CEQ Draft Guidance for GHG Emissions and the Effects of Climate Change
Committee on Natural Resources
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I am John R. Christy, Distinguished Professor of Atmospheric Science, Alabama's State Climatologist and Director of the Earth System Science Center at The University of Alabama in Huntsville. I have served as a Lead Author, Contributing Author and Reviewer of United Nations IPCC assessments, have been awarded NASA's Medal for Exceptional Scientific Achievement, and in 2002 was elected a Fellow of the American Meteorological Society.

It is a privilege for me to offer my analysis of the impact that proposed regulations might have on the climate system. My research area might be best described as building datasets from scratch to advance our understanding of what the climate is doing and why. I have used traditional surface observations as well as measurements from balloons and satellites to document the climate story. Many of our UAH datasets are used to test hypotheses of climate variability and change.

Impact of Single (or many) Federal Projects on Climate

The basic question under consideration here is to understand whether there is a causal relationship between the carbon emissions generated by a single proposed federal project and possible climate change related to those emissions. It is obvious that the emissions generated by a single project would be vanishingly small in comparison to the current emissions of the global economy or even of the United States as a whole. Because of the minuscule nature of the relative size of its emissions, the impact of a single project on the global climate system would be imperceptible.

To demonstrate any impact at all on the climate system, we must scale up the size of the emission changes to a much larger value than that of a single project. By doing so, our tools would then be able to provide some results. Let us assume, for example, that the total emissions from the United States are reduced to zero, today, 13 May 2015. In other words as of today and going forward, there would be no industry, no cars, no utilities, no people – i.e. the United States would cease to exist as of this day. With this we shall attempt to answer the question posed by the NEPA statement which is, essentially, what is the "climate change through GHG emissions."

[Note: There seems to be some confusion here. The NEPA statement appears to call for the calculation of the amount of climate change brought about by the emission levels proposed for each project. However, the CEQ guidance states, "the potential effects of a proposed action on climate change as indicated by its GHG emissions." The CEQ guidance, in effect, claims that any GHG emissions in some sense relate to all of the

alleged consequences of extra GHGs. Thus, the guidance apparently seeks to claim emissions are a direct proxy for negative impacts of climate change (which as shown below has not been established) while skipping any calculation of that effect from the individual projects. Then, inconceivably, the guidance does not even consider the inarguably positive consequences of increases in GHG emissions which are quantifiable as well: (1) the enhancement of the length and quality of human life through affordable energy, and (2) the invigoration of the biosphere (specifically plant material used for human food).]

Using the U.N. IPCC impact tool known as Model for the Assessment of Greenhouse-gas Induced Climate Change or MAGICC, graduate student Rob Junod and I reduced the projected growth in total global emissions by U.S. emission contribution starting on this date and continuing on. We also used the value of the equilibrium climate sensitivity as determined from empirical techniques of 1.8 °C. After 50 years, the impact as determined by these model calculations would be only 0.05 to 0.08 °C – an amount less than that which the global temperature fluctuates from month to month. [These calculations used emission scenarios A1B-AIM and AIF-MI with U.S. emissions comprising 14 percent to 17 percent of the 2015 global emissions. There is evidence that the climate sensitivity is less than 1.8 °C, which would further lower these projections.]

Because changes in the emissions of our entire country would have such a tiny calculated impact on global climate, it is obvious that single projects, or even entire sectors of the economy would produce imperceptible impacts. In other words, there would be no evidence in the future to demonstrate that a particular climate impact was induced by the proposed regulations. Thus, the regulations will have no meaningful or useful consequence on the physical climate system – even if one believes climate models are useful tools for prediction.

How well do we understand the climate?

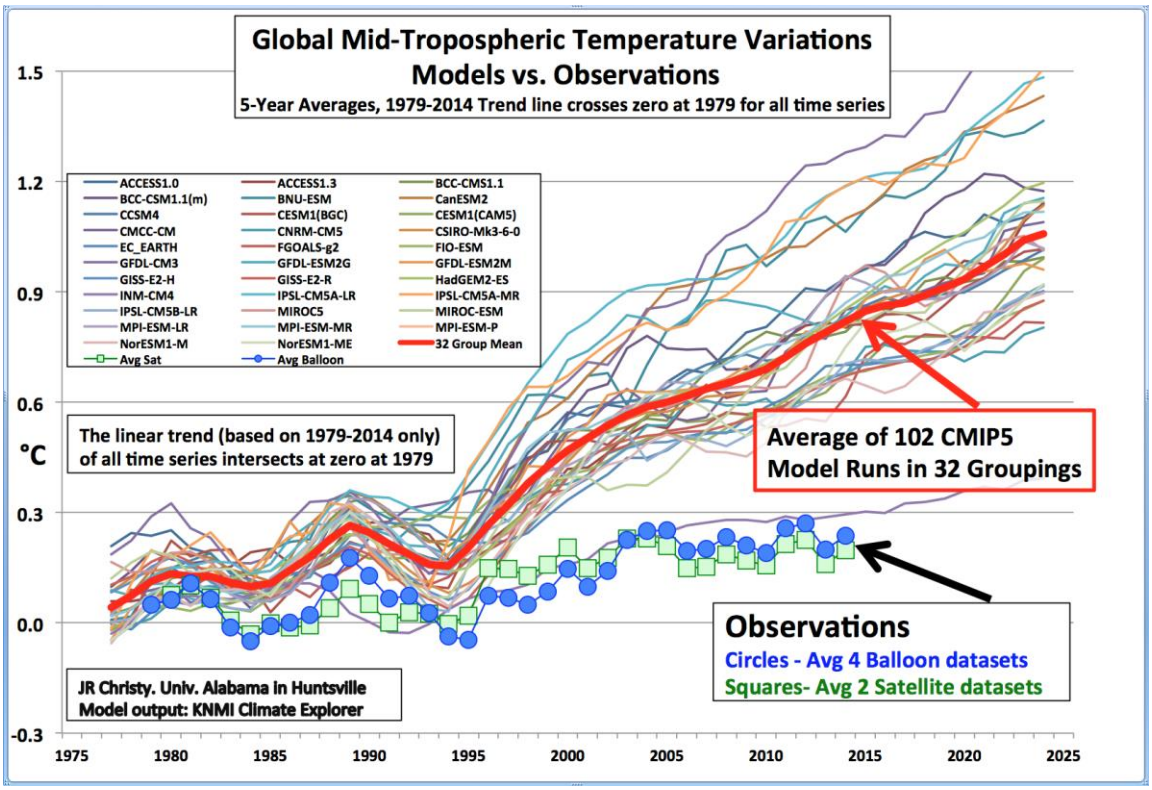
It is important to understand that projections of the future climate and the specific link that increasing CO2 might have on the climate are properly defined as scientific hypotheses or claims, not proof of such links. The projections being utilized for this and other policies are based on the output of climate model simulations. These models are complex computer programs which attempt to describe through mathematical equations as many factors that affect the climate as is possible and thus estimate how the climate might change in the future. The equations for many of the important processes are not exact, but represent the best approximations modelers can devise at this point.

A fundamental aspect of the scientific method is that if we say we understand a system (such as the climate system) then we should be able to predict its behavior. If we are unable to make accurate predictions, then at least some of the factors in the system are not well defined or perhaps even missing. [Note, however, that merely replicating the behavior of the system (i.e. reproducing "what" the climate does) does not guarantee that the fundamental physics are well-known. In other words, it is possible to obtain the right

answer for the wrong reasons, i.e. getting the "what" of climate right but missing the "why".]

Do we understand how greenhouse gases affect the climate, i.e. the link between emissions and climate effects? A very basic metric for climate studies is the temperature of the bulk atmospheric layer known as the troposphere, roughly from the surface to 50,000 ft altitude. This is the layer that, according to models, should warm significantly as CO2 increases. And, this CO2-caused warming should be easily detectible by now, according to models. This provides a good test of how well we understand the climate system because since 1979 we have had two independent means of monitoring this layer – satellites from above and balloons with thermometers released from the surface.

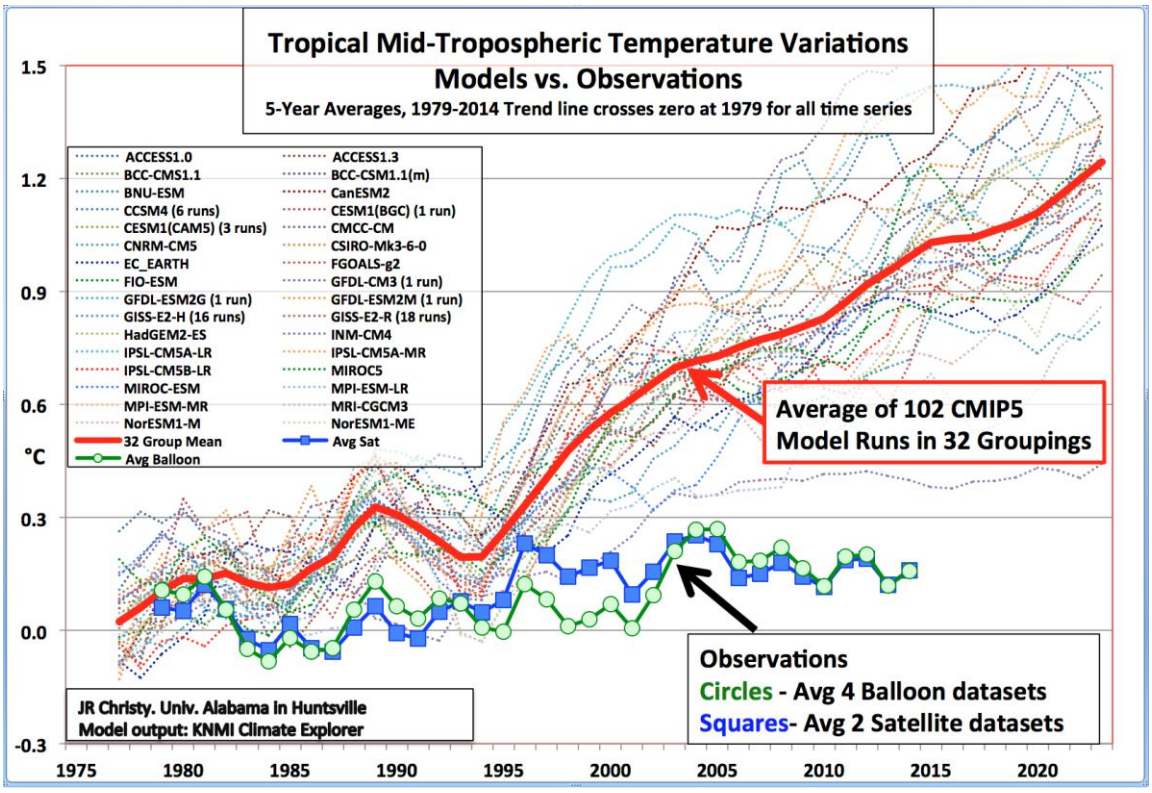
I was able to access 102 CMIP-5 rcp4.5 (representative concentration pathways) climate model simulations of the atmospheric temperatures for the tropospheric layer and generate bulk temperatures from the models for an apples-to-apples comparison with the observations from satellites and balloons. These models were developed in institutions throughout the world and used in the IPCC AR5 Scientific Assessment (2013).



Above: Global average mid-tropospheric temperature variations (5-year averages) for 32 models representing 102 individual simulations (lines). Circles (balloons) and squares (satellites) depict the observations.

The information in this figure provides clear evidence that the models have a strong tendency to over-warm the atmosphere relative to actual observations. On average the models warm the global atmosphere at a rate three times that of the real world. Using the scientific method we would conclude that the models do not accurately represent at least some of the important processes that impact the climate because they were unable to "predict" what has occurred. In other words, these models failed at the simple test of telling us "what" has already happened, and thus would not be in a position to give us a confident answer to "what" may happen in the future and "why." As such, they would be of highly questionable value in determining policy that should depend on a very confident understanding of how the climate system works.

There is a related climate metric that also utilizes atmospheric temperature which in models has an even larger response than that of the global average shown above. This metric, then, provides a stronger test for understanding how well models perform regarding greenhouse gases specifically. In the models, the tropical atmosphere warms dramatically in response to the added greenhouse gases – more so than that of the global average atmospheric temperature.



Above: Tropical average mid-tropospheric temperature variations (5-year averages) for 32 models representing 102 individual simulations (lines). Circles (balloons) and squares (satellites) depict the observations.

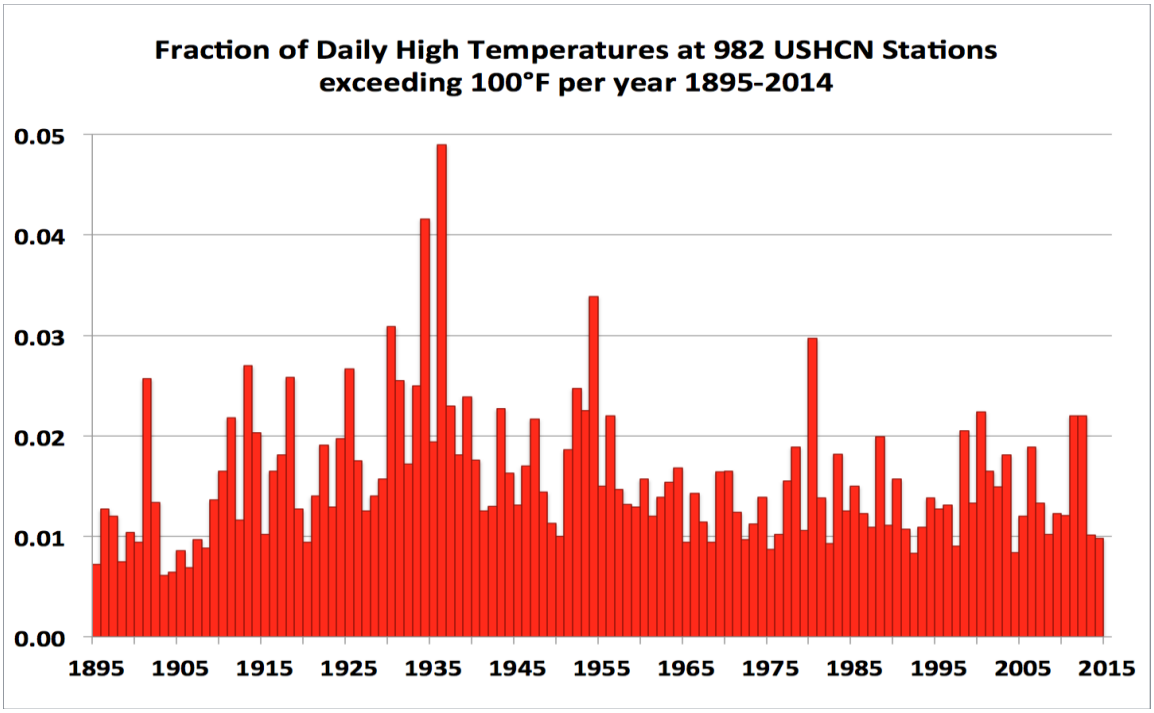
In the tropical comparison here, the disparity between models and observations is even greater, with models on average warming this atmospheric region by a factor of four times greater than in reality. Such a result re-enforces the implication above that the models have much improvement to undergo before we may have confidence they will provide information about what the climate may do in the future or even why the climate varies as it does. For the issue at hand, estimates of how the global temperature might be affected by emission reductions from the halting of projects would be over done and not reliable. *As such greenhouse gas emissions cannot be used as a proxy for alleged climate change because our capability to demonstrate how greenhouse gases influence the already-observed climate is so poor.*

Alleged impacts of human-induced climate changes outlined in the CEQ Guidance

As stated in the bracketed paragraph earlier, the CEQ guidance attempts to equate any GHG emissions with all alleged impacts of these emissions, which as mentioned earlier is apparently not consistent with NEPA. In other words, CO2 is assumed to be a direct proxy for alleged climate change due to human activities. However, these claimed impacts are not even consistently backed up by observational evidence: from the CEQ, "observed to date and projected to occur in the future include more frequent and intense heat waves, more severe wildfires, degraded air quality, more heavy downpours and flooding, increased drought, greater sea-level rise, more intense storms, harm to water resources, harm to agriculture, and harm to wildlife and ecosystems." (Section II.B pp 6-8.)

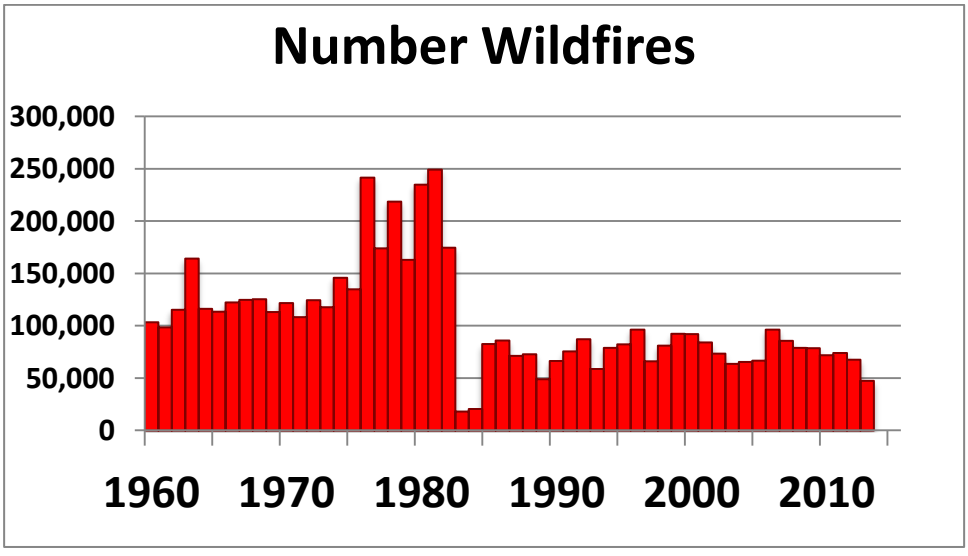
A simple examination of several of these alleged "observed to date" changes in the climate indicates the CEQ has evidently disregarded the actual observational record. I shall offer several examples which indicate these claims are misrepresentative.

In terms of heat waves, below is the number of 100 °F days observed in the U.S. from a controlled set of weather stations. It is not only clear that hot days have not increased, but it is interesting that in the most recent years there has been a relative dearth of them.

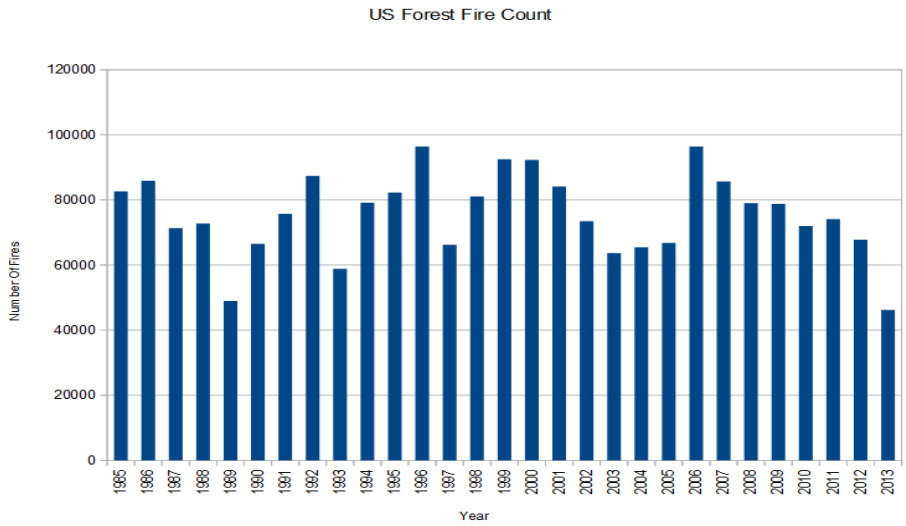


Above: Average per-station fraction of days in each year reaching or exceeding 100°F in 982 stations of the USHCN database (NOAA/NCEI, prepared by JRChristy). A value of 0.03 is equivalent to an average of 11 days per year greater than 99°F per station using all 982 stations nationwide.

Forest and wild fires are documented for the US. The evidence below indicates there has not been any change in frequency of wildfires. Acreage (not shown) shows little change as well.



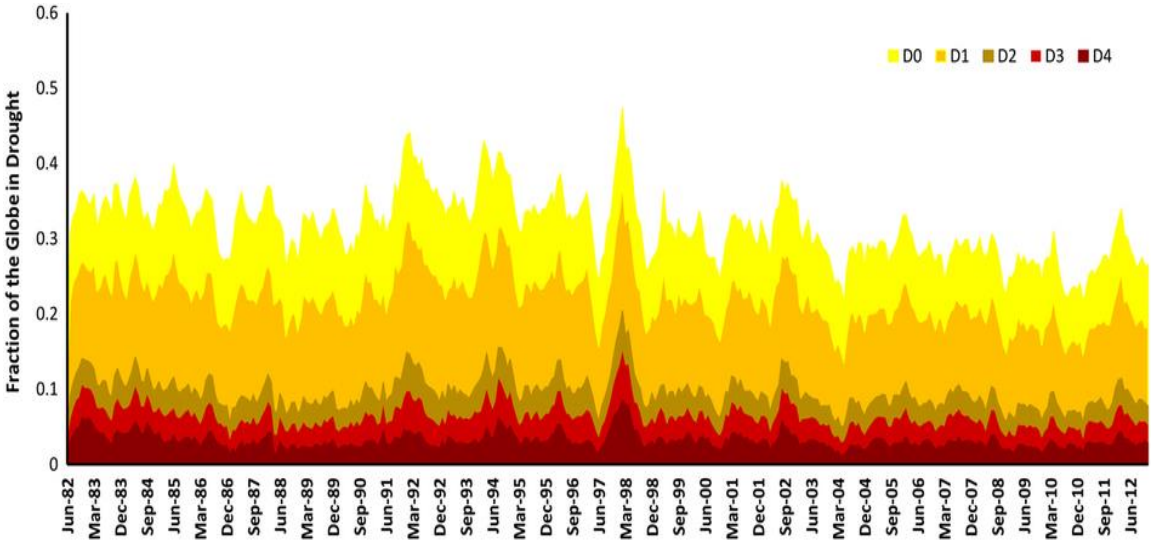
Above: Number of U.S. wildfires. As the management of these events changes, the number also changes, but the number of events since 1985 has remained constant.



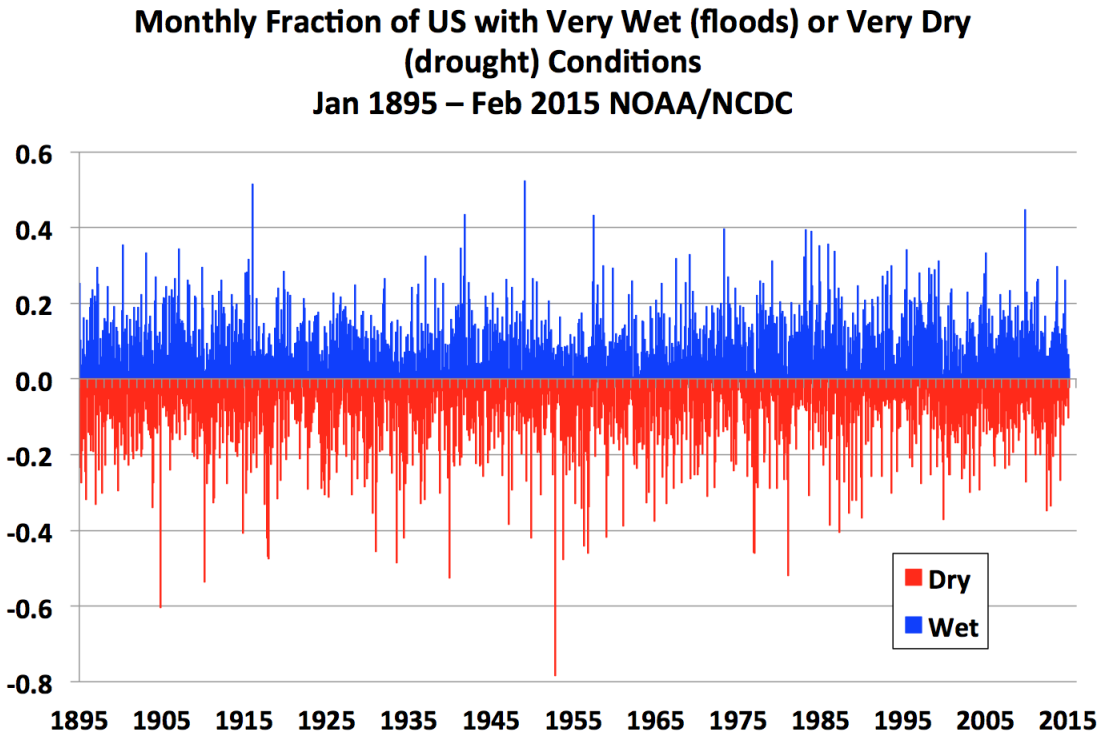
Above: Number of U.S. forest fires per year since 1965.

The two figures above demonstrate that fire events have not increased in frequency in the United States during the past several decades.

The claims that droughts and floods are increasing may be examined by the observational record as well.

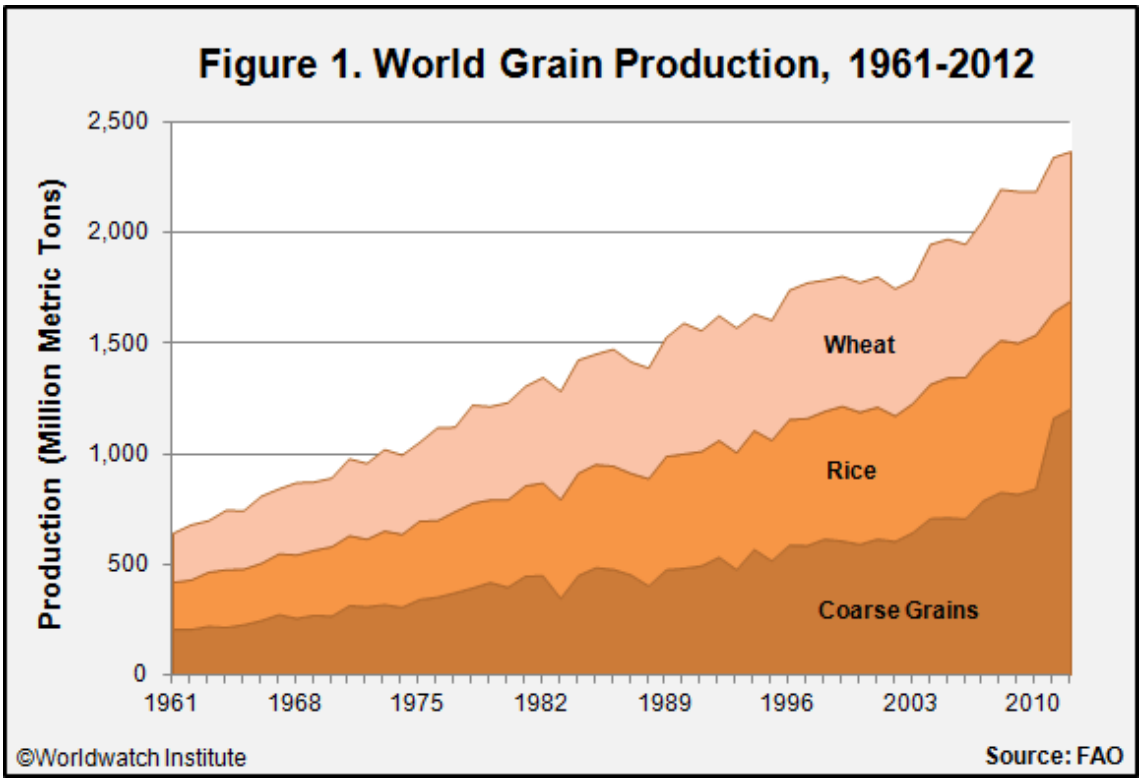


Above: Global areal extent of five levels of drought for 1982-2012 where dryness is indicated in percentile rankings with D0 < 30, D1 < 20, D2 < 10, D3 < 5 and D4 < 2 percentile of average moisture availability. (Hao et al. 2014)



Above: Areal fraction of conterminous U.S. under very wet (blue) or very dry (red) conditions. NOAA/NCEI.

The two figures above demonstrate that moisture conditions have not shown a tendency to have decreased (more drought) or increased (more large-scale wetness). Such information is rarely consulted when it is more convenient simply to make unsubstantiated claims that moisture extremes, i.e. droughts and floods (which have always occurred), are somehow becoming even more extreme. Over shorter periods and in certain locations, there is evidence that the heaviest precipitation events are tending to be greater. This is not a universal phenomenon and it has not been established that such changes may be due to changes in greenhouse gas concentrations as demonstrated earlier because the model projections are unable to reproduce the simplest of metrics.



Above: World grain production 1961-2012. U.N. Food and Agriculture Organization.

It is a simple matter to find documentation of the ever-rising production of grains. One wonders about the CEQ allegation that there has been "harm to agriculture" from human-induced climate change because when viewing the total growth in production, which appears to be accelerating, one would assume no "harm" has been done during a period of rising greenhouse gases.

With the evidence in these examples above, it is obviously difficult to establish the claims about worsening conditions due to human-caused climate change, or more generally that any change could be directly linked to increasing CO2. This point also relates to the issue of climate model capability noted earlier. It is clear that climate models fall short on some very basic issues of climate variability, being unable to reproduce "what" has happened regarding global temperature, and therefore not knowing "why" any of it happened. It is therefore premature to claim that one knows the causes for changes in various exotic measures of weather, such as rainfall intensity over short periods, which are not even explicitly generated in climate model output.

In summary, the information above indicates that preventing individual projects from going forward or even shutting down entire sectors of the energy economy will have no impact on the global climate system. Further, the information above indicates that the scientific understanding (i.e. climate models) of how increasing greenhouse gases are affecting the climate is rather poor, with no quantified and established link between emissions growth and specific changes in climate or disruptive weather.