

11-2016

Climate Change and the Integrity of Science

Peter H. Gleick
Pacific Institute

James L. Van Etten
University of Nebraska-Lincoln, jvanetten1@unl.edu

Members of the U.S. National Academy of Sciences

Follow this and additional works at: <https://digitalcommons.unl.edu/vanetten>

 Part of the [Environmental Sciences Commons](#), [Genetics and Genomics Commons](#), [Plant Pathology Commons](#), and the [Viruses Commons](#)

Gleick, Peter H.; Van Etten, James L.; and Members of the U.S. National Academy of Sciences, "Climate Change and the Integrity of Science" (2016). *James Van Etten Publications*. 27.
<https://digitalcommons.unl.edu/vanetten/27>

This Article is brought to you for free and open access by the Plant Pathology Department at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in James Van Etten Publications by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

[Science](#). Author manuscript; available in PMC 2016 Nov 28.

Published in final edited form as:

Science. 2010 May 7; 328(5979): 689–690.

doi: [10.1126/science.328.5979.689](https://doi.org/10.1126/science.328.5979.689)

PMCID: PMC5125622

NIHMSID: NIHMS463085

PMID: [20448167](https://pubmed.ncbi.nlm.nih.gov/20448167/)

Climate Change and the Integrity of Science

PH Gleick,* RM Adams, RM Amasino, E Anders, DJ Anderson, WW Anderson, LE Anselin, MK Arroyo, B Asfaw, FJ Ayala, A Bax, AJ Bebbington, G Bell, MVL Bennett, JL Bennetzen, MR Berenbaum, OB Berlin, PJ Bjorkman, E Blackburn, JE Blamont, MR Botchan, JS Boyer, EA Boyle, D Branton, SP Briggs, WR Briggs, WJ Brill, RJ Britten, WS Broecker, JH Brown, PO Brown, AT Brunger, J Cairns, Jr, DE Canfield, SR Carpenter, JC Carrington, AR Cashmore, JC Castilla, A Cazenave, FS Chapin, III, AJ Ciechanover, DE Clapham, WC Clark, RN Clayton, MD Coe, EM Conwell, EB Cowling, RM Cowling, CS Cox, RB Croteau, DM Crothers, PJ Crutzen, GC Daily, GB Dalrymple, JL Dangl, SA Darst, DR Davies, MB Davis, PV De Camilli, C Dean, RS Defries, J Deisenhofer, DP Delmer, EF Delong, DJ Derosier, TO Diener, R Dirzo, JE Dixon, MJ Donoghue, RF Doolittle, T Dunne, PR Ehrlich, SN Eisenstadt, T Eisner, KA Emanuel, SW Englander, WG Ernst, PG Falkowski, G Feher, JA Ferejohn, A Fersht, EH Fischer, R Fischer, KV Flannery, J Frank, PA Frey, I Fridovich, C Frieden, DJ Futuyama, WR Gardner, CJR Garrett, W Gilbert, RB Goldberg, WH Goodenough, CS Goodman, M Goodman, P Greengard, S Hake, G Hammel, S Hanson, SC Harrison, SR Hart, DL Hartl, R Haselkorn, K Hawkes, JM Hayes, B Hille, T Hökfelt, JS House, M Hout, DM Hunten, IA Izquierdo, AT Jagendorf, DH Janzen, R Jeanloz, CS Jencks, WA Jury, HR Kaback, T Kailath, P Kay, SA Kay, D Kennedy, A Kerr, RC Kessler, GS Khush, SW Kieffer, PV Kirch, K Kirk, MG Kivelson, JP Klinman, A Klug, L Knopoff, H Kornberg, JE Kutzbach, JC Lagarias, K Lambeck, A Landy, CH Langmuir, BA Larkins, XT Le Pichon, RE Lenski, EB Leopold, SA Levin, M Levitt, GE Likens, J

Lippincott-Schwartz, L Lorand, CO Lovejoy, M Lynch, AL Mabogunje, TF Malone, S Manabe, J Marcus, DS Massey, JC McWilliams, E Medina, HJ Melosh, DJ Meltzer, CD Michener, EL Miles, HA Mooney, PB Moore, FMM Morel, ES Mosley-Thompson, B Moss, WH Munk, N Myers, GB Nair, J Nathans, EW Nester, RA Nicoll, RP Novick, JF O'Connell, PE Olsen, ND Opdyke, GF Oster, E Ostrom, NR Pace, RT Paine, RD Palmiter, J Pedlosky, GA Petsko, GH Pettengill, SG Philander, DR Piperno, TD Pollard, PB Price, Jr, PA Reichard, BF Reskin, RE Ricklefs, RL Rivest, JD Roberts, AK Romney, MG Rossmann, DW Russell, WJ Rutter, JA Sabloff, RZ Sagdeev, MD Sahlins, A Salmond, JR Sanes, R Schekman, J Schellnhuber, DW Schindler, J Schmitt, SH Schneider, VL Schramm, RR Sederoff, CJ Shatz, F Sherman, RL Sidman, K Sieh, EL Simons, BH Singer, MF Singer, B Skyrms, NH Sleep, BD Smith, SH Snyder, RR Sokal, CS Spencer, TA Steitz, KB Strier, TC Südhof, SS Taylor, J Terborgh, DH Thomas, LG Thompson, RTT Jian, MG Turner, S Uyeda, JW Valentine, JS Valentine, **JL Van Etten**, KE Van Holde, M Vaughan, S Verba, PH Von Hippel, DB Wake, A Walker, JE Walker, EB Watson, PJ Watson, D Weigel, SR Wessler, MJ West-Eberhard, TD White, WJ Wilson, RV Wolfenden, JA Wood, GM Woodwell, HE Wright, Jr, C Wu, C Wunsch, and ML Zoback

The publisher's final edited version of this article is available at [Science](#)

This article has been corrected. See the correction in volume 328 on page 826.

See other articles in PMC that [cite](#) the published article.

We are deeply disturbed by the recent escalation of political assaults on scientists in general and on climate scientists in particular. All citizens should understand some basic scientific facts. There is always some uncertainty associated with scientific conclusions; science never absolutely proves anything. When someone says that society should wait until scientists are absolutely certain before taking any action, it is the same as saying society should never take action. For a problem as potentially catastrophic as climate change, taking no action poses a dangerous risk for our planet.

Scientific conclusions derive from an understanding of basic laws supported by laboratory experiments, observations of nature, and mathematical and computer modeling. Like all human beings, scientists make mistakes, but the scientific process is designed to find and correct them. This process is inherently adversarial—scientists build reputations and gain recognition not only for supporting conventional wisdom, but even more so for demonstrating that the scientific consensus is wrong and that there is a better explanation. That’s what Galileo, Pasteur, Darwin, and Einstein did. But when some conclusions have been thoroughly and deeply tested, questioned, and examined, they gain the status of “well-established theories” and are often spoken of as “facts.”



For instance, there is compelling scientific evidence that our planet is about 4.5 billion years old (the theory of the origin of Earth), that our universe was born from a single

event about 14 billion years ago (the Big Bang theory), and that today's organisms evolved from ones living in the past (the theory of evolution). Even as these are overwhelmingly accepted by the scientific community, fame still awaits anyone who could show these theories to be wrong. Climate change now falls into this category: There is compelling, comprehensive, and consistent objective evidence that humans are changing the climate in ways that threaten our societies and the ecosystems on which we depend.

Many recent assaults on climate science and, more disturbingly, on climate scientists by climate change deniers are typically driven by special interests or dogma, not by an honest effort to provide an alternative theory that credibly satisfies the evidence. The Intergovernmental Panel on Climate Change (IPCC) and other scientific assessments of climate change, which involve thousands of scientists producing massive and comprehensive reports, have, quite expectedly and normally, made some mistakes. When errors are pointed out, they are corrected. But there is nothing remotely identified in the recent events that changes the fundamental conclusions about climate change:

- i. The planet is warming due to increased concentrations of heat-trapping gases in our atmosphere. A snowy winter in Washington does not alter this fact.
- ii. Most of the increase in the concentration of these gases over the last century is due to human activities, especially the burning of fossil fuels and deforestation.
- iii. Natural causes always play a role in changing Earth's climate, but are now being overwhelmed by human-induced changes.
- iv. Warming the planet will cause many other climatic patterns to change at speeds unprecedented in modern times, including increasing rates of sea-level rise and alterations in the hydrologic cycle. Rising concentrations of carbon dioxide are making the oceans more acidic.
- v. The combination of these complex climate changes threatens coastal communities and cities, our food and water supplies, marine and freshwater ecosystems, forests, high mountain environments, and far more.

Much more can be, and has been, said by the world's scientific societies, national academies, and individuals, but these conclusions should be enough to indicate why scientists are concerned about what future generations will face from business-as-usual practices. We urge our policy-makers and the public to move forward immediately to address the causes of climate change, including the unrestrained burning of fossil fuels.

We also call for an end to McCarthy-like threats of criminal prosecution against our colleagues based on innuendo and guilt by association, the harassment of scientists by politicians seeking distractions to avoid taking action, and the outright lies being spread about them. Society has two choices: We can ignore the science and hide our heads in

the sand and hope we are lucky, or we can act in the public interest to reduce the threat of global climate change quickly and substantively. The good news is that smart and effective actions are possible. But delay must not be an option.

Footnotes

¹The signatories are all members of the U.S. National Academy of Sciences but are not speaking on its behalf.

²Signatory affiliations are contained in the Supporting Materials (following):

Erratum

Letters: “Climate change and the integrity of science” by P. H. Gleick *et al.* (7 May, p. [689](#)). Due to an editorial error, the original image was not a photograph but a collage. It was a mistake to have used it. The image (link available at www.sciencemag.org/cgi/content/full/328/5979/689/DC2) has been replaced in the HTML version and in the online PDF by an unaltered photograph from National Geographic (CREDIT: Paul Nicklen/National Geographic/Getty Images) of two polar bears on an ice floe.

Institutional List for Signers of Climate and Integrity of Science piece

Adams	Robert	McCormick	University of California, San Diego
Amasino	Richard	M.	University of Wisconsin
Anders	Edward		University of Chicago
Anderson	David	J.	California Institute of Technology
Anderson	Wyatt	W.	University of Georgia
Anselin	Luc	E.	Arizona State University
Arroyo	Mary	Kalin	University of Chile
Asfaw	Berhane		Rift Valley Research Service
Ayala	Francisco	J.	University of California, Irvine
Bax	Adriaan		National Institutes of Health
Bebbington	Anthony	J.	University of Manchester
Bell	Gordon		Microsoft Research
Bennett	Michael	V. L.	Albert Einstein College of Medicine
Bennetzen	Jeffrey	L.	University of Georgia
Berenbaum	May	R.	University of Illinois
Berlin	Overton	Brent	University of Georgia
Bjorkman	Pamela	J.	California Institute of Technology
Blackburn	Elizabeth		University of California, San Francisco
Blamont	Jacques	E.	Centre National d' Etudes Spatiales
Botchan	Michael	R.	University of California, Berkeley
Boyer	J.	S.	University of Delaware
Boyle	Ed	A.	Massachusetts Institute of Technology
Branton	Daniel		Harvard University
Briggs	Steven	P.	University of California, San Diego
Briggs	Winslow	R.	Carnegie Institution of Washington
Brill	Winston	J.	Winston J. Brill and Associates
Britten	Roy	J.	California Institute of Technology Lamont-Doherty Earth Observatory and Columbia University
Broecker	Wallace	S.	
Brown	James	H.	The University of New Mexico
Brown	Patrick	O.	Stanford University School of Medicine
Brunger	Axel	T.	Stanford University Virginia Polytechnic Institute and State University
Cairns, Jr.	John		
Canfield	Donald	E.	University of Southern Denmark
Carpenter	Stephen	R.	University of Wisconsin
Carrington	James	C.	Oregon State University
Cashmore	Anthony	R.	University of Pennsylvania
Castilla	Juan	Carlos	Pontificia Universidad Católica de Chile
Cazenave	Anny		Centre National d' Etudes Spatiales
Chapin III	F.	Stuart	University of Alaska

Ciechanover	Aaron	J.	Technion-Israel Institute of Technology
Clapham	David	E.	Harvard Medical School
Clark	William	C.	Harvard University
Clayton	Robert	N.	The University of Chicago
Coe	Michael	D.	Yale University
Conwell	Esther	M.	University of Rochester
Cowling	Ellis	B.	North Carolina State University
Cowling	Richard	M.	Nelson Mandela Metropolitan University
Cox	Charles	S.	University of California, San Diego
Croteau	Rodney	B.	Washington State University
Crothers	Donald	M.	Yale University
Crutzen	Paul	J.	Max Planck Institute for Chemistry
Daily	Gretchen	C.	Stanford University
Dalrymple	G.	Brent	Oregon State University
Dangl	Jeffrey	L.	University of North Carolina
Darst	Seth	A.	The Rockefeller University
Davies	David	R.	National Institutes of Health
Davis	Margaret	B.	University of Minnesota, Minneapolis
De Camilli	Pietro	V.	Yale University School of Medicine
Dean	Caroline		John Innes Centre
DeFries	Ruth	S.	Columbia University
Deisenhofer	Johann		The University of Texas Southwestern Medical Center at Dallas
Delmer	Deborah	P.	University of California, Davis
DeLong	Edward	F.	Massachusetts Institute of Technology
DeRosier	David	J.	Brandeis University
Diener	Theodor	O.	University of Maryland
Dirzo	Rodolfo		Stanford University
Dixon	Jack	E.	Howard Hughes Medical Center
Donoghue	Michael	J.	Yale University
Doolittle	Russell	F.	University of California, San Diego
Dunne	Thomas		University of California, Santa Barbara
Ehrlich	Paul	R.	Stanford University
Eisenstadt	Shmuel	N.	The Hebrew University of Jerusalem
Eisner	Thomas		Cornell University
Emanuel	Kerry	A	Massachusetts Institute of Technology
Englander	S.	Walter	University of Pennsylvania School of Medicine
Ernst	W.	G.	Stanford University
Falkowski	Paul	G.	Rutgers, The State University of New Jersey
Feher	George		University of California, San Diego
Ferejohn	John	A.	Stanford University

Fersht	Sir Alan		University of Cambridge
Fischer	Edmond	H.	University of Washington
Fischer	Robert		University of California, Berkeley
Flannery	Kent	V.	University of Michigan
Frank	Joachim		Columbia University
Frey	Perry	Allen	University of Wisconsin
Fridovich	Irwin		Duke University Medical Center
Frieden	Carl		Washington University School of Medicine
Futuyma	Douglas	J.	Stony Brook University
Gardner	Wilford	R.	University of California, Berkeley
Garrett	Christopher	J. R.	University of Victoria
Gilbert	Walter		Harvard University
Gleick	Peter	H.	Pacific Institute
Goldberg	Robert	B.	University of California, Los Angeles
Goodenough	Ward	H.	University of Pennsylvania
Goodman	Corey	S.	venBio, LLC
Goodman	Morris		Wayne State University School of Medicine
Greengard	Paul		The Rockefeller University
Hake	Sarah		Agricultural Research Service
Hammel	Gene		University of California, Berkeley
Hanson	Susan		Clark University
Harrison	Stephen	C.	Harvard Medical School
Hart	Stanley	R.	Woods Hole Oceanographic Institution
Hartl	Daniel	L.	Harvard University
Haselkorn	Robert		The University of Chicago
Hawkes	Kristen		University of Utah
Hayes	John	M.	Woods Hole Oceanographic Institution
Hille	Bertil		University of Washington
Hökfelt	Tomas		Karolinska Institutet
House	James	S.	University of Michigan
Hout	Michael		University of California, Berkeley
Hunten	Donald	M.	University of Arizona
			Pontifical Catholic University of Rio
Izquierdo	Ivan	A.	Grande do Sul
Jagendorf	André	T.	Cornell University
Janzen	Daniel	H.	University of Pennsylvania
Jeanloz	Raymond		University of California, Berkeley
Jencks	Christopher	S.	Harvard University
Jury	William	A.	University of California, Riverside
Kaback	H.	Ronald	University of California, Los Angeles
Kailath	Thomas		Stanford University
Kay	Paul		International Computer Science Institute
Kay	Steve	A	University of California, San Diego

Kennedy	Donald		Stanford University
Kerr	Allen		University of Adelaide
Kessler	Ronald	C.	Harvard Medical School
Khush	Gurdev	S.	University of California, Davis
Kieffer	Susan	W.	University of Illinois
Kirch	Patrick	V.	University of California, Berkeley
Kirk	Kent		University of Wisconsin
Kivelson	Margaret	G.	University of California, Los Angeles
Klinman	Judith	P.	University of California, Berkeley
Klug	Sir	Aaron	Medical Research Council
Knopoff	Leon		University of California, Los Angeles
Kornberg	Sir Hans		Boston University
Kutzbach	John	E.	University of Wisconsin
Lagarias	J.	Clark	University of California, Davis
Lambeck	Kurt		Australian National University
Landy	Arthur		Brown University
Langmuir	Charles	H.	Harvard University
Larkins	Brian	A.	University of Arizona
Le Pichon	Xavier	T.	College de France
Lenski	Richard	E.	Michigan State University
Leopold	Estella	B.	University of Washington
Levin	Simon	A.	Princeton University
Levitt	Michael		Stanford University School of Medicine
Likens	Gene	E.	Cary Institute of Ecosystem Studies
Lippincott-Schwartz	Jennifer		National Institutes of Health
Lorand	Laszlo		Northwestern University
Lovejoy	C.	Owen	Kent State University
Lynch	Michael		Indiana University
Mabogunje	Akin	L.	Foundation for Development and Environmental Initiatives
Malone	Thomas	F.	North Carolina State University
Manabe	Syukuro		Princeton University
Marcus	Joyce		University of Michigan
Massey	Douglas	S.	Princeton University
McWilliams	Jim	C.	University of California, Los Angeles
Medina	Ernesto		Venezuelan Institute for Scientific Research
Melosh	H.	Jay	Purdue University
Meltzer	David	J.	Southern Methodist University
Michener	Charles	D.	University of Kansas
Miles	Edward	L.	University of Washington
Mooney	Harold	A.	Stanford University
Moore	Peter	B.	Yale University

Morel	Francois	M. M.	Princeton University
Moss	Bernard		National Institutes of Health
Munk	Walter	H.	University of California, San Diego
Myers	Norman		University of Oxford
Nair	G.	Balakrish	National Institute of Cholera and Enteric Diseases Johns Hopkins University School of Medicine
Nathans	Jeremy		University of Washington
Nester	Eugene	W.	University of California, San Francisco
Nicoll	Roger	A.	New York University School of Medicine
Novick	Richard	P.	University of Utah
O'Connell	James	F.	Lamont-Doherty Earth Observatory of Columbia University
Olsen	Paul	E.	University of Florida
Opdyke	Neil	D.	University of California, Berkeley
Oster	George	F.	Indiana University
Ostrom	Elinor		University of Colorado
Pace	Norman	R.	University of Washington
Paine	Robert	T.	University of Washington School of Medicine
Palmiter	Richard	D.	Woods Hole Oceanographic Institution
Pedlosky	Joseph		Brandeis University
Petsko	Gregory	A.	Massachusetts Institute of Technology
Pettengill	Gordon	H.	Princeton University
Philander	S.	George	Smithsonian Tropical Research Institute
Piperno	Dolores	R.	Yale University
Pollard	Thomas	D.	University of California, Berkeley
Price Jr.	P.	Buford	Karolinska Institutet
Reichard	Peter	A.	University of Washington
Reskin	Barbara	F.	University of Missouri
Ricklefs	Robert	E.	Massachusetts Institute of Technology
Rivest	Ronald	L.	California Institute of Technology
Roberts	John	D.	University of California, Irvine
Romney	A.	Kimball	Purdue University
Rossmann	Michael	G.	The University of Texas Southwestern Medical Center of Dallas
Russell	David	W.	Synergenics, LLC
Rutter	William	J.	University of Pennsylvania Museum of Archeology and Anthropology
Sabloff	Jeremy	A.	University of Maryland
Sagdeev	Roald	Z.	The University of Chicago
Sahlins	Marshall	D.	University of Auckland
Salmond	Anne		Harvard University
Sanes	Joshua	R.	

Schekman	Randy		University of California, Berkeley Potsdam Institute for Climate Impact Research
Schellnhuber	John		
Schindler	David	W.	University of Alberta
Schmitt	Johanna		Brown University
Schneider	Stephen	H.	Woods Institute for the Environment
Schramm	Vern	L.	Albert Einstein College of Medicine
Sederoff	Ronald	R.	North Carolina State University
Shatz	Carla	J.	Stanford University
Sherman	Fred		University of Rochester Medical Center
Sidman	Richard	L.	Harvard Medical School
Sieh	Kerry		Nanyang Technological University
Simons	Elwyn	L.	Duke University Lemur Center
Singer	Burton	H.	Princeton University
Singer	Maxine	F.	Carnegie Institution of Washington
Skyrms	Brian		University of California, Irvine
Sleep	Norman	H.	Stanford University
Smith	Bruce	D.	Smithsonian Institution Johns Hopkins University School of Medicine
Snyder	Solomon	H.	
Sokal	Robert	R.	Stony Brook University
Spencer	Charles	S.	American Museum of Natural History
Steitz	Thomas	A.	Yale University
Strier	Karen	B.	University of Wisconsin
Südhof	Thomas	C.	Stanford University School of Medicine
Taylor	Susan	S.	University of California, San Diego
Terborgh	John		Duke University
Thomas	David	Hurst	American Museum of Natural History
Thompson	Lonnie	G.	The Ohio State University
Tjian	Robert	T.	Howard Hughes Medical Institute
Turner	Monica	G.	University of Wisconsin
Uyeda	Seiya		Tokai University
Valentine	James	W.	University of California, Berkeley
Valentine	Joan	Selverstone	University of California, Los Angeles
Van Etten	James	L.	University of Nebraska
van Holde	K.	E.	Oregon State University
Vaughan	Martha		National Institutes of Health
Verba	Sidney		Harvard University
von Hippel	Peter	H.	University of Oregon
Wake	David	B.	University of California, Berkeley
Walker	Alan		Pennsylvania State University
Walker	John	E.	Medical Research Council
Watson	E.	Bruce	Rensselaer Polytechnic Institute

Watson	Patty	Jo	Washington University, St. Louis Max Planck Institute for Developmental Biology
Weigel	Detlef		
Wessler	Susan	R.	University of Georgia
West-Eberhard	Mary	Jane	Smithsonian Tropical Research Institute
White	Tim	D.	University of California, Berkeley
Wilson	William	Julius	Harvard University
Wolfenden	Richard	V.	University of North Carolina Harvard-Smithsonian Center for Astrophysics
Wood	John	A.	
Woodwell	George	M.	Woods Hole Research Center
Wright Jr.	H.	E.	University of Minnesota
Wu	Carl		National Institutes of Health
Wunsch	Carl		Massachusetts Institute of Technology
Zoback	Mary	Lou	Risk Management Solutions, Inc.