# TELECONFERENCE WITH
# RESOURCE MEDIA
# ON FRIDAY, AUGUST 24, 2007
# AT 2:00 P.M. EASTERN TIME

**OPERATOR:** Excuse me everyone, we now have our speakers in conference. Please be aware that each of your lines is in a listen-only mode. At the conclusion of the presentation we will open the floor for questions. At that time instructions will be given if you would like to ask a question.

I would now like to turn our conference over to Dr. Robert Corell. Sir, please begin.

**DR. ROBERT CORELL:** Thank you very much Operator. Welcome to this media advisory on extreme summer weather and our changing climate. We're really delighted that you all have called in to join in this briefing. We hope today to take a good look at this, the perspective that you face every day and describing your local weather and your region and many often how that sits in a global or national context. Your viewers do depend on your forecasts and projections of the weather in everyday planning, for not only industry activities but such things as weekend picnics and summer outings.

I'm Bob Corell. I'm a Senior Fellow at the American Meteorological Society and the Director of Global Change Programs at the Heinz Center.

Over the next hour we'll have an opportunity today to hear from and to be able to raise questions with some of our nation's leading scientists, whose research encompasses these issues of extreme weather and the world's climate. We're particularly delighted because all of them have been major contributors to the IPCC and the IPCC has been one of the most important sources of information and Dr. Somerville will give you more background on the IPCC.

Before we begin, as you must know by now, the background information for this session is contained in one of two, either one has the same basic information. One is www.ipccinfo, all one word, ipccinfo, or you can go to www.climatescience.tv. And of course all the basic information from the IPCC is available at ipcc.ch, C-H, that's ipcc.ch. But also note that shortly after this is over there'll be an MP3 audio recording of the entire session available to you within a few hours and it'll be up as fast as we can possibly get it. And there'll also be a transcript, for those of you who would like something in written form within the next 24 or 48 hours.

Since the bios are on the website, I'm just going to do a very short introduction of each of them in the order in which they are going to speak with us. And the plan is for each of them to give oh, five or so minutes of their perspective on these issues and then go to a time when you can raise questions with them individually or collectively as your experience in the broadcast meteorology world on this very important topic of the extremes of weather and the issue of climate change.

Our first speaker will be Dr. Richard Somerville, who is, Somerville, who is a distinguished Professor Emeritus from Scripps Institution of Oceanography at the University of California in San Diego. But he's a contributing lead author, a coordinating lead author, with a broad overview on the issues of climate change and in particular a long experienced person in the IPCC framework, and he'll give you a little background on the IPCC.

Kevin Trenberth will be the next, Dr. Kevin Trenberth. He's the Head of the Climate Analysis Section at the National Center for Atmospheric Research and he's also an IPCC coordinating lead author in what we call Working Group One. Working Group One deals with the science of climate change and he's particularly aware of the actual observations on surface and atmospheric conditions in the climate change issue.

Our third speaker will be Jerry Meehl, who's a Senior Scientist in a Climate and Global Dynamics Section at the National Center for Atmospheric, at the Center for Atmospheric Research in Boulder. He too is a coordinating lead author in Working Group

One and is particularly knowledgeable about our abilities to project into the future, the changing character of climate.

With us we also have another Scientist, who's a Broadcast Meteorologist at WDIV-TV in Detroit, and that's Paul Gross, who is the Chair of the AMS Committee on Station Scientists. So we have a really wonderful array of individuals and we're delighted they've joined us, but more importantly we're delighted that you have all come to join in this media advisory.

So let us begin, Richard, with some background on IPCC and how that leads us to better understandings of extremes and the climate change issue.

**DR. RICHARD SOMERVILLE:** Thanks very much Bob. This is Richard Somerville. As you've just heard, I and my colleagues Kevin Trenberth and Jerry Meehl are coordinating lead authors for the Working Group One part, that's the basic physical science part of the new IPCC report, the fourth assessment report, published this year and available for download free on the websites you've just heard about.

I'm going to give you my own opinions. We're not speaking officially as for IPCC, but I think everything we're going to say is consistent with the IPCC report. Two headline statements came out of this 1,000 page report, one was "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level". The key word there is unequivocal, global warming is unequivocal.

The second headline statement is most of the observed increase in globally average temperatures since the mid-20 century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. Very likely is calibrated language, it means it's 90% or more certainty. And so those two statements, that the climate system is warming and that most of the observed increase in roughly the last 50 years is likely due to man-made greenhouse gases, are the key statements. If you had to say, in just a nutshell what this report stated, that would be it. Those statements are stronger than in previous IPCC reports. The last report said, this was in 2001, there is new and stronger evidence that most of the warming observed over the last 50 years is human caused. And the one six years earlier than that simply said the balance of evidence suggests a discernable human influence on global climate. So the IPCC has been strengthening its statements.

You might ask what is the IPCC exactly and how does it work? It's an international organization, it's nearly 20 years old, it's set up to provide an authoritative assessment of results from climate science and to do it as an input to policy makers, but in a way that's policy neutral. It doesn't do research, the IPCC assess the research that gets published in the technical literature, the peer reviewed scientific research literature.

The IPCC has a tiny budget and staff and it basically organizes large numbers of scientists to get these assessments done and to get these big reports written. Thousands of scientists throughout the world, as well as governments, have contributed to this IPCC report and the reports are policy relevant, but not policy prescriptive. So anybody who likes or dislikes particular policy outcomes, like carbon taxes or nuclear power emissions controls or encouraging energy conservation and efficiency, those people have no quarrel with the IPCC. It doesn't take any policy positions period, it just assesses science.

Sometimes you'll hear the IPCC described as producing a consensus report, and some people think that consensus might be suppressing minority views, but the IPCC doesn't have this problem. What it does is it, where the science has been settled and experts agree and the research community has moved on to work on other issues, the IPCC states the resulting consensus, but where there are still unanswered scientific question, where there are different views among experts, where research remains to be done, the IPCC says that too. So for example if the question is arctic sea ice decreasing, the IPCC says yes, arctic sea ice is decreasing, that's a fact. But if the question is, what will happen to parts of the Greenland ice sheet in the near future, might it destabilize and cause a large increase in future sea level, the IPCC says that's an active area of research, we can't speak to that with certainty.

Overall, over recent years the IPCC has effectively become the voice of the mainstream scientific community, as the world seeks to understand the findings of climate science as input to policy.  It's been repeatedly vetted and endorsed by the National Academy of Science in the United States, its counterparts in other countries, and by the leading professional organizations like the American Meteorological Society, the American Geophysical Union, the American Association for the Advancement of Science.

I think it's an amazing organization; the assessment reports are the gold standard in climate science.  This latest one is even better than others.  It's apolitical and dedicated process.  It's true to the highest standards of science.  It works hard to be transparent. According to IPCC procedures, this report, which took three years to write, went through several formal and fully documented expert and government review processes, thousands of comments were responded to, and it assessed all the relevant peer reviewed literature prior to July of last year.  This widespread participation of the science community, the accuracy and the absence of any policy prescription are the characteristics of this report, that make this report so powerful.  It's exactly why it serves as a unique role in informing policy makers.

The main writing of this fourth assessment report for Working Group One, the physical science portion, was done by 152 lead authors.  It's in 11 chapters, each of the chapters had two people heading it, they're called coordinating lead authors.  We three are all coordinating lead authors, and these people were chosen by IPCC from hundreds and hundreds, over 700 author nominations from governments and other organizations, with considerations of all the balance you might think of, disciplinary, geographical, gender and so on, but uniquely in this report a quarter of the authors were young.  They had their PhD's, or equivalent in the last 10 years at the time of their appointment, and three-quarters of the report's authors including myself, had not been previous IPCC authors. We're not trying to defend an earlier version of the report; we had nothing to do with the earlier version. And more than a third of the authors, the lead authors were from developing countries, and countries with economies in transition.

My five minutes are up. I'll close right now. I just want to say that it's important the certainty of the IPCC conclusions has gone up and it's important to realize that this is not a brand new realization. We've understood the greenhouse effect since the 19th century. In this year's IPCC report the conclusions were more firm, the uncertainties went down, there's more attention to what climate change means for given regions and given climate phenomenon, like severe weather, there's more details.

We're already seeing, and I think this is the final part I'd like to leave with you, exactly the changes we've been predicting. Warming in the air and the ocean, arctic sea ice thinning, glaciers in retreat worldwide, the atmosphere becoming more humid, it's a long list. The atmospheric observations, the observations in the climate system resemble the predictions from the climate models that had been made in the past. Our predictions are coming true. Thanks.

**DR. ROBERT CORELL:** Thank you Richard. Kevin, it's your turn and as you, as most of you know, Kevin's done a lot of work on the actual observations, things we do know and also a contributing, a coordinating lead author. Kevin?

**DR. KEVIN TRENBERTH:** Thank you very much Bob. Hello everyone. My background is that I originally come from New Zealand and when I was in New Zealand I was actually a forecaster on the bench.

**DR. ROBERT CORELL:** That a way.

**DR. KEVIN TRENBERTH:** Doing shift work for about two or three years before I went to MIT to do my PhD. And so what I thought I would do is try and translate some of what has happened in the climate record into language that might be a little more familiar to a forecaster.

You know the global warming; the increase in global mean temperature is 1.4 degrees, that's the official, 1.4 degrees Fahrenheit, actually 1.76 degrees Celsius since the 1800s. But what does that mean in terms of the actual weather? Firstly we should make the point that carbon dioxide has increased in the atmosphere. Carbon dioxide is a greenhouse gas, it mainly occurs because of the burning of fossil fuels. It's increased about 35%. This is very well known, it's well established. The pre-industrial levels are well established by bubbles of air that can be analyzed for their composition in ice cores and so on, and because these are greenhouse gases and they have a long lifetime, they build up in the atmosphere, when we burn fossil fuels and that means that they produce a greenhouse effect and so global warming is happening. And one of the consequences is that we can make the statement that the global warming is unequivocal because the evidence is very widespread and many variables that symptoms of warming are occurring.

However, strictly speaking, we're dealing with warming and what the carbon dioxide does is produce what the IPCC scientists call radiative forcing, and so it's measured in terms of watts, or watts per meter squared. And this is like when you put the kettle on the stove and it starts to whistle when it's at a boil, you take it off the stove, it immediately stops whistling. And it, the key thing is that heat is going in. It's the flow of heat through the system that causes it to whistle and even though the temperature hasn't changed because you took the kettle off the stove, the effect is very different. And that's very important with regard to the kind of thing we're talking about with the effect on weather.

So when you have heating, some of that heat does go into raising temperature, and Jerry will talk more about that, but a lot of it also goes into evaporation, and that means that it causes drying in areas where there is no water available, it's not raining, and so that is likely to increase the incidence and the severity of droughts, but it also puts more water vapor into the atmosphere. And since the atmosphere is warming, with the warming of 1 degree Fahrenheit, that increases the water holding capacity by about 4%. That's a very important number to remember, 1 degree Fahrenheit is 4% increase in water holding capacity. And this is what we observe is actually happening.

So over the oceans, in particular, there's been about a 4% increase in the total water column, the precipitable water in the atmosphere, the total amount of water vapor in the atmosphere since about 1970, 4%. And so this means that any weather system that reaches out and sort of grabs the available water vapor and brings it in, whether it's a thunderstorm or an extra tropical cyclone, whether it's a rainstorm or a snowstorm or whether it's a hurricane, there is more water vapor that gets brought into the storm and so it rains harder. This is what we observe in the United States in the 20th century, the total precipitation was actually up about 7%, but the heavy rains, the top 5% were up 14% and the very heavy rains, the top 1% were up 20%.

And so this leads us to the sorts of things that we've seen in recent times. The flooding in Texas from the remnants of Erin, the current flooding in the mid-West that has been widespread, the extensive flooding in England that occurred in a period from May through July at the same time that there was a major drought and heat wave going on in Southeastern Europe. And then the other outstanding region this year has been the extensive flooding, especially in the period May through July in India and also in China. And so what happened in the early part of this hurricane season was that all the action was over in the Indian Ocean, affecting India and China and actually through wave patterns has affected England and Europe as well. And now the action seems to be picking up in the, in the Atlantic Ocean.

So this is an interpretation then of what the increased heating means in terms of things that directly affect the weather events that you see on a day-to-day basis. And so it's not just the temperature and it turns out the relative humidity is not changing much, but the total humidity, the absolute humidity or the specific humidity and usually broadcast meteorologists measure this more by the dew point. The dew point is increasing. So one of the things I would encourage you to do when you're making your broadcast is to comment a little more about the dew point. You know there were, there was some record high dew points in the Southeastern parts of the United States and you know this is a saying, it's not just the heat, it's the humidity and in this case this leads to very high minimum temperatures, it leads to great comfort (inaudible), factors and it also then can supply rainstorms and thunderstorms with record amounts of moisture.

So when this moisture flows into a storm, not only do you get something like a 4% increase in rainfall, you also get an increase in the heat, the latent heat that's given up in the storm that invigorates the storm and makes the storm more vigorous than it would before. And so the net effect can be up to double the 4% to something like 6 to 8% is the average effect of this change in the environment on all weather systems.

And so it's not a correct question to ask, is this global warming or is it natural variability, in fact it's both, and it's mostly natural variability but in all of the storms that we see these days there is a contribution from global warming because of the changes in temperature and the changes in humidity and this includes especially hurricanes and it includes snowstorms.

You know last December in the Rocky Mountain region we had record breaking heavy snows and normally in December when we get snows, the temperature is around 20 degrees, that's sort of like the minimum temperature, or the minimum temperatures in the 15 to 20 on average and we get up slopes, so the minimum temperature is a relevant number because the clouds block the sun. But in this case the temperature was around 30 degrees Fahrenheit and compared with 20 degrees Fahrenheit, that means there's about 40% more moisture in the atmosphere and we got dumped on and it had consequences, widespread consequences and so even a heavy snowfall can be a consequence of these warmer temperatures, as long as they're still below 32 degrees and can contribute to record breaking snows. And so this is the kind of information you might like to add to some of your broadcast information.

And then just turning to hurricanes again, you know all of the hurricanes are really heat engines. They involve heat coming from the ocean through evaporation that feed and fuel the storm and then the, the hurricane is actually trying to get rid of this heat by transporting it up and moving it into other areas. And one of the consequences is a very heavy rainfalls associated with these storms. In 2005 we broke all kinds of records. In 2006 the action shifted out, this is in the Atlantic should I say, in 2006 the action shifted out into the Pacific and in 2007, up until now the action has been more over in the Indian Ocean and this is competition around the world as to where the action occurs and so things like El Nino can play a key role in the distribution of where the most active storms are occurring. And it also affects the jet stream and the storm tracks in higher latitudes as well.

So that's the, those are the points I thought I would make to you and try to relate what global warming means to changes in actual weather events and storms in particular. And I'll be happy to answer any questions. Thanks.

**DR. ROBERT CORELL:** Thanks Kevin. Jerry you're next on this and Jerry's background has been very much involved in the IPCC, but also and most importantly helping us understand what this means for the future.

**DR. GERALD MEEHL:** Thanks Bob. Yeah I was going to say a little bit about projections of extremes in a future warmer climate and I guess the kind of the overall conclusion is the extreme events, weather and climate extreme events are projected to become more extreme in a warmer climate and as an example of this we can think about future heat waves. As the average temperatures warm up you can just imagine that the extremes of course will then become more extreme and future heat waves are projected to become more intense, more frequent and longer lasting.

In terms of precipitation, Kevin gave a nice overview as to the physical processes that are involved, which we've already observed. Where the atmosphere's able to hold more moisture because it's been getting warmer and the projections indicate that that will just continue on into the future, that as the climate continues to warm it will be able to hold even more moisture. That increase in available moisture will be made available for storms and so precipitation intensity is projected to increase. In other words, for a given precipitation event proportionally more precipitation will fall in the future in the warmer climate compared to present.

And this kind of relates to the character of precipitation and possibly drought and you may have heard the statements that seem to be kind of at odds, that we expect increased precipitation intensity, but also increased intensity of droughts in the future and to kind of interpret or to understand that I think you have to think about first of all geographically the changes are not geographically uniform. So in certain regions there is seasonal geographical differences that affect floods and droughts. So for example over the Northern interior of the US and wintertime the projections are in this warmer climate the storms that produce more moisture and will actually have wetter conditions during wintertime in the Northern interior states. And then in the summertime and even parts of the wintertime in the Southwest and Western US you'd have drier conditions, in other words less precipitation. So right there you can see that geographically and seasonally speaking we're talking about wetter or drier conditions depending on where you are and what time of year you're looking at.

But another kind of interesting thing and this is kind of a longstanding projection that's come from several generations of climate models is this tendency for what we often call a mid-latitude, or a mid-continental summer drying. This is a product of not only of precipitation, but temperature because the rapid transpiration goes up in a warmer climate, you get drier conditions, and therefore that gives you an increased risk of drought in the summertime.

Another kind of interesting thing about the character of changes in precipitation as the climate warms is that over most of the US, for example, we see that the projections are for increased precipitation and intensity, but over areas of the Western and Southwestern US we see actually average, the average precipitation goes down. You say well, how can this happen? If you're getting more rainfall out of the storms, why is average precipitation going down? And that's because the models are projecting that you'd actually have more days in between storms. So when it rains, it really rains hard, but then you have a longer gap in between storms and therefore when you average the precipitation summed over a season or a year, you tend to get a decrease in average precipitation. And then of course this contributes to conditions that could be conducive for more intense drought.

On the other hand, you can imagine that if you're in the Southwest US and you get amazingly intense rainfall, the risk for a flood or a flash flood or a short-term flood goes up and you can even have an increased risk of flooding in the face of a longer term average of overall drier conditions. So we've been able to assess the model results and the projections for these various things to try to disentangle these processes that contribute to the different character and the nature of precipitation and drought. And I think that's, I'm just going to leave it at that.

**DR. ROBERT CORELL:** Okay, thanks Jerry. Now Paul Gross is the Chair of the American Meteorological Society's Station Scientist Committee and he's joined us in that capacity and he's also going to raise some of the initial questions before we go to the questions from those of you who've signed onto this briefing. So Paul, it's yours.

**PAUL GROSS:** Yeah thanks a bunch, Bob and first before, my comments will be very, very brief and I want to thank all of you for taking time out of your days to be a part of this. The broadcast meteorologist has really become the public's closest link to the scientific community. If a major earthquake and a tsunami occurs, we are expected now to explain why that happened. If there's an aurora borealis, Northern lights, we're expected to explain why did that happen. If it's a volcanic eruption or, you know in this case global warming, we are now expected to explain this information to the public and provide them information to help them make up their own minds as to what a particular issue may be and how it relates to them. And so we have become the station scientists and that's why the American Meteorological Society has really put an emphasis on the creation of this committee to help, not just encourage but to enable broadcast meteorologists to convey scientific information to the public as part of their normal role as the station's broadcast meteorologist, and so that's why this teleconference is so, so important.

So with that, again my appreciation to all of you for being here and I'm going to, in my position as the Chair of the AMS Station Scientist Committee, I'm in touch with broadcast meteorologists all the time and I've kind of put together the four most discussed issues that we have in our conversations about global warming. I'll ask these questions one at a time and perhaps you fellows can chip in and provide us with some information and then we'll open it up to the others that are listening on the call.

The first question that I think a lot of people are trying to understand and get a real good handle on is just how unusual this current period of warming is. Is it something that this planet has ever experienced before? I mean how unusual is this, but most importantly what we need to know is, what is the basis, what is the certainty for this conclusion?

**DR. ROBERT CORELL:** Okay Richard, how about you taking this one?

**DR. RICHARD SOMERVILLE:** I'll take a crack at it. We might all have different, different spins on this. The IPCC has said that it's warmer now on average than it has been for over 1,000 years. We know that from looking in the pre-instrumental period at temperature proxies, things like tree rings for example. And we've furthermore seen that the rate of rise has been extraordinarily rapid.

We know something about the causes of the very warm parts of our planet's history and they have to do with changes in the Earth's orbit, that's pacing the coming and going of ice ages. Nothing like that is happening now. And from a variety of chains of evidence we're quite sure that the current warming is overwhelmingly due to human causes. That's what's behind that IPCC statement about the, most of the observed increase since mid-20th century is more than 90% likely due to the human caused increase in greenhouse gas concentrations.

Has the planet ever been warm in the past? Yes, but for different reasons that we understand. And now we can establish the relationship, the relative importance of the various reasons. It's not the sun, for example because we've measured how much the sun has changed in recent decades. And so from a long set of different chains of evidence we're quite sure that the rapid rise in temperature is unusually rapid, that the warming here is unusually warm in over 1,000 years, and that the cause is overwhelmingly likely to be human activities.

**DR. ROBERT CORELL:** And Kevin, do you want to add to that?

**DR. KEVIN TRENBERTH:** Sure. Just to pick up on that, you know the best record we have on the paleoclimate record goes back about 650,000 years from the ice cores in Antarctica and we see increases and decreases in the temperature and in the greenhouse gases, for that matter, carbon dioxide and methane. And so we can see the major ice ages and the interglacials. The last major ice age was about 20,000 years ago and it's really in the last 10,000 years, which is a period called the Holocene that there's been a relatively benign climate, and that's the period when human civilization has really taken off. And it's in that context that the recent warming is really very unusual and maybe Jerry can talk a little bit more about the fact that we can run our climate models with and without the observed changes in composition of the atmosphere, and that's how we proved to ourselves that the recent warming is caused by humans.

And the other thing, well the key point really is that the magnitude of the warming is outside of the realm of any natural variability. Natural variability certainly occurs on long time scales, but what we're seeing now is well beyond anything that can be caused by things like El Nino for instance.

**DR. ROBERT CORELL:** Jerry, do you want to add anything to that?

**DR. GERALD MEEHL:** Yeah, I could just, just kind of follow up on what Kevin introduced there. That one of the things that we always get asked is well how do you know that humans are causing this warming? How do you know it's not natural, how do you know it's not the sun? How do you know it's not something else? And that's of course a very good question and one we really couldn't answer until about, within the last 10 years and especially just within the last five years. We got to the point where the models, they're much better now, we have a better handle on what factors influence climate both natural and human and we've been able to incorporate these in models in ways that we were able to deconstruct the climate, particularly of the 20th century, where we can run models with just the effect of volcanoes isolated, or just the effect of solar variability isolated, or just the effect of increasing CO2 isolated by itself. You can actually see the contributions of these different factors to the observed temperature record and we can conclude from these studies that most of the warming we saw in the early part of this century was mostly natural. If there wouldn't have been any humans on the planet, the planet would have warmed up a couple of tenths of a degree in the early part of the century, most of that was natural, but most of the warming in the last 30 or 40 years is due to human activity, mainly due to the increase of greenhouse gases. We can see that the natural factors really don't contribute much to the warming in the last 30 to 40 years and almost all of that is due to the increase in greenhouse gases from the burning of fossil fuels.

In this way I think the models have really been useful tools in allowing us to really answer this question of how much of this is natural and how much is human? And the answer is most of the recent warming is due to human activity.

**DR. ROBERT CORELL:** Good. Thank you. Paul, how about question number two?

**PAUL GROSS:** Well I think you've kind of answered it. I just want to make sure. There is no doubt that any of this warming can be explained by anything other than the anthropogenic warming? In other words we can't look at this and say that there is a climate cycle that is part of this? Or the solar activity, which you've already talked about? We, we don't have any of these other factors that we need to include as part of the reasoning for the warming?

**DR. KEVIN TRENBERTH:** Hey Jerry?

**DR. GERALD MEEHL:** Yeah.

**DR. ROBERT CORELL:** There should be a lot of this in the context of the deep convolution. You know I was trying to separate out all the factors, maybe you want to say a few more words about that, particularly the climate cycle issue.

**DR. GERALD MEEHL:** Yeah okay. Yeah, I think we've included the effects as best we're able to represent them at least from the solar physics community from, in terms of the output of the sun. This includes kind of the 11-year solar cycle and kind of longer term changes in that cycle. We've included this in the models and like I say we're able to conclude that a lot of the warming we saw in the early part of the century is actually due to an increase in solar output.

That hasn't been a factor in the recent warming. The solar output hasn't increased that much, or has actually stayed fairly constant, but the big change that's occurred is of course the ongoing and accelerating increase of greenhouse gases in the atmosphere. And so that's allowed us to say with 90% certainty that most of the warming is due to human activity in the last 30 to 40 years.

**DR. ROBERT CORELL:** Good. Paul, you want to go to the third question you had?

**PAUL GROSS:** Yeah. One of our biggest difficulties as broadcast meteorologists in reporting on this global warming story is accurately conveying to the public how much agreement or disagreement there is in the world's scientific community. And this is a big, big bone of contention with a lot of people, even with some of my colleagues. Now matter how loud one side screams, the other side screams louder and the public is ultimately left confused. So I need a very honest and candid answer, how much scientific consensus, international scientific consensus or disagreement is there on these conclusions?

**DR. ROBERT CORELL:** Okay Richard, I'm going to ask you to take that one, at least start on it.

**DR. RICHARD SOMERVILLE:** I'll be glad to just start on it. It's a very good question and it's an intelligent question, people should ask questions like that. And the fact is that the historians of science who have studied these issues have said that compared to other scientific problems, comparable ones, there has been more agreement, a closer consensus on the basics of the problem on climate change than there have been on many other issues.

For example you can always find outliers. You know science isn't a democracy; it only takes one person proving that the consensus is wrong, but in this case it's extraordinarily unlikely that that's going to happen. There are analogs in other fields of science to the few contrarians in the climate change issue. Most of us think that HIV causes AIDS, well there are experts on retroviruses who don't think that and some of them are prominent and credentialed. The rest of the field has largely decided that those are people who can no longer be reasoned with and in the fullness of time they'll be proven wrong.

I think it's important to keep in mind that the consensus here is very real and very significant. There is an overwhelming agreement among people who are genuinely expert, not just somebody who happens to have a PhD or somebody who once worked in an allied field, but among the active researchers, the people who have real expertise and are studying this issue, we differ on degree. We can't always agree on how much and how fast and where and when and so on, but on the basic picture that the climate is changing, warming is occurring, the overwhelming cause is human-made greenhouse gases, on the consequences that we all can agree on that will come from that, rising sea level, the kinds of alterations in humidity and storms and so on that have been discussed, there is a remarkable degree of agreement.

**DR. ROBERT CORELL:** Kevin or Jerry, you want to add?

**DR. KEVIN TRENBERTH:** Yeah, let me just add a little bit. You know the IPCC process itself is, involves so many people and there are two major reviews that are carried out. For the full IPCC report there were over 450 lead authors that are, that were involved. There were over 800 contributing authors and there were over 2,500 reviewers from over 130 countries. They're a very large number of people that have been involved and there were over 30,000 comments that were sent in and all of those are, are addressed. Over 30,000 comments, that's just for the Working Group One report from more than 600 reviewers.

And so my experience is that if people are informed about the climate change, then indeed they can go along with the fact that warming is occurring and, but there's still quite a lot of people who are not well informed. And this is also sort of brought home by the fact that 110 countries in the IPCC intergovernmental process approved this statement that, you know global warming is unequivocal. And so that would be the comment that I make and I give many presentations and after I give the presentations I find that the disagreements tend to evaporate because the evidence is just so compelling.

**DR. GERALD MEEHL:** And this is Jerry, I may follow up on that a little bit. When I'm talking to people about this and somebody uses the word consensus, a lot of times they use the word consensus in a way that implies some kind of passive acquiescence of a large number of scientists with a certain view point and accepting it just because everybody else is accepting it. Anybody that knows scientists knows that that couldn't be farther from the truth. Scientists are some of the most contentious people that I've ever run across and in fact even within the IPCC assessment process there was vigorous and active discussions, some disagreement and debate and what this ends up being is, it's a debate of the balance of evidence. So what we're trying to do as scientists is look at the evidence. Okay let's look at the evidence and try to make some kind of assessment as to what we think we know about this problem. It's not necessarily a consensus, but it's a judgment of the balance of evidence.

And so when you come to a point where you think you really have an overwhelming amount of evidence for a certain conclusion, that's where you can actually get a scientist who kind of, at least agree with each other that we have that kind of assessment and that kind of agreement and that's I think what the IPCC represents. Is we were always trying to find areas where we could actually agree that, where's there's an overwhelming amount of evidence for certain things. And as was mentioned in the introduction, there are some areas where there's still a lot of debate and we note those and make sure that people understand that it's not 100% settled problem, but the things that are settled I think we can agree on and there's really active research questions that everybody's interested in finding out more about, such as the ice sheet instability question as an example, that we're still really trying to look at and we don't have agreement on.

So I think that's an important thing, that to realize that it's a balance of evidence kind of thing and the overwhelming amount of evidence for the main points is really not, not beyond much more discussion.

**DR. RICHARD SOMERVILLE:** Bob, it's Richard. I'd like to add one more point here. It's an unpleasant reality. There is an active, well-funded professional effective disinformation campaign organized to spread misunderstanding and doubt about these confusions. It's very much analogous to what happened two decades ago when the tobacco industry, parts of it actively tried to raise into question the science linking smoking and health effects. And this campaign has been well documented. There's a cover story on it in the August 13 issue of Newsweek, which is available online and there's no doubt that there's been an effort made to sow confusion, to try to cast doubt on the science.

It's a highly politicized topic and people should be careful about where the contrary opinions are coming from. Are they coming from active scientists who are doing research on this topic, or are they coming from some other source, which has a special interest in sowing confusion?

**DR. ROBERT CORELL:** Thank you. And I want to just add that the three of you here on this conference call have been intimately engaged in the science and in the, the understanding of these issues that have contributed so much to the IPCC.

Paul, you want to do your wrap-up question?

**PAUL GROSS:** Yeah, and perhaps we can keep the answer to this kind of brief so we can get to some of the other…

**DR. ROBERT CORELL:** Right.

**PAUL GROSS:** Callers that are waiting. But basically in talking to my colleagues around the country, there are some of my colleagues, scientists that challenge the actual legitimacy of the IPCC document. They say that the scientists are appointed by governments, governments are political and they make accusations that there were dissenting opinions that were kind of squashed out. And as you said Richard, you know science is not a democracy. All it takes is one. So perhaps you can comment very briefly on how the body of opinions were brought into the final document that we all saw? In other words, were dissenting opinions considered or how was that, how does that process work so that we got to the document that we all saw?

**DR. ROBERT CORELL:** Richard I'm going to turn to you again, since you gave the introduction on the IPCC.

**DR. RICHARD SOMERVILLE:** I'll be very brief because I know the others want to chime in here. Having participated in this process over the last three years, I've never seen anything less politicized. Nobody ever discussed are you a liberal, are you a conservative? We were just a bunch of scientists doing our best to evaluate the science and to take into account minority views, questioning views. We're all aware of the nature of science. This was an open, honest, transparent, non-political process.

**DR. KEVIN TRENBERTH:** Let me just chime in from a standpoint of my own chapter, chapter 3, which dealt with the observations. You know the whole report undergoes two major reviews. The first is an expert review, and in my case we had 2,230 comments on the expert review and then there was a governmental review where NGO's and governments in addition to experts make comments and we go another 1,270 comments there on the next version, so a total of 3,500 comments.

There are two review editors for each chapter, so these are like editors for a journal. They oversee the fact that every single one of those comments is responded to. There's a great big Excel spreadsheet that has the comment and it has how these comments were addressed. This is actually available, as it turns out, and every single comment is addressed and none of them are blown off. Of course many of them are contradictory and some of them may not make sense, but this document that we prepare actually addresses all of those.

**DR. ROBERT CORELL:** Good. And I would just add, while I am doing what I've introduced, in my introduction, I was at the National Science Foundation and was very much involved and Chaired the National Program on Global Change and Climate Change from its inception in 1986 and '87 and I would just echo what, what Richard had said. In all those years I never saw any of those things. In fact one of the things we did over the four assessments was increase the participation of those who have questions and doubts and they became party to the process and I think it has made a much richer IPCC process over the four assessments. I consider the assessment process one of the great social inventions of the 20th century.

But we're now at a point where we'd really like to open up the questions to those of you who've called in. And I'll turn it over to the Operator for the first question.

**OPERATOR:** Thank you. At this time we will open the floor for questions. If you would like to ask a question please press the star key followed by the one key on your touchtone phone now. Questions will be taken in the order in which they are received. And if at any time you would like to remove yourself from the questioning queue, press star two. Again any time during the questioning session press star one to ask a question.

Our first question comes from Richard Albert with WCVB-TV.

**DR. ROBERT CORELL:** Welcome Richard, go ahead.

**RICHARD ALBERT:** I have this spirited conversation with many meteorologists and some of them bring up the fact that maybe 25 to 35 years ago people were talking about, we were getting into a cold episode and the climate was changing towards a very cold climate. And if scientists couldn't figure that out 35 years ago, how do they know now for sure what's happening? Have you ever come across that argument?

**DR. ROBERT CORELL:** Sure have. I'm sure we have. Kevin, do you want to take a crack at that, since you've done a lot on observations?

**DR. KEVIN TRENBERTH:** Well yeah, but Richard I think is more familiar with the history of that and it relates to the fact that there were some reports at the time, but there was never an IPCC process and there was never a consensus about that. Richard?

**DR. RICHARD SOMERVILLE:** I think that's right. There was some media activity, there was some hyped books by journalists and there were a couple of news magazines that went over the top in talking about global cooling, but it was never a serious concern in the research community.

I think the other thing to keep in mind is what Jerry said a while back. There's been extraordinary progress in climate. Everything has improved, the climate models, the computer simulations have improved, the observations have improved, the satellite remote sensing technology has improved. We're simply far better equipped to deal with questions like this in 2007 than we were 30 years ago.

But if you Google global cooling, you will find a lot of evidence that that was never a serious research concern; just Google global cooling.

**RICHARD ALBERT:** Okay. I appreciate that, thank you so much.

**DR. ROBERT CORELL:** All right. Next question Operator.

**OPERATOR:** Our next question comes from Joe Witte with WJLA.

**DR. ROBERT CORELL:** Hey, welcome. Go ahead.

**JOE WITTE:** Thank you, Jerry, Richard, Kevin, Paul and Bob. I appreciate the time you spend on this; a quick question for each one of you. Jerry, the Northeast states have come out with a detailed report on projections of changes in the Northeast. How good are our regional models for global change?

And for Richard, you I understand went to Albany to talk to what we call the gate keepers, essentially our news directors and producers who sort of challenge us when we want to do a global warming story. How successful was that effort?

And for Kevin, it seems that if maybe when we talk about the hurricane forecast for the season we should include the entire world, rather than just the Atlantic Ocean.

And then for Bob, how significant is it as we enter the international polar year that there seems to be a wealth of new observations coming in from Greenland ice, calculations by Mark Meyer (sp?) on small glacier (inaudible 48:38) and North Pole summer sea ice coming down to a record small number? What…

**DR. ROBERT CORELL:** That's a wonderful array of questions, so let's go (inaudible) Jerry, the Northeast report.

**DR. GERALD MEEHL:** Right. I think of course this is something that we've always been asked for more information on as we've gone through the various IPCC stages, is we want more and better regional information. Some of these people we want local climate change information. As we've been able to do a much better job of this, especially in the last five years due to a number of reasons. One is the computers have gotten bigger and faster so we're able to include more detailed, regional detail in the model. We have, the modeling resolutions are now, for climate are between 100 and 150 kilometers of each written point, so we're getting better regional simulations, especially the patterns, the extremes, we've been able to look at those in a real regional context and show the models are doing pretty well on that.

We also have other techniques to downscale, or go from the global model down to regional or even quasi local scales, the statistical downscaling or embedded very high resolution regional models. So I think the quality, the amount and quality of regional information that we're getting now, particularly in this generation of models is the best we've ever been able to do.

**DR. ROBERT CORELL:** Good. Richard, how about the gate keepers meeting?

**DR. RICHARD SOMERVILLE:** Well it was, I'll be very brief, Eugene Linden (sp?), who's a popular science author, and I did visit the editors of the main newspaper in Albany, New York, a while back. We had a very good, open frank discussion and then after we left, they actually ran an editorial saying that we in this newspaper are going to no longer try to pit adversaries' alarmists versus denialists, people who believe or don't believe in global warming against each other. We're going to take as our starting point for future coverage of this issue that there is solid science that's agreed upon.

And I think a lot of newspapers, a lot of media outlets have come to similar conclusions. I think it's been a real advance.

**DR. ROBERT CORELL:** Good. Kevin, the hurricane issue and the global context for cyclonic events.

**DR. KEVIN TRENBERTH:** Yes, it turns out that the total number of tropical storms around the world is much more constant than it is in any of the individual basins and what happens is there's variability from one basin to another. And so when there's more activity in the Atlantic, there is less in the Pacific, or vice versa and El Nino plays a key role in that, among other things. And especially in the Northeast Pacific, so that's the region between Hawaii and California, versus the Atlantic. There's a very strong negative correlation between those two regions.

Now of course when a storm does make landfall, it attracts an enormous amount of attention, but there also tends to be a very US-centric view on the reporting and you can even see that with the recent storm Dean. You know I haven't seen much in the way of reports about how much damage there was in Jamaica, for instance, or even Mexico. And in 2005 it turns out the storm which created the largest number of deaths was not Katrina or Rita or Wilma, but rather a much weaker storm called Stan that actually went into Mexico and caused over 1600 deaths and you don't hear as much about that. And so a bit more balanced reporting certainly could be beneficial here.

**DR. ROBERT CORELL:** Good, thank you. And on the question of the arctic and the IPY, the International Polar Year now is well underway, started back in March and it'll go for a full two-year period and there are two things to say about it. First, it was a very comprehensive process that lead to the identification of the key scientific issues that would be addressed, such as the melting of glaciers and the changing of the sea ice in the oceanic basin of the arctic, on over to many terrestrial issues.

But just to give you a little summary, I've just returned from Greenland, where we were delighted to take a number of very, very senior industrialists, CEO's of large corporations who said, you know we're not sure about this. We'd like to have what we call a field seminar where we could sit scientifically and talk about the issues and then climb in helicopters and boats and go sort of see it first hand. And the one thing that caught them pretty dramatically is in the Disko Bay (sp?) region of the Western part of Greenland where the Ilulissat Glacier, which drains about 7% of all of the Greenland ice sheet, over the past decade or two that glacier has gone from oozing forth ice at the rate of a few kilometers per year to about 2001 it was already up to 8 kilometers per year and the measurements now are of the order of 15 kilometers per year coming out of that glacier, which is about 5 or 6 kilometers wide and of course hundreds of meters thick as it comes forth. And it was really a dramatic, they sort of said, wow. If that's the case, to give you some idea of the number, the amount of ice that flows off of that glacier now currently and every day is enough, in fresh water equivalent, to supply the water supply of any large city of the world.

So there's a dramatic change in what's going on there and I think Jerry said it well, we're, our observations are clearer, our ability to project in the future is the one that is going to dominate our interest as the IPY proceeds over the next 18 to 24 months. But the arctic clearly is a bellwether and it's giving us some of the most rapid changes on the planet and all the physics suggest that that would be the case.

So with that, let's go onto the next question.

**OPERATOR:** Our next question comes from Elliott Abrams with Accuweather.

**DR. ROBERT CORELL:** Hi, welcome. Your question, go ahead.

**ELLIOTT ABRAMS:** Yes. It was stated earlier that, and first of all I agree with the assessment of the IPCC on global climate change and it's largely responsible, but find that some of the arguments made on details are internally inconsistent. For example the cited earlier that the summer's flooding rain the middle of the country is an example of the greater precipitation, but that does not match the thesis of the mid-continent drying that was also mentioned and what's your thought on that.

**DR. ROBERT CORELL:** Yeah, internal inconsistency is an important issue to address and I'm glad you raised the issue. Kevin, why don't you take a first crack at it and we'll let others add.

**DR. KEVIN TRENBERTH:** Well this is not inconsistent with some of the comments that Jerry raised. You know the, out here in the West has been where we've seen drying and there's been a drought that's going on, beginning in 1999. There was a brief break in the, in particular in the winter of 2004, 2005, which was influenced by El Nino conditions, but it really looks like the overall tendency for drought to prevail, somewhere out in the West is continuing and this is one of the symptoms of the mid-continental drying.

What happens in the summertime is that the, the recycling of water is much more important. The local sources of evaporation, and so if you go into a summer with drier conditions, the local evaporation is less and that tends to perpetuate itself, as long as the atmospheric circulation doesn't change in some radical way. So we've tended to have a big anticyclone sitting out here with very high temperatures associated with it in the Western parts of the US.

At the same time, you can easily get conditions and generally in the last 20 or 30 years it's been a bit wetter East of the Rockies and the storm track has been displaced a little bit farther South on average. And so it can, any storm sort of coming across the country can reach down and grab the moisture out of the Gulf of Mexico and can entrain that moisture into the storms and this is what happens with some of the flooding rains.

You know another good example might be if you look at Europe. In 2003 they had a record breaking heat wave with over 30,000 deaths and that was put in place by drought conditions. Then in 2002, there was a record-breaking floods. And then in 2004 they had more floods and so one year you have very dry conditions and drought, the next year you can end up having, very influence of sea surface temperature patterns around the world. And so you can get these alternating conditions, drought one year and floods the next.

**DR. ROBERT CORELL:** Good thank you. Anybody else want to add to that? Because it is often raised by individuals who are trying to better understand this question.

**DR. GERALD MEEHL:** Yeah this is Jerry. I may just be able to add a little bit more to that and I think, as I was talking about earlier, there can be seemingly contradictory things going on, on different time scales that are still consistent with the physical processes that we're looking at. And I think the generic statement of mid-continental summer drying is one that was made, started being made actually, was in the early generations of models where all we could look at was continental scale changes. Now we're able to get better regional information and when you look at a specific continent and a specific country for example, like the US, that's when we start to see this better result of regional detail, we're actually seeing projections of drier conditions, particularly in the Southwestern US and other parts of the Western US.

But even on top of that, drought is a long-term condition that's averaged over a number of years, whereas floods are usually on the time scales of days to weeks. And so you could have flooding conditions on days to weeks, but over a five-year period still have overall dry conditions in certain regions. But I think it's a combination of the, the character of the precipitation and the time period you're looking at, and also the specific geographical area you're looking at.

**DR. KEVIN TRENBERTH:** Let me just add one more thing to that. If you look historically at the major droughts, usually they're, it's not uncommon for there to be a flooding event in the middle of a drought. And sometimes it's even exacerbated by the drought because the, when the rain, the heavy rain does hit the soils, it doesn't soak in as much because of the drought conditions and it tends to run off and it exacerbates the local flooding conditions. And sometimes that's set up by just the sort of thing we're seeing in the recent past. Something like an El Nino event, you get a brief break, but then it reverts to the previous situation.

**DR. ROBERT CORELL:** Good, thank you. I wanted to ask the Operator, how many questions in the queue? Because I would take the prerogative of the Chair and continue this briefing if there are a sufficient number of questions.

**OPERATOR:** Yes Dr. Corell, we have four more callers in the queue.

**DR. ROBERT CORELL:** All right. So why don't we take those four and then we'll make some summary comments. Okay, the next question.

**OPERATOR:** Our next question comes from Shawna Matthews with the Storm Center.

**DR. ROBERT CORELL:** Hey Shawna, welcome; your question.

**DAVE JONES:** Hi, it's actually Dave Jones. Sorry Shawna registered so.

**DR. ROBERT CORELL:** Oh okay, hi Dave.

**DAVE JONES:** Hi. I just have two quick questions. One is for the, for the broadcast meteorologist. How would you prefer that they refer to the whole global warming issue? Is it climate change, or global warming? That's the first thing.

And the second one is, how do you recommend broadcast meteorologists, and you talked about this a little bit just a minute ago, how do you recommend that they talk about weather developments today and how that connects with the whole idea of climate change, because you always get that question. Oh this major tornado outbreak happened, is that because of global warming? Or is that because of climate change? These floods are going on right now in the upper mid-West. Is that climate change or global warming? Thanks very much.

**DR. ROBERT CORELL:** Hey thanks Dave. Hey Paul, why don't you take on this issue of the, of the phraseology we use that would be helpful to the public?

**PAUL GROSS:** Well the term climate change is an overall umbrella term, and to me, global warming is a subset of that. We're currently in a period of global warming and so to me that's a subset of climate change. I personally, I think the common buzz word that the public is familiar with and used to right now is global warming and I think it really, the terminology that you use is really, can be dependent upon the report, the context of the report that a broadcast meteorologist is doing, whether it's just an off the cuff comment made at the news desk, or whether it's a more formally written report. So I think the terminology is really, you know, I think the two terms are almost interchangeable from my perspective.

And as far as taking current weather events, I have always said the most dangerous thing that we can do is take a significant weather event and try in any way, shape or form to relate that to global warming or climate change. I mean you have to take these events in terms of long-term climatological points of view, in other words incidents of hurricanes or tornados over a long period of time, but you can't take a singular event and say that this is or is not or is somehow related to global warming. I just, that's to me one of the big trip wires. It's one of the big danger zones that broadcast meteorologists have to stay away from, taking an event and trying to relate that single event to global warming.

**DR. KEVIN TRENBERTH:** Let me take a slight exception to that. I mean I agree with the comment, but at the same time there is a pervasive underlying influence of global warming, the climate change that has occurred on all events that have occurred. The sea surface temperatures are in general about 1 degree higher now than they were 30 years ago. The water vapor in the atmosphere that's lurking around is 4% up from what it used to be 30 years ago. This influences the environment of all storms and it encourages more intense rainfall events and so to the extent that we are getting heavier rainfall events, that's consistent with the view that global warming is actually happening and there is an influence.

It's not to say that there is no influence and just to, so be careful how you deal with this particular question and don't say that there isn't an influence, but certainly most of what's going on is weather, it would have occurred probably anyway, but maybe not with quite the same characteristics or quite the same rainfall.

**PAUL GROSS:** And if, this is Paul again, if I could quickly clarify. What I meant was not to say that there is no relationship, but rather, and here's an example of something I once had to say on the air because the news anchor asked me if a particular weather event was due to global warming and I said, you can't explain this one weather event by saying that it's because of global warming. However, events like this, it is said that events like this would become more common in the future in a warmer world. But you can't just take this one event.

And your comment about, for example a hurricane, yes you could have higher ocean heat content, you could have more water vapor, but if the upper atmospheric winds are not favorable, that's going to work against it. So it is part of the explanation, but it's not the whole explanation.

So my comment was simply to make sure we don't attribute an event to global warming, but rather to put it in the proper climatological context.

**DR. RICHARD SOMERVILLE:** I think that's right. This is Richard. I think we probably all want to say a few words on this.

**DR. ROBERT CORELL:** Right.

**DR. RICHARD SOMERVILLE:** We're tiptoeing around the issue. Global warming changes the odds and it, you can't say that global warming caused hurricane Katrina. You can say that global warming may create conditions favorable to more intense hurricanes. Both natural variability, which as Kevin has correctly said is always there and often dominant, is a factor, but so are these man-made changes.

One of the best science writers on this topic, Susan Hassol, an expert in climate science communication, has said use the analogy of forest fires. There're naturally caused forest fires, lightning causes them. There are also arsonists running around. So you see a particular forest fire, you may not be able to say it was due to arson, but if you know that there's a bunch of arsonists running around that forest as well as lightning storms, you can say it's a factor, it changes the odds.

**DR. ROBERT CORELL:** Very good. Well let's go to the next question.

**OPERATOR:** Our next question comes from Mike Nelson with KMGH-TV Denver.

**DR. ROBERT CORELL:** Hey Mike, welcome; your question?

**MIKE NELSON:** Thank you, nice to be with you. My dog's glad that I'm here too. I have three comments, questions I'm always asked. I'm sure many of my colleagues out in the television world are, when you're speaking to groups and they are, first of all, what makes you think you can predict a century in advance when you guys can't even predict tomorrow all the time?

The second one is, give me a percentage. What percent of this climate change is mankind's fault?

And last one, what, if anything, can we do about it?

**DR. ROBERT CORELL:** Well, all right. Well I'm going to change, Jerry to get off on this.

**DR. GERALD MEEHL:** Thanks a lot. Yeah well this, this is a question we get asked all the time also and it's a good question. And it of course relates to the different nature of the problem we're addressing. And I know this is a hard concept to communicate to people, but when we're talking about actually trying to forecast the evolution of a single particular storm going in a single particular location on an exact day is a lot different than looking at the statistics of a collection of storms in a particular season 50 years from now, and that's what we're basically doing with climate change projections. We're looking at changes of the statistics of the weather. We're not looking at changes of an individual storm, or where an individual storm will go. But like Richard just said, it's the odds. We're shifting the odds.

And sometimes I find that's useful, and I don't know how useful that is, but I try to, a lot of times try to talk about things in terms of shifting the odds, and other scientists have done this also, that we're looking at a future climate where the chances of having a severe storm are increased in certain regions, or the chances of having a heat wave are better because we've changed the background state of the climate in some ways.

So it's just a different, a different problem and we're using somewhat different tools. Also for a weather forecast we don't really care about the slowly varying parts of the climate system, like sea ice and oceans, but for climate in the future that's a major contributor to how the statistics of weather will change, is how these slowly varying parts of the climate system, like the oceans and sea ice will change. So that's, that's kind of another way of explaining it. But I think it's a difficult concept to put across to people very simply.

**DR. KEVIN TRENBERTH:** Well let me comment on that, if I might.

**DR. ROBERT CORELL:** Yeah, go ahead.

**DR. KEVIN TRENBERTH:** Because the best example we have is…

**DR. ROBERT CORELL:** This is Kevin.

**DR. KEVIN TRENBERTH:** Yes, this is Kevin. The summer versus winter, you know we still can have a lot of variety in the weather in any particular summer. We, and the same thing with any particular winter and yet we know summer is systematically different than winter and this case it's of course, it's because of the rotation of the Earth around the, around its axis. And it's the same thing if we gradually change the greenhouse gases in the atmosphere we're, we're just changing the environment in ways that are predictable, but it doesn't mean that we're predicting the details of any individual weather. And so in answer to that question, the analogy of the seasons is perhaps a helpful one.

**DR. RICHARD SOMERVILLE:** I think it's good. This is Richard Somerville. I think it's good for a broadcast meteorologist to stock themselves with communications tools, including metaphors and analogies and one that I use for this issue, when you say you can't predict tomorrow, how can you predict next century is to say, well you can't predict the date where any particular individual is going to die, but you know very well and the life insurance companies make a good income at it, by predicting the statistics of the mortality of large numbers of people. They can set premiums and evaluate risks. And climate has to do with large numbers of events and it has to do also with long-term changes in slow parts of the climate system, the ice, the deep sea circulation and so on. So it's a different problem. It's an apples and oranges comparison.

I'd like to take a first crack at this question, what can we do about it and I'll start by saying that's not a scientific question, that's a question for people, their governments, politics, to decide because it mixes the science input with people's values and priorities and economic convictions and so on. But I think many of us would agree that if you keep loading the atmosphere, using it as an all-purpose dump and increasing the amount of carbon dioxide in it, you're eventually going to get serious climate change, no matter what your definition of serious is. You're talking about the planet you're going to bequeath to your children and grandchildren.

So the many things that can be done all start with reducing the rate at which carbon dioxide is rising and eventually stabilizing the amount of it in the atmosphere at a safe level. So switching to alternative sources of energy, energy conservation, energy efficiency, sequestering carbon, all those kinds of things have a role, and many of them are economically attractive. And many governments and many large corporations are pursuing them today.

**DR. ROBERT CORELL:** Good. Mike had also asked about the percentage that's man versus natural, versus land use, other factors. Anybody want to take a crack at that?

**DR. KEVIN TRENBERTH:** Well the easiest one is the one related to rainfall and there it relates directly to water vapor and because of, it actually works better as a percentage. And the change that's occurred is a 4% increase in water vapor since about 1970 and we think that that's the contribution due to humans. And so that translates into something like a 6 to 8% change increase in rainfall intensity for individual storms on average. Now it's much harder, or it doesn't really make much sense when you talk about say 1.5 degree increase in temperature to express it as a percent. Do you express it as a percent in Fahrenheit, or degree Celsius or degrees Kelvin, and so expressing it as a percent just doesn't make sense in that case.

**DR. ROBERT CORELL:** Right. And Richard, maybe you just reiterate the two principle findings, because they set the context for better understanding of how much of this is really human induced.

**DR. RICHARD SOMERVILLE:** Well I think that's right. The IPCC chose this language very carefully and has been mentioned these findings came in the document called the Summary for Policy Makers, which was arrived at in a government meeting, an IPCC plenary in January and February of this year in Paris, and the rule there was unanimous consent of any single government dug in its heels and said we can't accept that word or that sentence, it fell on the floor and didn't go into the report. So these have been unanimously approved by every government, including the government of the United States.

And one conclusion was that most, that means more than 50%, most of the observed increased in globally averaged temperature since the mid-20$^{th}$ century is very likely, that means nine out of 10 chances or better, due to the observed increase in anthropogenic, man-made greenhouse gas concentration.

And the other statement, again universally unanimously approved of, was warming of the climate system is unequivocal, as is now evident from many sources of evidence. Observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level, and I would encourage people, not everybody can read a thousand page report, but there's a 20 page summary for policy makers from Working Group One available on the website, the IPCC and other websites, that's readable. It's not easy going, but it's readable and I would suggest to people who, and also if they have skeptical or contrarian viewers or listeners, to stop talking for a moment about the politics and the media and go and see what the IPCC actually said. Take the time to read that 20-page summary.

**DR. ROBERT CORELL:** Good. Let's go to one more, or two more questions, so let's go to that. And Mike, I hope we got yours well answered.

**MIKE NELSON:** Thank you.

**DR. ROBERT CORELL:** Go ahead, next question.

**OPERATOR:** Thank you. Our next question comes from Richard Berler with KGNS-TV.

**DR. ROBERT CORELL:** Hey Richard, welcome. Your question?

**RICHARD BERLER:** Well thanks. I have a question for Dr. Meehl and one for Dr. Trenberth and for Dr. Meehl, I was wondering, I'm under the impression that the models are,

are not capable of representing the flickering, the rapid climate changes that have taken place in the past from time-to-time, sometimes on the order of 10 years or just several years, and also all the parameterizations that go into the models, the course grid scales, the lack of knowledge of aerosol feedbacks and the ocean system.  Given these uncertainties, is it fair to look at the projections that give the various scenarios, the 1.5 centigrade rise over 100 years, 4.5, is that just a variation of the models as they stand?  Or are these numbers that are given as the uncertainty, attempting to include or take into account all the uncertainties that exist that aren't able to be put into the models now?  And again, I don't think anything's ever produced the flickering.

And for Dr. Trenberth, I was involved in a study concerning the differing temperature platforms, MMTS, which the co-op observers use and ASAW (sp?) systems.  And they have different definitions as to what constitutes a temperature.  The MMTS takes for the high of the day, the highest instantaneous reading of a 16 second sampling frequency.  The ASAW is taking a running average of five consecutive one-minute averages of a 10 second sampling and I found that the, due to the differing definitions, you came up with almost a 2 degree difference in temperature, daily temperature range.  The ASAW, with its averaging scheme trimmed off about 2 degrees.  What impact do these differing platforms have in trying to assess what's actually taking place out in the field?  And I'm sorry for being so long winded.

**DR. ROBERT CORELL:** No Richard, those are really good questions so Jerry, why don't you take a crack at the first one?

**DR. GERALD MEEHL:** All right.

**DR. ROBERT CORELL:** And then we'll come back to Kevin.

**DR. GERALD MEEHL:** Yeah. And of course this, this how valid are the models, or how good are the models, this is a question we are constantly asking ourselves because we're trying to use the models as tools to try to understand what's going on in the climate system and understand the physical processes, mechanisms that we're actually observing. And so from our point of view we're constantly trying to figure out how good the models are and how well they can simulate certain features of the climate system.

And it turns out, as time has gone on, as we're learning more about the climate system we're able to incorporate that knowledge in the models and the models are improving with each succeeding generation, so we're able to simulate the statistics, now in a statistical way of El Nino, for example, roughly the frequency and the magnitudes of El Nino events on average, the various flow fluctuations of the climate system that are natural, that are on decadal time scales. And so we're able to quantify the statistics of this kind of natural variability or flickering, as you call it, from kind of just when we run the models out for very long time periods and look and accumulate statistics over those time periods.

But now, when we actually apply the models, when we're trying to simulate 20th and 21st century climate, because these events, these natural or inherently occurring events that are going on in the climate system are occurring more or less randomly. For example El Nino, as occurring as kind of a random process, decadal variability is occurring, inherent decadal variability is more or less a random process, we start the models in the late 1800's and start running them forward into the 20th century, but you can't expect the models to simulate any given El Nino event that occurred in any given particular year, just because the model is also generating these events randomly and of course they won't necessarily synch up.

So really what we use the models to do is to first quantify the statistics of inherent climate variability, which we can do actually fairly well because we can run the model with no changes in solar output or greenhouse gases for 1,000 years or 2,000 years and really generate much better statistics of inherent climate variability than we can even get from the observations. And we can apply the knowledge of that inherent variability to interpret these simulations we do of the 20th century, where we're putting in these external factors that affected the climate system, like changes in solar variability, changes in, the volcanic eruptions, the increases of greenhouse gases, changes in visible air pollution, especially with aerosols, and changes in things like ozone. So it's kind of a way where we're trying to look at the characteristics of the models and interpret these 20th century and 21st century simulations as a consequence.

Now the uncertainty in the models of course comes because each model has its own little set of, kind of peculiar or individual behaviors and so you do get a spread among the models, because no two models are exactly alike. The real advance we had in this IPCC assessment is we were able to coordinate all the modeling groups in the world, 16 modeling groups internationally that do this kind of high-end climate modeling with, from 11 countries, using 23 models and got everybody to do the same set of experiments for 21st, the 20th and 21st century climates. We were able to really for the first time quantify this uncertainty across the models and give much better estimates of the uncertainty for future climate projections, the ranges, in other words the spread, and even start doing some probabilistic estimates of climate change, which we've never been able to do before.

So I think those are the really, the ways we use these models as tools to try to understand present and also future climates.

**RICHARD BERLER:** Can I ask a follow-up real quick?

**DR. ROBERT CORELL:** Yeah.

**RICHARD BERLER:** Has any of the models ever reproduced any of the giant and rapid flickering of 10 or more degrees centigrade that is observed in the ice core records? Or is it possible that we're not getting that, only because you're trying to simulate 20$^{th}$ and 21$^{st}$ century weather?

**DR. GERALD MEEHL:** You know that's a good question also because that's another whole aspect of climate modeling called paleoclimate modeling, where we try to simulate past climates and this is really important because a lot of times a question gets asked, well you guys are trying to simulate something in the year 2100, when the conditions of the climate system are going to be drastically different than they are today. So how do you know what you're modeling for present-day climate is going to be valid for future?

And of course we don't know exactly what the future's going to be, but we can look in the past and we can actually use the models as tools to simulate these drastically past conditions that we had during the last ice age, or during interglacial period and we're able to get a pretty good estimate from the models as to what those climates were like, and actually get pretty good correspondence with the model simulations with the limited indications that we have from the geological record of what conditions were like then. That's another really important part of trying to, to build the confidence in these models that we can actually trust them to look at different climates in the future.

**DR. KEVIN TRENBERTH:** Let me just comment briefly, if I may. You know the, you're especially asking about the flickering and there are some processes that are not included in these models. Some of them relate to glacier dynamics, but in particular there's a number of feedbacks related to the biosphere and we've seen that there's major changes in carbon dioxide and methane in the distant past as well. And so those are typically not simulated, or not included in the models right now, and in that sense the models are probably conservative. It could be that there are bigger changes, but probably still on relatively longer time scales that could occur because these processes are not currently included.

**DR. ROBERT CORELL:** Good. Let's go onto the last question. Oh…

**DR. KEVIN TRENBERTH:** Yeah, there was a question about the changing platforms on temperature.

**DR. ROBERT CORELL:** Yes, yes.

**DR. KEVIN TRENBERTH:** Let me address it briefly. You know it's the bane of our existence and we really would like to have a better climate observing system and it relates to not only changes in instruments, but changes in moving from one site to another. If the airport moves or something like that, these all cause disruptions in the, in the record and the qualities which are most sensitive to these changes are the extremes. The minimum temperature and the maximum temperature are much more sensitive to these changes than the average temperature for instance. And so what, as climate scientists, what we try to do is, or encourage is to have an overlapping record so we can get a sense of what happens when there's a change in instrument, or change in location so that we can translate one record to another. And this has been done very carefully in the US, especially by the National Climate Data Center. It is done a little bit less well in some other parts around the world and, but nonetheless we try to take these things into account. We look for changes in one station relative to surrounding stations for instance as a way of trying to keep checks on this kind of thing and it is a major concern and it's something we'd like to have better under our control, I have to say.

**RICHARD BERLER:** But what I was amazed at is you could have instruments that agreed, that would agree in a laboratory setting, but due to the differing definitions as to what they described as a maximum temperature…

**DR. KEVIN TRENBERTH:** Yes, and the length of response time and how you average.

**RICHARD BERLER:** (Inaudible) it was. I couldn't believe that you could get that much of a difference just through definition changes, let alone changing sites or urbanization around the site. How do we control this?

**DR. KEVIN TRENBERTH:** Well hopefully we know what those definitions are and we can take them into account. It's the same thing actually with intensity of hurricanes, as to what constitutes the actual intensity. It varies from one region of the world to another and hopefully one can translate from one to the other, if you know what that is.

**DR. ROBERT CORELL:** Yeah. This is Bob Corell. I've watched this question being asked over and over again and I know that the science community writ large is working very hard to try to understand the definitional character of a particular date that's set and then relate that to others. The whole issue of interoperability issues that we have to worry about and it's very much on the agenda of the community and we're doing our best, I think, to try to not let those influence the outcome, because you're right. There could be large differences, just in definition.

With that I'm going to go to the last question and then there'll be a short wrap up.

**OPERATOR:** Okay Dr. Corell. That was our last question in the queue.

**DR. ROBERT CORELL:** Oh, okay very much. Thank you. Well let me just say first, we appreciate the interest of the broadcast meteorology community for joining us in this briefing. I think the scientists have given you a pretty good view of some of the key issues that have arisen as we've looked at the relationship of these extreme weather events and how they connect to the changing climate, and for that matter into the broad issue of the warming of the planet.

Remind you about the place where you can get further information: ipccinfo or climatescience.tv and reinforce Richard's comment of getting original information, which is at ipcc.ch.

We'd welcome your feedback in two ways. One, on the website are the contact information of the scientists. If you have a specific question you'd like to pursue further with any one of them, why they would welcome the opportunity to hear from you. On a broader scale, as you know from the announcement of this, Resource Media of San Francisco has been organizing this teleconference and Jillian Ward has been one of the key players. And if you would like to send feedback information, please do so at her address, which is jillian, J-I-L-L-I-A-N @resource-media.org. Let me give you that again, jillian, J-I-L-L-I-A-N @ resource-media.org.

And I would like also to note that the William and Flora Hewlett Foundation and the Rockefeller Brothers have helped us in putting forth this resource conference and again thank you all for joining us and we hope that you will follow up with some feedback and also to remind you there'll be an audio MP3 file out in several hours of the entire, this entire conference and also there'll be a transcript. So you'll either have audio or printed versions that you can use in any way you see fit in your work as broadcast meteorologists across the country.

**PAUL GROSS:** Hey Bob, can I jump in real quick?

**DR. ROBERT CORELL:** Yes.

**PAUL GROSS:** Yup, this is Paul. I just want to - on behalf of the broadcast meteorologists I want to thank you scientists for being here with us today. We need this kind of information. I would love to make what we did today an annual type of event to update us on this subject and we need from you the type of information, I forget who talked about metaphors, but I once heard a climate scientist responding to a question about, has, has the Earth been this warm before? And he said, oh sure, the Earth has been this warm before, but it took hundreds, or maybe 1,000 or more years to get that warm and we're going to do it in 100 years and species don't have time to adapt to that rapid of a change. And that was a very important statement. So we need that type of information to be able to convey this science to the public.

And you know we had a great question about all the climate modeling and stuff, but we can't get into that kind of detail with the general viewership that watch our television newscast. So again we appreciate what you did today and anything that we can do to keep getting this type of information that broadcast meteorologists can then turn over and report to our viewers would be so beneficial.

**DR. ROBERT CORELL:** Well Paul, maybe you can help because you Chair the AMS Station Scientist Committee, maybe over the month ahead you could work with us and by the way, don't hesitate to send Paul some feedback. Paul, what's your email address?

**PAUL GROSS:** Yeah it's paulg, no spaces or dashes, just P-A-U-L-G @wdiv.com. That's W, D as in dog, I as in I and V as in Victor.

**DR. ROBERT CORELL:** Good. So we hope to keep this as transparent as possible and Paul we'll work over the coming months to see whether we can do this again, based on the feedback, to sharpen up ways to better support the broadcast meteorological community across the country.

And with that we'll conclude this session and thank you all again for participating.

**PAUL GROSS:** Thank you all very, very much.

**DR. ROBERT CORELL:** Bye-bye.

**OPERATOR:** Thank you. This is the conclusion of your call and you may now disconnect.