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For the hearing on Weathering the Storm: The Need for a National Hurricane Initiative
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I thank Chairman Rockefeller, Ranking Member Hutchison, and the other Members of the Committee for the opportunity to speak today. My name is Kelvin Droegemeier and I am Associate Vice President for Research, Regents' Professor of Meteorology, and Weathernews Chair at the University of Oklahoma. I also am a member of the National Science Board (Board) and am appearing before you today in my role as co-chair of the former Task Force on Hurricane Science and Engineering of the Board. The final report of this Task Force was released on January 12, 2007.

As you are aware, every year hurricanes pose a threat to life, property, and the very economic vitality of our Nation. We spend billions of dollars on rescue and recovery after hurricanes occur, and yet hurricane research is a modest, loosely coordinated enterprise. Although of high quality, this research is conducted within the boundaries of traditional disciplines – stovepipes like meteorology, hydrology, engineering, computer science and ecology – with insufficient integration. And the engagement of social, economic, behavioral sciences – which is foundational to actually turning physical science and engineering research into useful practice – is woefully inadequate. In short, the hurricane is perhaps one of the best examples of a problem – absolutely vital to society – which must be studied in a multi-disciplinary fashion if we hope to lessen our vulnerability.

In recent years, the National Science Foundation (NSF) has supported research dealing with the geophysical, social, and engineering aspects of hurricane processes and the resultant impacts on society and the environment. This research has included the study of the physical genesis and lifecycles of hurricanes, the development of new simulation and forecast models of hurricane processes, the effect of land-falling hurricanes on ecosystems and the natural environment, the impacts on social systems in hurricane impacted areas, the engineering and structural aspects of damage resistant practices in areas prone to hurricane exposure, and damage assessment of facilities and infrastructure in hurricane impacted areas.

Despite the excellent research funded by NSF, there are still many areas that need to be addressed. While advances have been made during the past decade in meteorological understanding and prediction, we still know relatively little about the most important aspects of hurricanes from an integrative perspective, including their internal dynamics and interactions with the larger-scale atmosphere and ocean; methods for quantifying and conveying uncertainty and mitigating hurricane impacts; associated short and long term consequences on the natural and built environment; and the manner in which society responds before, during and after landfall.

Additional research relevant to hurricane understanding, prediction, mitigation, consequences and societal responses is especially needed in the social, behavioral and economic sciences. Communities are often overwhelmed with sometimes conflicting information regarding risk planning and procedures for action. Additionally, effective training and outreach activities, involving policy and decision makers, are needed to ensure that research efforts are appropriately applied, thus meeting the societal demand for protection of life and property and responsible management of resources. Finally, the social impacts of human-induced changes to coastal and off-shore vulnerability – ranging from land use development and practices that drastically modify the fate of precipitation runoff to social demographics of communities and their mobility – must be better understood and effectively incorporated into societal decision making.

Specific areas of concern raised in the National Science Board's 2007 report, *Hurricane Warning: The Critical Need for a National Hurricane Research Initiative*, include: (1) Impacts—including interaction of hurricanes with engineered structures, economic and social impacts of hurricanes and mitigation measures, and interactions of hurricanes with natural ecosystems; (2) Preparedness and Response Measures—that is, assessing and improving the reliance on the built environment, disaster response and recovery, human behavior and risk planning, and evacuation planning; and (3) Crosscutting Activities—such as computational capability, and training and education programs related to hurricane impacts. In that report we note, moreover, that many of the hurricane research efforts conducted to date are narrowly focused, with limited coordination across disciplines. This makes it difficult to engage the more challenging questions, the answers to which are not obtainable with short-duration studies. The bottom line is that many of the disciplines for which hurricanes are an important research challenge (e.g., physical science, engineering, social science, behavioral science, and economics) do not regularly interact, resulting in a myopic view that limits the effectiveness of problem formulation and translation of research outcomes into operational practice. Efforts are needed to bridge communications across disciplinary boundaries through workshops and interdisciplinary research approaches.

The Board encourages interdisciplinary research and NSF is experienced at supporting research that crosses disciplinary boundaries. The Board's Hurricane Task Force found in our roundtable discussions with the science and engineering community that researchers from multiple disciplines are eager to work with one another. An example of this is that in FY 2008 NSF and the National Oceanic and Atmospheric Administration issued a joint announcement calling for proposals to advance fundamental understanding of the communication of hurricane outlooks, forecasts, watches, and warnings both to decision makers (i.e., emergency managers, elected officials) and to the general public. NSF is also discussing with other agencies their interests and how coordination can be improved, taking into account the priorities related to hurricanes under development by the Disaster Reduction Subcommittee of the National Science and Technology Council's Committee on Environment and Natural Resources.

On behalf of the National Science Board and our Chairman, Dr. Steven Beering, I want to thank the Committee for the important work they do for U.S. scientific research, education, and training. We understand and appreciate that the Federal Government is undergoing significant budget pressures at this time, but the future strength of the nation depends on the investments we make in science and technology today. We appreciate your attention to the recommendations of the Board concerning hurricane research and stand ready to assist in whatever ways might be most beneficial.