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EXAMINING THE U.N. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE PROCESS

HEARING

BEFORE THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRTEENTH CONGRESS

SECOND SESSION

MAY 29, 2014

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EXAMINING THE U.N. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE PROCESS

THURSDAY, MAY 29, 2014

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

The Committee met, pursuant to call, at 11:02 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Lamar Smith [Chairman of the Committee] 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
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Examining the UN Intergovernmental Panel on Climate Change Process

Thursday, May 29, 2014
11:00 a.m.-1:00 p.m.
2318 Rayburn House Office Building

Witnesses

Dr. Richard S.J. Tol, Professor of Economics, University of Sussex

Dr. Michael Oppenheimer, Albert G. Milbank Professor of Geosciences and International Affairs, Department of Geosciences, Princeton University

Dr. Daniel Botkin, Professor Emeritus, Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara

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

HEARING CHARTER

Examining the UN Intergovernmental Panel on Climate Change Process

Thursday, May 29, 2014
11:00 a.m. – 1:00 p.m.
2318 Rayburn House Office Building

PURPOSE

The Committee on Science, Space, and Technology will hold a hearing entitled *Examining the UN Intergovernmental Panel on Climate Change Process* on Thursday, May 29, 2014 in Room 2318 of the Rayburn House Office Building. The purpose of the hearing is to evaluate the process behind the United Nations (UN) Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report (AR5).

WITNESS LIST

- **Dr. Richard S.J. Tol**, Professor of Economics, University of Sussex
- **Dr. Michael Oppenheimer**, Albert G. Milbank Professor of Geosciences and International Affairs, Department of Geosciences, Princeton University
- **Dr. Daniel Botkin**, Professor Emeritus, Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara
- **Dr. Roger Pielke Sr.**, Senior Research Scientist, Cooperative Institute for Research in Environmental Sciences, and Professor Emeritus of Atmospheric Science, Colorado State University

BACKGROUND

In order to examine the earth's changing atmosphere, the Intergovernmental Panel on Climate Change (IPCC) was created in 1988 by the World Meteorological Organization and the United Nation's Environment Program. The IPCC was tasked with preparing reports on all aspects of climate change and its impacts.[1] Today, the IPCC has evolved to "assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-

[1] United Nations, Intergovernmental Panel on Climate Change, History, As of May 2014, Available at: http://www.ipcc.ch/organization/organization_history.shtml#.UkXN6RBxPm4

economic information relevant to understanding the scientific basis of the risk of human-induced climate change, its potential impacts and options for adaptation and mitigation."[2]

IPCC Structure

The IPCC is an organization comprised of scientists from all over the world, who contribute as authors, contributors, and reviewers of its publications.[3] The IPCC meets in Plenary Sessions of the U.N., which currently has 195 members. The Panel meets approximately once per year at the Plenary level. The IPCC Bureau is comprised of the IPCC Chair, the Vice-Chair, the Co-Chairs, and Vice-Chairs of the working Groups, as well as the Co-Chairs of the Task Force.[4] The Bureau provides guidance to the Panel on scientific and technical aspects of its work, and advises on related management and strategic issues. Members of the Bureau are elected by the Panel for the duration of an assessment cycle. The members are also limited to one term in the same position.[5] In response to recommendations from the InterAcademy Council (IAC), the IPCC established an Executive Committee to strengthen and facilitate implementation of IPCC work. The IPCC is then divided into 3 working groups.

- Working Group I: The Physical Science Basis
- Working Group II: Climate Change Impacts, Adaptation, and Vulnerability
- Working Group III: Mitigation of Climate Change

Within these working groups, experts serve as authors in preparation of the IPCC assessment reports. There are usually two Coordinating Lead Authors per chapter, working in teams to produce the content for their responsible chapter.[6] Expert Reviewers are asked to comment on the accuracy and completeness of the scientific, technical, socio-economic contents of the assessments. According to the IPCC, the Fourth Assessment Report (AR4), released in 2007, involved over 3,500 experts from over 130 countries (450 Lead Authors, 800 Contributing Authors, 2,500 expert reviewers, and over 90,000 comments).[7]

IPCC Report Process

The IPCC writing and review process begins with a scoping meeting, which develops its outline. The IPCC then decides whether to prepare a report and agrees on the scope, outline, work plan, schedule, and budget. The Bureau of the relevant Working Group selects the authors from these lists. After selection, the first draft of the report is prepared by the authors based on

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[2] United Nations, Intergovernmental Panel on Climate Change, Principles Governing IPCC Work, October 2013, Available at: http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles.pdf

[3] United Nations, Intergovernmental Panel on Climate Change, Procedures for the Preparation, Review, Acceptance, Adoption, Approval, and Publication of IPCC Reports, 2013, Available at: http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles-appendix-a-final.pdf

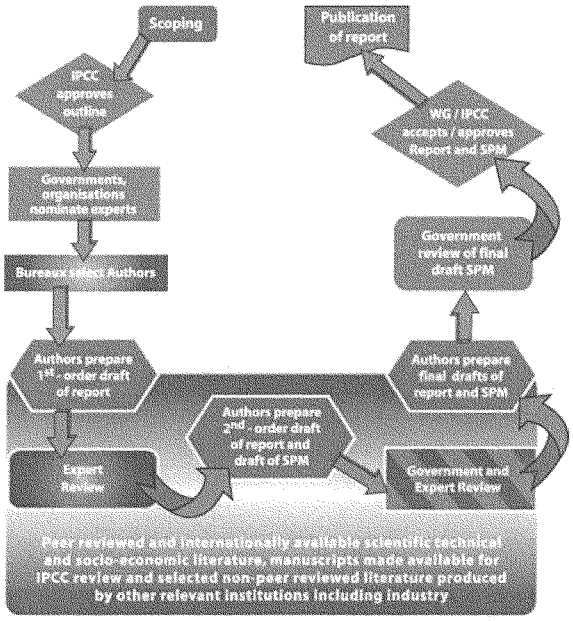
[4] United Nations, Intergovernmental Panel on Climate Change, Structure, As of May 2014, Available at: http://www.ipcc.ch/organization/organization_structure.shtml

[5] Ibid.

[6] Ibid.

[7] Ibid.

available scientific and technical information. Throughout the review process, expert reviewers and governments are invited to comment on the accuracy and completeness of the reports. Below is a depiction of the IPCC report process:[8]



IPCC Publications

In general, the reports of the IPCC are used globally to guide policy and provide support for climate change research. The assessment reports are released by each working group, with working group 1 starting, and a synthesis report concluding. All sections include a Summary for Policymakers, which compresses the large reports into smaller more concise documents for use by governments. The Summary for Policymakers is "subject to simultaneous review by both experts and governments, a government round of written comments of the revised draft before the approval Session and to a final line by line approval by a Session of the Working Group." .[9] Since 1990, the IPCC has released the following assessment reports:

[8] United Nations, Intergovernmental Panel on Climate Change, Principles and Procedures, As of May 2014, Available At: http://www.ipcc.ch/organization/organization_procedures.shtml

[9] United Nations, Intergovernmental Panel on Climate Change, Procedures for the Preparation, Review, Acceptance, Adoption, Approval, and Publication of IPCC Reports, 2013, Available at: http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles-appendix-a-final.pdf

- IPCC First Assessment Report 1990 (FAR)
- IPCC Second Assessment Report 1995 (SAR)
- IPCC Third Assessment Report 2001 (TAR)
- IPCC Fourth Assessment Report 2007 (AR4)
- IPCC Fifth Assessment Report 2013 (AR5)

Most recently in September 2013, the IPCC began the release of the Fifth Assessment Report (AR5) with the Working Group I report on the physical science basis of climate change.[10]

- **Working Group I Report** (September 2013) – The IPCC released its Working Group I report which focused on assessing the physical scientific aspects of the climate system and climate change. This report concluded that "Human influence on the climate system is clear."[11]
- **Working Group II Report** (March 2014) –Working Group II report focused on assessing "the scientific, technical, environmental, economic and social aspects of the vulnerability (sensitivity and adaptability) to climate change of, and the negative and positive consequences for, ecological systems, socio-economic sectors and human health, with an emphasis on regional sectoral and cross-sectoral issues."[12]
- **Working Group III Report** (April 2014) –The goal of Working Group III was to review "all relevant options for mitigating climate change through limiting or preventing greenhouse gas emissions and enhancing activities that remove them from the atmosphere." [13]

Independent Review of IPCC Process

In 2010, the IAC released an independent review of the processes and procedures of the IPCC. IAC is a multinational organization of science academies created to produce reports on scientific, technological, and health issues related to global challenges.[14] IAC also provides scientific advice to national governments and international organizations.[15] The report provided recommendations to the IPCC regarding its process and management:

- "The IPCC should establish an Executive Committee to act on its behalf between Plenary sessions.

[10] United Nations, Intergovernmental Panel on Climate Change, Working Group I, Fifth Assessment Report, 2013, Available at: http://www.climatechange2013.org/report/
[11] United Nations, Intergovernmental Panel on Climate Change, Working Group I, Fifth Assessment Report, Summary for Policymakers, 2013, Available at: http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf
[12] United Nations, Intergovernmental Panel on Climate Change, Working Group II, Fifth Assessment Report, 2014, Available at: http://www.ipcc-wg2.gov/
[13] United Nations, Intergovernmental Panel on Climate Change, Working Group III, Fifth Assessment Report, 2014, Available at: http://www.ipcc-wg3.de/
[14] InterAcademy Counil, Review of the IPCC, Overview, As of May 2014, Available at: http://reviewipcc.interacademycouncil.net/about.html#About%20IAC
[15] InterAcademy Counil, Review of the IPCC, Overview, As of May 2014 , Available at: http://reviewipcc.interacademycouncil.net/about.html#About%20IAC

- The IPCC should elect an Executive Director to lead the Secretariat and handle day-to-day operations of the organization.
- The IPCC should encourage Review Editors to fully exercise their authority to ensure that reviewers' comments are adequately considered by the authors and that genuine controversies are adequately reflected in the past.
- The IPCC should adopt a more targeted and effective process for responding to reviewer comments.
- Each working group should use the qualitative level-of-understanding scale in its Summary for Policymakers and Technical Summary, as suggested in IPCC's uncertainty guidelines for the Fourth Assessment Report.
- Quantitative probabilities should be used to describe the probability of well-defined outcomes only when there is sufficient evidence. Authors should indicate the basis for assigning a probability to an outcome or event.
- The IPCC should complete and implement a communications strategy that emphasizes transparency, rapid and thoughtful responses, and relevance to stakeholders, and that includes guidelines about who can speak on behalf of IPCC and how to represent the organization appropriately."[16]

In response to the recommendations from the IAC, the IPCC acknowledged the IAC review at its 32nd Panel Session in 2010. Four task groups were established to address the issues related to the procedures, governance and management, conflict of interest policy, and communications strategy.[17] The IPCC has since taken steps to address the recommendations of the IAC, including: the adoption of protocols for addressing possible errors in IPCC Assessment Reports, the establishment of an Executive Committee, and the adoption of conflict of interest policy.[18]

ADDITIONAL READING

- U.N. Intergovernmental Panel on Climate Change, Fifth Assessment Report, 2013, available at: https://www.ipcc.ch/report/ar5/wg1/

- InterAcademy Council Report on the IPCC, 2010, available at: http://reviewipcc.interacademycouncil.net/report.html

[16] InterAcademy Counil, Review of the IPCC, Executive Summary, 2010, Available at: http://reviewipcc.interacademycouncil.net/report/Executive%20Summary%20and%20Front%20Matter.pdf
[17] United Nations, Intergovernmental Panel on Climate Change, Organization Review, As of May 2014 , Available at: http://www.ipcc.ch/organization/organization_review.shtml
[18] Ibid.

Chairman SMITH. The Committee on Science, Space, and Technology will come to order.

Welcome to today's hearing titled "Examining the U.N. Intergovernmental Panel on Climate Change Process." I will recognize myself for an opening statement and then the ranking member for her opening statement.

The United Nations Intergovernmental Panel on Climate Change recently released three working group reports on climate science focused on physical sciences, impacts and adaptation, and mitigation. These documents make up the 5th Assessment Report. Similarly, the White House recently rolled out its National Climate Assessment, which takes a closer look at climate change and policy in the United States.

Both the IPCC and the White House's documents appear, in my view, to be designed to spread fear and alarm and provide cover for previously determined government policies. The reports give the Obama Administration an excuse to try and control more of the lives of the American people.

The IPCC's goal is an international climate treaty that redistributes wealth among nations. The Administration's goal is to impose greenhouse gas regulations, which will stifle economic growth and lead to hundreds of thousands of fewer jobs.

On the heels of these catastrophic predictions, the President plans to announce next Monday his most costly climate regulations: new climate standards for power plants. The Administration's regulatory agenda will hit workers and families hard but have no discernable impact on global temperature. One analysis used IPCC assumptions and found that if the United States stopped all carbon dioxide emissions immediately, the ultimate impact on global temperature would only be 0.08 degrees Celsius by 2050.

Serious concerns have been raised about the IPCC, including lack of transparency in author and study selection, and inconsistent approaches to data quality, peer review, publication cut-off dates, and the cherry-picking of results.

Significantly, the scientists working on the underlying science for the IPCC defer to international politicians when they develop a so-called Summary for Policy Makers. This really amounts, of course, to a summary by policy makers.

The document is disseminated ahead of the actual scientific assessment and provides biased information to newspapers and headline writers around the world, who gobble it up.

Dr. Robert Stavins of Harvard University, who served as a lead author for the IPCC, recently criticized this process as generating "irreconcilable conflicts of interest" that compromise scientific integrity. He wrote that "any text that was considered inconsistent with their interests and positions in multilateral negotiations was treated as unacceptable." The bias is there for all to see.

Following the 2007 assessment, key IPCC claims about the melting of Himalayan glaciers, the decline of crop yields, and the effects of sea-level rise were found to be completely erroneous and derived from non-peer-reviewed sources.

In 2010 the InterAcademy Council identified "significant shortcomings in each major step of IPCC's assessment process."

We all know that predictions are difficult and that the only certainty about projections far into the future is that they will be wrong. Incredibly, the IPCC predicts to the year 2100 and beyond.

The White House's Climate Assessment implies that extreme weather, hurricanes and severe storms are getting worse due to human-caused climate change. The President claims that droughts, wildfires and floods "are now more frequent and more intense." But the underlying science from the IPCC itself shows these claims are untrue, yet the Administration keeps repeating them.

The President and others often claim that 97 percent of scientists believe that global warming is primarily driven by human activity. However, the study they cite has been debunked. While the majority of scientists surveyed may think humans contribute something to climate change, and I would agree, only one percent said that humans cause most of the warming. So the President has misrepresented the study's results.

We should focus on good science, rather than politically correct science. The facts should determine which climate policy options the United States and world considers.

The IPCC and White House reports acknowledge that the United States has achieved dramatic reductions in emissions. The White House's National Climate Assessment recognized, for example, that "U.S. CO_2 emissions from energy use declined by around nine percent between 2008 and 2012."

U.S. contributions to global emissions are dwarfed by those of China, the world's largest emitter of greenhouse gases. And China shows no signs of slowing down.

The Obama Administration should stop trying to scare Americans and then impose costly, unnecessary regulations on them. The President says there is no debate. Actually the debate has only just begun.

When assessing climate change, we need to make sure that findings are driven by science, not an alarmist, partisan agenda.

[The prepared statement of Mr. Smith follows:]

PREPARED STATEMENT OF CHAIRMAN LAMAR S. SMITH

The United Nations Intergovernmental Panel on Climate Change (IPCC) recently released three working group reports on climate science—focused on physical sciences, impacts and adaptation, and mitigation. These documents make up the Fifth Assessment Report.

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Serious concerns have been raised about the IPCC, including lack of transparency in author and study selection, and inconsistent approaches to data quality, peer review, publication cut-off dates, and the cherry-picking of results.

Significantly, the scientists working on the underlying science for the IPCC defer to international politicians when they develop a so-called "Summary for Policy Makers." This really amounts to a "Summary by Policy Makers."

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U.S. contributions to global emissions are dwarfed by those of China, the world's largest emitter of greenhouse gases. And China shows no signs of slowing down.

The Obama administration should stop trying to scare Americans and then impose costly, unnecessary regulations on them.

The President says there is no debate. Actually the debate has only just begun.

When assessing climate change, we need to make sure that findings are driven by science, not an alarmist, partisan agenda.

Chairman SMITH. That concludes my opening statement, and the gentlewoman from Texas, Ms. Johnson, the ranking member of this committee, is recognized for her opening statement.

Ms. JOHNSON. Thank you very much, Mr. Chairman, and good morning to all. I want to join the Chairman in welcoming our witnesses to this morning's hearing.

Today our Committee will hear testimony about the process that is followed in carrying out the scientific assessments of the U.N.'s Intergovernmental Panel on Climate Change. I hope that today's hearing will be followed by a hearing at which scientists from the IPCC can actually present the findings of the 5th Assessment, because those findings are quite sobering and important for us to hear.

In the meantime, while the topic of today's hearing is a legitimate one, namely, how the IPCC process can be improved, I am concerned that the real objective of this hearing is to try to under-

cut the IPCC and to cast doubt on the validity of climate change research.

For the benefit of members who were not here in 2011, I would note that we had a hearing on this same topic back then, and the testimony to be given today echoes some of the claims made then. Ultimately, however, those claims were shown to be unfounded, yet here we are again.

The reality is that the IPCC assessment is unprecedented in its scope and inclusiveness. The United States, along with 194 other nations, has arrived at a rigorous and open process that yields the most comprehensive and objective assessments of the scientific literature relevant to the understanding climate change and its associated risks. We need only look at the results of the previous assessments to realize how much the IPCC has contributed to our understanding of climate change.

The latest assessment will be completed in October with the release of a synthesis report that integrates the results of each working group. Again, the IPCC's message is clear: the climate is changing, humans are playing a significant role, and the time for meaningful action is now. All over the country, Americans are observing and responding to a changing climate. In Texas, my home state, record droughts and other severe weather events are putting a significant strain on regional economies and presenting new challenges to the state's infrastructure and its ability to respond to these escalating threats. Developing timely solutions to these challenges is critical, and the IPCC provides policy makers with the factual basis to do just that.

We are likely to hear today that political agendas distort the IPCC's Summary for Policy Makers to make the impacts sound worse than they are or that the climate models or data the scientific assessments are based on are flawed. But we know that is not the case. In fact, if anything, the IPCC process of developing a consensus arguably results in a summary with more conservative estimates than some scientists believe are warranted, estimates that understate the impacts of climate change.

Let us be clear: the IPCC's summary document is policy-neutral and faithful to the underlying science. It is not a new assessment of the same information. It is not intended to be a substitute for the full assessment.

Mr. Chairman, we have a responsibility to listen to the facts and act to protect the American people from the growing risk of changing climate. The IPCC makes clear to anyone who will listen that the science is well established and well accepted by the vast majority of climate scientists. We cannot continue to turn a deaf ear to the pleas from our constituents to start working towards solutions.

This hearing is really a missed opportunity to consider the findings of the latest IPCC report and the kinds of actions the United States should be considering, and I—and as I stated earlier, I hope that we will have such a hearing in the coming months.

In closing, I am committed to working with my colleagues on both sides of the aisle to develop policies that address these new climate realities. But we are going—we are not going to get very far if we spend our time continually revisiting a scientific debate that has already been settled. Nor will we get far if we continue

a recent practice on this Committee of seeming to question the trustworthiness and integrity of this Nation's scientific researchers. That does them a disservice and does not reflect well on this Committee.

Mr. Chairman, climate change is real, its impacts are real, and the need to act is real. I sincerely hope that we will soon be able to work together to develop constructive policies to deal with changing climate.

Thank you, and I yield back.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF RANKING MEMBER EDDIE BERNICE JOHNSON

Good morning. I want to join the Chairman in welcoming our witnesses to this morning's hearing. Today our Committee will hear testimony about the process that is followed in carrying out the scientific assessments of the U.N.'s Intergovernmental Panel on Climate Change. I hope that today's hearing will be followed by a hearing at which scientists from the IPCC can actually present the findings of the 5th Assessment, because those findings are quite sobering and important for us to hear.

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The latest assessment will be completed in October with the release of a synthesis report that integrates the results of each working group. Again, the IPCC's message is clear: the climate is changing, humans are playing a significant role, and the time for meaningful action is now. All over the country, Americans are observing and responding to a changing climate. In Texas, record droughts and other severe weather events are putting a significant strain on regional economies, and presenting new challenges to the state's infrastructure and its ability to respond to these accelerating threats.

Developing timely solutions to these challenges is critical, and the IPCC provides policymakers with the factual basis to do just that. We are likely to hear today that political agendas distort the IPCC's summary for policymakers to make the impacts sound worse than they are or that the climate models or data the scientific assessments are based on are flawed. But we know that is not the case. In fact, if anything, the IPCC process of developing a consensus arguably results in a summary with more conservative estimates than some scientists believe are warranted-estimates that understate the impacts of climate change.

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This hearing is a missed opportunity to consider the findings of the latest IPCC report and the kinds of actions the U.S. should be considering, and as I stated earlier, I hope that we will have such a hearing in the coming months.

In closing, I am committed to working with colleagues on both sides of the aisle to develop policies that address these new climate realities. But we aren't going to get very far if we spend our time continually revisiting a scientific debate that has already been settled. Nor will we get far if we continue a recent practice on this

Committee of seeming to question the trustworthiness and integrity of this nation's scientific researchers. That does them a disservice and does not reflect well on this Committee. Mr. Chairman, climate change is real, its impacts are real, and the need to act is reaI. I sincerely hope that we will soon be able to work together to develop constructive policies to deal with that changing climate.

Thank you, and I yield back.

Chairman SMITH. Thank you, Ms. Johnson.

I will now proceed to introduce our witnesses today. Our first witness is Dr. Richard S.J. Tol, Professor of Economics at the University of Sussex and a Professor of Economics of Climate Change at the Institute for Environmental Studies at VRIJE University in Amsterdam. I know you made a big effort to be here today, and that is appreciated. Previously, Dr. Tol was a Research Professor at the Economic and Social Research Institute in Dublin, the Michael Otto Professor of Sustainability and Global Change at Hamburg University, and an Adjunct Professor at Carnegie Mellon University. Dr. Tol is ranked among the top 25 most-cited climate scholars in the world. He has written over 200 journal articles and authored three books. He specializes in the economics of energy, environment and climate. Dr. Tol has been involved with the IPCC since 1994, serving in various roles in all three working groups. Most recently, he served as a coordinating lead author in the economics chapter of Working Group II for the 5th Assessment Report. Dr. Tol received his Ph.D. in economics from the VRIJE University in Amsterdam.

Our second witness today is Dr. Michael Oppenheimer, the Albert G. Milbank Professor of Geosciences and International Affairs at Princeton University. Previously, Dr. Oppenheimer served as Chief scientist at the Environmental Defense Fund. Dr. Oppenheimer also was a coordinating lead author in the risk and vulnerabilities chapter of Working Group 2 for the 5th Assessment Report. Dr. Oppenheimer received his Ph.D. in chemical physics from the University of Chicago.

Our third witness today is Dr. Daniel Botkin, Professor Emeritus at the Department of Ecology, Evolution and Marine Biology at the University of California at Santa Barbara. He also teaches biology at the University of Miami. Dr. Botkin also served as a Professor at Yale University's School of Forestry and Environmental Studies and at George Mason University. In 1970, Dr. Botkin developed the first successful computer model of the effects of climate change on forests and species. Recently, Dr. Botkin served as an expert reviewer for the United Nations' IPCC's 5th Assessment Report and reviewed the recently released National Climate Assessment. Dr. Botkin received his Ph.D. in biology from Rutgers University.

Our final witness is Dr. Roger Pielke, Senior Research Scientist at the Cooperative Institute for Research and Environmental Sciences, a joint institute of the National Oceanic and Atmospheric Administration and the University of Colorado at Boulder. He is also Professor Emeritus of Atmospheric Science at Colorado State University. From 1999 to 2006, Dr. Pielke served as Colorado's State Climatologist. He is a Fellow of the American Meteorological Society and the American Geophysical Union, where he also served on the Committee on Climate Change. Dr. Pielke has published over 370 papers in peer-reviewed journals, 55 chapters in books,

and co-edited nine books to date. Beginning in 1992, Dr. Pielke has served in a number of capacities related to the U.N.IPCC including as an expert reviewer. Dr. Pielke received his Ph.D. in meteorology from the Pennsylvania State University.

We welcome you all and look forward to your testimony, and Dr. Tol, we will begin with you.

TESTIMONY OF DR. RICHARD S.J. TOL, PROFESSOR OF ECONOMICS, UNIVERSITY OF SUSSEX

Dr. TOL. Thank you, Mr. Chairman. It is an honor and pleasure to be here.

An appropriate solution to any problem requires a good understanding of its mechanisms, its consequences and the consequences of any countermeasure. The climate problem is so complex that at the moment, only the United States can mount sufficient expertise to cover the entire issue. Other countries need international collaboration from a body like the Intergovernmental Panel on Climate Change.

The common understanding of the issues is probably also helpful for the international climate negotiations. I therefore favor reform of the IPCC rather than its abolition.

I will focus my remarks on Working Group II of the IPCC because I know that one best. Working Group II is on the impacts of climate change. Researchers tend to study those impacts because they are concerned about climate change. Academics who research climate change out of curiosity but find less than alarming things are ignored unless they rise to prominence, in which case they are harassed and smeared.

People volunteer to work for the IPCC because they worry about climate change. Governments nominate academics to the IPCC but we should be clear that it is often the environment agencies that do the nominating. All this makes that the authors of the IPCC are selected on concern as well as on competence. This shows in the 5th Assessment Report of Working Group II. The Summary for Policy Makers talks about trends in crop yields but missed the important trend of them all, which is technological change. It shows the impacts of climate change on agriculture, assuming that farmers will not adjust their practices in the face of changed circumstances. It shows that the most vulnerable country would pay some ten percent of its annual income towards coastal protection but omits that the average country would pay less than one-tenth of a percent.

The SPM, the Summary for Policy Makers, emphasizes the health impacts of increased heat stress but downplays the health impacts of decreased cold stress. Therefore, the IPCC should investigate the attitudes of its authors and their academic performance and make sure that in the future they are more representative of their peers. If similar-minded people come together, they often reinforce each other's prejudices. The IPCC should therefore deploy the methods developed in business, medicine and social psychology to guard against groupthink.

Not all IPCC authors are equal. Some hold positions of power in key chapters. Others hold subordinate positions in irrelevant chapters. The IPCC leadership in the past has been very adept at putting troublesome—potentially troublesome authors in positions

where they cannot harm the cause. That practice must end. This is best done by making sure that leaders of the IPCC—the chairs, the vice chairs, the heads of technical support units—are balanced and open-minded.

The IPCC releases a major report every six years or so. That is not frequent enough to keep abreast of a fast-moving literature. A report that is rare should make a big splash, and an ambitious team wants to make a bigger splash than last time—"It is worse than we thought. We are all going to die an even more horrible death than before six years ago."

Launching a big report in one go also means that IPCC authors will compete with one another on whose chapter foresees the most terrible things. Therefore, I think that the IPCC should abandon its big reports and convert to journal-style assessments instead.

In learned journals, the editor guarantees that every paper is reviewed by experts. IPCC editors do not approach referees. Rather, they hope that the right reviewers will show up. Large parts of the IPCC reports are therefore not reviewed at all or reviewed by people who are not field experts, and the IPCC should move to journal-style reviews and editors.

The IPCC is best scene as a natural monopoly. Monopolies should be broken up but natural monopolies where the costs of duplication are greater than the benefits of competition should be tightly regulated. The clients of the IPCC—the environment agencies of the world—are often also its regulators. It is time to end that cozy relationship. The climate problem is serious enough to deserve a serious international body to assess the state of knowledge.

After the 4th Assessment Report, the InterAcademy Council suggested useful reforms. These were by and large ignored because the recommendations came after the preparations for the 5th Assessment Report had already started and because few countries supported IPCC reform. It should be said, though, that the 5th Assessment of IPCC Working Group II is a lot better than the 4th Assessment Report, and the IPCC does do useful things. The 5th Assessment Report shows, for instance, that the Stern Review overestimated the impacts of climate change and underestimated the impacts of climate policy. This undermines the justification of the two-degree target of the E.U., the U.N. and the current Administration of the United States. The 5th Assessment Report also shows double regulations, say, subsidies next to tradable permits, increases costs without further reducing emission. This conclusion was inadvertently dropped from the German translation, which is very unfortunate as double regulation is widespread in Germany.

We need an organization that is not beholden to any government or any party to anchor climate change in reality as we currently understand it. A reformed IPCC can play that role.

Thank you for your attention.

[The prepared statement of Dr. Tol follows:]

Testimony by
Dr Richard S.J. Tol
to the hearing entitled
Examining the UN Intergovernmental Panel on Climate Change Process for the Fifth Assessment Report
Committee on Science, Space and Technology
US House of Representatives
Thursday, May 29, 2014

It is an honour and pleasure to be here. My name is Richard Tol. I am a professor of economics at the University of Sussex and the Vrije Universiteit Amsterdam. I am a research fellow at the Tinbergen Institute and CESifo. **I am ranked among the Top 100 economists in the world by IDEAS/RePEc[1] and among the 25 most cited climate researchers according to Google Scholar[2].** I am an editor of Energy Economics, a top field journal. I was one of the first to statistically show that the observed global warming over the last one and a half century is caused by the accumulation of greenhouse gases in the atmosphere.[3] I used to advocate tradable permits, but having observed the EU ETS I now favour a carbon tax. I helped the UK government set its levy on methane from landfills, the Irish government design and set its carbon tax, and the US government set its carbon price. **I have been involved in the Intergovernmental Panel on Climate Change since 1994, serving in various roles in all three working groups, most recently as a Convening Lead Author in** the economics chapter of **Working Group II.**

An appropriate solution to any problem requires a good understanding of its mechanisms, its consequences, and the consequences of any countermeasure. The climate problem is so complex that at the moment only the USA can mount sufficient expertise to cover the entire issue. The EU cannot. Maybe China can in 20 years' time. **Other countries** than the USA **need international collaboration** on scientific and policy advice **through a body like the Intergovernmental Panel on Climate Change. A common understanding of the issues is probably also helpful for the international climate negotiations** although shared knowledge does not imply agreement on desirable outcomes. **I therefore favour reform of the IPCC rather than its abolition.**

I will focus my remarks on Working Group II of the IPCC because I know that one best. Working Group II is on the impacts of climate change, on vulnerability and adaptation. **Researchers tend to study those impacts because they are concerned about climate change.**

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[1] http://ideas.repec.org/top/top.person.all.html#pto90

[2] http://scholar.google.co.uk/citations?view_op=search_authors&hl=en&mauthors=label:climate_change&after_author=pOsLADa6__8J&astart=20

[3] Tol and de Vos (1993), *Theoretical and Applied Climatology*, **48**, 63-74.

Academics who research climate change out of curiosity but find less than alarming things are ignored, unless they rise to prominence in which case they are harassed and smeared. The hounding of Lennart Bengtsson is a recent example. Bengtsson is a gentle 79 year old. He has won many awards in a long and distinguished career in meteorology and climatology. He recently joined the advisory board of an educational charity and felt forced to resign two weeks later. As an advisor, he was never responsible for anything this charity did, let alone for the things it had done before he joined. For this, he was insulted by his peers. A Texas A&M professor even suggested he is senile.[4] Strangely, the climate "community" did not speak out when one of its own was elected for the Green Party[5]; nor does it protest against close ties between IPCC authors and the Environmental Defence Fund[6], Friends of the Earth[7], Greenpeace[8] or the World Wide Fund for Nature[9]. Other eminent meteorologists have been treated like Bengtsson was – Curry, Lindzen, Pielke Sr. Pielke Jr has been mistreated too, merely for sticking to the academic literature, as reflected by the IPCC, that there is no statistical evidence that the impact of natural disaster has increased because of climate change. I have had my share of abuse too. Staff of the London School of Economics[10] and the Guardian[11] now routinely tell lies about me and my work.

People volunteer to work for the IPCC because they worry about climate change. An old friend was an author for an IPCC special report. He was surprised that his co-authors were there for political reasons. In turn, they were surprised because he was there out of intellectual curiosity how electricity systems could possible function with a high penetration of non-dispatchable renewables.

Governments nominate academics to the IPCC – but we should be clear that it is often the environment agencies that do the nominating. Different countries have different arrangements, but it is rare that a government agency with a purely scientific agenda takes the lead on IPCC matters. As a result, certain researchers are promoted at the expense of more qualified colleagues. Other competent people are excluded because their views do not match those of their government. Some authors do not have the right skills or expertise, and are nominated on the strength of their connections only.

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[4] https://twitter.com/AndrewDessler/statuses/467100118844321792
[5] http://www.greenparty.bc.ca/elected_mla; http://www.europarl.europa.eu/meps/en/96725/BAS_EICKHOUT_home.html
[6] http://www.princeton.edu/step/people/faculty/michael-oppenheimer/
[7] http://www.up.ethz.ch/people/former/mmalte
[8] http://www.pik-potsdam.de/news/public-events/archiv/greencyclesii/programme/16.5.2011/hare/hare-cv
[9] http://www.biology.uq.edu.au/staff/hoegh-guldberg
[10] http://www.lse.ac.uk/GranthamInstitute/Media/Commentary/2014/April/A-flawed-conversation-about-the-Stern-Review.aspx; http://www.lse.ac.uk/GranthamInstitute/Media/Commentary/2014/March/Errors-in-estimates-of-the-aggregate-economic-impacts-of-climate-change.aspx
[11] http://www.theguardian.com/environment/climate-consensus-97-per-cent/2014/apr/30/economics-clear-need-climate-action; http://www.theguardian.com/sustainable-business/blog/environment-climate-change-denier-global-warming; http://www.theguardian.com/environment/earth-insight/2014/may/15/ipcc-un-climate-reports-diluted-protect-fossil-fuel-interests; http://www.theguardian.com/environment/planet-oz/2014/may/23/climate-mccarthyism-confected-outrage-checking-record-global-warming-policy-foundation

All this makes that the authors of the IPCC are selected on concern as well as competence. In the wake of the Fourth Assessment Report, the InterAcademy Council recommended that the IPCC be more transparent on the characteristics of the authors.[12] Putting their CVs online would be a small effort. It would be useful to systematically compare the academic performance of those selected, those nominated and those who volunteered.

This selection bias **shows in the Fifth Assessment Report of Working Group II. The Summary for Policy Makers** (SPM) **talks about trends in crop yields, but omits the most important of them all – technological change** – which has pushed up crop yields since times immemorial.[13] **It shows the impacts of climate change on agriculture assuming that farmers will not adjust their practices in the face of changed circumstances** – the far less dramatic impacts after adaptation are hidden in the main report. **It shows that the most vulnerable country would pay some ten percent of its annual income towards coastal protection, but omits that the average country would pay less than one-tenth of a percent**[14] – again, the lower, more relevant number is buried in the report. **It emphasizes the health impacts of increased heat stress but downplays the health impacts of decreased cold stress** – although the latter may well be numerically more important.[15]

This alarmist bias made me take my name of the Summary for Policy Makers in September 2013. My views on the impacts of climate change are well known. I liked the first draft of the Summary, which had as one of its key findings that the worst impacts of climate change really are symptoms of mismanagement and underdevelopment. It was just not credible that I would put my name to the final draft of the Summary, which its overemphasis on risk. Unfortunately, news of me stepping down made headlines in March 2014, giving the press an excuse to focus on the people involved rather than on the structural deficits of the IPCC.

Problems are not limited to the Summary for Policy Makers. There is a large body of work in the peace research literature that agrees that climate change is a minor, contributory factor in violent conflict, if at all.[16] There is a small body of work in the environmental science literature that argues that climate change is a major cause of violent conflict.[17] The IPCC grants the two literatures parity of esteem.[18]

The SPM worries that climate change may trap more people in poverty. One chapter[19] argues that this cannot be supported by the literature: There are a few weak papers

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[12] http://reviewipcc.interacademycouncil.net/
[13] Ruttan (2002), *Journal of Economic Perspectives*, **16**, 161-184.
[14] Nicholls and Tol (2006), *Philosophical Transactions of the Royal Society*, **A361**, 1073-1095.
[15] McGeehin and Mirabelli (2002), *Environmental Health Perspectives*, **109**, 185-189. Ye et al. (2012), *Environmental Health Perspectives*, **120**, 19-28.
[16] Gleditsch (2012), *Journal of Peace Research*, **49**, 3-9.
[17] Hsiang et al. (2013), *Science*, **341**, 6151.
[18] IPCC WG2 AR5 Chapters 12 and 19.
[19] IPCC WG2 AR5 Chapter 10

reaching opposite conclusions. Another chapter[20] cites two papers[21] – neither of which is on poverty traps – and the SPM echoes its language on climate change and poverty traps.

There is section on emerging risks. The first paper on an issue is always dramatic. That is the only way to get something onto the scientific agenda. Follow-up papers then pooh-pooh the initial drama. This has been repeated pattern in the climate change impacts literature from the 1980s onwards. The first papers on sea level rise, agriculture, health, ocean currents, and ice caps were sharply at odds with later, much better informed research.[22] But the IPCC chose not to wait for those follow-up papers.

Working Group III is not without fault either. A little bit of emission reduction costs little. But as targets get more stringent, costs escalate. Not so according to WG3: The tables in the SPM and the underlying chapter suggest that very ambitious targets are only slightly more expensive than ambitious targets, even though ambitious targets are far more expensive than lenient targets. This surprising finding is a statistical fluke. Emission reduction is easy according to some studies, which duly explore very ambitious targets. Emission reduction is hard according to other studies; very ambitious targets are prohibitively expensive and results not reported. The surprisingly low cost of meeting very stringent emission reduction targets is the result of selection bias: as targets get more stringent, an increasing number of expensive models are excluded. Oddly, the IPCC made the same mistake in the Fourth Assessment Report, and was alerted to the error.[23]

I think that these mishaps reflect bias in the authors. **The IPCC should** therefore **investigate the attitudes of its authors and their academic performance and make sure that, in the future, they are more representative of their peers.**

If similar-minded people come together, they often reinforce each others' prejudices.

The IPCC should deploy the methods developed in business management[24] and social psychology[25] to guard against group think. These include a balanced composition of peer groups, changing the compositing of groups, appointing devil's advocates, and inviting outside challengers. This requires active support from the IPCC leadership. To the best of my knowledge, outside challengers are rare. Indeed, I know of only one occasion. Peter Dixon, an Australian economist, told a group of IPCC authors they got it all wrong: The cost savings due to induced technological change as reported by the IPCC[26] are an artefact of misspecified models. Sjak Smulders, a Dutch economist,

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[20] IPCC WG2 AR5 Chapter 13
[21] Ahmed et al. (2009), *Environmental Research Letters*, **3**, 034004; Hertel et al. (2010), *Global Environmental Change*, **20**, 577-585.
[22] Tol (2008), *Environmental Values*, **17**. 437-470.
[23] Tavoni and Tol (2010), *Climatic Change*, **100**, 769-778.
[24] Eisenhardt et al. (2001), *Harvard Business Review*, **75**, 77-85.
[25] Postmes et al. (2001), *Journal of Personality and Social Psychology*, **80**, 918-930.
[26] IPCC WG3 AR4 Chapter 11

said much the same at an IPCC workshop.[27] Their advice was ignored and one of the authors duly promoted to working group chair.

Not all IPCC authors are equal. Some hold positions of power in key chapters, others subordinate positions in irrelevant chapters. The IPCC leadership has in the past been very adept at putting troublesome authors in positions where they cannot harm the cause.

That practice must end. This is best done by making sure that the leaders of the IPCC –chairs, vice-chairs, heads of technical support units – are balanced and open-minded.

The funding model of the IPCC is partly at fault. Multilateral organizations depend on their sponsors, but most have their own budget. The IPCC relies mostly on contributions in kind, and this hampers the IPCC's ability to control the quality of the contributions.

The leaders of the IPCC steer its assessment reports, and dictate its media presence. Working Group I conclude, in its latest assessment report, that the climate sensitivity – the eventual warming for a given change in the atmospheric concentration of greenhouse gases – is lower than previously thought. This is great news for all those who worry about climate change, but it somehow did not make it into the press release.

The IPCC releases a major report every six years or so. That is not frequent enough to keep abreast of a fast-moving literature.

When preparations started for the Fifth Assessment Report, the world hadn't warmed for 13 years. That is a bit odd, if the climate models are correct, but does not warrant a lot of attention. By the time the report was finished, it hadn't warmed for 17 years. That is decidedly odd[28], but hard to accommodate in a near-final draft that has been through three rounds of review. After the report was finalized, but before it was published, a number of papers appeared with hypotheses about the pause in warming.[29] The Fifth Assessment Report of Working Group I was out of date before it was released.

A report that is rare should make a big splash – and an ambitious team wants to make a bigger splash than last time. It's worse than we thought. We're all gonna die an even more horrible death than we thought six years ago.

Launching a big report in one go also means that IPCC authors will compete with one another on whose chapter foresees the most terrible things. IPCC reports are often two to three thousand pages long, but there are two or three main findings only. Authors who want to see their long IPCC hours recognized should thus present their impact as worse than the next one.

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[27] https://www.ipcc.ch/pdf/supporting-material/expert-meeting-2005-01.pdf
[28] Fyfe et al. (2013), *Nature Climate Change*, **3**, 767-769.
[29] http://www.economist.com/news/science-and-technology/21598610-slowdown-rising-temperatures-over-past-15-years-goes-being

The IPCC should abandon its big reports and convert to journal-style assessments instead. That would reduce the pressure for media attention. It would allow the IPCC to update its assessment as frequently as needed. It would also be easier to invite second opinions and minority reports.

In learned journals, the editor guarantees that every paper is reviewed by experts. IPCC editors do not approach referees. Rather, they hope that the right reviewers will show up. Large parts of the IPCC reports are, therefore, not reviewed at all, or not reviewed by field experts. In a journal, papers that are not good enough, are rejected. In a journal, a promising paper is sent back for further revision – regardless of deadlines. IPCC chapters are never turned down, and always finished on time. **The IPCC should move to journal style reviews and editors.**

The IPCC is best seen as a natural monopoly.[30] The IPCC cannot suppress supply to raise prices – as the typical monopolist would – but it reveals other signs of monopolistic behaviour. There is a lack of innovation – the First and Fifth Assessment Reports were prepared in much the same way, and cover similar ground. There is little regard for clients – the IPCC response to the scandals in the Third and Fourth Assessment Report was haughty. And the IPCC uses its monopoly power to muscle into other fields – most recently scholarships. **Monopolies should be broken up, but natural monopolies – where the costs of duplication are greater than the benefits of competition – should be tightly regulated.**

The clients of the IPCC, the environment agencies of the world, are often also its regulators. It is time to end that cosy relationship. Let the IPCC be run by the National Science Foundation and its counterparts in other countries and be overseen by the National Academy and its counterparts. These organizations are not without their faults, but at least their core mission is to do good science. **The climate problem is serious enough to deserve a serious international body to assess the state of knowledge.**

After the Fourth Assessment Report, the InterAcademy Council suggested useful reforms: More transparency in author selection, a registry of conflicts of interests, stronger review editors, open peer review.[31] Others suggested that the Bureau, which both runs and oversees the IPCC, should be split.[32] **These** recommendations **were by and large ignored because the recommendations came after preparations for the Fifth Assessment Report had started; and because few countries supported IPCC reform.** 'Conflicts of interests are now registered, but neither verified nor disclosed. **It should be said, though, that the Fifth Assessment Report of IPCC Working Group II is a lot better than the Fourth Assessment Report.** The IPCC should continue in this direction.

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[30] Tol (2011), *Climatic Change*, **108**, 827-839.
[31] http://reviewipcc.interacademycouncil.net/
[32] Tol (2011), *Climatic Change*, **108**, 827-839.

The IPCC does useful things. The Fifth Assessment Report shows that the Stern Review[33] overestimated the impacts of climate change[34] and underestimated the impacts of climate policy[35]. This undermines the justification of the two degree target of the EU, UN and the current administration of the USA. The Fifth Assessment Report shows that double regulation – say subsidies next to tradable permits – increases costs without further reducing emissions.[36] This conclusion was inadvertently dropped from the German translation[37], which is unfortunate as double regulation is widespread in Germany.

We need an organization that is not beholden to any government or any party to anchor climate policy in reality as we understand it. A reformed IPCC can play that role.

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[33] http://webarchive.nationalarchives.gov.uk/+/http:/www.hm-treasury.gov.uk/sternreview_index.htm
[34] IPCC WG2 AR5 Chapter 10
[35] IPCC WG2 AR5 Chapter 6
[36] IPCC WG3 AR5 Chapter 15
[37] http://www.welt.de/wirtschaft/article128124861/Die-dreiste-Berichtsfaelschung-der-Klimatrickser.html

Biography

Richard S.J. Tol is a Professor at the Department of Economics, University of Sussex, the Professor of the Economics of Climate Change, Institute for Environmental Studies and Department of Spatial Economics, Vrije Universiteit, Amsterdam, the Netherlands, and a Research Fellow of the Tinbergen Institute and CESifo. Formerly, he was a Research Professor at the Economic and Social Research Institute, Dublin, the Michael Otto Professor of Sustainability and Global Change at Hamburg University and an Adjunct Professor, Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, PA, USA. He has had visiting appointments at the Canadian Centre for Climate Research, University of Victoria, British Colombia, at the Centre for Social and Economic Research on the Global Environment, University College London, and at the Princeton Environmental Institute and the Department of Economics, Princeton University. He received an M.Sc. in econometrics (1992) and a Ph.D. in economics (1997) from the Vrije Universiteit Amsterdam. He is ranked among the top 100 economists in the world and among the top 25 most-cited climate scholars. He has well over 200 publications in learned journals (with 100+ co-authors), 3 books and many minor publications. He specialises in the economics of energy, environment, and climate, and is interested in integrated assessment modelling. He is an editor for *Energy Economics*, and an associate editor of *economics the e-journal*. He is advisor and referee of national and international policy and research. He is an author (contributing, lead, principal and convening) of Working Groups I, II and III of the Intergovernmental Panel on Climate Change, shared winner of the Nobel Peace Prize for 2007; an author and editor of the UNEP Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies; a GTAP Research Fellow; and a member of the Academia Europaea. He is actively involved in the European Climate Forum, the European Forum on Integrated Environmental Assessment, and the Energy Modeling Forum.

Chairman SMITH. Thank you, Dr. Tol.

Dr. Oppenheimer.

TESTIMONY OF DR. MICHAEL OPPENHEIMER, ALBERT G. MILBANK PROFESSOR OF GEOSCIENCES AND INTERNATIONAL AFFAIRS, DEPARTMENT OF GEOSCIENCES, PRINCETON UNIVERSITY

Dr. OPPENHEIMER. I would also like to thank you, Mr. Chairman, for convening these hearings because I think the subject is quite important, and for inviting me to testify.

The views I am expressing are mine. They don't adhere to IPCC and they don't reflect Princeton University's either.

IPCC has served a critical function in providing governments regular assessments of the consensus view in the scientific community on the state of the science of climate change. I served as an author of every IPCC assessment report since the first one in 1990 and also one special report. I am currently the coordinating lead author—a coordinating lead author of Chapter 19 for the Working Group II report.

Although I found participating in IPCC to be personally and professionally rewarding, I have never hesitated to provide constructive public criticism of IPCC when I thought it was warranted. It is to IPCC's credit that those who have been critical, even severely so, are invited to continue and even enhance their participation, and the smears that Richard talks about do not reflect IPCC practice nor the practice of most of the people involved in IPCC.

As to author selection, names of potential authors are suggested by governments to IPCC. The United States has an open selection process that allows anyone to propose a name including their own. All names are forwarded by the U.S. government to IPCC, which evaluates the suggestions in light of professional expertise and the need for balance in terms of national representation, institutional affiliation and expertise. For example, most authors come from universities, governments and private research institutions but their affiliations range broadly in the past from ExxonMobil on the one hand to Greenpeace on the other. Several studies have compared projections of IPCC reports to actual outcomes in the real world, providing a basis to assess the claims of bias. Overall, there is a significant bias. It reflects the professional caution of scientists. Note that the assessments by the U.S. National Academy of Sciences and other major national academies around the world have arrived at judgments which are materially the same as IPCC's.

As to the review process, each report consists of chapters that go through three levels of comprehensive review, further reducing the potential for bias. I am not aware of any scientific review process which approaches IPCC's in thoroughness. For example, over 50,000 review comments were received from over 1,700 reviewers of the Working Group II report this time. Distinct from most peer review journals, the review process is fairly transparent with review comments and author responses actually posted for public consumption. A key role is played by the so-called review editors, who are independent experts who review the responses that the

chapters make to each and every of those review comments and assure that the reviews are responded to appropriately.

As for the summary for policy makers, each working group report has a summary. It is intended for policy makers. Each SPM goes through two rounds of peer review. It is then reviewed at a plenary session with governments word by word. The objective of the approval process is to assure that it is clear and that it is accurate and that it is relevant to policy. The scientists who attend exercise an effective veto power over everything that goes into the SPM. Nothing can be inserted that is not scientifically accurate. No statement that the scientists who are present at the review session considered to be factually untrue and not representative of the science can survive. On the plus side, this process results in a clear document and, importantly, one that the governments accept as their own, including the United States and including under all Administrations. In this way, it is distinct from any other climate assessment performed by any another organization.

On the negative side, in my view and the view of many of my colleagues, there have been occasions when government intervention by causing omissions have diluted IPCC findings. However, my belief is that the process on the whole has reflected what is in the reports in the underlying chapters and made them on the whole clearer and more understandable and even in some cases more accurate.

My suggestions for improving the IPCC process are similar to Richard's: more transparency, publish more frequent but much briefer reports, open the plenaries to the press so that shenanigans as occured in the recent plenary session of Working Group III are less likely to happen because the public will be watching, and experiment with other types of assessment processes like a formalized expert elicitation or the Team B approaches that the Defense Department uses.

I found some of what Richard said to be a cartoon of the assessment process but we can talk about that in questions.

In the end, the world needs an IPCC, IPCC needs to continually improve its performance to meet that need. Our ability to deal with the risk of climate change depends on it.

Thank you.

[The prepared statement of Dr. Oppenheimer follows:]

Testimony of Dr. Michael Oppenheimer

Princeton University

At the

Committee on Science, Space, and Technology

US House of Representatives

May 29, 2014

On

Examining the UN Intergovernmental Panel on Climate Change Process for the Fifth Assessment Report

My name is Michael Oppenheimer. I am the Albert G. Milbank Professor of Geosciences and International Affairs at Princeton University and a member of the faculties of the Department of Geosciences and the Woodrow Wilson School of Public and International Affairs. I would like to thank Chairman Smith and the members of this committee for inviting my testimony at this hearing. The views expressed in this testimony are my own. I am not speaking as an official representative of either the Intergovernmental Panel on Climate Change (referred to in this testimony as IPCC) or Princeton University. IPCC has served a critical function in providing governments regular assessments of the consensus view in the scientific community on the state of the science of climate change. I welcome the opportunity provided by this hearing to explain the IPCC process to this committee and the broader public. Let me first describe my professional background and relationship with IPCC. Full curriculum vitae are attached to this testimony (Appendix 1).

I received a PhD in chemical physics from the University of Chicago and served as a postdoctoral fellow and then Atomic and Molecular Astrophysicist at the Harvard Smithsonian Center for Astrophysics, researching Earth's upper atmosphere. Subsequently, I served as Chief Scientist for the Environmental Defense Fund, a private, not-for-profit research and advocacy environmental organization (where I continue to provide scientific advice). In 2002, I became a professor at Princeton University. I have published over 140 articles in professional journals. Almost all of those published over the past 25 years are related to climate change science and climate change policy. My current research focuses on modeling the contribution of the Greenland and Antarctic ice sheets to past and future sea level changes; the risk to coastal areas from sea level rise due to global warming; and adaptation to climate change, sea level rise, and the risk of extreme events and climate-related disasters. Furthermore, I collaborate in a long term, ongoing study of scientific assessments and the assessment process (called *Assessing Assessments*, including IPCC's), which was funded by the National Science Foundation during the period 2010-2013.[1]

My relationship with IPCC goes back to its First Assessment Report, issued in 1990. I have served as an author (either as Contributing Author, Lead Author, or Coordinating Lead Author) of every IPCC Assessment Report as well as the Special Report on *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (referred to as SREX). My most recent involvement is in the Working Group II contribution to the Fifth Assessment Report, as a Coordinating Lead Author for Chapter 19, entitled *Emergent Risks and Key Vulnerabilities*. I also currently serve on the Core Writing Team for the Synthesis Report of the Fifth Assessment.

Personally, I have found participating in IPCC to be highly rewarding. The motivations of a few dozen other scientists we have interviewed to date in the development of the *Assessing Assessments* project are similar to my own: An opportunity to engage with the latest science across a very broad range of subject matter, a sense of professional obligation to make the results of our findings accessible to policy makers, and environmental concern - a desire to contribute a

scientist's perspective to understanding and averting the high-risk outcomes that characterize projected climate change. However, I would like to make clear that I have never hesitated to provide constructive, public criticism of IPCC when I thought it was warranted and could contribute to the improvement of the IPCC process, particularly in the wake of the Fourth Assessment Report. [2] It is to IPCC's credit that, unlike the situation with many other institutions, those who have been critical, even severely so, are invited to continue and even enhance their engagement in the process. IPCC appears capable of learning, adapting, and improving, making it an example in many respects of the kind of institution we will need to help us grapple with the climate problem.

IPCC Structure and the Development of Assessments[3]

The most important thing to understand about IPCC is that "The Panel" is composed of representatives of 195 governments. Scientists participate as authors of IPCC reports on a voluntary basis in three Working Groups that develop reports on the physical science of climate change; climate change impacts, adaptation and vulnerability; and mitigation of climate change. Assessments of the full range of the climate problem are published every 6-7 years; special reports on narrower topics (such as SREX, noted above) are occasionally published in the interim between full assessments.

The IPCC chair and the chairs of the three working groups for each assessment cycle are elected by the Panel, and the Panel also approves the outlines for each report.

Author Selection

The charge to authors is to provide an assessment of the peer reviewed journal literature and other literature ("non-journal literature" such as government reports) relevant to climate change and where possible, present a consensus view of the relevant expert community. Absent consensus in the scientific community, the goal is to characterize the range of views in the literature. Names of potential authors are suggested by governments to IPCC. The US has an open selection process that allows anyone to propose a name including their own. All names are forwarded by the US government to IPCC, which evaluates the suggestions in light of level of professional expertise and the need for balance in terms of expertise, national representation, and institutional affiliation, as noted below.

In developing the assessment conclusions, authors apply their expert judgment to weigh the value of the various contributions to the literature. Because substantial uncertainty attaches to many aspects of climate change, the authors are drawn from a wide range of technical, institutional, and national backgrounds in order to assure that the process of making such judgments captures the full range of views in the scientific community and that to the extent possible, bias does not creep into the process. Author areas of expertise range very widely from basic atmospheric processes to implementation of adaptation programs at the community level.

National representation is also broad but still is over-weighted toward the US and Europe. For example, for the Working Group II Fifth Assessment Report, author affiliations were 19% US and 26% Europe.[4]

Institutional affiliation is dominated by experts from universities and government and private research institutions but has included a breadth ranging from ExxonMobil to Greenpeace. Over eight hundred authors participated in the three working groups writing the Fifth Assessment Report.

Several studies have compared projections of IPCC reports to actual outcomes, providing a basis to assess bias. Overall, if there is a significant bias, it reflects the professional caution of scientists.[5] In this regard, it is important to note that assessments by the US National Academy of Sciences, the other major national academies around the world, the major scientific professional societies relevant to climate change, and the American Association for the Advancement of Science, have arrived at judgments largely similar to IPCC's.

The Review Process

Each report consists of chapters that go through three levels of comprehensive review, further reducing the risk of bias. The first is informal, by scientists chosen by working group members, some of whom also may be authors of other chapters. The draft is revised in response to these comments. A second, formal review is then performed by experts whose names have been forwarded to IPCC by governments and many of whom are independent of the governments and play no role in IPCC. The draft is revised, and each comment must be responded to individually; how it is dealt with in the revised text must be explained, as must any rationale for rejecting the comment. The responses are tabulated and are later posted for the public. A final draft is reviewed by experts associated with governments. Again, comments must be individually addressed and responses are made public along with the drafts. In both formal reviews, comments are also considered from any expert who wishes to submit them, not merely those selected by governments. I am not aware of any scientific review process which approaches IPCC's in its thoroughness. For Working Group II, the one with which I was associated in the Fifth Assessment, over 50,000 review comments were received from over 1700 reviewers.[6] That the review process is fairly transparent with review comments and author responses publicly posted differentiates the IPCC process from the generally-closed peer review at journals. A key role is played by Review Editors who independently review the responses that each chapter makes to review comments in order to assure their completeness.

Approval of the Summary for Policymakers (SPM)

Each Working Group report is accompanied by a ***Summary for Policymakers*** which captures the key findings. It is important to note that these documents (and the underlying chapters) are

supposed to be *policy relevant* but not *policy prescriptive*. IPCC assesses the effectiveness of policies but does not recommend that any particular policy or set of polices be adopted. Each Summary for Policymakers goes through two rounds of review, much like the chapter reviews described above, although the final round is by governments only. The draft SPM is then reviewed *word by word* at a Plenary Session of the governments of the Panel before final approval is given. This is the process that most people are familiar with and that has stirred the greatest controversy, so let me expand on it a bit. My observations are first-hand, based on my participation in four such sessions since 1995. Most recently, I participated in the approval of the SPM of Working Group II at Yokohama, Japan, in March. Representatives from 115 governments attended.[3] They worked diligently with the authors to produce a user-friendly document that was faithful to the underlying chapters. The proceedings were largely collaborative but occasionally confrontational as difficult questions of wording, both semantic and substantive, were worked out in sessions that went on most of the day and sometimes through much or all of the night.

Some of the government delegates are also experts, some are diplomats, and some are both. The objective of the approval process is to assure that the document not only *accurately* reflects the underlying chapters but that the language is *clear*. Governments need to understand what the scientists are saying or else the entire process would be a waste of time. Scientists are not known for their ability to communicate clearly in the vernacular so it is crucially important that government representatives participate in the process of developing the final version.

At the same time, government representatives are not always as knowledgeable about the technical details of the assessment as the experts, nor as free from political considerations. The last word on any statement is held by the scientists, who exercise *an effective veto power* over the insertion of any statement into the SPM. As reportedly happened during the approval session for the WGIII SPM in April, material scientists would have preferred to retain is sometimes removed at the behest of governments. But no statement that the scientists present consider to be factually untrue and not representative of the science can survive. In the end, the SPM is approved by governments.

Admittedly, the SPM approval process is imperfect. On the plus side, it results in a clearer document, and importantly, one that the governments accept as their own. In this way, it is distinct from any other climate assessment performed by any other organization. This outcome is part of the reason IPCC attained a special status as a "go-to" source for governments. On the minus side, in my view and the view of some of my colleagues, there have been occasions where government interventions, by causing omissions, have diluted IPCC findings. It is worth noting that government intervention sometimes strengthens findings by clarifying or highlighting them or advancing them from chapters to SPM. However, my belief is that on the whole across the working group reports with which I have been involved, the documents have become much clearer as a result of this singular (some would say peculiar) approach, have overwhelmingly

retained their important findings, and as a result of government collaboration have been much more widely influential than would otherwise have been the case.

Suggestions for Improving the IPCC Process

Assessment have been an effective tool for providing insights on technical matters to governments at least since the establishment of the National Academy of Sciences by President Lincoln in 1863. Nevertheless, IPCC was in many ways an experimental approach to assessment, and after 25 years, it is certainly timely to evaluate the experience and make adjustments. This process was already begun with the invitation to participants from the IPCC Chairman at the end of the Fourth Assessment to suggest changes in the process, and continued with the report of the InterAcademy Council in 2010.[7] My impression is that some but not all of the recommendations of the latter report were adopted, most importantly, strengthening the hand of the Review Editors. Governments have already begun another round of introspection and potential revision and even restructuring of IPCC, as evidenced by comments submitted by governments in relation to a call from IPCC last fall and more recently a request to authors.

My own recommendations for changes to IPCC procedures are as follows:

- **More frequent but briefer reports.** As effective and credible as IPCC assessments have been as a reflection of expert consensus, they consume much too much time of too many scientists who otherwise could be spending their time on research. While early IPCC reports were critical for establishing what was known about climate change, the gains in terms of new insights from full assessments have not been great enough recently to justify this diversion of experts. Instead, IPCC should focus on producing a larger number of briefer, more focused reports on questions of immediate interest to policy makers. SREX provides an example of such a report but the process could be slimmed down further. Potential topics could include an updated look at sea level rise with a special attention to the role of ice sheets; a close examination of the potential for a large release of methane, a potent greenhouse gas, from warming marine sediments; geoengineering as an abatement strategy; the effect of climate change on food security; and the potential role of shale gas in carbon mitigation with a view toward evaluating the leakage issue. These could be completed in one year each, including one or more formal review cycles.

- **Increase transparency.** As far as IPCC has come by posting review comments and drafts, the process of author deliberation and judgment remains shrouded. IPCC should be concerned with spelling out the full range of author views, not just their consensus. I strongly urge that IPCC take two steps to lift the veil: 1) Along with its

consensus findings, publish a record of significant divergences of viewpoints among authors, if any, and identify those holding each view. While I do not believe that such differences are common, when they do occur and indirectly become public, they can undermine IPCC's credibility in a broader community. A direct approach is called for; 2) Allow researchers to study IPCC thoroughly, including how decisions are reached by author/experts, in order to better understand how the process works and how it may be improved (I and my collaborators in *Assessing Assessments*, and others have made specific proposals for such research to IPCC).

- **Make the intergovernmental part of the process more accessible.** Plenaries where SPMs are approved are restricted to IPCC officials, authors, government representatives, and nongovernmental observer organizations. Opening the process to accredited media would strengthen understanding and acceptance with the broader public. Enhanced transparency might have reduced the odds of episodes such as that occurring at the recent WGIII plenary.

- **Experiment with more formal approaches to assessment.** Many interesting approaches to assessing the literature, including formalized expert elicitation, are available which could complement IPCC's current approach. Large scale expert assessment is a recent phenomenon. We need to be scientific about finding the best approaches to assessment because the problems are complex, the risks are high, and the effects of evidence-based decisions to act (or not act) are sometimes irreversible.

Conclusion

IPCC has performed an important service to governments and the general public by assessing the scientific literature, determining the consensus and range of expert views on critical questions, collaborating with governments to state those findings clearly and succinctly in the Summaries for Policymakers, and aiming to widely disseminate its reports. By and large, IPCC has been a highly successful experiment in science-policy interaction. But the interface of science with the intergovernmental process presents pitfalls, including contentiousness over the final products of the process. The best solution to this difficulty is to further increase transparency, both procedural and substantive. Furthermore, IPCC needs to lighten the burden it creates for the scientific community and its author-experts in particular. At the same time, it can sharpen its products and target them at issues of immediate interest. Finally, IPCC's procedures for carrying out the assessment process need a thorough study and review in order to assure that they are as effective as possible. The world needs an IPCC and IPCC needs to continually improve its performance to meet that need. Our ability to appropriately deal with the risk of climate change depends on it.

Once again, I thank the Chairman and the committee for availing me this opportunity to testify.

Endnotes

1. Collaborative Research: Assessing Assessments: A Historical and Philosophical Study of Scientific Assessments for Environmental Policy in the Late 20th Century. NSF Award Number 0958378
2. The Limits of Consensus (M Oppenheimer et al), *Science* **317**, 1505-6, 2007.
3. See www.ipcc.ch for details
4. Courtesy of IPCC WGII Technical Support Unit
5. Climate change prediction: erring on the side of least drama? (Brysse et al), *Global Environmental Change*, http://dx.doi.org/10.1016/j.gloenvcha.2012.10.008
6. Details available at https://www.ipcc-wg1.unibe.ch/; http://ipcc-wg2.gov/AR5; http://www.ipcc-wg3.de/
7. *Climate Change Assessments: review of the process and procedures of the IPCC.* Report of the InterAcademy Council, August 2010.

Michael Oppenheimer is the Albert G. Milbank Professor of Geosciences and International Affairs at Princeton University. He is also the Director of the Program in Science, Technology and Environmental Policy (STEP) at Princeton's Woodrow Wilson School. Oppenheimer, an atmospheric scientist, has an SB degree from MIT in chemistry and a PhD from the University of Chicago in chemical physics. He joined the Princeton faculty in 2002 after more than two decades with the Environmental Defense Fund, a non-governmental environmental organization, where he served as chief scientist and manager of the Climate and Air Program. Previously, he held the position of Atomic and Molecular Astrophysicist at the Harvard-Smithsonian Center for Astrophysics. Oppenheimer is a long-time participant in the Intergovernmental Panel on Climate Change (IPCC) which won the Nobel Peace Prize in 2007. Recently, he served as a coordinating lead author of IPCC's 2012 special report on climate extremes and disasters. Currently, he is a coordinating lead author on IPCC's Fifth Assessment Report and is on the Core Writing Team for the Fifth Assessment's Synthesis Report. Oppenheimer is coeditor of the journal *Climatic Change* and also editor of the journal's *Letters* section. He serves on the US National Academies Board on Energy and Environmental Systems and the New York City Climate Change Panel, and is also a science advisor to the Environmental Defense Fund. His research focuses on the natural science and policy aspects of climate change and its impacts. Much of his research aims to understand the potential for "dangerous" outcomes of increasing levels of greenhouse gases by exploring the effects of global warming on ice sheets and sea level, and on patterns of human migration. Oppenheimer is the author of more than 140 articles published in professional journals and is co-author (with Robert H. Boyle) of a 1990 book, *Dead Heat: The Race Against The Greenhouse Effect.*

May 2014

Chairman SMITH. Thank you, Dr. Oppenheimer.
Dr. Botkin.

TESTIMONY OF DR. DANIEL BOTKIN,
PROFESSOR EMERITUS,
DEPARTMENT OF ECOLOGY, EVOLUTION,
AND MARINE BIOLOGY,
UNIVERSITY OF CALIFORNIA, SANTA BARBARA

Dr. BOTKIN. I want to thank you also, Chairman Smith, for having me speak here. I think it is very——

Chairman SMITH. Dr. Botkin, press the——

Dr. BOTKIN. Okay. I want to thank you also, Chairman Smith, for inviting me to speak. I think this is a very important topic, and I am glad to be here.

Since 1968, I have published research on the possibility of a human-induced global warming and its potential human and ecological effects. I have spent my career trying to help conserve our environment and its great diversity of species, attempting to maintain an objective, intellectually honest approach in the best tradition of scientific endeavor. I have been dismayed and disappointed in recent years that this subject has been converted into a political and ideological debate. I have colleagues on both sides of the debate, and believe we should work together as scientists instead of arguing divisively about preconceived, emotionally based positions.

I was an expert review of both the IPCC and the White House National Climate Assessment, and I want to state up front that we have been living through a warming trend driven by a variety of influences. However, it is my view that this is not unusual, and contrary to the characterizations by the two reports, these environmental changes are not apocalyptic nor irreversible. I hope my testifying here will help lead to a calmer, more rational approach to dealing with climate change and with other major environmental problems. The two reports do not promote the kind of rational discussion we should be having. I would like to tell you why.

My biggest concern is that the IPCC 2014 and the White House Climate Change Assessment present a number of speculative, sometimes incomplete conclusions embedded in language that gives the more scientific heft than they deserve. The reports are scientific-sounding rather than based on clearly settled facts or admitting their lack. Established facts about global environment exist less often in science than laymen usually think.

The two reports assume and argue that the climate warming forecast by the global climate models is happening and will continue to happen and grow worse. Currently, these predictions are way off the reality. There is an implicit assumption in both reports that nature is in steady state, that all change is negative and undesirable for all life including people. This is the opposite of the reality. Environment has always changed. Living things have had to adapt to these changes and many require change. The IPCC report makes repeated use of the term "irreversible changes." A species going extinct is irreversible but little else about the environment is irreversible.

The report gives the impression that living things are fragile and rigid, unable to deal with change. The opposite is the case. Life is persistent, adaptable, adjustable. In particularly, the IPCC report for policy makers repeats the assertion of previous IPCC reports that large fraction of species face increased extinction risk. Overwhelming evidence contradicts this assertion. Models making these forecasts use incorrect assumptions, leading to overestimates of the extinction risks. Surprisingly few species became extinct during the past 2–1/2 million years, a period encompassing ice ages and warm periods.

The extreme overemphasis on human-induced global warming has taken our attention away from many environmental issues that used to be front and center but have been pretty much ignored in the 21st century and demand our attention.

Some of the report's conclusions are the opposite of those given in articles cited in defense of those conclusions. For example, the IPCC Terrestrial Ecosystem Report states that seven of 19 subpopulations of the polar bar are declining in number, citing in support of this an article by Vongraven and Richardson, but these authors state the contrary, that the "decline is an illusion." In addition, the White House Climate Assessment includes a table of 30 different ecological effects resulting from climate change, a striking list of impacts. However, I reviewed the studies cited to support this table and found that not a single one of these 30 is supported by a legitimate impact and analyzed from human-induced global warming of direct observations.

Some conclusions contradict and are ignorant of the best statistically valid observations. For example, the IPCC terrestrial ecosystem report states that terrestrial and freshwater ecosystems have sequestered about a quarter of the carbon dioxide emitted in the atmosphere by human activities in the past three decades—high confidence. Having done the first statistically valid estimates of carbon storage and uptake for any large areas of the earth, I can tell you that estimates of carbon uptake by vegetation used by IPCC are not statistically valid and overestimate carbon storage and uptake by as much as 300 percent.

The IPCC report uses the term "climate change" with two meanings: natural and human induced. These are not distinguished in the text and therefore confusion. If a statement is assumed to be about natural change, then it is a truism, something people have always known and experienced. If the meaning is taken to be human caused, then the available data do not support the statements.

The issues I brought up in my reviews of the reports have not been addressed in their final versions. With the National Climate Assessment, I stated that the executive summary is a political statement, not a scientific statement. It is filled with misstatements contradicted by well-established and well-known scientific papers.

Climate has always affected people and all life on earth, so it isn't new to say it is already affecting the American people. This is just a political statement. It is inappropriate to use short-term changes in weather as an indication one way or another about persistent climate change.

Thank you.
[The prepared statement of Dr. Botkin follows:]

WRITTEN TESTIMONY TO THE HOUSE SUBCOMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY. MAY 29, 2014

DANIEL B. BOTKIN

Since 1968 I have published research on theoretical global warming, its potential ecological effects, and the implications for people and biodiversity. I have spent my career trying to help conserve our environment and its great diversity of species. In doing so I have always attempted to maintain an objective, intellectually honest, scientific approach in the best tradition of scientific endeavor. I have, accordingly, been dismayed and disappointed in recent years that this subject has been converted into a political and ideological debate. I have colleagues on both sides of the debate and believe we should work together as scientists instead of arguing divisively about preconceived, emotionally based "positions." I hope my testifying here will help lead to a calmer, more rational approach to dealing with not only climate change but also other major environmental problems. The IPCC 2014 report does not have this kind of rational discussion we should be having. I would like to tell you why.

The IPCC 2014 report is actually a series of reports, each long, complex in organization, and extensive in scope. Since it's not possible to discuss the Summary Reports for Policymakers in detail today, I will highlight some of my thoughts for you here as they relate to the reports, hoping to bring a saner, more sober approach to this highly charged issue.

To characterize where we are with this report and this issue, I would like to quote James R. Schlesinger, the first U.S. Energy Secretary, who said: *"We have only two modes — complacency and panic."*—commenting on the country's approach to energy (1977)

Now to my major points.

1. **I want to state up front that we have been living through a warming trend driven by a variety of influences**. However, it is my view that this is not unusual, and contrary to the characterizations by the IPCC and the National Climate Assessment, these environmental changes are not apocalyptic nor irreversible.
2. **My biggest concern is that both the reports present a number of speculative, and sometimes incomplete, conclusions embedded in language that gives them more scientific heft than they deserve.** The reports are "scientific-sounding" rather than based on clearly settled facts or admitting their lack. Established facts about the global environment exist less often in science than laymen usually think.
3. **HAS IT BEEN WARMING? Yes, we have been living through a warming trend, no doubt about that**. The rate of change we are experiencing is also not unprecedented, and the "mystery" of the warming "plateau" simply indicates the inherent complexity of our global biosphere. Change is normal, life on Earth is inherently risky; it always has been. The two reports, however, makes it seem that environmental change is apocalyptic and irreversible. It is not.
4. **IS CLIMATE CHANGE VERY UNUSUAL? No, it has always undergone changes.**
5. **ARE GREENHOUSE GASES INCREASING? Yes, CO_2 rapidly**.
6. **IS THERE GOOD SCIENTIFIC RESEARCH ON CLIMATE CHANGE? Yes, a great deal of it.**
7. **ARE THERE GOOD SCIENTISTS INVOLVED IN THE IPCC 2014 REPORT?** Yes, the lead author of the Terrestrial (land) Ecosystem Report is Richard Betts, a coauthor of one my scientific papers about forecasting effects of global warming on biodiversity.
8. **ARE THERE SCIENTIFICALLY ACCURATE STATEMENTS AT PLACES IN THE REPORT? Yes, there are.**

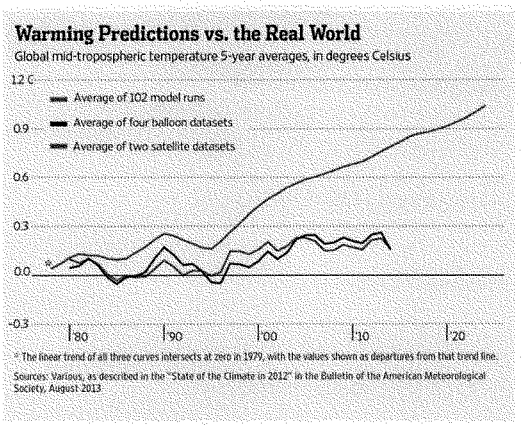
9. **What I sought to learn was the overall take-away that the reports leave with a reader.** I regret to say that I was left with the impression that the reports overestimate the danger from human-induced climate change and do not contribute to our ability to solve major environmental problems. I am afraid that an "agenda" permeates the reports, an implication that humans and our activity are necessarily bad and ought to be curtailed.

10. **ARE THERE MAJOR PROBLEMS WITH THE REPORTS? Yes, in assumptions, use of data, and conclusions.**

11. **My biggest concern about the reports is that they present a number of speculative, and sometimes incomplete, conclusions embedded in language that gives them more scientific heft than they deserve.** The reports, in other words, are "scientific-sounding," rather than clearly settled and based on indisputable facts. Established facts about the global environment exist less often in science than laymen usually think.

12. **The two reports assume and/or argue that the climate warming forecast by the global climate models is happening and will continue to happen and grow worse. Currently these predictions are way off the reality** (Figure 1). Models, like all scientific theory, have to be tested against real-world observations. Experts in model validation say that the climate models frequently cited in the IPCC report are little if any validated. This means that as theory they are fundamentally scientifically unproven.

Figure 1: Climate model forecasts compared to real world temperature observations (From John Christy, University of Alabama and Alabama State Climatologist. Reproduced with permission from him.)



13. **The reports suffers from the use term "climate change" with two meanings: natural and human-induced. These are both given as definitions in the IPCC report and are not distinguished in the text and therefore confuse a reader.** (The Climate Change Assessment uses the term throughout including its title, but never defines it.) There are places in the reports where only the second meaning—human induced---makes sense, so that meaning has to be assumed. There are other places where either meaning could be applied.

In those places where either meaning can be interpreted, if the statement is

assumed to be a natural change, then it is a truism, a basic characteristic of Earth's environment and something people have always know and experienced. If the meaning is taken to be human-caused, then in spite of the assertions in the report, the available data do not support the statements.

14. Some of the reports conclusions are the opposite of those given in articles cited in defense of those conclusions.

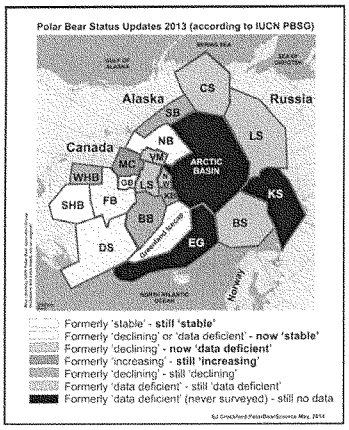
For example, the IPCC 2014 Terrestrial Ecosystem Report states that "there is medium confidence that rapid change in the Arctic is affecting its animals. For example, seven of 19 subpopulations of the polar bear are declining in number" citing in support of this an article by Vongraven and Richardson, 2011. That report states the contrary, that the "'decline' is an illusion.

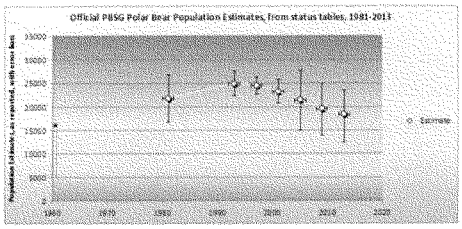
In addition, I have sought the available counts of the 19 subpopulations. Of these, only three have been counted twice; the rest have been counted once. Thus no rate of changes in the populations can be determined. The first count was done 1986 for one subpopulation.[1]

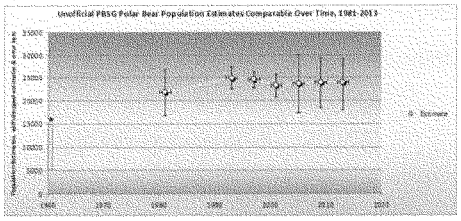
The U. S. Marine Mammal Commission, charged with the conservation of this species, acknowledges *"Accurate estimates of the current and historic sizes of polar bear stocks are difficult to obtain for several reasons–the species' inaccessible habitat, the movement of bears across international boundaries, and the costs of conducting surveys."*[2]

According to Dr. Susan Crockford, "*out of the 13 populations for which some kind of data exist, five populations are now classified by the PBSG* [IUCN/SSC Polar Bear Specialist Group] *as 'stable' (two more than 2009), one is still increasing, and three have been upgraded from 'declining' to 'data deficient'. . . . That leaves four that are still considered 'declining'- two of those judgments are based primarily on concerns of overhunting, and one is based on a statistically insignificant decline that may not be valid and is being reassessed (and really should have been upgraded to 'data deficient'). That leaves only one population – Western Hudson Bay – where PBSG biologists tenaciously blame global warming for all changes to polar bear biology, and even then, the data supporting that conclusion is still not available.*[3]"

Polar Bear Status (Source: Polar Bear Science Website.)







15. **Some conclusions contradict and are ignorant of the best statistically valid observations.** For example, the Terrestrial Ecosystems Report states that "terrestrial and freshwater ecosystems have sequestered about a quarter of the carbon dioxide emitted to the atmosphere by human activities in the past three decades (high confidence)." I have done the first statistically valid estimate of carbon storage and uptake for any large area of Earth's land, the boreal forests and eastern deciduous forest of North America, and subtropical forests in Queensland, Australia. The estimates of carbon uptake by vegetation used by IPCC and in major articles cited by the reports are based on what can best be called "grab samples," a relatively small number of studies done at a variety of times using a variety of methods, mainly in old-growth areas. The results reported by IPCC overestimate carbon storage and uptake by as much as 300 percent.[4]

16. **The report for policy makers on Impacts, Adaptation, and Vulnerability repeats the assertion of previous IPCC reports that "large fraction of species" face "increase extinction risks" (p15). Overwhelming evidence contradicts this assertion.** And it has been clearly shown that models used to make these forecasts, such as climate envelope models and species-area curve models, make incorrect assumptions that lead to erroneous conclusions, over-estimating extinction risks. Surprisingly few species became extinct during the past 2.5 million years, a period encompassing several ice ages and warm periods.[5] Among other sources, this is based on information in the book *Climate Change and Biodiversity* edited by Thomas Lovejoy, one of the leaders in the conservation of biodiversity.[6] The major species

known to have gone extinct during this period are 40 species of large mammals in North America and Northern Europe. (There is a "background" extinction rate for eukaryotic species of roughly one species per year.)

17. **THE REPORT GIVES THE IMPRESSION THAT LIVING THINGS ARE FRAGILE AND RIGID, unable to deal with change. The opposite is to case. Life is persistent, adaptable, adjustable.**

18. **STEADY-STATE ASSUMPTION: There is an overall assumption in the IPCC 2014 report and the Climate Change Assessment that all change is negative and undesirable; that it is ecologically and evolutionarily unnatural, bad for populations, species, ecosystems, for all life on planet Earth, including people. This is the opposite of the reality:** The environment has always changed and is always changing, and living things have had to adapt to these changes. Interestingly, many, if not most, species that I have worked on or otherwise know about require environmental change.[7]

19. **The summary for policy makers on Impacts, Adaptation, and Vulnerability makes repeated use of the term "irreversible" changes. A species going extinct is irreversible, but little else about the environment is irreversible.** The past confirms this. Glaciers have come and gone repeatedly. The Northwest Passage of North America has gone and come again. The average temperature has greatly exceeded the present and forecasted and has declined only to rise again.

    a. Implicit in this repeated use of irreversible is the belief that Earth's environment is constant — stable, unchanging — except when subjected to human actions. This is obviously false from many lines of evidence, including the simple

experience of all people who have lived before the scientific-industrial age and those who live now and so such work as farm, manage rivers, wildlife and forests.

20. **The extreme overemphasis on human-induced global warming has taken our attention away from many environmental issues that used to be front and center but have been pretty much ignored in the 21st century.** The Terrestrial report in a sense acknowledges this, for example by stating: "*Climate stresses occur alongside other anthropogenic influences on ecosystems, including land-use changes, nonnative species, and pollution, and in many cases will exacerbate these pressures (very high confidence).*"

Nine Environmental Issues that need our attention now
Energy
Fresh water
Phosphorus and other essential minerals
Habitat destruction
Invasive-species control
Endangered species
Pollution by directly toxic substances
Fisheries
Forests

21. **Do the problems with the se reports mean that we can or should abandon any concerns about global warming or abandon any research about it? Certainly not, but we need to put this issue within an appropriate priority with other major here-and-now environmental issues that are having immediate effects.**

22. **The concerns I have mentioned with the IPCC apply as well to the White House's National Climate Assessment.** I reviewed and provided comments on the draft White House's National Climate assessment and, unfortunately, it appears that these issues have not been addressed in the final assessment. For example, I stated:

"The executive summary is a political statement, not a scientific statement. It is filled with misstatements contradicted by well-established and well-known scientific papers."

"Climate has always affected people and all life on Earth, so it isn't new to say it is 'already affecting the American people.' This is just a political statement."

"It is inappropriate to use short-term changes in weather as an indication one way or another about persistent climate change."

WHAT HAS GONE WRONG, AND HOW TO FIX IT

1. **Rather than focus on key, specific and tractable aspects of climate-change science, the long-term approach throughout the 20th century was to try to create de nova a complete model of the climate.**
2. **This approach has been taken despite a lack of focus on monitoring key variables over time in statistically and scientifically valid ways, e. g. carbon sequestering by forests; polar bear population counts.** As a result, there is an odd disconnect between theory and observation. The attempt to create complete models of every aspect of climate has meant that many factors had to be guessed at, rather than using the best scientific methods. Too many guesses, too little checking against real, observed effects.
3. **The IPCC reports are the result of a very large number of people doing long reviews of the scientific literature. This easily leads to people being so overburdened that they misinterpret specific papers, fail to understand where the major observational gaps are, and have trouble making an accurate list of citations and all sources of information.** The fundamental IPCC and White House Climate Change Assessment approach has been to gather a huge number of scientists from a large number of disciplines, on the assumption that a kind of crowd approach to what can be agreed on is the same as true scientific advance. While this might seem a reasonable and effective approach, there is some danger in relying on this "crowd-sourced" model of information sharing. Groups of people, particularly when credentialed "experts" are involved, are very prone to a

condition called an "information cascade" in which error is compounded by group think, assumptions become unchallenged "fact" and observations play second fiddle to unchallenged models. The excellent scientists involved with the IPCC reports are no less prone to this than the excellent scientists who relied on Aristotelian models of a geocentric universe. Entrenched beliefs are hard to extricate, even amongst supposedly rational thinkers. This is probably in part responsible for the problems listed with the White House Climate Assessment report's table of Biological Effects, discussed in my document reviewing that report.

4. **What a scientist discovers is different from what a scientist says. The first is science, the second is opinion.** Have small groups of scientists work on this problem, no more than can easily argue with one another, that is less than 20 and preferably even smaller, representing the primary disciplines. Divide the problem into areas, rather than try to answer all questions in one analysis. I have used this approach in my own work and found it to be successful.[8, 9]

5. **The desire to do good has ironically overridden the desire to do the best science.**

6. **Under the weight of this kind of crowd rule and approach, some specific alternative approaches to the science of climate change, have not been allowed to rise to the surface.**

7. **Among the approaches that would improve climate science:**

   a. Return to the former reliance on science done by individuals and small groups with a common specific interest and focus.

   b. Change the approach from trying to make a complete, definitive model of

every aspect of climate to a different level. See kinds of models that explore specific possibilities and phenomena.

c. Get out of the blame game. None of the above suggestions can work as long as global warming remains a moral, political, ideologically dominated topic, with scientists pushed into, or at least viewed as, being either for or against a single point of view.

9. **We need to focus again on major environmental Issues that need our attention now** (see the list above).

10. **ARE THERE EXAMPLES OF THE KIND OF RESEARCH I BELIEVE WE NEED MORE OF? YES.**

    a. NASA Carbon Monitoring System (CMS)

    b. Hubbard Brook Ecosystem Study

    c. Whooping Crane monitoring, e.g. of an endangered species

    d. In-place monitoring on carbon flux, being done by the USGS in the Great Cypress Swamp, Florida.

    e. Many others.

NOTES

1. IUCN Summary of polar bear population status per 2013 http://pbsg.npolar.no/en/status/status-table.html

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3. Crockford, S., 2014. Polar Bear Science website http://polarbearscience.com/2014/03/20/polar-bear-status-changes-in-2013-deconstructed-with-a-map-to-the-good-news/

4. Botkin, D. B. and L. Simpson, 1990, Biomass of the North American Boreal Forest: A step toward accurate Global Measures: *Biogeochemistry* 9:161-174;Botkin, D. B., Simpson, L. G., and H. J. Schenk, 1992, Estimating Biomass, *Science* Letters. Vol. 257, No. 5067. (Jul. 10, 1992), pp. 146-147; Botkin, D. B., Simpson, L. G., and R. A. Nisbet, 1993, Biomass and Carbon Storage of the North American Deciduous Forest, *Biogeochemistry* 20: 1-17;Botkin, D. B., Ngugi, M.R., D. Doley (submitted) "Statistically Valid Estimates and Accurate Forecasts of Forest Biomass and Carbon Sequestration: A Forty-Five Year Quest." Keynote speech at IUFRO Forest Biomass Conference, October 7, 2013, to be published in *Drewno (Wood) Journal.*

5. Botkin, D. B., Henrik Saxe, Miguel B. Araújo, Richard Betts, Richard H.W. Bradshaw, Tomas Cedhagen, Peter Chesson, Margaret B. Davis, Terry P. Dawson, Julie Etterson, Daniel P. Faith, Simon Ferrier, Antoine Guisan, Anja Skjoldborg Hansen, David W. Hilbert, Craig Loehle, Chris Margules, Mark New, Matthew J. Sobel, and David R.B. Stockwell. (2007). "Forecasting Effects of Global Warming on Biodiversity." BioScience 57(3): 227-236.

6. Lovejoy, T. E., Lee Hannah, editors. (2005). Climate Change and Biodiversity. New Haven, Yale University Press.

7. Botkin, D. B., 2012, *The Moon in the Nautilus Shell: Discordant Harmonies Reconsidered* (Oxford University Press, New York, hardback and ebook, September 14, 2012).

8. Botkin, D.B., W.S.Broecker, L. G. Everett, J. Shapiro, and J. A. Wiens, 1988, *The Future of Mono Lake*, California Water Resources Center, University of California, Riverside, Report #68.

9. Botkin, D. B., Henrik Saxe, Miguel B. Araújo, Richard Betts, Richard H.W. Bradshaw, Tomas Cedhagen, Peter Chesson, Terry P. Dawson, Julie Etterson, Daniel P. Faith, Simon Ferrier, Antoine Guisan, Anja Skjoldborg Hansen, David W. Hilbert, Craig Loehle, Chris Margules, Mark New, Matthew J. Sobel, and David R.B. Stockwell. 2007 "Forecasting Effects of Global Warming on Biodiversity." *BioScience* **57**(3): 227-236.

Daniel B. Botkin scientific background regarding climate change and its ecological effects. Daniel Botkin is Professor of Biology Emeritus, University of California, Santa Barbara and adjunct professor of biology, University of Miami, Coral Gables. He has been on the faculty of the Yale School of Forestry and Environmental Studies, and George Mason University. At the University of California, Santa Barbara he was chairman of the Environmental Studies Program for six years.

His research is in ecology. He began research on the possibility of human-caused global warming in 1968 and have continued in that research ever since. In 1970, he developed the first successful computer model of forests, which for several decades was one of just two methods available to forecast the effects of climate change on forests and their endangered species. This computer model is in wide use around the world and has been well-validated.

He has participated in some development of global climate models. He has done observational – empirical research — on climate change, including the first statistically valid estimates of carbon storage and uptake by any large area of forests of Earth, did some of the first direct gas exchange measurements of carbon dioxide in forests. Among is recent research is a publication evaluating the methods in use to forecast effects of global warming on biodiversity, and the use of historical data from whaling ships logbooks to compare arctic sea ice extend in the 19th century with modern observations. In addition, he is one of 1800 "expert" reviewers of the new IPCC climate change report.

Chairman SMITH. Thank you, Dr. Botkin.
Dr. Pielke.

**TESTIMONY OF DR. ROGER PIELKE SR.,
SENIOR RESEARCH SCIENTIST,
COOPERATIVE INSTITUTE FOR RESEARCH
IN ENVIRONMENTAL SCIENCES,
AND PROFESSOR EMERITUS OF ATMOSPHERIC SCIENCE,
COLORADO STATE UNIVERSITY**

Dr. PIELKE. Okay. Mr. Chairman, thank you very much for inviting me to speak today.

I am going to focus on specifically one issue. The IPCC Working Group 1 and National Climate Assessment reports have not adequately tested the skill of the client models to predict changes in regional climate statistics on multiple decadal timescales when tested by using the observed human activities, including fossil fuel emissions over the last several decades. Indeed, even when these models are run using observed initial conditions on decadal time periods, they have at best only very limited regional skill.

The parts of the reports based on these model results is misleading the impact community and policymakers on the confidence that can be placed on regional climate impacts in the coming decades. This issue is independent of how important one has concluded is the addition of CO_2 for the atmosphere. Model projection skills should be a concern and addressed regardless of one's views on mitigation and adaptation.

So the summary of my major points: The 2013 IPCC report and the 2014 U.S. National Climate Assessment present a set of projections from local and downscaled regional climate models as the basis for projecting future societal and environmental impacts, and thus is offered as a guide to the future for decision-makers.

However, these projections have not been robustly shown to be accurate guides to the future. In fact, we aren't able to adequately quantify their reliability. The IPCC and NCA did not adequately discuss the skill run in hindcast predictions over the last several decades when the human activity, including fossil fuel emissions, are actually known.

Except for limited exceptions, the models cannot protect in hindcast runs over the last several decades the temporal evolution of major atmospheric circulation features over multi-decadal time periods, and these include, for example, the El Niño, the La Niña, the Pacific Decadal Oscillation, and the North Atlantic Oscillation. It is these major factors which determine which regions have drought, flood, tropical cyclone tracks, and other societally and environmentally important weather events. A global average is really not that useful of a metric for these particular very important weather phenomena.

The models have an even greater challenge in accurately predicting changes in statistics of these major atmospheric circulation features over multi-decadal timescales.

The IPCC and the National Climate Assessment should have reported such model limitations that were available to them in the peer-reviewed literature. And I document a whole series of these

papers in the peer-reviewed literature in my written testimony. Without this information, decision-makers who face decisions at the regional and local scale will have a false sense of certainty about the unfolding climate future.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Pielke follows:]

Written Testimony for the House Committee on Science, Space, and Technology

Hearing on "Examining the UN Intergovernmental Panel on Climate Change Process for the Process for the Fifth Assessment Report"

May 29 2014

Roger A. Pielke Sr.

Short Biographical Summary - At the University of Colorado-Boulder I currently am a Senior Research Scientist in CIRES and a Senior Research Associate in the Department of Atmospheric and Oceanic Sciences (ATOC) (November 2005 -present). I am also an Emeritus Professor of Atmospheric Science at Colorado State University. I have published books and peer reviewed papers on subjects in air pollution meteorology, hydrology, ecology, local, regional and global weather and climate.

Summary of my Main Points

- The 2013 IPCC WG1 report and the 2014 US National Climate Assessment present a set of projections from global and downscaled regional climate models as the basis for projecting future societal and environmental impacts, offered as a guide to the future for decision makers.
- However, these projections may not be reliable guides to the future. In fact, we are unable to accurately quantify their reliability. The IPCC and NCA did not adequately discuss the skill run in hindcast predictions over the last several decades when fossil fuel emissions, and other climate forcings, are actually known.
- Except for limited exceptions the models cannot accurately represent over the last several decades the temporal evolution of major atmospheric circulation features over multi-decadal time periods such as El Niño and La Niña, the Pacific Decadal Oscillation, and the North Atlantic Oscillation. These major factors determine which regions have drought, floods, tropical cyclone tracks, and other societally and environmentally important weather events.
- The models have an even greater challenge in accurately predicting changes in the statistics of these major atmospheric circulation features over multi-decadal time scales.
- The IPCC and NCA needs to more accurately report the importance of these model limitations, that were available to them in the peer reviewed literature. By not alerting them to these limitations, they are giving decision makers who face decisions at the regional and local level a false sense of certainty about the unfolding climate future.

Weather and Climate Modeling

Modeling studies have significant value to science and decision makers. However, the right tool is needed for the right job. There are three types of applications of models: for process studies, for diagnosis and for forecasting.

Process studies: The application of climate models to improve our understanding of how the system works. Adding CO2 to a global model is an example of a process study.

Diagnosis: The application of models, in which observed data is inserted into the model, to produce an analysis that is constrained by real world observations. This procedure is used for weather and climate reanalyses in order to provide the most accurate retrospective weather maps.

Forecasting: Models are used to predict (project) the future state of the system. Forecasts can be made from a single realization, or from an ensemble of forecasts which are produced by slightly perturbing the initial conditions and/or the input forcings such as fossil fuel emissions. The National Weather Service routinely runs the forecasts using initial observations and the accuracy are examined for every forecast. These National Weather model predictions are of enormous societal value.
Forecasts can be made from a single realization, or from an ensemble of forecasts which are produced by slightly perturbing the initial conditions and/or.

The models used by the IPCC and NCA are far more appropriate for use in process studies and diagnosis. They are poorly suited for use as forecasting tools until they have shown a better ability to predict changes in regional climate statistics over the last several decades.

I present below several examples of recent peer research papers that document significant inadequacies in even simulating multi-decadal regional climate, much less changes in regional climate statistics that have been observed when the models are run using the actual human activity including actual emissions for the last several decades (these are referred to as hindcast runs).

Evidence of the Limitations on the Skill of Multi-Decadal Regional Climate Projections.

The concern that I raise on using the multi-decadal regional climate predictions is shared by others. I list some examples as follows

Kim et al 2012 report that

"Most of the models produce cooler than observed global mean temperature during the entire period and overestimate the observed trend in their hindcasts... The AMO index is relatively well predicted in all models for the entire prediction period with a significant skill, while the predictive skill for the PDO index is relatively low for the entire period."

Fyfe et al. (2011) concluded that

"..for longer term decadal hindcasts a linear trend correction may be required if the model does not reproduce long-term trends. For this reason, we correct for systematic long-term trend biases."

Xu and Yang (2012) find that without tuning from real world observations, the model predictions are in significant error. For example, they found that

"....the traditional dynamic downscaling (TDD) [i.e. without tuning) overestimates precipitation by 0.5-1.5mmd-1...The 2-year return level of summer daily maximum temperature simulated by the TDD is underestimated by 2-6 C over the central United States-Canada region."

The paper van Oldenborgh et al. (2012) report just limited predictive skill in two regions of the oceans on the decadal time period, but no regional skill elsewhere, when they conclude that:

"A 4-model 12-member ensemble of 10-yr hindcasts has been analysed for skill in SST, 2m temperature and precipitation. The main source of skill in temperature is the trend, which is primarily forced by greenhouse gases and aerosols. This trend contributes almost everywhere to the skill. Variation in the global mean temperature around the trend does not have any skill beyond the first year. However, regionally there appears to be skill beyond the trend in the two areas of well-known low-frequency variability: SST in parts of the North Atlantic and Pacific Oceans is predicted better than persistence. A comparison with the CMIP3 ensemble shows that the skill in the northern North Atlantic and eastern Pacific is most likely due to the initialisation, whereas the skill in the subtropical North Atlantic and western North Pacific are probably due to the forcing."

Anagnostopoulos et al. (2010) report that

".. local projections do not correlate well with observed measurements. Furthermore, we found that the correlation at a large spatial scale, i.e. the contiguous USA, is worse than [even] at the local scale."

Stephens et al. (2010) wrote

"models produce precipitation approximately twice as often as that observed and make rainfall far too lightly...The differences in the character of model precipitation are systemic and have a number of important implications for modeling the coupled Earth system ...little skill in precipitation [is] calculated at individual grid points, and thus applications involving downscaling of grid point precipitation to yet even finer-scale resolution has little foundation and relevance to the real Earth system."

van Haren et al. (2012) concluded from their study with respect to climate model predictions of precipitation that

"An investigation of precipitation trends in two multi-model ensembles including both global and regional climate models shows that these models fail to reproduce the observed trends... A quantitative understanding of the causes of these trends is needed so that climate model based projections of future climate can be corrected for these precipitation trend biases.. To conclude, modeled atmospheric circulation and SST trends over the past century are significantly different from the observed ones."

Sun et al. (2012) found that

".in global climate models, [t]he radiation sampling error due to infrequent radiation calculations is investigated .... It is found that.. errors are very large, exceeding 800Wm 2 at many non-radiation time steps due to ignoring the effects of clouds.."

DiNezio (2014) reported that multi-decadal predictions of

"El Niño-Southern Oscillation ....may be entirely unpredictable"

He also wrote

"Predicting whether the coming decades will bring an onslaught of strong ENSO events - or none at all - is crucial because of the impact of such weather events on weather patterns around the world.....changes observed in ENSO behavior during the twentieth century could very well be random fluctuations unrelated to natural or man-made changes in the climate of the tropical Pacific."

Fyfe et al (2013) wrote

"Recent observed global warming is significantly less than that simulated by climate models. This difference might be explained by some combination of errors in external forcing, model response and internal climate variability."

Fyfe and Gillet (2014) followed up that study with the finding that

"...based on the CMIP5 ensemble of climate simulations, the probability of simulating the recently observed eastern tropical Pacific cooling with a freely running climate model under the CMIP5 radiative forcing protocol is very low, and hence so too is the probability of simulating the observed global temperature change over the past 20 years."

There is a summary of the limitations in multidecadal regional climate predictions in Kundzewicz and Stakhiv (2010) who conclude that

"Simply put, the current suite of climate models were not developed to provide the level of accuracy required for adaptation-type analysis."

On the global scale, John Christy provided me with this figure

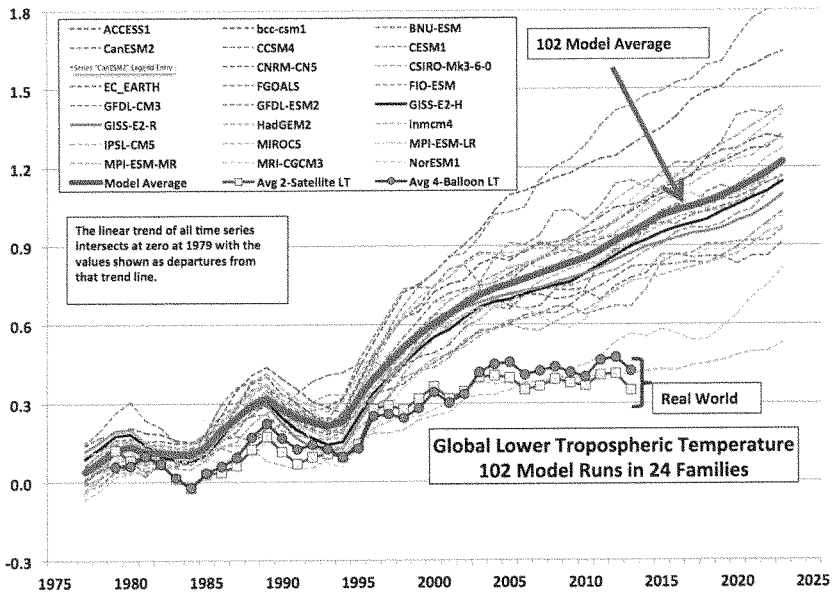

Figure: Model output of pressure-level temperature values provided by KNMI Climate Explorer. Observational values are those updated through 2013 from State of the Climate in 2012, Special Supplement, Bull. Amer. Meteor. Soc. 94, No. 8, August 2013.[figure prepared by John Christy, 2014]

The IPCC and NCA present a set of scenarios from global and downscaled regional climate model multi-decadal simulations in term of future potential societal and environmental impacts. They state that these are not predictions or forecasts, but projections focused on the modeled effect of the input forcings of fossil fuel emissions. However, the skill of these projections can be determined in hindcast runs since the fossil fuel emissions over the last several decades are known. In other words, the "scenario" over the last several decades can be prescribed in order to run the climate models. These studies should have been highlighted in both the NCA and IPCC WG1 reports so that policymakers can assess the expected skill of regional climate forecasts in the coming decades.

Appendix A Professional Credentials of Roger A. Pielke Sr.

Senior Research Scientist in CIRES and a Senior Research Associate at the University of Colorado-Boulder in the Department of Atmospheric and Oceanic Sciences (ATOC) at the University of Colorado in Boulder (November 2005 -present) and an Emeritus Professor of Atmospheric Science at Colorado State University. A more detailed vita is available at http://cires.colorado.edu/science/groups/pielke/people/pielke.html

I have 28047 citations of my research papers in my career and 10123 since 2009 according to google scholar. http://scholar.google.com/citations?user=ZCFFOQcAAAAJ&hl=en&oi=ao

I have several recent books that are relevant to my background with respect to the topic of the Hearing.

Pielke Sr, R.A., Editor in Chief., 2013: Climate Vulnerability, Understanding and Addressing Threats to Essential Resources, 1st Edition. J. Adegoke, F. Hossain, G. Kallos, D. Niyoki, T. Seastedt, K. Suding, C. Wright, Eds., Academic Press, 1570 pp.

Cotton, W.R. and R.A. Pielke Sr., 2007: Human impacts on weather and climate, Cambridge University Press, 330 pp.

Pielke Sr, R.A., 2013: Mesoscale meteorological modeling. 3rd Edition, Academic Press, 760 pp..

I have appeared before the House on two separate times and given the following written and oral testimony

Pielke Sr., Roger A., 2008: A Broader View of the Role of Humans in the Climate System is Required In the Assessment of Costs and Benefits of Effective Climate Policy. Written Testimony for the Subcommittee on Energy and Air Quality of the Committee on Energy and Commerce Hearing "Climate Change: Costs of Inaction" – Honorable Rick Boucher, Chairman. June 26, 2008, Washington, DC., 52 pp. View PDF of Oral Summary. http://pielkeclimatesci.files.wordpress.com/2010/01/testimony-written.pdf

Pielke Sr., R.A. 2011: Climate Science and EPA's Greenhouse Gas Regulation. Oral Testimony to the House Subcommittee on Energy and Power. Written Testimony http://republicans.energycommerce.house.gov/Media/file/Hearings/Energy/030811/Pielke.pdf

My latest summary on my views of the climate issue is presented as Appendix B, which was prepared as a minority viewpoint as a member of the American Geophysical Union committee on climate change.

Appendix B - My Perspective On Climate and My Involvement with the 2013 AGU Committee on Climate Change

Pielke Sr., R.A. 2013: Humanity Has A Significant Effect on Climate – The AGU Community Has The Responsibility To Accurately Communicate The Current Understanding Of What is Certain And What Remains Uncertain [May 10 2013]. Minority Statement in response to AGU Position Statement on Climate Change entitled: "Human-induced Climate Change Requires Urgent Action" released on 8/5/13.

The text is below

Humanity Has A Significant Effect on Climate – The AGU Community Has The Responsibility To Accurately Communicate The Current Understanding Of What is Certain And What Remains Uncertain [May 10 2013]

By Roger A. Pielke Sr.

I served on the AGU Panel to draft the updated Position Statement on "Human Impacts on Climate". We were charged by the AGU to provide

".....an up-to-date statement [that] will assure that AGU members, the public, and policy makers have a more current point of reference for discussion of climate change science that is intrinsically relevant to national and international policy."

In my view, this means we were tasked to report on the most important aspects of climate change. This was incompletely done in the Statement, where they inaccurately, in my view, discuss a view of climate change that is dominated by the emission of CO2 and a few other greenhouse gases. Indeed, the Committee, under the direction of Jerry North, with the report writing subgroup led by Susan Hassol, was clearly motivated to produce a Statement of this one particular view. Under his leadership, other views were never given an adequate opportunity to be discussed.

The Committee, instead of presenting the actual state of scientific understanding on the issue of climate change, used the following approach, as summarized in my son's book "The Honest Broker"

Scientific activity is diverse enough to provide information that can be used to support different perspectives on any topic ... [to] decide the course of action and then find information to back it up is a common practice across the political spectrum. "

The Committee leadership already had a course of action in mind even when we were appointed.

I presented to the Committee what I have concluded is a more scientifically robust Statement. I started from their Statement, and accepted what I could, as well as sought to remain close to their length.

I sought to answer the following questions, which the Statement accepted by the Committee incompletely does and/or does not address at all.

1. What is the definition of climate and climate change?

2. What are the societally and environmentally important climate metrics (e.g. a global average surface temperature trend; changes in ocean and atmospheric circulation patterns over multi-year time periods; sea level rise, trends in extreme weather etc)?

3. What are the main human and natural climate forcings?

4. What is the observational evidence for climate change?

5. What is the skill of the global and regional climate model projections (predictions) of changes in these metrics on multi-decadal time scales? 6. What are recommended pathways forward to reduce the risk from climate, including changes in climate over time?

My text of a more balanced Statement on "Human Impacts on Climate" is

Humanity Has A Significant Effect on Climate – The Scientific Community Has The Responsibility To Communicate The Current Understanding Of What is Certain And What Remains Uncertain

Climate is defined here as the statistical description of all the elements in the climate system (including the atmosphere, ocean, land surface and cryosphere), including both the mean state and any variations over time. Climate change is defined as a shift in the statistical description of climate. Climate change includes radiative, biophysical, biogeochemical and biogeographic effects. "Human-caused climate change" is a change resulting from one or more of the human climate forcings.

The natural Earth's climate system, even in the absence of humans, is nonlinear in which forcings and response are not necessarily proportional; thus change is often episodic and abrupt, rather than slow and gradual. Climate has always changed over time. As Earth's population has grown, however, human climate forcings have become significant on the local, regional and global scales. These human forcings include greenhouse gas emissions (e.g. CO2, methane, CFCs), aerosol emissions and deposition [e.g., black carbon (soot), sulfates, and reactive nitrogen], and changes in land use and land cover. A number of these forcings are spatially heterogeneous and include the effect of aerosols on clouds and associated precipitation. Most, if not all, of these human radiative, biophysical, biogeochemical and biogeographic influences on

regional and global climate will continue to be of concern during the coming decades. Natural climate forcings and feedbacks will also continue to be major effects on this time period.

With respect to human climate forcings, among their effects is their role in altering atmospheric and ocean circulation features away from what they would be in the natural climate system. While the greenhouse and aerosol emissions, in particular, have resulted in changes to the global average radiative forcings, the use of a global averaged radiative forcing or a global average surface temperature are grossly inadequate metrics to diagnose such effects as circulation changes on multi-decadal time scales. It is these regional scale atmospheric and ocean circulations that have the dominant effect on societally and environmentally important weather events such as droughts, floods, tropical cyclones, etc and any possible alteration by human climate forcings is a major concern.

It is also important to recognize that changes in the global radiative forcings (global warming or cooling) represent only a subset of climate change. The ocean is the component of the climate system that is best suited for quantifying climate system heat change. There are major unresolved issues concerning the ability of a global average surface temperature trend to accurately measure climate system heat changes. "Global Warming" can be much more accurately monitored in terms of an increase in the global annual average heat content measured in Joules.

Scientific confidence of the occurrence of climate change include, for example, that over at least the last 50 years there have been increases in the atmospheric concentration of CO2; increased nitrogen and soot (black carbon) deposition; changes in the surface heat and moisture fluxes over land; increases in lower tropospheric and upper ocean temperatures and ocean heat content; the elevation of sea level; and a large decrease in summer Arctic sea ice coverage and a modest increase in Antarctic sea ice coverage. Over the last ten years, lower tropospheric and upper ocean temperatures increases, however, have been less than in the preceding years, for reasons that are actively being debated.

These climate changes are a result of human and natural climate forcings and feedbacks - the relative role of each in altering atmospheric and ocean circulation features, and even the global annual average radiative forcing, however, is still uncertain. We do know that added carbon dioxide is the largest human-caused, and black carbon the second largest positive annual, global-averaged radiative forcing, while sulfates are among the largest human-caused negative annual, global-averaged radiative forcing. The importance of decadal and longer variations in natural annual, global-averaged radiative forcing (e.g. due to solar, and from internal natural climate feedbacks, such as from cloudiness), however, remains uncertain.

Climate models, unfortunately, are still unable to provide skillful predictions of *changes* in regional climate statistics on multi-decadal time scales at the detail desired by the impacts communities. Even on the global scale, the annual, global-averaged radiative forcing predicted by the models is significantly greater than has been observed based on the accumulation of

Joules in the climate system. The summer arctic sea ice extent, in contrast, has been significantly under predicted by the models, while the summer Antarctic sea ice extent increase has been missed by the models. Also attribution of specific extreme weather events to multi-decadal changes in climate has not yet been shown, and is likely not even possible.

We recommend a way forward that promotes effective policy decisions even with these uncertainties. The Statement on Climate Change that was adopted by the majority on the Committee, unfortunately, does not provide an accurate summary of our understanding of climate change issues, and, thus, is not an effective policy framework to reduce risks from the climate system.

The effective use of mitigation and adaption to reduce the risk to water resources, food, energy, human health and well-being, and ecosystem function from climate (including changes in the climate system) requires a multi-disciplinary, multi-faceted approach. Attempts to significantly influence climate impacts based on just controlling CO2 and a few other greenhouse gases emissions is an inadequate and incomplete policy for this purpose. The goal should be to seek politically and technologically practical ways (with minimal cost and maximum benefit) to reduce the vulnerability of the environment and society to the entire spectrum of human-caused and natural risks including those from climate, but also from all other environmental and social threats.

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Dr. Roger A. Pielke Sr. Biosketch

Dr. Roger A. Pielke Sr. is currently a Senior Research Scientist in CIRES and a Senior Research Associate at the University of Colorado-Boulder in the Department of Atmospheric and Oceanic Sciences (ATOC) at the University of Colorado in Boulder (Nov. 2005 -present). He is also an Emeritus Professor of Atmospheric Science at Colorado State University and has a five-year appointment (April 2007 - March 2012) on the Graduate Faculty of Purdue University in West Lafayette, Indiana. He received a B.A. in Mathematics from Towson State College in 1968 and an M.S. and Ph.D. in Meteorology from Pennsylvania State University in 1969 and 1973, respectively.

Pielke has studied terrain-induced mesoscale systems, including the development of a three-dimensional mesoscale model of the sea breeze, for which he received the NOAA Distinguished Authorship Award for 1974. Dr. Pielke has worked for NOAA's Experimental Meteorology Lab (1971-1974), The University of Virginia (1974-1981), and Colorado State University (1981-2006). He served as Colorado State Climatologist from 1999-2006. He was an adjunct faculty member in the Department of Civil and Environmental Engineering at Duke University in Durham, North Carolina (July 2003-2006) and a visiting Professor in the Department of Atmospheric Sciences at the University of Arizona from October to December 2004.

He has served as Chairman and Member of the AMS Committee on Weather Forecasting and Analysis, and was Chief Editor for the Monthly Weather Review for 5 years from 1981 to 1985. In 1977, he received the AMS Leroy Meisinger Award for "fundamental contributions to mesoscale meteorology through numerical modeling of the sea breeze and interaction among the mountains, oceans, boundary layer, and the free atmosphere." Dr. Pielke received the 1984 Abell New Faculty Research and Graduate Program Award, and also received the 1987/1988 Abell Research Faculty Award. He was declared "Researcher of the Year" by the Colorado State University Research Foundation in 1993. In 2000 he received the Engineering Dean's Council Award from Colorado State University.

He has authored a book published by Academic Press entitled Mesoscale Meteorological Modeling (1984) with a 2nd edition in 2002, and is currently preparing the 3rd edition to be published in 2013, a book for Routledge Press entitled The Hurricane (1990), a book (co-authored with W.R. Cotton) for Cambridge Press entitled Human Impacts on Weather and Climate (1995; 2nd Edition 2007), a book (co-authored with R.A. Pielke Jr.) entitled Hurricanes: Their Nature and Impacts on Society published in 1997 by John Wiley and Sons, and was Co-Chief Editor (with R.A. Pielke, Jr.) of a book entitled Storms, published by Routledge Press in 1999.

Roger Pielke Sr. was elected a Fellow of the AMS in 1982 and a Fellow of the American Geophysical Union in 2004. From 1993-1996, he served as Editor-in-Chief of the US National Science Report to the IUGG (1991-1994) for the American Geophysical Union. From January 1996 to December 2000, he served as Co-Chief Editor of the Journal of Atmospheric Science. In 1998, he received NOAA's ERL Outstanding Scientific Paper (with Conrad Ziegler and Tsengdar Lee) for a modeling study of the convective dryline. He was designated a Pennsylvania State Centennial Fellow in 1996, and named the Pennsylvania State College of Earth and Mineral Sciences Alumni of the year for 1999 (with Bill Cotton). He is currently serving on the AGU Focus Group on Natural Hazards (August 2009-present) and the AMS Committee on Planned and Inadvertent Weather Modification (October 2009-present). He is among one of three faculty and one of four members listed by ISI HighlyCited in Geosciences at Colorado State University and the University of Colorado at Boulder, respectively.

Dr. Pielke has published over 370 papers in peer-reviewed journals, 55 chapters in books, co-edited 9 books, and made over 700 presentations during his career to date. A listing of papers can be viewed and downloaded at the project website: http://cires.colorado.edu/science/groups/pielke/pubs/. He also launched a science weblog in 2005 to discuss weather and climate issues. This weblog was named one of the 50 most popular Science blogs by Nature Magazine on July 5, 2006. The weblog received more than 2.25 million hits from January-June 2007. The weblog is located at http://pielkeclimatesci.wordpress.com/.

Chairman SMITH. Thank you, Dr. Pielke. I will recognize myself for questions and then we will move on to the Ranking Member.

Now, Dr. Tol, you refused to sign onto the Summary for Policymakers for Working Group 2 for the most recent IPCC report. You were quoted as saying, "There are a number of statements that are widely cited that are just not correct." What would be some examples of those kinds of statements?

Dr. TOL. I mentioned a couple of them already. What the SPM says about agriculture and the impacts of agriculture I just don't think reflect the literature or would be accurate. What they say is that, because of climate change, crop yields would fall by about two percent per decade. It is probably true. They also say the population will probably grow by 30 percent over the same time period so it is probably true as well. But they admit that because of technological change, crop yields have been going up, so the IPCC sort of paints this picture of eminent famine which I don't think is supported by any evidence whatsoever.

Chairman SMITH. Okay. Thank you, Dr. Tol.

Dr. Oppenheimer, I don't have a question for you but I wanted to thank you for your suggestions as to how the IPCC could be more open and transparent and I hope they will heed your good suggestions.

Dr. OPPENHEIMER. Thank you.

Chairman SMITH. Dr. Botkin, you made some head-turning statements here. You mentioned the White House list of 30 impacts, that not one was true. You said the polar bear population, statements about it being declining, was the opposite; they were increasing. You said the Administration or the IPCC doesn't distinguish between natural and human-caused climate change and you said it was largely a political statement. I don't know what more to ask you. That covers it pretty well. But one question I had for you was the Administration's claim that extreme weather is directly connected by human-induced climate change. What do you think about their statements in that regard?

Dr. BOTKIN. When I was a graduate student, I read Bryson, one of the great men of climatology, and at that time it was 1960. He told me that the climate had been cooling since 1940, and if present trends continued, this was going to lead to a new Ice Age. And I was in a position to be on the right newspaper article, so I went back to him with that as a lead story because that was a great lead, and he thought about it and thought about it and he said, you know, Dan, this is just a 20-year weather change. We can't make that kind of extrapolation.

And then in the 1980s I worked closely with Steve Schneider who, along with Jim Hansen, did a lot to promote our concern with global warming. And Steve and I spoke on the same platforms and often discussed things and he always made the point that you cannot use short-term weather, meaning decadal even, weather changes has an index of climate change.

So to assert, as the White House report does right at the beginning, that current weather changes are due to climate changes, it violates one of the basic principles of how I understand you approach climatology.

And also, there is analyses that show that the changes are not out of the ordinary.

Chairman SMITH. Okay. Thank you, Dr. Botkin.

And, Dr. Pielke, I want to put a PowerPoint up on the screen here and ask you about it. This shows, I believe, that even if the United States eliminated all emissions entirely, it would have almost no impact on global temperatures. But I would like for you to address that. I mean no one thinks that is going to happen, but what if we were to cut emissions in half? Is that going to have any discernible, any appreciable effect on global temperatures or not? If you can kind of put this in perspective.

And, by the way, as I mentioned in my opening statement of course the United States has actually cut emissions over the last several years, I think nine percent over the last four years. We are going that direction. But even if we went further, even if we cut emissions even more, is that going to have any impact?

Dr. PIELKE. Well, that is a really good question. I think the way to answer this question is to use those models that the IPCC uses as process studies, not as predictions but look at sensitivities, and I think that is the kind of numbers that one produces when you insert that in the models.

Chairman SMITH. And just so that I am clear, so if the United States were to either eliminate emissions or cut them in half or dramatically reduce them, as the Administration proposes, it is not going to have any discernible impact on global temperatures in the near future and perhaps even long-term?

Dr. PIELKE. That is true by any country of course that——

Chairman SMITH. Yes.

Dr. PIELKE. —if one would do that, yes.

Chairman SMITH. Okay. What about other countries? If other countries follow the United States, they will even cut their emissions, is that going to have any particular impact?

Dr. PIELKE. Well, it would have more of an impact of course. And again, the way to quantify this is with—to use the models as these process tools. And I think the figure that you have up there illustrates that——

Chairman SMITH. Okay.

Dr. PIELKE. —you have to have a huge reduction in order to get a large impact.

Chairman SMITH. And again, to make my point, if the United States were to eliminate all emissions, the projection is that by 2050 it would only reduce global temperatures by 0.08 percent. Do you agree with that?

Dr. PIELKE. Well, I would accept your results because I mean I think you are presenting results from the models and that——

Chairman SMITH. Right.

Dr. PIELKE. —I think that is the kind of sensitivities they show.

Chairman SMITH. Okay. Thank you, Dr. Pielke. That concludes my questions.

And the Ranking Member, Ms. Johnson, is recognized for hers.

Ms. JOHNSON. Thank you very much.

Dr. Oppenheimer, some of the testimony from the other panelists today seems to suggest that minority views or opinions are not adequately considered as part of the IPCC process. However, in your

testimony you state that, unlike the situation with many other institutions, those who have been critical, even severely so, are invited to continue and even enhance their engagement in the process. Can you please describe the inclusive nature of the IPCC process and how lead authors deal with differences in opinion?

And secondly, also, it is my understanding that comments on the report can be submitted from any scientist or expert who chooses to do so and that every comment is individually considered. Can you please describe the review process and the role of review editors in ensuring a transparent process?

Dr. OPPENHEIMER. Thank you. Yes, I can. With regard to the first question, differences of opinion, I will give you an anecdote. During the last assessment, the fourth assessment, there were significant differences of opinion about how to represent what was going on in the Greenland and Antarctica ice sheets. Both ice sheets known to be losing ice and adding to sea level. They now account for about 1/3 of sea level rise that we are seeing today. And the question was what models should be used in projecting that into the future? There was disagreement among the authors, disagreement across working groups, and as a result, authors met during meetings. There were about four author meetings for each working group, and they met on the side in between meetings in order to work out differences and they exchanged a lot of email. And the final language, although it wasn't adequate in my view, did reflect the fact that there were differences of opinion on this issue. I think IPCC can do a much better job of showing the full spectrum of opinion on issues by the authors and I hope it will do so in the future.

As far as the review procedure, it is actually very painful. As I said, 50,000 comments on 30 chapters, that is an average of more than 1,000 per chapter, and we have to address every single one of them. And if we fail to do so, we have these independent scientists on our neck insisting that we go back and they actually can hold up the completion of a chapter until comments are adequately addressed.

Ms. JOHNSON. Thank you. In Dr. Botkin's testimony he characterizes IPCC process as a very large number of people doing long reviews of the scientific literature and cautions against using, as he described it, a crowdsourcing model of information-sharing. Dr. Tol also suggests that IPCC process is vulnerable to this kind of groupthink. It seems to me that consensus does not equal groupthink and that this is a mischaracterization of the process and the resulting assessments. What do you think of these claims by the two witnesses?

Dr. OPPENHEIMER. First of all, I would want to say there were a number of particular scientific claims by both of them that were inaccurate, but there is no room to actually talk about all the inaccuracies right now so let me go on and answer your question.

I think groupthink is a real possibility. It has been shown to occur when you have groups of people together. And I think occasionally IPCC is the victim of the scientific tendency to all be cautious at the same time, and we need to find ways to get over that. And the suggestion that Richard made and that I made of having

alternative teams of scientists within IPCC looking at the same question I think would be an improvement.

But given the current structure of IPCC, I think by and large the review process helps push in the right direction so that although I can't say that there isn't any groupthink, I also think it is minimized but I think the process can be improved further.

Ms. JOHNSON. Now, Dr. Tol also suggests that leadership of IPCC intentionally marginalizes authors that they view as troublesome by placing them in positions where they cannot "harm the cause." As I understand it, the United States has a very open selection process in which anyone can submit their name and all of those names are forwarded to the IPCC. Can you please describe the—how IPCC selects the authors for the assessment?

Dr. OPPENHEIMER. Well, that comment puzzled me because Richard, who is a very smart guy, is also one of the biggest troublemakers among authors in that he says what he thinks, which is great, and he hasn't been marginalized. He was made the cohead of a chapter. He has done before and he did a great job. So, I don't know what this cabal is about frankly.

Ms. JOHNSON. Thank you. My time is up.

Chairman SMITH. Thank you, Ms. Johnson.

The gentleman from California, Mr. Rohrabacher, is recognized.

Mr. ROHRABACHER. Thank you very much.

First, Dr. Oppenheimer, I don't mean this as—don't take—I guess you will take it personally or not. Okay. Let me just state right out one of the things that has disturbed me most about the debate on global warming over the years has been the tendency of people who are pushing this concept to dismiss those who disagree with them. And I mean I remember in this Committee and I remember in other Committees listening to the words "case closed," which was basically trying to restrict an honest discussion rather than open an honest discussion.

And just today you, for example, just in passing noted that you felt your colleague, his views are like cartoons. And I am sorry, that doesn't reflect a good thing to me. That is a dismissal and you just mentioned you didn't have time enough to go through where you disagree. Most people when they disagree with someone at least encapsulate it in a time period that they have got, whether it is 15 seconds or 10 seconds where we disagree on this rather than dismiss. And I think that probably that is the thing that gets me the angriest about this whole issue of global warming is that one side dismisses the other. Please feel free to comment.

Dr. OPPENHEIMER. The cartoon remark was aimed at only one sentence that Richard spoke, which is that somehow everybody is out-racing the other one to make the most extreme assessment so that their chapter will get the headline. I just don't agree with that. I think if it goes on in anybody's head, it is a cartoon of the process and it bears no relation to how people behave.

As far as the scientific facts being right or wrong, I try very hard to let everybody have their say on scientific facts and then they can be discussed as facts. I think everyone should be listened to. But in the end, governments have to act on evidence that the large majority of the scientific community believes while not dismissing the

fringes, listening to them, weighing them, and making decisions. So that is my view and I try to behave accordingly.

Mr. ROHRABACHER. All right. Well, again, which leads one to believe that the other people on their outside views are fringes. And again, it is an attitude that I find overwhelming among those people who are pushing the global warming or believe in that theory.

Let me just go to some of the specifics on it. Let me just ask the panel if you can give me yes or no. Is this 97 percent of all scientists believe that global warming is a result—and that global climate change is a result of human activity? Is that accurate or inaccurate from what you see from other scientists and from what you know?

Dr. TOL. I guess this question is directed to me.

First, let me say that I did not take any offense with the cartoon statement by Dr. Oppenheimer. I have five minutes so what can you do other than draw a few——

Mr. ROHRABACHER. Oh, believe me, if I took offense at all the things they said about me, I would be offended all the time.

Dr. TOL. No, exactly.

The 97 percent estimate is bandied about by basically everybody. I had a close look at what this study really did and as far as I know, as far as I can see, this estimate just crumbles when you touch it. None of the statements in the papers are supported by any data that is actually in the paper, so unfortunately—I mean it is pretty clear that most of the science agrees that climate change is real and most likely human-made, but is—97 percent is essentially pulled from thin air. It is not based on any credible research whatsoever.

Mr. ROHRABACHER. I only have a couple more seconds in my time period. Would you say you agree with that assessment, the 97 percent is inaccurate?

Dr. OPPENHEIMER. I actually haven't read the paper, although I am familiar with the argument about it, but my view is similar to Richard's in the other respects, namely the lion's share of the scientific community believes that the Earth is warming——

Mr. ROHRABACHER. No——

Dr. OPPENHEIMER. —and that most of the warming is human-made.

Mr. ROHRABACHER. But I will have to also point out that one of the other things that upsets me in the debate is that people who are arguing the case for global warming always refuse to answer a specific question when they know that it will not bolster the argument for global warming.

Dr. OPPENHEIMER. You want me to comment on something I haven't read?

Mr. ROHRABACHER. Well, I wasn't asking about something that you read. This has not been just published in one article. This 97 percent figure has been repeated over and over and over again by such a wide variety of people that that is—I am asking about——

Dr. OPPENHEIMER. That is because there have been many scientific articles that have studied what scientists have said and have come to conclusions which are similar. Whether the 97 percent is defensible or not, I really don't know.

Dr. BOTKIN. I would like to break in here if I may. What a scientist finds out is science. What a scientist says is opinion and science is not a consensus activity. Science is innovative and invention and discovery.

Now, I have spent my life looking at facts and analyzing facts. I have been concerned about global warming since 1968 and in the 1980s it looked like the weight of evidence went towards human-induced significant—to a significant extent, and since then, it has moved against it. But for me it doesn't matter—it isn't the point. It is the wrong point about how many people approve. That is not science. What it is is the facts, the interpretation of the facts, and their analysis. So it is the wrong metric.

Chairman SMITH. Okay. Thank you, Mr. Rohrabacher.

This might be a good time for me, without objection, to put into the record an article from the Wall Street Journal three days ago, May 26. The headline is "The Myth of the Climate Change 97 Percent." So without objection, that will be made a part of the record.

[The information appears in Appendix II]

Chairman SMITH. The gentlewoman from Oregon, Ms. Bonamici, is recognized for her questions.

Ms. BONAMICI. Thank you very much, Mr. Chairman. Thank you to all the witnesses.

Dr. Oppenheimer, in written testimony Dr. Pielke asserts that the climate models used by the IPCC for projecting future societal and environmental impacts from climate change may not be reliable and that by not accurately reporting the limitations of the climate models, the IPCC is giving policymakers a false sense of certainty about the climate future. It is my understanding that the climate models have improved since the previous assessment, so will you address how important our model projection is to our understanding of the climate issue and can you also discuss the current state of climate modeling? And I do have another couple of questions as well.

Dr. OPPENHEIMER. Well, first of all, there are endless, and I mean endless and painful discussions in the underlying chapters about the uncertainties, which are mentioned in the Summary for Policymakers. Everybody is aware that projecting the future is a fraught activity, that it can be—we can be highly inaccurate, but we have tools and we use them as best we can.

The fact of the matter is, though, that if you took the climate models and threw them away and never referred to them, there would be adequate evidence that Earth is changing, that the climate is warming, that much of that change is due to human activity, and that in the past such changes have wrought very substantial impacts which would be quite threatening to society if they were left unabated. That evidence comes from not only observations of climate change and change to ecosystems that those climate changes are causing but also a very deep understanding of what are called paleo climates, climates of 1,000, 10,000, 1 million years ago.

Even without the evidence from models, we know that over time large warming has been generally associated with changes in carbon dioxide levels in the atmosphere. Those in the past were natural changes. The current changes are by and large faster and the

carbon dioxide levels have already reached a level which is above any for many million years.

Ms. BONAMICI. And thank you. And I do want to also ask, you mentioned something about——

Dr. BOTKIN. Can I break in and make a comment?

Ms. BONAMICI. I need to finish with my time, Dr. Botkin——

Dr. BOTKIN. Okay. But I do——

Ms. BONAMICI. —I have got another question——

Dr. BOTKIN. —want to disagree because I——

Ms. BONAMICI. Well, somebody else can ask you. I wanted to ask Dr. Oppenheimer again.

As I understand that the IPCC has fairly robust guidelines on how authors are to treat uncertainty as part of the assessment. So oftentimes in this committee and in Congress we talk about uncertainty and it is used sometimes as a tool to discredit in the field of climate science as a whole as if any scientific theory that is less than 100 percent certain should be discredited. So what role does uncertainty play? How should it be considered in decision-making and considering the current climate conditions and the impacts of global climate change and ocean acidification that I know many of my constituents are already beginning to experience? Can you talk about the potential risks of inaction if we were to wait for 100 percent consensus or certainty on climate change?

Dr. OPPENHEIMER. Well, on the last point we know that the lifetime of carbon dioxide in the atmosphere, unless some genius invents a way to cost-effectively remove it from the atmosphere, is very long, ranging from hundreds of years to even longer, and about 20 percent of the carbon dioxide that is in the atmosphere today due to human activity will still be there 1,000 years from now warming the climate. So there is an irreversibility in the system. Actions or lack thereof today make a commitment to what the climate will look like 10, 50, 100, 1,000 years from now.

Ms. BONAMICI. And, Dr. Oppenheimer, you suggest in your testimony that there is a way to improve transparency of the IPCC process and that is to publish a record of significant divergent viewpoints. Dr. Tol testified about outside challengers and that their advice is ignored. That is interesting because if there is an outside challenger, there—just because their view is not accepted does not mean they were ignored. They are considered and maybe not agreed with. But can you talk about your rationale for this suggestion to improve the transparency by publishing that record of divergent viewpoints and how would that contribute to the assessment as a whole?

Dr. OPPENHEIMER. Yes. It would be healthy for everyone if everyone could measure who was saying what and what their view was and how it diverged from what was reported as the main view or the consensus and people could make their own judgments. You as our leaders could make your own judgments about who to listen to and whose view made sense and why and why not. Right now it is too much—there is too much going on behind the curtain and I would like to lift that curtain and make it more public.

I want make one comment on the irreversibility question. Dr. Botkin says nothing is effectively irreversible. Well, if you lose most of the ice from the West Antarctic ice sheet and it raises sea

level, that is irreversible on a timescale of 10,000 years. That is irreversible enough for me.

Ms. BONAMICI. Thank you. And——

Dr. BOTKIN. That is not actually irreversible.

Ms. BONAMICI. And I only have five minutes and my time is expired. I yield back, Mr. Chairman.

Mr. SCHWEIKERT. [Presiding] Thank you.

Representative Neugebauer.

Mr. NEUGEBAUER. Thank you, Mr. Chairman. And thank you for holding this hearing.

Dr. Pielke, several years ago I had an opportunity with some other Science Committee members to go to the South Pole and obviously, as many of you know, they are doing a lot of research on climate change in that laboratory down there, but one of the scientists that was sitting there showed me a very long graph of the temperatures dating back thousands of years and forecasting thousands of years. So that was my kind of first introduction to the models. And so I asked him, well, how long have we been recording data? And so this very long graph, and actually, on that graph if you looked at the time frame where we were actually recording have data, it was a very small part of that. And so his whole premise was based on these models. And in your testimony, it includes an image of 120 I think model runs, including those used by the IPCC and White House climate change for global temperature from 1975 to 2025. For the period of, say, 2000 to present, how many of these models have been in the ballpark as projected to the actual?

Dr. PIELKE. Well, it is a really good question. In terms of the global average, very few of them, but that is actually not even the complete question. The question is how well can they do on the major weather events? And in my written testimony I document a series of papers, one of them by the one of the authors of the National Climate Assessment that says these models can't be used for precipitation. They are not that good. So the reality of it is it is worse than that. Even if they could replicate the global average in the last 14 years or so, which they haven't been able to do very well, they have not been able to predict the major weather features that affect drought and floods.

And I think Michael's point was actually a good one. We don't need the models probably for that. The models I think are misleading us and I think we need to recognize that. They also may be misleading us in terms of attribution so it is a tougher problem, but we do have some information. We know that CO_2 is increasing. We know that land use is changing. We know we are putting more nitrogen on the Earth's surface. We know it is a very wide range of issues we face and I think that is how we should approach the problem is a broader perspective, and the models unfortunately, which were very heavily relied on by both the IPCC and the National Climate Assessment, I think are misleading everyone in terms of the confidence we have of what is going to happen in the future.

Mr. NEUGEBAUER. So I don't want to put words in your mouth, but the models are being used I think to drive a lot of policy. Would you agree?

Dr. PIELKE. I 100 percent agree with that, yes.

Mr. NEUGEBAUER. And so if the models aren't correct and as you say and Dr. Oppenheimer said, that possibly the models are irrelevant, then should we start disregarding that? And what is a better metric for climate policy to be made on if not the models?

Dr. PIELKE. Well I—first of all, in terms of what I would recommended is that we try to develop our society so it is more resilient to weather events that occurred in the past with today's infrastructure or maybe worst case scenarios events or maybe paleo record events. Try to make our society more vulnerable—more resilient to them so we are not as vulnerable. That way we can protect ourselves regardless to the extent we are altering the climate in the future. To me that is a much more inclusive approach. It should be bipartisan and everyone would benefit from that. But instead, we are relying on these models to say this is what it will be 20, 30, 40 years from now making policy based on that when the models clearly are not working.

Dr. BOTKIN. Could I add a point here?

Mr. NEUGEBAUER. Sure.

Dr. BOTKIN. Since my field is ecology, ecosystems and species, where we learn a lot is from the paleo record, the reconstructions of climate and the history of extinctions and persistence of species, and that is where I believe the key is if we are going to look on effects. Dr. Oppenheimer said it was clear that there were damaging ecosystem effects, but there are changes, just as there have been changes in the past.

And as I mentioned before, we look carefully and in the last 2–1/2 million years, in spite of widespread climate changes of many kinds, very few species went extinct, so it is that kind of information we need to use.

Mr. NEUGEBAUER. I think just one last question for the whole panel. One of the conversations in the past, speaking of the past, has the climate on Earth been warmer and colder or has it always been one trend? Have there been periods where it has been colder, then warmer, then colder again?

Dr. OPPENHEIMER. It has been colder, it has been warmer. What is distinct this time is that there is an extended warming which threatens, if we keep the emissions up, to go on indefinitely at a rate which is unprecedented over an extended period, and certainly in the history of civilization. The climate has been very stable over the last 10,000 years or so. We threaten to bring that period to an end through our emissions of the greenhouse gases.

Dr. BOTKIN. That is not correct. There has been a little Ice Age, there has been the warming.

Mr. SCHWEIKERT. Forgive me. For everyone on the panel and everyone here, because this is a back-and-forth, I will beg of you that when we have things we want to share, have the Members reach out to you.

Dr. BOTKIN. Okay.

Mr. SCHWEIKERT. Mr. Neugebauer, anything else?

Mr. NEUGEBAUER. My time is expired.

Mr. SCHWEIKERT. It is. Thank you, Mr. Neugebauer.

Mr. Swalwell.

Mr. SWALWELL. Thank you, Chairman.

And, Dr. Tol, you served as a convening lead author in Working Group 2. Is that right?

Dr. TOL. Correct.

Mr. SWALWELL. Who nominated you to that?

Dr. TOL. The Irish Government.

Mr. SWALWELL. And you noted that it is often the case that environmental agencies do the nominating but in your case it was not an environmental agency, is that right?

Dr. TOL. It was the Environmental Protection Agency of Ireland.

Mr. SWALWELL. But it was ultimately the government's appointment?

Dr. TOL. Yes.

Mr. SWALWELL. And it is correct that there were 308 total convening authors in Working Group 2, is that right?

Dr. TOL. 308 authors, yes.

Mr. SWALWELL. You were one of the 308?

Dr. TOL. Correct.

Mr. SWALWELL. How many scientists in the world at the time that you were appointed to that working group were working in this area of science? Can you estimate?

Dr. TOL. Tens of thousands.

Mr. SWALWELL. Tens of thousands. So you were in a working group, one of 308, in an area with tens of thousands of scientists?

Dr. TOL. Yes.

Mr. SWALWELL. And it is your position that competent people have been excluded because their views do not reflect the views of government from the working group?

Dr. TOL. That is correct.

Mr. SWALWELL. Yet you have views that are different from the working group, right?

Dr. TOL. Correct.

Mr. SWALWELL. And Dr. Oppenheimer pointed out that many times you are a loud voice against the views of the majority, is that right?

Dr. TOL. That is also correct.

Mr. SWALWELL. Yet you were still included in the working group?

Dr. TOL. Yes. I would argue that I am an exception. Yes.

Mr. SWALWELL. Okay. And you describe in your testimony mishaps in the process? Yes?

Dr. TOL. Yes.

Mr. SWALWELL. And you stated that you are worried about groupthink, is that right?

Dr. TOL. Correct.

Mr. SWALWELL. And you also said that there should be protections against groupthink, is that right?

Dr. TOL. Correct.

Mr. SWALWELL. So you had a lot of concerns about IPCC, safe to say?

Dr. TOL. Yes. Yes.

Mr. SWALWELL. And you were one of the few scientists in the whole world, one of 308, who had the privilege and honor of being at the table as these decisions were being made. That is safe to say, right?

Dr. TOL. Yes.

Mr. SWALWELL. But instead of fighting within the IPCC to be a force for reform and fight against groupthink and be a force for the minority views, you chose to quit the working group, is that right?

Dr. TOL. No. I am still a convening lead author of chapter 10 of Working Group 2. I quit the drafting team of the Summary for Policymakers.

Mr. SWALWELL. Okay. So you used in your words "step down" from the summary of policymakers team for Working Group 2?

Dr. TOL. Yes.

Mr. SWALWELL. Were there any other scientists in Working Group 2 that quit?

Dr. TOL. I don't think so.

Mr. SWALWELL. You were the only one?

Dr. TOL. Yes.

Mr. SWALWELL. You would agree, Dr. Tol, with the following statement: "Climate change is occurring and most likely caused by humans"?

Dr. TOL. Correct.

Mr. SWALWELL. And in fact you wrote in June 2013, "It is well known that most papers and most authors in the climate literature support the hypothesis that anthropogenic climate change, that most papers and most authors in the climate literature support the hypothesis of anthropogenic climate change. It does not matter, it does not matter whether the exact number is 90 percent or 99.9 percent." Is that right?

Dr. TOL. I can't recall that exact quote by would agree with that statement, yeah.

Mr. SWALWELL. Okay. Thank you, Dr. Tol.

And, Dr. Pielke, you stated that it would make no difference if we reduced our carbon emissions by 50 percent, is that correct? You told——

Dr. PIELKE. No, I didn't say it would take no difference. It just makes more difference if you reduce it 50 percent than if you reduce a 25 percent. No.

Mr. SWALWELL. Do you think we should double our carbon emissions? Would that make any difference?

Dr. PIELKE. You would have an effect. You would have more reinforcing if you increase in CO_2. I mean it is—if you use the models. The models are the tools that you use to assess that and they would say if you put more CO_2 in there, you get more positive reinforcing. You take it out, you get less reinforcing. I think the problem is that you are confusing—when we talk about anthropogenic climate forcing, people think fossil fuels. Fossil fuels is one of them. There is a whole range of them. There was an Academy report back in 2005 that talked about broadening out this perspective. We have to look at these other things. There is a black carbon, there is land use change, there is other aerosol effects. It is a more complicated problem, and I think one of the problems of the National Climate Assessment is they focused on fossil fuels. So that is what you are asking the question about but really our impact on the environment is much broader than that.

Mr. SWALWELL. Would we be healthier and better off if we doubled our carbon emissions or reduced them by 50 percent?

Dr. PIELKE. If we are healthier or not? I don't know about that question, but in terms of how our climate impact is, you double the CO_2, you have more of a climate impact that you have half. But healthy is not the right question because CO_2 is not a pollutant like a traditional pollutant.

Mr. SWALWELL. Would you prefer to live in a world that doubled its carbon emissions or one that cut them in half?

Dr. PIELKE. Everything else being equal, it—that is an interesting question actually.

Mr. SWALWELL. That is why we brought you here.

Dr. PIELKE. Well, that is an interesting question but, no, I was coming here to talk about the science and some of the science issues. That is a question—that is a broad-range question about what is the benefits and costs of doubling or decreasing CO_2. Obviously, if we have less emissions into the atmosphere, it is a positive thing. That includes aerosols, that includes nitrogen oxide, sulfur dioxide, et cetera. All of that is beneficial. If we don't put anything in the atmosphere, if we don't put anything in the ocean, but the reality of it is we have to try to optimize that. And by—I think we need a broad-based approach to this problem and not focusing on just one issue, which is what the question you are asking is.

Mr. SWALWELL. Thank you, Dr. Pielke. Thank you, Dr. Tol.

Mr. SCHWEIKERT. Thank you, Mr. Swalwell.

Mr. SWALWELL. I yield back the balance of my time.

Mr. SCHWEIKERT. Representative Brooks.

Mr. BROOKS. Thank you, Mr. Chairman. My questions are for Drs. Botkin and Pielke.

Testimony includes an image of 102 model runs done by John Christy of the University of Alabama in Huntsville, which is where I reside, in Huntsville, including those used by the IPCC and the White House Climate Assessment for Global Temperature from 1975 to 2025. For the period 2000 to the present, how many of these models have accurately projected actual observed temperatures?

Dr. BOTKIN. Well, that graph was to some of them but I also have been in contact with John Christy and he sent me other graphs that show in particular how the American—U.S.-based models have done and they haven't done any better. I can't speak to all of them. Actually, it is 102 model runs and about 34 models. But even the U.S. models don't do well at all. They don't even come close.

Dr. PIELKE. You know, on the figure have in my written testimony that John Christy graciously provided me, you can see the couple of models are close to what has been observed in the last 20 years, 15, 20 years, but by far the vast majority have overstated the warming.

Mr. BROOKS. Well, why does it matter that these climate models have failed so frequently?

Dr. PIELKE. Well, it is one of the tests of the model. I mean if you are going to use these models to try to predict what will happen in the next several decades, you want to have some confidence that they are robust tools. And I think the models have failed to show that. In fact, I think they have been a cause for a lot of debate and discussion.

And I think what Michael was saying we don't probably need the models because the models are misleading us. They are talking about a future that may not occur. It certainly hasn't shown that the models are able to replicate what has happening the last several decades, and so you wouldn't believe a weather prediction model that was forecasted for tomorrow or the next day if it kept failing all the time. I think that is what we have with these climate models. They are not ready for primetime.

Models are very useful. They understand processes. They can help assimilate data. But as forecasting tools decades into the future, they are not ready.

Mr. BROOKS. Dr. Botkin, do you have anything to add?

Dr. BOTKIN. Yes. And, first of all, the models are well known not to be very well validated for—at any level, and there is work such as by J. Scott Armstrong who is an expert on model validation mainly for businesses and he says that these climate models meet hardly any of the criteria for legitimate validation. And so you can—you have to question the validity of the model.

And I say this having worked on some of the models. I had a graduate student that added vegetation to one of the climate models as his Ph.D. thesis, so I think that the models, since they are so much failing to come close and haven't been well validated, they are not a good guide now.

Mr. BROOKS. Well, we have used this 97 percent of scientists agree kind of number. Is it fair to say that close to 100 percent of scientists agree that our models are failures?

Dr. PIELKE. No. A lot of people—obviously they don't believe they are failures because they base the IPCC and the——

Mr. BROOKS. Well——

Dr. PIELKE. —National Climate Assessment on it.

Mr. BROOKS. —let me be more specific. That for the time frame from 2000 to 2014 that they have failed?

Dr. PIELKE. I would think someone would still disagree. They have been trying to explain how they can—why they are not agreeing, why there is less warming. They say now the warming has gone deeper into the ocean, for example, which obviously raises the question if it has gone deeper in the ocean, why didn't they predict that? But I would think there are people that are still arguing the models are robust.

Mr. BROOKS. Well, I am looking at the graphs. Is this graph accurate?

Dr. PIELKE. Yes, the graph is accurate.

Mr. BROOKS. Well, the graph shows that the models don't correspond with actual temperatures, so how can people contend that the models are good if they are way off base with the temperatures with the exception of perhaps one or two out of all the models being run?

Dr. PIELKE. That is an excellent question, but I think it is even broader than that because, as I did in my—as I showed in my written testimony, there are a range of peer-reviewed papers that have shown when these models have run in the last several decades, they can't predict regional statistics well at all. They can't predict changes in regional climate statistics, and therefore, there is a

whole range of reasons they shouldn't be accepted. But the problem is this issue is not being discussed. It wasn't discussed in the IPCC.

Mr. BROOKS. Let me conclude with this question. Former Vice President Al Gore recently gave an interview to Politico in which he stated that "extreme weather events" are 100 times more common today than they were 30 years ago due to global warming. He also stated that these events are "getting more frequent, more common, bigger, more destructive." Do you agree with this statement and is a consistent with the state of the science? Dr. Botkin first and then Dr. Pielke.

Dr. BOTKIN. There is very good data—and Dr. Pielke and his son can provide them—that show that the average rate of tornadoes, hurricanes, droughts are within the range of what has happened in the past. It is not extreme. And I would add that as a now resident of Florida, there hasn't been a major hurricane hit the mainland of Florida for nine years, so somehow at least us in Florida are managing our climate.

Mr. BROOKS. Dr. Pielke.

Dr. PIELKE. I would refer you to my son's testimony last summer to the Senate. I mean it is in area he is an expert in and he has commented quite a bit about this subject.

Dr. BOTKIN. There was also another analysis that showed that if you looked over the Antarctic ice core data and then compared it to the recent changes, that the recent changes in climate are not outside the ranges of past climate. There is a published paper that shows that.

Mr. SCHWEIKERT. All right. Mr. Brooks.

Mr. BROOKS. Thank you, Mr. Chairman.

Mr. SCHWEIKERT. Thank you, Mr. Brooks.

Mr. Kennedy.

Mr. KENNEDY. Thank you, Mr. Chairman.

Dr. Tol, I think you have been clear about this but I just want to make sure that I have understood. You would agree with the statement that climate change is caused—or at least partially caused by greenhouse gases and that—I think you said earlier, most scientists agree that climate change is real. Is that true?

Dr. TOL. That is true.

Mr. KENNEDY. Okay. Dr. Oppenheimer, you believe that climate is changing. I think that is a safe assumption based on your testimony earlier?

Dr. OPPENHEIMER. Yes.

Mr. KENNEDY. Okay. The majority posted a chart earlier in this hearing that showed by some models anyway—and we will get to the reliability of those models in a second—but the end of—by the end of the century they predicted I believe it was a three degree centigrade change in global temperature. Can you color that a little bit for me? What does a three degree centigrade change in global climate temperature mean, Dr. Oppenheimer?

Dr. OPPENHEIMER. Well, just to give you an example, already with less than a one degree—and we are talking degrees Celsius here so you double it roughly for Fahrenheit, with a change somewhat less than one degree Celsius, the number of extremely hot days—and by the way, in response to the last set of questions, one extreme that we are sure about that has increased are very hot

days. Those have definitely increased. We have a lot of confidence in that.

The number of such extremes—for instance, in a city like Washington where a 90 degree day might be the hottest ten percent of days, such days have already become more frequent on the global average. The historical ten percent hottest days now represent 18 percent of days, and so we are moving to a hotter and hotter climate where we have more and more extremes of high temperature. The sea level has been rising. The sea level has been rising primarily because water expands when you heat it and because ice is melting——

Mr. KENNEDY. So three degrees centigrade change in global temperature, any rough prediction as to what that means for sea level rise?

Dr. OPPENHEIMER. Yes. It means a sea level rise which IPCC reckons will be something between almost a foot and three feet higher than today. And just to give you a rule of thumb, on an East Coast beach one foot of vertical sea level rise takes away in erosion and submergence typically 100 times as much land. One foot up this way, 100 feet inland go away unless you spend a heck of a lot of money defending the beaches.

Mr. KENNEDY. Thank you, Doctor.

And, Dr. Botkin, your testimony—written testimony you say that—I think your point one is that we are living through a warming trend but it is driven by a variety of influences. In part three you say, "Has the temperature been warming? Yes, we have been living through a warming trend, no doubt about that." And part five you say, "Are greenhouse gases increasing? Yes, CO_2 rapidly." You go on to say in part three change is normal on life. Or "Change is normal. Life on Earth is inherently risky and always has been."

Doctor, do you look both ways before you cross the street?

Dr. BOTKIN. What is the relevance of that question?

Mr. KENNEDY. Do you wear a seatbelt when you get in the car?

Dr. BOTKIN. Of course I do.

Mr. KENNEDY. So do you think it makes sense to mitigate against some of these changes that you indicate are—in your own testimony are taking place?

Dr. BOTKIN. I think that we——

Mr. KENNEDY. Yes or no, Doctor.

Dr. BOTKIN. Yes or no?

Mr. KENNEDY. Yeah, yes or no.

Dr. BOTKIN. Okay. Restate the question.

Mr. KENNEDY. Do you think—if you look both—if life is inherently risky, yet during the course of your daily activities you take steps to mitigate those risks, why would something that could be as catastrophic as climate change could be, why would we not take mitigating steps?

Dr. BOTKIN. That is not a yes-or-no answer. There is no yes or no to that.

Mr. KENNEDY. Well, would you suggest that we take mitigating steps or not?

Dr. BOTKIN. I—if we——

Mr. KENNEDY. That is a yes or no.

Dr. BOTKIN. We should do adjustments——

Mr. KENNEDY. So yes.

Dr. BOTKIN. —mitigate. It is very unlikely to work. So reducing carbon dioxide is unlikely to actually take place well within——

Mr. KENNEDY. I didn't ask that. So what other mitigating steps, short of—if you are saying CO_2 reduction, isn't going to mitigate climate change, what other mitigating steps would you suggest?

Dr. BOTKIN. I suggest that we deal with the situation by reducing the—going back to the major issues that face us. There are nine major environmental issues that affect us all the time and are much more damaging and much riskier to us than climate change, and I would be happy to give you those. And we need to focus on those.

Mr. KENNEDY. Okay.

Dr. BOTKIN. And if we focus on those, they are either neutral or beneficial to the global warming——

Mr. KENNEDY. Okay. So in your opinion, Doctor, climate change is not one of the top nine greatest environmental changes—challenges we face?

Dr. BOTKIN. I have been working on climate change since 1968 and I think it is one of the problems we need to deal with but we have to put it in its proper priority with those other nine.

Mr. KENNEDY. Sir, I have got——

Dr. BOTKIN. I am not saying that——

Mr. KENNEDY. —eight seconds left so let me ask——

Dr. BOTKIN. —we should ignore it.

Mr. KENNEDY. —one question for Dr. Pielke.

Sir, you have said that humanity has had a significant effect on climate. You have talked a little bit about whether—the faith that we put in these models and the models but I think you said are—also aren't working and I think there is some question as to how reliable and how accurate these models are concededly. You mentioned in your written testimony that—some of the National Weather Service funding and the models that have been created by that, have had enormous social value. Do you think those—investment in those types of models is a good thing?

Dr. PIELKE. Yes, I do and I think investment and predictability of climate models is also an excellent investment. That is different than providing——

Mr. KENNEDY. Understood. Understood. So how would you categorize the decision to cut NOAA climate funding by 24 percent, which is what the appropriations bill that we will be voting on this afternoon would do?

Dr. PIELKE. I think there is an issue—what you are calling climate change and there is climate. Climate——

Mr. KENNEDY. I am just saying the study, it is about funding for——

Dr. PIELKE. Well, I can't—obviously can't answer that question unless I know exactly where the funding is going to. But if it is funding predictive models for decades in the future, I don't think that is a good use of funds.

Mr. KENNEDY. Thank you.

Dr. BOTKIN. Could I comment a little more about your question?

Mr. SCHWEIKERT. Mr. Botkin, actually I have to move on, too.

Mr. Cramer.

Mr. CRAMER. Well, I might give Dr. Botkin a chance actually to answer it because, Dr. Botkin, what I would ask you as a follow-up to Representative Kennedy's question is if wearing your seatbelt increased your likelihood of surviving the crash by 0.08 percent but you were likely to lose your job as a result of it, would that be a good mitigation?

Dr. BOTKIN. No. Apparently not. But I always wear a seatbelt so——

Mr. CRAMER. Because the percentages are much better than that.

Dr. BOTKIN. Yes. Yes. But, look, I have written a lot about risk in life and how you deal with it. I have developed a computer model of forest that has risks. But think about—of course you want to deal with risk but think about how an impala in Africa deals with risks. These animals often know when a lion is hunting them and then they will move away, but once a kill has been made, then you will see the grazers grazing near the lion because it is no longer a threat.

So there is a book that says that is why they don't—part of the reason they don't get ulcers. You have to know when to respond to risk and what are real risks and how to deal with them. I have written a lot about them so it is not appropriate to say just because risk is real means I need to—that you ignore it. No. You say risk is reality. Now, where are the risks that we must reduce? Where are risks unacceptable for our human lives? And for example, right now, there is huge habitat destruction. There is invasive species that are threatening the entire citrus crop in Florida. That is a major risk that we need to deal with now. Our fisheries are in big trouble. There are major risks with them. We want to reduce those risks. So you have to know about risks, understand how to analyze it, use the mathematics, the statistics processes. You are very alert to risk. Just to say there is risk doesn't mean you ignore risk——

Mr. CRAMER. Yeah, we often don't do a cost-benefit analysis and we frankly create more risks by mitigating the risks that we think we are avoiding.

I want to get to the issue a little more of peer review and peer pressure if you will. And, Dr. Pielke, you referenced your son's testimony in the United States Senate. Of course the President's Science Advisor Dr. Holden has been critical of I think your son's testimony and in fact has stated, I don't think in the context of your son's testimony, but stated that anybody who disagrees with their premise makes themselves out to be "silly." Perhaps you could just elaborate a little bit on how—what kind of signal does that send from the top of our leadership to the scientific community that if you disagree with me you are somehow silly?

Dr. PIELKE. Well, it is not healthy for the scientific process and it is probably not—certainly not healthy for the political process. But I have had my own experiences. I was asked to be on the American Geophysical Union Committee on Climate Change and we put together a statement I could not agree with. It was very—I think sort of like a National Climate Assessment type statement. And I wrote a minority statement on that and I put it as an appendix in my testimony, but it wasn't reported in the Journal of the American Geophysical Union. They wouldn't publish that particular statement. And so I think there has been a chilling effect

on presenting alternative perspectives, and actually I was a sort of intrigued that Michael was talking about maybe the need for another team. Maybe there should be a red team that try to come up with other perspectives challenging these reports and maybe together we could create a better consensus than what is available now. Because now if you stand up and you make a view that is different, you get either ignored or you get dismissed.

Mr. CRAMER. Well, Dr. Pielke, you make a great point. And I was very encouraged by Dr. Oppenheimer's statement about transparency because that is what this hearing is all about. And one of the things I have found in this place is that the lack of transparency creates way more mistrust than honest discussion of even—in fact, one of the things I think I rather am proud of is that I like to hear the opposing view, and if I talk to four advisors and they all agree with me, I try to find a fifth one, otherwise I just don't think you have the type of robust and honest discussion that you need to get the consensus.

And, Dr. Tol, I would be interested in your opinion as well on what happens to people who disagree, especially in the academic world. I mean how does this peer pressure play itself out if we don't have greater transparency, more robust opposing discussion?

Dr. TOL. For people who disagree on climate or on climate policy are sorted disinvited or not invited or ignored. Their papers can get into trouble, their funding can get into trouble, they can be smeared in the media, and so on and so forth. And it even goes as far as that they are personally threatened or their family is threatened. And I think it is very unfortunate and very unhealthy.

Mr. CRAMER. I agree. Thank you. Thank you all.

Thank you, Mr. Chairman.

Chairman SMITH. Thank you, Mr. Cramer.

And the gentleman from Texas, Mr. Veasey, is recognized for questions.

Mr. BERA. Marc, can I take it?

Chairman SMITH. Of course. I assume the gentleman from Texas will defer to the gentleman from California, Dr. Bera. And so Dr. Bera is recognized for his questions.

Mr. BERA. First, I want to thank my colleague from Texas for that.

My thought process here—this is a fascinating hearing. We agree that the climate is changing and I think all of our colleagues agree that the climate is changing and all of our witnesses certainly have agreed to that as well. Now, what is causing that change we can debate. You know, is it cyclical, is it natural, is it human? For the record, I do think humans have impacted climate change and our behaviors impact on our accelerating climate change.

Dr. Tol, you touched on the danger of groupthink. And I come out of academia. I am a biological scientist before going to medical school and getting my M.D. And there is a danger for groupthink. Groupthink, hundreds of years ago, said the Earth was flat. So part of advancing science, part of academia is challenging groupthink, is inviting all views in a nonjudgmental way. The scientific method requires that we explore and engage in this debate.

There is consensus as well. I am from California and we are going through an incredibly bad drought here this year. We have

very wet years as well in my region and flood so we know we have to—you know, when we talk about risk and mitigating risk, we have to assess risk, we have to look at how we can mitigate that risk, how we can do the things that are within our control to better manage that risk and there is no model of predictability that is 100 percent but, we sit there and say, okay, well it looks like it is going to be a dry year next year. Let's try to manage that risk and mitigate that risk. It may be a wet year. But we do our best with the data that is available and we invite that conversation.

So I think this is incredibly important. We all agree the climate is changing. The objective data says the globe is getting warmer. You know, we are having weather extremes. Dr. Botkin talked about impacts on agriculture, such as the impacts on our fisheries. So let's just acknowledge these risks and let's have an adult conversation about how we can mitigate and what we can do.

Now, my question. Dr. Oppenheimer, you touched on a real issue that does concern me. You know, we already have quite a significant amount of CO_2 trapped in our atmosphere and we have had our Secretary of Energy in here and you also commented on how long it will take to degrade that, hundreds of years to degrade the CO_2 that is already trapped in our atmosphere. From your perspective within the IPCC and within the scientific community, that to me there is an urgency in advancing the science of how we might go about degrading these masses of carbon. And, yeah, I pass that over to you.

Dr. OPPENHEIMER. Yeah. I mean what I am concerned about—and Mr. Kennedy asked me about this—is what does the world look like if you just let this keep going on and you get past 3 degrees? And the things I would worry about the most are food supply particularly in poor or low latitude countries, but also if you just let it go on indefinitely, global food supply; secondly, extreme heat, as I mentioned before; third, particularly in the context of all the other problems that humans are causing for species and ecosystems, the pressure of a rapid warming on species and ecosystems. Some are already very sensitive like coral reefs and the Arctic systems are already under threat and that involves just also the people that depend on them, not just the other species; and fourth, what is going to go on along the coast where we know how vulnerable our coast is.

So that is the picture of the world when you get 3 degrees and beyond that I am worried about. And if you look at the scenarios about how you would avoid that world, you really have to get going now with some substantial reductions in emissions.

Mr. BERA. Dr. Botkin, would you want to——

Dr. BOTKIN. Yes. Mr.—Dr. Oppenheimer has just misstated some things. You know, I do work on the Arctic and I have friends—colleagues who work there, including Craig George, who lives up in Barrow—lives up in the very north end of Alaska. And anyway——

Mr. BERA. You wouldn't disagree that the Arctic is changing, though, would you, that ice is melting, that——

Dr. BOTKIN. Well, we did a study in which we used the records from logbooks from whaling ships hunting the bowhead whales in the 19th century and compared it with late 20th century and we

found two things. We found that the end of winter sea ice extent was the same in the 19 century as by the end of the 20th century.

Mr. BERA. But it has changed over the last decade so it may have changed 200 years ago but there is change occurring.

Dr. BOTKIN. There are changes but it has happened in the past. In fact, the Northwest Passage has opened before. We know that because there is DNA from bowhead whales in Atlantic—relatives of them which couldn't have happened. So these kind of changes have happened in the past.

And as I point out, the evidence about polar bears is really negligible. So there are changes. The question is whether these changes are really damaging or not and the evidence is not strong that it is damaging.

Mr. BERA. I have gone over my time so again thank you to my colleague from Texas.

Chairman SMITH. Thank you, Dr. Bera.

And the gentleman from Arizona Mr. Schweikert is recognized for his questions.

Mr. SCHWEIKERT. Thank you, Mr. Chairman.

I wish we were just sitting around the table not drinking beer because we know what happens then, but drinking coffee, and just be able to have an extended dialogue. One of my concerns is actually an odd one for a guy that is elected to Congress is we live in a two-year cycle, politics. When you deal with other countries, their parliamentary systems, they never know when their next election may be. We are in a political environment. You are trying to do in many ways data, maybe not even policy but do data, and yet those of us in the political world, we now control so much of the money that the academic community has access to. And one of my future goals here is trying to find a way to sort of separate the implied or actual sort of influence because, let's face it, the whole discussion here and the policy outcomes from this are stunning amounts of money to be made or to be lost depending on the country, the industry, the technology, how people have invested. And every single Member of Congress here has had someone in our office saying please regulate this, please do this because this is how I invested. As my father used to say, it is about money, power, ego and I am finding often it is all about all three.

There is actually a couple externalities I want to get my head around. I will try to speak actually faster. And this is sort of open to anyone on the panel. If I walked into you and said here is my incremental amount; here is $10 billion and I want to maximize beneficial effects over the next five years, so let's do a limited time frame, would I be focusing on A-CO_2? Would I be focusing on invasive species? Would I be focusing—my fear is because of the size and scale of this issue, we may be heading towards a misallocation of resources.

Let's just start, Dr. Pielke. Talk to me a little bit about my threat levels in allocations of resources and how we do sort of risk analysis?

Dr. PIELKE. I think that is really an excellent question. That gets up to this approach that we have been proposing where it is what I call a bottom-up resource-based perspective where you try to reduce risk to your important resources. So for Arizona, for example,

it is probably going to be water would be one of your big ones. How can you improve your water infrastructure so that you are robust against periods of drought?

Mr. SCHWEIKERT. Okay.

Dr. PIELKE. To me that is the single—probably number one item I would look at.

Mr. SCHWEIKERT. Dr. Botkin.

Dr. BOTKIN. Yes. I agree. We should focus on these issues I mentioned before. Freshwater is one. We are overusing worldwide freshwater and we have to reduce that. You would be surprised to know that phosphorus for agriculture is a limited resource. There is going to be a lot of competition for that. We need to focus on that. Habitat destruction is very destructive but in many ways——

Mr. SCHWEIKERT. But where I am heading more is—conceptually is my ranking because my great fear is we spend lots of time on CO_2 and issues involved in there and something slips through the crack that becomes much more——

Dr. BOTKIN. I would say you want to focus on these. I would start right now on invasive species. I think that the climate issue should be put—reduced and its priorities in favor these kind of issues.

Mr. SCHWEIKERT. Dr. Oppenheimer, if you were looking at limited resources in your prioritization—I am not saying you walk away from one—what would you be right now?

Dr. OPPENHEIMER. Within the context of the climate issue, I would balance money spent on finding ways to reduce emissions quickly and cost-effectively——

Mr. SCHWEIKERT. But even outside climate.

Dr. OPPENHEIMER. There are so many things——

Mr. SCHWEIKERT. And if I gave you a five year window because, let's face it, we live in two year windows so five years is forever for us. And I said here is my resources, go do something great, what would you do?

Dr. OPPENHEIMER. Climate would be a part of the picture; it wouldn't be the whole picture. And in dealing with climate I would deal with both reducing CO_2 and protecting people from climate extremes that are already happening——

Mr. SCHWEIKERT. But there would be a variety of things on your list?

Dr. OPPENHEIMER. Of course.

Mr. SCHWEIKERT. Dr. Tol.

Dr. TOL. For a five-year timescale and for a global perspective I would go for Golden Rice.

Mr. SCHWEIKERT. Okay. High-yield——

Dr. TOL. Yes, high yields in vitamin A because that would save most lives in this timescale. It would also reduce vulnerability to climate change. My second priority if it were a 15-year timescale would be a malaria vaccine which also would reduce the vulnerability to climate change but would do much good in itself.

When you are talking about 50- or 100-year time frame, then climate change would come into the picture.

Mr. SCHWEIKERT. Okay. It is—actually amazed you said the rice because that has actually been one of my interests.

Dr. Oppenheimer, just a quick reference, noise in the data, I have a great interest in sampling. One of the noises we were looking at years ago was we see urban high temperatures——

Dr. OPPENHEIMER. Um-hum.

Mr. SCHWEIKERT. —going up but when we actually looked at where the samples were being taken, we were seeing concrete islands, heat sink islands, regeneration islands and trying to find a methodology to adjust for that meaning that we actually had a lot of noise in urban temperature data.

Dr. OPPENHEIMER. That——

Mr. SCHWEIKERT. When you work on the committee, are you constantly looking for where there are these externalities that are creating noise in your data?

Dr. OPPENHEIMER. Yes. They are constantly looked at. And that particular one, which was interesting a couple of decades ago, has been resolved. There is an urban heat island effect.

Mr. SCHWEIKERT. Um-hum.

Dr. OPPENHEIMER. However, its effect on the global temperature trend of about .9 degrees Celsius over the last 100 years has only been less than .1 degree at the North Pole.

Mr. SCHWEIKERT. Yeah, but in recent sample sets they are still using the current temperature from those urban areas instead of doing——

Dr. OPPENHEIMER. No, there are different ways it is done and they removed those to the extent they affected data significantly.

Mr. SCHWEIKERT. I would love to look at that because I can show you some of the data sets where it wasn't adjusted 4.

Dr. OPPENHEIMER. I would be happy to——

Mr. SCHWEIKERT. I yield back, Mr. Chairman.

Chairman SMITH. Thank you, Mr. Schweikert.

The gentleman from Texas, Mr. Veasey, is recognized for his questions.

Mr. VEASEY. Mr. Chairman, I have an article from the Wall Street Journal. It is a MarketWatch I would like to submit for the record. The article expresses concern and frustration with an amendment passed last week by my Republican colleagues as part of the National Defense Authorization Act which restricts the Pentagon's use of climate science studies, including the IPCC which we are discussing today, as part of its strategic military planning. The article in the Journal states that "GOP science deniers have 'crossed the line,' they are now messing with national security. America is now under attack from an enemy within, irrational science denialism, a toxic mindset, a spreading self-destructive mental virus. Yes, this is 'War on America'." The military has been using this for—this science—this climate science research for decades now and the research studies show that they are an essential part of our national defense. And, Mr. Chairman, because of that, I would like to move to include this article as part of the record.

Chairman SMITH. Without objection, that article will be made a part of the record.

[The information appears in Appendix II]

Mr. VEASEY. And I have a question for Dr. Botkin—excuse me if I pronounced the name wrong—Dr. Pielke and Dr. Tol. You all cite John Christy as an example of someone whose model should be

considered in the IPCC process. Christy famously used tropospheric temperature records from satellite data to show little evidence of warming. Those results were challenged by two peers resulting in Dr. Christy acknowledging very serious errors in his data and correcting these results, which meant that his models then showed warming. Somehow, since this acknowledgment in Science magazine, Dr. Christy has returned to showing no significant change in global temperature.

My question for you is which Christy models should the IPCC rely on?

Dr. BOTKIN. Could I just——

Dr. PIELKE. Well, let me mention that one. I worked closely with John Christy. I was there when that error was discovered. It was not a major error. He corrected it and everything since then has moved forward. In fact, he actually has a slightly more warming than the RSS data, which is another group that analyzes tropospheric data. These are not models. He is working with satellite data so it is not a model. His model comparisons are taking the models that are available to anyone from the IPCC.

So John Christy's work is accepted as being robust by the entire scientific community. I am not aware of anyone that is critical of what he has shown. The—there is other evidence also presented about the models that I presented in my written testimony that shows there are problems with the models.

Mr. VEASEY. So which models do you think he should be using, the ones that he retracted, the ones that are consistent——

Dr. PIELKE. No, I can——

Mr. VEASEY. —with other researchers or the ones that mysteriously are consistent with his earlier work?

Dr. PIELKE. No, I have to correct that he did not—he does not use a model in his analysis of the tropospheric temperatures; he uses satellite data. These are observational data sets. He then compares it with model results that are computed by other people. There is a whole range over in my written testimony that he provided to me that are the models that are used to create the National Climate Assessment, models that are used to create the IPCC report. So there are—that is not his model. His model is robust, always has been robust. It was a small error that he found and it has been apparently blown out of proportion.

Mr. VEASEY. Dr. Oppenheimer, would you please comment?

Dr. OPPENHEIMER. There were a couple of adjustments that Dr. Christy had to make, but I think the more important point is that if you look at the IPCC report, they actually have a lengthy discussion of the difference between what models project and what Dr. Christy's data and other people's show for the warming in what is called the mid-troposphere, which is only a small slice of the atmosphere, over the last 35 years. And there are discrepancies not just between the models and the data but between different data sources.

This is an area of uncertainty. It is an area that has been looked at extensively. It is an area where the uncertainties are not completely resolved and it can't be used to undermine the credibility of the models, particularly because the observations themselves are disparate. So this is an example of where IPCC actually has this

stuff in the background report, looked at it, assessed it, and will continue to do so over the next series of assessments.

Dr. PIELKE. And I correct Michael a little bit. The data that John Christy provided me is lower tropospheric data.

Dr. OPPENHEIMER. Fine.

Mr. VEASEY. Thank you, Mr. Chairman. I yield back.

Chairman SMITH. Thank you, Mr. Veasey.

The gentleman from Georgia, Dr. Broun, is recognized for his questions.

Mr. BROUN. Thank you, Mr. Chairman.

Gentlemen, I am a medical doctor, a physician. I would submit that that is a scientist, an applied scientist. It is not the same as a research scientist obviously but I was trained in the scientific process. And I have got some problems with some terminology that is utilized particularly by folks that are researchers, people on the other side of the aisle here, and from my scientific background this notion of settled science to me is totally unscientific on its face.

And so I would like to start with Dr. Botkin. Would you agree with my last statement?

Dr. BOTKIN. Absolutely, and I have run workshops on cancer research and have a lot of friends in medical research, and I would like to add that I think that medical research and ecological research share a lot in common and I agree with you completely, yeah.

Mr. BROUN. Dr. Pielke, would you agree with that statement?

Dr. PIELKE. The science is not settled, no.

Mr. BROUN. Dr. Oppenheimer?

Dr. OPPENHEIMER. Some things are more or less settled; some things are not.

Mr. BROUN. Well——

Dr. OPPENHEIMER. The question of whether carbon dioxide is 40 percent above preindustrial times, that is settled. The question of exactly how warm the Earth will become as a result, that is not settled.

Mr. BROUN. Well, Dr. Tol?

Dr. TOL. Science is of course never settled but, as Michael Oppenheimer says, there are thoughts that everybody basically agrees on and there are parts of science where everybody disagrees essentially. And that is what we should focus on in our research.

Mr. BROUN. Well, the point of all this is that the idea of settled science, Mr. Rohrabacher talked about "case is closed." I heard it just on the Floor yesterday from Members of the other party, they were talking about this very issue that it is absolutely settled, it is a closed case, there is no question whatsoever that we have something called anthropogenic global warming. And of course the terminology has changed from human-induced global warming to anthropogenic global warming, now to anthropogenic climate change. Climate changes all the time. Of course it is called weather.

To go back to the IPCC report, I have seen in medical science and papers that are written, there is a lot of selectivity as far as what papers are considered to be valid and what is not, what is published and what is not, what peer review is accepted and what

is not. Data and assumptions and methodology all come to play in these. Would you all——

Dr. BOTKIN. Could I comment on that?

Mr. BROUN. I will come to you and just a second, Dr. Botkin.

Would you all agree with that statement?

Dr. BOTKIN. Yes.

Mr. BROUN. Everybody agree with that statement?

Okay. Dr. Botkin, you had a comment.

Dr. BOTKIN. As I said, I have worked on this since 1968, and in—by the mid-1980s the weight of evidence, as far as I was concerned, was heavily in favor that there was a human-induced climate warming and I gave talks and television interviews and—that said that. But since the middle of the 1990s the—there is evidence that is running against that. For example, the temperature change is not tracking carbon dioxide increase very well. I refer again to Christy's information.

Then there is the information from the Arctic long-term Antarctic ice cores that suggest—and from some recent papers in the Arctic that suggest that carbon dioxide change doesn't lead temperature change. It may actually lag it significantly or may not lag it—may not lead it at all. And if that is the case, that is still an open but important scientific question. So there are several lines of evidence that are suggesting that it is a weaker case today, not a stronger case.

Mr. BROUN. Dr. Pielke.

Dr. PIELKE. The question about science being settled I think is an interesting one. We probably should find out where there is common ground where there is not. And I think in terms of what Michael and Richard were saying and Dan was saying, CO_2 is increasing. There is a human component to it. Apparently it is not as closely connected to maybe the global temperature but there is a biogeochemical effect from added CO_2. So there are concerns. The question is how does that fit and—in the other realm of concerns that we had from other human forces on the climate and other environmental issues? And that is the science issue that is not settled. But if you come up to an approach where we can come to common ground on some issues, we can move forward on others where we disagree.

And in terms of political action, maybe all the information is already out there to deal with it. We know CO_2 is increasing but it is—where does it fit in terms of the range of all the other threats and costs that we have? I think that is the issue that has to be resolved.

Mr. BROUN. And how does that fit with policymakers because science cannot determine policy.

Dr. PIELKE. I completely agree.

Mr. BROUN. Yes. We have to take science, good science, and there is a lot of junk science out there, too. We have to take good science and take that into consideration and economic models have to come into play as far as we are concerned.

And I don't think from a policy perspective, what I see overwhelmingly, the people who want to make radical changes in public policy are liberals, and those of us who want to look at things from another perspective are more conservative. Why is that so? Why is

it that the liberals all say that we have got to make these huge changes that are going to affect our economy, it is going to affect job productions, et cetera, and they use IPCC reports, et cetera, to help bolster their claim and then we have Members that try to disqualify people with dissenting views. And to me that is unscientific and I think this whole discussion about settled science and how it is all said and done, case closed, period, is totally unscientific and I just encourage IPCC and those of you all who have the ability to make policy decisions there, not just one dissenting view but other dissenting views, scientific dissenting views across the board to publish those also.

Chairman, my time is expired. Thank you.

Chairman SMITH. Thank you, Dr. Broun.

Dr. Bucshon, the gentleman from Indiana, is recognized.

Mr. BUCSHON. Thank you, first of all, for all your valuable testimony. I was a medical doctor before coming to Congress, a surgeon, so analyzing data, analyzing studies in journals is something of course that you learn to do and you begin to realize that a lot of what is published is probably not accurate. And so that is my background just so everyone knows.

Were there previous warming trends in—on the Earth predating the fossil fuel era of energy production? Dr. Botkin first and then——

Dr. BOTKIN. Yes. If you look at the Antarctic ice cores, they show times where it was warmer than today and then there—in recent times there was the medieval warming that may not have been as warm but it was a warming trend that had a big effect on people. It was the time of exploration. So there has been warming and cooling periods.

Mr. BUCSHON. Dr. Oppenheimer.

Dr. OPPENHEIMER. There have been warming and cooling periods. What is unique about this period is, number one, the rate. And——

Mr. BUCSHON. Thanks. I have already heard your opinion on that.

Dr. OPPENHEIMER. Okay. Okay.

Mr. BUCSHON. The question that I have, and anyone can answer it—start with Dr. Botkin—and it is why did the climate change then?

Dr. BOTKIN. Well——

Mr. BUCSHON. Why was the temperature of the Earth warm then predating fossil fuel use? And just so you know, I am one that does believe the temperature of the Earth is changing, as it has for centuries. I am not one—I don't—I am not one of the people that don't believe that there are trends and the temperature of the Earth may very well be increasing at this time. I think the discussion is what the impact we are having on that versus historical temperature changes.

Dr. BOTKIN. I can't answer the question about the cause of the medieval warming but you do know that there is what are called the Milankovitch cycles, which have to do with the orbit of the Earth and how the Earth spins on its access that create long-term changes, 20,000, 40,000, 100,000 years. But what caused the medieval warming I don't——

Mr. BUCSHON. Dr. Pielke first and then Dr. Oppenheimer.

Dr. PIELKE. Well, climate is always changing. Actually the word climate change is sort of an oxymoron because the climate never is—it has always varied over different time periods. But human activity does have an effect. CO_2 adds things. But we are now recognizing there is a natural effect of large-scale warming over longer terms probably related to cloud processes that are poorly understood. So the climate system has become more complicated as we learn more about it and that makes it much more difficult to predict. But we know that humans have a role and there is a natural role and we are still trying to ferret out what the relative percentage——

Mr. BUCSHON. Dr. Oppenheimer.

Dr. OPPENHEIMER. The natural climate changes occur due to the orbital changes that Dr. Botkin just noted, which happen over tens or hundreds of thousands of years. They happen volcanic dust particles reflect sunlight. But we can measure that. We know that that is not the cause of the current warming. They happen because the strength of the sun changes. We can also measure that, have been doing so for more than 30 years.

Mr. BUCSHON. Okay.

Dr. OPPENHEIMER. We know that is not the cause of the current warming. The only plausible cause is the human emissions of the greenhouse gases.

Mr. BUCSHON. Thanks for that opinion. I tend to probably disagree but——

Dr. BOTKIN. The——

Mr. BUCSHON. —it is open, all of us should have this discussion.

And I want to make some comments about someone else who was addressing the money. This issue is about money, and when you look at the State that I represent, the State of Indiana, which depends on coal for 85 to 90 percent of our power generation, this is a huge issue. And I mean you only have to listen to the testimony and the discussion from other witnesses about federal funding, when you try to not give federal funding to people that they support, what happens, how horrible that is, and when the Republican-controlled House doesn't give money to people that support the Administration's position on this particular issue, you see the outrage.

Also, if you don't think this is about that, look at some of the line of questioning. And Dr. Botkin, I am going to apologize on behalf of Congress for the really, I think, juvenile insulting questions that you had about seatbelts and other things, trying to disparage the credibility of distinguished panel members, no matter who that is, that should not be part of the discussion. The money should not be part of the discussion. What this should be about is science and I am hopeful that we—all of us on either side, whatever we believe, can stick to science.

With that, Mr. Chairman, I yield back.

Chairman SMITH. Thank you, Dr. Bucshon.

And that concludes our Members who had questions.

And let me thank all the panelists, all the witnesses today for their testimony. I think this has been particularly helpful to us. We

heard things we haven't heard before and so the record is vastly improved because of your contribution.

So thank you again and we stand adjourned.

[Whereupon, at 12:59 p.m., the Committee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Richard S.J. Tol

QUESTIONS FOR THE RECORD
The Honorable Lamar Smith (R-TX)
U.S. House Committee on Science, Space, and Technology

Examining the UN Intergovernmental Panel on Climate Change Process

Thursday May 29, 2014

Questions for Dr. Tol

1. You indicated that, following the 2010 review of the IPCC process by the world's science academies, the recommended reforms were, in your words, "by and large ignored." Have there been any significant reforms implemented?

The IPCC has implemented a number of the recommendations of the InterAcademy Council. The IPCC approach has been to follow the letter of the recommendations rather than the spirit. Author selection is still not transparent. The ability to audit the evolution of the IPCC documents in response to review comments does not open until months after the Summary for Policy Makers is released (see 6). The review editors may have more power in theory, but are still weak in practice. From the inside, the IPCC is much the same as it always was, albeit a bit more bureaucratic.

2. In your testimony you mention that there are key figures in the IPCC with strong ties to a variety of environmental activist organizations. How widespread are these connections and do you think these ties affect the end product?

The IPCC has a record of potential conflicts of interest (see 1), but has chosen to keep the results under wraps. As far as I know, the IPCC has made no attempt to verify its conflict of interest statements. I am not aware of any other systematic inventory of links between IPCC personnel and lobby groups (see 7). Crucially, not every author is equally influential in the IPCC process (see 5), and any assessment of green bias should take this into account. It is clear that there are key people in the IPCC who are either associated with environmentalists groups or have strong sympathies. As the IPCC assesses the literature in an informal, qualitative way, the authors' outlook affects the results (see 12).

3. The U.S. has used your economic model as part of the process to develop a social cost of carbon for federal regulations. This metric was recently revised upward significantly. Does the updated social cost of carbon developed by the U.S. government agree with the estimates in the IPCC chapter for which you were the Coordinating Lead Author? As the developer of this model, were you surprised that it is now driving the cost of carbon compared to the other two models cited?

The Fifth Assessment Report compares older and newer estimates of the social cost of carbon, and finds little difference. Recent estimates from our FUND model do not differ much from earlier estimates.

4. Dr. Oppenheimer indicates that the IPCC receives tens of thousands of comments and, "we have to address every single one of them…until comments are adequately addressed." Do you agree with this characterization of the IPCC comment process?

   Dr Oppenheimer is correct that every comment has a response. The IPCC revises drafts until the deadline, rather than until all is fine. The adequacy of responses is hard to judge; some review editors take their job seriously, but others do not. Referees often contradict each other, giving discretion to the authors which comment to rebut and which to accept. The IPCC makes little effort to encourage field experts to review specific parts of the report, and the chaotic structure (of the WG2 report) makes it hard to identify where topics are discussed; parts of the IPCC reports are therefore never properly reviewed.

5. During the hearing an article was discussed which indicated that climate change may impact national security. This is one of the areas where, according to your testimony, Working Group II's Summary for Policymakers was more alarmist than the underlying report. Can you elaborate on the international security implications of climate change and the level of certainty the IPCC should have on this specific issue?

There is a large body of work in the peace research literature which shows that climate has a small, contributory role in violent conflict, if any. Following this literature, the impact of climate change is uncertain in sign, as precipitation is more important to conflict than temperature, and projections of changes in precipitation are very uncertain. There is also a small body of research in the environmental science literature which finds that climate has a dominant role in violent conflict, and that climate change would lead to more violent conflict (even though the historical association in Europe and China is that cold periods are more violent). IPCC WG2 AR5 Chapter 12 relies on the peace research literature, but Chapter 19 uses the environmental science literature. The Summary for Policy Makers leans towards Chapter 19 (see 2 on how some authors are more equal than others).

6. The Chairman of the IPCC has said "The IPCC is a totally transparent organization… Whatever we do is available for scrutiny at every stage." Do you agree with this characterization as it relates to the development of the summary for policymakers, the selection of authors and studies, or the response to comments from expert reviewers?

The IPCC certainly lacks in transparency. Most disturbingly, the IPCC does not provide much information on the qualifications and conflicts of interest of its officials and authors. The IPCC reports are still very much "science by press release": First, headlines are made, followed a little later by the Summary for Policy Makers. The underlying chapters, review comments and responses follow much later. This implies that scrutiny is long after the fact.

7. You have recently developed a "wiki" of the IPCC's Fifth Assessment Report. What advantages do you see from opening up this document for the public? Why hasn't the IPCC pursued a more open model for public participation?

   The main advantage of a "wiki" is that documentation can be layered, that it can be easily updated, and that anyone can participate. The IPCC has not moved with the times re. openness and technology because the IPCC Bureau is dominated by older people from less-than-fully-democratic countries.

8. Do you agree with the principle that national or international climate policy should be based on scientific information, data, and models that are transparent and reproducible?

   a. Are there any barriers to the climate science community, the IPCC, or the U.S. government requiring transparency and reproducibility in the science used to develop or justify policy?

Any and all public policy, including climate policy, should be informed by transparent and reproducible scientific information, data and models. The attitude of the IPCC towards these matters roughly reflects the accepted standards in the environmental sciences, where scrutiny of research results is less stringent than what is common in physics, medicine or economics. Although the environmental sciences as a whole would be better off with more scrutiny, the first environmental scientists that would try to impose tougher standards is likely to lose out. Replication attempts are rarely rewarded as many journals frown on non-original work.

9. The Chairman of the IPCC has stated that "IPCC studies only peer-review science. Let someone publish the data in a decent credible publication… otherwise we can just throw it into the dustbin."

   a. Do you agree with this characterization?
   b. A citizen audit of the 2007 IPCC report found that, of the more than 18,000 citations in the report, more than 30 percent were actually to non-peer reviewed science. Has this process been fixed since 2007?
   c. Similarly, the 2010 InterAcademy Council review of the IPCC "found few instances of information flagged" as not being peer reviewed. Has this process been fixed since 2010?
   d. Do you find that the peer review process is a sufficient guarantee of impartial evaluation of scientific work?

With regard to the use of grey literature by the IPCC:

a. Dr Pachauri was wrong to claim that the IPCC only assesses peer-reviewed science. Dr Pachauri was also wrong to argue that grey literature is worthless. Data, for instance, are often published in the grey literature.
b. The citizen audit did not distinguish between legitimate use of grey literature – average energy use in Arcania in 2008 was 7 GJ per person per year (Government of Arcania, 2009) – and illegitimate use – climate policy will make everyone in Arcania fabulously rich (Government of Arcania, 2010). IPCC AR4 certainly had strong elements of the latter. For instance, the assessment of the impact of climate policy on unemployment relied almost entirely on government literature while ignoring the academic literature (that reached the opposite conclusion). For AR5, the IPCC discouraged the use of grey literature by increasing the amount of effort for its use. No comparative statistics have been released, so we cannot judge whether the use of grey literature has improved over time.
c. Grey literature is identified in AR5, but not in any way that is obvious to the typical reader.
d. In scientific journals, peer-review weeds out most of the really bad stuff, but it is not very good at preventing minor mistakes or group-think. In the IPCC, the quality of the peer-review varies strongly from one section to the next (cf. 4).

10. In your testimony you discuss the IPCC's Working Group III report on climate change mitigation and highlighted the odd economic reasoning in claiming that costs would go down as regulations became more stringent. Can you explain why this logic doesn't make sense and more strict regulations will be more costly?

The costs of greenhouse gas emission reduction increase more than proportionally with the stringency of the emission reduction target. Initial emission reductions targets low hanging fruit. Further emission reduction requires greater effort. Radical emission reduction can be very expensive. Although this is observed in every individual model in the IPCC database, the average across IPCC models does not show this. This is because of selection bias. Expensive models report results for lenient targets only, while cheap models report results for both stringent and lenient targets. The IPCC thus underestimates the costs of stringent emission reduction.

11. One of the key findings of your Working Group report was that the impacts of significant climate change (2.5 degrees Celsius) would be only 0.2 percent to 2 percent of global gross domestic product. Is it possible that climate change mitigation strategies could cost more than that?

The total impact of a 2.5°C global warming would be somewhere between 0.2-2.0% of GDP. The total impact of climate policy can be smaller or larger than that, depending on the stringency of the emissions target and the design of the emission reduction policy.

12. You have examined the evolution of how IPCC has characterized the total economic impact of climate change across its five assessments and found a lack of consistency. Why do you think that is?

Subsequent IPCC reports reach different conclusions on the total impact of climate change even though the underlying literature has not changed much. There are three reasons for this. First, the IPCC rarely uses formal methods of meta-analysis, instead relying on informal assessment. Second, the composition of author teams changes over times. Third, IPCC authors need to find something new and different so as to justify their effort.

13. You have stated that "many impacts of climate change are really symptoms of underdevelopment and poor management." Can you explain the relationship between reliable, inexpensive energy and development? Is it possible that greater access to reliable energy could actually make parts of the world more resilient?

    Cheap, reliable and abundant energy is important for economic development, not just because it lowers production costs, transport costs and household expenditures, but also because it enables education and health care. Policies that increase the price of energy thus slow down economic growth. Because poorer people are more vulnerable to climate change than richer people, a policy that reduces greenhouse gas emissions at great expense may thus increase the impacts of climate change – as a little less climate change would fall on a much more vulnerable population.

QUESTIONS FOR THE RECORD
The Honorable Mo Brooks (R-AL)
U.S. House Committee on Science, Space, and Technology

Examining the UN Intergovernmental Panel on Climate Change Process

Thursday May 29, 2014

Questions for Dr. Tol

1. The Administration knows that the US actions, as proposed by the EPA, will not affect the climate in any significant way. Their "hope" is that this will lead other nations to reduce their emissions so that together there might be a reduction that is at least noticeable. Nations like China and India will continue to see steep rises in emissions as they develop their economies, lift citizens out of poverty, and provide better standards of

living demanded by their people. On the other hand, Japan and Germany are two strong advocates of reducing CO2 emissions and continue to spend billions to achieve this goal.

a. How many new coal-fired power plants have Japan and Germany recently completed or will be completing in the near future?

b. What are the projections for CO2 emissions in Japan and Germany for the next decade or more?

c. If two of the most "environmentally active" nations (Japan and Germany) will act to cause CO2 emissions to rise, what "hope" is there that any country will follow the U.S. when the demands for poverty alleviation will always trump unprovable environmental concerns?

On climate policy:

a. Germany is adding some 11 GW of coal-fired power plants, and Japan some 7 GW, essentially to replace nuclear power plants.
b. This has already increased carbon dioxide emissions, and they are project cted to rise further in Germany and Japan.
c. The EU has claimed to be a leader in climate policy for twenty years, without gathering any followers. Similarly, a US policy that raises energy prices now for the sake of slightly reduced climate change in the future, is unlikely to inspire many countries to follow suit.

Responses to the letter by Mr Robert ET Ward BSc

1. Mr Ward is a public relations person employed by Lord Stern of Brentford, the main author of the Stern Review on the Economics of Climate Change.
2. The Stern Review uses an estimate of the welfare loss of 0.9% of income due to a 2.5°C global warming. This estimate is reported as is by IPCC WG2 AR5. It is slightly lower than the central estimate of the IPCC (1.1%). However, IPCC WG2 AR5 did not adopt the methods and assumptions that make the Stern Review report "0.9% for 2.5°C" as "5-20% now and forever".
3. The Stern Review reports a central estimate of 1.0% of GDP in 2050 for the costs of stabilizing greenhouse gas concentrations at 550 ppm CO_2eq. IPCC WG3 AR5 reports a central estimate of 1.7% of GDP for the same year and target.

Responses by Dr. Michael Oppenheimer

Responses of Michael Oppenheimer to members' questions:

Questions from the Hon. Mo Brooks:

1. What is the basis for claiming that extreme heat events have increased in this country...?

Answer: My response was in the context of a question from Mr. Kennedy about "global temperature", not specifically US temperature. The data behind this statement are presented in the report of Working Group 1, chapter 2.6.1, which states, "Further evidence since (the Fourth Assessment) then indicates that the level of confidence that the majority of warm and cool extremes show warming remains high." This statement refers to extremes globally and only since the middle of the 20th century due to data quality issues for earlier times. A subsequent table (2.1.3) indicates substantial regional variations from the global trend, including for North and Central America, which saw "increases (in heat waves/warm spells) in more regions than decreases but 1930s dominates longer term trends in the USA." However, we note that daily extremes and heat waves are not identical: the same table also notes that there is "High confidence" in a "likely overall increase but spatially varying trends" for warm days and nights in North and Central America. Figure 11.17 of the Working Group 1 report is also informative about how global extremes have changed since 1960. So there is no contradiction between my testimony and the figure accompanying the question.

2. On upper air temperature...

Answer: With regard to questions parts a)-c), my testimony merely summarizes the IPCC findings, as was noted in the preamble to the question parts. I did not participate in the chapter team performing the assessment of this data. If the committee requires further details on the thinking or process that went into the development of that part of the report, I suggest they invite those performing the assessment to testify. However, from my point of view (as a climate scientist whose research is largely on other aspects of the climate), I found the assessment as written to be compelling: there is sufficient disagreement among the various observational approaches to mid-troposphere temperatures so that one cannot at this juncture use the observations to establish any particular bias or other inaccuracy in the models. I would not be surprised if the models did not represent actual trends in that part of the atmosphere as well as they do surface trends but I do not believe we can show this from the given observations.

With regard to question part d), I have no idea what another group pf scientists would have concluded. Please note that I have long advocated that on specific, important questions, IPCC should experiment with so-called "Team B" approaches which could test the proposition.

With regard the question part e), subpart a), I point to paleoclimate evidence which strongly supports the proposition that increased concentrations of CO2 and other greenhouse gases have in the past (and likely will in the future) lead to an increase in global mean temperature similar to that projected by IPCC (see for instance, **Making sense of palaeoclimate sensitivity,** PALAEOSENS Project Members, Nature vol.491, pp.683-691). This outcome is also consistent with the basic physics of the climate system. With regard to subpart b), with all due respect, the assertion that every climate anomaly seen today has occurred sometime in the past is puzzling. While global mean temperature changes larger than today's have occurred, other characteristics of today's climate change (versus 50 or 100 years ago), are likely

unique, such as the cooling of the stratosphere at a time when the surface and troposphere are warming, as well as other characteristics of the distribution of changes.

Question 3 is entirely outside the subject area of my testimony and partly outside my expertise so I will refrain from addressing it.

Questions from the Hon. Eddie Bernice Johnson

1. In regard to ice loss from Greenland and Antarctica...

Answer: The major ice sheets in Greenland and Antarctica contain ice equivalent to a sea level rise of about 7 meters and 57 meters, respectively. Greenland ice is both melting and sliding into the sea via iceberg formation, in roughly equal amounts. For Antarctica, the major process of ice loss is via the sliding (or dynamic) process. Both ice sheets are also gaining ice in some places due to increased precipitation but on balance, both have lost ice to the sea over recent decades. For small amounts of ice loss, this process may be reversible. But for large ice losses, the process could not be reversed in a human timescale. Of particular concern is the West Antarctic ice sheet which contains ice equivalent to about 5 meters of ice, at least 3 meters of which appears to have the potential to become unstable if warming continues. Some of this ice is already unstable. The only means to restore ice lost to the sea is via precipitation. At current rates of precipitation, if all of West Antarctica's unstable ice were lost to the sea, it would take thousands of years to grow back, even if Earth cooled again. The situation in Greenland is somewhat different due to a greater stability for much of the ice. Nevertheless, some models project that a large scale loss of ice to the sea would become irreversible due to local changes in meteorology as the ice is lost.

2. In regard to Dr. Tol's testimony...

Answer: While I agree with much of Dr. Tol's testimony, particularly his recommendations for future IPCC procedures, I found that his comments on statements in the Fifth Assessment on crop yields and farmer adaptation, heat-related deaths, and coastal adaptation do not accurately reflect the content of the report. Contrary to Dr. Tol's assertion, the Summary for Policy Makers of the WGII report shows projected changes in crop yields both with and without estimated farmer adaptation (see Figure SPM.7). Similarly, the summary notes both that heat-related deaths have increased and that cold related deaths have decreased (p.SPM.6), contradicting Dr. Tol's assertion that the presentation on this point is imbalanced. It is also worth noting that chapter 11 of the report projects that heat-related mortality increases will become larger than cold-related mortality decreases as warming continues. If anything, the Summary presentation was conservative. Finally, the great potential for coastal adaptation to reduce damages is made clear in several panels of Figure SPM.2. The text on p.17 also makes clear that the costs of adaptation vary widely from region to region and cites the relative cost of "several percentage points of GDP" only in the specific context of low-lying developing countries and small island states.

With regard to part b of this question, the process for approving the SPM often results in both the airing of disparate views if national delegates are aware of such differences among experts and at the same time a tendency to find and emphasize consensus. My personal view is that the draft reports should be clearer about the range of views held by both the broader expert community and the IPCC assessment report authors, and that to some extent, this diversity should be reflected in the SPM.

With regard to part c, the potential for bias is handled in several ways. First, authors submit forms which indicate potential conflicts of interest and these are taken into account, I believe, in the

appointment of authors. Secondly, a determined effort seems to be made to balance potential sources of institutional bias by selecting authors from, for instance, both industry and environmental NGOs. However, both of these approaches could be strengthened and made more transparent. Finally and most importantly, the multi-layered review process and the review editors' role go a long way toward assuring that diverse expert views receive ample consideration.

3. In regard to the need for continued investment in climate research...
Answer: Given the potential costs to society and ecosystems in terms of damage and loss to life, infrastructure, and societal cohesion worldwide, an expanded investment in research on projected climate changes and ways to avert and adapt to them should be one of the federal governments highest research priorities. Just as scientific research aimed at improving national security is a priority, improving our ability to understand, manage, and rein in climate change should also be a high priority.

4. In regard to the scientific consensus...
Answer: I have researched climate change, its causes and impacts, for almost 35 years. In that time, I have found near-unanimity among experts on the fundamentals: greenhouse gases are increasing due to human activity, primarily fossil fuel combustion; this increase has contributed most of the observed warming since the middle of the 20th century; unrestrained emissions would warm earth to a greater extent and faster than any global warming in the history of civilization, and include a rapid rise in sea level; such a warming would bring impacts to most of society the harm from which would grow faster over time; stabilization of the climate, especially at levels which avert widespread harm will require very large reductions in emissions of carbon dioxide and other greenhouse gases. Many details as to particular impacts at specific times and places remain uncertain. But a nearly unprecedented degree of consensus has emerged around the broad outlines of the problem, as well as many important details. This consensus is fully reflected in the IPCC process and resulting reports.

Responses by Dr. Daniel Botkin
QUESTIONS FOR THE RECORD
The Honorable Lamar Smith (R-TX)
U.S. House Committee on Science, Space, and Technology

Examining the UN Intergovernmental Panel on Climate Change Process

Thursday, May 29, 2014

Questions for Dr. Botkin
(Note that my replies are in italics and indented to separate them from the questions)

1. During the hearing Dr. Pielke described a chilling effect on presenting alternative perspectives to climate related issues. Do you agree? Are there examples that have taken place recently?
Sorry, I don't understand the question. What do you mean by "chilling effect"?

2. Dr. Oppenheimer indicates that the IPCC receives tens of thousands of comments and "we have to address every single one of them ...until comments are adequately addressed." Do you agree with this characterization of the IPCC comment process?
Of course I do not know what the IPCC procedures were, but I can say that none of the suggestions I made as an expert reviewer were taken into account in the final report. Also, I never received a technical reply to any of my comments. Given the large number of expert reviewers (about 1,800 according to what IPCC wrote me), addressing "every single one" would seem a very difficult task in the time available.

3. Dr. Oppenheimer said that even without evidence from models, "the current changes are by and large faster and carbon dioxide levels have already reached a level which is above any for many million years." Do you agree with this statement?
The Vostok glacier ice cores, Antarctica, have provided records of CO_2 and temperature for the past 800,000 and 400,000 years, and are generally considered among the best such reconstructions. According to these, Dr. Oppenheimer is correct in saying that CO_2 levels have not been as high as they are now for the past 800,000 years.
The important question is how has average Earth temperature changed? According to the Antarctica Vostok glacier ice cores from which the temperature has been reconstructed, temperature as high or higher than today's occurred between 136,000 and 125,000 years ago.[1]

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[1] (J. Jouzel etal. [1987]. Vostok ice core: a continuous isotope temperature record over the last climatic cycle (160,000 years). Nature, 329 , 403-408; J. Jouzel et al. [1993]. Extending the Vostok ice-core record of palaeoclimate to the penultimate glacial period. Nature, 364 , 407-412; J. Jouzel et al. [1996]. Climatic interpretation of the recently extended Vostok ice records. Climate Dynamics, 12 513-521; J. R. Petit et al. [1999]. Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica. N ature, 399, 4 29-436).

Additional information for the Antarctic Dome glacier has been used to reconstruct CO2 and temperature changes for the past 2,000 years. These show a warming during the Medieval warm period and cooling during the Little Ice Age, during which CO_2 appears to have been essentially constant. Ironically, this provides evidence contrary to the assertion that CO_2 is a major cause of climate change on Earth.

4. Do you agree with the principle that national or international climate policy should be based on scientific information, data, and models that are transparent and reproducible?
Yes; good science can and sometimes does lead to good policy. Bad science cannot.

a. Are there any barriers to the climate science community, the IPCC, or the U.S. government requiring transparency and reproducibility in the science used to develop or justify policy?
I and my colleagues find many barriers to an open, objective, sound, scientifically-based discussion of the science used to develop and justify public policy. What began as a scientific question has been turned into an ideological and political debate. Colleagues who point out scientific results that suggest the carbon dioxide may not have played a significant role in the past and may not in the present have been vilified as "deniers" and called by Nobel Laureate economist Paul Krugman in his New York Times *column "traitors." Colleagues who point out these scientific results that do not support IPCC and U.S. policy proposals tell me they have difficulty getting papers published and research funded, and suffer from vilification.*

5. The Chairman of the IPCC has stated that the "IPCC studies only peer-review science. Let someone publish the data in a decent credible publication ... otherwise we can just throw it into the dustbin."

a. Do you agree with this characterization?
No, on several grounds. First of all, apparently the IPCC has not only used peer reviewed scientific publications. Second, in some cases, because the subject has been converted into an ideological and political debate, some important results are not getting published in peer-reviewed literature. Science is what is actually found out, whether the results at the moment are in peer-reviewed literature. So there is a role for non-peer-reviewed studies. Of course, peer reviewed publications are preferable, but they are not always the only source of scientifically useful information.

b. A citizen audit of the 2007 IPCC report found that, of the more than 18,000 citations in the report, more than 30 percent were actually to non-peer reviewed science. Has this process been fixed since 2007?
I can't comment on this, as I do not know the details about how IPCC functions, never having been part of that process.

c. Similarly, the 2010 InterAcademy Council review of the IPCC "found few instances of

information flagged" as not being peer reviewed. Has this process been fixed since 2010?

I can't comment on this, as I do not know the details about how IPCC functions, never having been part of that process.

d. Do you find that the peer-review process is a sufficient guarantee of impartial evaluation of scientific work?

Not with the way that the climate debate has become an ideological and political debate.

6. Recently the President announced new regulations on greenhouse gases emissions for existing power plants. Do you believe this would have a measurable effect on global temperature by the end of this century?

The available analyses suggest that if the U.S. acts alone, this will not have a measurable effect. However, because the U.S.A. has been the leader in much science and the application of science, and has been a world leader in environmental improvement, the U.S. taking steps to improve the environment can play an important role in leadership. It is not the question of whether the U.S. acts alone, it is whether the U.S. will continue to be the leader in seeking good environmental practices. If we do not choose good environmental policies, then many other nations are also not likely to.

The problem is not so much whether we should act alone, but whether the policy is a useful one. It is my conclusion that the attempt to reduce carbon dioxide concentrations in the way the new policy proposes is unlikely to be effective even if the same approach were applied worldwide.

7. Is it possible that policies---like carbon taxes or subsidies for preferred companies--- that are intended to reduce greenhouse gas emissions might actually have the opposite effect?

This is a question for economists, political scientists, and historians. I do not think I am someone who can comment as an expert on this question.

8. The National Academy of Sciences reviewed a draft version of the recent White House Climate Assessment and argued that: "An overly narrow focus can encourage one-sided solutions, for instance by giving an impression that reducing greenhouse gas emissions alone will solve all of the major environmental concerns . . . ."Is there any sign that the White House addressed this issue in its final report?

Not as indicated by the final published report.

9. A key finding in the 2007 IPCC report regarded species extinction due to climate change and rested on a single study by Thomas et al. You have called this one of "the worst papers I have ever read." What was so flawed with this study, and how did it pass the peer review process and become a key piece of science for the IPCC?

The analysis this paper reports was based on inappropriate theory and bad data. The theory is called the species-area curve, and it has to do with how big an area a person has to study to get an estimate of the total number of species that might be there. It is an information theory. The paper used this as if it were an explanatory theory---that is, that area caused species, which isn't true. Then the paper used existing data about the area

that various biomes (kinds of ecosystems) cover on Earth. Having done the first statistically valid estimates of carbon storage and exchange by any large area of the land surface, I can tell you that the data the paper used were not statistically nor scientifically valid. They were based on very small samples of mostly old-growth long-disturbed ecosystems that happened to be easy to get to from major universities. Putting useless theory together with terrible data led to forecasts that had nothing to do with what happens in real ecosystems.

10. In light of some of the concerns you have raised about alarmist and political science in the IPCC report and the White House Climate Assessment, how should we best prioritize federal funds on climate and related environmental issues?

As I said in my testimony, including climate change there are ten major environmental issues by my count that need our attention. Many of the nine that are not climate change used to be in central focus, such as the management and conservation of forests and fisheries. But in the past 15 years, concerns about these have been pushed way into the background because of the single focus on a possible human-caused global warming. Species are in trouble today because of immediate pressures such as habitat destruction, overharvesting (as with elephant ivory and most fisheries), introduction of invasive species that bring problems to native species). If we do not work to solve these problems, there won't be much to do in that distant future even if there is a human-induced global warming.

Here is the list of major environmental problems other than climate change.

Nine Environmental Issues That Need Our Attention Now

1. *Energy*
2. *Fresh water*
3. *Phosphorus and other essential minerals*
4. *Habitat destruction*
5. *Invasive-species control*
6. *Endangered species*
7. *Pollution by directly toxic substances*
8. *Fisheries*
9. *Forests*

Responses by Dr. Roger Pielke Sr.

QUESTIONS FOR THE RECORD
The Honorable Lamar Smith (R-TX)
U.S. House Committee on Science, Space, and Technology

Examining the UN Intergovernmental Panel on Climate Change Process

Thursday May 29, 2014

Questions for Dr. Pielke

1. Dr. Oppenheimer indicates that the IPCC receives tens of thousands of comments and, "we have to address every single one of them…until comments are adequately addressed." Do you agree with this characterization of the IPCC comment process?

The comment process of the IPCC is seriously flawed. To state that the comments are "adequately addressed" begs the question as to who decides what is "adequate". In my view, the IPCC WG1 report is not a complete and adequate assessment of the current understanding of the climate system

2. You discuss the range of anthropogenic climate forcings, including land use and black carbon. Could you elaborate on climate forcings not directly related to fossil fuels?

I discuss this in earlier House testimony –

Pielke Sr., Roger A., 2008: A Broader View of the Role of Humans in the Climate System is Required In the Assessment of Costs and Benefits of Effective Climate Policy. Written Testimony for the Subcommittee on Energy and Air Quality of the Committee on Energy and Commerce Hearing "Climate Change: Costs of Inaction" – Honorable Rick Boucher, Chairman. June 26, 2008, Washington, DC., 52 pp

where I wrote in my oral testimony
[http://pielkeclimatesci.files.wordpress.com/2009/09/pielke_oral_testimony.pdf] that

The human climate forcings that have been ignored, or are insufficiently presented in the IPCC [Intergovernmental Panel on Climate Change] and CCSP [US Climate Change Science Program] reports include

• *The influence of human-caused aerosols on regional (and global) radiative heating*

• *The effect of aerosols on clouds and precipitation*

• *The influence of aerosol deposition (e.g. soot; nitrogen) on climate*

• *The effect of land cover/ land use on climate*

• *The biogeochemical effect of added atmospheric CO2*

Thus climate policy that is designed to mitigate the human impact on regional climate by focusing only on the emissions of CO2 is seriously incomplete unless these other first-order human climate forcings are included, or complementary policies for these other human climate forcings are developed. Moreover, it is important to recognize that climate policy and energy policy, while having overlaps, are distinctly different topics with different mitigation and adaptation options.

This failure to broaden out their perspective has continued with the 2013 IPCC report and in the US NCA. Indeed, they continued to ignore the findings in the 2005 NRC report

National Research Council, 2005: Radiative forcing of climate change: Expanding the concept and addressing uncertainties. Committee on Radiative Forcing Effects on Climate Change, Climate Research Committee, Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies, The National Academies Press, Washington, D.C., 208 pp.

where it is written

... the traditional global mean TOA radiative forcing concept has some important limitations, which have come increasingly to light over the past decade. The concept is inadequate for some forcing agents, such as absorbing aerosols and land-use changes that may have regional climate impacts much greater than would be predicted from TOA radiative forcing.

....Regional variations in radiative forcing may have important regional and global climatic implications that are not resolved by the concept of global mean radiative forcing. Tropospheric aerosols and landscape changes have particularly heterogeneous forcings. To date, there have been only limited studies of regional radiative forcing and response.... Regional diabatic heating can also cause atmospheric teleconnections that influence regional climate thousands of kilometers away from the point of forcing.

Several types of forcings—most notably aerosols, land-use and land-cover change, and modifications to biogeochemistry—impact the climate system in nonradiative ways, in particular by modifying the hydrological cycle and vegetation dynamics. Aerosols exert a forcing on the hydrological cycle by modifying cloud condensation nuclei, ice nuclei, precipitation efficiency, and the ratio between solar direct and diffuse radiation received. Other nonradiative forcings modify the biological components of the climate system by changing the fluxes of trace gases and heat between vegetation, soils, and the atmosphere and by modifying the amount and types of vegetation. ...

The policy recommendation in that report [which has been ignored by the IPCC and the NCA] includes

It is important to communicate the expanded forcing concepts as described in this report to the policy community and to develop the tools that will make their application useful in a policy context."

Another source of information on climate forcings other than those from fossil fuel emissions is in the 2010 American Meteorological Statement Inadvertent Weather Modification [http://www.ametsoc.org/policy/2010inadvertentweather_mod_amsstatement.html] where it is written

This statement highlights the causes and possible effects of inadvertent weather modification at local and regional scales due to aerosol and gas emissions and to changes in land use. The known effects can have unanticipated and often undesirable socioeconomic consequences.....

a. Aerosol radiative effects

By partially blocking solar radiation from heating the surface, air pollutants lower surface heating and evaporation rates. This slows vertical air motions, and hence causes slower dispersal rates of air pollutants, and suppresses formation of convective clouds and precipitation. Reduced surface evaporation has major implications for the global hydrological cycle and how it responds to the combined forcing of GHGs, land use change, and aerosol pollution. In addition, surface deposition of dark aerosols accelerates ice-melt rates, hence affecting water resources. While these conclusions are based on sound physical meteorology, many of these effects are yet to be quantified.

b. Cloud-mediated effects of aerosol

Aerosols act mostly as cloud-drop condensation nuclei (CCN), and some of them as ice nuclei (IN), both of which change cloud radiative and precipitation properties in complex ways. Over oceans, emissions from fossil-fuel-burning ships produce tracks, observed to dramatically influence the extent and persistence of local shallow cloud cover, reducing the amount of solar radiation received at the surface and enhancing the amount reflected back to space. Aerosols also suppress precipitation from shallow or short-lived clouds (e.g., orographic cap clouds). Their impacts on deep convective clouds are much less certain, but are of potentially great importance. Recent research suggests that, depending on meteorological conditions, aerosols can either increase or decrease rainfall from such clouds. In warm moist atmospheres, aerosols often invigorate deep convective clouds, usually resulting in greater electrical activity, stronger damaging winds, and a greater likelihood of flash floods. Studies indicate that aerosols might also modulate the intensity of tornadoes and hurricanes.

c. Changes in land use

One example of significant land use change is the rapid global increase in urbanization and its associated changes in land surface properties and topography that create "urban heat islands" and urban barrier effects that perturb regional air flows, which thus redistributes precipitation, runoff, and flood risk over and around cites. Land-use changes alter surface albedos, as well as surface fluxes of heat, water vapor, and momentum to the atmosphere, and thus modify local and regional atmospheric circulations, which in turn can modify weather. For example, when a forest is removed and replaced by an agricultural field, it can result in a significantly different albedo, especially after a snow storm. Artificial lakes, and wind and solar farms also change the surface fluxes and albedo. Such changes also occur indirectly through increases in nitrogen

deposition and atmospheric CO2, which alter leaf area amounts and thus the portioning of latent and sensible heat fluxes. Poor agricultural practices that favor wind erosion, such as from summer fallow, overgrazing, and deforestation, as well as from tillage, can produce large quantities of dust that absorb and reflect solar radiation thereby modifying clouds and precipitation processes.

d. Integrated effects

The cumulative changes in surface and atmospheric heat and moisture profiles modify atmospheric circulation and weather patterns on all scales, including synoptic storm tracks, in ways that are just beginning to be explored. In the aggregate, these changes can affect air quality, ecosystems, and water resources. The cumulative impacts of inadvertent weather modification may thus result in local or regional-scale climatic alterations superimposed on, and interacting with, natural and GHG-induced climate variability and change. Understanding of inadvertent weather modification, still in its infancy, is thus necessary for understanding the sources, triggers, and response mechanisms of climate change.

The IPCC and NCA reports chose to ignore these findings and, thus, have provided policymakers with biased assessments.

3. Dr. Tol's testimony stated that, following the 2010 review of the IPCC process by the world's science academies, the recommended reforms were, in his words, "by and large ignored." Have there been any significant reforms implemented?

The 2013 IPCC report continues to be a narrowly focused report which is clearly intended for specific policy actions. While they claim to be reporting objectively on climate science, the assessment is actually stealth advocacy. I do not see that any reforms have been implemented which change their flawed approach.

4. Do you agree with the principle that national or international climate policy should be based on scientific information, data, and models that are transparent and reproducible?

    a. Are there any barriers to the climate science community, the IPCC, or the U.S. government requiring transparency and reproducibility in the science used to develop or justify policy?

Transparency and reproducibility are essential components of the sound scientific process. This includes model tests against real world observations. There is no reason that transparency and reproducibility should not be a fundamental requirement for these assessments.

5. The Chairman of the IPCC has stated that "IPCC studies only peer-review science. Let someone publish the data in a decent credible publication… otherwise we can just throw it into the dustbin."

    a. Do you agree with this characterization?
    b. A citizen audit of the 2007 IPCC report found that, of the more than 18,000 citations in the report, more than 30 percent were actually to non-peer reviewed science. Has this process been fixed since 2007?
    c. Similarly, the 2010 InterAcademy Council review of the IPCC "found few instances of information flagged" as not being peer reviewed. Has this process been fixed since 2010?
    d. Do you find that the peer review process is a sufficient guarantee of impartial evaluation of scientific work?

Peer review is an essential part of the scientific process. However, it is not the only source of solid scientific information. Indeed, with the internet, weblogs, with their vigorous exchange of comments serves as an effective review. Excellent examples of non-standard excellent scientific studies can be found on the weblog posts such as this recent one by Bob Tisdale [http://wattsupwiththat.com/2014/06/18/may-2014-global-surface-landocean-and-lower-troposphere-temperature-anomaly-update/].

The citation of non-peer reviewed studies is, therefore, not a problem as long as it is transparent, reproducible, and has open, publically available comments.

6. As part of the 2010 InterAcademy Council review, IPCC participants stated that "as far as I can tell there is no data quality assurance associated with what the IPCC is doing…" Another stated that "quality assurance and error identification is not existent."

    a. Science used for regulatory purposes in this country are supposed to be subject to information quality and peer review requirements. In light of the fact that IPCC assessments have been used to justify the regulation of greenhouse gases, are you confident that the science disseminated by IPCC meets basic data quality requirements?

The multi-decadal climate model projections presented in the IPCC and NCA reports fails to perform a basic data quality assessment of the robustness of their projections. This failure also applies to claims to attribute extreme weather events to a particular human climate forcing.

I documented the failings of the multi-decadal climate predictions when run in a hindcast mode in my written testimony.

7. Everyone from the President to the USA Today has cited a statistic that 97 percent of scientists agree that humans cause climate change and we need to do something about it. Are you outside the scientific mainstream? And do you find this statistic credible?

a. In light of the much-hyped "97% consensus" on climate change, you published a 2009 study entitled "Climate Change: The Need to Consider Human Forcings besides Greenhouse Gases." What were the key findings?

I certainly am not out of the scientific mainstream. My research papers are widely cited [e.g. see http://scholar.google.com/citations?user=ZCFFOQcAAAAJ&hl=en&oi=ao] where they list over 28000 citations of my papers.

The 97% consensus statement is actually nonsensical. If the question is "do humans have an influence on the climate", no climate scientist would reject that assertion. However, if the question is "do humans dominate climate change through the emission from fossil fuel combustion", there is a much greater diversity of views.

We addressed this question in the paper you mention. This paper was co-authored by 19 Fellows of the American Geophysical Union. The paper is

Pielke Sr., R., K. Beven, G. Brasseur, J. Calvert, M. Chahine, R. Dickerson, D. Entekhabi, E. Foufoula-Georgiou, H. Gupta, V. Gupta, W. Krajewski, E. Philip Krider, W. K.M. Lau, J. McDonnell, W. Rossow, J. Schaake, J. Smith, S. Sorooshian, and E. Wood, 2009: Climate change: The need to consider human forcings besides greenhouse gases. Eos, Vol. 90, No. 45, 10 November 2009, 413. Copyright (2009) American Geophysical Union. http://pielkeclimatesci.files.wordpress.com/2009/12/r-354.pdf

In that paper we discussed three hypotheses and wrote

Hypothesis 1: Human influence on climate variability and change is of minimal importance, and natural causes dominate climate variations and changes on all time scales. In coming decades, the human influence will continue to be minimal.

Hypothesis 2a: Although the natural causes of climate variations and changes are undoubtedly important, the human influences are significant and involve a diverse range of first- order climate forcings, including, but not limited to, the human input of carbon dioxide (CO2). Most, if not all, of these human influences on regional and global climate will continue to be of concern during the coming decades.

Hypothesis 2b: Although the natural causes of climate variations and changes are undoubtedly important, the human influences are significant and are dominated by the emissions into the atmosphere of greenhouse gases, the most important of which is CO2. The adverse impact of these gases on regional and global climate constitutes the primary climate issue for the coming decades.

These hypotheses are mutually exclusive. Thus, the accumulated evidence can only provide support for one of these hypotheses. The question is which one?

Hypotheses 2a and 2b are two different oppositional views to hypothesis 1. Hypotheses 2a and 2b both agree that human impacts on climate variations and changes are significant. They differ, however, with respect to which human climate forcings are important. Because hypothesis 1 is not well supported, our scientific view is that human impacts do play a significant role within the climate system. Further, we suggest that the evidence in the peer- reviewed literature (e.g., as summarized by National Research Council (NRC) [2005]) is predominantly in support of hypothesis 2a, in that a diverse range of first- order human climate forcings have been identified.

We therefore conclude that hypothesis 2a is better supported than hypothesis 2b, which is a policy that focuses on modulating carbon emissions. Hypothesis 2b as a framework to mitigate climate change will neglect the diversity of other, important first- order human climate forcings that also can have adverse effects on the climate system. We urge that these other climate forcings should also be considered with respect to mitigation and adaptation policies.

In addition to greenhouse gas emissions, other first- order human climate forcings are important to understanding the future behavior of Earth's climate. These forcings are spatially heterogeneous and include the effect of aerosols on clouds and associated precipitation [e.g., Rosenfeld et al., 2008], the influence of aerosol deposition (e.g., black carbon (soot) [Flanner et al. 2007] and reactive nitrogen [Galloway et al., 2004]), and the role of changes in land use/land cover [e.g., Takata et al., 2009]. Among their effects is their role in altering atmospheric and ocean circulation features away from what they would be in the natural climate system [NRC, 2005]. As with CO2, the lengths of time that they affect the climate are estimated to be on multidecadal time scales and longer.

Therefore, the cost- benefit analyses regarding the mitigation of CO2 and other greenhouse gases need to be considered along with the other human climate forcings in a broader environmental context, as well as with respect to their role in the climate system. Because hypothesis 2a is the one best supported by the evidence, policies focused on controlling the emissions of greenhouse gases must necessarily be supported by complementary policies focused on other first- order climate forcings. The issues that society faces related to these other forcings include the increasing demands of the human population, urbanization, changes in the natural landscape and land management, long- term weather variability and change, animal and insect dynamics, industrial and vehicular emissions, and so forth. All of these issues interact with and feed back upon each other……..

The evidence predominantly suggests that humans are significantly altering the global environment, and thus climate, in a variety of diverse ways beyond the effects of human emissions of greenhouse gases, including CO2…..

... global climate models do not accurately simulate (or even include) several of these other first-order human climate forcings, policy makers must be made aware of the inability of the current generation of models to accurately forecast regional climate risks to resources on multidecadal time scales.

It is these three hypotheses that should have been discussed in the 2013 IPCC and 2014 NCA reports. Unfortunately, and erroneously, they adopted Hypothesis 2b which, is shown in our paper, is not supported by the scientific evidence.

8. Recently the President announced new regulations on greenhouse gases emissions for existing power plants. Do you believe this would have a measurable effect on global temperature by the end of this century?

Based on the models that were used by the IPCC, the effect of this particular regulation on the global average temperature would be minimal. There would be, based on the EPA assessment, a reduction of criteria air pollutants that are emitted from coal fired power plants; this conclusion should be confirmed independently.

QUESTIONS FOR THE RECORD
The Honorable Mo Brooks (R-AL)
U.S. House Committee on Science, Space, and Technology

Examining the UN Intergovernmental Panel on Climate Change Process

Thursday May 29, 2014

Questions for Dr. Pielke

1. The Administration knows that the US actions, as proposed by the EPA, will not affect the climate in any significant way. Their "hope" is that this will lead other nations to reduce their emissions so that together there might be a reduction that is at least noticeable. Nations like China and India will continue to see steep rises in emissions as they develop their economies, lift citizens out of poverty, and provide better standards of living demanded by their people. On the other hand, Japan and Germany are two strong advocates of reducing CO2 emissions and continue to spend billions to achieve this goal.

    a. How many new coal-fired power plants have Japan and Germany recently completed or will be completing in the near future?

    b. What are the projections for CO2 emissions in Japan and Germany for the next decade or more?

    c. If two of the most "environmentally active" nations (Japan and Germany) will act to cause CO2 emissions to rise, what "hope" is there that any country will follow the U.S. when the demands for poverty alleviation will always trump unprovable environmental concerns?

Questions #1 and #2, unfortunately, are outside of my area of expertise. I recommend the book by my son [The Climate Fix - http://sciencepolicy.colorado.edu/publications/special/climate_fix/] and his subsequent research and publications on this topic in order to address these important questions that you have asked.

REVIEW OF *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program
Jerry M. Melillo, Terese (T.C.) Richmond, and Gary W. Yohe, Eds.
841 pp. doi:10.7930/J0Z31WJ2.

By Daniel B. Botkin: May 29, 2014

[Note regarding my connections with Jerry M. Melillo, one of the three primary editors of this report: When I was on the faculty of the Yale School of Forestry and Environmental Studies, Jerry Melillo was a graduate student working on his doctorate and we interacted frequently. Beginning in 1975, Jerry Melillo and I worked at the Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA, and we published four scientific papers together, listed at the end of this document.[1]

COMMENTS ON THE ASSESSMENT

GENERAL COMMENTS:

The opening statement of the Assessment (p.1), reproduced here, is characteristic of the entire Assessment in that it violates one of the basic principles of good climatology --- never use short-term weather changes as proof of climate change. Climatologists I have worked with over the decades have said this repeatedly. In 1962, when I was a graduate student at the University of Wisconsin working under a science writing fellowship, I spoke with Reed Bryson, said to be the father of the International Geophysical Year and the person who persuaded Richard Keeling to begin measuring atmospheric carbon dioxide concentration on Mauna Loa, Hawaii. At that time Earth had been undergoing a global cooling since about 1940. At first Professor Bryson said "if present trends continue, we are entering a new ice age." But when I drafted a press release that quoted him so, he thought about it carefully and told me that we could not make that statement, because this was just a short-term weather event.

In the 1980s, I worked closely with climatologist Stephen Schneider and we often gave talks at the same events. Steve, one of the leaders of the modern concern about a possible human-induced global warming, also said that you should never use short-term weather events to infer climate change. I agreed with these experts, and therefore was taken aback by the overall tone of the new White House Climate Change Assessment, which begins: "Climate change, once considered an issue for a distant future, has moved firmly into the present. Corn producers in Iowa, oyster growers in Washington State, and maple syrup producers in Vermont are all observing climate-related changes that are outside of recent experience. So, too, are coastal planners in Florida, water managers in the arid Southwest, city dwellers from Phoenix to New York, and Native Peoples on tribal lands from Louisiana to Alaska. This National Climate Assessment concludes that the evidence of human-induced climate change continues to strengthen and that impacts are increasing across the country.

Based on what my climatologist colleagues had always told me, the Assessment should

have begun instead by stating: *"Corn producers in Iowa, oyster growers in Washington State, and maple syrup producers in Vermont are all observing weather-related changes" outside of their personal recent experience. So, too, are coastal planners in Florida, water managers in the arid Southwest, city dwellers from Phoenix to New York, and Native peoples on tribal lands from Louisiana to Alaska."*

The Assessment concludes that opening paragraph by stating: *This National Climate Assessment concludes that the evidence of human-induced climate change continues to strengthen and that impacts are increasing across the country.*

Americans are noticing changes all around them. Summers are longer and hotter, and extended periods of unusual heat last longer than any living American has ever experienced. Winters are generally shorter and warmer. Rain comes in heavier downpours. People are seeing changes in the length and severity of seasonal allergies, the plant varieties that thrive in their gardens, and the kinds of birds they see in any particular month in their neighborhoods (p.1).

These opening paragraphs and several that follow directly communicate to the reader, both lay and professional, that human-induced global warming in an immediate disaster. For example:

Other changes are even more dramatic. Residents of some coastal cities see their streets flood more regularly during storms and high tides. Inland cities near large rivers also experience more flooding, especially in the Midwest and Northeast. Insurance rates are rising in some vulnerable locations, and insurance is no longer available in others. Hotter and drier weather and earlier snowmelt mean that wildfires in the West start earlier in the spring, last later into the fall, and burn more acreage. In Arctic Alaska, the summer sea ice that once protected the coasts has receded, and autumn storms now cause more erosion, threatening many communities with relocation.

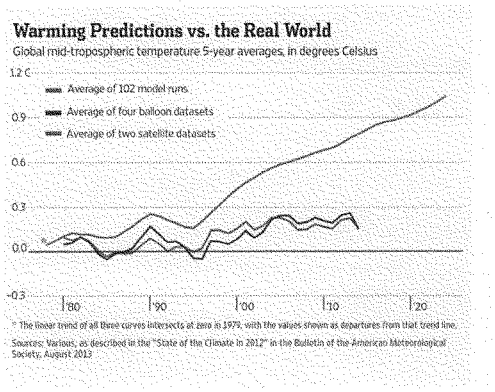
Scientists who study climate change confirm that these observations are consistent with significant changes in Earth's climatic trends. Long-term, independent records from weather stations, satellites, ocean buoys, tide gauges, and many other data sources all confirm that our nation, like the rest of the world, is warming. Precipitation patterns are changing, sea level is rising, the oceans are becoming more acidic, and the frequency and intensity of some extreme weather events are increasing (p. 1).

To be scientifically accurate, these paragraphs should instead have been written (my changes noted by underlining): *Other weather changes are even more dramatic. Residents of some coastal cities see their streets flood more regularly during storms and high tides. Inland cities near large rivers also experience more flooding, especially in the Midwest and Northeast. Insurance rates are rising in some vulnerable locations, and insurance is no longer available in others. Hotter and drier weather and earlier snowmelt mean that wildfires in the West start earlier in the spring, last later into the fall, and burn more acreage. In Arctic Alaska, the summer sea ice that once protected the coasts has receded, and autumn storms now cause more erosion, threatening many communities with relocation.*

Scientists who study weather and climate change point out that short-term, including several decades and longer, changes in weather do not confirm that these observations are consistent with significant changes in Earth's climatic trends.

These opening statements are directly followed by: *Many lines of independent evidence demonstrate that the rapid warming of the past half-century is due primarily to human activities. The observed warming and other climatic changes are triggering wide-ranging impacts in every region of our country and throughout our economy. Some of these changes can be beneficial over the short run, such as a longer growing season in some regions and a longer shipping season on the Great Lakes. But many more are detrimental, largely because our society and its infrastructure were designed for the climate that we have had, not the rapidly changing climate we now have and can expect in the future. In addition, climate change does not occur in isolation. Rather, it is superimposed on other stresses, which combine to create new challenges* (p. 1). **The assertions in this paragraph are based on the forecasts from climate models and from temperature records. However, Figure 1 shows that the climate models greatly exaggerate the rate and amount of temperature change and are not making forecasts that come even close to fitting the data. Furthermore, Figure 1 also shows that the average Earth temperature in the past 30 years has changed very little if at all, contradicting the assertions on the first page of the Assessment.**

Figure 1: Climate model forecasts compared to real world temperature observations (From John Christy, University of Alabama and Alabama State Climatologist. Reproduced with permission from him.)



The Assessment further attributes the supposed climatic warming to human activities that are releasing greenhouse gases, especially carbon dioxide, into the atmosphere. Therefore the claimed disaster is our fault. But recent evidence shows that temperature change is not tracking the increase in carbon dioxide. The gas has increased from 370 ppm to just over 400ppm, 8 percent, between year 2000 and year 2014 (Figure 2), while the temperature has changed either only slightly or not at all, depending on how one does the analysis (Figure 3). Instead, temperature change tracks closely changes in the energy output from the sun (Figure 4).

Figure 2. Mauna Loa Observatory CO_2 measurements

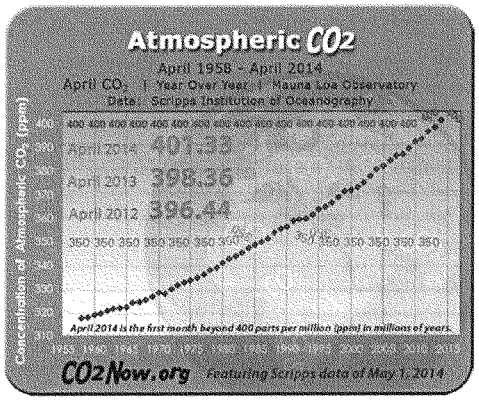


Figure 3. Earth Surface Temperature Departure from 1950-1980 Average

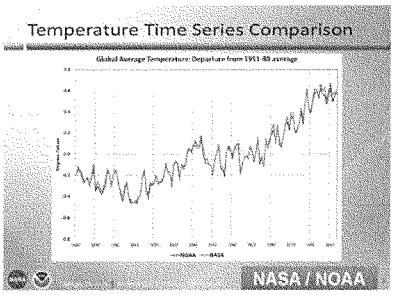
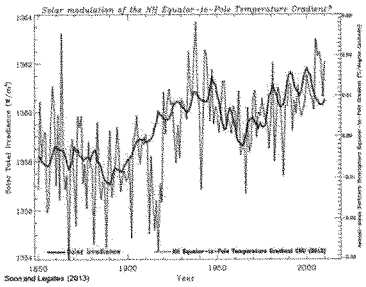


Figure 4. Correlation Between Solar Irradiance and Poleward flux of energy.
Thus the Assessment's early statements about the dangerous climate change have to do with a hypothetical, not a real, world.



The current evidence from scientific observations show that Earth's temperature has not changed very much, if at all, since the start of the new century, while carbon dioxide has increased considerably.

Given these facts, the basic opening assertions of the new U.S. Climate Change Assessment are about a hypothetical world, not a real world, and must be taken as a "what if" rather than "what is". Therefore the dire consequences forecast in the Assessment cannot be taken as reliable, nullifying many, if not most, of the ecological and biological implications the Assessment makes heavy use of.

The time available to write and the space available to publish as written testimony prevent a comprehensive, detailed review of the entire White House Climate Change Assessment. As a result, I have used as an example of the kinds of problems throughout the Assessment the table appearing on pages 204-5, *Biological Responses To climate Change.* As an ecologist, I have taken that table and reorganized it. This reorganization follows.

Although the document is titled "Climate Change Assessment," the term "climate change" is not defined and is in fact used with two meanings, natural and human-induced. There are places in the Assessment where only the second meaning makes sense, so that meaning has to be assumed. There are other places where either meaning could be applied. In those places where either meaning can be interpreted, if the statement is assumed to be a natural change, then it is a truism, a basic characteristic of Earth's environment and something people have always known and experienced. If the meaning is taken to be human-caused, then in spite of the assertions in the Assessment, the available data do not support the statements.

For example, the Assessment's section titled *CLIMATE CHANGE AND THE AMERICAN PEOPLE* begins with the statement: *Climate change, once considered an issue for a distant future, has moved firmly into the present. Corn producers in Iowa, oyster growers in Washington State, and maple syrup producers in Vermont are all observing climate-related changes that are outside of recent experience.*

If this is to be interpreted as natural, then people have frequently in history experienced

"climate-related changes that are outside of [their] recent experiences," as the Medieval Warming and Little Ice Age demonstrate,[2, 3, 4] and therefore it is not unusual nor unexpected in ordinary life. If this is to be interpreted to be human-induced, then the evidence just discussed demonstrates that this kind of change cannot be attributed to human actions and therefore the statement is false.

ANALYSIS OF THE CLIMATE CHANGE IMPACTS ASSESSMENT TABLE OF ECOLOGICAL EFFECTS (Assessment's pages 204-205)

Biological responses to climate change

The Assessment presents a list of 30 biological responses to climate change. Since this is my particular area of expertise, I have analyzed this list and sorted the items into the following categories: **Where the Assessment is wrong** based on my understanding (10 items); **Improvements** (12 items); **Declines** (which can be taken as worsening) (No items); **Predicted from Climate Models,** Therefore Not Fact, especially given the failure of climate models to forecast with any reliability Earth's increase in temperature since the 1990s (see figure 1) (3 items); and **Unlikely or Unsupported** Statement (5 items). **Within the context of the Assessment, this table comes across as meaning to demonstrate more very negative effects of a human-induced global warming, but since upon analysis none of the 30 appears to be a legitimately supported decline that might occur under a hypothetical global warming or have been directly observed, this table in fact is an argument against the overall message of the Assessment.**

(The number that appears at the beginning of each entry is the number in the Assessment's list. The numbers following each of the Assessment's entry are the citation number as listed in the Assessment. The Assessment's statements are in italics; my comments appear in plain font.)

ASSESSMENT IS WRONG

1. *21. Seedling survival of nearly 20 resident and migrant tree species decreased during years of lower rainfall in the Southern Appalachians and the Piedmont areas, indicating that reductions in native species and limited replacement by invading species were likely under climate change.134* Since the climate models are admittedly weak about changes in rainfall, this statement has no relevance to purported human-induced global warming.
2. *27. Water temperature data and observations of migration behaviors over a 34-year time period showed that adult pink salmon migrated earlier into Alaskan creeks, and fry advanced the timing of migration out to sea. Shifts in migration timing may increase the potential for a mismatch in optimal environmental conditions for early life stages, and continued warming trends will likely increase pre-spawning mortality and egg mortality rates.87* Salmon have evolved and are adapted to environmental change.
3. *3. Conifers in many western forests have experienced mortality rates of up to 87% from warming-induced changes in the prevalence of pests and pathogens and stress from drought.118* Important causes of the mortality of trees in western forests are: fire suppression, which promotes insect and disease outbreaks, and from introduced (invasive) insects and diseases. The paper cited is much more careful in the analysis than the Assessment statement, That paper states: "Regional warming and consequent increases in water deficits are likely contributors to the increases in tree mortality

rates," and "Instead, the evidence is consistent with contributions from exogenous causes, with regional warming and consequent drought stress being the most likely drivers."

4. *8. Warmer and drier conditions during the early growing season in high-elevation habitats in Colorado are disrupting the timing of various flowering patterns, with potential impacts on many important plant-pollinator relationships.77 On the contrary, the authors conclude that such timing changes are"that phonological decoupling alone is "unlikely to threaten population persistence for most species in our study area." Also, "Disrupting" is a politically loaded term. The scientific term would be "changed" "*

5. *12. Variation in the timing and magnitude of precipitation due to climate change was found to decrease the nutritional quality of grasses, and consequently reduce weight gain of bison in the Konza Prairie in Kansas and the Tallgrass Prairie Preserve in Oklahoma.124.* Results provide insight into how climate change will affect grazer population dynamics in the future. This is stated in a way that is not open to scientific evaluation. No doubt lower rainfall has negative effects, but the statement is "variation." In fact, the publication cited (Craine et al., 2008)[5] states that "Greater late-summer precipitation increased bison weight gain . . . "greater midsummer precipitation decreased weight gain." This is a scientifically interesting result for those focused on wildlife in grasslands, but it is neither a negative nor positive in terms of global warming, because the forecasting models are weakest in forecasting rainfall even annually, let alone seasonally. Therefore these results cannot be taken as negative (nor positive) effects of a global rise in average temperature.

6. *10. Cutthroat trout populations in the western U.S. are projected to decline by up to 58%, and total trout habitat in the same region is projected to decline by 47%, due to increasing temperatures, seasonal shifts in precipitation, and negative interactions with nonnative species.8.* The paper cited uses "outputs from general circulation models," which are acknowledged even by their creators to be weakest in forecasting precipitation, so these "projections" have to be taken as what might happen if a hypothetical and theoretically unvalidated and doubtful decline in water flow occurred, rather than a reliable forecast. It is a "what if" not a "what is likely to be". Stresses on Cutthroat extend considerably beyond climate change and have to do with fishing intensity, water diversions and other habitat changes, such as competition from introduced, invasive species such as lake trout and rainbow trout.[6]

7. 28. *Warmer springs in Alaska have caused earlier onset of plant emergence, and decreased spatial variation in growth and availability of forage to breeding caribou. This ultimately reduced calving success in caribou populations.*138 The implication is that warming will necessarily have a negative effect on caribou, but the paper cited (Post et al., 2008) actually is much more cautious, stating "*it is highly relevant to herbivore ecology to consider the manner in which warming will alter spatial patterns of plant phenology at more immediate spatial scales than that of the regional landscape.* The paper concludes, cautiously: " *Large herbivores prefer newly emergent forage, presumably owing to the high digestibility and nutrient content of young plant tissues . . . future warming could conceivably impair the ability of herbivores such as caribou to forage selectively, with adverse consequences for their productivity.We suggest, therefore, that it is highly relevant to herbivore ecology to consider the manner in which*

warming will alter spatial patterns of plant phenology at more immediate spatial scales than that of the regional landscape."[7]

There is again an inherent assumption that a steady-state between living things and climate is natural and necessary for a species's persistent. Wildlife population can and do adjust to changes, but this can take some time. See the examples of current adjustments, which I have added below this table. Give the populations a little time to adjust.

8. *26. Changes in female polar bear reproductive success (decreased litter mass and numbers of yearlings) along the north Alaska coast have been linked to changes in bodysize and/or body condition following years with lower availability of optimal sea ice habitat.137.* There is evidence that polar bears are adjusting by feeding more on terrestrial prey. Contrary to the publicity about polar bears, there is little information demonstrating any statistically, scientifically valid decline in polar bear populations. I have sought the available counts of the 19 subpopulations. Of these, only three have been counted twice; the rest have been counted once. Thus no rate of change in the population is possible. The first count was done 1986 for one subpopulation.[8]

9. *7. Quaking aspen-dominated systems are experiencing declines in the western U.S. after stress due to climate induced drought conditions during the last decade.122 Anderegg,*
W. R. L., J. M. Kane, and L. D. L. Anderegg, 2012: Consequences of widespread tree mortality triggered by drought and temperature stress. Nature Climate Change, 3, 30-36, doi:10.1038/nclimate1635. Given the failure of the climate models to predict temperature change and the observed lack of a significant recent rise in temperature, it is incorrect to refer to this as a "climate induced' drought. Moreover, a thousand year tree-ring study shows that deep droughts are characteristic of California. Meteorologist Martin P. Hoerling wrote on March 8,2014 that "At present, the scientific evidence does not support an argument that the drought there is appreciably linked to human-induced climate change." Hoerling is a research meteorologist, specializing in climate dynamics, at the Earth System Research Laboratory of the National Oceanic and Atmospheric Administration, and the White House's National Climate Assessment cites many of Hoerling's papers, including figure 20.4 "Longer Frost-free Season Increases Stress on Crops," so his work is respected by the authors.

10. 9. *Population fragmentation of wolverines in the northern Cascades and Rocky Mountains is expected to increase as spring snow cover retreats over the coming century.*123 Population fragmentation of wolverines in the northern Cascades and Rocky Mountains is expected to increase as spring snow cover retreats over the coming century. The idea is that less snow cover means smaller and more fragmented areas where the wolverine lives in winter. But the paper cited as the source for this (citation 123, page 214) states to the contrary that: "Large (greater than 1000 sq. km.) contiguous areas of wolverine habitat are predicted to persist within the study area throughout the 21st century for all projections." And the analysis is based on forecasts of snow cover from climate models, which are acknowledged even by their authors to be weakest in forecasting precipitation.

IMPROVEMENTS

1. *2. Northern flickers arrived at breeding sites earlier in the Northwest in response to temperature changes along migration routes, and egg laying advanced by 1.15 days for every degree increase in temperature, demonstrating that this species has the capacity to adjust their phenology in response to climate change.117*
2. *11. Comparisons of historical and recent first flowering dates for 178 plant species from North Dakota showed significant shifts occurred in over 40% of species examined, with the greatest changes observed during the two warmest years of the study.75*
3. *14. Migratory birds monitored in Minnesota over a 40-year period showed significantly earlier arrival dates, particularly in short-distance migrants, indicating that some species are capable of responding to increasing winter temperatures better thanothers.126.*
4. *15. Up to 50% turnover in amphibian species is projected in the eastern U.S. by 2100, including the northern leopard frog, which is projected to experience poleward and elevational range shifts in response to climatic changes in the latter quarter of the century.127*
5. *16. Studies of black ratsnake (Elaphe obsoleta) populations at different latitudes in Canada, Illinois, and Texas suggest that snake populations, particularly in the northern part of their range, could benefit from rising temperatures if there are no negative impacts on their habitat and prey.128*
6. *17. Warming-induced hybridization was detected between southern and northern flying squirrels in the Great Lakes region of Ontario, Canada, and in Pennsylvania after a series of warm winters created more overlap in their habitat range, potentially acting to increase population persistence under climate change.129*
7. *18. Some warm-water fishes have moved northwards, and some tropical and subtropical fishes in the northern Gulf of Mexico have increased in temperate ocean habitat.130 Similar shifts and invasions have been documented in Long Island Sound and Narragansett Bay in the Atlantic.131*
8. *23. Over the last 130 years (1880-2010), native bees have advanced their spring arrival in the northeastern U.S. by an average of 10 days, primarily due to increased warming. Plants have also showed a trend of earlier blooming, thus helping preserve the synchrony in timing between plants and pollinators.135*
9. *24. In the Northwest Atlantic, 24 out of 36 commercially exploited fish stocks showed significant range (latitudinal and depth) shifts between 1968 and 2007 in response to increased sea surface and bottom temperatures.55*
10. *25. Increases in maximum, and decreases in the annual variability of, sea surface temperatures in the North Atlantic Ocean have promoted growth of small phytoplankton and led to a reorganization in the species composition of primary (phytoplankton) and secondary (zooplankton) producers.136*
11. *29. Many Hawaiian mountain vegetation types were found to vary in their sensitivity to changes in moisture availability; consequently, climate change will likely influence elevation-related vegetation patterns in this region.139*
12. *5. In response to climate-related habitat change, many small mammal species have altered their elevation ranges, with lower-elevation species expanding their ranges*

and higher-elevation species contracting their ranges.120

DECLINES
None.

PREDICTED FROM CLIMATE MODELS, THEREFORE NOT FACT

1. 30. Sea level is predicted to rise by 1.6 to 3.3 feet in Hawaiian waters by 2100, consistent with global projections of 1 to 4 feet of sea level rise (see Ch. 2: Our Changing Climate, Key Message 10). This is projected to increase wave heights, the duration of turbidity, and the amount of re-suspended sediment in the water; consequently, this will create potentially stressful conditions for coral reef communities.140
2. 6. Northern spotted owl populations in Arizona and New Mexico are projected to decline during the next century and are at high risk for extinction due to hotter, drier conditions, while the southern California population is not projected to be sensitive to future climatic changes.121
3. 19. Global marine mammal diversity is projected to decline at lower latitudes and increase at higher latitudes due to changes in temperatures and sea ice, with complete loss of optimal habitat for as many as 11 species by midcentury; seal populations living in tropical and temperate waters are particularly at risk to future declines.132

UNLIKELY CORRELATION OR UNSUPPORTED STATEMENT

1. 13. (a and b) Climatic fluctuations were found to influence mate selection and increase the probability of infidelity in birds that are normally socially monogamous, increasing the gene exchange and the likelihood of offspring survival. 125
2. 20. Higher nighttime temperatures and cumulative seasonal rainfalls were correlated with changes in the arrival times of amphibians to wetland breeding sites in South Carolina over a 30-year time period (1978-2008).133 Of course. The time period precedes any possible effect of human-induced global warming, and the effect is a truism. Rainfall will affect amphibians. Since the climate models are admittedly weak about changes in rainfall, this statement has no relevance to purported human-induced global warming.
3. *22. Widespread declines in body size of resident and migrant birds at a bird-banding station in western Pennsylvania were documented over a 40-year period; body sizes of breeding adults were negatively correlated with mean regional temperatures from the preceding year.*85 The authors do not mention body size change at all, and just make a general statement that there is state to the contrary "There was much variation among species in phenological change, especially in autumn. . . these results illustrate "a complex and dynamic annual cycle in songbirds, with responses to climate change differing among species and migration seasons.".
4. *4. Butterflies that have adapted to specific oak species have not been able to colonize new tree species when climate change-induced tree migration changes local forest types, potentially hindering adaptation.119* The paper cited starts with the assertion that tree species "are limited in in their ability to shift theier geographic ranges quickly under climate change." This is an out-of-date assumption. A variety of recent papers

show that tree species have in the past moved more quickly that previously were assumed. Moreover, the paper discusses the ability of butterfly species to use other tree species if such tree migration did not occur and the butterflies could not adjust range range, both hypotheticals of doubtful likelihood. The paper concludes to the contrary of the Assessment's generalization that some species "performed quite well" while others did not, and under the severe assumptions of the analysis "may preclude popualtions from colonizing new locales under climate change." This is again another "what might be" given severe and ecologically unrealistic assumptions.

5. *1. Mussel and barnacle beds have declined or disappeared along parts of the Northwest coast due to higher temperatures and drier conditions that have compressed habitable intertidal space.116.* The implication is that these declines have already happened and apparently over large areas. On the contrary, the paper cited deals with experiments, not with the implied large area actual decline in mussel and barnacle beds. The paper states in reference to the world beyond the experiments that "anthropogenic climate change can alter interspecific interactions and produce unexpected changes in species distributions, community structure, and diversity."

SOME OTHER EXAMPLES OF SPECIFIC STATEMENTS THAT ARE INCORRECT, OR OVERSTATED, OR LIMITED TO A FEW SPECIFIC CASES, OR OTHERWISE OF DOUBTFUL GENERALITY

Given the length of the just-released White House Climate Change Assessment and the time available to review it, I am able to consider only a few examples of other specific problems with the Assessment. I have focused on those that have to do with biological factors. These, however, are representative of problems throughout the Assessment. (Once again, the material in italics is quotes from the Assessment; the material in standard font is my text.)

Cores from corals, ocean sediments, ice records, and other indirect temperature measurements indicate the recent rapid increase of ocean temperature is the greatest that has occurred in at least the past millennium and can only be reproduced by climate models with the inclusion of human-caused sources of heat-trapping gas emissions (p. 559). As we saw earlier, the climate models are not coming even close to forecasting air temperature change, and therefore could not be expected to forecast accurately changes in ocean temperature, so it is not correct to say that something "can only be reproduced by climate models with the inclusion of human-caused sources of heat-trapping gas emissions."

Warmer air and ocean temperatures are also causing the continued, dramatic decline in Arctic sea ice during the summer (panel D) (p. 560). We published a paper comparing Arctic sea ice extent in the nineteenth century, using historical records from ships hunting the bowhead whale, with those in recent times.[10] In this paper we wrote, "Records from May indicate that end-of-winter sea-ice extent in the Bering Sea during the mid-19th century closely resembled that in the 1972–82 data. However, the historical data reveal that sea ice was more extensive during summer, with the greatest difference occurring in July. This pattern indicates a later and more rapid seasonal retreat." While the statement in the White House Climate Change

Assessment is not contradicted by our paper, the limited statement (about the summer) in the Assessment once again paints a dire picture to the average reader, whereas our work suggests that in fact the sea ice extent recovered over winter, and changes in arctic sea ice are more complicated than the Assessment implies. The problem here is a matter of tone and communication.

Key Message 4: Seasonal Patterns: Timing of critical biological events—such as spring bud burst, emergence from overwintering, and the start of migrations—has shifted, leading to important impacts on species and habitats (p.201). The implication here is that this is entirely negative for life on Earth and will forever be so. But on the contrary, the environment has always changed and is always changing, and living things have had to adapt to these changes. Interestingly, many, if not most, species that I have worked on or otherwise know about require environmental change, including salmon and sequoia trees. [11] [12]

Two of the longest studies of animals and plants in Great Britain show that at least some species are adjusting to recent weather changes in "timing of critical biological events, such as spring bud burst, emergence from overwintering." For example, a 47-year study of the bird *Parus major* (one of the longest monitoring of any bird species) shows that these birds are responding behaviorally to recent weather changes. A species of caterpillar that is one of the main foods of this bird during egg-laying has been emerging earlier as spring temperatures have risen. In response, females of this bird species are laying their eggs an average of two weeks earlier.[13]

The second study, one of the longest experiments about how vegetation responds to temperature and rainfall, shows that long-lived small grasses and sedges are highly resistant to climate change. The authors of the study report that changes in temperature and rainfall during the past 13 years "have had little effect on vegetation structure and physiognomy."[14]

Of course with any environmental change, not all species will do well. This has always been the case, and is consistent with Darwinian evolution and with ecological knowledge. Black guillemots (Cepphus grylle), birds that nest on Cooper Island, Alaska, illustrate that some species are having difficulties adjusting to climate change. (However, black guillemots in their entire range are not a threatened or endangered species. It is only their abundance on Cooper Island that has declined.)

The problem has been that temperature increases in the 1990s caused the sea ice to recede farther from the island each spring. The parent birds feed on Arctic cod found under the sea ice and must then return to the nest to feed their chicks, who are not yet mature enough to survive on their own. For the parents to do this, the distance from feeding grounds to nest must be less than about 30 km, but in recent years the ice in the spring has been receding as much as 500–800 km (300–500 mi) from the island. As a result, the black guillemots on the island have lost an important source of food. The birds have sometimes targeted sculpin, which is not as abundant as cod.[15]

But the real problem these Cooper Island birds face today is egg predation by polar bears. With less sea ice during this time period, bears have gone ashore and eaten young birds. In 2009, of the 180 guillemots that hatched, only one on the island fledged (flew away).The solution to this has been to build bear-proof nesting boxes for the birds. In 2010, bear-proof nesting boxes resulted in about 100 birds that fledged.

Two points emerge here. One is that living things do in fact often adjust to changes in

the timing of climate events; if not, there would be little or no life on Earth. The second is that the real problem black guillemots face is here-and-now predation, which can be and has been dealt with and does not require a single focus on whether on not the climate change was human-induced.

Chapter 7, *Forests*, opens with this:
Key Messages
1. Climate change is increasing the vulnerability of many forests to ecosystem changes and tree mortality through fire, insect infestations, drought, and disease outbreaks.
As I noted before, the Assessment suffers from the use of the term "climate change" with two meanings: natural and human-induced. The implication in this key message is that the forest problems are the result of human-induced climate change, but as I have made clear, both the failure of the models and the failure of temperature change to closely track CO_2 make this key statement false. Furthermore, it is well known that (1) forest wildfires are largely due to long-term suppression of fires in the twentieth century, which allowed the buildup of excessive fuel; and (2) that insect infestations and disease outbreaks are heavily the result of introduced species and the failure to remove dead and decaying timber from forests. In addition, this key statement is another example where recent weather patterns are said to represent and prove human-induced global warming, which I pointed out at the beginning is incorrect.

Key Message 2. *U.S. forests and associated wood products currently absorb and store the equivalent of about 16% of all carbon dioxide (CO_2) emitted by fossil fuel burning in the U.S. each year. Climate change, combined with current societal trends in land use and forest management, is projected to reduce this rate of forest CO_2 uptake.*

As explained in my review of the IPCC 2014 report, the estimates of carbon uptake by vegetation used by IPCC and in major articles cited by the reports are based on what can best be called "grab samples," a relatively small number of studies done at a variety of times using a variety of methods, mainly in old-growth areas. The results reported by IPCC overestimate carbon storage and uptake by as much as 300%.[16] Therefore this is an unreliable statement.

As I stated at above, these are representative examples of problems that exist throughout the Climate Change Assessment.

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Appendix II

Additional Material for the Record

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OPINION

The Myth of the Climate Change '97%'

What is the origin of the false belief—constantly repeated—that almost all scientists agree about global warming?

By JOSEPH BAST And ROY SPENCER

May 26, 2014 7:13 p.m. ET

Last week Secretary of State John Kerry warned graduating students at Boston College of the "crippling consequences" of climate change. "Ninety-seven percent of the world's scientists," he added, "tell us this is urgent."

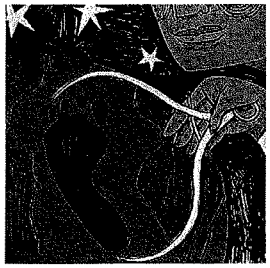
Where did Mr. Kerry get the 97% figure? Perhaps from his boss, President Obama, who tweeted on May 16 that "Ninety-seven percent of scientists agree: #climate change is real, man-made and dangerous." Or maybe from NASA, which posted (in more measured language) on its website, "Ninety-seven percent of climate scientists agree that climate-warming trends over the past century are very likely due to human activities."

Yet the assertion that 97% of scientists believe that climate change is a man-made, urgent problem is a fiction. The so-called consensus comes from a handful of surveys and abstract-counting exercises that have been contradicted by more reliable research.

One frequently cited source for the consensus is a 2004 opinion essay published in Science magazine by Naomi Oreskes, a science historian now at Harvard. She claimed to have examined abstracts of 928 articles published in scientific journals between 1993 and 2003, and found that 75% supported the view that human activities are responsible for most of the observed warming over the previous 50 years while none directly dissented.

Ms. Oreskes's definition of consensus covered "man-made" but left out "dangerous"—and scores of articles by prominent scientists such as Richard Lindzen, John Christy, Sherwood Idso and Patrick Michaels, who question the consensus, were excluded. The methodology is also flawed. A study published earlier this year in Nature noted that abstracts of academic papers often contain claims that aren't substantiated in the papers.

Another widely cited source for the consensus view is a 2009 article in "Eos, Transactions American Geophysical Union" by Maggie Kendall Zimmerman, a student at the University of Illinois, and her master's thesis adviser Peter Doran. It reported the results of a two-question online survey of selected scientists. Mr. Doran and Ms.



Getty Images/Imagezoo

Zimmerman claimed "97 percent of climate scientists agree" that global temperatures have risen and that humans are a significant contributing factor.

The survey's questions don't reveal much of interest. Most scientists who are skeptical of catastrophic global warming nevertheless would answer "yes" to both questions. The survey was silent on whether the human impact is large enough to constitute a problem. Nor did it include solar scientists, space scientists, cosmologists, physicists, meteorologists or astronomers, who are the scientists most likely to be aware of natural causes of climate change.

The "97 percent" figure in the Zimmerman/Doran survey represents the views of only 79 respondents who listed climate science as an area of expertise and said they published more than half of their recent peer-reviewed papers on climate change. Seventy-nine scientists—of the 3,146 who responded to the survey—does not a consensus make.

In 2010, William R. Love Anderegg, then a student at Stanford University, used Google Scholar to identify the views of the most prolific writers on climate change. His findings were published in Proceedings of the National Academies of Sciences. Mr. Love Anderegg found that 97% to 98% of the 200 most prolific writers on climate change believe "anthropogenic greenhouse gases have been responsible for 'most' of the 'unequivocal' warming." There was no mention of how dangerous this climate change might be; and, of course, 200 researchers out of the thousands who have contributed to the climate science debate is not evidence of consensus.

In 2013, John Cook, an Australia-based blogger, and some of his friends reviewed abstracts of peer-reviewed papers published from 1991 to 2011. Mr. Cook reported that 97% of those who stated a position explicitly or implicitly suggest that human activity is responsible for some warming. His findings were published in Environmental Research Letters.

Mr. Cook's work was quickly debunked. In Science and Education in August 2013, for example, David R. Legates (a professor of geography at the University of Delaware and former director of its Center for Climatic Research) and three coauthors reviewed the same papers as did Mr. Cook and found "only 41 papers—0.3 percent of all 11,944 abstracts or 1.0 percent of the 4,014 expressing an opinion, and not 97.1 percent—had been found to endorse" the claim that human activity is causing most of the current warming. Elsewhere, climate scientists including Craig Idso, Nicola Scafetta, Nir J. Shaviv and Nils- Axel Morner, whose research questions the alleged consensus, protested that Mr. Cook ignored or misrepresented their work.

Rigorous international surveys conducted by German scientists Dennis Bray and Hans von Storch —most recently published in Environmental Science & Policy in 2010—have found that most climate scientists disagree with the consensus on key issues such as the reliability of climate data and computer models. They do not believe that climate processes such as cloud formation and precipitation are sufficiently understood to predict future climate change.

Surveys of meteorologists repeatedly find a majority oppose the alleged consensus. Only 39.5% of 1,854 American Meteorological Society members who responded to a survey in 2012 said man-made global warming is dangerous.

Finally, the U.N.'s Intergovernmental Panel on Climate Change—which claims to speak for more than 2,500 scientists—is probably the most frequently cited source for the consensus. Its latest report claims that "human interference with the climate system is occurring, and climate change poses risks for human and natural systems." Yet relatively few have either written on or reviewed research having to do with the key question: How much of the temperature increase and other climate changes observed in the 20th century was caused by man-made greenhouse-gas emissions? The IPCC lists only 41 authors and editors of the relevant chapter of the Fifth Assessment Report addressing "anthropogenic and natural radiative forcing."

Of the various petitions on global warming circulated for signatures by scientists, the one by the Petition Project, a group of physicists and physical chemists based in La Jolla, Calif., has by far the most signatures—more than 31,000 (more than 9,000 with a Ph.D.). It was most recently published in 2009, and most signers were added or reaffirmed since 2007. The petition states that "there is no convincing scientific evidence that human release of . . . carbon dioxide, methane, or other greenhouse gases is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate."

We could go on, but the larger point is plain. There is no basis for the claim that 97% of scientists believe that man-made climate change is a dangerous problem.

Mr. Bast is president of the Heartland Institute. Dr. Spencer is a principal research scientist for the University of Alabama in Huntsville and the U.S. Science Team Leader for the Advanced Microwave Scanning Radiometer on NASA's Aqua satellite.

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ARTICLE SUBMITTED BY REPRESENTATIVE MARC VEASEY

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Paul B. Farrell

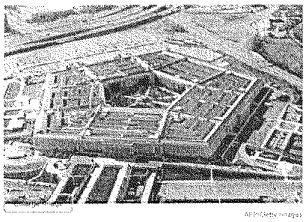
May 29, 2014, 11:32 a.m. EDT

GOP science deniers threaten U.S. national defense

Commentary: Republican House wants to limit Pentagon's use of climate studies

By Paul B. Farrell, MarketWatch

SAN LUIS OBISPO, Calif. (MarketWatch) — I'm mad as hell. The GOP used to be the party of national defense. No more. What happened? In 2003 Bush launched the Iraq War to "defend our freedom." Flash forward: Last week 227 of 231 GOP members of the House voted to turn the Pentagon into climate-science deniers, a decision certain to weaken national security. That's about as absurd as telling Silicon Valley they can't use technology.



AP/Getty Images

The Pentagon building in Washington.

Seriously, the Republicans just passed an amendment to the $607 billion National Defense Authorization Act funding the Pentagon in 2014. Yes, 227 members of the GOP-dominated House just voted to limit the Pentagon's ability to defend America, by preventing military planners from using any strategic research the military's been gathering for years about threats to national security. Listen:

"None of the funds authorized to be appropriated or otherwise made available by this act may be used to implement the U.S. Global Change Research Program National Climate Assessment, the Intergovernmental Panel on Climate Change's Fifth Assessment Report, the United Nation's Agenda 21 sustainable development plan, or the May 2013 Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order."

Get it? The Republican Party is now officially on record as the party of climate-science denialism. These research programs, ongoing and widely used by the Pentagon in strategic national defense planning for many years, could, if the Senate agrees, become illegal to use.

Yes, this Marine veteran is mad as hell. GOP science deniers have "crossed the line," they're now messing with national security. America is now under attack from an enemy within, irrational science denialism, a toxic mind-set, a spreading, self-destructive mental virus. Yes, this is a "War on America." The military has been using climate-science research for decades. This vote is self-destructive. These research studies are essential in our national defense.

If you're at all concerned about the safety of your family and our nation, you'll be mad as hell, too, about this new "War on America." All 227 Republicans are on record as science deniers, a real dumb message to send to our allies worldwide. Why? If the GOP regains the Senate in November, it may become the law of the land.

For the Democrats, this should be the last straw. These 227 GOP science deniers exposed a dangerous mind-set that's more than just part of an attack sabotaging our national defense, but a deep attack on America's moral conscience. This vote exposes a toxic virus spreading nationally. In fact, the GOP's science denialism is now so self-destructive even the Koch Bros. should be embarrassed for no other reason than that the military is the world's largest consumer of oil.

Pentagon's historic use of climate-science research in defense planning

What if the GOP regains control of the Senate? Ask the CNA Corporation Military Advisory Board, a longtime Pentagon consultant that includes 16 retired generals and admirals. They just updated a report that earlier "described projected climate change as a threat multiplier."

Get it? The Pentagon has seen climate change as a threat to our national defense for over seven years. Their updated report "drills down on the new vulnerabilities created and tensions amplified due to climate change, which it deems a catalyst for conflict." No wonder the Dems warned GOP leaders before that radical amendment to the budget vote: "That's science denial at its worst and it fails our moral obligation to our children and grandchildren."

So here's the likely scenario if the GOP takes back the Senate. The senator most likely to head the Senate Armed Services Committee is ranking GOP Sen. James Inhofe of Oklahoma, "a vocal skeptic of the established science that greenhouse-gas emissions contribute to global warming." Inhofe "scoffed at the idea that climate change is linked to national security threats."

Inhofe dismissed the updated Pentagon report by personally attacking retired Air Force Gen. Charles Wald, one of the 16 contributors. "There is no one in more pursuit of publicity than a retired military officer," said Inhofe. "I look back wistfully at the days of the Cold War. Now you have people who are mentally unbalanced, with the ability to deploy a nuclear weapon. For anyone to say that any type of global warming is anywhere close to the threat that we have with crazy people running around with nuclear weapons, it shows how desperate they are to get the public to buy this."

When the report was first released, Secretary of State John Kerry said that for years climate-science research has alerted the U.S military to hot spots and increasing regional conflicts: "Tribes are killing each other over water today. Think of what happens if you have massive dislocation, or the drying up of the waters of the Nile, of the major rivers in China and India. The intelligence community takes it seriously, and it's translated into action."

Now imagine Inhofe chairing the Senate Armed Services Committee enforcing the GOP's climate-science-denialism amendment, warning Pentagon generals never to use climate science in national defense planning.

Yes, the GOP crossed a line ... now attacking national defense

This is scary, in fact a "War on America" ... from deep within America's collective conscience. Science denialism is spreading wide and deep, sabotaging our ability to intelligently plan the defense of our nation ... by tying the hands of the Pentagon. Yes, this attack takes direct aim at America's status as the global leader in science and technology, a role that elevated us as the world's largest economy and military superpower.

Don't get us wrong, science deniers are entitled to all Bill of Rights freedoms, to fight carbon taxes, energy regulations, to deny the existence of the science that's made so many oil billionaires. Yes, they can dismiss climate science is a hoax, the biggest conspiracy against the American people. But don't vote climate-science denialism into a law limiting military defense planning.

The GOP fringe minority is now a dangerous majority. When 227 Republicans crossed the line, they exposed a vision of a GOP-run America, with a weaker national defense strategy. If this antiscience amendment passes the Senate and becomes law, why in God's name would anyone ever join the military of a nation run as an irrational anarchy?

Ironically, this is not the first time. The GOP's climate-science denialism was part of the Bush strategy in selling the Iraq war. The London Observer/Guardian exposed the GOP's plans with this headline in 2004, a year after the attack: "Now the Pentagon tells Bush: climate change will destroy us ... Secret report warns of rioting and nuclear war ... Britain will be 'Siberian' in less than 20 years ... Threat to the world is greater than terrorism." But it was then too late to stop a war that was really all about oil.

That was a decade ago. The Guardian exposed Bush's hidden 2003 warnings that "climate change over the next 20 years could result in a global catastrophe costing millions of lives in wars and natural disasters." That secret report to Bush was "suppressed by U.S. defense chiefs." The report warned "that major European cities will be sunk beneath rising seas as Britain is plunged into a Siberian climate by 2020. Nuclear conflict, megadroughts, famine and widespread rioting will erupt across the world."

America's own climate-science research predicts global anarchy

The public was not warned "that abrupt climate change could bring the planet to the edge of anarchy as countries develop a nuclear threat to defend and secure dwindling food, water and energy supplies." Worse, "the threat to global stability vastly eclipses that of terrorism ... Disruption and conflict will be endemic features of life," as "warfare would define human life" on Planet-Earth. The Guardian as quoted a Greenpeace spokesman. America has a "president who says global warming is a hoax, and across the Potomac river you've got a Pentagon preparing for climate wars."

And it gets even worse: After noting the world was already overpopulated, the Guardian added: "Climate change 'should be elevated beyond a scientific debate to a U.S. national security concern,' say the report authors, Peter Schwartz, CIA consultant and former head of planning at Royal Dutch/Shell Group, and Doug Randall of the California-based Global Business Network."

Why? Because "by 2020 catastrophic shortages of water and energy supply will become increasingly harder to overcome, plunging the planet into war," with "widespread crop failure, famine, disease and mass migration of populations." They knew climate was a a "threat multiplier" over a decade ago

Flash forward: Today ClimateProgress.org tells us Pentagon planners know "sea level rise is impacting naval bases. Climate change altering natural disaster response. Drought influenced by climate change in the Middle East and Africa leading to conflicts over food and water, for instance, Syria. The military understands the realities of climate change and the negative impacts of heavy dependence on fossil fuels. The U.S. House does not."

Bottom line: Unfortunately the GOP is now politicizing every in their blind obsession with regaining absolute power over America. They had it back in 2003. Misused that power to lead America into two wars. Now will do anything, including sabotage the Pentagon's strategic national defense planning to rule America ... proof of the historic warning that "power corrupts, and absolute power corrupts absolutely." Exactly what's happening with the new amendment to the 2014 National Defense Authorization Act.

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