Climate Change: The Public Health Response

George Luber, PhD
Intergovernmental Panel on Climate Change (IPCC) 2007 Landmark Reports
Climate Change is Happening Now

- Warming is unequivocal; most of the warming of the past 50 years is very likely (90%) due to increases in greenhouse gases.

- Physical and biological systems on all continents and oceans already affected by climate changes.

- Already committed to more warming (next few decades); choices about emissions affect the longer term more and more. (IPCC2007)
Important Considerations

- There will be significant regional variation in the effects of climate change.
- There will be significant variation in the demographic groups effected by climate change.
Extremes impact people more than mean

Peterson et al., 2007b
Some occurrences will be well beyond historical experience

European heat wave of 2003

<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>

Climate Change and Urban “built” environments

- Cities and climate are coevolving in a manner that will place more populations at risk.

- Increase in vulnerable populations:
  - Today, more than half of the world’s population lives in cities, up from 30% in 1950.
  - By 2100 there will be 100 million more people > 65 years old (relative to 2000) (Ebi et al. 2006).

- Intensification of exposures: Urban heat islands
Urban Heat Island can add 7° – 12° F

Thermal Satellite Image of Phoenix, AZ Night Surface Temperature
Heat Island Impacts on Air Pollution

Maximum Daily Ozone Concentrations vs. Maximum Daily Temperature

Atlanta

New York

Atlanta, GA

New York, NY
Heat Island and CO$_2$ Dome Impact on Aeroallergens

- **Ragweed** (*Ambrosia spp.*)
- \( \uparrow \text{CO}_2 \) and temperature \( \rightarrow \uparrow \) pollen counts, longer growing season

### Something in the Air

Researchers at the U.S. Dept. of Agriculture planted ragweed in and around Baltimore in 2001 to test how the plant responds to different concentrations of CO$_2$. The results:

<table>
<thead>
<tr>
<th>Area</th>
<th>Period of collection</th>
<th>Urban</th>
<th>Suburban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>July 30-Sept. 7</td>
<td>Aug. 6-Sept. 10</td>
<td>Aug. 15-Sept. 17</td>
</tr>
<tr>
<td>Average CO$_2$ level, parts per million in the air</td>
<td></td>
<td>600</td>
<td>400</td>
<td>200</td>
</tr>
<tr>
<td>Pollen count, grains per cubic meter of air</td>
<td></td>
<td>12,138</td>
<td>3,262</td>
<td>2,294</td>
</tr>
</tbody>
</table>

Source: Lewis Ziska, U.S. Dept. of Agriculture

Forest Fires

↑ drier climates → forest fires, smoke, particulate matter

Vulnerable Populations:
- Young Children
- Elderly
- Pregnant Women
- People with Preexisting Respiratory and Cardiac Diseases

Source: Ziska et al., *J Allerg Clin Immunol* 2003;111:290-95; Graphic: www.abcnews.net/au
Changes in the Hydrologic Cycle: Heavy Precipitation Events

- Increasing levels of greenhouse gases warm the climate and lead to increases in very heavy precipitation events.

Why: Increasing air temperatures result in a greater amount of water vapor in the air.
Extreme Precipitation Events

- ↑ frequency of more intense rainfall → ↑ severe floods, landslides, and debris and mud flows.

On July 26-27, 2005, 37+ in. of rain fell in Mumbai, leading to 1,000+ deaths.

Sources: Cruz et al., 2007; Image: Peterson et al., 2007b; news.bbc.co.uk
Water-borne Disease Outbreaks:

Milwaukee 1993

Cryptosporidiosis epidemic

405,000 exposed

54 fatalities

Preceded by heaviest rainfall in 50 years
Tropical Cyclones

- ↑ sea-surface temperatures → ↑ tropical cyclone intensity and ↑ the height of storm surges

Sources: Ali, 1999; Images: NOAA.gov; www.weatherunderground.com
Harmful Algal Blooms (Red-tides)

Enhanced by:
- Increased water temps
- nutrient runoff

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.
Emerging Exposures: Ciguatera Fish Poisoning
Prediction:
Because of Climate Change, Vector distributions will increase in latitude and altitude.
Increased Temperature and Malaria’s Expanded Global Reach

10-fold increase in density of malaria-bearing mosquitoes in upper highlands of Africa.
Distribution of Lyme Disease, 1991-2000 and 2020

Tick abundance at model equilibrium

Potential Health Effects of Climate Change

Climate Change:
- Temperature rise
- Sea level rise
- Hydrologic extremes

Adapted from J. Patz
Strategies for Climate Change

- Develop region and city-specific strategies
  - Focus on vulnerable populations in urban areas

- Enhanced surveillance integrating environmental and health data
  - Climate change indicators?

- Identify Co-Benefits
Conclusions

- Climate change is now a mainstream issue
- Climate change must also be framed as a public health issue
- Opportunity costs of not taking action are high
Thank You

Contact:
George Luber, PhD
Associate Director for Global Climate Change
National Center for Environmental Health

gluber@cdc.gov
Tel: 770-488-3429