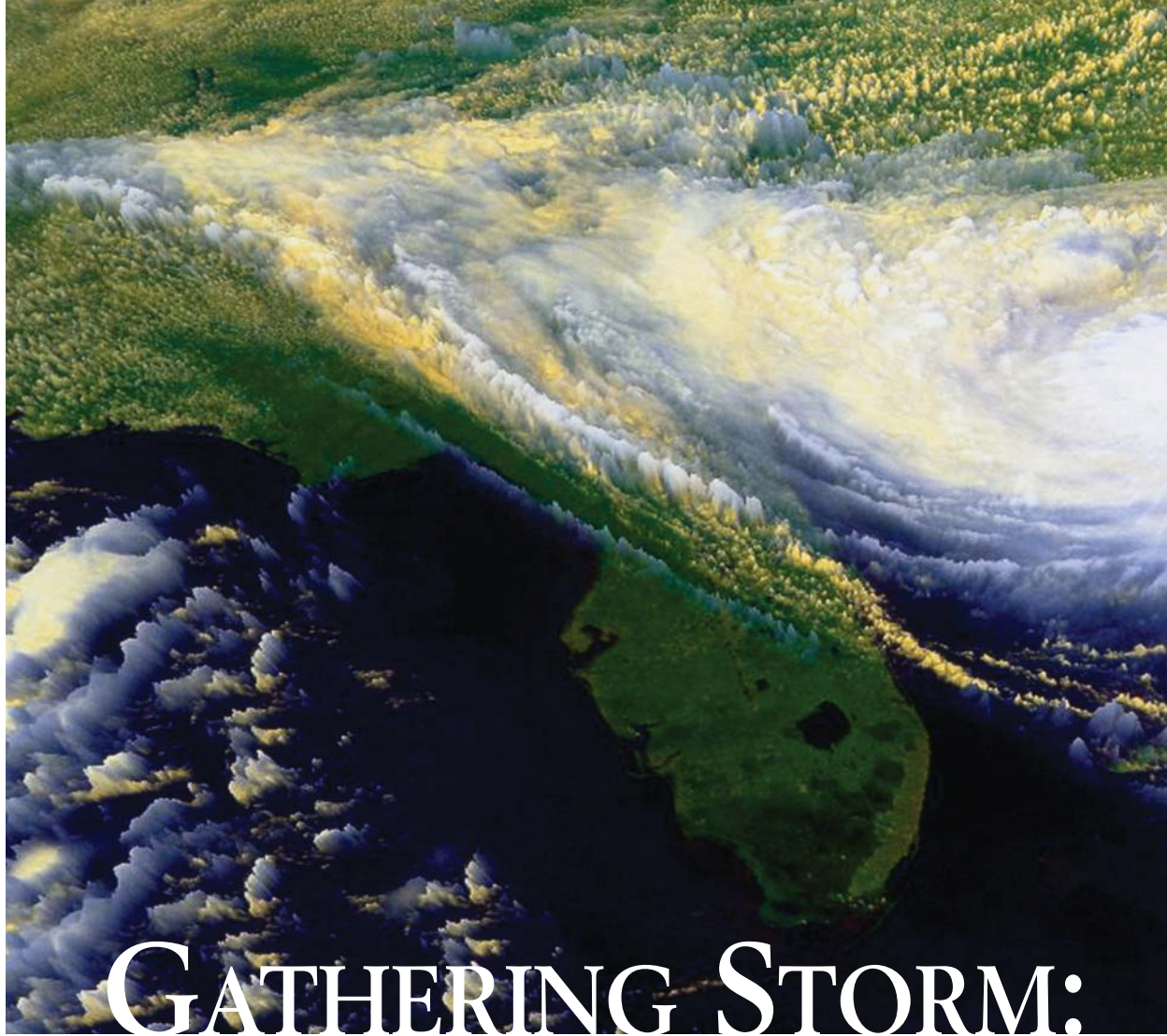


**MOUNTING
EVIDENCE OF
THE CURRENT
AND POTENTIAL
HARMFUL
HUMAN IMPACTS
ASSOCIATED WITH
THE PLANET'S
WARMING TREND
CALLS FOR
PUBLIC HEALTH
LEADERSHIP.**



GATHERING STORM: The Health Effects of Global Climate Change

“Global climate change is not just a problem of melting glaciers and drowning polar bears. The human health consequences are significant and underappreciated.”

— Dr. Linda Rosenstock

Hurricanes pound the Gulf Coast with

unrelenting force. Floods deluge the Midwest. Wildfires rage out of control in California and Florida. A “red tide” blooms off the West Coast, and dengue (“breakbone”) fever spikes in Mexico and looms over the United States. No one can say with certainty that any single one of these events is due to global climate change. But there is little doubt among scientists that these events are on the rise as we are making unprecedented changes to our environment, with grave potential consequences.

“We are conducting an inadvertent experiment by changing the greenhouse gas composition of the atmosphere,” says Dr. Arthur Winer, professor of environmental health sciences at the UCLA School of Public Health. “We can’t know exactly how it’s going to play out, but we can infer there are enormous implications for almost every aspect of human society.”

The world has warmed by approximately 1 degree Fahrenheit since the mid-19th century, when temperature records started being kept, and most of that heating has occurred in the last three decades, coinciding with an exponential increase in burning of fossil fuels. Given the long atmospheric lifetime of



heat-trapping greenhouse gases such as carbon dioxide, methane and nitrous oxide, barring major changes the warming trend is bound to accelerate. The United Nations' Intergovernmental Panel on Climate Change (IPCC), a prestigious body of 2,500 scientists, projects an increase in average temperature of 3-10 degrees Fahrenheit by the end of this century. Sea levels are projected to rise between a few inches and more than two feet, putting tens of millions at risk.

Global climate change is more than a weather phenomenon; it is also a major public health issue. "The environmental threats are increasingly appreciated, but the human health effects have received less attention," says Dr. Linda Rosenstock, the school's dean. But the effects – through the intense weather events such as heat waves, wildfires and floods, and indirectly from changes in water, air, agriculture, and infectious disease patterns – are troubling, and already with us. The World Health Organization estimates the shifting climate is now responsible for about 150,000 deaths each year as well as millions of illnesses, many of those from the spread of malaria into new areas where the mosquitoes that carry the disease were once unable to survive. If greenhouse

gases are not controlled soon, the projections are far more sobering.

The school is doing its part to enhance the focus on these concerns. On October 17, just five days after the Nobel Peace Prize was awarded to former Vice President Al Gore and the IPCC for their efforts in raising awareness about man-made climate change and the measures needed to counteract it, the school hosted "Changing Climate/Changing Lives: A Summit on the Public Health Effects of Climate Change." The summit, the first of its kind, was open to the public and featured an international panel of experts and political leaders, including U.S. Sen. Barbara Boxer (by video). In addition, Rosenstock has formed a search committee to recruit faculty who study the human health impacts of climate change.

"The science is clear that global climate change is not just a problem of melting glaciers and drowning polar bears," says Rosenstock. "The human health consequences of global climate change are significant and underappreciated, not just in the future but today, and they affect us all."

What was once called global warming is increasingly referred to by scientists as global climate change, for a good reason. "Although many areas are warming, some aren't," says Dr. Hilary Godwin, chair of the school's Department of Environmental Health Sciences. "But it's clear that patterns of weather are changing. There are predicted increases not only in average temperatures, but also in extreme temperatures. In California we will be seeing hotter, drier weather, but other parts of the country may see more precipitation and more severe storms."

Dr. Jonathan Patz, associate professor of environmental studies at the University of Wisconsin-Madison and author of more than 50 peer-reviewed scientific papers addressing the health effects of global climate change, notes that studies of temperature-related mortality have found that the further temperatures drop from an optimal level, the more the death toll rises; as temperatures increase above the optimal level, though, the mortality increase is much steeper. More than 700 deaths were attributed to the week-long heat wave in Chicago in 1995, and tens of thousands died in the more recent 2003 European heat wave. Extreme heat is also associated with increased emergency room visits and hospitalizations for people with heart disease. The elderly and people with pre-existing cardiovascular and respiratory illness are the most vulnerable, notes Patz, a featured speaker at "Changing Climate/Changing Lives."

The extreme weather pattern is epitomized by the projection of increases in both droughts and floods. "People ask how you can get more of both,"



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—Dr. Hilary Godwin

As the insects that carry malaria and other diseases are able to thrive in higher elevations, major population centers are newly at risk. Low-lying cities face disaster from floods that are expected to become increasingly common, as well as the specter of rising sea levels.



Patz says. “Warmer air temperature evaporates soil moisture quickly, which can contribute to a drought, but it also holds more moisture, so that when it rains it can really rain hard.” As Hurricane Katrina demonstrated, for low-lying areas in Florida and Louisiana, increasingly severe weather is a recipe for disaster.

Higher temperatures indirectly affect health by creating conditions for greater photochemical smog formation, notes Winer, who teaches about the greenhouse effect and its impact on air quality. Hot weather leads to increases in two key ozone precursors: volatile organic compound emissions from fuels, paints and coatings; and nitrogen oxides from spikes in energy usage for cooling. Moreover, at higher temperatures, the chemical reactions producing smog occur more rapidly. Numerous studies have established that higher levels of ground-level ozone and fine particles lead to significant increases in respiratory impact and deaths, Winer notes. Among the most vulnerable are the elderly, children, and people with asthma or other respiratory conditions.

This is a special concern in California, where an estimated 9,000 deaths per year are attributed to what is still considered the nation’s worst air quality. “We’ve made tremendous progress over the last three decades in lowering ozone levels and meeting the air quality standards for pollutants such as carbon monoxide, lead and nitrogen dioxide,” says Winer, a core member of the Environmental Science and Engineering program, based in the school. “Now there is a danger that because of the growth in population and the increasing temperatures, the levels of ozone could begin to rise again.” California’s air quality concerns are exacerbated by the prospect of an increase in the frequency and severity of wildfires, fueled by drought and higher temperatures. Godwin notes that people with asthma are especially vulnerable to the particulate matter emitted during such events.

Recent studies have also shown that higher levels of carbon dioxide in the atmosphere lead to increased ragweed production – more bad news for people with allergic conditions. Other studies suggest that ozone itself increases sensitivity to airborne allergens. “We’re looking at more days with high smog levels and high pollen counts hitting at the same time in the warm months of the year, and the writing on the wall is pretty clear for that segment of the population,” says Dr. Gina Solomon, a senior scientist at the Natural Resources Defense Council, associate clinical professor of medicine at UC San Francisco and a featured speaker at the recent UCLA School of Public Health summit.



Another concern heightened in California has to do with water – both quantity and quality. The drought-prone state, home to so much of the nation’s agriculture, is already vulnerable to water shortages; with increased temperatures, the forecast is for a higher proportion of future precipitation to come as rain rather than snow. “We have had a free ecosystem service in which snow packs in the Sierras store water that we can use later in the year as it melts,” explains Dr. Richard Ambrose, professor of environmental health sciences and director of the Environmental Science and Engineering program. “If in the future we are getting less precipitation as snow, the water we do get is going to rush out to the ocean in the winter floods and we will lose that service.” One way to preserve that water is to build new dams, Ambrose says, but that will be costly, both in economic terms and in the negative ecological consequences associated with dams.

Altered rainfall patterns also present water quality issues. For example, much of California’s water comes from the San Joaquin Delta. As levels of fresh water drop, there is increased infiltration from the San Francisco Bay. Sea water contains high concentrations of bromine, which at certain levels can lead to carcinogenic reactions. In addition, Solomon points out that outbreaks of cryptosporidiosis – a persistent problem in drinking-water systems, particularly affecting people with compromised immune systems – have been linked to extreme rainfall, which can wash contaminated soil into lakes and streams, leading to urban water drinking systems that are not effectively treated with standard filtration techniques.



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Increased malnutrition could be one of the biggest health implications of climate change. Rising temperatures and more severe droughts are likely to result in a migration of where crops can thrive. Dr. Cristina Tirado, a former WHO regional food-safety adviser for Europe and contributor to the health portion of the most recent 2007 IPCC assessment report, says the impacts of climate change on food and water security and safety are a concern particularly for developing countries. "It is essential to develop health, food and water security adaptation strategies that will protect vulnerable populations," says Tirado, who has come to the school's Department of Community Health Sciences from Spain to pursue research on climate change and adaptation strategies for health, as well as health impacts of agricultural policies.

Dr. Matthew Kahn, professor of economics and member of the UCLA Institute of the Environment, cites research suggesting that as weather conditions adversely affect rural farmers' incomes in developing countries, they move to the cities in search of urban wages. "When millions of these farmers independently make the same rational decision, an unfortunate consequence is that many cities are unprepared and unable to handle the influx and you have increased problems related to congestion, pollution, and disease contagion," he says.

Many of today's most problematic infectious diseases, particularly those that are vector- and water-borne, are likely to intensify in their transmission and spread in their geographic distribution, according to the IPCC. Malaria is responsible for 1-2 million deaths each year, most of them children. The mosquitoes that carry the disease, as well as the ticks and fleas that spread other infections, are sensitive to small changes in temperature and humidity. "Malaria is already shifting its range in developing countries," says Solomon. As the mosquito carrier has become capable of thriving at higher elevations, she notes, major population centers in Zimbabwe and Kenya are newly at risk. Questions are also being raised as to the effect of extreme heat waves and droughts on the dominant mosquito carrier of the West Nile virus, which has moved rapidly through the United States since first arriving in 1999; in hot weather, the virus is produced in the mosquito more



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In October the school hosted “Changing Climate/Changing Lives: A Summit on the Public Health Effects of Climate Change,” featuring an international panel of experts and political leaders. Shown, from left to right: Dr. Gina Solomon, senior scientist, Natural Resources Defense Council; Dr. Nathan Wolfe, professor of epidemiology, UCLA School of Public Health; Dr. Tord Kjellstrom, Australia’s National Centre for Epidemiology; and Dr. J.R. DeShazo, associate professor, UCLA School of Public Affairs.

quickly and is thus more infectious sooner. The mysterious resurgence of dengue fever in Mexico this year has raised concerns in the United States, where the Asian tiger mosquito capable of carrying the disease has already been found.

Many of these current and potential consequences raise issues of environmental justice. When taken together, the negative impacts of global climate change are expected to be disproportionately felt by poor nations and low-income households, according to the IPCC. “This is an enormous ethical challenge,” says Patz. “When you place the map of the countries most vulnerable to climate change next to the map showing where the highest proportions of greenhouse gas emissions are coming from, you see a huge imbalance – although in a globalized world, the industrialized countries will also be affected.”

Since he began teaching at the school nearly two decades ago, Winer has annually provided his students with rankings of the half-dozen or so most important air pollution problems as he sees them. In the 1980s and early 1990s, the accumulation of greenhouse gases and its effect on climate change ranked low in importance relative to issues such as acid rain, photochemical smog, and airborne toxic chemicals. Today, Winer says, climate change has moved to the top of the list, where it will be far more difficult to displace than were the other problems.

“This problem is so enmeshed in the way we have constructed our society,” he says. “You can go down the list – from our energy use to the way we use fertilizers and domesticated herds to feed a population of 6 billion people – and because most of these applications are rising exponentially, so are the greenhouse gas concentrations.” But as great as the challenge may seem, Winer is quick to point out that much can be done. “Given human ingenuity and technology, along with the will to change things, it’s not impossible to reverse course,” he says.

Public health responses to global climate change fall into two categories: mitigation strategies, which seek to prevent, reduce, or delay the climate change impacts; and adaptation strategies, designed to address climate change’s effects to the extent that they are inevitable.



On the mitigation side, the most obvious and fundamental steps would be energy policies that reduce the burning of fossil fuels. Beyond government policies and regulations, there are many commercially available mitigation technologies, and more development in this area should be encouraged, says Godwin. “We can shift the focus of the scientific community toward mitigation technologies in energy and water through the practices of funding agencies and through government incentives for private industry to invest in those technologies,” she explains, noting that the governments of Japan and Germany have advanced development and implementation of new solar energy technologies through incentives to individuals and private companies. Incentives for consumers to purchase hybrid vehicles have already proved effective, Kahn notes.

Among adaptation measures, perhaps the most important strategy in cities prone to heat waves is to assist vulnerable populations, including the elderly and those living in poverty, with access to affordable air conditioning in housing units. In addition, public health departments will need to have plans for heat wave emergencies, floods, and other weather disasters; increased surveillance and infrastructure for water systems; and, in partnership with other agencies, the ability to track patterns of disease to make sure that infectious outbreaks are rapidly detected. “The tools that are the basic foundations of public health will become ever more critical with the changing climate,” says Solomon. “We’re not talking about changing the way we do things in public health; we’re talking about doing more of what we do well.” Public health will

also have an important role to play in educating the population on precautions they should take during extreme weather, she adds.

Godwin believes public health should become more active in raising awareness about the likely impacts of global climate change on people’s lives, both to motivate them to make the individual changes that might help to mitigate some of the effects and to mobilize the population to pressure their government to make the broader policy changes that are needed.

“Because the issues tend to be gradual and there is a delay between the actions we take and when we see effects, it’s easy for people to feel as if climate change isn’t as pressing as some of the other concerns we face,” Godwin says. “And when you really impress on people how bad the situation is, you risk overwhelming them to the point that they dissociate themselves from the issue. Our challenge in public health is to convey the urgency while helping people understand that they can have a positive effect and be part of the solution.”

Public health has mostly remained on the sidelines in the ongoing policy debates on reducing greenhouse gas emissions. Rosenstock believes that’s a mistake. “As members of a profession whose goal is to promote population health, when we know from research that reducing greenhouse gases will help to prevent the worst health effects of global climate change it is our responsibility to explain the science and advocate for that policy change,” she says. “In addition, addressing the root causes of global warming has the dual benefit of dealing with the climate change catastrophe unfolding before us and reducing other environmental air pollutants – often generated by the same pollutant sources as greenhouse gases – that are also causing an unacceptable burden of cardiac and respiratory illness and death.”

Patz also envisions additional benefits if the importance of climate change is impressed on the population in a way that leads to a fundamental redesign of American cities. He argues that the epidemic of obesity in the United States is perpetuated by urban designs that are not conducive to exercise; shifting those designs toward better mass transit and greater opportunities to walk and bicycle would address that problem as well. “When you think about this on the scale of moving toward greener cities that are promoting exercise while reducing greenhouse gases and pollution,” Patz says, “this is the most significant public health opportunity we have had in a century.”

In California, where water is a major concern, climate change could adversely impact both water quantity and water quality. Concerns about the harmful environmental effects of CO2 emissions from motor vehicles are leading many to turn to greener alternatives.

