

Comment by:

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on the

Office of Management and Budget’s Request for Comments on the Technical Support Document entitled *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*

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Comment:

This is our second Comment made to the Office of Management and Budget’s Request for Comments on the Technical Support Document entitled *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866*. Our first comment was submitted under the first deadline which was January 27—a deadline which was extended for 30 days. This additional Comment is submitted for consideration along with our first Comment (which we refer to below as our “initial comment”).

Summary

In our initial Comment, we concluded that the determination of the social cost of carbon (SCC) as made by the Interagency Working Group (IWG) and detailed in the May 2013 Technical Support Document (updated in November 2013, IWG2013) is discordant with the best scientific literature on the equilibrium climate sensitivity and the fertilization effect of carbon dioxide—two critically important parameters for establishing the net externality of carbon dioxide emissions, at odds with existing Office of Management and Budget (OMB) guidelines for preparing regulatory analyses, and founded upon the output of Integrated Assessment Models

(IAMs) which encapsulate such large uncertainties as to provide no reliable guidance as to the sign, much less the magnitude, of the social cost of carbon.

In this Comment, we demonstrate the illogical results produced by the IAMs that indicate a misleading disconnect between a climate change and the SCC value, we show that the sea level rise projections (and thus SCC) of the DICE 2010 model cannot be supported by the mainstream climate science, and we provide additional evidence that the equilibrium climate sensitivity used by IGW2013 requires extensive revision in that it is too high and too poorly constrained.

The additional evidence provided in this Comment acts to further cement the recommendations and conclusions set out in our initial Comment—that the OMB should act not just to revise the IWG2013 determination of the SCC, but to suspend its use in all federal rulemaking. It is better not to include any value for the SCC in cost/benefit analyses, than to include a value which is knowingly improper, inaccurate and misleading.

The Misleading Disconnect Between Climate Change and the Social Cost of Carbon in the Integrated Assessment Models

The impetus behind efforts to determine the “social cost of carbon” is generally taken to be the desire to attempt to quantify the externalities that result from climate changes produced from anthropogenic emissions of carbon dioxide and greenhouse gases. Such information could be a useful tool in guiding policy decisions regarding greenhouse gas emissions—it if were robust and reliable.

However, as is generally acknowledged, the results of such efforts (generally through the development of Integrated Assessment Models, IAMs) are highly sensitive not only to the model input parameters but also to how the models have been developed and what processes they try to include. One prominent economist, Robert Pindyck of M.I.T. recently wrote (Pindyck, 2013) that the sensitivity of the IAMs to these factors renders them useless in a policymaking environment:

Given all of the effort that has gone into developing and using IAMs, have they helped us resolve the wide disagreement over the size of the SCC? Is the U.S. government estimate of \$21 per ton (or the updated estimate of \$33 per ton) a reliable or otherwise useful number? What have these IAMs (and related models) told us? I will argue that the answer is very little. As I discuss below, the models are so deeply flawed as to be close to useless as tools for policy analysis. Worse yet, precision that is simply illusory, and can be highly misleading.

...[A]n IAM-based analysis suggests a level of knowledge and precision that is nonexistent, and allows the modeler to obtain almost any desired result because key inputs can be chosen arbitrarily.

Nevertheless, the federal government has now incorporated the IWG2013 determinations of the SCC into many types of new and proposed regulations—ill-advisedly so in our opinion.

Consider the following: the social cost of carbon should reflect the relative impact on future society that human-induced climate change from greenhouse gas emissions would impose. In this way, we (policymakers and regular citizens) can decide how much (if at all) we are willing to pay currently to reduce the costs to future society. It would seem logical that we would probably be more willing to sacrifice more now if we knew that future society would be impoverished and suffer from extreme climate change than we would be willing to sacrifice if we knew that future society would be very well off and be subject to more moderate climate change. We would expect that the value of the social cost of carbon would reflect the difference between these two hypothetical future worlds—the SCC should be far greater in an impoverished future facing a high degree of climate change than an affluent future with less climate change.

But if you thought this, you would be wrong.

Instead, the IAMs as run by the IWG2013 produce nearly the opposite result—the SCC is far *lower* in the less affluent/high climate change future than it is in the more affluent/low climate change future. Such a result is not only counterintuitive but misleading.

We illustrate this illogical and impractical result using the DICE 2010 model (hereafter just DICE) used by the IWG2013 (although the PAGE and the FUND models generally show the same behavior). The DICE model was installed and run at the Heritage Foundation by Kevin Dayaratna and David Kreutzer using the same model set up and emissions scenarios as prescribed by the IWG2013. The projections of future temperature change (and sea level rise, used later in the Comment) were graciously provided to us by the Heritage Foundation.

Figure 1 shows the projections of the future change in the earth's average surface temperature for the years 2000-2300 produced by DICE from the five emissions scenarios employed by the IWG2013. The numerical values on the right-hand side of the illustration are the values for the social cost of carbon associated with the temperature change resulting from each emissions scenario (the SCC is reported for the year 2020 using constant \$2007 and assuming a 3% discount rate—numbers taken directly from Table A3 of the IWG2013 report). The temperature change can be considered a good proxy for the magnitude of the overall climate change impacts.

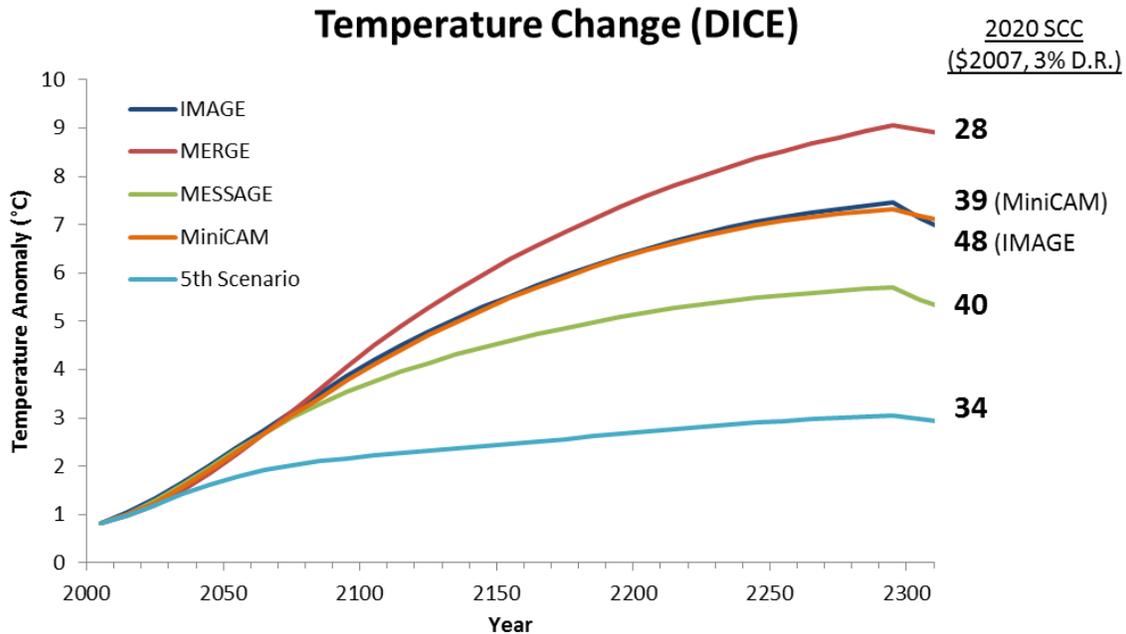


Figure 1. Future temperature changes, for the years 2000-2300, projected by the DICE model for each of the five emissions scenarios used by the IWG2013. The temperature changes are the arithmetic average of the 10,000 Monte Carlo runs from each scenario. The 2020 value of the SCC (in \$2007) produced by the DICE model (assuming a 3% discount rate) is included on the right-hand side of the figure. (DICE data provided by Kevin Dayaratna and David Kreutzer of the Heritage Foundation).

Notice in Figure 1 that the value for the SCC shows little (if any) correspondence to the magnitude of climate change. The MERGE scenario produces the greatest climate change and yet has the smallest SCC associated with it. The “5th Scenario” is a scenario that attempts to keep the effective concentration of atmospheric carbon dioxide at 550 ppm (far lower than the other scenarios) has a SCC that is more than 20% *greater* than the MERGE scenario. The global temperature change by the year 2300 in the MERGE scenario is 9°C while in the “5th Scenario” it is only 3°C. The highest SCC is from the IMAGE scenario—a scenario with a mid-range climate change. All of this makes absolutely no logical sense—and confuses the user.

If the SCC bears little correspondence to the magnitude of future human-caused climate change, than what does it represent?

Figure 2 provides some insight.

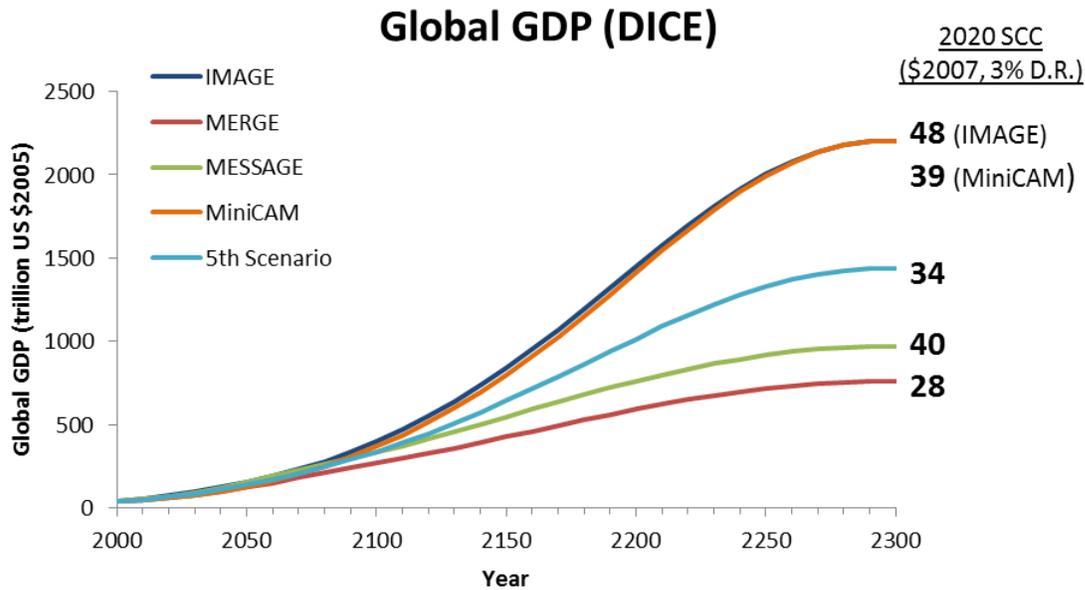


Figure 2. Future global gross domestic product, for the years 2000-2300 for each of the five emissions scenarios used by the IWG2013. The 2020 value of the SCC (in \$2007) produced by the DICE model (assuming a 3% discount rate) is included on the right-hand side of the figure.

When comparing the future GDP to the SCC, we see, generally, that the scenarios with the higher future GDP (most affluent future society) have the higher SCC values, while the futures with lower GDP (less affluent society) have, generally, lower SCC values.

Combining the results from Figures 1 and 2 thus illustrates the absurdities in the IWG's use of the DICE model. The scenario with the richest future society and a modest amount of climate change (IMAGE) has the highest value of the SCC associated with it, while the scenario with the poorest future society and the greatest degree of climate change (MERGE) has the lowest value of the SCC. A logical, thinking person would assume the opposite.

While we only directly analyzed output data from the DICE model, by comparing Tables 2 and Tables 3 from the IWG2010 report, it can be ascertained that the FUND and the PAGE models behave in a similar fashion.

This counterintuitive result occurs because the damage functions in the IAMs produce output in terms of a percentage decline in the GDP—which is then translated into a dollar amount (which is divided by the total carbon emissions) to produce the SCC. Thus, even a small climate change-induced percentage decline in a high GDP future yields greater dollar damages (i.e., higher SCC) than a much greater climate change-induced GDP percentage decline in a low GDP future.

Who in their right mind would want to spend (sacrifice) more today to help our rich decedents deal with a lesser degree of climate change than would want to spend (sacrifice) today to help our relatively less-well-off decedents deal with a greater degree of climate change? No one. Yet that is what the SCC would lead you to believe and that is what the SCC implies when it is incorporated into federal cost/benefit analyses.

In principle, the way to handle this situation is by allowing the discount rate to change over time. In other words, the richer we think people will be in the future (say the year 2100), the higher the discount rate we should apply to damages (measured in 2100 dollars) they suffer from climate change, in order to decide how much we should be prepared to sacrifice today on their behalf.

Until (if ever) the current situation is properly rectified, the IWG's determination of the SCC is not fit for use in the federal regulatory process as it is deceitful and misleading.

Sea Level Rise

The sea level rise module in the DICE model used by the IWG2013 produces future sea level rise values that far exceed mainstream projections and are unsupported by the best available science. The sea level rise projections from more than half of the scenarios (IMAGE, MERGE, MiniCAM) exceed even the highest end of the projected sea level rise by the year 2300 as reported in the *Fifth Assessment Report (AR5)* of the Intergovernmental Panel on Climate Change (see Figure 3).

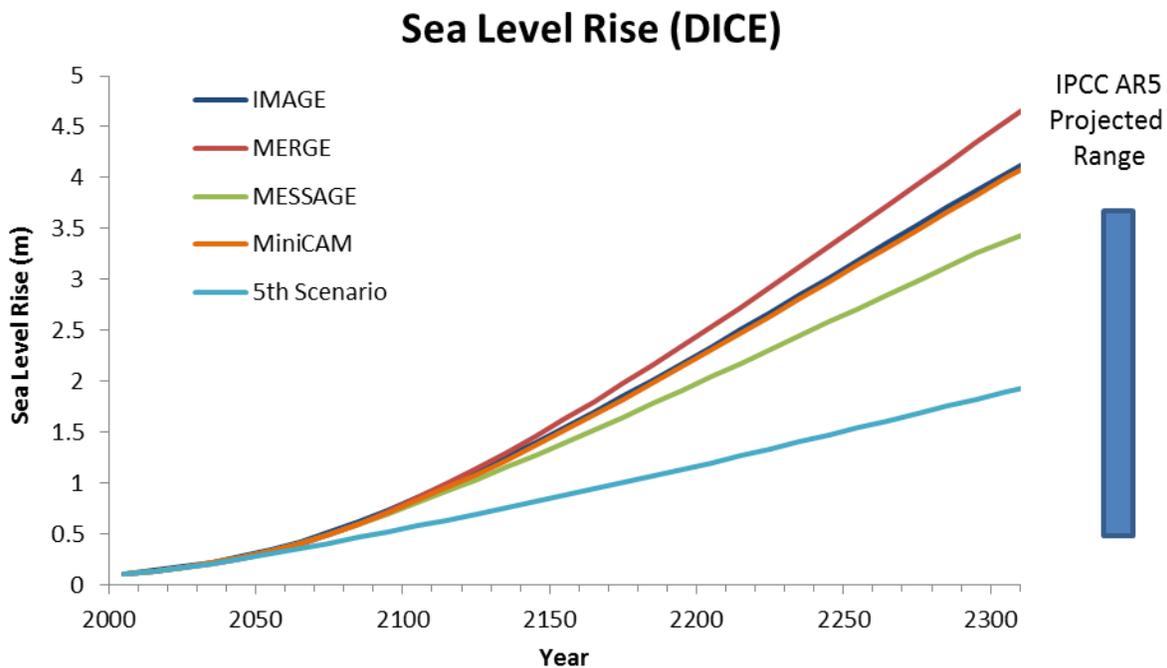


Figure 3. Projections of sea level rise from the DICE model (the arithmetic average of the 10,000 Monte Carlo runs from each scenario) for the five scenarios examined by the IWG2013 compared with the range of sea level rise projections for the year 2300 given in the IPCC AR5 (see AR5 Table 13.8). (DICE data provided by Kevin Dayaratna and David Kreutzer of the Heritage Foundation).

How the sea level rise module in DICE was constructed is inaccurately characterized by the IWG2013 (and misleads the reader). The IWG2013 report describes the development of the DICE sea level rise scenario as:

“The parameters of the four components of the SLR module are calibrated to match consensus results from the IPCC’s Fourth Assessment Report (AR4).⁶”

However, in IWG2013 footnote “6” the methodology is described this way (Nordhaus, 2010):

“The methodology of the modeling is to use the estimates in the IPCC Fourth Assessment Report (AR4).”

“Using estimates” and “calibrating” are two completely different things. Calibration implies that the sea level rise estimates produced by the DICE sea level module behave similarly to the IPCC sea level rise projections and instills a sense of confidence in the casual reader that the DICE projections are in accordance with IPCC projections. However this is not the case. Consequently, the reader is misled.

In fact, the DICE estimates are much higher than the IPCC estimates. This is even recognized by the DICE developers. From the same reference as above:

“The RICE [DICE] model projection is in the middle of the pack of alternative specifications of the different Rahmstorf specifications. Table 1 shows the RICE, base Rahmstorf, and average Rahmstorf. *Note that in all cases, these are significantly above the IPCC projections in AR4.*” [emphasis added]

That the DICE sea level rise projections are far above the mainstream estimated can be further evidenced by comparing them with the results produced by the IWG-accepted MAGICC modelling tool (in part developed by the EPA and available from <http://www.cgd.ucar.edu/cas/wigley/magicc/>).

Using the MESSAGE scenario as an example, the sea level rise estimate produced by MAGICC for the year 2300 is 1.28 meters—a value that is less than 40% of the average value of 3.32 meters produced by the DICE model when running the same scenario (Figure 4).

Projected Sea Level Rise (MESSAGE)

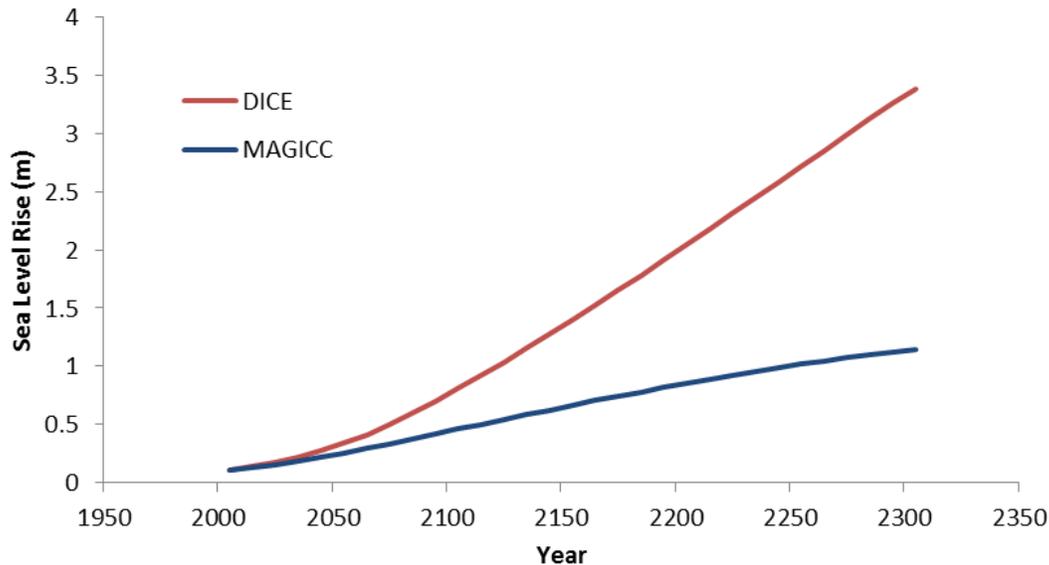


Figure 4. Projected sea level rise resulting from the MESSAGE scenario produced by DICE (red) and MAGICC (blue).

The justification given for the high sea level rise projections in the DICE model (Nordhaus, 2010) is that they well-match the results of a “semi-empirical” methodology employed by Rahmstorf (2007) and Vermeer and Rahmstorf (2009).

However, subsequent science has proven the “semi-empirical” approach to projecting future sea level rise unreliable. For example, Gregory et al. (2012) examined the assumption used in the “semi-empirical” methods and found them to be unsubstantiated. Gregory et al (2012) specifically refer to the results of Rahmstorf (2007) and Vermeer and Rahmstorf (2009):

The implication of our closure of the [global mean sea level rise, GMSLR] budget is that a relationship between global climate change and the rate of GMSLR is weak or absent in the past. The lack of a strong relationship is consistent with the evidence from the tide-gauge datasets, whose authors find acceleration of GMSLR during the 20th century to be either insignificant or small. It also calls into question the basis of the semi-empirical methods for projecting GMSLR, which depend on calibrating a relationship between global climate change or radiative forcing and the rate of GMSLR from observational data (Rahmstorf, 2007; Vermeer and Rahmstorf, 2009; Jevrejeva et al., 2010).

In light of these findings, the justification for the very high sea level rise projections (generally exceeding those of the IPCC AR5 and far greater than the IWG-accepted MAGICC results) produced by the DICE model is called into question and can no longer be substantiated.

Given the strong relationship between sea level rise and future damage built into the DICE model, there can be no doubt that the SCC estimates from the DICE model are higher than the

best science would allow and consequently, should not be accepted by the OMB as a reliable estimate of the social cost of carbon.

We did not investigate the sea level rise projections from the FUND or the PAGE model, but suggest that such an analysis must be carried out prior to extending any confidence in the values of the SCC resulting from those models—confidence that we demonstrate cannot be assigned to the DICE SCC determinations.

Revised Equilibrium Climate Sensitivity Compilation

In our initial Comment, we included a compilation of studies published in the recent scientific literature that provide evidence that the equilibrium climate sensitivity is both lower and more tightly constrained than the Roe and Baker distribution employed by the IWG2013. Since that time, another study has been published (Loehle, 2014) with a result that falls firmly in the middle of the recent estimates (Figure 5). The result of Loehle (2014) further firms the argument that the IWG2013's use of the Roe and Baker distribution is no longer defensible.

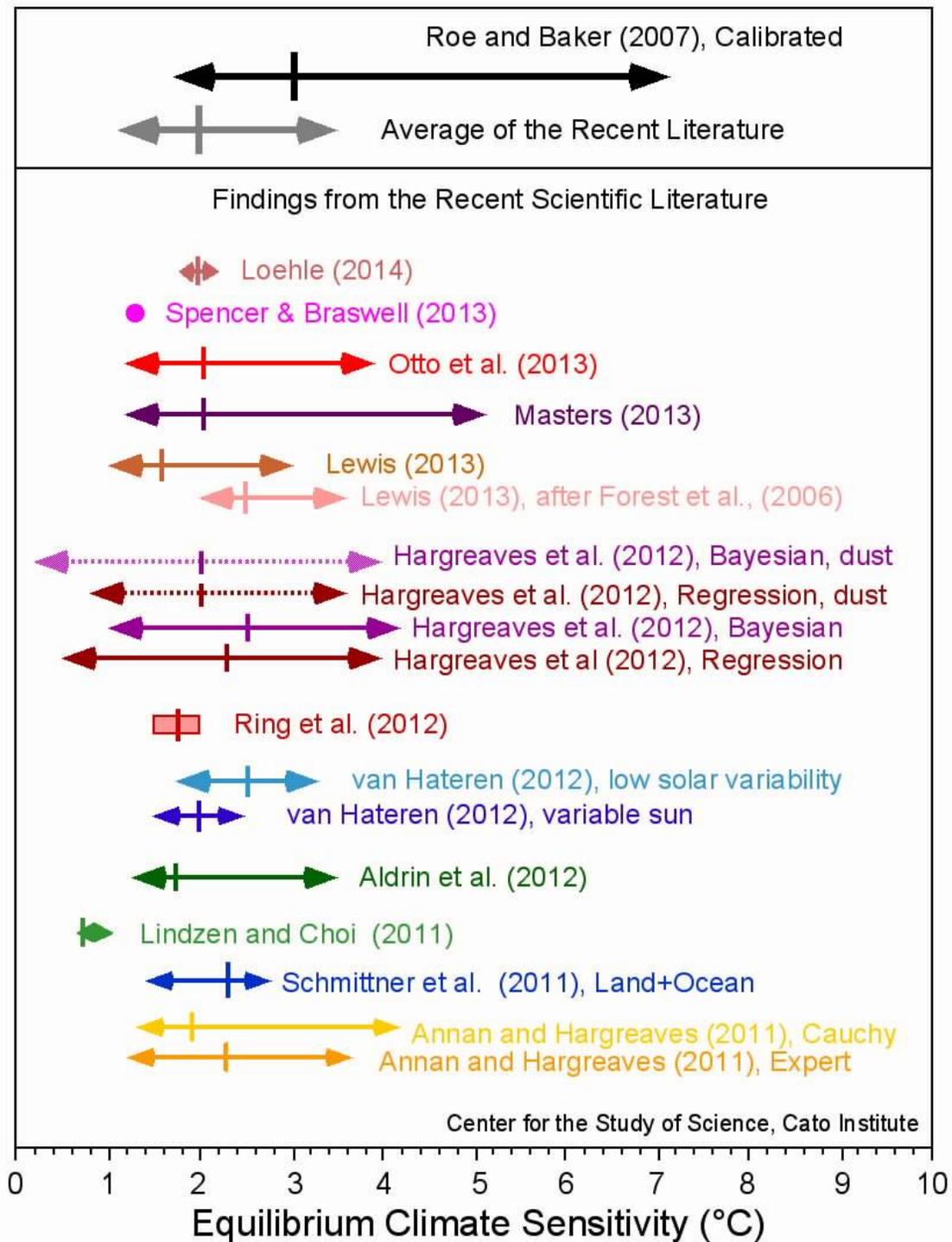


Figure 5. Climate sensitivity estimates from new research beginning in 2011 (colored), compared with the assessed range given in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) and the collection of climate models used in the IPCC AR5. The “likely” (greater than a 66% likelihood of occurrence) range in the IPCC Assessment is indicated by the gray bar. The arrows indicate the 5 to 95 percent confidence bounds for each estimate along with the best estimate (median of each probability density function; or the mean of multiple estimates; colored vertical line). Ring et al.

(2012) present four estimates of the climate sensitivity and the red box encompasses those estimates. The right-hand side of the IPCC AR5 range is actually the 90% upper bound (the IPCC does not actually state the value for the upper 95 percent confidence bound of their estimate). Spencer and Braswell (2013) produce a single ECS value best-matched to ocean heat content observations and internal radiative forcing.

Conclusion

As a result of the above, along with the problems identified and described in our initial Comment, we reiterate that the OMB should not act to update the IWG2013's SCC determination, but rather to discard it in its entirety. It is unfit for use in federal rulemaking.

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