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"Climate Change Science: An Analysis
of Some Key Questions"

western part of the nation is highly dependent on the amount of snow pack and the timing of melt. The noted increased rainfall rates have implications for pollution run-off, flood control, and water availability to plant and animal habitat. Any significant climate change is likely to result in increased costs because the nation's investment in water supply infrastructure is largely tuned to the current climate.

Health outcomes in response to climate change are the subject of intense debate. Climate change has the potential to influence the frequency and transmission of infectious disease, alter heat and cold-related mortality and morbidity, and influence air and water quality. Climate change is just one of the factors that influence the frequency and transmission of infectious disease, and hence the assessments view such changes as highly uncertain.¹² This said, changes in the agents that transport infectious diseases (e.g. mosquitoes, ticks, rodents) are likely to occur with any significant change in precipitation and temperature. Increases in mean temperatures are expected to result in new record high temperatures and warm nights and an increase in the number of warm days compared to the present. Cold-related stress is likely to decline whereas heat stress in major urban areas is projected to increase if no adaptation occurs. The National Assessment ties increases in adverse air quality to higher temperatures and other air mass characteristics. However, much of the United States appears to be protected against many different adverse health outcomes related to climate change by a strong public health system, relatively high levels of public awareness, and a high standard of living. Children, the elderly, and the poor are considered to be the most vulnerable to adverse health outcomes. The understanding of the relationships between weather/climate and human health is in its infancy and therefore the health consequences of climate change are poorly understood. The costs, benefits, and availability of resources for adaptation are also uncertain.

Fifty-three percent of the U.S. population lives within the coastal regions, along with billions of dollars in associated infrastructure. Because of this, coastal areas are more vulnerable to increases in severe weather and sea level rise. Changes in storm frequency and intensity are one of the more uncertain elements of future climate change prediction. However, sea level rise increases the potential damage to coastal regions even under conditions of current storm intensities and can endanger coastal ecosystems if human systems or other barriers limit the opportunities for migration.

In contrast to human systems, the U.S. National Assessment makes a strong case that ecosystems are the most vulnerable to the projected rate and magnitude of climate change, in part because the available adaptation

¹² *Under the Weather: Climate, Ecosystems, and Infectious Disease*, 2001

options are very limited. Significant climate change will cause disruptions to many U.S. ecosystems, including wetlands, forests, grasslands, rivers, and lakes. Ecosystems have inherent value, and also supply the country with a wide variety of ecosystem services.

The impacts of these climate changes will be significant, but their nature and intensity will depend strongly on the region and timing of occurrence. At a national level, the direct economic impacts are likely to be modest. However, on a regional basis the level and extent of both beneficial and harmful impacts will grow. Some economic sectors may be transformed substantially and there may be significant regional transitions associated with shifts in agriculture and forestry. Increasingly, climate change impacts will have to be placed in the context of other stresses associated with land use and a wide variety of pollutants. The possibility of abrupt or unexpected changes could pose greater challenges for adaptation.

Even the mid-range scenarios considered in the IPCC result in temperatures that continue to increase well beyond the end of this century, suggesting that assessments that examine only the next 100 years may well underestimate the magnitude of the eventual impacts. For example a sustained and progressive drying of the land surface, if it occurred, would eventually lead to desertification of regions that are now marginally arable and any substantial melting or breaking up of the Greenland and Antarctic ice caps could cause widespread coastal inundation.¹³

"Safe" Level of Concentration of Greenhouse Gases

The potential for significant climate-induced impacts raises the question of whether there exists a "safe" level of greenhouse gas concentration. The word "safe" is ambiguous because it depends on both viewpoint and value judgment. This view changes dramatically if you are part of an Eskimo community dependent on sea ice for hunting, or an inhabitant of a coastal city, or a farm community. It depends on whether an industry is robust or sensitive to climate change. The viewpoint changes distinctly between countries with sufficient resources for adaptation and poorer nations. Value judgments become particularly important when assessing the potential impacts on natural ecosystems. The question can be approached from two perspectives. The first issue is whether there is a threshold in the concentration of greenhouse gases that, if exceeded, would cause dramatic or catastrophic changes to the Earth system. The second issue is whether the

¹³ Appreciable desertification on a regional scale could take place within a decade or two. Many centuries would be required for substantial melting of the ice sheets to occur and the likelihood of a breakup during this century is considered to be remote.

CC:

Subject: FYI: Excerpt from Pew Report on Health and climate (December 2000)

"This report on the effects of climate change on human health in the United States finds that the complexity of the pathways by which climate affects health represents a major obstacle to predicting how, when, where, and to what extent global climate change may influence human well-being."

Pew Center on Climate Change

www.pewclimate.org



CLIMATE CHANGE AND HUMAN HEALTH

*The Potential Consequences
of Climate Variability and Change*

*A Report of the
National Health
Assessment Group*

*For the
U.S. Global Change
Research Program*

May 2001

Strategies That Could Reduce Risk

- Improved disease surveillance
- Enhanced insect-control programs
- Vaccine development and improved protections for U.S. travelers to disease-endemic areas

Need for Research About Climate and Health

"Projections of the extent and direction of the potential health impacts of climate variability and change are extremely difficult to make because of the many confounding and poorly understood factors associated with potential health outcomes, population vulnerability, and adaptation. In fact, the relationship between weather and specific health outcomes is understood for a relatively small number of diseases, with few quantitative models available for analysis. The costs, benefits and availability of resources to address adaptation measures also require evaluation. Research aimed at filling the priority knowledge gaps identified in this assessment would allow for more quantitative assessments in the future"

From the Report to the President and Congress,
National Assessment Synthesis Team, 2001

The following research areas were among those identified as priorities by the expert health assessment team:

Research areas on heat-related illness and death

- Improved prediction, warning, and response systems
- Relationship of weather to influenza and other causes of winter mortality
- Techniques to enhance urban design and energy systems

Research areas on health impacts from extreme weather events

- Improved surveillance for long-term health effects from storms
- Techniques to enhance prediction, warning, and response
- Investigation of past impacts and effectiveness of warnings

Research areas on air pollution-related health effects

- Relationship between weather and air pollution concentrations
- Relationships between exposure patterns and health effects
- Effect of weather on vegetative emissions and allergens (such as pollen)

Research areas on water-borne and food-borne diseases

- Improved monitoring of weather/ecological effects on marine-related disease
- Impacts of land use and agriculture on water quality
- Enhanced monitoring and mapping of the movement of contaminants in surface water and groundwater, combined with improved monitoring for human disease

Research areas on vector-borne and rodent-borne diseases

- Improved rapid diagnostic tests, especially in the field
- Enhanced disease surveillance strategies
- Linkages between climate, altered ecology, and infectious disease transmission

Expertise from many disciplines is required to solve these important questions.

For More Information

The full assessment document was published in the May 2001 special supplement issue of the journal *Environmental Health Perspectives*. Also, visit the health assessment Web site at <http://www.jhsph.edu/nationalassessment-health> or call 410/614-6976.

To view the official report to Congress, or for information on the other sector and regional assessment reports of the U.S. National Assessment on the Potential Consequences of Climate Variability and Change, visit the U.S. Global Change Research Program Web site at <http://www.usgcrp.gov/usgcrp/library/nationalassessment>

This health assessment is sponsored by the U.S. Environmental Protection Agency, Global Change Research Program (<http://www.epa.gov/globalresearch>).

*from prior
Administration's
National Assessment
on
Climate
Change*