STATEMENT OF DR. ROGER A. PIELKE, JR. TO THE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS OF THE UNITED STATES SENATE

Roger A. Pielke, Jr.
University of Colorado
Boulder, CO
pielke@colorado.edu

13 March 2002

I thank the Chairman and the Committee for the opportunity to offer testimony this morning on the economic and environmental risks associated with increasing greenhouse gas emissions.

My name is Roger Pielke, Jr. and I am an Associate Professor of Environmental Studies at the University of Colorado where I also direct the CIRES Center for Science and Technology Policy Research. My research focuses on the connections of science and decision making. A short biography can be found at the end of my written testimony.

In my oral testimony I'd like to highlight six "take home points," which are developed in greater detail in my written testimony and in the various peer-reviewed scientific papers cited therein.

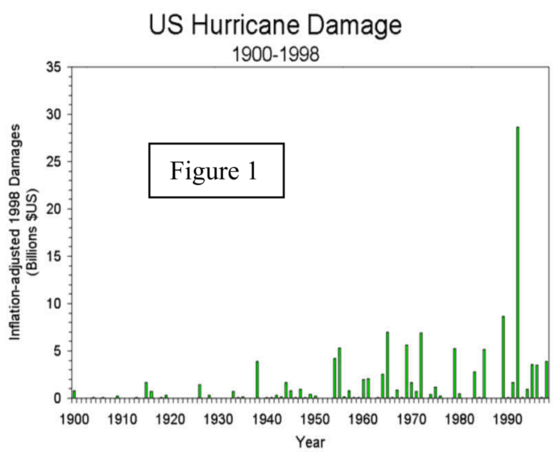
Take Home Points

- Weather and climate have growing impacts on economies and people around the world.[1]
- The primary cause for the growth in impacts is the increasing vulnerability of human and environmental systems to climate variability and change, *not* changes in climate per se.[2]
- To address increasing vulnerability, and the growing impacts that result, requires a broader conception of "climate policy" than now dominates debate.[3]
- We must begin to consider adaptation to climate to be as important as matters of energy policy in discussion of response options. Present discussion all but completely neglects adaptation.[4]
- Increased attention to adaptation would not mean that we should ignore energy policies, but instead is a recognition that changes in energy policy are insufficient to address the primary reasons underlying trends in the societal impacts of weather and climate.[5]
- The nation's investments in research could be more efficiently focused on producing usable information for decision makers seeking to reduce vulnerabilities to climate. Specifically, the present research agenda is improperly focused on prediction of the distant climate future.[6]

The remainder of this document develops these points through a case study focused on tropical cyclones. Considerably more detail can be found in the set of peer-reviewed articles cited in support of the arguments presented here.

Policy debate and advocacy on the issue of climate change frequently focus on the potential future impacts of climate on society, usually expressed as economic damage or other human outcomes. Today I would like to emphasize that societal impacts of climate are a joint result of climate phenomena (e.g., hurricanes, floods, and other extremes) *and* societal vulnerability to those phenomena. The paper concludes that policies focused on reducing societal vulnerability to the impacts of climate have important and under-appreciated dimensions that are independent of energy policy.

In the climate change debate, people often point to possible increases in extreme weather events (e.g., hurricanes, floods, and winter storms) as a potentially serious consequence of climate change for humans around the world. For instance, the January 22, 1998 issue of *Newsweek* carried the following headline: "THE HOT ZONE: Blizzards, Floods, and Hurricanes, Blame Global Warming." In this testimony I use the case of hurricanes to illustrate the interrelated climate-society dimensions of climate impacts. Research indicates that societal vulnerability is the single most important factor in the growing damage related to extreme events. An implication of this research for policy is that decision making at local levels (such as related to land use, insurance, building codes, warning and evacuation, etc.) can have a profound effect on the magnitude and significance of future damage.[7]



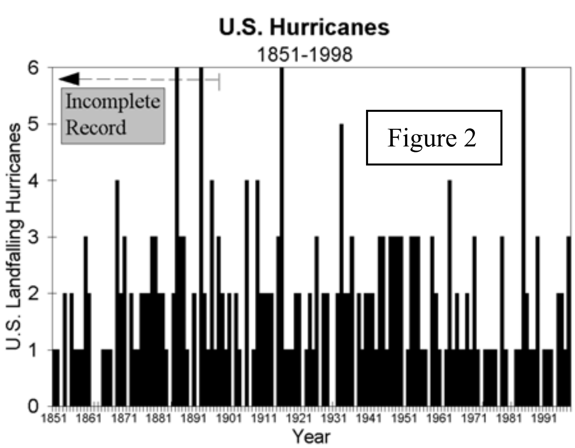


Figure 1 shows economic damage (adjusted for inflation) related to hurricane landfalls in the United States, 1900-1998.[8] Because damage is growing in both frequency and intensity, one possible interpretation of this figure is that hurricanes have become more frequent and possibly stronger in recent decades. However, while hurricane frequencies have varied a great deal over the past 100+ years, they have not increased in recent decades (Figure 2, provided courtesy of C. Landsea, NOAA).[9] To the contrary, although damage increased during the 1970s and 1980s, hurricane activity was considerably lower than in previous decades.

To explain the increase in damage it is necessary to consider factors other than climate. In particular, society has changed enormously during the period covered by Figure 2. Figures 3a and b show this dramatically. Figure 4a shows a stretch of Miami Beach in 1926. Figure 3b shows another perspective of Miami Beach from recent years. The reason for increasing damages is apparent from the changes easily observable in these figures: today there is more potential for economic damage than in the past due to population growth and increased wealth (e.g., personal property).

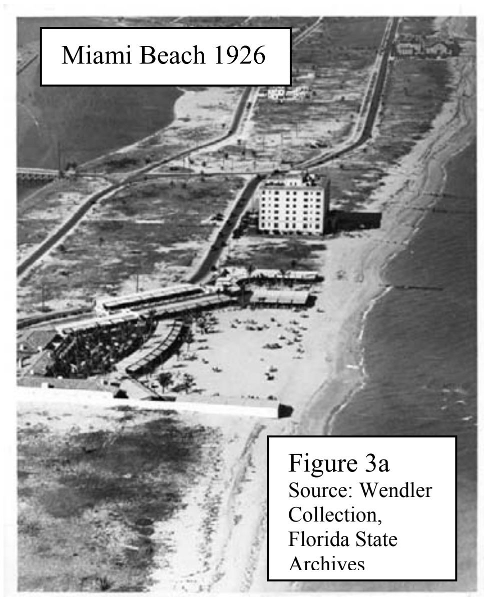


Figure 3a
Source: Wendler Collection, Florida State Archives

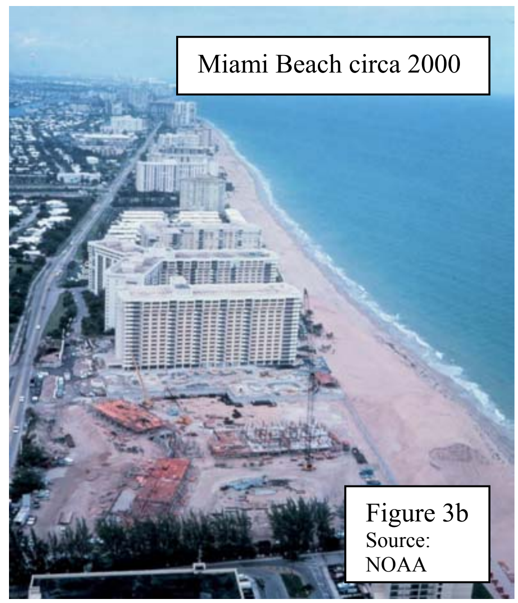


Figure 3b
Source: NOAA

Figure 4b shows the increase in population along the Gulf and Atlantic coasts for 168 coastal counties from Texas through Maine (Figure 4a). In 1990, the population of Miami and Ft. Lauderdale (2 counties) exceeded the combined population of 107 counties from Texas to Virginia.[10] Clearly, societal changes such as coastal population growth have had a profound effect on the frequency and magnitude of impacts from weather events such as hurricanes.[11]

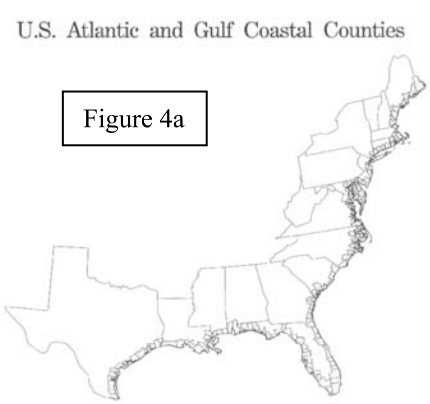


Figure 4a

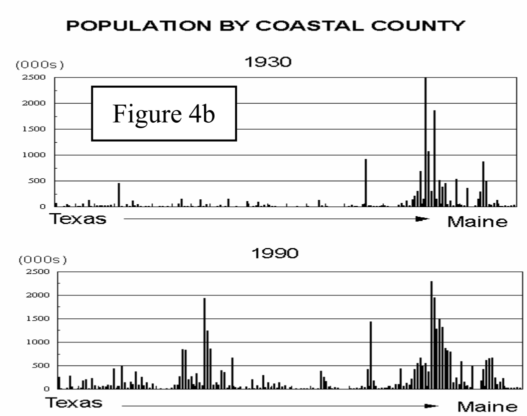
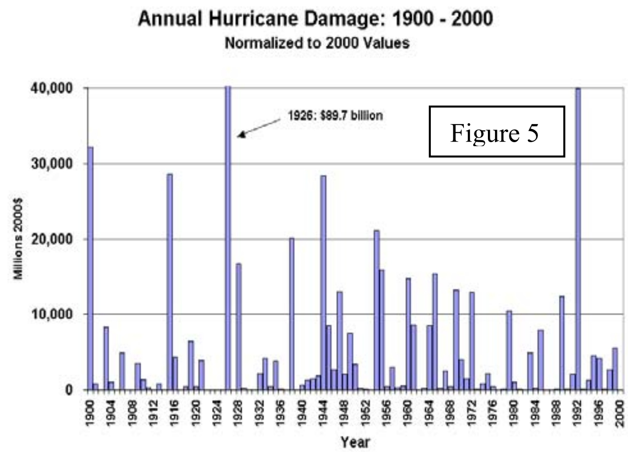


Figure 4b

One way to present a more accurate perspective on trends in hurricane-related impacts is to consider how past storms would affect present society. A 1998 paper presented a methodology for "normalizing" past hurricane damage to present day values (using wealth, population and inflation). Figure 5 shows the historical losses of Figure 1 normalized to 2000 values.[12]



The normalized record shows that the impacts of Hurricane Andrew, at close to $40 billion (2000 values), would have been far surpassed by the Great Miami Hurricane of 1926, which would cause an estimated $90 billion damage had it occurred in 2000. We can have confidence that the normalized loss record accounts for societal changes because the adjusted data contains climatological information, such as the signal of El Niño and La Niña.[13]

The normalization methodology provides an opportunity to perform a sensitivity analysis of the relative contributions of climate changes and societal changes, as projected by the Intergovernmental Panel on Climate Change (IPCC), to future topical cyclone damages. Figure 6 shows the results of this analysis.[14] The three blue bars show three different calculations (named for their respective authors) used by IPCC in its Second Assessment Report for the increase in tropical cyclone-related damage in 2050 (relative to 2000) resulting from changes in the climate, independent of any changes in society. The four green bars show the sensitivity of tropical cyclone-related damage in 2050 (relative to 2000) resulting from changes in society based on four different IPCC population and wealth scenarios used in its Third Assessment Report. These changes are independent of any changes in climate.

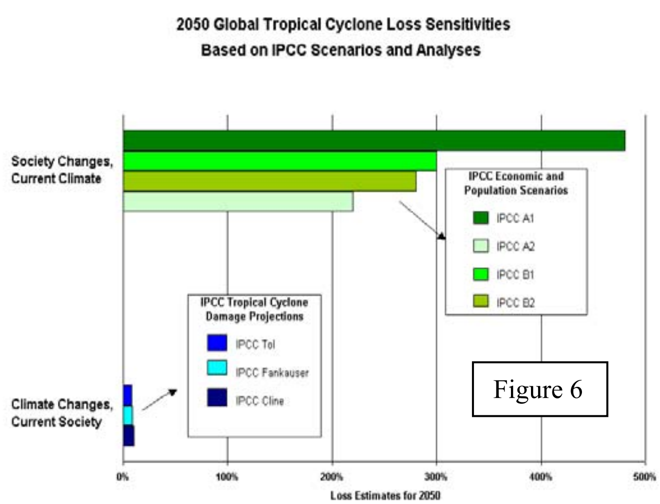


Figure 6 illustrates dramatically the profound sensitivity of future climate impacts to societal change, even in the context of climate changes projected by the IPCC. The relative sensitivity of societal change to climate change ranges from 22 to 1 (i.e., smallest societal sensitivity and largest climate sensitivity) to 60 to 1 (i.e., largest societal sensitivity and smallest climate sensitivity). This indicates that insofar as tropical cyclones are concerned, steps taken to modulate the future climate (e.g., via greenhouse gas emissions or other energy policies) would only address a very small portion of the increasing damages caused by tropical cyclones. Similar results have been found for tropical cyclone impacts in developing countries,[15] flooding,[16] other extremes,[17] and water resources.[18]

The perspective offered in this discussion paper raises the possibility that the UN Framework Convention on Climate Change (FCCC) has a critical, but largely unrecognized flaw with profound implications for policy. Under the FCCC the term "climate change" is defined as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability over comparable time periods." This definition stands in stark contrast to the broader definition used by the Intergovernmental Panel on Climate Change (IPCC) which states that climate change is "any change in climate over time whether due to natural variability or as a result of human activity."

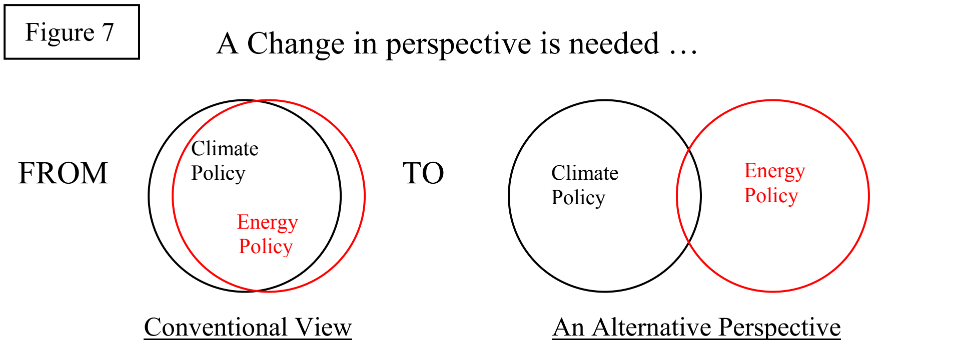
As a consequence of the FCCC definition, "adaptation" refers to actions in response to climate changes attributable solely to greenhouse gas emissions. It does not refer to efforts to improve societal responses to "natural" climate variability. Consequently, adaptation has only "costs" because adaptive responses would by definition be unnecessary if climate change could be prevented. Hence, it is logical for many conclude that preventative action is a better policy alternative and recommend adaptive responses only to the extent that proposed mitigation strategies will be unable to prevent changes in climate in the near future. But this overlooks the fact that even if energy policy could be used intentionally to modulate future *climate*, other factors will play a much larger role in creating future *impacts* and are arguably more amenable to policy change.

Based on these results implicit in the work of the IPCC and shown in Figure 6, an increased focus on "adaptation" makes sense under any climate scenario. But the Framework Convention is structured to deal only with the growth in impacts related to the greenhouse gas impacts on the climate (the blue bars) and not the profound societal vulnerability (green bars) that will dominate future climate impacts under any climate change scenario.

Consider that the International Red Cross estimates that in the 1990s around the world, weather and climate events were directly related to more than 300,000 deaths and more than US$700 billion in damages.[19] Many of these human losses are preventable and economic losses are manageable with today's knowledge and technologies.[20] Simple steps taken to reduce societal vulnerability to weather and climate could also make society more resilient to future variability and change. Seen from this perspective, costs of adaptation could easily be exceeded by the benefits of better dealing with the impacts of climate, irrespective of future changes in climate and their causes. The Framework Convention's definitional gerrymandering of "climate change" according to attribution prejudices policy and advocacy against such common sense activities.

An implication of this work is that policy related to societal impacts of climate has important and under-appreciated dimensions that are independent of energy policy. It would be a misinterpretation of this work to imply that it supports either business-as-usual energy policies, or is contrary to climate mitigation. It does suggest that if a policy goal is to reduce the future impacts of climate on society, then energy policies are insufficient, and perhaps largely irrelevant, to achieving that goal. Of course, this does not preclude other sensible reasons for energy policy action related to climate (such as ecological impacts) and energy policy action independent of climate change (such as national security, air pollution reduction and energy efficiency).[21] It does suggest that reduction of human impacts related to weather and climate are not among those reasons, and arguments and advocacy to the contrary are not in concert with research in this area.

Figure 7



The arguments presented in this testimony highlight a need to distinguish "climate policy" from "energy policy" (Figure 7). "Climate policy" refers to the actions that organizations and individuals take to reduce their vulnerability to (or enhance opportunities afforded by) climate variability and change.[22] From this perspective governments and businesses are already heavily invested in climate policy. In the context of hurricanes and floods, climate policies might focus on land use, insurance, engineering, warnings and forecasts, risk assessments, and so on. These are the policies that will make the most difference in reducing the future impacts of climate on society.

The conventional view is that climate policy *is* energy policy. However, much of the debate and discussion on climate change revolves around energy policy and ignores the fact that such policies, irrespective of their merit, can do little to address growing societal vulnerabilities to climate around the world. In all contexts, improving policies targeted on the societal impacts of climate depends on a wide range of factors other than energy policy. Consequently, in light of the analyses presented here, a common interest objective of climate policy would be to improve societal and environmental resilience to climate variability and change, and to reduce the level of vulnerability. Climate policy should be viewed as a complement, not an alternative, to energy policies.

Biographical Information – March 2002

Roger A. Pielke, Jr.
Email: pielke@cires.colorado.edu

Roger A. Pielke, Jr. joined the faculty of the University of Colorado in July 2001. Roger is an Associate Professor in the Environmental Studies Program and a Fellow of the Cooperative Institute for Research in the Environmental Sciences (CIRES). At CIRES Roger oversees the development of a new Center for Science and Technology Policy Research. From 1993-2001 Roger was a Scientist at the Environmental and Societal Impacts Group at the National Center for Atmospheric Research in Boulder, Colorado where he studied societal responses to extreme weather events, policy responses to climate change, and U.S. science policy. With a B.A. in mathematics and a Ph.D. in political science, both from the University of Colorado, he focuses his research on the relation of scientific information and public and private sector decision making. His current areas of interest include technology policy in the atmospheric and related sciences, use and value of prediction in decision making, and policy education for scientists. In 2000, he received the Sigma Xi Distinguished Lectureship Award. He chaired the American Meteorological Society′s Committee on Societal Impacts 1999-2002, and has served on the Science Steering Committee of the World Meteorological Organization's World Weather Research Programme and the Board on Atmospheric Sciences and Climate of the National Research Council, among other advisory committees. In 2001, Roger received the Outstanding Graduate Advisor Award by students in the University of Colorado's Department of Political Science. Roger sits on the editorial boards of *Policy* Sciences, *Bulletin of the American Meteorological Society*, and *Natural Hazards Review*. He is a co-author or co-editor of three books, most recently (with D. Sarewitz and R. Byerly) ***Prediction: Science, decision making and the future of nature*** (2000, Island Press).

Figure Captions

Figure 1. U.S. hurricane damage 1900-1998, adjusted for inflation to 1998 values.

Figure 2. U.S. hurricane landfalls, 1851-1998, figure courtesy of C. Landsea.

Figure 3a. Miami Beach, 1926. Photo from the Wendler Collection, Florida State Archives.

Figure 3b. Miami Beach, recent decades. Undated photo from the NOAA Arcive.

Figure 4a. Map of 168 coastal counties from Texas through Maine.

Figure 4b. Population of the 168 coastal counties from Texas through Maine for 1930 and 1990 based on U.S. Census data.

Figure 5. Historical losses from hurricanes adjusted to 2000 values based on inflation, population, and wealth. The graph suggests the damage that would have occurred had storms of past years made landfall with the societal conditions of 2000.

Figure 6. A sensitivity analysis of the impacts of tropical cyclones in 2050 based on the assumptions of the Intergovernmental Panel on Climate Change. The green bars show sensitivity of future impacts to societal changes and the blue bars show sensitivity to climate changes. Societal changes are the overwhelmingly dominant factor.

Figure 7. How our perspective on “global warming” might change. Rather than defining climate policy *as* energy policy, we might instead more clearly distinguish the two with implications for research and policy.

Endnotes

[1] For a review, see Kunkel, K., R. A. Pielke Jr., S. A. Changnon, 1999: Temporal Fluctuations in Weather and Climate Extremes That Cause Economic and Human Health Impacts: A Review, *Bulletin of the American Meteorological Society*, **80**:1077-1098, online at http://sciencepolicy.colorado.edu/pielke/hp_roger/pdf/bams8006.pdf

[2] For documentation of this assertion, see Pielke and Landsea (1997), Kunkel et al. (1999), Pielke et al. (2000), Pielke and Downton (2000), Downton and Pielke (2001), cited in the endnotes below.

[3] For an in depth presentation of this perspective, see Sarewitz, D., R. A. Pielke, Jr., 2000: Breaking the Global-Warming Gridlock. *The Atlantic Monthly*, July:55-64, online at http://www.theatlantic.com/cgi-bin/o/issues/2000/07/sarewitz.htm

[4] For discussion, see Pielke, Jr., R. A., 1998: Rethinking the role of adaptation in climate policy. *Global Environmental Change*, **8**:159-170, online at http://sciencepolicy.colorado.edu/pielke/hp_roger/pdf/1998.13.pdf

[5] See Pielke, Jr., R. A., R. Klein, and D. Sarewitz, 2000: Turning the Big Knob: An Evaluation of the Use of Energy Policy to Modulate Future Climate Impacts, *Energy and Environment*, **11**:255-276, online at http://sciencepolicy.colorado.edu/pielke/knob/index.html

[6] On the use of predictions in decision making see Sarewitz, D., R. A. Pielke, Jr., and R. Byerly, (eds.), 2000**: Prediction: Science, Decision-Making and the Future of Nature**. Island Press: Washington, DC. On the history and performance of the U.S. global Change Research program, see Pielke, Jr., R. A., 2000. Policy History of the U.S. Global Change Research Program: Part I, Administrative Development. *Global Environmental Change*, **10**:9-25. Pielke, Jr., R. A., 2000: Policy History of the U.S. Global Change Research Program: Part II, Legislative Process. *Global Environmental Change*, **10**:133-144. Pielke Jr., R. A., 1995. Usable Information for Policy: An Appraisal of the U.S. Global Change Research Program. *Policy Sciences*, **38**:39-77, online at: http://sciencepolicy.colorado.edu/pielke/hp_roger/pdf/1995.07.pdf

[7] See Sarewitz and Pielke 2000, op. cit.

[8] For discussion, see Pielke, Jr., R. A., and C. W. Landsea, 1998: Normalized Hurricane Damages in the United States: 1925-1995. *Weather and Forecasting*, **13**:351-361, online at http://sciencepolicy.colorado.edu/pielke/hp_roger/pdf/wf13.pdf

[9] See Landsea, C. L., R. A. Pielke, Jr., A. Mestas-Nuñez, and J. Knaff, 1999: Atlantic Basin Hurricanes: Indicies of Climate Changes, *Climatic Change*, **42**:89-129, online at http://www.aoml.noaa.gov/hrd/Landsea/atlantic/index.html
See also Landsea, C. W., C. Anderson, N. Charles, G. Clark, J. Partagas, P. Hungerford, C. Neumann and M. Zimmer, 2001: The Atlantic Hurricane Database Re-analysis Project: Documentation for the 1851-1885 Addition to the HURDAT Database. Chapter for the Risk Prediction Initiative book, R. Murnane and K. Liu, Editors. Online: http://www.aoml.noaa.gov/hrd/hurdat/index.html

[10] Pielke, Jr., R. A., and R. A. Pielke, Sr., 1997: Hurricanes: Their Nature and Impacts on Society. John Wiley and Sons Press: London.

[11] See Kunkel et al. 1999, op. cit.

[12] After Pielke and Landsea, 1998, op. cit.

[13] Pielke, Jr., R.A., and C.W. Landsea, 1999: La Niña, El Niño, and Atlantic Hurricane Damages in the United States. *Bulletin of the American Meteorological Society*, **80**:2027-2033, online at http://sciencepolicy.colorado.edu/pielke/hp_roger/pdf/bams8010.pdf

[14] Details on this sensitivity analysis can be found in Pielke et al. 2000, op. cit.

[15] Pielke, Jr., R. A., J. Rubiera, C. Landsea, M. Molina, and R. Klein, 2001: Hurricane Vulnerability in Latin America and the Caribbean, Natural Hazards Review, (in review).

[16] Pielke, Jr., R.A., and M.W. Downton, 2000: Precipitation and damaging floods: Trends in the United States, 1932-1997. *Journal of Climate*, **13**:3625-3637, online at http://sciencepolicy.colorado.edu/pielke/hp_roger/pdf/jc1320.pdf and, Downton, M. and R. Pielke, Jr., 2001. Discretion Without Accountability: Climate, Flood Damage and Presidential Politics, *Natural Hazards Review*, **2**:157-166, online at http://sciencepolicy.colorado.edu/pielke/hp_roger/pdf/downtonpielke2001.pdf

[17] See Kunkel et al. 1999, op. cit.

[18] C. J. Vörösmarty, P. Green, J. Salisbury, and R. B. Lammers, 2000. Global Water Resources: Vulnerability from Climate Change and Population Growth, *Science* **289**: 284-288. D.P. Lettenmaier, A.W.

Wood, R.N. Palmer, E.F. Wood, and E.Z. Stakhiv, 1999, Water Resources Implications of Global Warming: A U.S. Regional Perspective, *Climatic Change*, **43**:537-579.

[19] International Federation of Red Cross and Red Crescent Societies (IFRC), 2000.**World Disasters Report**, www.ifrc.org.

[20] See, e.g., D. Mileti, 2000. **Second Assessment of Natural Hazards**, (Joseph Henry Press).

[21] See, e.g., F. Laird 2001, Just say no to emissions reductions targets, *Issues in Science and Technology*, Winter, online: http://www.nap.edu/issues/17.2/laird.htm R. Brunner 2001. Science and the Climate Change Regime, *Policy Sciences* **34**:1-33.

[22] Note that here I use the broad definition of "climate change" used by the IPCC: "… related to any source" rather than the more restricted definition of the FCCC which defines climate change only in terms of those changes directly or indirectly attributable "to human activity that alters the composition of the global atmosphere …" For discussion, see Pielke, Jr., R. A., 1998, op. cit.