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

HEARING CHARTER

A Factual Look at the Relationship Between Climate and Weather

Wednesday, December 11, 2013
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

PURPOSE

The Subcommittee on Environment will hold a hearing entitled *A Factual Look at the Relationship Between Climate and Weather* on Wednesday, December 11, 2013 in Room 2318 of the Rayburn House Office Building. The purpose of the hearing is to examine the links between climate change and extreme weather events such as hurricanes, tornadoes, droughts, and floods.

WITNESS LIST

- **Dr. John Christy**, Professor and State Climatologist, University of Alabama in Huntsville.
- **Dr. David Titley**, Director, Center for Solutions to Weather and Climate Risk, Pennsylvania State University.
- **Dr. Roger Pielke Jr.**, Professor, Center for Science and Technology Policy Research, University of Colorado.

BACKGROUND

Extreme weather events are often characterized as being severe in nature. In the United States, tornadoes, hurricanes, and droughts are examples of weather events that most often have the potential to become extreme. Definitions also note that the term "extreme weather" is based on expected distribution of events, for example occurring less than 5% of the time.[1] Even though extreme weather events are rare, their impacts to the United States are calculable in terms of loss of life and damage to the economy.

Links between extreme weather events and climate change are often cited after such weather events occur. In order to examine climate change and the Earth's atmosphere, the Intergovernmental Panel on Climate Change (IPCC) was created in 1998 by the World Meteorological Organization and the United Nation's Environment Program. The IPCC was

[1] http://www.emc.ncep.noaa.gov/gmb/ens/target/ens/albapr/albapr.html

originally tasked with preparing reports on all aspects of climate change and its impacts.[2] Since then, the IPCC has evolved to "assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation."[3]

In 1990, the IPCC released its first Assessment Report, which expressed the importance of climate change and the need for international cooperation.[4] In general, the subsequent reports of the IPCC are used globally to guide policy and provide support for climate change research. Last September, the IPCC released the Summary for Policymakers of Working Group 1's contributions to the Fifth Assessment Report (AR5).[5] Working Group 1 re-characterized the links between extreme weather events and climate change in its Summary for Policy Makers (see Appendix).

In 2012, the IPCC released a Special Report on "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation." Within the IPCC's Summary for Policymakers, they explained that:

> There is evidence from observations gathered since 1950 of change in some extremes. Confidence in observed changes in extremes depends on the quality and quantity of data and the availability of studies analyzing these data, which vary across regions and for different extremes…. Extreme events are rare, which means there are few data available to make assessments regarding changes in their frequency or intensity. The more rare the event the more difficult it is to identify long-term changes. Global-scale trends in a specific extreme may be either more reliable (e.g., for temperature extremes) or less reliable (e.g., for droughts) than some regional-scale trends, depending on the geographical uniformity of the trends in the specific extreme…. Attribution of single extreme events to anthropogenic climate change is challenging.[6]

The difficulty in attributing specific severe weather events to climate change was further described in a September 2012 editorial in Nature:

> Attribution is the attempt to deconstruct the causes of observable weather and to understand the physics of why extremes such as floods and heatwaves occur. This is important basic research. Extreme weather and changing weather patterns — the obvious manifestations of global climate change — do not simply reflect easily identifiable changes in Earth's energy balance such as a rise in atmospheric temperature. They usually have complex causes, involving anomalies in atmospheric circulation, levels of soil moisture and the like. Solid understanding of these factors is crucial if researchers are to improve the performance of, and confidence in, the climate models on which event attribution and longer-term climate projections depend.[7]

[2] http://www.ipcc.ch/organization/organization_history.shtml#.UkXN6RBxPm4
[3] http://www.ipcc.ch/pdf/ipcc-principles/ipcc-principles.pdf
[4] http://www.ipcc.ch/ipccreports/far/wg_I/ipcc_far_wg_I_full_report.pdf
[5] http://www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf
[6] http://ipcc-wg2.gov/SREX/images/uploads/SREX-SPMbrochure_FINAL.pdf
[7] http://www.nature.com/news/extreme-weather-1.11428.

ADDITIONAL READING

- IPCC Special Report on Extreme Weather: http://ipcc-wg2.gov/SREX/images/uploads/SREX-SPMbrochure_FINAL.pdf
- IPCC Assessment Report 5. Working Group 1. Summary for Policy Makers: http://www.climatechange2013.org/images/uploads/WGI_AR5_SPM_brochure.pdf

Table SPM.1 | Extreme weather and climate events: Global-scale assessment of recent observed changes, human contribution to the changes, and projected further changes for the early (2016–2035) and late (2081–2100) 21st century. Bold indicates where the AR5 (black) provides a revised* global-scale assessment from the SREX (blue) or AR4 (red). Projections for early 21st century were not provided in previous assessment reports. Projections in the AR5 are relative to the reference period of 1986–2005, and use the new Representative Concentration Pathway (RCP) scenarios (see Box SPM.1) unless otherwise specified. See the Glossary for definitions of extreme weather and climate events.

Phenomenon and direction of trend	Assessment that changes occurred (typically since 1950 unless otherwise indicated)		Assessment of a human contribution to observed changes		Likelihood of further changes	
					Early 21st century	Late 21st century
Warmer and/or fewer cold days and nights over most land areas	*Very likely*	{2.6}	***Very likely***	{10.6}	*Likely* {11.3}	*Virtually certain* {12.4}
	Very likely *Very likely*		*Likely* *Likely*			*Virtually certain* *Virtually certain*
Warmer and/or more frequent hot days and nights over most land areas	*Very likely*	{2.6}	***Very likely***	{10.6}	*Likely* {11.3}	*Virtually certain* {12.4}
	Very likely *Very likely*		*Likely* *Likely* (nights only)			*Virtually certain* *Virtually certain*
Warm spells/heat waves. Frequency and/or duration increases over most land areas	***Medium confidence*** on a global scale *Likely* in large parts of Europe, Asia and Australia	{2.6}	***Likely***[a]	{10.6}	Not formally assessed[b] {11.3}	*Very likely* {12.4}
	Medium confidence in many (but not all) regions *Likely*		Not formally assessed *More likely than not*			*Very likely* *Very likely*
Heavy precipitation events. Increase in the frequency, intensity, and/or amount of heavy precipitation	*Likely* more land areas with increases than decreases[c]	{2.6}	***Medium confidence***	{7.6, 10.6}	*Likely* over many land areas {11.3}	***Very likely*** over most of the mid-latitude land masses and over wet tropical regions {12.4}
	Likely more land areas with increases than decreases *Likely* over most land areas		*Medium confidence* *More likely than not*			*Likely* over many areas *Very likely* over most land areas
Increases in intensity and/or duration of drought	***Low confidence*** on a global scale *Likely* changes in some regions[d]	{2.6}	***Low confidence***	{10.6}	*Low confidence*[g] {11.3}	***Likely*** *(medium confidence)* on a regional to global scale[h] {12.4}
	Medium confidence in some regions *Likely* in many regions, since 1970[e]		*Medium confidence*[f] *More likely than not*			*Medium confidence* in some regions *Likely*[e]
Increases in intense tropical cyclone activity	***Low confidence*** in long term (centennial) changes *Virtually certain* in North Atlantic since 1970	{2.6}	***Low confidence***[i]	{10.6}	*Low confidence* {11.3}	***More likely than not*** in the Western North Pacific and North Atlantic[j] {14.6}
	Low confidence *Likely* in some regions, since 1970		*Low confidence* *More likely than not*			*More likely than not* in some basins *Likely*
Increased incidence and/or magnitude of extreme high sea level	*Likely* (since 1970)	{3.7}	***Likely***[k]	{3.7}	*Likely*[l] {13.7}	***Very likely***[l] {13.7}
	Likely (late 20th century) *Likely*		*Likely*[k] *More likely than not*[k]			*Very likely*[m] *Likely*

* The direct comparison of assessment findings between reports is difficult. For some climate variables, different aspects have been assessed, and the revised guidance note on uncertainties has been used for the SREX and AR5. The availability of new information, improved scientific understanding, continued analyses of data and models, and specific differences in methodologies applied in the assessed studies, all contribute to revised assessment findings.

Notes:

[a] Attribution is based on available case studies. It is *likely* that human influence has more than doubled the probability of occurrence of some observed heat waves in some locations.

[b] Models project near-term increases in the duration, intensity and spatial extent of heat waves and warm spells.

[c] In most continents, *confidence* in trends is not higher than *medium* except in North America and Europe where there have been *likely* increases in either the frequency or intensity of heavy precipitation with some seasonal and/or regional variation. It is *very likely* that there have been increases in central North America.

[d] The frequency and intensity of drought has *likely* increased in the Mediterranean and West Africa, and *likely* decreased in central North America and north-west Australia.

[e] AR4 assessed the area affected by drought.

[f] SREX assessed *medium confidence* that anthropogenic influence had contributed to some changes in the drought patterns observed in the second half of the 20th century, based on its attributed impact on precipitation and temperature changes. SREX assessed *low confidence* in the attribution of changes in droughts at the level of single regions.

[g] There is *low confidence* in projected changes in soil moisture.

[h] Regional to global-scale projected decreases in soil moisture and increased agricultural drought are *likely (medium confidence)* in presently dry regions by the end of this century under the RCP8.5 scenario. Soil moisture drying in the Mediterranean, Southwest US and southern African regions is consistent with projected changes in Hadley circulation and increased surface temperatures, so there is *high confidence* in *likely* surface drying in these regions by the end of this century under the RCP8.5 scenario.

[i] There is *medium confidence* that a reduction in aerosol forcing over the North Atlantic has contributed at least in part to the observed increase in tropical cyclone activity since the 1970s in this region.

[j] Based on expert judgment and assessment of projections which use an SRES A1B (or similar) scenario.

[k] Attribution is based on the close relationship between observed changes in extreme and mean sea level.

[l] There is *high confidence* that this increase in extreme high sea level will primarily be the result of an increase in mean sea level. There is *low confidence* in region-specific projections of storminess and associated storm surges.

[m] SREX assessed it to be *very likely* that mean sea level rise will contribute to future upward trends in extreme coastal high water levels.

Appendix