

1 **Panel Discussion on Climate Change**

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3 Committee on Science, Space, and Technology

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5 Introductory remarks by Benjamin D. Santer
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7
8 June 20, 2017

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10 My name is Ben Santer. Since 1992, I have been a climate scientist at Lawrence Livermore
11 National Lab. Today, I am not representing Lawrence Livermore. I traveled here at my own
12 expense, and am speaking as a private citizen.

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14 In the mid-1990s, I was the lead author on chapter 8 of a report of the Intergovernmental Panel
15 on Climate Change – the IPCC. Our bottom-line finding was this sentence: “The balance of
16 evidence suggests a discernible human influence on global climate”.¹ These 12 words changed
17 the world.

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19 The IPCC report was published in early 1996. Soon thereafter, my role as lead author of chapter
20 8 was the subject of Congressional investigation. I spent several years of my life defending the
21 “discernible human influence” finding.² The buck stopped with me.

22
23 After 1996, I was not just an individual scientist – I was a representative of the larger scientific
24 community. I had to be accountable. I had to seek respectful dialogue with different
25 stakeholders. I had to communicate complex science in plain English. I had to enter the public
26 arena.

27
28 Today, 21 years after the “discernible human influence” finding, the scientific evidence for
29 human effects on global climate is overwhelming.³ The evidence has at least four different

30 sources. The first is basic understanding of the heat-trapping properties of greenhouse gases.
31 This understanding goes back several centuries. The second source is the evidence from
32 paleoclimate data. Such “deep time” information reveals the unusual nature of recent climate
33 change. The third source of evidence is in historical observations of temperature, rainfall,
34 clouds, sea level, snow, sea-ice, glaciers, and many other climate attributes. Observations tell
35 an internally consistent story of large and rapid planetary warming. The last source of scientific
36 evidence is from computer models of the climate system. In the real world, many different
37 influences on climate vary simultaneously. With models, we can vary one thing at a time. This
38 helps us to isolate the unique climate “fingerprints” of changes in the Sun, volcanic activity,
39 greenhouse gases, and other factors.

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41 The 1995 IPCC report did not have sufficient evidence to make confident statements about the
42 relative sizes of human and natural influences on climate. Today, we do have enough evidence
43 to make such statements. Human fingerprints have been detected from the top of Earth’s
44 atmosphere to the depths of the oceans. The most recent IPCC report – the 2013 report –
45 reached this conclusion: “it is extremely likely that human influence has been the dominant
46 cause of the observed warming since the mid-20th century”.⁴ We can no longer plead ignorance
47 of the climatic consequences of our actions.

48

49 There is – and will always be – some irreducible uncertainty in assessments of complex science.
50 Climate scientists do not ignore these uncertainties. We try to identify and quantify
51 uncertainties in models and in data. We routinely test claims that the climate system is not
52 warming, or that it is warming, but the warming is solely due to natural causes.⁵ Such claims are
53 mutually inconsistent.⁶ They are also inconsistent with reality.

54

55 Let me say a few words about satellite data. In recent hearings, satellite temperature data were
56 presented as “Exhibit A” in the case against global warming.⁷ In fact, satellite data show
57 significant warming of the troposphere – the lowest layer of Earth’s atmosphere.⁸ Globally
58 averaged, tropospheric warming is about 1.25°F (0.75°C) over the full 38 years of satellite

59 temperature records. Warming of this size is highly unusual relative to our best estimates of
60 natural climate variability.⁸ While there are normal decade-to-decade fluctuations in
61 tropospheric temperature, there is no sign of “leveling off” of warming over the last 18 to 20
62 years, as some have claimed.^{8,9}

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64 Our government is charged with keeping the people of the United States safe from harm.
65 Human-caused climate change constitutes a real and serious form of harm – a clear and present
66 danger to the lives, livelihoods, and health of the citizens of this country, and the citizens of this
67 planet. If our government fails to protect us from this harm, it will have failed to fulfil its most
68 important responsibility to the American people.

¹Houghton, J.T., et al., 1996: *Climate Change 1995: The Science of Climate Change*. Cambridge University Press, Cambridge, U.K., page 4.

²<http://www.realclimate.org/index.php/archives/2010/02/close-encounters-of-the-absurd-kind/>

³UK Royal Society and US National Academy of Sciences, 2014: *Climate Change Evidence and Causes*. The full report is available at: <http://dels.nas.edu/resources/static-assets/exec-office-other/climate-change-full.pdf>

⁴IPCC, 2013: Summary for Policymakers. In: *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

⁵Santer, B.D., J. Painter, C. Bonfils, C. Mears, S. Solomon, T.M.L. Wigley, P.J. Gleckler, G.A. Schmidt, C. Doutriaux, N.P. Gillett, K.E. Taylor, P.W. Thorne, and F.J. Wentz, 2013b: Human and natural influences on the changing thermal structure of the atmosphere. *Proceedings of the National Academy of Sciences*, **110**, 17235-17240, [doi:10.1073/pnas.1305332110](https://doi.org/10.1073/pnas.1305332110)

⁶Lewandowsky, S., J. Cook, and E. Lloyd, 2016: The ‘Alice in Wonderland’ mechanics of the rejection of (climate) science: simulating coherence by conspiracism. *Synthese*, [doi: 10.1007/s11229-016-1198-6](https://doi.org/10.1007/s11229-016-1198-6)

⁷U. S. Senate, 2015. Data or Dogma? Promoting open inquiry in the debate over the magnitude of human impact on Earth’s climate. Archived webcast of Hearing before the U. S. Senate Committee on Commerce, Science, and Transportation, Subcommittee on Space, Science, and Competitiveness, December 8, 2015. Available online at: <http://www.commerce.senate.gov/public/index.cfm/2015/12/data-or-dogma-promoting-open-inquiry-in-the-debate-over-the-magnitude-of-human-impact-on-earth-s-climate>

⁸Santer, B.D., S. Solomon, F.J. Wentz, Q. Fu, S. Po-Chedley, C. Mears, J.F. Painter, and C. Bonfils, 2017a: Tropospheric warming over the past two decades. *Scientific Reports*, **7**, 2336, [doi:10.1038/s41598-017-02520-7](https://doi.org/10.1038/s41598-017-02520-7)

⁹Santer, B.D., S. Solomon, G. Pallotta, C. Mears, S. Po-Chedley, Q. Fu, F.J. Wentz, C.-Z. Zou, J.F. Painter, I. Cvijanovic, and C. Bonfils, 2017b: Comparing tropospheric warming in climate models and satellite data. *Journal of Climate*, **30**, 373-392.