Changing Climate Could Alter Biology of Infectious Diseases (2008)

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Washington -- For 10,000 years the people, plants, animals and microbes of planet Earth have experienced an unusually long period of climate stability. This is ending as rising levels of greenhouse gases, especially carbon dioxide, disrupt sensitive interrelationships forged among these life forms in the dependable environments of the past.

“Warming of the climate system is unequivocal,” say the international authors of Climate Change 2007: Impacts, Adaptation and Vulnerability, part two of the Intergovernmental Panel on Climate Change (IPCC) fourth assessment report.

Most of the warming over the past 50 years likely is due to the increase in concentrations of greenhouse gases, an increase probably caused by human activity.

In response to the warming, a growing body of evidence shows discernible, physically consistent changes. These include increases in global average air temperature and atmospheric temperatures above the surface, increases in surface and subsurface ocean water temperature, widespread snow melting, decreases in the extent and thickness of Arctic sea ice, decreases in the extent of glacier and small ice caps and a rise in global mean sea level.

DIFFERENT PLANET

“The dangerous amount of carbon dioxide in the atmosphere is less than what is there already,” James Hansen, director of the NASA Goddard Institute for Space Studies in New York, told attendees at the May 12-13 American Institute of Biological Sciences (AIBS) annual meeting in Arlington, Virginia, whose theme was Climate, Environment and Infectious Diseases.

“We’ve already increased carbon dioxide [in the atmosphere] from 280 parts per million [ppm, by volume of air] to 385 ppm, and I think we’re going to have to reduce it down to at least the 350 ppm level, if not further,” said Hansen, who is known for his congressional testimony on climate change in the 1980s that helped raise broad awareness about global warming.

Averaged over the world, warming in the last century has increased by eight-tenths of a degree Celsius (1.5 degrees Fahrenheit). Over land areas, the increase is about 1.4 degrees Celsius (2.5 degrees Fahrenheit), and three-quarters of the warming has occurred in the past 30 years.

Also in that time, Hansen said, isotherms -- lines on a map that mark a given average temperature -- have been moving poleward at about 56 kilometers per decade. Such rising temperatures, along with land development and human population growth, are displacing a range of animals, plants and microbes, forcing them to adapt or perish.

“In effect,” Hansen said, “what we will be doing is pushing the species off the planet as the isotherms move still higher.”

If the amount of carbon dioxide in the atmosphere is allowed to double or triple beyond current levels, he added, “we’re going to produce a completely different planet.”

CLIMATE AND FLU

This aspect of climate change also poses risks to international public health -- from floods, heat waves and droughts promoted by rising temperatures, and from disruptions in the intimate relationships between disease-carrying insects (vectors) and their hosts.

“Changes in environment very often are the drivers for an infection to emerge,” Stephen Morse, professor of epidemiology at the Columbia University Mailman School of Public Health, told the AIBS meeting attendees.

Emerging infectious diseases, according to Morse, who originated the term and the concept in 1989, are infections that newly appear in a population or have existed but rapidly increase in incidence or geographic range. Examples are HIV/AIDS, hantavirus pulmonary syndrome and severe acute respiratory syndrome (SARS).

A driver, he added, “can be something that causes a greater chance or frequency of contact with a natural host and therefore a greater chance of introduction of a pathogen that might be able to get into the human population. Luckily for us, most are not very good at this.”

GLOBAL VILLAGE

Influenza viruses, including some avian flu viruses, are pretty good at getting into the human population. Despite their regular appearance in people, so little is known about some basic aspects of how flu viruses work that researchers are struggling to predict how climate change might affect the disease. Seasonality presents one the gaps in knowledge.

“In temperate zones [like the United States and Europe], we think of influenza very much as a winter disease,” Morse said.” In subtropical areas it shows two peaks -- winter and summer.”

In the tropics, the picture is a little more complicated -- some argue that influenza occurs at similar levels year round. In other tropical settings, there appear to be at least two major peaks -- summer and winter, or dry season and rainy season.

“What we think of as a winter disease does very well under hot, humid conditions,” he said, “so it’s not just the cold, dry conditions we always point to [as a promoter of human flu infectivity], but other things.” A warming climate could change the nature of seasonal flu and potentially affect the global distribution of disease.

For avian flu, a warming climate could change the traditional flyways of migratory birds that are suspected of infecting domestic fowl around the world with highly pathogenic H5N1 avian flu. Such

changes also could affect interactions between wild waterfowl and domestic poultry, farmers' interactions with poultry and the export and import of poultry worldwide.

"We are a global village and the microbes certainly are taking full advantage of that," Morse said, "as we've seen with HIV/AIDS and SARS.