

Mitigating, Adapting, and Suffering: The Health Aspects of Each

Kirk R. Smith, Professor
Environmental Health Sciences
University of California, Berkeley

Visiting Senior Scientist
Woods Hole Research Center
Falmouth MA

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Climate Change and Health

- Climate change adds to the age-old challenges of public health due to
 - poverty
 - inequity
 - ignorance
 - complacency
 - counterproductive personal behavior
 - conflict
 - Infection, and
 - environmental stress
- It threatens to enhance existing risks at every level of development, from
 - heat stress in Barcelona to
 - malaria in Botswana.

CC and Health (cont.)

- In terms of absolute burden of disease, however, it most threatens the poorest and most vulnerable in all societies, closely in inverse proportion to income, wealth, and power.
- The rich will find their world to be more expensive, inconvenient, uncomfortable, disrupted, and colorless;
 - in general more unpleasant and unpredictable, perhaps greatly so.
- The poor will die.

Society has three basic options for responding to human-caused climate change

- **Mitigate** by working to reduce greenhouse gas (GHG) emissions from energy and land use or to capture them from the atmosphere in order to slow or, perhaps, reverse warming
- **Adapt** by reducing the negative effects of climate change through protecting coastlines, moving populations away from impacted areas, increasing efforts to control climate-related vectorborne diseases, insulating cities from heat stress, and so on.
- **Suffer**, i.e., given that efforts in the first two arenas above are moving slowly, there is very likely to be suffering, perhaps considerable in poorer parts of the world, because of the climate change committed already
- We will be doing all three, but can reduce the third if we put more effort into the first two.

What can the public health community do?

- **Suffering**; Apply and adapt well-developed methods in public health research to identify and quantify the size, distribution, type, and probability of health impacts to come from climate change to better gauge the value and urgency of mitigation and to direct adaptation efforts.
- **Adaptation**; Prepare the health community to handle the impacts that are expected and, in its traditional role in prevention, to urge people and institutions to take mitigation steps
- **Mitigation**; Guide mitigation measures so they avoid negative side-effects and, even better, actually help achieve other health goals. This is in the realm of “co-benefits,” in which activities are designed to maximize the joint product of GHG mitigation and health protection.

Three short briefings

- Co-benefits
 - achieving both GHG and health goals
- Keeping in mind the principle of “polluter pays,” what is the global distribution of responsibility for ill-health due to climate change?
 - the Natural Debt index
- The IPAT-Health formulation and the
 - importance of working on vulnerability

To Bring Co-benefits Into Policy

- Need consistent, repeatable, credible, quantified assessments
- Health field has much to offer
- Indeed, compared to major parts of the energy and emissions worlds, public health science is far ahead, e.g., we have
 - Standard methods and expectations about peer review
 - Clear rules about study design and the level of evidence provided
 - Ways of dealing with confounding and other bias
 - Understanding and ways of handling misclassification
 - Relative risks and confidence intervals
 - Etc.

Recent International Collaborative Assessments Provide Much Needed for Co-benefits

- IPCC/UNFCCC: *Inter alia*, metrics and procedures for calculating carbon credits
- Millennium Development Goals: 8 MDGs with ~30 explicit indicators and metrics
- Commission on Macro-economics and Health: established health burden metrics and standard methods for cost-effectiveness analysis
- WHO Comparative Risk Assessment: Metrics of exposure and health burden with estimated exposure –response relationships and uncertainties

Summary metrics for use in co-benefits scoping.

	Health	Climate Change	Money	
Metric	DALYs (Disability-Adjusted Life Years)	GWC (Global Warming Commitment)	International Dollars	
Unit	Years	Tons CO ₂ equivalent	US Dollars	
Formulation	Years lost from premature death plus weighted years lost to disability	Tons CO ₂ plus tons other GHGs multiplied by their global warming potentials (GWPs)	Local currency adjusted by its capability to buy standard market basket of purchases	
Discount Rates	DALYs	GWPs	Benefits	Costs
Kyoto Case	0%	100-year ~ 0.7%	1%	3%
Base Case	3%	20-year ~ 4.3%	3%	3%
Financial Case	3%	20-year ~ 4.3%	3%	6%

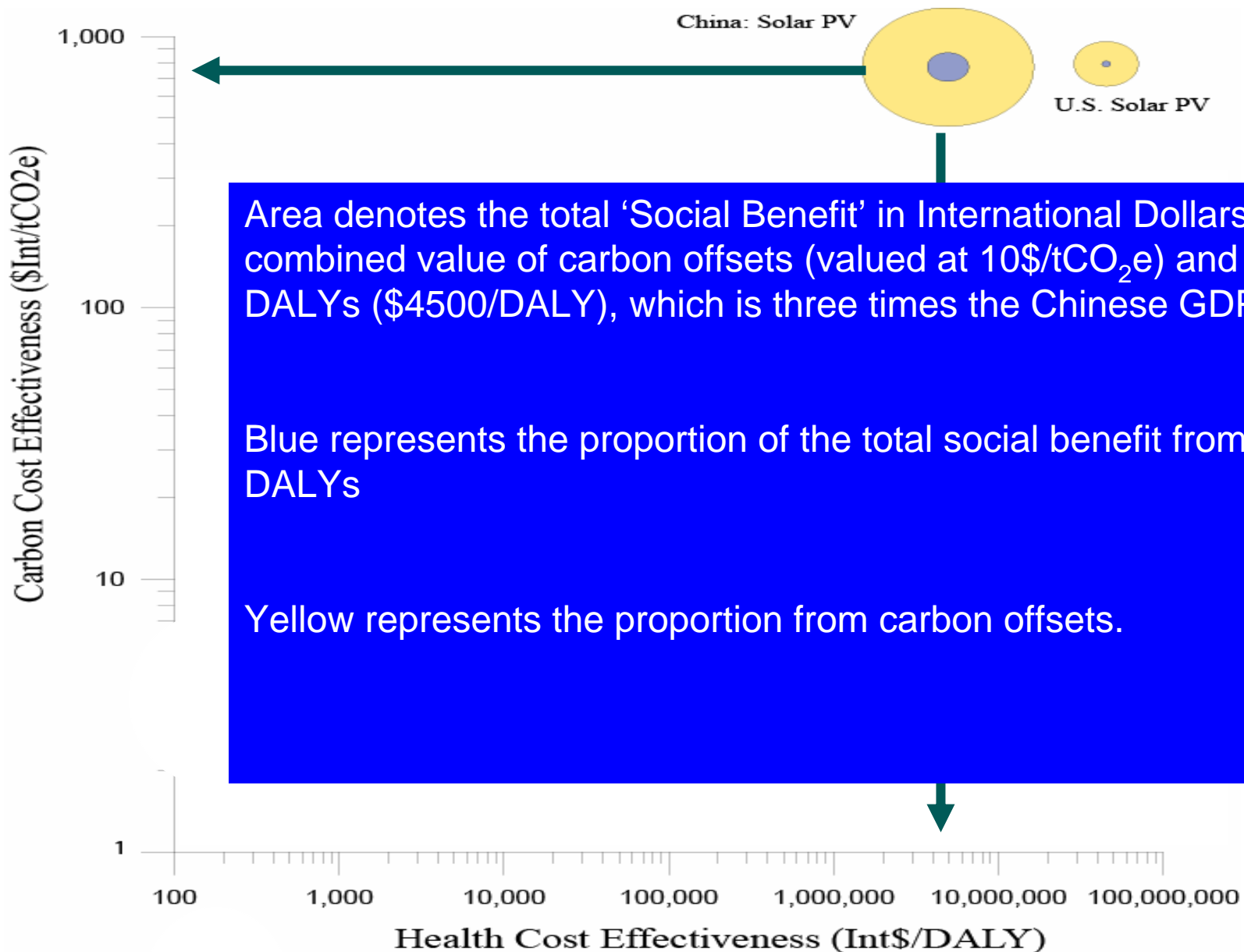


Figure: Smith & Haigler, in press

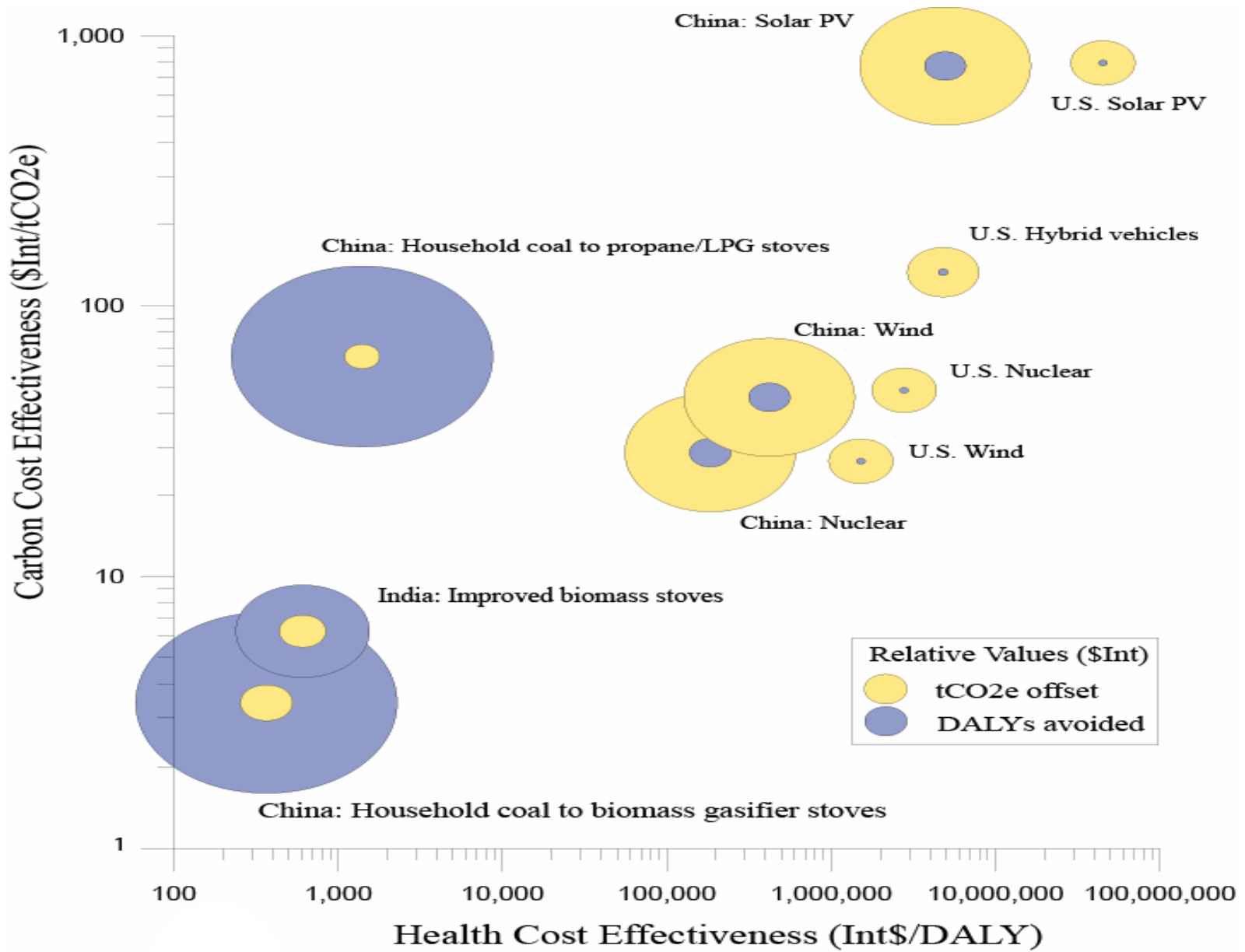


Figure: Smith & Haigler, in press

Introduction to Natural Debt

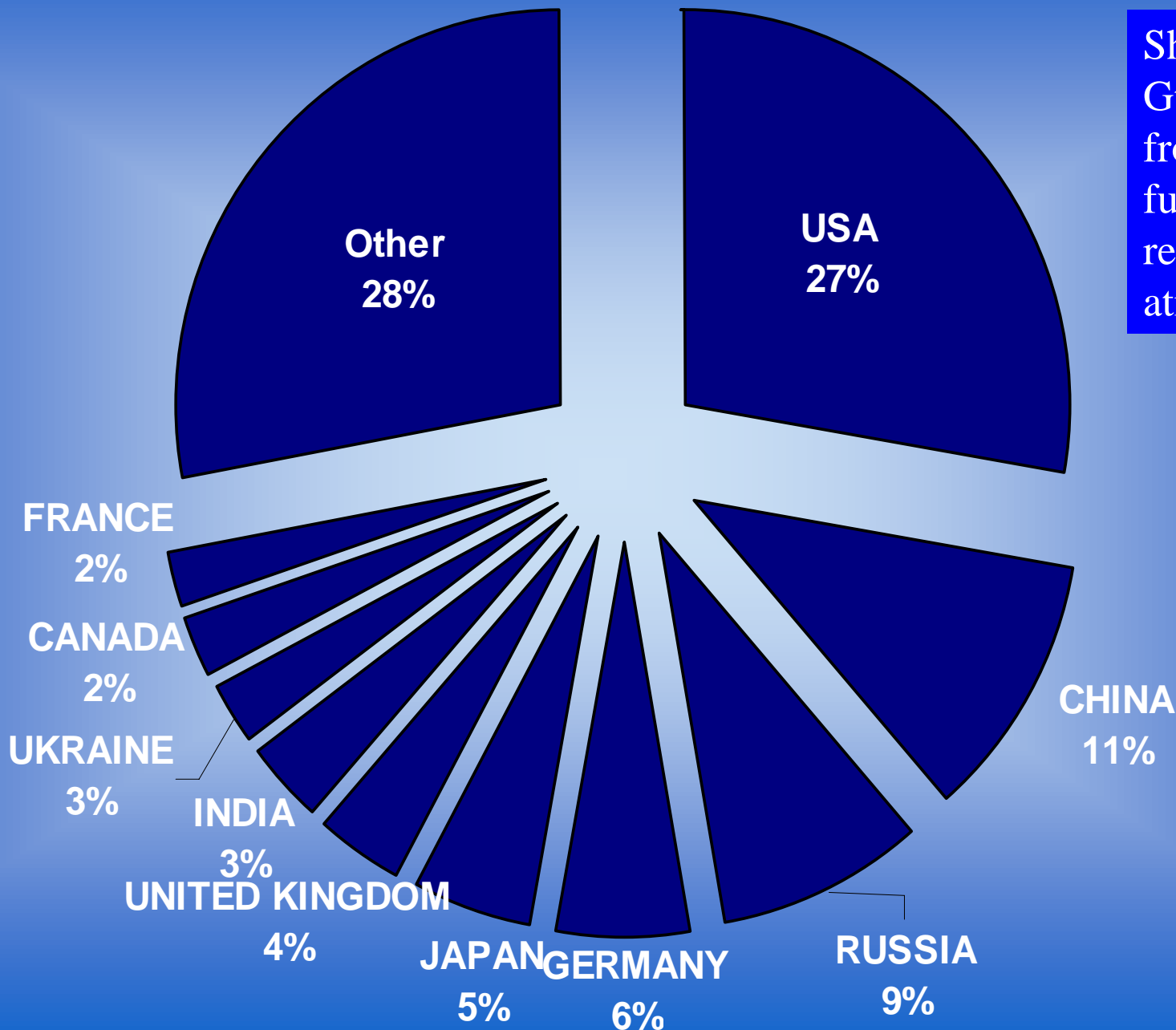
- Warming of GHGs this year is not directly due to this year's emissions but to the amount in the atmosphere.
- Is thus due to the GHG accumulation of all past emissions that are still left today in the atmosphere
- Current emissions are a problem only if they add GHGs faster than they are removed by natural processes, i.e. exceed assimilative capacity
- We have been adding GHGs faster, thus borrowing assimilative capacity from the future, building up a “natural debt”

Natural Debt (cont.)

- Natural debt is analogous to “national debt”, which we build up by borrowing financial resources from the future.
- A bit of debt is probably ok, but too much of either type can be serious
- For greenhouse pollutants, our Natural Debt is measured as the cumulative amount of emissions per capita from past activities minus the amount removed by natural processes (mainly capture by the ocean)

National Natural Debts - 2003

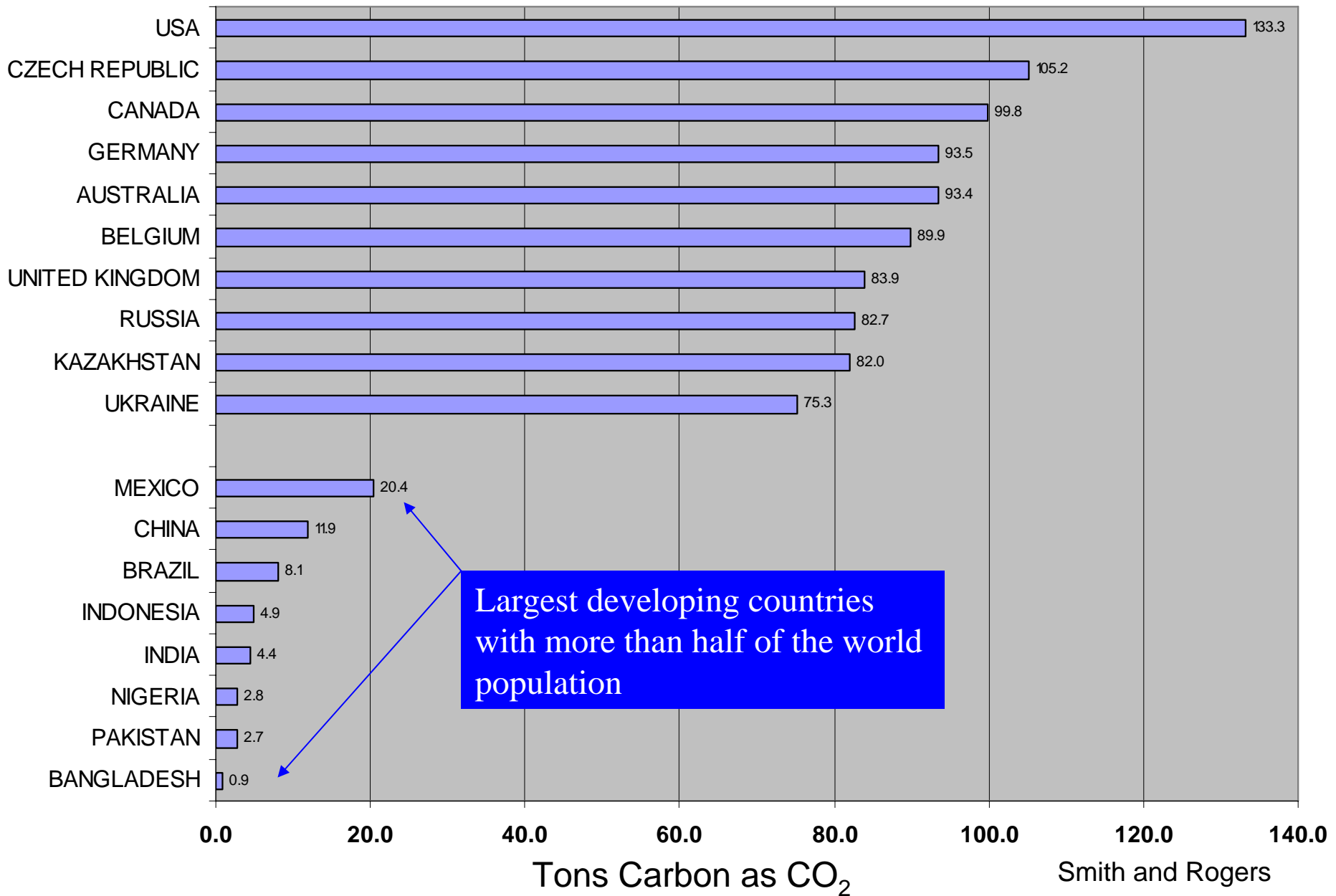
Share of 140 Gt carbon from fossil fuel burning remaining in atmosphere



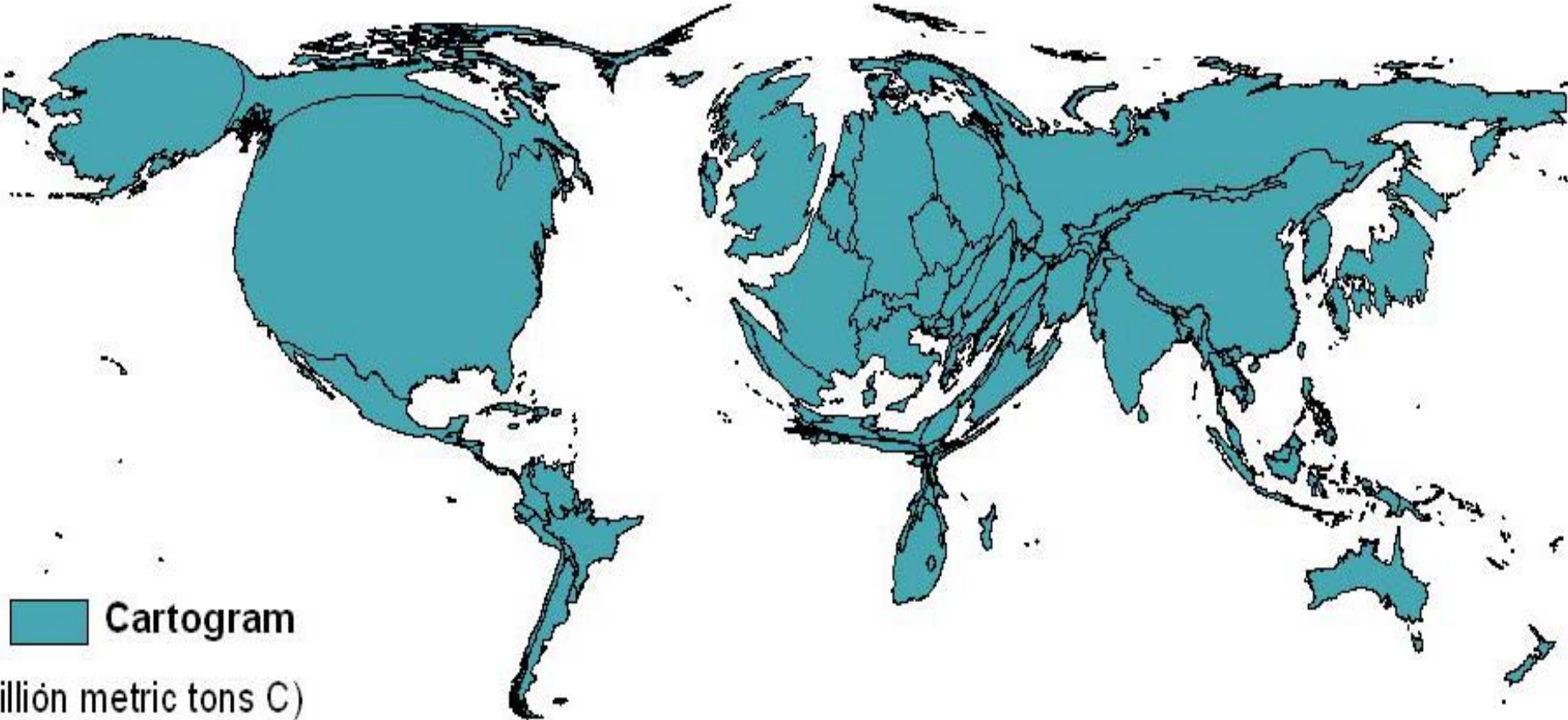
Smith & Rogers

Top 10 nations

Natural Debts per Capita



Distribution of Natural Debt by Country: Carbon in Cumulative CO₂ emissions



Patz et al.



Comparative Risk Assessment (CRA)

2-year 30-institution project
organized by the
World Health Organization

Disease, injury, and death due to
26 major risk factors calculated by
age, sex, and 14 global regions.

Fully published in late 2004
(Being updated 2007-2009)

COMPARATIVE QUANTIFICATION
OF HEALTH RISKS

GLOBAL AND REGIONAL BURDEN OF DISEASE
ATTRIBUTABLE TO SELECTED MAJOR
RISK FACTORS

VOLUME 1

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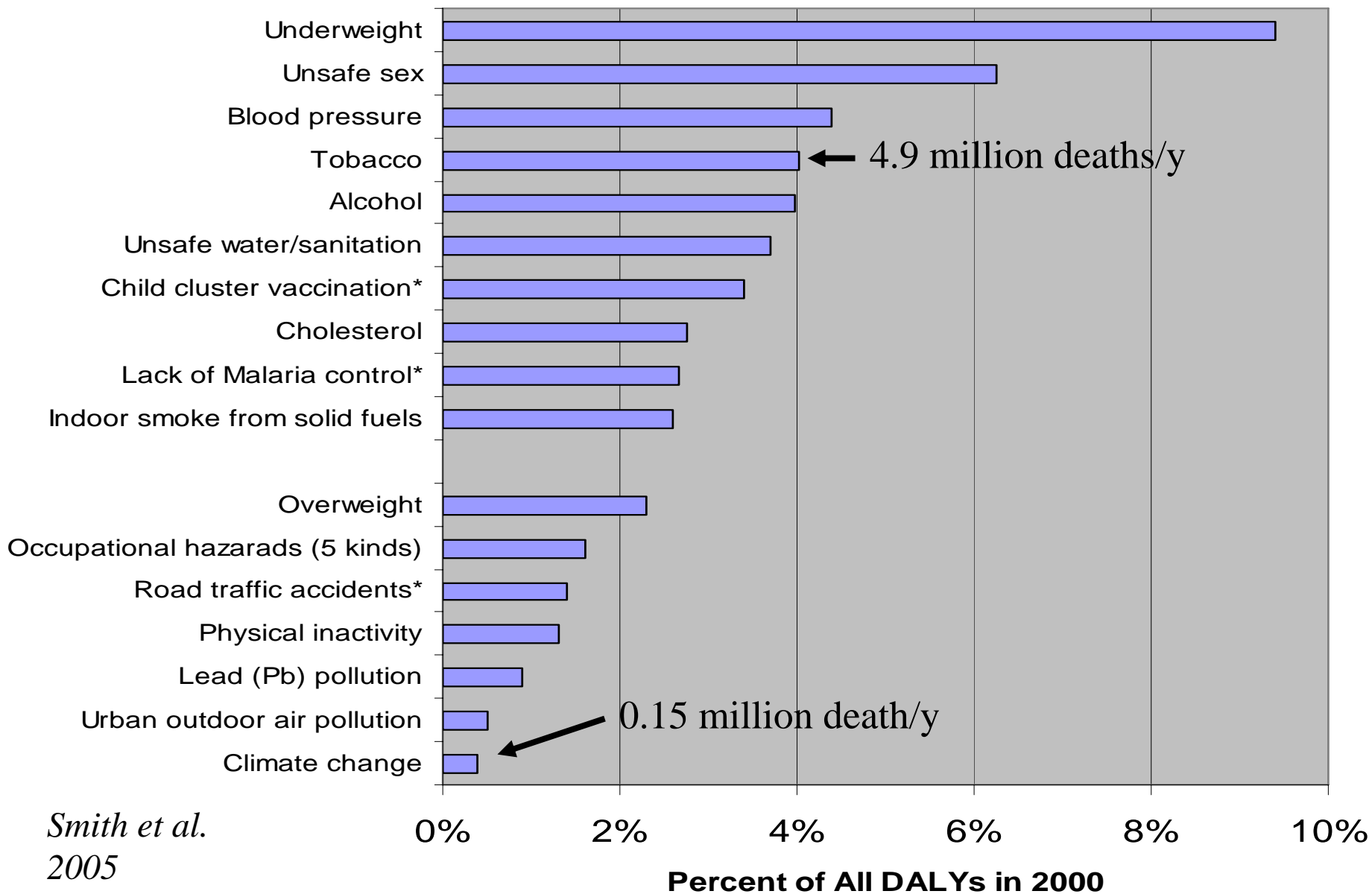
MAJID EZZATI, ALAN D. LOPEZ, ANTHONY RODGERS
AND CHRISTOPHER J.L. MURRAY



World Health Organization
Geneva

Published in 2004, 2 vols, ~2500 pp
(available on WHO CRA website)

Global Burden of Disease from Top 10 Risk Factors plus selected other risk factors

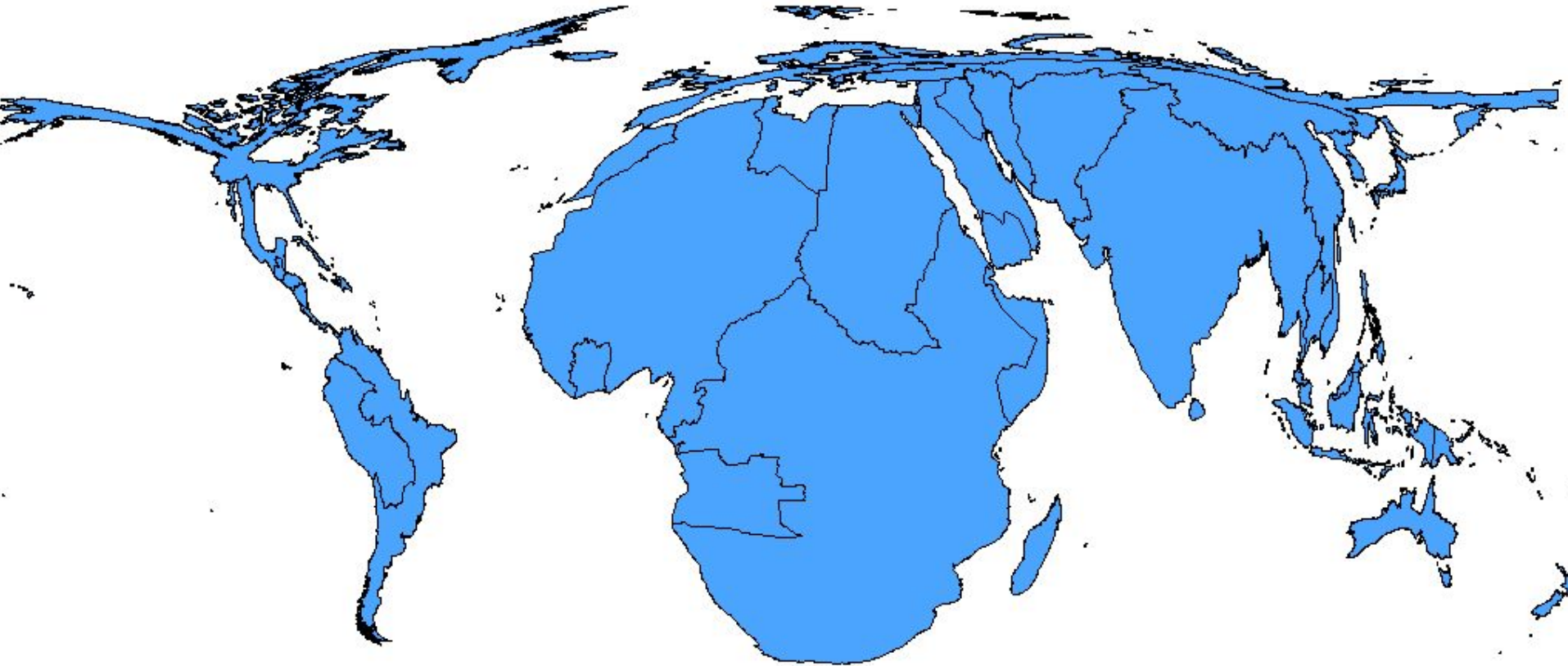


Smith et al.
2005

WHO Comparative Risk Assessment Burden of Disease from Climate Change in 2000

- Diarrhea – 2.4% of global burden
- Malaria – 2%; 6% in some regions
- 17% of protein-energy malnutrition
- 7% of dengue fever in some rich countries
- 150,000 deaths, 99% in poor countries (46% in South Asia)
- 0.4% of all DALYs
- Most (88%) of impact in children under 5
- Major concern is not this “attributable” risk, but the “avoidable” risk related to what we do now

Cartogram of Climate-related Mortality (per million pop) yr. 2000



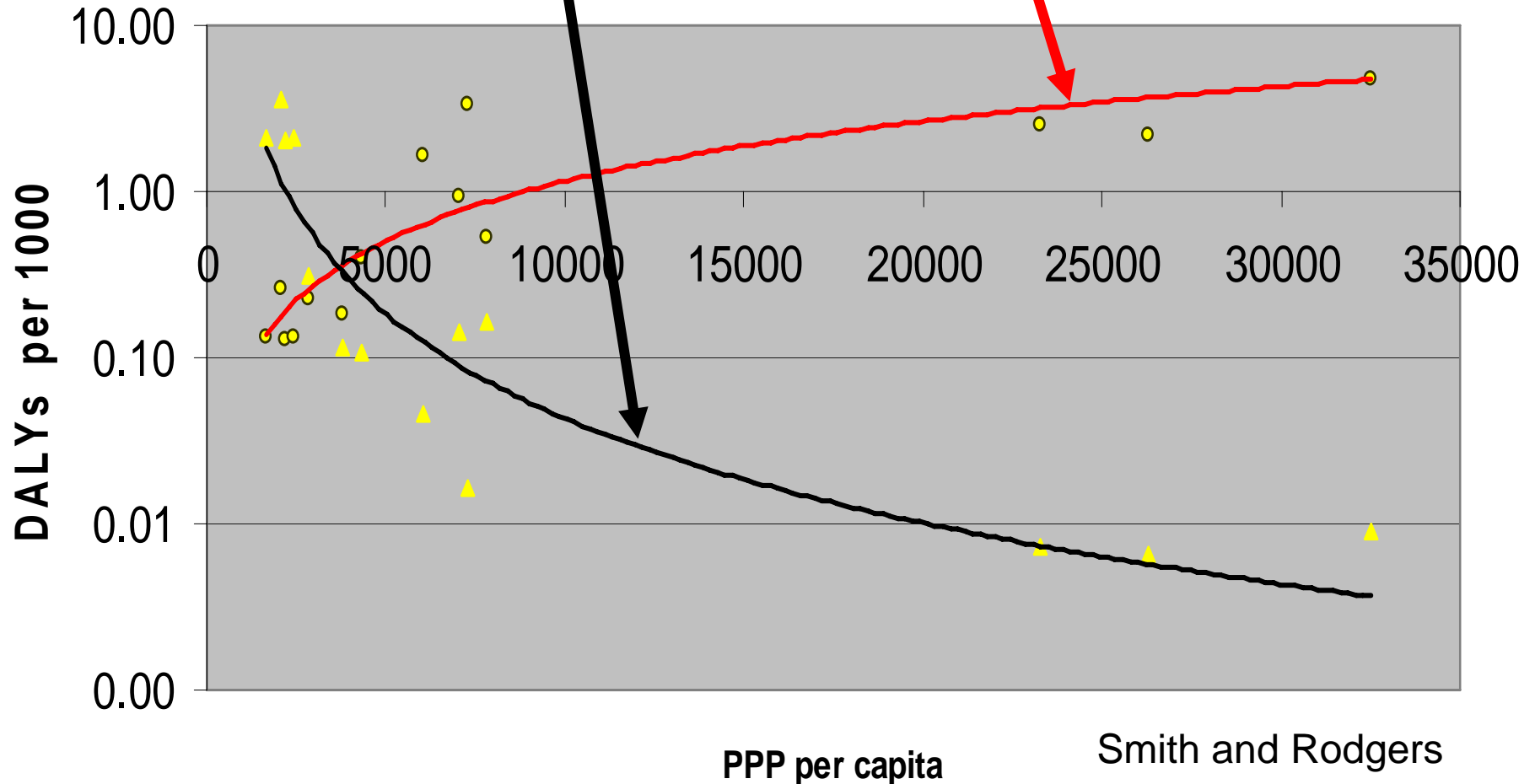
Patz et al.

This map shows estimated mortality (per million people) attributable to climate change by the year 2000. Map is a density-equalizing cartogram in which the sizes of the 14 WHO regions are proportional to the increased mortality.



Distribution of Health Impacts from Climate Change

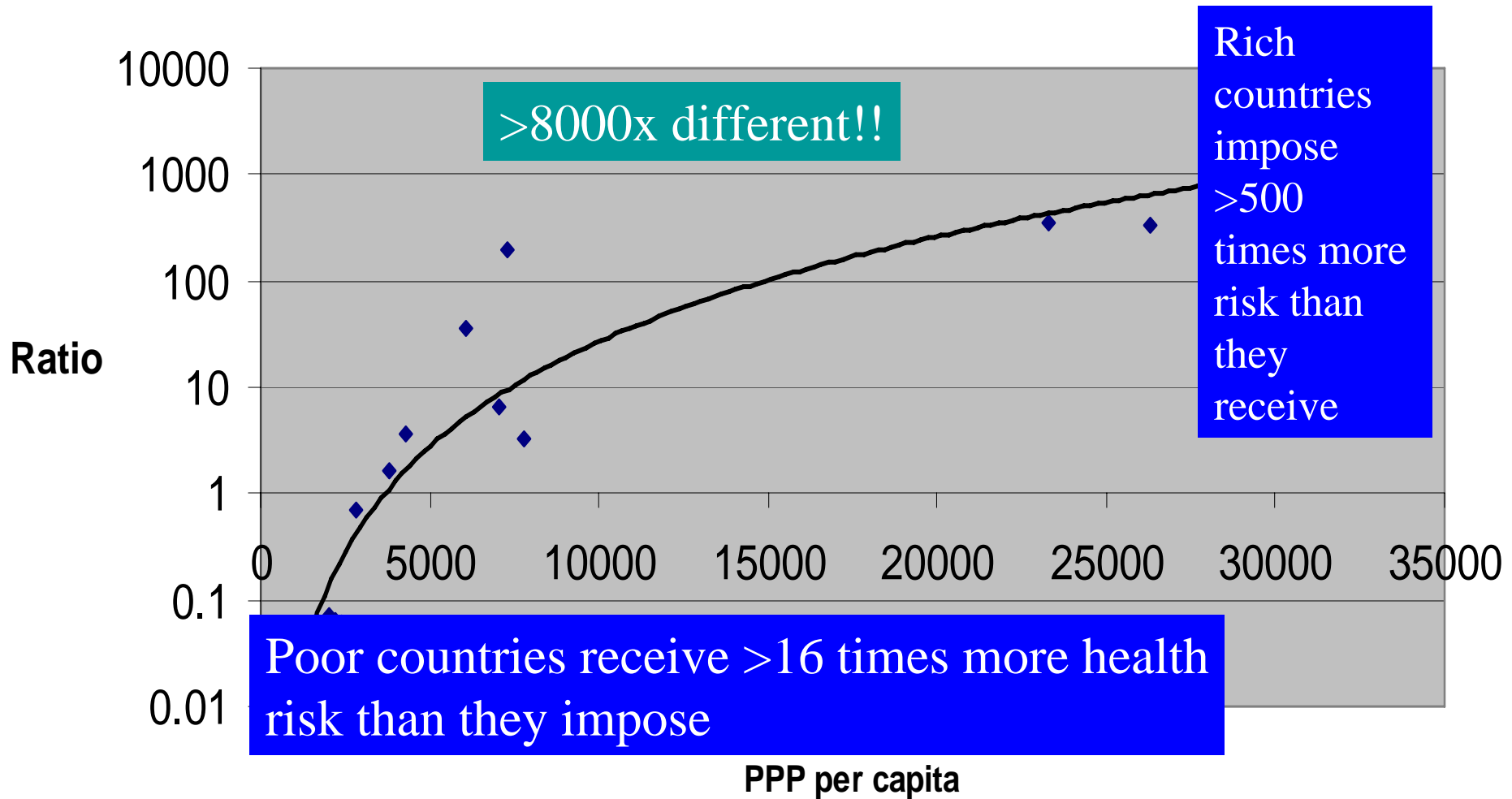
(Experiencing versus Imposing)



Smith and Rodgers

Distribution of Health Impacts from Climate Change

(Ratio: Imposing/Experiencing)



Classic IPAT Equation

$$I = P \times A \times T$$

where I represents the impact;

P is the population size;

A (affluence) is the per capita income; and

T (technology) represents the impact per unit income.

For climate, a more useful variant is $I=P*A*E*T$

I = Carbon emissions =

P = Population x

A = Economic level per capita x

E = Energy use per unit economy x

T = Carbon emissions per unit energy

For example, in the year 2000, we had

6.1×10^9 pers x

\$7400/pers x

0.061 GJ/\$ x

14 kgC/GJ

= 6.4×10^{12} kgC = 6.4 billion tons C

IPAET-health

- In the classic and climate change versions, I is not really impact, but in health terms, exposure – Ex
- Thus, if $I = Ex = PAET$ - what about health burden?
- Burden is a function of Exposure (Ex), Risk per unit exposure ($RR-1 = R_0$), and background disease (D).
- Using the classic Population Attributable Fraction (PAF) formulation (for a 100% exposed population),
 - $PAF = (RR-1)/((RR-1)+1)$, but
 - for reasonably small RRs, $PAF = \sim RR - 1 = R_0$
- $Burden = PAF \times D$, but $PAF = \sim R_0$
- $I (Burden) = R_0 \times D \times Ex$ or, since $Ex = PAET$
- $I (burden) = R_0 \times D \times PAET$

How to define Vulnerability

- Burden/population = $R_0 \times D \times AET$
- Burden/affluence = $R_0 \times D \times PET$
- Individual Vulnerability (V) can be defined
 - $V = \text{Burden}/PAET$ (impact per unit Ex), but since $\text{Burden} = R_0 \times D \times PAET$,
 - V would reduce to $R_0 \times D$ (risk per unit exposure and background disease)
- i.e., the Public Health twosome
- Note: For all important impacts, D is also affected by a range of other risk factors
- Need to work on D as well as $PAET$ and R_0

Implications for Climate Change Health Intervention Strategy

- To date, the attributable burden of diseases from climate change for which evidence is available has been modest by comparison to the traditional threats to public health
- Over time, however, the burden will rise, even with major additional efforts at mitigation and adaptation.
- Most of this increase will be in the form of enhancing existing health risks (malnutrition, adverse weather, vectorborne disease, poor water supplies, etc.)
- But since I (burden) = V (i.e., $R_0 \times D$) \times PAET
- Efforts to work on $R_0 \times D$ are just as important as those for PAET
- This implies that public health efforts to reduce background disease rates for these traditional hazards be granted even greater urgency so their enhancement by climate change in future years will be less serious

Conclusion

- Perhaps the most telling simple definition of public health is that it is the
 - “Science and art of making people healthy before they are wealthy (and then keeping them that way).”
- Although altering both the rules and the stakes, the emergence of climate change on the world stage reinforces this vision of public health’s mission.
- The profession has much to offer, both directly and indirectly through its well-developed methods for making quantitative judgments about the effectiveness of interventions to promote human welfare
- It will also, however, need infusions of new methods, strategies, and resources in order to prevent climate change from slowing or reversing progress toward acceptable standards of health worldwide.

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