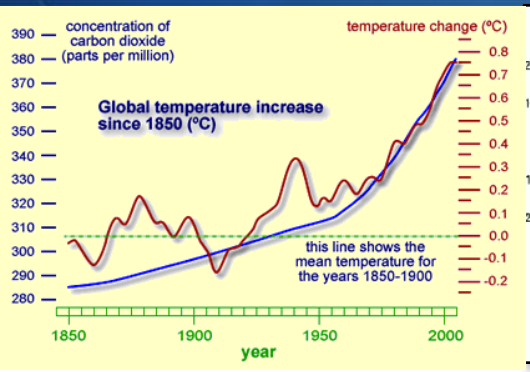
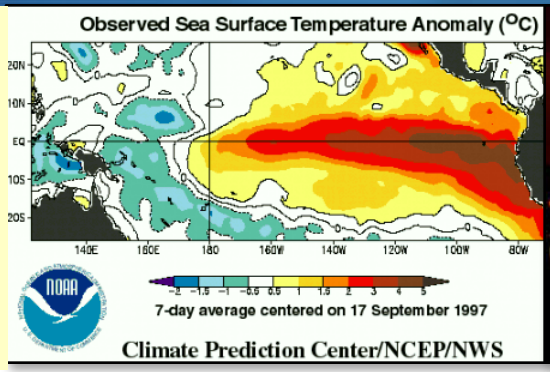
The Health Connection: Perspectives on Climate Change Past and Present

AGCI Workshop on Climate & Health

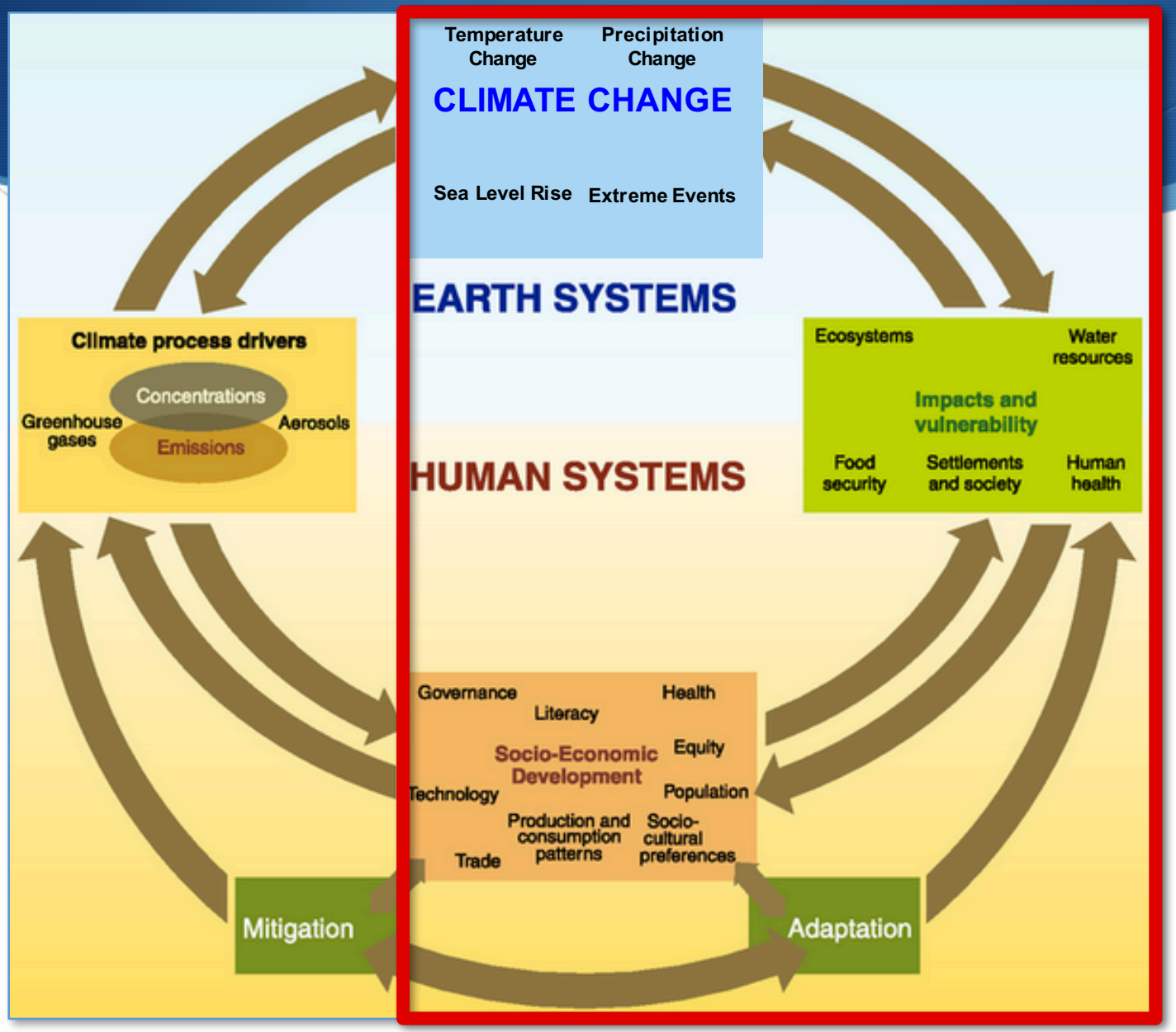
Henry F. Diaz

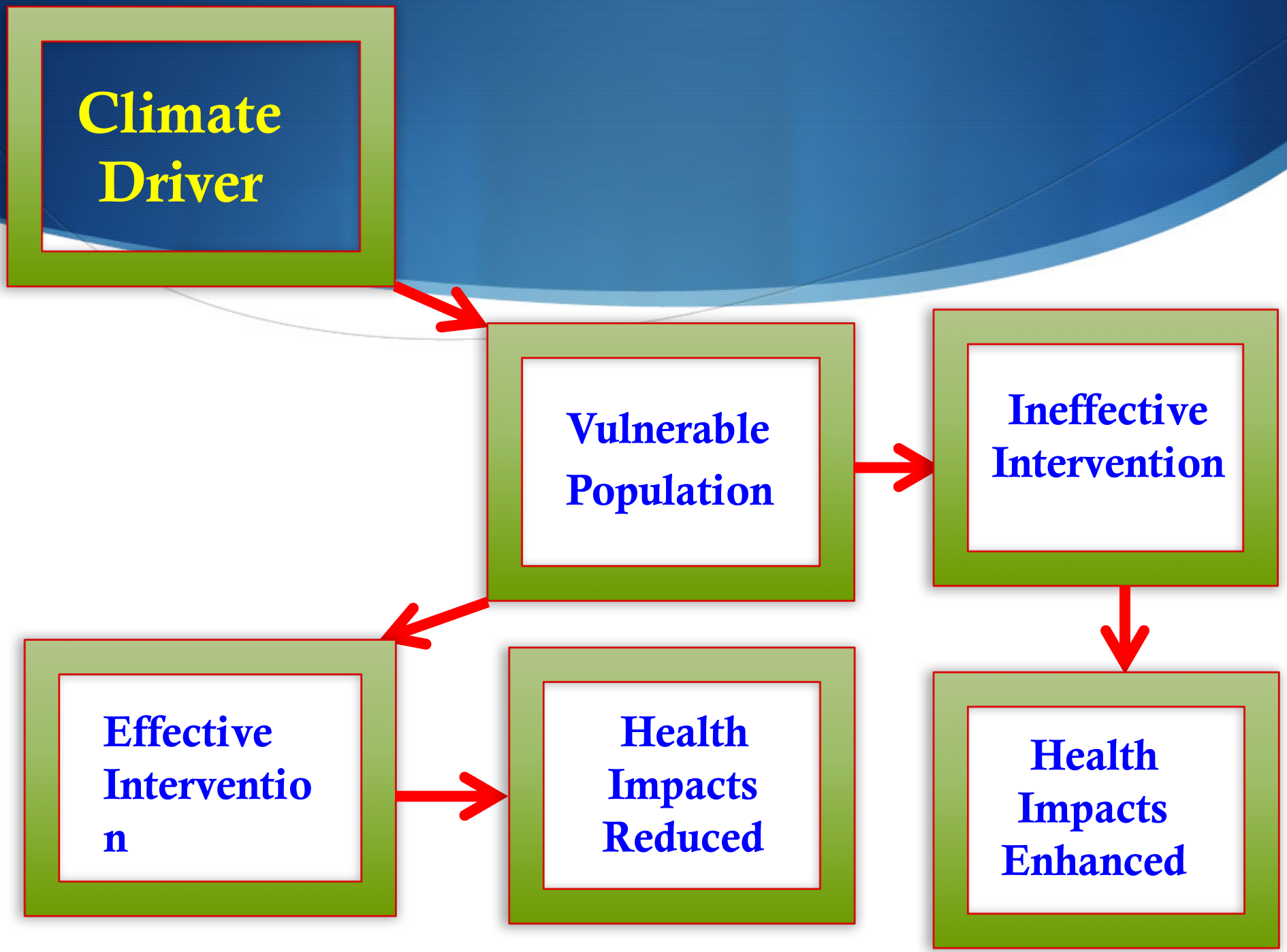
September 2016





Climate Change Impacts on Human Health: A Combination of Multiple Factors




Climate Driver
Vulnerable Population
Ineffective Intervention
Effective Interventio n
Health Impacts Reduced
Health Impacts Enhanced

Failure to plan for natural disasters often lead to dire consequences—e.g., the 2015-2016 drought in India

Over 330 million Indians — about one quarter of the country's population — have been affected by the drought. In this western state, where over half the population is dependent on the rural economy, the effects are severe. An average of nearly nine farmers committed suicide every day last year, primarily over debt related to crop failure.

In May, the Supreme Court scolded several state governments for their "ostrich-like" behavior, and demanded the creation of a national disaster mitigation fund within three months. But nothing has happened yet, a principal adviser to the court told The Indian Express this week.

Climate Change Impacts on Human Health: Evolution in Two Decades

1990s
Climatic modulation of VBDs largely mosquito-borne illnesses

Eos, Vol. 78, No. 45, November 11, 1997

Workshop Focuses on Study of Climate's Effects on Health

Acknowledgments: The workshop was supported by the International Research Institute for Climate Prediction, the Office of Global Programs of the National Oceanic and Atmospheric Adminstration, the Inter-American Institute for Global Change Research, the Pan American Health Organization, and the Meteorological Service of Belize.—*Henry F. Diaz, Climate Diagnostics Center, Boulder, Colo.; Paul R. Epstein, Center for Health and the Global Environment, Harvard Medical School, Boston, Mass.; Joan L. Aron, Science Communication Studies, Columbia, Md.; and Ulisses E. C. Confalonieri, Rio de Janeiro, Brazil*

The workshop on Climatic Changes and Human Health Linkages in the Tropical Americas was held in Belize City, Belize, May 4–6, 1997.

Climate Change Impacts on Human Health: Evolution in Two Decades

Climate and ENSO variability associated with vector-borne diseases in Colombia

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The Netherlands

Climate and human health linkages on multiple timescales

HF Diaz, RS Kovats, AJ McMichael, N Nicholls

History and Climate, 267-289

Climate Change and Human Health

Paul R. Epstein, M.D., M.P.H.

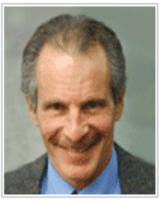
N Engl J Med 2005; 353:1433-1436 | October 6, 2005 | DOI: 10.1056/NEJMp058079

Article | References | Citing Articles (80)

In 1998, Hurricane Mitch dropped six feet of rain on Central America in three days. In its wake, the incidence of malaria, dengue fever, cholera, and leptospirosis soared. In 2000, rain and three cyclones inundated Mozambique for six weeks, and the incidence of malaria rose fivefold. In 2003, a summer heat wave in Europe killed tens of thousands of people, wilted crops, set forests ablaze, and melted 10 percent of the Alpine glacial mass.

This summer's blistering heat wave was unprecedented with regard to intensity, duration, and geographic extent. More than 200 U.S. cities registered new record high temperatures. In Phoenix, Arizona, sustained temperatures above 100°F (38°C) for 39 consecutive days, including a week above 110°F (43°C), took a harsh toll on the homeless. Then came Hurricane Katrina, gathering steam from the heated Gulf of Mexico and causing devastation in coastal communities.

Audio Interview



Interview with Dr. Paul Epstein on the effects of climate change on human health. (6:46)

Listen
Download

Biological and Physical Signs of Climate Change: Focus on Mosquito-borne Diseases

Paul R. Epstein,* Henry F. Diaz,+ Scott Elias,# Georg Grabherr,@ Nicholas E. Graham,& Willem J. M. Martens,** Ellen Mosley-Thompson,++ and Joel Susskind##

Climate Change Impacts on Human Health: Evolution in Two Decades

1990s
Climatic modulation of VBDs largely mosquito-borne illnesses

→

Early 2000s
Emphasis on heat waves and VBDs (West Nile and Equine Encephalitis)

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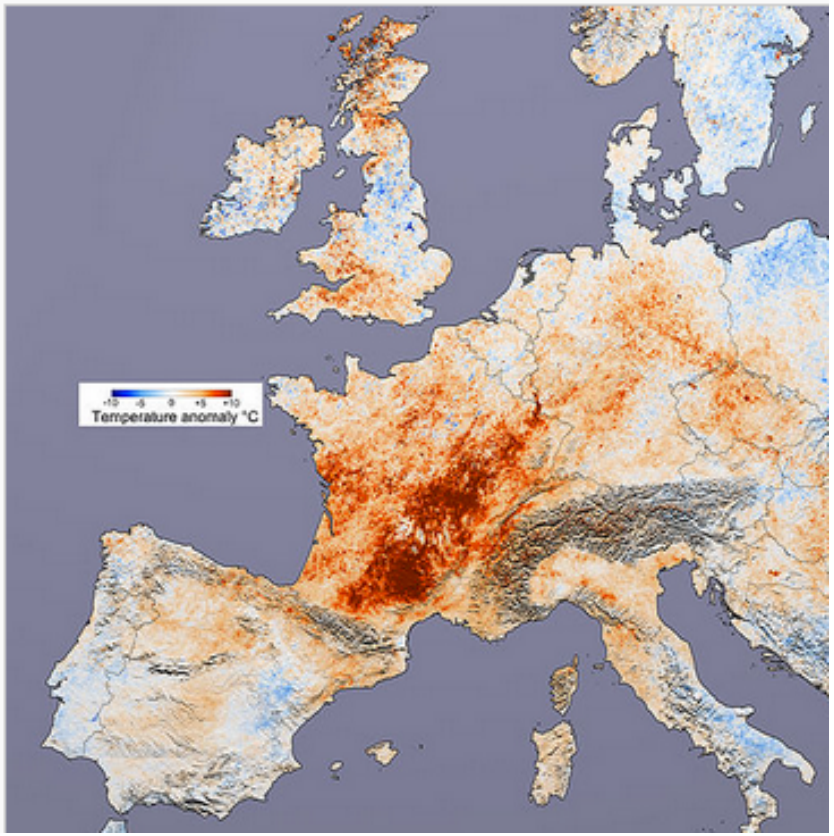
Climate Change Impacts on Human Health: Evolution in Two Decades

The heatwave of 2003

More than 20,000 people died after a record-breaking heatwave left Europe sweltering in August 2003. The period of extreme heat is thought to be the warmest for up to 500 years, and many European countries experienced their highest temperatures on record.



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Mid- to Late 2000s
Increasing emphasis regarding connections between climate stressors and human behavior

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Climate Change Impacts on Human Health: Evolution in Two Decades

Nature **438**, 310-317 (17 November 2005) | doi:10.1038/nature04188

Impact of regional climate change on human health

Jonathan A. Patz[1,2], Diarmid Campbell-Lendrum[3], Tracey Holloway[1] & Jonathan A. Foley[1]

The World Health Organisation estimates that the warming and precipitation trends due to anthropogenic climate change of the past 30 years already claim over 150,000 lives annually. Many prevalent human diseases are linked to climate fluctuations, from cardiovascular mortality and respiratory illnesses due to heatwaves, to altered transmission of infectious diseases and malnutrition from crop failures.

▲ Top

THE LANCET

Volume 367, Issue 9513, 11–17 March 2006, Pages 859–869

Review

Climate change and human health: present and future risks

Prof Anthony J McMichael, PhD[a], Rosalie E Woodruff, PhD[a], Simon Hales, PhD[b]

[a] National Centre for Epidemiology and Population Health, The Australian National University, Canberra 0200, Australia

[b] University of Otago, Wellington School of Medicine and Health Sciences, Wellington, New Zealand

Environmental Health Perspectives > Vol. 114, No. 12, Dec., 2006 > An Approach for Asse...

An Approach for Assessing Human Health Vulnerability and Public Health Interventions to Adapt to Climate Change

Kristie L. Ebi, R. Sari Kovats and Bettina Menne

Environmental Health Perspectives
Vol. 114, No. 12 (Dec., 2006), pp. 1930-1934

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Page Count: 5

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Mid- to Late 2000s
Increasing emphasis regarding connections between climate stressors and human behavior

2010s
Climate change, environmental & human factors leading to chronic illnesses

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Climate Change Impacts on Human Health: Evolution in Two Decades

The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

GLOBAL HEALTH

Globalization, Climate Change, and Human Health

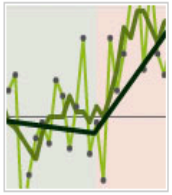
Anthony J. McMichael, M.B., B.S., Ph.D.

N Engl J Med 2013; 368:1335-1343 | April 4, 2013 | DOI: 10.1056/NEJMra1109341

Comments open through April 10, 2013

The global scale, interconnectedness, and economic intensity of contemporary human activity are historically unprecedented,[1] as are many of the consequent environmental and social changes. These global changes fundamentally influence patterns of human health, international health care, and public health activities.[2] They constitute a syndrome, not a set of separate changes, that reflects the interrelated pressures, stresses, and tensions arising from an overly large world population, the pervasive and increasingly systemic environmental impact of many economic activities, urbanization, the spread of consumerism, and the widening gap between rich and poor both within and between countries.

Interactive Graphic



Global Temperature Trend, 1880–2010

Environmentally induced, occupational diseases with emphasis on chronic kidney disease of multifactorial origin affecting tropical countries

Shehani A. Wimalawansa and Sunil J. Wimalawansa

Annals of Occupational and Environmental Medicine
The official journal of the Korean Society of Occupational and Environmental Medicine 2016 28:33
DOI: 10.1186/s40557-016-0119-y

Received: 7 March 2016 | Accepted: 26 July 2016 | Published: 5 August 2016

Abstract

Background

Environmentally induced, occupational diseases are increasing worldwide, especially in rural agricultural communities. Poverty-associated malnutrition, environmental hazards and pollution, and lack of access to clean water, safe sanitation, and modern healthcare facilities are often associated with these chronic illnesses.

Some key points regarding global warming (climate change)

- Driven by unprecedented rapid increase in greenhouse gases in an evolutionary context

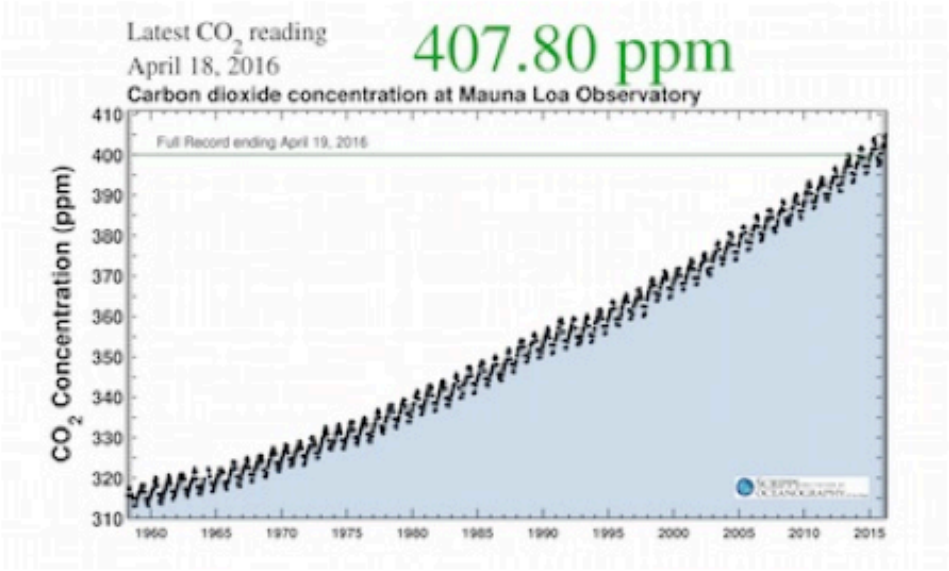
- The world is now warmer than at any time in at least 2000 years

- By analogy to body temperature, small changes in planetary temperature---observed warming by almost 2^{o}C is a big deal!

- Cause and effect has been established: The increase in GHG has led to the overall observed planetary warming

- A continuation of the current rate of growth of GHG's in the atmosphere will result in extreme and unprecedented environmental conditions

Atmospheric CO_2 concentrations higher now than for at least the past 800K years



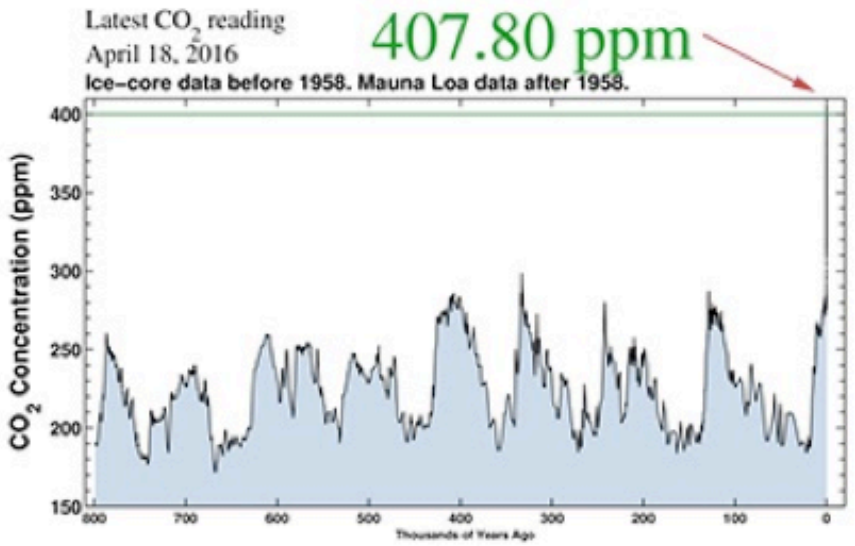


Figure 2. Two longer-term perspectives on CO2: the increase since 1958 measured at Mauna Loa (left), and the ups and downs produced by ice-age cycles over the last 800,000 years, as retrieved from polar ice cores. The increase of more than 120 parts per million since the mid-1800s (vertical line at far right of right-hand image) is larger than the typical difference between the frigid depths of ice ages (the dips in the right-hand image) and the relatively mild interglacial periods. Predictable variations in Earth's orbit help trigger the onset and decline of ice ages. Image credit: Scripps Institution of Oceanography.

Global surface temperature >1.5°C warmer than at the turn of the 20th C

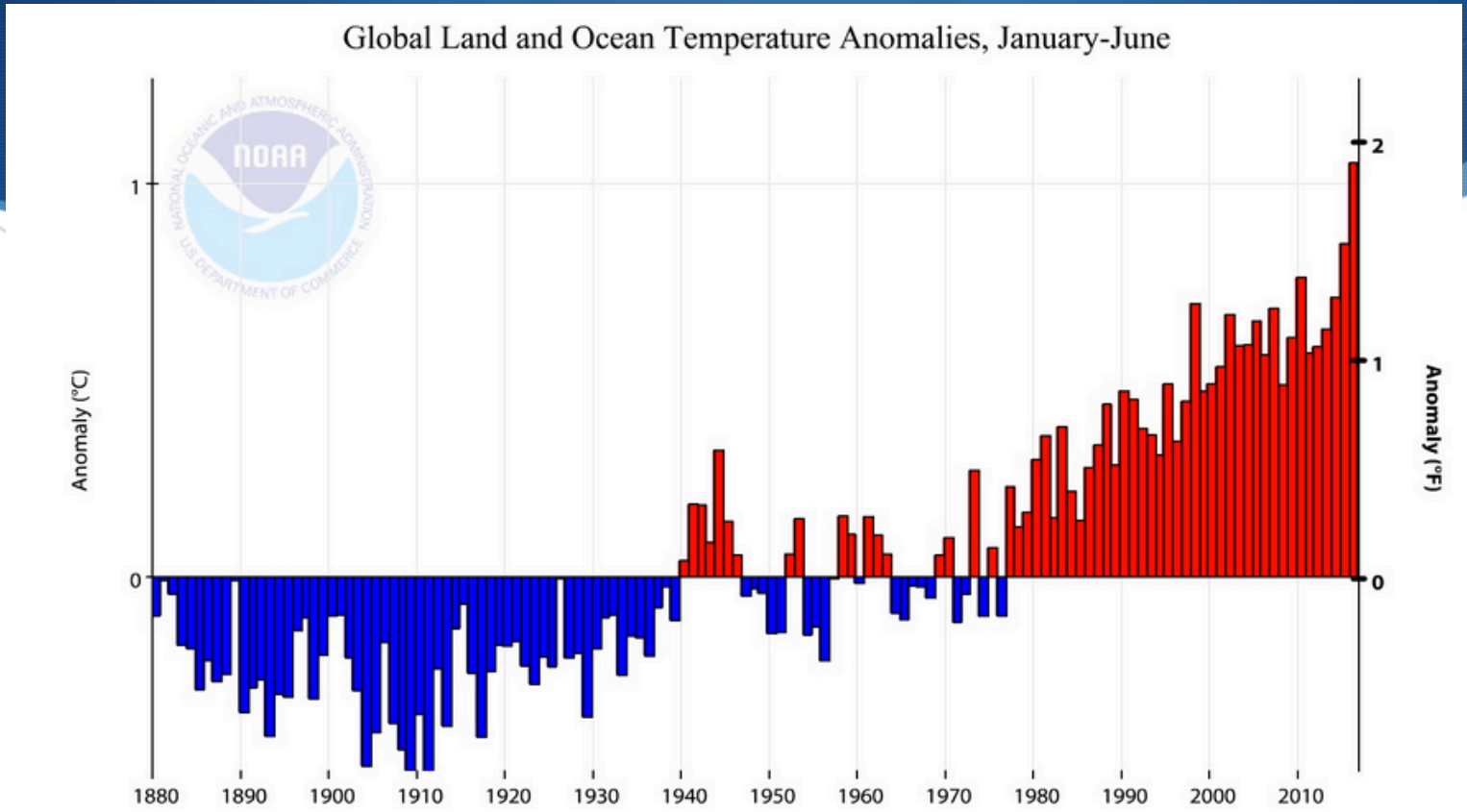


Figure 1. Departure from average for the global January-through-June temperature for the years 1880 - 2016. This year has seen by far the warmest temperatures on record for the year-to-date period. Image credit: NOAA/National Centers for Environmental Information (NCEI).

The rate of increase in global temperatures slowed down at the start of the millennium, but are again trending at a faster pace.

The warmest years on record (all have occurred since 1998)
The year 2015 was the warmest and 2016 on a pace to exceed it

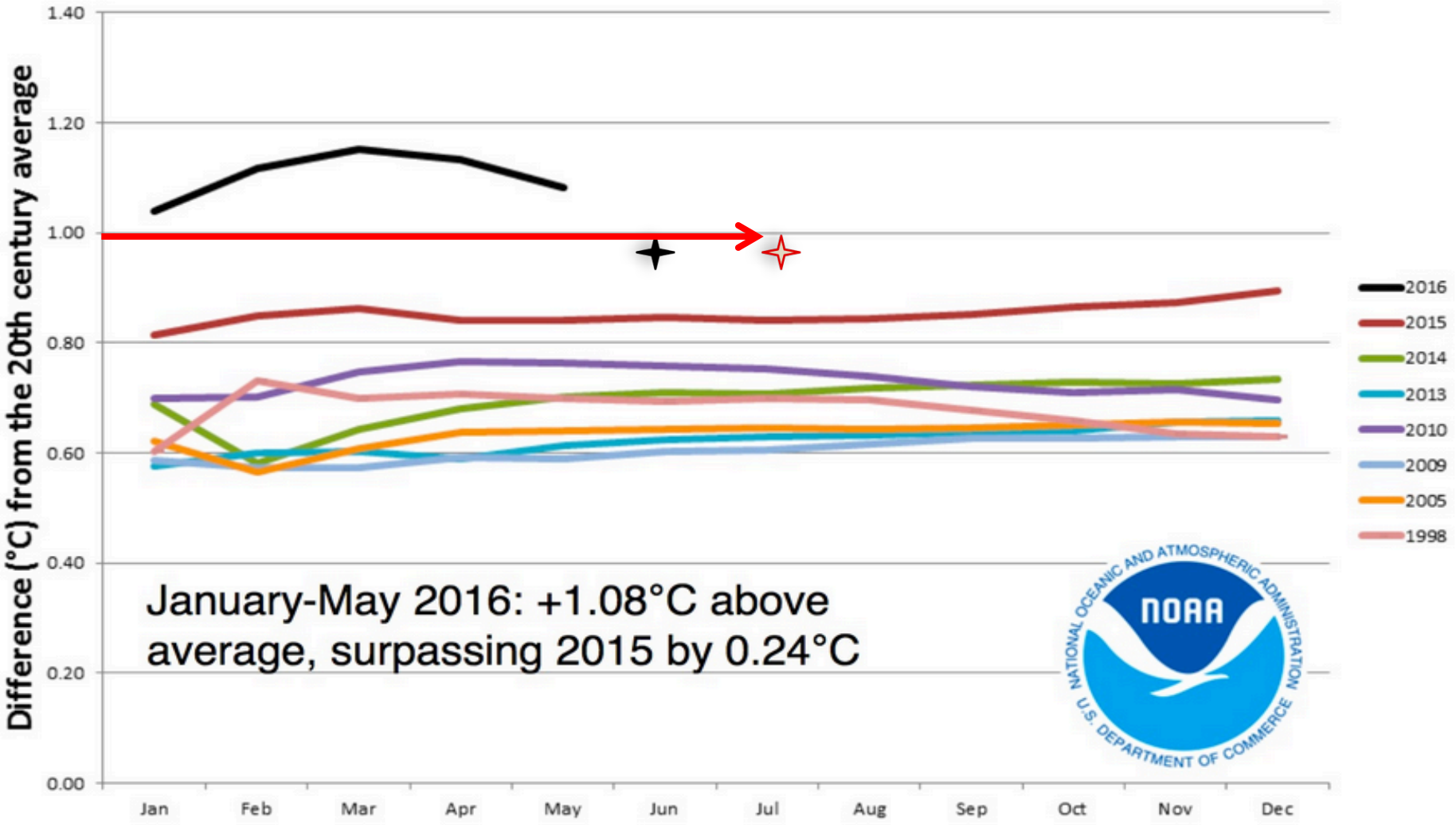


Figure 1. Cumulative departures from normal in global temperature [year to date] for each month in 2016. For the year thus far [January-May], 2016 is head and shoulders above all other years in the NOAA database going back to 1895. The six closest competitors are shown above. Image credit: NOAA/NCEI.

March 2016 had the biggest monthly temperature departure from average on record (~2°C warmer than pre-industrial mean)

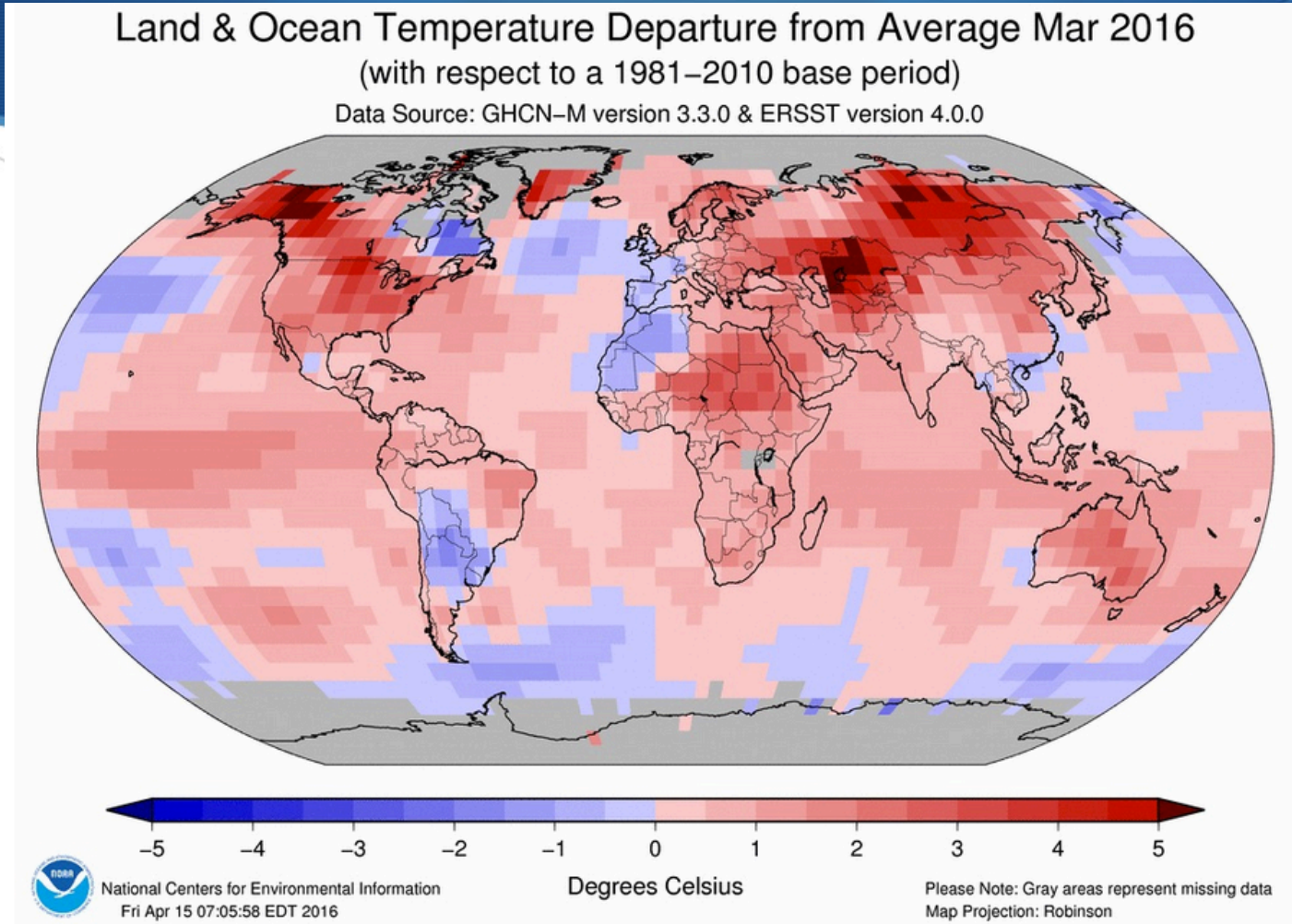


Figure 1. Departure of temperature from average for March 2016, the warmest March for the globe since record keeping began in 1880. Record warmth was observed over most land areas on Earth, with especially warm readings over much of Siberia, central Asia, northern Africa, the eastern U.S., western Canada, and Alaska. Image credit: National Centers for Environmental Information [NCEI].

Percent of global area observed to be warmer than the long-term mean

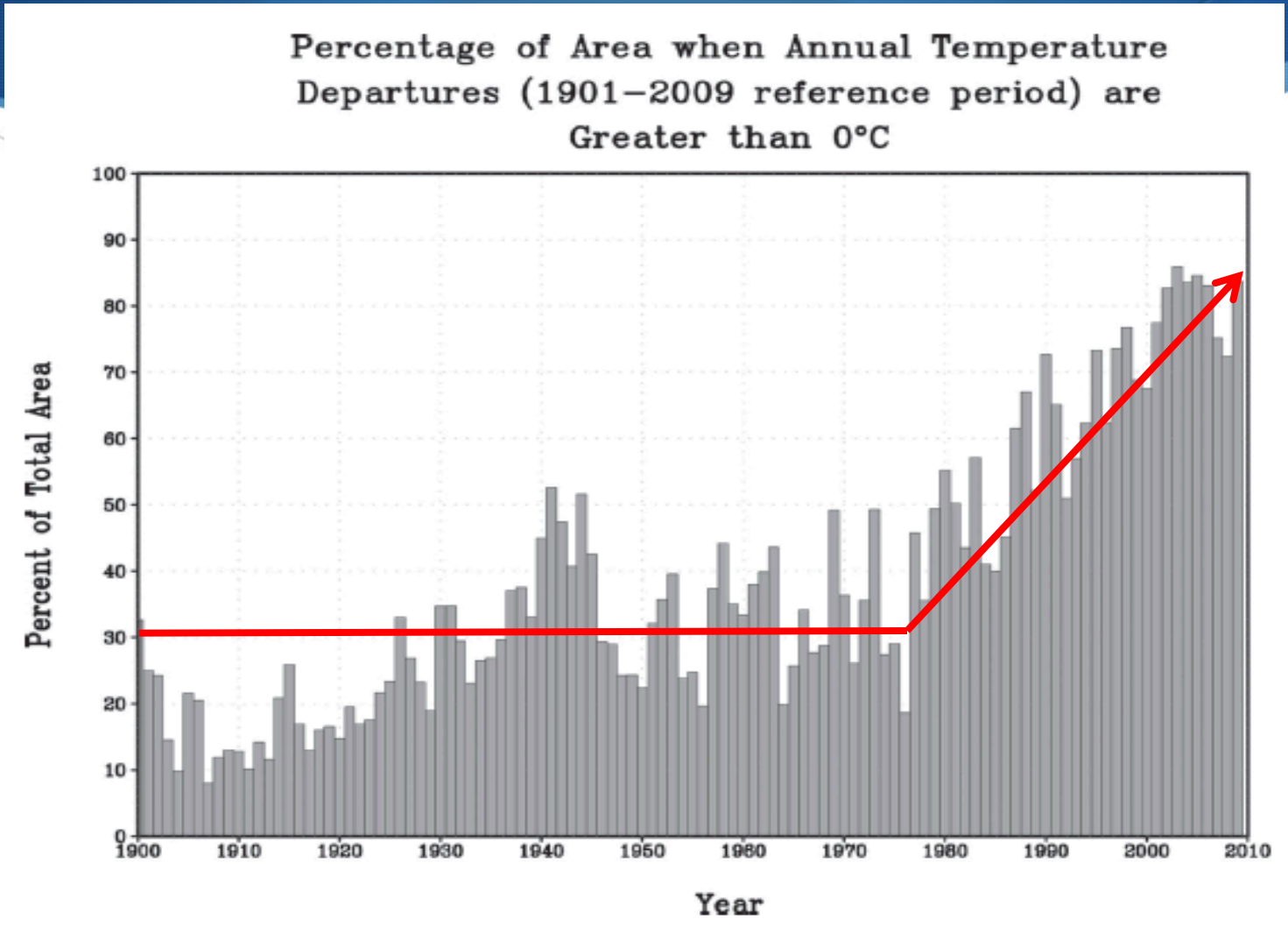
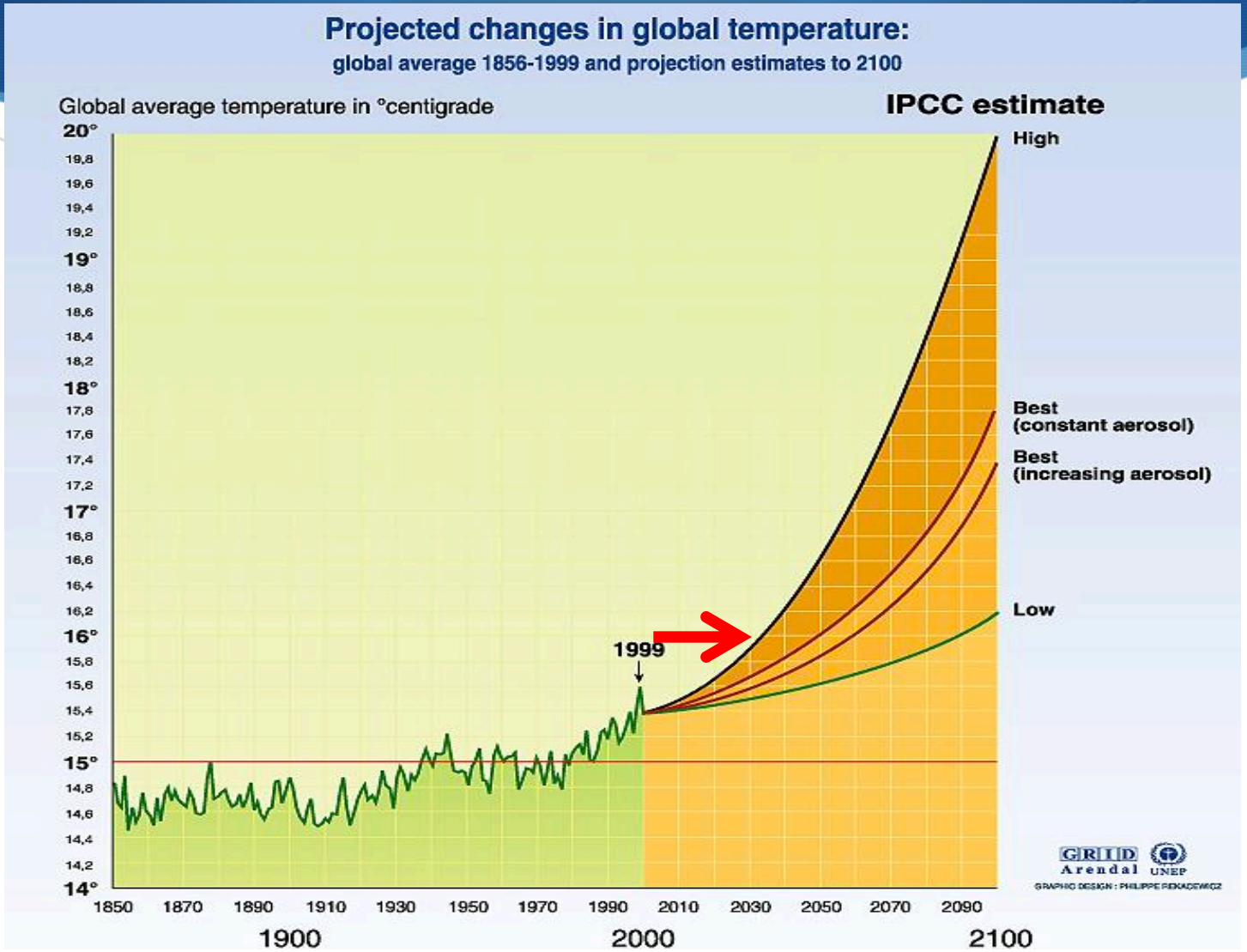


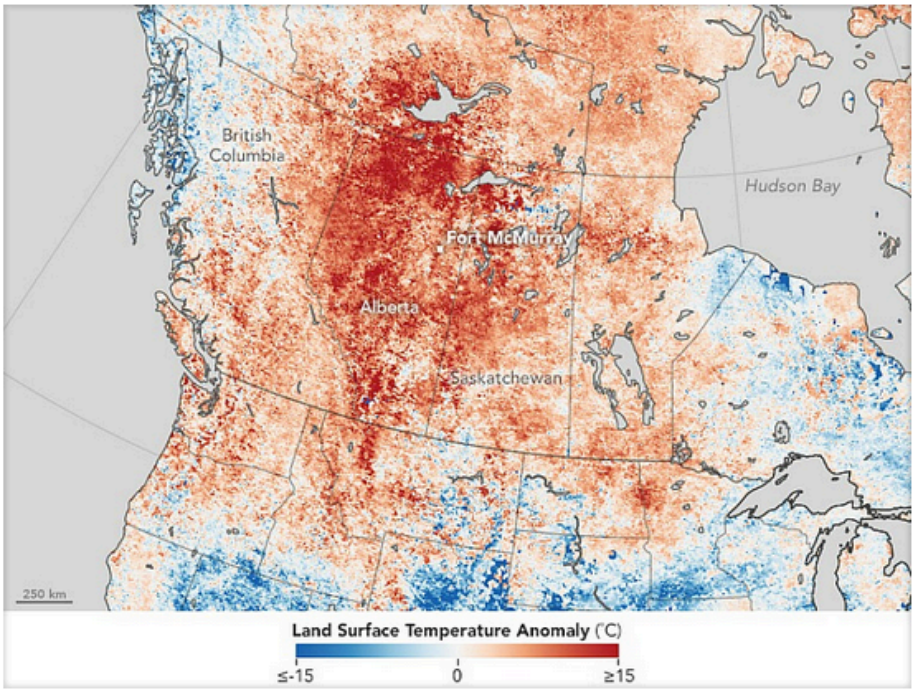
FIG. 2. Time series of the percentage area with positive mean annual surface temperature departures. Based on mapped data shown in Fig. 1.

Visualization of Climate Change since 1850
Simultaneous Growth of Atmospheric CO2 and Global Warming

Global surface temperature projection from IPCC



Sustained Record High Early Season Heat



Map showing land surface temperature from April 26–May 3, 2016, compared with the 2000–2010 average for the same one-week period. Red areas were hotter than average and blue areas were below average. (Image: NASA Earth Observatory)

Canada Wildfire Explodes To Double In Size

Unprecedented Wildfire Behavior

Extreme fire behaviour in high-latitude forests

Year-round California wildfire season

Figure 4. Smoke from wildfires burning in Angeles National Forest fills the sky behind the Los Angeles skyline on Monday, June 20, 2016. The wildfires several miles apart devoured hundreds of acres of brush on steep slopes above foothill suburbs erupted in Southern California as an intensifying heat wave stretching from the West Coast to New Mexico blistered the region with triple-digit temperatures. Image credit: AP Photo/Ringo H.W. Chiu

2015 & 2016 saw world record high temperatures (in excess of 50°C)

Figure 1. Residents of New Delhi endure another day of sizzling heat on Monday, May 2, 2016. Monday hit a record 46°C (114.8°F) at Indira Gandhi International Airport and 44°C (111.2°F) at the city's Safdarjung

Pre-Monsoon Record High Early Season Heat

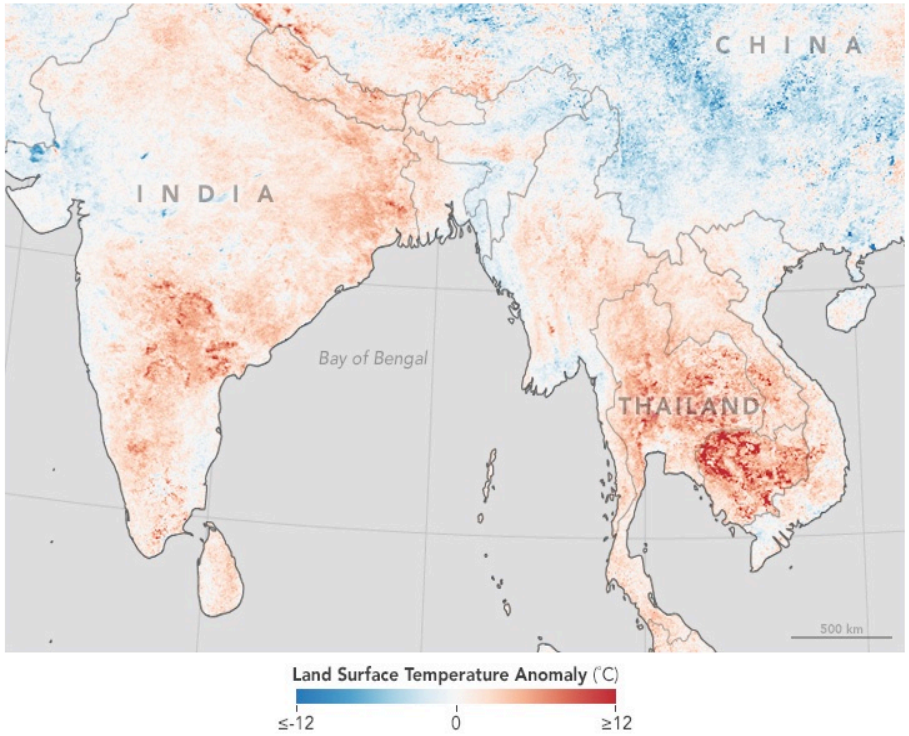


Figure 2. Departures from average in land-surface temperature across South and Southeast Asia for April 2016,

Large Populations at Risk

Increasing severity of heat waves with dangerous heat index levels (several days of 115°F--122°F in Southwest)

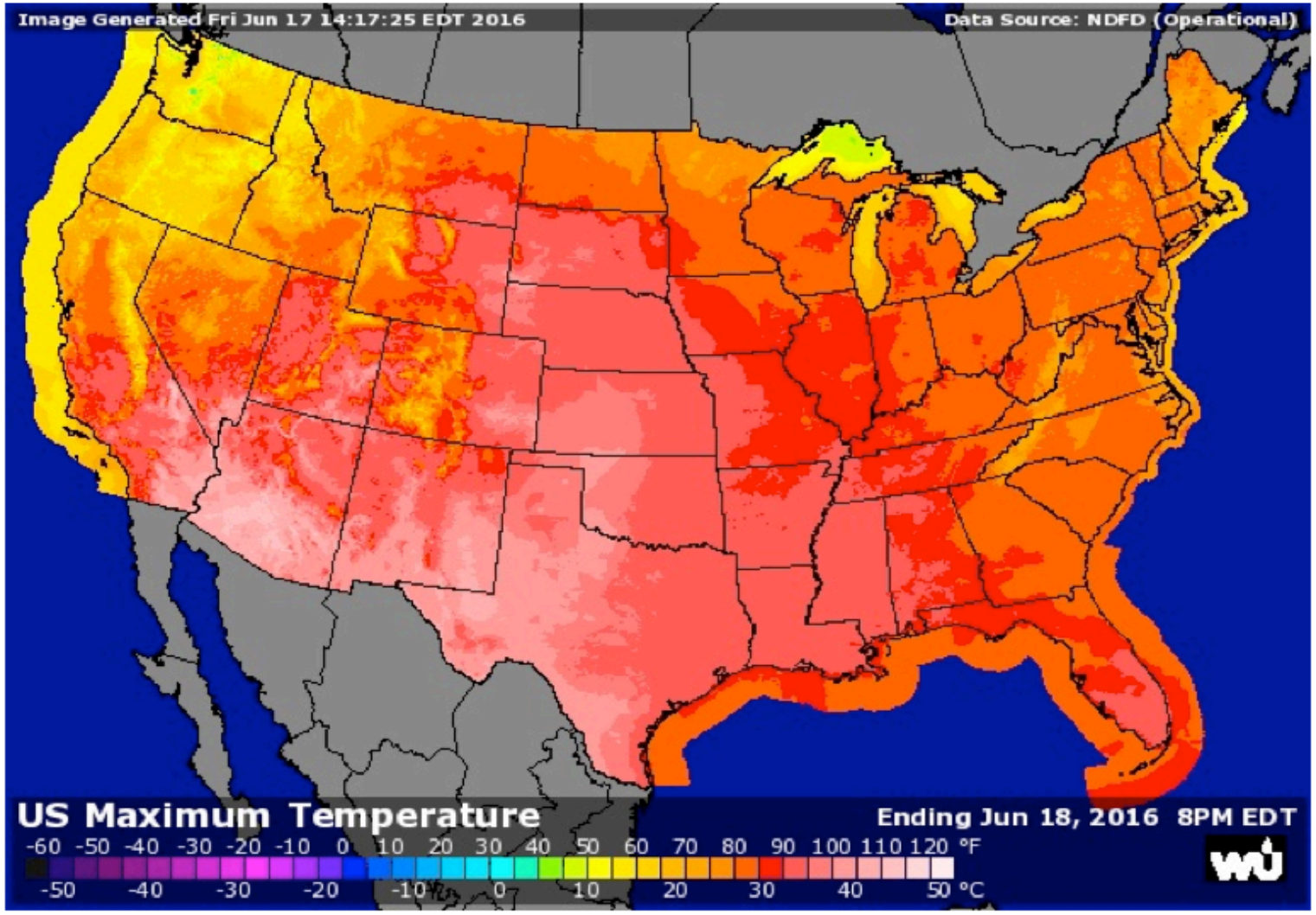
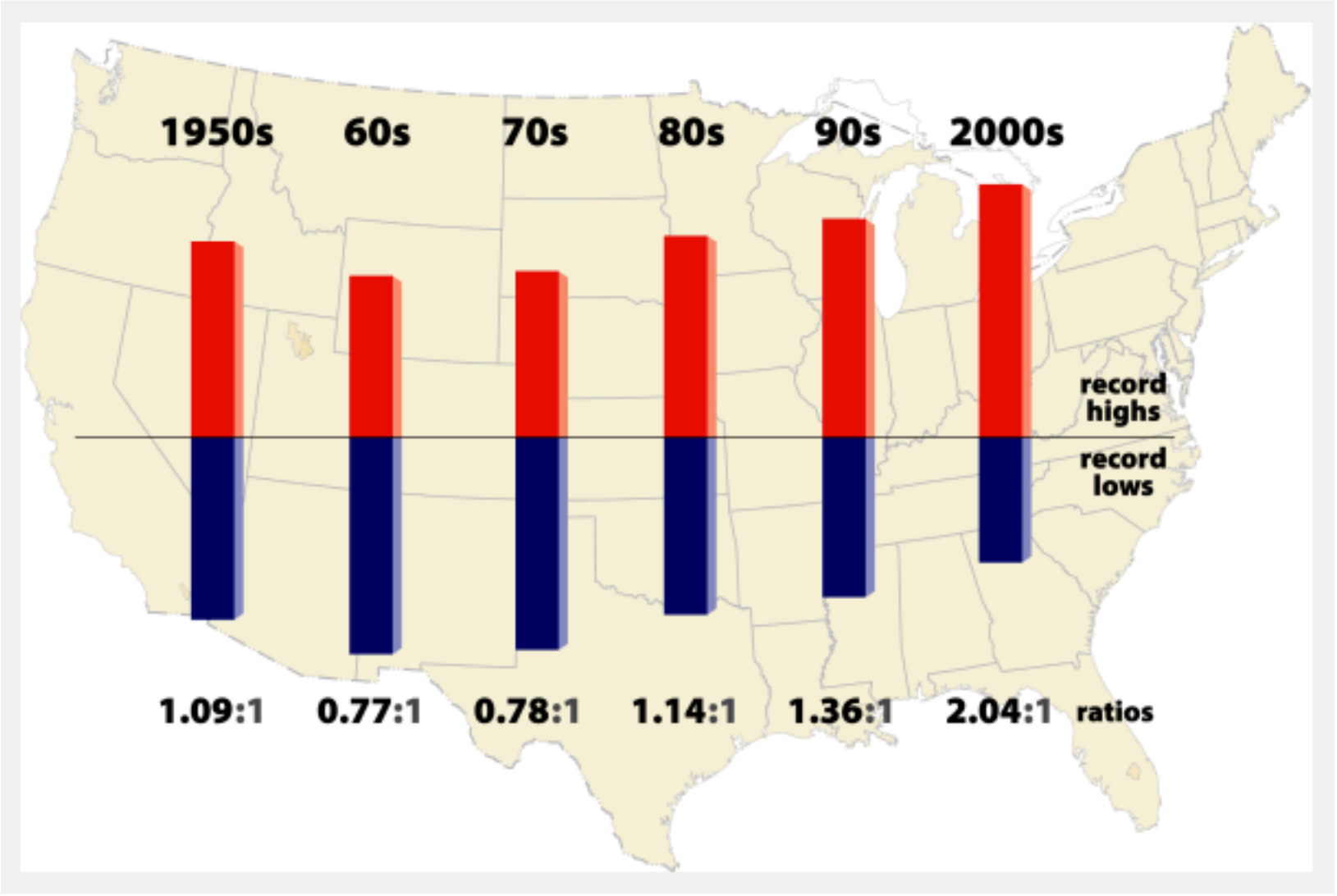


Figure 1. WU depiction of maximum temperature predicted at midday Friday for Saturday, June 18, 2016, by t
National Digital Forecast Database.

Changing ratio of the number of record high temperatures observed compared to record low temperatures by decade. After G. Meehl et al.



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Warmer nights are a hallmark of a climate being heated by added greenhouse gases

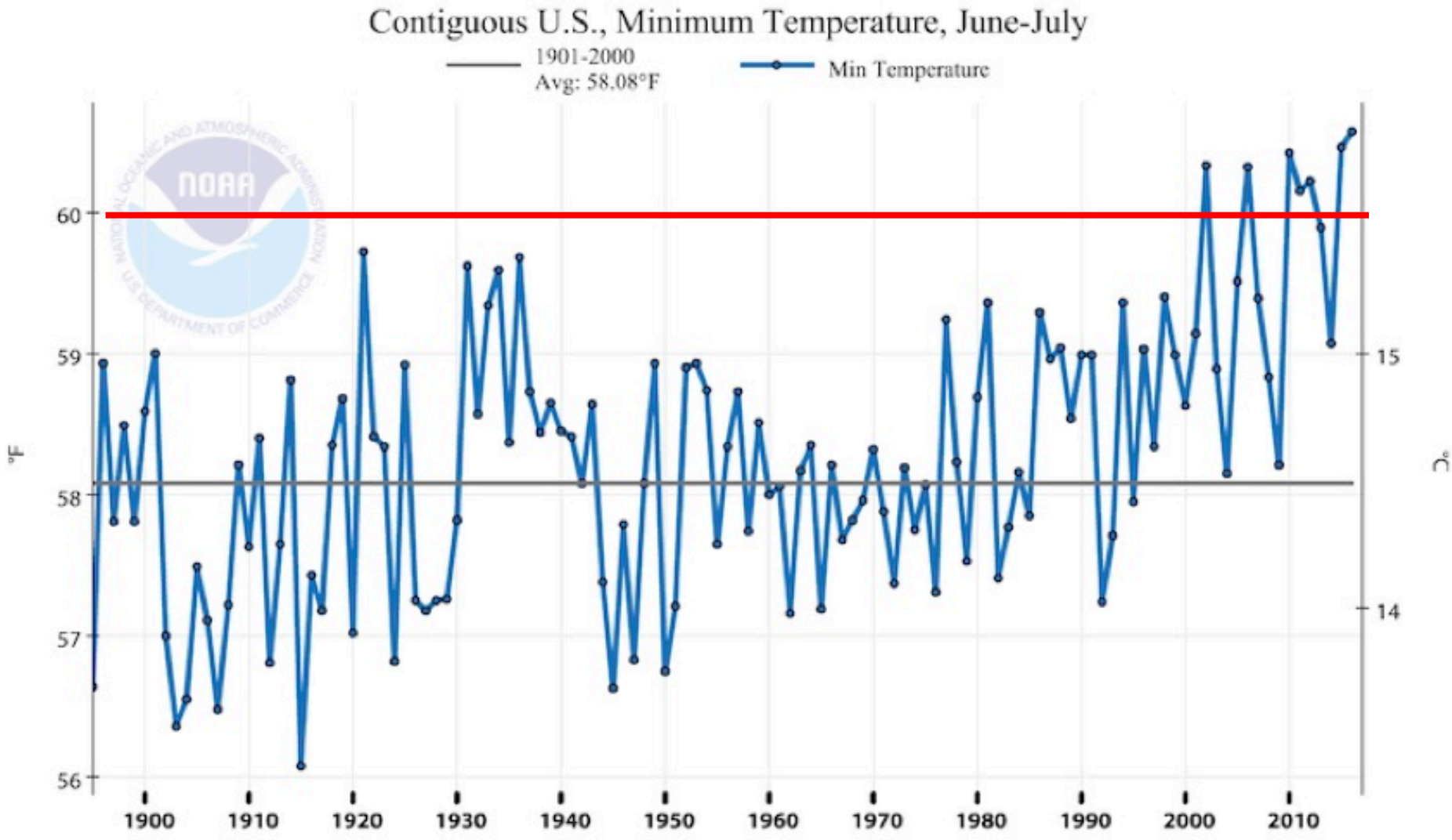


Figure 2. The average daily minimum temperature for the contiguous U.S. is at record-warm values for the summer of 2016 thus far [June plus July]. Image credit: NOAA/NCEI.

The concept of tipping points in the global climate system

Natural systems often respond to seasonal changes, which include:

- **Phenological clocks that modulate a range of ecological functions, such as spring flowering, plant emergence, bird migrations, etc.**
- **The geographical ranges of plants and animals is controlled by a number of factors, with climate being among the most important.**

➢ **Crossing certain natural thresholds can result in unanticipated and unwelcome outcomes**

The Western USA is experiencing relatively rapid warming
Map shows warming in excess of 1.5°F over the past two decades

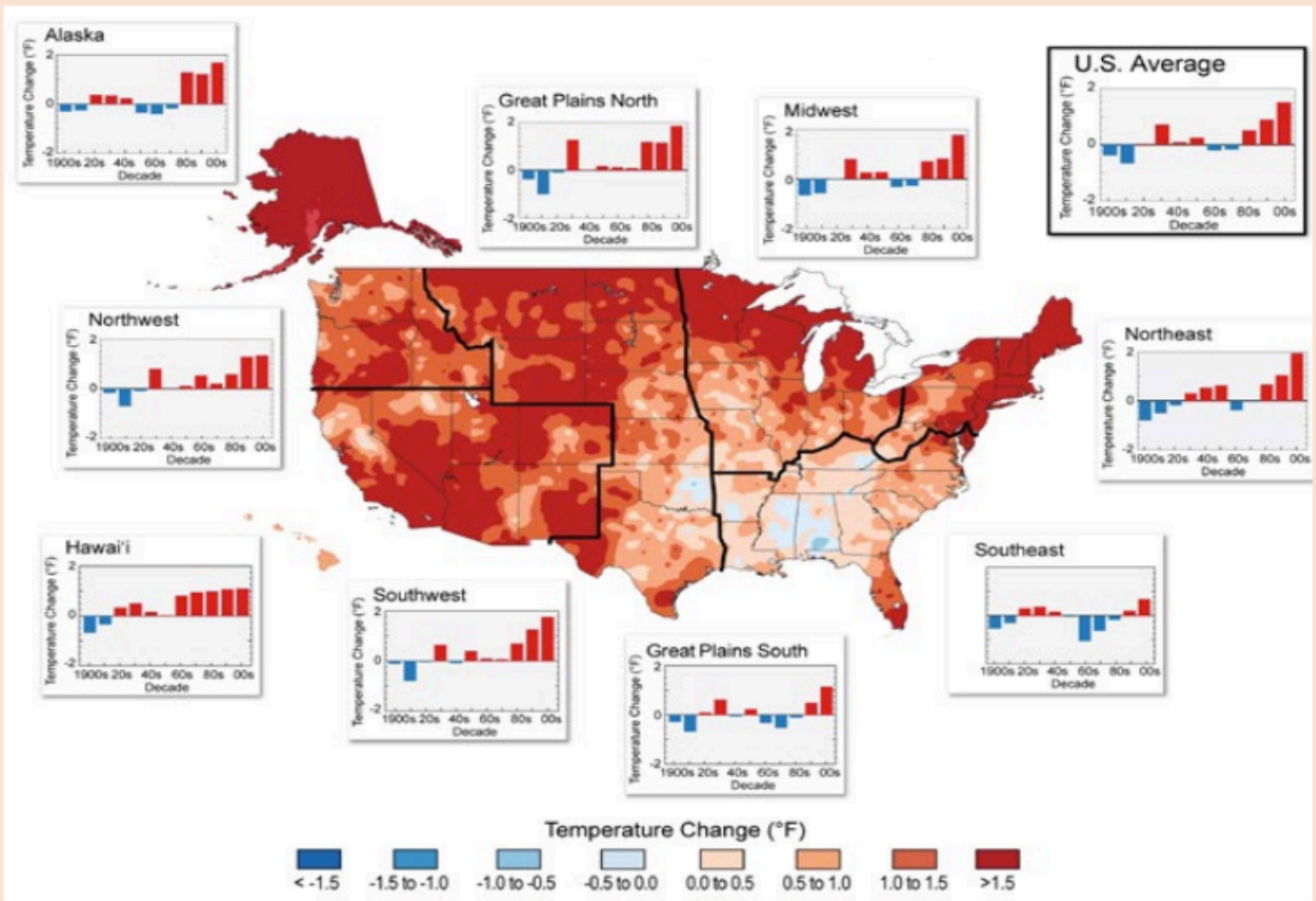
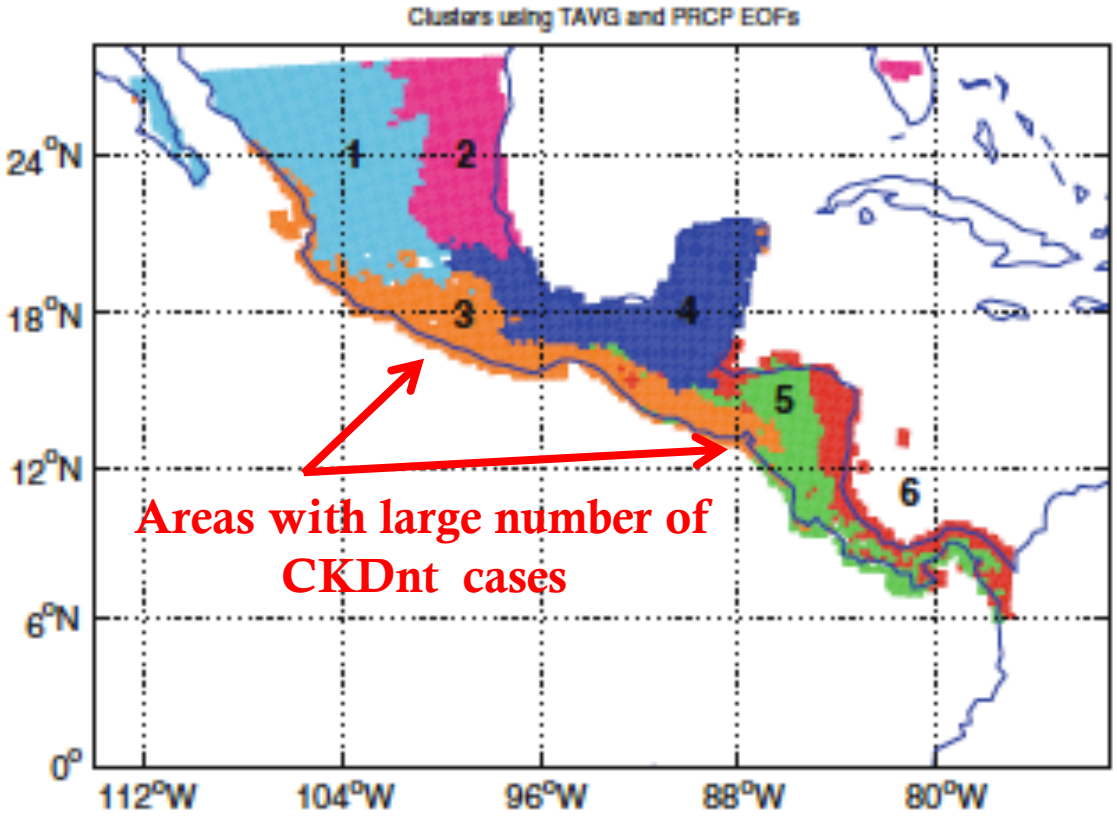


Figure 2.7. The colors on the map show temperature changes over the past 22 years (1991-2012) compared to the 1901-1960 average, and compared to the 1951-1980 average for Alaska and Hawai'i. The bars on the graphs show the average temperature changes by decade for 1901-2012 (relative to the 1901-1960 average) for each region. The far right bar in each graph (2000s decade) includes 2011 and 2012. The period from 2001 to 2012 was warmer than any previous decade in every region. (Figure source: NOAA NCDC / CICS-NC).

Important to emphasize regional aspects of climate change: Central America climate regions



Mean monthly temperature and maximum temperature expected to shift by several degrees by the end of 21st Century

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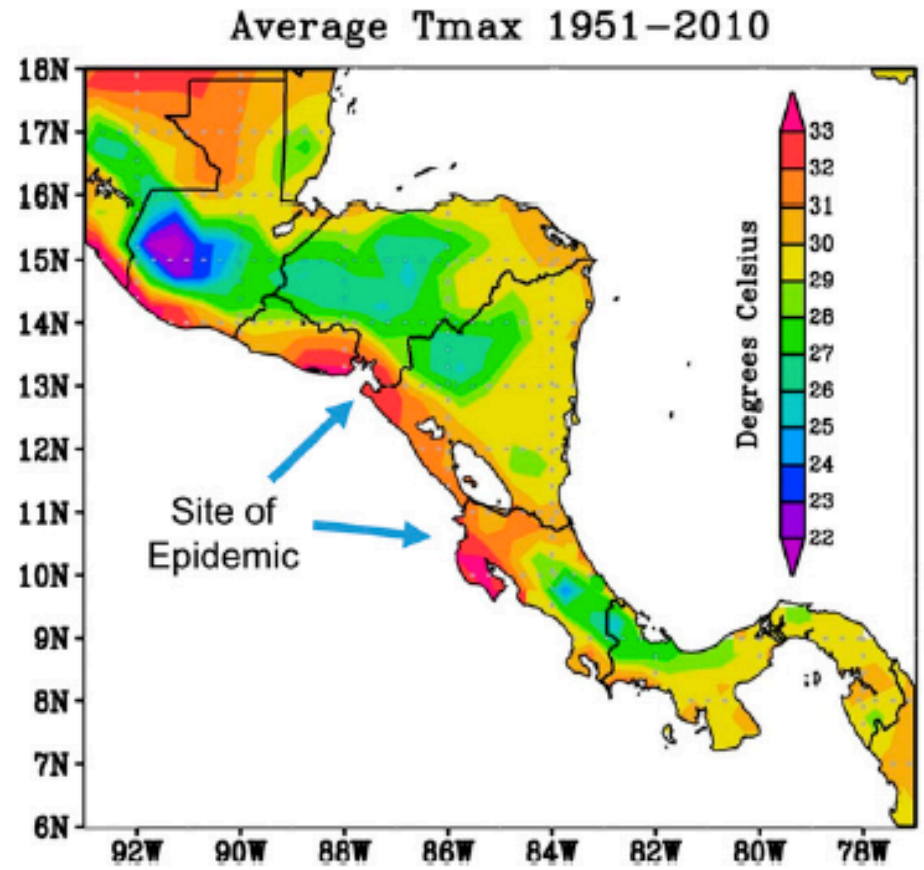
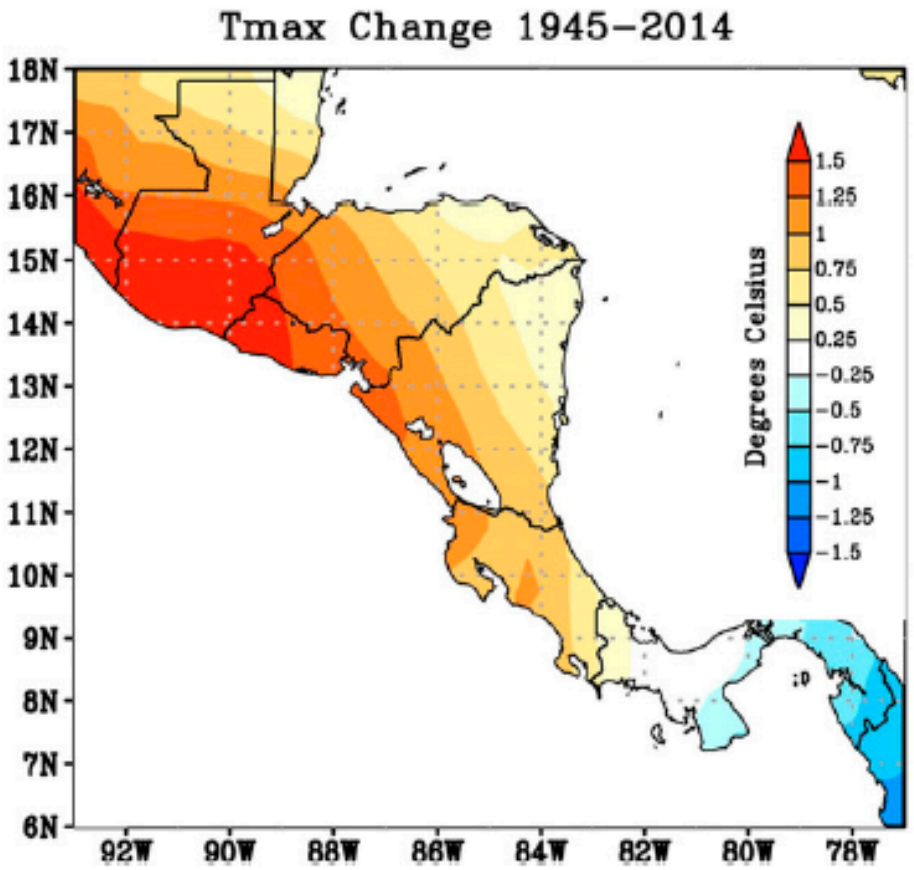
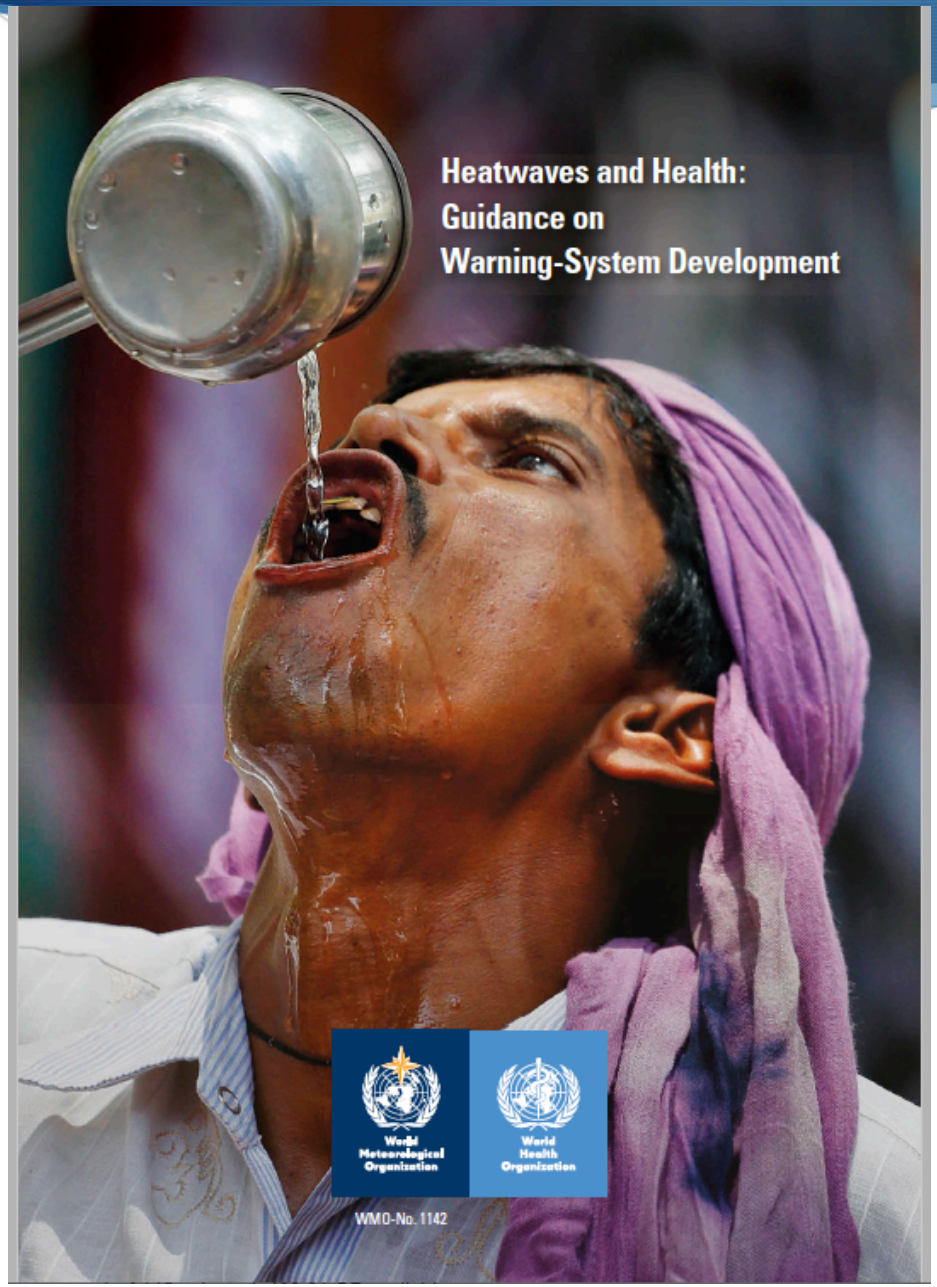
Climate Change and the Emergent Epidemic of CKD from Heat Stress in Rural Communities: The Case for Heat Stress Nephropathy

CJASN Published on May 5, 2016 as doi: 10.2215/CJN.13841215





https://www.wmo.int/media/content/wmo-who-issue-guidance-heat-health-warning-systems



In 2015 WMO & WHO promulgate the need to develop a heatwave and health warning system (HHWS)

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A Climate & Health Partnership: CU/SOM, CU/CIRES & NOAA

- Interdisciplinary collaboration at the interface between climate, water availability and disease.
- A focus not only on the potential spread of infectious diseases, but in particular for diseases associated with dehydration-associated kidney disease.
- Focus on regional hot spots such as in Central America and southern Asia, as well as potential hot spots in the agricultural valleys of Colorado and California.

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