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**Testimony of Dr. Peter H. Gleick to the
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Hearing on Energy as a Weapon: Implications for U.S. Security**

“The Implications of Global Climatic Changes for International Security”

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Over the last few decades, there has been growing concern over the international security implications of large-scale environmental problems, including those associated with the production and use of energy resources. Recently, this attention has focused on the possibility of major climatic changes caused by growing atmospheric concentrations of carbon dioxide and other trace gases that result, primarily from our combustion of fossil fuels. Given the extent and severity of the likely climatic changes, it is increasingly urgent that we begin to ask how climate changes will affect international relationships, economics, access to resources, and national security.

It is widely acknowledged that the dependence of the U.S. on imported energy resources can lead to economic pressures and tensions or as triggers to conflict when other pressures and tensions exist between nations. Less appreciated is the extent to which the environmental impacts of energy use can lead to international security threats, especially when those impacts are as severe and wide-ranging as climate change. My testimony today discusses the most likely paths for such effects and what responses might be appropriate to minimize the adverse consequences for international stability and tensions.

Global climate change is a real and serious problem. Impacts are already evident and are worsening rapidly in many parts of the world and the United States. It is vital to identify our greatest vulnerabilities to climatic stresses and the areas where those stresses will most affect national and international security, behavior, and policy.

Five critical areas stand out as important examples of national vulnerabilities with security implications: agricultural productivity, the availability and quality of freshwater resources, access to strategic minerals, rising sea level, and the deterioration of political relationships with other countries that result from disagreements about international climate policy.

Agricultural productivity fluctuates with the weather and the level of international trade is large. As climate change improves agricultural production in some regions and worsens it in others, there will be significant economic shifts and dislocations, affecting trade, food independence, and economic health of farming communities and regions.

Water resources are sensitive to both floods and droughts and are limited in many regions due to natural variability or high societal demand. Conflicts over shared water resources are already on the rise (see the historical compilation of these conflicts in the Water Conflict Chronology at www.worldwater.org). As climatic changes increasingly alter rainfall and runoff patterns and water availability, the risks of some regional water disputes may grow. Particular hotspots include the Middle East, Northern Africa, and Southeast Asia.

Certain mineral resources, including oil and gas, are found in significant amounts in regions constrained by climatic conditions and the importance of these resources to particular nations and alliances warrants attention. Access to these resources may ease or worsen, altering geopolitical strengths and weaknesses. In particular, access to North Slope oil and gas resources in Alaska may worsen as warming undermines permafrost and oil and gas transportation infrastructure. New sea routes may open up on the far north.

Despite many uncertainties about details of climate impacts, not all impacts are uncertain. One of the most certain effects will be rising sea levels as the oceans warm and land ice melts. Hundreds of millions of people live in coastal regions within a few feet of sea level and they are already vulnerable to severe storms and high tides. While countries like the United States with long coastlines will experience rising damages and deaths from coastal storms, we are likely to spend financial resources to defend coastal property or to relocate vulnerable populations. Other parts of the world will not be in the same position, and large numbers of refugees may be created in regions like Bangladesh, India, and many island nations. Among the greatest concern of experts is that massive dislocations of populations can lead to regional political instability that spills over into the international arena.

Finally, there are growing international political disagreements over policies to address climatic changes and greenhouse gas emissions. Any international agreement to prevent major climatic changes will be hard to reach, as we already see. But climate policies are also complicated by the desire of certain actors (alliances, nations, sub-national groups, corporations) to capitalize on perceived regional advantages. Those actors who believe – rightly or wrongly – that the science is inadequate for policy, or they will benefit from a warmer earth, or they will bear a disproportionate share of the costs of reducing emissions will have no direct incentive to cooperate in any international agreement to prevent climatic change. We’ve already seen evidence of this in the actions of the U.S. government as well as certain U.S. corporations dependent on fossil fuels production. These growing international disagreements can lead to worsening relations with long-time allies over environmental policies as well as new disputes with developing countries

over how to address both the causes and effects of climate change. These disagreements spill over into economic policy, trade agreements, and security arrangements.

It would be a serious mistake to wait to address these concerns. More research on the impacts of climate change is certainly needed, and underway at both the U.S. and international levels. But the longer that we wait to address greenhouse gas emissions, the worse and more rapid will be the changes.

Agricultural Productivity and Trade

Threats to the basic food supplies of a country are already cause for frictions and tensions between nations. Possible mechanisms for such threats include trade embargoes or other forms of political manipulation of access to food, environmental degradation such as loss of soil fertility, or competition among conflicting land uses. Because regional scarcity is a fundamental condition for a good to become a political tool, the disparity in food needs and food resources between the developing and the developed world has long hinted at the possibility of future conflict over access to food resources.

Food availability depends on a complex array of factors, including patterns of production, purchasing ability, and the operation of food distribution systems. The vulnerability of political behavior to the availability and quality of agricultural resources was demonstrated long ago by internal conflicts and violence over food shortages throughout the Sahel in the 1970s, in Sudan in 1981 and 1985, in Poland in 1980, in Tunisia in 1983 and 1984, and in Morocco in 1984. These internal events often serve to increase external tensions as well, as was demonstrated in the conflicts involving the U.S. military in Somalia.

Even today, some countries are acutely vulnerable to natural climatic variability that may cripple their own food production or substantially reduce the supply and raise the price of foodstuffs on the world market. Under conditions of changing climate and growing population, this situation may grow more precarious. As far back as the 1980s, observers noted the sensitivity of some countries to national food production. One analyst noted about the Soviet Union:

"The need to turn to international markets for grain became a regular humiliation and a drain of scarce foreign currency. In the eyes of Soviet leaders, problems with agricultural productivity threatened domestic stability, national security, and economic growth."¹

This situation is even truer today for China. As temperatures increase, agricultural production could expand into northern regions of the United States, the Soviet Union, China, and Canada if soil conditions, water availability, and other factors permit. But output in regions that are now productive, such as the northern China, the Great Plains of the United States, the Ukraine, and Kazakhstan, could be reduced by higher temperatures and changes in water availability. Analysis of the net effect (both regionally and globally)

¹ Gustafson, T. 1981. Reform in Soviet Politics: Lessons of Recent Policies on Land and Water. (Cambridge University Press, Cambridge, England.) 218 pp.

of climatic changes on food production will be further complicated by the size of food stocks and reserves, investment and planting patterns, international prices, and the character of trading agreements.

Water and Security

International political frictions and tensions have arisen over the control of, access to, or the quality of freshwater resources². Even in the absence of climatic changes, pressures on existing water resources are growing due to increases in population, industrial water demand, and development in semi-arid and arid regions. Where water resources are shared, as in international river basins or bodies of water bordering more than one country, the possibility of friction and conflicting demands exists. The nature of such frictions varies from region to region – from disputes over water quality in humid regions to competition for scarce resources in arid and semi-arid regions.

Nearly half the land area on the planet is in an international river basin and over 260 major rivers are shared by two or more nations.³ Regions with a history of international tensions or competition over water resources include the Jordan and Euphrates Rivers in the Middle East, the Nile, Zambezi, and Niger Rivers in Africa, the Ganges in Asia, the Colorado and Rio Grande Rivers in North America. As water demands increase, the probability of conflict over remaining water resources will also increase.

Future climatic changes can reduce or exacerbate these water-related tensions. Among the critical concerns are changes in (1) water availability from altered precipitation patterns or higher evaporative losses due to higher temperatures, (2) the seasonality of precipitation and runoff, (3) flooding or drought frequencies, and (4) the demand for and the supply of irrigation water for agriculture.

Details about water allocation and use in the Colorado River and the Nile River – both international rivers – can provide insights into how water conflicts arise and what appropriate mechanisms for resolving such frictions might look like. The Colorado River flows through seven states of the United States and into Mexico. It is vital for agriculture in both countries. As a result, the Colorado is extensively used – so extensively that Mexico would receive almost no flow were it not for an international treaty signed in 1944 that guarantees a fixed volume of water to Mexico annually. This treaty was negotiated after nearly 50 years of contention and disagreement over the sharing of the Colorado River.

Unfortunately, the treaty provisions for allocating shortages during a drought are ambiguous and no provisions in the treaty cover the possibility of a climatic change that could alter the long-term availability of water in the river. These ambiguities and omissions could result in a revival of U.S. - Mexican frictions if the runoff available in

² Gleick, P.H. 1998. Conflict and Cooperation over Fresh Water. In P.H. Gleick The World's Water 1998-1999. Island Press, Washington, D.C., pp.105-135.

³ Wolf, A.T. J.A. Natharius, J.J. Danielson, B.S. Ward, J. Pender. 1999. "International River Basins of the World." International Journal of Water Resources Development, Vol. 15, No. 4 (December).

the Colorado were to be reduced by climatic changes. In fact, research by the U.S. government suggests that even modest climatic changes will have serious and dramatic impacts on Colorado River flow.⁴

Similar problems face other rivers. Although the principal water users of the Nile, for example, are Egypt and the Sudan, the runoff is mostly generated by precipitation in Ethiopia and the other countries. Competition for the waters of the Nile arose in the early 1900s over growing Egyptian needs and continues to this day. Existing agreements are inadequate and fail to include all users in the region. Any climatically-induced change in water availability will further complicate the future use of the Nile, contributing to political jousting and friction. U.S. diplomatic resources must be brought to bear to address the risks that climate change may pose to key U.S. interests, allies, and resources, particularly in the context of water.

Northern Mineral Resources

Access to certain strategic minerals is already constrained in some regions by climatic conditions. In particular, the ability to extract oil and natural gas in Arctic continental and offshore regions depends on expensive and vulnerable methods and materials. Yet significant resources underlie these regions and they are a vital element in the U.S. economy, energy strategy, and world trade markets. Any change in climate that affects the ease of extracting or moving these resources will play a role in the response of international actors to initiatives to control climatic change.

Globally, the oil and gas potential of the northern Arctic regions is very large. Despite only limited exploration, Arctic proven reserves already comprise a substantial fraction of the proved reserves of the countries of the region and the volume of "potentially recoverable" oil is several times larger. Overall, as much as 25 percent of all oil may lie in Arctic regions, and the Arctic is warming twice as fast as the rest of the globe. For example, as much as 20 percent of total U.S. proved reserves are in Arctic regions; as much as 30 to 40 percent of Russian reserves are in the far north. I note that the U.S. is currently launching an effort to more accurately map Arctic oil reserves.⁵

The technical and environmental challenges, monetary costs, and ecological and economic risks of finding and extracting Arctic energy resources are immense. Development of much of the new oil and gas potential in the Arctic will be substantially more expensive than the production of the already costly Prudhoe Bay and Western Siberian fields. The difference in capital costs of production between the Arctic Chukchi Sea and the sands of Saudi Arabia is a factor of 60.

Higher temperatures from climatic changes could reduce some of the difficulties of

⁴ Nash, L. and P. Gleick. 1993. The Colorado River Basin and Climatic Change: The Sensitivity of Streamflow and Water Supply to Variations in Temperature and Precipitation. U.S. Environmental Protection Agency, EPA230-R-93-009, Washington, D.C. 121 pp.

⁵ U.S. Arctic Survey Program of the U.S. Geological Survey.

extracting mineral resources in the far north, but other climatic factors may worsen these difficulties. For example, as temperatures rise, partial melting of the permafrost layer is already occurring affecting construction practices and existing physical developments. Similarly, a reduction in sea-ice extent and changes in atmospheric patterns may lead to higher precipitation. This in turn may lead to higher snowfall and more difficult operating conditions.

Given the importance of northern mineral resources, climatic constraints are unlikely to prevent future development. The major question is whether or not future climatic changes will significantly increase or decrease the difficulty – and hence the expense – of that production. The goal of reducing U.S. dependence on Middle Eastern oil (and thus theoretically increasing national security) is often claimed to hinge upon the development of Alaskan/Arctic oil reserves. The uncertainties posed by future climatic changes will complicate these problems.

Coastal Dislocations, Environmental Refugees, and Security

Sea level is expected to rise between one and three feet over the next century, considerably faster than experienced over the past hundred years, with a risk that the rate could accelerate even faster if land-ice feedbacks turn out to be significant. Coastal developments and populations are already at risk from storms, as Hurricane Katrina so clearly demonstrated last year. Yet even small increases in sea level greatly increase the risk of damages and deaths by magnifying the areas and people at risk.

In the United States and other developed countries, investments will be made to protect the most important and vulnerable infrastructure near sea level, such as ports, airports, transportation corridors, power plants, and so on. While such investments will be increasingly expensive, they will offer at least some protection. In other regions, it is likely that populations will be relocated over time as risks grow.

Far more worrisome, however, is the inability of many developing countries to protect their populations and infrastructure to the same degree, especially in regions where large numbers of people are at risk. For example, a study from Myers and Kent of Oxford University suggested that as many as 26 million people in Bangladesh, 12 million in Egypt, 73 million in China, 20 million in India, and more than 30 million elsewhere are at direct risk of displacement from rising sea level.⁶ As these environmental refugees are displaced, there is likely to be an increase in illegal cross border migrations, ethnic tensions, and civil disorder. These regional security disruptions may well spill over into the international arena, directly threatening U.S. national and regional security interests in ways we do not fully understand or appreciate. Far more attention should be given to this issue than it has received to date, including more detailed analysis by the U.S. Department of State and other appropriate agencies.

The International Politics of Climate Change, and Implications for U.S. Security Interests

⁶ Myers, N. and J. Kent. 1995. Environmental Exodus: An Emergent Crisis in the Global Arena. Oxford University and the Climate Institute.

The international political disagreements over policies to address climatic changes and greenhouse gas emissions are spilling over into U.S. relations with allies, trading partners, and the international community. An international agreement to prevent major climatic changes will be hard to reach, as we already see. But there is growing evidence that U.S. interests will be affected by perceptions of our willingness and ability to participate in international climate policy. The perception that the U.S. bears a disproportional responsibility for impacts and is unwilling to join multi-lateral efforts to reduce emission affects our international reputation and standing. These growing international disagreements can lead to worsening relations with long-time allies over environmental policies as well as new disputes with developing countries over how to address both the causes and effects of climate change. There is also a risk that these disagreements will spill over into economic policy, trade agreements, and security arrangements.

Avoiding political polarization on the issue of climatic change depends greatly on the perceptions of the participants. If some international actors believe that they will benefit from climatic changes while others suffer, such perceptions – correct or not – will drive policy actions and decisions. The views of those with the financial and technological means at their disposal to affect the outcome or mitigate the impacts of climatic changes are especially important. Arguments for international action are complicated by individual actors taking positions dependent **not** on the global good, but on the perceived advantage or disadvantage to them of the likely change and impact. We've already seen evidence of this in the international debates, and in debates over science, where major funding of pseudoscience by oil companies and other interests opposed to policy action on climate change has introduced uncertainty into the minds of policy makers where little real uncertainty exists in the scientific community.

Conclusions

Future climatic changes caused by human activities will have widespread impacts. Some climate impacts will affect international security and the security of the United States. Among these will be changes in the quality, quantity, or ease of access to freshwater and mineral and energy resources, growing numbers of environmental refugees, and changes in the productivity of agriculture. These impacts, in turn, will alter human well-being, the quality of life, and the range of options and policy choices available to governments. In order to prevent these climatic impacts from causing international tensions and conflicts, they must be more thoroughly explored and strategies developed to either mitigate or prevent the worst effects.

The most effective ways of reducing the risks to U.S. national security from climate changes are to reduce the rate and severity of those changes by slowing emissions of greenhouse gases, and to reduce our dependence on energy sources that are both out of our direct control and that contribute to greenhouse gas emissions. Both approaches suggest that policies to reduce demand on oil and gas and to shift to non-fossil-fuel alternatives are urgently needed, as President Bush recently suggested.

Where existing political tensions may be worsened by climatic change, such as in disputes over water resources, advances are needed in both conflict resolution among states and in the development of international resource law. Such advances would be useful not only for resolving international resource controversies, but for addressing the very issue of future climatic change.

Finally, differing perceptions about the severity of global climatic changes must not be allowed to stop comprehensive international negotiations. Although there are likely to be disagreements about specific regional impacts, no region or country can expect to benefit from rapid climatic changes that would overwhelm the capacity of even wealthy countries to adapt. Many actions that would prevent or delay climatic change are appropriate in their own right, such as improvements in energy efficiency, a reduction of dependence on imported fossil fuels, and the development of effective international mechanisms to reduce greenhouse gas emissions. These cooperative strategies can reduce the rate of climatic change and give us time to both improve our understanding of climatic impacts and to reflect on appropriate international responses.

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