

Curriculum Vitae

Drew T. Shindell

Nicholas School of the Environment &
Duke Global Health Initiative, Duke University

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EDUCATION

Ph.D. (Physics), State University of New York at Stony Brook, 1995
B.A. (Physics), University of California at Berkeley, 1988

EMPLOYMENT

2016-present: Nicholas Distinguished Professor of Earth Science, Duke University
2015-present: Senior Scientist (Climate Sciences), UN Environment
2014-2016: Professor of Climate Sciences, Duke University
2000-2014: Physical Scientist, NASA Goddard Institute for Space Studies, NYC
1997-2010: Lecturer, Dept. of Earth and Environmental Sci., Columbia University
1997-2000: Associate Research Scientist, Columbia University & NASA GISS
1995-1997: NASA EOS Postdoctoral Researcher, Columbia Univ. & NASA GISS

RESEARCH INTERESTS

Interactions between atmospheric composition and climate change
Climate and air quality linkages and public policy
Natural modes of climate variability and detection/attribution of climate change
Historical and paleoclimate
Interdisciplinary assessment of the impact of emissions and related metrics

PROFESSIONAL EXPERIENCE

Chair, Scientific Advisory Panel to the Climate and Clean Air Coalition (~50 nations plus various IGOs and NGOs), 2012-present
Coordinating Lead Author, “Mitigation pathways compatible with 1.5°C in the context of sustainable development” chapter, Intergovernmental Panel on Climate Change Special Report on 1.5°C, 2017-2018
AAAS Atmospheric and Hydrological Sci. Section Member-at-large, 2016-2019
NCAR Atmospheric Composition, Observations and Modeling Laboratory Advisory Board Member, 2015-
Environment/Climate Advisory Committee, Global Alliance for Clean Cookstoves, 2015-
Foreign Expert, China Council for International Cooperation on Environment and Development, Special Policy Study: Coordinated Actions for Addressing Climate Change and Air Pollution, 2014-2015.
Review Panel, NOAA Office of Atmospheric Research, Laboratory Review, 2014

Coordinating Lead Author, Anthropogenic and Natural Radiative Forcing chapter, Intergovernmental Panel on Climate Change Fifth Assessment Report, 2013
Contributing Author, 3 chapters (Long-term Climate Change: Projections, Commitments and Irreversibility; Detection and Attribution of Climate Change: from Global to Regional; and Evaluation of Climate Models), IPCC Fifth Assessment Report, 2013
Originator & Co-Lead, Atmospheric Chemistry and Climate Model Intercomparison Project, 2009-2013
Chair, Integrated Assessment of Black Carbon and Tropospheric Ozone, United Nations Environment Programme & World Meteorological Organization, 2011.
Member, National Academy of Sciences Assessment of the Effects of US Tax Policy on Greenhouse Gas Emissions, 2011-2013
Member, National Academy of Sciences Assessment of Himalayan Glaciers: Climate Change, Water Resources, and Water Security, 2011-2012
Co-Editor, Atmospheric Chemistry and Physics, 2009-2014
Co-Chair, US Climate Change Science Program Synthesis & Assessment Product 3.2: Climate Projections Based on Emissions Scenarios for Long-Lived and Short-Lived Radiatively Active Gases and Aerosols, 2006-2008
Co-author, Arctic Climate Impacts Assessment, 2005
Co-author, UNEP/WMO Scientific Assessment of Ozone Depletion, 1998, 2002, 2006
AGU Atmospheric Physics and Climate Section Secretary, 2002-2004
Visiting Scientist, Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette, France. 2009
Visiting Scientist, Max-Planck Institute for Meteorology, Hamburg, Germany, 2003
Visiting Scientist, Imperial College, London, UK, 2000

PUBLIC OUTREACH/GOVERNMENT/MEDIA

Education: Co-creator of 'Climate Change Science' course offered by American Museum of Natural History (AMNH) to middle & high school teachers. Consultant on AMNH exhibits.
Government: Testimony delivered to both houses of the US Congress, US EPA, US National Academy, US State Dept., the Arctic Council, and the UNFCCC.
Media: Numerous outreach activities including interviews and appearances on NOVA, NPR, BBC, CBC, CNN, New York Times, Washington Post, etc.

AWARDS & HONORS

AAAS Fellow, 2015
AGU Fellow, 2014
US EPA Scientific and Technological Achievement Award, 2013
MIT Henry Kendall Honorary Lecturer, 2013
NCAR Earth System Research Laboratory Distinguished Lecturer, 2013
AGU Atmospheric Science Charney Lecturer, Fall meeting, 2012
Ne'eman Distinguished Lecturer, Tel Aviv University, 2012
Scientific American 'Top 50' Scientists, 2004

NASA GISS ‘Best Popular Science Article’ peer award, 2002 and 2011
NASA GISS ‘Publication of the Year’ peer award, 1998, 1999 and 2012
National Science Foundation, Antarctic Service Medal, 1994

MENTORING

PhD: K. Seltzer, T. Tang, M. Ru
Postdoctoral: J. Lee Grenfell (now at Free U Berlin), Volker Grewe (now at DLR), Nadine Unger (now at U Exeter), Daven Henze (now at U Colorado), Apostolos Voulgarakis (now at Imperial), Pavan Racherla (now at NextClimate), Olga Pechony, Yunha Lee (now at U Washington)
Thesis committee: Mark Potosnak (Columbia), Sun Wong (Columbia), Jae Lee (Stony Brook), Ben Kravitz (Rutgers), Miriam Marlier (Columbia), Justin Wood (Murdoch), Patrick Brown (Duke)

GRANTS

Funding as PI from NASA’s Atmospheric Chemistry Modeling and Analysis Program (1998, 2003, 2006, 2010); NASA Applied Sciences program (2008); NASA Living with a Star (2009), NASA National Climate Assessment (2011, 2013), NASA Aura Science (2014); NASA SORCE (2015); NASA GISS (2015); NSF (2000, 2014); California Air Resources Board (2008); US EPA (2010); US DoT (2014); Pisces Foundation (2016).
Co-I on numerous NSF and NASA proposals.

PEER-REVIEWED PUBLICATIONS

- 219 Shindell, D., N. Borgford-Parnell, M. Brauer, A. Haines, J. C. I. Kuylenstierna, S. A. Leonard, V. Ramanathan, A. Ravishankara, M. Amann, L. Srivastava, A Climate Pathway for Near- and Long-term Benefits, *Science*, 356, 493-494, 2017.
- 218 Prather, M. J., X. Zhu, C. M. Flynn, S. A. Strode, J. M. Rodriguez, S. D. Steenrod, J. Liu, J.-F. Lamarque, A. M. Fiore, L. W. Horowitz, J. Mao, L. T. Murray, D. T. Shindell, S. C. Wofsy, Global Atmospheric Chemistry – Which Air Matters, *Atmos. Chem. Phys.*, in press, 2017.
- 217 Bergin, M., C. Ghoroi, D. Dixit, J. Schauer, D. Shindell, Large reductions in solar energy production due to dust and particulate air pollution, *Env. Sci. Tech.*, in press, 2017.
- 216 Campbell, B., D. Beare, E. Bennett, J. Hall-Spencer, J. Ingram, F. Jaramillo, R. Ortiz, N. Ramankutty, J. Sayer, D. Shindell, Agriculture production as a major driver of the Earth System exceeding planetary boundaries, *Ecology & Society*, in press, 2017.
- 215 Silva, R. A., J. J. West, J.-F. Lamarque, D. T. Shindell, W. J. Collins, G. Faluvegi, G. A. Folberth, L. W. Horowitz, T. Nagashima, V. Naik, S. T. Rumbold, K. Sudo, T. Takemura, D. Bergmann, P. Cameron-Smith, R. M. Doherty, B. Josse, I. A. MacKenzie, D. S. Stevenson, and G. Zeng, Future global mortality from change in air pollution attributable to climate change, *Nature Climate Change*, in press, 2017.
- 214 Shindell, D., J. S. Fuglestedt, W. J. Collins, The Social Cost of Methane: Theory and Applications, *Faraday Disc.*, doi: 10.1039/C7FD00009J, 2017.
- 213 Gasser, T., G. P. Peters, J. S. Fuglestedt, W. J. Collins, D. T. Shindell, and P. Ciais, Accounting for the climate-carbon feedback in emission metrics, *Earth Syst. Dynam.*, 8, 235-253, doi:10.5194/esd-2016-55, 2017.

- 212 Westervelt, D.M., A.J. Conley, A.M. Fiore, J.-F. Lamarque, D. Shindell, M. Previdi, G.
Faluvegi, G. Correa, L.W. Horowitz, Multi-model precipitation responses to removal
of U.S. sulfur dioxide emissions, *J. Geophys. Res.*, 122, 5024–5038, 2017.
- ,211 Samset, B. H., G. Myhre, P. M. Forster, Ø. Hodnebrog, T. Andrews, O. Boucher, G.
Faluvegi, D. Fläschner, M. Kasoar, V. Kharin, A. Kirkevåg, J.-F. Lamarque, D. Olivie,
T. Richardson, D. Shindell, T. Takemura, A. Voulgarakis, Weak hydrological
sensitivity to temperature change over land, independent of climate forcing, *Nature
Climate and Atm. Sci.*, in press, 2017.
- 210 Myhre, G., Aas, W., Cherian, R., Collins, W., Faluvegi, G., Flanner, M., Forster, P.,
Hodnebrog, Ø., Klimont, Z., Lund, M. T., Mülmenstädt, J., Lund Myhre, C., Olivie,
D., Prather, M., Quaas, J., Samset, B. H., Schnell, J. L., Schulz, M., Shindell, D.,
Skeie, R. B., Takemura, T., and Tsyro, S.: Multi-model simulations of aerosol and
ozone radiative forcing due to anthropogenic emission changes during the
period 1990–2015, *Atmos. Chem. Phys.*, 17, 2709–2720, 2017.
- 209 Collins, W. J., J.-F. Lamarque, M. Schulz, O. Boucher, V. Eyring, M. I. Hegglin, A.
Maycock, G. Myhre, M. Prather, D. Shindell, S. J. Smith, AerChemMIP: Quantifying
the effects of chemistry and aerosols in CMIP6, *Geosci. Model. Dev.*, in press, 2017.
- 208 G. Myhre, P. M. Forster, B. H. Samset, Ø. Hodnebrog, J. Sillmann, T. Andrews, O.
Boucher, G. Faluvegi, D. Fläschner, T. Iversen, M. Kasoar, V. Kharin, A. Kirkevåg,
J.-F. Lamarque, D. Olivie, T. Richardson, D. Shindell, K. P. Shine, C. W. Stjern, T.
Takemura, A. Voulgarakis, F. Zwiers, PDRMIP: A Precipitation Driver and Response
Model Intercomparison Project, Protocol and preliminary results, *Bull. Amer. Met.
Soc.*, in press, 2017.
- 207 Shindell, D., Crop Yield Changes Induced by Emissions of Individual Climate-Altering
Pollutants, *Earth's Future*, 4, 373–380, doi:10.1002/2016EF000377, 2016.
- 206 Gonsamo, A., J. M. Chen, D. T. Shindell, and G. P. Asner, Coherence among the
Northern Hemisphere land, cryosphere, and ocean responses to natural variability and
anthropogenic forcing during the satellite era, *Earth Sys. Dyn.*, 7, 717–734, 2016.
- 205 Silva, R. A., West, J. J., Lamarque, J.-F., Shindell, D. T., Collins, W. J., Dalsoren, S.,
Faluvegi, G., Folberth, G., Horowitz, L. W., Nagashima, T., Naik, V., Rumbold, S. T.,
Sudo, K., Takemura, T., Bergmann, D., Cameron-Smith, P., Cionni, I., Doherty, R.
M., Eyring, V., Josse, B., MacKenzie, I. A., Plummer, D., Righi, M., Stevenson, D. S.,
Strode, S., Szopa, S., and Zengast, G.: The effect of future ambient air pollution on
human premature mortality to 2100 using output from the ACCMIP model ensemble,
Atmos. Chem. Phys., 16, 9847–9862, doi:10.5194/acp-16-9847-2016, 2016.
- 204 Kasoar, M., Voulgarakis, A., Lamarque, J.-F., Shindell, D. T., Bellouin, N., Collins, W.
J., Faluvegi, G., and Tsigaridis, K.: Regional and global temperature response to
anthropogenic SO₂ emissions from China in three climate models, *Atmos. Chem.
Phys.*, 16, 9785–9804, doi:10.5194/acp-16-9785-2016, 2016.
- 203 Liu, H., M. Fu, X. Jin, Y. Shang, D. Shindell, G. Faluvegi, C. Shindell, K. He, Health
and climate impacts of ocean-going vessels in East Asia, *Nature Climate Change*,
doi:10.1038/nclimate3083, 2016.
- 202 Geller, M. A., T. Zhou, D. Shindell, R. Ruedy, I. Aleinov, L. Nazarenko, N.L. Tausnev,
M. Kelley, S. Sun, Y. Cheng, R.D. Field, and G. Faluvegi, Modeling the QBO – Other
Model Improvements Resulting from the Required Increased Vertical Resolution, *J.
Adv. Model. Earth Syst.*, 8, 1092–1105, 2016.
- 201 Lee, Y., D. T. Shindell G. Faluvegi, and R. W. Pinder, Potential impact of a US climate
policy and air quality regulations on future air quality and climate change, *Atmos.
Chem. Phys.*, 16, 5323–5342, 2016.
- 200 Shindell, D. T., Lee, Y., and Faluvegi, G., Climate and Health Impacts of US Emissions
Reductions Consistent with 2°C, *Nature Climate Change*, 6, 503–507,

- doi:10.1038/nclimate2935, 2016.
- 199 Parrish, D. D., I.E. Galbally, J.-F. Lamarque, V. Naik, L. Horowitz, D.T. Shindell, S.J. Oltmans, R. Derwent, H. Tanimoto, E Brunke, M. Cupeiro, Seasonal cycles of O₃ in the marine boundary layer: Observation and model simulation comparisons, *J. Geophys. Res.*, 121, 538-557, 2016.
- 198 Samset, B. H., G. Myhre, P. Forster, Ø. Hodnebrog, G. Faluvegi, D. Fläschner, M. Kasoar, S. Kharin, A. Kirkevåg, J.-F. Lamarque, D. Olivie, T. Richardson, D. Shindell, K. Shine, T. Takemura, A. Voulgarakis, Fast and slow precipitation responses to individual climate forcings: A PDRMIP multi-model study, *Geophys. Res. Lett.*, 43, doi:10.1002/2016GL068064, 2016.
- 197 Kristiansen, N. I., A. Stohl, D. J. L. Olivie, B. Croft, O. A. Søvde, H. Klein, T. Christoudias, D. Kunkel, S. J. Leadbetter, Y. H. Lee, K. Zhang, K. Tsigaridis, T. Bergman, N. Evangeliou, H. Wang, P.-L. Ma, R. C. Easter, P. J. Rasch, X. Liu, G. Pitari, G. Di Genova, S. Y. Zhao, Y. Balkanski, S. E. Bauer, G. S. Faluvegi, H. Kokkola, R. V. Martin, J. R. Pierce, M. Schulz, D. Shindell, H. Tost, and H. Zhang, Evaluation of observed and modelled aerosol lifetimes using radioactive tracers of opportunity and an ensemble of 19 global models, *Atmos. Chem. Phys.*, 16, 3525–3561, 2016.
- 196 Zhang, S., M. Wang, S. Ghan, A. Ding, H. Wang, K. Zhang, D. Neubauer, U. Lohmann, S. Ferrachat, T. Takeamura, A. Gettelman, H. Morrison, Y. Lee, D. Shindell, D. Partridge, P. Stier, Z. Kipling, and C. Fu, On the characteristics of aerosol indirect effect based on dynamic regimes in global climate models, *Atmos. Chem. Phys.*, 16, 2765-2783, 2016.
- 195 Shindell, D. T., Faluvegi, G., Rotstayn, L., Milly, G., Spatial Patterns of Radiative Forcing and Surface Temperature Response, *J. Geophys. Res.*, 120, 5385-5403, 2015.
- 194 Scovronick, N., C. Dora, E. Fletcher, A. Haines, and D. Shindell, Reduce short-lived climate pollutants to yield multiple benefits, *The Lancet*, 386, 1-3, 2015.
- 193 Harmsen, M. J., D P van Vuuren, M van den Berg, A F Hof, C Hope, V Krey, J-F Lamarque, A Marcucci, D T Shindell & M Schaeffer, How well do integrated assessment models represent non-CO₂ radiative forcing?, *Clim. Chg.*, 133, 565–582, 2015.
- 192 Marvel, K., G.A. Schmidt, D. Shindell, C. Bonfils, A. N. LeGrande, L. Nazarenko, and K. Tsigaridis, Do responses to different anthropogenic forcings add linearly in climate models?, *Environ. Res. Lett.*, 10, 104010, 2015.
- 191 Rotstayn, L., M. Collier, D. Shindell, and O. Boucher, Why does aerosol forcing control historical global-mean surface temperature change in CMIP5 models?, *J. Climate*, 28, 6608-6625, 2015.
- 190 Schnell, J., M. J. Prather, B. Josse, V. Naik, L. W. Horowitz, P. Cameron-Smith, D. Bergmann, G. Zeng, D. A. Plummer, K. Sudo, T. Nagashima, D. T. Shindell, G. Faluvegi, and S. A. Strode, Use of North American and European air quality networks to evaluate global chemistry–climate modeling of surface ozone, *Atmos. Chem. Phys.*, 15, 10581–10596, 2015.
- 189 Hood, L., et al., Solar Signals in CMIP-5 Simulations: The Ozone Response, *Q. J. Royal Met. Soc.*, 141, 2670-2689, 2015.
- 188 Mitchell, D., et al., Solar Signals in CMIP-5 Simulations: The Stratospheric Pathway, *Q. J. Royal Met. Soc.*, 141, 2390-2403, 2015.
- 187 Voulgarakis, A., M. E. Marlier, G. Faluvegi, D. T. Shindell, K. Tsigaridis, and S. Mangeon, Interannual variability of tropospheric trace gases and aerosols: The role of biomass burning emissions, *J. Geophys. Res.*, 120, 7157-7173, doi:10.1002/2014JD022926, 2015.
- 186 Nazarenko, L., et al., Future climate change under RCP emission scenarios with GISS

- ModelE2, *J. Adv. Model. Earth Syst.*, 7, 244-267, 2015.
- 185 Shindell, D. T., The Social Cost of Atmospheric Release, *Climatic Change*, 130, 313-326, 2015.
- 184 Myhre, G., O. Boucher, F. Bréon, P. Forster, and D. Shindell, Declining uncertainty in transient climate response as CO₂ dominates future climate change, *Nature Geoscience*, 8, 181-185, doi:10.1038/NGEO2371, 2015.
- 183 Lee, Y., P. Adams, and D. T. Shindell, Evaluation of the global aerosol microphysical ModelE2-TOMAS model against satellite and ground-based observations, *Geosci. Model Dev.*, 8, 631-667, 2015.
- 182 Gettelman, A., D. T. Shindell, and J. F. Lamarque, Impact of aerosol radiative effects on 2000-2010 surface temperatures, *Climate Dyn.*, 45, 2165-2179, 2015.
- 181 Shindell, D. T., Inhomogeneous forcing and transient climate sensitivity, *Nature Climate Change*, doi:10.1038/nclimate2136, 4, 274-277, 2014.
- 180 Schmale, J., D. Shindell, E. von Schneidemesser, I. Chabay, M. Lawrence, Clean up our skies, *Nature*, 515, 335-337, 2014.
- 179 Anenberg, S. C., et al., Impacts of intercontinental transport of anthropogenic fine particulate matter on human mortality, *Air Qual. Atmos. Health*, 7, 369-379, 2014.
- 178 Manzini, E., et al., Northern winter climate change: Assessment of uncertainty in CMIP5 projections related to stratosphere-troposphere coupling, *J. Geophys. Res. Atmos.*, 119, 7979-7998, doi:10.1002/2013JD021403, 2014.
- 177 Lee, Y.C., D.T. Shindell, G. Faluvegi, M. Wenig, Y.F. Lam, Z. Ning, S. Hao, C.S. Lai, Increase of ozone concentrations, its temperature sensitivity and the precursor factor in South China, *Tellus B*, 66, 23455, doi:10.3402/tellusb.v66.23455, 2014.
- 176 Schmidt, G.A., et al., Configuration and assessment of the GISS ModelE2 contributions to the CMIP5 archive, *J. Adv. Model. Earth Syst.*, 6, 141-184, 2014.
- 175 Miller, R. L., et al., CMIP5 Historical Simulations (1850-2012) with GISS ModelE2, *J. Adv. Model. Earth Syst.*, 6, 441-477, 2014.
- 174 Cooper, O. R., et al., Global distribution and trends of tropospheric ozone: An observation-based review, *Elementa Sci. Anth.*, 2, doi:10.12952/journal.elementa.000029, 2014.
- 173 Parrish, D. D., et al., Long-term changes in lower tropospheric baseline ozone concentrations: Comparing chemistry-climate models and observations at northern midlatitudes, *J. Geophys. Res.*, 119, 5719-5736, doi:10.1002/2013JD021435, 2014.
- 172 Marlier, M. E., A. Voulgarakis, D. T. Shindell, G. Faluvegi, C. Henry, and J. T. Randerson, The role of temporal evolution in modeling atmospheric emissions from tropical fires, *Atmos. Env.*, 89, 158-168, 2014.
- 171 Schmidt, G.A., D. T. Shindell, and K. Tsigaridis, Reconciling warming trends, *Nature Geoscience*, 7, 158-160, 2014.
- 170 Rogelj, J., M. Schaeffer, M. Meinshausen, D. T. Shindell, W. Hare, Z. Klimont, G. J. M. Velders, M. Amann, and H. J. Schellnhuber, Disentangling the effects of CO₂ and short-lived climate forcer mitigation, *Proc. Natl. Acad. Sci.*, doi:10.1073/pnas.1415631111, 2014.
- 169 Tsigaridis, K., et. al., The AeroCom evaluation and intercomparison of organic aerosol in global models, *Atmos. Chem. Phys.*, 14, 10845-10895, 2014.
- 168 Nolte, C., T. Otte, R. Pinder, J. Bowden, J. Herwehe, G. Faluvegi, D. Shindell, Influences of Regional Climate Change on Air Quality Across the Continental U.S. Projected from Downscaling IPCC AR5 Simulations, in Air Pollution Modeling and its Application XXII, NATO Science for Peace and Security Series C: Environmental Security, D. G. Steyn, P. J. H. Builtjes, and R. M. A. Timmermans, Eds., Springer Netherlands, 2014.
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- 166 Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T. Nakajima, A. Robock, G. Stephens, T. Takemura and H. Zhang, 2013: Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T. F., et al., (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2013.
- 165 Kirschke, S., et al., Three decades of global methane sources and sinks, *Nature Geoscience*, 6, 813-823, 2013.
- 164 Streets, D. G., D. T. Shindell, Z. Lu, and G. Faluvegi, Radiative forcing due to major aerosol emitting sectors in China and India, *Geophys. Res. Lett.*, 40, 4409–4414, doi:10.1002/grl.50805, 2013.
- 163 Silva, R. A., et al., Global premature mortality due to anthropogenic outdoor air pollution and the contribution of past climate change, *Environ. Res. Lett.*, 8, doi:10.1088/1748-9326/8/3/034005, 2013.
- 162 Hsu, A., A. Reuben, D. Shindell, A. de Sherbinin, M. Levy, Toward the next generation of air quality monitoring indicators, *Atmos. Env.*, 80, 561-570, 2013.
- 161 Pechony, O., D. T. Shindell, and G. Faluvegi, Direct top-down estimates of biomass burning CO emissions using TES and MOPITT versus bottom-up GFED inventory, *J. Geophys. Res.*, 118, 8054–8066, doi:10.1002/jgrd.50624, 2013.
- 160 Naik, V., et al., Preindustrial to present-day changes in tropospheric hydroxyl radical and methane lifetime from the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP), *Atmos. Chem. Phys.*, 13, 5277–5298, 2013.
- 159 Charlton-Perez, A. J., et al., Mean Climate and Variability of the Stratosphere in the CMIP5 models, *J. Geophys. Res.*, 118, 2494-2505, 2013.
- 158 Lamarque, J.F., et al., Multi-model mean nitrogen and sulfur deposition from the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP): evaluation of historical and projected future changes, *Atmos. Chem. Phys.*, 13, 7997–8018, 2013.
- 157 Eyring, V. et al., Long-term changes in tropospheric and stratospheric ozone and associated climate impacts in CMIP5 simulations, *J. Geophys. Res.*, doi:10.1002/jgrd.50316, 2013.
- 156 Doherty, R. M., Wild, O., Shindell, D. T., Zeng, G., Collins, W. J., MacKenzie, I. A., Fiore, A. M., Stevenson, D. S., Dentener, F. J., Schultz, M. G., Hess, P., Derwent, R. G. and Keating, T. J., Impacts of climate change on surface ozone and intercontinental ozone pollution: A multi-model study, *J. Geophys. Res.*, 118, 3744-3763, 2013.
- 155 Nabat, P. et al., A 4-D climatology (1979-2009) of the monthly tropospheric aerosol optical depth distribution over the Mediterranean region from a comparative evaluation and blending of remote sensing and model products, *Atmos. Meas. Tech.*, 6, 1287–1314, 2013.
- 154 Shindell, D. T. et al., Radiative forcing in the ACCMIP historical and future climate simulations, *Atmos. Chem. Phys.*, 13, 2939–2974, 2013.
- 153 Stevenson, D. S. et al., Tropospheric ozone changes, radiative forcing and attribution to emissions in the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP), *Atmos. Chem. Phys.*, 13, 3063–3085, 2013.
- 152 Bowman, K. W. et al., Evaluation of ACCMIP outgoing longwave radiation from tropospheric ozone using TES satellite observations, *Atmos. Chem. Phys.*, 13, 4057–4072, 2013.

- 151 Bond, T., et al., Bounding the role of black carbon in the climate system: A scientific assessment, *J. Geophys. Res.*, 118, 5380–5552, doi:10.1002/jgrd.50171, 2013.
- 150 Shindell, D., G. Faluvegi, L. Nazarenko, K. Bowman, J.- F. Lamarque, A. Voulgarakis, G. A. Schmidt, O. Pechony, R. Ruedy, Attribution of historical whole-atmosphere ozone forcing to emissions, *Nature Climate Change*, 3, 567-570, doi:10.1038/nclimate1835, 2013.
- 149 Marlier, M. E., R. S. DeFries, A. Voulgarakis, P. L. Kinney, J. T. Randerson, D. T. Shindell, Y. Chen, and G. Faluvegi, El Niño and health risks from landscape fire emissions in Southeast Asia, *Nature Climate Change*, 3, 131–136, 2013.
- 148 Nordhaus, W.D., M.L. Cropper, F. de la Chesnaye, N. Diffenbaugh, D.G. Hawkins, R.F. Mann, B.C. Murray, J.M. Reilly, D. Shindell, E. Toder, R.C. Williams, III, and C. Wolfram, *Effects of U.S. Tax Policy on Greenhouse Gas Emissions*. W.D. Nordhaus, S.A. Merrill, and P.T. Beaton, Eds. National Academies Press, 2013.
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- 146 Shindell, D. T., Pechony, O., Voulgarakis, A., Faluvegi, G., Nazarenko, L., Lamarque, J.-F., Bowman, K., Milly, G., Kovari, B., Ruedy, R. and Schmidt, G. A., Interactive ozone and methane chemistry in GISS-E2 historical and future climate simulations, *Atmos. Chem. Phys.*, 13, 2653–2689, 2013.
- 145 Collins, W. J., Fry, M. M., Yu, H., Fuglestedt, J. S., Shindell, D. T. and West, J. J., Global and regional temperature-change potentials for near-term climate forcers, *Atmos. Chem. Phys.*, 13, 2471–2485, 2013.
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