

PRESENTATIONS

The Arctic Climate Impact Assessment Human Health Recommendations

James E. Berner, MD
Alaska Native Tribal Health Consortium

Alaska Forum on the Environment
14 February 2008

Conclusions

1. There is a lack of comparability in health status data between countries.
2. There is a need for a carefully planned strategy, at the community and regional level, to monitor and document environmental change.

Conclusions cont.

3. There is a lack of an organized effort to collect and utilize indigenous knowledge regarding climate and climate changes.
4. There are few data on the impact of changing UV-B exposure in the Arctic on the biota and human residents. There is a little systematic monitoring of ground-level UV-B radiation.

Conclusions cont.

5. There are few data on climate change impacts on regional biota. A critical need exists for the monitoring of wildlife diseases, and human-wildlife disease interaction. There are few data on climate-induced changes in the diet of subsistence species, which affects their nutritional value in traditional diets.

Conclusions cont.

6. There is no systematic monitoring in all regions for safety of snow and ice conditions for local/regional travel and subsistence activities.
7. Monitoring is critical in regions of the Arctic where physical infrastructure depends on permafrost or where a village site depends on sea ice protection from storm erosion.

Conclusions cont.

8. Data on contaminant transport into and out of the Arctic is critical for projecting impact and risk for arctic wildlife and residents. Changing climate makes monitoring essential.



Climate Change: Place, Health, and The Public Health Response

Alaska Forum on the Environment 2008

Jeremy Hess, MD, MPH

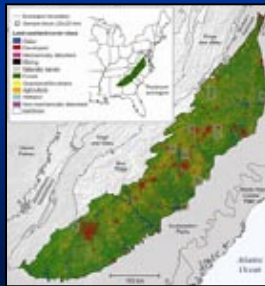
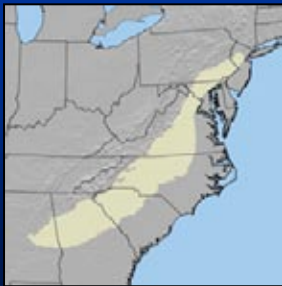
**National Center for Environmental Health
Centers for Disease Control and Prevention**



Where are you from?

- How is that place changing?
- How do you feel about the changes?
- How will they affect human health?
- Who is most at risk?
- How do we know?
- What is to be done?

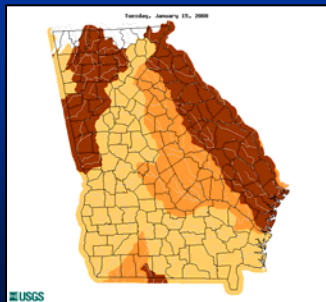
The Piedmont



A Healthy Place



A Troubled Place



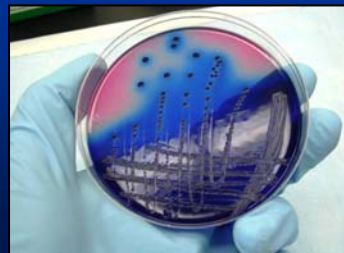
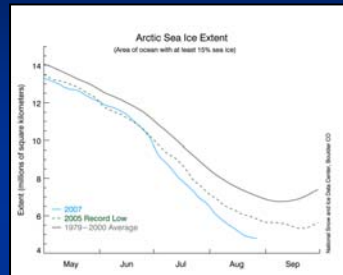
Where are you from?



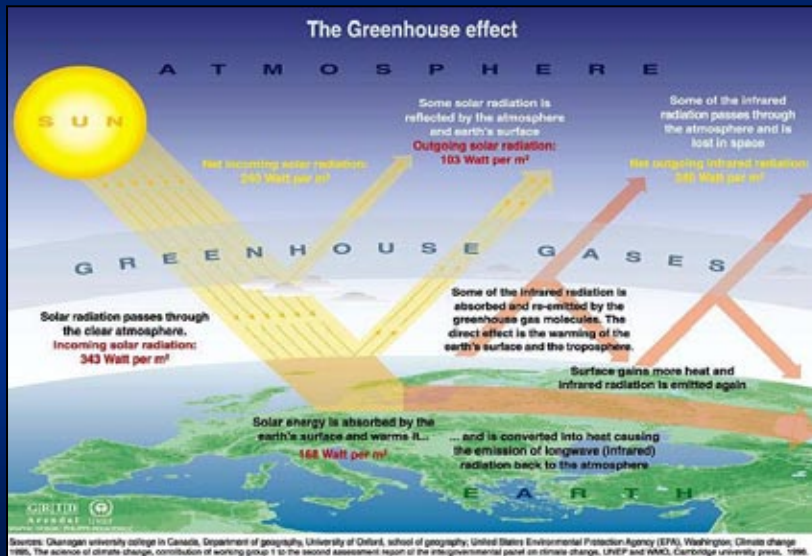
A Healthy Place



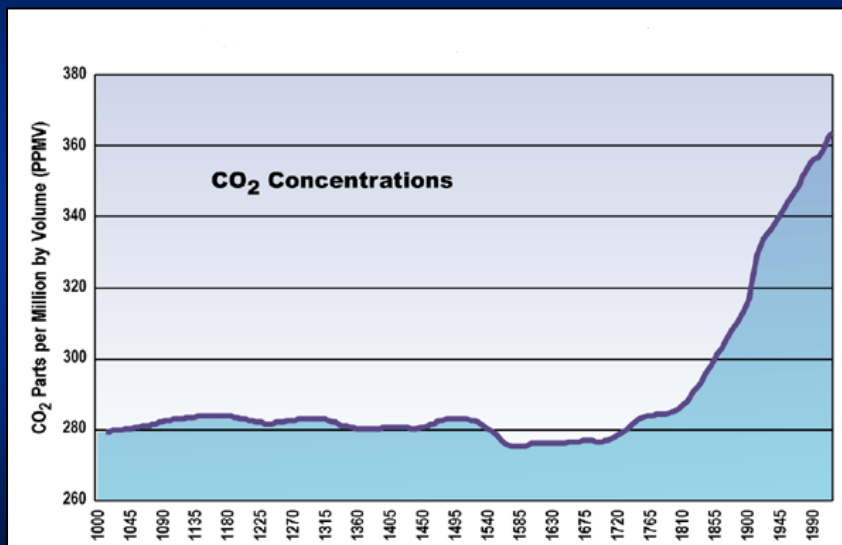
A Troubled Place



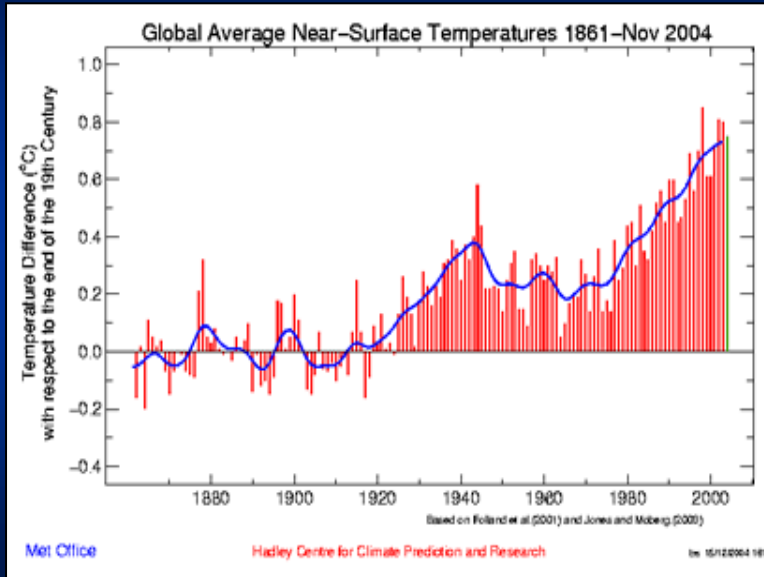
More Troubles Ahead



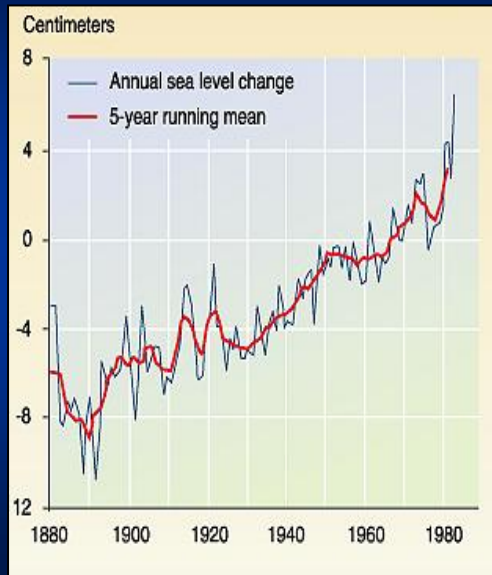
Of Our Own Doing



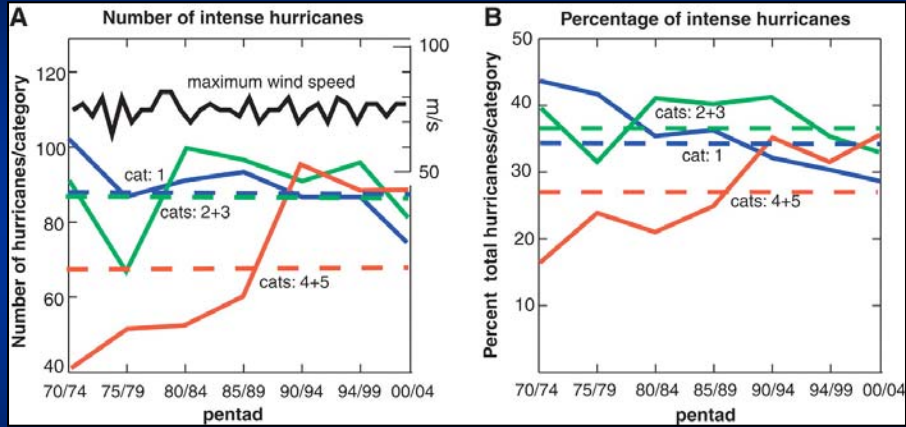
Rising temperatures



Sea level rise



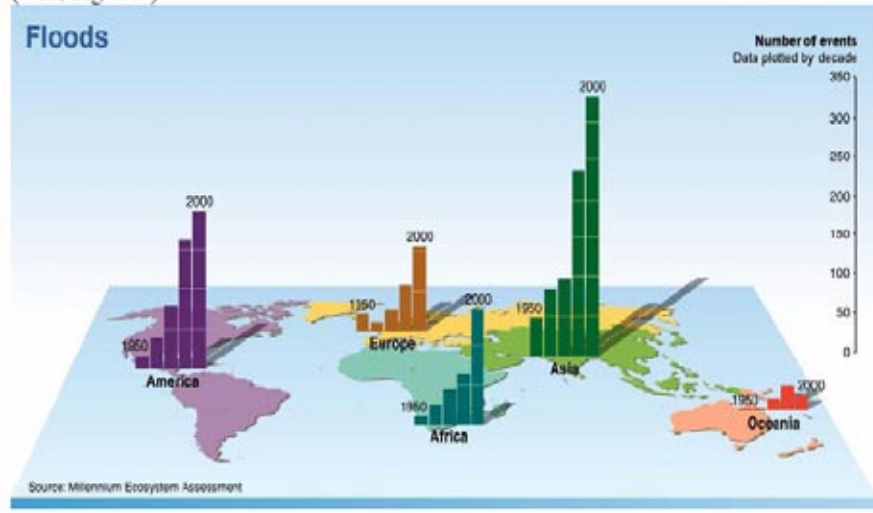
Hurricanes, 1972-2004



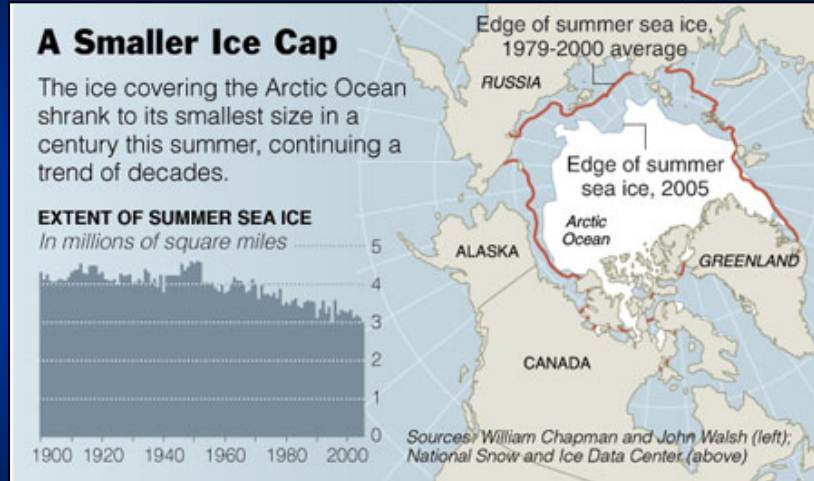
Hurricane intensity (Saffir-Simpson scale categories 1 to 5), global, 1970-2004, including number of storms by category (A) and proportion of storms in each category (B). Bold curve in (A) is the maximum global hurricane wind speed (in m/sec). Dashed lines show the 1970–2004 average numbers in each category. Source: Webster et al., *Science* 2005;309:1844-46.

Floods

Appendix Figure A.7. Number of Flood Events by Continent and Decade Since 1950 (C16, Fig 16.6)

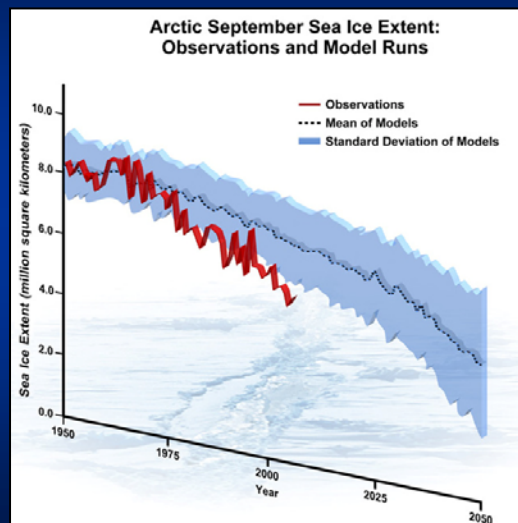


Dwindling Polar Ice Cap



New York Times, 29 September 2005, p 1

Faster Than Predicted



Polar Bears in Distress



- Hudson Bay polar bear population ↓ 22% from 1987-2004
- Polar bear cub one-year survival in Alaska's Beaufort Sea ↓ from 65% (late 1980s) to 43% (current)
- Reports of polar bears drowning while swimming long distances between ice floes
- Reports of polar bear cannibalism

Source: USGS Alaska Science Center

Glacier loss



Glacier Bay National Park, 1941. The glacier is 2,000 feet thick.
USGS photo, available www.coasttocoastam.com/shows/2005/01/29.html



Glacier Bay National Park, 2004. Receding glacier, new vegetation since 1941.
Photo: USGS/Bruce Molnia, available www.coasttocoastam.com/shows/2005/01/29.html



1875



2004

Pasterze Glacier, Austria



1914



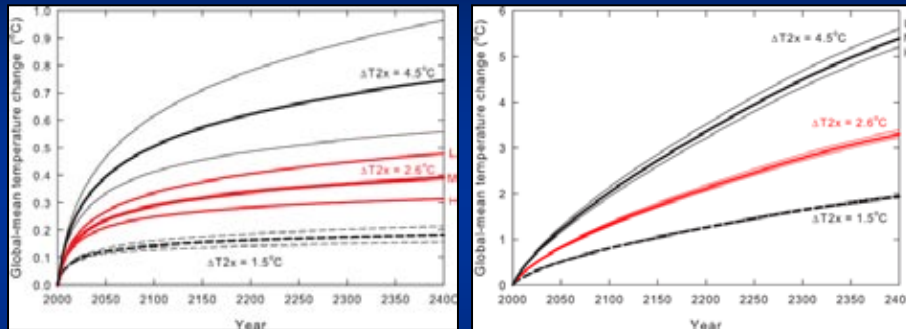
2004

Portage Glacier, Alaska

IPCC Projections to 2100

- Higher temperatures: 1.1 – 6.4 °C (2.0 – 11.5 °F) mean global surface temperature rise
- Rising sea-levels: 0.18 - 0.59 m (7.1 – 23.2 inches)
- More severe precipitation extremes (storms and droughts)

“Climate Change Commitment”

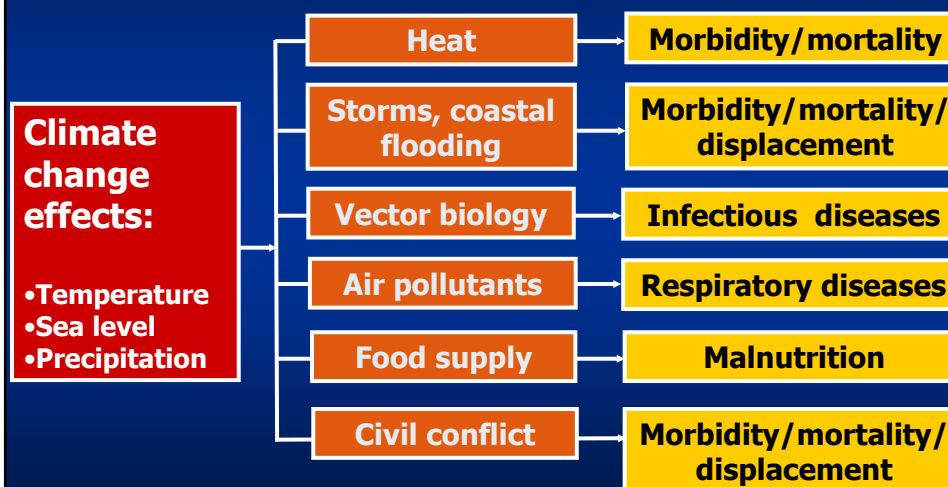


CONSTANT COMPOSITION

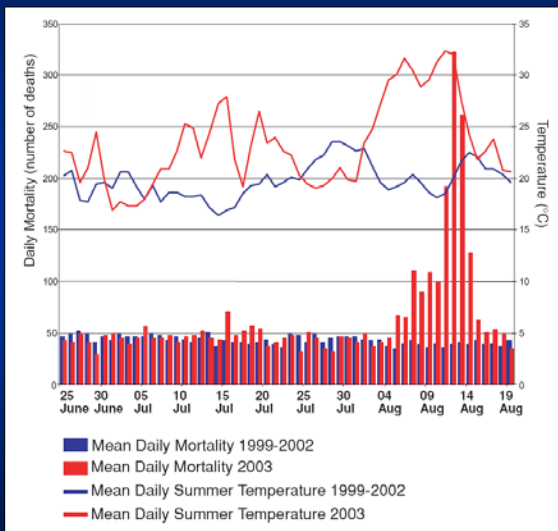
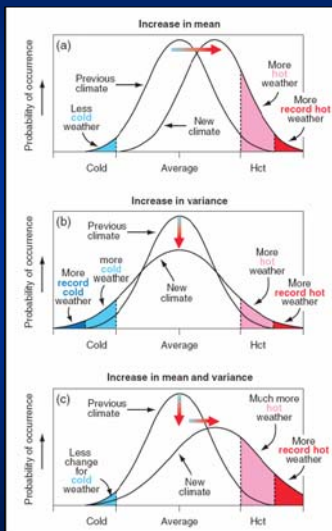
CONSTANT EMISSIONS

Wigley TML. The climate change commitment. *Science* 2005;307:1766-69.

Potential Impacts on Human Health



Heat Waves



Extreme Weather Events

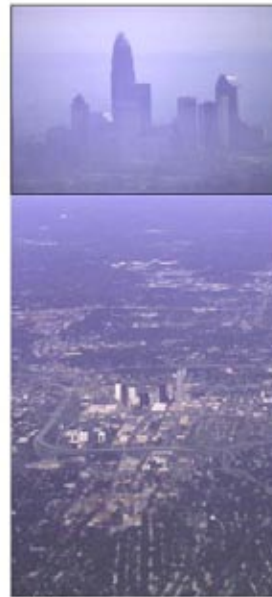


Place Specific and Path Dependent

- Coasts, Islands, Lowlands
 - Sea level rise
 - Water table salinization
 - Agricultural effects
 - Extreme weather events
- Cities
 - Heat waves
 - Air pollution
 - Waterborne disease outbreaks
- Desert Southwest
 - Drought
 - Infectious disease
 - Heat waves
- Vector-border regions
 - Lyme
 - Dengue
 - Hantavirus
 - West Nile
- The Arctic
 - Displacement
 - Injuries
 - Infectious disease
 - Water- and foodborne disease
 - Infrastructure loss
 - Positive effects
 - Decreased hypothermia
 - Decreased cold-related infectious disease

Hotspots: Cities

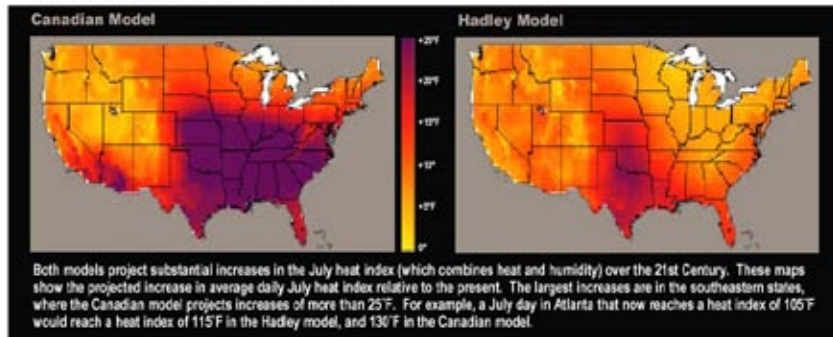
- Heat waves
- Air pollution
- Exacerbations of chronic disease
- Extreme precipitation events and waterborne disease



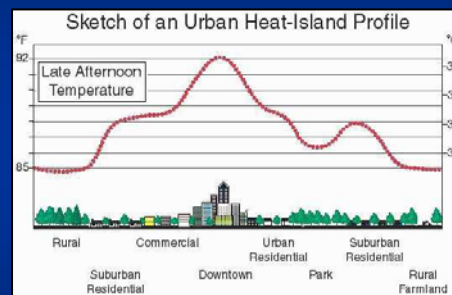
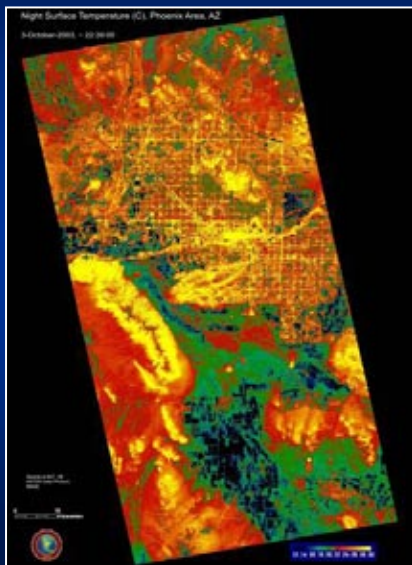
Atlanta

Heat Indices – 21st Century

July Heat Index Change - 21st century



Urban Heat

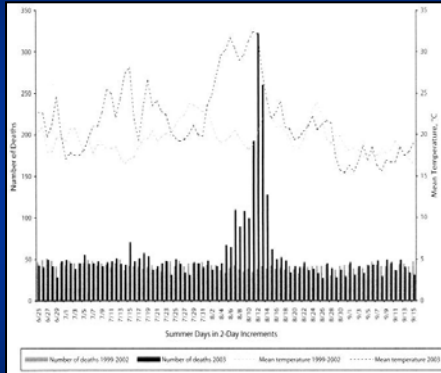


Thermal Satellite Image of Phoenix, AZ Night Surface Temperature



European heat wave, 2003

TIME LINE (FRANCE)



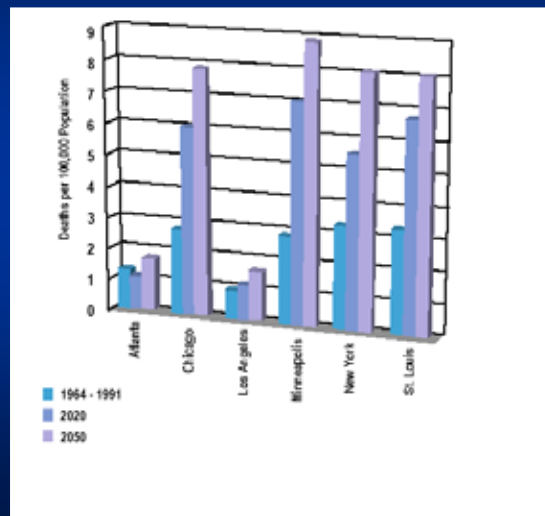
Vandentorren et al. Mortality in 13 French cities during the August 2003 heat wave. *Am J Public Health* 2004; 94(9):1518-20.

CONFIRMED MORTALITY

UK	2,091
Italy	3,134
France	14,802
Portugal	1,854
Spain	4,151
Switzerland	975
Netherlands	1,400-2,200
Germany	1,410
TOTAL	29,817-30,617

Haines et al. Climate change and human health: Impacts, vulnerability and public health. *Public Health* 2006;120:585-96.

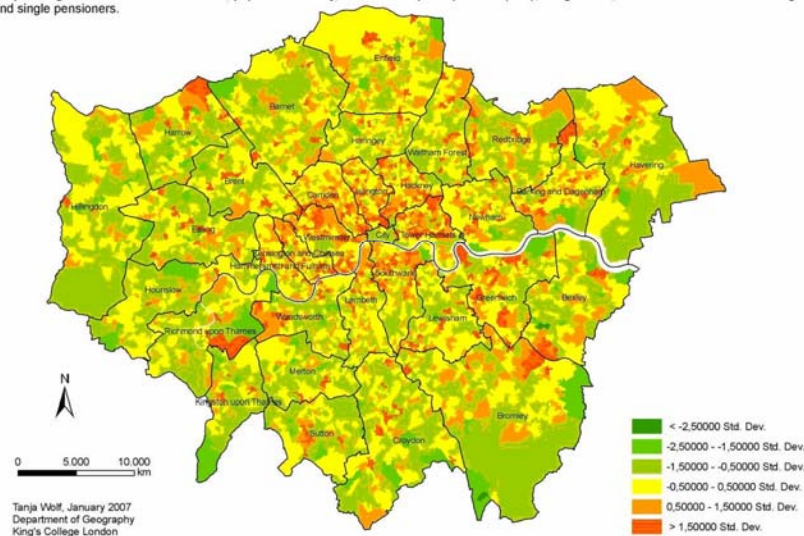
Analog Mortality for European Heat Wave in US



Composite Vulnerability Map

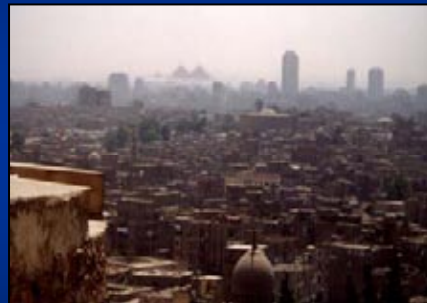
Sensitivity to heat stress in London

sensitivity index based on percentages per district (Lower Level Output Area) on high age, preexisting illness, people living in communal establishments, population density, Index of multiple deprivation (IMD), living in flats, households on 5th floor and higher and single pensioners.



Health Effects of Air Pollution

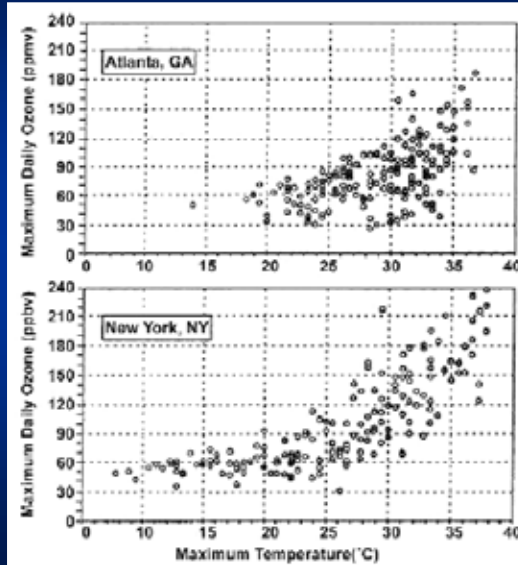
- Damages lung tissue
- Exacerbates respiratory disease
- Reduces lung function
- Aggravates cardiovascular disease



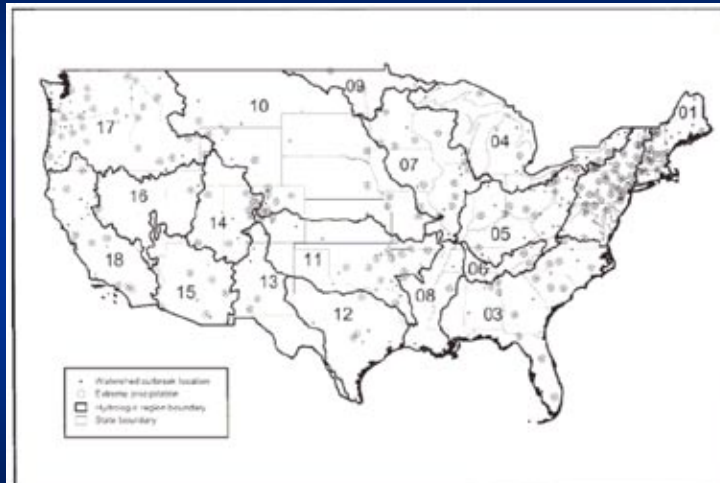
Ozone & Air pollution

Atlanta

New York

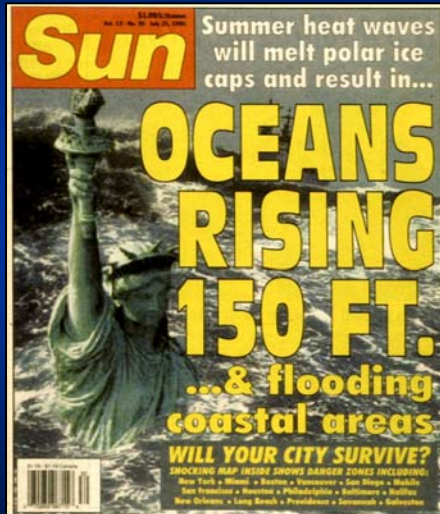


Waterborne Disease Outbreaks



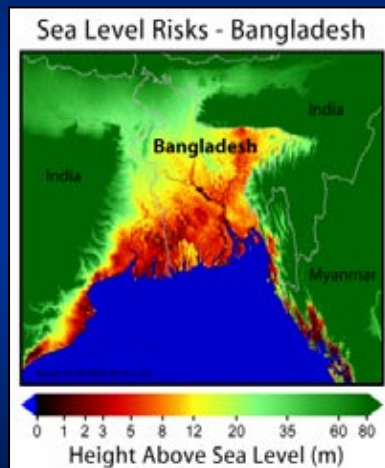
Curriero FC. Patz JA. Rose JB. Lele S. The association between extreme precipitation and waterborne disease outbreaks in the United States, 1948-1994. American Journal of Public Health. 91(8):1194-9, 2001 Aug.

Hotspots: Coasts and Islands

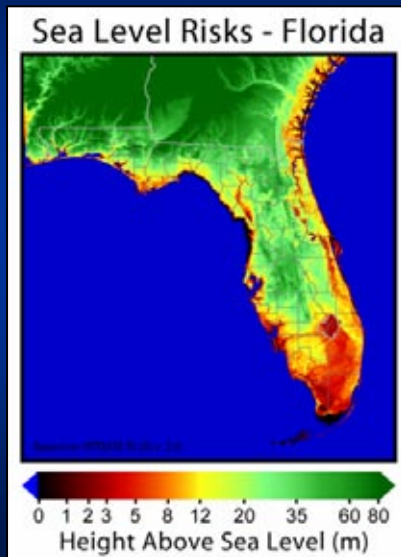
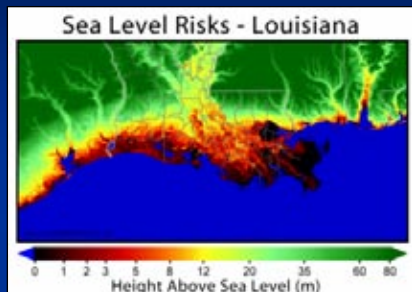


- Floods
- Extreme weather events
- Injuries
- Population displacement
- Water table salinization

A Global Health Concern



And a Domestic One



Water Table Salinization



Available at <http://pubs.usgs.gov/circ/2003/circ1262/#heading156057192>



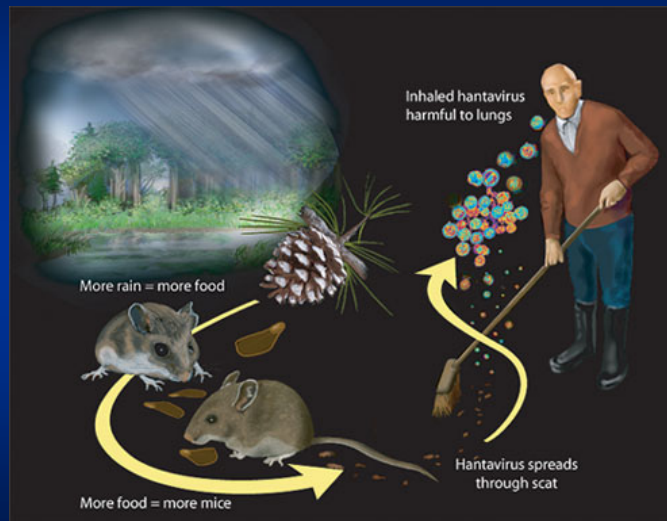
Available at <http://water.usgs.gov/ogw/pubs/fs00085/pdf/fs-085-00.pdf>

Hotspots: Desert Southwest

- Drought
- Heat waves
- Infectious disease

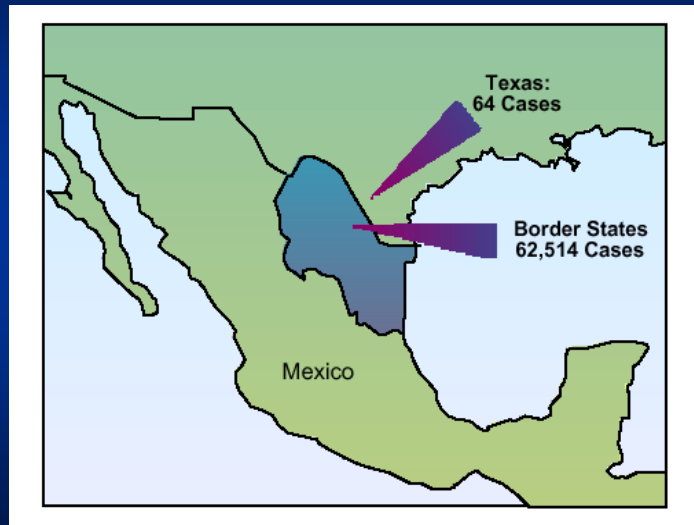


Hantavirus Pulmonary Syndrome



Available at http://www.nsf.gov/news/special_reports/ecoinf/solved.jsp

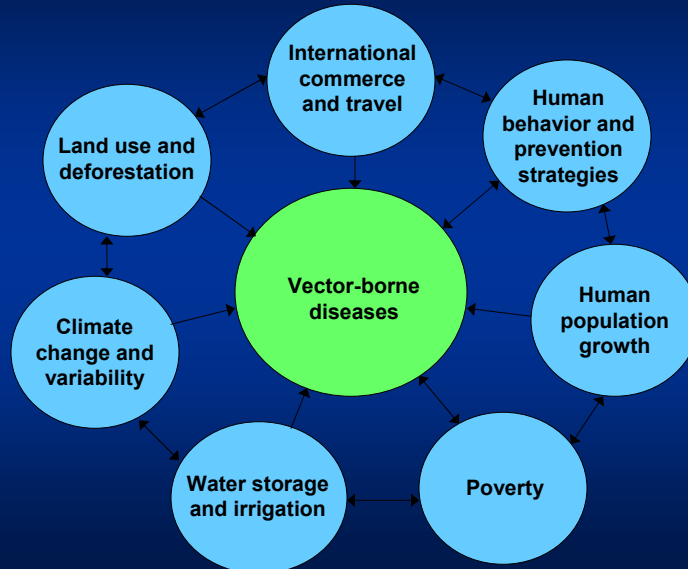
Hotspots: Vector Border Regions



World's Most Dangerous Animals



Climate One Determinant



Modified from Sutherst R.W. Clin Microbiol Rev 2004;17:136-73

Housing Characteristics

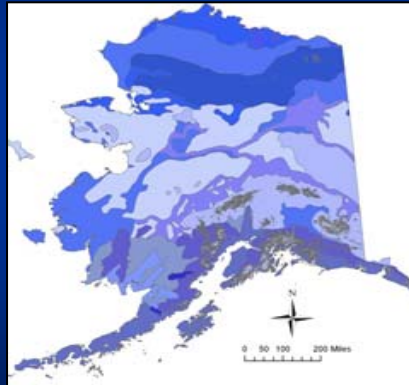
	Mexico (%)	U.S.(%)
Central AC	1.9	35.8*
Room AC	23.4	51.5*
Evaporative cooler	28.5	17.3*
Screens	54.2	77.7*
Intact screens	35.6	59.9*
# occupants	4.5 \pm 2.5	3.8 \pm 2*

*P<0.01

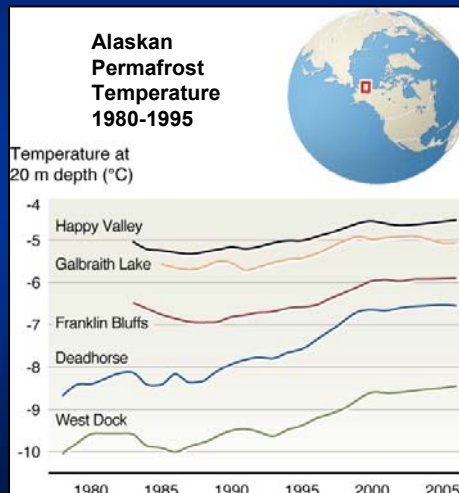
Air conditioning: IgM seropositive O.R. 0.39 (0.18 -0.83)

Hotspots: The Arctic

- Decreased permafrost
- Injuries
- Infectious diseases
- Changing food supply
- Displacement



Decreased Permafrost



Vulnerable Populations

- Alaska Natives:
 - 116,000 (1/6 population)
 - Life exp 69.4 yrs vs 76.7 all US
 - 3.3 x higher injury mortality
 - 4.2 x higher suicide mortality
 - 25.7% below poverty level



Infectious Diseases

- Shigella
- Salmonella
- Staph Aureus
- Clostridium Botulinum
- Giardia
- Cryptosporidium
- Echinococcus



Subsistence Food Supply



What is Place?

- Physical location
- Topography, geography, climate
- Where you are physically
- Where you have been
- The sum of resources and human relationships in a given location



Displacement

“...the sense of belonging, which is necessary for psychological well-being, depends on strong, well-developed relationships with nurturing places. A major corollary of this proposition is that disturbance in these essential place relationships leads to psychological disorder.”

Health Effects of Displacement

- Exacerbations chronic disease
- Depression
- Suicidality
- Disempowerment
- Disengagement
- Community paralysis



The Limits of Our Thinking

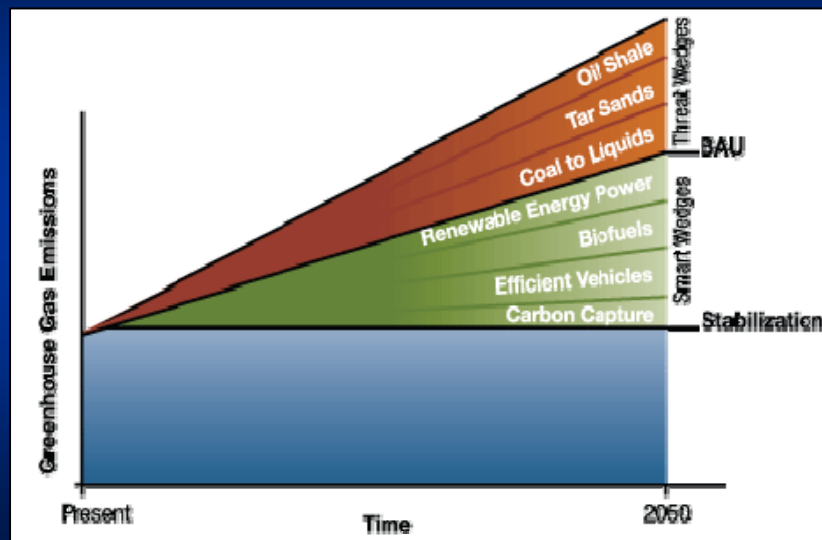
- Highly technical and complex
- Beyond anyone's experience or imagination
- Terrifying to contemplate
- Resistance to necessary changes
- Misinformation actively disseminated



Action on climate change

- Mitigation (primary prevention)
- Adaptation (secondary and tertiary prevention)

Climate stabilization wedges

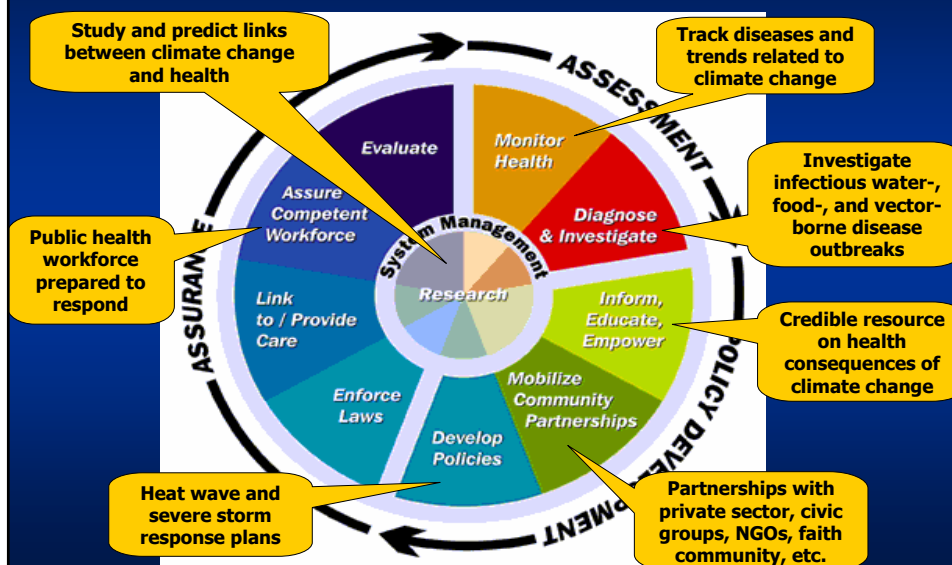


Public Health Role

- Despite existing breadth of organizations and sectors with initiatives on climate change
- Despite the anticipated health effects of climate change

The public health effects of climate change remain largely unaddressed

Climate Change Leadership



Climate Change Synergies

Heat wave plans, “buddy systems”	↑ social capital
↓ vehicular travel	↓ car crashes, ↓ air pollution
↑ fuel efficiency	↓ air pollution
Locally grown food	↓ pesticide loading
Energy-efficient buildings	↓ operating costs
Alternative energy sources	Business opportunities

CDC’s Priority Actions for Climate Change

- #1 Serve as a credible source of information on the health consequences of climate change.
- #2 Track data on environmental conditions, disease risks, and disease occurrence related to climate change.
- #3 Expand capacity for modeling and forecasting health effects that may be climate-related.



CDC's Priority Actions for Climate Change

- #4 Enhance the science base to better understand the relationship between climate change and health outcomes.
- #5 Identify locations and population groups at greatest risk for specific health threats, such as heat waves.
- #6 Communicate the health-related aspects of climate change, including risks and ways to reduce them, to the public, decision makers, and healthcare providers.



CDC's Priority Actions for Climate Change

- #7 Develop partnerships with other government agencies, the private sector, nongovernmental organizations, universities, and international organizations
- #8 Provide technical advice and support to partners in developing and implementing response plans for health threats such as heat waves, severe weather events, and infectious diseases.



CDC's Priority Actions for Climate Change

- #9 Promote workforce development by ensuring the training of a new generation of competent, experienced public health staff to respond to the health threats posed by climate change.



Conclusions

- The future ain't what it used to be
- Place is a key exposure variable for the health effects of climate change
- Place is also fundamental to the response
- The opportunity costs of inaction are high
- CDC is uniquely poised to make contributions



Overview of the Health Implications of Climate Change in the Arctic

Workshop on Climate Change & Impacts on Human Health in the Arctic

**Joel D. Scheraga, Ph.D.
National Program Director
Global Change Research Program
Office of Research and Development**

February 13, 2008

Arctic Human Health-Successes



- Life expectancy in many Arctic regions has greatly increased
 - Improved social conditions
 - Access to medical care
 - Control of tuberculosis
- Increasing birth rate
- Decreasing Infant mortality
- Increasing population
 - <15 years; > 55years



A changing world

- Rising temperatures
- More severe weather events
- Loss of polar ice cover
- Ecosystem changes
- Glacier loss
- Sea level rise
- Floods

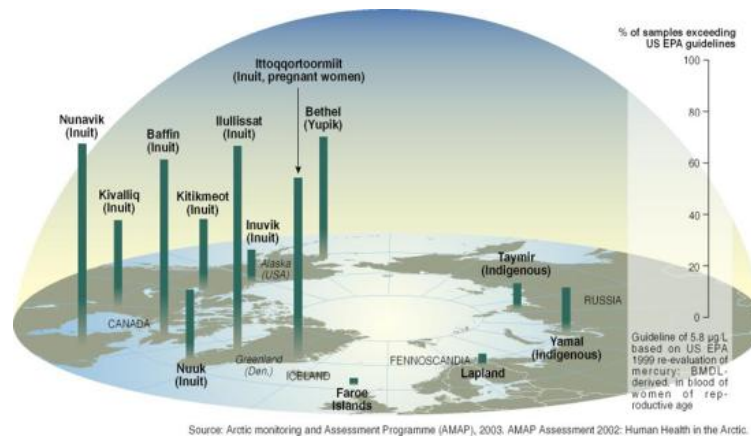
Arctic Human Health-Challenges

- Cultural & Economic Change
- Globalization



Arctic Human Health-Challenges

- Environmental Contaminants



Arctic Human Health-Challenges

- Climate Change



The polar bear might not be the only threatened species

“How it threatens your health”



HEALTH EFFECTS OF CLIMATE CHANGE

CLIMATE CHANGE

*Temperature Rise*¹
*Sea level Rise*²
Hydrologic Extremes

Patz, 1998

Urban Heat Island Effect

Heat Stress
 Cardiorespiratory failure

Air Pollution & Aeroallergens

Respiratory diseases, e.g.,
 COPD & Asthma

Vector-borne Diseases

Malaria
 Dengue
 Encephalitis
 Hantavirus
 Rift Valley Fever

Water-borne Diseases

Cholera
 Cyclospora
 Cryptosporidiosis
 Campylobacter
 Leptospirosis

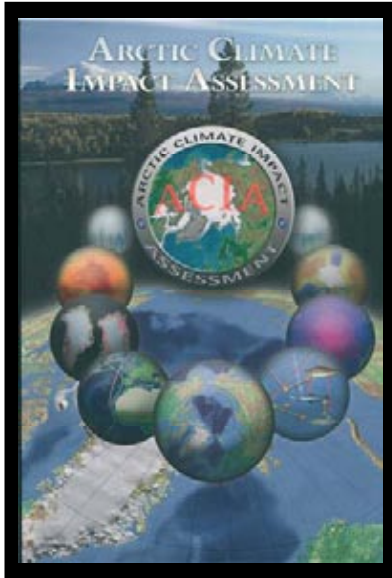
Water resources & food supply

Malnutrition
 Diarrhea
 Toxic Red Tides

Mental Health & Environmental Refugees

Forced Migration
 Overcrowding
 Infectious diseases
 Human Conflicts

Arctic Climate Impact Assessment 2005 (Chapter 15: Human Health)



- Team of 300 international scientists led by Dr. Robert Corell
- Full examination of present state of knowledge of how Arctic systems function and how they may respond to climate change and warming
- “Must read” for those interested in consequences of climate change
- Provides a jumping off point to drill down into special topics, i.e. how warming may impact marine mammals or seabirds, fish and humans
- Will provide a baseline for future generations studying climate change

Who's Vulnerable?

- Health impacts will vary by location and demographic groups
 - Elderly
 - Very young children
 - Very ill
- Most vulnerable:
 - Those living in close association with the land
 - Remote communities
 - Those already facing variety of health challenge

The direct health effects of heat



Direct Impacts

- Changes in incidence of extreme events
 - Avalanches
 - Storms
 - Floods
 - Rockslides
- Reduction in cold-induced injuries
 - Frostbite
 - Hypothermia
 - Reduction in cold stress
- Increased heat stress
- Accidents associated with unpredictable ice and weather conditions

Indirect Effects

- Impacts on air quality
- Impacts on water supplies
 - Changes in timing and amount of water
 - Changes in access to good quality drinking water sources
- Impacts on sanitation infrastructure
- Impacts associated with changes in ecosystems
 - Potential changes in bacterial and viral proliferation
 - Vector-borne and water-borne disease outbreaks
- Impacts on nutrition (“food security”)
 - Changes in animal distribution
 - Changes in accessibility to food supplies
 - Changes from “traditional” diets to “western” diets
 - Diabetes
 - Cancer risk
 - Cardiovascular disease
- Increased mental and social stress (due to changes in the environment and lifestyle)



“This past summer, I got deeply depressed about our planet—as if I didn’t have enough problems of my own.”

Larger Context

- Cultural and socio-economic change and evolution
- Another stress on societies and cultures
 - as they affect relationship between people and their environment
 - a defining element of many northern cultures
- **“Win-Win” Opportunities:** Improvements in public health infrastructure to address health risks under current climate also increase resilience to climate change

Floodwaters combine w/sewage lagoon & landfill surrounding homes, school, & community buildings



Health Opportunity



... Why global climate change could be the **greatest public health opportunity** we've had in over a century!



We can plan ahead.... or we can react

Wildlife can only react



But humans can anticipate



Newtok Interagency Coordination



Newtok Traditional Council, U.S. Army Corps of Engineers, Village Safe Water Program, AK Department of Transportation, AK Division of Commerce Community & Economic Development, Denali Commission, Department of Military and Veterans Affairs, Division of Homeland Security & Emergency Management, Housing & Urban Development

It Pays to Plan Ahead: Reactive Adaptation During a 1957 Kentucky Flood



(KY Power office in Lothair, 1957)

**The pig knew how to get to higher ground...
Getting back down was a problem.**

Sometimes it pays
to plan ahead...



New Orleans, 2005

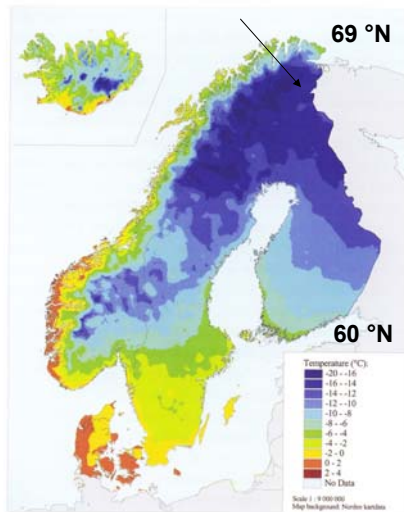


(Scheraga, 2005)

Sometimes it pays
to plan ahead...



Winter in Finland, climatic analog of Alaska



- Climate temperature -54 - +33°C
- Number of yearly days when mean daily temperature below 0 °C 90-220 and over +26°C 3-20
- Winter ($\leq 0^{\circ}\text{C}$) lasts for 3-7 months depending on the geographical region
- Population 5,3 million, 85% is living in cities and towns

Kuusi 1. Tammi-kuun keskilämpötilat Pohjois Suomessa vuonna 1961 - Juhani Hassi Anchorage 13. February 2008
(Tveito ym. 2000)

Tveito et al. 2000

1

Northern Climate Change Human Thermal Health Impacts -

Juhani Hassi MD, Ph.D.
Institute of Health Sciences, University of Oulu
International Journal of Circumpolar Health

Photo: Ilpo Okkonen

Juhani Hassi Anchorage 13. February 2008

2

Content of Presentation



- Dominant Details of Climate Change on Human Thermal Health
- Human Health Impacts of Thermal Factors in Climate
- Effects of Climate Change on Thermal Health Impacts
- Human Health Impacts of Thermal Factors

Dominant Details of Climate Change on Human Thermal Health



- Average warming of climate
- Increase of thermal extremes
- Increase of high winds and storms (strengthen cold impacts)
- Increase of autumn raining (strengthen cold impacts)

- Living in city centres increases heat impacts

Human Health Impacts of Thermal Factors in Climate



- Health impacts of thermal climate are dependent on temperature, wind and moisture
- Human physical activity and clothing modify them
- Impacts are death, hypo and hyperthermia, frostbite and burns, symptoms and attacks of diseases, increased frequency of main injuries, decrease of performance, sensations of cold and heat and discomfort

Juhani Hassi Anchorage 13. February 2008

5

Human modifiers on his thermal health impacts



- Human thermal responses are dependent on his local or main body thermal strain
- Thermal deaths, symptoms of diseases and performance decrease are dependent on whole body thermal strain,
- Human adaptation reduces his thermal strain effectively
- Human adaptation is very high and targeted to thermal environment of his living region

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Thermal strain in human



- By average clothed man
- Cold strain is present in environmental temperatures lower than +10°C (+50°F)
- Heat strain present in temperatures higher than +26°C (+72°F)
- Thermal strain affects especially cardiovascular and respiratory organs
- The level of thermal strain is modified by adaptation and so in the certain temperature different in different living regions

Effects of Climate Change on Thermal Health Impacts



- Thermal health impacts have in the future same quality as today, but their intensity and frequencies may be changed
- Average warming of the climate modifies human behaviour in the North
- Thermal health impacts in the future North are most predictable like health impacts seen today at more southern latitudes
- Future increasing extreme temperatures in climate increase adverse health effects
- Urban lifestyle reduces human behavioural adaptation : Increases incorrect clothing and activities

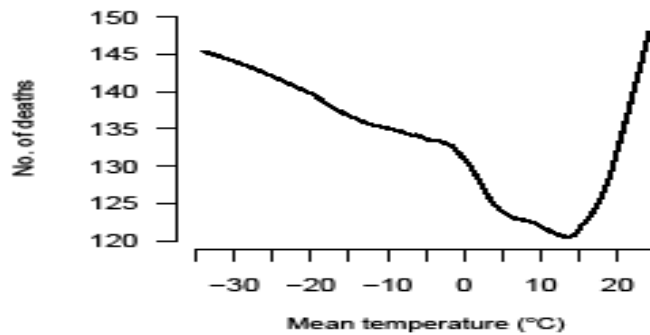
Cold and heat mortality



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Photo: Ilpo Okkonen

Mortality and daily temperature IN FINLAND



Lowest mortality at +14 °C

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Näyhä 2005₁₀

Shortcut 1 Thermal Health Impacts 1



- Exposure to cold in Finland is on average short, but recurrent and most of the exposure occurs during the leisure time
- Cold injuries are common in general population and occur more frequently in the North but in higher temperatures among southern urban people
- Negative health impacts are related on missclothing and missbehaviour

Shortcut 2 Thermal Health Impacts 2



- Cold related mortality 7% from total mortality and is 6 times higher than heat mortality
- In the main population 30% of persons have cold related symptoms
- Symptoms and complaints in the cold are present by sick and elderly people in more than 50% Similar information on hot environment would be available in 2009
- Most important symptoms of diseases in the cold are related on respiratory and hearth diseases
- Cold temperature increases the risk for upper respiratory infections

Shortcut 3

future climate change impacts




- Heat strain more frequent than today
- Cold strain perhaps less frequent than today
- Cold strain still more frequent than heat strain
- Frequencies of cold and heat mortality increase
- Temperature of minimum mortality is higher than today
- Hypothermic deaths increase (urbanisation)
- Frostbite frequency decreases
- Cold symptoms less frequent in the same age group
- Cold caused performance decrease is more common
- **Thermal negative health impacts are preventable**

What should be done



- Develop public outreach system for extreme temperatures
- Worthwhile, because climate adverse health effects are common and preventable
- Target populations are
 - Elderly population
 - People suffering from some chronic disease : cardiovascular, asthma COPD, diabetes
 - People frequently involved in recreational activities or outdoor work
- CHWS under development in European Union
- HHWS for average population in use in many countries



Thank you !

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The Finnish Defence Forces

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