ORAL ARGUMENT NOT YET SCHEDULED

No. 13-5192

IN THE UNITED STATES COURT OF APPEALS

FOR THE DISTRICT OF COLUMBIA CIRCUIT

ALEC L., *et al*.,

Plaintiffs – Appellants,

v.

GINA McCARTHY, *et al*.,

Defendants – Appellees,

THE NATIONAL ASSOCIATION OF MANUFACTURERS, *et al*.,

Intervenors for Defendants – Appellees

On Appeal from the United States District Court for the District of Columbia (No. 11-cv-02235 (RLW))

BRIEF OF SCIENTISTS AMICUS GROUP AS *AMICI CURIAE* IN SUPPORT OF PLAINTIFFS-APPELLANTS SEEKING REVERSAL

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CERTIFICATE OF INTERESTED PARTIES, RULINGS, AND RELATED CASES

A. Parties and *Amici*. Except for the following, all parties, intervenors, and *amici* appearing before the district court and in this Court are listed in the Brief for Plaintiffs-Appellants. James Hansen, David Beerling, Paul J. Hearty, Ove Hoegh-Guldberg, Pushker Kharecha, Valérie Masson-Delmotte, Camille Parmesan, Eelco Rohling, Makiko Sato, Pete Smith, and Lise Van Susteren are *amici curiae* in this appeal (referred to hereinafter as "Amici Scientists.").

B. Rulings under Review. The rulings under review are the District Court's May 31, 2012 order granting Defendants and Defendant-Intervenors' Motions to Dismiss (A085) (and incorporated memorandum opinion (A074-84)); and May 22, 2013 order denying Plaintiffs' Motion for Reconsideration (A097) (and incorporated memorandum opinion (A086-96)), in *Alec L., et al. v. Jackson, et al.*, No. 1:11-cv-02235-RLW (Hon. Robert L. Wilkins).

C. Related Cases. Amici Scientists are unaware of any related cases.

Dated:
November 12, 2013

Respectfully submitted,

/s/ Daniel M. Galpern
Daniel M. Galpern
Counsel for Amici Curiae

CORPORATE DISCLOSURE STATEMENT

Amici curiae Scientists, James Hansen, David Beerling, Paul J. Hearty, Ove Hoegh-Guldberg, Pushker Kharecha, Valérie Masson-Delmotte, Camille Parmesan, Eelco J. Rohling, Makiko Sato, Pete Smith and Lise Van Susteren are individuals and co-authors of Exhibit 1 to this Amicus Brief. They are not publicly held corporations, they issue no stock, they have no parent companies, and no publicly held company owns any stock in them. *Amici Scientists* have the purpose here only to assist the Court's consideration of the nature of the climate crisis, including the burden being imposed on present and future generations, and to describe a prescription for a plan of action that, if pursued, could be adequate to preserve essential features of the climate system under which civilization developed.

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GLOSSARY

°C	Degrees centigrade
Amici Scientists	James Hansen, David Beerling, Paul J. Hearty, Ove Hoegh- Guldberg, Pushker Kharecha, Valérie Masson-Delmotte, Camille Parmesan, Eelco Rohling, Makiko Sato, Pete Smith, and Lise Van Susteren
CO_2	Carbon dioxide
EPA	Environmental Protection Agency
GISS	Goddard Institute for Space Studies
Holocene	a geological epoch which began approximately 12,000 years ago
IPCC	Intergovernmental Panel on Climate Change
ppm	parts per million by volume

INTEREST AND IDENTITY OF *AMICI SCIENTISTS*[2]

Amici Scientists appear here in their individual capacity and not as representatives of any institution with which they are affiliated. The information and opinions in this brief are not necessarily those of any institution with which *Amici Scientists* are affiliated or those of any party to the present litigation. This brief is offered as an aid to the Court's deliberations over whether the relief sought by Appellants in their appeal is needed to preserve a climate system that is conducive to the survival and wellbeing of today's young people and their progeny.

Amicus James Hansen is the former director of the NASA Goddard Institute for Space Studies (GISS) and is an Adjunct Professor of Earth Sciences at Columbia University's Earth Institute. His research, since the mid-1970s, has focused on studies of the Earth's climate, using ongoing climate observations, Earth's climate history, and computer simulations of the global climate system. Dr. Hansen's testimony to Congress in the 1980s helped raise awareness of the global

[2] All parties have consented in writing to the filing of this brief. No counsel for a party authored this brief in whole or in part, and no counsel, party, or other person made a monetary contribution intended to fund the preparation or submission of this brief. Pursuant to D.C. Circuit Rule 29(d), *amici curiae* certify that no other brief of which they are aware of addresses the science behind the relief sought in this case. *Amici curiae* are aware that there will be other *amicus curiae* briefs supporting Appellants, but to their knowledge none of them overlap with the arguments presented herewith. *Amici curiae* only submit information to the Court in their area of expertise and certify that filing a joint brief is not practicable and that it is necessary to submit separate briefs.

warming issue. In recent years, he has drawn attention to the danger of passing climate tipping points, producing irreversible impacts that would yield a different planet from the one on which civilization developed. As part of that work, Dr. Hansen has outlined steps that are needed to stabilize climate, with a cleaner atmosphere and ocean. Dr. Hansen was elected to the National Academy of Sciences in 1995.

Amicus Professor David Beerling is a palaeobiologist in the Department of Animal and Plant Sciences, University of Sheffield, UK. His research, which is rooted in experiments and models -- and the emergence of fossil plants as biosensors recording the chemical composition of the ancient atmosphere – illuminates the causal relationships between terrestrial plant life and the global environment, and helps inform our understanding of human-made global change issues. He has authored over 200 scientific papers, holds a Royal Society Wolfson Research Merit Award, serves on several international scientific committees, and has organized Royal Society meetings (1997, 2006, 2010) on plant and ecosystem responses to past, present and future global environmental change.

Amicus Paul J. Hearty is Research Associate Professor at the University of North Carolina at Wilmington. His Ph.D. education was in glacial and Quaternary geology at the Institute of Arctic and Alpine Research and Geology Department at the University of Colorado at Boulder. He has over 100 peer-reviewed

publications. In the past 3 decades, Hearty's research has focused on the geologic record of sea-level changes, including confirmation that past warmer-than-present interglacial periods experienced substantial melting of polar ice sheets and subsequent sea-level rise. His current NSF (US) research examines the dynamic behavior of sea level and ice sheets during the mid to late Pliocene (3.3-2.9 million years ago), the last geologic interval when atmospheric CO_2 was at or above 400 ppmv -- a level surpassed in May 2013.

Amicus Ove Hoegh-Guldberg is Professor of Marine Studies and Director of the Global Change Institute, at the University of Queensland in Brisbane, Australia. His published works include over 200 refereed publications and book chapters, including the first major evidence of the serious threat that climate change poses for coral reefs and other coastal ecosystems. He is currently a member of the Australian Climate Scientists and the Royal Society (London) Marine Advisory Network, and recently served on the on the Board of Editing Reviewers at Science Magazine. He is currently serving as a Coordinating Lead Author of Chapter 30 (The Oceans) in the Fifth assessment report of the Intergovernmental Panel on Climate Change, due to be released in 2014.

Amicus Pushker Kharecha is a climate scientist with NASA GISS and the Columbia University Earth Institute whose main focus is conducting scientific research that can help to inform sound environmental policies. His research

interests are broad and generally relate to the human dimensions of the carbon cycle, such as the impacts of past, present, and future land use and fossil fuel use on climate, as well as mitigation of anthropogenic climate change via changes in these activities. Dr. Kharecha has served as a co-lead author for a major UNEP publication and has authored multiple high-impact peer-reviewed scientific papers.

Amicus Valérie Masson-Delmotte is a senior climate scientist and head of the "climate dynamics and archives" research group of Laboratoire des Sciences du Climat, Gif-sur-Yvette, France, related to French National Research Center, Atomic Energy Agency, University of Versailles-St Quentin and Institut Pierre Simon Laplace. She has co-authored 150 peer-reviewed publications on climate variability and climate change throughout different time scales, and has contributed to several outreach books for children and for the general public. She has received several prizes for collaborative research, including the Irène Joliot-Curie "French female scientist of 2013" award from the Ministery of Research and the Academy of Sciences. She was a lead author of Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report (AR4) (2007) and a coordinating lead author of IPCC AR5 (released September 2013), for the IPCC Working Group I paleoclimate chapters.

Amicus scientist Dr. Camille Parmesan is a Professor in Integrative Biology at the University of Texas at Austin (USA) and holds the National Aquarium Chair

in the Public Understanding of Oceans and Human Health in the Marine Institute, Plymouth University (UK). Professor Parmesan's research focuses on the current impacts of climate change on wildlife. Her documentation of the global extent and pervasiveness of the effects of anthropogenic climate change on biodiversity have received multiple international awards, including several from Reuters ISI for being very highly cited in the scientific literature. Parmesan is a Fellow of the Ecological Society of America and is a co-recipient of the Nobel Peace Prize awarded to IPCC in 2007.

Amicus Eelco J. Rohling is Professor (Ocean and Climate Change) at the Research School of Earth Sciences, at The Australian National University. His research concerns past ocean and climate changes, present-day and past states of circulation and property distribution, changes in deep-sea ventilation with impacts on nutrient distributions and the carbon cycle, ecological responses to ocean change, and integration of palaeoclimate research with archaeological records. He has been an international corresponding Fellow of the Royal Netherlands Academy of Arts and Science, a Japan Society for Promotion of Science Senior Invited Researcher, a UK Royal Society Wolfson Research Merit Award winner, and an Australian Laureate Fellow (started 1 March 2013). Eelco has been vice-chairman (2003-2004) and chairman (2005-2008) of the 26-nation International Marine Global Changes Study programme (IMAGES), vice-president of

Palaeoclimatology at the Climates section of the European Geosciences Union (2000-2006), associate editor with *Climate of the Past*, *Geology*, *Paleoceanography*, and *Quaternary Science Reviews*, and editor of both *Paleoceanography* (2006-2009) and *Reviews of Geophysics* (2010-today).

Amicus Makiko Sato is a research scientist at the Earth Institute, Columbia University with over 50 publications in the field of planetary energy balance and climate change. She holds her B.S. and Ph.D. in Physics, and worked at NASA Goddard Institute for Space Studies from 1978 through 2013. Her academic interests include analysis of global change data, especially atmospheric temperature, and analysis of computational results of climate modeling due to different climate forcings -- including that by well-mixed long-lived greenhouse gases (CO_2, CH_4, O_3, and N_2O) and atmospheric aerosols.

Amicus Pete Smith is the Royal Society-Wolfson Professor of Soils and Global Change at the Institute of Biological and Environmental Sciences at the University of Aberdeen (Scotland, UK), Science Director of the Scottish Climate Change Centre of Expertise (ClimateXChange) and Director of Food Systems for the Scottish Food Security Alliance-Crops. Since 1996, he has served as Convening Lead Author, Lead Author and Author for the Intergovernmental Panel on Climate Change (IPCC), including as the Convening Lead Author of the Agricultural Mitigation chapter of the IPCC Fourth Assessment Report and the

Agriculture and Forestry Mitigation chapter of the IPCC Fifth Assessment. He has coordinated and participated in many national and international projects on soils, agriculture, food security, greenhouse gases, climate change, mitigation and impacts, and ecosystem modelling and is a Fellow of the Society of Biology, a Rothamsted Research Fellow, a Research Fellow of the Royal Society (London; 2008-2013), and a Fellow of the Royal Society of Edinburgh.

Amicus Lise Van Susteren is a board certified general and forensic psychiatrist practicing in Washington DC. Van Susteren serves on the advisory board of the Center for Health and the Global Environment at Harvard School of Public Health and is a member of the Board of Directors of the National Wildlife Federation and the Chesapeake Climate Action Network. Van Susteren is the founder and CEO of "Lucky Planet Foods," a company dedicated to providing low-carbon, plant-based, healthy foods for sustainable living. In 2011, Van Susteren co-founded "Interfaith Moral Action on Climate," a multi-faith coalition dedicated to organizing people of religion and spirituality to speak out against climate change.

SUMMARY OF ARGUMENT

Global warming due to emissions of greenhouse gases, mainly CO_2 from fossil fuel consumption, is 0.8°C in the last 100 years, with most of this warming in the last 35 years. Due to physical climate system inertia, a comparable amount is "in the pipeline," ensuring further warming even without further change in the atmospheric concentration of CO_2 and other greenhouse gases.

Already-observed impacts of this warming include rising sea levels, increased atmospheric moisture resulting in more intense precipitation events, higher temperatures causing more frequent and intense heat waves, droughts, and wildfires, loss of sea ice, ice sheet mass and glaciers, expansion of the subtropics, acidification of the oceans, shifting distributions of plant and animal species, and an increasing rate of species extinctions.

Maintaining a climate that resembles the Holocene epoch, the world with a relatively stable climate system under which civilization developed, requires rapid reduction of fossil fuel CO_2 emissions and massive reforestation. Atmospheric CO_2 concentrations passed the level that Amici Scientists consider a safe initial target in, approximately, 1988. Global mean temperature is now close to and may exceed the prior Holocene peak, and unabated fossil fuel emissions continue to drive the Earth increasingly out of energy balance. Unless action is undertaken without further delay, the continuing increase of atmospheric CO_2 will drive Earth's

climate system toward and past points of no return, with disastrous consequences for young people and future generations. Effective action remains possible, but delay in undertaking sharp reductions in emissions will undermine any realistic chance of preserving a habitable climate system, which is needed by future generations no less than by prior generations.

Appellants in this case (hereinafter, "Alec L.") sought a preliminary injunction to ensure that Respondents (hereinafter, "McCarthy") submit to the Court a plan to ensure that the United States commences effective action before it is too late, including efforts to reduce CO_2 emissions by at least 6% annually. That prescription remains consistent with the scientific understanding of what minimally must be done by the United States and other nations to restore planetary energy balance on the century time scale. The inadequacy of the US response – even when accounting, generously, for both present law and stated policy goals – renders action by this Court essential to preserve a viable planet for young people and future generations.

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ARGUMENT

I. GREENHOUSE GASES HAVE ALREADY REACHED THE DANGEROUS LEVEL AND, WITHOUT EFFECTIVE ACTION, WILL PRODUCE CATASTROPHIC AND IRRETRIEVABLE LOSSES.

At an earlier stage of these proceedings, the United States argued that climate change presents "the possibility of some remote future injury." Def. Opp'n to Pl. Motion for Prelim. Inj. at 9. That assertion evinced a fundamental misunderstanding of the nature of the threat we face, both as to current impacts and the likelihood of future harm.

Paleoclimate research establishes that for most of the Holocene period – the period of the most recent 10,000 years – Earth's climate, though highly variable on a regional basis, has been characterized by reasonably constant mean global temperatures. *See* summary of research in James Hansen et al., in *Climate Change and Intergenerational Justice: Rapid Reduction of Carbon Emissions Required to Protect Young People, Future Generations and Nature,* Public Library of Science ONE (forthcoming, Dec. 2013) (Attached hereto as Exhibit 1) at 25 ("[H]umanity and nature, the modern world as we know it, is adapted to the Holocene climate that has existed more than 10,000 years.").[3] This constancy enabled the Greenland

[3] *See also*, J. Hansen, M. Sato, G. Russell, and P. Kharecha, Climate sensitivity, sea level, and atmospheric carbon dioxide. *Phil. Trans. R. Soc. A*, 371, 20120294, doi:10.1098/rsta.2012.0294. (2011), *available at* http://rsta.royalsocietypublishing.org/content/371/2001/20120294.

and Antarctic ice sheets to remain in near mass balance, sea levels to be relatively stable, species to flourish, and civilization to develop.

Largely due to the burning of fossil fuels, the atmospheric CO_2 concentration has climbed sharply in recent decades – from 316ppm in 1959 to 395ppm in 2013.[4] In that period, US CO_2 emissions nearly doubled, from 2.83 to 5.43 billion metric tons.[5] The CO_2 concentration is now at a level not seen on Earth for at least 3 million years. Exhibit 1 at 6. The CO_2 increment functions as an added blanket on the planet, reducing the amount of heat that would otherwise be radiated to space and throwing the planet into energy imbalance. In response, Earth has warmed by approximately 0.8°C over the last century, possibly breaching the prior Holocene peak. Exhibit 1 at 34. Due to Earth's thermal inertia, a similar or greater amount of additional 2.0°C warming is "in the pipeline" before Earth reaches energy balance at the present level of atmospheric CO_2 concentration. *Id*. 6-8.

[4] Mauna Loa CO_2 annual mean data downloaded Oct. 20, 2013 from http://www.esrl.noaa.gov/gmd/ccgg/trends/#mlo_full.

[5] T.A. Boden, G. Marland, and R.J. Andres. 2013. Global, Regional, and National Fossil-Fuel CO_2 Emissions Carbon Dioxide Information Analysis Center (CDIAC), with emissions of carbon reported through 2010. Data downloaded on Oct. 20, 2013 from http://cdiac.ornl.gov/CO2_Emission/timeseries/national. This amicus brief reports the data in units of CO_2, utilizing the CDIAC's carbon-to-CO_2 conversion factor of 3.667.

Avoidance of climate tipping points and subsequent points of no return, Exhibit 1 at 23-26,[6] requires effective action to return the atmospheric CO_2 concentration to, at most, approximately 350 ppm by the end of the century. Exhibit *1* at 7-8, 16-18, 30. This would allow additional heat radiation to escape to space so as to restore the planet's energy balance without additional prolonged global warming. *Id. at 8*. Such action could stabilize Earth's climate system and mitigate human suffering, but further delay may doom this prospect.

The already apparent impact of warming to date, and the likely future impacts of climate change, are addressed in turn.

(a) Present Impacts

While, as noted, global warming to date measures 0.8°C above the 1880-1920 period,[7] it has already led to a 40 percent reduction and an accelerating downward trend in summer Arctic sea ice cover, and an even faster decline in its thickness. Exhibit *1* at 5. Continental ice sheets of Greenland and Antarctica have begun to shed ice at a rate of several hundred cubic kilometers per year. *Id*. In the

[6] Hansen, et al define "the tipping level [as] the global climate forcing that, if long maintained, gives rise to a specific consequence [and] the point of no return [as] a climate state beyond which the consequence is inevitable, even if climate forcings are reduced." Hansen, J., et al., *Target Atmospheric CO_2: Where Should Humanity Aim?*, The Open Atmospheric Science Journal, p. 225 (2008), *available at* http://www.columbia.edu/~jeh1/2008/TargetCO2_20080407.pdf.

[7] The 1880-1920 period is the base period Amici Scientists use for preindustrial time. Exhibit 1 at 5.

past decade, sea level increased about 3cm—a rate of about one foot per century, and nearly twice as fast as the rate of increase during the preceding century.[8] This rise has resulted in losses of coastal wetland areas and greater levels of damage from coastal flooding.[9] For example, in the United States, increased sea level and regional land subsidence have led to the loss of 1900 square miles of coastal wetland in Louisiana, which in turn exacerbates the area's vulnerability to storm surges like Hurricane Katrina.[10] Mountain glaciers, the source of fresh water to major world rivers during dry seasons, are receding rapidly all around the world. Exhibit 1 at 5. In 1850, Glacier National Park in Montana had 150 glaciers measuring larger than twenty-five acres—today, it has just twenty-five.[11]

Tropospheric water vapor and heavy precipitation events have increased. Droughts are more common, especially in the tropics and subtropics. Exhibit 1 at 5. Coral reef ecosystems are being impacted by a combination of ocean warming

[8] Decl. of James Hansen, PhD., filed in *Central Valley Chrysler-Jeep, Inc. et al. v. Catherine E. Witherspoon*, 1:04-cv-06663-REC-LJO, 12 (May 5, 2006).

[9] Intergovernmental Panel on Climate Change, 2007: Impacts, Adaptation, and Vulnerability, Table 4.1 (hereinafter "IPCC Working Group II").

[10] U.S. Global Change Research Program, 2009: *Global Climate Change Impacts in the United States*, (T. Karl, J.M. Melillo, T.C. Peterson eds., Cambridge Univ. Press, 2009).

[11] United States Geological Survey, Retreat of Glaciers in Glacier National Park, *available at* http://nrmsc.usgs.gov/research/glacier_retreat.htm (last visited November 12, 2013).

and acidification from rising atmospheric CO_2, resulting in a 0.5-2% per year decline in geographic extent. Exhibit 1 at 5.[12] World health experts have concluded with "very high confidence" that climate change already contributes to the global burden of disease and premature death with altered distribution of some infectious disease vectors. *Id*. at 13. Subtropical climate belts have expanded, contributing to more intense droughts, summer heat waves, and devastating wildfires. Exhibit 1 at 5. Further, "[m]ega-heatwaves, such as those in Europe in 2003, the Moscow area in 2010, Texas and Oklahoma in 2011, Greenland in 2012, and Australia in 2013 have become more widespread with the increase demonstrably linked to global warming." *Id*. (internal citations omitted). The probability of such heat events has increased "by several times because of global warming, and the probability will increase even further if global warming continues to increase." Exhibit 1 at 49 (internal citations omitted).[13]

(b) Future effects

Based on measurements of observed climate change, computer simulations of the climate system's responses to additional CO_2 emissions, as well as information from the paleoclimate record, Amici Scientists have concluded that a

[12] Due to the oceans' update of excess CO2, "ocean pH is already outside its range of the past several million years." Exhibit 1 at 12 (internal citations omitted).

[13] *See* also J. Hansen, M. Sato, R. Ruedy, *The New Climate Dice: Public Perception of Climate Change* (August 2012) at http://www.giss.nasa.gov/research/briefs/hansen_17/ (visited Oct. 19, 2013).

continued high rate of burning of fossil fuels over several decades would render multi-meter sea level rise practically certain, and that "if most of the fossil fuels are burned" the sea-level rise could be on the order of tens of meters, with a consequential "loss of hundreds of historical coastal cities worldwide [and] hundreds of millions of global warming refugees from highly-populated low-lying areas." Exhibit 1 at 10. Global demographics would be thrown into chaos.

Amici Scientists note, as well, that acidification stemming from ocean uptake of a portion of increased atmospheric CO_2 is expected to increasingly disrupt coral reef ecosystem health, with potentially devastating impacts to certain nations and communities. Exhibit 1 at 12-13.

With respect to public health, Amici Scientists warn of receding mountain glaciers "with effects on seasonal freshwater availability of major rivers," Exhibit 1 at 5, illustrating that present atmospheric CO_2 levels are already a threat to future fresh water security, and that increasing concentrations of CO_2 and associated increased global temperatures will deepen impacts on human health, with children being especially vulnerable. Exhibit 1 at 13. Climate threats to health move through various pathways, including by placing additional stress on the availability of food, clean air, and clean water. *Id.* Summarizing the work of the Intergovernmental Panel on Climate Change, Amici Scientists warn of climate change impacts including "increased malnutrition and consequent disorders,

including those related to child growth and development," "increased death, disease and injuries from heat waves, floods, storms, fires and droughts," and "increased cardio-respiratory morbidity and mortality associated with ground-level ozone." *Id*. at 13.

As noted *supra*, climate zones are already shifting at rates that exceed natural rates of change; this trend will continue as long as the planet is out of energy balance, a conclusion "based on comparison of the observed trend with inter-decadal variability in climate simulations."[14] Amici Scientists note that "as the shift of climate zones becomes comparable to the range of some species, the less mobile species will be driven to extinction." Exhibit 1 at 11. Again summarizing the work of the Intergovernmental Panel on Climate Change, Amici Scientists note that for global warming of 1.6°C or more, relative to pre-industrial levels, 9-31 percent of species are anticipated to be driven to extinction, while with global warming of 2.9°C, an estimated 21-52 percent of species will be driven to extinction.[15]

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[14] J. Hansen, M. Sato, R. Ruedy, et al., *Dangerous human-made interference with climate: a GISS modelE study*, Atmos. Chem. & Phys., **7**, 2287-2312 (2007), *available at* http://pubs.giss.nasa.gov/docs/2007/2007_Hansen_etal_1.pdf.

[15] Amici Scientists note that "Mass extinctions occurred several times in Earth's history [117-118], often in conjunction with rapid climate change. New species evolved over millions of years, but those time scales are almost beyond human comprehension. If we drive many species to extinction we will leave a more desolate, monotonous planet for our children, grandchildren, and more generations

(footnote continued)

II. ACTION TO PHASE OUT CO_2 EMISSIONS IS URGENTLY REQUIRED, WHILE DELAY VIRTUALLY ENSURES CALAMITY.

The 2007 consensus statement by the IPCC, summarizing research through 2005, indicated that human-induced warming of Earth of approximately 2°C constituted dangerous climate change. From that, however, no conclusion logically could be drawn as to the danger inherent in lower levels of global warming.

Research by Amici Scientists and others to assess this question has been spurred on by the realization, as described *supra*, that large climate impacts have commenced already, even though Earth's lagged temperature response to the recent climb in atmospheric CO_2 is "only" 0.8°C above preindustrial levels. Amici Scientists estimate that current global temperature already exceeds Holocene mean temperature by at least 0.25°C, Exhibit 1 at 5, and there is strong evidence that the current temperature already exceeds the prior warmest Holocene levels reached in the early Holocene.[16] Empirical research showing an ongoing and accelerating mass loss of the Greenland and West Antarctic ice sheets, which began within the

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than we can imagine. We will also undermine ecosystem functions (e.g., pollination which is critical for food production) and ecosystem resilience (when losing keystone species in food chains), as well as reduce functional diversity (critical for the ability of ecosystems to respond to shocks and stress) and genetic diversity that plays an important role for development of new medicines, materials, and sources of energy." Exhibit 1 at 12.

[16] Miller, G.H., Lehman, S.J., Refsnider, K.A., Southon, J.R., Zhong, Y., *Unprecedented recent summer warmth in Arctic Canada*, Geophys. Res. Lett., doi:10.1002/2013GL057188 (2013), *available at* http://onlinelibrary.wiley.com/doi/10.1002/2013GL057188/abstract.

last few decades, provides confirming evidence that today's global temperature has reached a level higher than prior Holocene temperatures. *Id*.

Accordingly, the best available current science establishes that today's atmospheric CO_2 level is already into the "dangerous zone." *Id*. at 16. Because the recently-observed climate effects with respect to the ice sheets are still relatively small compared to total ice sheet mass, these feedbacks may not be a major factor if maximum global warming overshoot of ~1°C occurs only briefly and then recedes. *Id*. at 10-12.

Action therefore must be undertaken to restore the atmosphere's level of CO_2 concentration to 350ppm at most, so as to avert avoidable additional warming that may drive the climate system past tipping points that assure transition to "a very different planet," *Id*. at 3, and keep the period of overshoot to a minimum. *Id*. at 30. In particular, Amici Scientists determine that the present path of "continued extraction of all fossil fuels, including development of unconventional fossil fuels such as tar sands, tar shale, [and] hydrofracking," if continued for another 20 years, likely would lead to irreversible warming of the ocean and other climate impacts. *Id.* at 30.

The underlying reason why delay in emissions reductions practically forecloses the opportunity to protect and restore the climate system is that, as illustrated in Fig. 1, below, a substantial share of any additional infusion of CO_2 lasts in the

atmosphere for centuries (and while there, continuously acts to further heat the planet). Accordingly, Earth's temperature response to the "radiative forcing" effect of the higher atmospheric CO_2 concentration is a function not only of recent emissions, but the persisting share of prior emissions.

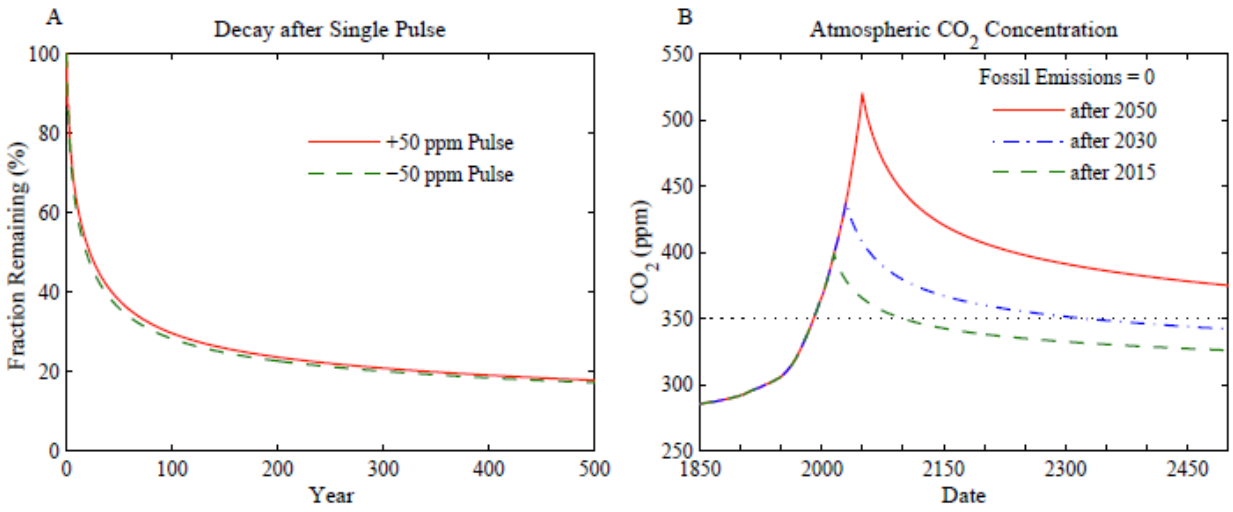

Figure 1. (a) Decay of instantaneous (pulse) injection and extraction of atmospheric CO_2, (b) CO_2 amount if fossil fuel emissions are suddenly terminated at the end of 2015, 2030, 2050. Exhibit 1 at 16.

As a consequence of the long-lived nature of CO_2 and the fact that human-derived emissions have already caused a substantial overshoot of the long-term safe atmospheric concentration level, any substantial delay in undertaking effective action – even if such action included a sharp cut-off of emissions – would render it impossible to return the atmospheric CO_2 concentration to 350ppm within this century. Thus, as illustrated in Fig. 1B, above, if emissions of CO_2 are allowed per business as usual for even two decades longer the concentration of CO_2 in the

atmosphere will not return until the year 2300 to the nominally safe level of 350ppm even if all such emissions were abruptly ceased in the year 2030. *Id.* at 17.[17] In contrast, complete cessation in 2015 would return to the atmospheric CO_2 concentration to 350ppm by the end of the century. *Id.* at 16 .

An abrupt cessation of all CO_2 emissions, whether in 2015 or 2030, is unrealistic, in part because industry, other business, and consumers alike need time to retool and reinvest in emission-free options to fossil fuels. Accordingly, Amici Scientists have proposed a glide path to secure an atmosphere whose CO_2 concentration is no higher than 350ppm. Their plan requires fossil fuel CO_2 emissions reductions of 6 percent annually, coupled with programs to limit and reverse land use emissions (i.e., massive reforestation). Exhibit 1 at 18, 35-36. These actions could achieve the goal of restoring the atmosphere to approximately 350ppm within this century if the plan were commenced without delay, and then adhered to. However, consistent with the abrupt phase out scenarios discussed in the prior paragraph *supra*, if the 6 percent annual emission reductions are delayed until 2030, then the global temperature will remain more than 1^{o}C higher than preindustrial levels for nearly 300 years. *Id*. at 22.

[17] Were the emission cessation only to commence after 40 years, Amici Scientists estimate that the atmosphere would not return to 350ppm CO_2 for nearly 1000 years. *Id*. at 17.

Considered in another way, the required rate of emissions reduction would have been about 3.5% per year if reductions had started in 2005, while the required rate of reduction, if commenced in 2020, will be approximately 15% per year. *Id.* at 17. Accordingly, the dominant factor is the date at which fossil fuel emissions phase-out begins.[18]

III. THE DISTRICT COURT MISAPPREHENDED THE NATURE OF THE CLIMATE CRISIS

In its conclusion to its memorandum opinion, the lower court observed that "[t]hroughout history, the federal courts have served a role both essential and consequential in our form of government by resolving disputes that individual citizens and their elected representatives could not resolve without intervention." *Alec L. v. Jackson*, 863 F. Supp. 2d 11, 17 (D.D.C. 2012). But the court declined to take action to adopt what it deemed to be the "sweeping court-imposed remedy" urged by Alec L. *Id*. To do so, according to the court, would implicate "the

[18] Amici Scientists further stress that the rate of annual emissions reductions must be sufficiently deep and, at minimum, maintained until phase out. With respect to both of these requirements, the present U.S. Climate Action Plan appears inadequate on its face. *See* U.S. Department of State, 2014 Climate Change Report, Ch. 1 at 3 ("Given implementation of programs and measures in place as of September 2012 and current economic projections, total gross U.S. GHG emissions are projected to be 4.6 percent lower than 2005 levels in 2020. Between 2005 and 2011 total gross U.S. GHG emissions have declined significantly due a combination of factors, including the economic downturn and fuel switching from coal to natural gas (U.S. EPA 2013). Emissions are projected to rise gradually between 2011 and 2020. Emissions are projected to remain below the 2005 level through 2030. . . ."). Available at www.state.gov/e/oes/climate/ccreport2014/.

fundamental nature of our government and our constitutional system." *Id.* Instead, the court urged the parties to keep talking to each other "to seek (and perhaps even seize) as much common ground as courage, goodwill and wisdom might allow to be discovered." *Id*.

However, with respect, the time for mere talk has passed, and the window of opportunity for effective action is closing fast. As Amici Scientists observe, "[W]e have a planetary climate crisis that requires urgent change to our energy and carbon pathway to avoid dangerous consequences for young people and other life on Earth." Exhibit 1 at 32-33.

Because the United States has admitted that business as usual poses a dire threat to humanity,[19] the question of whether the United States must act to avert

[19] *See, e.g.,* EPA, Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act; Final Rule, 74 Fed. Reg. 66496, 66535 (Dec. 15, 2009) ("Looking across all of the sectors discussed above, the evidence provides compelling support for finding that greenhouse gas air pollution endangers the public welfare of both current and future generations [and that] the risk and the severity of adverse impacts on public welfare are expected to increase over time."); Statement of Secretary of State John Kerry on Statement of September 27, 2013 ("What one country does impacts the livelihoods of people elsewhere – and what we all do to address climate change now will largely determine the kind of planet we leave for our children and grandchildren.") available at http://www.state.gov/secretary/remarks/2013/09/214833.htm.; Executive Office of the President, *The President's Climate Action Plan*, 4 (declaring climate change to be "one of our greatest challenges of our time"), 6 (citing President Obama that a failure to respond "would betray our children and future generations) available at www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf.

dangerous climate change is not at issue in this matter. What is at issue is the adequacy of U.S. action to meet the threat.

In order to *fully* evaluate that adequacy, Amici Scientists acknowledge that the Court would need to measure the course of U.S. action against some specific standard. In Exhibit 1, Amici Scientists attempted to establish such a scientifically defensible standard. Specifically, Amici Scientists address and answer the question of what is minimally required to restore the relatively moderate climate that has enabled civilization to develop. Toward that end, as discussed above, Amici Scientists advocate a glide path of annual fossil fuel emissions reductions of at least six percent that could restore atmospheric carbon dioxide concentrations to return to no more than 350ppm by the end of the century. If commenced without delay, and coupled with reasonable land use improvements and phase down of other potent greenhouse gases and precursors, Amici Scientists believe it feasible that humanity could still avoid climate tipping points that could trigger uncontrollable consequences.

District courts retain equitable authority to "fashion a less expansive remedy" than that urged in an original complaint, as the lower court itself observed. *Alec L. v. Jackson* 863 F. Supp. 2d at 13, n.5. Accordingly, even if the lower court were precluded from ordering the full panoply of remedies in Alec L.'s prayer for relief, it nonetheless could have ordered the United States to

demonstrate whether and how *its* own climate action plan, if fully pursued, would reduce fossil fuel emissions, *inter alia*, sufficiently and quickly enough that, in conjunction with similar action by other nations, would preserve the central features of the Holocene climate system for our children and future generations.

Amici Scientists file this brief in the expectation that a deeper understanding of the risks of unabated emissions and the closing opportunity for meaningful action will assist the Court of Appeals in evaluating the question whether the lower court at least should have required the United States to report to it as to the long-term adequacy of its climate action plan.

CONCLUSION

Systematic reductions in CO_2 emissions, for the reasons provided by Amici Scientists in the work cited throughout this Amicus Brief, must be undertaken in conjunction with land use improvements so as to return the concentration of CO_2 in the atmosphere to a level no higher than 350ppm by the end of the century, if not sooner. Appellants in this matter seek an Order by the Court remanding the matter to the lower court in order to require Respondents to submit a "Climate Recovery Plan" whose key features, if followed, would slow fossil fuel emissions at a rate leading to stabilization of Earth's energy balance as required to preserve a habitable climate system. This Brief has established that such action is urgently required. In particular, the failure to commence CO_2 emissions reductions without further

delay, and to undertake other measures consistent with the prescription developed by Amici Scientists, would consign our children and their progeny to a very different planet, one far less conducive to their survival. At minimum here, Amici Scientists urge this Court to remand with instructions for the United States to demonstrate that its plan of action would avert dangerous climate change and preserve a viable climate system. Such remand order by this Court may be the best, the last, and, at this late stage, the only real chance to preserve a habitable planet for young people and future generations.

Respectfully submitted this 12th day of November, 2013.

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CERTIFICATE OF COMPLIANCE

I hereby certify that this brief complies with the type-volume limitation of Fed. R. App. P. 32(a)(7)(B) and Fed. R. App. P. 29(d) because it contains 5742 words, excluding the parts of the brief exempted by Fed. R. App. P. 32(a)(7)(B)(iii) and Circuit Rule 32(a)(1).

I further certify that this brief complies with the typeface requirements of Fed. R. App. P. 32(a)(5) and the type-style requirements of Fed. R. App. P. 32(a)(6), because this brief has been prepared in a proportionally spaced typeface using Microsoft Word 2010 14-point Times New Roman font.

/s/ Daniel M. Galpern
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Counsel for Amici Curiae
Dated: November 12, 2013

CERTIFICATE OF SERVICE

I hereby certify that on this 12th day of November, 2013, I have served the foregoing *Amicus Curiae* Brief on all registered counsel through the Court's Case Management/Electronic Filing System (CM/ECF).

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