BEFORE THE ADMINISTRATOR OF THE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

In Re:	)
	)
Proposed Endangerment and	)
Cause or Contribute Findings for	)
Greenhouse Gases Under Section 202(a)	)
of the Clean Air Act; Proposed Rule,	)
74 FED. REG. 18,886 (APR. 24, 2009)	)
	)

Declaration of George T. Wolff, Ph.D.

I, George T. Wolff, declare and state as follows:

1. I am an environmental scientist with expertise and training in air quality, meteorology, and climate science. I hold a Ph.D. in Environmental Sciences from Rutgers University and have authored or co-authored more than 100 refereed papers and chapters in scientific treatises on subjects within my area of expertise. I was a member of the Science Advisory Board of the U.S. Environmental Protection Agency ("EPA" or "the Agency") from 1985 to 2006, and from 1992 to 1996 served as Chairman of EPA's Clean Air Scientific Advisory Committee. My academic training, professional activities and affiliations, awards and publications are listed on Attachment A to this Declaration.

2. I provide this Declaration in support of a Petition being filed today by the U.S. Chamber of Commerce ("the Petition") with EPA. The Petition is based upon a proposed endangerment finding under section 202(a) of the Clean Air Act published in the April 24, 2009, edition of the *Federal Register*. In that *Federal Register* notice, the Administrator proposes to find that anthropogenic greenhouse gas ("GHG") emissions endanger human health and the public welfare, with the latter criterion defined to include impacts on the biosphere such as those

related to air quality, water resources, biodiversity and agriculture. The *Federal Register* notice was accompanied by a Technical Support Document ("TSD").

3. This Declaration is divided into two main parts. Part I provides an overview of the approach taken to the relevant scientific literature in the TSD and briefly comments on the peer-review process for the TSD. Part II provides additional background and references for the discussion of health and welfare effects in the Petition.

4. I base this Declaration on my professional training and expertise. Were the Petition to be granted, I would be fully competent to testify to the matters stated herein under oath and subject to cross-examination.

I.

5. The TSD does not contain original research or analysis of the issues it examines, and relies mainly on a relatively short list of what it calls "core references." Many of those core references are themselves not works of original science and instead report on other literature. Chief among those references are the publications of the Intergovernmental Panel on Climate Change (the "IPCC") and the U.S. Climate Change Science Program (the "CCSP"). Neither the *Federal Register* publication or the TSD note the fact that the same IPCC and CCSP assessments on which the TSD is largely based have been challenged by many in the scientific community for the use of biased perspectives and for inadequate peer review (particularly with respect to the summaries that are found at the front of the IPCC publications). Examples of the type of independent review that could have been undertaken are contained in a report published by the Fraser Institute in March 2009, authored by leading independent academics and other researchers

in the field of climate science, under the supervision of a distinguished editorial board that includes two Nobel Laureates.[1]

6. From my many years of participation in EPA's technical projects I am familiar with the normal process used to obtain peer review of important EPA publications. The peer-review process for the endangerment TSD falls well short of that norm, as well as accepted practice in the scientific community. The 11 expert reviewers of the TSD are federal employees who were also heavily involved in the IPCC and CCSP projects on which the TSD is based. Those peer reviewers are thus essentially reviewing their own work. Some of the peer reviewers, including Dr. Karl, Dr. Solomon and Dr. Schmidt, had major leadership roles in the IPCC and/or CCSP projects. In addition, of the 29 listed authors of the TSD, nine played some role in the IPCC process and at 13 in the CCSP process. To the extent that one function of an independent peer review is to address possible issues of bias in the treatment of the literature, the peer review process designed by EPA for the proposed endangerment finding cannot perform that function. This is another reason, in and of itself, why the scientific dialectic that only an on-the-record proceeding can guarantee is essential to ensuring that the endangerment issue is addressed using all the public and independent scientific resources available to EPA.

II.

7. Sea level rise is relevant to the welfare issues involved in the endangerment proceeding, in view of the long coastlines of many portions of the United States. The TSD asserts that sea level rose in the 20th Century and is currently rising at an increased rate.

[1] *See* Attachment B (Fraser Institute Report); *see also* Peiser, B. (2007), "IPCC: the only game in town?," *Energy & Environment,* **18**, i-iii; Holland, D. (2007), "Bias and concealment in the IPCC process: the "Hockey-stick" affair and its implications," *Energy & Environment*, **18**, 951-983; McKitrick, R. ed, (2007), *Independent summary for policymakers IPCC Fourth Assessment Report*, The Fraser Institute, Vancouver, Canada; Zillman, J.W., (2007), "Some observations on the IPCC Assessment process," *Energy & Environment*, **18**:869-891; Pielke, R., comments at: http://climatesci.org/index.php?s=CCSP&submit=Search.

Nevertheless, Idso has shown in his submittal to the U.S. Senate last year that although there have been short term fluctuations in sea level rise, sea level has risen at a nearly steady, linear rate since about 1860 (corresponding to the end of the Little Ice Age) until 2000 (see Figure 1). The most recent trend derived from satellite measurements[2] is shown in Figure 2. A nearly constant rate of 3.2 ± 0.4 mm/year continues to persist with one caveat. As previously noted, the oceans have been losing heat since about 2003. Consequently, thermal expansion of the ocean has ceased.[3] Consequently, the rate of sea level rise has slowed to about 2.5 mm/yr. Thus, the observations do not support the TSD's claim of accelerating sea level rise. Because the discovery of the slower sea level rise and the cessation of the ocean warming, has been only recently document, EPA may not have been aware of these when the TSD was written.

8. The TSD notes that Arctic temperatures have been rising about twice as fast as the global average temperatures and that the aerial extent of Arctic sea ice has been shrinking by 2.7% per decade on an annual basis and 7.4% per decade during the summer reaching a record low in the satellite record (since 1979) in September 2007.[4] The time series for Arctic surface temperature from Polyakov *et al*., (2002)[5] is presented in Figure 3. It will be noted that the temperature has risen more than 1^{o}C since the mid 1960s, which is greater than the global value. However, there was a comparable warming rate earlier resulting in the record resulting in a period in the late 1930s that had temperatures comparable to the temperatures in the late 1990s.

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[2] *See* http://sealevel.colorado.edu/current/sl_ib_global.pdf.

[3] Cazenave, A., Dominh, K., Guinehut, S., Berthier, E., Llovel, W., Ablain, M. and Larnicol, G., 2009, "Sea level budget over 2003-2008: a reevaluation from GRACE space gravimetry, satellite altimetry and Argo," *Global & Planetary Change*, 65:83-88.

[4] Conditions in the Arctic are relevant to the United States insofar as they pertain to Alaska.

[5] Polyakov, I., V., *et al.*, 2002, "Observationally based assessment of polar amplification of global warming," *Geophys. Res. Lett*, doi:10.1029/2001GL0111111.

Accordingly, the recent USCCSP Arctic report[6] states on page 280 that "Thus far, human influence does not stand out relative to other natural causes of climate change … The data clearly show that strong natural variability has been characteristic of the Arctic at all time scales considered."

9. The TSD states that since preindustrial times the pH of the oceans have decreased 0.1 pH units due to the enhanced absorption of CO_2 by the oceans and it is predicted that by 2100 the pH will decrease another 0.3-0.4 units. All of the projected pH changes (both for the past and the future) are model based. Ocean-wide pH measurements of preindustrial time pH do not exist, so they have been estimated from physical-chemical models that do not contain biological processes.[7] Nevertheless, techniques have been developed to infer past pHs by determining the concentration of boron-11 in the ocean sediments. For example, Pelejero *et al*.,[8] reconstructed the ocean pH for the past 300 years near Flinders Reef in the South Pacific and that is shown in Figure 4. This figure illustrates two important points. First, there are no long-term trends apparent from the time series. Second, there is a cyclic, natural variability that is on the order 0.35 pH units which is greater than 0.1 units claimed by EPA to have occurred before CO_2 started increasing and is on the order of the 2100 predictions. The authors attribute the natural variations to shifts in ocean currents associated with the naturally occurring Pacific Decadal Oscillation. In addition there are a number of studies that measured the diurnal fluctuations of

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[6] White, J.W.C., Alley, R.B., Jennings, A., Johnsen, S., Miller, G.H., and Nerem, S., 2009, "Past Rates of Climate Change in the Arctic. In *Past Climate Variability and Change in the Arctic and at High Latitudes*." A report by the U.S. Climate Change Program and Subcommittee on Global Change Research. U.S. Geological Survey, Reston, VA, pp. 247-302.

[7] Caldeira, K. and Wickett, M.E., 2005, "Anthropogenic carbon and ocean pH," *Nature*, 425:365.

[8] Pelejero, C. *et al*., 2005, "Preindustrial to modern interdecadal variability in Coral Reef pH," *Science*, 309-2204-2207. . . Work like that of Pelejero et al. and other researchers who have examined global acidification is relevant and should be considered by the Administrator, because the extensive ocean territories of the United States.

pH near coral reefs and found them to range from 0.15 pH units to 1.0 pH units.[9,10,11,12] Consequently, there are both short term and long term natural fluctuations that are observed that are larger than the pH changes that concern EPA and these variation do not appear to be having adverse effects on the coral reefs and other marine calcifiers. In addition, it is important not to overlook the fact that corals evolved between 200 to 500 millions of years ago and coccolithophores evolved about 150 million years ago when the atmosphere contained much higher concentration of CO_2 than they do today (*see* Figure 5).

10. Finally, I also wish to note that the TSD also does not account for numerous other studies that offer important analyses on the magnitude of climate change, possible future trends in the climate, and the role of natural forcings in affecting the climate of the United States. To determine the magnitude of the health and welfare effects due to climate change caused by increased anthropogenic CO_2, it is necessary to understand how much of a temperature change will result. To make a quantitative estimate of how much the of the observed temperature change is due to anthropogenic greenhouse gases requires a thorough understanding of the underlying science of all possible processes, both natural and man-made, that could contribute to temperature change. This includes an understanding of the feedbacks that that occur in conjunction with rising CO_2, which could be positive or negative. It also requires a thorough understanding of the potential natural forces that change the temperature including, but not limited to, coupled oceanic-atmospheric cycles and solar variability. Finally, these processes

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[9] Yates, K.K. and Halley, R.B., 2006, *Biogeosciences Discussions*, 3:123.

[10] Ohde, R. and van Woesik, 1999, *Bull. Marine Sci.*, 65:559.

[11] Suzuki, A., Nakamori, T., Kayanne, H., 1995, *Sediment.Geol.*, 99:259.

[12] Schmalz, R.F. and Swanson, F.J., 1969, *J. Sediment. Petrol.*, 39:255.

must be adequately represented in the climate models that are used in the attribution studies and future forecasts. Such models need to be thoroughly tested to make sure that they adequately reproduce climatic observations.

11. An examination of the primary literature indicates that many of these highly uncertain scientific issues, which impact both the U.S and global aspects of the endangerment issue, have not been considered in the TSD and need to be resolved in an open scientific forum. These issues include the following claims that have been made by credible scientists:

- The US temperature record is contaminated with poorly sited stations.[13]
- Both land and sea temperatures since the beginning of this century appear to have stopped rising and may even be decreasing.[14,15,16,17,18]
- The attribution studies have fatal flaws.[19]
- The climate sensitivity used in the climate models is significantly overstated.[20,21,22,23]

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[13] Watts, A., "Is the U.S. Surface Temperature Record Reliable?" The Heartland Institute, Chicago, IL, 2009.

[14] Willis, J.K., 2008, "Is it me, or did the oceans cool?" *U.S. Clivar,* 6:1-4.

[15] Pielke, R. A., 2008, "A broader view of the role of humans in the climate system," *Physics Today*, November 2008, pp 54-55.

[16] Willis, J.K., Chambers, D.P. and Nerem, R.S., 2008, "Assessing the globally averaged sea level budget on seasonal to interannual time scales," *J. Geophys. Res.*, DOI:10.1029/2007JC004517.

[17] Loehle, C., 2009, "Global cooling of the oceans since 2003," *Energy & Environment,* 20: 99-102.

[18] Levitus, S., Antonov, J.I., Boyer, T.P., Locarnini, R.A. and Garcia, H.E., 2009 "Global ocean heat content 1955-2008 in light of revealed instrumentation problems," *Geophys. Res. Lett.*, DOI:10.1029/2008GL037155.

[19]Lindzen, R.S., 2007, "Taking greenhouse warming seriously," *Energy & Environment*, 18:937-950.

[20] Lindzen, R.S., 2007, "Taking greenhouse warming seriously," *Energy & Environment*, 18:937-950.

[21] Douglass, D. H., Pearson, B.D., and Singer, S.F. (2004), "Altitude dependence of atmospheric temperature trends: Climate models versus observations," *Geophys. Res. Let.*, **31**, doi:10.29/2004GL020103.

[22] Spencer, R.W., Braswell, W.D., Christy, J.R., and Hnilo, J. (2007), "Cloud and radiation budget changes associated with tropical intraseasonal oscillations," *Geophys. Res. Let.*, **34**, L15707. doi:10.1029/2007GL029698.

- The solar influence on climate has been significantly underestimated.[24]
- The role of coupled oceanic-atmospheric cycles has been underestimated.[25]
- The performance of the coupled General Circulation Models is poor for many climatic variables other than temperature.[26]

Pursuant to 28 U.S.C. § 1746, I hereby declare that the foregoing is true and correct to the best of my knowledge and belief.

Executed this 22nd day of June 2009 at Farmington Hills, Michigan.

George T. Wolff

George T. Wolff, Ph.D.

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[23] Lindzen, R.S. (2009), "Global Warming – Sensibilities and Science," Presented at the Third International Conference on Climate Change," June 2, 2009, Washington, DC.

[24] Soon, W. H., (2005): Variable solar irradiance as a plausible agent for multidecadal variation in the Arctic-wide surface air temperature of the past 130 years," *Geophys. Res. Lett.,* doi:10.1029/2005GL023429; Soon, W. H., (2009), Solar Arctic-mediated climate variation on multidecadal to centennial timescales: empirical evidence, mechanistic explanation, and testable consequences," *Physical Geography* (in press); Neff et al., (2001), "Strong coherence between solar variability and the monsoon in Omen between 9 and 6 kyr ago," *Nature,* **411**: 290-293; Scafetta, N. and West, B. J., (2008), "Is climate sensitive to solar variability?", *Physics Today,* March 2008, pp. 50-51; Archibald, D.C. (2006), "Solar cycles 24 and 25 and predicted climate response," *Energy & Environment,* **17**, 29-35.

[25] Tsonis, A.A., Swanson, K. and Kravtsov, S., (2007), "A new dynamicalmechanism for major climate shifts," *Geophysic. Res. Lett.,* doi:10.1029/2007GL030288; Wang, G., Swanson, K.L. and Tsonis, A.A., (2009), " The pacemaker of major climate shifts," *Geophysic. Res. Lett.,* doi:10.1029/2008GL036874; Swanson, K.L. and Tsonis, A.A., (2009), "Has the climate recently shifted?", *Geophysic. Res. Lett.,* doi:10.1029/2008GL0307022.

[26] Gates, W.L. et al., 1999, "An overview of the results of the Atmospheric Model Intercomparison Project (AMIP I)," *Bulletin Am. Meteorol. Soc.,* **80**:29-55.

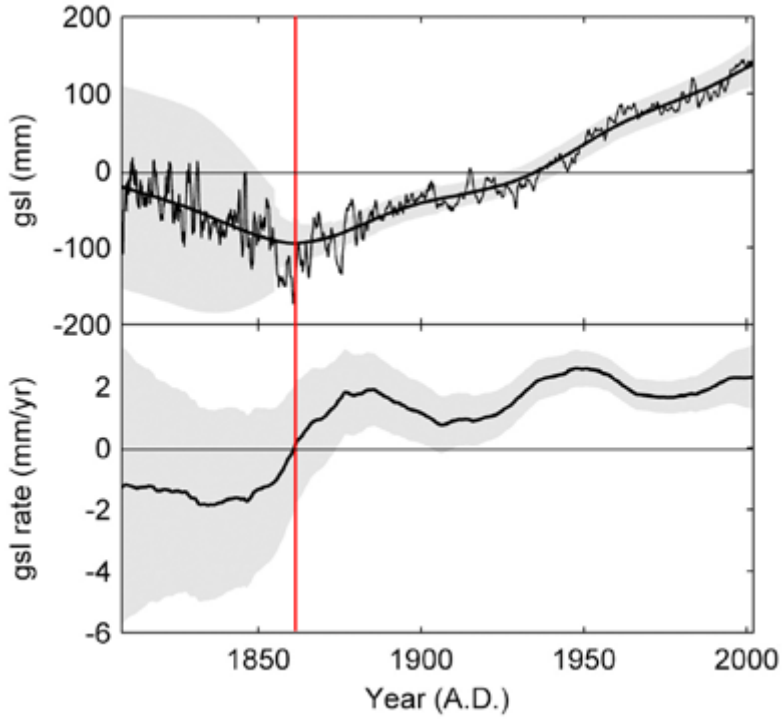

Figure 1: Mean global sea level (top) with shaded 95% confidence interval and mean gsl rate-of-rise (bottom) with shaded standard error interval. Reproduced from Idso 2008.

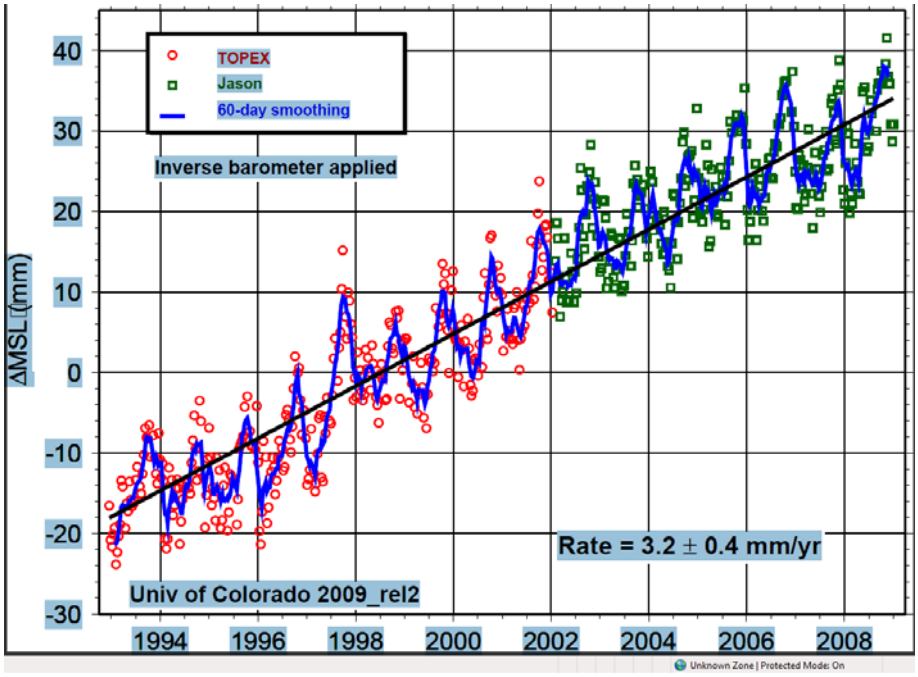

Figure 2: Recent sea-level changes. Source: http://sealevel.colorado.edu/current/sl_ib_global.pdf

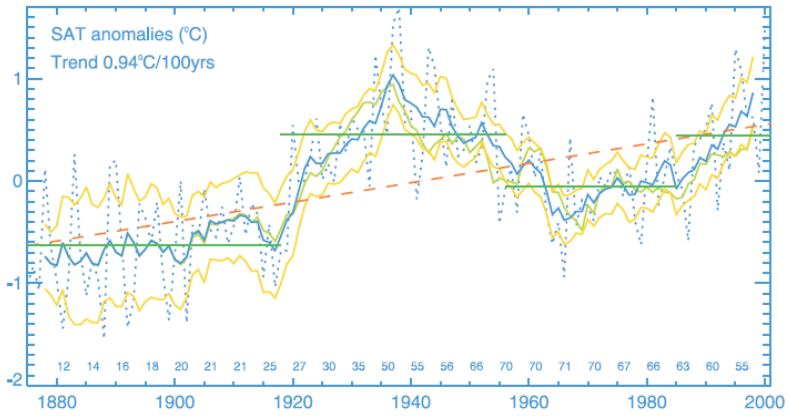

Figure 3: Composite time series of the surface air temperature anomalies (^{o}C) relative to 1961-90 for the region poleward of 62^{o}N. The plot displays the annual means (dashed blue), six-year running means (solid blue), 95% significance level (yellow), means for positive and negative LFO phases (horizontal green), and six-year running means using the 24 longest (century plus) records. Number at bottom of the panel denote the number of stations used for averaging. (From Polyakov et al., 2002).

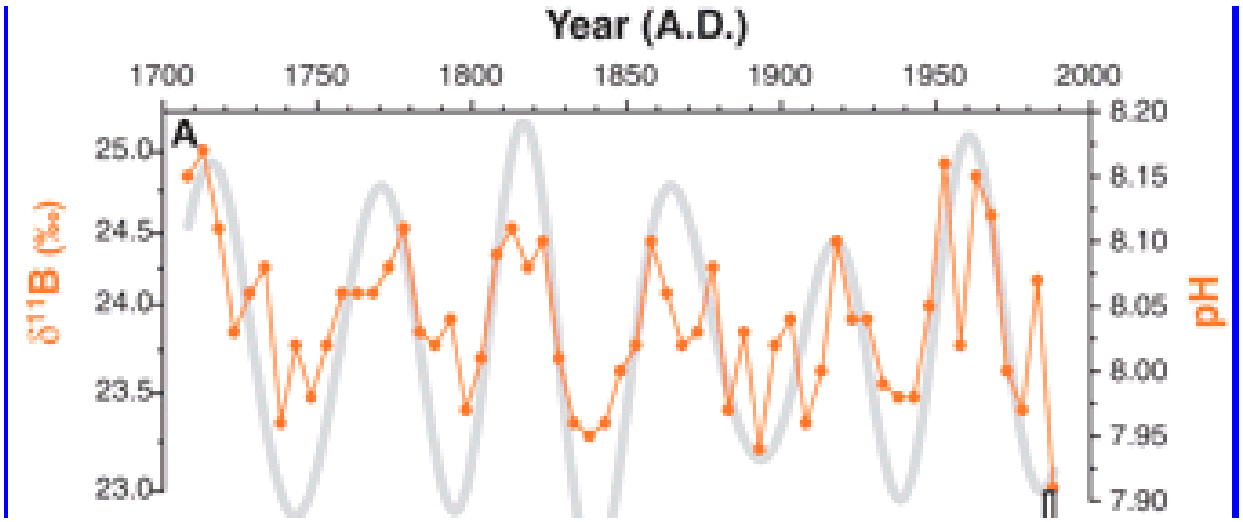

Figure 4: Inferred pH values near Flinders Reef in the South Pacific. From Pelejero et al., 2005.

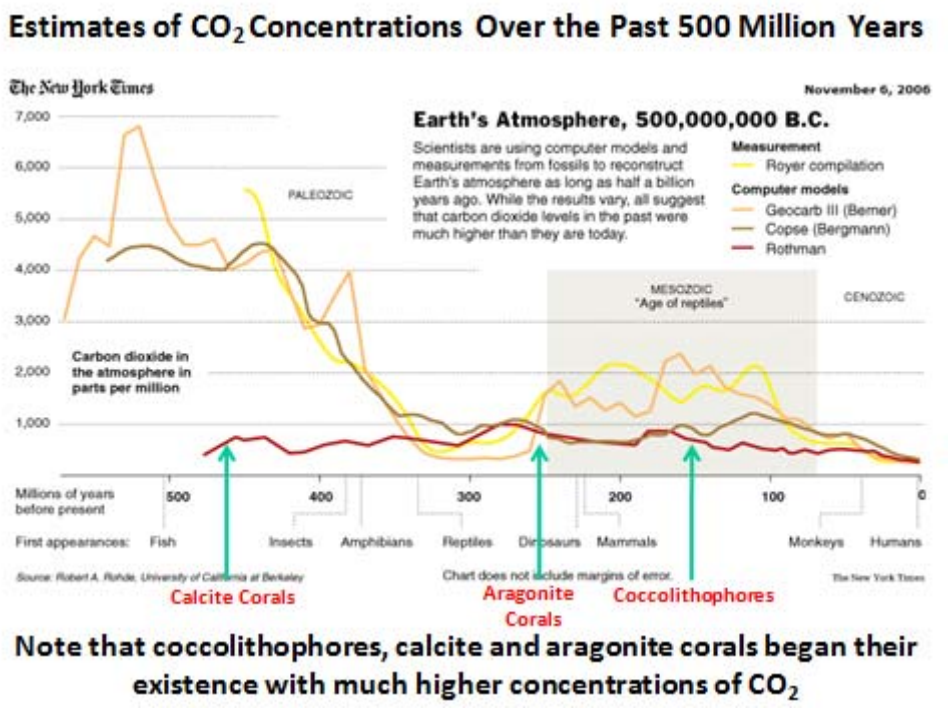

Figure 5: Atmospheric CO_2 concentration estimates for the past 600 milion years.

ATTACHMENT A

George T. Wolff, Ph.D.

I. Educational Background

B.S., Chemical Engineering, New Jersey Institute of Technology, Newark, NJ, 1969

M.S., Meteorology (and Air Resources Management), New York University, New York, NY, 1970

Ph.D., Environmental Sciences (Water, Air and Waste Management), Rutgers University, New Brunswick, NJ, 1974

II. Professional Career

Senior Air Pollution Engineer, Interstate Sanitation Commission, New York, NY, 1973-1975

Associate Engineer and Director of Air Pollution Program, Interstate Sanitation Commission, New York, NY, 1975-1977

Senior Research Scientist, Environmental Science Department, General Motors Research Laboratories, Warren, MI, 1977-1978

Group Leader and Senior Research Scientist, Atmospheric Sampling and Analysis Group, Environmental Science Department, General Motors Research Laboratories, Warren, MI, 1978-1981

Senior Staff Research Scientist and Group Leader, Atmospheric Sampling and Analysis Group, Environmental Science Department, General Motors Research Laboratories, Warren, MI, 1981-1987

Adjunct Professor, Department of Atmospheric and Oceanic Sciences, University of Michigan, Ann Arbor, MI, 1984-1988

Principal Research Scientist and Manager, Atmospheric Modeling and Assessment and Climate Change Programs, General Motors Research Laboratories, Warren, MI, 1987-1990

Principal Research Scientist and Manager, Air Quality and Global Warming Programs, General Motors Research Laboratories, 1990-1992

Adjunct Professor, Department of Environmental Science, School of Public Health, University of Michigan, Ann Arbor, MI, 1991-1995

Principal Scientist, General Motors Environmental and Energy Staff, Detroit, MI, 1992-1996

Principal Scientist, General Motors Public Policy Center, Detroit, MI, 1996-2003

Adjunct Professor, Department of Civil and Environmental Engineering, Michigan State University, East Lansing, MI, 1998-2000

Technical Fellow, Principal Scientist, General Motors Public Policy Center, Detroit, MI, 2003-2008

Principal Scientist Air Improvement Resource, Inc., Novi, MI, 2008-

III. Other Professional Activities

USEPA Science Advisory Board, 1985-2006
- Executive Committee, 1992-1996
  - Membership Subcommittee, 1995-1996
- Clean Air Scientific Advisory Committee (CASAC), 1987-1997
- Chairman, 1992-1996
  - Ozone Review Panel, 1985-1989
  - Subcommittee on Visibility, 1987-1988
  - Subcommittee on Acid Aerosols, 1988-1989
  - Carbon Monoxide Review Panel, 1991-1993
  - Nitrogen Dioxide Review Panel, 1992-1995
  - Subcommittee on Retrospective Air Quality Modeling, 1993-1994
  - Short-term Sulfur Dioxide Standard Review Panel, 1993-1995
  - Ozone Review Panel, 1993-1996
  - PM Review Panel, 1994-1996, 1999-2006
  - Motor Vehicle Emissions Research Panel, 1994
  - Diesel Health Effects Panel, 1995
- Research Strategies Advisory Committee (RSAC), 1992-1994
- Environmental Futures Committee, 1993-1994
- Advisory Council on Clean Air Compliance Analysis, 1995-1998
  - Physical Effects Review Subcommittee, 1994-1997
  - Air Quality Modeling Subcommittee, 1997-1998
  - Health and Ecological Effects Committee, 1997-1998

National Research Council – Committee to Review DOE's Office of Fossil Energy's Research Plan for Fine Particulates, 1999-2000.

Annapolis Center – Board of Directors, 1999-present

Health Effects Institute
- Advisory Board for the Epidemiology Reanalysis Project, 1998-2001
- Sponsors Advisory Committee, 1999-present

University of Michigan School of Public Health – External Advisory Committee for the Michigan Center for the Environment and Children's Health, 1998-2003

Motor Vehicle Manufacturers Association Committee on the Denver "Brown" Cloud, 1978-1980

Reviewer for various EPA, EPRI and HEI research programs, 1979-present

Chairman, International Symposium on Carbonaceous Particles, General Motors Research Laboratories, 1980

NOAA Western Atlantic Ocean Experiment Advisory Committee, 1981-1984

Michigan Department of Natural Resources' 1981 Southeast Michigan Ozone SIP Committee, 1980-1982

California Air Resources Board's Management Advisory Group for the Southern California Air Quality Study (SCAQS), 1985-1991

California Air Resources Board's Emissions Working Group for the Southern California Air Quality Study, 1985-1991

Coordinating Research Council Committee on the Southern California Air Quality Study, Chairman, 1985-1991
California Air Resources Board's Statewide Modeling Coordination Group, 1989-1991
Michigan Department of Natural Resources' Southeast Michigan Receptor-Modeling and PM-10 SIP Committees, 1988-1991
Michigan Department of Natural Resources' Southeast Michigan Ozone Modeling Committee, 1989-1990
Motor Vehicle Manufacturers Association Committee on Air Quality Modeling, 1989 - 1992
Lake Michigan Ozone Study (LMOS) Advisory Committee, 1990-2000
Executive Committee of the Consortium to Assess and Improve Global Climate Model Reliability (MECCA), 1990-1992
Southern Oxidant Study Scientific Advisory Committee, 1991-1994
Michigan Comparative Risk Assessment Science Committee, 1991-1992
Southeast Michigan Ozone Study (SEMOS) Management Committee, 1992-present
Michigan Environmental Science Board, 1992-2003
- Mercury Panel, 1992-1993
- Lead Panel, 1994-1995
- Air Quality Panel, 1996-1997
- Hydrogen Sulfide Panel, 1998-2000
- Children's Standards Investigation Panel, 1998-2000
- Environmental Indicators Panel, 2000-2002

USEPA ROMNET II External Review Committee, 1992-1994
Great Lakes Commission Air Toxic Emission Inventory Technical Steering Committee, 1992-1994
Southeast Michigan Ozone Study (SEMOS)
- Management Committee, 1992- present
- Air Quality Task Force, 1992-1995, 2002-present
- Monitoring Committee, Chair, 1992-1993
- Data Analysis Committee, Chair, 1993-1995

Modeling Ozone Cooperative (MOCA) Management Board, 1994
North American Research Strategy for Tropospheric Ozone (NARSTO) Organizing Committee, 1994
- Assessment-Synthesis Team, 1996-1998

North American Research Strategy for Tropospheric Ozone in the Northeast (NARSTO-NE) Executive Steering Committee, 1994-1996
Ozone Transport Assessment Group (OTAG) - Modeling and Assessment Workgroup, 1995- 1996
Michigan Governor's Air Quality Issues Task Force, Chairman, 1995-1999
Alliance of Automobile Manufacturers' Association – Air Toxics Committee, 1999-
Engine Manufacturers Association – Environmental Activities Committee, 1999-

IV. Professional Societies

Air and Waste Management Association, 1970-present
- Fellow Member, 1991-present
- Vice President, 1988-1989
- Director, 1986-1989
- Planning Committee, 1987-1990
- Editorial Review Board, 1984-2007 (Secretary, 1984-1992; Vice-Chair, 1992-1994; Chair, 1994-1996)
- Publications Committee, 1984-2007 (Vice-chairman, 1985-1988, Chairman, 1988-1992)
- Technical Program Chairman for 1985 Annual Meeting in Detroit, MI, June 16-21, 1985
- Technical Program Chairman for International Specialty Meeting on Photo-chemical Oxidants, Hartford, CT, November, 1987
- Fellow Member Admissions Committee, 1991-present
- Member of various technical committees, 1975-1990
- Technical Chairman, Mid-Atlantic States Section, 1974-1977
- Education Committee, Mid-Atlantic States Section, 1975-1977
- Scholarship Committee Co-Chairman, Michigan Chapter, 1985-present

American Meteorological Society, 1980-present
- Atmospheric Chemistry Committee, 1981-1985, Chairman, 1984-1985

American Geophysical Union, 2003-present

American Association for the Advancement of Science, 2002-present

American Association for Aerosol Research
- 1991 Annual Meeting Committee

Engineering Society of Detroit
- Editorial Review Board *The Journal of Environmental Engineering and Management*, 1991-1995
- Air & Waste Technologies Conference Committee, 1990-1991

Sigma Xi

V. Awards

Environmental Achievement Award, 1983 - Presented by General Motors Corporation for outstanding employee contributions in the environmental field.

John Campbell Award, 1984 - Presented by General Motors Research Laboratories for outstanding contributions to pure or applied science.

Award for Outstanding Services to Meteorology by a Corporation, 1989 - Presented by the American Meteorological Society to General Motors Research Laboratories for my research.

Frank A. Chambers Award, 1997 - Presented by the Air and Waste Management Association for outstanding technical achievement to the science of air pollution.

Technical Publications

Books

1. Wolff, G. T. and Klimisch, R. L., (eds.), *Particulate Carbon: Atmospheric Life Cycle*, Plenum Press, N.Y., N.Y., 411pp (1982).
2. Wolff, G. T., Hanisch, J. and Schere, K. (eds.) *The Scientific and Technical Issues Facing Post-1987 Ozone Control Strategies*, Air Pollution Control Association, Pittsburgh, PA, 736pp (1988).

Chapters in Books

1. Wolff, G. T., Lioy, P. J., Wight, G. D., and Pasceri, R. E., "Aerial investigation of photochemical oxidants over the Northeast, in: Bufalini, J. J. and Lonneman, W. A. (editors) *Symposium on 1975 Northeast Oxidant Transport Study*, EPA-600/3-77-017, p. 70-86 (1977).
2. Wolff, G. T., "The issue of optimum oxidant control strategy," in: Dimitriades, B. (editor) *International Conference on Oxidants, 1976 - Analysis of Evidence and Viewpoints, Part IX. The Issue of Optimum Oxidant Control Strategy*, EPA-600/3-77-120. pp. 73-93 (1977).
3. Wolff, G. T., Lioy, P. J., and Wight, G. D., "An overview of the current ozone problem in the northeastern and midwestern U.S.," In: *Hydrocarbon Control Feasibility: Its Impact on Air Quality*. Air Pollution Control Association, Pittsburgh, PA, pp. 98-110 (1977).
4. Wight, G. D., Wolff, G. T., Lioy, P. J., Meyers, R. E., and Cederwall, R. T., "Formation and transport of O_3 in the Northeast quadrant of the U.S.," in: Morris, A. L., and Barras, R. C. (eds.), *Air Quality Meteorology and Atmospheric Ozone*, p. 445-457, American Society of Testing and Materials, Philadelphia, PA (1978).
5. Kneip, T. J., Leaderer, B. P., Bernstein, D. M., and Wolff, G. T., "The New York Summer Aerosol Study," in: Kneip, T. J. and Lippmann, M. (editors), *The New York Summer Aerosol Study, 1976*, New York Academy of Sciences, N.Y., pp. 29-43 (1979).
6. Lippmann, M., Kleinman, M. T. Bernstein, D. M., Wolff, G. T., and Leaderer, B. P., "Size-mass distributions of the New York summer aerosol," in: Kneip, T. J. and Lippmann, M. (editors), *The New York Summer Aerosol Study, 1976*, New York Academy of Sciences, N.Y., pp. 29-43 (1979).
7. Wolff, G. T., Lioy, P. J., Leaderer, B. P., Bernstein, D. M. and Kleinman, M. T., "Characterization of aerosols upwind of New York City: I transport" in: Kneip, T. J. and Lippmann, M. (editors), *The New York Summer Aerosol Study, 1976*, New York Academy of Sciences, N.Y., pp. 57-71 (1979).
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