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12 UNITED STATES DISTRICT COURT
 13 NORTHERN DISTRICT OF CALIFORNIA
 14 SAN FRANCISCO DIVISION

15 THE PEOPLE OF THE STATE OF
 16 CALIFORNIA, acting by and through Oakland
 17 City Attorney BARBARA J. PARKER,

18 Plaintiff and Real Party in Interest,

19 v.

20 BP P.L.C., a public limited company of England
 and Wales, CHEVRON CORPORATION, a
 21 Delaware corporation, CONOCOPHILLIPS
 COMPANY, a Delaware corporation,
 22 EXXONMOBIL CORPORATION, a New
 Jersey corporation, ROYAL DUTCH SHELL
 23 PLC, a public limited company of England and
 Wales, and DOES 1 through 10,

24 Defendants.
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Case No.: 3:17-cv-06011-WHA

**PLAINTIFF'S NOTICE OF
 SUBMISSION OF MATERIALS
 PRESENTED AT MARCH 21, 2018
 TUTORIAL**

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THE PEOPLE OF THE STATE OF CALIFORNIA, acting by and through the San Francisco City Attorney DENNIS J. HERRERA,

Plaintiff and Real Party in Interest,

v.

BP P.L.C., a public limited company of England and Wales, CHEVRON CORPORATION, a Delaware corporation, CONOCOPHILLIPS COMPANY, a Delaware corporation, EXXON MOBIL CORPORATION, a New Jersey corporation, ROYAL DUTCH SHELL PLC, a public limited company of England and Wales, and DOES 1 through 10,

Defendants.

Case No.: 3:17-cv-06012-WHA

PLAINTIFF'S NOTICE OF SUBMSSION OF MATERIALS PRESENTED AT MARCH 21, 2018 TUTORIAL

1 Plaintiffs hereby submit copies of the following materials that were used or submitted for
2 consideration during their Climate Change Tutorial presentation to the Court on March 21, 2018 in
3 the above-captioned actions:

- 4 Exhibit 1: *Curriculum Vitae* of Dr. Myles Richard Allen;
5 Exhibit 2: *Cirriculum Vitae* of Dr. Gary B. Griggs;
6 Exhibit 3: *Cirriculum Vitae* of Dr. Donald J. Wuebbles;
7 Exhibit 4: Presentation: “Answers to the Questions Posed by Judge Alsup”;
8 Exhibit 5: Presentation: “Understanding how carbon dioxide emissions from human
9 activity contribute to global climate change”;
10 Exhibit 6: Presentation: “A Tutorial on Climate Change Science: The 4th National
11 Climate Assessment”;
12 Exhibit 7: Presentation: “Sea-Level Rise and the San Francisco Bay Shoreline”;
13 Exhibit 8: Presentation: “The History of Climate Change”; and

14 Also attached as Exhibit 9 is an article entitled “Seasonal and Interannual variations in
15 atmospheric oxygen and implications for the global carbon cycle” by Ralph F. Keeling and Stephen
16 R. Shertz of the National Center for Atmospheric Research, as requested by the Court.

17 Dated: March 23, 2018

Respectfully submitted,

18 ** /s/ Erin Bernstein

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** Pursuant to Civ. L.R. 5-1(i)(3), the electronic
filer has obtained approval from this signatory.

** /s/ Matthew D. Goldberg

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EXHIBIT 1

Name: Myles Robert Allen

Current position: Professor of Geosystem Science in the Environmental Change Institute, School of Geography and the Environment and Department of Physics, University of Oxford. Leader of the Climate Research Cluster of the ECI.

Summary of research interests: Understanding how human and natural influences on climate contribute to observed climate change and risks of extreme weather and in quantifying their implications for climate adaptation and mitigation policy.

Address: Environmental Change Institute, OUCE, South Parks Road, Oxford OX1 3QY, UK

Email: myles.allen@ouce.ox.ac.uk

Nationality: British

Date of birth: 11 August 1965

Marital status: Married to Professor Irene M C Tracey, 3 children

Education:

D.Phil. in Atmospheric, Oceanic and Planetary Physics, University of Oxford, 1992

BA in Physics and Philosophy (1st Class), University of Oxford, 1987

Awards and Measures of Esteem:

2010 Appleton Medal and Prize from the Institute of Physics "[*For his important contributions to the detection and attribution of human influence on climate and quantifying uncertainty in climate predictions.*](#)"

Science Watch [Highly Cited Authors in Climate Change Research, 1999-2009](#)

Fellow of the Institute of Physics

Employment:

2011 onwards Professor of Geosystem Science, Environmental Change Institute, School of Geography and the Environment, University of Oxford, and Department of Physics, University of Oxford

2003–2011: University Lecturer, Atmospheric, Oceanic and Planetary Physics, Department of Physics, University of Oxford, (appointed 2000; on parental leave 2006–2007)

1997–2003: NERC Advanced Research Fellow & Head, Climate Dynamics Group, Space Science and Technology Department, Rutherford Appleton Laboratory, & Atmospheric, Oceanic and Planetary Physics, University of Oxford

1994–1995: NOAA Global Change Fellow, Massachusetts Institute of Technology (Host: Richard S Lindzen)

1993–1997: Atlas Research Fellow, Rutherford Appleton Laboratory & Dept of Physics, University of Oxford

1989–1992: Doctoral student, Dept of Physics, University of Oxford (Supervisors: Dr D.L. T Anderson, Dr M K Davey & Dr L A Smith)

1989: Consultant, Energy Unit, United Nations Environment Programme, Kenya

1987–1989: Technical Manager, Bellerive Foundation, Nairobi, Kenya

Current management responsibilities:

- Leader, ECI Climate Research programme: School of Geography and the Environment & Department of Physics, University of Oxford. Leading a research group on climate modelling and attribution, currently comprising one Senior Research Scientist, 4 PDRAs and 2 doctoral students.
- Principal Investigator, "Climateprediction.net - distributed computing for global climate research", collaborative project (2000 to present, overall budget c. £4m), performing large-scale Monte Carlo simulation of climate change 1900 - 2100 using idle CPU on personal computers volunteered by the general public.

Membership of national and international panels:

- Coordinating Lead Author, "Framing and Context", Chapter 1 of the IPCC Special Report on 1.5°C, 2017-2018
- Lead Author, "Detection and Attribution of Climate Change: from Global to Regional", Chapter 10 of the IPCC WG1 Fifth Assessment and Synthesis Report Core Writing Team, 2012-2014

- Review Editor, “Global Climate Projections, IPCC Working Group 1 Fourth Assessment Report, 2007
- Lead Author and member of Summary for Policymakers writing team, “Detection of climate change and attributions of causes”, IPCC Working Group 1 Third Assessment Report, 2001
- Member of the US NOAA/Dept of Energy International Advisory Group on the Detection and Attribution of Anthropogenic Climate Change, 2001-present.
- Member of the Scientific Advisory Group to the UK National Flood Resilience Review, 2016
- Member of the US National Academies Panel on Assessing Approaches to Updating the Social Cost of Carbon, 2015-2017.
- Member of the Scoping Meeting, IPCC 2018 Special Report on 1.5 degrees, 2016
- Member of the Editorial Board, *Environmental Research Letters*

Research Funding:

UK Natural Environmental Research Council (RC Oxford contribution shown, Oxford PI unless otherwise indicated):

- 2016-2019 Drivers Of Change In mid-Latitude weather Events (DOCILE) £572,000
- 2012-2017 Co-I Managing the Risks, Impacts and Uncertainties of droughts and water Scarcity (MaRIUS), £1,056,000
- 2012-2016 Attribution of Climate-related Events in Africa (ACE-Africa), £640,000
- 2009-2014 Risk Analysis of Rapid Climate Change (RAPID-RAPIT), £184,000
- 2009-2013 End-to-End Quantification of Uncertainties in Impact Projections, £205,000
- 2010-2012 Robustness of Climate Change Detection and Attribution Results to Representation of Model-Simulated Variability, £59,000
- 2009-2012 Change in the Atlantic Atmosphere Ocean System, £490,000
- 2008-2012 The Role of the oceans in Coupled, Non-Flux-Adjusted Ensembles, £395,000
- 2003-2010 *Climateprediction.net*, £895,000 (multiple funding lines)

European Commission (Oxford resources shown)

- 2014-2016 EUCLEIA (European Climate-related Events, Interpretation and Attribution), £290,000
- 2007-2011 WATCH (Water and Global Change), £390,000
- 2007-2010 MILLENNIUM (Modelling drivers of climate change over the past millennium), £460,000.

Microsoft Research

- 2007-2010 Distributed computing for research climate modelling: weather@home project, £960,000

The Nature Conservancy

- 2016-2019 Co-I The TNC-Oxford Partnership on extreme weather, the biosphere and land-use in South America, £860,000

The Oxford Martin School

- 2012-2016 The Oxford Martin Programme on Resource Stewardship, £1,450,000
- 2015-2016 The Oxford Martin Net Zero Carbon Investment Initiative, £100,000

Research contributions and impact:

In 1999 I developed the application of Total Least Squares to quantifying the magnitude of human influence on global climate (Allen et al, 2000) which has remained the default algorithm in use in three subsequent assessments of the Intergovernmental Panel on Climate Change to provide the basis of core assessed quantities including the fraction of warming to date that is attributed to human influence on climate.

In 2003 I proposed the use of Probabilistic Event Attribution (Allen, 2003; Pall et al, 2011) to quantify the role of external drivers of climate change in specific instances of extreme weather which has become the standard model for extreme event attribution in climate services at the UK Met Office and the basis for the first near-real-time attribution service provided by the World Weather Attribution service.

In 2005 we demonstrated the application of very large ensemble perturbed-parameter experiments to quantify uncertainty in climate forecasting, in addition to the application of volunteer distributed computing for climate research (Stainforth et al, 2005).

In 2009 I led and co-authored two papers (Allen et al, 2009; Meinshausen et al, 2009) that drew attention to the need to limit cumulative emissions of carbon dioxide to stabilize climate, now recognized in Article 4 of the 2015 Paris Agreement of the United Nations Framework Convention on Climate Change and the basis of the concept of a finite "carbon budget" that has informed much recent discussion of climate mitigation policy. We recently updated the carbon budget for 1.5°C (Millar et al, 2017).

In 2009 we proposed an approach to limiting cumulative carbon emissions through the mandatory introduction of a carbon capture and storage imposed on fossil fuel extraction and imports (Allen, Frame and Mason, 2009). This was taken up in the 2015 House of Lords [debate on the recent UK Energy Bill](#) and represented one of the key policy recommendations of the 2016 Report of the Parliamentary Advisory Group on Carbon Capture and Storage ([Oxburgh et al, 2016](#)).

In 2016 I published a paper (Allen, 2016) demonstrating that, in a consumption-maximizing integrated assessment framework, the core determinants of peak warming are the time-averaged ratio of total emissions to the compound rate of economic growth and the marginal cost of reducing emissions as emissions reach zero, which has significant potential implications for policy priorities.

Selected recent and key publications:

Millar, R.J., Fuglestedt, J.S., Friedlingstein, P., Rogelj, J., Grubb, M.J., Matthews, H.D., Skeie, R.B., Forster, P.M., Frame, D.J. & Allen, M.R. 2017, "Emission budgets and pathways consistent with limiting warming to 1.5 °C", *Nature Geoscience*, vol. 10, no. 10, pp. 741-747.

Ekwurzel, B., Boneham, J., Dalton, M.W., Heede, R., Mera, R.J., Allen, M.R. & Frumhoff, P.C. 2017, "The rise in global atmospheric CO₂, surface temperature, and sea level from emissions traced to major carbon producers", *Climatic Change*, vol. 144, no. 4, pp. 579-590.

Millar, J.R., Nicholls, Z.R., Friedlingstein, P. & Allen, M.R. 2017, "A modified impulse-response representation of the global near-surface air temperature and atmospheric concentration response to carbon dioxide emissions", *Atmospheric Chemistry and Physics*, vol. 17, no. 11, pp. 7213-7228.

Mitchell, D., Davini, P., Harvey, B., Massey, N., Haustein, K., Woollings, T., Jones, R., Otto, F., Guillod, B., Sparrow, S., Wallom, D. & Allen, M. 2017, "Assessing mid-latitude dynamics in extreme event attribution systems", *Climate Dynamics*, vol. 48, no. 11-12, pp. 3889-3901.

Mote, P.W., Rupp, D.E., Li, S., Sharp, D.J., Otto, F., Uhe, P.F., Xiao, M., Lettenmaier, D.P., Cullen, H. & Allen, M.R. 2016, "Perspectives on the causes of exceptionally low 2015 snowpack in the western United States", *Geophysical Research Letters*, vol. 43, no. 20, pp. 10,980-"10,988".

Parker, H.R., Boyd, E., Cornforth, R.J., James, R., Otto, F.E.L. & Allen, M.R. 2017, "Stakeholder perceptions of event attribution in the loss and damage debate", *Climate Policy*, vol. 17, no. 4, pp. 533-550.

P. Pall et al, [Anthropogenic greenhouse gas contribution to flood risk in England and Wales in autumn 2000](#), *Nature*, 470:382-385, 2011 (Cover).

M. R. Allen et al: [Warming caused by cumulative carbon emissions towards the trillionth tonne](#), *Nature*, 458:1163-1166, 2009 (Cover).

D. A. Stainforth, et al. [Uncertainty in predictions of the climate response to rising levels of greenhouse gases](#). *Nature*, 433:403-406, 2005.

P. A. Stott, D. A. Stone and M. R. Allen, [Human contribution to the European heatwave of 2003](#), *Nature*, 432:610-614, 2004.

M. R. Allen et al: [Quantifying the uncertainty in forecasts of anthropogenic climate change](#), *Nature*, 407:617-620, 2000.

Public engagement and outreach:

Climate*prediction*.net has recruited over 400,000 volunteers to participate in climate modeling research since its inception in 2003 and remains the world's largest single climate modeling project. As the BBC Climate Change Experiment, it was awarded the [Prix Europa](#) Exploration Award for Internet Project of the Year 2007, and was the subject of two BBC documentaries. Under the [World Weather Attribution](#) project with Climate Central, we now provide a core component of current near-real-time weather event attribution services.

External referees:

Professor Jan Fuglestedt

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E-mail: j.s.fuglestedt@cicero.oslo.no

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Director, Priestley International Centre for Climate

University of Leeds, Leeds, LS2 9JT

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Professor Corinne Le Quéré

Director, Tyndall Centre for Climate Impacts Research

University of East Anglia, Norwich NR4 7TJ

E-mail: C.LeQuere@uea.ac.uk

Publication list for Myles R. Allen, October 2016 (for 2017 publications, see CV body)

Source: *SCOPUS*, total citations 11,503, H-index 47 (now 52)

1. Uhe P, Otto FEL, Hausteine K, van Oldenborgh GJ, King AD, Wallom DCH, **Allen MR**, Cullen H. Comparison of methods: Attributing the 2014 record european temperatures to human influences. *Geophysical Research Letters* 2016; 43(16):8685-93.
2. Otto FEL, Van Oldenborgh GJ, Eden J, Stott PA, Karoly DJ, **Allen MR**. The attribution question. *Nature Climate Change* 2016; 6(9):813-6.
3. Mitchell D, Davini P, Harvey B, Massey N, Hausteine K, Woollings T, Jones R, Otto F, Guillod B, Sparrow S, Wallom D, **Allen MR** Assessing mid-latitude dynamics in extreme event attribution systems. *Climate Dynamics* 2016:1-13.
4. **Allen MR**, Fuglestedt JS, Shine KP, Reisinger A, Pierrehumbert RT, Forster PM. New use of global warming potentials to compare cumulative and short-lived climate pollutants. *Nature Climate Change* 2016; 6(8):773-6.
5. Mitchell D, Heaviside C, Vardoulakis S, Huntingford C, Masato G, P Guillod B, Frumhoff P, Bowers A, Wallom D, **Allen MR** Attributing human mortality during extreme heat waves to anthropogenic climate change. *Environmental Research Letters* 2016; 11(7).
6. **Allen MR**. Drivers of peak warming in a consumption-maximizing world. *Nature Climate Change* 2016; 6(7):684-6.
7. Hallegatte S, Rogelj J, **Allen MR**, Clarke L, Edenhofer O, Field CB, Friedlingstein P, Van Kesteren L, Knutti R, Mach KJ, Mastrandrea M, Michel A, Minx J, Oppenheimer M, Plattner G-, Riahi K, Schaeffer M, Stocker TF, Van Vuuren DP. Mapping the climate change challenge. *Nature Climate Change* 2016; 6(7):663-8.
8. Hausteine K, Otto FEL, Uhe P, Schaller N, **Allen MR**, Hermanson L, Christidis N, McLean P, Cullen H. Real-time extreme weather event attribution with forecast seasonal SSTs. *Environmental Research Letters* 2016; 11(6).
9. Schaller N, Kay AL, Lamb R, Massey NR, Van Oldenborgh GJ, Otto FEL, Sparrow SN, Vautard R, Yiou P, Ashpole I, Bowers A, Crooks SM, Hausteine K, Huntingford C, Ingram WJ, Jones RG, Legg T, Miller J, Skeggs J, Wallom D, Weisheimer A, Wilson S, Stott PA, **Allen MR**. Human influence on climate in the 2014 southern england winter floods and their impacts. *Nature Climate Change* 2016; 6(6):627-34.
10. Rogelj J, Schaeffer M, Friedlingstein P, Gillett NP, Van Vuuren DP, Riahi K, **Allen MR**, Knutti R. Differences between carbon budget estimates unravelled. *Nature Climate Change* 2016; 6(3):245-52.
11. Sippel S, Otto FEL, Forkel M, **Allen MR**, Guillod BP, Heimann M, Reichstein M, Seneviratne SI, Thonicke K, Mahecha MD. A novel bias correction methodology for climate impact simulations. *Earth System Dynamics* 2016; 7(1):71-88.
12. Mote PW, **Allen MR**, Jones RG, Li S, Mera R, Rupp DE, Salahuddin A, Vickers D. Superensemble regional climate modeling for the western united states. *Bulletin of the American Meteorological Society* 2016; 97(2):203-15.
13. Millar R, **Allen MR**, Rogelj J, Friedlingstein P. The cumulative carbon budget and its implications. *Oxford Review of Economic Policy* 2016; 32(2):323-42.
14. Parker HR, Boyd E, Cornforth RJ, James R, Otto FEL, **Allen MR**. Stakeholder perceptions of event attribution in the loss and damage debate. *Climate Policy* 2015:1-18.
15. Mera R, Massey N, Rupp DE, Mote P, **Allen MR**, Frumhoff PC. Climate change, climate justice and the application of probabilistic event attribution to summer heat extremes in the california central valley. *Climatic Change* 2015; 133(3):427-38.
16. Bergaoui K, Mitchell D, Zaaboul R, McDonnell R, Otto F, **Allen MR**. The contribution of human-induced climate change to the drought of 2014 in the southern levant region. *Bulletin of the American Meteorological Society* 2015; 96(12):S66-70.
17. Otto FEL, Rosier SM, **Allen MR**, Massey NR, Rye CJ, Quintana JI. Attribution analysis of high precipitation events in summer in england and wales over the last decade. *Climatic Change* 2015; 132(1):77-91.
18. Huntingford C, Lowe JA, Howarth N, Bowerman NHA, Gohar LK, Otto A, Lee DS, Smith SM, den Elzen MGJ, van Vuuren DP, Millar RJ, **Allen MR**. The implications of carbon dioxide and methane exchange for the heavy mitigation RCP2.6 scenario under two metrics. *Environmental Science and Policy* 2015; 51:77-87.
19. Millar RJ, Otto A, Forster PM, Lowe JA, Ingram WJ, **Allen MR**. Model structure in observational constraints on transient climate response. *Climatic Change* 2015; 131(2):199-211.
20. Otto FEL, Boyd E, Jones RG, Cornforth RJ, James R, Parker HR, **Allen MR**. Attribution of extreme weather events in africa: A preliminary exploration of the science and policy implications. *Climatic Change* 2015; 132(4):531-43.
21. Rupp DE, Li S, Massey N, Sparrow SN, Mote PW, **Allen MR** Anthropogenic influence on the changing likelihood of an exceptionally warm summer in texas, 2011. *Geophysical Research Letters* 2015; 42(7):2392-400.

22. Van Oldenborgh GJ, Haarsma R, De Vries H, **Allen MR**. Cold extremes in north america vs. mild weather in europe: The winter of 2013-14 in the context of a warming world. *Bulletin of the American Meteorological Society* 2015; 96(5):707-14.
23. Otto FEL, Frame DJ, Otto A, **Allen MR**. Embracing uncertainty in climate change policy. *Nature Climate Change* 2015; 5(10):917-21.
24. Li S, Mote PW, Rupp DE, Vickers D, Mera R, **Allen MR**. Evaluation of a regional climate modeling effort for the western united states using a superensemble from weather@home. *J. Climate* 2015; 28(19):7470-88.
25. Parker HR, Cornforth RJ, Boyd E, James R, Otto FE, **Allen MR**. Implications of event attribution for loss and damage policy. *Weather* 2015; 70(9):268-73.
26. Massey N, Jones R, Otto FEL, Aina T, Wilson S, Murphy JM, Hassell D, Yamazaki YH, **Allen MR**. weather@home-development and validation of a very large ensemble modelling system for probabilistic event attribution. *Quart. J. Royal Meteorological Society* 2015; 141(690):1528-45.
27. Huntingford C, Marsh T, Scaife AA, Kendon EJ, Hannaford J, Kay AL, Lockwood M, Prudhomme C, Reynard NS, Parry S, Lowe JA, Screen JA, Ward HC, Roberts M, Stott PA, Bell VA, Bailey M, Jenkins A, Legg T, Otto FEL, Massey N, Schaller N, Slingo J, **Allen MR**. Reply to 'drivers of the 2013/14 winter floods in the UK'. *Nature Climate Change* 2015; 5(6):491-2.
28. Lopez A, Suckling EB, Otto FEL, Lorenz A, Rowlands D, **Allen MR**. Towards a typology for constrained climate model forecasts. *Climatic Change* 2014; 132(1):15-29.
29. Frame DJ, Macey AH, **Allen MR**. Cumulative emissions and climate policy. *Nature Geoscience* 2014; 7(10):692-3.
30. Huntingford C, Marsh T, Scaife AA, Kendon EJ, Hannaford J, Kay AL, Lockwood M, Prudhomme C, Reynard NS, Parry S, Lowe JA, Screen JA, Ward HC, Roberts M, Stott PA, Bell VA, Bailey M, Jenkins A, Legg T, Otto FEL, Massey N, Schaller N, Slingo J, **Allen MR**. Potential influences on the united kingdom's floods of winter 2013/14. *Nature Climate Change* 2014; 4(9):769-77.
31. Frame DJ, Booth B, Kettleborough JA, Stainforth DA, Gregory JM, Collins M, **Allen MR**. Erratum: Constraining climate forecasts: The role of prior assumptions (*Geophysical Research Letters* (2005) 32 (L09702) DOI: 10.1029/2004GL022241). *Geophysical Research Letters* 2014; 41(9):3257-8.
32. **Allen MR**, Stocker TF. Impact of delay in reducing carbon dioxide emissions. *Nature Climate Change* 2014; 4(1):23-6.
33. Imbers J, Lopez A, Huntingford C, **Allen MR**. Sensitivity of climate change detection and attribution to the characterization of internal climate variability. *J. Climate* 2014; 27(10):3477-91.
34. Levy AAL, Jenkinson M, Ingram W, **Allen MR**. Correcting precipitation feature location in general circulation models. *J. Geophysical Research Atmospheres* 2014; 119(23):13350-69.
35. James R, Otto F, Parker H, Boyd E, Cornforth R, Mitchell D, **Allen MR**. Characterizing loss and damage from climate change. *Nature Climate Change* 2014; 4(11):938-9.
36. Levy AAL, Jenkinson M, Ingram W, Lambert FH, Huntingford C, **Allen MR** Increasing the detectability of external influence on precipitation by correcting feature location in GCMs. *J. Geophysical Research Atmospheres* 2014; 119(22):12466-78.
37. Bowerman NHA, Frame DJ, Huntingford C, Lowe JA, Smith SM, **Allen MR**. Erratum: The role of short-lived climate pollutants in meeting temperature goals (*Nature climate change* (2013) 3 (1021-1024)). *Nature Climate Change* 2014; 4(1):74.
38. Pretis F, **Allen MR**. Breaks in trends. *Nature Geoscience* 2013; 6(12):992-3.
39. Otto FE, Jones RG, Halladay K, **Allen MR**. Attribution of changes in precipitation patterns in african rainforests. *Phil. Trans. Roy. Soc. London B, Biol Sci* 2013; 368(1625):20120299.
40. Bowerman NHA, Frame DJ, Huntingford C, Lowe JA, Smith SM, **Allen MR**. The role of short-lived climate pollutants in meeting temperature goals. *Nature Climate Change* 2013; 3(12):1021-4.
41. Gillett NP, Arora VK, Matthews D, **Allen MR**. Constraining the ratio of global warming to cumulative CO2 emissions using CMIP5 simulations. *J. Climate* 2013; 26(18):6844-58.
42. Otto FEL, Jones RG, Halladay K, **Allen MR**. Attribution of changes in precipitation patterns in african rainforests. *Phil. Trans. Roy. Soc. London B Biol Sci* 2013; 368(1625).
43. Otto A, Otto FEL, Boucher O, Church J, Hegerl G, Forster PM, Gillett NP, Gregory J, Johnson GC, Knutti R, Lewis N, Lohmann U, Marotzke J, Myhre G, Shindell D, Stevens B, **Allen MR**. Energy budget constraints on climate response. *Nature Geoscience* 2013; 6(6):415-6.
44. Kunreuther H, Heal G, **Allen MR**, Edenhofer O, Field CB, Yohe G. Risk management and climate change.

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EXHIBIT 2

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1991-present: Director-Institute of Marine Sciences, University of California Santa Cruz
1991-1994: Associate Dean-Division of Natural Sciences, University of California Santa Cruz
1995-1997: Editorial Board-*Geology*

1995-2006: Consortium for Oceanographic Research and Education: Member of Executive Committee and Governor, Central California Consortium.
1997-98: NAS-NRC Committee on Coastal Engineering Research & Education Needs
1998: Chair-California Sea Grant Program Review Committee
1999-2009: Chair-University of California Marine Council
2002-07: Chair of Steering Committee and Principal Investigator-Center for Integrated Marine Technologies
2003-2004: Board of Directors- Island Conservation
2003-2004: Chair- Strategic Futures Committee, University of California Santa Cruz
2003-2010: Advisory Board-California Center for Ocean Science Education Excellence
2003-2010; 2014-present: Advisory Board-California Sea Grant
2002-07: Exec. Comm.-Central and Northern California Ocean Observing System
2007- present: Save-Our-Shores Science Advisory Council
2007-09: Consortium for Ocean Leadership-Board of Trustees and Executive Committee
2007-08: Planning Committee: California Current Ecosystem-Based Management Initiative
2008-present: Scientific Advisory Team to the California Ocean Protection Council; (2009-2013 Co-Chair of Team and Executive Committee member)
2010-2011: Cooperation Across the Atlantic for Marine Governance Integration (CALAMAR). American Co-Chair for Working Group on Oceans and Climate Change.
2010-2012: Member of National Academy of Sciences-National Research Council Committee on: Sea-Level Rise for Coasts of California, Oregon and Washington.
2012: Chair, Geological Society of America Panel on Developing Position Paper: The Role of Geology in Managing U.S. Coastal Hazard Risk.
2014: Visiting Professor-Semester at Sea, University of Virginia
2015-present: Member, California Ocean Sciences Trust
2015-2017: Member and Chair, National Academy of Sciences-National Research Council Committee on: Environmental Science and Assessment for Ocean Energy Management
2017-2018: Member and Chair, California Ocean Science Protection Council Advisory Team Working Group to update California Sea-Level Rise Projections.

AWARDS

1974-75: Fulbright Fellow- Institute of Oceanographic Research, Athens, Greece
1998: University of California, Santa Cruz, Division of Natural Sciences- Outstanding Faculty Award (teaching-research-service)
2001: Distinguished Alumnus Award- Geological Sciences Department, University of California Santa Barbara
2003: American Shore and Beach Preservation Association: Joe Johnson Coastal Research Award
2006: University of California Santa Cruz: Alumni Distinguished Teaching Award
2006: University of California: Santa Cruz Pioneer Faculty Award
2007: Ed Ricketts Award for Sustained Research in Marine Science- Monterey Bay National Marine Sanctuary.
2009: California Coastal Commission/Sunset Magazine California Coastal Hero award.
2010: Elected to California Academy of Sciences

2016: Santa Cruz Museum of Natural History Laura Hecox Naturalist Award

RESEARCH AREAS

- Coastal Processes: Littoral drift, sand budgets and littoral cells; Evaluation of long-term shoreline changes and geomorphic evolution of coastlines.
- Coastal Erosion and Protection: sea cliff and beach erosion; coastal engineering; coastal protection structures and their effectiveness and impacts; coastal hazard analysis and planning.
- Impacts of sea-level rise on coastlines: vulnerability and adaptation.

COURSES TAUGHT

Oceanography
Geologic Hazards
Hydrology
Coastal Geology
Geologic Principles
Tectonic Geomorphology
Frontiers in Earth Sciences
Coastal Processes
Coasts in Crisis

PUBLICATIONS

1. Weaver, D.W., Griggs, G.B., McClure, D.V. and Mackey, J.R., 1969. Volcaniclastic sequence, south central Santa Cruz Island, In: Geology of the Northern Channel Islands, by D.W. Weaver, Special Publication Pacific Section AAPG-SEPM, p. 85-90.
2. Griggs, G.B. and Kulm, L.D., 1969. Glacial marine sediments from the Northeast Pacific, *Journal Sed. Petrology* 39:1142-1149.
3. Griggs, G.B., Carey, A.G., and Kulm, L.D., 1969. Deep-sea sediments and sediment-fauna interaction in Cascadia Channel and on Cascadia Abyssal Plain, *Deep-Sea Research* 16:157-170.
4. Kulm, L.D., Fowler, G.A., Duncan, J.R. and Griggs, G.B., 1969. Late Quaternary deep-sea stratigraphy and paleoclimatology of a middle to high latitude region, Northeastern Pacific, *Geol. Soc. Amer. Ann. Mtg. Program*, p.275-277.
5. Griggs, G.B. and Kulm, L.D., 1970. Sedimentation in Cascadia Deep-Sea Channel, *Bull. Geol. Soc. Amer.* 81:1361-1384.
6. Duncan, J.R., Kulm, L.D., and Griggs, G.B., 1970. Clay mineral composition of Late Pleistocene and Holocene sediments of Cascadia Basin, Northeastern Pacific Ocean, *Journal of Geology* 78: 213-221.

7. Griggs, G.B., Kulm, L.D., Duncan, J.R., and Fowler, G.A., 1970. Holocene faunal stratigraphy and paleoclimatic implications of deep-sea sediments in Cascadia Basin, *Paleogeography, Paleoclimatology, Paleoecology* 7: 5-12.
8. Griggs, G.B. and Kulm, L.D. 1970. Physiography of Cascadia Deep-Sea Channel, *Northwest Science* 44: 82-94.
9. Griggs, G.B., Kulm, L.D., Waters, A.C., and Fowler, G.A., 1970. Deep-sea gravel from Cascadia Channel, *Journal of Geology* 78:611-619.
10. Griggs, G.B. and other, 1970. Santa Cruz and the environment, Big Trees Press, Felton, CA 28 p.
11. Griggs, G.B. and Fowler, G.A., 1971. Foraminiferal trends in a Holocene turbidite, *Deep-Sea Research* 18:645-648.
12. Hein, J.R. and Griggs, G.B., 1972. Distribution and scanning electron microscope (SEM) observations of authigenic pyrite from a Pacific deep-sea core, *Deep-Sea Research* 19: 133-138.
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15. Griggs, G.B., 1973. The effect of coastal currents on ocean outfalls, *Effluent and Water Treatment Jour.* 14:29-32.
16. Papakostidis, G., Griggs, G.B., Grimanis, A.P. Hopkins, T.S., and Zafiroopoulos, D., 1974. The distribution of heavy metals in bottom sediments in the vicinity of the Athens sewage outfall, XIV Congress International Exploration Mediterranean Sea, Monaco, 8p.
17. Griggs, G.B., 1974. The evolution of the coastline, In: *In the Ocean Wind*, P. Scott and C. Wayburn, Editors, Big Trees Press, Felton, CA p. 37-45.
18. Hein, J.R., Allwardt, A.O. and Griggs, G.B., 1974. The occurrence of glauconite in Monterey Bay, California: diversity, origins and sedimentary environmental significance, *Journal of Sedimentary Petrology* 44:562-571.
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25. Griggs, G.B., and Hopkins, T.S., 1976. The growth and delineation of a sludge field, *Water Research* 10: 501-506.
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31. Coppersmith, K.J. and Griggs, G.B., 1978. Multi-factor fault activity analysis of the San Gregorio Fault, In: *Special Pub. California Div. Mines & Geology*, No. 147:33-44.
32. Griggs, G.B. and Johnson, R.E., 1979. Erosional processes and cliff retreat along the Northern Santa Cruz County Coastline, *California Geology* 32: 67-76.
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62. Griggs, G.B. and Fulton-Bennett, K.W., 1987. Failure of coastal protection at Seacliff State Beach, Santa Cruz County, California, *Envir. Manage.* 11: 175-182.

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EXHIBIT 3

Donald James Wuebbles

The Harry E. Preble Professor of Atmospheric Sciences
University of Illinois

Biography

Donald J. Wuebbles is the Harry E. Preble Professor of Atmospheric Sciences at the University of Illinois. He is a professor in the Department of Atmospheric Sciences as well as an affiliate professor in both the Department of Civil and Environmental Engineering and in the Department of Electrical and Computer Engineering. He was Head of the Department of Atmospheric Sciences from 1994 until 2006, and was the first Director of the School of Earth, Society, and Environment, from 2006 to 2008. He was also the first Director of the Environmental Council at the University of Illinois, from early 1996 until August 1999; as Director, he held a Dean's level position and was responsible for the coordination and further development of educational and research programs, including initiating a number of new faculty positions, across the University of Illinois relating to the environment.

Professor Wuebbles earned his B.S. (1970) and M.S. (1972) degrees in Electrical Engineering from the University of Illinois. He received his Ph.D. in Atmospheric Sciences from the University of California at Davis in 1983. Professor Wuebbles spent many years as a research scientist and group leader at the Lawrence Livermore National Laboratory before returning to the University of Illinois to be Head of the Department of Atmospheric Sciences in 1994.

Dr. Wuebbles returned to the University in June 2017 after being on special assignment through the National Science Foundation as Senior Advisor for the Geosciences Directorate. For 1.7 years, until mid-January 2017, he was Assistant Director with the Office of Science and Technology Policy (OSTP) of the Executive Office of the President in Washington DC. In coordination with the U.S. Global Change Research Program, he co-led the preparation of the Climate Science Special Report, which serves as Volume I of the 4th National Climate Assessment (NCA4) that provides a comprehensive assessment of the science of climate change with a special focus on the United States. He is also serving on the steering committee for NCA4 and is Coordinating Lead Author for Chapter 2 for Volume II of NCA4. While at OSTP and in coordination with USGCRP, Dr. Wuebbles also led a multi-agency committee focused on increased coordination to understand the sources and sinks of greenhouse gases.

At the University of Illinois, Dr. Wuebbles led the development of the School of Earth, Society, and Environment, and was its first director. He also has led the development of two highly successful undergraduate programs, one in Atmospheric Sciences, and the other, an interdisciplinary major, in Earth, Society and Environment Sustainability (ESES). The ESES major is held as a model for interdisciplinary environmental sustainability programs across the nation. Dr. Wuebbles also led the development of an online major in Environmental Sustainability that was transitioned to largely become an online version of the ESES major. On his return from DC, Dr. Wuebbles was asked to be a Presidential Fellow (one of five across the University of Illinois system) to lead new initiatives on urban sustainability for the University of Illinois.

Professor Wuebbles is the author of over 500 scientific articles, most of which relate to the interactions of atmospheric chemistry and physical processes affecting atmospheric composition (e.g., tropospheric and stratospheric ozone, urban air quality), resulting radiative forcing on climate, and the effects on the climate system resulting from both human activities and natural phenomena. His research emphasizes the development and use of mathematical models of the chemical and physical processes in the atmosphere that affect all of these processes. Through his research, Professor Wuebbles has had a number of important science contributions and "firsts" during his career. Some of his early contributions include studies of the importance of both temperature feedback and multiple scattering on stratospheric composition, and a study demonstrating "diurnal" behavior of trace gases during a solar eclipse that led to a NASA measurement campaign during a solar eclipse. He developed one of the first comprehensive urban air quality models (which was used in the first study of its kind showing the VOC-limited (VOC = volatile organic compounds) behavior of ozone formation in the San Francisco area and one of the first two-dimensional models for studying atmospheric chemistry. In the last 1970s, he authored the most complete analysis of the effects of nuclear tests on stratospheric ozone done to date.

Professor Wuebbles' research has had a direct impact on policies to protect the ozone layer. His early 1980s analyses of a broad range of halocarbon future scenarios had a significant impact on early ozone policy considerations. During that time period, he also developed the concept of Ozone Depletion Potentials used in most policymaking aimed at protection of the ozone layer (e.g., the Montreal Protocol and its amendments, the U.S. Clean Air Act). He coauthored a series of papers on trends in stratospheric ozone, including the first to statistically prove that a decrease in stratospheric ozone was occurring in the early 1980s. These papers led to Professor Wuebbles and colleagues receiving the Stratospheric Ozone Protection Award from the U.S. Environmental Protection Agency in 2005. Professor Wuebbles also coauthored the 1986 paper that provided the basic principles explaining the existence of the Antarctic ozone hole. Professor Wuebbles' graphic of the effects of our evolving understanding of atmospheric chemistry and physics on ozone perturbations during the 1970s and 1980s is still used extensively to point out the historical process of learning in science. His 1991 paper on the relationship between solar flux variations and upper stratospheric ozone changes was the first to capture these interactions accurately. More recently, he also developed the revised concept for ODPs to account for the effects of short-lived halocarbons on ozone. For these many accomplishments, Professor Wuebbles was elected a member of the International Ozone Commission in 2000 (and reelected in 2004, 2008 and 2102 as Director of Communications for the IO3C). IN 2016, he was elected to the SPARC (Stratosphere-Troposphere Processes and Their Role in Climate) Scientific Steering Group (which is under the auspices of the WMO's World Climate Research Programme).

As a convening lead author on the first and second international assessments of climate change sponsored by the UN's Intergovernmental Panel on Climate Change (IPCC), Professor Wuebbles co-authored development of the Global Warming Potentials concept being used in policy considerations on greenhouse gases and their potential effects on climate; this concept is included in the Kyoto Protocol and most carbon trading applications. In a paper combining observations with theory, Professor Wuebbles and colleagues provided the first analysis showing that observed trends in lower stratospheric temperature could be explained in terms of the observed trends in ozone and carbon dioxide. Mostly with his students, Professor Wuebbles has used satellite-based trends of several gases to show that the dynamics of the stratosphere is being changed by climate change and that changes in climate could have a significant impact on air quality in the U.S. More recently he and his students have done a number of published research studies on the changes occurring in the intensity of severe weather event under a changing climate.

Professor Wuebbles has been a lead author on a number of national and international assessments related to concerns about stratospheric ozone (including the WMO published Scientific Assessment of Ozone Depletion: 2014; he was recently asked to be a lead author on the 2018 WMO assessment) and about climate change, and is also a lead author on several assessments of the effects of current and projected subsonic and supersonic aircraft on the global environment. He chaired a major workshop on the aviation effects on climate for the FAA and NASA in 2006 that resulted in a new research program in the U.S. to better understand these issues. In 2007, he co-chaired the Climate Panel for a major workshop for the UN's International Civil Aviation Organization. Dr. Wuebbles has also led committees reviewing various programs in the U.S. Department of Energy and at its national laboratories. Dr. Wuebbles was a leader in assessments of the potential impacts of climate change on the Great Lakes region, the U.S. Northeast, and the city of Chicago, and is coauthor of the 2009 assessment of the understanding of potential climate impacts of climate change on the United States that was done for the U.S. Government (the 2nd National Climate Assessment). He also chaired the Global Environmental Change Focus Group for the American Geophysical Union from 2009-2012 that accounts for a major fraction of AGU membership.

Amongst his honors, Prof. Wuebbles is a Fellow of the American Association for the Advancement of Science, the American Geophysical Union, and the American Meteorological Society. Dr. Wuebbles is a Faculty Fellow in the National Center for Supercomputing Applications. He has been a Coordinating Lead Author and contributed to a number of the reports of the international Intergovernmental Panel on Climate Change (IPCC), which was awarded the Nobel Peace Prize in 2007. Professor Wuebbles was also a Coordinating Lead Author for the more recent major international IPCC assessment of climate change published in 2013. He also served on the Federal Advisory Committee and the Executive Secretariat Committee for the 3rd U.S. National Climate Assessment published in 2014, and was Convening Lead Author on the science of climate change chapter and two appendices. He was also a member of a small team for the U.S. National Academy of Sciences that prepared a special report on climate done jointly with the UK Royal Society. He co-led the chapter on policy considerations for the 2014 WMO-UNEP international assessment of stratospheric ozone and contributed to the Assessment for Decision-Makers summary. Dr. Wuebbles was the recipient of the 2014 Cleveland Abbe Award for Distinguished Service to the Atmospheric

Sciences from the American Meteorological Society. He was also a coauthor of the book *Engineering Response to Climate Change* that has been awarded The Choice Outstanding Academic Title Award in 2014 by the American Library Association. He recently received the Cozzarelli Prize from the Proceedings of the National Academy of Sciences for a research paper published in 2014 (Lin et al.) and the 2014 Choice Award for Outstanding Academic Titles for the book *Engineering Response to Climate Change* that he co-wrote with other scientists and engineers.

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Education

B.S., 1966-1970, University of Illinois, Urbana
 M.S., 1970-1972, University of Illinois, Urbana
 Ph.D., 1976-1983, University of California, Davis

Honors or Awards

NOAA Special Achievement Award, 1972
 NASA Group Achievement Award, 1982
 Eta Kappa Nu (Scholastics Honorary)
 Sigma Tau (Scholastics Honorary)
 Phi Eta Sigma (Scholastics Honorary)
 Tau Beta Pi (Scholastics Honorary)
 American Men and Women of Science, 1982-present
 Who's Who in Frontier Science and Technology, 1983-present
 Who's Who in California, 1984-1995
 International Who's Who of Contemporary Achievement, 1984-present
 Men of Achievement, 1985-present
 Who's Who in the West, 1986-1995
 LLNL Special Achievement Award for Best Journal Paper, 1991
 Who's Who in America, 1993-present
 LLNL Special Achievement Award for Best Book Publication, 1993
 Dictionary of International Biography, 1994-present
 Who's Who in the World, 1994-present
 Who's Who in the Midwest, 1995-present
 Five Thousand Personalities of the World, 1996-present
 2000 Outstanding People of the 20th Century, 1997-present
 Who's Who in Science and Engineering, 1998-present
 Lexington's Who's Who, 1999-present
 International Directory of Distinguished Leadership, 2000-present
 2000 Outstanding Scientists of the 20th Century, 2000-present
 UCAR Advocate for Science Award, 2000
 2000 Outstanding Scientists of the 21st Century, 2001-present
 Who's Who in the 21st Century, 2001-present
 2000 Outstanding Intellectuals of the 21st Century, 2001-present.
 Outstanding People of the 21st Century, 2001-present
 One Thousand Great Scientists, 2002-present
 Who's Who of Professionals, 2002-present
 Fellow, North American Academy of Arts and Sciences, 2002-present
 UCAR Champion of Science Award, 2002
 Who's Who of Professional Management, 2003-present
 Who's Who Executive and Professional Registry, 2003-present
 Empire Who's Who, 2003-present
 Strathmore's Who's Who, 2003-present
 2003 UCAR Science Advocate of the Year
 University of Illinois Alumni Discretionary Award to Faculty, 2003
 Faculty Fellow, National Center for Supercomputing Applications, 2003-2007

Who's Who in Sciences Higher Education, 2004-present
 Who's Who Among America's Teachers, 2003-present
 United's Who's Who, 2004-present
 Manchester's Who's Who, 2004-present
 2005 Stratospheric Ozone Protection Award, U.S. Environmental Protection Agency
 2005 UCAR Science Advocate of the Year Award
 2006 NASA Honor Group Achievement Award
 2006 UCAR Science Advocate of the Year Award
 List of Teachers Ranked as Excellent, UIUC, 2005, 2007, 2013
 2007 NASA Group Achievement Award as member of the Upper Atmosphere Research Satellite science team
 2007 UCAR Science Advocate of the Year Award
 Received personalized plaque for contributions to the award of the 2007 Nobel Peace Prize to the Intergovernmental Panel on Climate Change (served as Coordinating Lead Author and made other contributions to a number of international assessments relating to climate change)
 Fellow, American Association for the Advancement of Science (named in October 2007)
 Director of Communications (elected office), International Ozone Commission, 2008-present
 Member (Elected by academia peers), Board of Trustees, University Corporation for Atmospheric Research, 2008-2012
 Fellow, American Geophysical Union (named in January 2009)
 Paul Harris Fellow, Rotary International, 2010-present
 Fellow, American Meteorological Society (named in September, 2011)
 2014 Cleveland Abbe Award, American Meteorological Society (received in February 2014)
 The 2014 Choice Outstanding Academic Title Award from the American Library Association for the coauthored book Engineering Response to Climate Change; awarded in February 2015.
 2014 Cozzarelli Prize from the Proceedings of the National Academy of Sciences for Lin et al. paper ; awarded in February 2015.
 2014 Editors' Citation for Excellence in Refereeing – EOS, American Geophysical Union; March 2015.
 2015 Stephen Schneider Lecture, American Geophysical Union, San Francisco, December 2015.
 2017 Presidential Forum lecture for the American Meteorological Society, Feb. 2017.

Professional Employment

1970–1972

Research Assistant, University of Illinois, Urbana

1972–1973

Atmospheric Scientist, Aeronomy Lab., National Oceanic and Atmospheric Administration, Boulder, CO

1973–1994

Atmospheric Scientist, University of California, Lawrence Livermore National Laboratory, Livermore, CA

1987–1994

Group Leader, Global Radiation, Chemical, and Dynamical Interactions, University of California, Lawrence Livermore National Laboratory, Livermore CA

1994-present

Professor, Department of Atmospheric Sciences, University of Illinois, Urbana, IL

1996-1999

Director, The Environmental Council, University of Illinois, Urbana, IL

1994-2006

Head, Department of Atmospheric Sciences, University of Illinois, Urbana, IL

2006-2008

Executive Coordinator / Director, School of Earth, Society, and Environment, University of Illinois, Urbana, IL

2009-present

Harry E. Preble Professor of Atmospheric Sciences, University of Illinois, Urbana, IL

2015-2017

Asst. Director, Office of Science and Technology Policy, Executive Office of the President, Washington DC

2015-2017

Senior Advisor, National Science Foundation, Arlington, VA
 2017-present,
 Presidential Fellow, University of Illinois system

Professional Affiliations

Member, American Geophysical Union
 Member, American Meteorological Society
 Member, American Association for the Advancement of Science
 Member, American Chemical Society
 Member, Sigma Xi

Highlights of Professional Activities (past 5 years)

Member Representative, University Corporation for Atmospheric Research, 1994-present
 Member, Advisory Board, Aspen Global Change Institute, 1997-present
 Member, Science Team, Biomass Burning and Lightning Emissions atmospheric measurement campaigns, sponsored by Japan, 2000-present
 Member and officer, International Ozone Commission, 2000-2016
 Member, Federal Aviation Administration's Research Engineering and Development Advisory Committee, Energy and Environment Subcommittee, 2007-present
 Chair, Committee of Visitors, review of Climate Change Research Program, Department of Energy, April 2007.
 Member, UCAR Board of Trustees (elected October 2008), 2008-2012
 President, AGU Global Environmental Change Focus Group, 2009-2013
 Member, American Geophysical Union Council, 2009-2012
 Member, UIUC Vice-Chancellor For Research, Energy Advisory Committee, 2009-present
 Guest Editor, Journal of Great Lakes Research, 2009-2010
 2009 Chancellor's Lecture, University of Illinois, October 6, 2009
 Member, American Geophysical Union Strategic Planning Task Force, 2009
 Lead author, WMO-UNEP assessment on stratospheric ozone, 2009-2011
 Editor-in-Chief, Insciences Journal on Climate Change, 2010-present
 Coordinating Lead Author, IPCC international climate assessment, 2010-2014
 Member, Federal Advisory Committee, U.S. National Climate Assessment, 2011-2014
 Member, Executive Secretariat, U.S. National Climate Assessment, 2011-2014
 Coordinating Lead Author, U.S. National Climate Assessment, 2011-2014
 AGU Council Leadership Team, 2012-2013
 Member, Committee on Admissions and Academic Standards, College of Liberal Arts and Sciences, University of Illinois, 2012-present
 Member, NCAR CESM Advisory Board, 2012-2013
 Joint U.S. National Academy of Science and UK Royal Society Committee on Climate Change, 2013- 2014.
 AGU Fellows Program Review Task Force, 2013-present
 Member, Steering Committee, UIUC Institute for Sustainability, Energy, and Environment, 2013-present
 Member, Steering Committee, University of Illinois Inequality Initiative, 2013-present
 Member, AMS Committee on Effective Communication of Weather and Climate Information (CECWCI), 2013-present
 Member, AGU Special Task Force on Awards, 2013-2014
 Coordinating Lead author, WMO-UNEP assessment on stratospheric ozone, 2012-2014
 Coordinating Lead Author, Climate Science Special Report, U.S. National Climate Assessment, 2016-present
 Member, SPARC Scientific Steering Group, World Climate Research Programme, 2016-present
 Member, national steering committee, 4th National Climate Assessment, 2016-present
 Lead author, WMO-UNEP 2018 assessment on stratospheric ozone, 2017-present

Highlights of Public Engagement (last 5 years) (last updated February 2017 but very incomplete)

Special talk at Chicago Botanical Gardens for World Environment Day, June 2, 2012.
 Special talk to the U.S. Department of Agriculture, Washington DC, June 7, 2012 (broadcast throughout the U.S.).

Talk to executives at State Farm Insurance, June 11, 2012.
Keynote talk at the International Laser and Radar Conference, Helios, Greece, June 25, 2012.
Cited in The Week magazine, July 2012
Interview with PBS Newshour, July 2012
I serve on national advisory committees for the Federal Aviation Administration and for the Union of Concerned Scientists
Half hour television interview for WILL PBS, October 2012
Talk at G8 Exascale Projects meeting, November 2012
Invited talk at Advisory Board meeting of the Illinois Soybean Assn., December 2012
Invited talk at AGU Annual Meeting, December 2012
Invited talk at AMS annual meeting, January 2012
Talk at St. Louis Zoo, February 2013
Talk at Monsanto Corp., February 2013
Invited talk at AAAS annual meeting, February 2013
Seminar at Illinois State Water Survey, January 22, 2013.
Invited presentation at St. Louis Zoo, St. Louis, MO, February 5, 2013.
Keynote presentation at Conference on Agriculture and Climate Change, Monsanto Corporation (near St. Louis), February 6, 2013.
Invited presentation at the AAAS Annual Meeting, Boston, February 15-20, 2013.
Presentation to Physicans for a Responsible Society, Chicago, February 20, 2013.
Special presentation at the annual severe weather conference at Fermi National Laboratory, Chicago area, April 6, 2013.
Seminar at Illinois State University to kickoff their new annual event on climate change, April 15, 2013.
One of the keynote talks at The Big Data Workshop, University of Illinois, May 9, 2013.
Seminar at ITW Corporation in Chicago, June 5, 2013
June 6, 2013, presentation on climate change in downtown Chicago (with Tom Skilling of WGN TV).
Invited speaker and attendee at the Snowmass, CO special Climate Change Impacts and Integrated Assessment (CCI/IA) Workshop on July 23-27, 2013. This workshop brought together scientists, economists, and experts across a wide range of disciplines.
September 9, 2013, seminar at North Carolina state University.
September 11, 2013, seminar at Duke University.
October 7, 2013, invited keynote presentation at the Tri-Agency (NSF, NASA, and DOE) Educators Conference.
November 3-7, 2013, presentation at the WCRP Regional Climate Conference in Brussels, Belgium.
Keynote presentation at conference on Frontiers in Statistics and Forecasting in Taipei, Taiwan on December 16-19, 2013
November 16, 2013, invited speaker at special conference on climate and ethics at Chicago Loyola University.
Invited special presentation (with the head of FEMA) at the annual meeting of the American Meteorological Society, February 4, 2014.
Invited presentation on challenges in climate science at the annual meeting of the American Association for the Advancement of Science, February 14, 2014.
Invited presentation at Conference on Effects of Climate Change on the East Coast, Arlington, VA, February 26, 2014
March 9, 2014, seminar at Chicago Loyola University retreat center.
Invited keynote presentation at An International Symposium on Diagnosis and Early Warning of Urban Weather/Climate Extremes, Nanjing, China, March 19, 2014.
Invited presentation at G8 Exascale Computing Forum, Kobe, Japan, March 26, 2014.
Invited presentation at Severe Weather Forum, Fermi Lab, April 5, 2014.
Invited presentation at Conference on Societal Impacts on Natural Hazards, April 17, 2014.
May 6, 2014; Presentation at the White House for the release of the National Climate Assessment.
May 7-8, three presentations at the U.S. Congress (one at the House and two at the Senate).
Invited presentation at 2nd annual Blue Waters Conference, Champaign, May 13, 2014.
Special presentation on climate change at the Museum of Science and Industry, June 4, 2014.

Special presentation to be given at the Chicago Botanical Gardens for their World Environment Day, June 7, 2014.

Op-ed in Chicago Tribune, June 2014.

Special presentation on climate change given at the Museum of Science and Industry, Chicago, June 4, 2014.

Special presentation given at the Chicago Botanical Gardens for their World Environment Day, June 7, 2014.

Invited talk at the AMS Broadcast Meteorologists Conference, Lake Tahoe, CA, June 18, 2014.

Invited seminar at Los Alamos National Lab, Los Alamos, NM, July 2014.

Invited talk at Agriculture and Temperature Workshop, Ames, IA, August 2014.

Invited talk at AGCI meeting on Frontiers in Global Change Science, Aspen, CO, August 2014.

Invited talk at special workshop on agriculture and climate, St. Louis, September 2014.

Seminar at Boeing, Seattle, September 2014.

Special seminar at Bradley University, Peoria, September 22, 2014.

Keynote talk, Pan Pacific Conference on Climate Change, Taipei, Taiwan, October 2014.

Talk at ASCENT meeting, Alexandria, VA, October 2014.

Invited talk at DOE Workshop on Climate, Washington, DC, October, 2014.

Special seminar at Illinois College, Jacksonville, November 2014.

Keynote talk at workshop held at Morton Arboretum, November 2014.

Invited talk, ICAO workshop on aviation and the environment, Alexandria, VA, February, 2015

Seminar at McHenry College, Crystal Lake, IL, February 2015.

Invited talk, Fermi National Lab, March 2015.

Keynote talk, U.S.-Iran workshop on climate change, Irvine, CA, March 2015.

Invited talk, Blue Waters Annual Workshop, Oregon, May 2015.

Stephen Schneider Lecture, American Geophysical Union, December 2015

Invited talk, Fermi National Lab, March 2016.

Keynote Talk, international meeting on transportation led by the National Academy of Sciences, Brussels, June 2016.

Invited talk, American Geophysical Union Annual Meeting, San Francisco, December 2016.

Invited talk, meeting of the Transportation Research Board of the National Academy of Sciences, Washington, DC, January 2017.

Presidential Forum, American Meteorological Society Annual Meeting, Seattle, January 2017.

Session chair, AAAS meeting, Boston, March 2017.

Live interview on WGN-TV, April 2017.

Invited speaker, Severe Storms Colloquium, FermiLab, April 2017.

Panel for The Atlantic Monthly special event on climate and health in Chicago, April 2017.

Panel on The Signal and the Noise: A Response to Nate Silver, Northwestern University, April 2017

Panel for Earth Day, Chicago Botanic Garden, April 2017.

Talk at Blue Waters Symposium, Oregon, May 2017

Invited talk at Geological Society of America Annual Meeting, Seattle, October 2017

{{ needs updating}}

Plus many other speeches and talks too numerous to list.

Also additional interviews with newspapers, television and radio.

Publications, Book Chapters, and Reports (>500 total)

Snyder, R.B., D.J. Wuebbles, J.E. Pearson, and B.E. Ewing, 1971: A study of environmental pollution by lead, State of Illinois, Institute for Environmental Quality, IIEQ Document 71-7.

Shimazaki, T. and D.J. Wuebbles, 1972: Time-dependent two-dimensional parameterized model. *Proceedings of the Second Conference on the Climatic Impact Assessment Program*, DOT Report DOT-TSC-OST-73-4, p. 291–297.

Wuebbles, D.J., T. Shimazaki, and C.F. Sechrist, Jr., 1972: A mathematical model for the radon density distribution in the 1–20 km region. *Aeronomy Report No. 46*, University of Illinois, 58 pp.

Shimazaki, T., and D.J. Wuebbles, 1973: On the theoretical model for vertical ozone density distributions in the mesosphere and upper stratosphere. *Pure and Applied Geophysics*, 106–108, 1446–1463.

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- Wuebbles, D.J., and J.S. Chang, 1975: Sensitivity of time-varying parameters in stratospheric modeling. *Journal of Geophysical Research*, 80, 2637–2642.
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- Chang, J.S., D.J. Wuebbles, and D.D. Davis, 1977: A theoretical model of global tropospheric OH distributions. Lawrence Livermore National Laboratory report UCRL-78392, Rev.1.
- Duewer, W.H., D.J. Wuebbles and J.S. Chang, 1977: Effect of NO photolysis on NO_x mixing ratios. *Nature*, 265, 523–525.
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- Wuebbles, D.J., 1977: A reexamination of potential space shuttle effects on the stratosphere. Lawrence Livermore National Laboratory report UCID-17689 (this version appeared in EIS for NASA use of space shuttle).
- Ackerman, M., D. Frimout, C. Muller, and D.J. Wuebbles, 1978: Stratospheric methane measurements and predictions. *Pure and Applied Geophysics*, 117, 367–380.
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- MacCracken, M.C., D.J. Wuebbles, J.J. Walton, W.H. Duewer, and K.E. Grant, 1978: The Livermore regional air quality model: I. Concept and development. *Journal of Applied Meteorology*, 17, 254–272.
- Wuebbles, D.J., 1978: A theoretical study of solar eclipse effects on the stratosphere. Proceedings of the AMS Meeting on Meteorology of the Upper Atmosphere, October 24–27, Boston, MA; Lawrence Livermore National Laboratory report UCRL-80963.
- Wuebbles, D.J., 1978: A reexamination of potential space shuttle effects on the stratosphere. Appendix D of *Revised Estimates for Ozone Reduction by Shuttle Operation*, NASA Tech. memorandum 58209.
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- Wuebbles, D.J., and J.S. Chang, 1979: A theoretical study of stratospheric trace species variations during a solar eclipse. Lawrence Livermore National Laboratory Report UCRL-80936, *Geophysical Research Letters*, 6, 179–182.
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- Wuebbles, D.J., and W.H. Duewer, 1980: Effects of recent kinetics measurements on our understanding of chemical processes in the troposphere and stratosphere. Published in *Proceedings of 14th Informal Conference on Photochemistry*, Newport Beach, CA, March 30–April 3; also available as Lawrence Livermore National Laboratory report UCRL-83960.

- Wuebbles, D.J., and J.S. Chang, 1980: A study of the effectiveness of the Cl_x catalytic ozone loss mechanisms. Presented at and published in the *Proceedings of the Quadrennial International Ozone Symposium*, Boulder, CO, August 4–9; also available as Lawrence Livermore National Laboratory report UCRL-84071.
- Wuebbles, D.J., 1980: Impact of new OH+HNO₃ rate measurement on models of atmospheric chemistry. Lawrence Livermore National Laboratory report UCID-18727.
- Wuebbles, D.J., 1980: A summary of current two-dimensional transport-kinetics models. Lawrence Livermore National Laboratory G-Division report UASG 80-25.
- Wuebbles, D.J., 1980: A comparison study between 2-D models. Lawrence Livermore National Laboratory report UASG 80-21.
- Wuebbles, D.J., 1980: The treatment of dynamical processes in two-dimensional models of the troposphere and stratosphere. Lawrence Livermore National Laboratory report UCID-18771.
- Wuebbles, D.J., and R.L. Tarp, 1980: Potential changes to stratospheric ozone from possible chlorofluorocarbon production scenarios. Lawrence Livermore National Laboratory report UCID-18583.
- Wuebbles, D.J., and R.L. Tarp, 1980: Sensitivity of quantum yield for O(1D) production from ozone photolysis. Lawrence Livermore National Laboratory report UCID-18734.
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- Chang, J.S., and D.J. Wuebbles, 1984: Nuclear explosions and atmospheric ozone. Lawrence Livermore National Laboratory report UCRL-91367; also in *The Environmental Effects of Nuclear War*, Julius London and G.F. White, editors.
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- He, H., X.-Z. Liang, and D. J. Wuebbles, 2018: Effects of emissions change, climate change and long-range transport on regional modeling of future U.S. particulate matter pollution. *Atmos. Environ.*, 179, 166-176, <https://doi.org/10.1016/j.atmosenv.2018.02.020>.
- Sulbaek Andersen, M. P., J. A. Schmidt, A. Volkova, and D. Wuebbles, 2018: A Three-dimensional Model of the Atmospheric Chemistry of E and Z-CF₃CH=CHCl (HCFO-1233(zd) (E/Z)): Atmospheric Lifetimes, Global Warming Potentials and Formation of Trifluoroacetic Acid. *Atmos. Environ.*, 179, 250-259, <https://doi.org/10.1016/j.atmosenv.2018.02.018>.
- Sanyal, S., D. J. Wuebbles, S. C. Olsen, L. Mazzoleni, C. Mazzoleni, D. Helmig, and P. Fialho, 2018: Modeling CO, O₃ and BC in North Atlantic Free Troposphere after long range transport and impact of North American outflow on on pollutant concentration in Pico. *Atmospheric Environment*, in press.
- Um, M.-J., W. Nam, D. J. Wuebbles, M. Markus, and J.-H. Heo, 2018: Nonlinear regression analysis for the optimal location parameter for the nonstationary GEV with projected extreme precipitation around Chicago. *JAMC*, in press.
- Schlie, E., et al., 2018: A radar-based analysis of severe hail outbreaks over the contiguous United States for 2000-2011. *Earth's Future*, submitted.
- Gao, Y., J. Fu, S. Zhang, J. Drake, D.J. Wuebbles and J.-F. Lamarque, 2018: The increase in heat wave and seasonal extreme temperatures in CCSM4 in the 21st century. *Advances in Atmospheric Sciences*, submitted.
- Wuebbles, D. J., 2018: Health Impacts in a Changing Climate. Chapter 10 in *One Health*, Wiley, in press.

RESEARCH GRANTS AND CONTRACTS (Incomplete; not updated entirely)

Title: ANALYSIS OF ODPS AND GWPS FOR SELECTED IODINE COMPOUNDS (ENVIRONMENTAL TECHNOLOGY & EDUCATION CENTER)

Source of Support: US Air Force Office of Scientific Research (AFOSR)

Date & Period: 9/1/1995 1 yr

Amount: \$20,000

Title: OZONE DEPLETION POTENTIAL FOR CHLOROBROMETHANE (ENVIRO TECH - INTERNATIONAL)

Source of Support: Misc Commercial (Domestic) Corporations

Date & Period: 10/18/1995 .5 yr

Amount: \$18,000

Title: EXTENSION OF MODEL VALIDATION & SENSITIVITY STUDIES FOR DETERMINING AIRCRAFT.....

Source of Support: NASA

Date & Period: 2/08/96 .2 yr

Amount: \$10,000

Title: ASSESSING THE ROLE OF COUPLING BETWEEN CHEMISTRY & CLIMATE

Source of Support: NASA

Date & Period: 2/20/96 1 yr

Amount: \$91,110

Title: COORDINATION STUDIES WITH PNNL'S GLOBAL CHANGE ASSESSMENT MODEL: INTEGRATED SCIENCE MODELING & APPLICATIONS TO THE HUMAN DIMENSION

Source of Support: U.S. Dept Energy

Date & Period: 3/19/1996 3 yrs

Amount: \$140,562

Title: INDICES FOR OZONE & CLIMATE CHANGE: ANALYSES & NEW APPROACHES

Source of Support: US Environmental Protection Agency (EPA)

Date & Period: 5/16/1996 3 yrs

Amount: \$60,000

Title: MODELING STUDIES TO REDUCE UNCERTAINTIES IN EVALUATION OF SUBSONIC & HSCT AIRCRAFT EFFECTS ON THE GLOBAL ATMOSPHERE

Source of Support: NASA

Date & Period: 8/13/1996 3 yrs

Amount: \$187,681

Title: ASSESSING THE ROLE OF COUPLING BETWEEN CHEMISTRY & CLIMATE

Source of Support: NASA

Date & Period: 11/15/1996 1 yr

Amount: \$95,176

Title: CHEMICAL TRANSPORT MODELING OF THE GLOBAL ATMOSPHERE FOR ENVIRONMENTAL PROBLEMS EVALUATION COMPARISONS AND INITIAL....

Source of Support: US Environmental Protection Agency (EPA)

Date & Period: 1/14/1997 3 yrs

Amount: \$312,334

Title: EFFECTS OF METHANE EMISSIONS ON GLOBAL CLIMATE & THEIR ROLE IN GREENHOUSE GAS ABATEMENT STRATEGIES

Source of Support: US Environmental Protection Agency (EPA)

Date & Period: 1/31/1997 1 yr

Amount: \$100,000

Title: ADVANCED INTEGRATED SCIENCE MODELING CAPABILITY FOR INTEGRATED ASSESSMENT STUDIES

Source of Support: NSF/Natl Science Fdn

Date & Period: 2/13/1997 3 yrs

Amount: \$280,000

Title: INDICIES FOR OZONE & CLIMATE CHANGE: ANALYSES & NEW APPROACHES

Source of Support: US Environmental Protection Agency (EPA)

Date & Period: 3/25/1997 1 yr

Amount: \$115,000

Title: REEXAMINING GLOBAL WARMING POTENTIALS FOR A COMMON FRAMEWORK (ALTERNATIVE FLUOROCARBONS ENV. ACCEPTABILITY STUDY-AFEAS)

Source of Support: Misc Associations

Date & Period: 5/7/1997 1 yr

Amount: \$45,040

Title: UNCERTAINTY & INTEGRATED CLIMATE ASSESSMENT MODELS (HARVARD UNIV)

Source of Support: U.S. Department of Energy

Date & Period: 5/19/1997 2.2 yrs

Amount: \$27,647

Title: GREENHOUSE GASES RISK MANAGEMENT PROJECT

Source of Support: Electric Power Research Inst (EPRI)

Date & Period: 5/20/1997 .8 yr

Amount: \$10,000

Title: EVALUATING PEM-TROPICS OBSERVATIONS: UNCERTAINTY ANALYSES & EFFECTS OF DEEP CONVECTIVE MIXING ON TROPOSPHERIC CHEMISTRY

Source of Support: NASA

Date & Period: 1/9/1998 3 yrs

Amount: \$166,393

Title: ASSESSING THE ROLE OF COUPLING BETWEEN CHEMISTRY & CLIMATE

Source of Support: NASA

Date & Period: 1/28/1998 1 yr

Amount: \$95,000

Title: INDICES FOR OZONE & CLIMATE CHANGE: ANALYSES & NEW APPROACHES

Source of Support: US Environmental Protection Agency (EPA)

Date & Period: 5/12/1998 1 yr

Amount: \$30,000

Title: EVALUATING INTERACTIONS BETWEEN CHEMICAL & CLIMATE PROCESSES IN THE TROPOSPHERE & STRATOSPHERE

Source of Support: NASA

Date & Period: 6/17/1998 3 yrs

Amount: \$168,770

Title: EFFECTS OF METHANE EMISSIONS ON GLOBAL CLIMATE & THEIR ROLE IN GREENHOUSE GAS ABATEMENT STRATEGIES

Source of Support: US Environmental Protection Agency (EPA)

Date & Period: 6/19/1998 1 yr

Amount: \$138,414

Title: REDUCING UNCERTAINTIES IN UNDERSTANDING THE POTENTIAL EFFECTS OF HSCT AIRCRAFT ON THE GLOBAL ATMOSPHERE

Source of Support: NASA Goddard Space Flight Ctr

Date & Period: 8/17/1998 2 yrs

Amount: \$100,000

Title: RESEARCH TO IMPROVE MODELING CAPABILITIES FOR DETERMINING OZONE DEPLETION POTENTIALS FOR N...(GREAT LAKES CHEMICAL COMP)

Source of Support: Great Lakes Chemical

Date & Period: 12/22/1998 1 yr

Amount: \$95,000

Title: TRACE GASES IN THE GLOBAL ATMOSPHERE: EFFECTS ON OZONE & CLIMATE

Source of Support: US Environmental Protection Agency (EPA)

Date & Period: 4/16/1999 3 yrs

Amount: \$300,000

Title: GREENHOUSE GASES RISK MANAGEMENT PROJECT.

Source of Support: Electric Power Research Inst (EPRI)

Date & Period: 7/19/1999 .8 yrs

Amount: \$1,470

Title: EFFECTS OF METHANE EMISSIONS ON GLOBAL CLIMATE & THEIR ROLE IN GREENHOUSE GAS ABATEMENT STRATEGIES

Source of Support: US Environmental Protection Agency (EPA)

Date & Period: 9/27/1999 1 yr

Amount: \$116,000

Title: BIOGEOCHEMICAL CYCLES & CLIMATE CHANGE: POTENTIAL FEEDBACKS & INTERACTIONS (NASA AT WASHINGTON)

Source of Support: NASA

Date & Period: 3/14/2000 1 yr

Amount: \$22,000

Title: ATMOSPHERIC MODELING TO SUPPORT STATISTICAL TREND ANALYSIS (EPA SBC - UNIVERISTY OF CHICAGO)

Source of Support: US Environmental Protection Agency (EPA)

Date & Period: 3/9/2001 5 yrs

Amount: \$40,000

Title: BIOGEOCHEMICAL CYCLES & CLIMATE CHANGE: POTENTIAL FEEDBACKS & INTERACTIONS

Source of Support: NASA

Date & Period: 3/13/2001 1 yr

Amount: \$22,000

Title: TRACE GASES IN THE GLOBAL ATMOSPHERE: EFFECTS ON OZONE & CLIMATE

Source of Support: US Environmental Protection Agency (EPA)
Date & Period: 6/8/2001 3 yrs
Amount: \$50,000

Title: EVALUATING INTERACTIONS BETWEEN CHEMICAL AND CLIMATE PROCESS IN THE TROPOSPHERE AND STRATOSPHERE
Source of Support: NASA
Date & Period: 8/15/2001 .7 yr
Amount: \$20,000

Title: MODELING THE EFFECTS OF AVIATION ON THE ATMOSPHERE
Source of Support: US Environmental Protection Agency (EPA)
Date & Period: 9/19/2001 .6 yr
Amount: \$24,950

Title: PARAMETRIC STUDIES OF THE POTENTIAL EFFECTS ON GLOBAL ATMOSPHERIC CHEMISTRY & CLIMATE FROM SUPERSONIC (GULF STREAM AEROSPACE CORP.)
Source of Support: GULF STREAM AEROSPACE CORP
Date & Period: 11/13/2001 1 yr
Amount: \$80,000

Title: PARAMETRIC STUDIES OF AIRCRAFT EFFECTS ON OZONE
Source of Support: NASA
Date & Period: 4/18/2002 .4 yr
Amount: \$40,000

Title: TRACE GASES IN THE GLOBAL ATMOSPHERE: EFFECTS ON OZONE & CLIMATE
Source of Support: US Environmental Protection Agency (EPA)
Date & Period: 5/2/2002-12/31/06
Amount: \$380,000

Title: BIOGEOCHEMICAL CYCLES & CLIMATE CHANGE: POTENTIAL FEEDBACKS & INTERACTIONS
Source of Support: NASA
Date & Period: 5/28/2002 1 yr
Amount: \$24,000

Title: STUDIES FOR BOEING TO BETTER UNDERSTAND THE EFFECTS FROM AIRCRAFT EMISSIONS ON OZONE & CLIMATE
Source of Support: Boeing
Date & Period: 5/28/2002 1 yr
Amount: \$144,980

Title: METHODOLOGY FOR ANALYSES OF REGIONAL CLIMATE CHANGE: APPLICATION TO THE US MIDWEST/GREAT LAKES REGION (UNIVERSITY OF CALIFORNIA)
Source of Support: U.S. Energy-Misc
Date & Period: 8/19/2002 1 yr
Amount: \$19,695

Title: IMPACTS OF GLOBAL CLIMATE & EMISSION CHANGES ON U.S. AIR QUALITY
Source of Support: US Environmental Protection Agency (EPA)
Date & Period: 9/6/2002 3 yrs
Amount: \$900,000

Title: PARAMETRIC STUDIES WITH TWO DIMENSIONAL MODEL
Source of Support: NASA

Date & Period: 9/26/2002 .5 yr
Amount: \$75,000

Title: DEVELOPMENT OF AN UNDERGRADUATE MAJOR IN THE EARTH SYSTEM, ENVIRONMENT AND SOCIETY
(UNIVERSITIES SPACE RSRCH ASSOC)

Sponsor: NASA

Date & Period: 12/20/2002 2 yrs
Amount: \$70,000

Title: ASSESSMENT OF AIRPORT EMISSIONS IMPACT OF AIR QUALITY IN THE CHICAGO AREA

Source of Support: NASA

Date & Period: 6/25/2003 3 yrs
Amount: \$484,588

Title: STUDIES FOR BOEING TO BETTER UNDERSTAND THE EFFECTS FROM AIRCRAFT EMISSIONS ON OZONE AND
CLIMATE (BOEING)

Source of Support: Boeing

Date & Period: 8/21/2003 2.6 yrs
Amount: \$111,093

Title: EVALUATING INTERACTIONS BETWEEN CHEMICAL AND CLIMATE PROCESSES IN THE TROPOSPHERE AND
STRATOSPHERE

Source of Support: NASA

Date & Period: 2/17/2004 1.9 yrs
Amount: \$60,001

Title: ATMOSPHERIC IMPACT OF CF31 REPLACING CF3BR FOR SUPPRESSING IN-FLIGHT FIRES IN ENGINE NACELLES

Source of Support: US Dept of Commerce (DOC)

Date & Period: 4/15/2004 .6 yr
Amount: \$24,999

Title: EVALUATING INTERACTIONS BETWEEN CHEMICAL AND CLIMATE PROCESSES IN THE TROPOSPHERE AND
STRATOSPHERE

Source of Support: Science Applications Intl Corp

Date & Period: 7/14/2004 .8 yr
Amount: \$60,001

Title: STATISTICAL APPLICATIONS FOR CLIMATE CHANGE PROJECTIONS

Source of Support: CISES/University of Chicago (through EPA)

Period: 01/05 3 yrs
Amount: \$185,842

Title: CLOSING THE LOOP: SPATIAL DEMOGRAPHIC-ECONOMIC IMPACTS ON FUTURE AIR POLLUTION EMISSIONS

Source of Support: Environmental Protection Agency

Period: 01/05 3.25 yrs
Amount: \$749,999

Title: STUDIES FOR BOEING TO BETTER UNDERSTAND THE EFFECTS FROM AIRCRAFT EMISSIONS ON OZONE &
CLIMATE

Source of Support: Boeing

Period: 12/05 2 yrs
Amount: \$420,754

Title: HONEYWELL FLUOROCARBONS
Source of Support: Honeywell Specialty Materials Grp
Date & Period: 4/18/2006 4.5 yr (likely to be renewed)
Amount: \$174,361

Title: ENVIRO Tech - Ozone depletion Potential Studies for n-Propyl Bromide
Source of Support: Albemarle Corp
Date & Period: 5/1/2006 .5 yr
Amount: \$50,000

Title: VOLPE
Source of Support: Volpe Natl Transportation Systems Ctr
Date & Period: 5/4/2006 .5 yr
Amount: \$25,000

Title: OZONE DEPLETION POTENTIAL STUDIES FOR TRICHLOROETHYLENE AND PERCHLOROETHYLENE
Source of Support: ENVIRO Tech Intl Inc
Date & Period: 6/22/2006 1.1 yr
Amount: \$20,000

Title: ASSESSMENT OF POTENTIAL CLIMATE CHANGE IMPACTS ON THE CHICAGO AREA
Source of Support: Global Philanthropy Partnership
Date & Period: 1/18/2007 1 yr
Amount: \$165,000

Title: Ozone Depletion Potentials for Short-Lived Compounds
Source of Support: Honeywell Corporation
Amount: \$155,000
Covered: June 2006 to June 2010 (to be extended; currently discussing new statement of work)

Title: Advancing Hydrologic Science through Synthesis: Water Cycle Dynamics in a Changing Environment
Source of Support: NSF
Amount: \$875,000
Covered: May 2007 to May 2011

Title: CMG Collaborative Research: Statistical Evaluation of Model-Based Uncertainties Leading to Improved
Climate Change Projections at Regional to Local Scales
Source of Support: NSF
Amount: \$900,000
Covered: October 2007 to October 2010

Title: Evaluation of the Potential Environmental Impacts from Large-Scale Use and Production of Hydrogen in
Energy and Transportation Applications
Source of Support: Department of Energy
Amount: \$600,000
Covered: October 2007 to June 2010

Title: Studies for Boeing to Better Understand the Effects for Aircraft Emissions on Ozone & Climate
Source of Support: The Boeing Company
Amount \$72,041
Covered: September 2009 to September 2010 (in process of getting another \$69,633 added; likely to be extended further with new support)

Donald J. Wuebbles—Curriculum Vitae

February 22, 2018

Title: Virtual Observatory for Sustainability of Intensively Managed Environmental Systems
Source of Support: University of Illinois – IACAT program
Amount: \$500,000
Covered: June 2008 to September 2012

Title: Climate Metrics and Aviation: Analysis of Current Understanding and Uncertainties
Source of Support: Volpe National Transportation Systems (FAA)
Amount; \$50,000
Covered: September 2007 to August 2008

Title: Water Cycle Dynamics in a Changing Environment Advancing Hydrologic Science Through Synthesis
Source of Support: NSF
Amount; \$750,000
Covered: June 2007 to December 2013

Title: New analyses of climate impacts on Midwest agriculture and hydrology
Source of Support: ECI
Amount; \$25,000
Covered: June 2009 to June 2010

Title: Consequences of Global Climate and Emissions Changes on U.S. Water Quality: An Integrated Modeling Assessment
Source of Support: US EPA
Amount: \$800,000
Covered: May 2009 to May 2012

Title: Development and Evaluation of Climate Metrics for Aviation Based on Climate-Chemistry Modeling Analyses
Source of Support: FAA
Amount: \$200,000
Covered: September 2013 to May 2014

Title: Using Petascale Computing Capabilities to Address Climate Change Uncertainties
Source of Support: NSF
Amount: \$18,963 (plus millions of dollars of petascale computing time)
Covered: April 2011 to April 2015

Title: Enabling Climate Simulation at Extreme Scale
Source of Support: NSF, for G8 organization
Amount: \$450,000 (our part at UIUC)
Covered: April 2011 to April 2014

Title: Studies for Boeing to Better Understand the Effects for Aircraft Emissions on Ozone & Climate
Source of Support: The Boeing Company
Amount: Over \$1Million since began
Covered: latest two projects went from December 2012 to March 2014

Title: Using CMIP5 Results in Climate Analyses for the United States
Source of Support: NASA
Amount: \$250, 770
Covered: May 2012 to February 2015

Title: High Resolution Earth System Modeling for International Climate Assessment Using Blue Waters Capabilities
Source of Support: NSF PRAC (Bob Rauber is PI while I am in DC)

Amount: \$15,000 (plus millions of dollars of petascale computing time on Blue Waters)
Covered: August 2015 to August 2016 (new proposal submitted; we also have new support directly from NCSA)

Title: Climate Change Impacts to Department of Defense Installations
Source of Support: SERDP (project coordinated with Argonne National Laboratory) (Bob Rauber is PI while I am in DC)
Amount: \$264,970
Covered: August 2012 to June 2016

Title: Evaluation of FAA Climate Tools
Source of Support: FAA (Bob Rauber is PI while I am in DC)
Amount: \$180,000
Covered: September 2014 to August 2016 (to be renewed in August 2016)

Title: Particulate Matter Prediction and Source Attribution for U.S. Air Quality Management in a Changing World
Source of Support: EPA (Bob Rauber is PI while I am in DC)
Amount: \$790,000 (part to UIUC)
Covered: April 2016 to April 2019

Title: An Investigation into Current and Future Trends in Severe Thunderstorms and their Environments
Source of Support: NOAA NCEI (through CICS cooperative agreement) (Jeff Trapp is PI while I am in DC)
Amount: \$150,000
Covered: July 2015 to June 2018

Title: Scaling Mixing State to Predict Properties of Carbonaceous Aerosols: From Laboratory to Field to Climate Models
Source of Support: Los Alamos National Laboratory (Nicole Riemer is PI while I am in DC)
Amount: \$165,315
Covered: August 2015 to July 2018