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DANGEROUS EXPOSURE: THE IMPACT OF GLOBAL WARMING ON PRIVATE AND FEDERAL INSURANCE

HEARING

BEFORE THE

COMMITTEE ON HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

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DANGEROUS EXPOSURE: THE IMPACT OF GLOBAL WARMING ON PRIVATE AND FEDERAL INSURANCE

THURSDAY, APRIL 19, 2007

U.S. SENATE,
COMMITTEE ON HOMELAND SECURITY
AND GOVERNMENTAL AFFAIRS,
Washington, DC.

The Committee met, pursuant to notice, at 9 a.m., in room SD–342, Dirksen Senate Office Building, Hon. Joseph I. Lieberman, Chairman of the Committee, presiding.

Present: Senators Lieberman, Tester, and Collins.

OPENING STATEMENT OF CHAIRMAN LIEBERMAN

Chairman LIEBERMAN. Good morning and welcome to this hearing where we will examine the human and economic consequences of global warming through the eyes of private and Federal programs that insure tens of millions of American property owners, including farmers, against weather-related losses that already result in claims totaling billions of dollars a year.

On April 6, just a few weeks ago, the United Nations Intergovernmental Panel on Climate Change (IPCC) issued a report on the impacts that world scientists projected would result from unchecked global warming. Here are some of the impacts that the IPCC finds that the United States will experience by the middle of this century unless we dramatically reduce our greenhouse gas emissions: Warming in Western mountains will decrease the snowpack, causing winter flooding, reduced summer flows, and increased competition for already strained water resources; droughts and new invasions of insects will kill crops as well as forests, leaving forests even more prone to fires; coastal communities and habitats will be battered by intensified storms, with the damage compounded by more erosion.

In sum, we are looking at more floods, intensified floods, droughts, pestilence, fires, and storms—all carrying dire economic consequences.

In the United States, a significant portion of the economic losses from such disasters is covered by private insurance and by two taxpayer-funded programs—the National Flood Insurance Program and the Federal Crop Insurance Corporation.

So it is natural to ask: How are the private insurance industry and the Federal Government insurance programs responding to the predictions of a sharp increase in financial liability that they will

face as a result of climate changes they may not have anticipated, probably did not anticipate, a decade or two ago? How are they responding to the scientific consensus that the increase in weather-related loss will accelerate in the decades ahead if global warming remains uncontrolled? What effect will this response, or lack of one, have on the tens of millions of Americans who rely on insurance to protect them from weather-related loss?

In 2005, Senator Collins and I asked the Government Accountability Office to answer these questions. That report is now complete, and I am pleased to say that John Stephenson is here with us as a witness to describe GAO's findings. I want to highlight briefly three specific conclusions that I think are important for all of us to understand and face.

First, storm-related economic losses do not increase on a one-to-one ratio as storm strength increases. Rather, the losses increase at an exponential rate. For instance, Category 4 storms tend to cause 100 times more economic damage, not just four times more, than Category 1 storms. In light of the mounting evidence that unchecked global warming will increase the intensity of hurricanes and other weather activity, this conclusion has very serious economic consequences.

Second, one-half to two-thirds of the structures in America's floodplains do not have any flood insurance at all, and nearly 60 percent of homeowners in our country carry insurance amounting to less than the value of their property. So as we discuss potential losses to insured property from these weather events, we have to keep in mind that those losses represent just a portion of the direct, weather-related economic harm that global warming, if unchecked, threatens our country with.

Third, the Federal Government has itself grown markedly more exposed to weather-related losses since 1980. In that time, for example, the number of policies in the National Flood Insurance Program has more than doubled, and the total value covered by the program has increased fourfold.

GAO believes that the two Federal insurance programs it examined could see their losses grow by many billions of dollars in the coming decades as a result of climate changes. In the absence of careful planning and mitigation, the impact of global warming on these two programs, therefore, could substantially increase the annual budget imbalance and the overall deficit of our Federal Government.

In addition to GAO, this morning we are privileged to hear from Eldon Gould, Administrator of the Department of Agriculture's Risk Management Agency, which administers the Federal Crop Insurance Corporation, and from Michael Buckley, Deputy Assistant Administrator for Mitigation at the Federal Emergency Management Agency, which oversees the National Flood Insurance Program.

These are the two Federal insurance programs that GAO examined. Together, they paid one-quarter of the $320 billion that public and private insurers together paid on weather-related claims in the last 25 years.

In 1999, the Agriculture Department's Risk Management Agency declared, "The risks of climate change, such as higher tempera-

tures, changes in precipitation, increased climate variability, and extreme weather events can result in significant impacts on agriculture, forestry, and rural areas.

"The risks posed by climate change and the substantial challenge presented by mitigation and adaptation strategies require a strong USDA commitment to global change issues."

A year later, the Director of FEMA said, "There is no doubt that the human and financial costs of weather-related disasters have been increasing in recent years. It is time to increase our efforts in applying prevention strategies to reduce the impacts of the changes in weather climates."

In light of those statements that were made 7 and 8 years ago, I am going to ask our witnesses today what USDA's Risk Management Agency and FEMA's mitigation office have done to prepare for and overcome the increasing weather-related risks attributable to global warming.

Finally, I look forward to hearing today from Andrew Castaldi, head of Catastrophe and Perils in the Americas Division of the Swiss Re America Corporation. We could probably use a little of that around the Senate, a head of catastrophe and perils. Swiss Re is the largest private reinsurer in the world, and I am glad to say that they also have a presence in the great State of Connecticut. We look forward to hearing from Mr. Castaldi about how this private insurance company estimates the costs of global warming if we do not do something about it soon.

I thank you all for coming today, and I am now pleased to call on our Ranking Member, Senator Susan Collins of Maine.

OPENING STATEMENT OF SENATOR COLLINS

Senator COLLINS. Thank you, Mr. Chairman.

The rapidly mounting evidence of climate change depicts a threat that extends even beyond vital environmental and social concerns. Global warming threatens to burden consumers and taxpayers with billions of dollars in added costs as insured losses from floods and storms cause increases in Federal spending and in insurance premiums. The new Government Accountability Office report that this Committee requested paints an alarming picture of "escalating exposures to catastrophic weather events." Between 1980 and 2005, the GAO tells us, the loss exposure of the Federal flood insurance program has quadrupled to nearly $1 trillion while the crop insurance program's exposure has risen by a factor of 26 to $44 billion.

Nearly 5 million Americans depend on the Federal flood insurance program, whose loss exposures are rising with population growth and construction in vulnerable areas, such as the Gulf Coast, with more active hurricane cycles and with the prospect of additional severe weather effects from human-accelerated climate change. A prime example of our exposure is the year 2005—the year of Hurricane Katrina—when Federal flood insurance claims soared to $16.7 billion.

Given the scientific consensus that climate change will continue for the foreseeable future, affecting the frequency and severity of droughts, floods, and storms, our insured loss exposures will most assuredly grow.

Our Committee's investigation into Hurricane Katrina showed the catastrophic consequences of being ill prepared for a natural disaster. We cannot afford to ignore the even greater risks of climate change. I have had the privilege of visiting with climate change researchers—including several scientists from Maine—in Alaska, Norway, New Zealand, and Antarctica, and I have seen firsthand the striking effects of climate change on snowfall, ice caps, and glaciers. Important work has been done, but we must deepen our understanding and improve our preparations for the new risks we confront.

Some people are already working on that imperative. The GAO report notes that the private insurance industry, driven by the discipline of the marketplace, has been paying serious attention to the increased risks presented by climate change.

Unfortunately, as the GAO observes, "Federal insurance programs, on the other hand, have done little to develop the kind of information needed to understand the programs' long-term exposure to climate change."

Now, it is obviously true that our Federal insurance programs serve social purposes that do not involve profitability measures. But taxpayers deserve good stewardship of their resources just as much as stockholders do. We learned during the Hurricane Katrina investigation that private sector entities were often better prepared and quicker to respond to emergencies than some government agencies. If we fail to learn from industry best practices, taxpayers could face serious financial consequences.

Like private insurers, government insurance programs must not only identify risks, but also determine appropriate pricing and risk mitigation. If we fail to act prudently in the face of climate change, we will be exposing the Federal budget—and the taxpayers who fund it—to unquantified risks and to potentially devastating financial consequences.

Our actions must include more than more appropriations and premium increases. We must also consider policy adjustments after asking some critical questions. Is the Federal Government subsidizing overdevelopment in areas vulnerable to severe weather or flooding? Is the Federal Government unnecessarily placing vital infrastructure in harm's way? Are State and local building codes taking new risks into account?

Most important for the long run, however, we must ask what we can do, collectively and as individuals, to reduce climate change. Last Saturday, in communities in Maine and throughout the Nation, citizens came together to heighten awareness of climate change and to urge action.

While we cannot solve these problems overnight, many actions that we can take now will lead us toward a more stable climate future. We must take sensible steps today in light of the knowledge that we now possess.

In January, I cosponsored the Climate Stewardship and Innovation Act introduced by our Chairman, Senator Lieberman, and Senator McCain. In addition to backing that far-sighted bill, I will soon introduce a comprehensive approach designed to reduce our greenhouse gas emissions and slow climate change. It will quickly put us on the path of reduced emissions.

I hope this hearing this morning will improve our understanding of our exposure to the challenges and the risks of climate change, and I commend our Chairman for his leadership on this very important issue.

Thank you, Mr. Chairman.

Chairman LIEBERMAN. Thank you, Senator Collins, for that excellent statement and for your leadership in this critical cause.

Now we turn to the witnesses. Mr. Stephenson, thanks very much for your work, which is the basis of this hearing. We welcome your testimony now.

TESTIMONY OF JOHN B. STEPHENSON,[1] DIRECTOR, NATURAL RESOURCES AND ENVIRONMENT, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Mr. STEPHENSON. Thank you, Mr. Chairman, Senator Collins, and Senator Tester. You have both done an excellent job in summarizing the report, so this may seem a bit redundant, but I will press on.

Chairman LIEBERMAN. Please.

Mr. STEPHENSON. I am pleased to be here today to discuss our report to this Committee on the potentially significant risk facing private and Federal insurers as a result of climate change. Copies of this report are being released today and will be available on GAO's website this afternoon.[2]

One of the most important aspects of our study was to begin to show the significant economic implications of climate change by examining one of the Nation's most important and forward-thinking sectors—the insurance industry. The uncertain and potentially large losses associated with weather-related events are among the biggest risks that property insurers face. Projections by the Intergovernmental Panel on Climate Change (IPCC), as you have already mentioned, expect warmer surface temperatures to increase the frequency and severity of damaging weather-related events, such as flooding and drought.

As you know, the IPCC is a large international body of scientists that was established by the World Meteorological Organization and the United Nations Environmental Program in 1988 to synthesize scientific information on the impacts of climate change. Products released by the IPCC are thoroughly reviewed by hundreds of scientists and approved by member countries.

In addition, IPCC's projections have been endorsed by both the National Academy of Sciences and the U.S. Government's Climate Change Science Program. It is also important to note that both the IPCC and the National Academy have reported that observed temperature increase during the 20th Century cannot be explained by natural variability alone, but is largely attributable to human activities.

GAO is, of course, not a science organization, but what our report attempts to do is examine past losses associated with weather-related events together with the implications of the IPCC's projec-

[1] The prepared statement of Mr. Stephenson appears in the Appendix on page 27.

[2] The GAO report entitled "Climate Change, Financial Risks to Federal and Private Insurers in Coming Decades Are Potentially Significant" appears in the Appendix on page 47.

tions for continued and increasing global warming to get a better understanding of the potential impact on the insurance industry.

Based on our examination of loss data from several different sources, we found that insurers paid claims of more than $320 billion in weather-related losses from 1980 through 2005. As shown in Figure 1 on page 9 of my prepared statement,[1] insured losses varied significantly from year to year, but generally increased during this period from under $5 billion in 1980 to over $75 billion in 2005. And the majority of these losses were due to the incident and effects of extreme weather events such as hurricanes, flooding, and droughts. Private insurers paid about 75 percent of this total, while the two Federal insurance programs we have already mentioned account for the remaining 25 percent. So the Federal share over this time period was about $78 billion—$44 billion in crop insurance, and $34 billion in flood insurance.

While both private and Federal insurers are exposed to the increases in the frequency and severity of damaging weather-related events associated with climate change, the two sectors are responding in very different ways. Many private insurers are incorporating elements of climate change into their annual and strategic risk management practices to reduce their exposure to catastrophic risk posed by these extreme weather events. You will hear more from Mr. Castaldi from Swiss Re on this. As a result, some of their exposure is transferred to the policyholders, for example, by increasing premiums or deductibles, and, in effect, some exposure is transferred to the public sector by limiting coverage in specific areas.

Federal insurance programs have similarly seen their exposure grow significantly, as you have mentioned, largely from increases in policies, and the IPCC's projections suggest that weather-related risk will continue to grow. But unlike the private sector, the Federal programs have not incorporated the increased likelihood of extreme weather events associated with climate change into the risk management practices.

As shown in Figure 4 on page 16 of my prepared statement,[2] the National Flood Insurance Program's total exposure has quadrupled to nearly $1 trillion over the last 25 years. Now, this is largely due to increased policies and the value of property, but, nevertheless, it is a very high exposure. And the Federal Crop Insurance Corporation's exposure has increased nearly 26-fold to $44 billion during that same period.

We believe that in light of the projections of the IPCC, the prospect of escalating exposures to catastrophic weather events are putting the Federal Government at ever increasing financial risk. We are concerned because the Federal insurers' retrospective approach to estimating future exposure may not be appropriate in this case. Federal insurers need to develop and disseminate to the Congress and other key decisionmakers information needed to understand climate change's impact on the increased financial risks their programs will face in the future.

We acknowledge in our report that the mandate and operating environment of the major Federal insurance programs is signifi-

[1] Figure 1 appears in the Appendix on page 37.
[2] Figure 4 appears in the Appendix on page 44.

cantly different from that of the private sector. The flood insurance and crop insurance programs, for example, are not expected to turn a profit. Quite the opposite. They are directed in statute to prioritize broad participation over financial self-sufficiency. However, the programs are expected to be sound stewards of the taxpayers' money. Accordingly, we believe that better information about the Federal Government's exposure to potential changes in weather-related risk would help the Congress and the Federal agencies responsible for these programs identify and manage this emerging risk area, one that potentially has significant implications for the Nation's growing fiscal imbalance.

Accordingly, we recommend in our report that the Department of Agriculture, which operates the Federal Crop Insurance Corporation, and the Department of Homeland Security, responsible for the National Flood Insurance Program, each analyze the potential long-term fiscal implications of climate change on their respective programs and report their findings to Congress. Both the Departments of Agriculture and Homeland Security in commenting on our draft report raised several points about how we characterize the operation of their programs, but both generally agreed with our recommendation.

Mr. Chairman, that concludes my summary. I will be happy to answer questions at the appropriate time.

Chairman LIEBERMAN. Thanks very much, Mr. Stephenson. That gets us off to a good start. Mr. Gould, thanks for being here.

TESTIMONY OF ELDON GOULD,[1] ADMINISTRATOR, RISK MANAGEMENT AGENCY, U.S. DEPARTMENT OF AGRICULTURE

Mr. GOULD. Mr. Chairman, Senator Collins, and Senator Tester, I am Eldon Gould, the Administrator of the Risk Management Agency (RMA). I am a lifelong farmer from northern Illinois with a 1,500-acre corn, soybean, and wheat farm and a 700-sow farrow-to-wean hog operation. I appreciate the opportunity this morning to explain the role of the Federal crop insurance program as it relates to the financial risks to the Federal and private insurers covering production agriculture.

First, I would like to provide you some background about the Risk Management Agency and its objectives.

Some of you may know our structure and mission very well, while others may have only limited knowledge of our role with crop insurance. As a vital part of the USDA, the Risk Management Agency plays an essential role in American agriculture by promoting, supporting, and regulating sound risk management solutions to preserve and strengthen the economic stability of America's agricultural producers.

RMA oversees and administers the crop insurance program via the Federal Crop Insurance Corporation, which is often referred to as the FCIC, which is led by its Board of Directors. The FCIC reinsures the policies sold to American farmers by private insurance companies approved to participate in the delivery of the Federal crop insurance program. The agency has a unique partnership with

[1] The prepared statement of Mr. Gould appears in the Appendix on page 120.

16 private insurance companies that are responsible for the sales, service, and loss adjustment of the various insurance policies.

Crop insurance is the government's principal means of helping farmers survive a major crop loss. It is also extremely useful to agricultural producers even when it is not paying losses. More and more, we see that crop insurance enables producers to secure approval of their operating loans, aggressively market a portion of their crop, and allow them to plan more reliably for their future.

Regarding the recommendations contained in the GAO Report, RMA agrees with the need to analyze the long-term implications of climate change for the crop insurance program. We are particularly interested in the Intergovernmental Panel on Climate Change Assessment Report, which was released on April 6, and a report of the U.S. Climate Change Science Program that is expected to be released in December of this year. This IPCC report provides a rigorous assessment of what is known with regard to climate change impacts, adaptation, and vulnerability. As William Brennan, Director of the U.S. Climate Change Science Program, stated, "This is a valuable report that our Nation has contributed to in important ways through investments in observations and research."

With regard to agriculture in North America, the IPCC report concludes that "moderate climate change in the early decades of the century is projected to increase aggregate yields of rainfed agriculture by 5 to 20 percent, but with important variability among regions. Major challenges are projected for crops that are near the warm end of their suitable range or depend on highly utilized water resources."

The Department of Agriculture is also an important contributor to the U.S. Climate Change Science Program. The USDA is the lead agency for a CCSP Synthesis and Assessment Report on the Impacts of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity that is expected to be completed in December 2007. A primary goal of the report is to enhance our understanding and ability to estimate impacts of future climate change on these systems and resources in the United States. This report is being prepared by the Department's Global Change Program Office.

As RMA proceeds in its analysis of climate change, it is worth noting that any analysis will be complicated by the fact that agricultural technology is continually progressing, resulting in a decrease in risk from weather events. Although the USDA agrees with GAO's recommendations, we caution that much of the focus of this report is with losses related to coastal weather events, especially hurricanes. However, the main causes of catastrophic losses for the crop insurance program are drought, excess moisture, and freezes in the Nation's interior. This is why the loss experience of the crop insurance program is distinct from the loss experience described in the report for the National Flood Insurance Program and property and casualty losses for private insurers.

Much of the increase in crop insurance indemnities over time reflects the rapid growth of the crop insurance program rather than an increase in either the frequency or the severity of catastrophic weather events. In 1980, for example, the total liability of the Fed-

eral crop insurance program was $3 billion. By 2006, total liability had reached almost $50 billion.

USDA does take prospective actions to assess the potential increases in program risk associated with changes in weather and production agriculture. RMA continually analyzes available information to look for ways to improve its rating and program assessments. Currently, RMA tracks total program liability, a definitive measure of the total value at risk from climatic weather events, and updates this information on a weekly basis available on our public website. RMA also estimates expected changes in liability up to 10 years ahead through RMA's budgetary baseline projections. In addition, RMA can assess the long-term as well as current exposure of the crop insurance program to catastrophic weather events, as GAO has pointed out with regard to a recurring 1993 flood loss.

When GAO surveyed private insurers about what they were doing to estimate and prepare for the risks of climate change, it found that insurers were using catastrophe models that incorporate the hurricane cycle. RMA also incorporates hurricane risk into premium rates for several of its insured commodities. However, rather than focusing on short-term fluctuations in the hurricane cycle, RMA uses historic hurricane data that spans several cycles, which is not dissimilar to how predictions centers, like Colorado State University, make use of such data.

Obviously, changes in weather patterns play a role in the Federal crop insurance program. Recognizing this role, FCIC is moving the Federal crop insurance program forward in adopting new technologies. For example, the FCIC recently introduced a pilot insurance program for pasture, rangeland, and forage that relies on weather station data and satellite imagery to monitor plant growth and determine insurance payments.

In conclusion, let me reiterate that RMA agrees with the GAO recommendation with regard to the need to analyze the long-term implications of climate change for the crop insurance program. We view the inclusion of the new information and analysis as an opportunity to strengthen and improve the Federal crop insurance program. As I have stated, Mr. Chairman, I am a producer myself, and one of my goals as Administrator of the Risk Management Agency is to ensure that RMA is doing everything it can within its legislative authority to assist the farmer and rancher and to keep rural America and its critical agricultural industry competitive and sound. We recognize that RMA is a critical component of the safety net for the business of agriculture in this country.

RMA continues to evaluate and provide new products and to promote the adoption of crop insurance as a risk management tool so that the government can further reduce its need for ad hoc disaster payments to the agricultural community. The growth and effectiveness of the crop insurance program is dependent on a reliable delivery system; insurance products that meet the needs of producers; investment in information technology to ensure the delivery system is timely, accurate, and dependable; and adequate funding to support compliance and program integrity, maintenance, and administration, product evaluation, and new product development.

In 2007, we will continue to strive toward providing a useful, practical safety net for America's farmers and ranchers. We thank

you for the opportunity to participate this morning, and at the appropriate time I would be happy to answer any questions.

Chairman LIEBERMAN. Thanks, Mr. Gould. I look forward to asking you some of those questions. Mr. Buckley, thank you for being here.

TESTIMONY OF MICHAEL BUCKLEY,[1] DEPUTY ASSISTANT ADMINISTRATOR FOR MITIGATION, FEDERAL EMERGENCY MANAGEMENT AGENCY, U.S. DEPARTMENT OF HOMELAND SECURITY

Mr. BUCKLEY. Good morning, Chairman Lieberman, Senator Collins, and Senator Tester. I am Michael Buckley. I am the Deputy Assistant Administrator for FEMA's Mitigation Directorate, and I appreciate the opportunity to appear today to discuss the potential impact of climate change on the National Flood Insurance Program (NFIP)

The NFIP is predicated on planning for a changing environment. The program has an inherent ability to readily recognize, plan for, and respond to gradually changing environmental conditions, whether caused by human activity or natural variability. Consequently, with respect to climate change research, studies, estimates, and ongoing discussions, the NFIP's daily operations are unlikely to be dramatically affected. This does not mean that the NFIP should ignore the warnings associated with climate change. On the contrary, it means that the program already effectively accounts for gradual environmental changes, regardless of their cause.

To explain, I would like to give a brief description of the NFIP and some related activities.

As a vital component of Mitigation's mission to help communities reduce their vulnerabilities to natural hazard events, the NFIP is straightforward. FEMA identifies flooding risk through its floodplain mapping program. Communities join the program and adopt building codes and land-use policies to mitigate flood risk. Residents in these communities can then purchase flood insurance, which standard homeowner policies do not cover. Residents pay premiums, and the Federal Government provides insurance coverage to those policies after a loss is suffered. With over $1 trillion in insured assets and more than 5.4 million policies, the National Flood Insurance Program floodplain management standards and building codes help communities reduce their vulnerability to flooding, protect lives, prevent property loss, recover faster after floods, protect their investment with a financial backstop, and also help to reduce the cost to the Federal Government when a disaster does happen.

FEMA pushes communities to go beyond the minimum standards for the program to further reduce their vulnerabilities. As an example, the community rating system offers insurance rate discounts in the communities that go beyond the minimum standards, adopt higher standards. We feel that this has been a successful program, and many communities are participating.

[1] The prepared statement of Mr. Buckley appears in the Appendix on page 127.

Understanding that the landscape is in a constant state of flux, the NFIP also develops, uses, and provides extensive current and historic data, Flood Insurance Rate Maps, the best available state-of-the-art information and technologies to help people and communities understand their flood risks, take action to reduce those risks, and insure against such risks. We are well on our way to completing a 5-year initiative to update and modernize the Nation's flood insurance mapping inventory where we are combining historical and current data with state-of-the-art technology to compile modern digitized maps with updated flood risk information. These new digital FIRMs can clearly depict faster and more accurately than ever before the dynamic landscape conditions that affect important flood insurance and floodplain management decisions.

With continued adequate funding, FEMA's map modernization program will give the NFIP and the Nation's communities a reliable planning and floodplain management resource for years to come. Just as important, FEMA will be able to update the flood maps to clearly reflect the gradually changing landscape and climate conditions that affect flood risk, providing a valuable support to the program's continuing effort to accurately and fairly set flood insurance rates.

Also, in relation to changing climatic conditions that may affect the frequency and intensity of future storms, it is important to note that Congress intended the National Flood Insurance Program to strike a balance between the long-term goal of fiscal accountability and the near-term objective of making sure that affordable flood insurance is available to residents and businesses located in flood-prone areas. The unique factors that help the NFIP offer affordable flood insurance coverage for everyone—discounts on structures built before the National Flood Insurance Program came into being, a 10-percent cap on annual increases in rates, our Federal obligation to provide coverage to all applicants, regardless of the degree of risk—tend to impede our ability to strengthen the program's financial condition.

Finally, it is important to remember that the NFIP's risk management strategies are designed to assess and insure against current risks and to respond to changes on flood risk data as appropriate when it becomes available. During an average historic loss year, for example, the NFIP covers claims with policyholders' premiums and related fees. However, as climate change evaluations and discussions consider a future of more extreme weather activity, it should be pointed out that the NFIP is not always self-supporting and was not designed to handle a catastrophic event without the authority to borrow from the Federal Treasury.

That said, the NFIP operates on the premise that Hurricane Katrina cannot be viewed as an anomaly, and we stand ready to work with Congress and others to strengthen the program's effectiveness.

In conclusion, the Mitigation Division and the NFIP respect the warnings associated with climate change, and we believe our program effectively accounts for gradual environmental changes, regardless of their cause or origin. This way, no matter how frequently storms strike in the future and no matter how increasingly violent they may become, fewer communities will be declared dis-

aster areas, lives will be saved and damages reduced, recovery will be faster, and more homes and businesses will be protected with the financial safety net of flood insurance.

Thank you for this opportunity to appear before this Committee, and I will be happy to answer your questions at the appropriate time.

Chairman LIEBERMAN. Thank you, Mr. Buckley. Mr. Castaldi, all yours.

TESTIMONY OF ANDREW CASTALDI,[1] HEAD, CATASTROPHE AND PERILS, AMERICAS DIVISION, SWISS RE AMERICA CORPORATION

Mr. CASTALDI. I would like to thank Chairman Lieberman and Ranking Member Collins for holding this hearing on the impact of global warming on private and Federal insurance. My name is Andrew Castaldi, and I am representing Swiss Re, the largest reinsurer in North America and the world. Over the next 10 minutes, I would like to share with you Swiss Re's view regarding climate change, how climate change may impact weather and natural catastrophes, how reinsurers model these natural catastrophes, and, finally, a few words about how we incorporate this information into our business.

Swiss Re's core property business includes mitigating the financial consequences of natural catastrophes such as hurricanes, earthquakes, and floods. We provide life and property casualty reinsurance and products, which facilitate the convergence of the insurance and capital markets. Our business is to assume the liabilities from others onto our balance sheet. Or to put it more simply, we take other companies' risk off their hands. As risk experts, our time horizon stretches out 50 to 100 years.

Our interest in climate change began almost 20 years ago, and it has become an important component of our long-term risk management strategy. We believe unequivocally that climate change presents an increasing risk to the world economy and social welfare. There is now indisputable scientific evidence that the Earth's temperature is rising at an alarming rate and that this rise is due mainly to human activities. According to the Intergovernmental Panel on Climate Change, also known as the IPCC, it can be concluded now with a 90- to 95-percent probability that human-produced greenhouse gas increases from fossil fuel use, agriculture, and land-use changes have caused most of the observed increase in global average temperatures since the mid-20th Century. To put it simply, global warming is a fact, and a robust response is required.

Climate change over time will affect weather and weather patterns. How it will affect severe weather events varies and depends upon the region of the world and the natural hazard being evaluated. As an example, global warming suggests more extreme events, such as more intense rainfall or prolonged drought, which may lead to localized inland flooding or, in the case of flood and drought, agricultural problems. Combining intense rainfall with rising ocean levels from melting polar land-ice and warming sea water will place much of our coastal properties at greater risk.

[1] The prepared statement of Mr. Castaldi appears in the Appendix on page 131.

More to the interest of this panel, will global warming affect the annual frequency and severity of tropical cyclone activity? After the record-setting experiences of 2004 and 2005, this question is often asked.

In 2005, we had more named North Atlantic storms and hurricanes than ever—27. It was also the costliest hurricane season ever. The economic cost of Hurricane Katrina alone was an estimated $135 billion. Hurricanes Rita, Wilma, and Katrina were the first, third, and sixth strongest North American tropical cyclones or hurricanes on record.

Were the 2004 and 2005 seasons attributable to global warming? We do not know for sure. One or 2 years of experience is not enough to confirm a trend. But here is what we do know. On a worldwide basis, CO2 levels are up significantly and sea surface temperatures are higher also.

Hurricane severity is impacted by warmer waters. One recent study by Webster and Holland indicates a trend, since about 1970, toward more intense tropical cyclones. In the early 1970s, 17 percent of all tropical cyclones were Category 4 or 5 hurricanes. That number has increased to 35 percent—an increase two times higher than it was 35 years ago.

Today there are open questions. But given the potentially catastrophic implications, the precautionary principle should be applied consistent with prudent risk management. It is quite clear that, if left unchecked, CO2 emissions will alter the natural variations of climate change and will affect U.S. weather patterns and some natural catastrophes. Preventative action, therefore, must be taken today. If we wait until we have achieved absolute certainty, we will run the risk of acting too late.

In many areas outside the Atlantic, we see indications of global warming's impact on atmospheric hazards that are presently easier to quantify. In Europe, there is already enough evidence today to demonstrate that European winter storms have and will continue to increase with climate change. Swiss Re, and perhaps others, have incorporated these findings into our risk and loss models for the European regions. Throughout the world our scientists continually monitor new studies on the subject, and once we are convinced, we incorporate the new science into our models.

Presently, Swiss Re is collaborating with various research initiatives on the topic of how climate change will impact us here in the United States and around the world.

In general, risk modeling varies depending upon the peril we study. For tropical cyclone wind and storm surge, Swiss Re starts with the historical database of the last 100-plus years of storm activity and then considers the climate factors coinciding with each of those years. We use these historical records as a base and then apply current climate conditions in order to estimate the frequency and severity of tropical cyclones for future years. Very short-term climate conditions, such as El Nino, are recognized too late to be incorporated into the models that the industry uses. Moderate-term climate variability, such as the Atlantic Multi Decadal Oscillation and other oscillations, cause a definite swing in the Atlantic sea surface temperatures and do correlate with hurricane intensity. The scientific community has not yet reached a consensus regard-

ing the extent to which these oscillations are either natural or exaggerated by human activities. Regardless of the cause, it is expected that the warm phase, which we are currently in, correlates with increased hurricane activity. This warm phase is expected to last for the next 10 to 20 years. This means we could be in for some bad weather for some time to come.

Consequently, industry models have been adjusted to bring them in line with the changing hazard and risk assessments. As a result, expected losses for natural peril covers in the United States rose markedly. Modelers factored in a general increase in hurricane activity in the North Atlantic, regardless of cause, and quantified some other factors. These other aggravating factors include the following: Increased values and complexities associated with concentrations of risk in coastal regions, increased vulnerability of assets and production processes, and increased insurance penetrations.

These changes in risk assessment have prompted insurers and investors to take a more cautious look at the risks they take. Some insurers have greatly limited their market participation in the Gulf States. It is also true that Florida property owners are paying more for coverage than they did before. In light of these developments, some have suggested that natural catastrophes are not insurable in the private market and that a government backstop is required. This is not Swiss Re's view. Because these risks can be modeled by the private sector and are random in nature, they are insurable. The largest events can and have been adsorbed by the industry. We believe, therefore, that a government backstop for such risks is inappropriate public policy.

There are steps the public sector can take to mitigate future damages including better zoning and building codes. These are key components to reducing our natural catastrophe vulnerability. We must all grapple with this new weather environment. We must recognize that we can no longer always build what we want or where we want.

Recognizing the importance of climate change, Swiss Re is deploying a broad strategy to confront the challenges including the following: Working to understand the risk and adapting pricing and risk models accordingly; developing products and services for mitigation and adaptation; increasing risk awareness, especially with governments—we believe governments must provide leadership by passing legislation to limit CO2 emissions and passing stricter and enforceable zoning and building codes' and finally, addressing our own environmental footprint by pledging to be greenhouse neutral by 2013.

Swiss Re looks forward to sharing our knowledge and working with the Congress and other policymakers to develop workable and innovative ideas to bring more private capital to the insurance market. Thank you for the opportunity to testify on these critical issues, and I look forward to any questions that you may have.

Chairman LIEBERMAN. Mr. Castaldi, thanks very much for that testimony. I am struck by the fact that the three of you, Mr. Gould, Mr. Buckley, and Mr. Castaldi, have referred to the U.N. IPCC conclusions and have accepted them, which is that climate change is occurring, and it is caused by humans.

I am very appreciative—and obviously I am acting as an advocate here—that Swiss Re as a matter of business, not as a matter of ideology, is calling for governmental action to limit the emissions of greenhouse gases that are causing the climate to warm. I appreciate that very much.

Mr. Gould and Mr. Buckley, I want to ask you to clarify your reaction to the recommendation that Mr. Stephenson makes from the GAO that both of your programs, crop insurance and flood insurance programs, analyze and report to Congress on the consequences of climate change to your activities, including particularly the increased cost to the Federal Treasury. Mr. Gould, I think you specifically said you accepted that responsibility. Mr. Buckley, I did not hear it or see it in your written statement. Does FEMA agree with the recommendation of Mr. Stephenson about this and intend to comply with it?

Mr. BUCKLEY. Yes, FEMA has no issue with the recommendation in the GAO report. We did provide some informal comments, and we do not object. In fact, we think it would be good to analyze the impacts, and we would move forward on that.

Chairman LIEBERMAN. I appreciate that, and we will be following it and monitoring it closely. To me, we have now reached a state of scientific consensus about what is happening that it would be irresponsible not to have you make this kind of analysis and report to Congress. I would compare it to the way in which the administrators of the Social Security trust fund—it is a bit different, but not that different—use demographic projections to determine what requirements the Social Security fund will have to meet the obligations that law gives it to pay benefits to people. In the same sense, we have assumed a responsibility through these two Federal insurance programs. I think it is clearly important for Congress and, of course, you who run the programs to have your best estimate about what the potentially significant changes in climate and, therefore, losses from climate events will have on your programs and on the Federal Treasury.

Mr. Gould, I want to give you a chance to clarify something. In your testimony, you said at one point, "Although the USDA agrees with GAO's recommendations, we caution that much of the focus of this report is with losses related to coastal weather events, especially hurricanes. However, the main causes of catastrophic losses for the crop insurance program are drought, excess moisture, freeze, etc., in the Nation's interior."

Mr. Stephenson, isn't part of what you are saying to us that one of the potential impacts of climate change in the United States is not just on the coastal events, but also on some of the inland events that this statement of Mr. Gould refers to, such as drought, particularly?

Mr. STEPHENSON. Absolutely. If you look at the IPCC report, both the third one and the fourth one that is coming out now, we may have highlighted hurricanes a little more in our report because they are such a money drain, on the one hand. But, yes, certainly drought and flooding will affect croplands and absolutely will affect the Federal crop insurance program. And that is what we are talking about, which should be considered.

Chairman LIEBERMAN. So, Mr. Gould, let me give you a chance to respond to that because I do not want anybody to come away with the conclusion that the Department of Agriculture feels, because there will be a lot of coastal events, that there probably will not also be significant climate-related increases in drought as a result of global warming.

Mr. GOULD. No. We recognize that, and as I said in my testimony, over time drought has been our major cause of loss. And, obviously, that is caused by weather events, and most of the crop production and our insured liability is in the interior of the United States. Our second cause of loss, major cause of loss, is what we call excess moisture. It may or may not be to the degree of flooding, but it is more related to preventive planting claims or there is excess moisture in the spring when producers should be planting their crops.

So obviously those are weather-related events, and they come and go over time and could very well be caused over a long period of time by climatic weather changes.

Chairman LIEBERMAN. I saw a story recently that relates to the subject of this hearing, and I believe this will be of interest to Senator Collins. It happened to be about Vermont and the health of the maple trees there and the concern expressed by the farmers there that the season was shorter or coming earlier, and the trees were beginning to weaken. And there was some suggestion that there was a danger that the maples, if this continues, would actually die and no longer produce the maple syrup, which is not only part of the history of Vermont—and Maine—but a staple of the economy. There would be maple trees, but they would be north, in Canada. That is a reminder of the potential impact.

Mr. Castaldi, just one question. Has Swiss Re tried to quantify at all in dollars the potential impact of changes in the climate in the time ahead?

Mr. CASTALDI. The way that we do it is we just look at certain events and what they could be, based upon if we see increased activity and also the increases of population. At this time we do not have enough information to say is it 5 years, 10 years, 15 years down the road, but we could see what happens if we have more Category 4 or 5 hurricanes, what happens if we have extensive periods of drought and increased flooding. We do know what potentially the loss dollars might be, but we do not know when that will occur.

Chairman LIEBERMAN. What is the potential? Have you tried to quantify it?

Mr. CASTALDI. We do not have any statistical—I mean, I could probably get some of that information, what the probability is in the next 5 or 10 years of going from, let's say, an average loss of $35 billion a year to $50 billion. I do not have those numbers in front of me.

Chairman LIEBERMAN. I would appreciate hearing that. What you have concluded, without regard to specific numbers, is that the great probability is that the losses that you will have to cover as a result of climate related incidents in the years ahead are going to be greater than they are today, significantly greater.

Mr. CASTALDI. Absolutely. When I talk to people, I always mention that we base all of our studies off the past 100 years of activity.

Chairman LIEBERMAN. Right.

Mr. CASTALDI. And it is not going to be your grandfather's hurricanes or climate anymore. It is going to be something significant. And we might be looking at the last 10 years and projecting that forward, and climate change might exaggerate the normal cycles of climate activity that we see. And every time we do it, we take two steps forward, perhaps one step back, as the cycles go.

Chairman LIEBERMAN. Thanks very much. My time is up.

Senator Collins.

Senator COLLINS. Mr. Gould and Mr. Buckley, as I listened to your testimony this morning, I was struck by a lack of any sense of urgency.

For example, Mr. Buckley, you said that the respective risks of bankruptcy accounts for much of the differences in approach to climate change on the part of private insurers compared to public insurers, such as RMA.

Mr. Gould, you also, in discussions with my staff, said that the agency you administer would have adequate time to adjust its rates and its procedures. And I contrast that, another comment, Mr. Buckley says that the NFIP's day-to-day operations are not likely to be affected by current climate change estimates.

There seems to be a very relaxed attitude on the behalf of both of your agencies toward what many of us view as a looming crisis. And I contrast it to Mr. Castaldi's testimony where he ticks off a litany of actions that his company is already taking, both within the company and also with respect to its exposure to future losses.

It concerns me that there seems to be an assumption on both of your parts that because the taxpayers stand behind your agencies and its programs, you do not have to do the kind of analysis that the private sector is doing, and the statement that our different approaches reflect the difference in not having to worry about going bankrupt, it really distresses me because ultimately it is the taxpayers that are going to be on the hook.

So I guess I would like both of you to give me more assurance than I am hearing in your oral testimony and in reading your written statement that you are taking this seriously and are taking actions. Mr. Gould, we will start with you.

Mr. GOULD. OK. Thank you for the opportunity to respond. I think I can alleviate some of your concerns. We do not take our responsibility lightly. We are mandated by Congress to have a loss ratio of not over 1.075, but we, in fact, rate for a loss ratio of 1.0, which means we take in as much dollars in premium as we spend in dollars for indemnities. And, in fact, over recent years, in the last decade or so, we have been well under 1.0, which I think reflects the job the agency is doing in its rating for its various products in various parts of the country.

So we not only legislatively are mandated to be good stewards of the taxpayer dollars; I think the people in the agency would do that even if they were not directed by the Congress to do so.

The other thing that is important is that we look back over time, look and see what has been the results of our losses, and adjust

our losses for various crops, various products, and actually on a county-by-county basis, and that is done rigorously on an ongoing basis. So, again, I wish to assure you that we do take our job seriously and will continue to do so, and as we can look at new information and available information, that would only enhance our process.

Senator COLLINS. Mr. Buckley.

Mr. BUCKLEY. Thank you for the opportunity to respond, Senator Collins. The goal of the National Flood Insurance Program is really to be self-supporting—in other words, collect enough premium to pay the losses. Since 1986, and prior to Hurricane Katrina, that was the case, that we were able to pay the losses without excessive borrowing, or when we did have to borrow, we were able to pay it back—and, I might add, with interest.

Prior to the hurricane season in 2004, which was a significant season, the balance in the fund was over $1 billion. The 2004 hurricanes that hit Florida caused at that time the greatest single loss year the program had experienced. Those losses were slightly over $2 billion. We were able to pay those claims with only minimal borrowing. I believe that we borrowed $300 million, and we were able to pay back $75 million before Hurricane Katrina hit. And, obviously, Hurricane Katrina was an extreme event for the National Flood Insurance Program.

We are constantly monitoring data associated with flooding. Flooding is a very site-specific issue, and through our mapping program, we continually update the maps when there is an indication that the risk is changing. And in terms of the seriousness that we take the predictions for climate change, as I said, we are in full agreement with the GAO report that we should conduct a study, take a look at it, and we are prepared to do that.

Senator COLLINS. Thank you, Mr. Chairman.

Chairman LIEBERMAN. Thank you very much, Senator Collins, for those excellent questions.

Senator Tester, thanks for being here this morning.

OPENING STATEMENT OF SENATOR TESTER

Senator TESTER. Thanks for having this hearing, Chairman Lieberman and Ranking Member Collins, and I thank you four gentlemen for being here and the job that you folks do.

I guess I will start with Mr. Stephenson, and you will just have to help me out here a little bit. If your charts are correct, in 2005 in the flood insurance area, there was $78 billion of taxpayer liability, in other words, to support there, out of a $321 billion loss year. Did I read the chart right?[1]

Mr. STEPHENSON. That was over a period of time.

Senator TESTER. How many years?

Mr. STEPHENSON. I think it was 1980 through 2005.

Senator TESTER. Oh, so it is a cumulative chart.

Mr. STEPHENSON. Correct.

Senator TESTER. And for crop insurance during that time, it was $44 billion, if I read it right. And what was the total loss? I assume it is still a 20-year period or so.

[1] The chart referred to appears in the Appendix on page 148

Mr. STEPHENSON. Correct.

Senator TESTER. And what was the total loss on that?

Mr. STEPHENSON. I do not have that. I think the crop insurance program is relatively close to the premiums that it is taking in right now.

Senator TESTER. OK, so it is about 100 percent taxpayer liability.

Mr. STEPHENSON. Yes.

Senator TESTER. Is that the way you see it, too, Mr. Gould?

Mr. GOULD. I am not sure I understood your question.

Senator TESTER. Well, the question is there was $321 billion of losses in the flood—in the crop insurance program and $78 billion of that was taxpayer liability. In that same period there was a $44 billion payout, if the chart is right, through crop insurance?

Mr. GOULD. Over that 27-year period?

Senator TESTER. Yes, the 27-year period. I am just trying to get the figures right. Basically what I am really looking for, as a percentage of loss, what is the taxpayer liable for?

Mr. GOULD. Well, probably your numbers—I do not have those numbers in front of me.

Senator TESTER. Actually, they are not mine.

Mr. GOULD. Obviously it distorts the numbers quite a bit when you talk about what has happened over a 27-year period, particularly when our program has grown so dramatically in the last few years.

Senator TESTER. I am just looking as a percentage of loss what the taxpayers—if it was $1 million, I would ask the same question. Is the taxpayer liability on the loss to agriculture 100 percent? It is about 20 percent in the flood insurance. Is it 100 percent?

Mr. GOULD. The charts are exposure, so we are not saying this is taxpayer liability. A lot of these payments are made from collecting premiums for both programs.

Senator TESTER. OK.

Mr. GOULD. We are talking about—we are trying to describe how big the risk to the Federal Government is.

Senator TESTER. How big of a check did the Federal Government have to write out for flood insurance over the last 27 years?

Mr. GOULD. I am sorry. I was getting the information here. Actually, since we have the private insurance companies involved, a lot of that money comes from the private industry as well, so it is not all taxpayer dollars.

Senator TESTER. I understand that. I thought I heard testimony today that said that there was a $78 billion taxpayer check that was written out, and I did not know if it was 2005 or over 27 years, because of flood loss. Is that correct? Go ahead.

Mr. BUCKLEY. Yes, I would like to respond to that. Prior to Hurricane Katrina, the National Flood Insurance Program paid out I believe on the order of $14 billion since the beginning of the program. These were claims that were paid with premiums that were collected. On occasion, we did have to borrow from——

Senator TESTER. So there has been no taxpayer liability?

Mr. BUCKLEY. That is correct. And since Hurricane Katrina, we have had to increase the borrowing quite substantially. The program is obligated to pay that borrowing back with interest.

Senator TESTER. So those losses due to flood, the $321 billion, taxpayers did not pay a nickel of reimbursement on that?

Mr. STEPHENSON. Until 2005.

Senator TESTER. Until Hurricane Katrina.

Mr. STEPHENSON. Right.

Mr. BUCKLEY. The way the program was set up was where there was not sufficient reserves in the fund, the program could borrow from the Treasury. Obviously, we did borrow quite significantly because——

Senator TESTER. But you have been paying it back.

Mr. BUCKLEY. So far this year, we have paid interest to the tune of about $700 million.

Senator TESTER. Now, I know for a fact that the same cannot be said about crop insurance, so is there some way you can give me some sort of idea about what the liability is to the taxpayer per dollar of loss? I am just curious. Actually, this was just a forerunner to a series of other questions. I was just trying to get this straight in my mind what the taxpayer liability is. And the reason is this is a huge issue. We are tasked here with putting out some long-term policy that business can work with and depend upon that deals with climate change. What we are dealing with here is specific areas that are the impacts of those climate changes, whether it is flood or whether it is crop loss. And I happen to be a farmer, as you are, Mr. Gould, and I can tell you things have happened on my farm in the last 10 years that I have not seen and I do not think my folks saw and I do not think my grandparents saw either. Things are changing, and it is not increasing my production. So we have some problems.

Let me run down some more specific questions. Mr. Castaldi, is fire part of what you reinsure?

Mr. CASTALDI. When we reinsure, we are reinsuring—basically our property product is large-scale catastrophes. So most of the fire losses that you see are never going to be catastrophes unless it is a brush fire or something like that. And those will penetrate the reinsurance program, but the losses there are so insignificant to those from wind, flood, and earthquake that it is not really worth even measuring.

Senator TESTER. The change in exposure is due somewhat—you said it is due to drought and excess moisture and frost, but it is also due to increased acres enrolled in the program.

Mr. GOULD. Right.

Senator TESTER. Have you guys done any analysis to see if those percentages of losses—now we are comparing 20 million acres to 242 million acres. Have those percentages of losses increased per acre?

Mr. GOULD. Well, yes, we monitor that closely, and I think the important thing is to look back—and it may even be in a chart in my testimony. But up until about 1993, prior to that our loss ratio was high, it was around 1.5. Since that time, there were things done within the program by Congress to increase the participation so we have a broader base of support, less adverse selection. We do not only have producers that are likely to have crop problems, but all producers involved in the program. And probably we have done a better job of rating since 1993. So since 1994—I am sorry.

That is kind of a magical year when there was more participation. Since then, our loss ratio has been 0.88. And if you look over time across the country and because we have such a huge program that covers the width and breadth of the United States, our loss ratios do not change dramatically, nor do the causes of loss change dramatically from year to year.

Senator TESTER. So your loss ratio is at 0.88. I am not an insurance person. I do not know what that means. But let's just assume if the number goes up, it is a bad thing, and if the number goes down, it is a good thing.

Mr. GOULD. That is correct.

Senator TESTER. And it has not changed——

Mr. GOULD. You are almost an insurance agent. [Laughter.]

Senator TESTER. All right. Well, I do not want to go there, but that is OK. That 0.88 has not changed since 1994? That 0.88 loss ratio—and you have not——

Mr. GOULD. Well, it varies from year to year, but I think with the exception of 1 year in there, it has stayed under 1.

Senator TESTER. That would indicate to me that global warming has had no affect on your loss payments.

Mr. GOULD. That may not be an accurate conclusion. It means that the program is accounting for changes in crop losses, whatever those losses may be caused by.

Senator TESTER. OK.

Mr. STEPHENSON. Senator, if I could offer one comment?

Senator TESTER. Yes.

Mr. STEPHENSON. We are not suggesting anything about the management of these programs.

Senator TESTER. Nor am I. What I am trying to do with these questions is get my hands around what the taxpayer liability is, if that taxpayer liability is increasing because of climate conditions or if it is increasing because of governmental decisions that have been made potentially in the Legislative Branch, or if it has been made by administrative decisions. And if it has been increased by environmental conditions, we have a problem that we have to deal with. And if it has no effect on the taxpayer liability, let the private sector handle it. If it does, then we have to deal with it.

Mr. STEPHENSON. We are only suggesting that with the size of the exposure and the potential of climate change, history may not be a good predictor of the future and you have to incorporate that into your out-looking modeling to make sure that the taxpayer is not unduly liable in the future. That is really what we are concerned about.

Senator TESTER. I understand. Being in production agriculture myself, though, I see things that have happened over the last 10 years that would indicate to me that the future—that we need to do some planning, if you know what I mean. Now, 10 years is nothing in the overall scheme of this Earth. There is no doubt about it. It is the blink of an eye, if even that much. But the concern is that when we—in Montana right now, the western part of the State is so dry that if you dropped a match on it, it would burn right now. Glacier Park is losing its glaciers. The snowpack was gone in February, probably, in the State. Where I am at right now,

I am getting great rain. The last 8 years before that, we did not cut a crop. And we cut every crop during the 1930s.

So things are happening out there, and the programs that you have focus around the edge of the impacts of global warming. I am talking about crop insurance and flood insurance. We have to do something more globally here from an administrative standpoint. But in the meantime, we still need food, we still need wood products, we still need places for people to live. And so it is a big issue, and I do not mean to take 10 minutes. Sorry. At any rate, you guys go ahead, and if I can come back, I will ask some more questions.

Chairman LIEBERMAN. Go ahead because we are probably going to move toward summarizing. Your experience as a farmer is really important here. You add a lot to the discussion from personal experience. Also, your questions have been very good and direct. So if you have one or two more.

Senator TESTER. I do. [Laughter.]

Chairman LIEBERMAN. It is always a danger to open that door.

Senator TESTER. Well, I guess that we depend a lot on local land-use planning, and if local land-use planning is not done right, particularly in the area of flood insurance—but now in our State, in the area of fire insurance, we have a huge landowner in the State of Montana that is going to sell off some acres in the forest, places where you have to bring light in through a tube because it is forest. And my question is—and it probably goes to Mr. Castaldi. If folks build their house in a forest, it is kind of like building it in a floodplain. Does the Federal Government as a firefighting entity have any liability if they choose not to fight that fire and there are houses there?

Mr. CASTALDI. I am not the expert on that, but I know that if there is a fire there, the insurance company is going to pay. We might look to subrogate against somebody, but we cannot subrogate against the government. So we are going to wind up being liable for the loss. I mean, there would be selective criteria and rating recommendations upon the inspections or suggestions to that homeowner, if the company deems them insurable, to try to mitigate any losses.

Senator TESTER. This will be my last one. Thank you, Mr. Chairman.

Mr. Gould, you talked about that the RMA FCIC has a 10-year projection. They have looked into that. What does that 10-year projection tell you as far as that 0.88 number goes, if everything is left the same?

Mr. GOULD. I do not have those numbers in front of me, but I suspect that we have looked ahead and projected what that would be. That is part of our normal budget process so that we can provide some input to the Congress on what should be budgeted to the FCIC. But we will have to get back to you with that actual number.[1]

Senator TESTER. That would be great. One last point. Does it take congressional action to change the way it is rated? And let me give you an example. Crop insurance works really well if you have

[1] Charts provided by Mr. Gould in response to Senator Tester appear in the Appendix on page 148.

a loss every 5 years or 10 years. It does not work really well if you have a loss—you have heard this before—3, 4, or 5 years in a row.

What does it take to change that? And what kind of input could you give us long term as to how we could change that to make it more workable for the farmers? I do not want anybody getting rich. I just want them to be able to stay in business until things square themselves around.

Mr. GOULD. Well, that comes under the term of what we call "declining yields." Obviously, the program is based off of average yields over a 10-year period of time, and we are pretty well locked into statute as to what we can do with that.

Senator TESTER. So it is a statutory thing.

Mr. GOULD. Yes, but we have had two different studies out looking at ways that we can address the declining yield problem. Again, we have not liked either one of those. We have not made any changes, but to make any dramatic changes, it would take legislative change. And in Montana and the Dakotas, that has been a problem.

Senator TESTER. The only other thing I need, along with that 10-year projection, is what percentage the taxpayer is liable for, for FCIC losses.

Thank you, Mr. Chairman.

Chairman LIEBERMAN. Thanks very much, Senator Tester. Excellent questions. And it strikes me that your last one really raises a point that we are potentially, as a result of climate change, going to see a very different kind of weather-related loss.

For instance, if drought settles into some areas, it is not just going to be for 1 year if it is a result of climate change. So there is going to be a different kind of meaning to the notion of declining crop yields because it is going to be longer term and, therefore, the cost may be much more significant.

I appreciate, first, the report that you have done, Mr. Stephenson. Thank you and your colleagues at GAO. It provokes a response. And I must say, Mr. Gould and Mr. Buckley, I share the restlessness that Senator Collins expressed, it is really important to us. I was troubled, Mr. Gould, in your statement where you said that—and you are speaking the truth, but it could be disconcerting to us, which is, "RMA does not face the risk of insolvency, as do private insurers, should an unexpectedly large loss event occur. The respective risks of bankruptcy account for much of the differences in approach to climate change on the part of private insurers as compared to public insurers, such as RMA." That is the truth. The Federal Government will hopefully—not without limit, but will stand behind these two insurance programs. But we need you now to approach the programs in the face of this unusual probable threat of global warming.

I think it is a definite threat, but the consequences that we can now say are probably going to happen, they will impact both the occurrences that activate your respective crop insurance and flood insurance programs over a longer term with much greater costs than ever before. So we need you to go at it—although you will not go bankrupt, as Swiss Re potentially could, we need you to examine this as if it was possible.

Mr. GOULD. Well, I think you have to look at those numbers and that statement in the light that, because of the way the program is structured, we do not have to build additional reserves into the program to be prepared for upcoming catastrophic losses. We, again, continue to rate that at an expected loss of 1.0, and based on history, if we have to change our rating to achieve those goals, we can and will.

Chairman LIEBERMAN. In other words, because you are an insurance program, not an insurance company.

Mr. GOULD. That is correct.

Chairman LIEBERMAN. You are backing up the insurance companies. I appreciate that. I would really urge you to consider some of the unusual losses that are possible here as both agencies' programs do the report that Mr. Stephenson has called for and as you have said you would do.

Can you give a ballpark estimate as to how long it will take you to submit that kind of report to the relevant committees of Congress?

Mr. GOULD. Well, we submit a report on an annual basis. Actually, it is about a 2-year lag time. We just submitted the 2004 report. That seems like a terribly long time, but it is because it takes time for our losses to get settled, the claims to get settled. So by the time we get that done and the data comes forth, it is about a 2-year lag time, but it is an ongoing event that we do.

Chairman LIEBERMAN. Here is what I would like you to do, and I think this is what Mr. Stephenson has in mind. This is a unique report to make, apart from your regular reporting to Congress. And unless you are ready to give me an answer now, I would urge you to go back to your agencies, talk to your colleagues, and then communicate with us, if you would, giving yourselves a deadline for when you hope to give us a report in response to Mr. Stephenson's recommendations.

Mr. GOULD. OK.

Chairman LIEBERMAN. I thank you for a very important and helpful morning. Again, in our ongoing discussion and attempt to adopt legislation that will reduce the greenhouse gas emissions that contribute to global warming, the very cold, no pun intended, calculations that Swiss Re has done about the probability of billions and billions of dollars of extra losses as a result of climate change to me is another very compelling, non-ideological, non-political, non-partisan argument for adopting economy-wide controls on greenhouse gas emissions. I thank you for bringing that perspective to the table.

Senator Collins, do you have final questions or comments?

Senator COLLINS. Thank you very much, Mr. Chairman, and thank you for holding this hearing and focusing our attention not only on the environmental and social impacts of climate change, which are often discussed, but on the financial implications. I just want to make a couple of closing comments.

Discussion of climate change usually focuses on the impact on coastal communities' rising sea levels, but, in fact, as your comments and the comments of Senator Tester remind us, the consequences for agriculture are potentially enormous in this country and around the world.

In addition, people often talk about climate change as if it only produces warming. In fact, it will produce most likely, the models tell us, extensive droughts in the interior of the United States, perhaps a deep freeze in Western Europe if the Gulf Stream changes because of rising sea levels.

The consequences are very different for different parts of our globe. It is not always warming. And that is why I think we need to look at the consequences for these two Federal insurance programs, which I believe the consequences are potentially enormous, and that is why I urge a sense of urgency. And I am still troubled by the statement, Mr. Buckley, that you made that day-to-day operations are not likely to be affected by current climate change estimates.

The University of Maine is doing some fascinating research which suggests that climate change could happen abruptly and indeed that over the centuries there have been periods where climate change has happened within a space of years rather than decades or centuries.

So I think we need to take a really hard look at this issue, and, Mr. Stephenson, I thank you for the excellent work the GAO has done. I think it is a call for action and for us not to be complacent and not to think that we have a long time to factor in the implications of global climate change into our insurance programs.

It was very helpful to hear of Swiss Re's projections analysis and planning for climate change, and I think we have to bring that same approach to public sector programs and to public sector planning, not only at the Federal level but at the State and local level as well. The policy and financial and fiscal implications are indeed enormous.

So thank you, Mr. Chairman, for holding this excellent hearing today to help us broaden our thinking about the implications of climate change.

Chairman LIEBERMAN. Thanks, Senator Collins. Your reference to the research being done at the University of Maine in some sense clarifies the challenge that we have, which is whether, if I can put it this way, our political system reaches the tipping point to get something done about global warming before the climate reaches the tipping point where something sudden and disastrous happens. And that is our challenge.

Senator Tester, do you want to have a final word?

Senator TESTER. I just want to thank you, Mr. Chairman and Ranking Member Collins. I want to thank the witnesses for your testimony here today. I really do appreciate the work that you folks do. Thank you.

Chairman LIEBERMAN. Thanks. My thanks to all of you.

The record for the hearing will be kept open for 15 days in case we have any further questions for you to answer in writing or you have any statements you would like to add to the record.

I thank you again. The hearing is adjourned.

[Whereupon, at 10:28 a.m., the Committee was adjourned.]

APPENDIX

United States Government Accountability Office

GAO

Testimony

Before the Committee on Homeland Security and Governmental Affairs, U.S. Senate

For Release on Delivery
Expected at 9:00 a.m. EDT
Thursday, April 19, 2007

CLIMATE CHANGE

Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant

Statement of John B. Stephenson, Director
Natural Resources and Environment

GAO-07-760T

April 19, 2007

GAO
Accountability·Integrity·Reliability

Highlights

Highlights of GAO-07-760T, testimony before the Committee on Homeland Security and Governmental Affairs, United States Senate

CLIMATE CHANGE

Financial Risks to Federal and Private Insurers in Coming Decades Are Potentially Significant

Why GAO Did This Study

Weather-related events in the United States have caused tens of billions of dollars in damages annually over the past decade. A major portion of these losses is borne by private insurers and by two federal insurance programs—the Federal Emergency Management Agency's National Flood Insurance Program (NFIP), which insures properties against flooding, and the Department of Agriculture's Federal Crop Insurance Corporation (FCIC), which insures crops against drought or other weather disasters.

In this testimony, GAO (1) describes how climate change may affect future weather-related losses, (2) provides information on past insured weather-related losses, and (3) determines what major private insurers and federal insurers are doing to prepare for potential increases in such losses. This testimony is based on a report entitled *Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant* (GAO-07-285) being released today.

What GAO Recommends

In the report, GAO is recommending that the Secretaries of Agriculture and Homeland Security analyze the potential long-term fiscal implications of climate change for the FCIC and the NFIP, respectively, and report their findings to the Congress. Both agencies expressed agreement with the recommendation.

www.gao.gov/cgi-bin/getrpt?GAO-07-760T.

To view the full product, including the scope and methodology, click on the link above. For more information, contact John Stephenson at (202) 512-3841 or stephensonj@gao.gov.

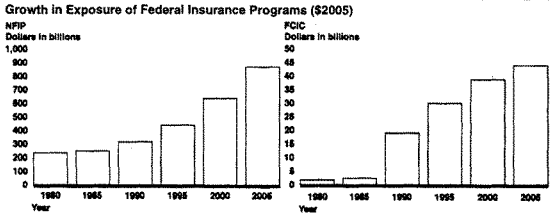
What GAO Found

Key scientific assessments report that the effects of climate change on weather-related events and, subsequently, insured and uninsured losses, could be significant. The global average surface temperature has increased over the past century and climate models predict even more substantial, perhaps accelerating, increases in temperature in the future. Assessments by key governmental bodies generally found that rising temperatures are expected to increase the frequency and severity of damaging weather-related events, such as flooding or drought, although the timing and magnitude are as yet undetermined. Additional research on the effect of increasing temperatures on weather events is expected in the near future.

Taken together, private and federal insurers paid more than $320 billion in claims on weather-related losses from 1980 to 2005. Claims varied significantly from year to year—largely due to the effects of catastrophic weather events such as hurricanes and droughts—but have generally increased during this period. The growth in population in hazard-prone areas and resulting real estate development have generally increased liabilities for insurers, and have helped to explain the increase in losses. Due to these and other factors, federal insurers' exposure has grown substantially. Since 1980, NFIP's exposure nearly quadrupled to nearly $1 trillion in 2005, and program expansion increased FCIC's exposure 26-fold to $44 billion.

Major private and federal insurers are both exposed to the effects of climate change over coming decades, but are responding differently. Many large private insurers are incorporating climate change into their annual risk management practices, and some are addressing it strategically by assessing its potential long-term industry-wide impacts. In contrast, federal insurers have not developed and disseminated comparable information on long-term financial impacts. GAO acknowledges that the federal insurance programs are not profit-oriented, like private insurers. Nonetheless, a strategic analysis of the potential implications of climate change for the major federal insurance programs would help the Congress manage an emerging high-risk area with significant implications for the nation's growing long-term fiscal imbalance.

Growth in Exposure of Federal Insurance Programs ($2005)



Source: GAO.

Mr. Chairman and Members of the Committee:

I am pleased to be here today to discuss our findings on the potential financial implications of climate change for federal and private insurers. My testimony is based on our report being released today entitled *Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant.*[1] The uncertain and potentially large losses associated with weather-related events are among the biggest risks that property insurers face. Virtually anything that is insured is vulnerable to weather-related events.

The property and casualty segment of the insurance industry, spanning both the private and public sector, bears a large portion of weather-related losses—the dollar value of claims paid on damage attributable to weather-related events.[2] The private sector includes primary insurers that insure individuals and businesses directly, and reinsurers that insure the primary insurers. The public sector includes federal and state programs that were established as an alternative to disaster assistance in markets where private insurance markets did not exist, such as for crop losses, and for losses that private insurers had deemed uninsurable, such as flood damage. The Federal Crop Insurance Corporation (FCIC) was established in 1938 to temper the economic impact of the great Depression, and was significantly expanded in 1980 to protect farmers from the financial losses brought about by drought, flood, or other natural disasters. The Department of Agriculture's Risk Management Agency (RMA) administers the program in partnership with private insurance companies, which share a percentage of the risk of loss and the opportunity for gain associated with each insurance policy written. The National Flood Insurance Program (NFIP) was established in 1968 to protect communities vulnerable to flood damage. The Federal Emergency Management Agency (FEMA), within the Department of Homeland Security, is responsible for oversight and management of the NFIP. Private insurers administer the program in partnership with the federal government, but the federal government assumes the full liability for losses.

[1]GAO, *Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant*, GAO-07-285 (Washington, D.C.: Mar. 16, 2007).

[2]Insurers use the term "loss" to refer to the dollar value of approved or settled claims arising from damages incurred by a policyholder. "Loss" does not account for premium or other income, deductibles, co-payments, or damages in excess of coverage.

To remain financially solvent, the insurance industry must estimate and prepare for the potential impact of future weather-related events. Any unanticipated changes in the frequency or severity of weather-related events can have financial consequences at the company level and industry-wide. Some infrequent weather-related events—drought or hurricanes, for example—are so severe that they pose unique challenges for insurers and reinsurers. Commonly referred to as extreme or catastrophic events, the unpredictability and sheer size of these events—both in terms of geography and number of insured parties affected—have the potential to overwhelm insurers' and reinsurers' capacity to pay claims.

The earth's climate and weather patterns are dynamic, varying on seasonal, decadal, and longer time scales. Of particular concern, the global average surface temperature has increased by 1.3 degrees Fahrenheit (0.74 degrees Celsius) over the past 100 years, and the National Academy of Sciences (NAS) and other scientific organizations have concluded that available evidence points to continued, perhaps accelerating, increases over the next century. Much research and policy debate of late has centered on the extent to which human activities have contributed to this warming and accompanying changes in climate, and how much is due to natural variability. But in any case, climate change, defined by the Intergovernmental Panel on Climate Change (IPCC) as any change in the climate over time due to either natural variability or as a result of human activity,[3] may affect social and economic activities in potentially profound ways—by raising sea levels, changing precipitation patterns, and altering the frequency or severity of weather-related events.

My testimony summarizes our report, focusing on (1) what is known about how climate change might affect the frequency and severity of damaging weather-related events, (2) the extent of the insured losses incurred by private and federal insurers and reinsurers resulting from weather-related events, and (3) what major federal agencies and private insurers and reinsurers are doing to prepare for the potential risk of increased losses.

[3]More specifically, the IPCC definition refers to climate change as a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural factors (e.g., internal processes or external forcings such as solar variations or heavy volcanic activity), or to persistent human-induced changes in the composition of the atmosphere or land use patterns.

To describe how climate change might affect insured and uninsured losses, we reviewed and summarized key scientific assessments by reputable international and national research organizations, including the IPCC, NAS, and the multi-federal agency Climate Change Science Program (CCSP). To determine the extent of insured losses, we analyzed key data from 1980 through 2005 from the insurance industry and federal agencies. Comparable data on 2006 losses were not available at the time we completed work on our report. To determine what federal and private insurers are doing to prepare for potential increases in losses, we interviewed agency officials and a subset of the largest insurers and reinsurers operating within the United States. We also interviewed officials from catastrophe modeling firms, insurance industry associations, the National Association of Insurance Commissioners,[4] and universities to provide additional context for respondents' statements. In addition, we reviewed key reports and publications from federal agencies, insurance experts, and selected insurance companies. We performed our work in accordance with generally accepted government auditing standards.

Summary

Assessments by key governmental scientific bodies have found that the effects of climate change on weather-related events could be substantial. IPCC projections, endorsed by NAS and CCSP, expect warmer surface temperatures to increase the frequency and severity of damaging weather-related events (such as flooding or drought), although the timing, magnitude, and duration of these changes are as yet undetermined. Further research on the relationship between increasing temperatures and weather events is ongoing. Of particular note, the IPCC is in the process of releasing its *Fourth Assessment Report* of the state of climate science throughout 2007, and CCSP has undertaken an assessment of the potential changes specific to North America in a report scheduled for release in 2008.

Taken together, private and federal insurers paid more than $320 billion in claims on weather-related losses from 1980 through 2005. In constant dollars, private insurers paid the largest part of this total, $243.5 billion (about 76 percent); followed by federal crop insurance, $43.6 billion (about 14 percent); and federal flood insurance, $34.1 billion (about 11 percent). Claims varied significantly from year to year—largely due to the

[4]The National Association of Insurance Commissioners is an organization of insurance regulators from the 50 states, the District of Columbia, and the five U.S. territories.

incidence and effects of extreme weather events such as hurricanes and droughts—but generally increased during this period. The growth in population in hazard-prone areas, and resulting real estate development and increasing real estate values, have increased federal and private insurers' total coverage and have helped to explain the increase in losses.

While both major private and federal insurers are exposed to increases in the frequency or severity of weather-related events associated with climate change, the two sectors are responding in different ways. Many major private insurers are incorporating elements of climate change into their annual and strategic risk management practices to reduce their exposure to catastrophic risk—that is, their vulnerability to extreme weather-related events and the associated financial losses. One consequence is that they are transferring some of their exposure to policyholders and to the public sector. Federal insurance programs, on the other hand, have seen their exposure grow significantly—NFIP's total coverage has quadrupled from 1980 to 2005, nearing $1 trillion, and program expansion has increased FCIC's total coverage nearly 26-fold to $44 billion. These escalating exposures to catastrophic weather events are putting the federal government at increased financial risk, but federal insurers have done little to develop and disseminate the kind of information they, and other key decision-makers such as the Congress, need to understand their programs' long-term exposure to the increased financial risks associated with climate change.

While we acknowledge that the mandate and operating environment of the major federal insurance programs is different from that of the private sector, we believe that better information about the federal government's exposure to potential changes in weather-related risk would help the Congress identify and manage this emerging high-risk area—one that potentially has significant implications for the nation's growing fiscal imbalance. Accordingly, our report being released today recommends that the Departments of Agriculture (USDA) and Homeland Security (DHS) analyze the potential long-term fiscal implications of climate change for the FCIC and NFIP, respectively, and report their findings to the Congress.

In commenting on a draft of this report, both USDA and DHS agreed with our recommendation, although USDA took issue with several points made in the report. The Department of Commerce neither agreed nor disagreed with the report's findings, but instead commented on the presentation of several issues in the draft and offered technical comments which we incorporated into this report as appropriate. The Department of Energy elected not to provide comments on the draft.

Background

Insurance is a mechanism for spreading risk over time, across large geographical areas, and among industries and individuals. While private insurers assume some financial risk when they write policies, they employ various strategies to manage risk so that they earn profits, limit potential financial exposure, and build capital needed to pay claims. For example, insurers charge premiums for coverage and establish underwriting standards, such as refusing to insure customers who pose unacceptable levels of risk or limiting coverage in particular geographic areas. Insurance companies may also purchase reinsurance to cover specific portions of their financial risk. Reinsurers use similar strategies as primary insurers to limit their risks.

Under certain circumstances, the private sector may determine that a risk is uninsurable. For example, homeowner policies typically do not cover flood damage because private insurers are unwilling to accept the risk of potentially catastrophic losses associated with flooding. In other instances, the private sector may be willing to insure a risk, but at rates that are not affordable to many property owners. Without insurance, affected property owners must rely on their own resources or seek out disaster assistance from local, state, and federal sources.

In situations where the private sector will not insure a particular type of risk, the public sector may create markets to ensure the availability of insurance. The federal government operates two such programs—the NFIP and the FCIC. NFIP provides insurance for flood damage to homeowners and commercial property owners in more than 20,000 communities. Homeowners with mortgages from federally regulated lenders on property in communities identified as being in high flood risk areas are required to purchase flood insurance on their dwellings. Optional, lower cost flood insurance is also available under the NFIP for properties in areas of lower flood risk. NFIP offers coverage for both the property and its contents, which may be purchased separately. FCIC insures agricultural commodities on a crop-by-crop and county-by-county basis based on farmer demand and the level of risk associated with the crop in a given region. Major crops, such as grains, are covered in almost every county where they are grown, while specialty crops such as fruit are covered only in some areas. Participating farmers can purchase different types of crop insurance and at different levels.

Climate Change Is Expected to Alter the Frequency or Severity of Damaging Weather-Related Events

Assessments by leading scientific bodies suggest that climate change could significantly alter the frequency or severity of weather-related events, such as drought and hurricanes. Leading scientific bodies report that the Earth warmed during the twentieth century— 1.3 degrees Fahrenheit (0.74 degrees Celsius) from 1906 to 2005 according to a recent IPCC report—and is projected to continue to warm for the foreseeable future.[5] While temperatures have varied throughout history, triggered by natural factors such as volcanic eruptions or changes in the earth's orbit, the key scientific assessments we reviewed have generally concluded that the observed increase in temperature in the past 100 years cannot be explained by natural variability alone. In recent years, major scientific bodies such as the IPCC, NAS, and the United Kingdom's Royal Academy have concluded that human activities are significantly increasing the concentrations of greenhouse gases and, in turn, global temperatures. Assuming continued growth in atmospheric concentration of greenhouse gases, the latest assessment of computer climate models projects that average global temperatures will warm by an additional 3.2 to 7.2 degrees Fahrenheit (1.8 to 4.0 degrees Celsius) during the next century.[6]

Based on model projections and expert judgment, the IPCC reported that future increases in the earth's temperature are likely to increase the frequency and severity of many damaging extreme weather-related events (summarized in table 1). The IPCC recently published summaries of two of the three components of its *Fourth Assessment Report*. The first, in which IPCC summarized the state of the physical science, reports higher confidence in projected patterns of warming and other regional-scale features, including changes in wind patterns, precipitation, and some aspects of extreme events such as drought, heavy precipitation events, and hurricanes. The second, in which IPCC addresses climate impacts and

[5]This estimate comes from a recently released summary of a key component of IPCC's *Fourth Assessment Report* of the state of climate science, which reported an updated 100-year linear trend (1906 through 2005) of 1.3 degrees Fahrenheit—larger than the corresponding 1.0 degrees Fahrenheit (0.6 degrees Celsius) reported in the 2001 *Third Assessment Report*.

[6]IPCC narrowed its range of projected warming in its recently released summary from the corresponding range of 2.5 to 10.4 degrees Fahrenheit (1.4 to 5.8 degrees Celsius) reported in the 2001 *Third Assessment Report*. Although these two sets of projections are broadly consistent, they are not directly comparable. IPCC notes in the summary that the new range is more advanced in that it provides best estimates and an assessed likelihood range. It also relies on a larger number of climate models of increasing complexity and realism, as well as new information regarding the nature of feedbacks from the carbon cycle and constraints on climate response from observations.

vulnerabilities, reported that the potential societal impacts from changes in temperature and extreme events vary widely across sector and region. For example, although the IPCC projects moderate climate change may increase yields for some rain-fed crops, crops that are near their warm temperature limit or depend on highly-used water resources face many challenges. Additionally, local crop production in any affected area may be negatively impacted by projected increases in the frequency of droughts or floods. Furthermore, the IPCC stated that the economic and social costs of extreme weather events will increase as these events become more intense and/or more frequent. Rapidly-growing coastal areas are particularly vulnerable, and the IPCC notes that readiness for increased exposure in these areas is low. These reports have not been publicly released in their entirety, but are expected sometime after May 2007.

Table 1: Selected IPCC Estimates of Confidence in Projected Changes in Weather-Related Events

Weather-related event	Confidence in projected future changes, 2007	Examples of major projected impacts relevant to property insurers
Warmer and fewer cold days and nights; warmer/more frequent hot days and nights over most land areas	Virtually certain[a]	• Increased crop yields in colder environments • Decreased crop yields in warmer environments • Increased insect outbreaks in agriculture and forestry
Warm spells/heat waves: frequency increases over most land areas	Very likely	• Reduced crop yields in warmer regions due to heat stress • Wildfire danger increases
Heavy precipitation events: frequency increases over most areas	Very likely	• Damage to crops • Soil erosion • Inability to cultivate land due to excessive moisture content of soils • Damage and disruption due to flooding
Area affected by drought increases	Likely	• Land degradation, lower yields and damage or failure of crops • Increased livestock deaths • Increased risk of wildfire • Disruptions due to water shortages
Intense tropical cyclone activity increases	Likely	• Damage to crops and trees • Disruption and damage due to flooding and high winds • Withdrawal of private insurance from vulnerable areas

Source: IPCC, Climate Change 2007: Impacts, Adaptation, and Vulnerability, Summary for Policymakers, 2007.

Note: IPCC used the following terms to indicated the assessed likelihood of an outcome--"virtually certain," which indicates a 99% probability of occurrence; "very likely" indicates a greater than 90% probability of occurrence; and "likely" indicates a greater than 66% probability of occurrence.

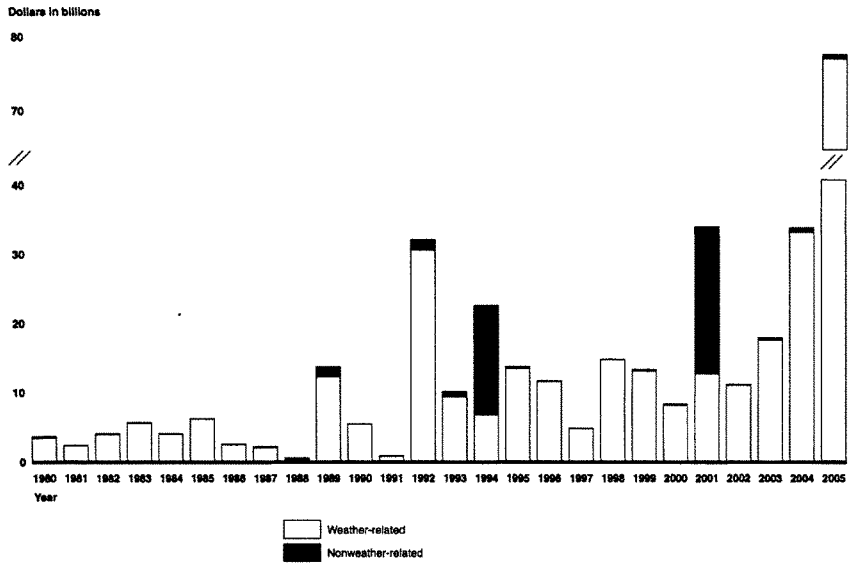
[a]Warming of the most extreme days and nights each year.

In addition to the IPCC's work, CCSP is assessing potential changes in the frequency or intensity of weather-related events specific to North America in a report scheduled for release in 2008. According to a National Oceanic and Atmospheric Administration official and agency documents, the report will focus on weather extremes that have a significant societal impact, such as extreme cold or heat spells, tropical and extra-tropical storms, and droughts. Importantly, officials have said the report will provide an assessment of the observed changes in weather and climate extremes, as well as future projections.

Weather-Related Insured Losses Totaled More Than $320 Billion between 1980 and 2005 and Appear to Be Increasing

Based on an examination of loss data from several different sources, we found that insurers incurred about $321.2 billion in weather-related losses from 1980 through 2005. In particular, as illustrated in Figure 1, our analysis found that weather-related losses accounted for 88 percent of *all* property losses paid by insurers during this period. All other property losses, including those associated with earthquakes and terrorist events, accounted for the remainder. Weather-related losses varied significantly from year to year, ranging from just over $2 billion in 1987 to more than $75 billion in 2005.

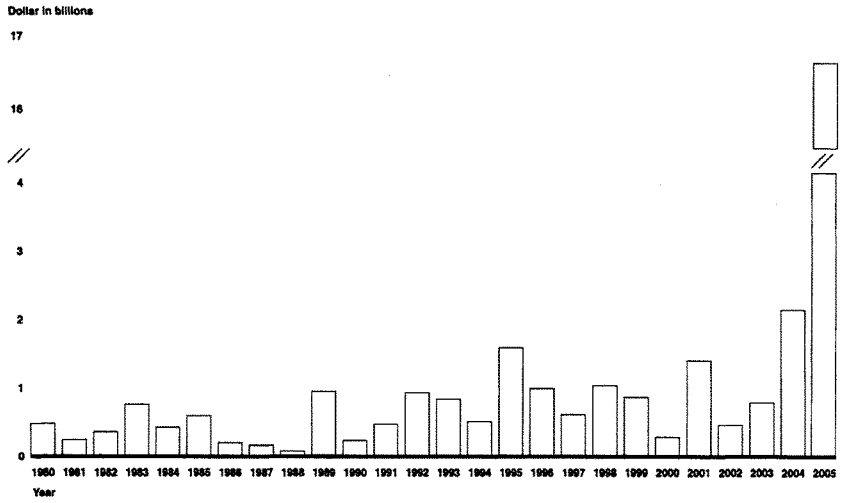
Figure 1: Annual Weather- and Nonweather-Related Insured Losses



Sources: GAO analysis of PCS, NFIP, and FCIC data.

Private insurers paid $243.5 billion—over 75 percent of the total weather-related losses we reviewed. The two major federal insurance programs—NFIP and FCIC—paid the remaining $77.7 billion of the $321.2 billion in weather-related loss payments we reviewed. NFIP paid about $34.1 billion, or about 11 percent of the total weather-related loss payments we reviewed during this period. As illustrated in Figure 2, claims averaged about $1.3 billion per year, but ranged from $75.7 million in 1988 to $16.7 billion in 2005.

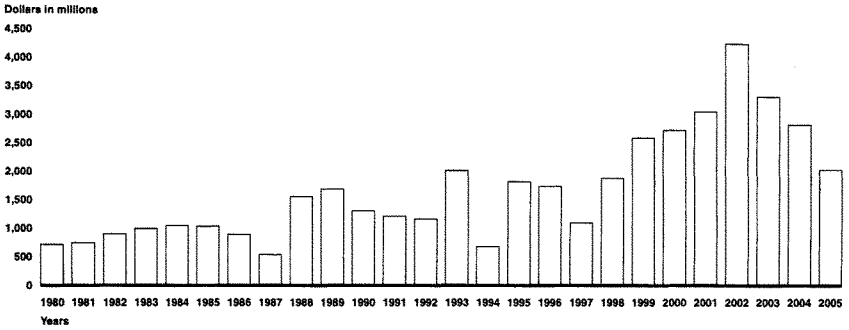
Figure 2: Weather-Related Losses Paid by NFIP



Source: GAO anaylsis of NFIP data.

Since 1980, FCIC claims totaled $43.6 billion, or about 14 percent of all weather-related claims during this period. As illustrated in Figure 3, FCIC losses averaged about $1.7 billion per year, ranging from $531.8 million in 1987 to $4.2 billion in 2002.

Figure 3: Weather-Related Losses Paid by FCIC



Source: GAO analysis of FCIC data.

The largest insured losses in the data we reviewed were associated with catastrophic weather events. Notably, crop insurers and other property insurers both face catastrophic weather-related risks, although the nature of the events for each is very different. In the case of crop insurance, drought accounted for more than 40 percent of weather-related loss payments from 1980 to 2005, and the years with the largest losses were associated with drought. Taken together, though, hurricanes were the most costly event in the data we reviewed. Although the United States experienced an average of only two hurricanes per year from 1980 through 2005, weather-related claims attributable to hurricanes totaled more than 45 percent of all weather-related losses—almost $146.8 billion. Moreover, as illustrated in Table 2, these losses appear to have increased during the past three decades.

Table 2: Insured Losses Associated with Hurricanes

	Category 1 & 2	Category 3, 4, & 5	Total
1980s	$807 (11)	$9,905 (6)	**$10,712 (17)**
1990s	$9,039 (11)	$29,099 (8)	**$38,138 (19)**
2000s	$8,072 (7)	$89,210 (7)	**$97,282 (14)**
Total	**$17,918 (29)**	**$128,214 (21)**	**$146,132 (50)**

Source: GAO analysis of PCS and NFIP data; National Oceanic and Atmospheric Administration (hurricane severity classification).

Note: Totals in millions of 2005 dollars. Totals do not include crop losses associated with hurricanes. Number of hurricanes associated with losses is included in parentheses. Hurricane classification was based on peak intensity at landfall.

Several recent studies have commented on the apparent increases in hurricane losses during this time period, and weather-related disaster losses generally, with markedly different interpretations. Some argue that loss trends are largely explained by changes in societal and economic factors, such as population density, cost of building materials, and the structure of insurance policies. Others argue that increases in losses have been driven by changes in climate. To address the issue, Munich Re—one of the world's largest reinsurance companies—and the University of Colorado's Center for Science and Technology Policy Research jointly convened a workshop in Germany in May 2006 to assess factors leading to increasing weather-related losses.[7] The workshop brought together a diverse group of international experts in the fields of climatology and disaster research. Workshop participants agreed that long-term records of disaster losses indicate that societal change and economic development are the principal factors explaining weather-related losses.[8] However, participants also agreed that changing patterns of extreme events are drivers for recent increases in losses, and that additional increases in losses are likely, given IPCC's projections.

The close relationship between the value of the resource exposed to weather-related losses and the amount of damage incurred may have ominous implications for a nation experiencing rapid growth in some of its most disaster-prone areas. AIR Worldwide, a leading catastrophe modeling

[7]Peter Höppe and Roger Pielke, Jr., eds., *Report of the Workshop on Climate Change and Disaster Losses: Understanding and Attributing Trends and Projections*, Hohenkammer, Germany, May 25-26, 2006 (Munich, Germany: October 2006).

[8]Consensus statements agreed to at the workshop are listed in their entirety in appendix IV of GAO-07-285.

firm, recently reported that insured losses should be expected to double roughly every 10 years because of increases in construction costs, increases in the number of structures, and changes in their characteristics. AIR's research estimates that, because of exposure growth, probable maximum catastrophe loss—an estimate of the largest possible loss that may occur, given the worst combination of circumstances—grew in constant 2005 dollars from $60 billion in 1995 to $110 billion in 2005, and it will likely grow to over $200 billion during the next 10 years.

Major Private and Public Insurers Differ in How They Manage Catastrophic Risks Associated with Climate Change

Major private and federal insurers are responding differently to the prospect of increasing weather-related losses associated with climate change. Many large private insurers are incorporating both near and longer-term elements of climatic change into their risk management practices. On the other hand, for a variety of reasons, the federal insurance programs have done little to develop the kind of information needed to understand the programs' long-term exposure to climate change.

Major Private Insurers Prospectively Manage Potential Increases in Catastrophic Risk Associated with Climate Change

Catastrophic weather events pose a unique financial threat to private insurers' financial success because a single event can cause insolvency or a precipitous drop in earnings, liquidation of assets to meet cash needs, or a downgrade in the market ratings used to evaluate the soundness of companies in the industry. To prevent these disruptions, the American Academy of Actuaries (AAA)—the professional society that establishes, maintains, and enforces standards of qualification, practice, and conduct for actuaries in the United States—recommends, among other steps, that insurers measure their exposure to catastrophic weather-related risk. In particular, AAA emphasizes the shortcomings of estimating future catastrophic risk by extrapolating solely from historical losses, and endorses a more rigorous approach that incorporates underlying trends and factors in weather phenomena and current demographic, financial, and scientific data to estimate losses associated with various weather-related events.

In our interviews with eleven of the largest private insurers operating in the U.S. property casualty insurance market, we sought to determine what key private insurers are doing to estimate and prepare for risks associated with potential climatic changes arising from natural or human factors. Representatives from each of the 11 major insurers we interviewed told us they incorporate near-term increases in the frequency and intensity of

hurricanes into their risk estimates. Six specifically attributed the higher frequency and intensity of hurricanes to a 20- to 40-year climatic cycle of fluctuating temperatures in the north Atlantic Ocean, while the remaining five insurers did not elaborate on the elements of climatic change driving the differences in hurricane characteristics.

In addition to managing their aggregate exposure on a near-term basis, some of the world's largest insurers have also taken a longer-term strategic approach to changes in catastrophic risk.[9] Six of the eleven private insurers we interviewed reported taking one or more additional actions when asked if their company addresses climatic change in their weather-related risk management processes. These activities include monitoring scientific research (4 insurers), simulating the impact of a large loss event on their portfolios (3 insurers), and educating others in the industry about the risks of climatic change (3 insurers), among others. Moreover, major insurance and reinsurance companies, such as Allianz, Swiss Re, Munich Re, and Lloyds of London, have published reports that advocate increased industry awareness of the potential risks of climate change, and outline strategies to address the issue proactively.

Major Federal Insurers Have Taken Little Action to Prospectively Assess and Disseminate Information on Potential Increases in Catastrophic Risk Associated with Climate Change

NFIP and FCIC have not developed information on the programs' longer-term exposure to the potential risk of increased extreme weather events associated with climate change as part of their risk management practices. The goals of the key federal insurance programs are fundamentally different from those of private insurers. Whereas private insurers stress the financial success of their business operations, the statutes governing the NFIP and FCIC promote affordable coverage and broad participation by individuals at risk over the programs' financial self-sufficiency by offering discounted or subsidized premiums. Also unlike the private sector, the NFIP and the FCIC have access to additional federal funds during high-loss years.[10] Thus, neither program is required to assess and limit its catastrophic risk strictly within its ability to pay claims on an annual basis. Instead, to the extent possible, each program manages its

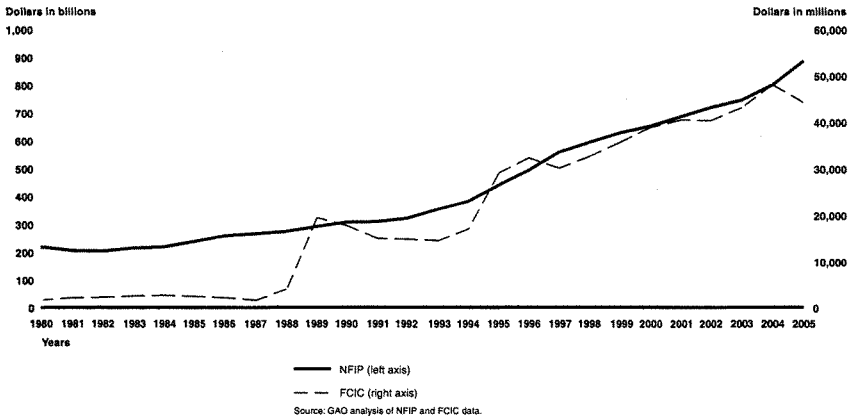
[9]Additionally, concern over the potential impacts of climate change on the availability and affordability of private insurance has led the National Association of Insurance Commissioners to establish a task force to formally address the issue in a report expected this summer.

[10]FCIC receives additional funds for excess losses through USDA's annual appropriations process. The NFIP is authorized to borrow additional funds from the Treasury on an as-needed basis, and repay the borrowed funds with interest.

risk within the context of its broader purposes in accordance with authorizing statutes and implementing regulations.

Nonetheless, an improved understanding of the programs' financial exposure is becoming increasingly important. Notably, the federal insurance programs' liabilities have grown significantly, which leaves the federal government increasingly vulnerable to the financial impacts of catastrophic events. Data obtained from both the NFIP and FCIC programs indicate the federal government has grown markedly more exposed to weather-related losses. Figure 4 illustrates the growth of both program's exposure from 1980 to 2005. For NFIP, the program's total coverage increased fourfold in constant dollars during this time from about $207 billion to $875 billion in 2005 due to increasing property values and a doubling of the number of policies from 1.9 million to more than 4.6 million. The FCIC has effectively increased its exposure base 26-fold during this period. In particular, the program has significantly expanded the scope of crops covered and increased participation. The main implication of the exposure growth for both the programs is that the magnitude of potential claims, in absolute terms, is much greater today than in the past.

Figure 4: Total Coverage of NFIP and FCIC, 1980-2005



Source: GAO analysis of NFIP and FCIC data.

Neither program has assessed the implications of a potential increase in the frequency or severity of weather-related events on program operations, although both programs have occasionally attempted to estimate their aggregate losses from potential catastrophic events. For example, FCIC officials stated that they had modeled past events, such as the 1993 Midwest Floods, using current participation levels to inform negotiations with private crop insurers over reinsurance terms. However, NFIP and FCIC officials explained that these efforts were informal exercises, and were not performed on a regular basis. Furthermore, according to NFIP and FCIC officials, both programs' estimates of weather-related risk rely heavily on historical weather patterns. As one NFIP official explained, the flood insurance program is designed to assess and insure against current—not future—risks. Over time, agency officials stated, this process has allowed their programs to operate as intended. However, unlike private sector insurers, neither program has conducted an analysis of the potential impacts of an increase in the frequency or severity of weather-related events on continued program operations in the long-term.

Information on Federal Agencies' Long-Term Exposure to Catastrophic Risk Could Better Inform Congressional Decision-Making

While comprehensive information on federal insurers' long-term exposure to catastrophic risk associated with climate change may not inform the NFIP's or FCIC's day-to-day operations, it could nonetheless provide valuable information for the Congress and other policy-makers who need to understand and prepare for fiscal challenges that extend well beyond the two programs' near-term operational horizons. We have highlighted the need for this kind of strategic information in recent reports that have expressed concern about the looming fiscal imbalances facing the nation. In particular, we observed that, "Our policy process will be challenged to act with more foresight to take early action on problems that may not constitute an urgent crisis but pose important long-term threats to the nation's fiscal, economic, security, and societal future."[11] The prospect of increasing program liabilities, coupled with expected increases in frequency and severity of weather events associated with climate change, would appear to fit into this category.

Agency officials identified several challenges that could complicate their efforts to assess these impacts at the program level. Both NFIP and FCIC officials stated there was insufficient scientific information on projected impacts at the regional and local level to accurately assess their impact on the flood and crop insurance programs. However, members of the insurance industry have analyzed and identified the potential risks climatic change poses to their business, despite similar challenges. Moreover, as previously discussed, both the IPCC and CCSP are expected to release significant assessments of the likely effect of increasing temperatures on weather events in coming months.

The experience of many private insurers, who must proactively respond to longer-term changes in weather-related risk to remain solvent, suggests the kind of information that needs to be developed to make sound strategic decisions. Specifically, to help ensure their future viability, a growing number of private insurers are actively incorporating the potential for climate change into their strategic level analyses. In particular, some private insurers have run a variety of simulation exercises to determine the potential business impact of an increase in the frequency and severity of weather events. For example, one insurer simulated the impact of multiple large weather events occurring simultaneously. We believe a similar analysis could provide Congress with valuable information about

[11]GAO, *21st Century Challenges: Reexamining the Base of the Federal Government*, GAO-05-325SP (Washington, D.C.: February 2005), 77.

the potential scale of losses facing the NFIP and FCIC in coming decades, particularly in light of the programs' expansion over the past 25 years.

Concluding Observations

We believe that the FCIC and NFIP are uniquely positioned to provide strategic information on the potential impacts of climate change on their programs—information that would be of value to key decision makers charged with a long-term focus on the nation's fiscal health. Most notably, in exercising its oversight responsibilities, the Congress could use such information to examine whether the current structure and incentives of the federal insurance programs adequately address the challenges posed by potential increases in the frequency and severity of catastrophic weather events. While the precise content of these analyses can be debated, the activities of many private insurers already suggest a number of strong possibilities that may be applicable to assessing the potential implications of climate change on the federal insurance programs.

Accordingly, our report being released today recommends that the Secretary of Agriculture and the Secretary of Homeland Security direct the Administrator of the Risk Management Agency and the Under Secretary of Homeland Security for Emergency Preparedness to analyze the potential long-term implications of climate change for the FCIC and the NFIP, respectively, and report their findings to the Congress. This analysis should use forthcoming assessments from the Climate Change Science Program and the Intergovernmental Panel on Climate Change to establish sound estimates of expected future conditions. Both agencies expressed agreement with this recommendation.

Mr. Chairman, this concludes my prepared statement. I would be happy to respond to any questions that you or other Members of the Committee may have.

Key Contact and Staff Acknowledgments

For further information about this testimony, please contact me, John Stephenson, at 202-512-3841 or stephensonj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. Contributors to this testimony include Steve Elstein, Assistant Director; Chase Huntley; Alison O'Neill; and Lisa Van Arsdale.

United States Government Accountability Office

GAO

Report to the Committee on Homeland Security and Governmental Affairs, U.S. Senate

March 2007

CLIMATE CHANGE

Financial Risks to Federal and Private Insurers in Coming Decades Are Potentially Significant

GAO-07-285

March 2007

GAO
Accountability Integrity Reliability

Highlights

Highlights of GAO-07-285, a report to the Committee on Homeland Security and Governmental Affairs, U.S. Senate

CLIMATE CHANGE

Financial Risks to Federal and Private Insurers in Coming Decades Are Potentially Significant

Why GAO Did This Study

Weather-related events have cost the nation billions of dollars in damages over the past decade. Many of these losses are borne by private insurers and by two federal insurance programs—the National Flood Insurance Program (NFIP), which insures properties against flooding, and the Federal Crop Insurance Corporation (FCIC), which insures crops against drought or other weather disasters.

GAO was asked to (1) describe how climate change may affect future weather-related losses, (2) determine past insured weather-related losses, and (3) determine what major private insurers and federal insurers are doing to prepare for potential increases in such losses. In response, among other things, GAO reviewed key scientific assessments; analyzed insured loss data; and contacted private insurers, NFIP, and FCIC.

What GAO Recommends

GAO is recommending that the Secretaries of Agriculture and Homeland Security analyze the potential long-term fiscal implications of climate change for the FCIC and the NFIP, respectively, and report their findings to the Congress. In commenting on a draft of this report, the two agencies agreed with the recommendation. The Departments of Agriculture and Commerce made comments and suggestions on the presentation of several findings. The Department of Energy elected not to comment.

www.gao.gov/cgi-bin/getrpt?GAO-07-285.

To view the full product, including the scope and methodology, click on the link above. For more information, contact John Stephenson at (202) 512-3841 or stephensonj@gao.gov.

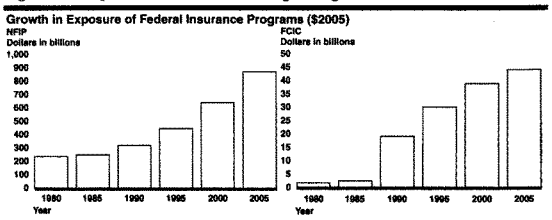
What GAO Found

Key scientific assessments report that the effects of climate change on weather-related events and, subsequently, insured and uninsured losses, could be significant. The global average surface temperature has increased by 0.74 degrees Celsius over the past 100 years and climate models predict additional, perhaps accelerating, increases in temperature. The key assessments GAO reviewed generally found that rising temperatures are expected to increase the frequency and severity of damaging weather-related events, such as flooding or drought, although the timing and magnitude are as yet undetermined. Additional research on the effect of increasing temperatures on weather events is expected in the near future, including a highly anticipated assessment of the state of climate science this year.

Taken together, private and federal insurers paid more than $320 billion in claims on weather-related losses from 1980 to 2005. Claims varied significantly from year to year—largely due to the effects of catastrophic weather events such as hurricanes and droughts—but have generally increased during this period. The growth in population in hazard-prone areas and resulting real estate development have generally increased liabilities for insurers, and have helped to explain the increase in losses. Due to these and other factors, federal insurers' exposure has grown substantially. Since 1980, NFIP's exposure quadrupled, nearing $1 trillion in 2005, and program expansion increased FCIC's exposure 26-fold to $44 billion.

Major private and federal insurers are both exposed to the effects of climate change over coming decades, but are responding differently. Many large private insurers are incorporating climate change into their annual risk management practices, and some are addressing it strategically by assessing its potential long-term industry-wide impacts. The two major federal insurance programs, however, have done little to develop comparable information. GAO acknowledges that the federal insurance programs are not profit-oriented, like private insurers. Nonetheless, a strategic analysis of the potential implications of climate change for the major federal insurance programs would help the Congress manage an emerging high-risk area with significant implications for the nation's growing fiscal imbalance.

Growth in Exposure of Federal Insurance Programs ($2005)



Source: GAO.

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Abbreviations

AAA	American Academy of Actuaries
AMO	Atlantic Multidecadal Oscillation
CCSP	Climate Change Science Program
FAIR	Fair Access to Insurance Requirements
FEMA	Federal Emergency Management Agency
FCIC	Federal Crop Insurance Corporation
HUD	Department of Housing and Urban Development
IPCC	Intergovernmental Panel on Climate Change
NAIC	National Association of Insurance Commissioners
NAS	National Academy of Sciences
NFIP	National Flood Insurance Program
NHC	National Hurricane Center
NOAA	National Oceanic and Atmospheric Administration
PCS	Property Claim Services
RMA	risk Management Agency
SAP	synthesis and assessment product
SFIP	standard flood insurance policy
USDA	U.S. Department of Agriculture

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United States Government Accountability Office
Washington, DC 20548

March 16, 2007

The Honorable Joseph I. Lieberman
Chairman
The Honorable Susan M. Collins
Ranking Member
Committee on Homeland Security and Governmental Affairs
United States Senate

As the 2004 and 2005 hurricane seasons demonstrated, weather-related events can devastate affected communities and individuals, and are costly to the insurance industry, government disaster assistance programs, and other relief organizations. Apart from the record-setting losses experienced in 2005, weather-related events over the past decade have cost the country tens of billons of dollars each year.

The property and casualty segment of the insurance industry, spanning both the private and public sector, bears a large portion of weather-related losses.[1] The private sector includes primary insurers that insure individuals and businesses directly, and reinsurers that provide insurance to the primary insurers. The public sector includes federal programs—in particular, the National Flood Insurance Program (NFIP), which insures properties at risk of damage from flooding, and the Federal Crop Insurance Corporation (FCIC), which insures crops that are vulnerable to drought, floods, or other natural disasters. Many states also administer insurance pools that provide coverage for losses caused by weather-related events.

The uncertain and potentially large losses associated with weather-related events are among the biggest risks that property insurers face. Virtually anything that is insured—property, crops and livestock, business operations, or human life and health—is vulnerable to weather-related events. To remain financially solvent, the insurance industry must estimate and prepare for the potential impact of weather-related events. As such, any unanticipated changes in the frequency or severity of weather-related

[1]Insurers use the term "loss" to refer to the dollar value of approved or settled claims arising from damages incurred by a policyholder. For the purposes of this report, weather-related loss refers to the dollar value of claims made on damage attributable to weather-related events. "Loss" does not account for premium or other income, deductibles, co-payments, or damages in excess of coverage.

events can have financial consequences at the company level and industry-wide.

The earth's climate and weather patterns are dynamic, varying on seasonal, decadal, and longer time scales. The global average surface temperature has increased by 0..74 degrees Celsius over the past 100 years and climate models predict additional, perhaps accelerating, increases in temperature. While the temperature increases to date may appear small, climate models project that additional changes in temperature may alter social and economic activities in potentially profound ways. Much research and policy debate has centered on the extent to which human activities have contributed to the warming and how much is due to natural variability. For the purposes of this report, *climate change* refers to any change in the climate over time, whether due to natural variability or as a result of human activity.[2] Regardless of the cause, some contend that increasing temperatures—accompanied by changes in other aspects of the climate—may have adverse financial consequences for property insurers, which might slow the growth of the industry and shift more of the burden to governments and individuals.

Concerned about the implications of climate change for weather-related losses incurred by federal agencies and private insurers, you asked us to (1) describe what is known about how climate change might affect insured and uninsured losses, (2) determine insured losses incurred by major federal agencies and private insurers and reinsurers resulting from weather-related events, and (3) determine what major federal agencies and private insurers and reinsurers are doing to prepare for the potential risk of increased losses due to more frequent or more severe weather-related events associated with climate change.

To describe how climate change might affect insured and uninsured losses, we reviewed and summarized key scientific assessments by reputable international and national research organizations, including the Intergovernmental Panel on Climate Change *Third Assessment Report*, National Academy of Sciences reports, and the multifederal agency

[2]More specifically, we used the Intergovernmental Panel on Climate Change definition, which refers to climate change as a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural factors (e.g., internal processes or external forcings such as solar variations or heavy volcanic activity), or to persistent human-induced changes in the composition of the atmosphere or land use patterns.

Climate Change Science Program. To determine insured losses attributable to weather-related events, we analyzed data from 1980 through 2005 from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) for the NFIP; from the Department of Agriculture's Risk Management Agency (RMA) for FCIC; and from the Property Claims Service, a leading source of insurance data. We analyzed changes in weather-related losses since 1980 and supplemented this analysis with a review of existing literature and the views of subject area experts on the key drivers of changes in losses.

To determine what key federal agencies and private insurers are doing to assess and manage the potential for increased losses, we conducted semistructured interviews with officials from the NFIP, RMA, and a sample of the largest private primary insurers and reinsurers in the United States, Europe, and Bermuda. The companies we interviewed represent about 45 percent of the total domestic insurance market but should not be generalized to represent all insurance companies. We also interviewed officials from catastrophe modeling firms, insurance industry associations, the National Association of Insurance Commissioners (NAIC),[3] and universities to provide additional context for respondents' statements. To supplement these interviews, we reviewed documentation of federal agencies' risk management practices, studies by subject area experts, industry reports, insurance company documents, and previous GAO reports. We performed our work between February 2006 and January 2007 in accordance with generally accepted government auditing standards. A more extensive discussion of our scope and methodology appears in appendix I.

Results in Brief

Assessments by the National Academy of Sciences (NAS) and the Intergovernmental Panel on Climate Change (IPCC), a leading source for international climate expertise, report that the effects of climate change on weather-related events and—by extension—weather-related losses could be substantial. IPCC reports that global mean temperatures increased by 0.74 degrees Celsius over the last 100 years and are projected to continue to rise over the next century. Although temperatures have varied throughout history due to natural processes, such as changes in the Earth's orbit and volcanic eruptions, the IPCC and NAS report that the

[3]The National Association of Insurance Commissioners is an organization of insurance regulators from the 50 states, the District of Columbia, and the five U.S. territories.

observed temperature increase during the twentieth century cannot be explained by natural variability alone but is largely attributable to human activities. Warmer surface temperatures are linked to global-scale oceanographic, meteorological, and biological changes. For example, as the earth warms, more water evaporates from oceans and other sources, eventually falling as rain or snow. Key assessments that rely on both observational data and computer models have reported that warmer temperatures are expected to increase the frequency and severity of damaging extreme weather-related events (such as flooding or drought), although the timing, magnitude, and duration of these changes are as yet undetermined. Further research on the effect of increasing temperature on weather events is ongoing. Of particular note, the IPCC is expected to release its fourth assessment of the state of climate science throughout 2007, and the Climate Change Science Program is currently assessing potential changes in the frequency or intensity of weather-related events specific to North America in a report scheduled for release in 2008.

Taken together, private and federal insurers paid more than $320 billion in claims on weather-related losses from 1980 through 2005. In constant dollars, private insurers paid the largest part of the claims during this period, $243.5 billion (about 76 percent); followed by federal crop insurance, $43.6 billion (about 14 percent); and federal flood insurance, $34.1 billion (about 11 percent). Claims varied significantly from year to year—largely due to the incidence and effects of catastrophic weather events such as hurricanes and droughts—but generally increased during this period. In particular, the years with the largest insured losses were generally associated with major hurricanes, which comprised well over one-third of all weather-related losses since 1980. The growth in population in hazard-prone areas, and resulting real estate development and increasing real estate values, have increased federal and private insurers' exposure, and have helped to explain the increase in losses. In particular, heavily-populated areas along the Northeast, Southeast, and Texas coasts have among the highest value of insured properties in the United States and face the highest likelihood of major hurricanes. Due to these and other factors, federal insurers' exposures have grown substantially. Since 1980, NFIP's exposure has quadrupled, nearing $1 trillion, and program expansion has increased FCIC's exposure nearly 26-fold to $44 billion. These escalating exposures to catastrophic weather events are leaving the federal government at increased financial risk. FCIC officials told us, for example, that if the widespread Midwest floods of 1993 were to occur today, losses would be five times greater.

While both major private and federal insurers are exposed to increases in the frequency or severity of weather-related events associated with climate change, the two sectors are responding in different ways. Using computer-based catastrophe models, many major private insurers are incorporating some near-term elements of climate change into their risk management practices. One consequence is that, as these insurers seek to limit their own catastrophic risk exposure, they are transferring some of it to policyholders and to the public sector. In addition, some private insurers are approaching climate change at a strategic level by publishing reports outlining the potential industry-wide impacts and strategies to proactively address the issue. Federal insurance programs, on the other hand, have done little to develop the kind of information needed to understand the programs' long-term exposure to climate change for a variety of reasons. The federal insurance programs are not oriented toward earning profits like private insurers but rather toward increasing participation among eligible parties. Consequently, neither program has had reason to develop information on their long-term exposure to the fiscal risks associated with climate change.

We acknowledge the different mandate and operating environment in which the major federal insurance programs operate, but we believe that better information about the federal government's exposure to potential changes in weather-related risk would help the Congress identify and manage this emerging high-risk area—one which may not constitute an immediate crisis, but which does have significant implications for the nation's growing fiscal imbalance. Accordingly, GAO is recommending that the Secretary of Agriculture and the Secretary of Homeland Security direct the Under Secretary for Farm and Foreign Agricultural Services and the Under Secretary of Homeland Security for Emergency Preparedness to analyze the potential long-term fiscal implications of climate change for the FCIC and the NFIP, respectively, and report their findings to the Congress.

In commenting on a draft of this report, both the Departments of Agriculture (USDA) and Homeland Security (DHS) agreed with our recommendation, and USDA commented on the presentation of several findings in the draft. The Department of Commerce neither agreed nor disagreed with the report's findings, but instead commented on the presentation of several issues in the draft and offered technical comments which we incorporated into this report as appropriate. The Department of Energy elected not to provide comments on the draft.

Background

Insurance is a mechanism for spreading risk over time, across large geographical areas, and among industries and individuals. While insurers assume some financial risk when they write policies, they employ various strategies to manage risk so that they earn profits, limit potential financial exposures, and build capital needed to pay claims.[4] For example, they charge premiums for coverage and establish underwriting standards, such as refusing to insure customers who pose unacceptable levels of risk, or limiting coverage in particular geographic areas. Insurance companies may also purchase reinsurance to cover specific portions of their financial risk. Reinsurers use similar strategies to limit their risks, including charging premiums, establishing underwriting standards, and maintaining close, long-term business relationships with certain insurers.

Both insurers and reinsurers must also predict the frequency and severity of insured losses with some reliability to best manage financial risk.[5] In some cases, these losses may be fairly predictable. For example, the incidence of most automobile insurance claims is predictable, and losses generally do not occur to large numbers of policyholders at the same time. However, some infrequent weather-related events—hurricanes, for example—are so severe that they pose unique challenges for insurers and reinsurers. Commonly referred to as catastrophic or extreme events, the unpredictability and sheer size of these events—both in terms of geography and number of insured parties affected—have the potential to overwhelm insurers' and reinsurers' capacity to pay claims. Catastrophic events may affect many households, businesses, and public infrastructure across large areas, resulting in substantial losses that deplete insurers' and reinsurers' capital.

Given the higher levels of capital that reinsurers must hold to address catastrophic events, reinsurers generally charge higher premiums and restrict coverage for such events. Further, in the wake of catastrophic events, reinsurers and insurers may sharply increase premiums to rebuild capital reserves and may significantly restrict insurance and reinsurance coverage to limit exposure to similar events in the future.

[4]Federal insurance programs are not designed to earn financial profits.

[5]To insure a risk, private insurers must be able to both estimate an event's occurrence and its associated damages and be able to set premiums sufficient to cover their risk and earn a profit. In some cases, insurers may be prevented from charging sufficient premiums due to state regulatory actions.

Under certain circumstances, the private sector may determine that a risk is uninsurable. For example, while homeowner insurance policies typically cover damage and losses from fire and other perils, they usually do not cover flood damage because private insurance companies are largely unwilling to bear the financial risks associated with its potentially catastrophic impact. In other instances, the private sector may be willing to insure a risk, but at rates that are not affordable to many property owners. Without insurance, affected property owners must rely on their own resources or seek out disaster assistance from local, state, and federal sources.

In situations where the private sector will not insure a particular type of risk, the public sector may create markets to ensure the availability of insurance. For example, several states have established Fair Access to Insurance Requirements (FAIR) plans, which pool resources from insurers doing business in the state to make property insurance available to property owners who cannot obtain coverage in the private insurance market, or cannot do so at an affordable rate. In addition, six southern states have established windstorm insurance pools that pool resources from private insurers to make insurance available to property owners who cannot obtain it in the private insurance market.

Similarly, at the federal level, the Congress established the NFIP and the FCIC to provide coverage where voluntary markets do not exist.[6] The Congress established the NFIP in 1968, partly to provide an alternative to disaster assistance for flood damage. Participating communities are required to adopt and enforce floodplain management regulations, thereby reducing the risks of flooding and the costs of repairing flood damage. FEMA, within the Department of Homeland Security, is responsible for, among other things, oversight and management of the NFIP. Under the program, the federal government assumes the liability for covered losses and sets rates and coverage limitations.

The Congress established the FCIC in 1938 to temper the economic impact of the Great Depression and the weather effects of the dust bowl. In 1980, the Congress expanded the program to provide an alternative to disaster assistance for farmers that suffer financial losses when crops are damaged by droughts, floods, or other natural disasters. Farmers' participation is

[6]See appendixes II and III for additional information on how these programs operate, how they assess risk, and how they are funded.

voluntary, but the federal government encourages it by subsidizing their insurance premiums. USDA's RMA is responsible for administering the crop insurance program, including issuing new insurance products and expanding existing insurance products to new geographic regions. RMA administers the program in partnership with private insurance companies, which share a percentage of the risk of loss or the opportunity for gain associated with each insurance policy written.

Climate Change May Increase Losses by Altering the Frequency or Severity of Weather-Related Events

Global temperatures have increased in the last 100 years and are projected to continue to rise over the next century. Using observational data and computer modeling, climatologists and other scientists are assessing the likely effects of temperature rise associated with climate change on precipitation patterns and on the frequency and severity of weather-related events. The key scientific assessments we reviewed generally found that warmer temperatures are expected to alter the frequency or severity of damaging weather-related events, such as flooding or drought, although the timing, magnitude, and duration of these changes are as yet undetermined. Additional research on the effect of increasing temperature on weather events is expected in the near future. Nevertheless, research suggests that the potential effects of climate change on damaging weather-related events could be significant.

Warming Temperatures Are Expected to Alter the Frequency and Severity of Damaging Extreme Weather-Related Events

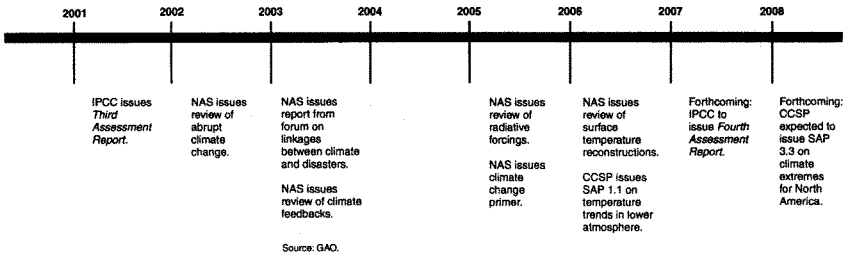
We reviewed the reports released by IPCC, NAS, and the federal Climate Change Science Program (CCSP) that are shown in figure 1.[7] These leading scientific bodies report that the Earth warmed during the twentieth century—0.74 degrees Celsius from 1906 to 2005 according to a recent IPCC report—and is projected to continue to warm for the foreseeable future.[8] IPCC, NAS, CCSP, and other scientific bodies report that this increase in temperature cannot be explained by natural variation alone. IPCC's 2001 assessment of the impact of increasing temperatures on extreme weather events found that it was likely the frequency and severity

[7]Appendix I contains additional information on the specific assessments we reviewed. CCSP is a multiagency effort to coordinate federal climate change science that is responsible for preparing a series of 21 climate science synthesis and assessment products (SAP) for the United States by 2008.

[8]This estimate comes from a recently released summary of a key component of IPCC's *Fourth Assessment Report* of the state of climate science, which reported an updated 100-year linear trend (1906-2005) of 0.74 degrees Celsius—larger than the corresponding 0.6 degrees Celsius reported in the 2001 *Third Assessment Report*.

of several types of events will increase as greenhouse gas emissions continue.[9]

Figure 1: Time Line of Key Scientific Assessments



Source: GAO.

Average Global Temperatures Have Increased and Are Expected to Continue to Rise

The earth's climate system is driven by energy from the sun and is maintained by complex interactions between the atmosphere, the oceans, and the reflectivity of the earth's surface, among other factors. Upon reaching the earth, the sun's energy is either reflected back into space, or is absorbed by the earth and is subsequently reemitted. However, certain gases in the earth's atmosphere—such as carbon dioxide and methane—act like the glass in a greenhouse to trap some of the sun's energy and prevent it from returning to space. While these gases play an important part in maintaining life on earth, their accumulation in the atmosphere can significantly increase global temperatures.

The earth warmed by roughly 0.74 degrees Celsius over the past 100 years, and is projected to continue warming for the foreseeable future. While temperatures have varied throughout history, triggered by natural factors such as volcanic eruptions or changes in the earth's orbit, the key scientific assessments we reviewed have generally concluded that the observed increase in temperature in the past 100 years cannot be explained by natural variability alone. In recent years, major scientific

[9]For the purposes of this report, extreme weather-related events are those with a low frequency of occurrence, but that cause severe damage, such as hurricanes, drought, winter storms, tornadoes, wildfires, and floods, among others.

bodies such as the IPCC, NAS, and the Royal Academy (the United Kingdom's national academy of science) have concluded that human activities, including the combustion of fossil fuels, industrial and agriculture processes, landfills, and some land use changes, are significantly increasing the concentrations of greenhouse gases and, in turn, global temperatures.

Although climate models produce varying estimates of the extent of future changes in temperature, NAS and other scientific organizations have concluded that available evidence points toward continued global temperature rise. Assuming continued growth in atmospheric concentration of greenhouse gases, the latest assessment of computer climate models projects that average global temperatures will warm by an additional 1.8 to 4.0 degrees Celsius during the next century.[10]

Some scientists have questioned the significance of the earth's present temperature rise relative to past fluctuations. To address this issue, the NAS recently assessed the scientific community's efforts to reconstruct temperatures of the past 2,000 years and place the earth's current warming in an historical context.[11] Based on its review, the NAS concluded with a high level of confidence that global mean surface temperature was warmer during the last few decades of the twentieth century than during any comparable period during the preceding 400 years. Moreover, NAS cited evidence that temperatures at many, but not all, individual locations were higher during the past 25 years than any period of comparable length over the past 1,100 years.

[10]IPCC narrowed its range of projected warming in its recently released summary from the corresponding range of 1.4 to 5.8 degrees Celsius reported in the 2001 *Third Assessment Report*. Although these two sets of projections are broadly consistent, they are not directly comparable. IPCC notes in the summary that the new range is more advanced in that it provides best estimates and an assessed likelihood range. It also relies on a larger number of climate models of increasing complexity and realism, as well as new information regarding the nature of feedbacks from the carbon cycle and constraints on climate response from observations.

[11]National Research Council, *Surface Temperature Reconstructions for the Last 2,000 Years* (Washington, D.C.: 2006).

IPCC Expects Continued Warming to Alter Frequency and Severity of Damaging Extreme Weather-Related Events

Determining the precise nature and extent of the relationship between average global temperatures and weather-related events is an exceedingly challenging task. Several key assessments of the state of this science have addressed the large body of work on this topic. Using observational data and computer models, scientists are examining the effects of rising temperatures on precipitation patterns and the frequency and severity of extreme weather-related events. The complexity of weather systems, together with the limited statistical precision of projections of the extent of future temperature change, often produces different model results, and the results themselves represent a range of potential future conditions.

Nonetheless, a key assessment of climate model projections indicates that an increase is likely in the frequency or severity of damaging extreme weather-related events. In 2001, the IPCC, a leading scientific authority on climate science, released its *Third Assessment Report*, which assessed the state of knowledge of, among other things, the potential for global changes in extreme weather-related events. The IPCC described the relationship between temperatures, precipitation, and weather-related events. Increased global mean surface temperatures are linked to global-scale oceanographic, meteorological, and biological changes. For example, as the earth warms, more water evaporates from oceans or lakes, eventually falling as rain or snow. IPCC reported that permafrost is thawing, and the extent of sea ice, snow cover, and mountain glaciers are generally shrinking. The IPCC also noted that global sea level rose between 0.1 and 0.2 meters during the twentieth century through thermal expansion of seawater and widespread loss of land ice, and that this sea level rise could increase the magnitude of hurricane storm surge in some areas. Warming is expected to change rainfall patterns, partly because warmer air holds more moisture.

Based on model projections and expert judgment,[12] the IPCC reported that future increases in the earth's temperature are likely to increase the frequency and severity of many damaging extreme weather-related events (summarized in table 1). For instance, IPCC reported that increased drought is likely across many regions of the globe, including the U.S. Great

[12]Likelihoods for projected changes are defined by the following conditions set by the IPCC: "very likely" indicates that a number of models have been analyzed for such a change, all those analyzed show it in most regions, and it is physically plausible; and "likely" indicates that theoretical studies and those models analyzed show such a change, but only a few models are configured in such a way as to reasonably represent such changes.

Plains. Also, IPCC concluded that the intensity of precipitation events is very likely to increase across almost all regions of the globe and that heavy precipitation events are expected to become more frequent. Compared with projected temperature increases, changes in the frequency and severity of extreme events can occur relatively rapidly, according to the IPCC.

Table 1: Selected IPCC Estimates of Confidence in Projected Changes in Weather-Related Events

Weather-related event	Confidence in projected future changes
Higher maximum temperatures and more hot days over nearly all land areas	Very likely
Higher minimum temperatures and fewer cold and frost days over nearly all land areas	Very likely
More intense precipitation events	Very likely
Increased summer drying and associated risks of drought	Likely[a]
Increase in hurricane peak wind intensities	Likely[b]
Increase in hurricane average and peak precipitation intensities	Likely

Source: IPCC, *Climate Change 2001: The Scientific Basis*, 2001.

[a]Projections for most midlatitude continental interiors. IPCC found a lack of consistent projections in other regions.

[b]IPCC reported that changes in the regional distribution of hurricanes are possible but have not been established.

Much research has been done since the IPCC's *Third Assessment Report*, but there has not been a similarly rigorous assessment of what is known with regard to temperature increase, precipitation, and weather-related events for the United States.[13] However, significant assessments will be completed in the near future. In particular, the IPCC is expected to release its *Fourth Assessment Report* throughout 2007.

[13]The most recent national assessment for the United States, entitled *Climate Change Impacts on the United States*, was forwarded by a federal advisory committee to the Congress and the President in 2000 as required by the Global Change Research Act of 1990. We reported in 2005 that the subsequent assessment was not submitted in November 2004 as required by the act. Instead, according to the Department of Commerce, CCSP has committed to issuing 21 shorter reports by 2008. See GAO, *Climate Change Assessment: Administration Did Not Meet Reporting Deadline*, GAO-05-338R (Washington, D.C.: Apr. 14, 2005).

While we were completing our review, the IPCC released a summary of the first of three components of its *Fourth Assessment Report*, which builds upon past IPCC assessments and incorporates new findings from the physical science research since the *Third Assessment Report*. The summary reports higher confidence in projected patterns of warming and other regional-scale features, including changes in wind patterns, precipitation, and some aspects of extreme events. In particular, the summary reports that it is very likely that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent. Moreover, based on a range of models, IPCC's summary states that it is likely that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and more heavy precipitation associated with ongoing increases in tropical sea surface temperatures. IPCC reports less confidence in projections of a global decrease in the number of tropical cyclones, and that the apparent increase in the proportion of very intense storms since 1970 in some regions is much larger than simulated by current models for that period. The full first component report was not publicly released prior to the issuance of our report and is expected some time after May 2007.

The other two components of the *Fourth Assessment Report* will cover impacts, adaptation, and vulnerability, and mitigation. These reports are expected to assess, among other things, key vulnerabilities and risks from climate change, including changes in extreme events. Additionally, the IPCC has committed to producing a capping report that is intended to synthesize and integrate material contained in the forthcoming reports, as well as other IPCC products.

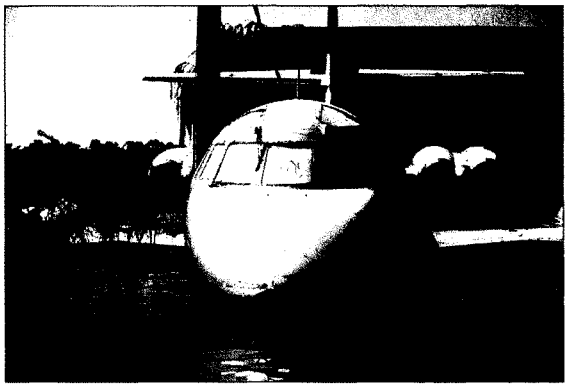
In addition to the IPCC's work, CCSP is assessing potential changes in the frequency or intensity of weather-related events specific to North America in a report scheduled for release in 2008. According to a National Oceanic and Atmospheric Administration (NOAA) official and agency documents, the report will focus on weather extremes that have a significant societal impact, such as extreme cold or heat spells, tropical and extra-tropical storms, and droughts. Importantly, officials have said the report will provide an assessment of the observed changes in weather and climate extremes, as well as future projections.

More Frequent or More Severe Extreme Weather-Related Events Could Significantly Increase Insured Losses

Extreme weather-related events impact communities and economic activity by damaging homes and vehicles (e.g., see fig. 2), interrupting electrical service and business operations, or destroying crops. IPCC reported that the insurance industry—especially the property and casualty segment—are sensitive to the effects of weather-related events. This was highlighted in the Department of Commerce's comments on a draft of this report, which observed that altering either the frequency or severity of high impact extreme weather-related events could result in a significant increase in the risk posed to an insurer. For example, the agency said that what had been considered a 500-year event (i.e., its probability of occurring in a given year is 1 in 500) could shift under climate change to become a 100-year event (i.e., its probability of occurring in a given year is 1 in 100). Consequently, more frequent or more severe events have a greater potential for damage and, in turn, insured losses. As an official from Aon Re Australia, a large global reinsurer, reported, "The most obvious impact of climate change on the insurance sector will be the increase in insured property losses from extreme weather events."[14]

[14]Andrew Dlugolecki, *The Changing Risk Landscape: Implications for Insurance Risk Management* (1999) http://www.aon.com.au/pdf/reinsurance/Aon_Climate_Change.pdf (downloaded Jan. 8, 2007).

Figure 2: July 1993 Flood Damage at Chesterfield Airport in St. Louis, Missouri



Source: FEMA.

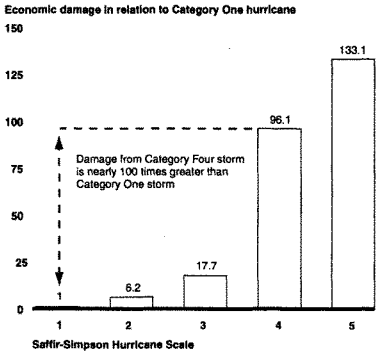
Note: According to FEMA, the depth of the floodwaters underscores the extent of the damage caused by the 1993 Midwest flood. A total of 534 counties in nine states were declared for federal disaster aid.

Notably, the economic damages associated with some extreme weather-related events could increase at a greater rate in comparison with changes in the events themselves. Seemingly small changes in the characteristics of certain weather-related events can lead to substantial increases in damage. For example, recent work on hurricanes by researchers at the University of Colorado, the National Weather Service, and other institutions examined losses associated with hurricanes that made landfall in the United States since 1900.[15] Holding constant the increased population and development in coastal counties during this period, the study compared the economic damage of stronger storms with weaker storms, based on

[15]See Roger Pielke, Jr., et al., *Normalized Hurricane Damages in the United States: 1900-2005* (2007), accessed via http://sciencepolicy.colorado.edu/publications/special/normalized_hurricane_damages.html (downloaded Jan. 8, 2007).

the Saffir-Simpson Hurricane Scale.[16] The researchers found that stronger storms have caused many times more economic damages than weaker storms, as shown in figure 3. These findings are consistent with other independent analyses conducted by insurers and catastrophe modelers.

Figure 3: Economic Damages by Hurricane Category for U.S. Hurricanes Making Landfall, 1900-2005



Source: GAO adaption of Pielke et al. data.

Note: Value of each bar compares the median economic damage associated with hurricanes of that Saffir-Simpson category with the median economic damage of Category One storms. Of the 158 hurricanes reviewed, only three were Category Five.

Moreover, public reports from several of the world's largest reinsurance companies and brokers underscore the potential for substantially increased losses. These reports note that, in addition to greater losses in

[16]The Saffir-Simpson hurricane intensity category system was developed in the 1970s to calculate the destructive force of hurricanes. The scale ranges from Category One to Category Five, with Category Five being the most severe. For example, Category Three hurricanes have winds of 111 to 130 mph, whereas Category Five hurricanes have winds greater than 155 mph.

absolute terms, the potential for greater variability in weather-related events could significantly enhance the volatility of losses.

Insured Weather-Related Losses Have Been Sizeable, and Federal Insurers' Exposure Has Grown Significantly

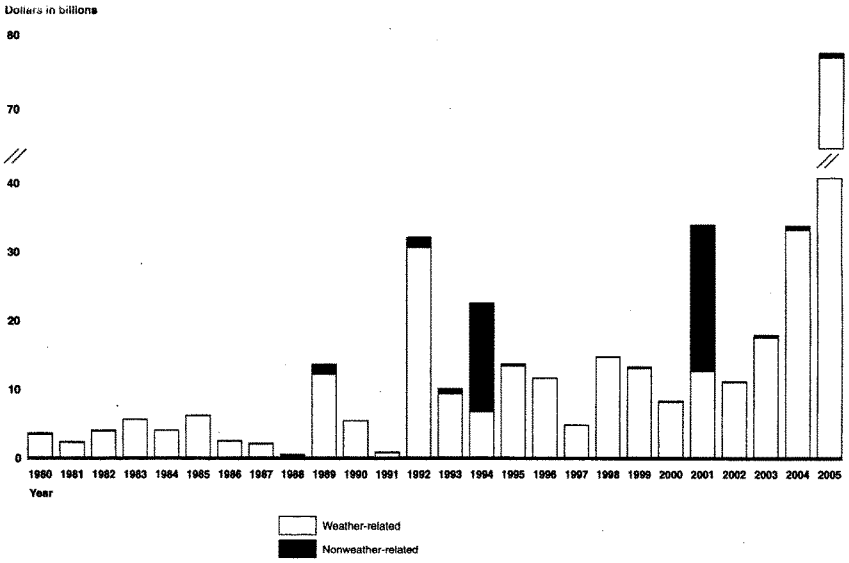
Taken together, insurers paid more than $320 billion in claims for weather-related losses between 1980 and 2005.[17] Claims varied significantly from year to year—largely due to the effects of catastrophic weather events such as hurricanes and droughts—but generally increased during this period. The growth in population in hazard-prone areas, and consequent real estate development and increasing real estate values, have generally increased insurers' exposure to weather-related events and help to explain their increased losses. Due to these and other factors, the federal insurance programs' liabilities have grown significantly, leaving the federal government increasingly vulnerable to the financial impacts of extreme events.

Claims Paid on Weather-Related Losses Totaled More Than $320 Billion between 1980 and 2005

Based on an examination of loss data from several different sources, insurers incurred more than $320 billion in weather-related losses from 1980 through 2005 (see fig. 4). Weather-related losses accounted for 88 percent of *all* property losses paid by insurers during this period. All other property losses, including those associated with earthquakes and terrorist events, accounted for the remainder. Weather-related losses varied significantly from year to year, ranging from just over $2 billion in 1987 to more than $75 billion in 2005.

[17]Data throughout this section are presented in constant 2005 dollars to allow for a comparison of the dollar value of losses over time and are not otherwise adjusted. See appendix I for more information on data used in this report.

Figure 4: Annual Weather- and Nonweather-Related Insured Losses

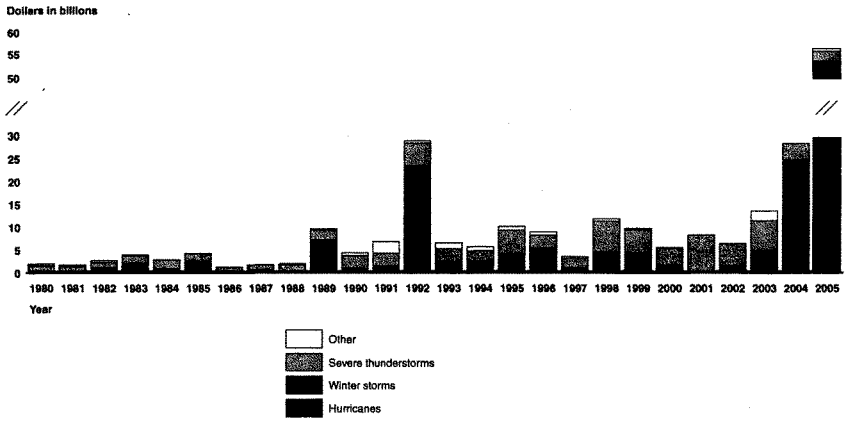


Sources: GAO anaylsis of PCS, NFIP, and FCIC data.

Privately-Insured Losses

Of the $321.2 billion in weather-related loss payments we reviewed, private insurers paid $243.5 billion—over three-quarters of the total.[18] Figure 5 depicts the breakdown of these payments among key weather-related events. Of the $243.5 billion paid by private insurers, hurricanes accounted for $124.6 billion, or slightly more than half. Wind, tornados, and hail associated with severe thunderstorms accounted for $77 billion, or nearly one-third of the private total. Winter storms were associated with $25.1 billion, or about 10 percent.

Figure 5: Weather-Related Losses Paid by Private Insurers



Source: GAO analysis of PCS data.

[18]Property Claim Services (PCS), an authority on insured property losses, maintains a database of estimated losses determined to be "catastrophes"—that is, loss events larger than $25 million that affect a significant number of policyholders. PCS estimates include losses under personal and commercial property insurance policies and typically include payments made on behalf of state-administered risk pools. PCS data are described in greater detail in appendix I.

Federally-Insured Losses

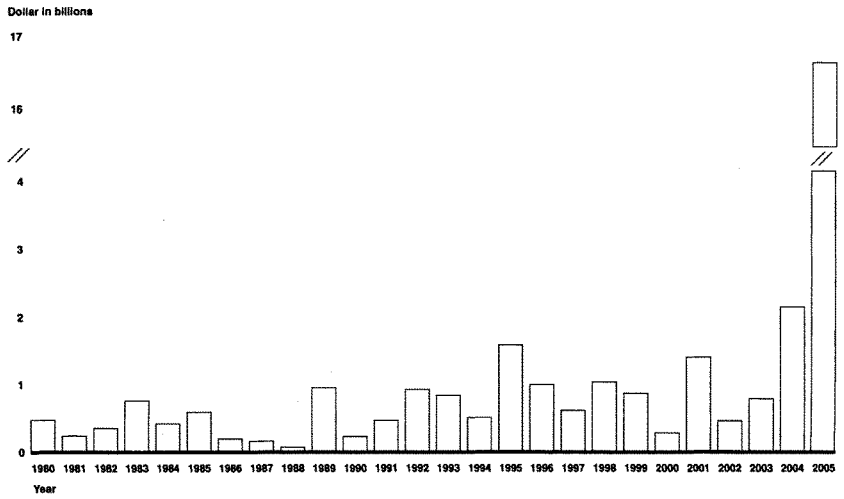
The two major federal insurance programs—NFIP and FCIC—paid the remaining $77.7 billion of the $321.2 billion in weather-related loss payments we reviewed.[19] Although the performance of both NFIP and FCIC is sensitive to weather, the two programs insure fundamentally different risks and operate in very different ways.

NFIP provides insurance for flood damage to homeowners and commercial property owners in more than 20,000 communities. Homeowners with mortgages from federally regulated lenders on property in communities identified as being in high flood risk areas are required to purchase flood insurance on their dwellings. Optional, lower cost flood insurance is also available under the NFIP for properties in areas of lower flood risk. NFIP offers coverage for both the property and its contents, which may be purchased separately.

NFIP claims totaled about $34.1 billion, or about 11 percent of all weather-related insurance claims during this period. As shown in figure 6, NFIP covers only one cause of loss—flooding. Claims averaged about $1.3 billion per year, but ranged from $75.7 million in 1988 to $16.7 billion in 2005.

[19]Appendixes II and III provide additional information about the structure and operation of FCIC and NFIP. Importantly, totals only reflect what was paid during this time—some losses incurred in 2005 may be omitted from this data set.

Figure 6: Weather-Related Losses Paid by NFIP

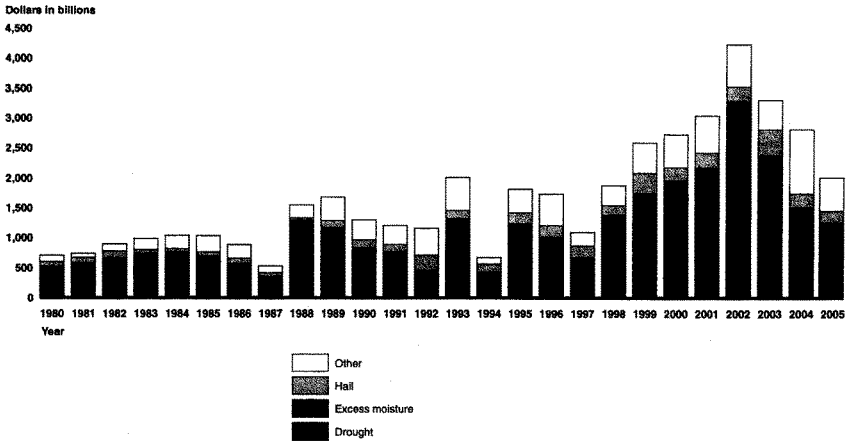


Source: GAO anaylsis of NFIP data.

FCIC insures commodities on a crop-by-crop and county-by-county basis based on farmer demand for coverage and the level of risk associated with the crop in a given region. Over 100 crops are covered by the program. Major crops, such as grains, are covered in almost every county where they are grown, and specialty crops, such as fruit, are covered only in some areas. Participating farmers can purchase different types of crop insurance, including yield and revenue insurance, and at different levels. For yield insurance, participating farmers select the percentage of yield of a covered crop to be insured and the percentage of the commodity price received as payment if the producer's losses exceed the selected threshold. Revenue insurance pays if actual revenue falls short of an assigned target level regardless of whether the shortfall was due to low yield or low commodity market prices.

Since 1980, FCIC claims totaled $43.6 billion, or about 14 percent of all weather-related claims during this period. FCIC losses averaged about $1.7 billion per year, ranging from $531.8 million in 1987 to $4.2 billion in 2002. Figure 7 shows the three causes of loss—drought, excess moisture, and hail—that accounted for more than three-quarters of crop insurance claims. In particular, drought accounted for $18.6 billion in losses, or more than 40 percent of all insured crop losses. Excess moisture totaled $11.2 billion, followed by hail with total claims of $4.2 billion. The remaining $9.6 billion in claims was spread among 27 different causes of loss, including frost and tornados.

Figure 7: Weather-Related Losses Paid by FCIC



Source: GAO analysis of FCIC data.

Insured Losses Understate Total Economic Damage

Importantly, the insured loss totals used in our analysis do not account for all economic damage associated with weather-related events.[20] Specifically, data are not available for several categories of economic losses, including uninsured, underinsured, and self-insured losses. As we reported in 2005, FEMA estimates that one-half to two-thirds of structures in floodplains do not have flood insurance because the uninsured owners either are unaware that homeowners insurance does not cover flood damage, or they do not perceive a serious flood risk.[21] Furthermore, industry analysts estimate that 58 percent of homeowners in the United States are underinsured—that is, they carry a policy below the replacement value of their property—by an average of 21 percent.[22] Finally, some individuals and businesses have the means to "self-insure" their assets by assuming the full risk of any damage.

Various public and private disaster relief organizations provide assistance to communities and individuals who suffer noninsured economic losses, although it was beyond the scope of this report to collect data on these losses. In particular, since 1989, $78.6 billion in federal disaster assistance funds have been obligated through the Disaster Relief Fund administered by FEMA, the largest—but not only—conduit for federal disaster assistance money provided in the wake of presidentially declared disasters and emergencies.

Overall, according to data obtained from Munich Re, one of the world's largest reinsurers, the type of insured losses we reviewed account for no more than about 40 percent of the total losses attributable to weather-related events.[23] NOAA's National Hurricane Center (NHC) uses a similar proportion to produce the agency's estimates of total economic damage

[20]Weather-related damages are also responsible for many indirect and non-market impacts that are not entirely accounted for, if at all, in economic terms, such as environmental damage. See NAS, *The Impacts of Natural Disasters: A Framework for Loss Estimation* (Washington, D.C.: 1999), 55-64.

[21]GAO, *Catastrophe Risk: U.S. and European Approaches to Insure Natural Catastrophe and Terrorism Risks*, GAO-05-199 (Washington, D.C.: Feb. 28, 2005), 61.

[22]Estimate was produced by Marshall & Swift/Boeckh, a leading supplier of local building cost information, residential and commercial property valuation services for the property and casualty insurance sector in the United States. GAO did not independently evaluate the reliability of this estimate.

[23]Munich Re, *Topics 2000: Natural Catastrophes—the Current Position*. Geoscience Research Group (Munich, Germany: 1999).

attributable to hurricanes.[24] Although we did not independently evaluate the reliability of these estimates, subject area experts we spoke with confirmed that it was the best such estimate available and is widely used as an approximation of the relative distribution of losses.

The difficulties we and others faced in accounting for weather-related losses were the subject of the National Academies' *The Impacts of Natural Disasters: A Framework for Loss Estimation.*[25] Reporting how best to account for the costs of natural disasters, including weather-related events, NAS found that there was no system in place in either the public or the private sectors to consistently capture information about the economic impact. Specifically, the NAS report found no widely accepted framework, formula, or method for estimating these losses. Moreover, NAS found no comprehensive clearinghouse for the disaster loss information that is currently collected. To that end, NAS recommended that the Office of Management and Budget, in consultation with FEMA and other federal agencies, develop annual, comprehensive estimates of the payouts for disaster losses made by federal agencies. Reviewing the status of this recommendation was beyond the scope of this report. Nevertheless, our experience with trying to obtain comprehensive information on disaster costs and losses underscores the NAS findings.

Catastrophic Weather-Related Events Help Explain the Significant Year-to-Year Variance in Losses

The largest insured losses in the data we reviewed were associated with catastrophic weather events. These events have a low probability of occurrence, but their consequences are severe. Notably, both crop insurers and other property insurers face the catastrophic risks posed by extreme events, although the nature of the events for each is very different. In the case of crop insurance, drought accounted for more than 40 percent of all insured losses from 1980 to 2005, and the years with the largest losses were associated with drought. Taken together, though, hurricanes were the most damaging event experienced by insurers in the data we reviewed. Although the United States experienced an average of only two hurricanes per year from 1980 through 2005, weather-related claims attributable to hurricanes totaled more than 45 percent of *all* weather-related insured losses—more than $146 billion. Moreover, these losses appear to be increasing.

[24]NHC estimates total losses by extrapolating from insured losses by assuming they account for approximately 50 percent of total losses.

[25]NAS (1999), 1.

In the data we reviewed, the years with the largest insured losses were generally associated with major hurricanes, defined as Category Three, Four, or Five on the Saffir-Simpson Hurricane Scale. Table 2 shows that, while 29 Category One and Two storms account for nearly $18 billion in losses, the 21 major storms account for over $126 billion in losses. In fact, claims associated with major hurricanes comprised 40 percent of all weather-related insured losses since 1980.

Table 2: Insured Losses Associated with Hurricanes

Dollars in thousands

	Categories One, Two	Categories Three, Four, Five	Total
1980s	$807,422 (11)	$9,905,042 (6)	**$10,712,464 (17)**
1990s	9,038,801 (11)	29,099,303 (8)	**38,138,104 (19)**
2000s	8,071,619 (7)	89,210,093 (7)	**97,281,712 (14)**
Total	**$17,917,842 (29)**	**$128,214,438 (21)**	**$146,132,280 (50)**

Sources: GAO analysis of PCS and NFIP data; NOAA (hurricane intensity classification).

Note: Totals do not include crop losses associated with hurricanes. Number of hurricanes associated with losses is included in parentheses. Hurricane classification was based on peak intensity at landfall.

Importantly, hurricane severity is only one factor in determining the size of a particular loss—the location affected by the hurricane is also important. Generally, the more densely populated an area, the greater the extent of economic activity and accumulated value of the building stock. For instance, several studies have reviewed the economic impact of Hurricane Andrew, which tracked over Florida in 1992, in light of the dramatic real estate development that has occurred in the meantime. Researchers have normalized losses associated with the storm to account for societal changes by holding constant the value of building materials, real estate, and other factors so that the storm's impact could be adjusted to reflect contemporary conditions.[26] Hurricane Andrew, which resulted in roughly $25 billion in total economic losses in 1992, would have resulted in more than twice that amount—$55 billion—were it to have occurred in 2005, given current asset values.

[26]A normalization provides an estimate of the damage that would occur if storms from the past affected the same location under the societal conditions of another year.

Several recent studies have commented on the apparent increases in hurricane losses during this time period, and weather-related disaster losses generally, with markedly different interpretations. Some argue that loss trends are largely explained by changes in societal and economic factors, such as population density, cost of building materials, and the structure of insurance policies.[27] Others argue that increases in losses have been driven by changes in climate.[28]

To address this issue, Munich Re and the University of Colorado's Center for Science and Technology Policy Research jointly convened a workshop in Germany in May 2006 to assess factors leading to increasing weather-related loss trends.[29] The workshop brought together a diverse group of international experts in the fields of climatology and disaster research. Among other things, the workshop sought to determine whether the costs of weather-related events were increasing and what factors account for increasing costs in recent decades.

Workshop participants reached consensus on several points, including that analyses of long-term records of disaster losses indicate that societal change and economic development are the principal factors explaining observed increases in weather-related losses.[30] However, participants also agreed that changing patterns of extreme events are drivers for recent increases in losses and that additional increases in losses are likely given IPCC's projected increase in the frequency or severity of weather-related events.

[27]See, for example, Roger A. Pielke, Jr., "Disasters, Death, and Destruction: Making Sense of Recent Calamities," *Oceanography*, vol. 19, no. 2 (2006); Stanley A. Changnon et al., "Human Factors Explain the Increased Losses from Weather and Climate Extremes," *Bulletin of the American Meteorological Society*, vol. 81, no. 3 (2000); and Roger A. Pielke, Jr., and Christopher W. Landsea, "Normalized Hurricane Damages in the United States: 1925–95," *Weather and Forecasting*, vol. 13 (1998).

[28]See, for example, Evan Mills, Richard J. Roth, Jr., and Eugene Lecomte, *Availability and Affordability of Insurance Under Climate Change: A Growing Challenge for the U.S.* (Boston, Mass.: December 2005); Paul Epstein and Evan Mills, eds., *Climate Change Futures: Health, Ecological, and Economic Dimensions* (Boston, Mass.: November 2005); and Cynthia Rosenzweig et al., "Increased Crop Damage in the U.S. from Excess Precipitation Under Climate Change," *Global Environmental Change*, vol. 12 (2002).

[29]Peter Höppe and Roger Pielke, Jr., eds., *Report of the Workshop on Climate Change and Disaster Losses: Understanding and Attributing Trends and Projections*, Hohenkammer, Germany, May 25-26, 2006 (Munich, Germany: October 2006).

[30]Consensus statements agreed to at the workshop are listed in their entirety in appendix IV.

Value at Risk in Federal Insurers' Portfolios Increased Significantly between 1980 and 2005

The growth in population in hazard-prone areas, and consequent real estate development and increasing real estate values, are leaving the nation increasingly exposed to higher insured losses. The close relationship between the value of the resource exposed to weather-related losses and the amount of damage incurred may have ominous implications for a nation experiencing rapid growth in some of its most disaster-prone areas. We reported in 2002 that the insurance industry faces potentially significant financial exposure due to natural catastrophes.[31] Heavily populated areas along the Northeast, Southeast, and Texas coasts have among the highest value of insured properties in the United States and face the highest likelihood of major hurricanes. According to insurance industry estimates, a large hurricane in Miami could cause up to $110 billion in insured losses with total losses as high as $225 billion. Several states—including Florida, California, and Texas—have established programs to help ensure that coverage is available in areas particularly prone to these events.[32]

AIR Worldwide, a leading catastrophe modeling firm, recently reported that insured losses should be expected to double roughly every 10 years because of increases in construction costs, increases in the number of structures, and changes in their characteristics. AIR's research estimates that, because of exposure growth, probable maximum catastrophe loss grew in constant dollars from $60 billion in 1995 to $110 billion in 2005, and it will likely grow to over $200 billion during the next 10 years.

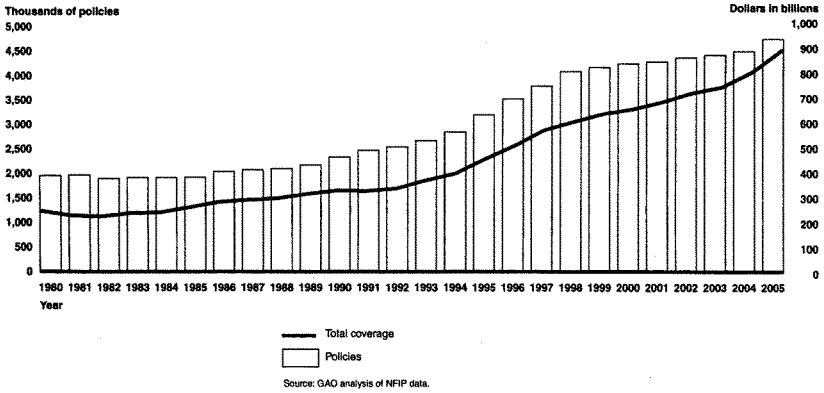
Data obtained from both the NFIP and FCIC programs indicate the federal government has grown markedly more exposed to weather-related losses regardless of the cause. For example, NFIP data show that the number of policyholders and the value of the properties insured have both increased since 1980. Figure 8 shows the growth of NFIP's exposure in terms of both number of policies and the total coverage. The number of policies has more than doubled in this time period, from 1.9 million policies to more than 4.6 million. Moreover, although NFIP limits coverage to $250,000 for a personal structure and $100,000 for its contents, and $500,000 of coverage

[31]GAO, *Catastrophe Insurance Risks: The Role of Risk-Linked Securities and Factors Affecting Their Use*, GAO-02-941 (Washington, D.C.: Sept. 24, 2002), 3.

[32]Past GAO work provided information on the Florida Hurricane Catastrophe Fund, California Earthquake Authority, and the Texas Windstorm Insurance Association. See GAO-02-941 and GAO, *Catastrophe Insurance Risks: Status of Efforts to Securitize Natural Catastrophe and Terrorism Risk*, GAO-03-1033 (Washington, D.C.: Sept. 24, 2003).

for a business structure and $500,000 on its contents, more policyholders' homes are approaching (or exceeding) these coverage limits. Accordingly, the total value covered by the program increased fourfold in constant dollars during this time from about $207 billion to $875 billion in 2005.

Figure 8: NFIP Policies and Total Coverage

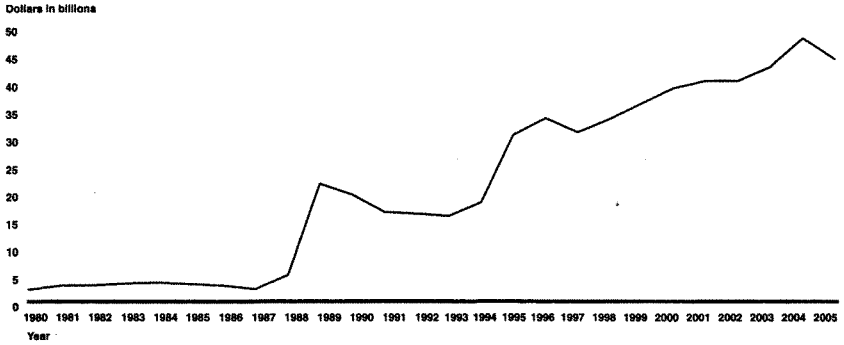


Source: GAO analysis of NFIP data.

Similarly, RMA data show that FCIC has effectively increased its exposure base 26-fold during this period (in constant dollars). In particular, the program has significantly expanded the scope of crops covered and increased participation. Figure 9 shows the growth in FCIC exposure since 1980.[33]

[33]To maintain comparability with other data, GAO did not adjust these data for changes in agricultural prices.

Figure 9: FCIC Total Coverage



Source: GAO analysis of FCIC data.

A senior RMA official told us that the main implication of FCIC's growth is that the magnitude of potential claims, in absolute terms, is much greater today than in the past. For example, if the Midwest floods of 1993 were to occur today, losses would be five times greater than the $2 billion paid in 1993, according to RMA officials.

Major Private and Public Insurers Differ in How They Manage Catastrophic Risks Associated with Climate Change

Although the relative contribution of event intensity versus societal factors in explaining the rising losses associated with weather-related events is still under investigation, both major private and federal insurers are exposed to increases in the frequency or severity of weather-related events associated with climate change. Nonetheless, major private and federal insurers are responding to this prospect differently. Many large private insurers are incorporating some elements of near-term climate change into their risk management practices. Furthermore, some of the world's largest insurers have also taken a long-term strategic approach toward changes in climate. On the other hand, for a variety of reasons, the federal insurance programs have done little to develop the kind of information needed to understand the programs' long-term exposure to climate change. We acknowledge the different mandate and operating environment in which the major federal insurance programs operate but believe that better information about the federal government's exposure to potential changes

in weather-related risk would help the Congress identify and manage this emerging high-risk area; one which may not constitute an immediate crisis but which may pose an important longer term threat to the nation's welfare.

Major Private Insurers Prospectively Manage Potential Increases in Catastrophic Risk Associated with Climate Change

Extreme weather events pose a unique financial threat to private insurers' financial success because a single event can cause insolvency or a precipitous drop in earnings, liquidation of assets to meet cash needs, or a downgrade in the market ratings used to evaluate the soundness of companies in the industry. To prevent these disruptions, the American Academy of Actuaries (AAA)—the professional society that establishes, maintains, and enforces standards of qualification, practice, and conduct for actuaries in the United States—has outlined a five-step process for private insurers to follow to manage their catastrophic risk. These steps include the following:

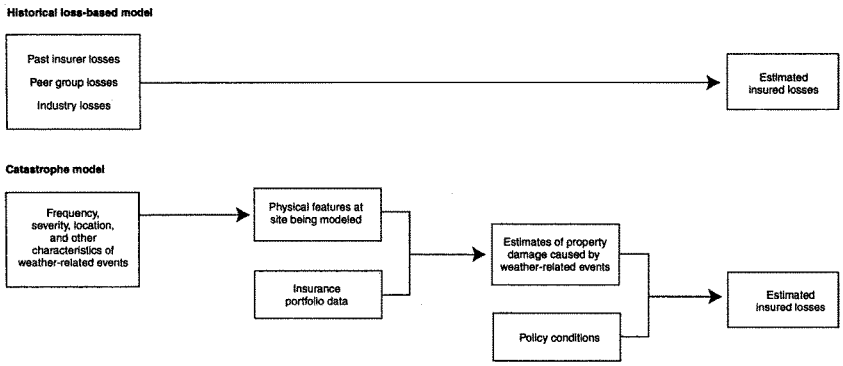
- identifying catastrophic risk appetite by determining the maximum potential loss they are willing to accept;
- measuring catastrophic exposure by determining how vulnerable their total portfolio is to loss, both in absolute terms and relative to the company's risk management goals;
- pricing for catastrophic exposure by setting rates to collect sufficient premiums to cover their expected catastrophic loss and other expenses;
- controlling catastrophic exposure by reducing their policies in areas where they have too much exposure, or transferring risk using reinsurance or other mechanisms; and
- evaluating their ability to pay claims by determining the sufficiency of their financial resources to cover claims in the event of a catastrophe.

Additionally, insurers monitor their exposure to catastrophic weather-related risk using sophisticated computer models called "catastrophe models."[34] AAA emphasizes the shortcomings of estimating future catastrophic risk by extrapolating solely from historical losses and

[34]There are three main catastrophe modeling firms: AIR Worldwide, Risk Management Solutions, and EQECAT. Although many of the insurers we interviewed use models from these firms, two of the eleven insurers have developed their own catastrophe models.

endorses catastrophe models as a more rigorous approach.[35] Catastrophe models incorporate the underlying trends and factors in weather phenomena and current demographic, financial, and scientific data to estimate losses associated with various weather-related events. According to an industry representative, catastrophe models assess a wider range of possible events than the historical loss record alone. These models simulate losses from thousands of potential catastrophic weather-related events that insurers use to better assess and control their exposure and inform pricing and capital management decisions. Figure 10 illustrates the difference between estimating future catastrophic losses using historical data versus catastrophe models.

Figure 10: Modeling Potential Catastrophe Losses



Sources: Adapted from the American Academy of Actuaries and Towers Perrin.

[35]American Academy of Actuaries, *Catastrophe Exposures and Insurance Industry Catastrophe Management Practices* (Washington, D.C.: American Academy of Actuaries, June 10, 2001), http://www.actuary.org/pdf/casualty/catastrophe_061001.pdf (downloaded Jan. 3, 2007), 10-12.

To determine what major private insurers are doing to estimate and prepare for risks associated with potential changes in climate arising from natural or human factors, we contacted 11 of the largest private insurers operating in the U.S. property casualty insurance market. Representatives from each of the 11 major insurers we interviewed told us they use catastrophe models that incorporate a near-term higher frequency and intensity of hurricanes. Of the 11 private insurers, 6 specifically attributed the higher frequency and intensity of hurricanes to the Atlantic Multidecadal Oscillation, which—according to NOAA—is a 20- to 40-year climatic cycle of fluctuating temperatures in the north Atlantic Ocean. The remaining 5 insurers did not elaborate on the elements of climate change driving the differences in hurricane characteristics.

Industry reports indicate that insurance companies' perception of increased risk from hurricanes has prompted them to reduce their near-term catastrophic exposure, in both reinsurance and primary insurance coverage along the Gulf Coast and eastern seaboard. For example, a recent industry analysis from a leading insurance broker reported that reinsurance coverage is substantially limited in the southeastern United States and that reinsurance prices have more than doubled from 2005 to 2006, following a record-setting hurricane season.[36] According to the Insurance Information Institute, a leading source of information about the insurance industry, primary insurance companies have also raised prices in coastal states to cover rising reinsurance costs.[37] Additionally, a recent report co-authored by a major international insurance company cites several examples of large primary insurers either limiting coverage or

[36]Guy Carpenter, *The World Catastrophe Reinsurance Market: Steep Peaks Overshadow Plateaus* (New York, N.Y.: Guy Carpenter, September 2006), http://www.guycarp.com/portal/extranet/insights/reports.html?vid=30 (downloaded Jan. 3, 2007).

[37]Insurance Information Institute, *Catastrophes: Insurance Issues* (New York, N.Y.: Insurance Information Institute, November 2006), http://www.iii.org/media/hottopics/insurance/xxx/ (downloaded Jan. 3, 2007).

withdrawing from vulnerable areas such as Florida,[38] the Gulf Coast, and Long Island.[39]

As private insurers limit their exposure, catastrophic risk is transferred to policyholders and the public sector. Insurance companies transfer risk to policyholders by increasing premiums and deductibles, or by setting lower coverage limits for policies. Insurers can also transfer risk to policyholders by passing along the mandatory participation costs of state-sponsored insurance plans.[40] For example, after the 2004 hurricane season, insurers assessed a surcharge of about 7 percent to every policyholder in Florida to recoup the cost of insurers' participation in the state-sponsored wind insurance plan. The public sector assumes management of weather-related risk at the local, state, and national level by providing disaster relief and recovery, developing mitigation projects, appropriating funds and, ultimately, providing insurance programs when private insurance markets are not sufficient or do not exist.

In addition to managing their aggregate exposure on a near-term basis, some of the world's largest insurers have also taken a long-term strategic approach to changes in catastrophic risk. For example, major insurance and reinsurance companies, such as Allianz, Swiss Re, Munich Re, and Lloyds of London, have published reports that advocate increased industry awareness of the potential risks of climate change and outline strategies to address the issue proactively. Moreover, 6 of the 11 private insurers we interviewed provided one or more additional activities they have undertaken when asked if their company addresses changes in climate through their weather-related risk management processes. These activities include monitoring scientific research (4 insurers), simulating the impact of a large loss event on their portfolios (3 insurers), and educating others

[38]Allianz Group and World Wildlife Fund, *Climate Change and Insurance: An Agenda for Action in the United States* (New York, N.Y.: Allianz Group and World Wildlife Fund, October 2006), http://www.allianz.com/en/allianz_group/sustainability/insight/studies_and_reports/page1.html?hits=reports (downloaded Jan. 4, 2007).

[39]The report notes that these decisions were due, in part, to state restrictions on rate increases that are designed to maintain insurance prices that are affordable, but may not accurately reflect the true potential for loss faced by the insured.

[40]Thirty-one states have FAIR plans, and six southern states have state-sponsored wind insurance plans that pool resources from insurers to cover the cost of coverage for their participants.

in the industry about the risks of climate change (3 insurers), among others.

Furthermore, recent research on insurers' activities to address climate change outlines several other actions that private sector companies are taking, such as developing specialized policies and new products, evaluating risks to company stock investments, and disclosing to shareholders information about company-specific risks due to climate change.[41] Additionally, concern over the potential impacts of climate change on the availability and affordability of private insurance has led state insurance regulators to establish a task force to formally address the issue. The report, issued by the NAIC, is expected to be published in the summer of 2007.

Major Federal Insurers Have Taken Little Action to Prospectively Assess Potential Increases in Catastrophic Risk Associated with Climate Change

The goals of the major federal insurance programs are fundamentally different from those of private insurers. Specifically, whereas private insurers stress the financial success of their business operations, the statutes governing the NFIP and FCIC promote affordable coverage and broad participation by individuals at risk. Although both programs manage risk within their statutory guidelines, unlike the private sector, neither program is required to limit its catastrophic risk strictly within the programs' ability to pay claims on an annual basis. One important implication of the federal insurers' risk management approach is that they each have little reason to develop information on their long-term exposure to the potential risk of increased low-frequency, high-severity weather events associated with climate change.

The statutes governing the NFIP and FCIC promote broad participation over financial self-sufficiency in two ways: (1) by offering discounted or subsidized premiums to encourage participation and (2) by making additional funds available during high-loss years.[42] For example, discounted insurance premiums are available under the NFIP for some older homes situated within high flood risk areas where insurance would

[41]Evan Mills and Eugene Lecomte, *From Risk to Opportunity: How Insurers Can Proactively and Profitably Manage Climate Change* (Boston, MA: Ceres, August 2006), http://www.ceres.org/pub/docs/Ceres_Insurance_Climate_%20Report_082206.pdf (downloaded Jan. 3, 2007), 34.

[42]Note that the federal government covers most, but not all, payments in the event of loss under the FCIC—insurance providers also share in the risk, as described in detail in appendix III.

otherwise have been prohibitively expensive. FEMA is also authorized to borrow additional federal funds for the NFIP on an as-needed basis, subject to statutory limits, to cope with catastrophes.[43] One effect has been that the NFIP's exposure has expanded well beyond the ability to pay claims in high-loss years.

Similar to the discounted premiums offered by the NFIP, the FCIC's subsidized premiums are designed to make crop insurance available and affordable to as many participants as possible. For example, the FCIC is mandated to provide fully subsidized catastrophic coverage for producers in exchange for a minimal administrative fee, as well as partial subsidies for additional levels of coverage. Also like the NFIP, the FCIC is authorized to use additional federal funds on an as-needed basis during high-loss years—although, unlike the NFIP, the FCIC is not required to reimburse those additional funds.

Unlike the private sector, the NFIP and the FCIC can use additional federal funds, and so neither program is required to assess and limit its catastrophic risk strictly within its ability to pay claims on an annual basis. Instead, each program manages its risk to the extent possible, within the context of its broader purposes, in accordance with its authorizing statutes and implementing regulations.[44] For example, the FCIC uses coverage limits, exclusions, and premium rates to meet their statutory goal of a long-term loss ratio no greater than 1.075—including premium subsidies.[45] Although the program has experienced high-loss years that required additional federal funds, over time, these high-loss years have been offset by low-loss years, which have allowed the program to meet its goal and build reserves.[46]

[43]The Congress increased the NFIP's borrowing authority from $1.5 billion to approximately $20.8 billion in the wake of unprecedented losses associated with the 2005 hurricane season.

[44]A detailed description of each program's risk management practices can be found in appendixes II and III for the NFIP and FCIC, respectively.

[45]Loss ratio, an indicator used to evaluate program performance, is calculated by dividing claims paid by total premiums collected. A loss ratio greater than 1.00 indicates that the program paid more in claims than was collected in premiums

[46]The FCIC's average loss ratio from 1995 through 2005 was 0.91. From 1981 through 1994, it was 1.47. See appendix III for more information on the FCIC's performance.

By developing a goal to generate sufficient revenue to pay for an average loss year, the NFIP has also been able to generate a surplus in low-loss years despite borrowing funds in high-loss years. In the past, the program has been able to repay borrowed funds with interest to the Department of the Treasury, however, it is unlikely FEMA will be able to repay the nearly $21 billion borrowed following the 2005 hurricane season based on the program's current premium income.

Although neither program faces the potential of financial ruin like the private sector, both programs have occasionally attempted to estimate their aggregate losses from potential catastrophic events. For example, FCIC officials stated that they had modeled past events, such as the 1993 Midwest floods, using current participation levels to inform negotiations with private crop insurers over reinsurance terms. NFIP and FCIC officials explained that these efforts were informal exercises and were not performed on a regular basis. FCIC officials also said they use a hurricane model developed by NOAA to inform pricing decisions for some commodities such as citrus crops, according to FCIC officials. However, unlike the catastrophic risk faced by private insurers, hurricane damages have not been a primary source of crop insurance claims.

According to NFIP and FCIC officials, their risk management processes adapt to near-term changes in weather as they affect existing data. As one NFIP official explained, NFIP is designed to assess and insure against current—not future—risks. Over time, agency officials stated, this process has allowed their programs to operate as intended. However, unlike the private sector, neither program has conducted an analysis to assess the potential impacts of an increase in the frequency or severity of weather-related events on their program operations over the near- or long-term.

Information on Federal Agencies' Long-term Exposure to Catastrophic Risk Could Better Inform Congressional Decision Making

While comprehensive information on federal insurers' long-term exposure to catastrophic risk associated with climate change may not inform the NFIP's or FCIC's annual operations, it could nonetheless provide valuable information for the Congress and other policymakers who need to understand and prepare for fiscal challenges that extend well beyond the two programs' near-term operational horizons. We have highlighted the need for this kind of strategic information in recent reports that have expressed concern about the looming fiscal imbalances facing the nation. In one report, for example, we observed that, "Our policy process will be

challenged to act with more foresight to take early action on problems that may not constitute an urgent crisis but pose important long-term threats to the nation's fiscal, economic, security, and societal future."[47] The prospect of increasing program exposure, coupled with expected increases in frequency and severity of weather events associated with climate change, would appear to pose such a problem.

Agency officials identified several challenges that could complicate their efforts to assess these impacts at the program level. Both NFIP and FCIC officials stated there was insufficient scientific information on projected impacts at the regional and local levels to accurately assess their impact on the flood and crop insurance programs. However, members of the insurance industry have analyzed and identified the potential risks climate change poses, despite similar challenges. Moreover, as previously discussed, both the IPCC and CCSP are expected to release significant assessments of the likely effect of increasing temperatures on weather events in coming months.

The experience of many private insurers, who must proactively respond to long-term changes in weather-related risk to remain solvent, suggests the kind of information that might be developed to help congressional and other policymakers in assessing current and alternative strategies. Specifically, to help ensure their future viability, a growing number of private insurers are actively incorporating the potential for climate change into their strategic level analyses. In particular, some private insurers have run a variety of simulation exercises to determine the potential business impact of an increase in the frequency and severity of weather events. For example, one insurer simulated the impact of large weather events occurring simultaneously. A similar analysis could provide the Congress with valuable information about the potential scale of losses facing the NFIP and FCIC in coming decades, particularly in light of the programs' expansion since 1980.

Conclusions

Recent assessments by leading scientific bodies provide sufficient cause for concern that climate change may have a broad range of long-term consequences for the United States and its citizens. While a number of key uncertainties regarding the timing, location, and magnitude of impacts

[47]GAO, *21st Century Challenges: Reexamining the Base of the Federal Government*, GAO-05-325SP (Washington, D.C.: February 2005), 77.

remain, climate change has implications for the fiscal health of the federal government, which already faces other significant challenges in meeting its long-term fiscal obligations. NFIP and FCIC are two major federal programs which, as a consequence of both future climate change and substantial growth in exposure, may see their losses grow by many billions of dollars in coming decades.

We acknowledge that to carry out their primary missions, these public insurance programs must focus on the near-term goals of ensuring affordable coverage for individuals in hazard-prone areas. Nonetheless, we believe the two programs are uniquely positioned to provide strategic information on the potential impacts of climate change—information that would be of value to key decision makers charged with such a long-term focus. Most notably, in exercising its oversight responsibilities, the Congress could use such information to examine whether the current structure and incentives of the federal insurance programs adequately address the challenges posed by potential increases in the frequency and severity of catastrophic weather events. While the precise content of these analyses can be debated, the activities of many private insurers already suggest a number of strong possibilities that may be applicable to assessing the potential implications of climate change on the federal insurance programs.

Recommendation for Executive Action

We recommend that the Secretary of Agriculture and the Secretary of Homeland Security direct the Administrator of the Risk Management Agency and the Under Secretary of Homeland Security for Emergency Preparedness to analyze the potential long-term implications of climate change for the Federal Crop Insurance Corporation and the National Flood Insurance Program, respectively, and report their findings to the Congress. This analysis should use forthcoming assessments from the Climate Change Science Program and the Intergovernmental Panel on Climate Change to establish sound estimates of expected future conditions. Key components of this analysis may include: (1) realistic scenarios of future losses under anticipated climatic conditions and expected exposure levels, including both potential budgetary implications and consequences for continued program operation and (2) potential mitigation options that each program might use to reduce their exposure to loss.

Agency Comments and Our Evaluation

We provided a draft of this report to the Departments of Agriculture (USDA), Commerce, Energy, and Homeland Security (DHS) for their review. DHS agreed via email with the report's recommendation, noting that conducting an assessment of the impact of climate change beyond FEMA's current statistical modeling (which is based on historical loss experience) could be helpful if resources were available to pursue such an analysis.

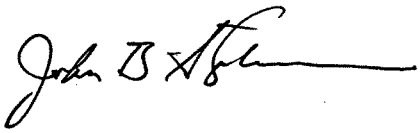
USDA also agreed with the report's recommendation, and commented on the presentation of several findings. (See app. V for the letter from the Under Secretary for Farm and Foreign Agricultural Services and GAO's point-by-point response.) In particular, USDA disagreed that it had thus far taken little action to prospectively assess potential increases in catastrophic risk associated with climate change. USDA explained that RMA does assess both the current and long-term exposure of the crop insurance program to catastrophic weather events, noting specifically that RMA (1) updates and publishes total program liability on a weekly basis and (2) estimates expected changes in liability up to 10 years ahead through its baseline projections. We acknowledge these activities, but believe it is important to note that they are limited in scope, focusing almost exclusively on retrospective measures of performance and not on the potential for increasingly frequent and intense weather-related events. These events, including drought and heavy precipitation events, are the key events acknowledged by USDA as posing catastrophic risk to the crop insurance program. Moreover, other RMA efforts to capture changes in weather-related risk rely on data reflecting what has been experienced in the past, not on what could be experienced in the future.

The Department of Commerce neither agreed nor disagreed with the report's findings, but instead offered several comments on the presentation of several issues in the draft (particularly the depth in which several issues are discussed) as well as technical comments. We have incorporated these comments as appropriate and address them in detail in appendix VI. Notably, the Department of Commerce underscored the vulnerability of high-risk coastal development, stating that such vulnerabilities will only be amplified by climate change-related increases in the frequency or severity of weather-related events.

Finally, the Department of Energy elected not to provide comments on the draft.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the Secretaries of Agriculture, Commerce, Energy, and Homeland Security, as well as other interested parties. We also will make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you or your staff has any questions regarding this report, please contact me at (202) 512-3841 or stephensonj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors are listed in appendix VII.



John B. Stephenson
Director, Natural Resources and Environment

Appendix I: Scope and Methodology

We were asked us to (1) describe what is known about how climate change might affect insured and uninsured losses, (2) determine insured losses incurred by major federal agencies and private insurers and reinsurers resulting from weather-related events, and (3) determine what major federal agencies and private insurers and reinsurers are doing to assess and manage the potential risk of increased losses due to changes in the frequency and severity of weather-related events associated with climate change.

Scientific Literature

To address the first objective, we reviewed and summarized existing literature from significant policy-oriented scientific assessments from reputable international and national research organizations including the Intergovernmental Panel on Climate Change, National Academy of Sciences, and the multifederal agency U.S. Climate Change Science Program, as specified in table 3. It was beyond the scope of this report to independently evaluate the results of these studies.

Table 3: Key Policy-Oriented Scientific Assessments Reviewed by GAO

Organization	Publication
Intergovernmental Panel on Climate Change (IPCC)	• *Climate Change 2007: The Physical Science Basis, Summary for Policymakers* (2007) • *Climate Change 2001: Synthesis Report* (2001) • *Climate Change 2001: The Scientific Basis* (2001) • *Climate Change 2001: Impacts, Adaptation & Vulnerability* (2001)
Climate Change Science Program (CCSP)	• *Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences, Synthesis and Assessment Product 1.1* (2006)
National Academy of Sciences (NAS)	• *Surface Temperature Reconstructions for the Last 2,000 Years* (2006) • *Understanding and Responding to Climate Change: Highlights of National Academies Reports* (2006) • *Radiative Forcing of Climate Change: Expanding the Concept and Addressing Uncertainties* (2005) • *From Climate to Weather: Impacts on Society and Economy–Summary of a Forum, June 28, 2002, Washington, D.C.* (2003) • *Understanding Climate Change Feedbacks* (2003) • *Abrupt Climate Change: Inevitable Surprises* (2002) • *Climate Change Science: An Analysis of Some Key Questions* (2001)

Source: GAO.

Note: Publication year follows publication title in parentheses.

Insured Loss Data

To address the second objective, we analyzed insured loss data from January 1, 1980, through December 31, 2005, from the Federal Emergency Management Agency (FEMA) for the National Flood Insurance Program (NFIP); the Department of Agriculture's Risk Management Agency (RMA) for the Federal Crop Insurance Corporation (FCIC); and the Property Claim Services (PCS) for private property insurance. Through electronic testing and other means, we assessed the reliability of each of the data sets to determine whether the data were sufficiently reliable for our purposes. Specifically, we interviewed the sources for each of the data sets to gather information on how records were collected, processed, and maintained. Because not all catastrophes are weather-related, we excluded all events attributable to terrorist acts, tsunamis, earthquakes, and other nonweather-related losses, based on discussions with the data provider. To adjust for the general effects of inflation over time we used the chain-weighted gross domestic product price index to express dollar amounts in inflation-adjusted 2005 dollars. We reviewed any changes in data collection methodologies that have occurred over time, and evaluated the effect of any changes on our ability to report losses. We believe that these data are sufficiently reliable for the purpose of describing insured losses. We note, however, that these data likely understate the actual insured losses.

PCS

PCS data are estimates of insured losses, or claims paid by private insurance companies, for catastrophe loss events for the 50 states, as well as the District of Columbia, Puerto Rico, and the U.S. Virgin Islands. PCS defines "catastrophes" as events that, in their estimation, affect a significant number of policyholders and that cause more than $25 million in damages. To identify catastrophes, PCS reviews daily weather reports and wire service news stories to determine if potentially damaging weather has occurred anywhere in the nation. PCS contacts adjusters, insurance claims departments, or public officials to gather additional information about the scope of damage and potential insured losses for events. Damages associated with a single storm event are grouped together as a single catastrophe, even if they are separated by distance. PCS obtains its insured loss data from information reported by insurers. PCS estimates include losses under personal and commercial property insurance policies covering real property, contents, business interruption, vehicles, and boats. PCS estimates also typically include amounts paid by state wind pools, joint underwriting associations, and certain other residual market mechanisms, such as Fair Access to Insurance Requirements (FAIR) plans. However, PCS estimates do not include damage to uninsured or self-insured property including uninsured publicly

owned property and utilities; losses involving agriculture, aircraft and property insured under NFIP or certain specialty lines (such as ocean marine), or loss adjustment expenses. Generally, PCS finalizes its estimates within 6 months of the occurrence of a PCS-identified catastrophe, according to company documents. PCS does not independently verify or audit the accuracy of the reported losses. Thus, loss totals are the best estimates of primary insurers compiled by PCS professionals, and may or may not accurately and completely reflect actual industry-insured losses. Nevertheless, PCS has determined their data to be very close to other independent estimates. PCS officials said that, when compared with state insurance commissioners' estimates based on all loss data from insurance companies following particularly large catastrophes, PCS data are within 3 to 5 percent of actual amounts. For the data used in our review, company officials told us that most estimates included in the data provided to us are final, except the 2005 hurricanes.

NFIP

NFIP data are actual claim payment totals, not estimated amounts. NFIP data represent the budget outlays that satisfy claims submitted by NFIP policyholders to their participating program companies. The companies report these data to the NFIP on a monthly basis. According to a senior program official, the Department of Homeland Security performs periodic audits of company records reported to NFIP. Although nearly all claims in the NFIP data we reviewed are considered closed by the agency (and, therefore, final), a small portion of claims associated with 2004 and 2005 hurricane season are not reflected in data we reviewed, according to the agency's database manager.

FCIC

The loss data provided by FCIC represent the actual amount paid to policyholders, not estimates. FCIC data represent the budget outlays that satisfy claims submitted by policyholders to their participating insurance companies. Participating insurance companies submit claims information for processing through a computerized validation system. Automated processing of claims information occurs annually for a period going back 5 years, but agency officials said that indemnities may have changed after automated processing closed in very specific cases, such as settlement of litigation or arbitration cases.

Identifying Insured Losses Associated with Hurricanes

To determine the insured losses associated with major and nonmajor hurricanes, we identified losses associated with hurricanes in both the PCS and NFIP data sets. We used the name and year of each hurricane to link loss records to information from the National Oceanic and Atmospheric Administration (NOAA) on the peak intensity of each hurricane at or near landfall.

Independent Studies

We supplemented our descriptive analysis with a review of existing literature and the views of subject area experts on the primary drivers of changes in the weather-related loss record in general. Given the data challenges faced by natural hazard researchers, the data sets used in these studies are generally different.

Interviews with Major Insurers

To address the third objective, we conducted semistructured interviews with officials from the NFIP, RMA, and a nonprobability sample of the largest private property/casualty primary insurance and reinsurance companies as defined by national market share. In the private sector, 11 out of 14 potential respondents elected to participate, drawing from companies in the United States, Europe, and Bermuda. Although the results from this sample should not be generalized to represent all insurance companies, the companies we interviewed represent about 45 percent of the total domestic insurance market. In developing our semistructured questionnaire, we reviewed existing literature on risk assessment and management practices, GAO guidance on risk management, and interviewed subject area experts knowledgeable about the insurance industry and federal insurance programs. Insurance industry experts included representatives from insurance brokers, catastrophe modeling firms, industry associations, the Insurance Information Institute, and academics. To reduce response error, we pretested our questions for clarity, relevancy, and sensitivity with representatives from several insurance industry associations, including the American Insurance Association, the National Association of Mutual Insurance Companies, the Property Casualty Insurance Association of America, and the Reinsurance Association of America. On the basis of feedback from the pretests, we modified the questions as appropriate. We distinguished proactive risk management responses to climate change from other responses according to whether insurers indicated that they were adjusting their activities based on projected changes in underlying weather trends rather than adapting only as changes in weather conditions reveal themselves in historical data. During our interviews, some private insurers attributed their actions to changes in the Atlantic Multidecadal Oscillation (AMO).

Because NOAA considers the AMO to be a climatic cycle, we categorized the actions of these insurers as responding to climate change.

We asked the participating federal agencies and private insurance and reinsurance companies to identify individuals knowledgeable about their weather-related risk management practices for our interviews. Based on these criteria, we spoke with a range of senior officials and representatives that included actuaries, underwriters, catastrophe specialists, regulatory affairs and counsel. During the interviews, we asked a series of questions about risk assessment and management practices for weather-related risk, significant drivers of changes to past and future weather-related risk, respondents' perception of and actions to address climate change in their risk management processes, and risk management best practices that might be transferable to federal insurers.

We also interviewed officials from rating agencies, catastrophe modeling firms, insurance industry associations, the National Association of Insurance Commissioners, and universities to provide additional context for respondents' statements. To supplement our interviews, we reviewed documentary evidence of risk management practices from federal agencies, studies from subject area experts, industry reports, publicly available insurance company documents, and previous work from GAO to provide context and support for respondents' statements.

We performed our work between February 2006 and January 2007 in accordance with generally accepted government auditing standards.

Appendix II: National Flood Insurance Program

Floods are the most common and destructive natural disaster in the United States. According to NFIP statistics, 90 percent of all natural disasters in the United States involve flooding. Because of the catastrophic nature of flooding and the inability to adequately predict flood risks, private insurance companies largely have been unwilling to underwrite and bear the risk of flood insurance. As a result, flooding is generally excluded from homeowner policies that cover damages from other types of losses, such as wind, fire, and theft.

The NFIP was established in 1968 to address uninsured losses due to floods. Prior to the establishment of the NFIP, structural flood controls on rivers and shorelines (e.g., dams and levees) and disaster assistance for flood victims were the federal government's primary tools for addressing floods. The Mississippi River Commission, created in 1879 to oversee the development of a levee system to control the river's flow, was the first of these federal efforts to address flooding. Due to the limited effectiveness of structural flood controls, continued development in flood-prone areas, and a desire to reduce postdisaster assistance payments, the Congress began examining the feasibility of prefunding flood disaster costs via federal insurance in the 1950s. Although the first federal flood insurance program authorized by the Congress in 1956 failed due to lack of funding, a series of powerful hurricanes and heavy flooding on the Mississippi River in the early 1960s prompted the Congress to revisit the issue and direct the Department of Housing and Urban Development (HUD) to conduct a feasibility study of a federal flood insurance program. The 1966 HUD feasibility study helped lead to the passage of the National Flood Insurance Act of 1968,[1] which authorized the creation of the NFIP.[2]

Since its inception, the NFIP has undergone several major changes in response to significant flood events. Hurricane Agnes in 1972 led to the mandatory flood insurance requirements on certain persons in flood-prone areas included in the Flood Disaster Protection Act of 1973, which also significantly increased coverage limits in a further effort to increase participation.[3] Following the Midwest floods of 1993, the Congress enacted the National Flood Insurance Reform Act of 1994, which strengthened

[1]Pub. L. No. 90-448, 82 Stat. 573.

[2]Senate Committee on Banking and Currency, *Insurance and Other Programs for Financial Assistance to Flood Victims*, 89th Cong., 2d Sess., 1966, Committee Print.

[3]Pub. L. No. 93-234, 87 Stat. 975 (1973).

lender compliance requirements with mandatory purchase provisions requiring mortgage-holders in flood-prone areas to purchase flood insurance and prohibited flood disaster assistance for properties that had not maintained their mandatory coverage.[4] In 2004, recognizing that losses from repetitive flooding on some insured properties was straining the financial condition of the NFIP, the Congress passed the Flood Insurance Reform Act of 2004, which provided NFIP with additional tools to reduce the number and financial impact of these properties.[5] These tools include: increased authorization of funding for mitigation of repetitive loss properties and statutory authority to penalize policyholders who refuse government assistance to mitigate certain structures that have been substantially or repetitively damaged by flooding, among others. Recently, the Congress has begun exploring additional changes to the NFIP to address the financial and operational challenges presented by the 2005 hurricane season.

How the Program Works

FEMA, within the Department of Homeland Security (DHS), is responsible for the oversight and management of the NFIP.[6] Under this program, the federal government assumes the liability for covered losses and sets rates and coverage limitations, among other responsibilities.

The NFIP combines three elements: (1) property insurance for potential flood victims, (2) mapping to identify the boundaries of the areas at highest risk of flooding, and (3) incentives for communities to adopt and enforce floodplain management regulations and building standards (such as elevating structures) to reduce future flood damage. The effective integration of all three of these elements is needed for the NFIP to achieve its goals of

[4]Pub. L. No. 103-325, 108 Stat. 2255 (1994).

[5]The Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, Pub. L. No. 108-264, 118 Stat. 712.

[6]In March 2003, FEMA and its approximately 2,500 staff became part of the Department of Homeland Security (DHS). Most of FEMA—including its Mitigation Division, which is responsible for administering the NFIP—is now part of the department's Emergency Preparedness and Response Directorate. However, FEMA retained its name and individual identity within the department. Under a reorganization plan proposed by the current Secretary of DHS, the Emergency Preparedness and Response Directorate would be abolished, and FEMA would report directly to the Undersecretary and Secretary of DHS.

- providing property flood insurance coverage for a high proportion of property owners who would benefit from such coverage,
- reducing taxpayer-funded disaster assistance when flooding strikes, and
- reducing flood damage through floodplain management and the enforcement of building standards.

Over 20,000 communities across the United States and its territories participate in the NFIP by adopting and agreeing to enforce state and community floodplain management regulations to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners and other property owners in these communities. As of 2005, the program had over 4.9 million policyholders, representing about $875 billion in assets. Homeowners with mortgages from federally regulated lenders on property in communities identified to be in high flood risk areas are required to purchase flood insurance on their dwellings. Optional, lower cost coverage is also available under the NFIP to protect homes in areas of low to moderate risk. The mandated coverage protects homeowners' dwellings only; to insure furniture and other personal property items against flood damage, homeowners must purchase separate NFIP personal property coverage.

Prior to the 2005 hurricanes, NFIP had paid about $14.6 billion in flood insurance claims, primarily from policyholder premiums that otherwise would have been paid through taxpayer-funded disaster relief or borne by home and business owners themselves. According to FEMA, every $3 in flood insurance claims payments saves about $1 in disaster assistance payments, and the combination of floodplain management and mitigation efforts save about $1 billion in flood damage each year.

To make flood insurance available on "reasonable terms and conditions to persons who have need for such protection,"[7] the NFIP strikes a balance between the scope of the coverage provided and the premium amounts required to provide that coverage. Policy coverage limits arise from statute and regulation, including FEMA's standard flood insurance policy (SFIP), which is incorporated in regulation and issued to policyholders when they purchase flood insurance. As of 2006, FEMA estimated 26 percent of its policies were subsidized, and 74 percent were charged "full-risk premium"

[7] 42 U.S.C. § 4001(a)(4).

rates. In 1981, FEMA set the operating goal of generating premiums at least sufficient to cover losses and expenses relative to the "historical average loss year." However, the heavy losses from the 2005 hurricane season may increase the historical average loss year to a level beyond the expected long-term average. In light of this, FEMA is currently revisiting the use of the historical average loss year as a premium income target.

Risk Assessment Practices

The NFIP uses hydrologic models to estimate loss exposure in flood-prone areas, based on the method outlined in the 1966 HUD report, *Insurance and Other Programs for Financial Assistance to Flood Victims*.[8] These techniques of analysis were first developed by hydrologists and hydraulic engineers to determine the feasibility of flood protection.

The hydrologic method uses available data on the occurrence of floods and flood damages to establish both the frequency of flood recurrence and the damage associated with a flood of a given height. The NFIP augments available flood data with detailed engineering studies, simulations, and professional judgment to establish the scientific and actuarial basis for its risk assessment process and rates.

Flood-elevation frequency data for specific communities is published in Flood Rate Insurance Maps, which differentiate areas based on their flood risk. These maps are the basis for setting insurance rates, establishing floodplain management ordinances, and identifying properties where flood insurance is mandatory.

To estimate expected annual losses and determine the basis for rate setting, NFIP combines flood-elevation frequency data with depth-damage calculations to estimate a range of flood probabilities and associated damages. Each possible flood is multiplied by the expected damage should such a flood occur, and then each of these is added together. The total of each possible flood's damage provides an expected per annum percentage of the value of property damage due to flooding. This expected damage can then be converted to an expected loss per $100 of property value covered by insurance. This per annum expected loss provides the fundamental component of rate setting. Rates are also adjusted to

[8]Senate Committee on Banking and Currency, *Insurance and Other Programs for Financial Assistance to Flood Victims*.

incorporate additional expense factors, such as adjustment costs and deductibles.

Program Funding

To the extent possible within the context of its broader purposes, the NFIP is expected to pay operating expenses and flood insurance claims with premiums collected on flood insurance policies rather than with tax dollars. However, as we have reported, the program is not actuarially sound by design because the Congress authorized subsidized insurance rates to be made available for policies covering certain structures to encourage communities to join the program. As a result, the program does not collect sufficient premium income to build reserves to meet the long-term future expected flood losses.[9] FEMA has statutory authority to borrow funds from the Department of the Treasury to keep the NFIP solvent.[10] Prior to the 2005 hurricane season, FEMA had exercised its borrowing authority four times, when losses exceeded available fund balances. For example, FEMA borrowed $300 million to pay an estimated $1.8 billion on flood insurance claims resulting from the 2004 hurricane season. Following hurricanes Katrina, Rita, and Wilma, FEMA estimates it will need to borrow nearly $21 billion dollars to cover outstanding claims. Although FEMA has repaid borrowed funds with interest in the past, FEMA does not expect to be able to meet the $1 billion in annual interest payments for these borrowed funds.

[9]GAO, *Flood Insurance: Information on the Financial Condition of the National Flood Insurance Program*, GAO-01-992T (Washington, D.C.: July 19, 2001).

[10]See 42 U.S.C. § 4016.

Appendix III: Federal Crop Insurance Corporation

In general, farm income is determined on the basis of farm production and prices, both of which are subject to wide fluctuations due to external factors. Because a substantial part of farming depends on weather, farm production levels can vary substantially on an annual basis. Commodity prices are also subject to significant swings due to supply and demand on the domestic and international markets. The Congress created FCIC in 1938 to administer a federal crop insurance program on an experimental basis to temper the weather effects of the dust bowl and the economic effects of the Great Depression.[1]

The federal crop insurance program protects participating farmers against financial losses caused by droughts, floods, or other natural disasters. Until 1980, the federal crop insurance program was limited to major crops in the nation's primary production areas. The Federal Crop Insurance Act of 1980 expanded crop insurance both in terms of crops and geographic areas covered.[2] The expansion was designed to allow the disaster assistance payment program provided by the government under previous farm bills to be phased out. To encourage participation, the 1980 act required a 30 percent premium subsidy for producers who purchased coverage up to the 65 percent yield level. Despite the subsidies, program participation remained low, and the Congress authorized several ad hoc disaster payments between 1988 and 1993. Congressional dissatisfaction with the size and frequency of these payments prompted the Congress to pass the Federal Crop Insurance Reform Act of 1994, which mandated participation in the crop insurance program as a prerequisite for other benefits, including agriculture price support payments.[3] The 1994 act also introduced catastrophic risk protection coverage, which compensated farmers for losses exceeding 50 percent of their average yield at 60 percent of the commodity price. Premiums for catastrophic risk protection coverage were completely subsidized, and subsidies for other coverage levels were also increased.

As part of the 1996 Farm Bill, the Congress created the Office of Risk Management under the U.S. Department of Agriculture (USDA), and USDA established RMA to administer the FCIC insurance programs, among other

[1]Federal Crop Insurance Act, tit. V, 52 Stat. 72 (1938) (codified as amended at 7 U.S.C. §§ 1501-1524).

[2]Pub. L. No. 96-365, 94 Stat. 1312 (1980).

[3]Pub. L. No. 103-354, 108 Stat. 3178 (1994).

things.[4] The Congress also required the creation of a revenue insurance pilot project and repealed the mandatory participation provision of the 1994 Act. However, participation in the crop insurance program has not necessarily precluded the need for further disaster assistance. For example, due to low commodity prices in 1997 and multiple years of natural disasters, the Congress enacted an emergency farm financial assistance package totaling almost $6 billion in 1998, which included over $2 billion in crop disaster payments, and an $8.7 billion financial assistance package in 1999 that included $1.2 billion in crop disaster payments.

In 2000, the Congress enacted the Agricultural Risk Protection Act, which further increased subsidies for insurance above the catastrophic risk protection coverage level, subsidized a portion of the cost of revenue insurance products, improved coverage for farmers affected by multiple years of natural disasters, required pilot insurance programs for livestock farmers, and authorized pilot programs for growers of other commodities not currently covered, gave the private sector greater representation on the FCIC Board of Directors, reduced eligibility requirements for permanent disaster payment programs for noninsured farmers, and provided new tools for monitoring and controlling program abuses, among other provisions.[5] These changes required $8.2 billion in additional spending from fiscal years 2001 through 2005.

How the Program Works

RMA has overall responsibility for supervising the federal crop insurance program, which it administers in partnership with private insurance companies. Insurance policies are sold and completely serviced through approved private insurance companies that have their losses reinsured by USDA. These companies share a percentage of the risk of loss or opportunity for gain associated with each insurance policy written. In addition, RMA pays companies a percentage of the premium on policies sold to cover the administrative costs of selling and servicing these policies. In turn, insurance companies use this money to pay commissions to their agents who sell the policies and fees to adjusters when claims are filed. RMA oversees the development of new insurance products and the expansion of existing insurance products to new areas to help farmers reduce the chance of financial loss.

[4]Pub. L. No. 104-127, 110 Stat. 888 (1996).

[5]Pub. L. No. 106-224, 114 Stat. 358 (2000).

The USDA determines whether the federal crop insurance program will insure a commodity on a crop-by-crop and county-by-county basis, based on farmer demand for coverage and the level of risk associated with the crop in the region, among other factors. Over 100 crops are covered; major crops such as grains are covered in almost every county where they are grown, and specialty crops such as fruit are covered in some areas. For many commodities, producers may also purchase revenue insurance. Based on commodity market prices and the producer's production history, producers are assigned a target revenue level. The producer receives a payment if their actual revenue falls short of the target level, whether the shortfall was due to low yield or low prices. Premiums for revenue insurance are subsidized at the same level as traditional crop insurance policies.

Farmers' participation in the federal crop insurance program is voluntary, but the federal government encourages it by subsidizing the insurance premiums. Participating farmers are assigned a "normal" crop yield based on their past production history and a commodity price based on estimated market conditions. The producer selects both the percentage of yield to be covered and the percentage of the commodity price received as payment if the producer's losses exceed the selected threshold. Premium prices increase as levels of yield and price coverage rise. However, all eligible producers can receive fully subsidized catastrophic risk protection coverage that pays producers for losses exceeding 50 percent of normal yield, at a level equal to 55 percent of the estimated market price, in exchange for a $100 administrative fee. Producers who purchase this coverage can buy additional insurance at partially subsidized rates up to 85 percent of their yield and 100 percent of the estimated market price.

As an alternative, the Group Risk Plan provides coverage based on county yields rather than a producer's actual production history. If county yield falls below the producer's threshold yield (a percentage of the historical county yield), then the producer receives a payment.

Risk Assessment Practices

RMA's risk assessment/rate-setting methodology is complex because the risk of growing a particular crop varies by county, farm, and farmer. Because of all the possible combinations involved, hundreds of thousands of rates are in place. Each year, RMA follows a multistep process to establish rates for each crop included in the program. The process involves establishing base rates for each county crop combination and adjusting these basic rates for a number of factors, such as coverage and

production levels. In addition, rates are adjusted to account for the legislated limitations in price increases.

For each crop, RMA extracts data on counties' crop experience from its historical database. The data elements for each crop, crop year, and county include (1) the dollar amount of the insurance coverage sold, (2) the dollar amount of the claims paid, and (3) the average coverage level. The historical data are adjusted to the 65 percent coverage level (the most commonly purchased level of coverage) so that liability and claims data at different coverage levels can be combined to develop rates. Using the adjusted data, FCIC computes the loss-cost ratio for each crop in each county. The loss-cost ratio is calculated by dividing the total claim payments by the total insurance in force; the result is stated as a percentage.[6] To reduce the impact a single year will have on the average loss-cost ratio of each county, RMA caps the adjusted average loss-cost ratio for any single year at 80 percent of all years.[7] To establish the base rate for each county, the average for all the years since 1975 is calculated using the capped loss-cost ratios and a weighting process to minimize the differences in rates among counties.

Rates are further adjusted by: a disaster reserve factor, a surcharge for catastrophic coverage for each crop based on pooled losses at the state level,[8] a prevented planting factor, farm divisions, crop type, and differences in both average yield and coverage levels.[9]

[6]For example, if the claims paid in 1 year totaled $7.36 and the insurance in force was $100, the loss-cost ratio is 7.36 percent. The percentage represents the rate that would need to be charged per $100 of insurance coverage if total premiums are to equal the total claim payments for that year. In this example, the 7.36 percent indicates that a rate of $7.36 was required per $100 of insurance coverage sold.

[7]The excess of losses above the capped amount is pooled at the state level and reallocated to the counties. According to FCIC, this procedure is intended to reduce the variation of rates from one year to the next.

[8]The surcharge is established by pooling the amount of insurance in force and the claim payments for capped years with the highest loss-cost ratios in each county that were not factored into the county unloaded rates at the state level. These data are used to calculate a statewide surcharge for catastrophic coverage (pooled claims payments divided by pooled insurance in force). If the pooled losses at the state level exceed five points, the excess is returned to the counties and included in the county unloaded rate.

[9]Prevented planting factor adds a provision for losses due to crops that were never planted because of external factors not directly related to yield loss.

Program Funding

The crop insurance program is financed primarily through general fund appropriations and farmer-paid premiums. In addition to the premiums paid by producers, FCIC receives an annual appropriation to cover necessary costs for the program's premium subsidies, excess losses, delivery expenses, and other authorized expenses. According to USDA budget documents, for fiscal year 2005, insurance premium and administrative fee revenue from farmers was approximately $2.1 billion, and gross claims equaled almost $3.3 billion. Total government operating costs in fiscal year 2005 were approximately $3 billion.

RMA is required to set crop insurance premiums at actuarially sufficient rates, defined as a long-run loss ratio target of no more than 1.075. From its initial expansion in 1981 through 1994, the crop insurance program had an average loss ratio of 1.47 and paid roughly $3.2 billion in claims excess of subsidized premium income during that period.[10] From 1995 to 2005, the program had an average loss ratio of 0.91, and collected roughly $2.7 billion in subsidized premium excess of claims during that period. Excluding subsidies and measuring performance on the basis of a producer premium, from 1981 to 1994, the crop insurance program averaged a loss ratio of 1.93 and paid roughly $5.2 billion in claims excess of producer premium over that period; from 1995 to 2005, the program averaged a loss ratio of 2.15 and paid roughly $14.2 billion in claims excess of a producer premium during that period.

Generally, producers can purchase crop insurance to insure up to 85 percent of their normal harvest (yield), based on production history. In 2007, the USDA expects the FCIC to provide $48 billion in risk protection on 287 million acres nationwide, which represents approximately 80 percent of the nation's acres planted to principal crops. The USDA estimates this level of coverage will cost the federal government $4.2 billion in 2007.

[10]The Federal Crop Insurance Reform Act of 1994 mandated participation in the program to receive other commodity support payments, although this requirement was rescinded in 1996.

Appendix IV: Consensus Statement among Participants at 2006 Munich Re Workshop

Munich Re, one of the world's largest reinsurance companies, and the University of Colorado jointly convened an international workshop on climate change and disaster loss trends in May 2006 in Hohenkammer, Germany. The workshop brought together 32 experts in the fields of climatology and disaster research from 13 countries. White papers were prepared and circulated by 25 participants in advance of the workshop and formed the basis of the discussions. In the course of the event, participants developed a list of statements that each represent a consensus among participants on issues of research and policy as related to the workshop's two central organizing questions: (1) What factors account for increasing costs of weather related disasters in recent decades? and (2) What are the implications of these understandings, for both research and policy?

Consensus (unanimous) statements of the workshop participants:

1. Climate change is real, and has a significant human component related to greenhouse gases.

2. Direct economic losses of global disasters have increased in recent decades with particularly large increases since the 1980s.

3. The increases in disaster losses primarily result from weather related events, in particular storms and floods.

4. Climate change and variability are factors which influence trends in disasters.

5. Although there are peer reviewed papers indicating trends in storms and floods there is still scientific debate over the attribution to anthropogenic climate change or natural climate variability. There is also concern over geophysical data quality.

6. IPCC (2001) did not achieve detection and attribution of trends in extreme events at the global level.

7. High quality long-term disaster loss records exist, some of which are suitable for research purposes, such as to identify the effects of climate and/or climate change on the loss records.

8. Analyses of long-term records of disaster losses indicate that societal change and economic development are the principal factors responsible for the documented increasing losses to date.

9. The vulnerability of communities to natural disasters is determined by their economic development and other social characteristics.

10. There is evidence that changing patterns of extreme events are drivers for recent increases in global losses.

11. Because of issues related to data quality, the stochastic nature of extreme event impacts, length of time series, and various societal factors present in the disaster loss record, it is still not possible to determine the portion of the increase in damages that might be attributed to climate change due to greenhouse gas emissions.

12. For future decades the IPCC (2001) expects increases in the occurrence and/or intensity of some extreme events as a result of anthropogenic climate change. Such increases will further increase losses in the absence of disaster reduction measures.

13. In the near future the quantitative link (attribution) of trends in storm and flood losses to climate changes related to greenhouse gas emissions is unlikely to be answered unequivocally.

14. Adaptation to extreme weather events should play a central role in reducing societal vulnerabilities to climate and climate change.

15. Mitigation of greenhouse gas emissions should also play a central role in response to anthropogenic climate change, though it does not have an effect for several decades on the hazard risk.

16. We recommend further research on different combinations of adaptation and mitigation policies.

17. We recommend the creation of an open-source disaster database according to agreed upon standards.

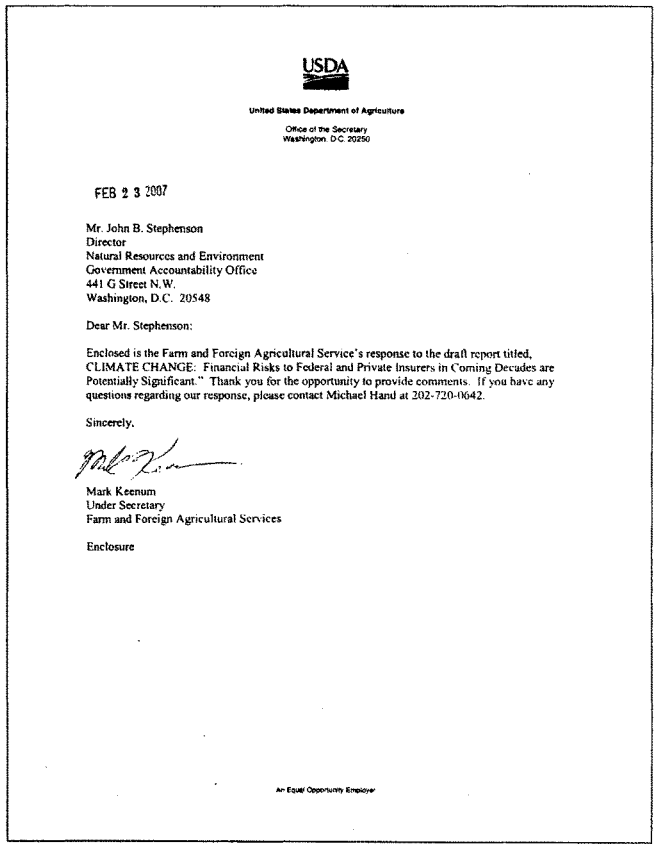
18. In addition to fundamental research on climate, research priorities should consider needs of decision makers in areas related to both adaptation and mitigation.

19. For improved understanding of loss trends, there is a need to continue to collect and improve long-term and homogenous data sets related to both climate parameters and disaster losses.

20. The community needs to agree upon peer reviewed procedures for normalizing economic loss data.

Appendix V: Comments from the U.S. Department of Agriculture

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



USDA

United States Department of Agriculture

Office of the Secretary
Washington, D.C. 20250

FEB 23 2007

Mr. John B. Stephenson
Director
Natural Resources and Environment
Government Accountability Office
441 G Street N.W.
Washington, D.C. 20548

Dear Mr. Stephenson:

Enclosed is the Farm and Foreign Agricultural Service's response to the draft report titled, CLIMATE CHANGE: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant." Thank you for the opportunity to provide comments. If you have any questions regarding our response, please contact Michael Hand at 202-720-0642.

Sincerely,

Mark Keenum
Under Secretary
Farm and Foreign Agricultural Services

Enclosure

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U.S. Department of Agriculture
Response to the
U.S. Government Accountability Office *Draft* Report GAO-07-285
"CLIMATE CHANGE: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant"

February 8, 2007

Weather-related events have caused billions of dollars in damage over the past decade. GAO examined actions taken by private and Federal insurers to address the potential increase in losses. As a result of the study, *GAO recommends that the United States Department of Agriculture (USDA), specifically the Risk Management Agency (RMA), analyze the potential long-term implications of climate change using forthcoming assessments from the Intergovernmental Panel on Climate Change to establish sound estimates of expected future conditions.*

USDA Response

USDA is in general agreement with GAO's recommendation.

Specific Comments

Although USDA agrees with GAO's recommendation, we do not agree with some of the conclusions drawn within the report.

See comment 1.

Much of the focus of this report is with losses related to coastal weather events, especially hurricanes. However, the main cause of catastrophic losses for the crop insurance program is drought in the nation's interior. This is why the loss experience of the crop insurance program is distinct from the loss experience described in the report for the National Flood Insurance Program and property and casualty losses for private insurers.

See comment 2.

The increase in crop insurance indemnities over time reflects the rapid growth of the crop insurance program, not an increase in either the frequency and/or severity of catastrophic weather events. In fact, the severity of loss for the crop insurance program, as measured by the loss ratio, has been generally lower in the 1990's and 2000's than in the 1980's. Thus, if anything, the frequency and severity of catastrophic loss events for the crop insurance program appears to be decreasing.

See comment 3.

USDA does not agree that it has "taken little action to prospectively assess potential increases in catastrophic risk associated with climate change." RMA tracks total program liability – a definitive measure of the total value at risk from climatic weather events. This number is updated on a weekly basis and is available on RMA's public website.

RMA also estimates expected changes in liability up to 10 years ahead through RMA's baseline projections. Therefore, RMA *does* assess the long-term, as well as current, exposure of the crop insurance program to catastrophic weather events.

See comment 4.

GAO's draft report treats the recurring 20- to 40-year Atlantic hurricane cycle as synonymous with climate change. However, other parts of the report describe climate change in terms of a long-run progression, such as global warming, that leads to an increase in frequency and severity of weather events. Referring to the normal cycle of Atlantic hurricanes as climate change appears to be inconsistent with how climate change is described in other parts of the report.

See comment 5.

When GAO surveyed private insurers about what they are doing to estimate and prepare for the risks of climate change, they found that insurers were using catastrophe models that incorporate the hurricane cycle. RMA also incorporates hurricane risk into premium rates for several of its insured commodities. However, rather than focusing on short-term fluctuations in the hurricane cycle, RMA uses historical hurricane data that spans several cycles.

The following are GAO's comments on the U.S. Department of Agriculture's letter dated February 23, 2007.

GAO Comments

1. We agree that the loss experiences of NFIP, FCIC, and private insurers are distinct and sought to reflect these distinctions in our draft report. For example, we acknowledged on page 23 of the draft the specific distinction USDA highlights—that the main cause of catastrophic losses for FCIC is drought in the nation's interior (see pages 24 and 25 of this document). Despite these and other differences, however, we believe the report's findings and underlying message are still applicable to the NFIP, the FCIC, and private insurers.

2. Our analysis of insured losses does not attempt to attribute increases in past losses to changes in the severity of weather events in the data sets we reviewed, as implied by the comment. Moreover, we acknowledge that the increase in FCIC's losses (indemnities) largely reflected the rapid growth of the crop insurance program. However, given the IPCC's projections for potential increase in the frequency and severity of weather-related events—including those that affect crops—we believe that limiting an evaluation of FCIC's *future* weather-related risk to the program's loss ratio—which only captures *historical* performance of the program based on past climatic and market conditions—to be a potentially misleading metric upon which to make a prospective assessment.

3. We acknowledged these activities in the draft report. However, we believe that USDA's actions are limited in scope, focusing almost exclusively on actuarial performance and not on the potential implications of climate change for FCIC's operations (i.e., changes in the frequency and severity of weather-related events, weather variability, growing seasons, and pest infestations). Accordingly, we believe the program should do more to prospectively assess the implications of climate change.

4. We employed the IPCC's definition of climate change, which includes statistically significant variations in climate, brought on by factors that are both internal and external to the earth's climate system, and that persist over time—typically decades or longer. Under this definition, the Atlantic hurricane cycle, as with other significant variations that are understood to be internal to the earth's climate system, can be considered climatic changes. Our use of the definition was corroborated by a senior NOAA scientist.

5. We updated our discussion of FCIC's modeling activities (see page 36) to reflect this hurricane model. However, as stated on page 22, 75 percent of FCIC's claims were associated with drought, excess moisture, and hail from 1980 to 2005, whereas hurricanes were associated with a much smaller portion of FCIC's claims during this period. Accordingly, we believe that if more sophisticated, prospective risk assessment techniques (such as those used in FCIC's hurricane model) were applied to drought, moisture, and hail events, it would allow for a far more useful assessment of the potential implications of climate change for FCIC's operations.

Appendix VI: Comments from the Department of Commerce

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

UNITED STATES DEPARTMENT OF COMMERCE
The Under Secretary of Commerce
for Oceans and Atmosphere
Washington, D.C. 20230

FEB 26 2007

Mr. John B. Stephenson
Director
Natural Resources and Environment
U.S. Government Accountability Office
441 G Street, NW
Washington, D.C. 20548

Dear Mr. Stephenson:

Thank you for the opportunity to review and comment on the Government Accountability Office's draft report entitled *Climate Change: Financial Risks to Federal and Private Insurers In Coming Decades are Potentially Significant* (GAO-07-285). Enclosed is the National Oceanic and Atmospheric Administration's comments on the draft report.

Sincerely,

Conrad Lautenbacher

Conrad C. Lautenbacher, Jr.
Vice Admiral, U.S. Navy (Ret.)
Under Secretary of Commerce for
Oceans and Atmosphere

Enclosure

THE ADMINISTRATOR

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Department of Commerce
National Oceanic and Atmospheric Administration
Comments on the Draft GAO Report Entitled
"Climate Change: Financial Risks to Federal and Private Insurers In Coming Decades are Potentially Significant"
(GAO-07-285/March 2007)

General Comments

The Department of Commerce (DOC) appreciates the opportunity to review this report. The issues covered in the report are very important and reflect the real world intersection between science, policy, and economics.

See comment 1.

We have three major comments on the structure of the report. First, GAO should provide a clear definition of the phrase "climate change" at the beginning of its report. While it is addressed on page 2, DOC recommends the authors refer to the definition provided by the 2007 Intergovernmental Panel on Climate Change (IPCC) Working Group 1:

> **IPCC Working Group 1 Climate Change Definition**
> Climate change refers to a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

See comment 2.

The second comment is directed to page 2 of the report and relates to the discussion of frequency and intensity of weather phenomenon. The authors write:

> "Regardless of the cause, increasing temperatures—accompanied by changes in other aspects of the climate—may impact communities and, by extension, the insurance industry by altering the frequency or severity of weather-related events such as hurricanes, tornadoes, severe thunderstorms and hail events, and wildfires."

While DOC recognizes the IPCC's Fourth Assessment Report was not available at the time of GAO's review, the issue of frequency and intensity has been well discussed in the scientific community, and policy makers would benefit from drawing information from the IPCC's Summary for Policy Makers for Working Group 1. According to page 10 of this summary, "there is insufficient evidence to determine whether trends exist…in small scale phenomena such as tornadoes, hail, lightning, and dust storms." The authors could state the frequency of heavy precipitation events has increased over most land areas… (page 8). On hurricanes, IPCC notes an increase in "intense tropical cyclone activity," but also mentions "there is no clear trend in the annual numbers of tropical cyclones," which refers to frequency. Tropical cyclones projections are addressed on page 16 of the summary, where the IPCC projects future tropical cyclones will become more intense, but there is less confidence in projections of a global decrease in numbers of tropical cyclones.

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See comment 3.

Further, DOC notes the report could be strengthened by a discussion of what is meant by "altering the frequency or severity of weather-related events" and how this is linked to risk. For example, altering either the frequency or severity of high impact extreme weather-related events could result in a five fold increase in risk for what has been considered a 500-year event (i.e., probability of occurring in a given year = 1/500) shifts under climate change to be a 100-year event (i.e., probability of occurring in a given year = 1/100).

See comment 4.

The third comment is the report should examine coastal development impacts more rigorously. The National Oceanic and Atmospheric Administration (NOAA) has done work that uses data from the Bureau of the Census to show coastal communities have seen population growth of nearly 40 million people from 1970 to 2000. The authors refer to Roger Pielke, Jr.'s work on coastal impacts, but cite it only to show that more intense hurricanes tend to have higher impacts. Pielke, Jr., and others, including Chris Landsea of NOAA and Kerry Emanuel of Massachusetts Institute of Technology, have examined hurricanes, climate change, and development, and found coastal development has increased the vulnerability to winter storm surge, wind damage, and hurricanes. These vulnerabilities, due to high risk coastal development, will only be amplified by climate change related increases in the frequency or severity of high impact extreme weather-related events.

The authors cite anecdotal evidence, such as increased development in the area hit by Hurricane Andrew, but the report lacks analysis of the long term trends and does not quantify what portion of the increase in losses is attributable to societal change and economic development as referenced on page 58 in the Munich Re consensus statement. This would be useful information for policy makers.

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The following are GAO's comments on the Department of Commerce's letter dated February 26, 2007.

GAO Comments

1. We agree that a clear and accurate definition of *climate change* is a necessary prerequisite for any discussion of the issue. While a variety of definitions for the term are in use, we did not attempt to independently define the term. Rather, we relied upon the IPCC's most current publicly-available definition.

2. We revised the introductory statement referred to in Commerce's comments for editorial purposes (see page 2). To the extent practicable, we also incorporated the Working Group I Summary for Policymakers of the IPCC's *Fourth Assessment Report* into the detailed discussion of the potential changes in the frequency and severity of weather-related events identified in the 2001 *Third Assessment Report* (see pages 8 to 13).

3. We included an elaboration on page 14 of how altering the frequency and severity of weather-related events is linked to risk.

4. It was outside the scope of this report to conduct our own quantitative trend analysis of the relative roles of societal factors (such as development or agricultural prices) and climate change in shaping the increases in weather-related insured losses observed in the data. In response to the comment, however, we clarified which studies we reviewed that addressed this question, both for coastal hazards (such as hurricanes) and inland hazards (such as drought and excess moisture).

Appendix VII: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the individual named above, Steve Elstein, Assistant Director; Chase Huntley; Alison O'Neill; Michael Sagalow; and Lisa Van Arsdale made key contributions to this report. Charles Bausell, Jr.; Christine Bonham; Mark Braza; Lawrence Cluff; Arthur James, Jr.; Marisa London; Justin Monroe; and Greg Marchand also made important contributions to this report.

We also wish to give special tribute to our dear friend and colleague, Curtis Groves, who died many years too soon after a long battle with multiple myeloma near the conclusion of our work.

Related GAO Products

National Flood Insurance Program: New Processes Aided Hurricane Katrina Claims Handling, but FEMA's Oversight Should Be Improved. GAO-07-169. Washington, D.C.: December 15, 2006.

Catastrophic Disasters: Enhanced Leadership, Capabilities, and Accountability Controls Will Improve the Effectiveness of the Nation's Preparedness, Response, and Recovery System. GAO-06-618. Washington, D.C.: September 6, 2006.

Crop Insurance: More Needs To Be Done to Reduce Program's Vulnerability to Fraud, Waste, and Abuse. GAO-06-878T. Washington, D.C.: June 15, 2006.

High-Risk Program. GAO-06-497T. Washington, D.C.: March 15, 2006.

Federal Emergency Management Agency: Improvements Needed to Enhance Oversight and Management of the National Flood Insurance Program. GAO-06-119. Washington, D.C.: October 18, 2005.

Crop Insurance: Actions Needed to Reduce Program's Vulnerability to Fraud, Waste, and Abuse. GAO-05-528. Washington, D.C.: September 30, 2005.

Catastrophe Risk: U.S. and European Approaches to Insure Natural Catastrophe and Terrorism Risks. GAO-05-199. Washington, D.C.: February 28, 2005.

21st Century Challenges: Reexamining the Base of the Federal Government. GAO-05-325SP. Washington, D.C.: February 2005.

Climate Change: Information on Three Air Pollutants' Climate Effects and Emissions Trends. GAO-03-25. Washington, D.C.: April 28, 2003.

Statement by Eldon Gould
Administrator
Risk Management Agency
United States Department of Agriculture
Before the Senate Committee on Homeland Security and Governmental Affairs
Thursday, April 19, 2007

Introduction

Mr. Chairman and members of the Subcommittee, I am Eldon Gould, Administrator of the Risk Management Agency (RMA). I am a life-long farmer in northern Illinois, with a 1,500-acre corn, soybeans and wheat farm and a 700 sow farrow-to-wean hog operation.

I appreciate the opportunity to explain the role of the Federal crop insurance program as it relates to the financial risks to Federal and private insurers covering production agriculture.

Background

First, I would like to provide some background about the Risk Management Agency and its objectives. Some of you may know our structure and mission very well, while others may have only limited knowledge of our role with crop insurance.

As a vital part of USDA, the Risk Management Agency plays an essential role in American agriculture by promoting, supporting and regulating sound risk management solutions to preserve and strengthen the economic stability of America's agricultural producers.

RMA oversees and administers the crop insurance program via the Federal Crop Insurance Corporation (FCIC) led by its Board of Directors (Board). The FCIC reinsures the policies sold to American farmers by private insurance companies approved to participate in the delivery of the Federal crop insurance program. The agency has a unique partnership with 16 private insurance companies that are responsible for the sales, service and loss adjustment of the various insurance policies.

Under the direction of the FCIC Board, RMA provides new and innovative insurance products to the agricultural community, validates the utility of current insurance products, ensures outreach to small and limited resource farmers, promotes equity in risk sharing and guards against fraud, waste and abuse within the program.

Risk management tools extend beyond crop insurance, and include a variety of risk management options and strategies developed to assist producers in mitigating the risks inherent in agricultural production. Risk management may include: financial management tools to mitigate price and production risks; tools to enhance measurement and prediction of risks in order to facilitate risk diversification; and tools to improve production management, harvesting, record keeping or marketing.

Crop insurance is the government's principal means of helping farmers survive a major crop loss. It is also extremely useful to agricultural producers even when it is not paying losses. More and more, we see that crop insurance enables producers to secure approval of their

operating loans, aggressively market a portion of their crop and allow them to plan more reliably for their future.

For 2006, the Federal crop insurance program provided producers with nearly $50 billion in protection on approximately 242 million acres through about 1.1 million policies. There are 21 plans of insurance available and nearly 30 new insurance products under various stages of evaluation or development. Approximately 80 percent of acres of major program crops are insured, with many at levels of coverage equaling 70-85 percent of potential crop value.

USDA Response to GAO Report Recommendations

Regarding the recommendations contained in the GAO Report (07-285 Climate Change), RMA agrees with the need to analyze the long-term implications of climate change for the crop insurance program. We are particularly interested in the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report, which was released on April 6 and a report of the U.S. Climate Change Science Program (CCSP) that is expected to be released in December 2007. This IPCC report provides a rigorous assessment of what is known with regard to climate change impacts, adaptation and vulnerability.

As William Brennan, Director of the U.S. Climate Change Science Program stated, "This is a valuable report that our nation has contributed to in important ways through investments in observations and research." With regard to agriculture in North America, the IPCC report concludes that "moderate climate change in the early decades of the century is projected to increase aggregate yields of rainfed agriculture by 5-20%, but with important variability among regions. Major challenges are projected for crops that are near the warm end of their suitable range or depend on highly utilized water resources."

The Department of Agriculture is also an important contributor to the U.S. Climate Change Science Program. USDA is the lead agency for a CCSP Synthesis and Assessment Report on the Impacts of Climate Change on Agriculture, Land Resources, Water Resources and Biodiversity that is expected to be completed in December 2007. A primary goal of the report is to enhance our understanding and ability to estimate impacts of future climate change on these systems and resources in the United States. This report is being prepared by the Department's Global Change Program Office.

As RMA proceeds in its analysis of climate change, it is worth noting that any analysis will be complicated by the fact that agricultural technology is continually progressing, resulting in a decrease in risk from weather events (e.g. drought tolerant corn).

Although USDA agrees with GAO's recommendations, we caution that much of the focus of this report is with losses related to coastal weather events, especially hurricanes. However, the main causes of catastrophic losses for the crop insurance program are drought, excess moisture, freeze, etc. in the nation's interior. This is why the loss experience of the crop insurance program is distinct from the loss experience described in the report for the National Flood Insurance Program and property and casualty losses for private insurers.

In 2004, crop insurance provided approximately $3.2 billion in indemnity payments to farmers and ranchers, including approximately $218 million for the four hurricanes in the Southeast and approximately $337 million for a brief freeze in the upper Midwest. For 2005, indemnity payments totaled approximately $2.4 billion, with hurricane-related losses accounting for $234 million of the total. During the period 1996-2005, hurricanes accounted for approximately 2 percent of losses paid under the Federal crop insurance program. In 2005, one of the more active hurricane years, approximately 10 percent of program losses paid were related to hurricane damage. (See Figure 3.)

Much of the increase in crop insurance indemnities over time reflects the rapid growth of the crop insurance program, rather than an increase in either the frequency and/or severity of catastrophic weather events. In 1980, for example, total liability of the Federal crop insurance program was $3 billion, with insurance in force on about 21 million acres. By 2006, total liability had reached almost $50 billion, and insured acreage in excess of 242 million acres. The phenomenal growth in the program will quite clearly lead to much larger indemnity payments, as measured in dollars. Yet, the severity of loss for the crop insurance program, as measured by the loss ratio, has been generally lower in the 1990s and 2000s than in the 1980s. RMA's loss ratio for 1980-1993 was 1.58, while from 1994-2006 it has been 0.88. (See Figure 2.) This most likely relates to the generally good growing conditions experienced in many of the major crop areas for production agriculture as well as improved methods for establishing premium rates.

USDA does take prospective actions to assess potential increases in program risk associated with changes in weather and production agriculture. RMA continually analyzes available information to look for ways to improve its rating and program assessments. Currently, RMA tracks total program liability, a definitive measure of the total value at risk from climatic weather events, and updates this information on a weekly basis available on our public website.

RMA also estimates expected changes in liability up to 10 years ahead through RMA's budgetary baseline projections. In addition, RMA can assess the long-term, as well as current, exposure of the crop insurance program to catastrophic weather events as GAO has pointed out with regard to a recurring 1993 loss (i.e. flooding in the Mississippi River Valley).

When GAO surveyed private insurers about what they are doing to estimate and prepare for the risks of climate change, it found that insurers were using catastrophe models that incorporate the hurricane cycle. RMA also incorporates hurricane risk into premium rates for several of its insured commodities. However, rather than focusing on short-term fluctuations in the hurricane cycle, RMA uses historical hurricane data that spans several cycles, which is not dissimilar to how predictions centers, like Colorado State University, make use of such data. This is because RMA does not face the risk of insolvency, as do private insurers, should an unexpectedly large loss event occur. As a result, private insurers expend considerable time, money and resources on strategies to appropriately manage the attendant insolvency risk following catastrophic events, including larger reserve factors and preemptive rate loadings. The respective risks of bankruptcy account for much of the differences in approach to climate change on the part of private insurers as compared to public insurers, such as RMA.

New Crop Insurance Products: Pasture, Rangeland and Forage Pilot Program
Obviously, changes in weather patterns play a role in the Federal crop insurance program. Recognizing this role, FCIC is moving the Federal crop insurance program forward in adopting new technologies. For example, FCIC recently introduced a pilot insurance program for pasture, rangeland and forage that relies on weather station data and satellite imagery to monitor plant growth and determine insurance payments.

These new insurance tools will help farmers and ranchers, especially those with operations located in drought-impacted areas, to improve their risk management capabilities. Designed to operate in a variety of range and pasture environments, these products utilize innovative technology to determine when a producer has suffered a loss.

The Rainfall Index insurance program is being pilot tested in 220 counties in Colorado, Idaho, Pennsylvania, South Carolina, North Dakota and Texas and is based on rainfall indices as a means to measure expected production losses. The Vegetation Index insurance program is being pilot tested in 110 counties in Colorado, Oklahoma, Oregon, Pennsylvania, South Carolina and South Dakota and is based on satellite imagery that determines the productivity of the acreage as a means to measure expected production losses. Together, these pilot programs will be available to provide coverage on approximately 160 million of the 640 million acres of grazing land and hay land in the United States.

As of April 2, the sales of the new Pasture, Rangeland and Forage Rainfall Index and Vegetation Index pilot programs have exceeded first year sales projections. There have been 8,023 Rainfall Index policies sold covering over 24 million acres with over $328 million in total liability. The Vegetation Index pilot program's sales are at 1,687 policies sold covering over 3.9 million acres and $61.7 million in total liability. This puts participation in the pilot program areas at approximately 17 percent.

Conclusion
In conclusion, let me reiterate that RMA agrees with the GAO recommendations with regard to the need to analyze the long-term implications of climate change for the crop insurance program. RMA views the inclusion of new information and analysis as an opportunity to strengthen and improve the Federal crop insurance program.

As I have stated, Mr. Chairman, I am a producer myself and one of my goals as Administrator of RMA is to ensure that RMA is doing everything it can, within its legislated authority, to assist the farmer and rancher and keep rural America and its critical agricultural industry competitive and sound. We recognize that RMA is a critical component of the safety net for the business of agriculture in this country.

RMA continues to evaluate and provide new products and to promote the adoption of crop insurance as a risk management tool so that the government can further reduce the need for ad hoc disaster payments to the agriculture community.

The growth and effectiveness of the crop insurance program is dependent on a reliable delivery system; insurance products that meet the needs of producers; investment in information

technology to ensure the delivery system is timely, accurate and dependable; and adequate funding to support compliance and program integrity, maintenance and administration, product evaluation and new product development.

In 2007, we will continue to strive toward providing a useful, practical safety net for America's farmers and ranchers.

Again, thank you for the opportunity to participate in this important hearing. I look forward to responding to questions on these issues.

Figure 1

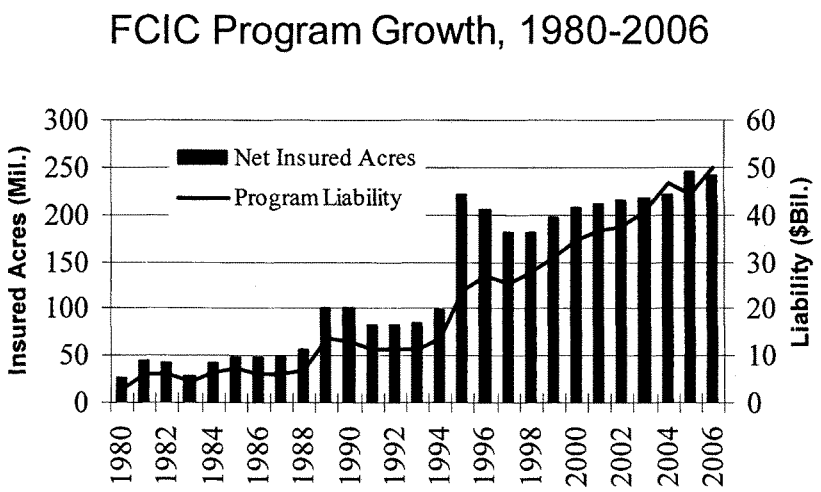


Figure 2

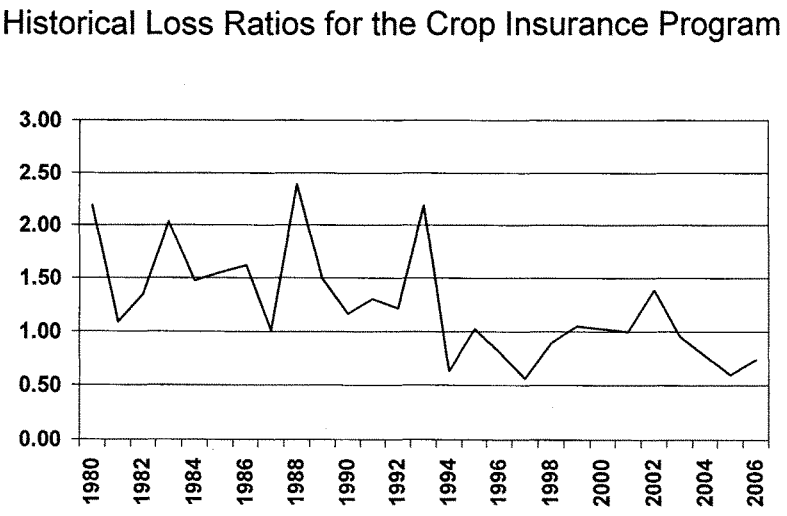
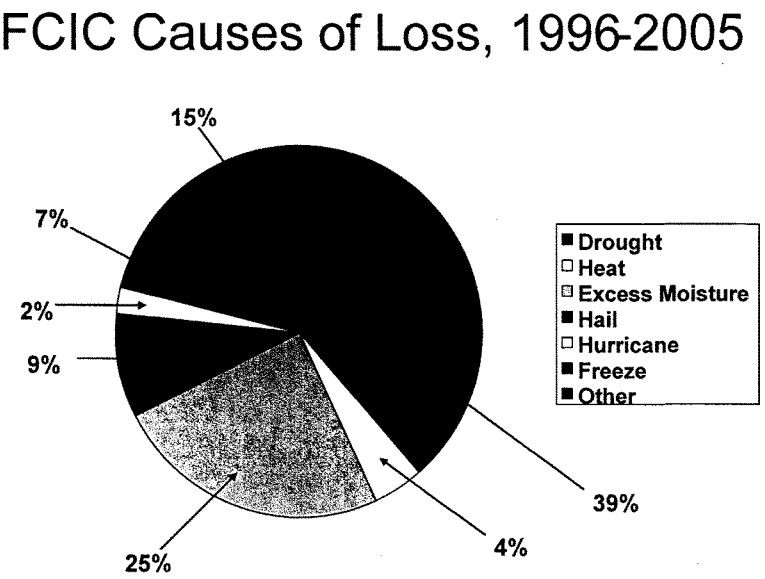
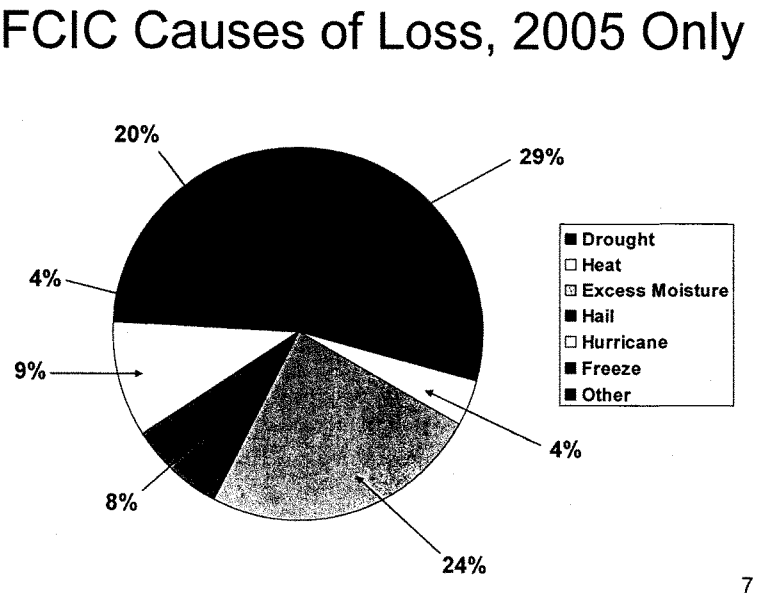


Figure 3


FCIC Causes of Loss, 1996-2005
15%
7%
2%
9%
25%
4%
39%
Drought
Heat
Excess Moisture
Hail
Hurricane
Freeze
Other


FCIC Causes of Loss, 2005 Only
20%
29%
4%
9%
8%
24%
4%
Drought
Heat
Excess Moisture
Hail
Hurricane
Freeze
Other

Testimony of
Michael Buckley
Deputy Assistant Administrator for Mitigation
Federal Emergency Management Agency
Department of Homeland Security
Before
The United States Senate
Committee on Homeland Security and Governmental Affairs
April 19, 2007

Good morning Chairman Lieberman, Ranking Member Collins, and Members of the Committee. I am Michael Buckley, Deputy Assistant Administrator for the Mitigation Directorate for the Federal Emergency Management Agency (FEMA) within the Department of Homeland Security. I appreciate the opportunity to appear today before the Committee to discuss the impact of climate change on the National Flood Insurance Program (NFIP).

As a cornerstone of FEMA's Mitigation strategy to help the Nation's communities reduce their vulnerability to weather-related hazard events, the NFIP is predicated on effectively planning ahead for a changing environment.

With an inherent ability to readily recognize, plan for, and respond to gradually changing environmental conditions – whether caused by human activity or natural variability – the NFIP's day-to-day operations are not likely to be affected by current climate change estimates. During an average historic-loss year, the NFIP covers claims with policyholder premiums and related fees. However, as climate change evaluations and discussions consider a future of more extreme weather activity, it is important to point out that the NFIP is not always self-supporting, and was

not designed to handle a catastrophic event without the authority to borrow from the Federal Treasury.

Understanding that the landscape is in a constant state of flux, the NFIP relies on effective floodplain management, extensive historical data, Flood Insurance Rate Maps (FIRMs) and the best available information to help people and communities understand the flood risks they face, take action to reduce those risks, and insure against such risk.

For example, FEMA is updating the NFIP's Flood Insurance Rate Map (FIRM) system; combining historical and current data with state-of-the-art technology to compile modern, digitized maps. These new, digital FIRMs can clearly depict – faster and more accurately than ever before – the dynamic landscape conditions that affect important flood insurance and floodplain management decisions. With continued, adequate funding, FEMA's Map Modernization Program will give the NFIP and the Nation's communities a reliable planning and floodplain management resource for years to come. Just as importantly, FEMA will be able to update digital FIRMs to clearly reflect the gradually changing landscape and climatic conditions that affect flood risk, providing valuable support to the NFIP's continuing effort to accurately and fairly set flood insurance rates.

The NFIP helps communities across the Nation implement and enforce safer construction measures so their residents and businesses can purchase flood insurance coverage, which the Federal government – through policyholder premiums – provides.

With over $1 trillion in insured assets and more than 5 million policyholders, the NFIP's land-use management and building code standards and guidelines help people and communities reduce their vulnerability to flooding, recover faster after floods, and protect their investments with a financial backstop. The NFIP requires participating communities to implement and maintain a standard, minimum set of building codes and floodplain management requirements, but the Program encourages NFIP communities to go beyond these minimum standards to effectively reduce their vulnerability. In fact, the NFIP's Community Rating System provides insurance rate discounts as incentives to NFIP communities that develop and implement floodplain management strategies that go beyond minimum NFIP requirements.

Of course, the NFIP is motivated to strike a balance between the long-term goal of fiscal accountability and the near-term objective of making sure that affordable flood insurance is available to residents and businesses located in flood-prone areas as Congress intended. Interestingly, the rather unique factors that help the NFIP offer affordable flood insurance coverage for everyone – discounts on pre-FIRM structures[1]; a 10 percent cap on annual premium increases; and our Federal obligation to provide coverage to all applicants, regardless of the degree of risk – also impede our efforts to strengthen the Program's financial condition. As policymakers consider climate change and other flood insurance-related matters, the NFIP stands ready to work with the Congress and others to improve the Program's stability.

Clearly, we are not prognosticators at the NFIP. Our risk management strategies are designed to assess and insure against current, not future, risks. However, that does not mean that the NFIP ignores the warnings associated with climate change. It simply means that the Program already

[1] Structures built prior to the mapping and implementation of NFIP floodplain management requirements. Discounted rates are charged on the first $35,000 of insured value because flood risks were not fully known to the property owner when the structure was built.

accounts for gradual environmental changes – regardless of their cause. This way, no matter how increasingly violent storms may become, fewer communities will be declared disaster areas – lives will be saved and damages reduced, recovery will be faster, and more homes and businesses will be protected with the financial safety net of flood insurance.

I will be happy to answer any questions that the Committee might have. Thank You.

April 19, 2007

Testimony of

Andrew Castaldi,
Senior Vice President, Head of Catastrophe Perils, Americas,
Swiss Reinsurance America Corporation

on

"Impact of Global Warming on Private and Federal Insurance"

before

The Senate Committee on Homeland Security

and

Governmental Affairs

I would like to thank Chairman Lieberman and Ranking Member Collins for holding this hearing on the impact of global warming on private and federal insurance. My name is Andrew Castaldi and I am representing Swiss Re, the largest reinsurer in North America and the world.

I am employed as the head of Swiss Re's catastrophe perils Americas team. The cat perils team is composed of natural scientists, engineers, and other experts who are dedicated to understanding the risk associated with worldwide natural hazards. In this role, we develop models that consider the economic and social impacts associated with natural hazards such as earthquake, wind, and flood.

Over the next 10 minutes I would like to share with you Swiss Re's view regarding climate change, how climate change may impact weather and natural catastrophes, how reinsurers model nat cat risk and finally a few words about

how we incorporate this information into our business.

Swiss Re's core property business includes mitigating the financial consequences of natural catastrophes such as hurricanes, earthquakes, and flooding. We provide life and property casualty reinsurance and products which facilitate the convergence of the insurance and capital markets. Our business is to assume the liabilities from others onto our balance sheet. Or to put it more simply – we take other companies' risk off their hands. As risk experts our time horizon stretches out 50-100 years.

Our interest in climate change began almost 20 years ago and it has become an important component of our long-term risk management strategy. We believe unequivocally that climate change presents an increasing risk to the world economy and social welfare. There is now indisputable scientific evidence that the earth's temperature is rising at an alarming rate and that this rise is due mainly to human activities. According to the Intergovernmental Panel on Climate Change, also known as the IPCC, it can be concluded now with a 90-95% probability that anthropogenic, or human produced, greenhouse gas increases from fossil fuel use, agriculture, and land-use changes have caused most of the observed increase in globally averaged temperatures since the mid-20th century. To put it simply, global warming is a fact and a robust response is required.

Climate change, over time, will affect weather and weather patterns. How it will affect severe weather events varies and depends upon the region of the world and natural hazard being evaluated. As an example, global warming suggests more extremes in weather, such as more intense rainfall or prolonged drought which may lead to more localized inland flooding or in the case of flood and drought, agricultural problems. Combining intense rainfall with rising ocean levels from melting polar land-ice and warming sea water will place much of our coastal properties at greater risk.

More to the interest of this panel, will global warming affect the annual frequency and severity of tropical cyclone activity? After the record setting experiences of 2004 and 2005, this is an often asked question. In 2005, we had more named North Atlantic storms and hurricanes than ever - 27. It was also the costliest hurricane season ever. The economic cost of Katrina alone was an estimated $135 billion. Rita, Wilma, and Katrina were the first, third and sixth strongest North American tropical cyclones on record.

Were the 2004 and 2005 seasons attributable to global warming? We do not know for sure. One or two years of experience is not enough to confirm a trend. But here is what we do know. On a world-wide basis, CO2 levels are up significantly and sea surface temperatures are higher too Hurricane severity is impacted by warmer waters. One recent study by Webster and Holland indicates a trend, since about 1970, toward more intense tropical cyclones. In the early 1970s, 17% of all tropical cyclones were category 4 or 5 hurricanes. That number has increased to 35% - an increase two times higher than it was just 35 years ago.

Today there are open questions. But, given its potentially catastrophic implications, the precautionary principle should be applied consistent with prudent risk management. It's quite clear that, if left unchecked, CO2 emissions will alter the natural variations of climate change and will affect US weather patterns and some natural catastrophes. Preventative action, therefore, must be taken today. If we wait until we have achieved absolute certainty, we run the risk of acting too late.

In many areas outside the Atlantic Tropical Cyclone basin, we see indications of global warming's impact on atmospheric hazards that are presently easier to quantify. In Europe, there is already enough evidence today to demonstrate that European winter storms have and will continue to increase with climate change. Swiss Re, and perhaps others, have incorporated these findings into our risk and

loss models for the European regions. Throughout the world our scientists continually monitor new studies on the subject and, once convinced, we incorporate the new science into our models. Presently, Swiss Re is collaborating with various research initiatives on the topic of how climate change will impact us here in the US and around the world.

In general, risk modeling varies depending upon the peril under study. For tropical cyclone wind and storm surge, Swiss Re starts with the historical database of the last 100+ years of storm activity and then considers the climate factors coinciding with each of those years. We use these historical records as a base and then apply current climate conditions in order to estimate the frequency and severity of tropical cyclones for future years. Very short term climate conditions are recognized too late to be incorporated into the models that the industry uses. Moderate term climate variability, such as the Atlantic Multi Decadal Oscillation (AMO) and other oscillations, cause a swing in the Atlantic sea surface temperatures and do correlate with hurricane intensity. The scientific community has not yet reached a consensus regarding the extent to which these oscillations are natural or exaggerated by human activities. Regardless of the cause, it is expected that the warm phase, which we are in now, correlates with increased hurricane activity. This warm phase is expected to last for the next 10-20 years.

This means we could be in for some bad weather for some time to come. Consequently industry models have been adjusted to bring them in line with the changing hazard and risk assessments. As a result, expected losses for natural peril covers in the US rose markedly. Modelers factored in a general increase in hurricane activity in the North Atlantic, regardless of cause, and quantified some other factors. These other aggravating factors include the following:

- increasing values and complexities associated with concentrations of risk in coastal regions,

- increasing vulnerability of assets and production processes, and
- increasing insurance penetration

These changes in risk assessment have prompted insurers and investors to take a more cautious look at the risks they take.

Some insurers have greatly limited their market participation in the Gulf Coast states. It is also true that Florida property owners are paying more for coverage than they did before. In light of these developments, some have suggested that natural catastrophes are not insurable in the private market and that a government backstop is required. This is not Swiss Re's view. Because these risks can be modeled by the private sector and are random in nature, they are insurable. The largest events can and have been adsorbed by the industry. We believe, therefore, that a government backstop for such risks is inappropriate public policy. There are steps the public sector can take to mitigate future damage including better zoning and building codes. These are key components to reducing our natural catastrophe vulnerability. We must all grapple with this new weather environment. We must recognize that we can no longer always build what we want or where we want.

Recognizing the importance of climate change, Swiss Re is deploying a broad strategy to confront the challenges including the following:

- working to understand the risk and adapting pricing and risk models accordingly
- developing products and services for mitigation and adaptation
- raising awareness especially with governments. We believe government must provide leadership by passing legislation to limit CO2 emissions and passing stricter and enforceable zoning and building codes and
- addressing our own environmental footprint by pledging to be

greenhouse neutral by 2013.

Swiss Re looks forward to sharing our knowledge and working with the Congress and other policymakers to develop workable and innovative ideas to bring more private capital to the insurance market.

Thank you for the opportunity to provide testimony on this critical issue.

TESTIMONY SUBMITTED

BY

DAVID R. CONRAD

SENIOR WATER RESOURCES SPECIALIST

NATIONAL WILDLIFE FEDERATION

TO THE

SENATE HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS COMMITTEE

FOR THE HEARING

DANGEROUS EXPOSURE: *THE IMPACT OF GLOBAL WARMING ON PRIVATE AND FEDERAL INSURANCE*

APRIL 19, 2007

I serve as the Senior Water Resources Specialist for the National Wildlife Federation, the nation's largest conservation education and advocacy organization, with four million members and supporters, and 47 state and territorial affiliate conservation organizations. We wish to applaud Chairman Lieberman, Ranking Member Collins, and the members of the Committee for holding this critically important hearing on the impacts of global warming on private and federal insurance, including the federal crop insurance and national flood insurance programs. For over 20 years, the National Wildlife Federation has been focused on efforts to address global warming and to reform the National Flood Insurance Program (NFIP).

On April 12, 2007, the National Wildlife Federation and Environmental Defense released the report, "America's Flood Risk is Heating Up," which chronicles the impacts of global warming on the nation's flood risk. The report emphasized the need for the U.S. Army Corps of Engineers to incorporate modern climate science as it plans and manages water resources projects, and it urged Congress to update the NFIP to reflect the new realities of global warming. We have called upon Congress to mandate that the Federal Emergency Management Agency (FEMA):

- Make the NFIP more actuarial and risk-based;
- Incorporate modern climate science in updating its antiquated flood maps and projecting future risk;
- Increase NFIP insurance rates to build a reserve fund;
- Require properties located behind levees and in other residual risk areas to buy flood insurance in case of a levee failure.

Global warming will have a significant impact on the private and public insurance industry. The recently released Intergovernmental Panel on Climate Change (IPCC) report's message is that global warming is expected to result in profound effects on water cycles – more droughts and floods in the West, more flooding in the East, and higher sea levels along all our coasts. On Sunday, April 15, 2007, we saw an intense storm in the Northeastern U.S. with 7.5 inches of rain falling in Central Park, the second wettest day ever-recorded since record-keeping began in 1869. Rain records were also set in Philadelphia and Baltimore. Winds were clocked at 72 mph in Milton, Massachusetts, 81 mph in Cape Elizabeth, Maine, and 156 mph at Mount Washington in New Hampshire.

The scientific community has agreed that weather events like this will become increasingly common because of global warming. In fact, at the National Press Club on April 17, 2007, IPCC report contributor Cynthia Rosenzweig of the Goddard Institute for Space Studies said that on the East Coast, rising sea levels and increasingly strong storms are "the number one vulnerability." She also warned that sea level rise and increased storms are "a very real threat that needs to be considered in all coastal development."

We appreciate your request for a Government Accountability Office (GAO) investigation of how private and public insurance programs are addressing global warming. The National Wildlife Federation has been especially engaged in efforts to reform the

National Flood Insurance Program (NFIP), and thus our comments will primarily focus on this important public insurance system.

We are greatly troubled by the GAO's findings that "federal insurance has done little to develop the kind of information needed to understand the programs' long-term exposure to climate change." When asked about FEMA's efforts to incorporate climate science into its programs, FEMA Deputy Assistant Administrator for Mitigation Michael Buckley declared that the NFIP "inherently incorporates gradual environmental changes." Yet, unlike the private insurance industry, FEMA's risk management modeling is based solely on historical data. Neither FEMA's risk models nor FEMA's floodplain maps implicitly or explicitly consider future conditions associated with climate change.

GAO's conclusions and Mr. Buckley's testimony provide a stark contrast to the practices of the private insurance industry. GAO found that 11 out of the 11 insurance companies interviewed incorporated near-term increases in frequency and intensity of hurricanes in their risk models. Mr. Castabaldi of Swiss Reinsurance America Corporation testified that his company projects risks 50 to 100 years in the future. He also stated that climate change has been an important component of the company's long-term risk strategy for the last 20 years. To model future risks, Swiss Re uses historical storm data and then considers the associated climate factors coinciding with each of those years. Swiss Re scientists use past climate conditions as a base, and then apply current conditions to estimate the frequency and severity of cyclones and other catastrophic weather events. The NFIP, however, bases its modeling solely on historical data. Mr. Castabaldi stated, "[t]o put it simply, global warming is a fact and a robust response is required." Unfortunately, FEMA has not provided a credible response to the threat of global warming on the NFIP.

I. The NFIP is Not Currently Designed to Handle Global Warming-Powered Weather Events like Increased Hurricane Intensity and Storm Surge, Sea Level Rise, and Associated Flooding.

The NFIP is currently facing the most serious crisis in its thirty-nine year history. The four major hurricanes which struck Florida in 2004 set a stage for a major strain on the NFIP's solvency. Hurricanes Katrina, Rita, and Wilma have now demonstrated what has long been predicted -- that the program's lack of an actuarially-based financial structure leaves it vulnerable to major catastrophic losses -- losses which can now only be repaid with enormous bailouts from the American taxpayers. And, these are losses that will likely increase due to impacts of global warming, including increased hurricane intensity and storm surge, sea level rise, and associated flooding. We hope that Congress will take significant actions to put the NFIP on a much sounder footing in the future and ensure that the NFIP addresses the future impacts of global warming.

During 2004 and 2005, the devastating back-to-back hurricane seasons in the U.S. caused a record $75 billion in insured losses, including $45 billion from Hurricane Katrina alone. The storm damage from Hurricane Katrina made approximately 300,000 homes along the Gulf Coast and in Louisiana uninhabitable. The NFIP only generates approximately $2

billion in annual revenues, so Congress has permitted the program to borrow $20 billion from the General Treasury. FEMA's annual interest payments are now approaching $1 billion. The program is essentially bankrupt.

To reach a sounder footing and to be able to adapt to climate change, improvements will have to be made both financially in how, where, and at what price we provide insurance and through a concerted effort to better manage risk. This, in turn, requires a commitment to apply the best scientific methods of determining risk and the best policy-setting regarding where and under what circumstances we allow building in the vicinity of floodprone areas.

We believe it would be wise to view the experiences of 2004 and 2005 as critical to bringing greater recognition to potential risks that many communities could find themselves facing in the future. Katrina has been a wake-up call for many communities to consider their own risks and vulnerabilities as we experience the impacts of global warming. In October of 2005, Dr. Chris Landsea of NOAA's National Hurricane Center told the Committee "an Atlantic hurricane era is underway, similar to that last seen from the late 1920's to the late 1960's. Our research suggests that many of the hurricane seasons in the next two or three decades may be much more active than they were in the 1970's through the early 1990's. Warmer sea surface temperatures are expected to contribute to conditions that foster increased hurricane development over this period."

The most recent IPCC report, released in April 2007, found that our coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea-level rise and the effect will be exacerbated by increasing human-induced development pressures on coastal areas. In North America, the IPCC predicts that warming in the western mountains will result in decreased snowpack, more winter flooding, and reduced summer flows, exacerbating competition for over-allocated water resources. Other research has also supported the notion that, because of global warming, we may be seeing more storms of increased intensity and duration and more flooding. Katrina shows the need to plan for the potential of larger, catastrophic storm events to better protect our citizens from their impacts, and where possible, locate new development away from floodprone areas.

Unfortunately, federal flood-control programs are increasing flood damages by encouraging development in floodprone areas. FEMA reports that there are already 8 to 12 million homes in the 100-year floodplain, otherwise known as the 1% annual chance flood, or "high-risk" flooding area. Census data indicates that more than half of the nation's population lives in 673 coastal counties, which comprise only 17% of the nation's land area. The NFIP currently insures approximately 5.3 million policies for more than $1 trillion in insured assets. It collects only $2 billion in annual premiums and fees. These fees do not cover all FEMA expenses. FEMA's flood insurance program is neither fiscally nor actuarially sound, and its subsidies unfortunately encourage risky development and redevelopment. For example, nearly 25% of the policyholders insured by the NFIP are paying less than half (40%) of what they would pay with private, risk-based premiums, because Congress explicitly grandfathers-in lower rates for these older

buildings. In contrast to the private insurance industry, NFIP holders with substantially varying risks pay the same premium.

A. Repetitive Losses Will Continue to Drain the Flood Insurance Fund as Global Warming Creates More Intense Hurricanes and Flooding.

In 1998, the National Wildlife Federation published a three-year study we had conducted on the NFIP and federal flood policies called **"Higher Ground – A Report on Voluntary Buyouts in the Nation's Floodplains."** This was the study that found that from 1978 through August of 1995, while repetitive loss properties represented only two percent of all insured properties they had experienced 25 percent of the losses and received 40 percent of total NFIP claims payments.

These properties have continued to be a large and chronic drain on the National Flood Insurance Fund. In 1995, the 74,000 repetitive loss properties had received $2.8 billion in claims and were costing the NFIP $200 million annually. Just prior to Hurricane Katrina (7-31-05), these numbers had grown to more than 111,000 properties nationally that have cost the NFIP a total of $5.6 billion, doubling the total cumulative cost in only 10 years, and again, cumulatively, having received 38 percent of all NFIP claims. The information generated in this study, we believe, was helpful to alerting FEMA and the Congress of problems with the NFIP and was one factor that led to the eventual passage of the Flood Insurance Reform Act of 2004.

There were other significant findings that may be relevant to today's concerns:

- Nationally, flood losses have risen alarmingly through this century, despite huge expenditures on traditional flood control projects. Twenty-five year average national flood losses (in constant dollars) had soared to $4.2 billion annually, more than double what they were early in the century. For the five-year period 1993 - 1998, the losses were more than $8 billion each year. Approximately $140 billion in federal tax revenues has been spent during the past 25 years preparing for and recovering from natural disasters.

- **A large number of properties (5,629 - 10% of all single family residence repetitive loss properties) had already received cumulative flood insurance payments in excess of the highest reported value of the property.** At the top end, a single family residence in the Houston area was valued at $114,000, yet it received $806,000 in payments for 16 floods over 18 years. [In July of 2005 FEMA reported that there were more than 12,500 currently insured properties with either 4 or more losses or total cumulative claims that exceeded the property value.]

- **Properties that sustained "substantial damage" were not subject to NFIP hazard mitigation requirements.** NFIP regulations require any owner of a building sustaining a single loss event exceeding 50% of the building's value to either remove the building or reconstruct the building to current code

requirements, including elevation to at least the base flood level to reduce flood risk. Nearly 11,000 repetitive loss properties (approximately 15% of the total) had sustained substantial damage on one or more occasions during the 18 years studied (costing more than $500 million in NFIP claims though the point of first being substantially damaged), yet overall they continued to sustain losses essentially as they did before they were substantially damaged. This suggested that many NFIP communities were delinquent in their enforcement of substantial damage rules. In all, 5,578 of the repetitive loss properties received $167 million in insurance payments after they were substantially damaged. We concluded that with better enforcement of substantial damage rules, it would be reasonable to expect that the subsequent damage would have been greatly reduced.

- **15,275 repetitive loss properties, or 20% of all repetitive loss properties, were classified as being *outside* the designated 100-year floodplain**. These structures had received a total of $530 million in NFIP payments. This raised serious concerns about the accuracy of flood insurance maps and further concern that the public was not being adequately informed of the risks of living in the vicinity of floodplain areas. We do not today have updated statistics for this class of properties.

- **The vast majority of repetitive loss properties (94%) are older "pre-FIRM" properties,** which were initially constructed before the establishment of flood insurance rate maps and NFIP building standards.

Our report showed that historically many repetitive loss building owners have simply continued to reinvest in extremely high risk properties with chronic flooding problems, often without instituting mitigation measures to reduce the associated risk, and at extremely high cost to the NFIP and other disaster relief programs. As global warming intensifies hurricane activity and flooding, the repetitive loss issue will become an even greater burden on taxpayers.

B. The NFIP Should Move All Policy Premiums to Actuarially Sound Rates.

The NFIP began in 1968 with a promise to do two things: provide affordable insurance for properties with flood-related risks -- and, working with local communities -- to guide new at-risk development out of harm's way. Failure to accomplish either of these goals would likely result in the overall failure of the NFIP.

The National Wildlife Federation believes the reduction and elimination of subsidies, especially for pre-FIRM structures and repetitive loss properties, is a long overdue reform of the NFIP and should be an urgent goal today, given the threats of global warming. The initial assumption when the program began was that overtime the highly subsidized pre-FIRM properties would be damaged and either be demolished and removed from the floodplain or rebuilt to safer standards, yet our study showed that this was seldom happening. The continuing drain on the National Flood Insurance Fund, combined with the wrong financial signals which subsidies send that discourage hazard mitigation are

critical reasons the NFIP is financially unsound. It has been suggested that an initial step could be to eliminate subsidies for vacation homes, non-primary residences and commercial properties. We would agree with this. An equally important alternative to help those for whom increased rates would constitute a significant hardship, is to provide substantial and sustained support through hazard mitigation grants to reduce risk. To continue with the insurance subsidies will prove to be more and more costly to taxpayers as we adjust to the reality of global warming.

C. NFIP Should Promote Increased Mitigation to Reduce Global-Warming Related Flood Damages.

In addition to eliminating NFIP subsidies, greater attention to hazard mitigation and strengthening NFIP standards should be cornerstones of addressing the impacts of global warming and restoring financial integrity to the NFIP.

Often the greatest strides that have been made toward reducing existing flooding risk have been made in the wake of flood disasters. After the Great Midwest Flood, FEMA approved more than 170 hazard mitigation projects in 9 states where some 10,000 highly flood prone and damaged structures were acquired and removed from floodplains. Many others were elevated, relocated, or floodproofed. These efforts were made possible especially with monies provided through the Stafford Act (Section 404 Hazard Mitigation Grants Program (HMGP)) and the NFIP's Flood Mitigation Assistance (FMA) Program.

In August 2004 FEMA reported it had to that point mitigated through **acquisition, elevation, floodproofing, relocation, and retrofitting more than 28,000 properties.** The vast bulk of funding for these activities came through the HMGP, which is made available *after* presidentially-declared disasters. We are concerned that in recent years there has been a reduction of overall HMGP funding and an unfortunate confusion over the relative importance of pre-disaster vs. post-disaster mitigation. Both are necessary; however, it is almost always after disasters that the greatest potential exists to implement meaningful hazard mitigation. While HMGP is not specifically targeted at pre-FIRM structures, by far the most flood hazard HMGP funds (more than FMA and the Pilot program) go toward mitigating these structures.

In addition, there are a range of measures that should be taken immediately to strengthen NFIP mitigation standards and improve the program's financial solvency. Basic community participation standards have remained largely unchanged since the start of the NFIP. Initially the program planners chose minimum standards such as requiring all new construction first floor elevation to be "at or above" the Base Flood Elevation (1% chance flood) to encourage all communities to join. While some communities adopted higher standards, many others chose only the minimums. Thirty-nine years into the program we would urge that key standards be increased in light of what we have learned and to promote greater safety. We would specifically urge that FEMA:

- **Require that all new and substantially improved buildings in the SFHA have the first floor elevated to at least one-foot above the Base Flood Elevation (BFE).** This would, in part, compensate for the large range of uncertainties associated with defining a base flood;

- **Adopt a "no-rise" standard for restricting flows in the 100-year flood instead of the current "one-foot rise".** The current standard has worked to draw large encroachment onto floodplains that through time results in substantial new flood risk and damages.

- **Require all "critical facilities" to be elevated above and flood protection structures to be designed and constructed to protect from at least the 500-year (.2 % annual chance) flood.** A host of government and professional reports and studies support the need for much higher than 100-year standards for urban flood protection and for key community infrastructure (e.g. schools, hospitals, eldercare, police, fire, and other public facilities, important roads, bridges, and transportation facilities).

The NFIP's Community Rating System has identified and rated 18 types of best management practices that can be employed by communities to reduce flood hazards. Communities representing about half the nation's population have already participated in this voluntary program. **We urge Congress to direct FEMA to identify what practices from the CRS could be adapted universally as part of the basic community participation criteria to reduce risks.**

I would also call special attention to the situation we found with **substantial damages**. Because the calculation and decisions related to substantial damage determinations in the current NFIP is left with local government officials, who are often subject to immense pressure in the wake of disasters, often these decisions result in negative determinations when all reasonable evidence points in the direction of requiring the reconstruction to be elevated at least to modern code.

We believe for the sake of improving the financial stability of the NFIP and consistency of decision making, that FEMA should be directly involved with substantial damage determinations. We would also suggest that the determinations be based on cumulative damage claims and not simply single events.

D. The NFIP Should Designate Places Where Insurance Should Not Be Provided.

When the NFIP was first conceived, it was recognized that there were places where insurance should be withheld – particularly in floodways and areas of moving water. These places were excluded because of the prohibitive cost of insuring these locations and the risks that building there posed to owners, their neighbors, first responders, and the public. Subsequently, Congress established a Coastal Barrier Resources System that withholds insurance on areas of barrier islands that were undeveloped. In light of the history of the program, we would urge the Committee to work with private insurers and

FEMA to identify what other such areas have flooding histories or risks or values that would warrant exclusion of availability of insurance.

E. The NFIP Should Expand Insurance Participation.

The National Wildlife Federation was a strong supporter during development of the 1994 Flood Insurance Reform Act of strengthening escrow authorities and improving federal bank regulator oversight and enforcement of the mandatory purchase requirements. Substantial measures were adopted, yet it still appears that many who should have insurance do not have it when disasters occur.

We believe that still not enough is being done by the nation's financial sector and government regulators to assure that those living in flood prone areas purchase insurance and maintain their policies. We urge Congress to consider stronger enforcement measures and penalties for failures to assure that there is required coverage.

We would also strongly support changes in the NFIP to expand the mandatory purchase requirement to "residual risk" areas behind levees and below dams within the natural floodplains. Too often, communities falsely believe that because there is a levee or other structure shielding them from floodwaters, that they are essentially safe. The fact that today no flood insurance is required only encourages this false sense of reality. In our 1998 report, we found in particular that across the nation damages from more rare, catastrophic-type flood events are growing at the greatest magnitude – in many cases when flood control structures fail and inundate populated areas or spread out beyond what is identified as the 100-year floodplain.

F. FEMA Must Improve NFIP Mapping Accuracy and Adequacy of the 1% Chance Flood Standard to Address the Impacts of Global Warming.

FEMA's flood insurance programs do not inherently take into consideration the impacts of climate change. FEMA's map program is based solely on historical records, and it does not incorporate modern climate science as it projects storm activity or flooding. As Mr. Castabaldi from Swiss Re testified, "history is not a good predictor of the future. So to reduce liability you must take climate change into consideration." We agree with Mr. Castabaldi's statement and the private insurance industry's approach. We urge Congress to mandate that FEMA incorporate modern climate science in its Map Modernization effort.

Because the flood insurance maps are literally the foundation of the NFIP and they are basic planning documents for the nation's urban and rural areas, it continues to be critical that the maps be updated and made accurate as possible. With one-third of the nation's 100,000 maps greater than 15 years old and another 30 percent at least 10 years old, we are seeing more and more instances of storms that result in much greater flooding than would be predicted by current maps. Again, we were rather shocked to learn in our 1998

study that fully 20 percent of repetitive loss properties were located ***outside*** the designated Special Flood Hazard Areas (1% chance flood zones). The repetitive loss properties had, on average more than 3 losses over 18 years, meaning that statistically they are probably located in the 5 – 10 year floodplains.

The National Wildlife Federation strongly supports continuation of FEMA's Map Modernization program and appreciates the Administration and Congress' continued support and funding. We are concerned, however, that in order to help place the NFIP on a course to fiscal solvency, the map program needs to be substantially expanded and extended and must explicitly incorporate modern climate science.

The 1% chance standard was admittedly a compromise when the original drafters of the NFIP conceived the program. It was even recognized at the time that the 1% chance flood was probably too high a risk for most cities and urban areas, yet it was adopted as a "minimum" in order to entice reluctant communities to join the program. Unfortunately, the minimum became the maximum for many areas, and the choice of terminology has failed to adequately convey the risks of flooding to the public. Many communities sought the minimum levels of protection behind levees or dams, then nurtured the notion that they were safe and did not need flood insurance or elevation or other protection for their properties.

The term "100-year flood" or "1% chance flood" is misleading. It is not the flood that will occur once every 100 years. Rather, it is the flood elevation that has a 1- percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. A structure located within a special flood hazard area shown on an NFIP map has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage.

Today it is clear that basic to helping put the NFIP in a financially sound position, we need to build out from the 1% chance standard. A critical step must be to map beyond the 1 % chance area or "high risk flooding area," and we strongly recommend that mapping extend to the .2 % chance ("500-year") flood level, and to all "residual risk" areas behind levees and below dams, in the event of structural failure. Furthermore, mapping should include other hazards, such as land subsidence, coastal erosion, sediment and mud flow areas, and areas subject to ice jams. In addition, mapping should be based upon reasonable estimates of "future conditions" – when growing communities are changing hydrologic regimes through their growth, and mapping should incorporate modern climate science to ensure the safety of our communities. Each of these elements is well within current technical capabilities.

We strongly urge the Committee to support efforts to reform the NFIP to address global warming.

CONCLUSION

Once again, Mr. Chairman and Members of the Senate Committee on Homeland Security and Governmental Affairs, we applaud your work to investigate the impacts of global warming on public and private insurance. The GAO report you requested confirmed what we suspected: the private insurance industry is light-years ahead of our public insurance programs when it comes to addressing the impacts of global warming.

The NFIP, for example, has fallen short of its initial promises and currently finds itself in dire financial trouble after Hurricanes Katrina and Rita. As we experience even more intense hurricane activity, sea level rise, and associated flooding from global warming, the demands on our public insurance programs will dramatically increase. Although the NFIP has been successful in many ways to reduce the adverse impacts of flooding on many of the nation's communities, it has overall failed to put insurance on an actuarial footing, failed to accurately assess flood risks, failed to adequately communicate those risks to the public, and failed to adequately discourage building and rebuilding in high and substantial risk areas. For 39 years it has continued to highly subsidize many of the policies it sells, thus skewing market signals as to the risks involved with certain floodplain locations and in some cases serving as an inducement to develop in high risk areas, rather than the opposite. The impacts of global warming will exacerbate these problems.

Perversely, the NFIP has also had a substantial adverse impact on many sensitive and critical ecosystems that support a large portion of the nation's wildlife – with the result sometimes being intensive urbanization and fill immediately along the nation's rivers, streams, coastlines, estuaries and barrier islands, with heightened flooding risks.

We look forward to reviewing the lessons learned from private industry, and we urge Congress to mandate that FEMA incorporate modern climate science as it identifies and maps high-risk floodplains and as it manages the NFIP program.

We all share a moral responsibility to confront global warming to protect our children's future, and we thank the Committee for holding this important hearing. We are ready to work with the Committee to make needed improvements.

Taxpayer Cost of Crop Insurance Indemnities

Year	Liability**	Indemnity**	Indemnity/ Liability	Total Premium**	Producer-Paid Premium**	Net Indemnity** (Indemnity minus Prod-Paid Prem)	Net Indemnity/ Liability
1980	$3,010	$ 343	11.4%	$ 156	$ 156	$ 186	6.2%
1981	$5,981	$ 407	6.8%	$ 377	$ 330	$ 77	1.3%
1982	$6,092	$ 527	8.7%	$ 394	$ 303	$ 224	3.7%
1983	$4,370	$ 584	13.4%	$ 286	$ 222	$ 362	8.3%
1984	$6,620	$ 638	9.6%	$ 434	$ 336	$ 303	4.6%
1985	$7,160	$ 683	9.5%	$ 440	$ 340	$ 343	4.8%
1986	$6,230	$ 616	9.9%	$ 380	$ 292	$ 324	5.2%
1987	$6,095	$ 370	6.1%	$ 365	$ 278	$ 92	1.5%
1988	$7,084	$ 1,068	15.1%	$ 447	$ 336	$ 732	10.3%
1989	$13,536	$ 1,212	9.0%	$ 814	$ 609	$ 603	4.5%
1990	$12,828	$ 973	7.6%	$ 836	$ 621	$ 352	2.7%
1991	$11,216	$ 955	8.5%	$ 737	$ 547	$ 408	3.6%
1992	$11,334	$ 918	8.1%	$ 759	$ 562	$ 356	3.1%
1993	$11,353	$ 1,655	14.6%	$ 756	$ 556	$ 1,100	9.7%
1994	$13,608	$ 601	4.4%	$ 949	$ 695	$ (93)	-0.7%
1995	$23,728	$ 1,568	6.6%	$ 1,543	$ 654	$ 914	3.9%
1996	$26,877	$ 1,493	5.6%	$ 1,839	$ 856	$ 636	2.4%
1997	$25,459	$ 994	3.9%	$ 1,775	$ 873	$ 121	0.5%
1998	$27,921	$ 1,678	6.0%	$ 1,876	$ 930	$ 748	2.7%
1999	$30,939	$ 2,435	7.9%	$ 2,310	$ 918	$ 1,516	4.9%
2000	$34,444	$ 2,595	7.5%	$ 2,540	$ 1,192	$ 1,403	4.1%
2001	$36,729	$ 2,960	8.1%	$ 2,962	$ 1,188	$ 1,772	4.8%
2002	$37,299	$ 4,067	10.9%	$ 2,916	$ 1,175	$ 2,892	7.8%
2003	$40,621	$ 3,261	8.0%	$ 3,431	$ 1,389	$ 1,871	4.6%
2004	$46,604	$ 3,208	6.9%	$ 4,186	$ 1,709	$ 1,500	3.2%
2005	$44,260	$ 2,365	5.3%	$ 3,949	$ 1,605	$ 759	1.7%
2006	$49,897	$ 3,408	6.8%	$ 4,577	$ 1,896	$ 1,512	3.0%
Grand Total	$551,297	$ 41,581	7.5%	$ 42,034	$ 20,567	$ 21,014	3.8%

* Based on the summary of business as of April 16, 2007

** All dollar amounts are in $ Millions

Historical Loss Ratios for the Crop Insurance Program

Year	Liability*	Indemnity*	Premium*	Loss Ratio
1980	$3,010	$ 343	$ 156	2.19
1981	$ 5,981	$ 407	$ 377	1.08
1982	$ 6,092	$ 527	$ 394	1.34
1983	$ 4,370	$ 584	$ 286	2.04
1984	$ 6,620	$ 638	$ 434	1.47
1985	$ 7,160	$ 683	$ 440	1.55
1986	$ 6,230	$ 616	$ 380	1.62
1987	$ 6,095	$ 370	$ 365	1.01
1988	$ 7,084	$ 1,068	$ 447	2.39
1989	$ 13,536	$ 1,212	$ 814	1.49
1990	$ 12,828	$ 973	$ 836	1.16
1991	$ 11,216	$ 955	$ 737	1.30
1992	$ 11,334	$ 918	$ 759	1.21
1993	$ 11,353	$ 1,655	$ 756	2.19
1994	$ 13,608	$ 601	$ 949	0.63
1995	$ 23,728	$ 1,568	$ 1,543	1.02
1996	$ 26,877	$ 1,493	$ 1,839	0.81
1997	$ 25,459	$ 994	$ 1,775	0.56
1998	$ 27,921	$ 1,678	$ 1,876	0.89
1999	$ 30,939	$ 2,435	$ 2,310	1.05
2000	$ 34,444	$ 2,595	$ 2,540	1.02
2001	$ 36,729	$ 2,960	$ 2,962	1.00
2002	$ 37,299	$ 4,067	$ 2,916	1.39
2003	$ 40,621	$ 3,261	$ 3,431	0.95
2004	$ 46,604	$ 3,208	$ 4,186	0.77
2005	$ 44,260	$ 2,365	$ 3,949	0.60
2006	$ 49,893	$ 3,421	$ 4,577	0.75

* Values are in $millions.

The Projected Liability for the Crop Insurance Program

Year	Projected Liability ($Millions)
2007	$ 63,006
2008	$ 67,796
2009	$ 70,386
2010	$ 69,591
2011	$ 69,939
2012	$ 70,252
2013	$ 71,182
2014	$ 71,643
2015	$ 71,994
2016	$ 72,173
2017	$ 72,625

* Based on the USDA Agricultural Projections (Feb 2007) and the Summary of Business as of Novebember 20, 2007

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COMMITTEE ON
HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS
WASHINGTON, DC 20510–6250

May 2, 2007

The Honorable Eldon Gould
Administrator
Risk Management Agency
U.S. Department of Agriculture
1400 Independence Avenue, S.W.
Washington, DC 20250

Dear Mr. Gould:

We are writing to follow up on a request made at the Homeland Security and Governmental Affairs Committee hearing of April 19, 2007, entitled "Dangerous Exposure: The Impact of Global Warming on Private and Federal Insurance."

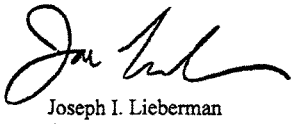
At that hearing, John Stephenson of the General Accountability Office submitted a report entitled: "Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades Are Potentially Significant." That report stated:

> We recommend that the Secretary of Agriculture and the Secretary of Homeland Security direct the Administrator of the Risk Management Agency and the Under Secretary of Homeland Security for Emergency Preparedness to analyze the potential long-term implications of climate change for the Federal Crop Insurance Corporation and the National Flood Insurance Program, respectively, and report their findings to the Congress. This analysis should use forthcoming assessments from the Climate Change Science Program and the Intergovernmental Panel on Climate Change to establish sound estimates of expected future conditions. Key components of this analysis may include: (1) realistic scenarios of future losses under anticipated climatic conditions and expected exposure levels, including both potential budgetary implications and consequences for continued program operation and (2) potential mitigation options that each program might use to reduce their exposure to loss.

You testified that USDA agreed with the recommendations. At the hearing, we requested that your agency submit a report to Congress, separate from any annual reports, that implements GAO's recommendations. We are writing now to ask that you provide to this Committee, in writing, a date by which you will be able to complete this report and a description of the analysis that will be included in the report. We believe that given the substantial potential financial liability to the federal government due to climate change, it is of the utmost importance that the FCIC begin to factor in the potential losses that climate change could create.

Thank you for your consideration of this request. We look forward to hearing back from you soon.

Sincerely,



Joseph I. Lieberman
Chairman

Susan M. Collins
Ranking Member

JIL/SMC:ars

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United States Senate

COMMITTEE ON
HOMELAND SECURITY AND GOVERNMENTAL AFFAIRS
WASHINGTON, DC 20510–6250

May 2, 2007

Michael Buckley
Deputy Assistant Administrator for Mitigation
Federal Emergency Management Agency
U.S. Department of Homeland Security
500 C St., S.W.
Washington, DC 20472

Dear Mr. Buckley:

We are writing to follow up on a request made at the Homeland Security and Governmental Affairs Committee hearing of April 19, 2007, entitled "Dangerous Exposure: The Impact of Global Warming on Private and Federal Insurance."

At that hearing, John Stephenson of the General Accountability Office submitted a report entitled: "Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades Are Potentially Significant." That report stated:

> We recommend that the Secretary of Agriculture and the Secretary of Homeland Security direct the Administrator of the Risk Management Agency and the Under Secretary of Homeland Security for Emergency Preparedness to analyze the potential long-term implications of climate change for the Federal Crop Insurance Corporation and the National Flood Insurance Program, respectively, and report their findings to the Congress. This analysis should use forthcoming assessments from the Climate Change Science Program and the Intergovernmental Panel on Climate Change to establish sound estimates of expected future conditions. Key components of this analysis may include: (1) realistic scenarios of future losses under anticipated climatic conditions and expected exposure levels, including both potential budgetary implications and consequences for continued program operation and (2) potential mitigation options that each program might use to reduce their exposure to loss.

You testified that DHS agreed with the recommendations. At the hearing, we requested that your agency submit a report to Congress, separate from any annual reports, that implements GAO's recommendations. We are writing now to ask that you provide to this Committee, in writing, a date by which you will be able to complete this report and a description of the analysis that will be included in the report. We believe that given the substantial potential financial liability to the federal government due to climate change, it is of the utmost importance that the NFIP begin to factor in the potential losses that climate change could create.

Michael Buckley
May 2, 2007
Page 2

Thank you for your consideration of this request. We look forward to hearing back from you soon.

Sincerely,

Joseph I. Lieberman
Chairman

Susan M. Collins
Ranking Member

JIL/SMC:ars

United States Government Accountability Office
Washington, DC 20548

June 7, 2007

The Honorable Joseph I. Lieberman
Chairman

The Honorable Susan M. Collins
Ranking Member
Committee on Homeland Security and Governmental Affairs
United States Senate

This letter acknowledges the questions you submitted concerning our testimony on climate change and federal insurance programs before the Senate Committee on Homeland Security and Governmental Affairs on April 19, 2007. Please see the enclosure for our responses.

Sincerely yours,

John Stephenson
Director
Natural Resources and Environment

Enclosure

Enclosure

Question 1: Use of IPCC 2001 *Third Assessment Report* – Why did this report heavily rely on the 2001 IPCC report in determining its conclusions? Why wasn't the report *Recent Cooling of the Upper Ocean* by Dr. John Lyman included in your analysis?

GAO Response – Since GAO is not a science agency, we made the decision early in our project not to arbitrate the ongoing scientific dialog regarding the changes in the incidence and effects of weather related events associated with climate change. Instead, we looked to the international and domestic governmental science bodies who regularly engage in assessments of climate change science. As you are aware, there are several entities who have been charged with this mission—namely, the Intergovernmental Panel on Climate Change, of which the U.S. has been an active member since 1988; the Climate Change Science Program, which carries out the assessment functions charged by Congress under the Global Change Research Act (GCRA); and the National Academy of Sciences, created by President Abraham Lincoln as scientific advisors to the nation. At the time we conducted our work, from February 2006 to January 2007, the IPCC's *Third Assessment Report*, approved by the U.S. and published in 2001, was the most recent large-scale assessment of climate science published by these bodies. A U.S.-specific assessment was provided to Congress under the GCRA in 2000-2001, but concerns have been expressed regarding the reliability of the underlying data—although the National Academies has endorsed both that product and the processes used to create it.

The report you specifically cite—*Recent Cooling of the Upper Ocean* published in September 2006—was not within the scope of our study, as with all other individual studies by the National Oceanic and Atmospheric Administration, the National Aeronautics and Space Administration, and academicians. Instead, we relied on the work of the most recent large-scale assessments as described above.

Question 2: Other Measures to Prevent the Development of Vulnerable Areas – What other measures would you encourage FCIC and NFIP to take to prevent the federal government from encouraging the development of vulnerable areas? Please comment further on observations made on pages 4 and 5 of your report.

GAO Response –
We raised concerns in our report with regard to the increasing social and economic development in hazard-prone areas in light of the potential for increased frequency or severity of weather-related events. Accordingly, we recommended that the Department of Agriculture's Risk Management Agency (RMA) and the Department of Homeland Security's Federal Emergency Management Agency (FEMA) assess the potential implications climate change may have for their programs' continued operations. Both of these agencies agreed with our recommendation, and we are happy to report that RMA has expressed their intent to produce a report on or before December 2009 to this effect. FEMA has not provided a timeframe for producing this assessment. Recommending measures to prevent the federal government from encouraging the development of vulnerable areas, however, was not within the scope of our report, although we have recent and ongoing work addressing several aspects

of this issue. For example, in response to a request from Representative Spencer Bachus, Ranking Member of the House Committee on Financial Services, we will be issuing a report in the coming weeks that examines areas of the United States that are most susceptible to natural hazards, including weather-related events, and factors that may be increasing these risks, as well as mitigation activities that could reduce losses from natural hazards.

You also asked us to comment further on two statements made in the report. First, we reported on page 4 that:

> "The growth in population in hazard-prone areas, and resulting real estate development and increasing real estate values, have increased federal and private insurers' exposure, and have helped to explain the increase in losses...Due to these and other factors, federal insurers' exposures have grown substantially." (GAO-07-285, page 4)

The growth in population in hazard-prone areas, and consequent real estate development and increasing real estate values, are leaving the nation increasingly exposed to higher losses. The close relationship between the value of property exposed to weather-related events and the amount of damage incurred may have ominous implications for a nation experiencing rapid growth in some of its most disaster-prone areas. We reported in 2002 that the insurance industry faces potentially significant financial exposure due to natural catastrophes.[1] Heavily populated areas along the Northeast, Southeast, and Texas coasts have among the highest value of insured properties in the United States and face the highest likelihood of major hurricanes. According to insurance industry estimates, a large hurricane in Miami could cause up to $110 billion in insured losses with total losses as high as $225 billion.

The federal government has grown markedly more exposed to weather-related losses due to the increasing population and property values in at-risk areas, as well as significant expansion of its programs' products as we illustrated in Figures 8 and 9 of our report using data obtained from both the NFIP and FCIC programs. Specifically, NFIP data show that the total value covered by the program increased fourfold in constant dollars from 1980 to 2005 from about $207 billion to $875 billion. In this same time period, NFIP has more than doubled its number of policies in force from 1.9 million policies to more than 4.6 million. Similarly, FCIC data show that the program has effectively increased its exposure base 26-fold during this period (in constant dollars), owing to a significant expansion in the number of crops covered and increased participation.

Second, we reported on page 5 that:

> "Federal insurance programs, on the other hand, have done little to develop the kind of information needed to understand the programs' long-term exposure to climate change for a variety of reasons. The federal insurance

[1]GAO, *Catastrophe Insurance Risks: The Role of Risk-Linked Securities and Factors Affecting Their Use*, GAO-02-941 (Washington, D.C.: Sept. 24, 2002), 3.

> programs are not oriented toward earning profits like private insurers but rather toward increasing participation among eligible parties. Consequently, neither program has had reason to develop information on their long-term exposure to the fiscal risks associated with climate change." (GAO-07-285, page 5)

The goals of the major federal insurance programs are fundamentally different from those of private insurers. Specifically, whereas private insurers stress the financial success of their business operations, the statutes governing the NFIP and FCIC promote affordable coverage and broad participation by individuals at risk. As we reported, the statutes governing the NFIP and FCIC promote broad participation over financial self-sufficiency in two ways: (1) by offering discounted or subsidized premiums to encourage participation and (2) by making additional funds available during high-loss years. Although both programs manage risk within their statutory guidelines, unlike the private sector, neither program is required to limit its catastrophic risk strictly within the programs' ability to pay claims on an annual basis.

One important implication of the federal insurers' risk management approach is that they each have little reason to develop information on their long-term exposure to the potential risk of increased low-frequency, high-severity weather events associated with climate change. According to NFIP and FCIC officials, their risk management processes adapt to near-term changes in weather as they affect existing data. As one NFIP official explained, NFIP is designed to assess and insure against current—not future—risks. Over time, agency officials stated, this process has allowed their programs to operate as intended. However, unlike the private sector, neither program has conducted an analysis to assess the potential impacts of an increase in the frequency or severity of weather-related events on its program operations over the near- or long-term.

Post-Hearing Questions for the Record
Submitted to Eldon Gould
From Senator Tom Coburn

"Dangerous Exposure:
The Impact of Global Warming on Private and Federal Insurance"
April 19, 2007

1. Could you comment on RMA's use of the recurring 20-40 year Atlantic hurricane cycle in pricing insurance policies?
    i. How accurate have your forecasts been over the last 10 years?

For certain crops, such as citrus and nursery crops in Florida, RMA includes a specific hurricane "load" in the premium rates. The hurricane load is based on historical hurricane data going back more than 100 years. The historical data is used to estimate the probability of a hurricane, of a particular strength, occurring in a given area. This probability is combined with a hurricane damage estimate to develop a premium rate load.

The time period used to develop the hurricane probabilities spans several Atlantic hurricane cycles. Therefore, the hurricane premium rate load represents an expected long-term average loss from hurricanes – across both high and low frequency periods. As such, the premium rate is not a forecast for a particular year, but rather represents an expectation of the long-term average.

Question#:	1
Topic:	Flood Map Modernization Program
Hearing:	Dangerous Exposure: The Impact of Global Warming on Private and Federal Insurance.
Primary:	The Honorable Mark Pryor
Committee:	HOMELAND SECURITY (SENATE)

Question: Could you please describe the criteria FEMA used to determine which areas needed to be mapped in the Flood Map Modernization Program? Did the disaster of Hurricanes Katrina and Rita make FEMA more risk averse and expand the number of risk zones that are required to have flood insurance? Do you anticipate reducing the flood insurance requirements in any regions of the country as a result of the Flood Map Modernization Program (i.e. if weather patterns have changed and some areas are no longer at high-risk for flooding, will they be taken off the maps in the FMMP)? How much do you think the new maps will vary from the version produced 35 years ago?

Question (Part 1): Could you please describe the criteria FEMA used to determine which areas needed to be mapped in the Flood Map Modernization Program?

Answer: As initially envisioned in 2003, the goal of the Flood Map Modernization Program was to create a complete digital Geographic Information System (GIS) map covering the entire Nation. The direction of the program was modified through a Mid-Course Adjustment, which refocused funds to reflect stakeholder input for FEMA to develop flood maps that meet new, higher quality standards for mapping and for allocating a greater percentage of resources to those communities at greatest flood risk. To determine those areas of greatest flood risk, FEMA has used the following data sets: population from the 2000 Census; population change 1980-2000; number of housing units; Flood Insurance Program (NFIP) policies, NFIP claims; repetitive loss claims; repetitive loss properties; federally declared flood disasters; predicted population growth to the year 2010; and the length of stream/coasts on non-federal lands.

In addition, for several years FEMA has worked actively with the U.S. Geological Survey, U.S. Army Corps of Engineers, National Resource Conservation Service, National Oceanic and Atmospheric Administration, the Forest Service, Bureau of Land Management, Census, National Aeronautic and Space Administration and National Geospatial-Intelligence Agency through the National Digital Elevation Program to coordinate on elevation mapping and mapping standards.

Question#:	1
Topic:	Flood Map Modernization Program
Hearing:	Dangerous Exposure: The Impact of Global Warming on Private and Federal Insurance.
Primary:	The Honorable Mark Pryor
Committee:	HOMELAND SECURITY (SENATE)

Question (Part 2): Did the disaster of Hurricanes Katrina and Rita make FEMA more risk averse and expand the number of risk zones that are required to have flood insurance?

Answer: While Hurricanes Katrina and Rita were devastating events, FEMA has not modified its fundamental approach to identifying flood risk as the result. FEMA utilizes the 1% annual chance flood as the minimum floodplain management and flood risk identification standard. After the occurrence of any significant flood event, FEMA will consider any newly collected scientific or technical flood data in the determination of the local flood risk to determine if a change to the flood map is warranted. The flood hazard data collected as a result of Hurricanes Katrina and Rita is being evaluated for incorporation into flood map updates along the Gulf Coast.

Question (Part 3): Do you anticipate reducing the flood insurance requirements in any regions of the country as a result of the Flood Map Modernization Program (i.e. if weather patterns have changed and some areas are no longer at high-risk for flooding, will they be taken off the maps in the FMMP)?

Answer: Flood hazards are dynamic and the risk of flooding is influenced by natural climate changes as well as development that may occur within the watershed. If technical data utilized to produce the flood map reflects an increase or decrease in the flood hazard risk, the subsequent floodplain will be revised to reflect the change, which may impact the flood insurance requirement.

We are aware that the U.S. Government Accountability Office has recommended that FEMA study the potential long-term fiscal implications of climate change for the National Flood Insurance Program and we are in the process of evaluating that recommendation.

Question (Part 4): How much do you think the new maps will vary from the version produced 35 years ago?

Answer: From a format and delivery perspective, the maps will vary greatly from those prepared at the beginning of the program. Over the years, FEMA has made some important advancements in how we prepare and deliver flood maps. FEMA has moved from a manual cartographic process that produced paper maps to a digital map production effort using state-of-the-art Geographic Information System (GIS) technology that enables rapid and cost-efficient map delivery via the Internet. Not only can these new GIS products be delivered over the Internet, local communities can also incorporate this

Question#:	1
Topic:	Flood Map Modernization Program
Hearing:	Dangerous Exposure: The Impact of Global Warming on Private and Federal Insurance.
Primary:	The Honorable Mark Pryor
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new digital information into their existing digital datasets to enable them to create a more comprehensive information system for local planning and mitigation activities. Also, through the Flood Map Modernization, FEMA is in the process of institutionalizing a higher quality standard to ensure that digitized maps not only align with the best available topography but to ensure that where engineering analysis is conducted new and validated engineering quality standards are met. Therefore, because of major technology and process improvements, the maps produced today will much more accurately estimate the flood risk then those prepared at the onset of the mapping program.

Question#:	2
Topic:	local levees
Hearing:	Dangerous Exposure: The Impact of Global Warming on Private and Federal Insurance.
Primary:	The Honorable Mark Pryor
Committee:	HOMELAND SECURITY (SENATE)

Question: A number of communities in Arkansas and other rural states were sent letters by the mitigation division last August. These letters notified the communities in question that the classification of their local levees as providing one percent annual-chance protection from floods was dependent upon the levees being certified. How did you determine the specific certification requirements? Was global warming and the dramatic and dangerous changes in weather patterns that accompany it a factor in expanding the risk zones and requiring new certification procedures for small, local levees that had not previously been required to have formal certification?

Answer: FEMA's primary role through the National Flood Insurance Program (NFIP) is to identify and map flood hazards and risks from flooding sources in various locations, including areas landward of (i.e., behind) levees. In accordance with NFIP regulations, FEMA requires levee owners or other parties seeking the recognition of a levee to provide levee certification if the levee is to be accredited on a Flood Insurance Rate Map (FIRM) with providing protection from the base (1-percent-annual-chance) flood. If a levee is not certified, FEMA maps the landward area as if the levee does not exist, which effectively designates it as a flood zone that requires residents to purchase flood insurance. The levee accreditation criteria are summarized in Title 44, Chapter 1, Code of Federal Regulations, Section 65.10 (44 CFR Section 65.10).

The criteria outlined in 44 CFR Section 65.10 were developed from an interim levee policy from February 1981 which was promulgated by regulation in August 1986. The list of criteria evolved as flood studies were being conducted but were coordinated with other Federal agencies with responsibility for levee design. The certification is required so that the FIRM accurately portrays the flood hazard and risk in the area landward of the levee or levee system.

FEMA is updating the Nation's flood hazard data and maps through the Flood Map Modernization Program. Accurately identifying the flood risk behind levees is an important element of Flood Map Modernization Program. On August 22, 2005, FEMA issued Procedure Memorandum 34 (PM 34), reiterating existing levee regulations and clarifying that it is the levee owner or community's responsibility to provide documentation that the levee meets the requirements of 44 CFR Section 65.10 as part of a study/mapping project.

Question#:	2
Topic:	local levees
Hearing:	Dangerous Exposure: The Impact of Global Warming on Private and Federal Insurance.
Primary:	The Honorable Mark Pryor
Committee:	HOMELAND SECURITY (SENATE)

In follow-up to PM 34, FEMA regional offices began to contact communities that were being remapped during Flood Map Modernization, and request that 44 CFR Section 65.10 be met at the time of a flood risk study or restudy. If certification is submitted by the community or levee owner, FEMA will accredit the levee on the FIRM. If certification is not submitted, the area landward of the levee will be mapped as a Special Flood Hazard Area, the area subject to inundation by the base (1-percent-annual-chance) flood.

FEMA works closely with communities to develop new flood hazard data or revise existing data during the flood study process. In general, FEMA coordinates with community officials to identify where new or revised flood studies are necessary as a result of physical changes to the land (both natural and man made) and the impact of additional years of historical flood data, which takes into account historical climate change patterns. FEMA does not have data that addresses the specific issue of global warming. Upon the completion of the flood study, FEMA provides the communities with preliminary "draft" flood maps for their review. After the completion of the administrative review process, the flood maps become final.

Since 1986, FEMA regulation has required communities to provide levee certification. Levees are designed to provide a specific level of protection and require regular maintenance and periodic upgrades to retain that level of protection. Improved technology and business processes have enabled FEMA to assess levees and identify flood plains to a higher degree of accuracy than ever before. As new areas at risk of flooding are identified, FEMA will continue to work with affected communities to address mitigation issues, including the certification of levees.

Swiss Re

Post Hearing Questions for the Record
Submitted to Andrew Castaldi
From Senator Tom Coburn

"Dangerous Exposure:
The Impact of Global Warming on Private and Federal Insurance"
April 19, 2007

1. Do you believe that there would be a sufficient private market for flood insurance without federal flood insurance programs?

Unlikely.

There are certain principles of insurability that are fundamental in determining the insurability of any risk, hazard, or coverage. A few of these principles; mutuality, assessibility, economic viability, and to some extent randomness are questionable to the majority of insurers when they consider the practicality of the private market providing flood insurance.

Mutuality describes the requirement for a large and diversified community (i.e. US) to share and spread the risk. The majority of the US community is not subject to potential flooding. To those that are subject to flooding, the extent and frequency of flooding is very specific and well known by location. As such only a subset of the community is exposed to high risk flooding and therefore likely to buy flood insurance. If only high-risk individuals are willing to purchase insurance, (so-called "adverse selection"), then the community may be too small to spread the risk adequately and coverage will become unaffordable as premiums rise to reflect the higher risk and less diversified profile of the high risk community.

Assessibility requires that the frequency and severity of claimable events to be estimated and quantified within reasonable confidence limits. This is an essential component of underwriting and is the basis for determining annualized expected losses (premiums), and potential loss levels (capacity). Presently there is not enough detail and up to date information available for the insurance industry to determine the frequency, severity, and correlation of, and between, potential flood events[i]. Without more detailed information the industry will be reluctant to provide insurance for a flood peril that it can not appropriately quantify nor manage. With the advent of new flood loss modeling technology (such as Swiss Re's USA Flood tool) the frequency, severity and dependency of flood loss events will be easier for the private market to assess.

Finally there is a growing concern that many locations which are protected by outdated levee or similar systems are flood exposed but not identified as such. Without knowledge of where these protections exist or as to the physical condition of these protective systems the insurer can not assess the risk properly.

Economic Viability means that insurers must be able to charge a premium that is commensurate with the risk, and the insured must be able and willing to pay the premium for that risk. At appropriate price levels it is expected that a low percentage of the population will purchase flood coverage and of those that do the majority of them will be of high risk. Under these constraints premiums will rise to reflect the higher risk profile of the flood insured community. Both the insured (high premiums) and the insurer (high losses) will find this situation economically impractical.

Within the present NFIP rating structure certain pre-firm locations are provided flood insurance at artificially low rates (subsidized) which are not commensurate to the risk. Under these conditions in order to balance the risk transfer mechanism between expected losses and premiums the remainder of the risk sharing community would have to pay a surcharge high enough to compensate for the "under pricing" of the high risk pre-firm locations. If no surcharge is applied then the risk sharing community would operate at an expected deficit. Neither a subsidized nor deficit approach is an economically sustainable and viable option.

Randomness requires the hazard to be random in nature, free from human interference and follow no describable deterministic pattern, but follow a probability distribution. If a location is known to flood with some degree of regularity then the possibility of flooding at these locations would no longer be considered random. Repetitive loss locations are too costly to insure and in effect considered as uninsurable.

- <u>If not what would necessary market conditions look like?</u>

Some barriers to the private market have been removed. The insurance industry is already providing some flood coverage in excess of available NFIP limits. Great strides have been made in individual and multiple location flood risk evaluation technology (such as Swiss Re's US Flood model) during the past few years. This technology will foster better **assessibility** (pricing, potential loss estimations, and risk selection) which in turn will improve long term **economic viability** - assuming that sound risk based pricing is encouraged.

Nevertheless as long as the percentage of the population willing to purchase flood coverage remains low and is limited to those at higher risk then the costs for providing flood coverage

will be considered unaffordable unless the risk sharing community increases, or further diversifies.

An obvious way to eliminate adverse selection, improve diversification and increase the risk sharing community is to include flood as a standard peril in all insurance contracts. This will bring down costs, eliminate any wind versus water questions, and protect the majority of the population from the economic hardships due to flooding. (NFIP statistics state that close to 25% of all paid flood losses are outside of high risk zones)

Unfortunately many consumers, insurers and reinsures will not favor mandatory flood coverage. Some consumers do not want to pay for what they do not need nor do they want to see their premiums increase further (even if it is a negligible increase). All insurers and reinsurers acknowledge that this will reduce the difficulty in settling some claims. However some share the concern that the added exposure will increase their combined (wind and flood) loss potential to certain hurricane events. This will reduce their capacity to write wind catastrophe exposure along coastal regions (due to flood and storm surge's high correlation with tropical cyclones).

If flood was insured within the private market then the policy terms and conditions for those risks prone to flooding would likely be more innovative and flexible. As an example alternative deductible structures, limits, and other covers would be used to help balance the risk and manage the cost of insuring the cover while maintaining an adequate risk adjusted rating format. However until we overcome the perception that flood is uninsurable and the industry can properly assess the impact on cat capacity supply and demand most of the private market will remain apprehensive.

The most acceptable condition would be a joint private-public partnership where flood is a mandatory peril yet the NFIP remains as an optional "reinsurer" for the first $250,000 in coverage per location.

2. <u>What relationship do you see between continued real estate development of vulnerable areas and increasing insurance payments and property losses resulting form tropical cyclone activity?</u>

There is a very strong relationship between development in vulnerable areas, tropical cyclone activity, property losses, and insurance payments (claims). An oversimplification is that the ultimate losses caused by tropical cyclone activity are a function of, frequency, severity, and the total property values exposed. Increase any one of these factors and the ultimate loss will also increase.

Swiss Re

Presently we are in the midst of a prolonged active hurricane period and one that has produced record breaking storm frequency and severity. Superimposed on top of an already active cycle is the upward trend in (hurricane friendly) warmer sea surface temperatures and other climate change factors, some of which may be human induced. Many believe that this warming trend is partly responsible for escalating the severity of the recent, and perhaps future, Atlantic basin tropical storm seasons.

The increased frequency and severity of storms is only partially the reason for why 7 of the 10 most costly storms ($81Bn insured) hit the United States within a14 month period between 2004 and 2005. Coastal population growth, the increased wealth of the population, and the escalating values of real estate have each played a role in rising losses.

Presently 53% of the population lives within coastal counties comprising only 17% of the US land area (excluding Alaska) and within these counties 62% of our nations GDP is produced[1]. The combined population of Broward, Miami-Dade, and Palm Beach counties is greater than those of 33 states[2] while 10 of the 15 most populated cities within the US are located in coastal counties. Many of these coastal communities are six (6) times greater in population then they were in 1960. This tendency is expected to increase. In Florida the projection is that the population will increase by 80% over the next 25 years. Even if the hurricane activity over the last few years were closer to the average then the increasing number of those at risk would cause losses to rise,

- What can be done to discourage risky behavior?

Mitigation efforts, stronger building codes, and practical zoning decisions need to be promoted, set, and enforced. Insurance and other costs of home ownership also can be used as deterrent for risky behavior and reward responsible behavior.

Coastal views, beaches, boating and for other quality of life reasons people want to live or vacation along the coast. These are the main reasons why we still see development and why people choose to build along the coast. To the local communities it is in their economic advantage to develop these high risk areas despite the risk. To the property owner much of the risk is transferred to others, at less than adequate costs, so that their financial risk for building in these high risk area becomes negligible.

[1] Population Trends Along The Costal United States , NOAA 2004
[2] 2000 Census

Swiss Re

Throughout the United States the local community is the sovereign responsible for setting and enforcing building codes and zoning requirements. Coastal regions happen to be the most economically lucrative and desirable sites for real estate development. All too often development in these areas is approved by the local community because of the associated local economic benefits despite the increased risk and effect that this development would have on other locations.

An imoprtant observation is that the economic benefits derived from local real estate development remain local whereas most of the financial burden, including insurance costs, amplified by the continued development of high risk coastal areas is spread to the surrounding communities. The cost of insurance when proper risked based pricing is applied should be a strong deterrent to irresponsible building and zoning practices and as an incentive used to promote mitigation efforts and responsible building practices. Unfortunately this is not the case as insurance over regulation has limited the industry's ability to apply the appropriate risk based pricing techniques where necessary.

Most people understand that with all else being equal a property four times greater in value than a similar property will and should pay higher premiums . Similarly and what many do not understand is that an equal valued property at four times greater risk than a similar valued property will and should pay a higher premium. This is a simple example of risk based pricing. Nevertheless many including most state insurance regulators want to suppress sound risk based pricing in high risk areas.

Such regulation forces much of the costs associated with higher risk locations to be passed on to those with less risk in one or two ways; higher regulated rates to the remainder of the community and through post loss assessments. (In the event of a catastrophic loss which exceeds the ability of a state's facility [fair plans, coastal pools, or FHCF] to pay losses then the state has the right to raise capital by assessing each policy holder within the state a surcharge on future insurance premiums [even those with less risk]).

Communities and land owners will continue to use their properties where it makes the most esthetic and economic sense. Without any financial responsibility for ensuing losses coastal and wetland areas will continue to be developed and irresponsible building practices will inadvertently be encouraged. Adding higher risk properties during a period of greater storm activity will continue to raise loss expectations at the estimated rate of twice every ten years.

Insurance, if allowed to properly allocate premiums based on risk, would be the easiest and most uniform way to discourage irresponsible development.

Swiss Re

[i] (Note regarding NFIP mapping: The NFIP FEMA flood zone frequency/severity maps are limited to identifying risks in either a 100 year [1% annual probability of flooding] or 500 year zone [.2% annual probability of flooding) with no references to severity (i.e. flood elevation levels] other than velocity of flooding. Reality is very different. Many risks designated within the 100 year flood plain will flood more often (i.e. once every 5 years) than others that are also designated to be within a 100 year flood plain. Similarly the severity (level of flooding) of hazard within a 100 or 500 year flood plain is lacking [i.e. is it 10 inches or 10 feet of expected flooding?].)