 7° – 12° F

Thermal Satellite Image of Phoenix, AZ Night Surface Temperature
Harlan et al 2006

- Slide on the Phoenix neighborhood study

Neighborhood Microclimates within the Phoenix UHI

Harlan et al 2006

Mean Summertime Temp (°F)
- 106°F
- 99°F

Heat Wave Temp (°F)
- 118°F
- 104°F

City Center

Each concentric circle is a distance of 8 km

North Desert Ranch

New Tract Development

West Side Suburban

North Central Apartments

Black Canyon Freeway

Historic Anglo Phoenix

Historic Mexican Phoenix

South Mountain Preserve
Disasters caused by weather and climate

- Meteorological events (Storms)
- Hydrological events (Floods, landslides and avalanches)
- Climatological events (Extreme temperatures, droughts, forest fires)

Source: Munich Re
Typhoon Haiyan, max sustained winds 196 mph

[157mph = Category 5]
Hurricane Patricia, max sustained winds 200 mph
[157mph = Category 5]
October 2012:
Hurricane Sandy swept through the Caribbean and Atlantic, at its peak covering more than 1,000 miles of the North American coastline— the largest storm system in recorded history.
>250 people lost their lives during the storm.
>$65 billion in immediate damage.

The long-term economic toll of Sandy, including reconstruction of power grids, infrastructure and homes, has not yet been fully tallied.
Observational Record:
Heavy Rain Events are More Frequent

- Observed Increases in Very Heavy Precipitation (heaviest 1% of all events) — 1958 to 2007

Source: Groisman et al. 2005
USGCRP 2009 Global Climate Change Impacts in the United States Report
Heavy Downpours and Exposure to Disease

Streams and rivers rise which contributes to flooding of homes, businesses, and critical infrastructure like sewer and storm water systems.

Sewage overflow from treatment plants, septic fields, and municipal lines can back up into people's homes.

Floodwaters can become contaminated with agricultural waste, chemicals, raw sewage, and other pollutants.

Floodwaters can contain disease-causing bacteria, viruses, and parasites.

Flooded materials in homes, schools, and businesses can cause molds to grow and be inhaled.

Climate change increases heavy downpours.
Harmful Algal Blooms (Red-tides)

Enhanced by:
- Increased water temps
- Nutrient runoff
- Upwelling events

Figure 2. Distribution of the CyanoHAB, *Cylindrospermopsis raciborskii*, in Florida (Williams 2001, Fristachi et al. 2007). *C. raciborskii*, which produces potent hepatotoxins (Table 2), was originally found only in tropical areas but has recently spread to cooler regions.
Direct Effects of Hydrologic Extremes

↑ drier climates = forest fires and smoke

Vulnerable Populations:
• Young Children
• Elderly
• Pregnant Women
• People with Preexisting Respiratory and Cardiac Diseases
BEFORE 1970
Cold temperatures caused freezing at high elevations and limited mosquitoes, mosquito-borne diseases and many plants to low altitudes

TODAY
Increased warmth has caused mountain glaciers to shrink in the tropics and temperate zones

Some mosquitoes, mosquito-borne diseases and plants have migrated upward
Impact on agricultural productivity with carbon fertilization (percent)
Adaptability?
Humans?
New Orleans today?
Climate change over the 21st century is projected to increase displacement of people (medium evidence, high agreement).
By 2050: 75 million Islanders will be forced to relocate
Threat Multipliers

Climate change and resource scarcity are rarely sole cause of violent conflict

Better understood as “threat multiplier” that will interact with other risk drivers …

…All with diverse sources of vulnerability

-Skip Burkle
Climate change can indirectly increase risks of violent conflicts in the form of civil war and inter-group violence

Amplifying poverty and economic shocks (medium confidence).
The rich will find their world to be more expensive, inconvenient, uncomfortable, disrupted and colorless — in general, more unpleasant and unpredictable, perhaps greatly so...

The poor will die...

Kirk R. Smith, 2008
Professor, Environmental Health Sciences, UC-Berkeley
Without the pledges, *global temperatures* would likely jump more than 8°F by 2100.
The **Paris pledges** lower the likely increase to just over 6°F.
But the goal countries agreed to in 2010 was to limit the temperature increase to 3.6°F.
Right now, most of the pledges do not extend past 2030.
Delegates in Paris are discussing a plan for ratcheting up national commitments over time.
SOLUTIONS ?
Rebranding Climate Change as a Public Health Issue

Why medical professionals may be the best messengers for global warning right now

By Courtney Subramanian @cmsub | Aug. 08, 2013 | 26 Comments
Re-Framing the Climate Change Dialogue
The power of science communication
Changing our collective risk assessment...
THINK
Thank You!

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