UNIVERSITÄT HEIDELBERG
Zukunft. Seit 1386.

Climate change and Global Health: any links?

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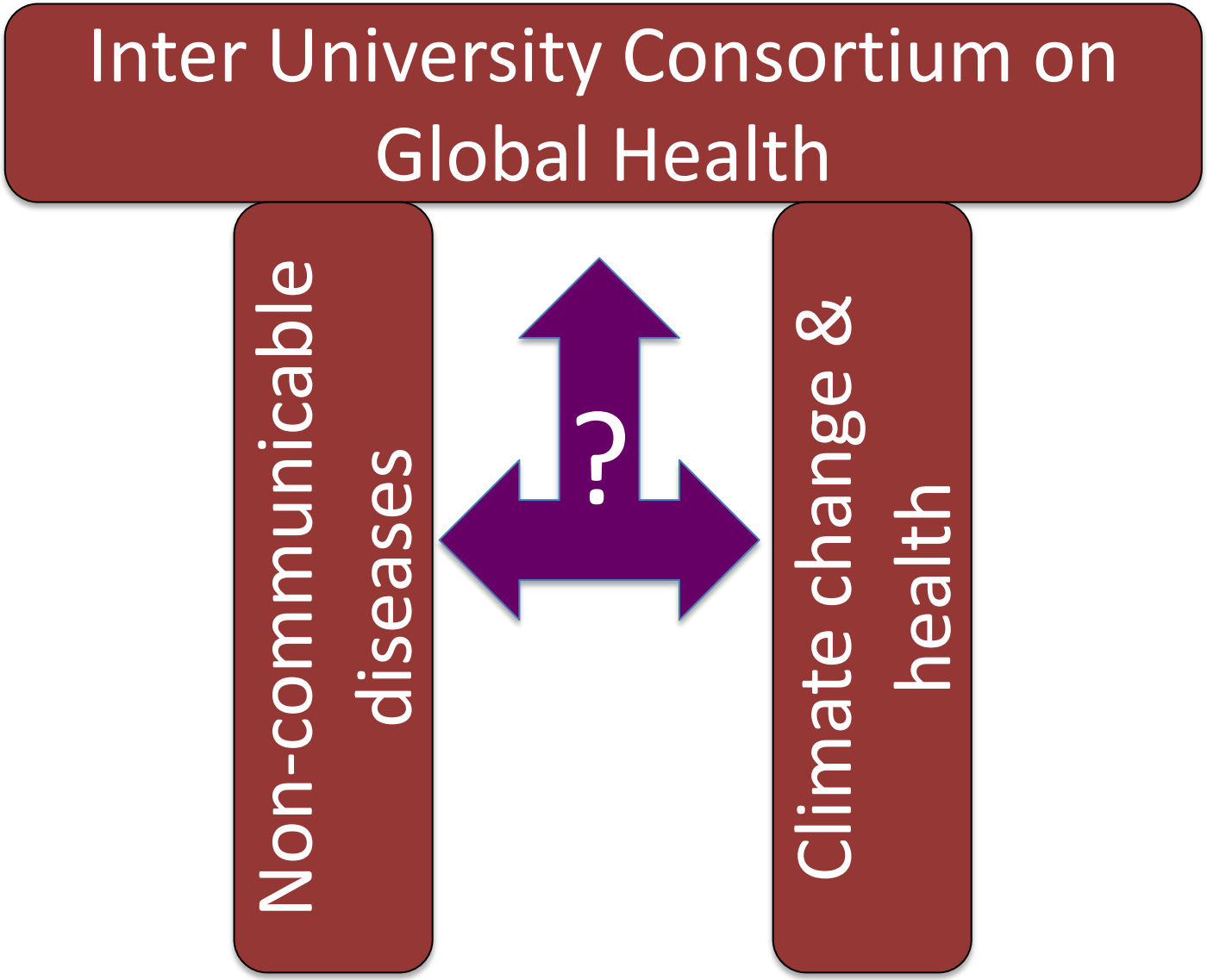
Guest professor at Umeå University, Sweden

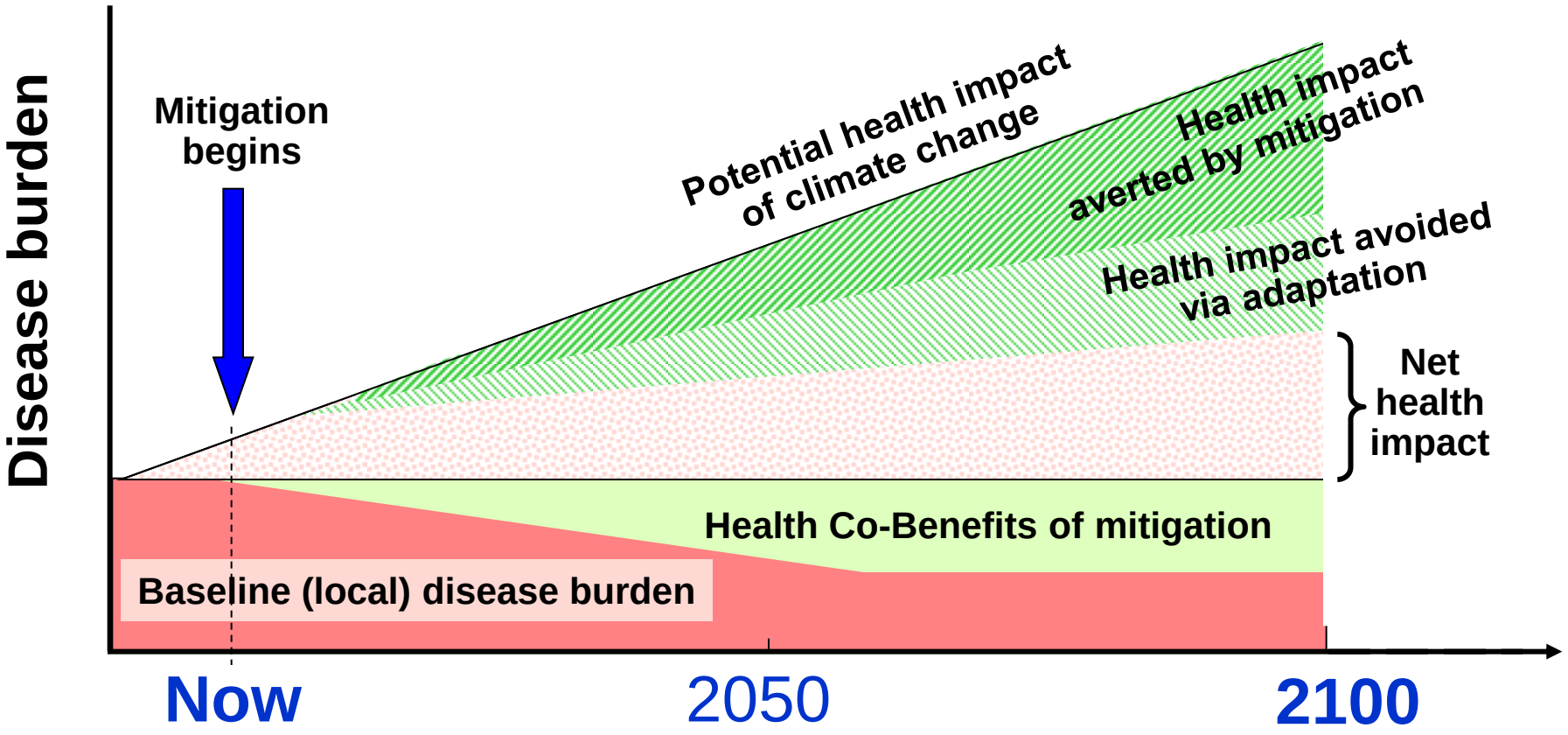
International Symposium on Research, Policy & Action to Reduce the Burden of Non-Communicable Diseases Universitas Gadjah Mada. Yogyakarta, September 26, 2013


Inter University Consortium on Global Health
Non-communicable diseases
?
Climate change & health

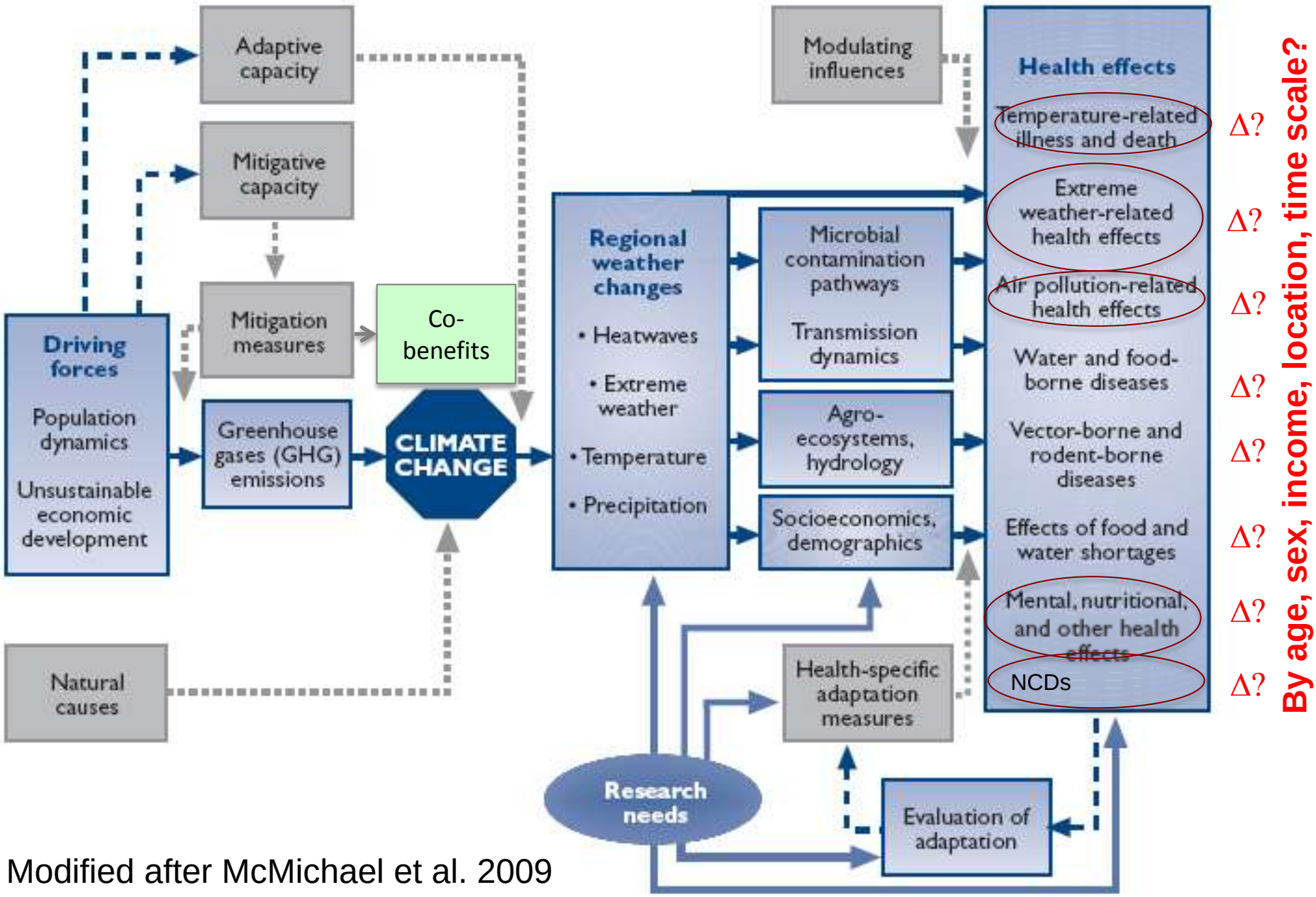
Concepts of Climate science useful for linking up with NCD control

- **Health Impact of climate change (CC)**
  - increase in disease burden, mortality, severity of diseases) attributable to climate change, in the absence of climate specific adaptation measures
- **Adaptation**
  - Disease control or health system specific measures to reduce the health impact of CC
- **Mitigation**
  - Measures to reduce emissions of Greenhouse Gases (GHG) or increase their sinks
- **Health co-benefits of mitigation**
  - Benefits accruing to our health while implementing a mitigation measure

Reducing the Health Impacts of Climate Change
… while increasing Health Co-Benefits of Climate Policy

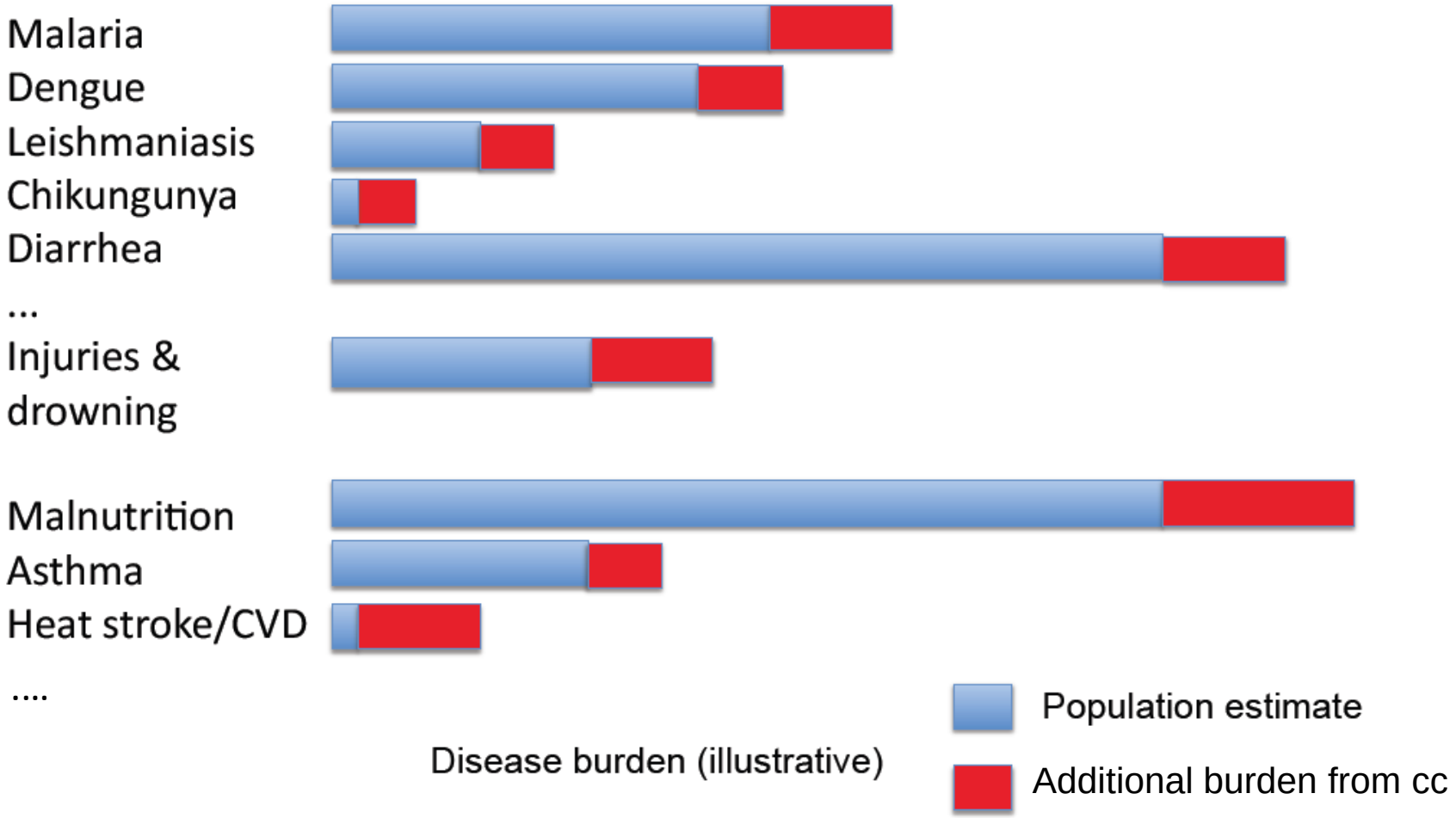


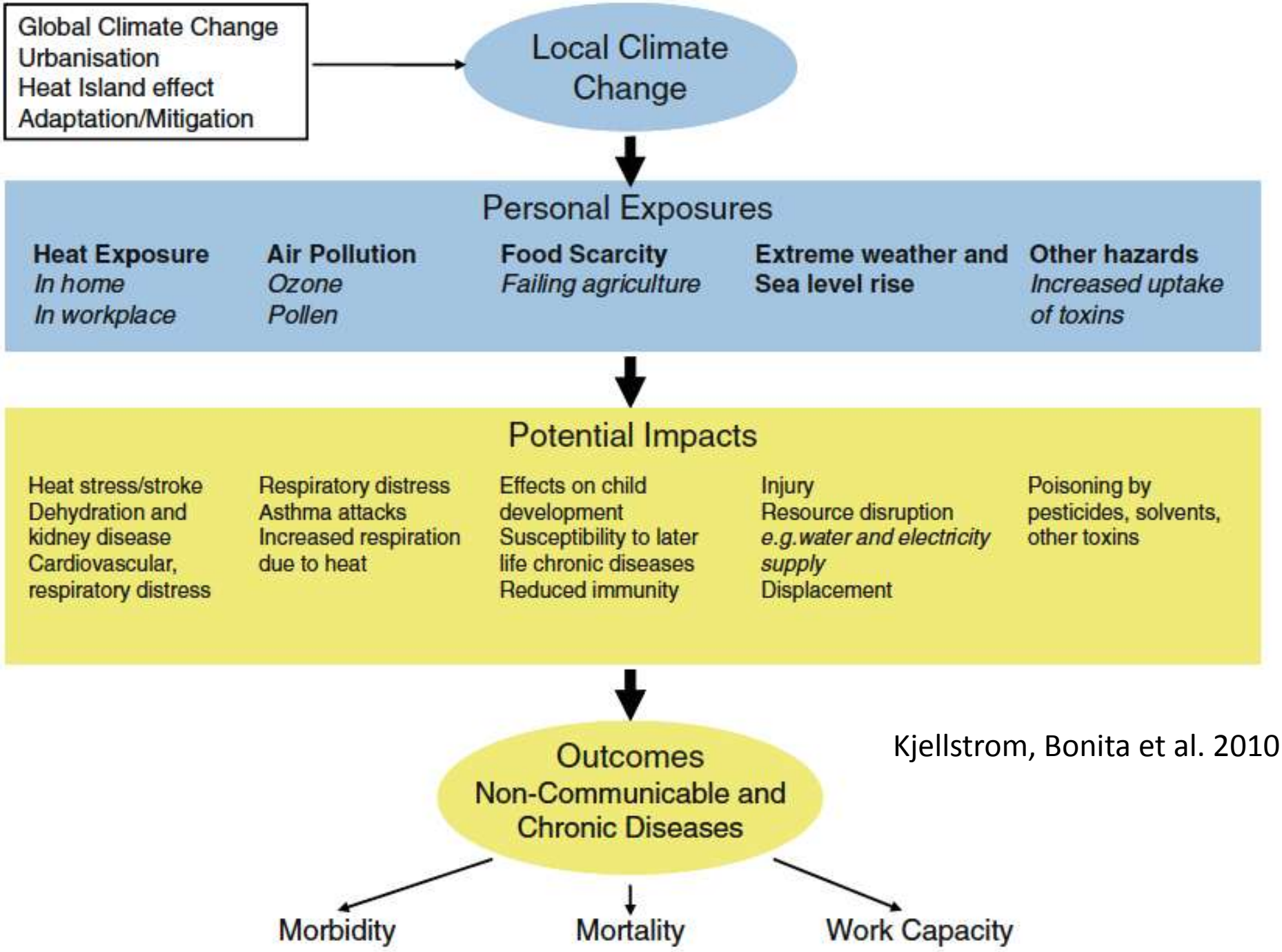
Processes leading to health impacts



Modified after McMichael et al. 2009

Climate change does not “create” new diseases, but increases the burden from some climate-sensitive ones, with a typical pattern of time, space and risk groups





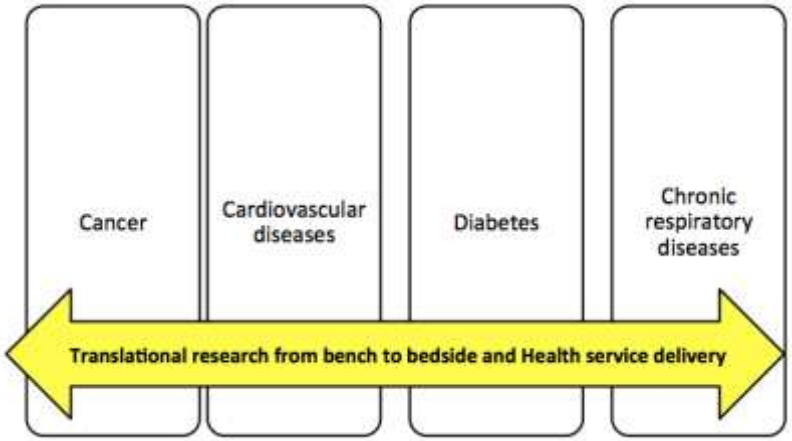
Kjellstrom, Bonita et al. 2010

The challenge: empirical, long-term, information:

- Population
  - Population denominator (age, sex,indiv. & hh disease covariates, location & time (L,T)
- Risk factor
  - Type
  - Probability it carries
  - Lag time till disease
  - Long time projections
- Climate
  - –T, Pr, …, -15 years
  - –Current measurement
  - –Long time projectiosn to 2030, 2050..
- Disease (NCDs)
  - –Deaths by cause, sex, age L,T
  - –Incident cases,
  - –Burden of disease

What is an NCD…?

- The big 4?



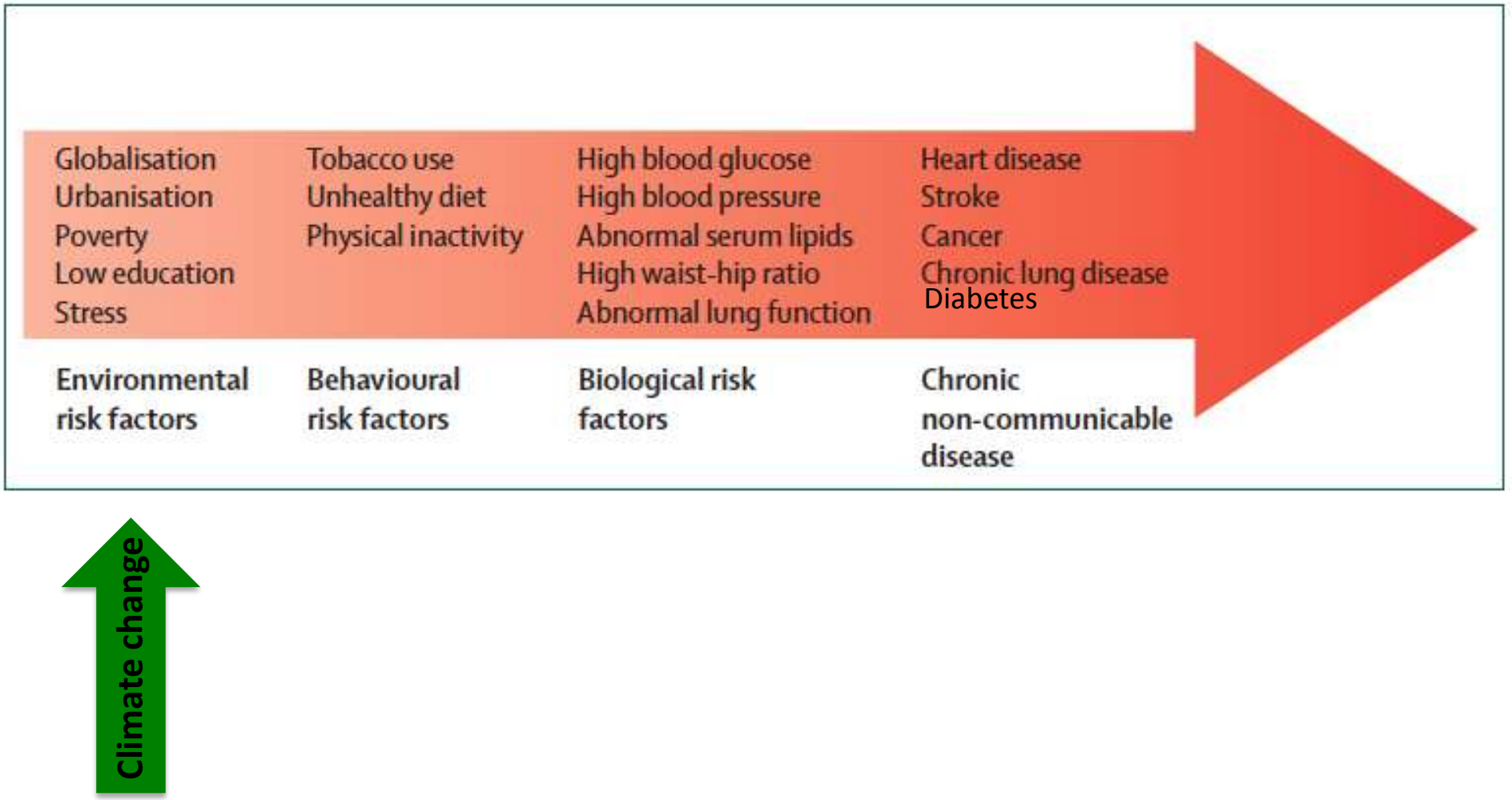
4 main risk factors
Smoking
Salt
Fat
Physical Inactivity

- NCD plus mental disorders?
- All non-communicable chronic diseases
  - Including MS, Parkinson, malnutrition, etc. etc.
    - Including HPV-caused cervical cancer, HBV-caused primary liver cancer etc.

Two-way relationship between NCDs and CC

- **Climate change can increase the incidence, severity and case fatality of NCDs**
  - Asthma
  - COPD
  - Allergies
  - Cardiovascular diseases (myocardial infarction)
  - Cerebrovascular diseases (stroke)
  - Multiple sclerosis
  - Renal failure/calculi
  - Chronic malnutrition
  - Mental disorders/depression/PSS
- **NCDs increase patients' vulnerability to cope with CC, e.g. heat waves**
  - Patients with reduced microcirculatory reactivity due to disease or/and drugs
    - Diabetes, hypertension, any vaso-actives substance, obesity
  - People with reduced mobility, e.g. the elderly
  - People with cognitive impairment/mental disorders
  - Patients with renal insufficiency

Climate change as a risk factor for NCDs

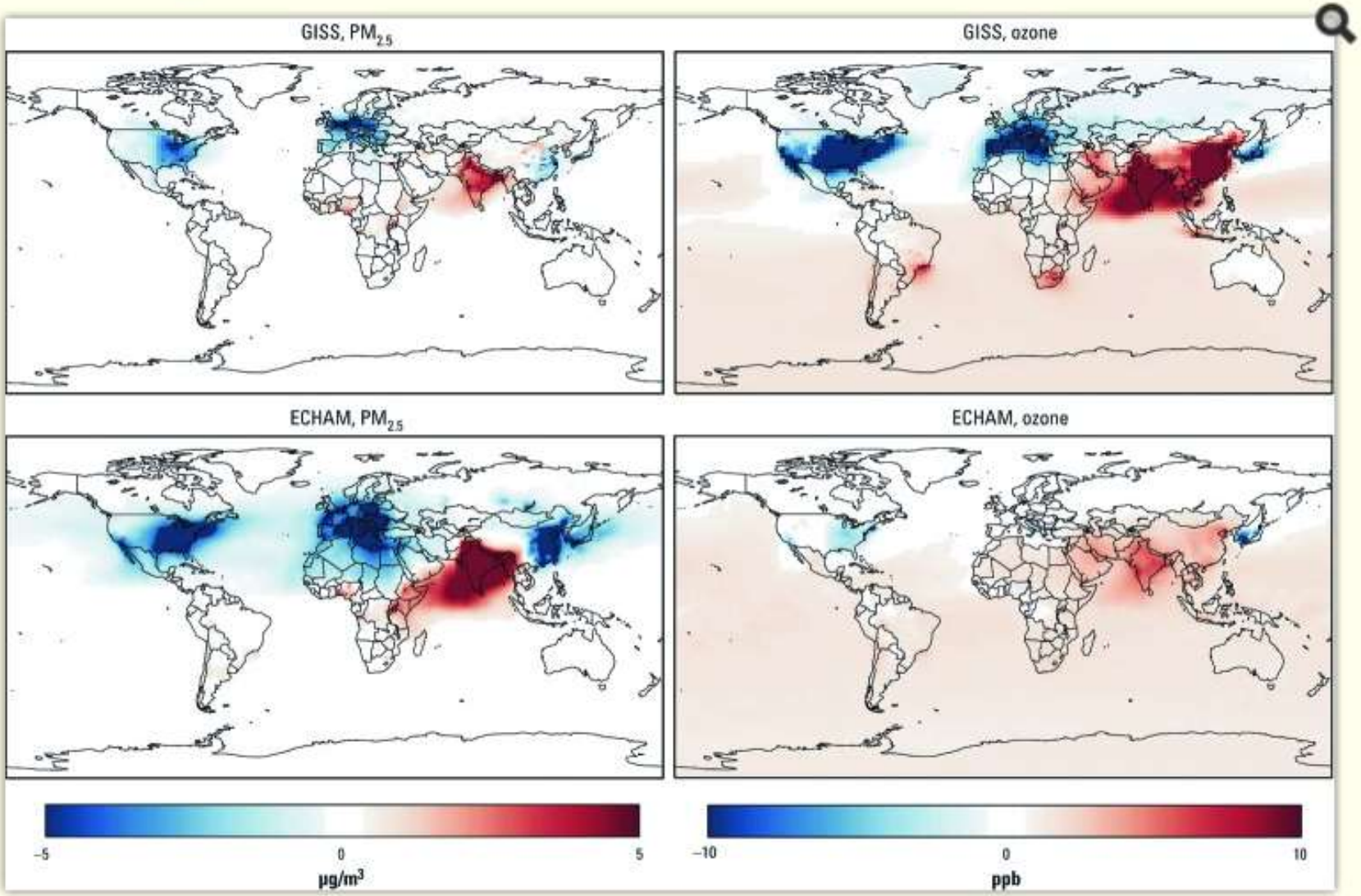


Climate change impact on NCDs

Climate change impacts	Pathway from climate change to NCDs	NCD outcome	Direction of health risk
	Direct		
More frequent and increased intensity of heat extremes	Heat stress	CVD Respiratory disease	Increased risk
Increased temperatures and less rainfall	Higher ground-level ozone and other air pollutants	CVD Respiratory disease (e.g., bronchitis, asthma)	Increased risk
	Increases in airborne pollens and spores	Respiratory disease (e.g., bronchitis, asthma)	Increased risk
Changes in stratospheric ozone and in precipitation and cloud coverage	Increased exposure to solar UVR	Autoimmune diseases (multiple sclerosis)	Reduced risk
Higher winter temperatures in temperate latitudes		CVD Respiratory disease	Reduced risk
Extreme weather event (fires, floods, storms)	Structural damage	Injuries	Increased risk
	Indirect		
Drought, flooding	Impaired agriculture, reduced food yields, and nutrition insecurity	Poor general health	Increased risk
Extreme weather event (fires, flooding, storms)	Trauma	Mental health (posttraumatic stress disorder)	Increased risk
Extreme weather event (fires, flooding, storms)	Impaired livelihood, impoverishment	Mental health (anxiety/depression)	Increased risk

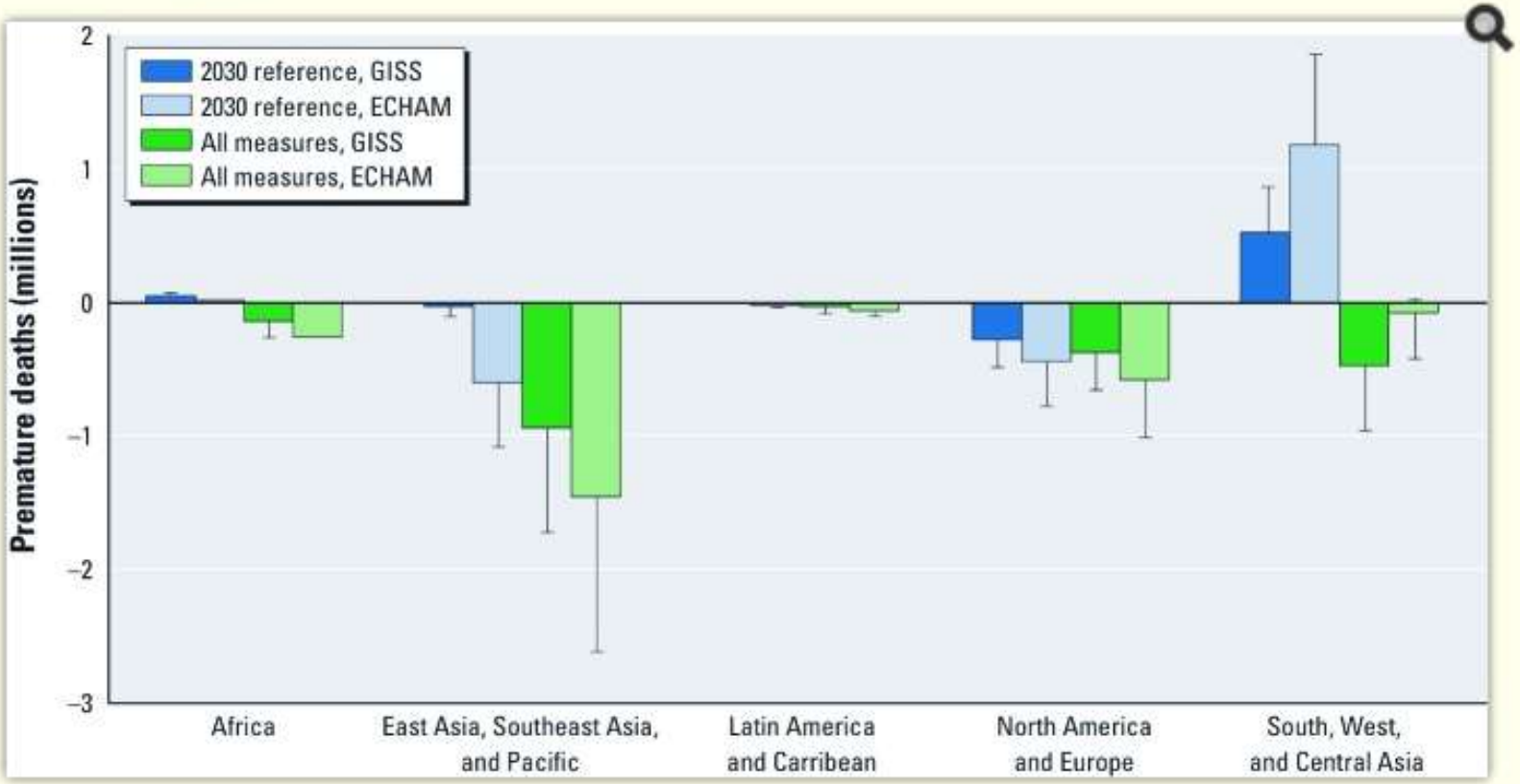
Friel et al, 2011

Figure 1



Estimated changes in annual average $PM_{2.5}$ (µg/m^3) and seasonal (6-month) average 1-hr daily maximum ozone (ppb) concentration for the 2030 reference scenario relative to 2005, based on the GISS and the ECHAM models.

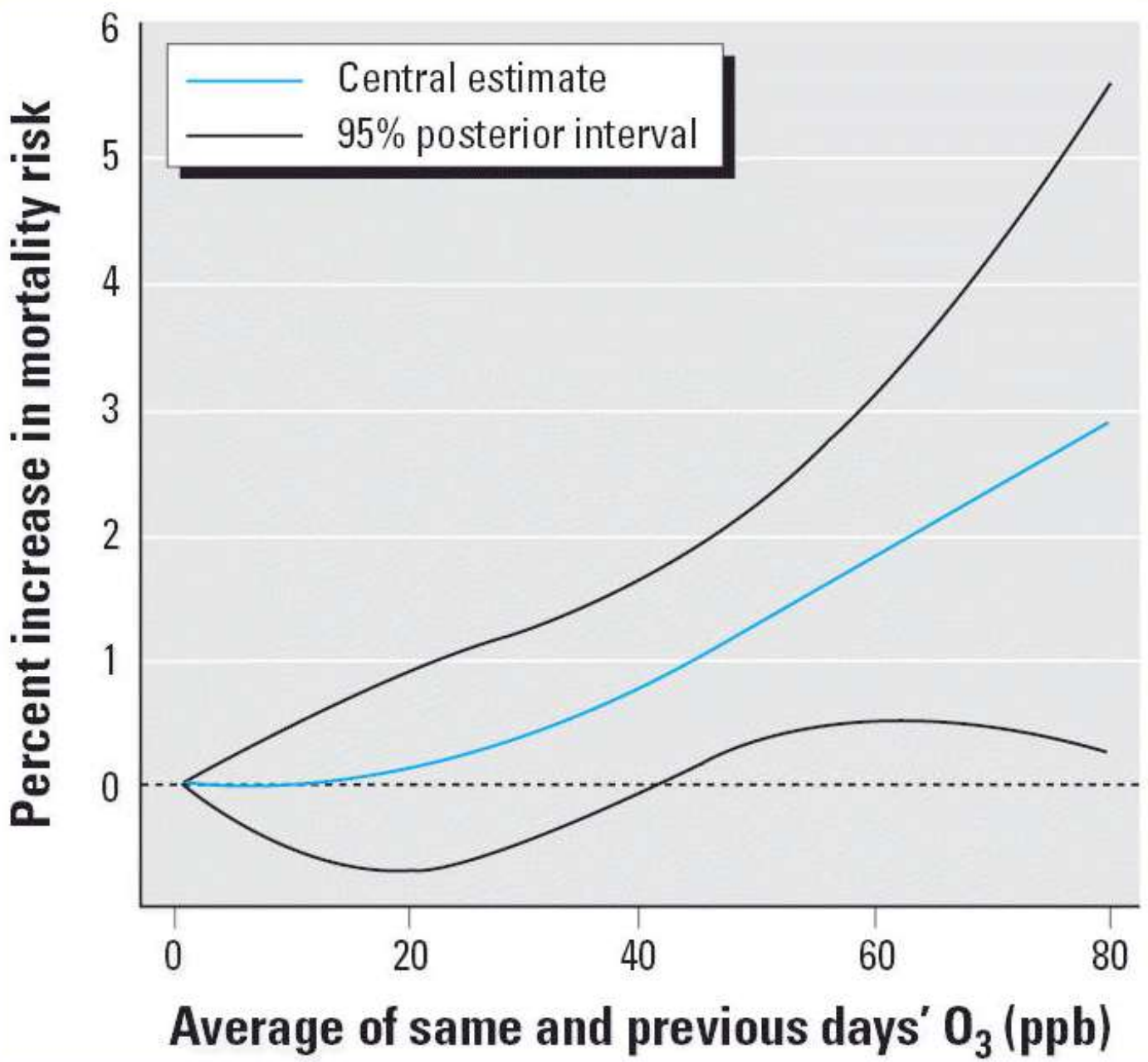
Climate change as risk factor for NCDs



Estimated changes in premature $PM_{2.5}$-related mortality (cardiopulmonary and lung cancer deaths) and ozone-related mortality (respiratory deaths) for the 2030 reference scenario and assuming implementation of methane plus BC group 1 and BC group 2 (all) measures relative to 2005, based on 2030 population projections. 95% CIs reflect uncertainty in the CRF only.

IPCC 2013 (draft)

Figure 3


Central estimate
95% posterior interval
Percent increase in mortality risk
6
5
4
3
2
1
0
0
20
40
60
80
Average of same and previous days' O_3 (ppb)

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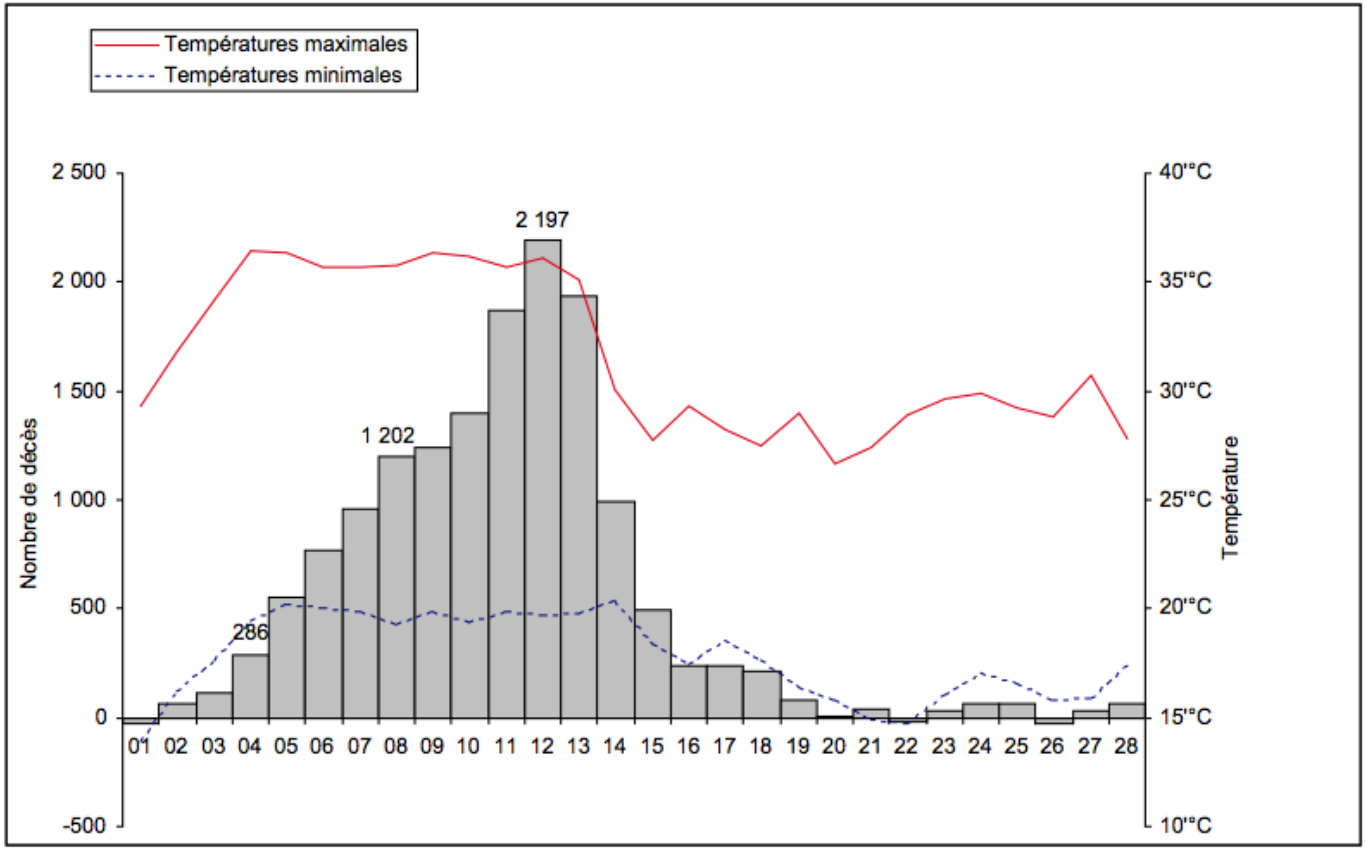
Friel et al, 2011

Daily plot of deaths and temperature, 1-20 August 2003



Source: Hémon and Jougla, 2003

Repartition of deaths by age and sex, 1-20 August 2003

TABLEAU III.1 : Répartition des décès par âge et sexe pendant la période du 1er au 20 août

	Femmes				Hommes				Total			
	O	E	O/E	O-E	O	E	O/E	O-E	O	E	O/E	O-E
< 44 ans	**538**	**547**	**1,0**	**-9**	**1 310**	**1 159**	**1,1**	**151**	**1 848**	**1 706**	**1,1**	**142**
< 1an	72	76	0,9		105	95	1,1		177	171	1,0	
1-14 ans	45	41	1,1		59	58	1,0		104	99	1,0	
15-24 ans	60	66	0,9		208	191	1,1		268	257	1,0	
25-34 ans	91	101	0,9		275	270	1,0		366	371	1,0	
35-44 ans	270	262	1,0		663	545	1,2		933	807	1,2	
45-74 ans	**3 896**	**2 852**	**1,4**	**1 044**	**7 345**	**5 939**	**1,2**	**1 406**	**11 241**	**8 791**	**1,3**	**2 450**
45-54 ans	646	543	1,2		1 566	1 255	1,2		2 212	1 798	1,2	
55-64 ans	995	695	1,4		2 070	1 633	1,3		3 065	2 328	1,3	
65-74 ans	2 255	1 614	1,4		3 709	3 050	1,2		5 964	4 664	1,3	
≥ 75 ans	**18 018**	**9 543**	**1,9**	**8 475**	**10 514**	**6 779**	**1,6**	**3 735**	**28 532**	**16 322**	**1,7**	**12 210**
75-84 ans	6 414	3 417	1,9		6 169	3 919	1,6		12 583	7 336	1,7	
85-94 ans	8 878	4 924	1,8		3 748	2 564	1,5		12 626	7 488	1,7	
≥ 95 ans	2 726	1 202	2,3		597	296	2,0		3 323	1 498	2,2	
Total	**22 452**	**12 942**	**1,7**	**9 510**	**19 169**	**13 877**	**1,4**	**5 292**	**41 621**	**26 819**	**1,6**	**14 802**

Source: Hémon and Jougla, 2003


Heat wave, Paris 2003, view from an elderly defunct’s appartment

The elderly die over proportionally in heat waves, both in OECD as well as in Low income countries (Diboulo et al. 2012)

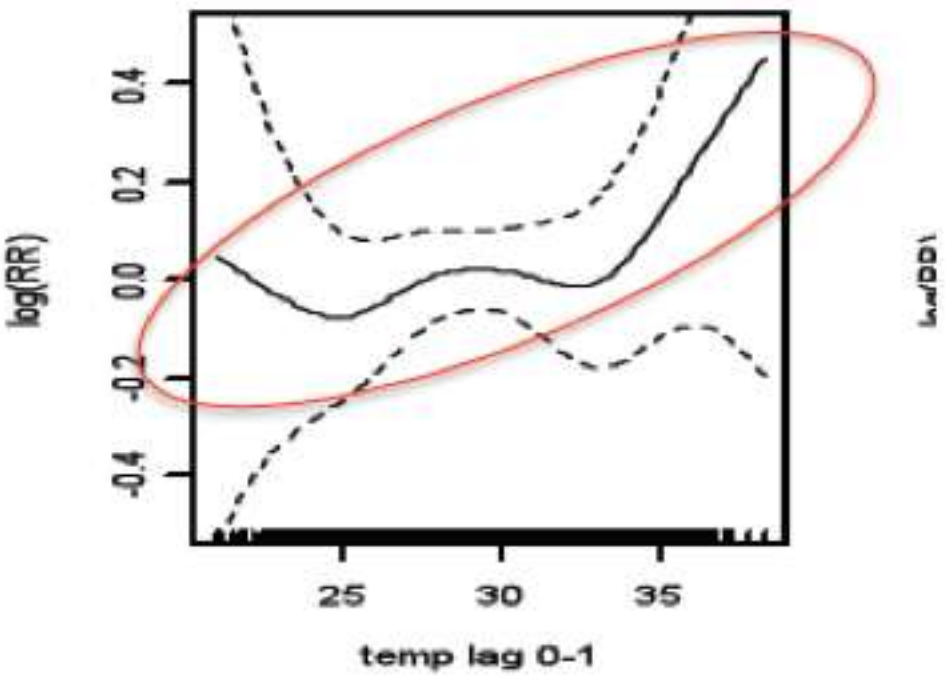


Fig. 11-5 B1. Relationship between the risk of dying and temperature on the preceding day. Y-axis: log(RR), XS-axis: Temp in °C, lagged by one day. <red elipse optional..>

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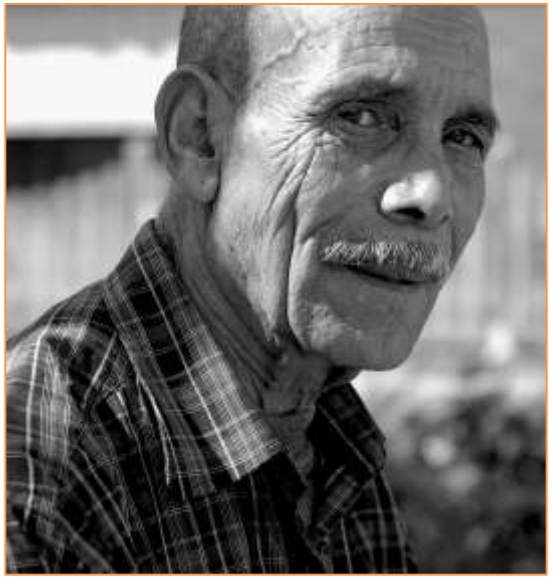
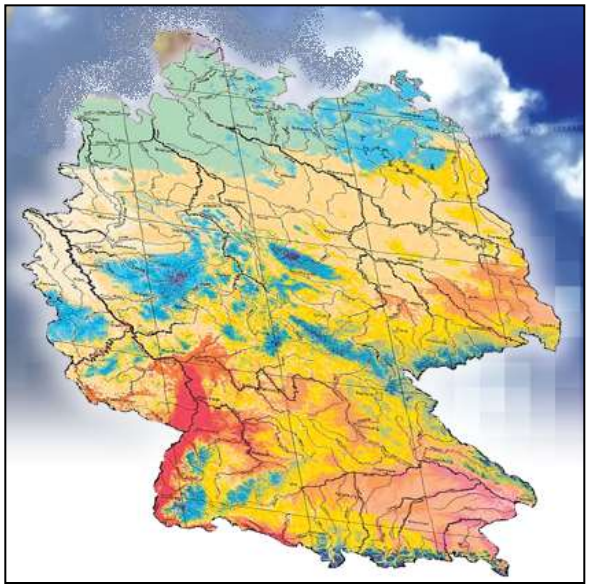
Exploring the potential of general practitioners to implement prevention of adverse health effects of heat for their elderly patients in Rhein-Neckar-County: A mixed-methods-study





Alina Vandenbergh, PhD student, Institute for Public Health and Network for Aging Research

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Co-benefits of climate-friendly energy policy

Sector	Strategy	Climate change implications	Pathway from climate change to NCDs	NCD risk
Energy	Reduce household use of solid (biomass) fuels	Mitigation: reduce GHG emissions	Reduced indoor air pollution	Reduced CVD Reduced respiratory diseases Reduced COPD
	Generate cleaner electricity	Mitigation: reduce GHG emissions	Reduced outdoor pollution	Reduced respiratory diseases
	Improve household energy efficiency: provide efficient heating and cooling appliances, improve home insulation	Mitigation and adaptation		Reduced CVD Reduced respiratory diseases Reduced extreme temperature mortality

[a]Abbreviations: COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; GHG, greenhouse gas; NCDs, noncommunicable diseases.

Co-benefits of climate-friendly agricultural practices

Sector	Strategy	Climate change implications	Pathway from climate change to NCDs	NCD risk
Food and agriculture	Reduce production and consumption of animal source products	Mitigation: reduce GHG emissions	Less saturated fat intake	Reduced CVD Reduced colorectal cancer Reduced general health
	Support rural development: new food production techniques, rural livelihoods	Adaptation: improve resilience to climate change	Improved and expanded supply of nutritional food sources	Decreased undernutrition and improved resilience to NCDs
	Food system diversification: invest in urban agriculture	Adaptation	Increased food security	Increased resilience to NCDs

[a]Abbreviations: COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; GHG, greenhouse gas; NCDs, noncommunicable diseases.

Co-benefits of urban planning

Sector	Strategy	Climate change implications	Pathway from climate change to NCDs	NCD risk
Urban planning	Improve walking and cycling infrastructure	Mitigation: reduce GHG emissions	Increased active transport, physical activity	Reduced CVD Reduced obesity Reduced respiratory diseases
	Develop and support community hubs	Mitigation: reduce GHG emissions	Increased connectivity; reduced use of fossil fuel–dependent cars; more active travel	Reduced obesity Reduced CVD Reduced heat stress Reduced respiratory diseases Improved mental health
	Reduce use of fossil fuel–dependent cars, supply hybrid or electric cars for fleet vehicles	Mitigation: reduce GHG emissions	Reduced urban air pollution; reduced road traffic volume	Reduced lung cancer Reduced respiratory diseases
	Improve urban design, including street trees, pedestrian crossings, more footpaths, reduced distance to public transport, more urban green space	Mitigation and adaptation	More social connectivity; more shade; greater walkability and active travel	Reduced obesity Reduced CVD Reduced heat stress Reduced respiratory diseases Improved mental health

[a]Abbreviations: COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; GHG, greenhouse gas; NCDs, noncommunicable diseases.

Health co-benefits of mitigation: transport, London

	Change in disease burden	Change in premature deaths
Ischaemic heart disease	10-19%	1950-4240
Cerebrovascular disease	10-18%	1190-2580
Dementia	7-8%	200-240
Breast cancer	12-13%	200-210
Road traffic crashes	19-39%	50-80

Andy Haines, 2010

Health co-benefits of mitigation: transport, Dehli

	Change in disease burden	Change in premature deaths
Ischaemic heart disease	11-25%	2490-7140
Cerebrovascular disease	11-25%	1270-3650
Road traffic crashes	27-69%	1170-2990
Diabetes	6-17%	180-460
Depression	2-7%	NA

Andy Haines, 2010

CONCLUSION (i): Similarities of NCD and CC&health research

- Long lag times between risk and disease
- Long-term population-based cohort studies are key
- Concept of risk factor/population-attributable risk
- Climate change as an effect-modifier of NCD risk
- NCD as increased vulnerability to CC impact
- NCD as climate impact
- Involvement of non-health sectors is key as in all global health approaches
  - In research
  - In policy response

CONCLUSION (ii)
Mutual influence of
NCDs and climate-related health impacts

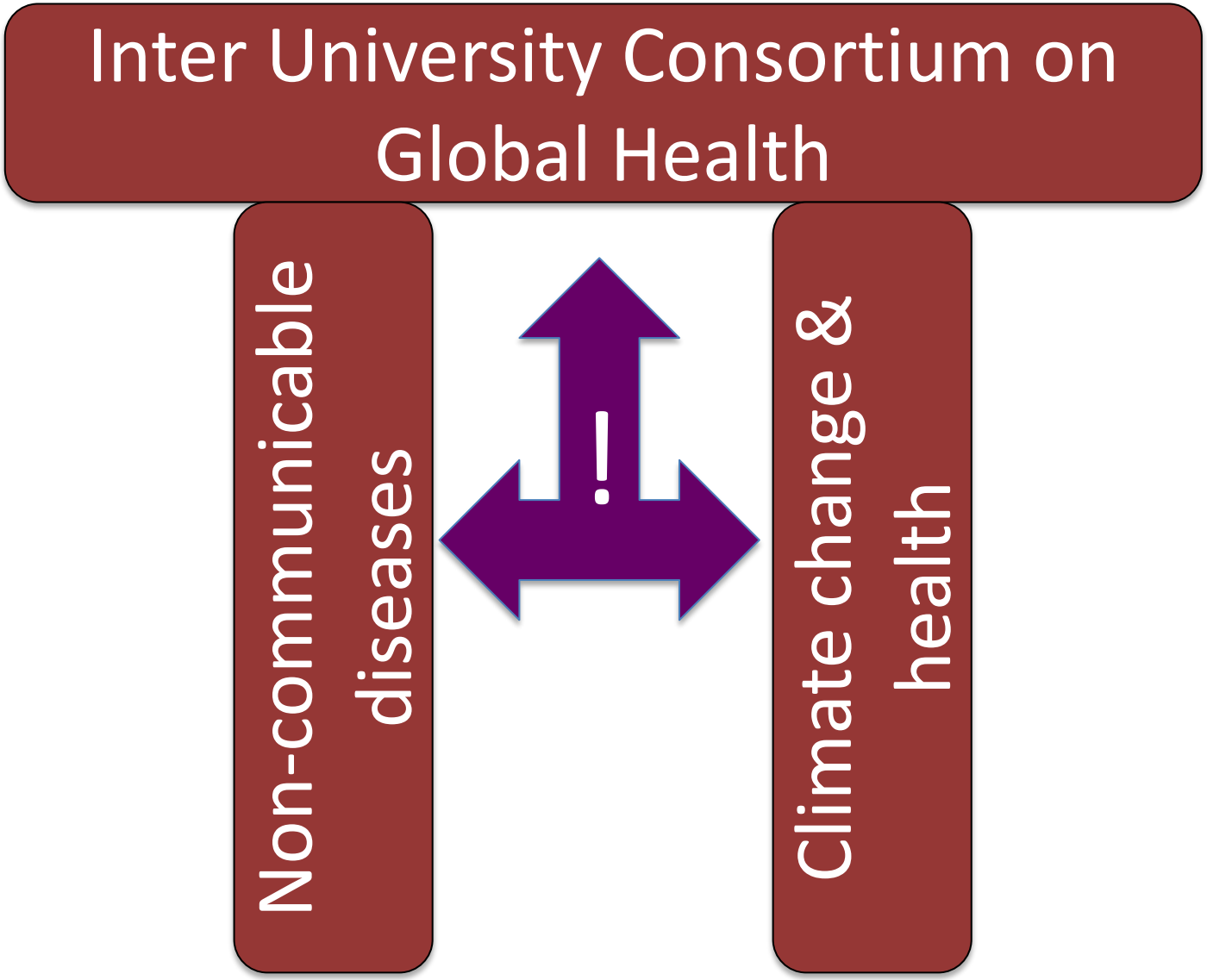
- Positive:
  - some co-benefits of mitigation (climate policy) reduce NCD risk
- Negative
  - Climate change increases NCD-burden
  - NCDs decrease the adaptation capabilities of the chronically ill/multi-morbid patient

Teaching challenges for our IUCGH

- Include NCD-CC links in all graduate and postgraduate training formats
- Fund PhD thesis in this area
- Create junior research group…

Research challenges for our IUCGH

- Quantify plausible pathways with measured effects in a longitudinal population-based approach
- Project climate-change negative attributable impacts on NCDs till 2050 and 2100
- Apply adaptation measures to NCD control
- Estimate their costs and effectiveness
- Quantify positive co-benefits
- Translation into national/regional policy



Terima kasih


CLIMATE
SUMMIT
WHAT IF IT'S A BIG HOAX AND WE CREATE A BETTER
• ENERGY INDEPENDENCE
• PRESERVE RAINFORESTS
• SUSTAINABILITY
• GREEN JOBS
• LIVABLE CITIES
• RENEWABLES
• CLEAN WATER
OK, That's All, thank you

Table 1 Likely ill health effects of climate change factors ordered by exposure route and type of ill health issue

Ill health, disease or injury issue related to climate change	Exposure route	Ill health issue type (N, C or I)
Heat exhaustion at work or in daily life	Direct: heat	N
Accidents related to heat exhaustion	Direct: heat	I
Clinical effects of heat on persons with chronic diseases	Direct: heat	N
Heat stroke illness and death	Direct: heat	N
Injuries and drowning due to extreme weather	Direct: extreme weather	I
Epidemics and drowning due to flooding of coastal areas (sea level rise)	Direct: extreme weather and sea level rise	N, C, I
Heart and lung effects due to air pollution	Indirect: air pollution	N
Diarrheal diseases	Indirect: water and food pollution	C
Malnutrition	Indirect: lack of food	N, C
Suicides among farmers	Indirect: lack of income and food	I
Vector-borne diseases, e.g. malaria, dengue	Indirect: ecologic change for vectors	C
Mental health effects among environmental refugees	Indirect: lack of basic necessities and social support	N

N non-communicable, chronic disease or mental health issue, *C* communicable or infectious disease issue, *I* injury issue


… et les femmes

Climate Change, Noncommunicable Diseases, and Development: The Relationships and Common Policy Opportunities

S. Friel,[1,2] K. Bowen,[1] D. Campbell-Lendrum,[3] H. Frumkin,[4] A.J. McMichael,[1] and K. Rasanathan[5]

Annu. Rev. Public Health 2011. 32:133–47

Additional warming as key factor

Tropical areas are already so hot during parts of the year that people's health, physiology and productivity are impaired

ANU

Summary of basic thermal physiology principles

$$M - W = E_{res} + C_{res} + R + C + E + S$$

Where M - the metabolic rate
W - the rate of external working
Eres - the rate of heat transfer by evaporation from respiration
Cres - the rate of heat transfer by convection from respiration
R - the rate of heat transfer by radiation
C - the rate of heat transfer by convection from the skin
E - the rate of heat loss by evaporation from the skin
S - the rate of heat storage in the body

The energy (metabolic rate, M) generated in the body by physical activity and work (W) will increase body heat, which must be released to the environment in order to avoid excessive core body temperature (which normally is 37 °C).

Construction workers in India:

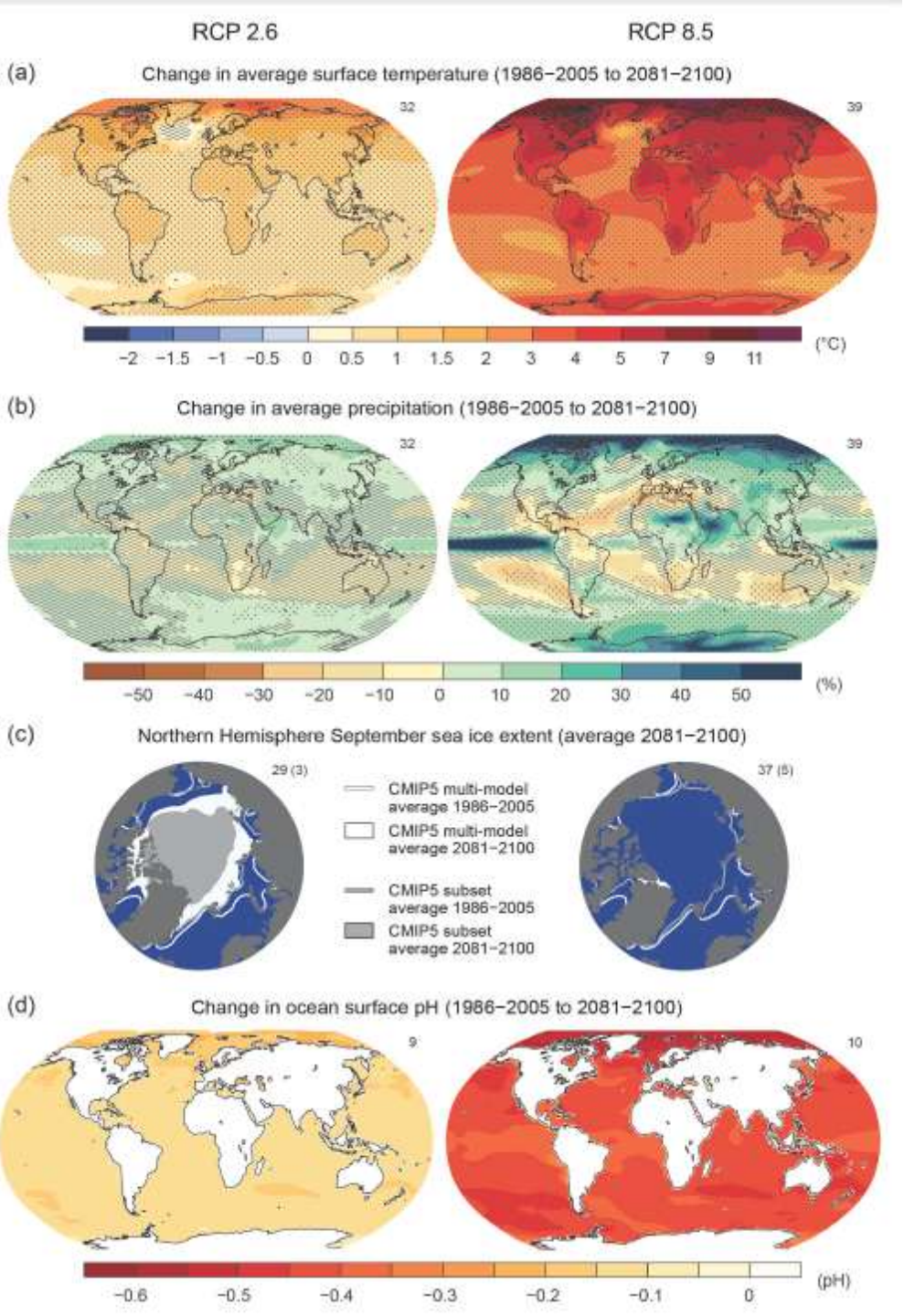
1-hour lunch break in cool period, 5-hour break in hot period

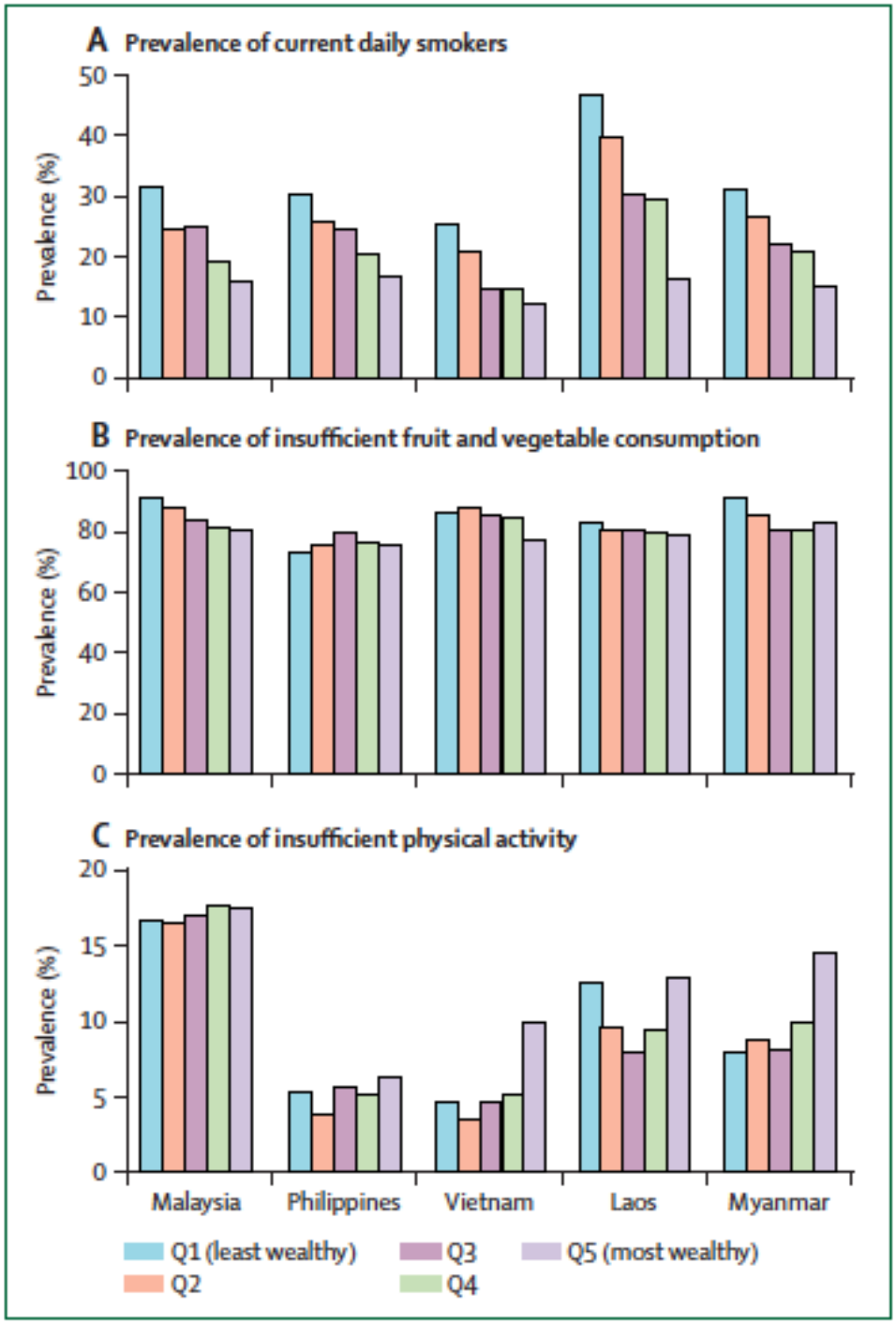
Only working in the morning hours; too hot after lunch

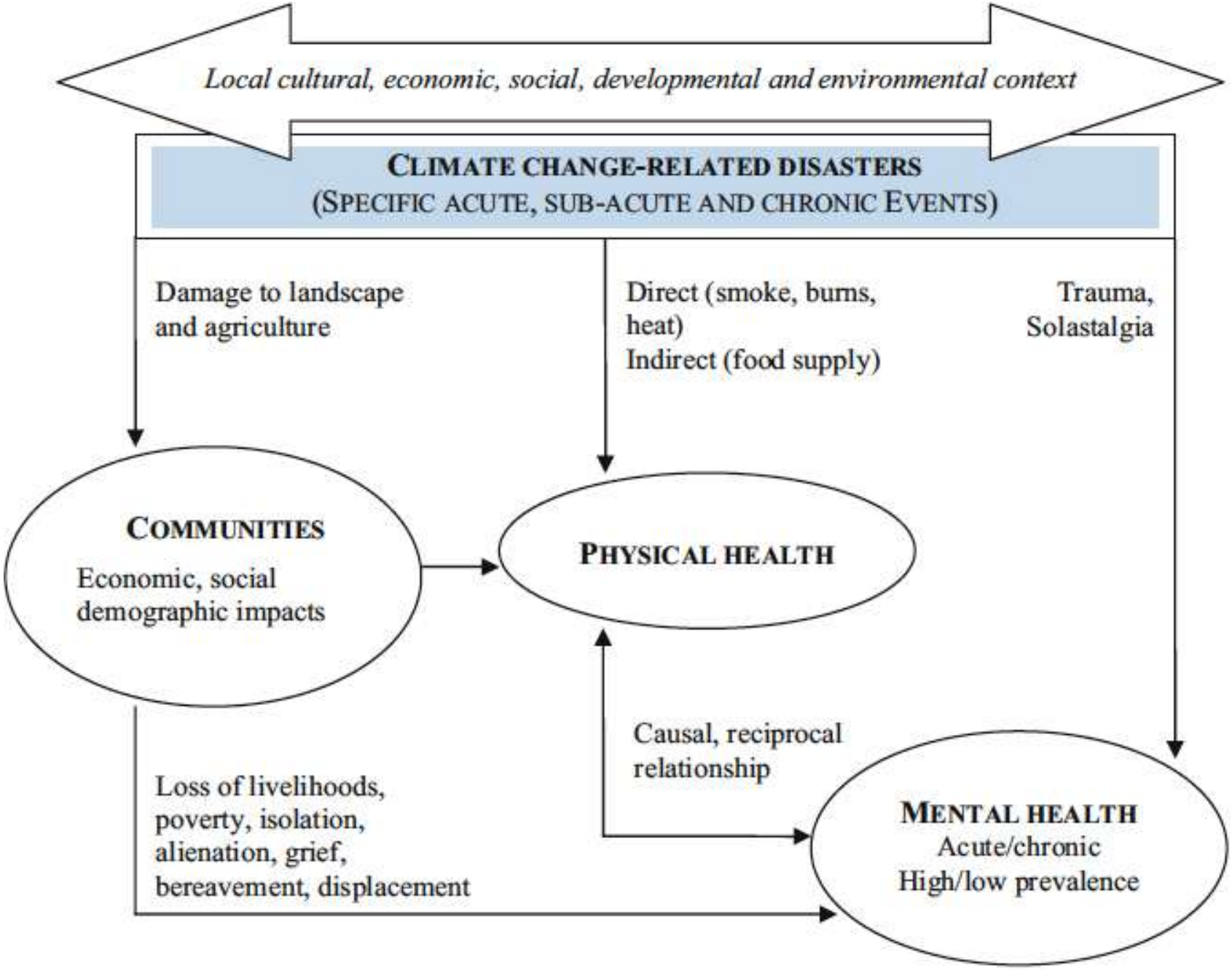
Sugar cane cutting, Nicaragua

Exposure to chemicals;

Heat increases evaporation of solvents and certain pesticides


RCP 2.6
RCP 8.5
(a)
Change in average surface temperature (1986–2005 to 2081–2100)
32
39
−2 −1.5 −1 −0.5 0 0.5 1 1.5 2 3 4 5 7 9 11
(°C)
(b)
Change in average precipitation (1986–2005 to 2081–2100)
32
39
−50 −40 −30 −20 −10 0 10 20 30 40 50
(%)
(c)
Northern Hemisphere September sea ice extent (average 2081–2100)
29 (3)
37 (5)
CMIP5 multi-model average 1986–2005
CMIP5 multi-model average 2081–2100
CMIP5 subset average 1986–2005
CMIP5 subset average 2081–2100
(d)
Change in ocean surface pH (1986–2005 to 2081–2100)
9
10
−0.6 −0.5 −0.4 −0.3 −0.2 −0.1 0
(pH)


A Prevalence of current daily smokers
Prevalence (%)
50
40
30
20
10
0
B Prevalence of insufficient fruit and vegetable consumption
Prevalence (%)
100
80
60
40
20
0
C Prevalence of insufficient physical activity
Prevalence (%)
20
15
10
5
0
Malaysia
Philippines
Vietnam
Laos
Myanmar
Q1 (least wealthy)
Q2
Q3
Q4
Q5 (most wealthy)


Local cultural, economic, social, developmental and environmental context
CLIMATE CHANGE-RELATED DISASTERS
(SPECIFIC ACUTE, SUB-ACUTE AND CHRONIC EVENTS)
Damage to landscape and agriculture
Direct (smoke, burns, heat)
Indirect (food supply)
Trauma, Solastalgia
COMMUNITIES
Economic, social demographic impacts
PHYSICAL HEALTH
Causal, reciprocal relationship
Loss of livelihoods, poverty, isolation, alienation, grief, bereavement, displacement
MENTAL HEALTH
Acute/chronic
High/low prevalence