NIEHS
National Institute of Environmental Health Sciences

Climate and Health

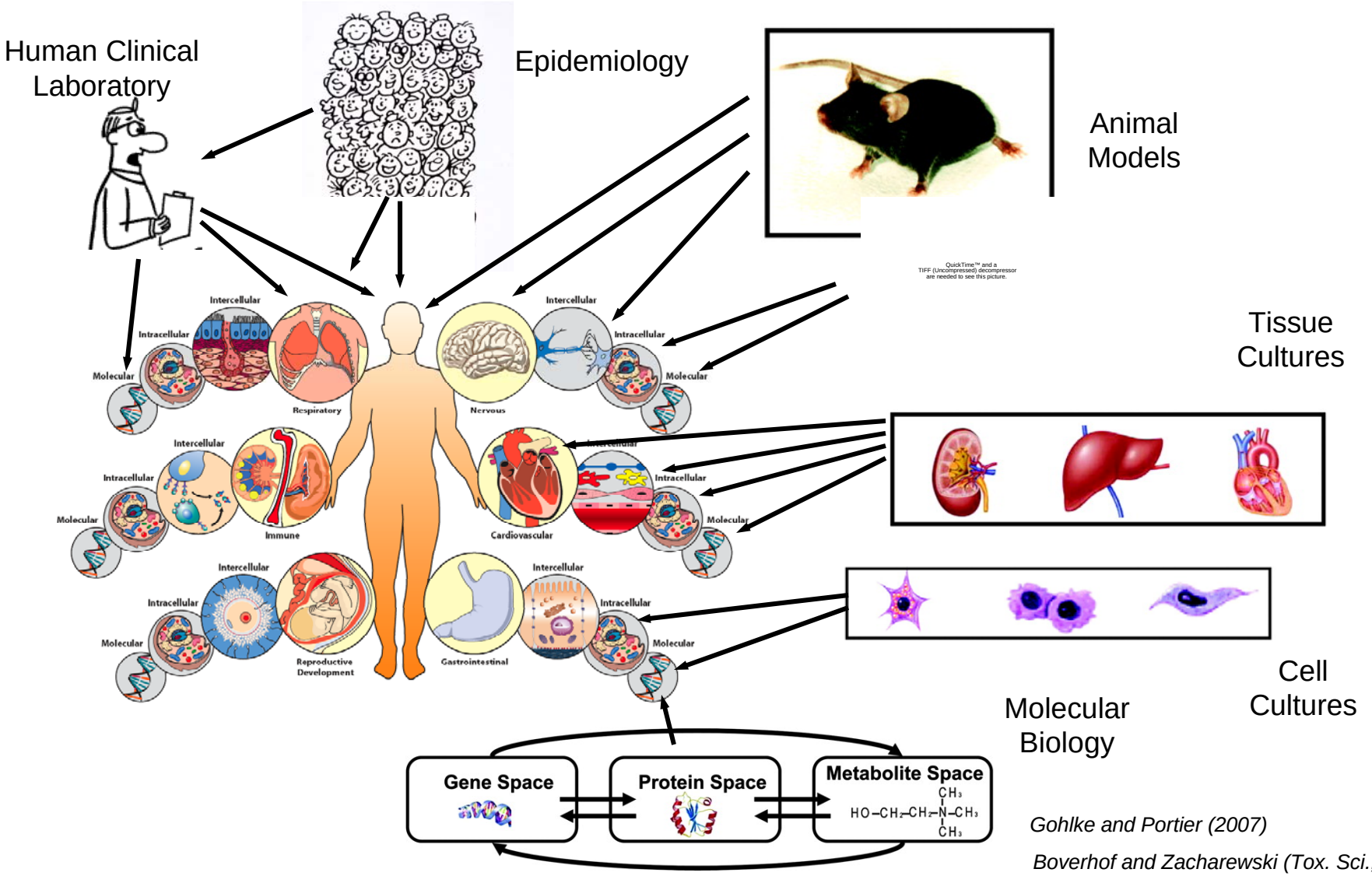
NIEHS Portfolio on Airborne Pollutants

Dr. Christopher J. Portier

NTP
National Toxicology Program

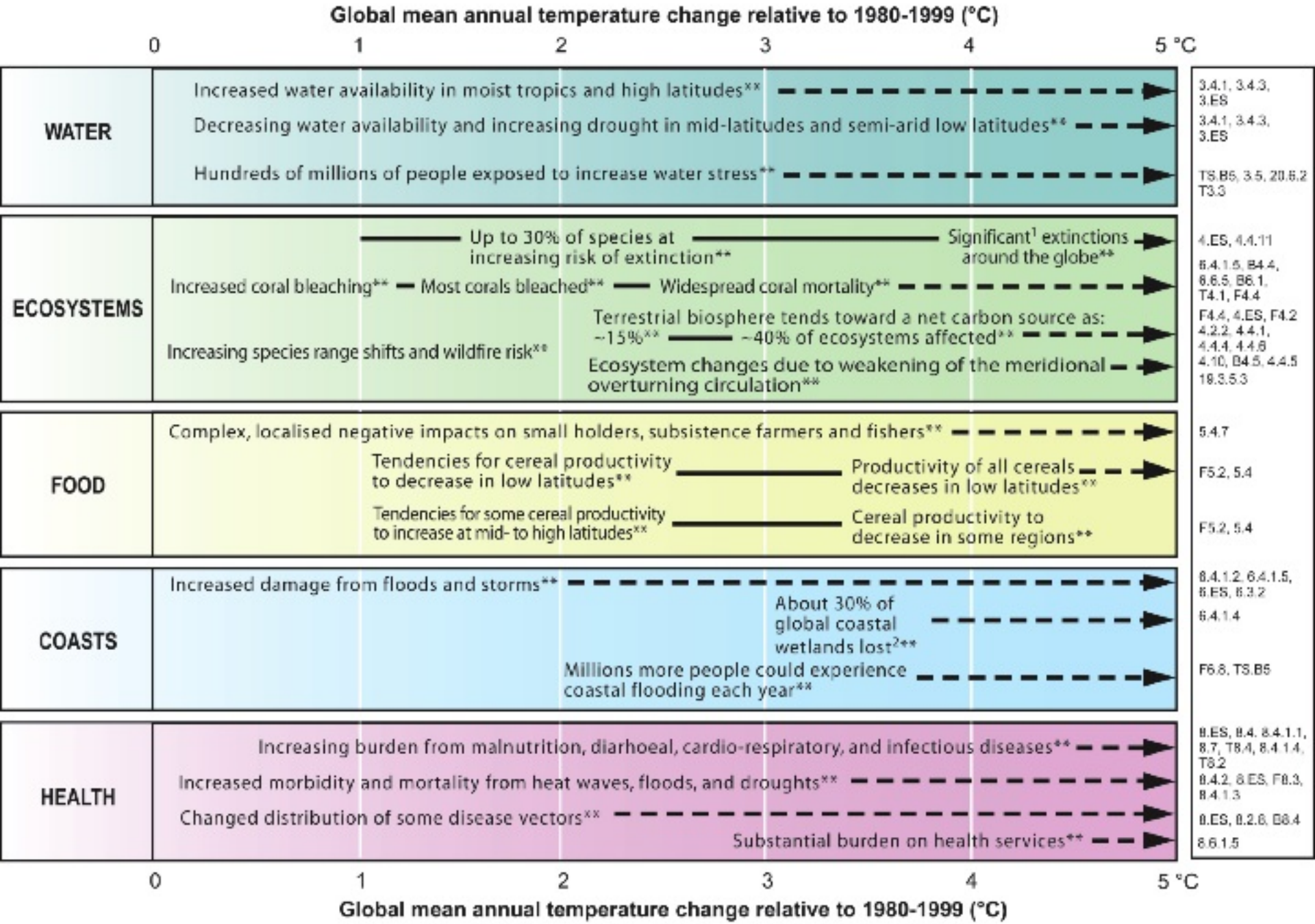
U.S. Department of Health and Human Services
National Institutes of Health
National Institute of Environmental Health Sciences

Research and the Human Model



Gohlke and Portier (2007)

Boverhof and Zacharewski (Tox. Sci., 2006)



[1] Significant is defined here as more than 40%.

[2] Based on average rate of sea level rise of 4.2 mm/year from 2000 to 2080.

Health Implication

Pollutant

Climate Change

Mechanism/Basic Research

Pollutants

- CO
- CO2
- NO2
- Particulates
  - Ultrafines
  - Carbon nanoparticles
- Naphthalenes
- Heavy metals
- Mercury
- PCBs
- Pollen

- Diesel exhausts
- Chromium
- MTBE
- Benzene
- Toluene
- Ethylbenzene

- Aldehydes

- Disasters
- Conflict

Health Impacts

- Respiratory
  - Asthma
  - cystic fibrosis
  - Inflammation
  - airway development
  - COPD
- Cardiovascular
  - Atherosclerosis
  - Miocardial Infarctions
  - Stroke
  - Atherosclerosis
  - Arrythmogenesis
- Neurotoxicity
- Influenza infectivity
- Preeclampsia/premature birth
- Immune changes
- Cancer
- Functional Changes
  - Signaling pathways
  - Oxidative stress

TABLE 4. Multivariable-adjusted† regression coefficients for indices of heart rate variability per one-standard-deviation increment of levels of ozone and sulfur dioxide, Atherosclerosis Risk in Communities Study, 1996–1998

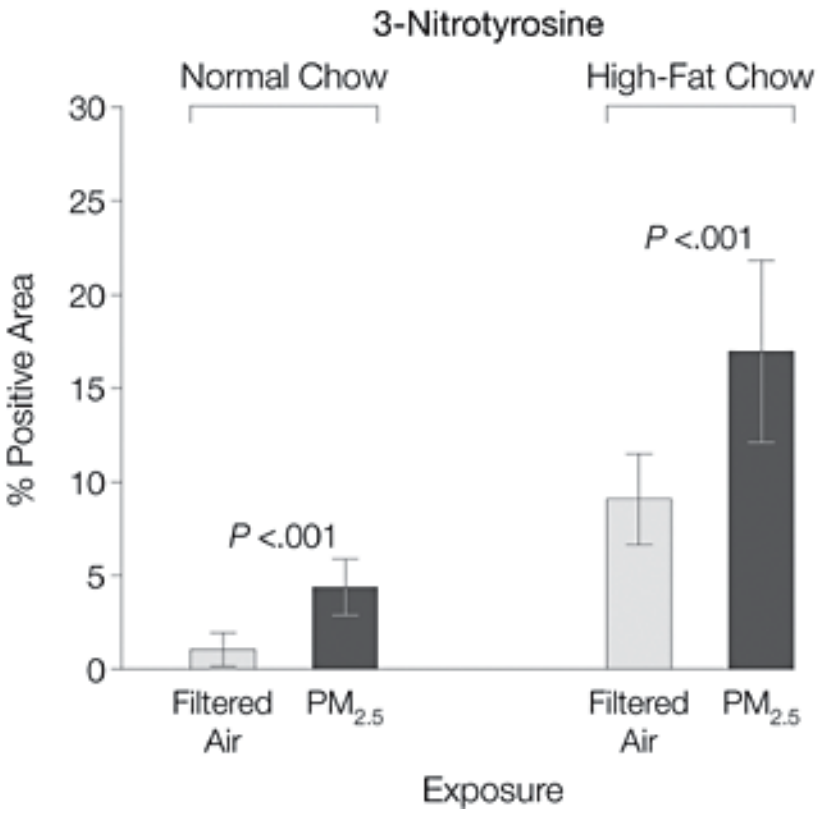
Heart rate variability index and stratification variable	Pollutant and one-standard-deviation increment			
	Ozone (0.016 ppm‡)		Sulfur dioxide (0.004 ppm)	
	β	SE‡	β	SE
Log-transformed high-frequency power (ms^2)				
White race	–0.069**	0.019		
Black race	0.047	0.034		
Log-transformed low-frequency power (ms^2)				
Prevalent CHD‡			–0.122*	0.056
No prevalent CHD			–0.012	0.016

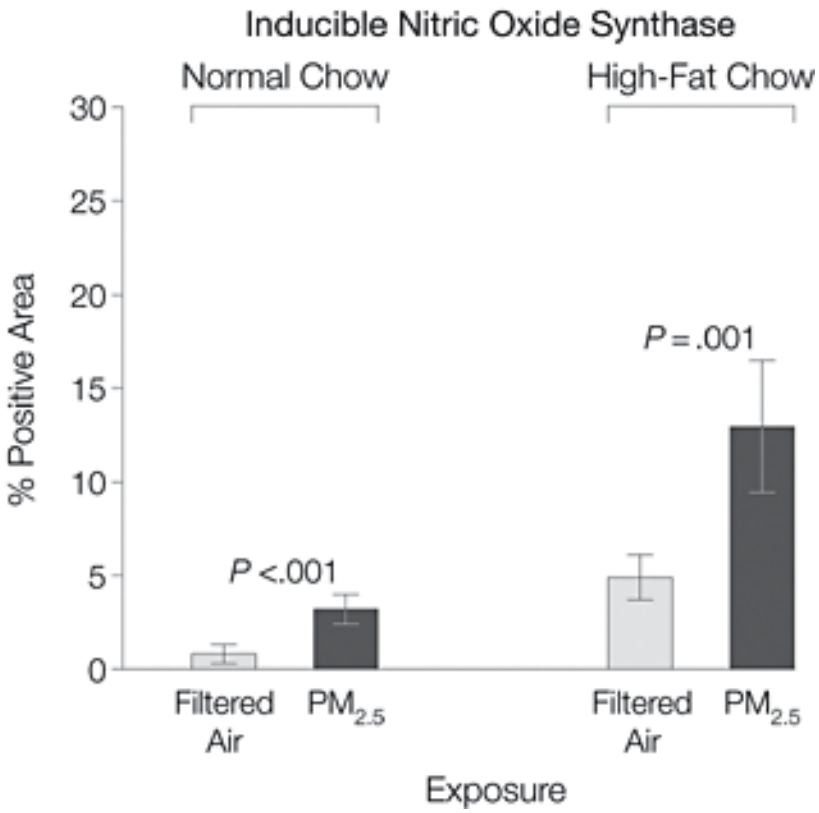
* $p < 0.05$; ** $p < 0.01$.

† Adjusted for age, ethnicity-center (where appropriate), sex, current smoking, education, body mass index, hypertension, diabetes, heart rate, prevalent coronary heart disease (where appropriate), and use of cardiovascular medication.

‡ ppm, parts per million; SE, standard error; CHD, coronary heart disease.

Liao *et al*, AJE 2004





Sun, Q. et al. JAMA 2005;294:3003-3010.

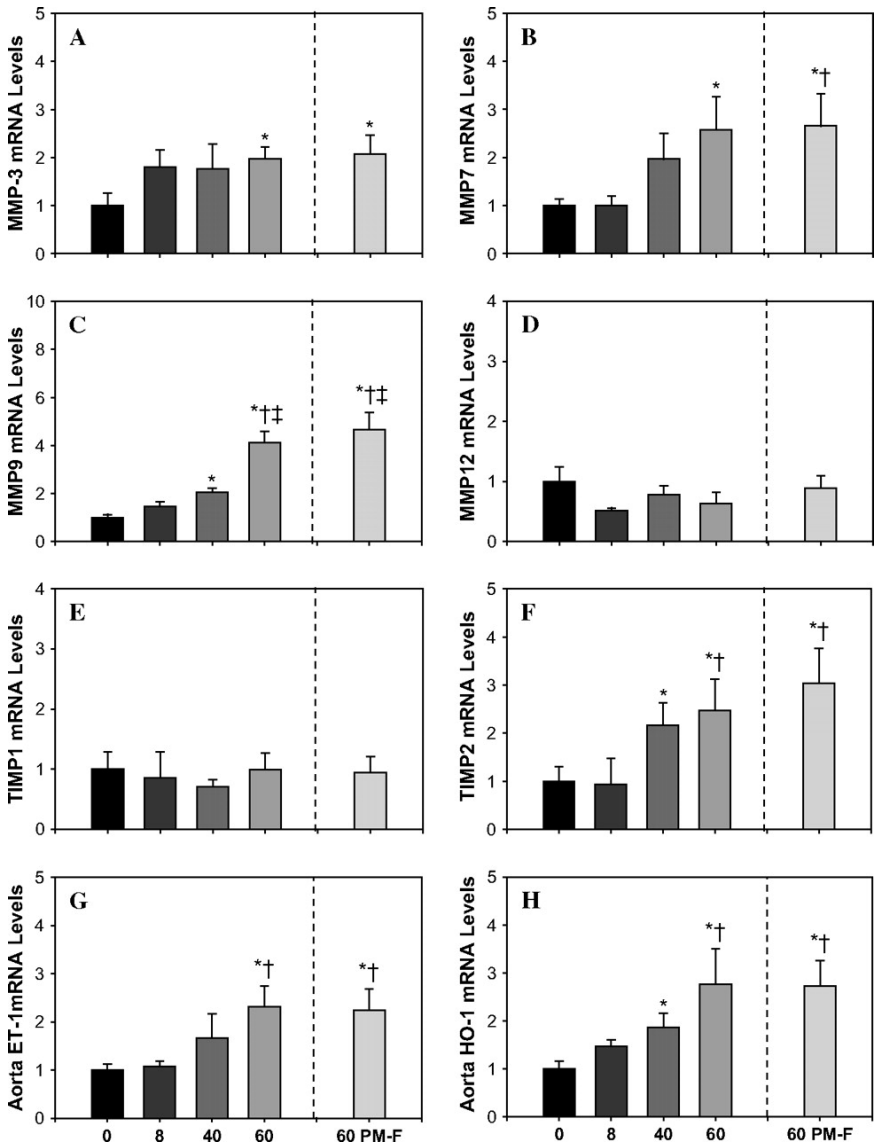


FIG. 1. Transcriptional changes in aortic MMP, TIMP, HO-1, and ET-1 mRNA, as determined by real-time RT-PCR. Expression of aortic MMP-3 (A), MMP-7 (B), MMP-9 (C), MMP-12 (D), TIMP1 (E), TIMP2 (F), ET-1 (G), and HO-1 (H) mRNA in ApoE–/– mice exposed for 6 h/day x 7 weeks to filtered air (controls, 0); 8, 40, and 60 μg/m3 PM; or 60 μg/m3 PM-filtered (60 PM-F) concentrations. N = 8 for each group represented. Data show mean normalized gene expression (to 18S) ± SEM. *p 0.050 compared to filtered-air controls; p 0.050 compared to 8 μg/m3 PM; p 0.050 compared to 40 μg/m3 PM.

Lund, A. K. et al. Toxicol. Sci. 2007 95:485-494

Other issues

- Environmental justice
- Co-exposures and synergy
- Modeling health implications and exposures
- Exposure devices
- Intervention
- Susceptibility
  - Genetic
  - Obesity
- Animal model development

QuickTime™ and a
decompressor
are needed to see this picture.

Alexeeff *et al*, Chest 2007

TABLE 7. Estimated odds ratios and 95% confidence intervals for the association of cardiovascular disease visits with daily ambient air quality measurements (average of pollution levels lagged 0, 1, and 2 days) in visits with and without comorbid congestive heart failure, Atlanta, Georgia, 1993–2000

	Ischemic heart disease		Dysrhythmia		Peripheral and cerebrovascular disease	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
With comorbid congestive heart failure*						
PM_{10}†	0.927‡	0.877, 0.980	1.016	0.924, 1.117	1.076	0.979, 1.183
Ozone	1.015	0.910, 1.132	0.981	0.815, 1.180	1.089	0.903, 1.314
Nitrogen dioxide	0.911‡	0.850, 0.977	1.136	1.006, 1.282	1.043	0.928, 1.172
Carbon monoxide	0.956‡	0.907, 1.007	1.065	0.968, 1.173	1.072	0.981, 1.172
Sulfur dioxide	0.981	0.905, 1.063	1.034	0.902, 1.186	1.067	0.931, 1.223
No comorbid congestive heart failure*						
PM_{10}	1.020‡	1.000, 1.039	1.011	0.991, 1.031	1.014	0.993, 1.036
Ozone	1.000	0.963, 1.039	1.013	0.973, 1.055	1.017	0.975, 1.061
Nitrogen dioxide	1.041‡	1.016, 1.066	1.017	0.992, 1.043	1.032	1.005, 1.061
Carbon monoxide	1.024‡	1.006, 1.042	1.015	0.996, 1.034	1.029	1.008, 1.051
Sulfur dioxide	1.017	0.990, 1.045	1.002	0.974, 1.030	1.021	0.990, 1.053

* Determined from secondary *International Classification of Diseases*, Ninth Revision, codes listed for the same visit.

† PM_{10}, particulate matter with an average aerodynamic diameter of less than 10 μm.

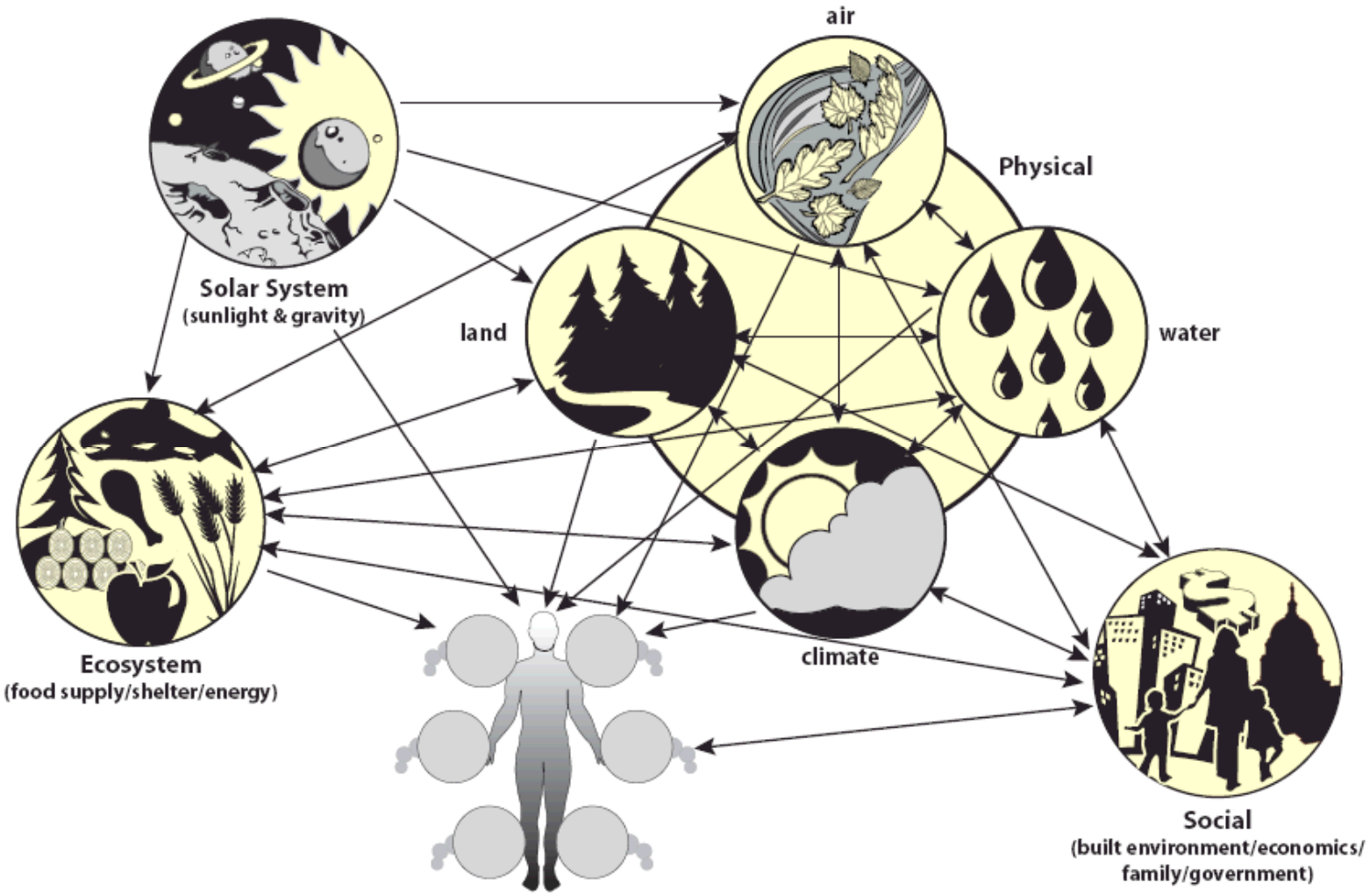
‡ Comparing the pollution regression coefficients for visits with and without comorbid congestive heart failure: $p < 0.05$.

Peel *et al*, AJE 2007

Limited in portfolio

- Biomass
- Biofuels
- Biodiesel
- Wind energy/ noise pollution
- Health consequences of conflict
  - Depleted uranium dust (radiation is in portfolio)
  - Explosives by-products

Interaction Network: Our Environment and Our Health



Gohlke and Portier (2007)