RESTORING U.S. LEADERSHIP IN WEATHER FORECASTING PART I

HEARING

BEFORE THE

SUBCOMMITTEE ON ENVIRONMENT

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRTEENTH CONGRESS

FIRST SESSION

THURSDAY, MAY 23, 2013

Serial No. 113–32

Printed for the use of the Committee on Science, Space, and Technology

Available via the World Wide Web: http://science.house.gov

U.S. GOVERNMENT PRINTING OFFICE

81–196PDF WASHINGTON : 2013

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2104 Mail: Stop IDCC, Washington, DC 20402–0001

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HON. LAMAR S. SMITH, Texas, *Chair*

DANA ROHRABACHER, California
RALPH M. HALL, Texas
F. JAMES SENSENBRENNER, JR., Wisconsin
FRANK D. LUCAS, Oklahoma
RANDY NEUGEBAUER, Texas
MICHAEL T. McCAUL, Texas
PAUL C. BROUN, Georgia
STEVEN M. PALAZZO, Mississippi
MO BROOKS, Alabama
RANDY HULTGREN, Illinois
LARRY BUCSHON, Indiana
STEVE STOCKMAN, Texas
BILL POSEY, Florida
CYNTHIA LUMMIS, Wyoming
DAVID SCHWEIKERT, Arizona
THOMAS MASSIE, Kentucky
KEVIN CRAMER, North Dakota
JIM BRIDENSTINE, Oklahoma
RANDY WEBER, Texas
CHRIS STEWART, Utah
VACANCY

EDDIE BERNICE JOHNSON, Texas
ZOE LOFGREN, California
DANIEL LIPINSKI, Illinois
DONNA F. EDWARDS, Maryland
FREDERICA S. WILSON, Florida
SUZANNE BONAMICI, Oregon
ERIC SWALWELL, California
DAN MAFFEI, New York
ALAN GRAYSON, Florida
JOSEPH KENNEDY III, Massachusetts
SCOTT PETERS, California
DEREK KILMER, Washington
AMI BERA, California
ELIZABETH ESTY, Connecticut
MARC VEASEY, Texas
JULIA BROWNLEY, California
MARK TAKANO, California
ROBIN KELLY, Illinois

SUBCOMMITTEE ON ENVIRONMENT

HON. CHRIS STEWART, Utah, *Chair*

F. JAMES SENSENBRENNER, JR., Wisconsin
DANA ROHRABACHER, California
RANDY NEUGEBAUER, Texas
PAUL C. BROUN, Georgia
RANDY WEBER, Texas

LAMAR S. SMITH, Texas

SUZANNE BONAMICI, Oregon
JULIA BROWNLEY, California
DONNA F. EDWARDS, Maryland
MARC VEASEY, Texas
MARK TAKANO, California
ALAN GRAYSON, Florida
EDDIE BERNICE JOHNSON, Texas

CONTENTS

Thursday, May 23, 2013

RESTORING U.S. LEADERSHIP IN WEATHER FORECASTING PART I

THURSDAY, MAY 23, 2013

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENVIRONMENT
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Subcommittee met, pursuant to call, at 9:35 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Chris Stewart [Chairman of the Subcommittee] presiding.

LAMAR S. SMITH, Texas
CHAIRMAN

EDDIE BERNICE JOHNSON, Texas
RANKING MEMBER

Congress of the United States
House of Representatives
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515-6301
(202) 225-6371
www.science.house.gov

Subcommittee on Environment

Restoring U.S. Leadership in Weather Forecasting

Thursday, May 23, 2013
9:30 a.m. – 11:00 a.m.
2318 Rayburn House Office Building

Witnesses

Mr. Barry Myers, Chief Executive Officer, AccuWeather, Inc.

Mr. Jon Kirchner, President, GeoOptics, Inc.

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON ENVIRONMENT

HEARING CHARTER

Restoring U.S. Leadership in Weather Forecasting

Thursday, May 23, 2013
9:30 a.m. – 11:00 a.m.
2318 Rayburn House Office Building

PURPOSE

The Subcommittee on Environment will hold a hearing entitled *Restoring U.S. Leadership in Weather Forecasting* on Thursday, May 23, 2013, at 9:30 a.m. in Room 2318 of the Rayburn House Office Building. The purpose of the hearing is to examine ways to improve the National Oceanic and Atmospheric Administration (NOAA) weather forecasting, and to receive testimony on draft legislation to prioritize weather-related research.

WITNESS LIST

- **Mr. Barry Myers**, Chief Executive Officer, AccuWeather, Inc.
- **Mr. Jon Kirchner**, President, GeoOptics, Inc.

BACKGROUND

Recent extreme weather events in the United States have underscored the need for reliable, first-class weather forecasting by NOAA and the private sector. Within NOAA, the National Weather Service (NWS), the Office of Oceanic and Atmospheric Research (OAR), and the National Environmental Satellite, Data, and Information Service (NESDIS) play important roles in developing and deploying U.S. weather forecasting capabilities.[1] NOAA line offices are joined in this effort by an ever-evolving weather enterprise. The National Academy of Sciences recently emphasized the importance of this partnership, noting that "[p]rivate sector and other organizations provide sensor data, weather forecasts, and end-user services to a broad set of customers."[2]

[1] For more information on these responsibilities, see: "To Observe and Protect: How NOAA Procures Data for Weather Forecasting," March 28, 2012, http://science.house.gov/hearing/subcommittee-energy-and-environment-hearing-how-noaa-procures-data-weather-forecasting.
[2] http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/Weather-Services-Report-Brief.pdf.

Weather impacts American lives, and extreme weather poses significant risks to important parts of the U.S. economy. NOAA has traced a rise in weather disasters costing the economy at least $1 billion in damage, and a recent analysis found that substantial parts of the economy are sensitive to weather variability, representing more than three percent of Gross Domestic Product and nearly $500 billion a year.[3]

In a 2012 report on the National Weather Service, the National Academy of Sciences stated that "[a]s an outgrowth of public and private sector investment in weather, climate, and hydrological research, new observational, data assimilation, prediction, and other technology advancements are exceeding the capacity of the NWS to optimally acquire, integrate, and communicate critical forecast and warning information based on these technological achievements."[4] Similarly, a *USA Today* editorial last October following Superstorm Sandy highlighted concerns about American weather forecasting abilities, concluding that "[t]he American model is the basis for many forecasts, and its reliability problems beyond the short term suggest something major is amiss.... The European model's embarrassing superiority on Sandy ought to accelerate efforts to identify and fix what's wrong."[5]

In response to the destruction of property and loss of life associated with Superstorm Sandy, Congress approved the *Disaster Relief Appropriations Act of 2013* which included significant funds to improve forecasting equipment and supercomputer infrastructure. The *Washington Post* characterized this action as a "down payment" for "game-changing improvements" for U.S. weather prediction.[6]

Citing ongoing concerns about potential data gaps for NOAA's polar-orbiting and geostationary satellite programs, including a potential polar-orbiting gap of 17 to 53 months, the Government Accountability Office added NOAA's satellite programs to its High Risk List in 2013. This potential gap in weather satellite coverage and management problems with NOAA's satellite has been the subject of several Science, Space, and Technology Committee hearings over many years.[7] The GAO emphasized the potential effects of a gap:

> According to NOAA program officials, a satellite data gap would result in less accurate and timely weather forecasts and warnings of extreme events, such as hurricanes, storm surges and floods. Such degradation in forecasts and warnings would place lives, property, and our nation's critical infrastructures in danger. Given the criticality of satellite data to weather forecasts, the likelihood of significant gaps and the potential impact of such gaps on the health and safety of the U.S. population and economy, GAO

[3] http://journals.ametsoc.org/doi/pdf/10.1175/2011BAMS2928.1.
[4] http://www.nap.edu/catalog.php?record_id=13429.
[5] http://www.usatoday.com/story/opinion/2012/10/30/sandy-forecasting-ecmwf-gfs/1670035/.
[6] Jason Samenow, "Game-changing improvements in the works for U.S. weather Prediction, The Washington Post, May 15, 2013, http://www.washingtonpost.com/blogs/capital-weather-gang/wp/2013/05/15/game-changing-improvements-in-the-works-for-u-s-weather-prediction/.
[7] http://science.house.gov/hearing/subcommittee-investigations-and-oversight-hearing-continuing-oversight-nation%E2%80%99s-weather; http://science.house.gov/hearing/joint-hearing-investigations-and-oversight-energy-and-environment-subcommittees-polar; http://science.house.gov/hearing/subcommittee-investigations-and-oversight-hearing-polar-weather-satellites.

has concluded that the potential gap in weather satellite data is a high-risk area and added it to the High Risk List in 2013.[8]

In addition, independent reviews of NOAA's weather research portfolio have also strongly recommended an emphasis on moving research-to-operations within NOAA's weather portfolio. In 2010, the National Academy of Public Administration stated that OAR "provides particularly important institutional glue to support innovation across NOAA."[9] In April 2013, NOAA's Science Advisory Board stated that "unless… science is transitioned into operations… NOAA will fail in its mission. NOAA must make certain that the intended end use of the scientific information is understood from the start by its researchers working on scientific questions and, ensure that internal as well as external end-user needs are incorporated explicitly into the problem formulation."[10]

NOAA plays an important role in making procurement decisions about observing systems that provide data for weather prediction in the U.S. NOAA currently uses information from over 100 observational networks, including space-based remote sensing, atmospheric observations, surface observations, and ocean observations. One method to analyze the value of weather data from observing systems is called an Observing System Simulation Experiment (OSSE). OSSEs employ computer modeling used to investigate the potential impact of planned observing systems or to test current observational and data assimilation systems. NOAA has stated that OSSEs "could play a critical role in…identifying future observation systems and data assimilation systems for improvement."[11]

ADDITIONAL READING

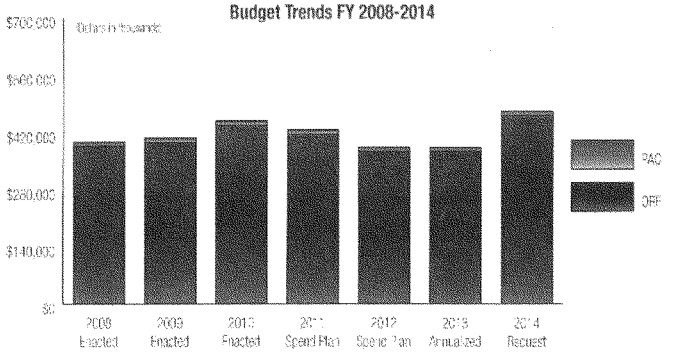
- National Academies of Science Report, *Weather Services for the Nation: Becoming Second to None, August 2012.*
- Dan Vergano, USA Today, *U.S. Forecast's Late Arrival Stirs Weather Tempest,* October 2012.
- NOAA Science Advisory Board Report, *In the Nation's Best Interest: Making the Most of NOAA's Science Enterprise,* April 2013.

[8] http://www.gao.gov/highrisk/mitigating_gaps_in_weather_satellite_data.
[9] http://www.napawash.org/wp-content/uploads/2010/09/NAPA-Final-Report_NOAA-Climate-Service-Study_September-20101.pdf.
[10] http://www.sab.noaa.gov/Reports/2013/SAB%20R&D%20Portfolio%20Review%20Report%20to%20NOAA%20FINAL.pdf.
[11] http://laps.noaa.gov/met/osse.html.

Appendix 1: OFFICE OF OCEANIC & ATMOSPHERIC RESEARCH BUDGET[12]

OFFICE OF OCEANIC & ATMOSPHERIC RESEARCH

(DOLLARS IN THOUSANDS)	FY 2012 SPEND PLAN	FY 2013 ANNUALIZED CR	FY 2014 REQUEST	INCREASE (DECREASE)
OAR — ORF				
Climate Research	$181,044	$141,394	$188,840	$47,446
Weather and Air Chemistry Research	67,779	68,191	81,624	13,433
Ocean, Coastal, and Great Lakes Research	114,719	156,165	179,806	23,641
Information Technology, R&D & Science Education	8,946	9,000	11,786	2,786
Total, OAR - ORF	372,488	374,750	462,056	87,306
Total, OAR - PAC	10,296	10,350	10,379	29
GRAND TOTAL OAR (Direct Obligations)	$382,784	$385,100	$472,435	$87,335
Total FTE	755	755	769	14



ORF: Operations, Research, and Facilities
PAC: Procurement, Acquisition, & Construction

[12] http://www.corporateservices.noaa.gov/nbo/fy14_bluebook/FINALnoaaBlueBook_2014_Web_Full.pdf.

Discussion Draft
Section-by-Section Analysis

Section 1. Title. Weather Forecasting Improvement Act of 2013.

Section 2. Public Safety Priority. Directs Under Secretary to make weather forecasting to protect lives and property NOAA's top planning and management priority in relevant line offices.

Section 3. Weather Research and Forecasting Innovation.

(a) Establishes/codifies NOAA weather research program, directing agency to place "priority emphasis on development more accurate and timely warnings and forecasts of high impact weather events that endanger life and property."
(b) (b)(1) and (b)(2) describe specific program elements to be pursued—advanced radar, aerial systems, computing/modeling, and OSSEs.
(b)(3) codifies longstanding joint OAR-NWS tech transfer program, moving its funding from NWS.

Section 4. Weather Research and Development Planning. Directs NOAA to develop a prioritized weather research plan to guide activities authorized under the Act, and restore U.S. world leadership in weather modeling, prediction, and forecasting.

Section 5. Observing System Planning. Directs NOAA to maintain a list of observation data requirements and systematically evaluate the combination of systems necessary to meet such requirements, including as they related to potential data gaps. Directs NOAA to develop a range of options to address any identified gaps.

Section 6. Observing System Simulation Experiments. Directs NOAA to undertake Observing System Simulation Experiments (OSSEs) to quantitatively assess the relative value and benefits of observing capabilities and systems. Specifies under what conditions OSSEs should be performed.

Section 7. Computing Resources Prioritization Report. Directs the NOAA CIO to issue a plan to ensure that the Agency is pursing cutting-edge high performance computing power and providing a balance of models and computing resources to support enhanced weather prediction capabilities.

Section 8. Commercial Weather Data. Clarifies that restrictions in existing law prohibiting the sale of weather satellite systems to the private sector do not extend to the purchase of weather data through contracts with commercial providers or the placement of instruments on private payloads.

Section 9. Definitions.

Section 10. Authorization of Appropriations. Authorizes modest increases to NOAA's weather R&D activities, offsetting increased spending through cuts to non-weather R&D (climate and ocean research).

Chairman STEWART. The Subcommittee on Environment will come to order.

Good morning, everyone. Welcome to today's hearing entitled "Restoring U.S. Leadership in Weather Forecasting." In front of you are packets containing the written testimony, biographies and Truth in Testimony disclosures for today's witness panels, and I now recognize myself for five minutes for an opening statement.

First, let me say, diverting from prepared comments for just a little bit, that our thoughts and prayers are with the people of Oklahoma, and I think this tragedy highlights the importance of real-time forecasting to protect lives and property.

I would like to thank our excellent witness panel as well for traveling here today, and while this hearing was scheduled several weeks ago to discuss draft legislation to help enhance weather forecasting, the tragedy in Oklahoma once again underscores the importance of this issue and should encourage us to start tackling these questions today.

It is unfortunate that the National Oceanic and Atmospheric Administration is unable to testify in-person. However, as the Ranking Member and I have just discussed, we will be asking Acting Administrator Kathy Sullivan to submit comments for the record, and we will work to accommodate her in-person testimony on these issues some time very soon.

We need a world-class system of weather prediction in the United States—one, as the National Academy of Sciences recently put it, that is "second to none." We can thank the hardworking men and women of the National Oceanic and Atmospheric Administration, or NOAA, and their partners throughout the weather enterprise for the great strides that have been made in forecasting in recent decades. But the reality is, is that we can do better. And it is not enough to blame failures on programming or sequestration or lack of resources. As Moore, Oklahoma, has demonstrated, we have to do better. But the good news is that we can.

Superstorm Sandy made clear what many in the weather community have known for years: Our model for weather prediction has fallen behind Europe and other parts of the world in predicting weather events in the United States. The Weather Forecasting Improvement Act, draft language our witnesses will be discussing today, would build upon the down payment made by Congress following this storm toward restoring the United States as a leader in this field through expanded computing capacity and data assimilation techniques.

The people of Moore, Oklahoma, received a tornado warning 16 minutes before the twister struck their town. Tornado forecasting is difficult but lead times for storms have become gradually better. The draft legislation would prioritize investments in technologies like multi-phased array radar, technology being developed at NOAA's National Severe Storms Laboratory in Oklahoma, which has, and I am quoting, "the potential to provide revolutionary improvements in tornado warning lead times and accuracy, reducing false alarms" and could move us toward the goal of being able to warn on forecast.

We have seen the devastating effects that severe weather can have in this country, and this bill would establish a priority mis-

sion for all of NOAA to improve forecasts and warnings to protect lives and property. Recent studies suggest that even routine weather variability every year can have an impact on a large portion of the economy with hundreds of billions of dollars in consequences.

The Weather Forecasting Improvement Act is based upon a number of recommendations received in the last Congress, and let me tell you what this bill will do. As the country faces severe satellite data gaps, it would encourage NOAA to systematically conduct cost-benefit assessments to ensure that we are getting the most bang for our buck in acquiring and procuring a mix of critical space-, air- and ground-based observational data. As Dr. Berrien Moore, Director of the National Weather Center at the University of Oklahoma, explained to this Subcommittee, "NOAA needs to do a better job of conducting quantitative assessments on data use, cost, and value."

This draft would help remove barriers to NOAA's cooperation with parts of the weather enterprise, including upstream data options and downstream, value-added forecasting capabilities from the private sector. As Dr. David Crain, President and CEO of GeoMetWatch, a company looking to develop critical sounding observations from a constellation of satellites, stated "a commercial approach can provide the needed data years earlier and with minimal cost and risk." It would balance NOAA's research portfolio by emphasizing weather research with the potential to protect lives and property. In 2012, NOAA barely spent one-third of the resources on weather research as it did on climate research.

And finally, the language would dedicate resources to transition next generation research into operational forecasting. As NOAA's Science Advisory Board stated last month, "Unless science is transitioned into operations, NOAA will fail in this mission."

Unfortunately, NOAA was unable to testify in-person this morning, but we will be providing the Subcommittee with comments—I am sorry—they will be providing the Subcommittee with comments on forecasting improvements, and we look forward to their feedback informing this legislation and their future testimony on this and other topics.

I look forward to discussing these absolutely critical issues with our witnesses today, and learning about how we can restore U.S. leadership in weather forecasting.

[The prepared statement of Mr. Stewart follows:]

PREPARED STATEMENT OF SUBCOMMITTEE CHAIRMAN CHRIS STEWART

Good morning and welcome to this morning's Environment Subcommittee hearing entitled "Restoring U.S. Leadership in Weather Forecasting."

First, let me say that our prayers are with the people of Oklahoma. This tragedy highlights the importance of real time forecasting to protect lives and property.

I'd like to thank our excellent witnesses for traveling to be here today. While this hearing was scheduled several weeks ago to discuss draft legislation to help enhance weather forecasting, the tragedy in Oklahoma underscores the importance of this issue and should encourage us to start tackling these questions now. It is unfortunate that the National Oceanic and Atmospheric Administration is unable to testify in-person today; however, we have asked Acting Administrator Kathy Sullivan to submit comments for the record and we will work to accommodate her in-person testimony on these issues next month.

We need a world-class system of weather prediction in the United States—one, as the National Academy of Sciences recently put it, that is "second to none." We

can thank the hard-working men and women at the National Oceanic and Atmospheric Administration, NOAA, and their partners throughout the weather enterprise for the great strides that have been made in forecasting in recent decades.

But we can do better.

Superstorm Sandy made clear what many in the weather community have known for years: Our model for weather prediction has fallen behind Europe and other parts of the world in predicting weather events in the United States. The Weather Forecasting Improvement Act, draft language our witnesses will be discussing today, would build upon the down payment made by Congress following this storm toward restoring the U.S. as a leader in this field through expanded computing capacity and data assimilation techniques.

We can do better.

The people of Moore, Oklahoma received a tornado warning 16 minutes before the twister struck their town. Tornado forecasting is difficult and lead times for storms have become gradually better. The draft legislation would prioritize investments in technologies like multi-phased array radar, technology being developed at NOAA's National Severe Storms Laboratory in Oklahoma, which "has the potential to provide revolutionary improvements in. tornado. warning lead times and accuracy, reducing false alarms" and could move us toward the goal of being able to "warn on forecast."

We can do better.

We have seen the devastating effects that severe weather can have on this country, and this bill would establish a priority mission for all of NOAA to improve forecasts and warnings to protect lives and property. Recent studies suggest that even routine weather variability every year can have impact a large portion of the economy with hundreds of billions of dollars in consequences.

We can do better.

The Weather Forecasting Improvement Act is based upon a number of recommendations received last Congress—As the country faces serious satellite data gaps, it would encourage NOAA to systematically conduct cost-benefit assessments to ensure that we are getting the most bang for our buck in acquiring and procuring a mix of critical space-, air-, and ground-based observational data. As Dr. Berrien Moore, Director of the National Weather Center at the University of Oklahoma, explained to this Subcommittee, "NOAA needs to do a better job in conducting quantitative assessments on data use, cost, and value."

This draft would help remove barriers to NOAA's cooperation with parts of the weather enterprise, including upstream data options and downstream, value-added forecasting capabilities from the private sector. Dr. David Crain, President and CEO of GeoMetWatch, a company looking to develop critical sounding observations from a constellation of satellites, stated that "a commercial approach can provide the needed data years earlier and with minimal cost and risk."

It would balance NOAA's research portfolio by emphasizing weather research with the potential to protect lives and property. In 2012, NOAA barely spent one-third of the resources on weather research as it did on climate research.

This language would dedicate resources to transition next generation research into operational forecasting. As NOAA's Science Advisory Board stated last month, "Unless. science is transitioned into operations. NOAA will fail in its mission."

Unfortunately, NOAA was unable to testify in-person this morning, but they will be providing the Subcommittee with comments on forecasting improvements, and we look forward to their feedback informing this legislation and their future testimony on this and other topics.

I look forward to discussing these absolutely critical issues with our witnesses today, and learning about how we can restore U.S. leadership in weather forecasting.

I yield back the balance of my time, and recognize Ranking Member Bonamici for an opening statement.

Chairman STEWART. With that, I yield my time, and recognize the Ranking Member, Ms. Bonamici, for an opening statement.

Ms. BONAMICI. Thank you very much, Chairman Stewart, and welcome to our witnesses, Mr. Myers and Mr. Kirchner. I want to thank you for appearing here to provide your insights regarding weather data and weather forecasting.

I join the Chairman in saying that our thoughts and prayers go out to all of the victims of the powerful and devastating tornado that just days ago swept through the State of Oklahoma. All of us have been moved by this event and the courageous efforts of the community. The event is a painful reminder that we are all vulnerable to unexpected disasters, and it also highlights how critical the work of the National Weather Service is as a public safety tool.

And that leads us to the purpose of today's hearing. The National Oceanic and Atmospheric Administration—NOAA—has an expansive mission: to predict the weather, to ensure healthy oceans and fisheries, to address climate mitigation and adaptation, and to enhance the resilience of our coastal communities and economies. To carry out all of these missions, NOAA must manage a very broad set of scientific challenges and look for ways to incorporate the findings of research into the daily lives of all our citizens.

In recent years, our Nation has experienced harsher climactic conditions and a wave of severe weather. From unprecedented heat waves and droughts, to severe record-breaking weather events across this country, we have received constant reminders of the importance of accurate and timely weather prediction.

Good weather prediction, however, doesn't just happen. It requires collection of the appropriate data, and our understanding of what is useful evolves over time. It also requires us to conduct scientific research to understand the physical processes that drive short- and long-term weather conditions.

Unfortunately, the draft legislation that we are considering today includes little or no acknowledgment of NOAA's other missions carried out by the Office of Oceanic and Atmospheric Research, particularly with regard to its climate and ocean research. Although my colleagues across the dais might not always agree on every issue around climate and ocean science, sacrificing these critical areas will only weaken us for the future. Understanding the climate is as critical to public protection as understanding the weather.

It is unfortunate that NOAA could not be here today. They received 10 days ago on May 13 a letter from the Chairman. It is my understanding that a copy of the draft bill was given to the agency at that time. That did not give them enough time for the agency to evaluate a bill, compose testimony, and then clear that testimony through OMB.

Also, I want to point out that NOAA just released their Weather Ready Nation Roadmap last month after they spent more than a year preparing the report and seeking public input. Additionally, there have been four outside reviews of NWS and NOAA R&D in the last year, two by the National Academies of Science, one by the National Academy of Public Administration, and one done for the NOAA Science Advisory Board. These reports address key issues like how to move from research to operation; the need for NOAA

to more actively tap the modeling and forecasting expertise in the research community; and the divisions within NWS and between NWS and OAR.

The draft legislation does not address all these relevant issues but they need to be considered. It would be both appropriate and beneficial for this Subcommittee to receive testimony about these reports before we move to mark up a bill. We can work together in this area if we have complete information, which requires a more complete Committee record than today's hearing will yield.

As I indicated to the Chairman, the minority submits that the importance of weather forecasting and the work of NOAA are so important that we are invoking our Rule XI right to ask for a second day of witnesses, and I am attaching that letter to my statement for inclusion in the record, and I appreciate the Chairman's cooperation in that regard.

I am sure we can work together, Mr. Chairman, to find a date and time and a range of expert witnesses who can help us craft strong legislation that will improve weather forecasting for the nation. I look forward to working with you, Mr. Chairman, and the Committee Members in this critically important area.

Thank you very much again for appearing before us, and I look forward to an informative discussion today. Thank you, Mr. Chairman, and I yield back.

[The prepared statement of Ms. Bonamici follows:]

PREPARED STATEMENT OF SUBCOMMITTEE RANKING MEMBER SUZANNE BONAMICI

Thank you, Chairman Stewart. And welcome to the witnesses, Mr. Meyers and Mr. Kirchner. I want to thank you for appearing here to provide your insights regarding weather data and weather forecasting.

My thoughts and prayers go out to all of the victims of the powerful and devastating tornado that just days ago swept through the state of Oklahoma. All of us have been moved by this event and the courageous efforts of the community. This event is a painful reminder that we are all vulnerable to unexpected disasters, and it also highlights how critical the work of the National Weather Service is as a public safety tool.

And that leads us to the purpose of today's hearing. The National Oceanic and Atmospheric Administration (NOAA) have an expansive mission: to predict the weather, to insure healthy oceans and fisheries, to address climate mitigation and adaptation, and to enhance the resilience of our coastal communities and economies.

To carry out all of these missions, NOAA must manage a very broad set of scientific challenges and look for ways to incorporate the findings of research into the daily lives of all our citizens.

In recent years, our nation has experienced harsher climactic conditions and a wave of severe weather. From unprecedented heat waves and droughts to severe record-breaking weather events across the country, we have received constant reminders of the importance of accurate and timely weather prediction.

Good weather prediction, however, doesn't just happen. It requires collection of the appropriate data, and our understanding of what is useful evolves over time. It also requires us to conduct scientific research to understand the physical processes that drive short- and long-term weather conditions.

Unfortunately, the draft legislation that we are considering today includes little to no acknowledgment of NOAA's other missions carried out by the Office of Oceanic and Atmospheric Research, particularly with regard to its climate and ocean research. Although my colleagues across the dais might not always agree on every issue around climate and ocean science, sacrificing these critical areas will only weaken us for the future. Understanding the climate is as critical to public protection as understanding the weather.

It's unfortunate that NOAA could not be here today. They were invited just 10 days ago on May 13 by a letter from the Chairman. It is my understanding that a copy of the draft bill was given to the agency at that time. Six working days is

simply not enough time for an agency to evaluate a bill, compose testimony, and then clear that testimony through OMB.

Also, NOAA just released their "Weather Ready Nation Roadmap" last month, after they spent more than a year preparing the report and seeking public input. Additionally, there have been four outside reviews of NWS and NOAA R&D in the last year-two by the National Academies of Science, one by the National Academy of Public Administration, and one done for the NOAA Science Advisory Board. These reports address key issues like how to move from research to operations; the need for NOAA to more actively tap the modeling and forecasting expertise in the research community; and the divisions within NWS and between NWS and OAR.

The draft legislation does not address all these relevant issues but they need to be considered. It would be both appropriate and beneficial for this Subcommittee to receive testimony about these reports before we move to markup a bill. We can work together in this area if we have more complete information, which requires a more complete Committee record than today's hearing will yield.

As I indicated to the Chairman, the minority submits that the importance of weather forecasting and the work of NOAA are so important that we are invoking our Rule XI right to ask for a second day of witnesses. I am attaching that letter to my statement for inclusion in the record.

I am sure we can work together, Mr. Chairman, to find a date and time and a range of expert witnesses who can help us craft strong legislation that will improve weather forecasting for the nation. I look forward to working with you Mr. Chairman in this critically important area.

Chairman STEWART. Thank you, Ms. Bonamici, and regarding your request, once you have provided us with the written request, we will certainly review it, and we look forward to working with you on that.

Okay. If there are Members who wish to submit opening statements, your statements will be added to the record at this point.

At this time I would like to introduce our witnesses. Our first witness today is Mr. Barry Myers, Chief Executive Officer for AccuWeather Incorporated. He previously served as AccuWeather's Executive Vice President and General Counsel. Mr. Myers has served as Special Advisor to three separate directors of the National Weather Service and is a Professional Member of the American Meteorological Society. He also currently serves on the Environmental Information Services Working Group for NOAA Science Advisory Board.

Our next witness today is Mr. Jon Kirchner, President and Chief Operating Officer of GeoOptics. Previously, Mr. Kirchner has held senior executive positions for large satellite communication companies, Loral Space and Communications, and Arqiva Satellite and Media. Mr. Kirchner has worked to develop long-term space-based infrastructure for data networking, Earth observations and sensing, and information management systems.

As our witnesses should know, spoken testimony is limited to five minutes after which the Members of the Committee will have five minutes each to ask questions, and I now recognize Mr. Myers for five minutes to present his testimony.

TESTIMONY OF MR. BARRY MYERS, CHIEF EXECUTIVE OFFICER, ACCUWEATHER

Mr. MYERS. Thank you for inviting me to speak today, and to the families and friends of those who lost loved ones on Monday in Oklahoma and to those who suffered injury and other loss, I can only offer my condolences and a hope that today's hearing will contribute to improved warnings of severe weather.

The United States has the most violent and challenging weather on Earth: tornados and hurricanes, lightning and hail, snow and ice and floods, to name a few. The United States has more tornados than any nation. In fact, we have four times the number that all of Europe has.

On Monday, NOAA's National Weather Service provided about 16 minutes of warning before the tornado touched down, and actually over 30 minutes before it reached Moore. The agency and the people of the National Weather Service did an outstanding job.

There can be no doubt without those warnings the toll would have been much worse. Mike Smith in his book "Warnings" points out the huge progress made in tornado forecasting since the 1950s. But we can and must do more relative to severe weather. People should not live in fear in America's heartlands, in its cities and along its coasts. With enhanced modeling, perhaps we might have known hours in advance exactly where the tornado would form, where it would touch down, how monstrous it would grow, and its exact path.

Imagine being able to tell people an hour or two in advance to move out of the zone of danger and have them watch the tornado from miles away. Is it a pipe dream? This year marks the 50th anniversary of AccuWeather's creation. Fifty years ago, weather forecasting was more art than science. A tornado might form at night in the darkness unknown to those in its deadly path, and no radar was there to help a forecaster spot a hook echo.

A storm like Hurricane Sandy without a weather satellite would have thought to have moved away out into the ocean only to return as a surprise, much like the great Galveston hurricane of 1900 that no one knew was coming because there were no eyes in the sky.

In the United States, the National Weather Service and America's weather industry and the academic and research communities each have important and complementary roles to play. It is a unique and special partnership and a benefit to the Nation. The United States government collects and disseminates data from local and remote sensing platforms, runs forecast models and prepares and makes special warnings. Weather companies and academic and research institutions use this information and also collect and disseminate data and make weather forecasts and warnings, some specific and tailored and some for the general public.

The joint system of public and private cooperation helps to save countless lives and prevent hundreds of millions of dollars in property damage a year in the United States. In fact, it has a name: the Public/Private Partnership. And it has been held up as a model by other Federal agencies and even a recent Executive Order mentioned it this month.

In 1962, if I had told anyone that a company named AccuWeather by 2008 would tell a manufacturing facility in Mississippi, a thousand miles away, 21 minutes in advance, that a tornado was headed right at it and that they needed to shelter their people and that the private weather warning would save 88 lives in a single electronic message, it would have not been believed, but it and similar situations have happened now repeatedly.

The government is uniquely positioned to ensure and enhance the provision of weather data and the issuance of warnings for the

public aimed at the protection of life and property. These activities require research and development, transfer of knowledge between government agencies and the private sector, and this is needed with regard to advanced radar technologies, aerial observation systems, high-performance computing networks, advanced forecast modeling and other government-appropriate activities. We all need to protect this core functionality and the research that keeps the entire American weather enterprise ahead of the curve.

Of special focus during Superstorm Sandy was the ECMWF, so-called European model, which did a better job at some points in the storm track than U.S. models did. This gap presents issues from an economic safety and national security standpoint. Relying on other countries for better weather models places America in a weak and subservient position.

Weather research and development and the creation and operation of core infrastructure remain a matter of national government urgency, which the Weather Forecasting Improvement Act will help to address. Thank you for your time.

[The prepared statement of Mr. Myers follows:]

Subcommittee on Environment of the Committee on Science, Space and Technology

Restoring U.S. Leadership in Weather Forecasting

Thursday, May 23, 2013, at 9:30 a.m. in Room 2318 of the Rayburn House Office Building

Barry Lee Myers, CEO, AccuWeather, Inc.

Formal Remarks

Thank you for inviting me to speak today.

On average, the United States experiences 100,000 thunderstorms annually, resulting in more than 1,200 tornadoes.

The tornado is the most violent storm on Earth.

The United States has more tornados than any nation; in fact, we have four times the number in all of Europe.

We also report more violent EF4 and EF5 tornadoes than anywhere else.

When hit by a powerful tornado, often entire buildings are destroyed . . . sometimes literally wiped off the face of the earth.

We saw the devastating and heart sickening results of this on Monday in Oklahoma.

The Magic of Weather Forecasting.

Meteorology is a rewarding field and also, like the job of first responders, one often filled with gratitude and devastating horror, all at the same time.

It is somewhat like being in the Twilight Zone because those of us in the field of meteorology have the ability to tell, with significant accuracy, what the future will hold.

We can tell ***what*** the temperature will be tomorrow or next week and whether it will be sunny or cloudy.

We can tell ***whether*** in the next 30 minutes, people are likely to be killed if they continue to stand where there are – in the path of a tornado or tsunami.

Based on seeing the future, one can decide whether to start planning to move the Sunday wedding indoors or under a tent. One can decide to take shelter, or leave town, and save a life.

We have a Crystal Ball that allows us to know the future. It is a privilege to have it. And it is a responsibility to continually improve the tools we have, and might develop, to improve the clarity of that crystal ball, to save lives and help people prosper.

The crystal ball in am referring to is not actually round and clear; and when it is seen, one may not realize they saw it.

But there is a ***magic in meteorology.***

From Government Operation to a Partnership Enterprise

This year marks the 50th Anniversary of AccuWeather's creation and the 30th Anniversary of The Weather Channel. That is interesting in light of how far the weather enterprise, and especially the weather industry, has come.

I will tell you that when the first customer of the company that would grow to be AccuWeather signed up for $50 a month in 1962, meteorology was still in relative infancy.

And what would become the American Weather Enterprise – consisting of the U.S. Weather Bureau (later NOAA's National Weather Service), academic and research organizations, and America's weather industry – was not a full concept in 1962.

TIROS-1 was launched just two years earlier and had operated for 78 days. And the first recorded weather radar observation occurred only 9 years before.

Absent a garage, in 1962, work building AccuWeather actually began around my older brother's kitchen table with a single rotary dial telephone. Joel Myers made perhaps 10,000 calls to secure the first dozen or so customers in the first two years.

So it would seem that the competitive landscape was wide open for those who would make the effort.

But that was not so.

At the time, weather forecasting was more art, than science, and even a forecast for a heavy snow storm just hours away might result in a sunny afternoon.

And a tornado might form at night and in the darkness, unknown to those in its deadly path – as no radar was there to help a forecaster spot a hook echo signature.

A storm like Hurricane Sandy, without a weather satellite, would have thought to have moved away out into the ocean and gone, only to return as a surprise. It would have been like the great Galveston hurricane of 1900 that no one knew was coming, because there were no eyes in the sky.

In 1962, most of the weather information reaching business, industry, the media, and the public came from the United States Weather Bureau – the government.

So, the idea of starting a weather company, literally on pocket change, and competing with the government's free services, is the story of AccuWeather . . . and American's weather industry in general.

When Joel and I were thinking through the weather company concept in those early years - probably 95% of all the weather information reaching the public came from the government.

Government employees did the weather broadcasts on radio.

Government employees did the newspaper weather maps and charts for The Associated Press and many newspapers.

Government employees consulted free with anyone who called them on the phone or stopped into their offices, and provided special scheduled services to large and small companies.

At the same time, as our business struggled to grow through the 1960s and 1970s, sometimes government employees discouraged potential customers from using our services, calling them up and offering services for "free," at government expense.

It was like the Post Office and Federal Express, except it would be like the Post Office offering to carry every letter without postage, and every package for free.

Despite that, it is estimated today, that 95% of the weather information reaching business and industry, the media, and the public comes - not from the National Weather Service - but from AccuWeather and other members of America's weather industry.

A complete reversal from 1962!

Basis for America's **Weather Success**

In 1994, I was asked to offer thoughts to the U.N.'s World Meteorological Organization about weather information and its use. What I said was, in part:

- Viewed broadly, weather is a world-wide resource.
- In gathering weather information, time is of the essence.
- In analyzing it, and in distributing the results of that analysis of weather observations, time is critical.
- And, in getting this analysis into the hands of those who need it to protect life and property, not only is time critical, but the very nature of the message and its understandability by those receiving it, is paramount.

In the United States, the National Weather Service has a specific role to play and America's weather industry, and the academic and research communities, each have important and complementary roles to play. It is a unique environment and special partnership for the benefit of the public.

The laws of the United States do not hamper or restrict the nature of the private sector. In fact, unlike many other countries, they encourage private sector and especially weather industry activities.

The United States government collects, and disseminates data from local and remote sensor platforms, runs forecast models, and prepares and makes special warnings and also general public forecasts.

Weather companies and academic and research institutions also collect and disseminate data, and make weather forecasts, some specific and tailored and some general public forecasts.

Weather companies also develop communication methods designed to move weather information as quickly and as understandably as possible to the end user.

In fact, the government and the weather industry work together, to carry out these functions.

This joint system of public and private cooperation helps to save countless lives and prevent hundreds of millions of dollars in property damage per year in the United States – in fact it has a name – The Public/Private Partnership.

This cooperative effort, better than anywhere else on earth, is dedicated to the proposition that weather information is (1) highly time sensitive and (2) a perishable scientific commodity, which, if utilized quickly and communicated to people who are in a position to act, effects real economic efficiencies, saves lives, and, results in benefit to the nation.

Another guiding principle is that all scientists should be free to access scientific data so that they may render timely viewpoints and opinions on what future weather may be – that is create forecasts and warnings.

This freedom of access to scientific data and its free use for the benefit of society is typically American.

In the United States this "free and open access" is founded upon principles having to do with free speech and freedom of information.

These comments seem self-evident to many. In making these remarks to the World Meteorological Organization, almost 20 years ago, these comments did not seem self-evident to many of the hundreds in the audience from around the world.

The weather industry in the United States was born of the concept of "free and open" availability of weather information.

It has led the world as a model of growing success, transitioning from a government agency "doing it all," at the end of World War II, to massive infusion of weather into every America's life through companies like The Weather Channel and AccuWeather - and a growing global presence by American companies as the preferred suppliers of weather to the world.

It has been a transition of work from the government to private industry involving no letting of government contracts, no industry subsidies, and no cost to the government.

In fact a tax paying industry creating perhaps tens of thousands of jobs - has been born.

It truly has built on a concept that if information is free for all, we should leave the rest to ingenious, innovative, and entrepreneurs, who would find ways to make a viable industry.

By the end of 2013, figures suggest that American Weather Companies will have weather apps and access portals on or accessible from perhaps two billion digital devices worldwide.

People who had no weather forecast of merit for 25 minutes ahead, now have forecasts, on an hour by hour basis, for 25 days ahead on AccuWeather.com.

People who had no warnings for severe and deadly weather, now can use at a device that looks like something they would have used to ask "Scotty beam me up" that contains more information than Star Trek creators ever imagined.

These comments seem self-evident to many today.

In 1994 if I had told anyone that by 2008 a private weather company in Pennsylvania would tell a manufacturing facility in Mississippi, a thousand miles away, 21 minutes in advance, that a severe tornado was heading right at it and they needed to shelter their people – and that the private weather warning would save 88 lives in a single electronic message – it would not have been believed.

In 2005 the U. S. Congress Bi-partisan Committee on the review of Hurricane Katrina cited AccuWeather saying "AccuWeather issued a forecast predicting the target of Katrina's landfall nearly 12 hours before the NHC [National Hurricane Center] issued its first warning, and argued the extra time could have aided evacuation of the region."

I am not telling you this to place AccuWeather in the spotlight. My friends at The Weather Channel and at many other non-governmental organizations have this and other important capabilities.

Everywhere within the American Weather Enterprise there are meteorologists, scientists, researchers, and professionals of all kinds of equal merit.

But the government is uniquely positioned to ensure and enhance the provision of weather data and the issuance of warnings for the public aimed at the protection of life and property.

These activities also require research and development, transfer of knowledge, technologies and applications to other government agencies and the private sector.

And this is needed with regard to advanced radar technologies, aerial observing systems, high performance computing networks, advanced forecast modeling and other government-appropriate activities.

We all need to protect this core functionality and the research that keeps the entire American weather enterprise ahead of the curve.

Free and Open Access Drives America's Unique Success

So indulge me for a few minutes to point out that if we want to successfully approach the present problems the weather enterprise may face we should understand that the huge success we have had, did not occur serendipitously. It was well planned, thought through, and took much hard work in all sectors of the weather enterprise over many years.

In 1980 the Paperwork Reduction Act was passed. The law stated its purpose was, among other things to:

Ensure the greatest possible public benefit from information created, collected, maintained, used, shared, and disseminated by or for the Federal Government.

It also said one of its purposes was to provide for the dissemination of public information on a timely basis, on equitable terms, and in a manner that promotes the utility of the information to the public and makes effective use of information technology.

In follow up to the law, the Office of Management and Budget issued Circular A-130, which was updated over the following decades.

The Circular is lengthy, but states in part:

- The free flow of information between the government and the public is essential to a democratic society. It requires dissemination of information on equitable and timely terms.
- It states the government must avoid establishing, or permitting others to establish on their behalf, exclusive, restricted, or other distribution arrangements that interfere with the availability of information dissemination on a timely or equitable basis.
- It declares agencies shall avoid establishing restrictions or regulations, including the charging of fees or royalties, on the re-use, resale, or re-dissemination of Federal information, setting user charges at a level only sufficient to recover the cost of dissemination, but no higher.

Under Section 105 of the Copyright Act of the United States, in general, government information is not entitled to domestic copyright protection declaring it free – domestically.

The 1991 NWS Public Private Partnership policy was an early cooperative attempt to implement concepts from the Paperwork Reduction Act, Circular A-130 and issues relating to the growing weather industry.

About ten years later the National Research Council was requested by the National weather Service to undertake a study of the status of the enterprise and the *Fair Weather Report* was issued in 2003.

This led to the AMS Commission on Weather and Climate Enterprise.

And, the Fair Weather Report led to a new partnership policy issued by NOAA governing its relationship with America's weather industry.

In the main policy section, the first sentence says: "NOAA will adhere to the policies contained in the Paperwork Reduction Act, OMB Circular A-130 and other relevant laws."

The second sentence says: "These policies are based on the premise that government information is a valuable national resource, and the benefits to society are maximized when government information is available in a timely and equitable manner to all."

It goes on to endorse "Open and unrestricted access."

And further that NOAA will promote the open and unrestricted exchange of environmental information worldwide.

NOAA also states it will avoid duplication and competition in areas not related to the NOAA mission.

So today's policies trace their origins to the core nature of the republic and critical pieces of federal legislation and rules long a part of the fabric of the country's legal structure.

Building on this, NOAA and NWS have developed formal and internal directives defining what they will do and not do and specifically stating where government personal will defer to the America's weather industry.

Even the Weather Ready Nation program now specifically endorses the role of America's weather industry and states that the requirements and activities of Weather Ready Nation participants may be fulfilled through arrangements with America's weather industry.

And, the Open Data Executive Order signed by President Obama just this month on May 9, 2013 stated:

"For example, decades ago, the Federal Government made both weather data and the Global Positioning System (GPS) freely available to anyone. Since then, American entrepreneurs and innovators have used these resources to create navigation systems, weather newscasts and warning systems, location-based applications, precision farming tools, and much more

---

Nature of America's Weather Industry Success

America's Weather Industry is the most robust weather industry existing in the world today.

AccuWeather and other companies in the weather industry are out of the kitchen, and into every ones garage, home, television, radio, newspaper, internet, and mobile device. And yes, back into the kitchen on Samsung refrigerator digital screen displays.

Weather is on the gas pump where you fuel your car or truck.

It is on the electronic signage in your doctor's office or retail store.

It is on the counter of the check-in desk at the hotel where you stay.

If products travel by rail or truck, America's weather industry helps get them to the nation.

If food is served, the industry helped grow it and assisted the commodities traders who transacted in it.

In banking or financial services the industry helps customers be more efficient and better able to pay their loans and increase their deposits.

In insurance, we help in planning for losses and adjusting them after a weather-related loss.

Weather is about the national economy.

No matter the business, you can protect property, increase efficiencies, and yes – save lives.

The weather is also the ***news every day.***

It is the single most accessed piece of information watched, listened for, or selected on radio, television, the wired web, and mobile devices.

You can watch local weather channels.

You can access the AccuWeather forecast on AccuWeather.com from anywhere on earth.

AccuWeather and other weather sources are available on just about any mobile phone or other mobile device you carry and your friends and family might carry.

And the AccuWeather mobile web site is available globally and in 39 languages.

You find it as a widget you can click on, on the screen of your new television set.

So weather is a media phenomenon, and it drives weather companies that wish to be successful - to become media companies - with weather as their core information.

While the weather may be interesting to many, and of economic importance to others, accuracy of weather information is the most important secret sauce of the weather - for businesses, government, and the public.

And the secret sauce potentiating accuracy – is communication.

The most accurate forecast or warning, not communicated in an effective and timely way, not understood and not leading to action, is merely a theoretical exercise.

So many weather companies are media companies empowering all weather information to be actionable and empowering businesses and people who receive it to use it to their advantage.

But the fact that America's weather industry is the most robust on the world today does not mean the American Weather Enterprise has the best that is possible. There is room for enhancement, there is room for improvement.

And improvement in the field of meteorology means saving lives and property.

Success Stories from the Partnership

Often warnings are issued by the government for tornados.

Usually community-warning sirens go off.

On February 5, 2008, at about 5:37 PM, a machinery company plant in Oxford, Mississippi, was bustling with activity, as 88 people were at work.

No government tornado warning extended to the location of the plant.

No warning siren was sounded.

In the winter darkness miles away, a tornado dipped from the sky, unseen by the naked eye, and began racing toward the plant.

Twenty-one minutes later the violent tornado struck the plant with a horrifying fury ripping and chewing the plant to pieces.

Steel girders twisted and collapsed, metal walls shredded.

All that debris fell in to the space people occupied inside.

The calm orderly work environment was suddenly a violent swirling mass of shrapnel, totally exposed to the monster storm.

It left a picture, of a plant perhaps hit by an aerial bomb or a terrorist attack. People would be lucky to have survived.

As the monster tornado formed in the darkness that winter night and began to dip from the sky, and started its race toward the people in the Caterpillar plant, a meteorologist at our office in Wichita was at work.

He saw a tornado signature on a radar image on a computer screen. He didn't just "happen" to see it. He was looking for it.

He knew what circumstances could lead to a tornado that night.

He had cutting-edge computer tools, developed by, and proprietary to AccuWeather, that notified him to be on guard.

He had access to the government's Doppler radar system; that did not exist in 1962.

At another time, or in another place, he might have looked on in horror wondering what humanity the monster storm would claim.

Instead, he pressed a key stroke and an AccuWeather computer sent an electronic message to another computer at the Caterpillar plant in Oxford, Mississippi.

A human at the plant was required to confirm receipt of the message.

In fact, a person-to-person telephone contact was also immediately established with the plant's safety director.

The message was clear; a tornado was forming about 30 miles southwest of the plant, and may be at or near the plant in about 22 minutes.

The first images of the destroyed plant were seen by the people who worked at the plant, not as they watched the horror around them, not as they and their co-workers were

contemplating death, but as they emerged from their tornado shelter, after the tornado had done its destructive work and moved on.

Not a single person was injured, not a single person died. They all went home - shaken, but safe.

Hundreds of miles away, an AccuWeather meteorologist also went home - shaken, but safe.

He went home knowing he had just saved the lives of scores of people, and the misery that death and injury would have brought to their families.

The government/private sector collaboration worked. A government radar network and a private weather company, working together, saved lives.

Why Support Weather Research and the American Weather enterprise?

Questions arise as other governments in other nations invest in improved modeling both in accuracy and timeliness.

This means others can forecast better for American shores than America itself.

Of special focus was the ECMWF (so called European Model) during Hurricane Sandy, which model did a better job at some points in the storm track, than the U.S. models did.

This gap presents issues from an economic, safety, and national security standpoint.

From an economic standpoint foreign companies and investors could potentially get the jump on Americans relative to weather events occurring on American shores.

Additionally, as America's weather industry continues to expand worldwide, restricted access to quality models could place it in a position of having second class primary information.

And interestingly, many foreign governments do not look at the weather industry as their partners, like we do here in America. And so those countries do not get to leverage the value of their government investment, like we do here. So a dollar spent on improved modeling, for example, in America, has greater value to our economy than a dollar spent by other governments.

Relying on other countries, for better weather models, places America in a weakened position in time of national and international crisis. And we cannot get full access even to the European Model from what my government sources tell me.

Weather infrastructure and related research and development, and operation of core infrastructure remain a matter of national urgency today.

Many functions that were only government functions at the dawn of the development of America's weather industry 50 years ago – such as media forecasting, business forecasting, and general public forecasting have been subsumed by America's weather industry.

Even some data sources such as mesonets and lightning networks have been taken under the wing of private sector entities.

But much remains, and may forever need to remain, government functionality.

So I entreat you to consider joining with me to support five primary tenets:

1. To empower and facilitate the American weather enterprise to achieve its full potential

2. To define the value chain of all parts of the American weather enterprise to ensure the American public is served with the best possible information employing the most cost efficient combination of private and public institutions.

3. To place special focus and funding on NOAA/NWS role as the builder of the nation's core weather infrastructure, core data sensing, core research and model development, operational modeling, public warnings for weather events that pose imminent threat to life and property, and working with America's weather industry, to achieve national and world-wide leadership in weather and weather media.

4. To focus federal support to ensure a legislative and budgetary agenda which makes maximum and optimum use of all parts, public and private, of the American weather enterprise.

5. And to encourage the execution of the aligned missions and roles through public and private partnerships.

Thank you for your time.

END

Barry Lee Myers is the Chief Executive Officer of AccuWeather, Inc., a position he has held since late 2007. AccuWeather is an American iconic brand in weather known around the world.

He previously served as the company's Executive Vice President and General Counsel.

Recognized as an expert in public/private relationships in the weather and weather media industry worldwide, (although not himself a meteorologist), Mr. Myers has served as special advisor to three separate directors of the National Weather Service and is a professional member of the American Meteorological Society (AMS).

He has been an invited speaker at the World Meteorological Organization (the United Nations body that coordinates international weather information) and at the World Federation of Scientists, on the topics of weather data exchange and public-private sector relationships in the weather field.

Mr. Myers was involved in advocating for language applying to real-time government data in the Paperwork Reduction Act, and worked with the author of OMB Circular A-130 to further support this concept. This portion of the statute serves as a basis for the free and open exchange of weather and other government data

He currently serves on the Environmental Information Services Working Group (EISWG) for the NOAA Science Advisory Board. Mr. Myers also is on the steering committee of the AMS Commission on the Weather and Climate Enterprise. He serves on the Boards of the Weather Coalition and of the American Weather and Climate Industry Association.

During Mr. Myers' tenure as CEO, AccuWeather has become the leading force in weather on mobile devices on a global basis. AccuWeather is now the largest mobile weather provider worldwide and in January became the only private company authorized in China to do business as a weather provider in the digital media space there.

Chairman STEWART. Thank you, Mr. Myers. I appreciate that. Mr. Kirchner.

TESTIMONY OF MR. JOHN KIRCHNER, PRESIDENT, GEOOPTICS

Mr. KIRCHNER. Chairman Stewart, Ranking Member Bonamici and distinguished Members of the Subcommittee, it is indeed the first time I have been to a hearing such as this, and it is a privilege for me to be present here today and provide you testimony in the absence of my colleague and our CEO, Vice Admiral Conrad Lautenbacher, former NOAA Administrator. The admiral sends his regards and regrets his inability to be here today.

We also pass on our condolences and thoughts with those in Oklahoma as well.

The U.S. weather forecasting capabilities are in need of repair and attention not solely because of technical shortcomings, inadequate computing power, or deficient weather models but also because of the explosive growth in the cost of acquiring critical weather data from satellites and the resulting significant delays in new satellite programs. The traditional methods for the collection of satellite data effectively block new instruments in more potent, lower cost and proven data sensing instruments. The net effect is damaging our Nation's ability to keep pace in weather observations and predictions. A transition of the weather data acquisition community to 21st-century methods, both technical and economic, is overdue and our weather-dependent economy depends on it.

The genius of American innovation and initiative has had technical and market solutions to the weather data crisis at the ready for many years. As analogs, a few working cases from related sectors already exist. At NASA, instead of operating a fleet of costly space shuttles, NASA has contracted with the private sector for its payload needs and works cooperatively with other governments. The commercial satellite-based communications industry provides the government 80 percent of its bandwidth globally. The commercial satellite-based imagery industry also provides government much of the imagery outside of the intelligence community application.

With these analogs in mind, the focus would be better placed on achieving data quality, accuracy and excellence from wherever that data may come rather than necessarily owning that data infrastructure. The added irony is that the costs of technologies of every kind have plummeted over the last 20 years except not seemingly in the wider space domain. Tragically, the benefits of mobile and miniaturized technologies that we all carry in our pockets are seemingly sheltered from the critical space mission of forecasting weather.

GeoOptics, our company, will advance a small satellite cellular-like observing model that starts with a GPS radio occultation. We believe an integrated private company can deploy such systems for a fraction over current cost to government. GeoOptics working with private-sector partners and the science community can realize uncommon efficiencies to deliver path-breaking science speedily at bargain prices for the public good and lower government's cost for satellite weather data.

We want to emphasize that today, our government and, as a consequence, our economy and citizens, is facing a weather data crisis that can be relieved almost immediately through procurement reform that would unleash the resourcefulness and the ingenuity of American private enterprise. In doing so, the government will foster a vibrant and innovative free market in satellite weather data, creating a new weather data economy that will be supported by weather data security that will once again stock our shelves with the best possible weather products and services.

In sum, we highlight some of the following comments regarding the bill and general recommendations. In section 3 regarding forecasting innovation, it mentions little regarding the general principal of the role of commercial private sources of innovation or the potential role of public-private partnerships; it could. Section 6 regarding OSSEs does not mention the potential role of the private sector or scientific university sources of research to support these efforts, which it also could. In section 8, we believe that overall procurement reform is needed. Elements of this reform could include shift the focus of Federal agencies and users away from the ownership of weather data infrastructure, open competition to acquire the best, most effective and lowest-cost efficient data. Government could articulate—should articulate and implement procurement reform by creating new performance-based pay-on-delivery data purchase procurement models that enable Federal agencies to immediately contract for services they need now from private companies that can provide them. This approach will energize capital for private-held companies and aid in rapid deployment of needed product and services. Establish specific programs within NOAA and the Air Force and possibly other agencies with budget authority beginning in Fiscal Year 2015. We recommend satellite data purchase line items of $10 each for NOAA and Air Force in 2015, growing to $50 million for each by 2020 accompanied by RFQs and/or BAAs soliciting proposals.

These recommendations and actions are necessary to ensure that the United States is never again lagging behind any country or consortium of countries in weather prediction or forecasting. Opening up the government through changes to procurement to very economical, proven and reliable data sources that meet the standards and specifications of NOAA, Air Force and other users will be the act that infuses innovation and creativity into our Nation's weather enterprise. The results of this change to the weather enterprise will not only enhance public safety through better forecasting but will also feed our economy and society with an important source of jobs and help participants in our economy manage vital risk.

Additional examples of GeoOptics' efforts in a small satellite cellularized world are available on our Web site. Admiral Lautenbacher and I will be happy to provide any follow-up comments needed by the Subcommittee. I will be happy to answer your questions. Thank you.

.The prepared statement of Mr. Kirchner follows:]

STATEMENT OF MR. JON KIRCHNER
PRESIDENT AND CHIEF OPERATING OFFICER
GEOOPTICS INC.

BEFORE THE HOUSE SUBCOMMITTEE ON ENVIRONMENT
HOUSE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

ADDRESSING THE RESTORAL OF U.S. LEADERSHIP IN WEATHER FORECASTING

May 23, 2013

Chairman Stewart, Ranking Member Bonamici and distinguished members of the Subcommittee: It is a privilege for me to be present here today and provide testimony to you in the absence of my colleague and our company's CEO, Vice Admiral Conrad Lautenbacher, Ret., former NOAA Administrator from 2002-2008. The Admiral sends his regards, and regrets his inability to be here today. He and I will be happy to provide any follow-up comments needed by the Subcommittee.

The U.S. weather forecasting capabilities are in need of repair and attention not solely because of technical shortcomings, inadequate computing power, or deficient weather models – but also because of the explosive growth in the cost of acquiring critical weather data from satellites and the resulting significant delays in new satellite programs. The status quo -- of continuously purchasing costly systems and marginally-effective improvements in current weather sensors -- effectively blocks investments in potentially new, more potent, lower cost, and proven data sensing instruments, and is damaging our Nation's ability to keep pace in weather observations and predictions.

The irony is that the costs of technologies of every kind – some of the very technologies used in the very newest satellite weather sensors – have plummeted over the past 20 years, except, conspicuously, in the space domain. A transition of weather data acquisition to 21st century methods, both technical and economic, is overdue and the weather-dependent economy depends on it. The Bureau of Economic Analysis reported to the National Research Council in the National Academy Press publication, *The Atmospheric Sciences Entering the Twenty-First Century*:

> *"There can be no doubt that weather is important to the U.S. economy and to the health and safety of its citizens. Estimates vary, but 25% to 42% of the U.S. gross domestic product is affected by weather, and hundreds of millions of dollars are saved each year by taking action based on improved forecasts and weather warnings."*

The 2011 figure for the Gross Domestic Product is $14.99 trillion. Using these estimates, the range of the economy directly impacted by weather is $3.3-$6.3 trillion. These comments were published in 1998 as we entered the 21st Century. Since weather conditions affect so much of the US economy it only makes sense in this century to have the best sensing instruments to provide critical weather data at a cost we can afford.

The genius of American innovation and initiative has had technical and market solutions to the weather data crisis at the ready for many years now. It is no longer cost-effective for the government to keep these solutions on the sidelines. One working government case study for this already exists with NASA. Instead of operating a fleet of costly space shuttles, NASA has contracted with the private sector for its payload needs and works through cooperative agreements with scientific space programs from other countries. With this model in mind, the focus might be better placed on achieving data quality, accuracy and excellence – from wherever data might come – rather than weather data infrastructure ownership. Economic imperatives beg such a new perspective. It is time for the government to start tangibly augmenting this transition – with no less than the U.S. weather forecasting program at stake.

One step: We respectfully recommend that you enable federal agencies to purchase satellite weather data from commercial providers, aided by contingent, milestone-based contracting vehicles and procurement process that both enable competition and incentivize the private sector to take action. There are a number of competitive, creative companies that will promptly respond to supply the Nation with a bounty of new weather data – vastly more data, better quality data, new kinds of data – and do so far more quickly, far more inexpensively, and with zero financial risk to the taxpayer. Another working model exists wherein the satellite-based communications industry provides the US Government a large majority of its needed bandwidth, commercially. In yet another, the satellite-based imagery industry also provides the US Government with much of its needed imagery, commercially. It is time for the government to encourage commercial providers of satellite-based weather data infrastructure to address similar needs of the earth observation and remote sensing community.

A little recent history: In early 2007, the Office of Space Commercialization (OSC), under the leadership of Vice Admiral Conrad Lautenbacher, then Administrator of NOAA, instituted a fledgling satellite data purchase program. The OSC met with private sector companies and solicited data suppliers of all kinds. In July 2007 OSC issued its first Request for Information for commercial solar irradiance data. In the Fall 2007 they issued a comprehensive RFI for satellite weather and environmental data, listing a dozen critical products. Dozens of private companies responded with creative ideas of every description.

In 2008, NOAA followed up by releasing a formal Request for Quotes from private companies to supply those satellite weather and environmental products. They funded several dozen studies by companies large and small, each laying out a plan for providing data commercially, quoting firm prices. Companies were told that by spring 2009, NOAA would select the initial products for acquisition, that funding for purchase of that data would be requested for FY2010 – or FY2011 at the latest. NOAA was on a proactive path to filling the looming weather data gap long before it would ever materialize. Companies across the Nation mobilized to provide commercial data, new enterprises were formed, and the private sector raised capital preparing to offer these new products.

Unfortunately, on the road to this would-be commercial realization, the program was shelved. Inquiries to NOAA from bidding companies continued to be met with encouraging words. But little to no substantive progress has occurred since.

In the meantime, the average cost-to-in-orbit-delivery per sensing instrument on NPOESS/JPSS has gone from $80 million in 2005 to over $500 million today, and the JPSS launch has slipped

another ten years. The annual budget for JPSS is less than the program's annual cost growth. Its future remains clouded. Please consider the following: With $80 million – the original estimate for *one* JPSS instrument – a private sector company can deploy a constellation of a dozen small satellites, each carrying a state-of-the-art sensor able to measure atmospheric temperature, pressure, density, and other critical weather parameters with accuracies and resolutions far surpassing those of any instrument that will fly on JPSS, and with far greater forecast impact per measurement, as documented by NOAA's own impact studies. With $500M a private sector company could put up more than 100 such satellites. The first instruments could be flying 18 months from now, at no up-front investment by, and thus no financial risk to the government.

The ultimate increased cost to government, and to those served by less than the best possible forecasts, is incalculable. The Space Act of 1998 and its successors, and current national remote sensing policy, explicitly encourage the development of private satellite data suppliers and forbid the government from deploying competing systems. Yet in practice, we have not seen any tangible encouragement to transition government practice to these laws and policies; and to support the technical and economic engines of American private enterprise in an arena where their innovations are most urgently needed.

Moreover, the fruits of the cellular/mobile technologies that we all carry in our pockets are seemingly sheltered from the critical mission of forecasting severe weather. These examples have transformed our lives and commerce in the past decade – the smartphone, tablets, and numerous others. Infinitely more powerful than what we knew just 10-15 years back, these devices are ubiquitous, affordable and accessible to those of the most modest means. The same benefits of these technologies offer the US weather forecasting infrastructure greater power and greatly reduced costs, and they are available now to the earth observation and remote sensing satellite arena -- but have yet to be captured.

Excellent examples of our own efforts are available on our website - www.geooptics.com - and can be described more expansively in written documents that we would be happy to provide to the Subcommittee. We want to emphasize that today our government – and as a consequence our economy and citizens – is facing a weather data crisis that can be relieved almost immediately through the simple act of unleashing the resourcefulness and genius of American private enterprise. In doing so the government will foster a vibrant and innovative free market in satellite weather data, a new "weather data economy" that will be supported by "weather data security" that will once again stock our shelves with the best possible weather products and services.

To amplify the point of the value of data excellence, and having access to cost-effective and efficacious data sources, in lieu of data infrastructure ownership, please consider what was recently reported in the Washington Post on March 3, 2013 by Professor Richard Rood, an atmospheric scientist at the University of Michigan:

> *"In contrast, the European Centre for Medium-Range Weather Forecasts (ECMWF), which owns no instruments, can and does identify the [weather data] observations that would most improve the forecast. ECMWF invests in observation quality control and the observation-use interface. In the past decade, ECMWF has been able to implement advanced methods that blend or assimilate observed [data] information into the weather*

model. As early as 1995, the weather forecasts from the ECMWF were emerging as higher quality than U.S. weather products. U.S. scientists and science managers found this development a matter of great concern.

ECMWF knows to invest in software and to spend on computers. For example, when faced with a paradigm shift in computational technology, as in the late 1990s, ECMWF invested, far in advance, in both software and sustained vendor-based benchmarking in order to be ready when the paradigm shift occurred. This practice has continued. In the United States, we remain largely reactionary to the evolution of high-performance computing systems. Therefore, each shift in computing technology is a moment in time that the forecast gap is increased.

ECMWF has integrated research and operations together with institution-wide attention to science-based, validated products. This stands in contrast to the United States, where we draw sharp contrasts between research and operations. In the United States scientists and science-program managers place high value on research, especially basic research. There is lower value on use-driven research; synthesis of research to provide products; the complex entanglement of observational, computational and scientific capabilities that must be brought together to produce a product; and the operations, monitoring and assessment of those products."

In sum, we highlight the following recommendations:

1. Shift the focus of our US Government weather agencies and users away from a bias of ownership of data infrastructure to an operational focus on data excellence and operational application of data, information and solutions. Shift that bias to the best, most effective and cost-efficient data – no matter where it comes from.
    a. Move to a weather enterprise biased toward operationally focused outcomes and the production of operationally driven forecasting products and technologies – supported and enabled by the research community. Start with the outward, market-oriented uses and desired outcomes of our weather community – and work inward towards the research community in a more seamless, pragmatic research-to-operations model.
    b. As the initial step in making this change, make a general announcement that to alleviate the weather data crisis the government, as of now, is in the market to buy satellite weather and space weather data from private suppliers; that this will be an ongoing program, so long as qualified suppliers remain; that the ultimate purpose is to establish a vibrant, innovative, self-sustaining weather data economy in the U.S. that will be a model for the world.
2. To actually deliver on this new focus, the US Government must take the necessary action to articulate and implement procurement reform.
    a. Create a new contingent, milestone-based pay-on-delivery procurement policies, procedures and process that enable US agencies to contract for services that they need now – from private companies that can provide them -- which will help underwrite financing for these very companies and aid in rapid manufacturing and deployment of needed products and services.
3. Under these newly established procurement policies, announce the government's intention to sign actual data purchase contracts immediately upon the review and

selection of proposals. These contracts need not include significant (or any) up-front payments. They can be purely pay-on-delivery of validated data, thus exposing the government to no financial risk whatever. We advocate a new method for procurement and contracting – one that places risk on the private sector and increases competition to develop better, more robust technologies that will boost the Nation's critical weather forecasting infrastructure and, as a result, help grow the economy.

4. Establish specific programs within both NOAA and the Air Force (AFWA and SSAEM), and possibly other agencies, with budget authority beginning in FY2015. We recommend satellite data purchase line items of $10M each for NOAA and the Air Force in FY2015, growing to $50M each by 2020.
5. As soon as possible, release an RFQ or BAA on behalf of NOAA and the Air Force soliciting proposals for commercial data provision beginning in FY2015.

It is these recommendations and actions that are necessary to ensure that the US is never again lagging behind any country or consortium of countries in weather prediction or forecasting. Opening up the government to very economical, proven and reliable data services – that meet the standards and specifications of NOAA, US Air Force and other users – will be the act that infuses innovation and creativity into our nation's weather enterprise. The results of this change to the weather enterprise will not only enhance public safety – the protection of life and property -- through better forecasting, but will feed our economy with an important source of jobs and help participants in our economy manage vital risk.

Environmental data – big, voluminous, flowing and open – will also create an industry with new and un-thought-of ideas, uses, applications, markets, products and solutions to weather and environmental problems. And, by implementing procurement reform policies that enable and incentivize the private sector to act now, our government can actually act immediately to: 1) resolve weather data gaps and; 2) add value to society and economy.

Thank you. I would be happy to answer your questions.

JON KIRCHNER

Jon Kirchner is President & Chief Operating Officer of GeoOptics, Inc. and a 20-year veteran of technology-based businesses having held C-level and general management positions of independent entrepreneurial start-ups, the management of large scaled engineering-based and aerospace-based companies, as well as start-ups within large, well-funded engineering-centered corporations.

These positions included full-time senior executive roles for large satellite communication companies Loral Space & Communications and Arqiva Satellite & Media, and start-up information services company Handley Group. Client and customer relationships have included Intelsat, Lockheed Martin, Echostar, MacDonald Dettwiler, Disney, Verizon, BT, DuPont, Cargill and Global Crossing amongst many others. These positions and relationships have revolved around building and managing long-term enabling space-based infrastructure for telecommunications, data networking, broadcast media, earth observation and sensing, satellite communications, public safety, energy and information management services.

Mr. Kirchner received his MBA, *with Distinction*, from Ashridge Management College, Hertfordshire, UK, and his BA, in Business Administration, from Westminster College, Fulton, Missouri, USA.

Chairman STEWART. Thank you, Mr. Kirchner. I thank the witnesses again for your testimony, for your dedicated service to our Nation. I remind Members that Committee rules limit questioning to five minutes, and the chair will at this point open the round of questioning.

Before I do, I ask unanimous consent to recognize Representative Bridenstein. Without objection, so ordered.

The chair now recognizes himself for five minutes for questions.

I think your testimony illustrates something that I pointed out in my opening comments, and that is that we can do better, and the innovation and the technology development that your companies represent is encouraging to us. You know, I have done some scary things in my life. I was a military B–1 pilot for many years. I do a lot of rock-climbing. Heck, I taught six teenagers how to drive. But I have never been as scared as I was one night in Texas when we lived in the plains of Texas and a storm around us and to hear the tornado warning siren go off. It is a terrifying and helpless feeling because there is really not much you can do other than pray that the storm misses you and jump in the bathtub, which isn't very comforting actually.

Mr. Myers, you mentioned the 16-minute warning that we had, and 16 minutes is significant, but I would ask, you know, what is our goal? How many minutes could we achieve? How many hours could we actually be able to provide warning? And I ask that hypothetically, but I would like you to address it if you could in your answer. And then what technologies will allow us to do that? And then I would like to follow up with Superstorm Sandy if I could, recognizing that the technologies for tornado warning is quite different than for hurricane warnings. So if you could, either one of you, what is a realistic goal for us in providing warning to people and what technologies will help us get to that?

Mr. MYERS. Well, I would suggest in looking at hurricanes and looking at tornados, there is an interesting comparison. Because we can see hurricanes, because they are large and they move relatively slowly over large land and sea areas, we can evacuate people. In fact, the prime objective is to determine the best path and get people out of the way, and we see news stories all the time of people who decided they were going to, quote, ride out the storm, and we think that is foolish.

With regard to tornados, we do the opposite. We expect people to ride out the storms in their bathtubs. That is not acceptable. The only reason that that is the case is because we cannot yet scientifically determine far enough in advance the strength, the exact path and location of where a tornado is going to form and where it is going to go. What we need to strive for is having sufficient lead time so that people can get out of the way. If you are not there, you cannot get hurt. We can't stop the buildings from being destroyed. What is that lead time? I don't know, but it seems to me, you know, an hour, two hours, plenty of time for people to get out of the way. The science is not there. I don't know how we are going to get it there. I think that is what research is required to do.

Chairman STEWART. Mr. Kirchner, do you have anything to add to that?

Mr. KIRCHNER. Sure. I am probably not in the best position to answer what happens, giving a warning minutes before a storm. The technology that we work with is in the polar-orbiting, I will call it the longer-term forecast realm. But I think within a portfolio of capabilities and the ability to do things faster, irrespective of whether you are right before the storm or days before the storm, the kinds of technologies that we are working with have been proven to, in the example of GPS RO, which is the technology that we are first and foremost focused on. There are studies that show that a portfolio of GPS RO observations can help four days in advance. It can give you eight hours of additional time ahead of existing methods of forecasting—eight hours. If you go out 8 days, it can help with 15 hours of additional time. Now, that is on the long end, but I think within a portfolio of predicting and planning for severity and weather patterns, anything we can do to be efficient and faster at any part of that time horizon is going to be extremely helpful to weather forecasters.

Chairman STEWART. Mr. Myers, I would like to come back to you if I could and just back up what we started to talk about. You know, knowing that technology is emerging and that we can't predict exactly until we test it and deploy it. With the current technology that you know as under development or being tested, is it reasonable to say that we could, say, double the warning time from 16 to, say, 30 minutes, give people a half-hour or more than that even?

Mr. MYERS. I think we could, and in fact, you know, the 16 minutes was in advance of when that storm actually touched down. People on the far end had more warning because it was on the ground and people knew it was coming. But as you can see, even 30 minutes, which was the case at the far end, is not enough, and people don't know what to do. It is interesting because in our business, I mentioned about a plant in Mississippi that we protected, and we do this all over the country. But we have specific sites that we can forecast for with regard to where a tornado was moving on a path. You can't do that publicly because you have large communities, and people don't all have shelters and places to go. So there needs to be enough lead time. You can probably double with improvement on current technology quickly. The lead time has increased significantly in the last 20 years.

Chairman STEWART. Okay. Thank you. I am a little bit over my time. Thank you to both of you and to the Ranking Member.

Ms. BONAMICI. Thank you very much, Mr. Chairman. Thank you for your testimony.

Mr. Kirchner, you spoke specifically about the bill, so I am going to ask this question to you, but if Mr. Myers wants to weigh in, that is great too. Section two of the legislation makes weather-related activities the top priority in the planning and management of programs within all relevant line offices. So which of the six NOAA line offices would you consider to be relevant?

Mr. KIRCHNER. That is a level of detail regarding the structure that I am not acquainted with. I am still relatively new to this industry. I have been in this position for about 6 months. I think the portfolio that we address as a company is one of weather data, data that serves the operational weather community, the space weather

community as well as the climate community, and to the extent that we can help our customer balance and address those needs, we will respond to that as a service company.

Ms. BONAMICI. Thank you. Mr. Myers, do you have any opinion about which of the six NOAA lines offices would be relevant and would have to prioritize weather-related activities under the legislation?

Mr. MYERS. Well, it seems to me the ones that deal with weather mostly are the National Weather Service, NESDIS and obviously OAR. I know I have seen over time, and I think that one of the good provisions in the bill is the need for the agencies to cooperate, especially the Weather Service, to make sure that they get the kind of research that they think is necessary and that there is a connection between the research that is being done in OAR that is tighter than perhaps we see today.

Ms. BONAMICI. Thank you. One of the concerns that I have, and I know I have other colleagues on this Committee who represent coastal areas, and in fact, we are having a lot of conversations in our Oregon coast about tsunami evacuation. So we are talking about how much warning do we need, so that goes on in a different context. So my constituents rely on the ocean economy for vital jobs in hard-hit coastal areas without research done by NOAA's Sea Grant program on invasive species, for example, without the work of NOAA's cooperative institutes, their livelihoods could be at risk. So if weather forecasting is the top priority in every line office, which is what we are trying to figure out under the draft proposal, what would happen to the climate and oceans and invasive species programs and all the other work that NOAA does. I just wanted to pose that question because there is a broad mission at NOAA, and we need some clarity about weather-related activities being the top priority in all relevant line offices.

I have another question for both of you. The OAR, Office of Atmospheric Research, which is the subject of much of this bill, has responsibilities that range well outside of weather research. They are also the lead on climate mitigation and adaptation. They do important work on oceans, Great Lakes, invasive species. So some have commented that the division between the weather forecasters and the research done at NWS and the research done at OAR leads to the OAR doing work that has no utility for the forecasters. So how do you view the proposal that the weather research be pulled out of OAR and moved to NWS to consolidate all of the weather work in one place? Would you support that?

Mr. MYERS. Anything that could improve the way in which the research is conducted as it relates to the critical needs of improving forecasts to protect life and property I would support. Whether that is the best division, I can't sit here and tell you, but things that move in that direction, I think, are useful.

Ms. BONAMICI. Mr. Kirchner, do you have an opinion if the weather research be pulled out of OAR and moved to NWS?

Mr. KIRCHNER. Well, I will echo some of what Mr. Myers just said. From an organizational perspective, it is about being the most effective and efficient in terms of structure. I can't speak to that in terms of how NOAA should operate in that regard. I think the most—the thing that I would say is that there are different func-

tions that the organization plays out. There is operational weather, which has heavy emphasis coming from NWS. We are supportive of all the areas of the weather enterprise that our data and other forms of data will support.

Ms. BONAMICI. Thank you. One more quick question. Section 4 directs the Assistant Administrator of OAR in coordination with the Assistant Administrator of Weather Services to issue a plan to restore U.S. leadership in weather modeling prediction and forecasting. That plan is supposed to be issued within 6 months of passage and then annually. Now, I mentioned in my opening statement two reports that the National Academy of Science has done, other reports that have recently been done, what National Weather Service, for example, worked for more than a year on such a plan. So do we need another study? Do we need it annually? If we need another study, why should the Assistant Administrator be in charge of it? Mr. Kirchner? Oh, I see my time is expired, but if you could do a brief response?

Mr. KIRCHNER. Again, I will just, not dissimilar to what I said earlier, that structure and how to organize oneself to meet these needs is an area that I am not going to be able to speak wholly to. We just would look for the best direction as a customer to give the market——

Ms. BONAMICI. Thank you, and I see my time is expired. Thank you.

Chairman STEWART. Yes, thank you. And gentlemen, we recognize that you are not experts on NOAA organization and structure, and that is why we look forward to hearing them from their representative at some time in the future.

Okay. We now recognize Mr. Rohrabacher for his questions.

Mr. ROHRABACHER. Thank you very much, Mr. Chairman. I remember when I was about six or seven years old and my family came from North Dakotato visit my mother's sister. It was very dark—there was a storm—and the radio said there was a tornado that might be happening that night. I recall that we felt absolutely helpless and we had no idea. We crawled down—this was into a cellar where my aunt had all these little jars of things that she had made, jellies and jams and things. We spent the night in this cellar underneath the floor, and we had no idea where were the tornados, how close they were, but we knew there were tornados. There were tornado warnings out there on the radio. And we have advanced so dramatically since then. However, it is—we also sat through Hurricane Hazel back in the 1950s. My dad joined the Marine Corps and we lived on a Marine base down in North Carolina. In fact, we went through two hurricanes at the same year, I remember. It was pretty incredible.

Gentlemen, there is all this talk about the weather getting worse than it used to be. Is that experience from your companies and your perspectives? You are around weather all the time. Do we have worse weather now? Is Sandy so much worse than Galveston, as you mentioned, in 1900, which was a horrible loss of life, or are we just more aware of the weather now?

Mr. MYERS. Well, Mr. Rohrabacher, I am not sure if I can answer that. I know my grandfather always told me that the winters had gotten much milder, that when he was a boy they were much

worse. I think you are thinking of Hurricane Hazel in 1954 and probably Connie and Diane in 1955.

Mr. ROHRABACHER. Yes.

Mr. MYERS. And clearly, when we see events like Sandy and we see an event like Moore, Oklahoma, we conclude that things are getting worse because where we are and what we see tends to influence us, I think, the most. I don't know that anyone has statistics that can demonstrate that is the case, but as I said in my talk, America really in a sense has the worst weather in the world, and it is so variable, the nature of it, from hurricanes to tornados to droughts to what have you, that we really need to focus on it, I think more than perhaps we have and more than other nations do.

Mr. ROHRABACHER. Well, there has been a lot of talk about climate and weather around here, and when I was young, I just remember people saying that you can—a lot of people are concerned about the weather and talk about the weather but nobody does anything about it. Now we are being told that we are actually affecting the weather and the long-term climate, which some of us are very skeptical about, but whatever it is, we do know that weather, for example, in Galveston—how many people lost their lives in the Galveston hurricane? Five thousand? So we are talking about—the fact is, with modern technology and satellite technology, especially space-based assets, we have been able to save thousands and thousands of lives that otherwise would have been lost, and I think that we can be proud that our country has invested in this, and I do—I remember, well, just one last note.

I remember when I first got here, Vice President Gore had a meeting with all of the weathermen that he could put together. There is a legend about that, that he had them all gathered there at the White House for a conference talking about weather, and the weathermen were supposed to be talking about global warming. But there was a huge storm front that came through while they were there. The rain was pouring down, but only about two of the weathermen bothered to bring an umbrella to the meeting. I don't know what that all indicates, but I think that we should pay a lot of attention to the weather. So thank you very much.

Chairman STEWART. Thank you, sir. Mr. Takano, your five minutes for questions.

Mr. ROHRABACHER. I would be out there selling umbrellas. That is what my job would be.

Mr. TAKANO. This is a question for both the gentlemen. As we consider how to reauthorize weather research, who would you recommend the Committee hear from? We have testimony from you, the private firms, representing private firms. What other experts or stakeholders should we take testimony from?

Mr. KIRCHNER. I would think the scientific community, university community in terms of research. I think there are models for how other countries look at this domain that may be useful to hear from, and I think the wealth of private industry—we come from—our two companies come from two different parts of the value chain. My company will produce some of the most advanced, best weather data on the planet. Mr. Myers' company will use that data downstream to inform the citizenry and enterprise. There are a va-

riety of people in between that could be useful from a private enterprise perspective to hear from.

Mr. TAKANO. Mr. Myers?

Mr. MYERS. I would agree with that. When you look at the American weather enterprise, we always think of it as a three-legged stool comprised of the government assets, the weather industry, in a broad sense as was just described by Mr. Kirchner, and the academic and research community, and I think it is appropriate to hear from all of those with regard to this that they get their viewpoint.

Mr. TAKANO. So you do not consider yourself of the academic and research community, you are—both of your—the authority from which you are able to speak is not academic or research oriented?

Mr. KIRCHNER. No, I can speak from an authority of sort of commercial data service provision, but not the technical aspects of satellite delivery and collection of that data.

Mr. MYERS. And we are a weather information company, and we don't view ourselves as heavily into the research aspect of basic modeling and things of that nature.

Mr. TAKANO. But you both have a respect and esteem for the research and scientific community, especially those who are recognized experts in the field of climate and weather research?

Mr. KIRCHNER. Indeed. Our company was founded by a gentleman by the name of Tom Yunck, who was at JPL for 30 years. We are engaged as a company with an organization called LASP, the Laboratory for Atmospheric Space Physics out in Colorado, which is part of the university. So there is no question that we are as a company drawing on the very research expertise both in the scientific community and in the university community to help build our company.

Mr. TAKANO. Do you happen to know your founder's view on global climate change? Does he take the scientific consensus on global climate change seriously or not seriously? Is he a skeptic, non-skeptic?

Mr. KIRCHNER. I cannot speak to that.

Mr. TAKANO. Would you say it is worthwhile to hear testimony from NOAA on this bill?

Mr. MYERS. I would think it would be quite necessary and appropriate to have the customer who we are dealing with who is, you know, involved in this domain, leading the domain in the United States to be heard from.

Mr. TAKANO. Thank you. I yield back the balance of my time.

Chairman STEWART. Okay. Thank you. Dr. Broun.

Mr. BROUN. Thank you, Mr. Chairman. Mr. Myers, thank you for AccuWeather. I have got my AccuWeather app here on my phone and I depend upon it greatly, so thank you for the service that you provide.

Mr. MYERS. Glad to hear that. Thank you.

Mr. BROUN. I am a pilot, though I am not currently flying, and I am also a hunter and a fisherman, and I like to follow you all's weather forecasts and what you have there, but thank you very much.

Dr. Cliff Mass, professor of atmospheric studies, or sciences, at the University of Washington recently wrote: "The politicization of

climate change—that's hard for a southerner to pronounce—also has had a major impact on government resource allocation with bountiful funding going into climate change research while other areas such as weather prediction are poor cousins. How else can one explain that climate research gets more than 100 times the computer resources provided to weather prediction, with the latter having huge benefits for people today. NOAA Administrators have continuously pushed the climate agenda while downplaying weather prediction. This needs to change." And I could not agree more.

Mr. Myers and Mr. Kirchner, do you agree with Dr. Mass's position on this?

Mr. MYERS. Well, I know Cliff, and he tends to state things rather emphatically. I agree that I think we need a reallocation between climate and weather resources. I don't know if I can ascribe reasons to why we have an imbalance the way we do, and so I am not interested in weighing into a maybe quasi-political debate on climate change and the causes of it. Whether or not, though, as many who do support the concerns over climate change state that weather events have become more severe, and I am not saying I agree or I don't agree, but if that is the case, that suggests that we really should be allocating more resources into looking at what is happening on the weather front. And so I think it is perfectly consistent with anyone's climate position that more money needs to go to weather research, whether it is because there is change that is affecting the weather now or those people who believe that there isn't, but we still have severe weather issues that we have got to address. So I think it is actually something that all sides of the political spectrum and the climate area should be supporting simply by the very nature of what people believe climate is causing.

Mr. BROUN. Mr. Kirchner?

Mr. KIRCHNER. I am not intimately, just due to time, not that intimately familiar with all the workings of NOAA. What I can say from being in this business for six months is that my understanding is that the National Weather Service has its primary focus to tend to day-to-day weather prediction. I think there is a broader question, though, that I think is worth talking about: what role does weather prediction in the short term, medium term or long term play in terms of a strategic role in our society and economy? Ultimately we believe that weather is of strategic interest to supporting our economy, industry, infrastructure; and our company's response to that broad belief has developed, and will continue to develop, products and services that will address the day-to-day operation of weather interests, which are forecasting now to the next 10 days and beyond, to space weather. Space weather is that weather that is out in the ionosphere, which is further from the ground but deals with the sun ejecting coronal mass, and indeed climate. Our particular technology, GPS RO, is both for operational weather and for climate application, is absolute in its establishment of temperature, water pressure and water vapor—air pressure and water vapor. It is unique. It does this in such a way that calibrates all other forms of data for both long-term climate application and operational weather, and our focus is on providing a suite of those capabilities, whether you are talking about the short term or the long term.

Mr. BROUN. Well, my time expired. Thank you, Mr. Chairman, but I agree with Dr. Mass. We have got to put more funds on weather research than we are on climate change. I think we are allocating those funds in an improper way. Thank you, Mr. Chairman.

Chairman STEWART. Thank you, Dr. Broun.

A vote has been called, and in order to provide all Members time to ask their questions, I would like to ask the witnesses if they would make themselves available after a short recess?

Mr. MYERS. Yes.

Mr. KIRCHNER. Yes.

Chairman STEWART. Thank you. That being the case then, the Committee will recess subject to the call of the chair, and without objection, so ordered. The Committee stands in recess.

[Recess.]

Chairman STEWART. The Subcommittee on Environment will come to order.

To the witness panel, thank you for bearing with us as we had other obligations there with our vote, and unfortunately, we have lost some of the Members who wanted to have the opportunity to ask you questions, so we remind them, as other Members, that they can always submit written questions, and if we do, we would appreciate your response within a two week period. We now turn to my colleague, Mr. Weber from Texas, for his five minutes of questions.

Mr. WEBER. Thank you, Mr. Chairman. I really don't know exactly where to begin. My wife and I have this conversation from time to time, a good job to have would be a weather forecaster because you can be wrong so much of the time and still get paid. So I want to ask you guys really about your satellite systems, if you will, some of the more technical aspects, I suspect.

First of all, let me get into the monetary side of it maybe. Are either of you aware of competition from foreign companies, I am talking about from foreign countries, where they could come in and put up a satellite or a system like an AccuWeather where they can do the kinds of things that we do? I guess what I am really driving at is, what is the pressure, what kind of pressure is there on you all to be your best and do your best? Is there pressure in the marketplace?

Mr. KIRCHNER. I will certainly respond to that. Depending on what industry we are talking about—I actually come out of the communication satellite world where there is a lot of global pressure and global competition that overlaps regions. In the weather domain, so far as I have seen, there is less pressure per se coming for satellite systems. They tend to be over particular regions or particular countries, especially the geosynchronous kind that are 22,000 miles away that are staring at a particular region. The polar orbiting systems, the lower earth orbit systems that cover the globe, to my knowledge, there are certainly other countries or consortium that have those kinds of systems the Europeans have those kinds of satellites.

What we would love to see more of, frankly, is intense competition, intense commercial competition, not state funded necessarily but privately funded, and that is part of what my company is here

to talk about is how do—in this world, how do we evolve to a model where the weather satellite community is privately funded, not necessarily on the balance sheets of the taxpayers. And we are looking for, hopeful that our customer can migrate to a world of looking to commercial provision of services to do that. Today there is a data buy provision. There are data buy policies that exist but those data buy policies within NOAA have to do with buying something that exists today. My company has a system that it is planning to deploy, which means my company needs to go to the marketplace, raise capital, talk to customers about something that we need to start building today that won't be available just due to technology for 18 to 24 months. What we are ultimately looking for are ways to change the procurement approach that allow us to get contingent commitments to say I will take the data that you are going to provide that meets the specifications of NOAA or Air Force or other agencies but give that commitment today so that we can begin to build our systems now. That would feed competition certainly in the United States. I am sure—we ultimately like competition. We want to deliver the best possible service on a highly competitive basis and we believe that we will do that if we have that kind of procurement structure in place.

Mr. WEBER. Mr. Myers?

Mr. MYERS. AccuWeather is really a downstream user of satellite information, and we are more than happy to see competition in the area. Right now we receive satellite information mostly from government and government consortiums around the world including, of course, the U.S. satellites which we read directly. The weather industry itself in the United States is very competitive, and worldwide, that is true as well. There are a number of robust weather companies in Korea, in China, in Japan, and in Europe at this point, and we compete with them on a worldwide basis. So I think the competitive landscape is good. I think it is a huge advantage that the United States has, though, that the American weather industry is really ahead of the rest of the world and some of the things that we are talking about in terms of enhanced research, I think we should realize get leveraged in a very great way because there is such an industry. So it does not only benefit the government and the ability for the government to issue warnings, but it benefits all those downstream who can make use of the information, the modeling and what have you to provide specialized services and even general public services on Web sites and mobile devices and so forth to the public.

Mr. WEBER. Okay. I see I am out of time, Mr. Chairman. I do have other questions. Are you going to round two hopefully?

Chairman STEWART. No, Mr. Weber, we actually don't anticipate doing that, but you are free to take as much time if you need additional time.

Mr. WEBER. Well, thank you. Let me ask this question then. So having said that about the pressure to be as good as you can be and looking forward to see, you know, what kind of policies we can put into place to make sure the taxpayers are getting the most bang for their buck, a couple of questions. Number one is more technical in nature about the ability of a satellite to look out into the—if you are looking at a hurricane that is forming over in the

Atlantic and coming off the Atlantic—I mean the African coast, for example, what kind of time degree of predictability is there? Can you predict with any degree of certainty three days, five days, seven days? I guess Mr. Myers.

Mr. MYERS. It depends on the weather regime that is occurring at that particular time. Some storms are more predictable than others as a result, so I can't give you a definitive answer to that.

Mr. WEBER. Can you give me a window? Is it three to five days? Is it one to three days?

Mr. MYERS. Well, the further out you go, the bigger the cone. We have all seen those cones at the Weather Service and the weather companies.

Mr. WEBER. But surely you have got statistics, and that was my follow-up question. How far back does your data go to say that we have had a degree of success in predicting these weather events by 30 percent, 60 percent, 90 percent going back as far as ten years or 20 years?

Mr. MYERS. There are statistics that do go back that far, and generally they indicate that the predictability has increased significantly, that the cones have narrowed. The accuracy going out has increased. I don't have those statistics here with me to refer to. But they have certainly improved significantly.

Mr. KIRCHNER. What I might add is that as I said earlier, the technology world that we are in is predominantly about looking, evaluating, gathering data that is going to tell you what is going to happen. Other technologies such as geosynchronous satellites tell you what—really focus on what is happening right now and near-term warnings. Two examples, one I mentioned earlier and the other one I will give in addition. The technology that we work with is GPS RO, radio occultation. It has been proven or has been studied within NOAA as well as other organizations that we can—that data can tell you four days out that something is going to happen eight hours sooner. We can tell you eight days out that we can give you 15-hour additional heads-up on a hurricane, as an example, or severe weather that might be coming. So those hours are precious, absolutely precious to the forecast community to predict what is going to happen.

The other example that I would give, which if I had a camera or a picture I could show you, is that the GPS RO data, looking back at Hurricane Ernesto back in 2006. This was done by UCAR. It actually visibly shows in simulation where with GPS RO data, you can see a storm that without it you could not see 54 hours, 78 hours and 102 hours. So there is actually mechanisms, and this technology does this, that enables with other data—it is not alone, it is with the other suite of data sources we have—but with GPS RO data, you can see things further in advance that you wouldn't have been able to see without it, and again, that is about bringing forward the ability to see and forecast that in a portfolio of analyzing weather you would want to grab every hour and every minute you could.

Chairman STEWART. Recognizing the time is short now, Mr. Weber, are you——

Mr. WEBER. Thank you for your indulgence, Mr. Chairman.

Chairman STEWART. And since we had additional time over here, to the minority side, would you request any additional time for further questions?

Ms. BONAMICI. No, thank you, Mr. Chairman.

Chairman STEWART. Okay. Thank you.

To the witnesses, again, thank you for your valuable testimony, and to the Members for their questions. The Members of the Committee, as I mentioned previously, may have additional questions for you as witnesses, and we ask you to respond to those in writing, if that is the case. The record will remain open for two weeks for additional comments and written questions from Members.

I would also like to note that the Ranking Member, my colleague from Oregon, Ms. Bonamici, and I have had an opportunity to discuss the minority's request for a House Rule XI hearing. We have agreed to hold a subsequent hearing with two witnesses from both the minority and the majority parties. I look forward to inviting a representative from NOAA as one of our witnesses to be a part of the witness panel, and we will work with all parties to schedule this most important second hearing on this topic at the nearest available time. And as a result of that agreement, the minority has agreed to withdraw their request for a Rule XI hearing.

With that, the witnesses are excused and this hearing is now adjourned. Thank you.

[Whereupon, at 11:21 a.m., the Subcommittee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
Subcommittee on Environment

Hearing Questions for the Record
The Honorable Chris Stewart

Restoring U.S. Leadership in Weather Forecasting
Mr. Barry Myers

1. What advanced technology systems might offer the greatest increase in NWS forecasting capability? In addition, what technologies would offer the best increase while also giving us the most "bang for our buck?"

    a. What specific technology would offer an increase in tornado forecasting?

    Answer: Enhanced radar capabilities, among others.

    b. What specific technology would offer an increase in hurricane forecasting?

    Answer: Enhanced modeling capabilities and operational computing capability, among others.

2. Who makes up the "American weather industry" and what steps could be taken to improve the cooperative relationships between NOAA and these companies?

    Answer: Different people and organizations may have different viewpoints on who makes up the American weather industry, but as a minimum it is comprised of companies who leverage government generated information for the public good, create value added services based on government and private sector information, make weather information available to the public through all forms of media, make weather information available to business, industry and governments, and extend America's reach internationally by partnering with global companies who manufacture and provide all forms of media and communications devices and services. Additionally, there is a whole related industry of weather system providers who provision hardware and software systems to the companies mentioned above and to government. Together these private sector companies save lives and property and generate significant numbers of American jobs, develop new technologies and pay substantial taxes, all without costing the government anything.

3. By many measures, U.S. numerical weather prediction by NOAA has fallen behind models in Europe and elsewhere.

    a. Mr. Myers, Is it possible that, in the next several years, the U.S. forecasting system can be restored to compete with the European model?

Answer: Yes. In fact research already announced, if implemented through the provision of the necessary computing power will enable the United States to draw equal to the European model, I believe based on the discussions I have had with NOAA and

NWS. With greater research and computer investment we can surge past the European's in a three to five year period.

b. Are there provisions in this draft legislation that would help accomplish that goal?

Answer: Yes. The designation of funding for weather research is essential to achieve these goals. This bill moves the needle in that direction. Some want to suggest that legislation in this area should be general and comprehensive and not specific and directive. I do not care to engage in a philosophical or political debate over that. To quote Ted Kennedy in eulogizing his brother Robert "[when he] saw wrong [he] tried to right it." If this bill can help address weather research that puts us on a better path toward saving lives, then I support moving it along. I also support other efforts to better focus and fund the nation's weather infrastructure while ending unneeded activities of government that can be or are being handled in the weather industry.

4. The National Academy of Sciences and the National Academy of Public Administration have recommended that NOAA establish a weather-focused advisory committee under the Federal Advisory Committee Act, while some in the weather community have recommended a weather commission modeled after the ocean commission.

a. What is the best mechanism to provide feedback on weather forecasting?

Answer: Right now, NOAA has some level of input on these topics from the EISWG reporting into the NOAA Science Advisory Board. This is good. A weather-focused advisory committee under the FACA would be an excellent additional or replacement vehicle. Some have advocated a weather commission, but there is no uniform agreement that such is needed or would be helpful. There have been many studies in the weather field by the National Academy of Sciences and the recent NAPA study. It would be good to implement these recommendations where appropriate, especially those that support the public/private partnership and encourage continued development of the American weather industry and support of the core functions of NOAA and NWS. This is much of the emphasis of these reports.

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
Subcommittee on Environment

Hearing Questions for the Record
The Honorable Suzanne Bonamici

Restoring U.S. Leadership in Weather Forecasting
Mr. Barry Myers

1. Your company, Accuweather, provides hourly forecasts to the American people, on the Internet, via smartphones, /fV, newspapers, and through many other sources. In the process, you have built a successful business and made a respectable profit. As you testified, your business depends on NOAA's infrastructure and data. Ifyou could not access that data, what would it mean for your business?

Answer: The American weather industry (defined above) of which AccuWeather is a part, is built upon use of available government data generated for government use, but made available to the public at the incremental cost of access – the public/private partnership. The access occurs not only with regard to government weather information but also economic information, agricultural information, health information, and much more. It is founded on both constitutional principles as well as federal legislation providing for and guaranteeing such access supported by administrative rules, OMB policies, and Executive Orders. If all of this was to be reversed and government information was hoarded by the government it would have disastrous effects on the American weather industry and the nation in general. Lives and property losses would escalate and government costs would grow substantially. America has the best weather information for its citizens of any nation in the world thanks to the public/private partnership. It, and the weather industry, need to be supported. The American weather industry has used this data and information to build new and different products, its own forecasts and warnings and brought weather information to the American public (see my formal remarks) in a way greater than available to any other nation on earth. Rather than simple relay government information, the weather industry has innovated in ways the government could not nor should be expected to do.

2. Ifyou had to pay a commercial data company for your data, how would this change your business model, and how would it change the private:-public partnership around weather?

Answer: This is an area of much concern and discussion at present. Some data is already available only from commercial suppliers, for example lightning data. As long as such data is available in a competitive marketplace with multiple suppliers it could be expected competition will keep the cost reasonable. Basic weather data does not command a high price at present (or historically), not only here in the United State but globally. It is the value added products where more targeted value is created in the value chain. We must ensure that information the government acquires from outside sources is provided under licensing rights that allows the

government agency to distribute that information and the derivative products created from that information. For example, we currently have a situation where America is kowtowing to the European Center in restricting a U.S. created MOS product built on top of the European Model by using American ingenuity at NWS, but which the European Center has insisted NWS agree not to distribute. So companies like AccuWeather, who have the highest customer status with the European Center and are paying hundreds of thousands of dollars for access to the European Model, cannot get access to the very additions our own government has created. The government by signing restrictive agreements with government or non-government entities. It disrupts the entire weather enterprise symbiotic relationship and value chain.

3. In2012, the NOAA Science Advisory Board issued a report titled, "Toward Open Weather and Climate Services", that outlined a strategy by which the nation could derive greater value from NOAA's weather and climate information. You served on the working group that drafted that report. The report recommended, and NOAA appears to have embraced, an Open Environmental Information Services (OEIS) concept. Could you briefly describe the OEIS concept? Are there any elements of the draft bill that might weaken the OEIS?

Answer: The OEIS concept is best understood by a full examination of the reports. Briefly it embraces the concept discussed above of free and open access to all government data, in this case weather data, and addresses the growing concern that "big data" can and may, through technological insufficiency, become bottled up at the source and not be able to flow freely to the citizens and businesses of the nation. It suggests ways to leverage the special value of the public/private partnership to liberate big data at its source. I did not see elements of the bill that might weaken OEIS. In fact, if some research aimed at this topic is funded by the bill, the bill will assist the OEIS concept.

4. Ifthe law were to be changed to allow for the private provision of weather data, what protections could be put in the law to guarantee continued full open access to that data for the public and weather enterprise?

Answer: See the answer to Question 2 above. I believe the law currently allows for the private provision of weather data to the government and currently the government has data acquisition and license agreements with some companies for data - lightning data being one example. Having all data generated by either public or private sources that the government acquires and/or uses in its products must be made available to the weather industry along with all the derivative products therefrom, and in real time. The reason for this is to continue to ensure a common data base of information that is foundation to all forecasts and the validation by all scientists, public, private and academic, of the validity of forecasts in real time.

5. Do you have any suggestions, beyond data buys, for how NOAA can be more creative in its public-private partnerships?

Answer: It has been suggested at professional meetings over recent years that NOAA and NWS should be looking at what it is doing and why, when it comes to creating products and services. Much of what is being done in government on the product creation side is duplicative of what is being done by the weather industry. And since it is generally acknowledged that about 95% of all information reaching

the public is coming from the weather industry (including the weather media component of the weather industry) spending taxpayer money to duplicate products – say for example web and mobile products – only being exposed to 5% of the total consumer base, suggests more creative approaches may lead to increased efficiency. Focus on core infrastructure, modeling and warning improvement, it is being suggested by many, is where the government function is strongest and most justifiable.

6. The director of the NWS, Lou Uccellini, has said that the Sandy Supplemental has given NWS sufficient computer funding to give them the most powerful weather computing power of any country. Does this make the provisions of the bill regarding a computer assessment unnecessary? If it is your position that we still need those provisions, please explain why.

Answer: I do not have his quote, but I have great respect for Lou Uccellini. What I can tell you is that I would caution that we need to always think ahead of the technology curve to be the leader. For our national weather services to be "second to none," we need to always be thinking ahead. The fact that Lou has said we will have the most powerful computing power of any country should not be taken to mean we will stay ahead unless we commit to stay ahead. It was a failure to do that that got us behind.

7. How would you define the boundary between what weather infrastructure and services should be built and run at NOAA and what should be done by extramural partners, such as the academic and private sectors?

Answer: NOAA/NWS should focus on core infrastructure (satellites, radars, remote sensing tools, data networks of sufficient density, research, modeling, warning improvement, and operational warnings). The weather industry already handles forecasts and services for business and industry and the general public.

8. The NOAA Science Advisory Board R&D Task Force issued a report earlier this year that recommended N0AA capitalize on the support and skills of the extramural research ,community by developing carefully targeted initiatives that ensure the results are integrated into NOAA's.

R&D operations. 'Based on your awareness of the weather enterprise, where do the academic· and government sectors of the enterprise stand on this bill? Are you concerned that the legislation under consideration has no role for the extramural community? Do you. agree that the academic and government sectors of the weather enterprise should be represented in the bill? .

Answer: I cannot speak for the academic and government sectors.

9. The bill prefers OSSE's as a method for examining alternative methods of data collection. However, a limitation on OSSEs is that these simulations are only as good as the data and assumptions that go into the model. What standards should be erected for the quality and reliability of claims regarding proposed systems submitted to NOAA? What steps should be taken to validate cost claims for proposed systems?

Answer: This is not an area of my personal expertise.

10. A body of peer reviewed literature is emerging that links certain current weather phenomenon with the changing climate. Do you agree that an understanding of the changing climate is important to forecasting and prediction of weather?

Answer: Climate and weather are inter-related in various ways. In a sense, weather occurrence over long periods is climate; and, climate is a perspective of smoothed weather trends over time. Based on my interaction with atmospheric scientists of all kinds, it seems to me that we are in a relatively early stage in understanding these relationships in depth. So one can argue research in all of these areas is valuable. Since the best life-protecting action related to severe and dangerous weather, regardless of cause, is lead time to escape the danger area, any research that enhances lead time as soon as possible is worthy of consideration.

Responses by

RESPONSES TO SUBCOMMITTEE QUESTIONS FROM MR. JON KIRCHNER
PRESIDENT AND CHIEF OPERATING OFFICER
GEOOPTICS INC.

BEFORE THE HOUSE SUBCOMMITTEE ON ENVIRONMENT
HOUSE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

ADDRESSING THE RESTORAL OF U.S. LEADERSHIP IN WEATHER FORECASTING

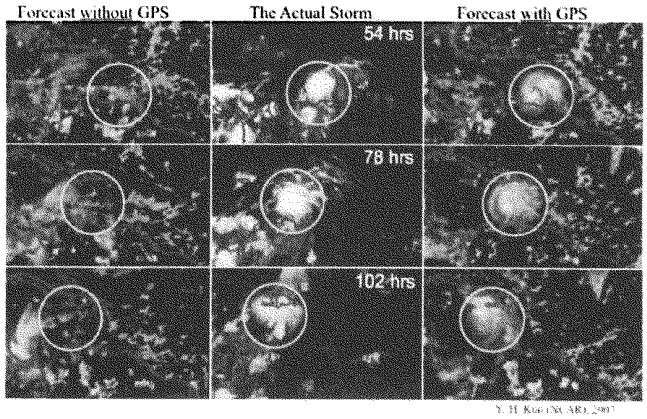
Chairman Stewart's Questions

1. What advanced technology systems might offer the greatest increase in NWS forecasting capability? In addition, what technologies would offer the best increase while also giving us the most "bang for our buck?"

    a. What specific technology would offer an increase in tornado forecasting?
    b. What specific technology would offer an increase in hurricane forecasting?

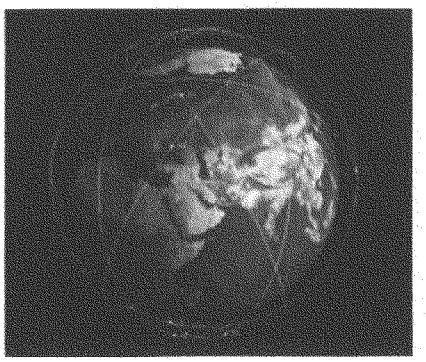
Establishing a measurable and achievable objective for warning times for each respective type of storm -- that can be agreed by the weather community and by public safety -- may be the first step toward achieving real change and progress.

Additionally, we believe that dramatically enhancing warning and preparedness times must be thought of as an objective across the entire weather-forecasting time spectrum – from the long-range forecast to the nowcast, and not only to the warnings themselves. It's not solely about what's happening right this second. It's also about what could have been better seen days earlier that also plays a role, as seen by the visual example below.



Directly above is a powerful illustration of the unique and disruptive value of the GPS-RO (radio occultation) data collection technique. GPS-RO is the most powerful measurement for hurricane forecasting ever devised, as demonstrated by a 2007 University Corporation for Atmospheric Research (UCAR) study of Hurricane Ernesto in 2006, in the picture above. The GPS-RO sensor is an all-weather sensor that sees completely through the storm to chart pressure, temperature and moisture with unparalleled accuracy. The illustration above shows what would have been forecasted without GPS RO (far left) versus with GPS RO data (far right) – as compared to the actual storm (middle) over 54, 78 and 102 hour forecasting time periods.

GPS RO can be as effective for tornado forecasting as for hurricane forecasting, but a significantly higher density of measurements is required because tornados are a more localized phenomenon. A global constellation of 24 satellite sensors generating over 36,000 soundings per day would be needed to provide the required level of local RO density over a single region the size of Oklahoma. Our 24-satellite CICERO constellation (Community Initiative for Continuous Earth Remote Observation) would cost about $180 million to build and launch and could be on orbit and operational in less than 32 months.



CICERO 24 Satellite Sensor Constellation

More broadly and as mentioned in our testimony GPS-RO soundings – even on the fairly small demonstrator level that exists today of ~2500 globally – have been shown in a NOAA Study to provide an eight hour improvement on the Four Day Forecast and a 15 hour improvement on the Eight Day Forecast. Achieving a scale of ~36,000+ soundings each day, across the globe, would dramatically improve our ability to forecast and nowcast catastrophic weather events.

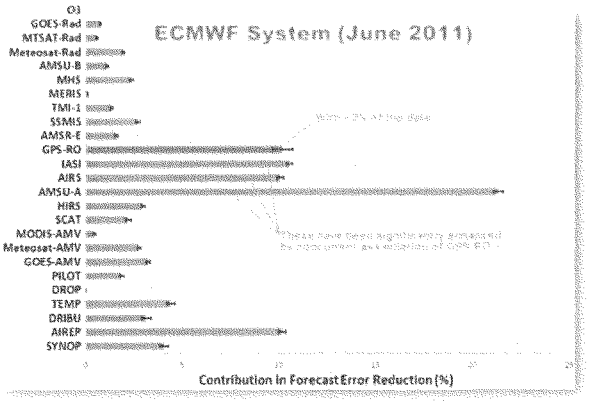
To draw a complementary comparison, GPS-RO soundings are very much like a weather balloon (radiosonde), but with much higher 10x accuracy. Weather balloons are launched twice daily across the US from 122 Weather Service Forecast Offices (WFO), at an average cost of about $200 each. These have been employed for decades and are used as a very reliable and foundational source of data for localized, near-term forecasting of severe storm cells, tornados, hurricanes and snowstorms.

With a 24-satellite constellation, providing approximately 36,000 soundings per day, GPS RO would cost ~$3.50 per sounding - a small fraction of the cost of a radiosonde. At such scale, across the US and the globe, GPS RO would be the most valuable contributor of complementary and redundant data to daily radiosonde deployments. It would also provide a "net" that could fill in the blanks between radiosonde deployments, creating a much more comprehensive picture of temperature, water vapor and air pressure, as well as the wind profiles that radiosondes uniquely provide.

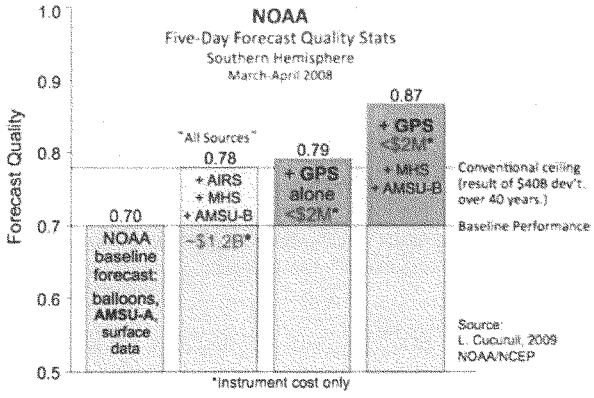
Outside of GPS RO, through other technologies, it is our understanding that severe weather warning lead times may be extended from the current 14 minutes and false alarm rates reduced from the current 75 percent. An example of such a promising new technology is Multimission Phased Array Radar (MPAR), a technological advance that would propel the country into a new era of better tornado predictability and weather security. MPAR's utility also goes beyond severe weather to multiple applications that benefit commercial aviation, the military and even the intelligence community. If we continue to use NEXRAD for the next 20 years it is our understanding from radar scientists that we will again be technologically disadvantaged in comparison to other countries. Until MPAR is deployed nationwide the country will continue to pay for and operate five individual radar systems. MPAR could replace all five current systems and real dollar savings to the government would be in the billions.

2. **Mr. Kirchner, NOAA is currently using funds provided by Congress after Superstorm Sandy to conduct an Observing System Simulation Experiment on GPS radio occultation. What do you expect will be the result of this experiment, and do you have any concerns?**

OSSEs have a long established record for providing reliable results. We believe that the OSSE conducted by NOAA about GPS RO will reveal what numerous previous studies at NOAA, European Centre for Mid-Range Weather Forecasts (ECMWF), the UK Met and UCAR have shown very recently – that RO is a very powerful data source for dramatically improving forecasting and prediction. What we believe an OSSE will confirm: (a) GPS RO data is the most potent single weather measurement ever devised, and (b) higher densities of GPS RO data deliver better and highly cost-effective performance, with a minimum 36,000 soundings from 24 satellite sensors. This can have a profound impact on Numerical Weather Prediction (NWP) modeling and could play a role in plugging a significant portion of the coming weather data-gap while in fact, changing the way modelers and assimilators design NWP models to include and amplify this powerful, scaled data source.



The above chart highlights the very high impact GPS-RO data have on NWP, acting in two ways: 1) by collecting with absolute accuracy temperature, water vapor and air pressure; and 2) as the sole and reliable calibrator of all other space-collected data. To this point, data from GPS-RO sensors has proven extraordinarily effective in operational forecasting. Dr. Sean Healy of the European Center has shown RO profiles to have 30 times more "impact per measurement" on forecasts than any other space measurement. What is particularly notable about, and missing from, the chart above is that this impact has been quantified using only the number of daily RO soundings currently available (about 2,500). When we marry this highly impactful data with the relative cost of these systems, we can begin to see how dollar-for-dollar, GPS-RO delivers the greatest value.



The chart above was produced by GeoOptics from a 2009 study by NOAA's Lidia Cucurull comparing the relative impact on global forecasts of different satellite measurements. It

compares the average 5-day forecast quality over a 40-day period in the southern hemisphere in 2008 using four different data combinations. The maximum value would be 1.0 for a perfect forecast (left axis). This was conducted using actual forecast results, not simulations.

- The first bar represents NOAA's standard operational data mix: ground, aircraft, balloons, and AMSU-A data from NOAA satellites. The value of 0.7 is considered their minimum acceptable standard. Anything below that is called a "dropout." They chose the five-day forecast quality and 40-day period time interval for analysis because it barely met the threshold in the southern hemisphere.

- The second bar includes the standard dataset plus data from three NASA/EOS instruments – two microwave and one infrared (AIRS). The total cost of building (not launching) those instruments, in today's dollars, is well above $1.2 billion. The additional data bumped performance to 0.78, which is considered a significant improvement. However, 0.78 represents a sort of ceiling. If they double the amount of additional data, or drop AIRS altogether, they still get about 0.78. They've essentially exhausted the information value of conventional satellite data.

- The third bar represents Bar 1 plus RO data from the equivalent of *two* of our sensors (~2,000 profiles per day). Today we can build those sensors for about $250,000 each. *No* NASA/EOS data was used. Performance slightly surpassed the Bar 2 ceiling, at 0.79.

- The fourth bar represents Bar 3 plus data from the two NASA microwave instruments (dropping the $600+ million AIRS). This is the most stunning and unexpected result. Performance was boosted to 0.87, truly uncharted territory. This is not a cherry-picked result; it is the only such study NOAA has done.

Our concerns, therefore, about our government's current approach to GPS-RO have more to do with the underlying model for the acquisition, procurement policy and provision of this powerful data capability to NOAA, and other Federal agencies and departments. According to UCAR, there are over 2500 organizations in 74 countries using RO data today, including NOAA itself, provided through the demonstrator platform COSMIC 1. The COSMIC 1 system, a six satellite constellation that was launched in 2006 in a collaboration between Taiwan's National Science Foundation, NASA, the US Air Force and UCAR, has fully demonstrated the concept of RO and the profound value RO data has in operational weather, space weather and climate modeling – around the world. This system is expected to reach its end of life in 2015.

A replacement system, called COSMIC 2, has been in the planning stages for a number of years. At present, the 12-satellite planned replacement system has two elements we refer to as: COSMIC 2(a) and COSMIC 2(b).

- COSMIC 2(a), funded primarily by Taiwan and the US Air Force, is a six-satellite constellation to fly in a near-equatorial orbit (24° inclination), planned for launch in 2016. The orbit was chosen by the Air Force to focus on space environmental monitoring, though the system will also be of value for tropical cyclone forecasting

and will provide coverage for weather forecasting in the southern US, up to about 35° latitude. It will hardly reach into Europe, Russia, or northern Asia at all.

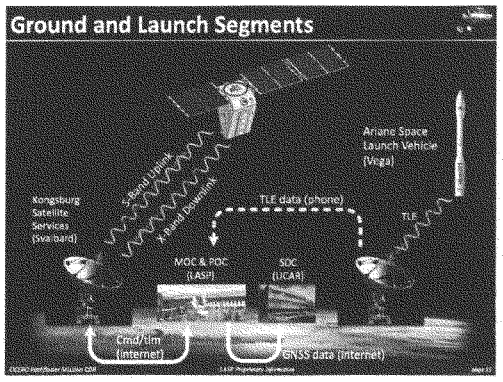
- COSMIC 2(b) is not yet scheduled for launch and is not foreseen to launch before 2018. This six-satellite high-inclination (72°) constellation is a direct replacement for COSMIC 1 to provide global coverage for NWP.

The RO user base needs this data, in scaled volume. COSMIC 2(a) is about 80% funded, though still at risk. However, COSMIC 2(b), offering coverage throughout the US, Europe, and Asia, is not funded and not expected to launch until 2018 or later. This gap is very significant. Under an anchor-tenancy competitive procurement, commercial sources of RO data would fill this gap within 24-36 months. In short, with the help of a commercial satellite weather data provider, like GeoOptics, the contracted company would deliver the data scale the user community requires for forecasting needs.

3. **The Government Accountability Office and NOAA have recognized that there may be future gaps in data provide by our polar-orbiting and geostationary satellites.**

    a. **Mr. Kirchner, what alternative observing systems might be able to minimize the information lost during these periods?**

The impending official JPSS weather data gap forecasted to start in late 2016 is a vital gap to close with all tools available to Government at costs it can better afford accompanied by appropriate levels of risk. GeoOptics' GPS-RO system could contribute to closing a large portion of this gap. At substantial scale, 36,000 soundings or more, GPS-RO could provide a major, long-term solution to significant elements of this gap and redefine how weather models are designed and implemented. That said, any significant increase in GPS-RO soundings beyond today's 2,500 per day would provide significant improvement -- at low cost and bargain levels compared to today's large government-owned and sponsored systems. Our integrated system of the future of RO data provisioning, is below.



GeoOptics Network Architecture

Regarding data actually needed and specified, NOAA, NASA and USAF have each published lists of each organization's most important and needed data types. GPS-RO is atop both the AF and NOAA lists, and is important for NASA, as well. Moreover, through two separate and qualified sources, we see documented the highest priority and transformative emphasis NOAA is placing on GPS-RO capability:

- See pages 4-135 to 4-136 of NOAA's FY 2013 Procurement, Acquisition and Construction (PAC) where NOAA's plan describes the emerging indispensability of GPS-RO (http://www.corporateservices.noaa.gov/nbo/fy12_bluebook/chapter4_2012_PAC.pdf).
- More recently, GPS-RO was emphasized and highlighted by Dr. Kathryn Sullivan, Acting NOAA Administrator in testimony to Congress addressing JPSS gap mitigation. During this testimony Dr. Sullivan cited a report by Riverside Technology, Inc[1] that highlights GPS-RO as one of the highest priority observations, amongst other sources, that could help fill the LEO polar-orbit weather data gap (http://www.legislative.noaa.gov/Testimony/Sullivan041813.pdf).

Other Global Earth Observing based systems are also being demanded, such as advanced hyperspectral soundings. This data/image form is being offered and will be provided by a private source such as GeoMetWatch, a commercial data company that will provide Geosynchronous-based (GEO) hyperspectral soundings beginning in 2016 (http://geometwatch.com/htm/our-partners). Other data sources could come from foreign governments where we have scientific cooperative agreements to supplement our gap coverage during the mitigation period.

In order for the government to begin filling this gap in GPS-RO data, NOAA and the government at large need to: 1) turn to a new, open and competitively inviting procurement philosophy; 2) implement fully the policies and laws that exist today; 3) enable a new fast-moving and competitive procurement environment; 4) create new legislation that directs NOAA to quickly turn to these commercial solutions into potential realities -- to fill the gap.

To the point of implementing what already exists in law we cite very specifically the language found from the Office of Space Commercialization regarding Advance Funding Commitments (http://www.space.commerce.gov/general/commercialpurchase/commitments.shtml) and Section 507 of the FY 1993 NASA Authorization Act (H.R. 6135, Public Law 102-588), codified as 15 USC Sec. 5806, that authorizes the Administrators of NOAA and NASA to enter into multi-year anchor tenancy contracts with termination liability. (http://www.space.commerce.gov/general/commercialpurchase/commitments.shtml#nasa)

[1] Page 9, Written Testimony before House Subcommittee on Fisheries, Wildlife, Oceans, and Insular Affairs, April 18, 2013, on the National Oceanic and Atmospheric Administration's FY 2014 Budget Request

If there are ambiguities concerning this law that need clarification, then this must be done. With this law and legislation in place it seems as though NOAA and the government can take advantage of commercial solutions – now.

Ranking Member Bonamici's Questions

1. **GeoOptics and other commercial data buy companies have said they can develop, launch, and manage certain space-based Earth observing systems and sell the resulting data at a lower cost to the taxpayer than can NOAA. Please explain how you can deliver the same quality data at a lower cost.**

Indeed, commercial companies have a very long track-record of doing things faster, cheaper and more effectively than public-sector equivalents. There are a number of reasons for this tendency and record:

- **Reduced costs to the buyer/user:** Reductions are achieved in two fundamental areas: 1) the core, underlying cost of the satellite sensor constellation and 2) the "shared global services platform" nature of the business model.
  - **The Core Satellite Network:** The underlying satellite system will be built drawing from a worldwide network of US and international suppliers using ruggedized, space-worthy commercial parts and world-class engineering labor. These parts are procured from innovative suppliers, which creates a supplier ecosystem of intense quality and cost competition, with incentives for speed and quality of delivery. This commercial, competitive approach will – by itself – result in dramatically lower costs. Component and system sourcing and product development methods -- that more efficiently map risks to costs – are very well documented and proven in commercial satellite communications, launch systems for NASA, and commercial satellite imagery.
  - **Shared Global Platform:** The resulting global services are meant to, and can, be sold to numerous customers. This, by this very shared nature, means no one country, agency, organization, research institute, university, business or citizen bears the total cost. Moreover, aside from contract deposits that might be collected to demonstrate a customer's commitment, this approach requires absolutely no capital commitment on the part of NOAA or other organizations. In total, this "shared approach" dramatically reduces capital and operational financial risks, and dramatically reduces monthly and annual costs for any one country or agency.

- **Rigorous Business Processes and Customer Service:** Process and a relentless focus on customer service and satisfaction means that – in addition to a cost-effective solution – customers receive highly personalized and responsive attention. My own long-term experience in providing integrated satellite-based communications services to the Department of Defense (DoD) makes quite real the value of this customer service. Competitive commercial companies differentiate themselves on the reliability and cost of product/services they offer and also how responsive these companies are to problems, failures or needs that arise. Competition and contracts are the vital incentives for companies

"to act" quickly and precisely. These incentives do not exist in the domain of internal Government-owned or inter-departmental service providers. The DoD has procured 80% of its worldwide bandwidth requirements through commercial providers – on the back of this reliance of customer service and service reliability.

- **Transferred Financial Risk:** Highlighting further the financial point above, the commercial services provision model results in a complete transfer of capital expenditure responsibilities from government and taxpayer, to service provider. The commercial provider takes on the complete responsibility to find the capital, to build the system, and provide appropriate back-up and redundancy capabilities to operate the system, reliably.

2. **You indicated that GeoOptics would sell its data to NOAA without limits on its ability to share that data. Please explain what this statement means. For example, will all the data you collect go to NOAA for public release without limit? If NOAA makes your data available to the public without charge, what other market do you envision for your product?**

As a commercial service provider, our objectives seek to strike a balance in providing the best possible data services to the market at competitive prices that reflect different levels of need of, and value sought by, our customers. Our approach will be to provide services at a price that enables our company to invest capital, deliver that service, make a fair profit and re-invest profits into continuous service, replenishment of a fleet, accompanied by better and more valuable services. We anticipate a price under a pay-for-delivery, anchor-tenancy data-buy -- provided by statute (http://www.space.commerce.gov/general/commercialpurchase/commitments.shtml) and Section 507 of the FY 1993 NASA Authorization Act (H.R. 6135, Public Law 102-588), codified as 15 USC Sec. 5806 -- to be one determined by the mix of factors, including the following:

1) research use versus operational use;
2) raw processed data versus enhanced processed data products;
3) narrow distribution vs. wide distribution of the data, itself.

These differences in services are the factors that differentiate prices. As an example, non-operational science and research users will not be charged for data. Operational forecasters will constitute the core of our paying customer base. The principal operational RO users in the US today, or in the relatively near future, will include:

1) NOAA, through the National Centers for Environmental Prediction (NCEP) and the National Weather Service (NWS);
2) The USAF for space weather through the Space Situational Awareness and Environmental Monitoring (SSAEM) office, and for weather forecasting through the Air Force Weather Agency (AFWA).
3) The US Navy through their weather service at the Naval Research Lab.

Today these organizations acquire data for use in their Numerical Weather Prediction (NWP) and space weather monitoring models, through both owned observing systems and

commercial systems. They in turn provide that data to US companies and citizens without charge. We do not anticipate changing that model in the sale of our weather data.

As a service provider under a 1993 NASA Authorization Act (http://www.space.commerce.gov/general/commercialpurchase/commitments.shtml#nasa) pay-for-delivery data buy procurement reform, GeoOptics would sell the data to NOAA under license and they could then distribute it to pre-defined users with pre-defined service attributes. Redistribution rights would be specified in the NOAA license.

As a customer, NOAA would define which of these and other attributes it requires of its service and GeoOptics would develop an offer to meet the value delivered. These services would include raw GPS-RO data and higher level data products and could include more sophisticated value-added services – delivering significantly increased accuracy and absolute calibration of all other forms of data. With specific regard to the question above, if NOAA wants to enable data users and the public in the United States to have access to the data – for free – they can do that and we will deliver that service level for a correspondingly competitive price. If NOAA wants to extend its distribution of our data beyond this we would enable them to do so -- at an agreed price -- that recognizes that value.

As for other markets, we consider GPS RO data to be a product for countries and organizations around the globe. As such we see other national meteorology agencies overseas, earth observation organizations and remote sensing entities being interested customers of this service.

3. **How many satellites do you currently operate? Please explain how and where your hardware has been tested, and explain whether you have done adequate testing to assure accuracy in space.**

Today, we do not operate any satellites as we are a new start-up company. We have a first-class satellite and sensor system design and well-qualified business partners working with us to build, launch and operate a new GPS-RO system. The spacecraft design has been developed for and provided to GeoOptics by LASP (Laboratory for Atmospheric and Space Physics) at the University of Colorado and the GPS RO sensor has been licensed from the Jet Propulsion Laboratory (JPL) at the California Institute of Technology, Pasadena, CA. Both are US aerospace jewels and world renowned for their work in space. LASP-designed and operated instruments have been sent to every planet of our solar system and Pluto. Dr. Thomas Yunck, our company's founder and the original creator of the GPS RO technique and technology, spent nearly 30 years at JPL. Dr. Yunck's team developed all GPS RO sensors that have flown from1995 through to COSMIC. They have built, flown, and operated more than a dozen RO instruments. JPL is the source of the proven RO technology on COSMIC 1, and that is now being delivered for COSMIC 2a. The newest JPL instrument technology has been licensed by GeoOptics for our RO constellation.

Our satellite systems and business processes, and those of our major partner, LASP, are well-proven and built on long records of demonstrated success, including painstaking testing

and retesting of all stages of the spacecraft manufacturing process. Our satellite system has passed Critical Design Review (CDR) and the first spacecraft is midway through development. We are in the process of financing production of the first six spacecraft.

4. **If commercial data buy businesses fail in developing their observing systems and the nation's weather forecast suffers, what might be the repercussions and how would you address any potential liabilities from such failure?**

An important element of a robust and vibrant economy and competitive environment is...choice. Opening up weather data satellite markets to fair and open competition from numerous potential providers results in that choice. Choice means that multiple companies can emerge as potential providers that gives the government user options for a primary provider, as well as back-up and redundant providers.

That said, as a commercial provider one of the most important attributes of successful commercial provision is to have technical and quality control procedures in place, along with sufficient and appropriate levels of redundancy and back-up systems in case errors or faults occur. This has been the case with communications satellite companies, satellite imagery companies and telecom service providers that today provide systems to the government, and its most demanding agencies and departments, including Department of Defense, FAA, Department of State, CIA, FBI, Department of Homeland Security, and numerous others.

Risks of failure, technical anomaly or in-orbit hazard exist for government-owned systems as they would for commercial-owned and operated systems, as seen recently with GOES 13. The aspects that the government must also consider include managing risks, decreasing costs and gaining additional value and innovation from commercial solutions. In existing service contracts, through which parts of government receive services today, there are contractual clauses that put the appropriate burden on individual companies to build their companies and services in ways to firstly, mitigate risks, and secondly, manage failures or technical anomalies that might occur.

What does change with commercial options is the certainty of timely-delivery and the provision of the highest service-level and dramatically lower costs that accompany a commercially created and competed data-buy solution.

5. **Do you have any suggestions, beyond data buys, about how NOAA can be more innovative in its public-private partnerships?**

Commercial data buys are likely to offer the most efficient, cost-effective approach to data acquisition in the long run since they harness the limitless power and innovative drive offered by market incentives and competition. The same forces that put prodigious computing and communications power in consumers' pockets at little cost will have the same impact on weather data collection. Other possible options include:

- Commercial hosted payloads of government instruments
- Delivery of on-orbit weather monitoring services through service level agreements
- Shared government/contractor investment
- Engage private research organizations, not just public research, in considering and solving problems – working in tandem with government
- Space weather consortia, such as those working with industry-government groups, like Federal Energy Regulatory Commission (FERC) and North American Electric Reliability Corporation (NERC)
- Operational weather and climate consortia, such as the Group on Earth Observations (GEO) and the UN International Strategy for Disaster Reduction
- Begin thinking and addressing the wide "weather and environmental enterprise" as an element of our Nation's Critical Infrastructure and Key Resources (CIKR) and consider merits of thinking of a "weather and environmental intelligence" machine. As cited in my testimony, the Bureau of Economic Analysis reported to the National Research Council in the National Academy Press publication, *The Atmospheric Sciences Entering the Twenty-First Century*, that an estimated $3-6 trillion – or about 25-40% -- of the US economy is directly impacted by weather.
- According to the National Association of Public Administration implement a "weather commission" as a Federal Advisory Committee Act (FACA) body that looks at the sector-wide aspects of operational weather and space weather – collectively -- on the weather-enabled economy and their long-term implications on the forecast.

6. The director of the National Weather Service (NWS), Lou Uccellini, has said that the Sandy Supplemental has given NWS sufficient funding to provide them with the most powerful weather computing power of any country. Does this make the provisions of the bill regarding a computer assessment unnecessary? If it is your position that we still need those provisions in the proposed legislation, please explain why?

A major upgrade to NWS operational computers is scheduled to be completed in July 2013, in which NOAA operational computing will undergo a threefold hardware capability increase. This upgrade will include major resolution enhancements and an advanced global model that runs more economically on the new hardware. The Disaster Relief Appropriations Act of 2013 is providing additional funds to improve operational and weather research computing in both FY 2014 and FY 2015. With these funds, NOAA's operational computing capability will increase tenfold by 2015. The FY 2014 President's Budget requests additional funds for NOAA to upgrade operational computing, which will provide a 27-fold increase in operational computing capability by 2018. That advancement will give the NWS unmatched operational computing capability and the ability to run the latest long-range forecast models with improved resolution. The funding received after Hurricane Sandy was is a much needed "jump-start," but continued funding is essential. The computing resources assessment will bring all this to light, and focus on the need to continue funding for operational computing capacity.

7. **How do you define the boundary between what weather infrastructure and services should be built and run at NOAA and what should be done by extramural partners, such as the academic and private sectors?**

The answer to this question is ultimately determined by what one defines as the desired and needed objectives and outcomes of the national weather enterprise and weather security system.

Our economy and society need and demand better forecasts, predictions and advance warnings. These are the desired objectives and outcomes. Breaking the service delivery chain down to what delivers these outcomes, the most valuable and value-creating elements are found in how to use, apply, manipulate, analyze and manage the data required to achieve those outcomes through computational power, HPC structures and data analytics. It is our belief that it is in these areas that NOAA and government should focus their owned-infrastructure dollars and ultimate excellence.

The above focus on data analytics and forecasting excellence is achieved through and supported by the identification and specification of the right data that are needed to achieve them. In short, weather data and its collection can and should be seen as a commodity – a lower value element of the entire weather data enterprise. As such, government should be looking at the best cost-performance sources of this data. NOAA should be precise in what data it needs and the specifications and standards it requires – and then ask the market to provide it reliably and cheaply.

The science-dependent and science-based sector of data analysis, manipulation and management to create desired forecasting outputs – the highest value ends that taxpayers and businesses want to pay for and benefit from -- should be demarcated from the data-collection world which, while vital and important, has the commodity and simplicity elements that a highly competitive and vibrant commercial services community can provide. NOAA/NASA should do what cannot be done profitably or cost-effectively, or what is not being offered, by the academic and private sectors. Over time, as the commercial data model takes hold, a greater portion of weather data provision will be commercialized at greatly reduced cost.

However, there will always remain unique, first-of-a-kind, experimental advancements, exemplified by a number of innovative instruments on EOS and JPSS that only the government is in a position to sponsor.

8. **The NOAA Science Advisory Board R&D Task Force issued a report earlier this year that recommended NOAA capitalize on the support and skills of the extramural research community by developing carefully targeted initiatives that ensure the results are integrated into NOAA's R&D operations. Based on your awareness of the weather enterprise, what is the position of the academic and government sectors of the enterprise on this bill? Should the academic and government sectors of the weather enterprise be represented in the bill?**

Indeed, academic, research, and government sectors today are active elements of, and play an indispensible role in, the weather enterprise. Organizations such as: UCAR, LASP, Pennsylvania State University, California Institute of Technology, University of Colorado, University of Wisconsin, University of North Dakota, University of Michigan, Utah State University, University of Oklahoma, the UK Met, ECMWF, Taiwan National Space Program Office, for COSMIC. These and countless other organizations and associations play an active role in our national weather enterprise and must be considered in the bill.

9. **The bill prefers Observing System Satellites Experiments as a method for examining alternative methods of data collection. However, a limitation on OSSEs is that these simulations are only as good as the data and assumptions that go into the model. What standards should be erected for the quality and reliability of claims regarding proposed systems submitted by NOAA. What steps should be taken to validate cost claims for proposed systems?**

OSSE's are a useful tool in the arsenal of simulation and validation. But as with most analytical tools OSSE's are as directly useful, reliable and conclusive as the quality and integrity of the data and assumptions that feed the models. Garbage in, garbage out. This is no different than how accurate our own decisions are, as humans - based on the quality, quantity and nature of the data upon which we rely.

Congress can instruct the National Institute for Standards and Technologies (NIST) to work with the weather data community – public, private, scientific, research and operational segments -- to develop standards on how to conduct OSSE's to ensure that there is a level of consistency and integrity to their methods, data sourcing and structure, and deliver its final report within 6 months of the passage of this ACT. Such studies should in principle be done by two or more independent groups and be subjected to intensive, comprehensive peer review, culminating in a public scientific workshop producing a "sense-of-the-community" report. With respect to GPS-RO specifically, such an effort may best be overseen in collaboration with the International Radio Occultation Working Group (IROWG).

Regarding claims about the pricing charged for the delivery of services, the principle of multiple suppliers and fair competition in the supply chain will render best pricing and cost-to-buyer understanding. Comparing apples-to-apples on service descriptions, service definitions, service levels and pricing are ways to compare different systems. Congress can request the Government Accountability Office to do an analysis of the different systems.

Respectfully submitted by,

Jon Kirchner
President & Chief Operating Officer
GeoOptics, Inc.

June 18, 2013

Appendix II

Additional Material for the Record

REVISED SUBMISSION FROM GEOOPTICS, INC.,
SUBMITTED BY MR. KIRCHNER

Revised Submission from

GeoOptics, Inc.

Adm. Conrad Lautenbacher, CEO; Mr. Jon Kirchner, President & COO; and Dr. Tom Yunck, Chairman & CTO

July 8, 2013

We would like to clarify our last response to Chairman Stewart and Ranking Member Bonamici

When we submitted our reply to Chairman Stewart asking what advanced technology systems might offer ***the greatest increase in NWS forecasting capability*** and also provide the ***"best bang for our buck"*** we stated that GPS-RO (Global Positioning System-Radio Occultation) satellite technology is the most powerful measurement for hurricane forecasting ever devised.

The GPS-RO sensor is an all-weather sensor that sees completely through a storm to chart pressure, temperature and moisture with unparalleled high accuracy. GPS-RO can be equally impactful for tornado forecasting as it is to hurricane forecasting.
To protect the residents of Oklahoma – a constellation of 24 GPS-RO microsatellites (each roughly the size of small suit case) would be able to provide target minimum density coverage for the nation and enable forecasters greater capabilities than they currently have.

A GeoOptics global constellation of 24 satellite sensors generating over 36,000 soundings per day would be needed to provide the required level of local RO density over a single region the size of Oklahoma (181.0 thousand sq km or 2.2% of Contiguous United States land mass - CONUS). Forecasters would receive approximately 2,200 profiles/day in the continental United States and 40-50/day in Oklahoma.

Compare this to the long-time and very reliable use of radiosondes. Twice every day each NWS Weather Field Office sends up a radiosonde (weather balloon) to get atmospheric readings. These profiles/measurements help determine base weather conditions in that area/local region. There are 2 field offices in Oklahoma and 4 radiosondes released each day.

In contrast, RO measurements are 10 times more accurate than radiosondes in the two key parameters, temperature and pressure. Forecasters would have 40-50 -- instead of 2 or 4 that NWS forecasters in Oklahoma have today. We know for a fact that that kind of quality and density of data will have a tremendous impact on regional forecasts. At present it is the sparseness of data that is the limiting factor, not the forecast models, but a significantly higher density of measurements is required – especially when

assisting forecasters with data about tornadoes. Having a deployed GPS-RO micro-satellite constellation would usher in an entirely new realm of information density to feed into forecasts. That info would contribute to helping save more lives in tornado prone regions of the country.

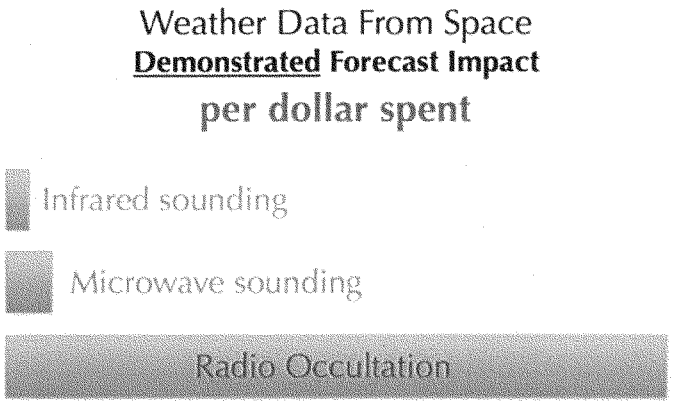
Reinforcing the value of GPS-RO, the Riverside Technologies Report prepared at the request of NESDIS had a high assessment for the capabilities of GPS-RO, rating it with others as the highest level of merit in helping mitigate our nation's looming data gap.

From a cost-to-customer perspective, our 24-satelilte CICERO constellation (Community Initiative for Continuous Earth Remote Observation) and our services business model saves the US Government the cost of taking on the full-capital cost and risks for such a robust system. **It would cost GeoOptics about $180 million to build, launch and operate and could be on orbit and operational in less than 32 months from today.**

NOAA and the federal government **DO NOT PAY** for the $180 Million. *We were not clear about this point in our response.* In the business model of GeoOptics, we affirm that the government does not provide the $180 Million for our satellite constellation. It is our business model that the government need not assume this financial risk. Instead, this risk belongs with the private sector in the marketplace.

First Point: GeoOptics saves the government $180 Million in upfront capital cost and risk -- a "best bang for the buck" -- with maximum dollar impact.

The government contracts for a pay-on-delivery data buy, and pays an annual "fee for service" for data delivered by our shared-platform and data service.



Second – More huge savings continue from GeoOptics with a deployed GPS-RO satellite constellation.

The traditional method of using radiosondes is estimated at $200.00 cost per profile. This does not include the human capital costs for at least two NWS employees to launch the radiosonde twice each day at Weather Field Offices. So the NWS cost is actually much higher.

The GeoOptics GPS-RO cost is ~$3.50 per profile, accompanied by 10x more accuracy.

Third Benefit – an Abundant Harvest of RO Data
NWS forecasters would have access to almost 13.1 million GPS-RO measurements per year globally, and 800 thousand GPS-RO soundings over CONUS versus the estimated 182,500 radiosondes profiles per year currently being collected over CONUS by NWS. These numbers demonstrate the significantly higher density of measurements that would be available to forecasters to assist them with severe storms like hurricanes and tornados.

If there were a 12 micro-satellite constellation orbiting the earth by 2017 – they would assist in closing the weather data gap that the Department of Commerce Inspector General cautioned in his report to Congress about the NOAA satellite program.

Space News *reported on 6/27/2013* that H.R. 2413*:* "Would ease restrictions on the commercialization of government weather satellite programs by allowing the Commerce Department, which encompasses NOAA, to contract with commercial providers for data acquisition. It would also allow hosting of private weather instruments aboard government satellites, and of government instruments aboard private satellites."

Congressman Rohrbacher on June 26th asked Acting NOAA Administrator Kathryn Sullivan whether NOAA purchases commercial weather data. Last year on March 28th, Chairman Ralph Hall asked Mary Kizca, Assistant Administrator of NESDIS in a hearing of the Subcommittee on Energy and Environment if "the potential benefits and cost savings seems too great to pass up" [from commercial weather satellites].

On the subject of viability of Commercial Weather Data from Space -- In 2008 NESDIS commissioned ***GeoOptics*** to conduct a comprehensive study on:
Commercial Weather Data Pricing and Feasibility Study for GNSS Radio Occultation and Ocean Scatterometry. The report link is for your review:
http://geooptics.com/NOAA-NESDIS/Commercial_Weather_Data_Study_FINAL_v2008.pdf.

How can we bring the advantages of GPS-RO into the mainstream to help forecasters?

We suggest the following amended changes to the bill:

Section 3

Add (H): implementation of existing pay-on-delivery, anchor tenancy, data-buy procurement agreement and policies that will lead to specific, fair and open competition for government-leased and government-owned systems.**

Section 5

Add (5): Implement a pilot program based on the formula suggested by GeoOptics that the vendor provide the full, 24-satellite system at NO UPFRONT CHARGE to the government. The vendor is only paid for annually contracted data services upon delivery according to NOAA scientific requirements.

Section 9
Amend (b): Report- Within "3" months

+++++++++

**Anchor Tenancy agreements:
http://www.space.commerce.gov/general/commercialpurchase/commitments.shtml#nasa)

Anchor Tenancy, Section 507 of the FY 1993 NASA Authorization Act (H.R. 6135, Public Law 102-588), codified as 15 USC Sec. 5806 that authorizes the Administrators of NASA and NOAA to enter into multi-year anchor tenancy contracts with termination liability. (Office of Space Commercialization – 1993 NASA Authorization Act)

GEOOPTICS, INC. CLOSING COMMENTS, SUBMITTED BY MR. KIRCHNER

GeoOptics -- Closing Comments
Weather Forecast Improvement Act – Discussion Draft

Overview:
The legislation that created the Office of Space Commercialization in the Department of Commerce that became Public Law 102-588 was signed into law by President George Herbert Walker Bush in the 102th Congress. Since then we have seen four presidential administrations and despite the encouragement that this law offered, NOAA has resisted purchasing satellite weather data and (in some people's minds) has developed a system in favor of irresponsibly costly, delay-ridden government-owned and dominated satellites. This approach thwarts any hope of intense competition in cost, great ideas, quality or ingenuity by rewarding only a handful of select vendors. Moreover, this resulting approach does not offer a means of removing profound financial, deployment and performance risks – to taxpayers or agencies. Year after year, the agency testifies that it is open to purchasing weather data, but nothing changes and nothing ever happens.

Perhaps, there can be no greater advocate for creation of specific legislation for this purpose than the Department of Commerce web page for the Office of Space Commercialization that states:

- This page provides information about existing legal authorities that allow certain government agencies to make advance purchase commitments for products and services. Such commitments can be critical to the development of commercial space systems, as they demonstrate serious government interest in becoming a paying customer. Having a "guaranteed" government customer helps companies raise the significant amounts of private capital needed to launch new space assets. **However, without specific enabling legislation; government agencies are forbidden from committing future funds to specific projects.**

Source:
http://www.space.commerce.gov/general/commercialpurchase/commitments.shtml

At a time when the nation faces the looming hardship from the weather data gap, one might think that NOAA would jump to create stop-gap data measures. Instead, we have learned that the funding for COSMIC 2B satellite program is in jeopardy. This is ironic since 75 countries, and 2,500 organizations within those countries including NOAA, depend on GPS-RO measurements that form the baseline for their forecasts using the Numerical Weather Prediction (NWP) system. Moreover, if the COSMIC GPS-RO services are grounded, what happens to these countries' forecasts?

Last year NOAA testified to the Subcommittee on Energy and Environment on 3/28/13 and said: "NOAA will pursue potential agreements with the commercial sector when it can provide data that addresses NOAA's requirements at a reasonable cost to the taxpayer. Some of the key considerations the commercial sector must demonstrate include:

- Ability to provide sustained and uninterrupted observations to meet operational requirements,
- Compliance with NOAA's data policy for full and open exchange and distribution of data,
- Demonstrated technical feasibility to acquire and deliver the observations and data in a reliable and timely manner, and
- Affordability of operations and cost-effectiveness to the Government."

Source:
http://democrats.science.house.gov/sites/democrats.science.house.gov/files/documents/NOAA%20Testimony.pdf

The private sector would say to NOAA they have been for years and continue to be ready to live by strict standards and will deliver a great product at a reasonable cost to the taxpayers. But, another year has passed and we are no closer to NOAA closing the looming data gap or creating an opportunity for the commercial marketplace to help close it, cheaply and reliably. Only this legislation can instruct NOAA to do so. The clock is literally ticking.

Thank you for your consideration.