Testimony of Dr. Kelvin K. Droegemeier
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Submitted June 24, 2008 to the Subcommittee on Energy and Environment, and Subcommittee on Research and Science Education
U.S. House of Representatives Committee on Science and Technology
Regarding the State of Hurricane Research and H.R. 2407, the National Hurricane Research Initiative Act of 2007

I thank Chairman Lampson, Chairman Baird, Ranking Members Ehlers and Inglis, and the other Members of the two Committees for the opportunity to speak with you today. My name is Kelvin Droegemeier and I am a professor of meteorology at the University of Oklahoma. I also am a member of the National Science Board and am appearing before you today in my role as co-chair of the National Science Board's Task Force on Hurricane Science and Engineering. The final report of this Task Force was published on January 12, 2007, and I understand that it largely served as the blueprint for H.R. 2407 as introduced in the House of Representatives. Dr. Kenneth Ford, Director of the Institute for Human and Machine Cognition and fellow NSB member, served as my co-chair.

I needn't tell you that every year, hurricanes pose a threat to life, property, and the very economic vitality of our Nation. Yet impact of hurricanes extends well beyond a given storm, often for many years, as we've seen in recent storms such as Katrina and Rita. Among all weather hazards in the US, hurricanes account for over half the total damage inflicted, and annual economic losses average approximately $10 billion in constant 2006 dollars. Of course, the 2005 hurricane season was notably destructive, with Katrina losses exceeding $130 billion. Remarkably, 50% of the US population lives within 50 miles of a coastline and that some 80% of our population resides within 200 miles of a coast. The $3 trillion of physical infrastructure in the Gulf and Atlantic coastal regions continues to grow at a rapid pace, and thus we as a Nation are increasingly vulnerable to hurricanes. Of particular relevance today is the immense energy infrastructure located in "hurricane alley" -- 33,000 miles of pipeline that transports some 30% of our Nation's domestically-produced oil and gas from offshore wells to onshore refineries. According to the U.S. Department of the Interior, some 3,000 of the Gulf's 4,000 platforms, and 22,000 of the 33,000 miles of the Gulf's pipelines, were in the direct paths of Hurricanes Katrina and Rita. A total of 115 offshore platforms were destroyed, 52 were damaged, and 535 pipeline segments were damaged. Considerable destruction occurred to onshore facilities – for example, refineries and supporting infrastructures in and around Lake Charles, Louisiana. More than nine months later, 22% of Federal oil production and 13% of natural gas production remained unavailable, resulting in the loss of 150 million barrels of oil and 730 billion cubic feet of gas from domestic supplies.

Motivated in part by recent hurricanes, the National Science Board decided to undertake an intensive effort to frame the hurricane science and engineering research challenges and recommend a national imperative to address them in a holistic manner. We did so by engaging the academic, government and private sector communities in a series of workshops; by evaluating previous studies of hurricanes and other natural disasters; and by obtaining input from the public on a draft version of the report.

As you well know, we spend billions of dollars on rescue and recovery after hurricanes occur. But can we better anticipate and react to hurricanes ahead of time to avoid loss of life, property, vital infrastructures, and disruptions in our economy? The answer from our study is yes. Are we using existing knowledge effectively? The answer from our study is no. Is the research now being done adequate and properly coordinated? The answer from our study is no. In fact, research in hurricanes appears to be a modest, loosely coordinated enterprise. Although of high quality, this research is generally 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 is inadequate. In short, the hurricane is perhaps one of the best examples of a problem –vital to society – which <u>must</u> be studied in a multi-disciplinary fashion if we hope to lessen our vulnerability.

H.R. 2407 reflects very closely the recommendations made in our report. This truly is a wonderful testimony of Congress responding quickly to recommendations of the broad community and using existing frameworks (such as OSTP and the National Windstorm Impact Reduction Act) to deal with a profoundly important problem. Given that you are familiar with the bill, I wish to highlight just a few key points.

First, strong collaboration between NSF and NOAA is vital to the success of this effort, as is the involvement of other agencies, as articulated in the bill. Second, it is important to note that the hurricane is not a weather problem alone but rather a weather-driven problem that must be studied in a multi-disciplinary fashion. It is for this reason that the components of the research agenda described in the bill – including, for example, hurricane intensity change, assessment and response of structures to wind and waves, ecosystem impacts, and economic and societal impacts – are important and must be performed in a coordinated manner. Third, the national infrastructure data base is important for hurricanes but also for numerous other uses, ranging from earthquakes to homeland security. Fourth, the National Hurricane Research Model – which in our report was referred to as a Test Bed and involves all relevant disciplines of the research program – is essential for bringing together the research components and moving them to operational practice.

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On behalf of the National Science Board and our Chairman, Dr. Steven Beering, I want to thank the Committees for the important work they do for U.S. scientific research, education, and training. We appreciate your attention to the recommendations of the Board and stand ready to assist in whatever ways might be most beneficial.

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Kelvin K. Droegemeier earned a B.S. with Special Distinction in Meteorology in 1980 from the University of Oklahoma, and M.S. and Ph.D. degrees in atmospheric science in 1982 and 1985, respectively, from the University of Illinois at Urbana-Champaign under the direction of R. Wilhelmson. He joined the University of Oklahoma in September, 1985 as an Assistant Professor of Meteorology, and was tenured and promoted to Associate Professor in July, 1991, and promoted to Professor in July, 1998. Dr. Droegemeier was co-founder in 1989 of the NSF Science and Technology Center (STC) for Analysis and Prediction of Storms (CAPS), and served for five years as its deputy director. He then directed CAPS from 1994 until 2006, and today CAPS is recognized around the world as the pioneer of storm-scale numerical weather prediction. Dr. Droegemeier is now Director Emeritus of CAPS. In 1998, Dr. Droegemeier was named a President's Associates Presidential Professor at the University of Oklahoma, and for 2 years, beginning in summer 1999, wrote a daily weather science column for the *Daily Oklahoman* newspaper, which is Oklahoma's largest. He was awarded a Regents' Professorship at OU in fall, 2001, which is a life-long title. In 2003, Dr. Droegemeier co-founded the NSF Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) and currently serves as its deputy director. He is the only person in the nation to have co-founded an NSF Science and Technology Center and an NSF Engineering Research Center. In 2004, he was awarded the Roger and Sherry Teigen Presidential Professorship and became the first OU professor to receive two Presidential Professorships. In 2005, he was named the Weathernews Chair in Applied Meteorology at the University of Oklahoma and also the Director of the Sasaki Institute, a non-profit organization that fosters the development and application of knowledge, policy, and advanced technology in the government, academic and private sectors. In 2004, Dr. Droegemeier was appointed by President George W. Bush to a 6-year term on the National Science Board, the governing body of the National Science Foundation that also provides science policy guidance to the Congress and President. In 2005, Dr. Droegemeier was appointed Associate Vice President for Research at the University of Oklahoma.

In 1987, Dr. Droegemeier was named a Presidential Young Investigator by the National Science Foundation. As director of the CAPS model development project for 5 years, he managed the creation of a multi-scale numerical prediction system that has helped pioneer the science of storm-scale numerical forecasting. This computer model was a finalist for the 1993 National Gordon Bell Prize in High Performance Computing. In 1997, Dr. Droegemeier received the *Discover Magazine* Award for Technology Innovation (computer software category), and also in 1997 CAPS was awarded the *Computerworld* Smithsonian Award (science category). Droegemeier also is a recipient of the NSF Pioneer Award and the Federal Aviation Administration's Excellence in Aviation Award.

Dr. Droegemeier has been a major force behind the development and application of high performance computing systems both at OU and across the US. In 1989 and 1990, he chaired the OU Computing Advisory Committee and was the lead author on a 5-year strategic plan. He has served on numerous NSF High Performance Computing and Communication panels and is a member of the NCSA User Advisory

Committee. In 1995 he created as principal investigator, and now directs, a $1.4 million NSF/OU project known as the Environmental Computing Applications System. He served on the National Science Foundation's Blue Ribbon Panel on Cyberinfrastructure, and is a member of the Board of Directors of the OU Supercomputer Center for Education and Research (OSCER), which he helped establish. Dr. Droegemeier is now a member of the Advisory Committee for the National Center for Computational Sciences and the Computer Science and Math Division at Oak Ridge National Laboratory.

Dr. Droegemeier is a national leader in the creation of partnerships among academia, government and industry. He initiated and led a 3-year, $1M partnership with American Airlines to customize weather prediction technology for commercial aviation, and this resulted in him founding a private company, Weather Decision Technologies, Inc., located in Norman, that is commercializing advanced weather technology developed by the University of Oklahoma and other organizations. The success with American Airlines also played a role in the establishment in Oklahoma of the Aviation Services Division of Weathernews, the world's largest private weather company. Dr. Droegemeier led a $10.6M research alliance with Williams Energy Marketing and Trading Company in Tulsa, which is the largest such partnership between a university and a private company in the field of meteorology. He initiated and led the Collaborative Radar Acquisition Field Test (CRAFT), a national project directed toward developing strategies for the real time delivery of NEXRAD radar data via the Internet. CRAFT won two awards from the National Oceanic and Atmospheric Administration, and its success led the National Weather Service to adopt its Internet data delivery strategy. As a follow-on to CRAFT, Droegemeier established Integrated Radar Data Services (IRaDS) at OU, which is a National Weather Service-designed top-tier provider of NEXRAD radar data to private industry.

Dr. Droegemeier's research interests lie in thunderstorm dynamics and predictability, variational data assimilation, mesoscale dynamics, computational fluid dynamics, massively parallel computing, and aviation weather. He has served as an associate editor for *Monthly Weather Review* for 6 years served on the UCAR University Relations Committee, the last two as chair. Elected to the UCAR Board of Trustees in 2002 and as its Vice Chairman in 2003, he became Chairman of the Board in 2004. Dr. Droegemeier has served as a consultant to Honeywell Corporation, American Airlines, the National Transportation Safety Board, and Climatological Consulting Corp. Dr. Droegemeier has graduated 27 students and served on the committees of numerous others. He has served on the Advisory Committee for the Geosciences Directorate at the National Science Foundation and the NSF Advisory Committee for the Computer Information Science and Engineering Directorate.

In his 23 years at the University of Oklahoma, Dr. Droegemeier has generated over $40 million in external research funding. For over a decade, he has been among the top 5 faculty at the University of Oklahoma in external research grant funding, averaging over $2 million per year. Dr. Droegemeier has been an invited speaker at or organizer of several international conferences and symposia on meteorology, high-performance computing, and computational fluid dynamics in the U.S., England, Japan, Australia, Korea, and France, notably the series of Joint US-Korea Workshops on Storm and Mesoscale Weather Analysis and Prediction, which he initiated in the mid 1990s. He has authored and co-authored more than 60 refereed journal articles and over 200 conference publications, and is a former Vice President of the Central Oklahoma Chapters of the American Meteorological Society and National Weather Association. He is a former Member of the Board of Directors of the Norman, OK Chamber of Commerce and chaired the Weather and Climate Team for Governor Brad Henry's EDGE (Economic Development Generating Excellence) Program. He is a Fellow of the American Meteorological Society, and served as a Councilor from 2005-2008.