Climate Change and Health

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Learning Objectives

Background About Climate Change

Health Impacts Locally and Globally

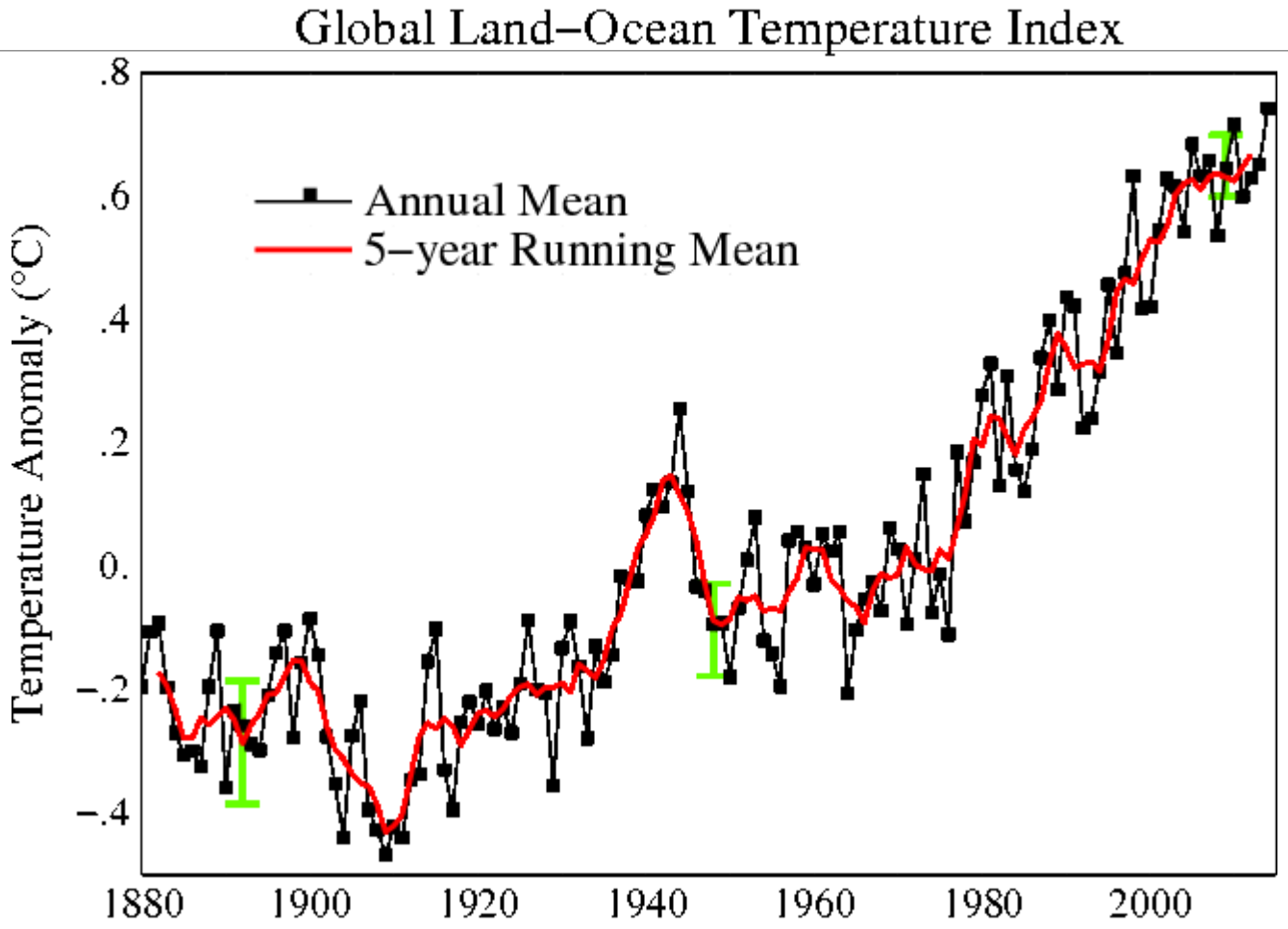
Health Care and Climate Change

Potential Solutions and actions

What we knew

Global warming is related to greenhouse effect and causing the melting of snow in the arctic

Temperature records appeared to be warming by the period 1980-2000 in all regions



Source: NASA GISS

Climate System and Weather

Weather

Weather <u>refers to:</u>

The status of the atmosphere in a particular place and time.

Weather occurs over short time periods. The weather expectations (forecast) usually cover days or weeks.

Types of Weather

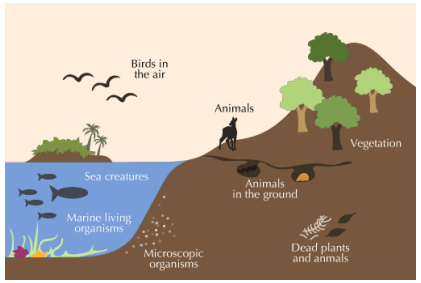
What terms do you associate with weather?

What Causes Weather?

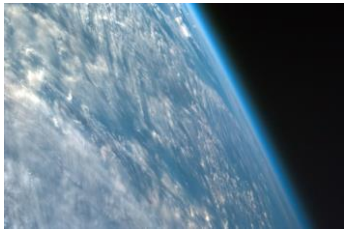
Weather is an expression of the **climate system**.

The climate system is the interaction of 5 components: the atmosphere (air up to 2 Km high), hydrosphere (water), cryosphere (ice sheets in north and south poles), biosphere (all living things), and lithosphere (land mass).

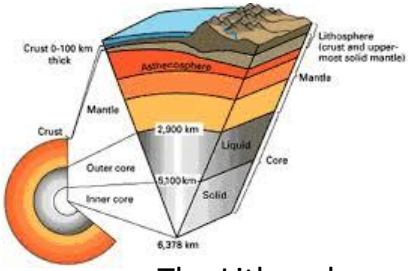
hydrosphere



The Biosphere

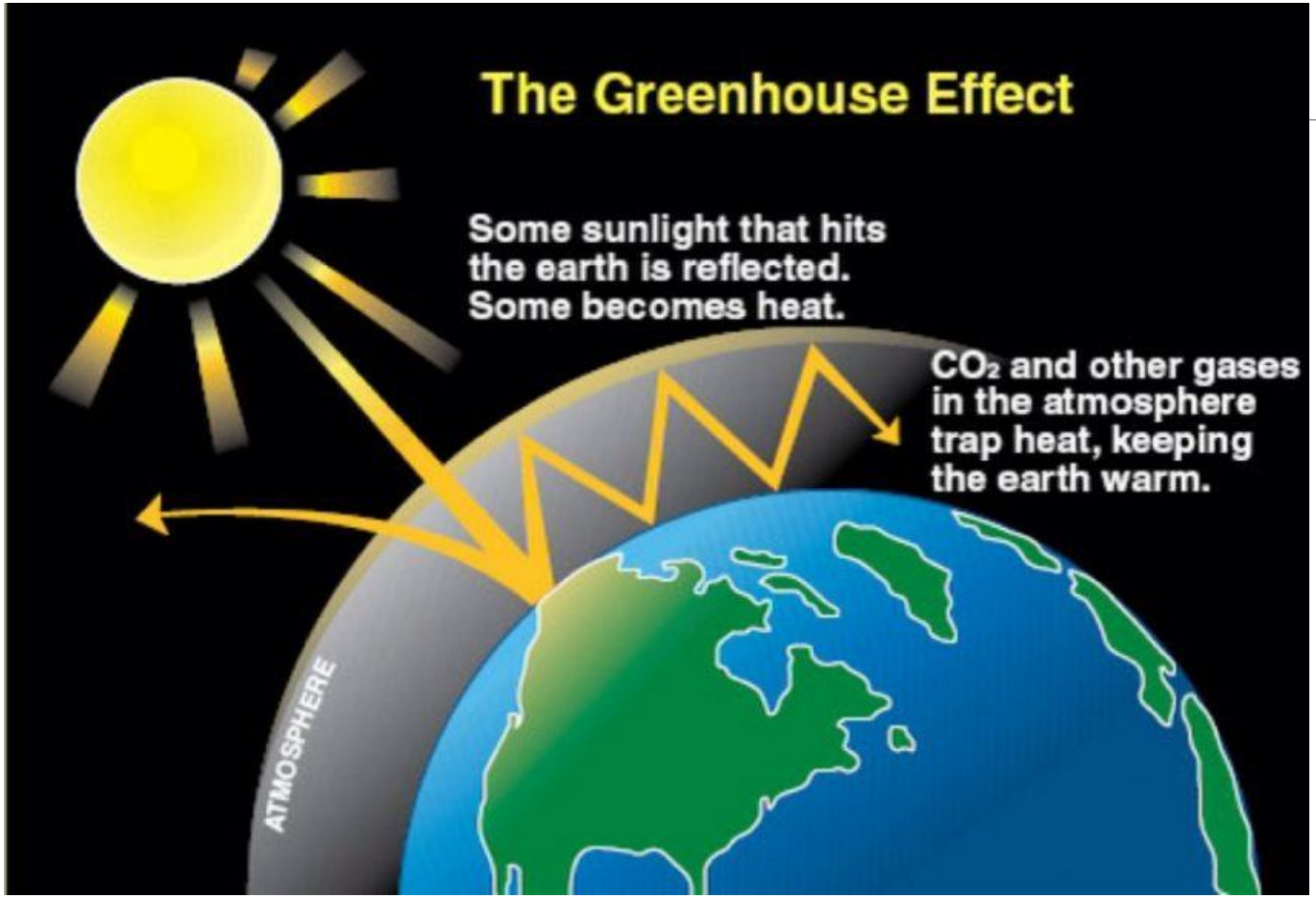


The Atmosphere

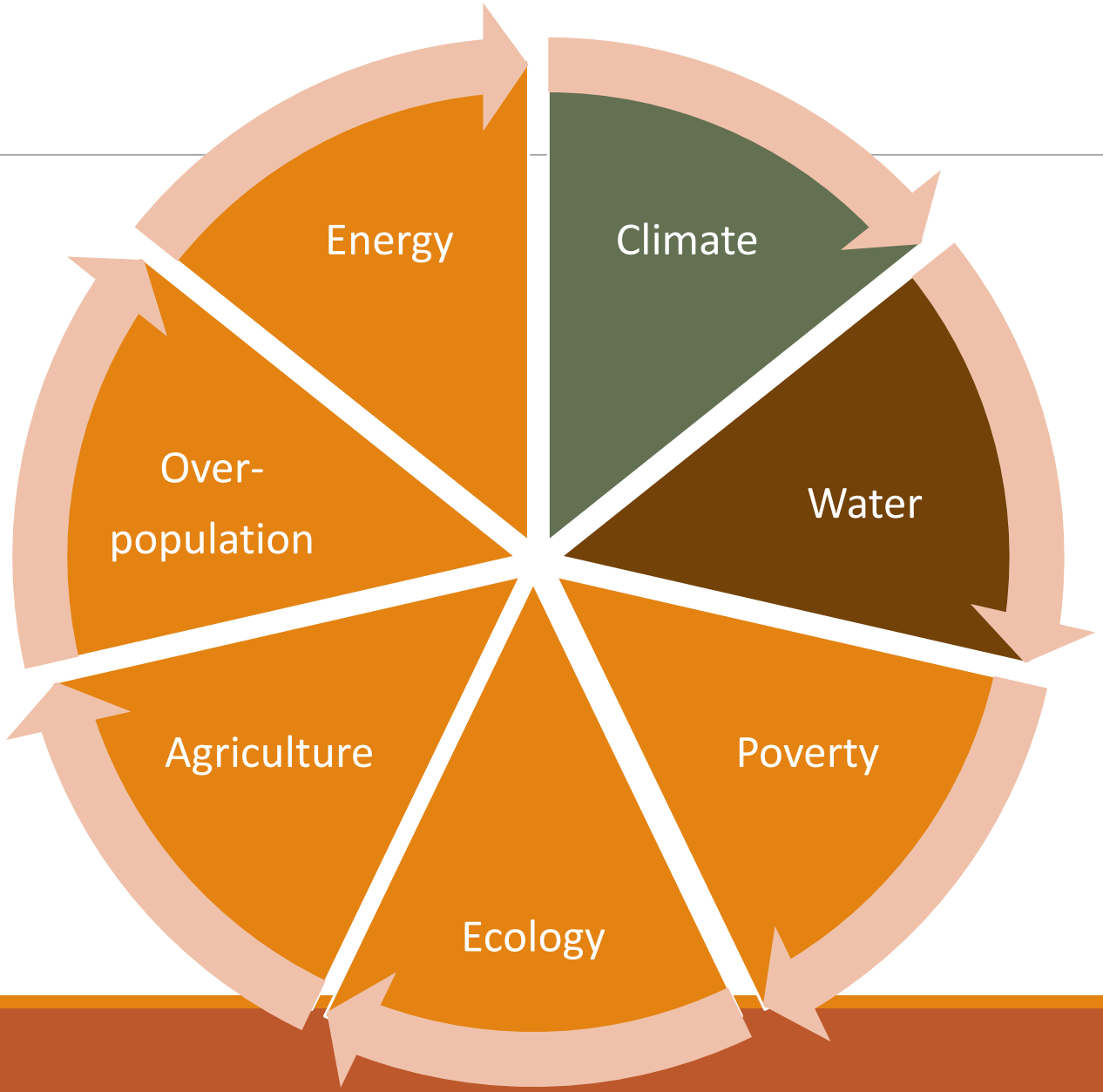


The Lithosphere

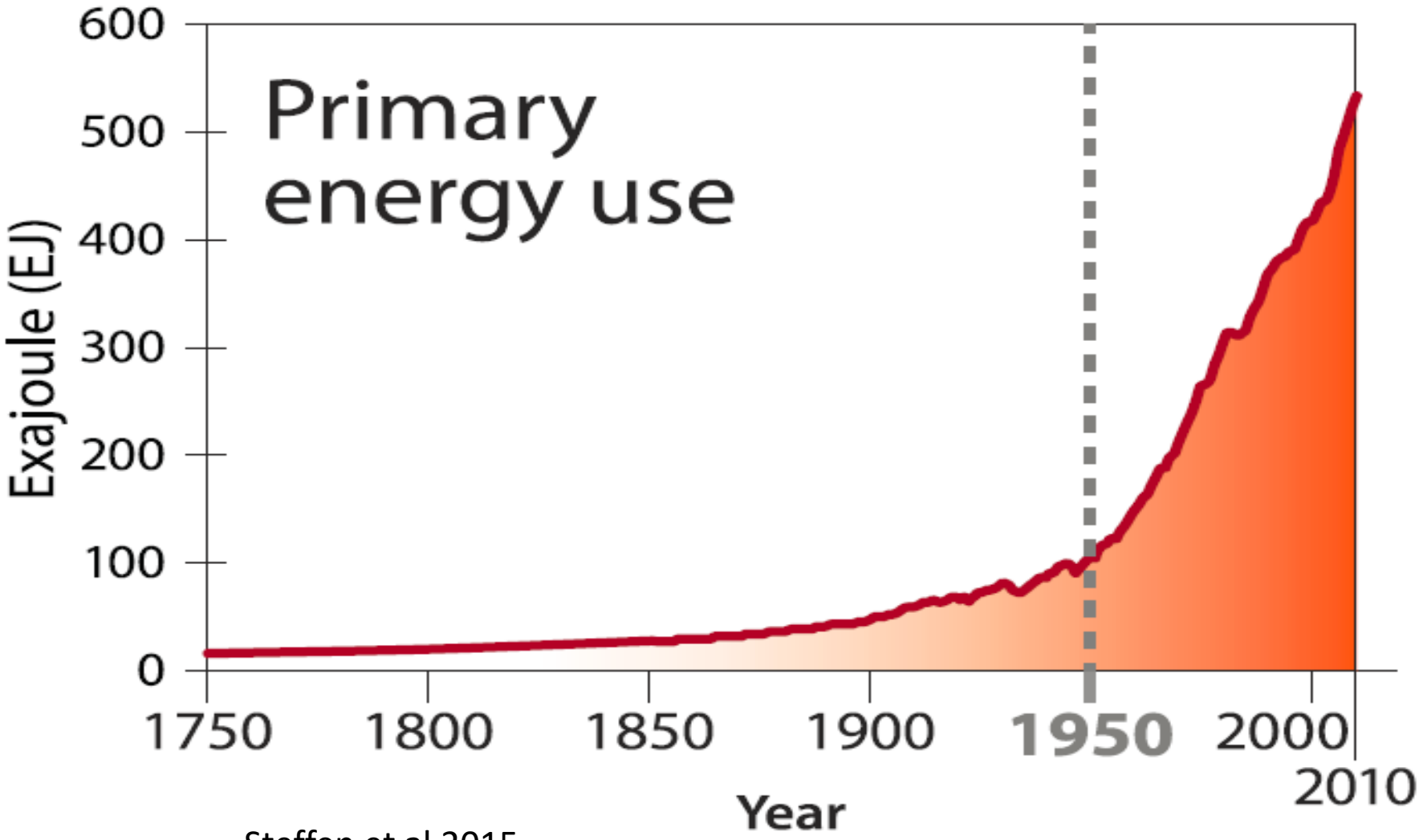
The Cryosphere


The Greenhouse Effect
Some sunlight that hits the earth is reflected. Some becomes heat.
CO_2 and other gases in the atmosphere trap heat, keeping the earth warm.
ATMOSPHERE

Anthropocene



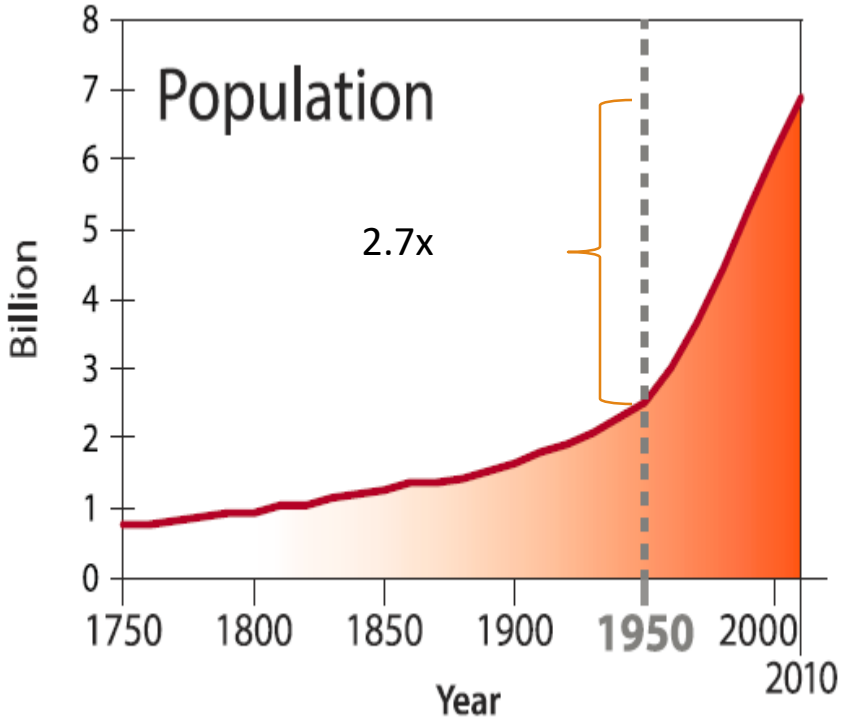
Energy crisis and solid, fossil fuel and biofuel

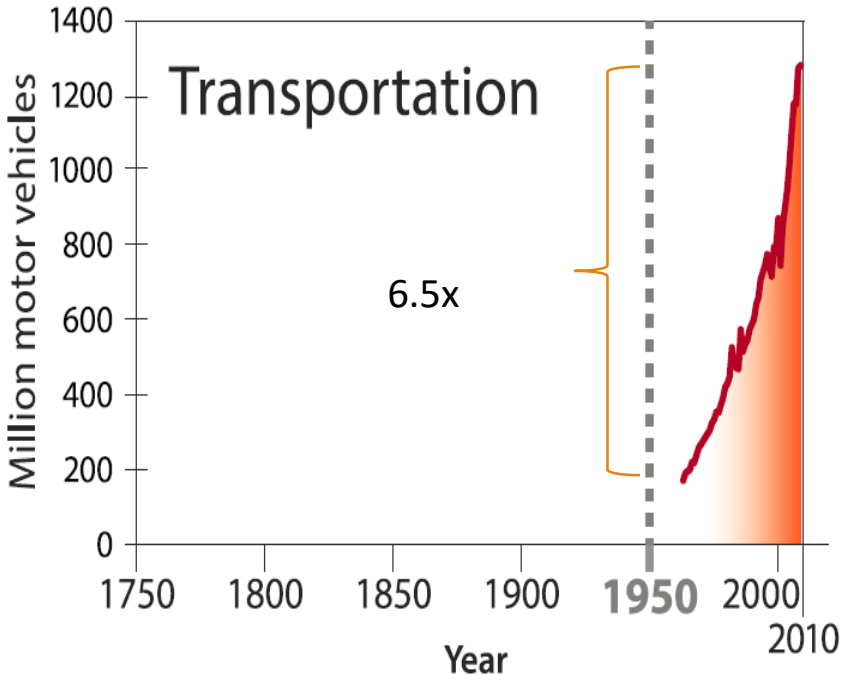


Steffen et al 2015

Spread of Wealth and Affluence

Or is it just population growth?

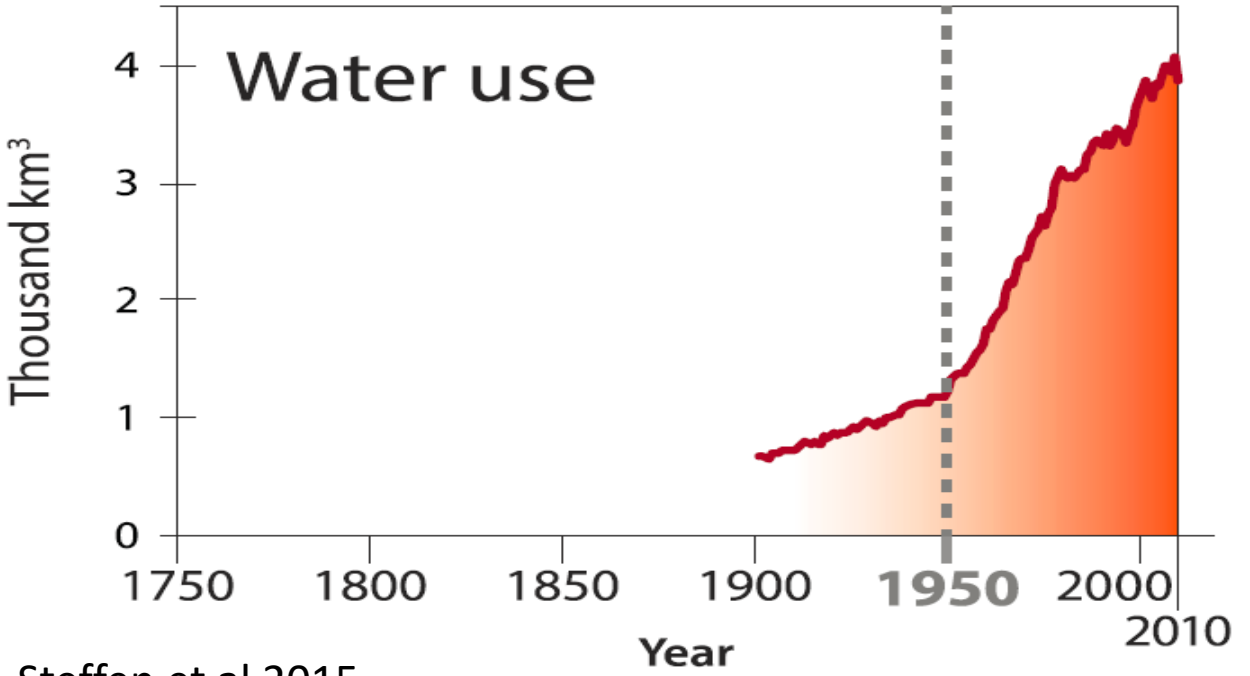




Steffen et al 2015

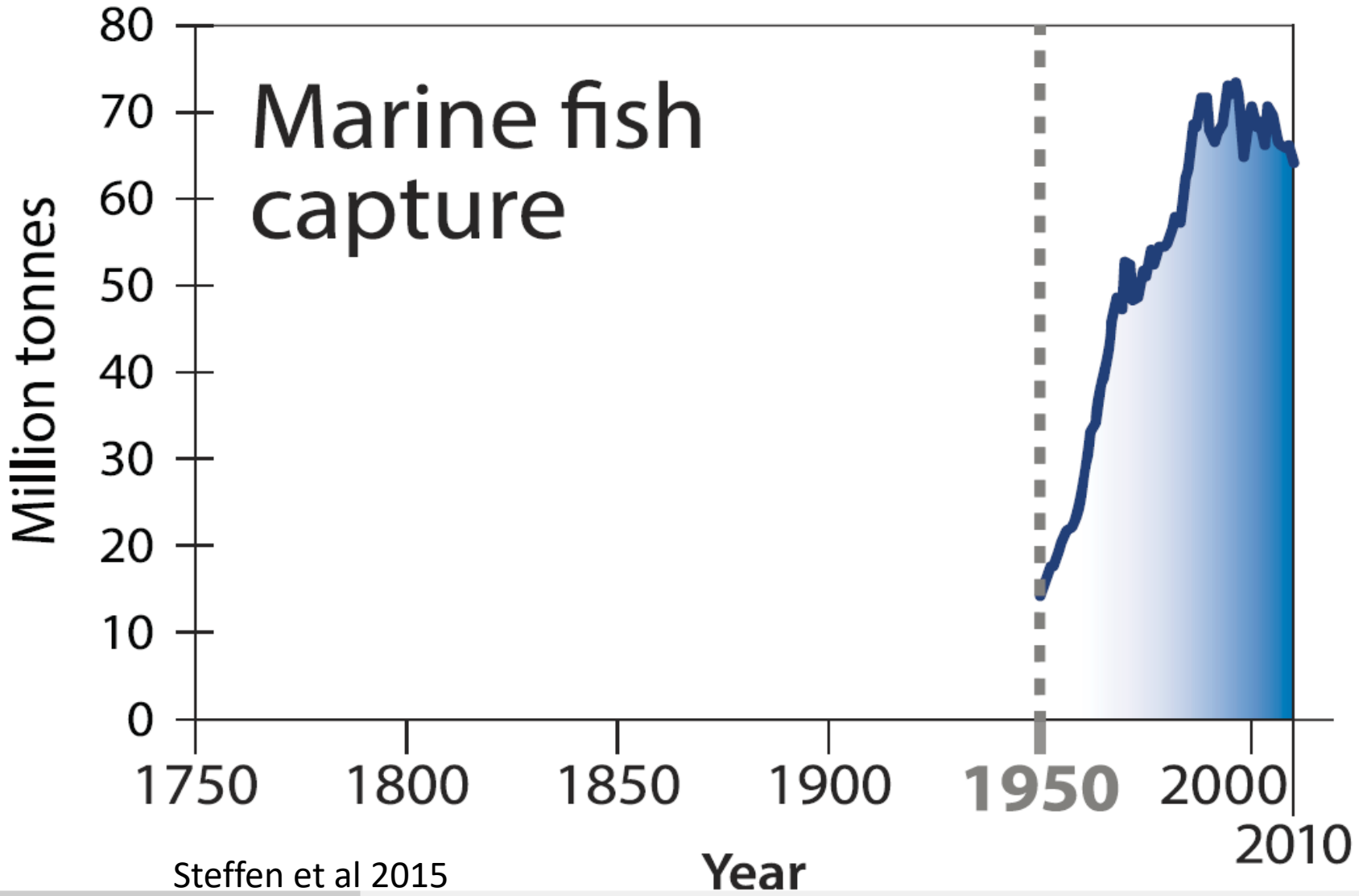
Plundering of the resources

Many people in the world exist on 3 gallons of water per day or less. We can use that amount in one flush of the toilet. – Clift and Cuthbert 2007



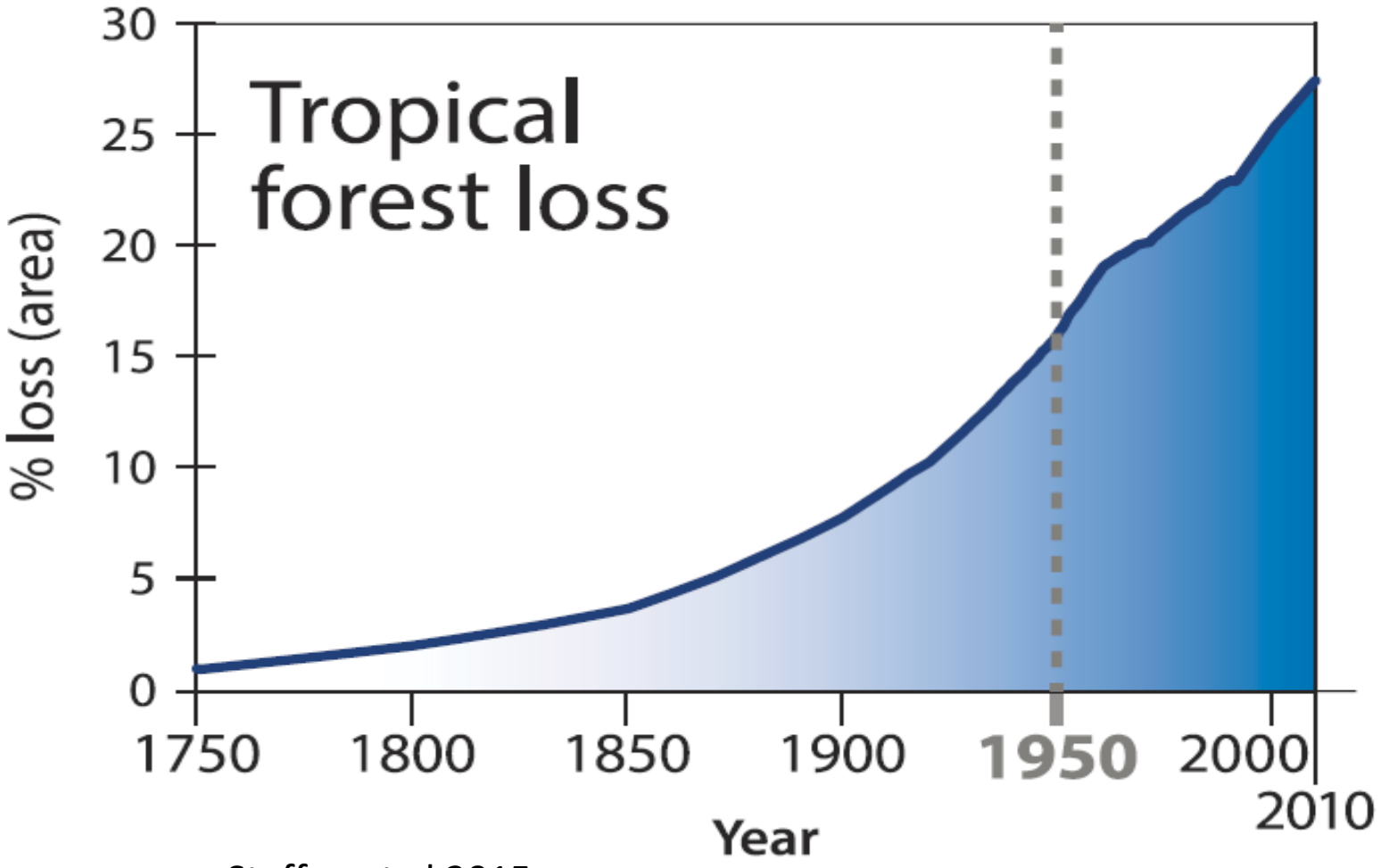
Steffen et al 2015

Plundering of the resources

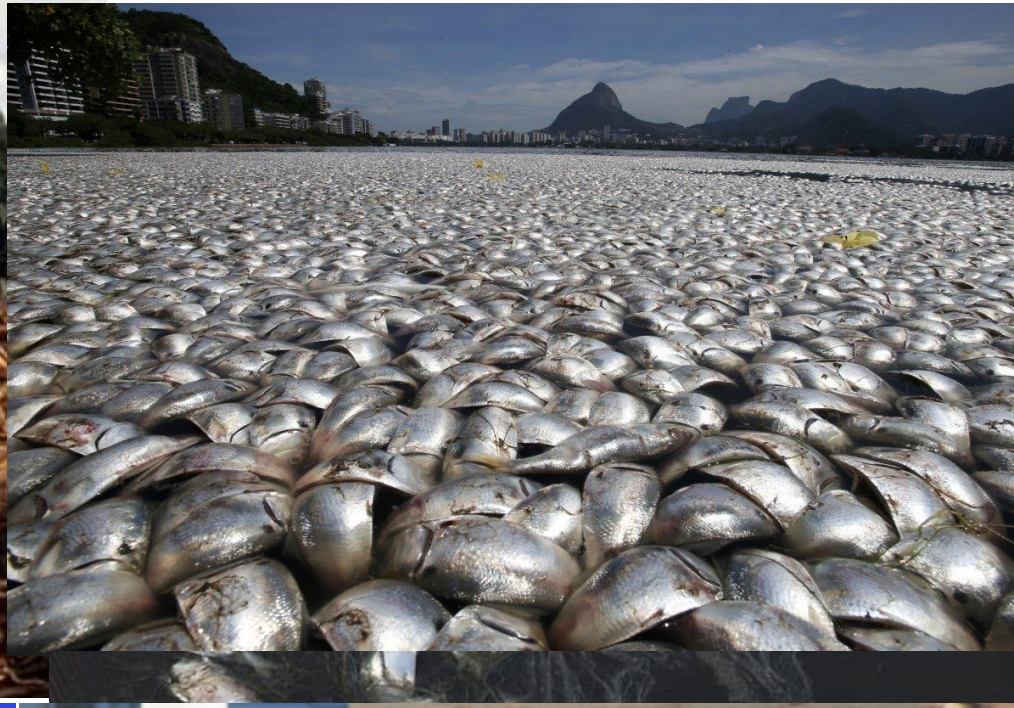


Steffen et al 2015

Plundering of the resources

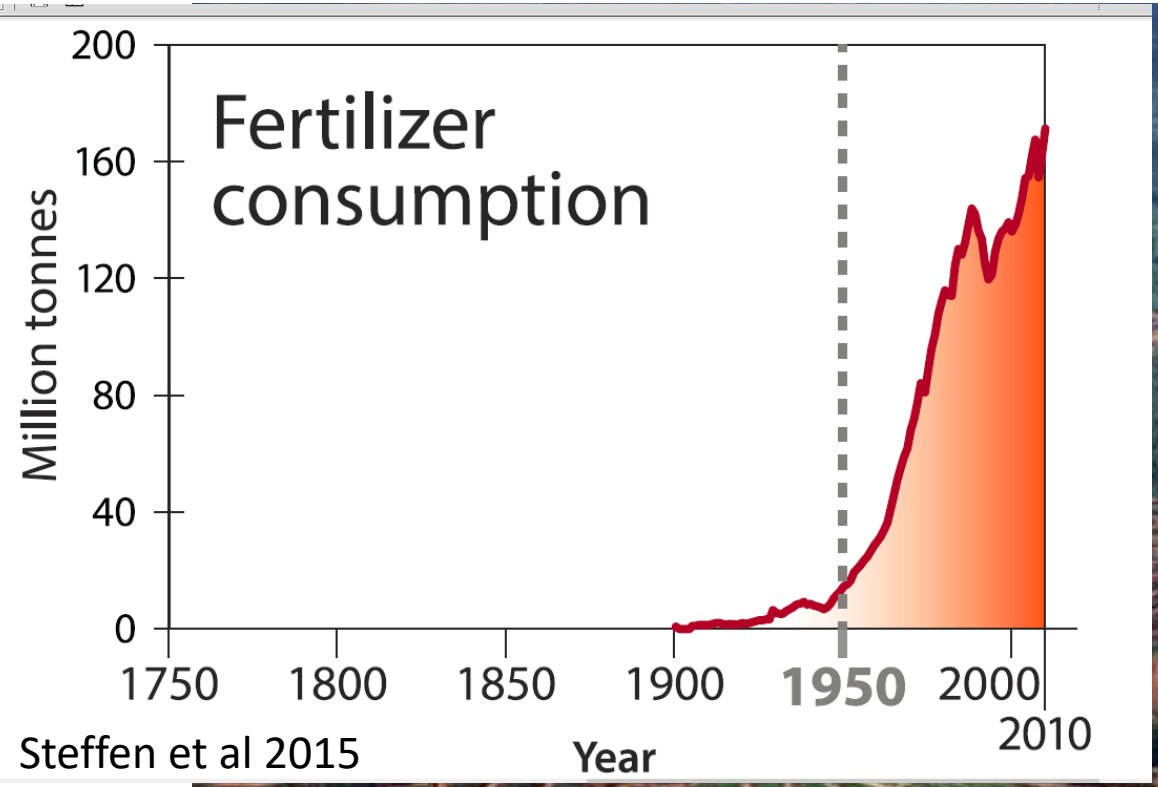


Steffen et al 2015

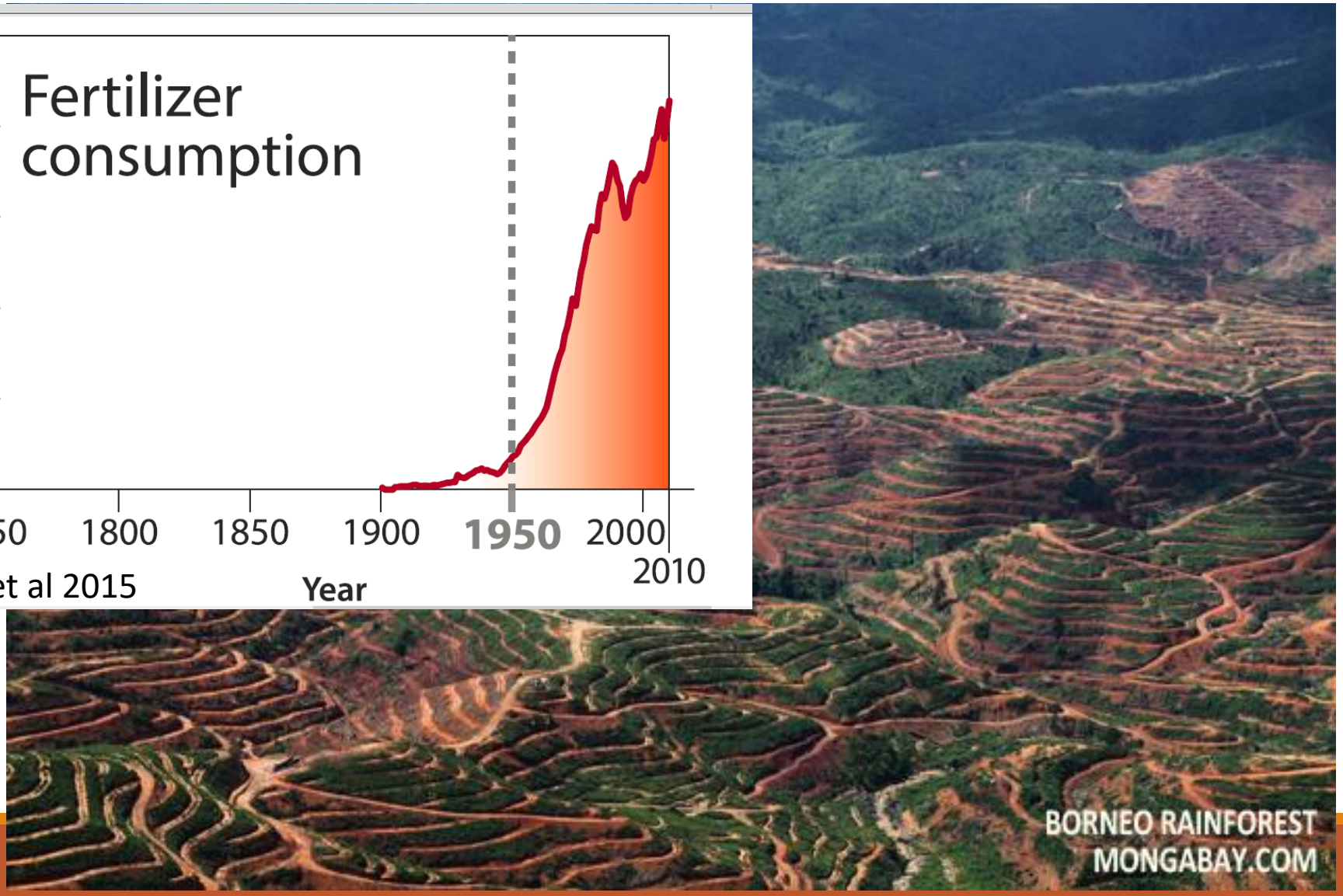


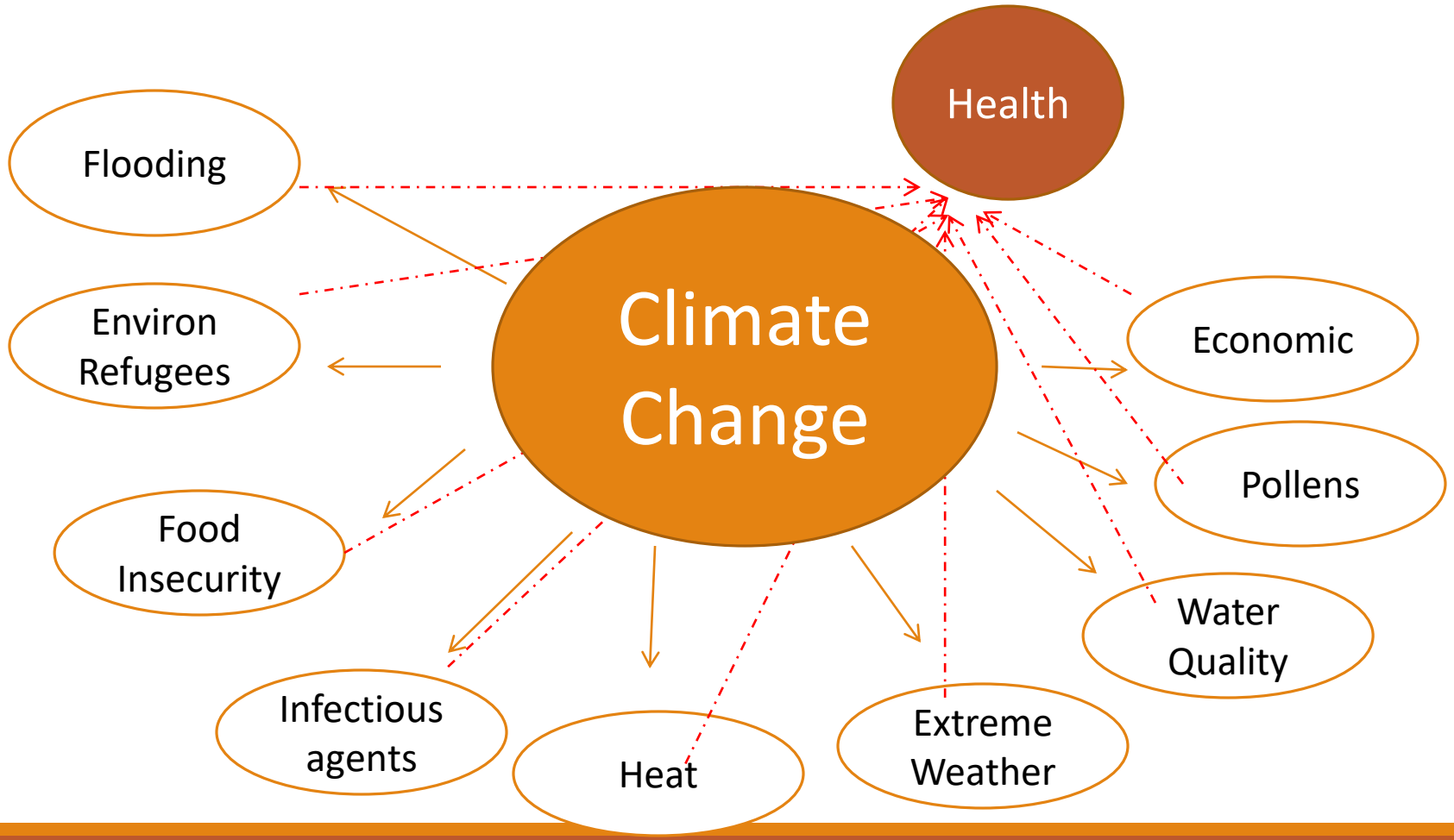
Food waste by consumers in Europe and North-America is 95-115 kg/year, while this figure in sub-Saharan Africa and South/Southeast Asia is only 6-11 kg/year. 1/3 of food is wasted

Unsustainable Agriculture



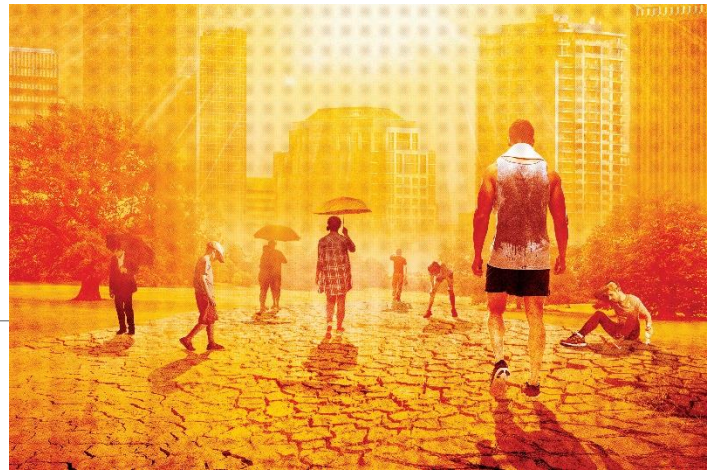
Steffen et al 2015




Health
Flooding
Climate Change
Environ Refugees
Economic
Pollens
Food Insecurity
Water Quality
Infectious agents
Heat
Extreme Weather

video

https://www.youtube.com/watch?v=6JgE0aTEFpQ



Heat-Wave Effects

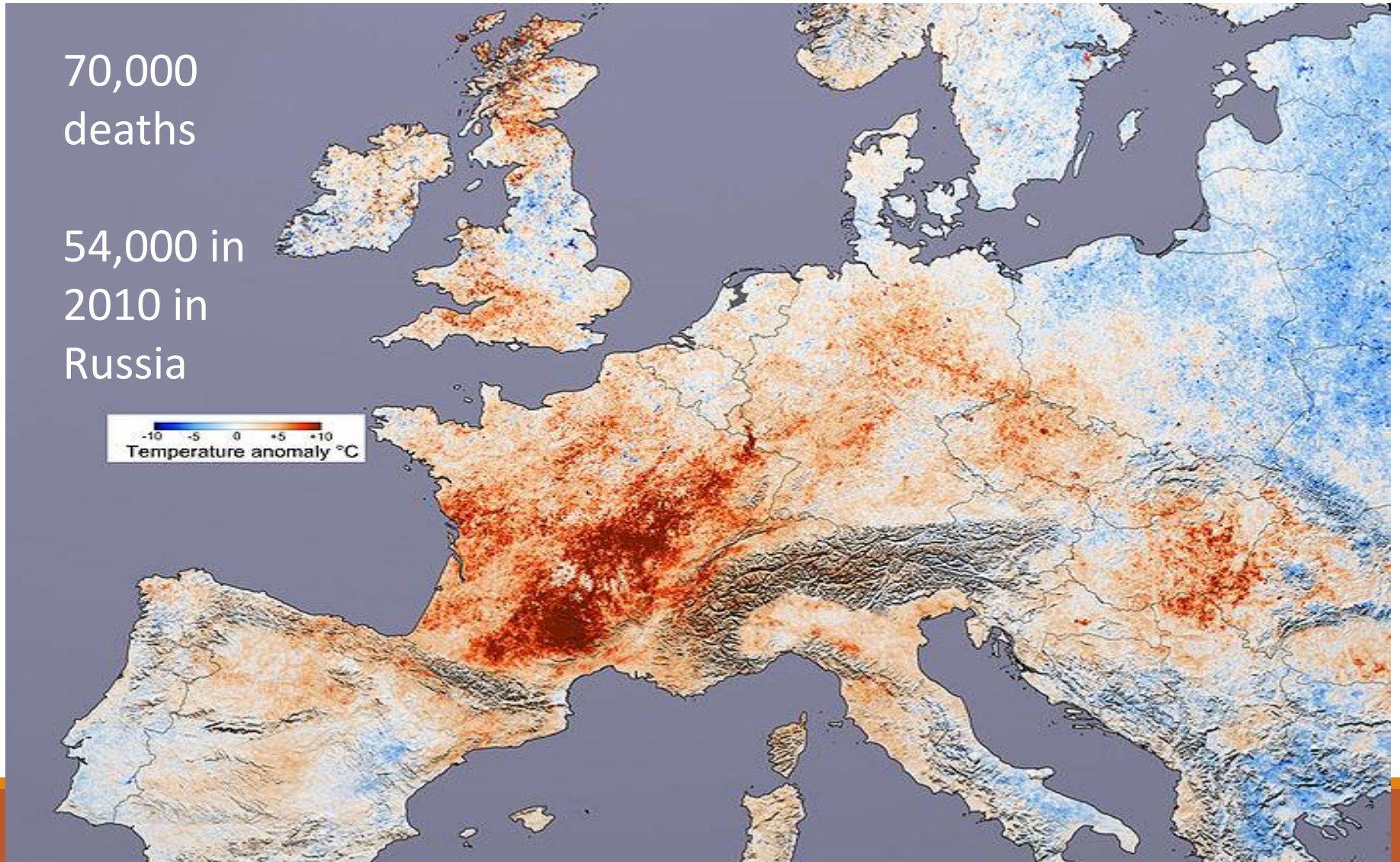
According to the IPCC Fourth Assessment (2007), **by 2100:**

- Chicago is expected to experience 25% more frequent heat waves
- Los Angeles is expected to experience a four to eight-fold increase in heat-wave days

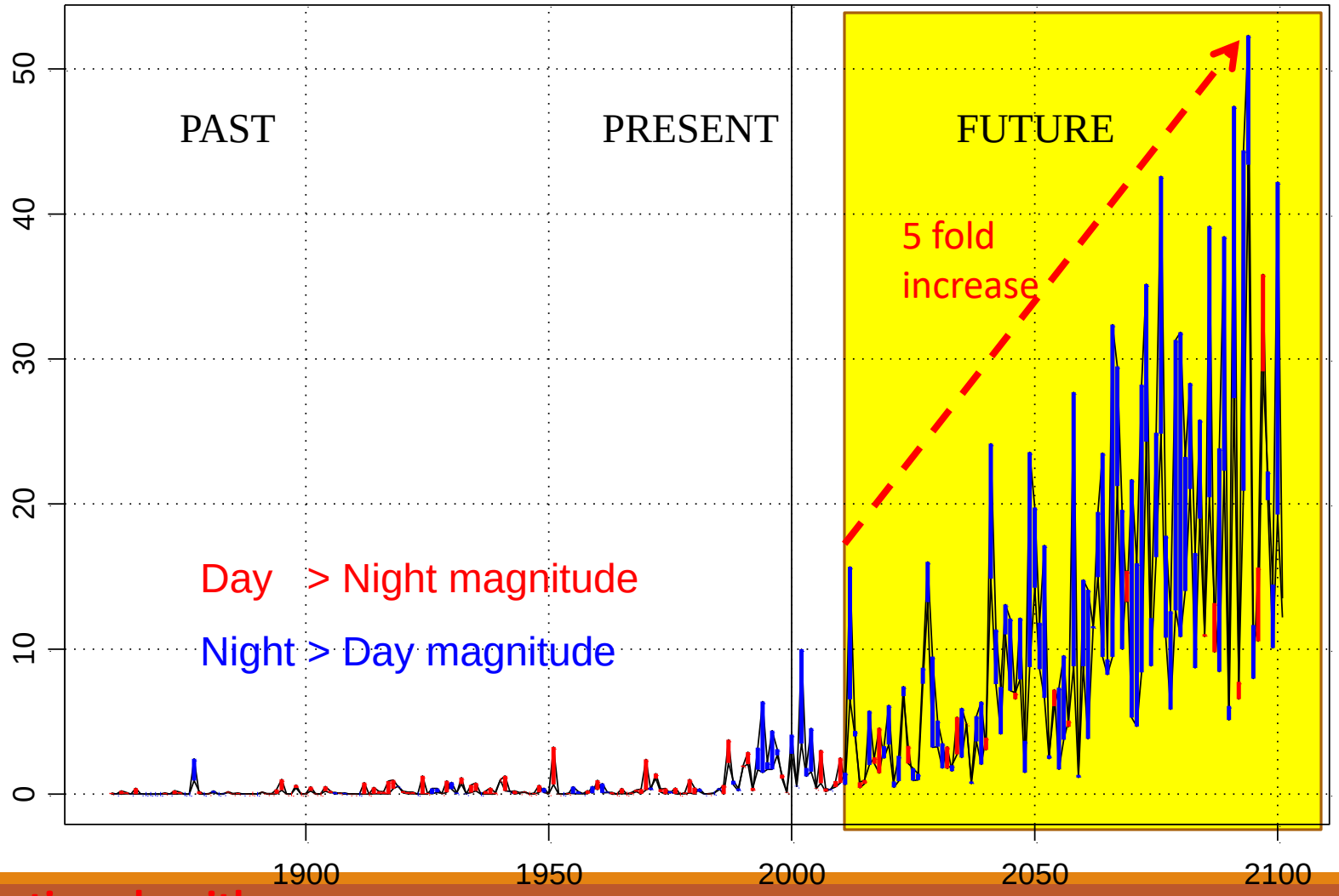
Those with heart problems, asthma, the elderly, the very young and the homeless can be especially vulnerable to extreme heat

Temperature

2003Heat wave in Europe



California Heat Waves and Climate Change (CRNM Model)



Gershunov and Guirguis 2012

Outpatient Clinic Visits During Heat Waves: Findings From a Large Family Medicine Clinical Database

Aim: to determine whether heat waves are associated with increased frequency of clinic visits for ICD-9 codes of illnesses traditionally associated with heat waves.

Population: clinic data between 2012 and 2016, we identified six heat wave events in San Diego County.

Scheduling a visit on a heat wave day (versus a non-heat wave day) was the primary predictor, and receiving a primary ICD-9 disease code related to heat waves was the outcome.

cardiac, renal, UTIs, respiratory, fluid and electrolyte disorders and mental health disorders

5448 visits

Vashishtha, et al 2018 Family Practice

Table 2. Chi-square and two-sample t-test analysis of demographic characteristics in individuals seen during heat wave periods versus control periods in San Diego County, 2012-2016
note: all values are listed as frequency (percentage) for categorical variables and mean (SD) for continuous variables

Variable	Heat Wave Period (n = 1839)	Control Period (n = 3609)	P-value
Age	47.9 (17.2)	47.0 (17.1)	0.07
Gender			
Female	1221 (66.7%)	2447 (66.4%)	0.30
Male	618 (32.2%)	1162 (33.6%)	
Race/Ethnicity			
White	1081 (58.8%)	2104 (58.3%)	0.13
Asian	237 (12.9%)	552 (15.3%)	
Black	108 (5.9%)	200 (5.5%)	
Hispanic	225 (12.2%)	395 (10.9%)	
Other	188 (10.2%)	358 (9.9%)	
Marital Status*			
Married	1004 (54.6%)	1971 (54.8%)	0.99
Single	830 (45.2%)	1618 (45.0%)	

p-values are from chi-square tests for categorical variables or two-sample t-tests for continuous variables; SD = Standard Deviation
*some individuals were missing information on marital status

Table 3. Multivariable Logistic Regression of factors associated with receiving a Heat Wave-related ICD-9 code in San Diego County, 2012-2016

Variable	AOR*	95% CI	P-value
Visit Scheduled during Heat Wave	1.35	0.86-1.36	0.51
Age	1.03	1.02-1.04	<0.01
Male gender	1.12	0.89-1.41	0.33
Race/Ethnicity			
White (reference)	-	-	-
Asian	1.20	0.88-1.62	0.23
Black	1.15	0.70-1.80	0.57
Hispanic	1.01	0.69-1.46	0.95
Other	1.12	0.75-1.61	0.57
Single	0.87	0.69-1.09	0.22

*The odds ratio compare heat wave days to control days. AOR: Adjusted Odds Ratio; 95% CI: 95% Confidence Interval

Study Conclusions

Patients who schedule appointments during heat waves are not being more frequently seen for diagnoses typically associated with heat waves

Given that heat waves are increasing in frequency, intensity and duration due to climate change, it is essential that primary care clinics become better equipped to inform and treat patients about the health impacts of extreme heat events

Problem

Inconsistency in the use of climate measures and thresholds for providing actionable health policies at local and regional levels

Heat waves have the most acute health impacts

"Heat waves tend to kill the sick, the old, and the infirm, especially through cardiovascular failure and air pollution." Patz et al 2015

Heat Waves Globally

MENA Will Become So Hot That Human Habitability Is Compromised

(Max-planck Institute And Cyprus Institute Report)

WARM SPELL DURATION INDEX (WSDI)

Count Of Days With At Least *6 Consecutive Days* When The Daily Maximum T Exceeds The 90th Percentile In The Calendar 5-day Window For The Base Period 1979-2009. Reaching 60 °C By 2100

Baghdad, Iraq 162 Days Per Year

Kuwait City, Kuwait 167 Days Per Year

Beirut, Lebanon 187 Days Per Year

Riyadh, Saudi Arabia 202 Days Per Year

The Effect of Increased Heat

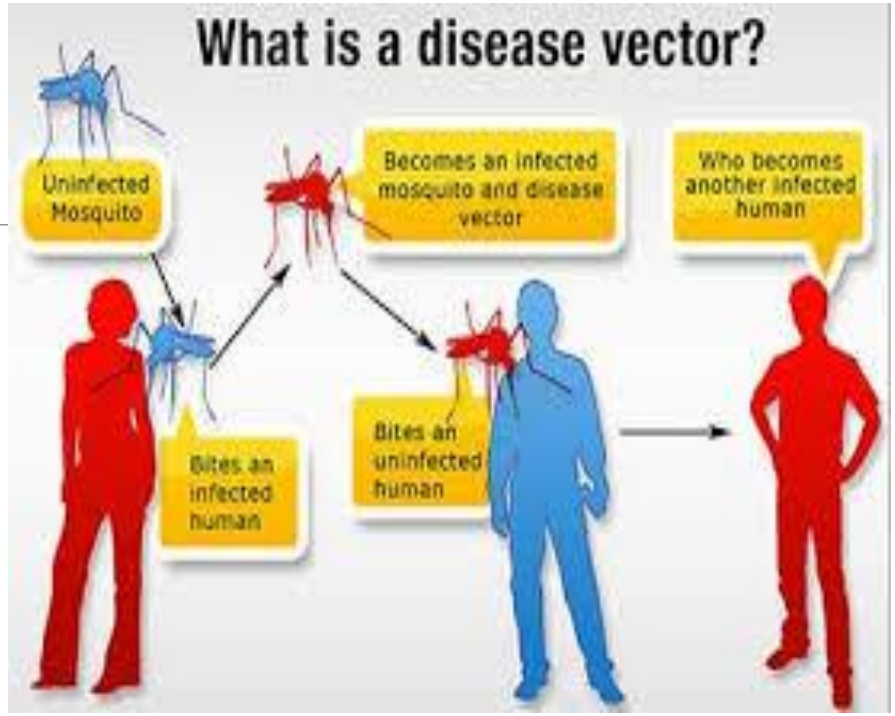
Hotter, more humid weather shortens mosquito breeding cycles

The infectivity of dengue virus is speeded up by increased temperatures

Milder winters also allow the survival of many disease related organisms

- Mosquitoes, ticks and mice
- Lyme disease, Rocky Mountain spotted fever,

Vector-borne Disease



A vector serves two functions:

- It is required for part of the parasite's growth cycle
- It also transmits the parasite directly to hosts

Most commonly known vectors consist of insects, domestic animals, or mammals that assist in transmitting parasitic organisms to humans or other mammals

Common Vectors
(carriers of disease)

- Mosquitoes serve as vectors for Malaria, Dengue fever, Yellow fever, and Zika virus

- Ticks can serve as vectors for Lyme disease, Typhoid

Food Poisoning

Risk increases due to higher temperatures

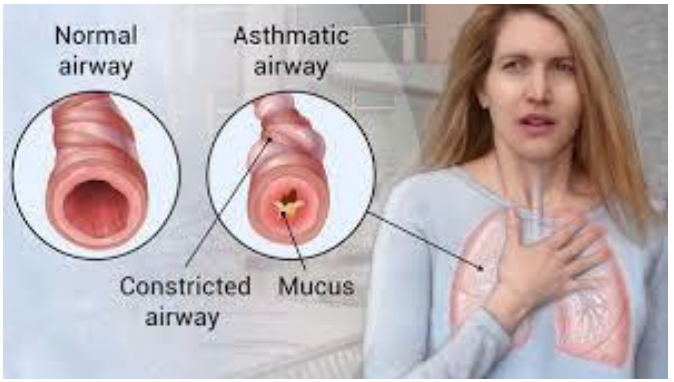
Salmonellosis bacterial infection is especially likely to be a problem

Allergens

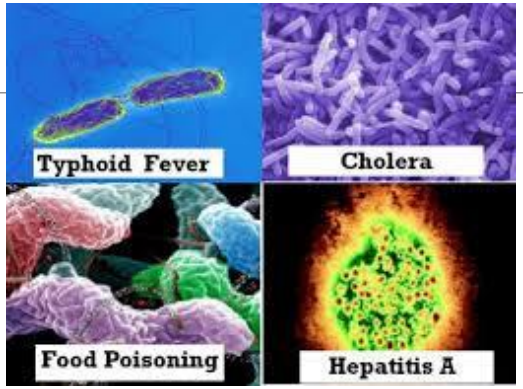
Risk – Increased allergic illnesses, including hay fever and asthma due to longer pollen seasons

Benefit – decrease of allergens in some places due to lower productions or shorter seasons of pollen circulation

- Higher temperatures and changed humidity may shorten the growing seasons for some plants



Water-borne Infection



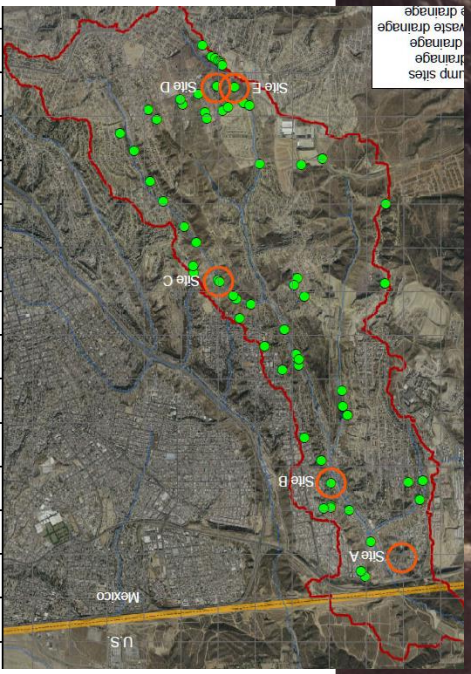
Risk - Cholera risk will increase in coastal regions, due to a warming of water temperatures

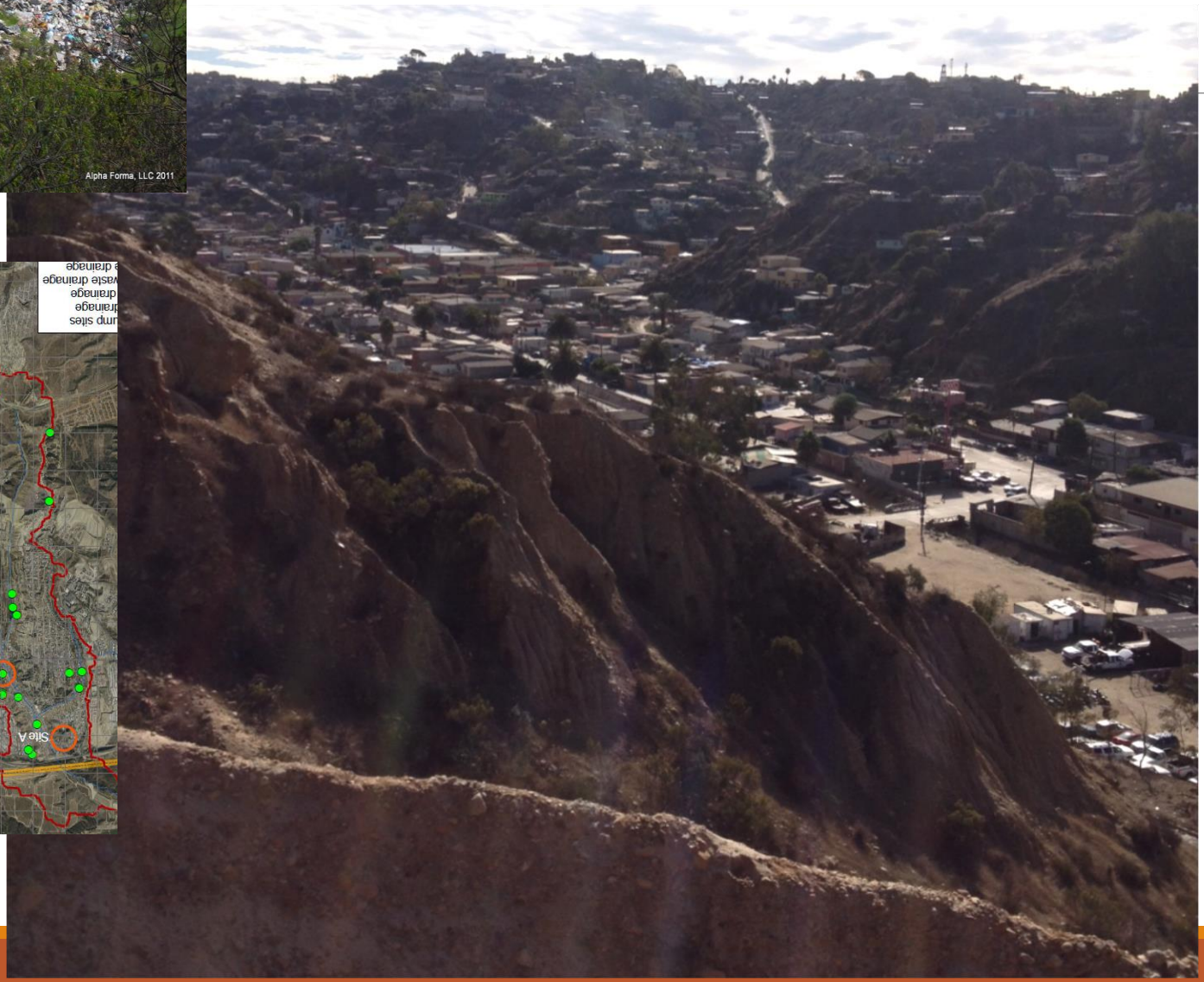
Benefit – risk will diminish in areas where heavy rainfalls decrease

Droughts

- Droughts represent the other extreme of weather related precipitation problems
- Globally, disaster effects are greatest for droughts (and associated famines) because of their regional extent, which are usually much larger than flood-related regions
- Mental illnesses from loss of crops and income
- Wildfires associated pollution
- Transmission of valley fever, a fungal infection that can cause permanent lung damage and, in rare cases, death. Can travel 75 miles

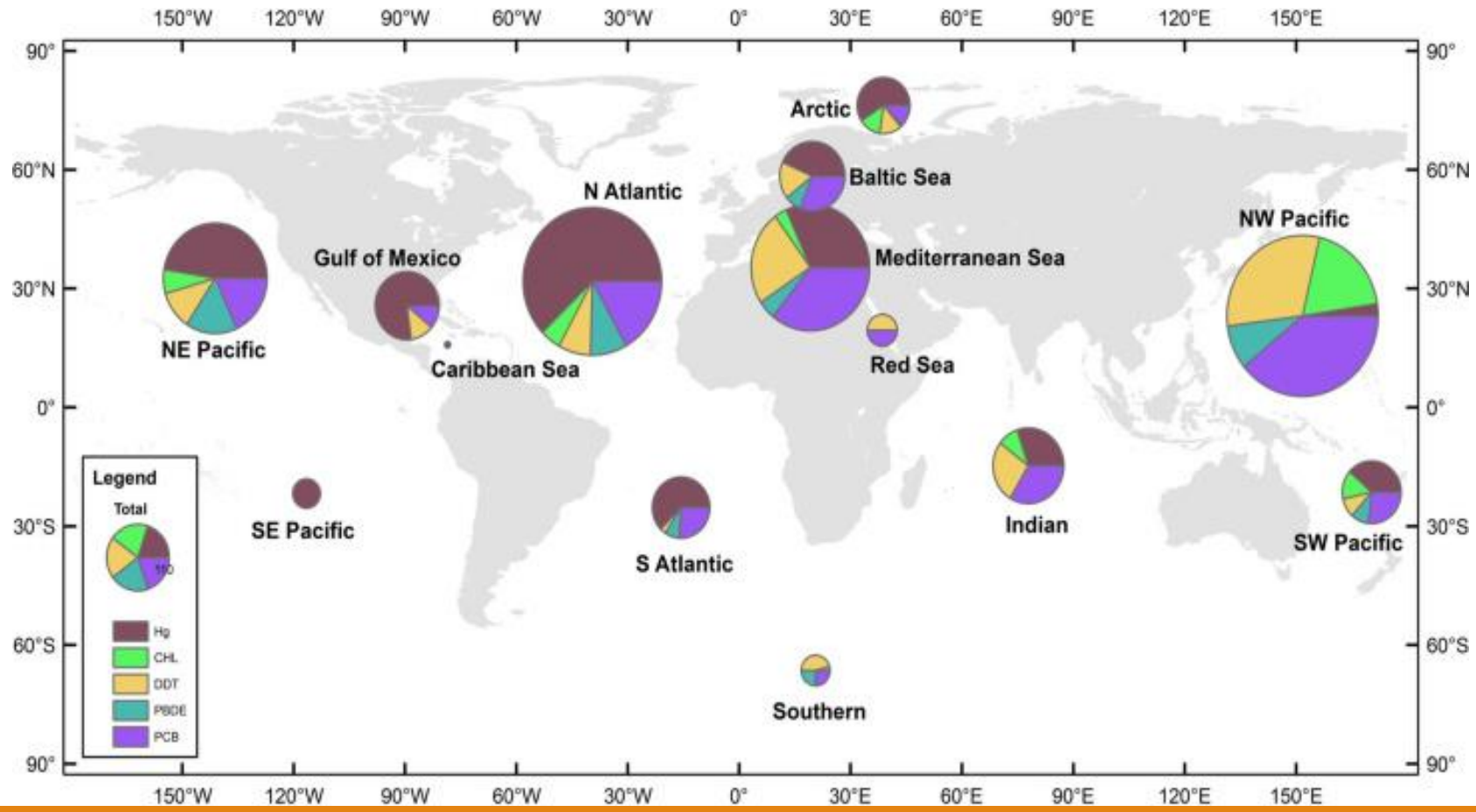

Alpha Forma, LLC 2011


Site A
Site B
Site C
Site D
Site E
U.S
Mexico



Water Quality

Establishing sources of toxicants in ocean fish and their population health impacts



Sandin et al 2016

Particulate Matter (PM)

PM10, 2.5 and ultrafine 0.1 μm

When inhaled, these particles can reach the deepest regions of the lungs and into the blood system

Exposure to PM is linked to a variety of significant health problems

Air pollution currently represents the fifth cause of death-mostly cardiovascular and respiratory diseases

29% of the stroke burden attributed to air pollution which was most significant in emerging regions (and highest in sub-Saharan Africa and South Asia) Feigin VL et al 2016 Lancet Neurology

Wildfires occur more commonly following heat waves and drought, releasing particulate matter into the air

Flooding

Floods are not frequent but when they happen they have high impact

For the decade 1992-2001, there were nearly 100,000 flood related deaths, and 1 to billion people were affected by flooding

More injuries and deaths due to flooding

Increased risk of infectious disease due to flooding, and mental

health disease brought on by flood-related stress

Exposure to toxic pollutants

Human sewage and animal wastes enters into waterways and drinking water supplies, increasing the risk of water-borne diseases

Flooding and extreme Weather impact on health care

Disrupt health service delivery and continuity

Requires medical surge during the disaster because of increased demand

Causes long term impact on chronic diseases

Disparity by impacting the most vulnerable low income communities-**Threat multiplier**

The Facilities itself can be damaged with no electricity, water, or access

Reliance on out-dated FEMA Flood Insurance Rate Maps from the 1970s and 80s to assess flood hazards in their service area

South Carolina's Healthcare facilities exposure metric resulting from 4 scenarios of an increase in global mean sea-level rise (GM-SLR).

Sea-level rise (ft)	Number of Healthcare Facilities Impacted
1	0
2	3
3	51
4	68

Runkle et al 2019

What we knew

Global warming is related to greenhouse effect and causing the melting of snow in the arctic

Temperature records appeared to be warming by the period 1980-2000 in all regions

IPCC reports 1989

…….

IPCC report 2007 Chapter 8 in Human health impacts of Climate Change

Lancet Commission 2008

WHO Report 2009

Challenges

Methodological challenge

Climate change is not an exposure like smoking or diet or any other exposure we have worked with: Poor measurement of exposures Documentation of individual health impacts

Its impact is in decades and its health impact too slow or too sudden to document

New Methodological approaches beyond what we are used to in epidemiology

Challenges

Large scale health outcome data not accessible

Lack of data in the literature

No funding from traditional sources

Vulnerable populations with limited adaptation are least studied

- Disparity of Impact (income, age, ethnicity, geography, corrupt governments, political instability)

Indifference to the long term and gradual impact (like NCDs Vs CDs)

Health effects are mostly indirect

Floods

Freezing temperatures

Heat waves

Drought

Severe storm

Tropical cyclone

Wild fires

Water and food supply

Poverty

Algal bloom, red tide

Attacks by Climate Denier

A senate member receiving over 2 million from Fossil Fuel Industry

A previous staffer for that senator with funding from Exxon and Chevron

Energy and Environment Legal Institute

Murray Energy Corp-largest Coal Co.

Roy Spencer, Fred Singer, Patrick Michaels

80 Billion Koch Brothers Industry 1991!!

86% of climate news on Fox News is **Denial**

Political Affiliation

Al Gore Factor

Started in 1989

An inconvenient truth 2006

Climate change is the democrats'

ploy to take control of government through regulation, take away your car, take away your beef and hamburger, …etc

Upstream Ethical Predictors of the Anthropocene

Energy crisis and solid, fossil fuel and biofuel

Plundering of the resources because they are available and not regulated (e.g. water)

Culture of consumerism and un-necessary overspending

Over consumption and wasting because of affluence and spread of wealth

Self-centered vs Community centered

Deniers

Indifference to the long term and gradual impact (like NCDs Vs CDs)

Self-centered vs Community centered

Golden Rule (ethics of reciprocity):

One should treat others as one would like others to treat oneself (directive form).

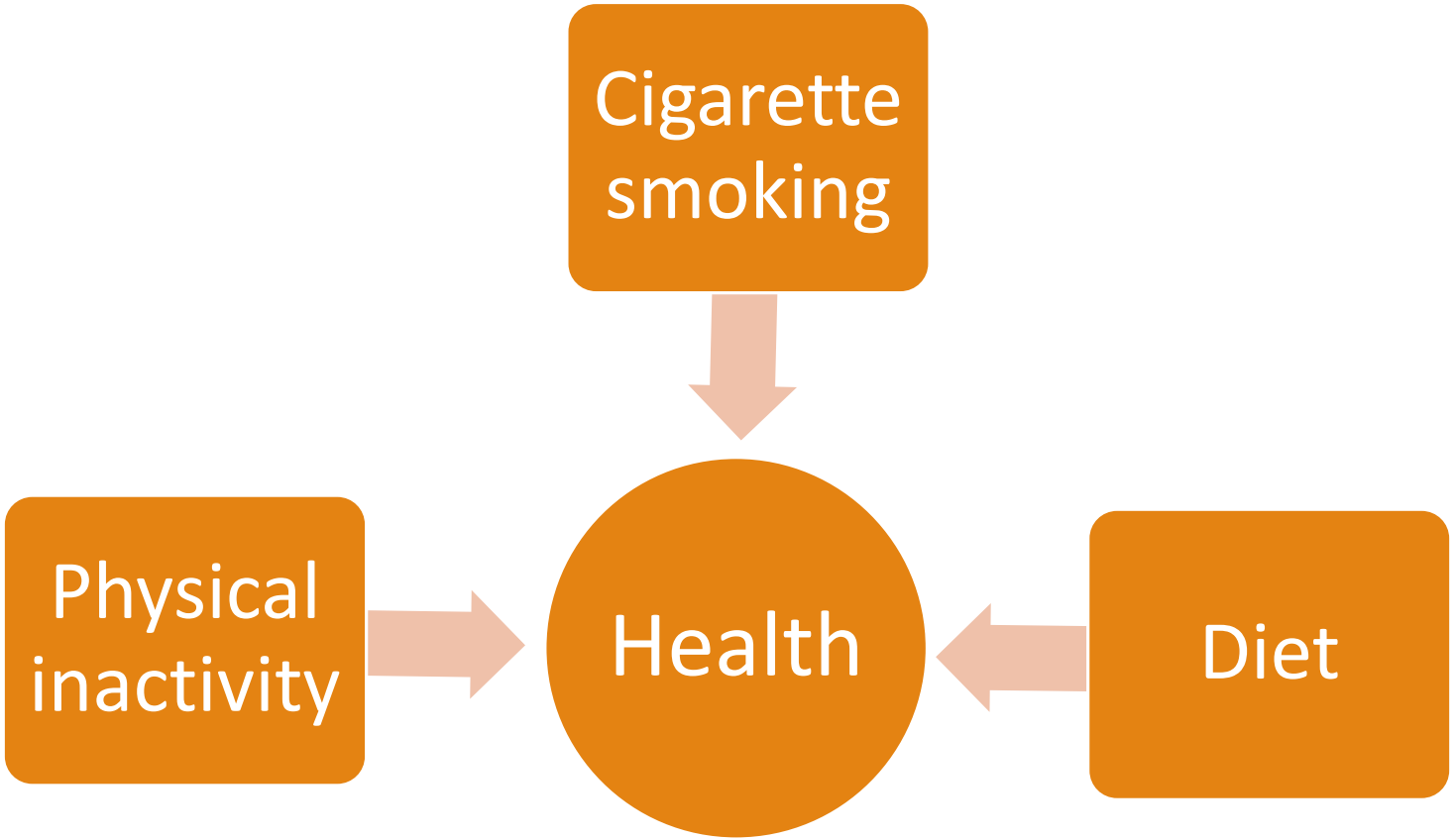
Antony Flew 1979

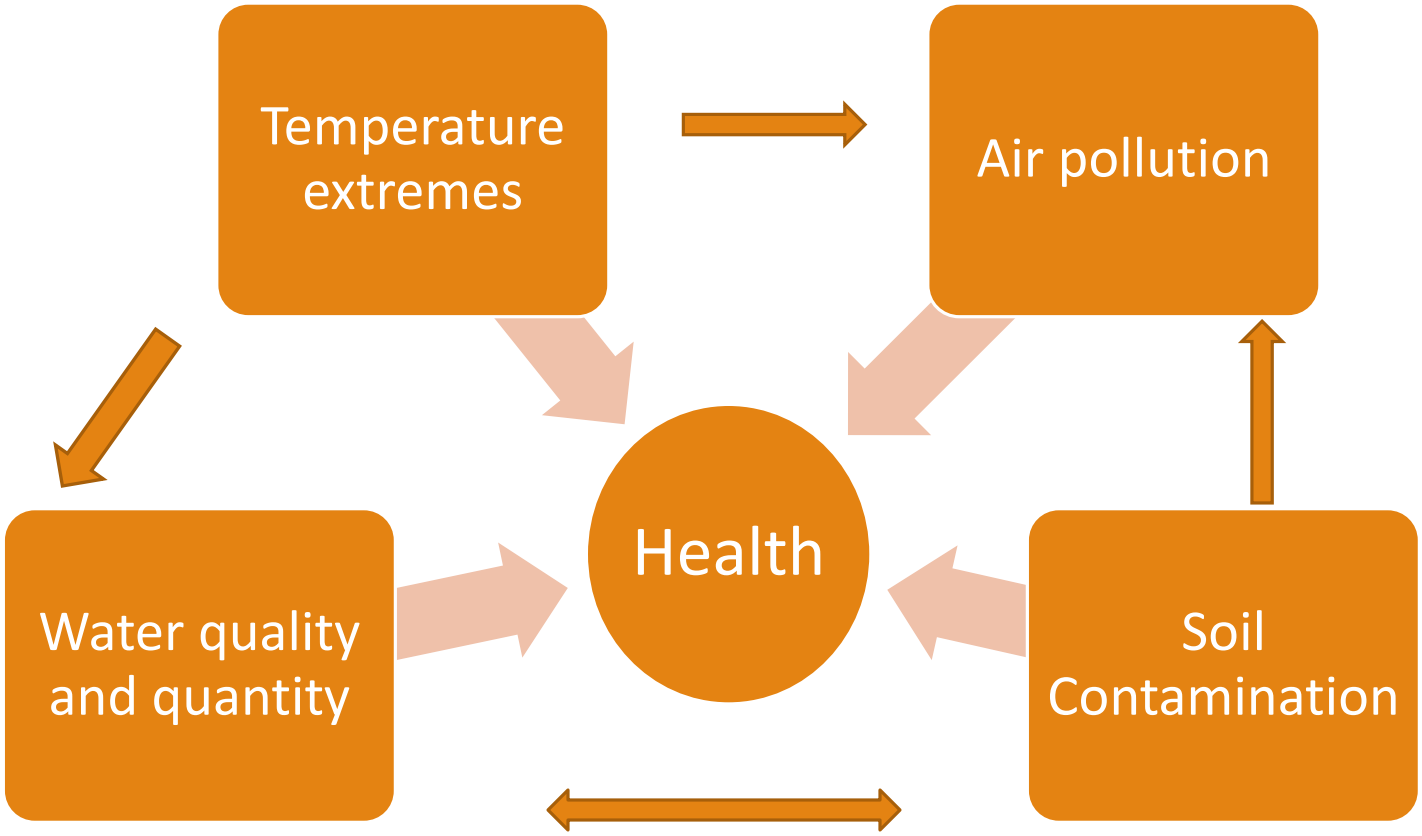
Christian: "*So whatever you wish that others would do to you, do also to them, for this is the Law and the Prophets" Matthew 7:12*

Islam: *"None of you [truly] believes until he wishes for his brother what he wishes for himself."* Number 13 of Imam "*Al-Nawawi's Forty Hadiths*."

Buddhism: *Hurt not others in ways that you yourself would find hurtful."* Udana-Varga 5:18

Judaism: *And what you hate, do not do to any one*." Tobit 4:15


Cigarette smoking
Physical inactivity
Health
Diet


Temperature extremes
Air pollution
Water quality and quantity
Health
Soil Contamination

What can we do to reduce the effects of climate change on health?

Behavioral Change

Not wasting at the individual level (energy, food, water)

Clean energy

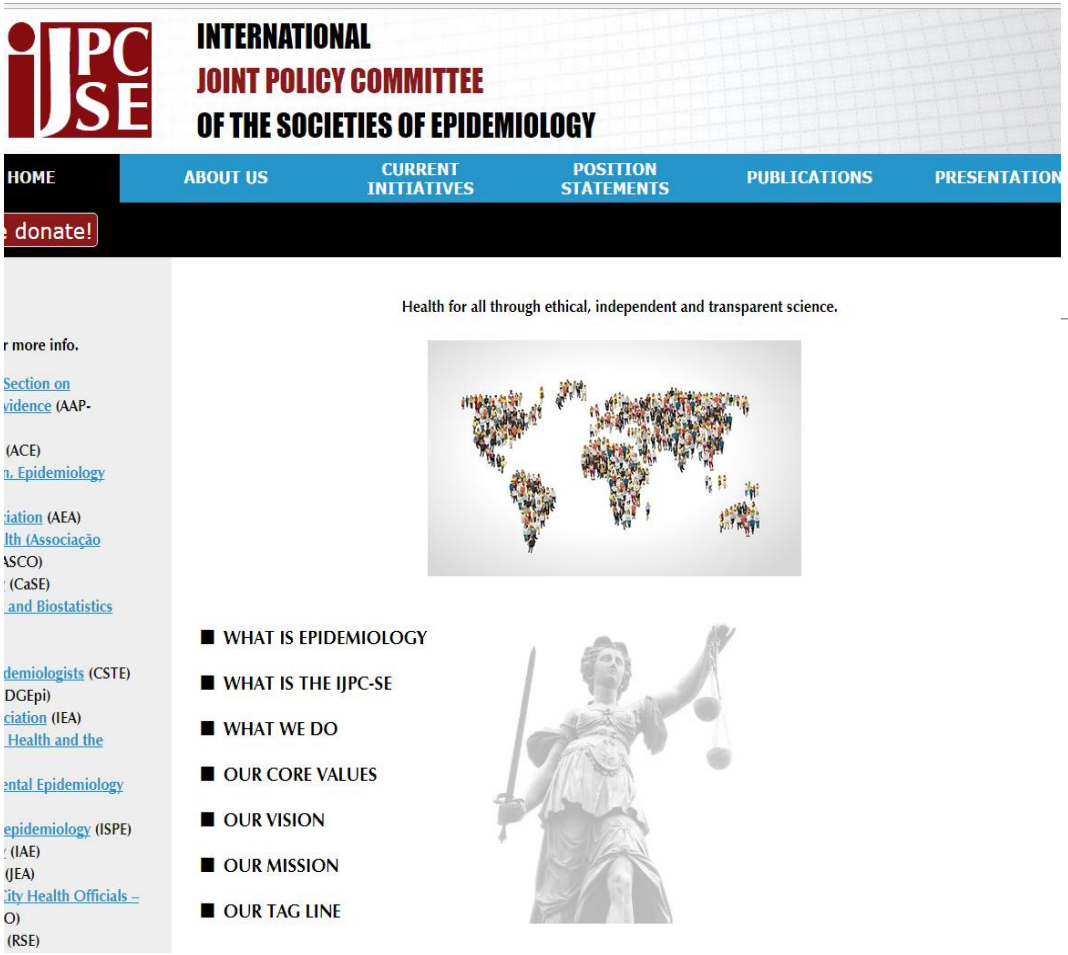
Support sustainable agriculture practice

Home insulation to preserve energy

Less reliance on personal cars

Education K-12 to University

Policy



Health for all through ethical, independent and transparent Science

20 Epidemiology Societies

6 from the US
5 International
Canada
Brazil
Australia and New Zealand
Cameroon
Germany
Italy
Japan
Romania
UK
Spain

We host forums and develop position statements with recommendations to protect and improve public health. Through our collective efforts, we bring to our member organizations the benefit of a unified professional voice in the public interest.

EPIDEMIOLOGY

A Policy Brief

Climate Change and Epidemiology

Al-Delaimy, Wael K.[a]; Krzyzanowski, Michal[b]

Epidemiology: January 2019 - Volume 30 - Issue 1 - p 1–3
doi: 10.1097/EDE.0000000000000925
Commentary

Policy Brief on Climate and Epidemiology

Health aspects of climate change are complex and require interdisciplinary research

Policymakers need to work with epidemiologists so they can contribute to evidence-based policies

Funding agencies need to increase opportunities for epidemiologists

New methodological approaches and training by epidemiologists

Health Policy

In Australia, the Climate and Health Alliance led the development of a comprehensive national policy roadmap on climate change and health—called the ***Framework for a National Strategy on Climate, Health and Well-being for Australia***

Consensus on policy among key influential health and medical groups

Australia is heavily dependent on fossil fuel but the health professionals created an effective bridge to overcome the divide

Commitment by the government to implement it

What can Health Care Providers Do?

Clinical Solutions

Talk to your patients about climate change and its health impact

Physicians should consider air pollution as a recognized risk factor for vascular disease and act accordingly with patients exposed to different levels of pollutants

Climate resilience of critical health care infrastructure and other services.

Update hazard vulnerability analysis (HVA) for hospitals to deal with frequent extreme weather

Clime-sensitive health outcomes survielence

Organize

Climate and Health Alliance (Australia),

Canadian Association of Physicians for the Environment

UK Health Alliance on Climate Change

US Climate and Health Alliance,

Physicians for Social Responsibility (US),

American Public Health Association,

Alliance of Nurses for Healthy Environments (US),

Medical Society Consortium for Climate and Health (US).

Health & Environment Alliance

Healthy Energy Initiative

Health Professionals

Selected Resources for Physicians' Response to Climate Change.

Resource	Website	Description
American College of Physicians	www.acponline.org	Climate change tool kit
American Lung Association	www.lung.org	"State of the Air" report on air pollution
Health Care without Harm	https://noharm.org	Environmentally responsible health care, physician advocacy network
Medical Society Consortium on Climate and Health	https://medsocietiesforclimatehealth.org	Coalition of U.S. medical societies supporting climate action, educational materials, and consensus statements
Physicians for Social Responsibility	www.psr.org	List of local chapters, "Climate change makes me sick" educational campaign
The Lancet Countdown on Health and Climate Change	www.lancetcountdown.org	International research collaboration tracking the world's response to climate change, including a policy brief for the United States

Climate Change-A Health Emergency
Solomon and LaRocque NEJM January 2019

Advocacy and Activism

The world's health professionals are uniquely suited to lead the effort to persuade the world's leaders to increase their commitments to the goal of the Paris Agreement and to rapidly initiate the actions necessary to fulfill their commitments.

Why?

Health professionals are the most trusted members of every society worldwide. They speak with not just scientific but also ethical and moral authority.

Maibach et al Ch.33, *Health of People, Health of Planet and Our Responsibility*, Editors Al-Delaimy, Ramanathan, Sanchez-Sorondo 2020

Messaging

The health harms of climate change and air pollution are happening now

We must take immediate action to protect our communities

Prevention offers the most powerful protection against future harms

Preventive actions will create immediate health and economic benefits.

We must double our commitment to reducing carbon pollution—and then live up to it.

Founding Members

UC Website | Research | Faculty Research Centres | Centre for Research and Action in Public Health | H-Earth

Health-Earth (H-Earth)

H–earth is an international and interdisciplinary network of institutions and individuals which aims to build knowledge about global change and health and develop capacity for effective responses by policymakers, practitioners and communities thereby ensuring long-term population health. Recognising, assessing, forewarning, minimising and adapting to the risks brought by global ecological and social change is vital if global population health is to be improved and to endure. The teaching of this material in schools and universities, at all levels, and to all health workers (i.e. beyond public health) is an important H-earth goal. Understanding the adverse health consequences of unchecked adverse global environmental change is also important for many other disciplines, professions, policy makers and people of all faiths. H-earth has five major research themes:

H-earth
health for all on a single planet

- Poverty
- Climate Change
- Infectious Disease
- Ecosystem disruptions
- Security
- Transformation

For more information contact:

Univ. of Canberra, Australia
Univ of Oulu, Finland
UN Univ, Malaysia

Univ of Victoria, Canada
Massey Univ, New Zealand

Univ of Liverpool, UK
Univ of Strathclyde, UK

Univ of Washington, USA
UC San Diego, USA

Faith Leaders

Faith-based Initiatives: The Encyclical of the Pope (16%), Muslims Scholars (23%), Buddhists (8%)

Encyclical *Pope Francis,* Laudato si' 2015

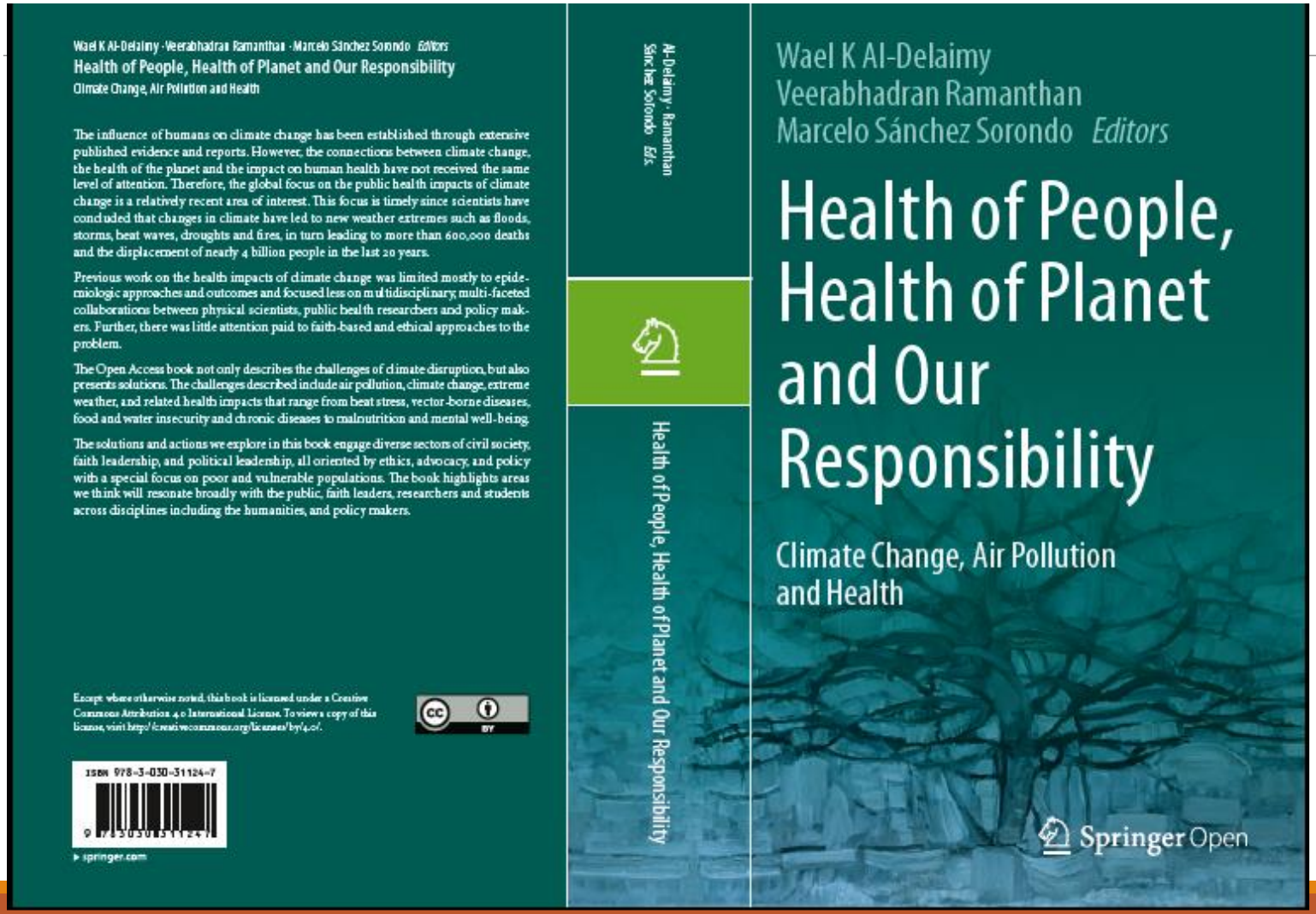
Church of England 2015

Dali Lama 2015

Rabbinic Letter 2016

Muslim Scholars deceleration 2009

The Book-2020



The Pontifical Academy of Sciences

HEALTH OF PEOPLE, HEALTH OF PLANET AND OUR RESPONSIBILITY CLIMATE CHANGE, AIR POLLUTION AND HEALTH

Casina Pio IV • 2-4 November 2017

California Collaborative for Climate Change Solutions (C4S)

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Mission Statement

Speed the translation of research findings into practical solutions, and the movement of solutions to demonstration and pilot projects, and use the pilot projects to promote societal scale-up.

Solutions

Analyses of existing data through linkage

New High Quality Data Collection

Multidisciplinary collaboration

Public Health policy papers and evidence

Develop standard health policy measures of global warming and extreme events that researchers can use in future climate and health research

Media communication and Public Health Advocacy

Solutions

Government adaptation plans that can deal with extreme heat events and dust storms and long-term mitigation initiatives

Evidence based policies and reliance on local epidemiology studies for health impact

Sustainable water resource including the use of grey water

Focus on health of displaced populations and including long term mental impact

Environmental Risk Immigration

Political Instability, conflict and Refugee crises

SYRIA IS THE WORST HUMANITARIAN CRISIS OF OUR TIMES (4 M)

(UNHCR HIGH COMMISSIONER)

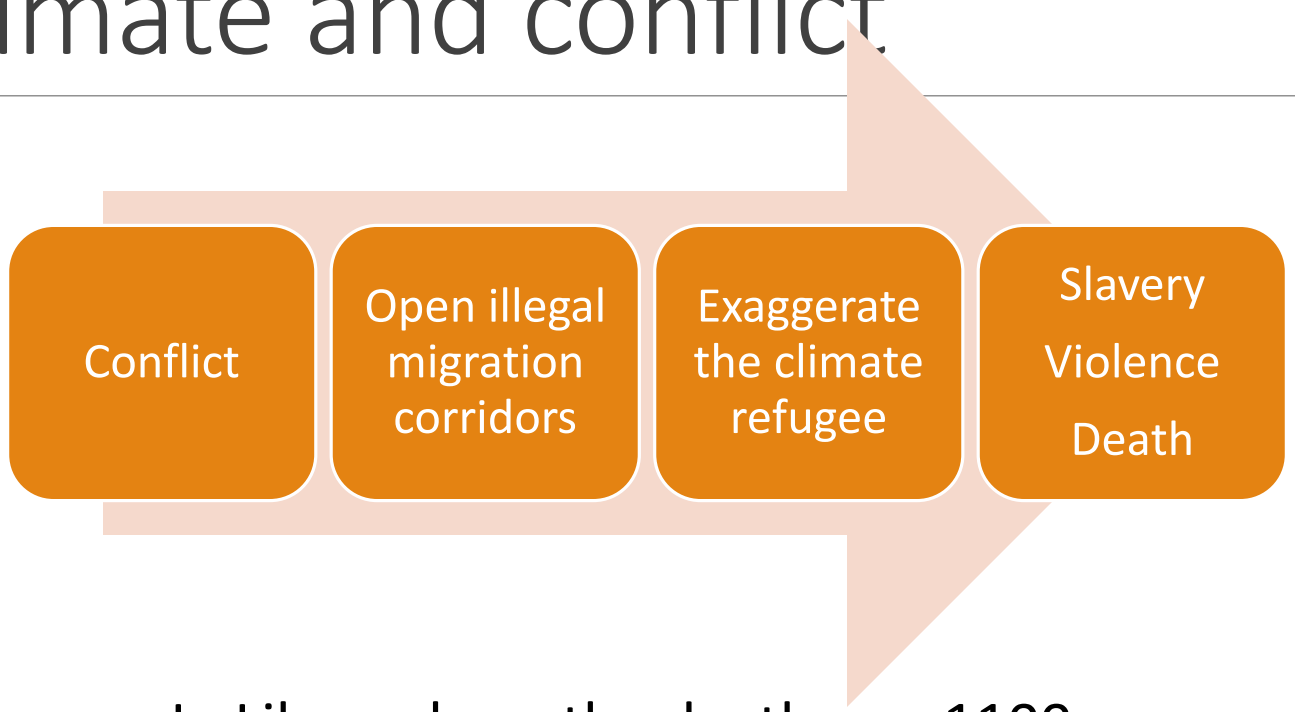
Conflict and Climate

For Syrian conflict, a risk multiplier (Butler 2017).

Maybe?

Climate change is not the cause of that conflict

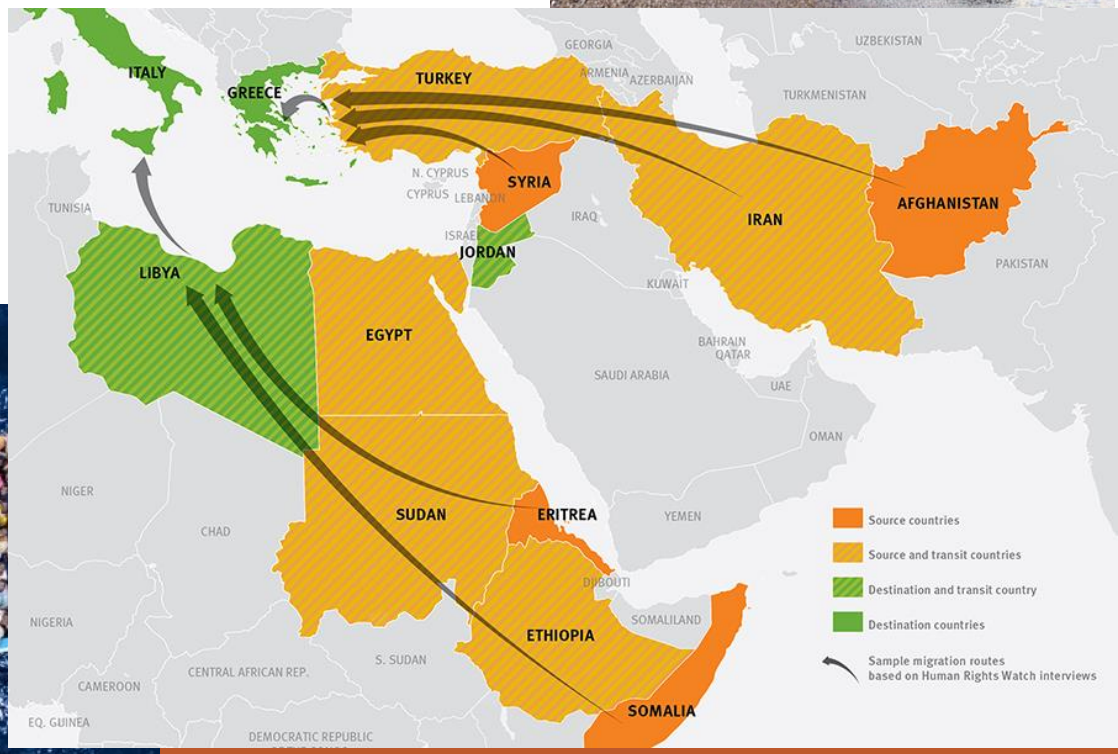
Climate and conflict



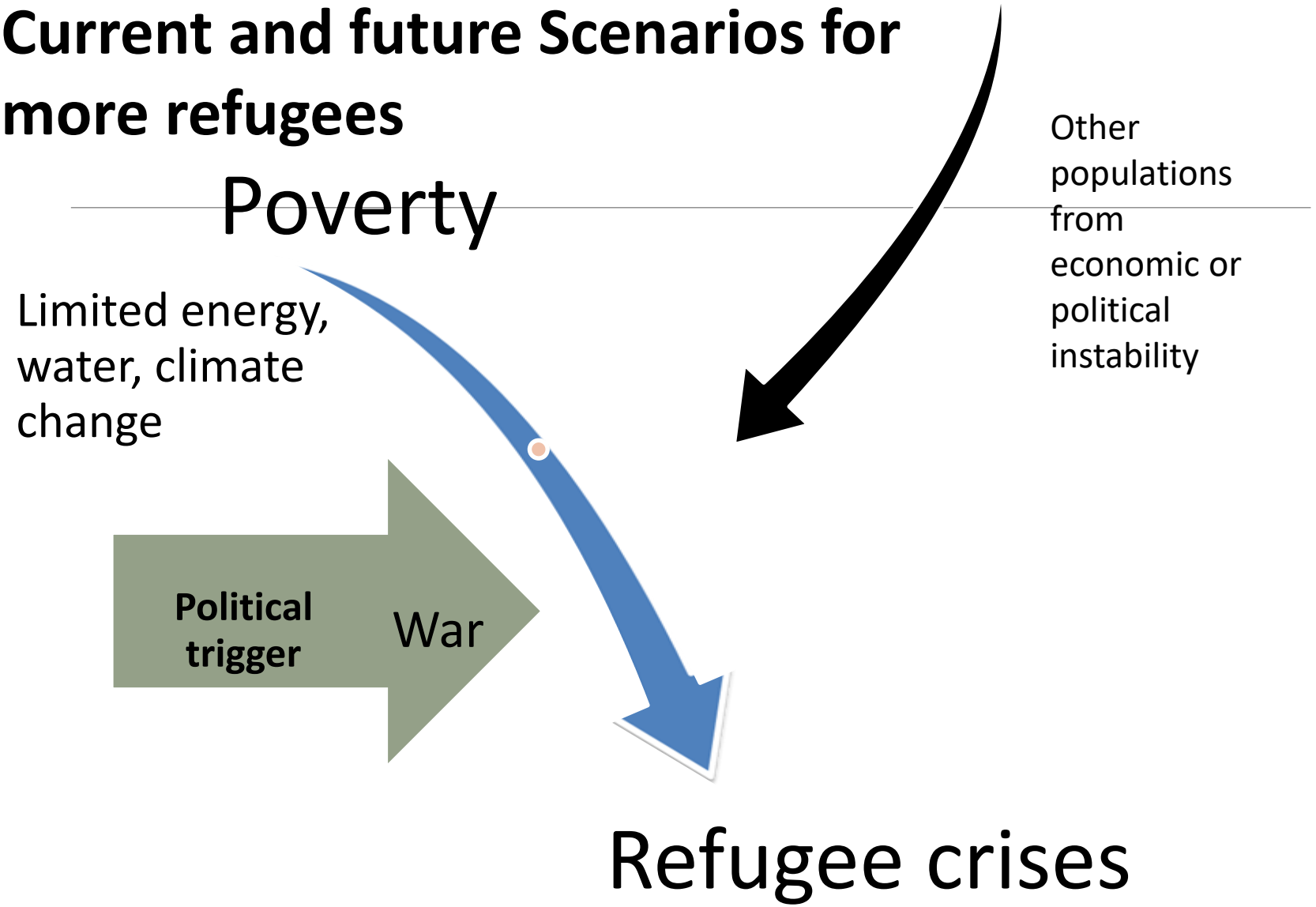
In Libya where the death was 1100 drowning in the past year and 10 times higher risk of death than other routs

Refugee Crisis

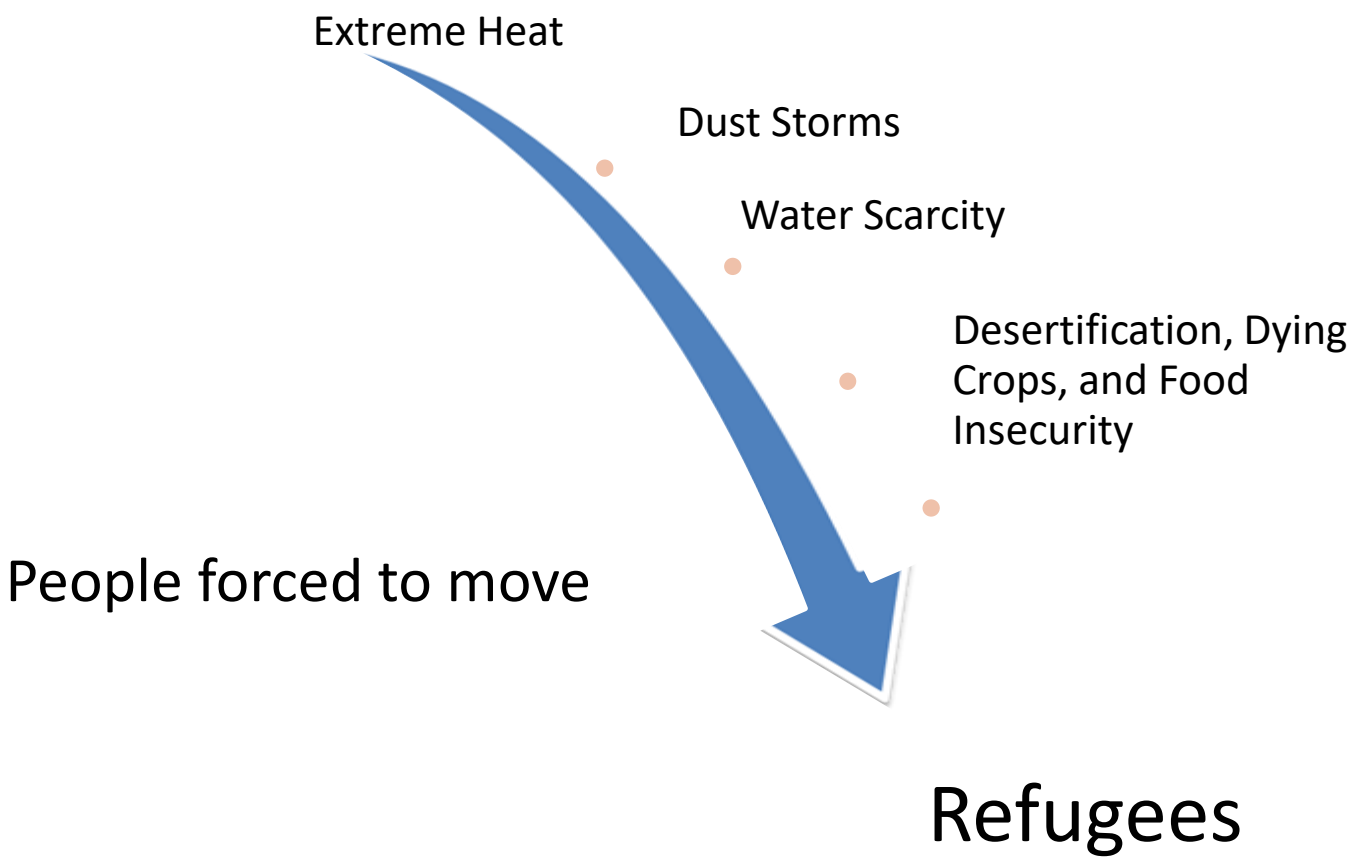
12.4 million newly displaced in 2015
(34,000 per day)
51% <18 years old



Current and future Scenarios for more refugees



Future Scenarios for more refugees from Climate Change in MENA



The Global Mental Health Initiative in the Middle East

University of California San Diego

University of San Diego

George Washington University

Harvard University

http://fpmglobalhealth.ucsd.edu/gmh-about.html

Summary

Humans and their health are the ultimate beneficiaries from protection of the planet

There is a major deficiency in assessment of health impact of degradation of the planet and its environment

Interdisciplinary science will move forward innovation appropriate for the future of the planet

Anthropocene and climate change is an ethical and moral argument and we have the upper hand of this argument but are not using it