

S.Abraham

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SURREBUTTALS TO: Spencer, Lindzen, Happer, Tol, Bezdek

p.3 "Drs. Spencer, Lindzen, Bezdek and Happer do not provide much substance in their rebuttal testimony and for the most part they merely reiterate the statements and assertions made in their direct testimony to which I have already provided a response"

p.4 "Richard Tol offers testimony that primarily responds to the direct testimony submitted by Drs. Polasky and Hanemann in this proceeding and I do not offer testimony on those issues. I point out some errors Dr. Tol has made in his research, however, and suggest that the Commission use caution when assessing Dr. Tol's testimony. He also questions the assertion that 97 percent of climate scientists agree that "climate change is real, human-made, and dangerous," to which I offer a response."

p.5 re Fyfe et al, "Moreover, satellites are not used to measure the Earth's surface, they are used to measure the atmosphere (contrary to his assertion above). Dr. Spencer therefore misrepresents this study and its conclusions."

p.6 "Dr. Spencer lists four papers which he claims deal with urban heat islands. This is an issue which has been considered in great detail by the scientific community. Great effort has been made to ensure urban heat islands do not contribute to the global temperature trends. The papers Dr. Spencer lists do not contradict this."

pp.7-8 "Dr. Spencer has changed his claim. His initial claim is that climate sensitivity is as low as 1°C or less. In his rebuttal testimony, he now asserts that studies find climate sensitivity less than 3°C. These claims are very different from each other. ... In general, the papers Dr. Spencer cited in response to Information Request 10c from the Clean Energy Organizations ("CEO") are either from advocacy organizations (such as the Global Warming Policy Foundation, Climate Audit, Cato Institute), have been shown to be incorrect, or do not claim what he asserts." "As stated in my rebuttal testimony, the "the self-cited work Spencer and Braswell, 2013 has been shown to be faulty and Dr. Spencer is aware that his work was rebutted in the scientific literature. ... Dr. Spencer also cites work by Dr. Lindzen, (Lindzen and Choi 2011), which has been shown to be in error."

p.10 "Dr. Lindzen is incorrect. To accept a hiatus, he has to ignore 99 percent of the Earth's climate system as I indicated in my rebuttal testimony. Furthermore, he is obligated to show that there has been a statistically significant halt to the Earth's temperature increase. There has been no halt. 2014 is the hottest year on record. 2015 is likely to exceed 2014. Finally, we are currently at the 12-month hottest period ever recorded by instruments."

p.14 ECS: "Figure 1 below shows, however, that among these views, **Dr. Lindzen is a considerable outlier.**"

p.15 "Dr. Lindzen cites to six non-peer reviewed sources, without a single citation to a peer-reviewed article that stands for this assertion."

p.16 "Dr. Happer presents many non-reviewed and non-scientific citations including newspaper opinion letters, advocacy organizations, and blog posts. Among the scientific papers he cites, they have either been shown to be in error, more recent studies have invalidated them, or they do not support his conclusions."

p.18 "Dr. Tol indicates that "[t]he 97% number 1 is taken from Cook et al. (2013)," a paper that he previously criticized. Are you aware of whether the authors of Cook et al. (2013) have responded to these criticisms?

Yes, they have, and their response demonstrates that **many of the claims in Tol's testimony are outright falsehoods.**"

p.19 "As I have written in the peer-reviewed literature and as I discussed in my rebuttal testimony, there is a strong consensus among scientists that humans are a major cause of climate change. A number of studies have provided independent reinforcement of this conclusion, as indicated in my rebuttal testimony"

p.20 'On the same day, he wrote "**The consensus is of course in the high nineties.** No one ever said that it was not."

p.21 "Dr. Tol is a unique researcher in that his work has been found to be faulty in many instances. In recent years, there have been many instances of errors and corrections. For instance, Dr. Tol published a paper in 2009 that he first corrected in 2014 by claiming that **gremlins caused the errors.**"

p.23 re Bezdek 'The papers he cites are irrelevant to this claim and in fact contradict his assertion. The vast majority of these papers are not policy papers; rather they deal with climate science. So, the question is whether these papers reflect a disagreement that carbon dioxide and other greenhouse gases have a "warming effect on the planet." Dr. Bezdek provides 20 citations that allegedly support this assertion. As discussed below, they do not.'

p.24 "It is apparent that **Dr. Bezdek either does not understand the research he has cited or that he is misinterpreting the conclusions.** Either way, these works do not call into question the ability of greenhouse gases to trap heat and warm the planet, but they do call into question Dr. Bezdek's credibility as a witness."

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1 **I. INTRODUCTION.**

2 **Q. Please state your name.**

3 **A. Dr. John Abraham.**

4 **Q. Are you the same Dr. John Abraham who provided rebuttal testimony on behalf of**
5 **the Clean Energy Organizations in this proceeding?**

6 **A. I am.**

7 **Q. What is the purpose of your surrebuttal testimony?**

8 **A. In this surrebuttal testimony, I respond to the rebuttal testimony of Drs. Roy Spencer,**
9 **Richard Lindzen, William Happer, Richard Tol, and Roger Bezdek, witnesses for**
10 **Peabody Energy.**

11 **Q. What is your overall impression of the rebuttal testimony submitted by Drs.**
12 **Spencer, Lindzen, Bezdek and Happer?**

13 **A. Drs. Spencer, Lindzen, Bezdek and Happer do not provide much substance in their**
14 **rebuttal testimony and for the most part they merely reiterate the statements and**
15 **assertions made in their direct testimony to which I have already provided a response.¹**
16 However, each of these witnesses claims in their rebuttal testimony to have supplied
17 evidentiary support for certain statements made in their direct testimony in response to
18 Information Requests from the Clean Energy Organizations. I disagree that their

¹ rebuttal testimony of Dr. John Abraham submitted August 12, 2015.

1 responses to these questions provides additional evidentiary support and my surrebuttal
2 testimony focuses on these assertions.

3 Richard Tol offers testimony that primarily responds to the direct testimony submitted by
4 Drs. Polasky and Hanemann in this proceeding and I do not offer testimony on those
5 issues. I point out some errors Dr. Tol has made in his research, however, and suggest
6 that the Commission use caution when assessing Dr. Tol's testimony. He also questions
7 the assertion that 97 percent of climate scientists agree that "climate change is real,
8 human-made, and dangerous," to which I offer a response.

9 **II. RESPONSE TO DR. ROY SPENCER.**

10 **Q. In Dr. Spencer's rebuttal testimony he states that his "discovery responses provide**
11 **significant evidentiary support for [certain] statements." Have you reviewed the**
12 **discovery responses to which Dr. Spencer is referring?**

13 **A.** Yes.

14 **Q. Dr. Spencer cites one "core article" to support his claim that "The models, on**
15 **average, produce surface warming rates at least twice those observed since the**
16 **satellite record began in 1979. Models, on average, produce deep-atmosphere**
17 **(tropospheric) warming rates about 2-3 times those observed over the same period."**
18 **In your opinion, does this study support Dr. Spencer's assertion?**

19 **A.** No. The "core" article which Dr. Spencer refers to is:

1 J.C. Fyfe, N.P. Gillett, and F.W. Zwiers, Overestimated global warming over the
2 past 20 years, *Nature Climate Change*, Vol. 3, pp. 767-768.

3 First, it is important to note that Dr. Spencer makes two separate claims in his comment
4 which are oftentimes conflated with each other. The first relates to surface temperatures
5 and the second claim relates to atmospheric temperatures far away from the Earth's
6 surface. This paper he cites does not deal with deep atmosphere warming, rather it is a
7 study which focuses on surface warming. Furthermore, as stated in the title, this paper
8 does not focus on temperatures since 1979, rather it looks at the temperatures for the time
9 period 1993-2012. Moreover, satellites are not used to measure the Earth's surface, they
10 are used to measure the atmosphere (contrary to his assertion above). Dr. Spencer
11 therefore misrepresents this study and its conclusions.

12 Furthermore, Dr. Spencer does not recognize that subsequent publications show that the
13 discrepancy between surface temperatures for models and measurements is largely a
14 result of measurement bias, model-measurement comparison of two dissimilar
15 temperatures, changes to measurement technique, and volcanic eruptions which have
16 temporarily affected global temperatures. These issues have already been discussed in my
17 rebuttal testimony.

1 **Q. Do you agree that Dr. Spencer “provide[d] significant evidentiary support” for the**
2 **statement that:**

3 **“Yes, surface thermometers are capable of directly measuring temperatures**
4 **near the surface of the Earth, but tend to have long-term spurious warming**
5 **effects over land from urbanization effects”?**

6 **A.** No. Dr. Spencer lists four papers which he claims deal with urban heat islands. This is an
7 issue which has been considered in great detail by the scientific community. Great effort
8 has been made to ensure urban heat islands do not contribute to the global temperature
9 trends. The papers Dr. Spencer lists do not contradict this. For instance, one of the papers,
10 C. Wang, L. Zhang, S.K. Lee, L. Wu, and C.R. Meschoso, A global perspective
11 on CMIP5 model biases, *Nature Climate Change*, Vol. 4, pp. 201-205, 2014
12 does not deal with the urban heat island. Rather it deals with sea surface temperatures
13 which are by definition not urban.

14 Another paper he references:

15 ZX. Yang, Y. Hou, and B. Chen, Observed surface warming induced by
16 urbanization in East China, *J. Geophysical Research* Vol. 116, D 14113

17 does not discuss the techniques to remove the urban effect from temperature records. In
18 fact, in the conclusion of the paper, the authors write a word of caution that urban heating
19 is an additional threat to greenhouse gas warming and that policy makers should consider
20 both influences on health.

21 As I stated in my rebuttal testimony, other researchers have looked at the issue of
22 contamination and have found that the techniques used to remove bias have been
23 successful. In fact, Dr. Spencer’s colleague came to this conclusion in 2011. The

1 conclusion of the scientists is reinforced by ocean warming, by worldwide ice loss, and
2 by measurements that are made with and without urban temperatures. They all agree that
3 the Earth is warming and that this warming is not due to urbanization.

4 **Q. Do you agree that Dr. Spencer “provide[d] significant evidentiary support for the**
5 **following statement”:**

6 **“An increasing number of peer-reviewed studies are suggesting much lower**
7 **climate sensitivity than the [Intergovernmental Panel on Climate Change]**
8 **IPCC and its models assume, possibly as low as 1 deg. C or less for a**
9 **doubling of atmospheric CO₂”?**

10 **A.** No. First it should be noted that Dr. Spencer has changed his claim. His initial claim is
11 that climate sensitivity is as low as 1°C or less.² In his rebuttal testimony, he now asserts
12 that studies find climate sensitivity less than 3°C.³ These claims are very different from
13 each other.

14 Perhaps it is most noteworthy that Dr. Spencer omits many studies which report higher
15 than 3 degree climate sensitivity.⁴

16 In general, the papers Dr. Spencer cited in response to Information Request 10c from the
17 Clean Energy Organizations (“CEO”) are either from advocacy organizations (such as the

² Page 8, lines 19-20, Spencer direct testimony.

³ Peabody Energy Response 10c to Information Requests Nos. 2-10 of Clean Energy Organizations to Peabody Energy.

⁴ For a summary, see chapter 12, IPCC AR5 report, 2013.

1 Global Warming Policy Foundation, Climate Audit, Cato Institute),⁵ have been shown to
2 be incorrect, or do not claim what he asserts.

3 As stated in my rebuttal testimony, the self-cited work Spencer and Braswell, 2013 has
4 been shown to be faulty and Dr. Spencer is aware that his work was rebutted in the
5 scientific literature. To my best knowledge, he has not responded in the peer-reviewed
6 literature to the errors which were identified in his work. It is not intellectually honest to
7 use his faulty paper as a supporting document without also mentioning these identified
8 errors.

9 Dr. Spencer also cites work by Dr. Lindzen, (Lindzen and Choi 2011), which has been
10 shown to be in error. It is misleading to cite this work as a supporting reference without
11 acknowledging the errors which were later found.

12 Dr. Spencer also cites other works which he claims supports his assertion that climate
13 sensitivity as low as 1°C. However the citations do not assert this. For instance, in all of
14 these papers cited by Dr. Spencer in response to CEO Information Request 10c, the
15 climate sensitivity estimate is greater than 1 degree or at the very least, highly unlikely to
16 be as low as 1 degree:

17 J. Annan, J.C. Hargreaves, On the Generation and Interpretation of Probabilistic
18 Estimates of Climate Sensitivity, *Climatic Change*, Vol. 194, Vol. 104, pp. 423-
19 436, 2011.

⁵ See, e.g., Peabody Energy Response 10c to Information Requests Nos. 2-10 of Clean Energy Organizations to Peabody Energy at pp. 22-23.

1 A. Schmittner et al., Climate sensitivity estimated from temperature
2 reconstructions of the last glacial maximum, *Science*, Vol. 333, pp. 1385-1388,
3 2011.

4 M. Aldrin et al., Bayesian Estimate of Climate Sensitivity Based on a Simple
5 Climate Model Fitted to Observations of Hemispheric Temperatures and Global
6 Ocean Heat Content, *Environmetrics*, Vol. 23, pp. 253-271, 2012.

7 J.C. Hargreaves et al., Can the Last Glacial Maximum Constrain Climate
8 Sensitivity, *Geophysical Research Letters*, Vol. 39, L24702, 2012.

9 A. Otto, et al., Energy Budget Constraints on Climate Response, *Nature*
10 *Geoscience*, Vol. 6, pp. 415-416, 2013.

11 J.H. van Hateren, A Fractal Climate Response Function can Simulate Global
12 Average Temperature Trends of the Modern Era and the Past Millennium,
13 *Climate Dynamics*, Vol. 40, pp. 2651-2670, 2013.

14 R.B. Skie, et al., A Lower and More Constrained Estimate of Climate Sensitivity
15 Using Updated Observations and detailed Radiative Forcing Time Series, *Earth*
16 *System Dynamics*, Vol. 5, 139-175, 2014.

17 C. Loehle, A Minimal Model for Estimating Climate Sensitivity, *Ecological*
18 *Modeling*, Vol. 276, pp. 80-84, 29014

19 T. Masters, Observational Estimate of Climate Sensitivity from Changes in the
20 Rate of Ocean Heat Uptake and Comparison to CMIP5 Models, *Climate*
21 *Dynamics*, Vol. 42, pp. 2173-2181, 2014.

22 N. Lewis, An objective Bayesian, Improved Approach for Applying Optimal
23 Fingerprint Techniques to Estimate Climate Sensitivity, *Journal of Climate*, Vol.,
24 26, pp. 7414-7429, 2013.

25 N. Lewis, J.A. Curry, The Implications for Climate Sensitivity of AR5 Forcings
26 and Heat Uptake Estimates, *Climate Dynamics*, Vol. 45, pp. 1009-1023, 2015.

27 Dr. Spencer also neglects including the most recent two years in his analysis, which show
28 that the rate of temperature change is greater than many of the instrumental studies show.

29 Not only is 2014 the hottest year on record, and 2015 on pace to exceed 2014, but recent

1 studies have found errors in temperature measurements and comparison of models to
2 measurements which invalidate the conclusion of these studies.

3 **Q. RESPONSE TO DR. RICHARD LINDZEN.**

4 **Q. On page three of Dr. Lindzen's rebuttal testimony he asserts that existence of a**
5 **global warming "hiatus" has "until now been widely accepted by climate**
6 **researchers." Do you agree?**

7 **A.** No. Dr. Lindzen is incorrect. To accept a hiatus, he has to ignore 99 percent of the
8 Earth's climate system as I indicated in my rebuttal testimony. Furthermore, he is
9 obligated to show that there has been a statistically significant halt to the Earth's
10 temperature increase. There has been no halt. 2014 is the hottest year on record. 2015 is
11 likely to exceed 2014. Finally, we are currently at the 12-month hottest period ever
12 recorded by instruments.

13 Even ignoring the recent temperature records, two studies have shown that there has not
14 been a statistically significant hiatus. It is therefore incorrect to say that the existence of a
15 "hiatus" has ever been "widely accepted" by climate researchers.

16 **Q. In Dr. Lindzen's rebuttal testimony he states that his "responses [to Information**
17 **Requests from CEO] supply citations supporting certain elements of [his]**
18 **testimony." Have you reviewed the discovery responses to which Dr. Lindzen is**
19 **referring?**

20 **A.** Yes.

1 **Q. Do you agree that Dr. Lindzen provided evidentiary support for the statement that:**

2 **“... only mild warming at most, which will be beneficial to the planet and to**
3 **society as a whole.”**

4 **A.** No. Dr. Lindzen cites advocacy organizations (such as the Cato Institute) and non-peer-
5 reviewed books. His other references do not support his assertion that warming will be
6 beneficial. For instance,

7 A. Bennet, K.B.G. Dear, and A.J. McMichael, Shifts in the Seasonal Distribution
8 of Deaths in Australia, 1968-2007, Int. *Journal Biometeorology*, Vol. 58, pp. 835-
9 842, 2014

10 states:

11 We had hypothesized that rising temperatures over time in Australia would be
12 reflected in a trend towards higher summer:winter mortality ratios and our results
13 support this. . . . In the short term, an increase in the summer:winter mortality
14 ratio could be interpreted as a positive benefit. However in the long-term, with
15 climate change expected to increase average temperatures as well as bring more
16 frequent extreme heat events in summer, the resultant absolute increase in
17 summer deaths will become an increasingly detrimental outcome.

18 It also states:

19 The frequency of temperature extremes in Australia appears to be changing in a
20 similar manner with more extremely hot days and fewer extremely cold days
21 observed every decade since 1960.

22 This conclusion does not indicate that mild warming will be beneficial to
23 society as a whole.

24 Dr. Lindzen also cites:

25 N. Christidis et al., Causes for Recent Changes in Cold- and Heat-Related
26 Mortality in England and Wales, *Climatic Change*, Vol. 102, pp. 539-553, 2010.

27 This study does not claim that warming will be beneficial. Rather, the study deals with
28 different adaption of winter and summer weather in England and Wales. The authors state

1 that, “[o]ur analysis suggests that in the absence of adaptation, the human influence on
2 climate would have been the main contributor to increases in heat-related mortality and
3 decreases in cold-related mortality.” The authors conclude that:

4 It would be easy to compare the recent decrease in cold-related mortality with the
5 increase in temperature and make the seemingly logical assumption that fewer
6 people have died because of milder winters. Our work, however, shows that this is
7 not the case. We find that adaptation of the population to colder temperatures can
8 explain much of the observed change. . . . With regard to heat-related mortality,
9 future changes in the frequency and intensity of heat waves also pose a concern
10 that raise the question about whether adaptation will manage to keep pace with
11 such changes.

12 Dr. Lindzen also cites:

13 J. Cheng, et al., Impact of Diurnal Temperature Range on Human Health: A
14 Systematic Review, *Int. J. Biometeorology*, Vol. 58, pp. 2011-2024, 2014.

15 This paper does not claim that future warming will be beneficial to human health. In fact,
16 in the first sentence of the Introduction, the paper acknowledges the negative impact of
17 climate change on human health.

18 There are other examples of Dr. Lindzen citing papers which do not support his claim
19 that warming will be beneficial, but this sample is representative of his tendency to
20 mischaracterize the conclusions of these sources.

21 **Q. Do you agree that Dr. Lindzen has provided evidentiary support for the statement**
22 **that “evidence indicates that climate sensitivity may fall within a range of from**
23 **about 0.85C to 1.5C”?**

24 **A.** No. Dr. Lindzen cites a number of articles which do not support his conclusion or are
25 irrelevant. For instance, he cites:

1 J.C. Fyfe, N.P. Gillett, and F.W. Zwiers, Overestimated global warming over the
2 past 20 years, *Nature Climate Change*, Vol. 3, pp. 767-768;

3 and

4 P. Stott, et al., The Upper End of Climate Model Temperature Projections is
5 Inconsistent with Past Warming, *Environmental research Letters*, Vol. 8, 014024,
6 2013.

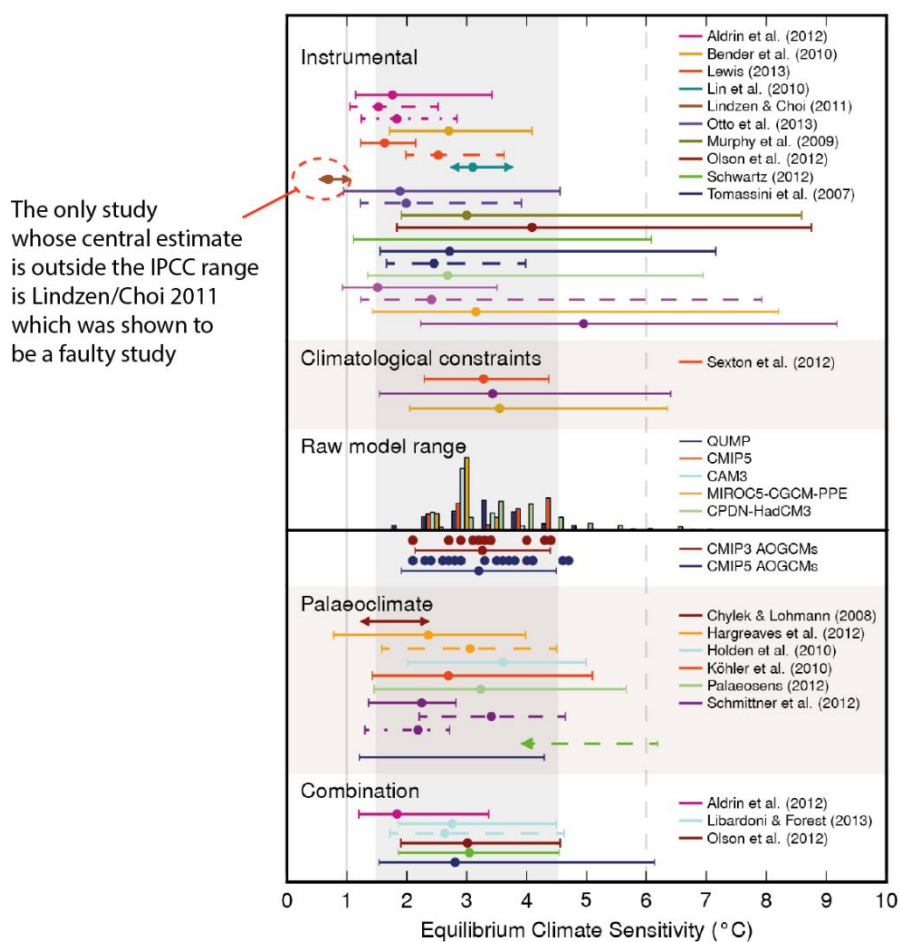
7 I have already discussed this topic in my response to Dr. Spencer. However, here I
8 emphasize that Dr. Lindzen does not recognize that subsequent publications show that the
9 discrepancy between surface temperatures for models and measurements is largely a
10 result of measurement bias, model-measurement comparison of two dissimilar
11 temperatures, changes to measurement technique, and volcanic eruptions which have
12 temporarily affected global temperatures. These issues have already been discussed in my
13 rebuttal testimony.

14 Dr. Lindzen also cites his own papers which I have already shown to be faulty.

Q. In your opinion, is Dr. Lindzen's proposed equilibrium climate sensitivity range shared by others in the scientific community?

A. No. The scientific community is diverse and there are many different studies that propose various equilibrium climate sensitivity ranges. All of these views, including that of Dr. Lindzen, were considered by the IPCC when developing its likely range. Figure 1 below⁶ shows, however, that among these views, Dr. Lindzen is a considerable outlier.

Figure 1



⁶ The image is from the IPCC 5th Assessment Report, with my annotation.

1 **Q. Dr. Lindzen cites a paper that he authored in 2009 to support his assertion. This**
2 **work was criticized by the scientific community. Does Dr. Lindzen acknowledge the**
3 **criticism when citing his paper?**

4 **A.** Dr. Lindzen neglects to acknowledge the criticisms of his work in prepared documents
5 for this case. However, he has acknowledged his errors in public in the past. Dr. Lindzen
6 acknowledged that the 2009 paper contained “some stupid mistakes” in his handling of
7 the satellite data. “It was just embarrassing,” he said in an interview. “The technical
8 details of satellite measurements are really sort of grotesque.”⁷

9 **Q. Does Dr. Lindzen supply any credible authorities for the assertion that the policy**
10 **risks of limiting the burning of fossil fuels are likely to exceed the risks of climate**
11 **change?**

12 **A.** No. In response to CEO information request 8e, requesting citations to peer-reviewed
13 literature supporting this assertion, Dr. Lindzen cites to six non-peer reviewed sources,
14 without a single citation to a peer-reviewed article that stands for this assertion. In
15 particular, the citation D. Stern (2010) was presented at a conference which states:

16 The *USAEE/IAEE Working Paper Series* includes only papers that present
17 original, scholarly research related to energy economics and policy. Editorials,
18 marketing tracts, and promotional material and papers carrying a high degree of
19 opinion to analysis will not be accepted. Other than this initial screening, the
20 working papers will be unrefereed and authors are solely responsible for their
21 content.⁸

⁷ http://www.nytimes.com/2012/05/01/science/earth/clouds-effect-on-climate-change-is-last-bastion-for-dissenters.html?pagewanted=3&_r=3.

⁸ <https://usaee.org/workingpapers.aspx>.

III. RESPONSE TO DR. WILLIAM HAPPER.

Q. In Dr. Happer’s rebuttal testimony he states that his discovery “responses supply citations supporting certain elements of [his] testimony.” Have you reviewed the discovery responses to which Dr. Happer is referring?

A. Yes.

Q. Do you agree that Dr. Happer has provided evidentiary support for this statement: “A small increase will be a net benefit to the Earth”?

A. No: Dr. Happer misinterprets these studies. See my earlier response to Dr. Lindzen.

Q. Do you agree that Dr. Happer has provided evidentiary support for this statement: “Observations are consistent with little, and perhaps even negative feedback, corresponding to doubling sensitivities of $S = 1\text{ K}$ or less”?

A. No. Dr. Happer presents many non-reviewed and non-scientific citations including newspaper opinion letters, advocacy organizations, and blog posts.

Among the scientific papers he cites, they have either been shown to be in error, more recent studies have invalidated them, or they do not support his conclusions. I have already addressed this in discussions of Fyfe et al., (2013), Lindzen et al., (2001), Lindzen and Choi (2009), Lindzen and Choi (2011), Monckton et al., (2015), and Stott et al., (2013).

1 **Q. Do you agree that Dr. Happer has provided evidentiary support for this statement:**

2 **“Even the lower limit, 1.5 K, is hard to reconcile with the almost complete**
3 **lack of warming since the year 1998”?**

4 **A.** No. The claim that the Earth has not warmed is not supported by the literature. I have
5 addressed this in my rebuttal testimony.

6 **Q. Do you agree that Dr. Happer has provided evidentiary support for this statement:**

7 **“And ground-based warming are known to have serious systematic errors**
8 **associated with the loss of observing stations and urban heat island effects,**
9 **both of which bias the results to more warming than actually exists”?**

10 **A.** No. This claim is not supported by the literature. I have already addressed this in my
11 rebuttal testimony and previously in this surrebuttal testimony. The citations listed by Dr.
12 Happer are not scientific or do not conclude what he claims. For instance, he references a
13 website, an advocacy organization, and studies which focus on sea surface temperatures
14 or regional rather than global temperatures.

15 **IV. RESPONSE TO DR. RICHARD TOL.**

16 **Q. Have you reviewed the written testimony of Dr. Richard Tol?**

17 **A.** Yes.

18 **Q. Do you agree with his conclusions about the consensus of climate scientists?**

19 **A.** No.

1 **Q. Dr. Tol indicates that “[t]he 97% number is taken from Cook et al. (2013),” a paper**
2 **that he previously criticized. Are you aware of whether the authors of Cook et al.**
3 **(2013) have responded to these criticisms?**

4 **A. Yes, they have, and their response demonstrates that many of the claims in Tol’s**
5 **testimony are outright falsehoods.** For example, Tol claims that “Cook and colleagues
6 have claimed that abstracts were rated by two independent raters, even though these
7 raters freely interacted with each other,” but the abstracts were indeed rated by two
8 independent raters. Early in the process, the raters discussed a few example abstracts in
9 order to ensure that they agreed upon the definitions of each category and in which
10 category papers should be placed, in order to maximize consistency. However, virtually
11 all papers and ratings were not discussed among raters and were done completely
12 independently. Tol’s accusation is based on a misrepresentation of private discussions
13 obtained from an illegal hacking event.

14 Tol also accuses the authors of claiming “that the raters did not know journal and author,
15 even though they did.” This accusation is also completely false. The system used by
16 Cook et al. only displayed abstracts—the journal and author names were not displayed. In
17 the stolen private forum material, identified by the authors, there may have been
18 discussions of people Googling a few abstracts after they had completed the ratings
19 process, but the ratings were done blind to journal and author names.

20 Tol goes on to make the unfounded assertion that the authors “have claimed that data
21 could not be inspected by independent experts because that would violate a

1 confidentiality agreement, even though such an agreement never existed.” But Cook et al.
2 have been clear that the author self-ratings were performed under a confidentiality
3 agreement.

4 Lastly, Tol makes the inflammatory accusation that “Cook and colleagues collected data,
5 inspected the results, collected more data, inspected the results again, changed the way
6 the data was classified, collected yet more data, inspected the results, and changed the
7 data classification again before the final results were presented. The same team collected
8 and analyzed the data. Cook and colleagues thus broke all rules about scientific data
9 gathering.” This accusation is false. After the initial categorizations were completed,
10 Cook et al. proceeded to address the disagreements where they existed between the two
11 independent raters, and then proceeded with a tiebreaking process. This is all discussed in
12 Cook et al. (2013).

13 **Q. Does Dr. Tol’s Testimony support the claim that “[t]he 97% figure is flawed”?**

14 **A.** No. As I have written in the peer-reviewed literature and as I discussed in my rebuttal
15 testimony, there is a strong consensus among scientists that humans are a major cause of
16 climate change. A number of studies have provided independent reinforcement of this
17 conclusion, as indicated in my rebuttal testimony. In addition to the numerous studies
18 mentioned in my rebuttal testimony, Verheggen et al., (2014)⁹ found that expertise was
19 correlated with recognition that greenhouse gases are the dominant driver of recent

⁹ D. Verheggen et al., Scientists’ Views about Attribution of Global Warming, *Environmental Science and Technology*, Vol. 48, 8963-8971, 2014.

1 warming, in fact, for scientists with more than 10 published papers in climate science,
2 there was a 90 percent consensus. Furthermore, this survey found an expert sentiment of
3 the climate sensitivity to be close to that of the central estimate of the IPCC. Conversely,
4 very few of these scientists agree with the Peabody Energy experts that the climate
5 sensitivity is very low. These studies are strongly reinforcing, using different methods
6 and data sources. Nevertheless, they come to the same conclusion on the consensus.

7 Even Dr. Tol agrees that there is a very strong consensus among climate scientists. In his
8 own publication in 2014, he states “There is no doubt in my mind that the literature on
9 climate change overwhelmingly supports the hypothesis that climate change is caused by
10 humans. I have very little reason to doubt that the consensus is indeed correct.”¹⁰

11 Dr. Tol has made similar comments in public. For instance, on a website June 14, 2013
12 he stated, “The literature has been overwhelming pro-[Anthropogenic Global Warming]
13 for 20 years or more. The people who I know that disagree with the consensus are well
14 aware that they are a tiny minority.”

15 On the same day, he wrote “The consensus is of course in the high nineties. No one ever
16 said that it was not. We don’t need Cook’s survey to tell us that.”

17 Dr. Tol further neglected to mention the response to his 2014 paper which was published
18 in Cook et al., Reply to Quantifying the consensus on anthropogenic global warming in
19 the scientific literature: A re-analysis, *Energy Policy* Vol. 73, pp. 706-708, 2014. An

¹⁰ R. Tol, Quantifying the Consensus on Anthropogenic Global warming in the Literature: A Reanalysis, *Energy Policy*, Vol. 73, pp. 701-705.

1 expanded list of Tol's errors was reported in Cook et al., 24 Critical Errors in Tol (2014),
2 available at: http://www.skepticalscience.com/docs/24_errors.pdf. Dr. Tol also neglects
3 to mention that his paper was rejected for publication in a climate journal prior to
4 appearing in an off-topic journal.¹¹

5 **Q. Have you read the biographical statements of Dr. Tol?**

6 **A.** Yes.

7 **Q. Can you comment on his expertise and research capacity?**

8 **A.** Dr. Tol is a unique researcher in that his work has been found to be faulty in many
9 instances. In recent years, there have been many instances of errors and corrections.¹² For
10 instance, Dr. Tol published a paper in 2009¹³ that he first corrected in 2014 by claiming
11 that gremlins caused the errors.¹⁴ Shortly thereafter, a second correction was also
12 published.¹⁵

¹¹ <http://archive.is/p8VxA>.

¹² See, e.g., <http://www.theguardian.com/environment/climate-consensus-97-per-cent/2014/apr/30/economics-clear-need-climate-action>.

¹³ R. Tol, The economic effects of climate change, *Journal of Economic Perspectives*, Vol. 23, pp. 29-51, 2009.

¹⁴ R. Tol Correction and Update: The Economic Effects of Climate Change, *Journal of Economic Perspectives*, Vol. 28, pp. 221-226, 2014, <https://www.aeaweb.org/articles.php?doi=10.1257/jep.28.2.221>.

¹⁵ Editorial Note: Correction to Richard S. Tol's "The Economic Effects of Climate Change", *Journal of Economic Perspectives*, Vol. 29, pp. 217-220, 2015 <http://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.29.1.217>.

1 More recently, Dr. Tol published a paper¹⁶ that was once again found to be in error and
2 which he corrected.¹⁷ Dr. Tol wrote yet another article in 2013¹⁸ that needed to be
3 corrected.¹⁹ These errors have been covered in the media and are known to Dr. Tol.²⁰
4 Errors are not often found in capable and competent researchers. The large number of
5 errors recently found in Dr. Tol's work cast great doubt on the veracity of his other
6 conclusions.

¹⁶ R. Tol, Targets for Global Climate Policy: An Overview, J. of Economic Dynamics and Control, Vol. 37, pp. 911-928, 2013.

<http://www.sciencedirect.com/science/article/pii/S0165188913000092>

¹⁷ R. Tol, Corrigendum to "Targets for Global Climate Policy: An Overview", Journal of Economic Dynamics and Control, Vol. 42, p. 121, 2014.

<http://www.sciencedirect.com/science/article/pii/S0165188914000840>.

¹⁸ D. Anthoff and R. Tol, The Uncertainty About the Social Cost of Carbon: A Decomposition Analysis Using FUND, Climatic Change, Vol. 117, pp. 515-530, 2013.

<http://link.springer.com/article/10.1007%2Fs10584-013-0706-7>.

¹⁹ D. Anthoff and R. Tol, Erratum to: The Uncertainty About the Social Cost of Carbon: A Decomposition Analysis Using FUND, Climatic Change, Vol. 121, p. 413, 2013.)

<http://link.springer.com/article/10.1007%2Fs10584-013-0959-1>.

²⁰ http://www.huffingtonpost.co.uk/bob-ward/global-warming_b_6631350.html;

<http://retractionwatch.com/2014/05/21/gremlins-caused-errors-in-climate-change-paper-showing-gains-from-global-warming/>;

<http://retractionwatch.com/2015/07/22/second-correction-for-controversial-paper-on-economic-gains-of-climate-change/>;

<http://www.theguardian.com/environment/2014/oct/17/ipcc-corrects-claim-suggesting-climate-change-would-be-good-for-the-economy>;

<http://www.theguardian.com/environment/climate-consensus-97-per-cent/2014/apr/30/economics-clear-need-climate-action> (self-authored).

V. RESPONSE TO DR. ROGER BEZDEK.

Q. Have you reviewed Dr. Bezdek’s response to the Information Request Number 8 from the Department of Commerce, Division of Energy Resources?

A. Yes. It is included as Schedule 1 to this surrebuttal testimony.

Q. Do you agree that Dr. Bezdek has provided support for his assertion that distinguished scientists do not agree with the statement that “emissions of CO₂ and other greenhouse gases have a warming effect on the planet and that the evidence is sufficiently strong to justify policy action”?

A. No. The papers he cites are irrelevant to this claim and in fact contradict his assertion. The vast majority of these papers are not policy papers; rather they deal with climate science. So, the question is whether these papers reflect a disagreement that carbon dioxide and other greenhouse gases have a “warming effect on the planet.” Dr. Bezdek provides 20 citations that allegedly support this assertion. As discussed below, they do not.

I have already dealt with the first reference (Fyfe et al., 2013) in response to Drs. Spencer and Lindzen, which does not argue against greenhouse gas warming of the planet. The other articles typically do not even address the issue of greenhouse warming. For instance, citation 3, (Dole et al., 2011), deals with a particular weather event and the introduction section to that paper acknowledges the greenhouse effect. Citation 4 (Perlwitz et al., 2009) clearly discusses the long-term warming trend and greenhouse gas

1 emissions. Similarly citation 5 (Kiegwin 1996), which ostensibly deals with historic
2 temperature reconstructions, does not deny the greenhouse gas effect. Even more
3 blatantly, citation 6, (Rosenthal et al., 2013) was actually accompanied by a press release
4 from the institute which stated

5 A recent slowdown in global warming has led some skeptics to renew their claims
6 that industrial carbon emissions are not causing a century-long rise in Earth's
7 surface temperatures. But rather than letting humans off the hook, a new study in
8 the leading journal *Science* adds support to the idea that the oceans are taking up
9 some of the excess heat, at least for the moment. In a reconstruction of Pacific
10 Ocean temperatures in the last 10,000 years, researchers have found that its
11 middle depths have warmed 15 times faster in the last 60 years than they did
12 during apparent natural warming cycles in the previous 10,000.²¹

13 The very first sentence is the paper is: "Observed increases in ocean heat content (OHC)
14 and temperature are robust indicators of global warming during the past several decades."

15 The article in Citation 9, (Ge et al., 2010) evaluates past climate in China (not globally)
16 and concludes that the warming of the 20th century is unprecedented in all evaluated
17 regions within the past 500 years.

18 It is apparent that Dr. Bezdek either does not understand the research he has cited or that
19 he is misinterpreting the conclusions. Either way, these works do not call into question
20 the ability of greenhouse gases to trap heat and warm the planet, but they do call into
21 question Dr. Bezdek's credibility as a witness.

²¹ <http://www.ldeo.columbia.edu/news-events/research-news/2013>.

VI. RECENT DEVELOPMENTS.

Q. Have there been any recent developments in the scientific understanding of the effects of climate change on extreme weather events?

A. Yes. Peabody Energy's experts have repeatedly discounted changes to extreme weather.²² While I discussed this in my rebuttal testimony, very recent research makes the case more strongly. For instance, Mazdiyasni and AghaKouchak (2015)²³ find a substantial increase in current droughts and heatwaves in the USA from 1960 through 2010, not even including the droughts of 2011, 2012, and the multiyear drought in California. Similarly, Wang et al., (2015)²⁴ finds that human emissions of greenhouse gases are increasing extreme precipitation events. Finally, prompted by the recent drought and heat wave in Europe, Dr. Jurgen Vogt from the European Drought Observatory has noted that "extreme temperatures and dry conditions as observed this year are likely to increase in frequency and severity over the coming decades, posing great challenges to our societies."²⁵

²² See, e.g., Bezdek Rebuttal Ex. 1 at 6:208-211.

²³ O. Mazdiyasni and A. AghaKouchak, Substantial Increase in Concurrent Droughts and Heat Waves in the United States, Proceedings of the National Academy of Sciences, (in press); <http://www.pnas.org/content/early/2015/08/27/1422945112.abstract?sid=2e849db6-ccea-4d08-bd13-f5d7e37b85bb>.

²⁴ S.Y. Wang, W.R. Huang, H.H. Hsu, and R. Gillies, Role of the Strengthened El Nino Teleconnection in the May 2015 Floods over the Southern Great Plains, Journal of Geophysical Research, doi: 10.1002/2015GL065211 <http://onlinelibrary.wiley.com/doi/10.1002/2015GL065211/full>.

²⁵ European Drought Observatory, Drought News August 2015, <http://edo.jrc.ec.europa.eu/documents/news/EDODroughtNews201508.pdf>.

1 So, it is clear from my rebuttal testimony and the recently published reports that severe
2 weather is increasing and will continue to increase as humans emit more greenhouse
3 gases. The weather experts agree on this, despite the unsubstantiated statements of
4 Peabody Energy's experts.

5 **VII. CONCLUSION.**

6 **Q. Does this conclude your testimony?**

7 **A. Yes.**

State of Minnesota
DEPARTMENT OF COMMERCE
DIVISION OF ENERGY RESOURCES

Nonpublic ☐

Public ☒

Utility Information Request

Docket Number: E-999/CI-14-643

Date of Request: August 24, 2015

Requested From: Roger H. Bezdek

Response Due: September 3, 2015

Analyst Requesting Information: Zac Ruzycki

Type of Inquiry: ☐..... Financial ☐..... Rate of Return ☐..... Rate Design
 ☐..... Engineering ☐..... Forecasting ☐..... Conservation
 ☐..... Cost of Service ☐..... CIP ☒..... Other:

If you feel your responses are trade secret or privileged, please indicate this on your response.

Request No.	
8	<p>On page 3, lines 90-95 of your August 12, 2015 Rebuttal Testimony, you state:</p> <p>First, numerous distinguished scientists do not agree with this hypothesis, and their findings have been presented in U.S. Congressional testimony and published in peer-reviewed international scientific journals such as <i>Science</i>, <i>Nature</i>, <i>Energy Policy</i>, <i>Energy & Environment</i>, <i>Theoretical and Applied Climatology</i>, <i>Asia-Pacific Journal of Atmospheric Sciences</i>, <i>Journal of Geophysical Research</i>, and <i>Geophysical Review Letters</i>.</p> <p>Please supply the publications in <i>Science</i>, <i>Nature</i>, <i>J. Geophys. Res</i>, <i>GRL</i>, <i>Theoretical and Applied Climatology</i>, authored by “distinguished scientists” in which they demonstrate that they do not agree with the statement “emissions of CO₂ and other greenhouse gases have a warming effect on the planet and that the evidence is sufficiently strong to justify policy action”.</p>

Response:

Response by: Roger H. Bezdek List sources of information: _____

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These are listed in Bezdek Exhibit 3: "Compendium of Scientific Literature on Climate Change," Chapter II, "Climate Models Are Not Sufficiently Reliable to Form a Basis for Policymaking," pp. 35-66, submitted in this Proceeding.

The following lists selected examples of relevant articles in *Science*, *Nature*, *Journal of Geophysical Research*, *Geophysical Research Letters*, and *Theoretical and Applied Climatology*:

1. Fyfe, J.C., Gillett, N.P. and Zwiers, F.W. 2013. Overestimated global warming over the past 20 years. *Nature Climate Change* 3: 767-769.
2. Esper, J., Frank, D.C., Timonen, M., Zorita, E., Wilson, R.J.S., Luterbacher, J., Holzammer, S., Fischer, N., Wagner, S., Nievergelt, D., Verstege, A. and Buntgen, U. 2012. Orbital forcing of tree-ring data. *Nature Climate Change* 2: 862-866.
3. Dole, R., Hoerling, M., Perlwitz, J., Eischeid, J., Pegion, P., Zhang, T., Quan, X.-W., Xu, T. and Murray, D. 2011. Was there a basis for anticipating the 2010 Russian heat wave? *Geophysical Research Letters* 38: 10.1029/2010GL046582.
4. Perlwitz, J., Hoerling, M., Eischeid, J., Xu, T. and Kumar, A. 2009. A strong bout of natural cooling in 2008. *Geophysical Research Letters* 36: 10.1029/2009GL041188.
5. Keigwin, L.D. 1996. The Little Ice Age and Medieval Warm Period in the Sargasso Sea. *Science* 274: 1504-1508.
6. Rosenthal, Y., Linsley, B.K. and Oppo, D.W. 2013. Pacific Ocean heat content during the past 10,000 years. *Science* 342: 617-621.
7. Thomas, E.R., Bracegirdle, T.J., Turner, J. and Wolff, E.W. 2013. A 308-year record of climate variability in West Antarctica. *Geophysical Research Letters* 40: 5492-5496.
8. Kress, A., Hangartner, S., Bugmann, H., Buntgen, U., Frank, D.C., Leuenberger, M., Siegwolf, R.T.W. and Saurer, M. 2014. Swiss tree rings reveal warm and wet summers during medieval times. *Geophysical Research Letters* 41: 1732-1737.
9. Ge, Q.S., Zheng, J.-Y., Hao, Z.-X., Shao, X.-M., Wang, W.-C. and Luterbacher, J. 2010. Temperature variation through 2000 years in China: An uncertainty analysis of reconstruction and regional difference. *Geophysical Research Letters* 37: 10.1029/2009GL041281.
10. Zhao, C., Yu, Z., Zhao, Y. and Ito, E. 2009. Possible orographic and solar controls of Late Holocene centennial-scale moisture oscillations in the northeastern Tibetan Plateau. *Geophysical Research Letters* 36: 10.1029/2009GL040951.
- A. Schmittner et al., "Climate Sensitivity Estimated From Temperature Reconstructions of the Last Glacial Maximum." *Science* 334: 1385-1388, 2011
11. J.C. Hargreaves et al., "Can the Last Glacial Maximum Constrain Climate Sensitivity?" *Geophysical Research Letters* 39: L24702, Doi: 10.1029/2012GL053872, 2012
12. H. Douville, et al., "The Recent Global Warming Hiatus: What is the Role of Pacific Variability?," 42 *Geophys. Resch. Letters* 880 (Feb. 16, 2015).
13. Richard Lindzen & Yong-Sang Choi, "On the Determination of Climate Feedbacks from ERBE Data," 36 *Geophys. Resch. Letters* L16705 (2009), available at <http://www.drroyspencer.com/Lindzen-and-Choi-GRL-2009.pdf>.
14. Thorsten Mauritsen & Bjorn Stevens, "Missing Iris Effect as a Possible Cause of Muted Hydrological Change and High Climate Sensitivity in Models," *Nature Geosci.* (Apr.

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- 20, 2015) (advance online publication), available at <http://www.nature.com/ngeo/journal/vaop/ncurrent/full/ngeo2414.html>.
15. Xian Yao Chen & Ka-Kit Tung, "Varying Planetary Heat Sink Led to Global-Warming Slowdown and Acceleration," 345 *Science* 897 (Aug. 2014), available at <http://www.sciencemag.org/content/345/6199/897>.
 16. Paul J. Durack, *et al.*, "Quantifying Underestimates of Long-Term Upper-Ocean Warming," 4 *Nature Climate Change* 999 (2014).
 17. W. Llovel, *et al.*, "Deep-Ocean Contribution to Sea Level and Energy Budget Not Detectable Over the Past Decade," 4 *Nature Climate Change* 1031 (2014).
 18. Ding, Q., Wallace, J.M., Battisti, D.S., Steig, E.J., Gallant, A.J.E., Kim, H.-J. and Geng, L. 2014. Tropical forcing of the recent rapid Arctic warming in northeastern Canada and Greenland. *Nature* 509: 10.1038/nature13260.
 19. Neukom, R., Gergis, J., Karoly, D.J., Wanner, H., Curran, M., Elbert, J., Gonzalez-Rouco, F., Linsley, B.K., Moy, A.D., Mundo, I., Raible, C.C., Steig, E.J., van Ommen, T., Vance, T., Villalba, R., Zinke, J. and Frank, D. 2014. Inter-hemispheric temperature variability over the past millennium. *Nature Climate Change* 4: 362-367.
 20. Ray, S. and Giese, B.S. 2012. Historical changes in El Niño and La Niña characteristics in an ocean reanalysis. *Journal of Geophysical Research* 117: 10.1029/2012JC008031.

The following are examples of peer-reviewed articles that question the ability of climate models to simulate climate accurately:

1. Chen, L. and Frauenfeld, O.W. 2014. A comprehensive evaluation of precipitation simulations over China based on CMIP5 multimodel ensemble projections. *Journal of Geophysical Research: Atmospheres* 119: 5767-5786.
2. Toreti, A., Naveau, P., Zampieri, M., Schindler, A., Scoccimarro, E., Xoplaki, E., Dijkstra, H.A., Gualdi, S. and Luterbacher, J. 2013. Projections of global changes in precipitation extremes from Coupled Model Intercomparison Project Phase 5 Models. *Geophysical Research Letters* 40: 4887-4892.
3. Kim, J., Grise, K.M. and Son, S.-W. 2013. Thermal characteristics of the cold-point tropopause region in CMIP5 models. *Journal of Geophysical Research: Atmospheres* 118: 8827-8841.
4. Fyfe, J.C., Gillett, N.P. and Zwiers, F.W. 2013. Overestimated global warming over the past 20 years. *Nature Climate Change* 3: 767-769.
5. Li, J. and Sharma, A. 2013. Evaluation of volcanic aerosol impacts on atmospheric water vapor using CMIP3 and CMIP5 simulations. *Journal of Geophysical Research: Atmospheres* 118: 4448-4457.
6. Sabeerali, C.T., Dandi, A.R., Dhakate, A., Salunke, K., Mahapatra, S. and Rao, S.A. 2013. Simulation of boreal summer intraseasonal oscillations in the latest CMIP5 coupled GCMs. *Journal of Geophysical Research: Atmospheres* 118: 4401-4420.
7. Ault, T.R., Deser, C., Newman, M. and Emile-Gray, J. 2013. Characterizing decadal to centennial variability in the equatorial Pacific during the last millennium. *Geophysical Research Letters* 40: 3450-3456.

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8. Ho, C.K., Hawkins, E., Shaffrey, L., Brocker, J., Hermanson, L., Murphy, J.M., Smith, D.M. and Eade, R. 2013. Examining reliability of seasonal to decadal sea surface temperature forecasts: The role of ensemble dispersion. *Geophysical Research Letters* 40: 5770-5775.
9. Rosenfeld, D., Sherwood, S., Wood, R. and Donner, L. 2014. Climate effects of aerosol-cloud interactions. *Science* 343: 379-380.
10. Fu, G., Liu, Z., Charles, S.P., Xu, Z. and Yao, Z. 2013. A score-based method for assessing the performance of GCMs: A case study of southeastern Australia. *Journal of Geophysical Research: Atmospheres* 118: 4154-4167.
11. Rosa, D. and Collins, W.D. 2013. A case study of subdaily simulated and observed continental convective precipitation: CMIP5 and multiscale global climate models comparison. *Geophysical Research Letters* 40: 10.1002/2013GL057987.
12. Brown, J.R., Colman, R.A., Moise, A.F. and Smith, I.N. 2013. The western Pacific monsoon in CMIP5 models: Model evaluation and projections. *Journal of Geophysical Research: Atmospheres* 118: 12,458-12,475.
13. Rupp, D.E., Abatzoglou, J.T., Hegewisch, K.C. and Mote, P.W. 2013. Evaluation of CMIP5 20th century climate simulations for the Pacific Northwest USA. *Journal of Geophysical Research: Atmospheres* 118: 10,884-10,906.
14. Wang, C., Zhang, L., Lee, S.-K., Wu, L. and Mechoso, C.R. 2014. A global perspective on CMIP5 climate model biases. *Nature Climate Change* 4: 201-205.
15. Crook, J.A. and Forster, P.M. 2014. Comparison of surface albedo feedback in climate models and observations. *Geophysical Research Letters* 41: 1717-1723.
16. Trenberth, K.E., Dai, A., van der Schrier, G., Jones, P.D., Barichivich, J., Briffa, K.R. and Sheffield, J. 2014. Global warming and changes in drought. *Nature Climate Change* 4: 17-22.
17. Li, J.-L.F., Waliser, D.E., Chen, W.-T., Guan, B., Kubar, T., Stephens, G., Ma, H.-Y., Deng, M., Donner, L., Seman, C. and Horowitz, L. 2012. An observationally based evaluation of cloud ice water in CMIP3 and CMIP5 GCMs and contemporary reanalyses using contemporary satellite data. *Journal of Geophysical Research* 117: 10.1029/2012JD017640.
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19. Cesana, G. and Chepfer, H. 2012. How well do climate models simulate cloud vertical structure? A comparison between CALIPSO-GOCCP satellite observations and CMIP5 models. *Geophysical Research Letters* 39: 10.1029/2012GL053153.
20. Cesana, G., Kay, J.E., Chepfer, H., English, J.M. and de Boer, G. 2012. Ubiquitous low-level liquid-containing Arctic clouds: New observations and climate model constraints from CALIPSO-GOCCP. *Geophysical Research Letters* 39: 10.1029/2012GL053385.
21. Li, G. and Xie, S.-P. 2012. Origins of tropical-wide SST biases in CMIP multi-model ensembles. *Geophysical Research Letters* 39: 10.1029/2012GL053777.
22. Kelley, C., Ting, M., Seager, R. and Kushnir, Y. 2012. Mediterranean precipitation climatology, seasonal cycle, and trend as simulated by CMIP5. *Geophysical Research Letters* 39: 10.1029/2012GL053416.

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23. Nam, C., Bony, S., Dufresne, J.-L. and Chepfer, H. 2012. The 'too few, too bright' tropical low-cloud problem in CMIP5 models. *Geophysical Research Letters* 39: 10.1029/2012GL053421.
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25. Zhang, W. and Jin, F.-F. 2012 Improvements in the CMIP5 simulations of ENSO-SSTA Meridional width. *Geophysical Research Letters* 39: 10.1029/2012GL053588.
26. Chen, L., Pryor, S.C. and Li, D. 2012. Assessing the performance of Intergovernmental Panel on Climate Change AR5 climate models in simulating and projecting wind speeds over China. *Journal of Geophysical Research* 117: 10.1029/2012JD017533.
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29. Waliser, D.E., Li, J.-L.F., L'Ecuyer, T.S. and Chen, W.-T. 2011. The impact of precipitating ice and snow on the radiation balance in global climate models. *Geophysical Research Letters* 38: 10.1029/2010GL046478.
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36. Lavers, D., Luo, L. and Wood, E.F. 2009. A multiple model assessment of seasonal climate forecast skill for applications. *Geophysical Research Letters* 36: 10.1029/2009GL041365.
37. Solomon, S., Rosenlof, K., Portmann, R., Daniel, J., Davis, S., Sanford, T. and Plattner, G.-K. 2010. Contributions of stratospheric water vapor to decadal changes in the rate of global warming. *Science* 327: 1218-1220. doi:10.1126/science.1182488.

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38. Woppelmann, G., Marcos, M., Santamaria-Gomez, A., Martin-Miguez, B., Bouin, M.-N. and Gravelle, M. 2014. Evidence for a differential sea level rise between hemispheres over the twentieth century. *Geophysical Research Letters* 41: 1639-1643.
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41. Anandhi, A. and Nanjundiah, R.S. 2015. Performance evaluation of AR4 Climate Models in simulating daily precipitation over the Indian region using skill scores. *Theoretical and Applied Climatology* 119: 551-566
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43. Saha, A., Ghosh, S., Sahana, A.S. and Rao, E.P. 2014. Failure of CMIP5 climate models in simulating post-1950 decreasing trend of Indian monsoon. *Geophysical Research Letters* 41: 7323-7330.

Response by: Roger H. Bezdek

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