WASHINGTON ROUNDTABLE
ON SCIENCE & PUBLIC POLICY

Extreme Weather Events: Examining Causes and Responses

By Sallie Baliunas & Willie Soon

GEORGE C. Marshall INSTITUTE

Washington, D.C

The George C. Marshall Institute

The George C. Marshall Institute, a nonprofit research group founded in 1984, is dedicated to fostering and preserving the integrity of science in the policy process. The Institute conducts technical assessments of scientific developments with a major impact on public policy and communicates the results of its analyses to the press, Congress and the public in clear, readily understandable language. The Institute differs from other think tanks in its exclusive focus on areas of scientific importance, as well as a Board whose composition reflects a high level of scientific credibility and technical expertise. Its emphasis is public policy and national security issues primarily involving the physical sciences, in particular the areas of missile defense and global climate change.

The Washington Roundtable

on Science and Public Policy

The Washington Roundtable on Science and Public policy is a program of the George C. Marshall Institute. The Roundtable examines scientific questions that have a significant impact on public policy and seeks to enhance the quality of the debate on the growing number of policy decisions that look to science for their resolution.

The opinions expressed during Roundtable discussions do not necessarily represent those of the Marshall Institute or its Board of Directors. Additional copies of this transcript may be ordered by sending $7.00 postage paid to:

The George Marshall Institute
1625 K Street, NW - Suite 1050
Washington, D.C. 20006
Phone: 202/296-9655
Fax: 202/296-9714
E-mail: info@marshall.org
Website: www.marshall.org

Extreme Weather Events: Examining Causes and Responses

by Sallie Baliunas and Willie Soon

George C. Marshall Institute
Washington, D.C.

Sallie Baliunas, a research astrophysicist and Senior Scientist at the Marshall Institute, is co-host of TechCentralStation.com, and leads its Science and Environment section. She previously served as Deputy Director of Mount Wilson Observatory.

Willie Soon, a research physicist, is also a Senior Scientist at the Marshall Institute.

Extreme Weather Events: Examining Causes and Responses[*]

Sallie Baliunas and Willie Soon
March 25, 2003

Introduction

Costs of damage from storms, fires and floods have increased dramatically in recent decades, and these events are often attributed to human-induced global warming. Doctors Baliunas and Soon examine the scientific basis of possible links between catastrophic weather events and human-caused global warming. Their research, drawing on long-term climate records, indicates that recent global weather patterns fall well within the range of natural historical climate variability, and that dramatic decreases of carbon dioxide emissions would have little or no affect on climate, at great social and economic costs. Since social and economic factors contribute most to human vulnerability to extreme weather events, they recommend focusing our scientific, political and social resources on addressing these issues in order to reduce weather-related deaths and damage.

Remarks of Dr. Baliunas and Dr. Soon

> "Scientific and technical reports present compelling evidence that human-induced climate change is upon us, and that its consequences could be devastating…" (UNEP FI, *Module 2,* p. 8).

On 8 October 2002 the UNEP Finance Initiatives (UNEP FI)[1] Climate Change Working Group released a report *Climate Change and the Financial Services Industry*. The Executive Summary opens:

> "Climate change represents an unprecedented and highly complex threat to long-term economic interests across the spectrum of finance and insurance industry activities.… [I]ncreasingly severe climatic events and underlying socio-economic trends…have the potential to undermine the value of business assets.… In the extreme

[*] The views expressed by the authors are solely those of the authors and may not represent those of any institution with which they are affiliated.

[1] UNEP FI is a partnership among UNEP and 295 banks, insurance and investment companies.

case, whole regions may become unviable for commercial financial services." (*Module 1*, p. 4)

The first of the report's "major conclusions" is that

"policymakers should commit to clear [greenhouse gas] emissions reductions targets via policies and measures consistent with the Kyoto Protocol that establish a clear value on carbon...." (*Module 1,* p. 5)

In support of the UNEP FI conclusions, alarming statistics are given:

"Worldwide economic losses due to natural disasters appear to be doubling every ten years, and have reached almost $1 trillion over the past 15 years... Each year now brings 4-times as many weather-related natural disasters as 40 years ago, resulting in 11-times the insurance losses (equivalent to $10 billion per year over the course of the 1990s." (*Module 1*, p. 6)

UNEP underscores those statements with a chart displaying economic and insured losses for natural disasters, from 1950 through 2001 (see Figure 1). Note that the value for the year 1995 is off the scale, at more than $167 billion (all costs are in US constant dollars). The dramatic, almost exponentially rising trend line is drawn to create a forecast for future economic losses from natural disasters. The report projects, "If current trends persist, the annual loss amounts will, within the next decade, come close to US$150 billion (2001 dollars), of which a significant fraction will be insured." (*Module 1*, p. 6)

Natural catastrophes: Weather and other

How good is the UNEP projection for future *natural* disasters, and how are they related to the report's call for reductions in greenhouse gas emissions from human activities? First to note is that the opening chart encompasses "great natural catastrophes."[2] Some cannot be plausibly related to climate change, much less climate change resulting from increased atmospheric greenhouse gas concentrations. For example, the two highest

[2] "Natural catastrophes are classed as great if the ability of the region to help itself is distinctly overtaxed, making interregional or international assistance necessary. This is usually the case when thousands of people are killed, hundreds of thousands are made homeless, or when a country suffers substantial economic losses, depending on the economic circumstances generally prevailing in that country." (Munich Re Group)

peaks in the UNEP figure, which occur in 1994 (over $80 billion in natural disaster loss costs) and 1995 (over $167 billion), owe to earthquakes – the 1994 Northridge and 1995 Kobe earthquakes – not weather.

Natural disasters like earthquakes and volcanic eruptions cannot be linked in any believable way to the increased atmospheric concentration of greenhouse gases.

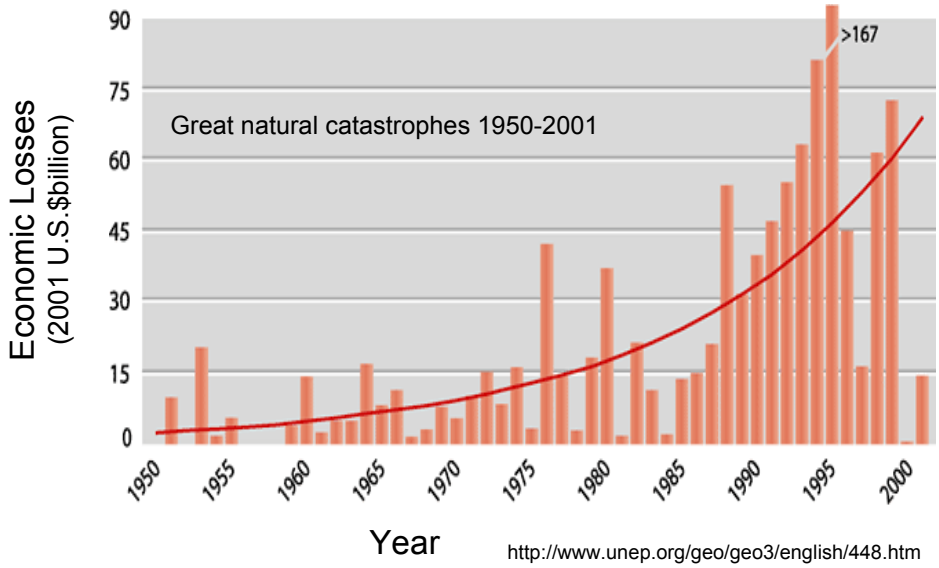

Figure 1 – Loss costs, in constant U.S. dollars, for great natural catastrophes from 1950 to 2001, compiled by UNEP. The smooth curve is the UNEP FI report's fit to the information. The two highest values occurred in 1994 and 1995 (the latter of which is off the scale of the chart) and owe primarily to the Northridge, CA and Kobe earthquakes. A comparison over several decades should include a normalization for changes in socio-economic factors that raise the disaster costs apart from the intrinsic destructive strength of the disaster.
Source: http://www.unep.org/go/geo3/english/448.htm

Weather disaster costs

The focus now narrows on potential economic losses for only weather disasters, resulting from two factors: (1) increases in socio-economic trends like population growth, urbanization, etc.; and (2) increase in the concentration of greenhouse gases in the air that would then drive global climate change and ultimately influence local weather events.

Pielke et al. (2000)[3] estimate for the year 2050 that economic losses for natural weather disasters – tropical cyclones, floods, water resources – would grow dramatically, even in the absence of climate change (human-made or natural, or both). The rise in economic losses occurs primarily from population growth plus societal and economic development. Compared to the estimated losses for human-made climate change (e.g., projected rise in flooding, extreme precipitation, tropical cyclones, etc.) societal trends would be 22 to 60 times more potent in creating economic losses than the projected rise in losses from greenhouse-gas weather disaster losses. That is to say, committing to mitigation of a greenhouse-enhanced atmosphere will be of little consequence in reducing the enormous weather losses that would come from societal trends.

Moreover, greenhouse gas emission cuts prescribed by the Kyoto Protocol will be largely ineffective in preventing increases in the air's greenhouse gas content, and therefore they will not prevent much of the forecast weather-related catastrophes. Additionally, the Kyoto Protocol's implementation is likely to cost several percent of the GDP (in the U.S.) and divert resources for preparation for and recovery from chronic weather extremes.

Societal trends have long existed as a factor in adaptation to extreme weather events. For example, the Dutch Rhine delta has been managed for at least 1,000 years in an effort to control floods. That period includes times when climate has been warmer or cooler, including periods of more extreme rainfall or drought, than in the 20th century. Researchers looking at the influence of societal trends on flood risk, mitigation and adaptation during periods of extreme climate change conclude, "The influence of climate on changes in flood hazards was indirect, virtually absent, or confounded with social dynamics. A proper indicator would [not] be a function of only climate, thus rendering it improper as a guide for greenhouse gas emission reduction." (p. 367)[4]

Modern floods in Europe

While the United States experienced widespread drought, August of 2002 saw massive floods in central Europe throughout the Elbe and Da-

[3] R.A. Pielke, Jr., 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.

[4] R. S. Tol and A. Langen 2000, *Climatic Change* 46: 357-369.

nube River systems (Czech Republic, Germany, Russia and Austria) which caused severe economic losses. Across Europe the loss from floods was about $27.5 billion for the year. The 2002 floods had followed the 1993 and 1995 floods on the Rhine and Meuse, and 1997 floods on the Morava and Oder.

Europe's rivers flooded in 2002 just after the end of the Johannesburg Summit on Sustainable Development, during which the U.S. maintained its position on refusing to ratify the Kyoto Protocol. News cycles juxtaposed the U.S. failure to ratify the Kyoto Protocol and Europe's floods, as if those disasters were supernatural omens of greenhouse-gas enhanced climate disasters. Germany's environment minister, Jürgen Trittin, intoned: "If we don't want this development to get worse, then we must continue with the consistent reduction of environmentally harmful greenhouse gases."[5]

The U.K. Meteorological Office was forthcoming in correcting the minister's misunderstanding of European flooding affected by the increased greenhouse gas content of the air. Computer simulations show that winter, not summer floods, would be expected to increase in an atmosphere warmed by additional greenhouse gases. The UN IPCC *Third Assessment Report*[6] shows five projections (p. 597, WG I) for changes in summer precipitation. For central and northern Europe summer precipitation would either stay the same or decrease. The computer simulations cannot relate recent severe summer floods to a rise in the air's greenhouse gas concentration.

There is a temptation to characterize an unusual weather event like an extreme flood as unnatural – i.e., caused by human-made rise in atmospheric greenhouse gas concentration.

Danica Leskova of the Slovak Hydrometeorological Institute also warned against galloping conclusions about the uniqueness of the August 2002 floods in Europe: "Our memory is too short. Our regular and scientific observations did not begin long enough ago to make such self-assured deductions."[5]

---

[5] *The Guardian*, August 14, 2002, http://www.guardian.co.uk/international/story/0,3604,774124,00.html

[6] J.T. Houghton et al. *Climate Change 2001*, Working Group I, Third Assessment Report

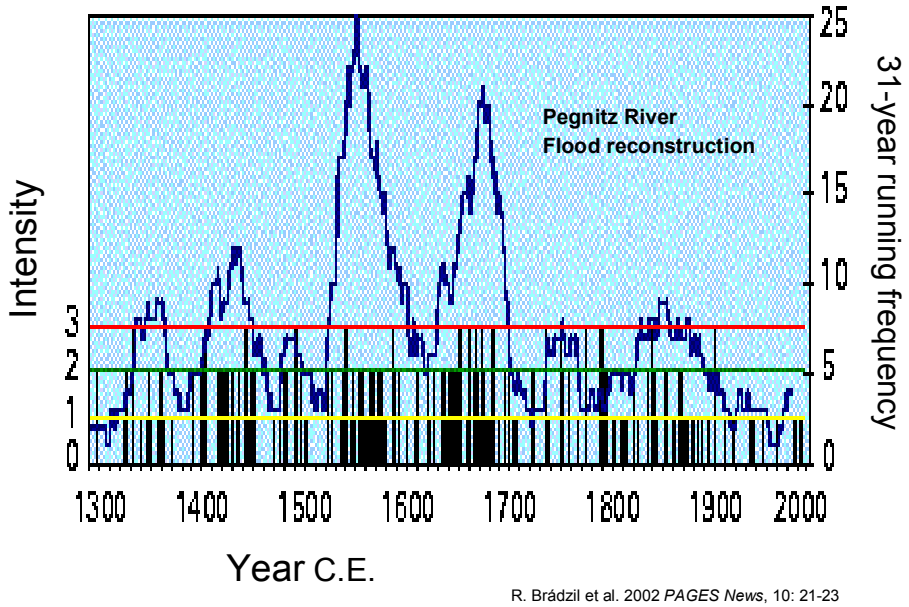

Figure 2 – Reconstructed flooding of the Pegnitz River in Nuremburg, from 1300 to 2000 C.E. The estimated intensity of the events is shown on a relative scale from 1 to 3; frequency is denoted by the spacing of the events. The curve is the 31-year mean of the frequency and occurrence of flooding events, and shows two pronounced peaks, one in the 16th and the other in the 17th century. The flood peaks occur during the coldest period of the Little Ice Age in Central Europe. Source: R. Brázdil et al. 2002, *PAGES News*, 10, No. 3, pp. 21-23

An example of necessary perspective over centuries of flooding in Europe comes from the Pegnitz River in Nuremberg, Germany.[7] Past flood patterns for the Pegnitz River have been reconstructed (in the early period, from documentary evidence) back to 1300 C.E. (Figure 2). The intensity of individual events is shown, with a 31-year running mean that encompasses frequency and intensity of events. In terms of climate change (defined as persisting over several decades or longer) central Europe experienced the most severe flooding occurred in the 16th and 17th centuries. As the authors write, "Two distinct phases of high flood frequency stand out during the main phase of the Little Ice Age between 1550 and 1700." The period covering the extreme flooding of the 16th and 17th centuries coincides with

[7] R. Brázdil et al. 2002, *PAGES News*, 10, No. 3, pp. 21-23.

the coldest part of a generally cold phase in central Europe.[8] In contrast, the average frequency of intense floods during the 20th century is the *lowest* of all the centuries shown. Despite the devastation of the floods of 2002, overall the 20th century climate has been moderate in terms of measured hydrological parameters of river floods in the Pegnitz. Extreme loss costs for Europe's 2002 floods most likely owe to societal trends, not climate change drawn from the air's increased greenhouse gas content.

The long memory in the record of lake sediments of New England reveals millennial-scale natural variations in floods there.[9] Following the course of long-term periodicities, storminess in the U.S. northeast has slowly risen in the last 600 years, and may continue for 900 years more. The authors note, "…[D]etected increases in contemporary storminess may not be a reliable indicator of human-induced climate change." (p. 823)

Hurricanes

The most costly weather disasters for the U.S. are tropical cyclones, or hurricanes. Damage arises from the high winds, swift rainfall, oceanic storm surges along coastlines, and floods. Economic and insurance losses from hurricanes in the U.S. have increased, especially in the latter part of the 20th century when greenhouse gas concentrations in the air have risen. Even on a constant-dollar basis, losses from hurricanes have increased through the 20th century. Is this cause-and-effect evidence that the increase in atmospheric greenhouse gas concentrations has transformed the climate to one that spawns more disastrous or more frequent "superstorms" and "hypercanes"?

Observations

As mentioned above, societal changes have greatly influenced the trend toward increased storm costs. Thus, catastrophe loss is not a good proxy for trends in climate change, unless societal trends are factored into loss costs across history, as the quantity labeled *normalized losses* attempts to do. R. Pielke, Jr. and C. Landsea[10] estimated the normalized losses for U.S. hurricane damage over the last 100 years. The most destructive hurricane year is 1926, dominated by one massive storm, the Great Miami Hur-

[8] H.H. Lamb 1977, *Climatic History and the Future* (Princeton: Princeton University Press) 835pp.
[9] A.J. Norne et al. 2002, *Nature* 419:821-824
[10] R. A. Pielke, Jr. and C.W. Landsea 1998, *Weather and Forecasting*, 13: 621-631

ricane. Had this storm occurred in the year 2000, losses of $80-90 billion would have been expected. In comparison, the second highest normalized loss year is 1992 ($40 billion), which owes predominantly to Hurricane Andrew.

What is the distribution of years with normalized losses totaling $20 billion or more, compared with the period before and after 1950, that is, before and after the dramatic rise in the air's anthropogenic greenhouse gas concentration? Five of the years with normalized losses over $20 billion occurred prior to 1950: 1900 (including the unnamed Galveston Hurricane, which killed over 6,000 people, the largest hurricane death toll in U.S. history), then 1915, 1926, 1938 and 1944. But after 1950 there are only two such years: 1954 (Hurricanes Carol and Hazel) and 1992 (Hurricane Andrew).[10]

Better than plumbing measures of storm costs to seek an association between higher storm severity and the air's increased concentration of greenhouse gases is to examine directly the record of meteorological parameters of Atlantic Basin tropical cyclones.

One long-term regional view of hurricanes in the U.S. is the reconstruction of tropical cyclone frequencies around Charleston, South Carolina, going back to 1778.[11] Mock finds that, on average, from 1870 to 2000 a major storm hit the Charleston area every 1.8 years, a less frequent incidence than that of every 1.3 years during the period 1778-1870. In addition, there were extraordinarily active hurricane decades near Charleston in the 1830s and 1880s through 1890s.

The meteorology of recent hurricanes comes from quantitative measurements. The maximum wind speed of the strongest Atlantic hurricanes has decreased between 1944 and 2002.[12] The frequency of intense (Saffir-Simpson category 3, 4 and 5) Atlantic hurricanes has not risen since 1944. Hurricane researchers C. Landsea and W. Gray note, "[B]y far the biggest decade during the last active era was the 1940s, where five major hurricanes made landfall in Florida. This contrasts dramatically with the very low activity of the 1970s, 1980s, and 1990s."[13]

---

[11] C. J. Mock 2002 *PAGES News*, vol. 10, no. 3, pp. 20-21
[12] C. Landsea of NOAA, private communication
[13] C. Landsea and W. Gray, 23 July 2002, *Miami Herald*

It is important to remember that global average (and U.S.) surface temperatures showed a downward trend from around 1940 until the late 1970s; since then, the surface temperatures have shown a warming trend. Also, most of the greenhouse gases have been added to the air after 1950. Neither maximum wind speeds of hurricanes nor the frequency of intense hurricanes has increased during the recent period when human-produced greenhouse gases, and warmer surface temperatures, occurred.

No observed correlation can be found between rising temperature trends or increased greenhouse gas concentration at the end of the 20th century and increased Atlantic basin hurricane frequency or severity.

Forecasts

IPCC's *Third Assessment Report*[6] Table 1 (p. 15) profiles the estimate in "confidence in projected changes during the 21st century" in extreme weather. In terms of forecasts, the table states

> Increase in tropical cyclone peak wind intensities – likely, over some areas.
>
> Increase in tropical cyclone mean and peak precipitation intensities – likely, over some areas.

In terms of the "confidence" in observed changes of such phenomena, the table's entry of confidence for the first forecast states "Not observed in the few analyses available" while for the latter the entry states that there are "Insufficient data for assessment." In other words, the confidence of the forecasts is classified as "likely" while the observations are deemed insufficient to have validated the results of the computer simulations that generated the forecasts for the latter half of the 20th century.

Droughts and Forest Fires

Over the latter half of the 20th century, as the air's greenhouse gas content has risen, the variance in temperature has dropped while the variance in precipitation remains unchanged. U.S. precipitation has slightly and gradually increased over the 20th century (by approximately 10%) but precipitation through the century is uncorrelated with temperature.[14] U.S.

[14] P.J. Michaels et al. 2002 *Proceedings of the 13th Conference on Applied Climatology*, 13-16 May, Portland OR, 153-155.

drought frequency or drought area extent shows no upward trend in the 20th century. A longer view of reconstructed drought shows the 19th century's droughts were more frequent and more severe. For instance, from 1830 - 1860 the Great Plains and Southwest experienced a worse drought than that of the 1930s Dustbowl, despite the fact that the temperature was cooler in that 19th century period than in the 1930s.[15]

The acreage burned in U.S. forest fires has been reduced from its dramatically high natural values of the early 20th century by about a factor of 4-5. Since the 1960s, both U.S. surface temperature and precipitation have shown general upward trends while the average acreage burned by wildfires per decade has remained relatively constant.[16]

Summary

In an atmosphere theoretically warmed by the air's increased concentration of greenhouse gases, climate-related catastrophe losses would be little influenced by policies like the Kyoto Protocol, for three reasons.

First, there is no reliable evidence for increased severity or frequency of storms, droughts, or floods that can be related to the air's increased greenhouse gas content. The computer simulations do not give reliable forecasts on future extreme weather. Reconstruction of past climate change links the coldest times of the last millennium with periods of more frequent or more severe events, or both.

Second, in terms preventing predicted catastrophe losses, socio-economic trends, not the forecast human-made climate effects from a rise in the air's greenhouse gas content, would by far dominate the loss costs.

The UNEP report admits the importance of the socio-economic factors in catastrophic losses, but fails to recognize how small a component the forecast human-made climate effects would play: "Although the steady increase in economic and insured losses is more a function of the concentration of economic development in vulnerable regions than climate change per se, it is clear that climate change will exacerbate these loss trends." (*Module 1*, p. 7)

---

[15] S. Jain et al. 2002 *Geophysical Research Letters*, 29:32-1 – 32-4; D. Meko et al. 1995, *Journal of the American Water Resources Association*, 31(5): 789-801

[16] National Interagency Fire Center; see also *World Climate Report* Vol. 7, No. 21, July 8, 2002.

Third, the Kyoto Protocol would not only fail to lower the abundance of human-made greenhouse gases that are already in the air but also would allow the concentration to rise, and is therefore *ineffective* in reducing the forecast risk of increased weather disasters from human-made global warming.

The scientific facts are clear that preparation for ever-present extreme weather rests with enormous socio-economic factors, not with mitigating greenhouse gases in the air according to the Kyoto Protocol.

The UNEP report realizes that its recommendation that greenhouse gas emissions be cut may be derailed by other events like "U.S. corporate governance and accounting scandals" or "increasing concerns over the ability to fund burgeoning health and retirement programs." UNEP is concerned: "…[T]here is clearly a risk that the climate change issue will not garner the level of attention necessary for any serious action to take place." (*Module 2,* p.15).

Such a statement in the face of facts on extreme weather clings to the precautionary principle, a philosophy that is anti-scientific and anti-environment. In a recent interview, Prof. H. Rolston, a leading philosopher of environmental ethics, commented, "Our planetary crisis is one of spiritual information, not so much sustainable development, certainly not escalating consumption, but using the Earth with justice and charity. Science cannot take us there, religion perhaps can." [17]

Ignoring the scientific facts on climate change, a physical process, means inviting vulnerability to great natural catastrophes. How does that bring justice to the world?

* * *

Questions and Answers

Q: I have just been wondering: nobody seems to know at all about the pollution, but isn't it possible that pollution is seeding the clouds? What happens when you stop seeding the clouds by taking it out all of a sudden?

---

[17] The interviewee continues, "Global warming is a bigger threat to the world than Saddam Hussein." March 19, 2003 BBC News http://news.bbc.co.uk/1/hi/sci/tech/2864845.stm

Baliunas: Do you mean seeding the clouds from aerosol soot?

Q: Yes, just general pollution. When you seed the clouds, you get rain, but to what extent do you have the reverse? For example, in Central Europe, industry collapses, all the pollution is taken out and the air suddenly is much, much cleaner. Then what happens? Seeding the clouds makes rain, what does "un-seeding" the clouds do?

Baliunas: I think you can actually go back and look at something like Figure 2. There was much less soot emitted during the 15th and 16th centuries (the period of intense storminess) compared to the 20th century. The local pollution effect might be there, but it should be small compared to the overall. During the Little Ice Age major changes in the wind circulation patterns occurred and the Arctic system moved southward. That brought a lot of storminess.

Soon: You can also look at the results of flooding in the Rhine River and other places. They all peak about the same time and then decrease again, so it is coherent; maybe it's a large-scale synoptic phenomenon. It is a bit hard to see how the local pollution of sulfate aerosols can occur all over the place simultaneously.

Baliunas: One has to be careful about the impression of "extreme weather." A very catastrophic, damaging blizzard occurred in England a few months ago. It brought the motorways to a halt, people were stranded, the electricity was out. Nothing like it had occurred in a while. Yet all the strife was the result of two inches of snow! The point is that London was totally unprepared to deal with two inches of snow.

Q: I have a question on the disaster loss part. It's not obvious that money is always the best way of measuring loss; if you look at the number of lives lost, you actually see a decrease in the impact of the storms.

Baliunas: The number depends on the economic level of development of the area. For example, in 1900 a Category-5 hurricane hit Galveston, Texas without any warning, and over 6,000 people were killed. The death toll from a Category-5 hurricane in the U.S. today is much, much less, but when Hurricane Mitch hit Honduras in 1998, 11,000 people or more were killed. It really is the difference in having resources to protect people.

Q: The other question I have about the hurricanes relates to your point about insurance claims over time. I understand a lot of damage from hurricanes comes from storm surges and other irregular events. Do you know what the historical evidence is for an increase – I mean is it possible to measure that?

Soon: The records on storm surges are hard to come by. But if you look over, let's say the Nordic area, there are maybe a hundred years of data. Yet I don't think you can make any strong case there. The Nordic area really has good records, to the best of my knowledge, but I haven't been able to find really convincing evidence, and believe me, I am looking very hard to prove myself wrong.

Baliunas: Precipitation in the U.S. has increased by about 10% just over the 20th century, and that, again, is a very short time-scale. But precipitation is uncorrelated with the temperature over the record.

Soon: The climate seems to work and operate in that multi-decadal mode. The Pacific Ocean, for example, seems to operate in that way. For several decades, the overall mode seems to be storing up heat, then all of a sudden there is a shift to another state or mode of operation in which the heat is released. We have a qualitative description of this behavior from instrumental and proxy data related, for example, to the Pacific Decadal (or rather Multi-decadal) Oscillation. Although we don't know how to explain it, the key question is if we can expect such a response from adding CO_2 to the air. The shifts up and down and rapid changes seen in the real world are not found in the climate models – at least I have not seen a self-consistent treatment of the problem. Some climate models add excessive amounts of CO_2 and are especially unrealistic in their rate of CO_2 increase over time, and then project forward; based on their results, the modelers claim that the frequency of storm surges will increase if more CO_2 is added, even though we do not know how to simulate the multi-decadal shift in the real oceans. This is something I don't understand.

Q: After we had our blizzard here in Washington this winter, I was waiting for someone to write that this was caused by global warming. I had to wait until March 7th in the Wall Street Journal, when Sharon Begley wrote in a column that she calls "Science Journal" that in fact, this blizzard was caused by global warming. I am not sure whether she knew that was the case because it was a topic of discussion at the World Economic Forum in Switzerland, which apparently now is the center of science on the planet. So I just wondered, where does this come from?

Soon: The idea behind all these newspaper stories is actually fairly simple. In the game of predicting CO_2 effects from climate models, it is just another case of extrapolation. Some of these extrapolations deal with the famous North Atlantic thermohaline circulation of currents in the Gulf Stream, which starts in the tropics, then goes north toward Greenland. As water evaporates from the surface, the remaining water becomes saltier and heavier and therefore sinks to the bottom in this higher latitude region of the Atlantic Ocean. This motion drives the circulation. Some people are worried about the possibility of increased freshening of water of the ocean in the higher latitudes, around the North Atlantic sinking region. The idea is that global warming might cause more evaporation from the ocean, causing more rain which freshens the water up, so that these particular chains of sinking flow would slow down or stop altogether. Supposedly this scenario has happened before, which might explain a lot of the things that we thought happened during the last Ice Age 20,000 years ago or perhaps even during the Medieval Ice Age that happened between AD 1300 and 1900 or so. But unfortunately I have seen only hand wavings in all these suggestions and worries – about five times during this explanation.

Factually, this pattern of circulation in the North Atlantic is a complicated thing. Any real oceanographer will say that the ocean doesn't work like this so-called "conveyor belt," as most popular discussions try to describe it. This simple picture is used because it is easy to understand and therefore attractive to popularizers. Climate models in the early 1990s predicted clearly that this conveyor belt would shut down if CO_2 were added; mind you, not two times – they had to add four and even *eight* times the present level of CO_2. That's a lot: we are talking about burning almost everything we have, and only then do we have this shut-down. Then over time, more and more sophisticated models came into the market and there was a completely opposite change in their claims: "Well, maybe it won't shut down, because there are other effects controlling and interacting with the situation in the North Atlantic. For example, when you add more CO_2, the tropical Pacific may become more active, drawing more and more fresh water from the tropical Atlantic, so the North Atlantic Thermohaline circulation won't be shut down after all." So far, you can see that even with their own models, the predictions have been "shut down" and "no shut down." This is a very strange proposition – hardly any serious science. Today the answer is basically bending toward "no change," because there are three or four more new studies from the National Center for Atmospheric Research (NCAR). The Max Planck Institute for Meteorology in Hamburg was the first to predict this shutting down of the thermo-

haline circulation, but their most recent studies say they don't expect a shutdown. The NCAR results show that as well, and there's one more result from NASA's Goddard Institute for Space Studies (GISS) showing no shutting down of the North Atlantic Thermohaline circulation.

Q: I think we have to take with a grain of salt the claims that come from the insurance industry. In particular it may have been insuring by the dollar values that pay ten times more for a billion dollar building than for a hundred thousand dollar building, and they collect it all anyway. It sounds like they are trying to raise premiums by saying "Oh, we have an escalator on top of it, 10% per year, because of global warming, so pay up."

Baliunas: That may be. But even if Kyoto were to be followed, it would not solve the claimed problem.

Q: What's the motivation of some of these industrialized nations that are pushing this notion, despite the fact that, at best, the science is weak?

Baliunas: This is beyond atoms, stars and galaxies. I need someone who is an expert on world affairs. I have been told, for example, that one European outlook is that whatever disadvantages the American economy would advantage Europe, as if there were some equal shift and flow between those economies. I don't even agree with that; Economics 101 tells me not to say that.

Q: Back to the scientific, for a moment. Have you been looking at the typhoon intensity and frequency, as well as done a chart for that?

Soon: We know some records, and again the typhoon records show this multi-decadal trend is like the one that is happening in the Atlantic Ocean similar to the intense (category 3, 4 and 5 of the Saffir-Simpson scale) Atlantic hurricane.

Baliunas: Typhoons in the Pacific were low here, high here. There are modes to these, to each ocean base.

Baliunas: Hurricane experts like Bill Gray at Colorado State University find that in a globally-warmed world, no matter the cause of the warming, hurricanes may tend to be suppressed, when the temperature gradient, the difference between the warm tropics and the higher latitudes, is lowered.

* * *

RECENT WASHINGTON ROUNDTABLES ON SCIENCE AND PUBLIC POLICY

Randall Correll – *National Security Implications of the Asteroid Threat* (February 2003)

David Trachtenberg – *Weapons of Mass Destruction and Terrorism* (November 2002)

Henry Cooper – *Defending America from Offshore Missile Attack* (October 2002)

Baker Spring – Missile Defense in a World Without the ABM *Treaty* (June 2002)

Gregory Canavan – *Update on Missile Defense Technology* (May 2002)

Dorothy Denning – *Is Cyber Terrorism Coming?* (May 2002)

Jesse Ausubel – *Does Energy Policy Matter?* (April 2002)

Bruce Ames – *The Causes and Prevention of Cancer: Do Federal Regulations Help?* (March 2002)

James Schlesinger – *Responding to National Security Threats in the Post 9/11 World* (February 2002)

The Marshall Institute – Science for Better Public Policy