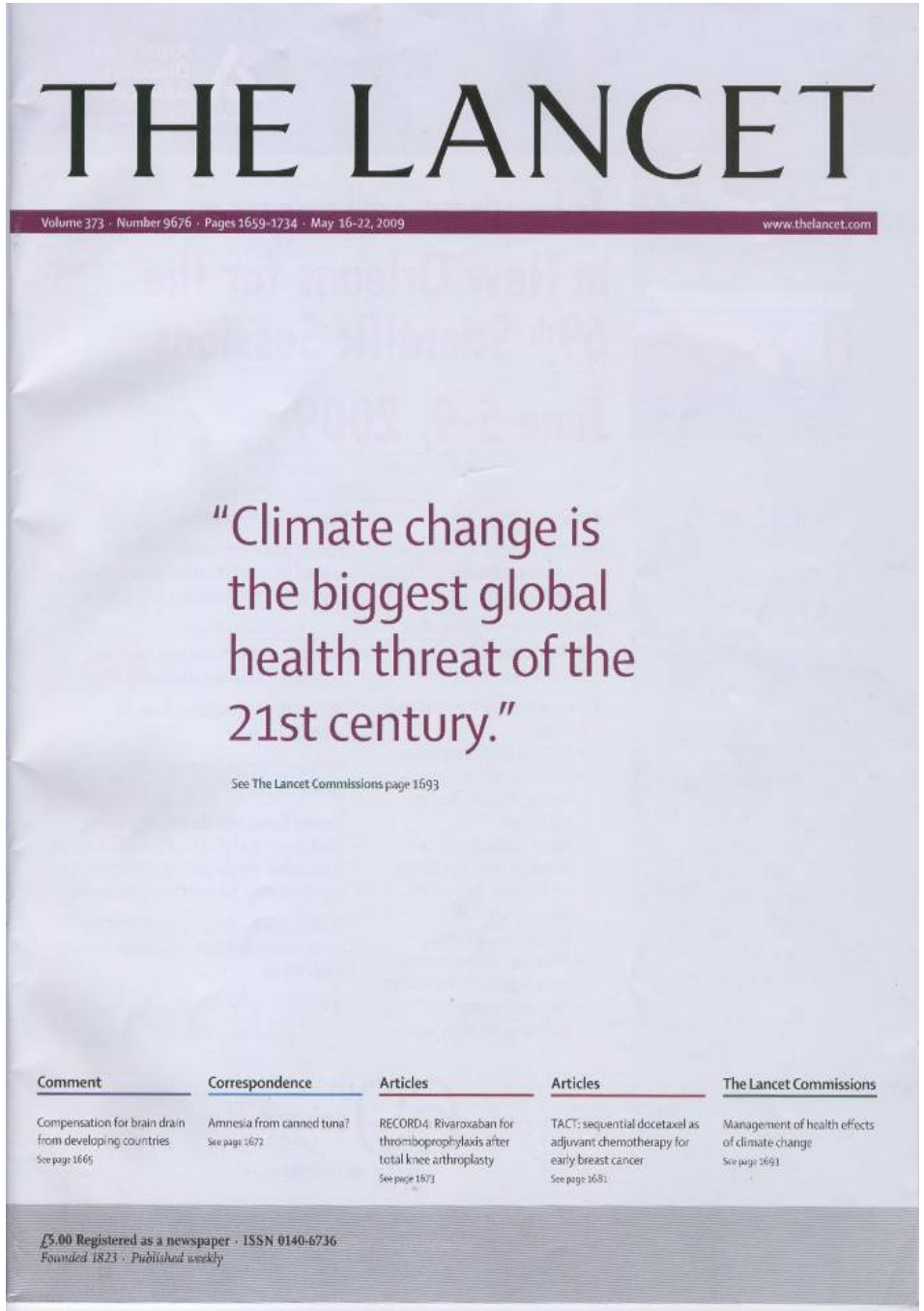
Climate Change and Human Health

Washington Carbon Emissions Reduction Task Force
October, 2014

Howard Frumkin, M.D., Dr.P.H.
Dean, School of Public Health
University of Washington

Agenda

- Climate change is a health issue
- Climate communication: The role of health
- Co-benefits: Health is money


THE LANCET
Volume 373 · Number 9676 · Pages 1659–1734 · May 16–22, 2009
www.thelancet.com
"Climate change is the biggest global health threat of the 21st century."
See The Lancet Commissions page 1693
Comment
Compensation for brain drain from developing countries
See page 1665
Correspondence
Amnesia from canned tuna?
See page 1672
Articles
RECORD4: Rivaroxaban for thromboprophylaxis after total knee arthroplasty
See page 1673
Articles
TACT: sequential docetaxel as adjuvant chemotherapy for early breast cancer
See page 1681
The Lancet Commissions
Management of health effects of climate change
See page 1693
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Health effects of climate change

Climate change:
- **Temperature rise**
- **Sea level rise**
- **Weather extremes**

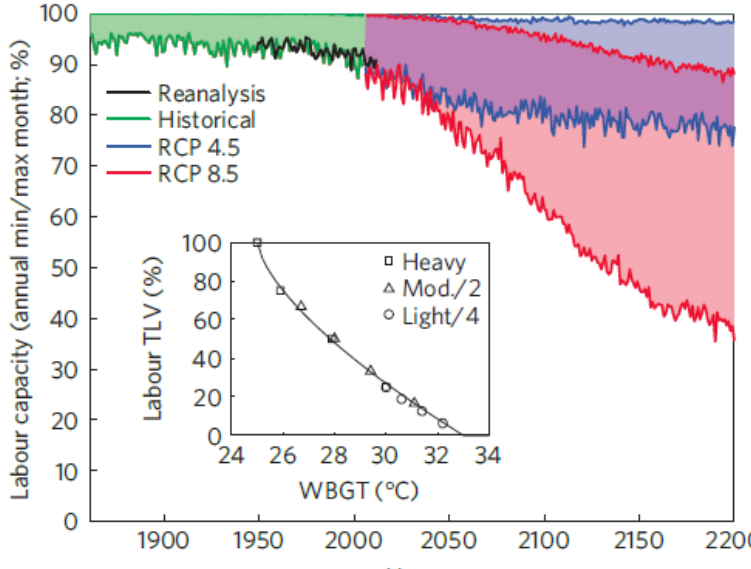
HEAT	Heat stress, cardiovascular failure
SEA LEVEL RISE AND SEVERE WEATHER	Injuries, fatalities
AIR POLLUTION	Asthma, cardiovascular disease
ALLERGIES	Respiratory allergies, poison ivy
VECTOR-BORNE DISEASES	Malaria, dengue, hantavirus, encephalitis, Rift Valley fever
WATER-BORNE DISEASES	Cholera, cryptosporidiosis, campylobacter, leptospirosis
WATER AND FOOD SUPPLY	Malnutrition, diarrhea, harmful algal blooms
MENTAL HEALTH	Anxiety, post-traumatic stress, depression, despair
RESOURCE SCARCITY AND COMPETITION	Forced migration, civil conflict

Heat

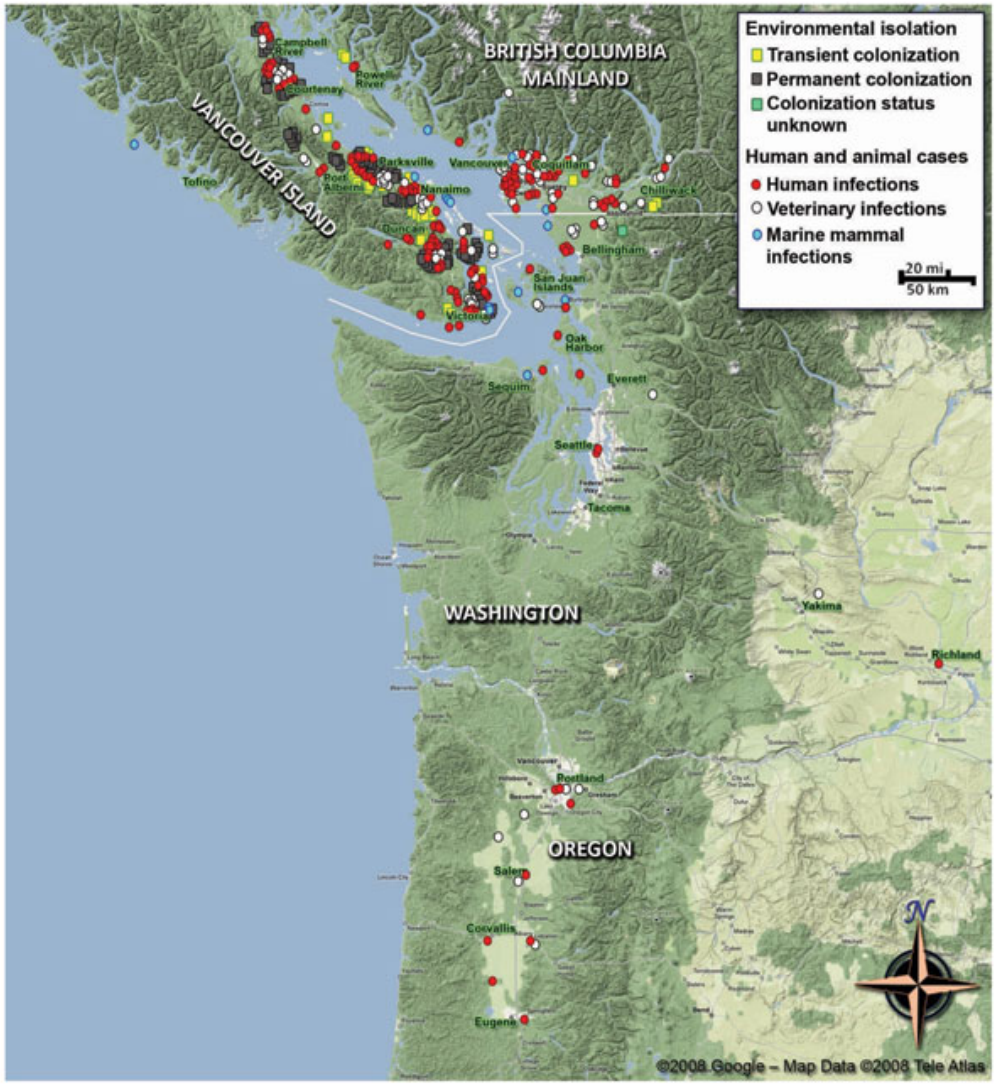
- Excess deaths

	2025	2045	2085
GREATER SEATTLE	68-211	89-401	107-988
SPOKANE, TRI-CITIES, YAKIMA	12-31	15-45	17-76

- Reduced work capacity



Infectious diseases



Infectious diseases

A role of high impact weather events in waterborne disease outbreaks in Canada, 1975–2001

M. KATE THOMAS[1,2], DOMINIQUE F. CHARRON[2],

Rainfall and outbreaks of drinking water related disease and in England and Wales

Gordon Nichols, Chris Lane, Nima Asgari, Neville Q. Verlander and Andre Charlett

The Association Between Extreme Precipitation and Waterborne Disease Outbreaks in the United States, 1948–1994

Frank C. Curriero, PhD, Jonathan A. Patz, MD, MPH, Joan B. Rose, PhD, and Subhash Lele, PhD

Epidemiol. Infect. (2013), **141**, 671–686. © Cambridge University Press 2012
doi:10.1017/S0950268812001653

SYSTEMATIC REVIEW
Extreme water-related weather events and waterborne disease

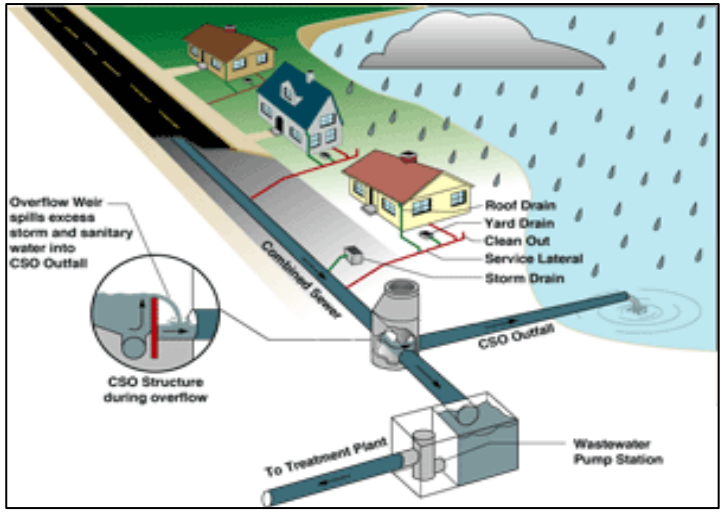
K. F. CANN[1]*,

Journal of Toxicology and Environmental Health, Part A, 67:1879–1887, 2004
Copyright© Taylor & Francis Inc.
ISSN: 1528–7394 print / 1087–2620 online
DOI: 10.1080/15287390490493475

Taylor&Francis healthsciences

HEAVY RAINFALL AND WATERBORNE DISEASE OUTBREAKS: THE WALKERTON EXAMPLE

Heather Auld,[1] D. MacIver,[2] J. Klaassen[3]



Food: Climate change and crop production

- "CO_2 fertilization"
  - C3 crops (rice, wheat, soy) more than…
  - C4 crops (maize, sugarcane, sorghum)
- BUT…negative effects of
  - Drought, heat waves, storms
  - Altered growing season timing
  - Enhanced weed & pest growth
  - Saline intrusion near coasts

Food: Climate change and crop production

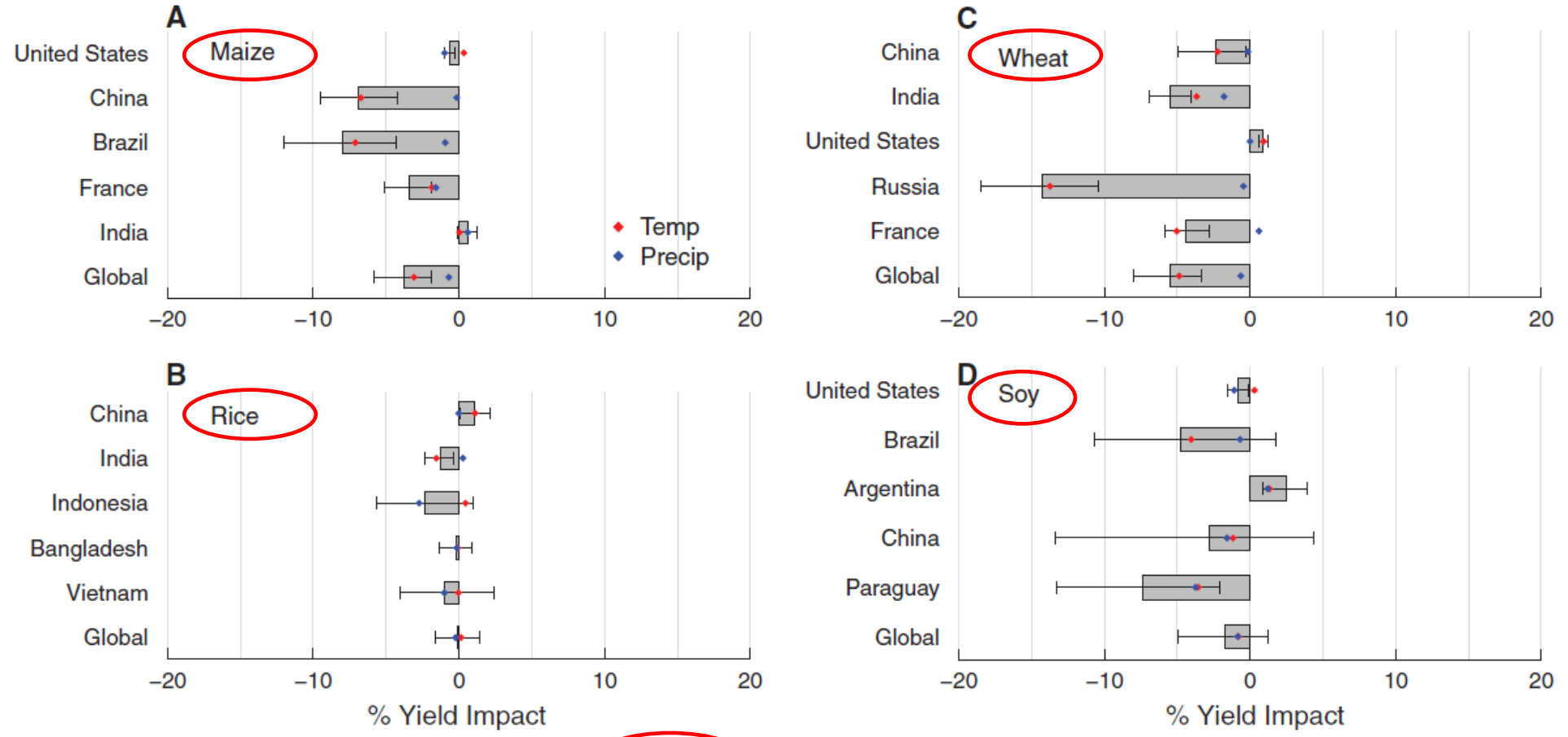
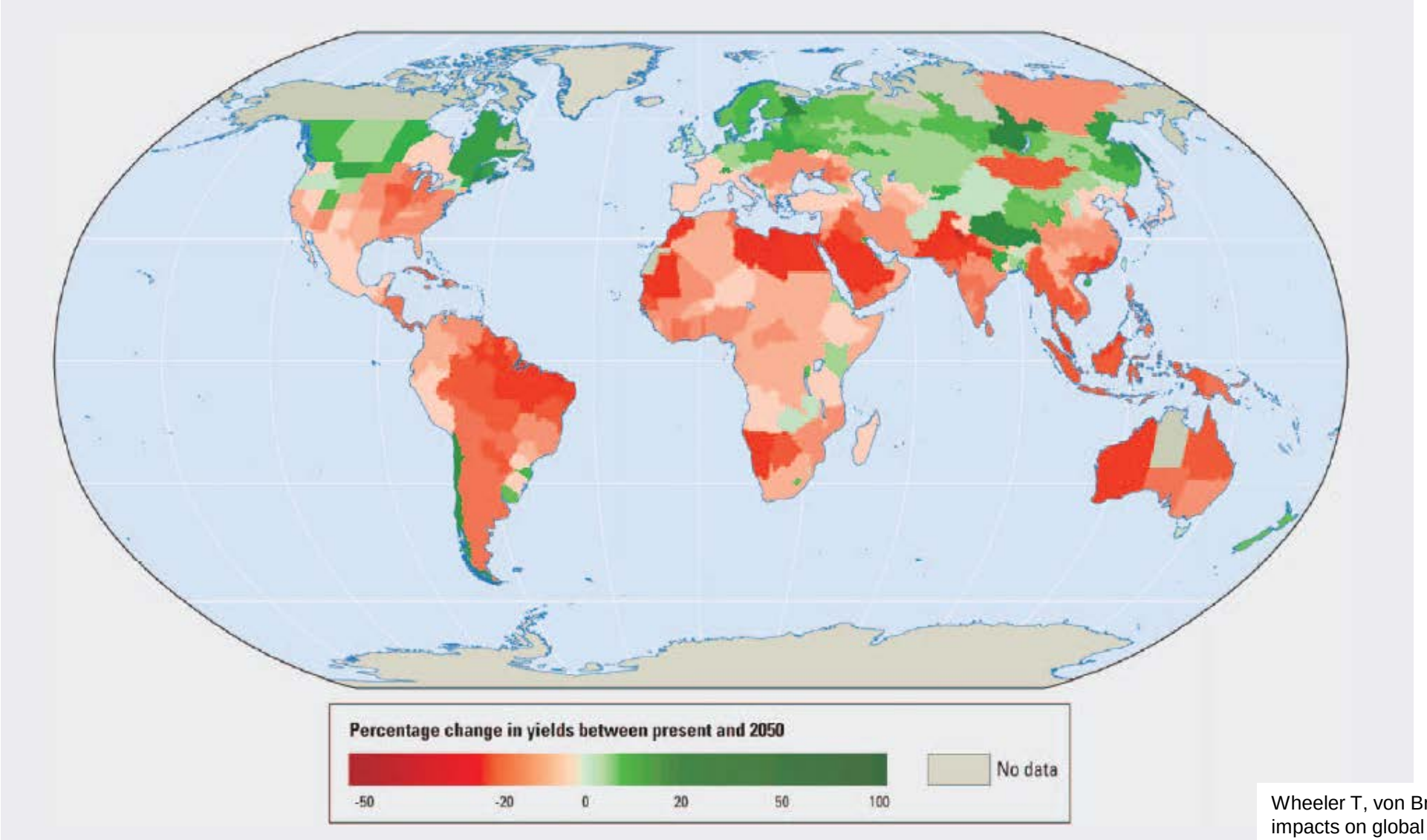


Fig. 3. (**A** to **D**) Estimated net impact of climate trends for 1980–2008 on crop yields for major producers and for global production. Values are expressed as percent of average yield. Gray bars show median estimate; error bars show 5% to 95% confidence interval from bootstrap resampling with 500 replicates. Red and blue dots show median estimate of impact for T trend and P trend, respectively.

Lobell et al, Climate trends and global crop production since 1980. *Science* 2011;333:616

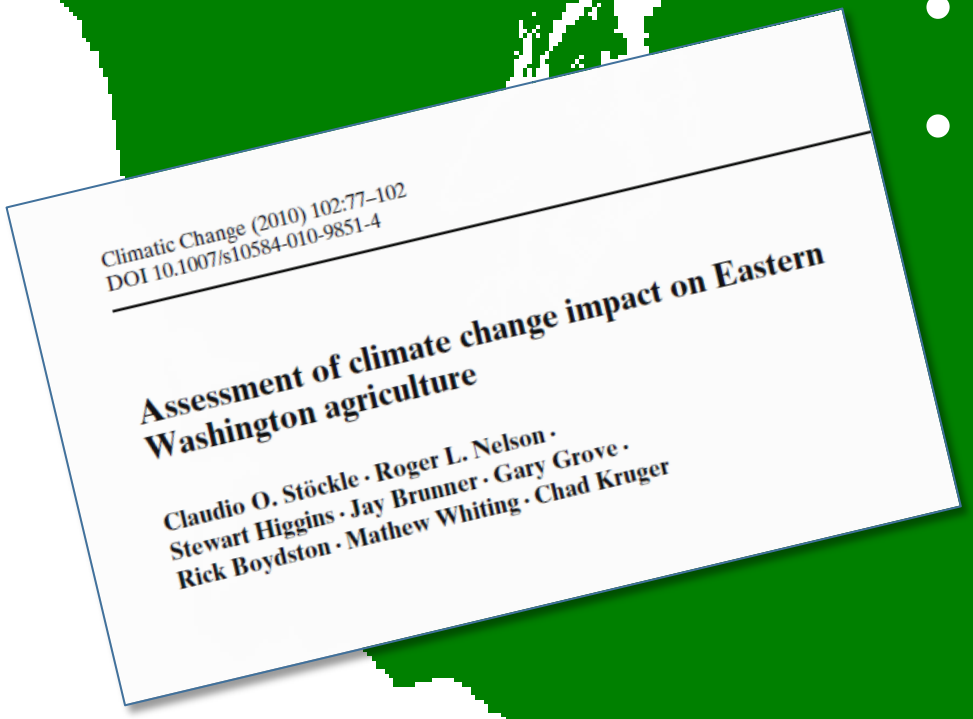
Projected crop yields, 2050

11 crops, averaged across multiple emission scenarios and GCMs



Wheeler T, von Braun J. Climate change impacts on global food security. *Science* 2013;341;508-13.

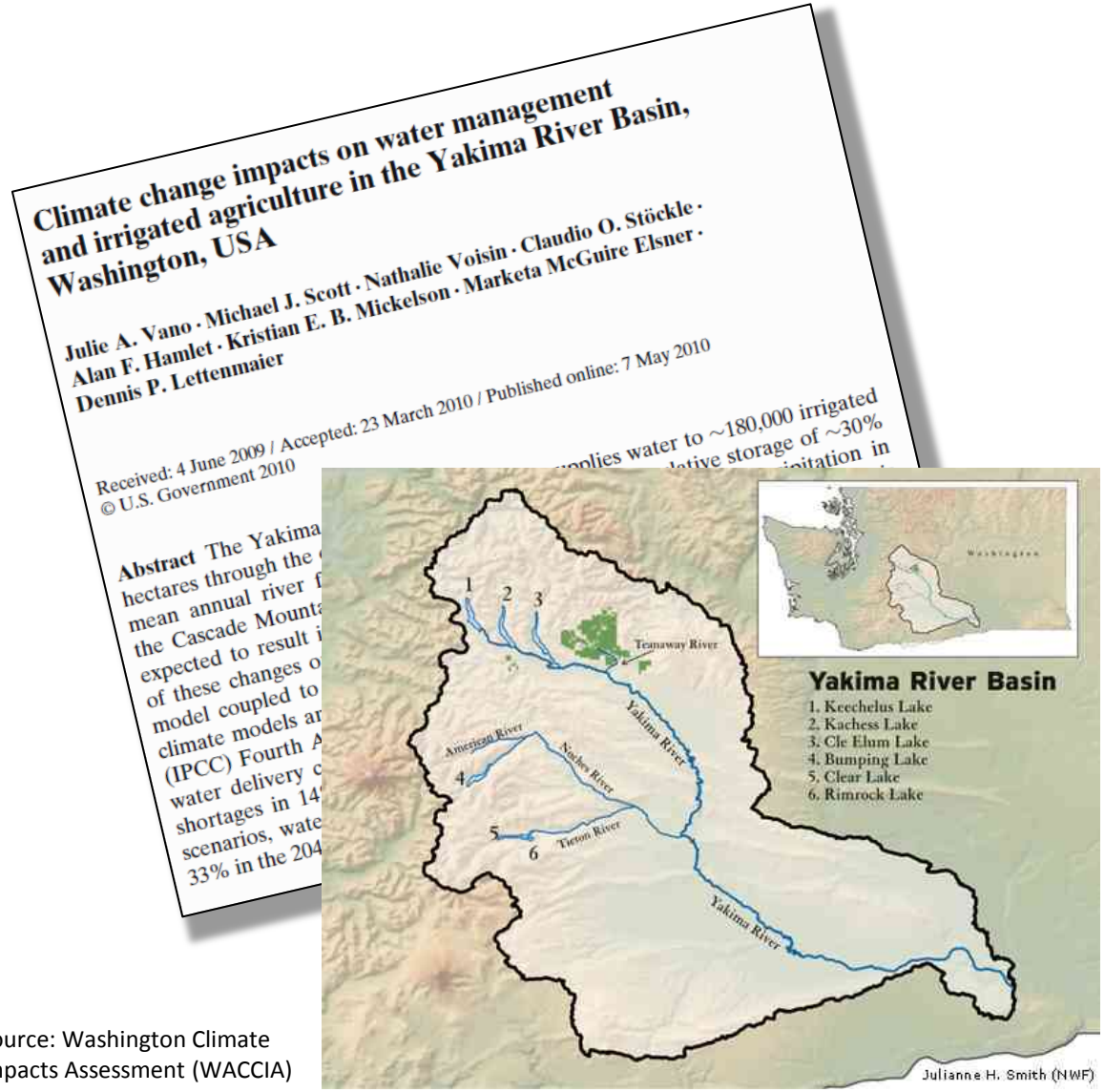
Impacts in Washington state: Eastern Washington agriculture



- Minimal impact predicted
- BUT…
  - Assumed ample irrigation
  - Did not consider pests, weeds, diseases
  - Did not consider floods, droughts, storms

Original source: Washington Climate Change Impacts Assessment (WACCIA)

Impacts in Washington state: Yakima River basin



Original source: Washington Climate Change Impacts Assessment (WACCIA)

- Water shortages
  - Historically: 14% of years
  - 2020s: 24% - 27% of years
  - 2040s: 31% - 33% of years
  - 2080s: 43% - 68% of years
- Greatest vulnerability: junior water rights holders
- Production declines: 5 - 16%
- Relevant to other snow-pack dependent irrigated regions (i.e.., Wenatchee, Methow, Okanogan, Walla Walla, etc.)

Food: Climate change and livestock

Dairy cows: Heat stress leads to

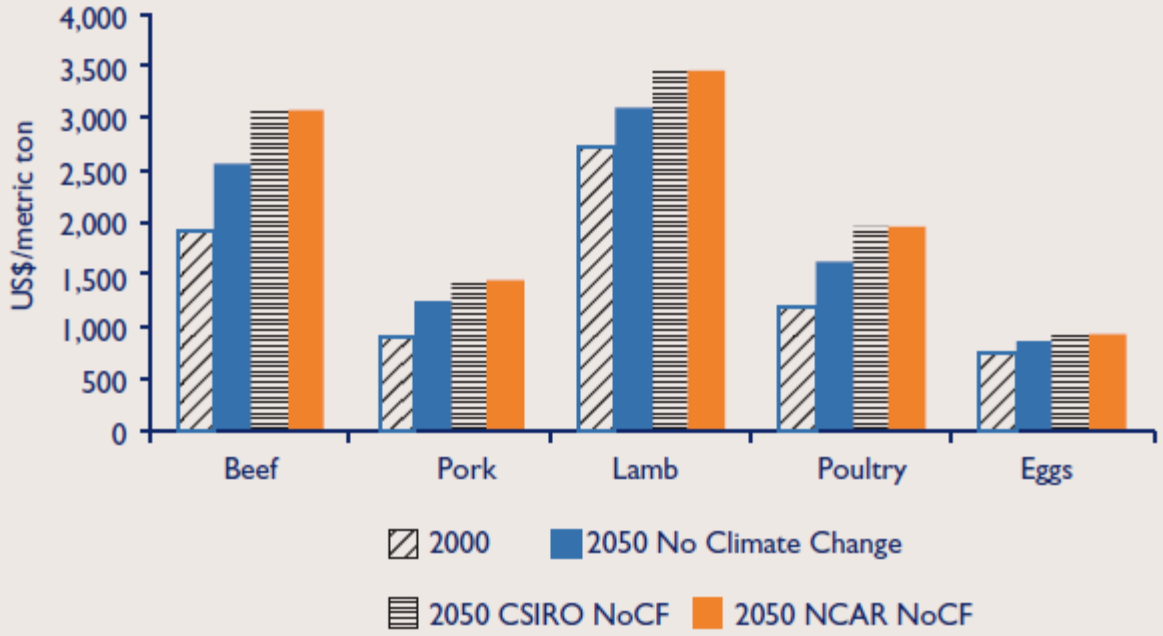
- ↓ milk production
- ↓ fat and protein content
- ↓ reproductive rates
- (and ↓ forage quality)

Other livestock (pigs, chickens):

- ↓ feed intake
- ↓ laying performance (chickens)
- ↓ fertility

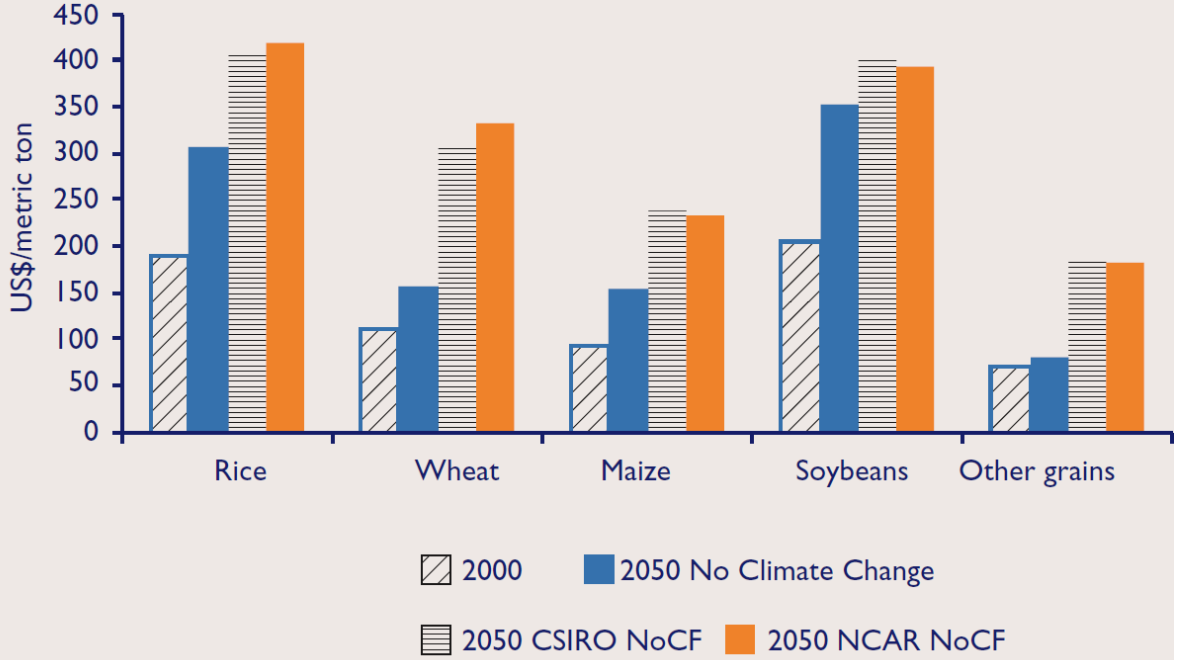
Projected rise in food prices

Figure 3—World prices, Livestock products



Source: Compiled by authors.
Note: Prices are in 2000 US$.

Figure 4—World prices, Major grains



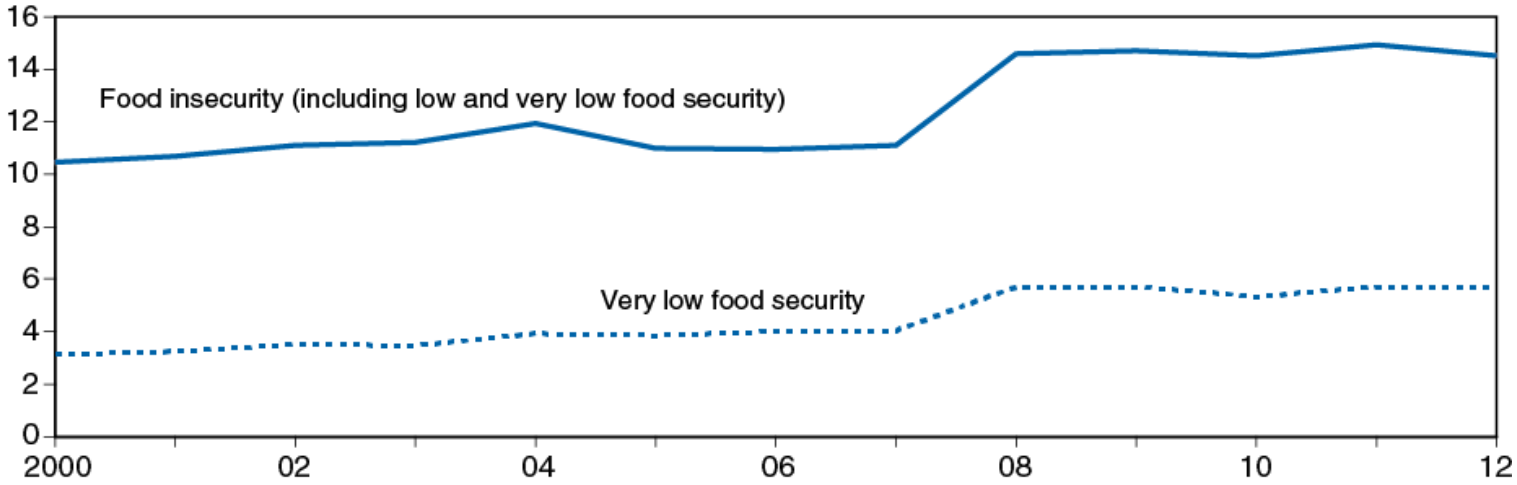
Source: Compiled by authors.
Note: Prices are in 2000 US$.

Source: Nelson et al. *Climate Change Impact on Agriculture and Costs of Adaptation*. International Food Policy Research Institute, 2009.

High food prices and hunger

Food insecurity in the United States, 2000-2012

Percent of households



Source: Calculated by USDA, Economic Research Service using Current Population Survey Food Security Supplement data.

In WA:

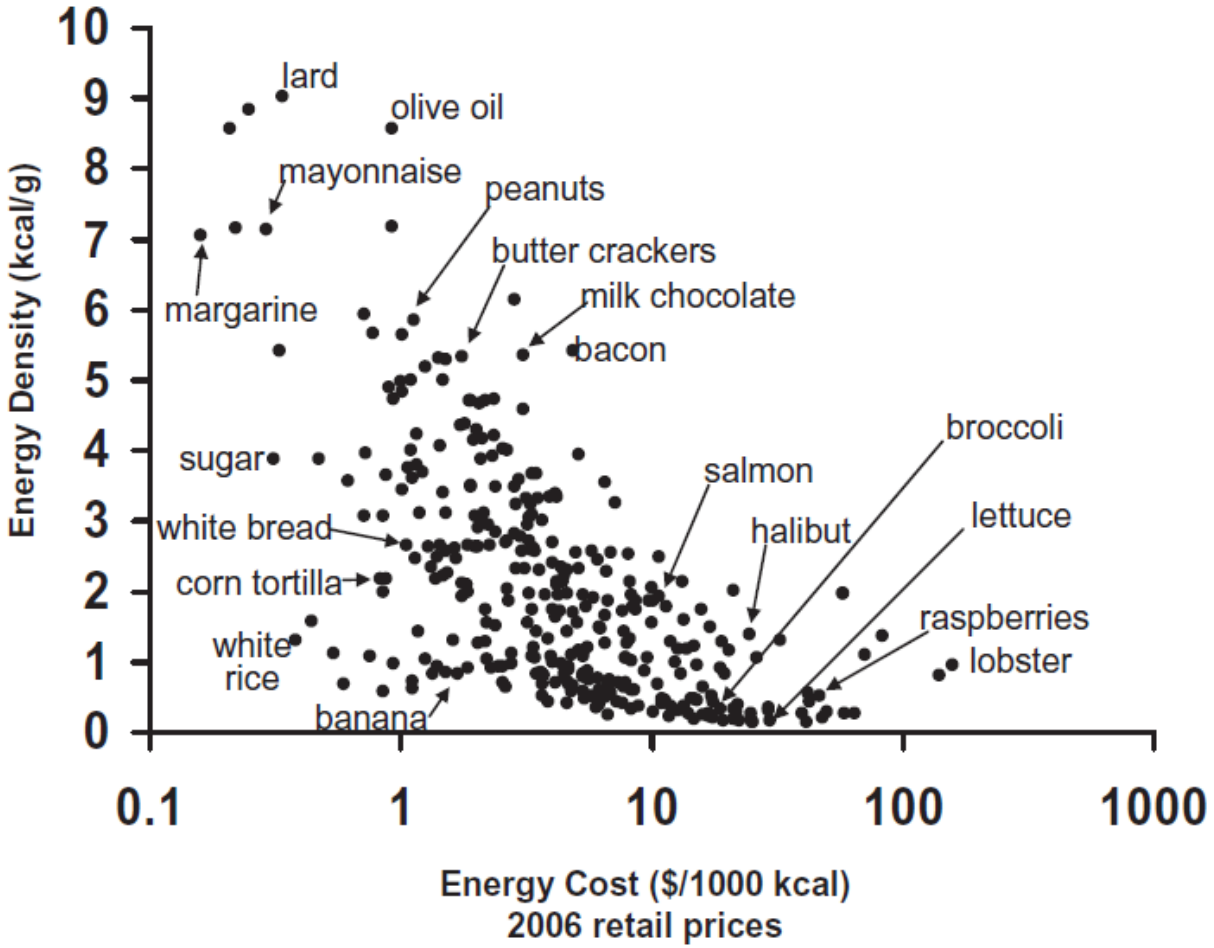
15% overall (1.03M)

23.4% in children (370K)

Source: USDA, 2013.

Source: http://www.feedingamerica.org/hunger-in-america/our-research/map-the-meal-gap/

Food prices, nutrition, and health

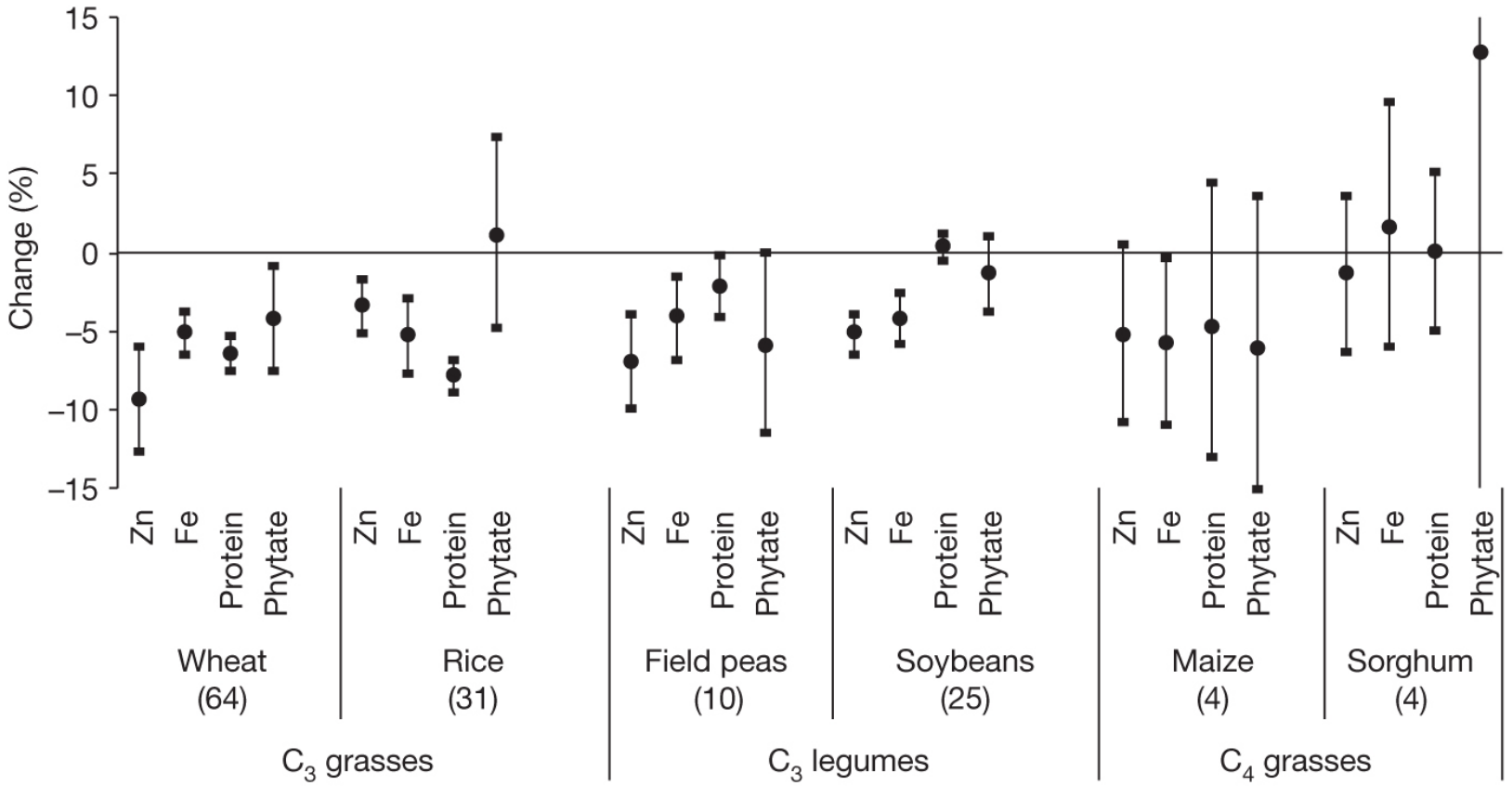


Relationship between energy density of selected foods (kcal/g) and energy costs (USD/1,000 cal)

Source: Drewnowski A. The cost of US foods as related to their nutritive value. *Am J Clin Nutr* 2010 92: 1181-88.

Increasing CO_2 threatens human nutrition

Samuel S. Myers[1,2], Antonella Zanobetti[1], Itai Kloog[3], Peter Huybers[4], Andrew D. B. Leakey[5], Arnold J. Bloom[6], Eli Carlisle[6], Lee H. Dietterich[7], Glenn Fitzgerald[8], Toshihiro Hasegawa[9], N. Michele Holbrook[10], Randall L. Nelson[11], Michael J. Ottman[12], Victor Raboy[13], Hidemitsu Sakai[9], Karla A. Sartor[14], Joel Schwartz[1], Saman Seneweera[15], Michael Tausz[16] & Yasuhiro Usui[9]



Percent change in nutrients at elevated [CO_2] relative to ambient [CO_2]

Myers *et al. Nature* 2014;510:139-42

Weeds: the bad news

Climate change may lead to

More weed growth

Lower herbicide efficacy

Changes in biomass and root:shoot ratio of field-grown Canada thistle (*Cirsium arvense*), a noxious, invasive weed, with elevated CO_2: implications for control with glyphosate

Weed Science, 52:584–588. 2004

Lewis H. Ziska

Elevated Atmospheric Carbon Dioxide and Weed Populations in Glyphosate Treated Soybean

Lewis H. Ziska* and Ernie W. Goins

Future atmospheric carbon dioxide may increase tolerance to glyphosate

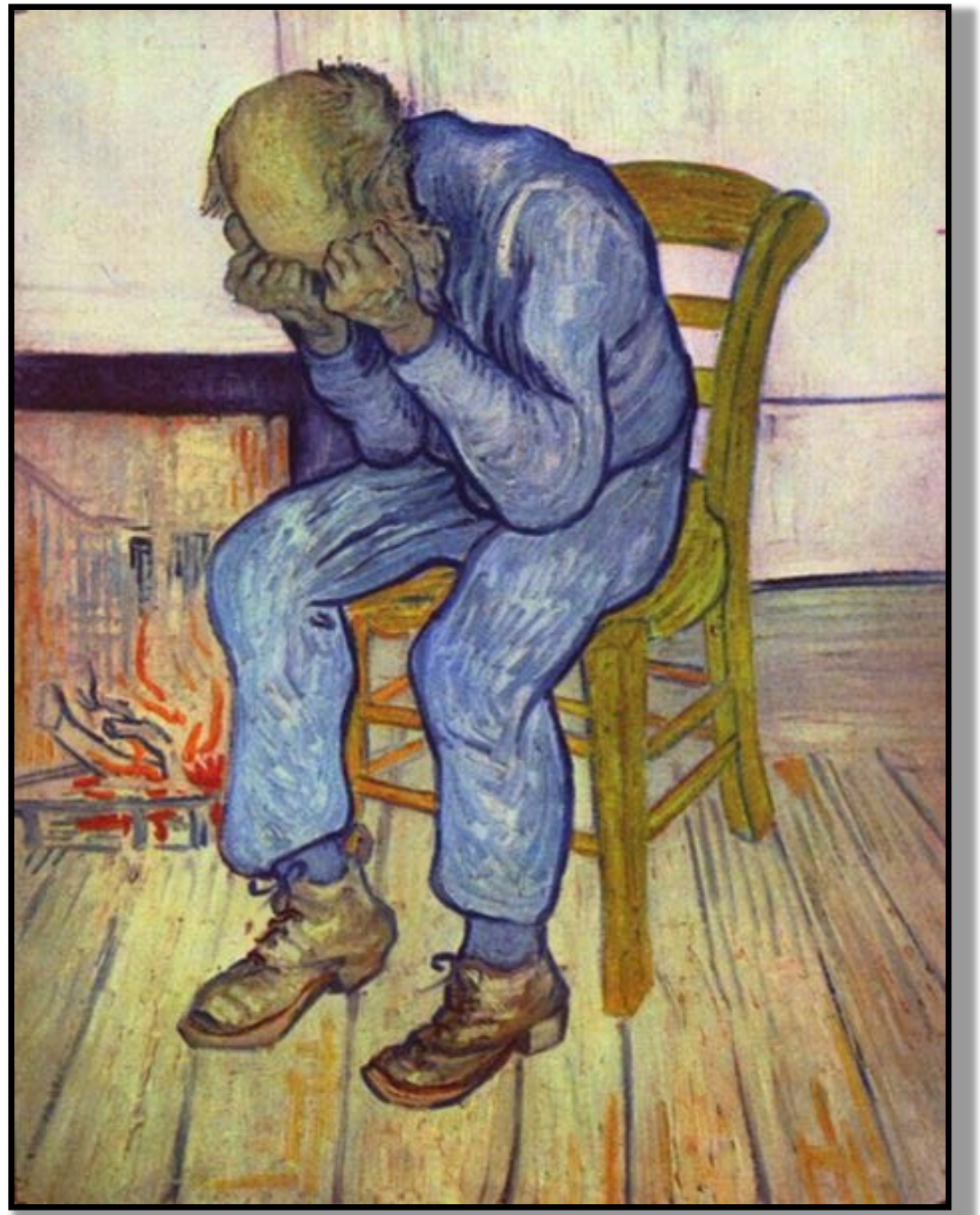
Weed Science, 47:608–615. 1999

Lewis H. Ziska

Climate change and decreasing herbicide persistence†

Pest Management Science

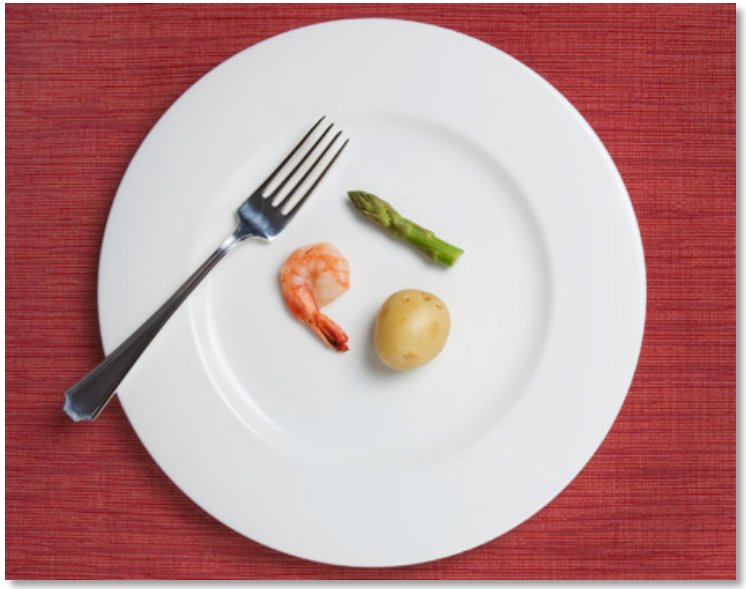
Steven W Bailey*



Mental health

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

Climate communication



QUIT
SMOKING!

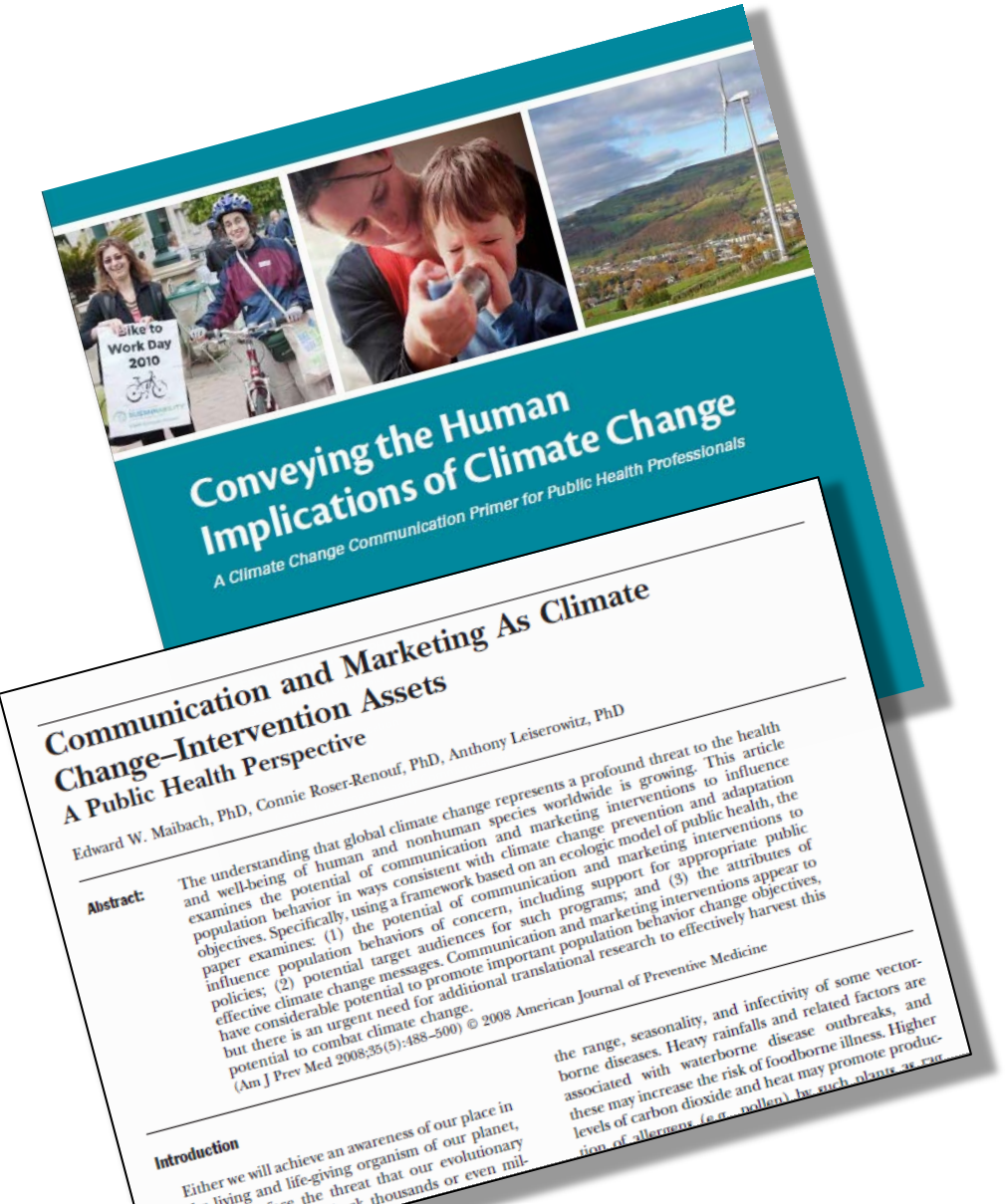
TROJAN
NON-LUBRICATED
TROJAN
ULTRA PLEASURE
TROJAN
TROJAN
TROJAN
ULTRA THIN
TROJAN
TROJAN
TROJAN
TROJAN
TROJAN
PLEASURE PACK
TROJAN
TROJAN

What we say to dogs
Okay, Ginger! I've had it! You stay out of the garbage! Understand, Ginger? Stay out of the garbage, or else!
What they hear
Blah blah GINGER blah blah blah blah blah blah GINGER blah blah blah blah...

Psychological barriers

- Climate change is unprecedented
- Climate change is complicated
- People discount risks
- Daily experience doesn’t confirm climate change
- Climate change is frightening
- People mistrust information sources and authorities
- People don’t like the needed behavioral changes
- Climate change has been hitched to ideology

What do we learn from health communication?



- Segment and understand your audiences
- Simple clear messages, repeated often, by a variety of trusted sources
- Make it easy, make it fun, and make it popular

Health: A frame for climate communication?

Climatic Change
DOI 10.1007/s10584-012-0513-6

LETTER

A public health frame arouses hopeful emotions about climate change

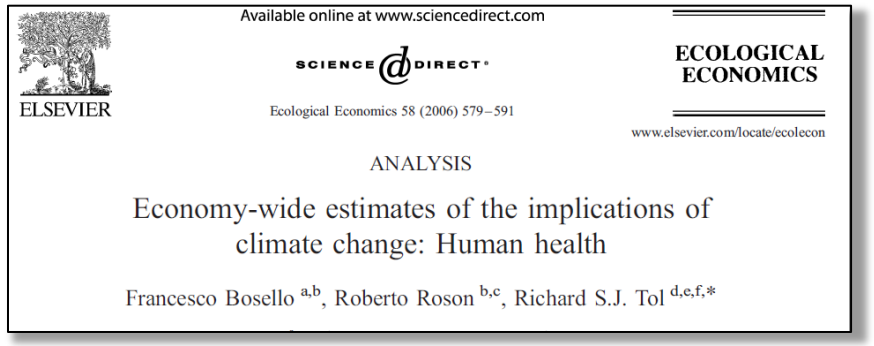
A Letter

Teresa A. Myers • Matthew C. Nisbet • Edward W. Maibach • Anthony A. Leiserowitz

Received: 18 January 2012 / Accepted: 22 May 2012
© The Author(s) 2012. This article is published with open access at Springerlink.com

Abstract Communication researchers and practitioners have suggested that framing climate change in terms of public health and/or national security may make climate change more personally relevant and emotionally engaging to segments of the public who are currently disengaged or even dismissive of the issue. To evaluate these assumptions, using a nationally representative online survey of U.S. residents (N=1,127) conducted in December, 2010, we randomly assigned six previously identified audience segments on climate change to one of

Co-benefits: Health is money



Available online at www.sciencedirect.com

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ECOLOGICAL ECONOMICS

Ecological Economics 58 (2006) 579–591

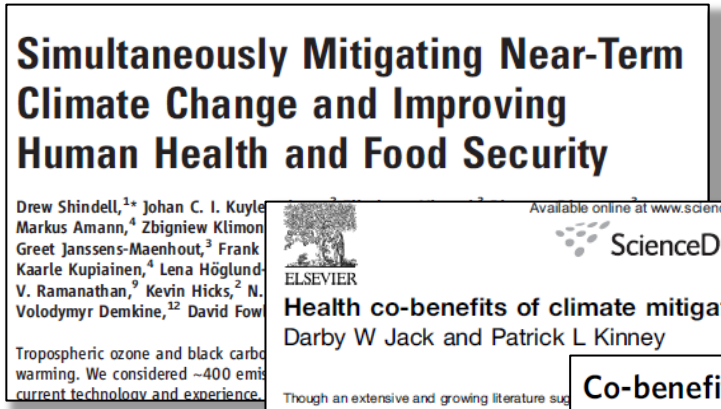
www.elsevier.com/locate/ecolecon

ANALYSIS

Economy-wide estimates of the implications of climate change: Human health

Francesco Bosello [a,b], Roberto Roson [b,c], Richard S.J. Tol [d,e,f,*]

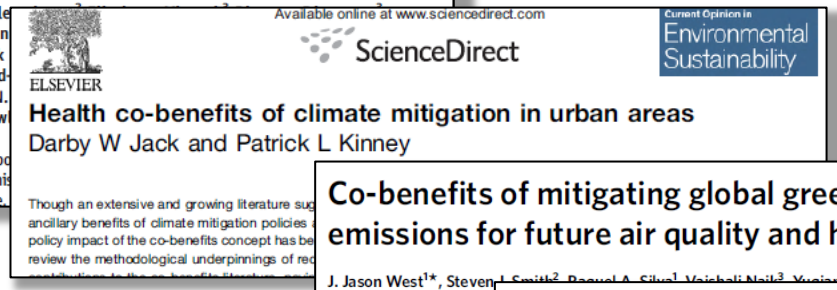
- The health costs of climate change are VERY HIGH



Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security

Drew Shindell,[1*] Johan C. I. Kuyle
Markus Amann,[4] Zbigniew Klimon
Greet Janssens-Maenhout,[3] Frank
Kaarle Kupiainen,[4] Lena Höglund-
V. Ramanathan,[9] Kevin Hicks,[2] N.
Volodymyr Demkine,[12] David Fow

Tropospheric ozone and black carbo
warming. We considered ~400 emis
current technology and experience.



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Current Opinion in Environmental Sustainability

ELSEVIER

Health co-benefits of climate mitigation in urban areas

Darby W Jack and Patrick L Kinney

Though an extensive and growing literature sug
ancillary benefits of climate mitigation policies
policy impact of the co-benefits concept has be
review the methodological underpinnings of rec

Co-benefits of mitigating global greenhouse gas emissions for future air quality and human health

J. Jason West[1*], Steven J. Smith[2], Raquel A. Silva[1], Vaishali Naik[3], Yuqiang Zhang[1]
Zachariah Adelman[1], M
and Jean-Francois Lama

Actions to reduce greenhou
reduce co-emitted air polluta
quality and human health. Pa
near-term and local co-bene
transport of air pollutants[7–9],
and the influence of climate
we simulate the co-benefits

- The health co-benefits of climate mitigation and adaptation have VERY LARGE ECONOMIC VALUE

MITIGATION AND HEALTH

Climate policy not so costly

Climate change mitigation can benefit human health by reducing air pollution. Research now shows that the economic value of health improvements can substantially outweigh mitigation costs, and that more flexible policies

Air Quality and Exercise-Related Health Benefits from Reduced Car Travel in the Midwestern United States

Maggie L. Grabow,[1,2] Scott N. Spak,[1,3,4] Tracey Holloway,[1,4] Brian Stone Jr.,[5] Adam C. Mednick,[1,6,7] and Jonathan A. Patz[1,2,8]

[1]Nelson Institute, SAGE (Sustainability and the Global Environment), University of Wisconsin–Madison, Madison, Wisconsin, USA; [2]Department of Population Health Sciences, School of Medicine and Public Health, University of Wisconsin–Madison, Madison, Wisconsin, USA; [3]Now: Public Policy Center, University of Iowa, Iowa City, Iowa, USA; [4]Department of Atmospheric and Oceanic Sciences, University of Wisconsin–Madison, Madison, Wisconsin, USA; [5]School of City and Regional Planning, Georgia Institute of Technology, Atlanta, Georgia, USA; [6]Department of Urban and Regional Planning, University of Wisconsin–Madison, Madison, Wisconsin, USA; [7]Wisconsin Department of Natural Resources, Madison, Wisconsin, USA; [8]Global Health Institute, University of Wisconsin–Madison, Madison, Wisconsin, USA

Recap

- Climate change is a health issue
  - A wide range of outcomes
  - Certain populations especially vulnerable
- Climate communication: The role of health
  - Effective climate communication challenging but essential
  - Health communication offers valuable lessons
  - Health an effective frame for climate communication
- Co-benefits: Health is money
  - Health costs of climate change are very high
  - Many health co-benefits from mitigation and adaptation
  - These co-benefits offer substantial economic returns

Thank you!