Written Testimony of

Dr. Kim Cobb
Professor, Earth & Atmospheric Sciences
Director, Global Change Program
Georgia Institute of Technology

Before the U.S. House of Representatives Committee on Natural Resources

"Climate Change: Impacts and the Need to Act"
February 6, 2019

1324 Longworth House Office Building

Washington D.C.

I thank Chairman Grijalva and the rest of the Committee for allowing me to contribute to this important conversation about our nation's climate future. My message today is simple: there are many no-regrets, win-win actions to reduce the growing costs of climate change, but we're going to have to come together to form new alliances, in our home communities, across our states, and yes, even in Washington. I know I speak for thousands of my colleagues when I say that scientists all over the country are willing and eager to assist policymakers in the design of data-driven defenses against both current and future climate impacts. It is not too late to alter the damaging trajectory of inaction. There are plenty of prizes for early, meaningful action. These include cleaner air and water, healthier, more resilient communities, a competitive edge in the low-carbon 21st century global economy, and the mantle of global leadership on the challenge of our time. I'm confident that through respectful discourse, we will recognize that our shared values unite us in seeking a better tomorrow for all Americans.

My own journey began 20 years ago, at the Scripps Institution of Oceanography, where my research focused on extracting records of past climate variability and change from far-flung, remote islands in the deep tropics. At the time, I never thought that I would ever find myself testifying to Congress about climate change. I was a passionate and dedicated student of our earth system, eventually settling into a rewarding academic career at the Georgia Institute of Technology, where I teach courses on energy and climate change, and manage a lab full of instruments and student research assistants. Over the last 15 years, I have published over 60 peer-reviewed articles, been awarded a Presidential Early Career Award for Scientists and Engineers, and am currently a Lead Author for the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Together with my students and collaborators, I

work to advance the tools and approaches of in my chosen field of paleoclimatology, in part by generating more and better records of past climate change. Such records help us peer into the distant future by quantifying the response of the climate system to past climate forcings, including greenhouse gases. I've led over 20 expeditions to the middle of the Pacific, SCUBA-diving on abundant, diverse reefs where the largest corals are 10ft tall and contain 100 or more years of past climate data.

But three years ago, I witnessed something that would change my personal and professional life forever.

In 2015, we received funding from the National Science Foundation for a series of field expeditions to document the evolution of a strong El Niño event projected that winter. I was giddy with the expectation of scientific discovery. After all, I had waited 15 years for this opportunity. What I could not have predicted was that ocean temperatures 6 degrees Fahrenheit warmer than usual would kill up to 90% of the coral at our study site over 9 months. And I got a front-row seat to the carnage. By early 2016, even the largest corals would succumb – corals that had lived through record-breaking El Niño's in 1983 and 1998. And the carnage was global – scientists report that by 2017, up to 75% of global reefs had experienced bleaching-level heat stress and for up to up to 30% of reefs, heat stress reached lethal levels (Eakin et al., 2018). Reefs in Hawaii and Florida were not spared. It will take decades for our study site to recover, but with ocean warming accelerating (Cheng et al., 2019), we know that the next ocean heat wave is lurking around the corner. 2016 was my wakeup call.

Unfortunately, 2017 and 2018 brought a number of devastating wake-up calls much closer to home. As a physical climate scientist, I am trained to focus on data, and their uncertainties, but let me cut to the chase: many of the natural disasters in past years bear the unmistakable signature of climate change. Hurricanes Harvey, Lane, and Florence delivered record-breaking rainfall (National Weather Service) while Hurricanes Maria and Michael decimated entire communities with their force, including many in my home state of Georgia. The National Climate Assessment (hereafter NCA, 2018) – released this last November – documents how climate change loads the dice in favor of extreme precipitation events, and how warmer oceans fuel larger tropical storms. On the other side of the country, record-breaking wildfires raged across California, linked to prolonged drought and warmer temperatures (Abatzoglou and Williams, 2016). The economic toll of these disasters can be measured in the hundreds of billions of dollars. However, their real toll - the vast human suffering left in their wake - is immeasurable.

And beyond these deadly extremes, a host of additional climate change impacts represent a growing threat to ecosystems and communities alike. Sea levels are rising, with 6ft of global sea level rise projected this century (Sweet et al., 2017; NCA, 2018). Drought threatens water supplies across the western US (NCA, 2018), with no end in sight. The oceans are becoming more acidic as excess atmospheric carbon dioxide reacts with seawater (NCA, 2018). A warming ocean holds less oxygen, increasing the risk for deadly coastal hypoxia events (NCA, 2018). All of these trends are expected consequences of climate change – most through fairly straightforward physics and chemistry – and all have been borne out by repeated sets of observations.

The National Climate Assessment outlines the region-by-region and sector-by-sector impacts of ongoing climate change. The report makes clear that climate change is already impacting the lives of many Americans, with outsize impacts to those who can least afford it. The report singles out indigenous communities as uniquely vulnerable, given their economic and cultural dependence on natural resources. But there's plenty of threats to go around – America's farmers, fishermen, coastal residents, children, the elderly, and low-income families sit squarely in the crosshairs of climate change. As a resident of the southeastern US, I am particularly concerned about the high concentration of vulnerable populations in our region, given that studies predict a pile-on of escalating climate impacts in our region (e.g. Hsiang et al., 2017).

Climate change also represents a major threat to national security, a "threat multiplier", in the words of a 2015 Department of Dense report (DOD report Ref ID 8-6475571). In the last month, a new Department of Defense report highlights the risk that current and future climate change poses to its infrastructure (DOD report RefID 9-D30BE5A). It notes that fifty-three installations are currently subject to recurrent flooding, growing to 60 at risk over the next 20 years.

Climate change impacts are now detectable all across America. And they will get worse. That's the bad news. I'm sure you're ready for some good news, and there is plenty to go around.

The good news is that science can help inform measures to protect communities, as well as our oceans, forests, parks, waterways, and wildlife, from the most devastating impacts of climate change. Here, early action is essential to success, delivering vast returns on investment.

Many jurisdictions – from the local to the federal level - have developed a range of adaptation measures informed by the best science, stakeholder engagement, and rigorous cost-benefit analysis. But the adaptation portfolio is still spotty, and nowhere near the scale justified by the set of well-established climate impacts. Towards that end, The National Climate Assessment provides an actionable blueprint for such adaptive measures, including an in-depth analysis of climate impacts on ecosystem structure, function, and services. For example, the report highlights a key role that our nation's natural resources, such as coastal wetlands, which can protect communities from rising seas while delivering a range of other valuable ecosystem services. The National and Regional Climate Adaptation Science Centers (https://casc.usgs.gov) provide a mechanism to accelerate adaptation planning and implementation to protect our nation's natural resources and safeguard the critical services that they provide.

And there is plenty of room for innovation and advanced technology to assist communities in quantifying their unique risks and vulnerabilities to specific climate-related threats. At Georgia Tech, teams of scientists and engineers are teaming up with city and county officials in and around Savannah, GA to design and deploy sensors for monitoring water levels and air temperatures in real time, from neighborhood to neighborhood (see https://www.sealevelsensors.org).

The other good news is that it's not too late to avoid the most damaging impacts of future climate change. We have the tools we need to dramatically reduce greenhouse gas emissions. And in doing so, we will enjoy cleaner water, cleaner air, and healthier communities.

The rapid expansion of renewable energy across the nation demonstrates a strong appetite for carbon-free, clean power on the part of private homeowners and large utilities alike. Even so, US greenhouse gas emissions were up 3% last year (Rhodium Group, 2019). The bottom line is that we are running out of time. Comprehensive federal policies are needed to speed the transition to low-carbon energy sources. Top on the list must be a price on carbon, to reflect the true costs of continued fossil fuel emissions, and to incentivize consumers, companies, and the market to find the cheapest, most effective means of reducing emissions.

As much as we need to ramp up low-carbon energy production, we also have a huge opportunity to dramatically reduce emissions in the near term through energy efficiency, while delivering energy cost savings to consumers and corporations alike. It's worth noting that efficiency gains come with significant health benefits, largely from reduced air pollution, and are effective even without a price on carbon. A 2018 energy efficiency scorecard by the American Council for an Energy Efficient Economy (ACEEE) reports state-by-state gains in energy efficiency, with the winners providing a wide range of policy instruments to achieve large-scale gains. In general, southeastern states like Georgia rank near the bottom of the list, despite high energy burdens that leave many low-income families struggling to afford their monthly energy bills (ACEEE, 2017). In this case, policies that promote energy efficiency will improve living conditions for many of the most vulnerable members of society. And of course, improved energy efficiency will be critically important going forward, as demand for cooling increases across many areas of the country.

I became a passionate spokesperson for energy efficiency after Georgia Tech undergraduates showed me what could be achieved by partnering with local businesses as part of the "Carbon Reduction Challenge" (http://carbonreduction.gatech.edu). In one semester, 30 students routinely design and implement strategies to save their organizational partners energy, simultaneously banking carbon reductions and cost savings. During one Challenge, student teams brought 12 million lbs of CO_2 reductions to fruition, simply by identifying low-hanging interventions to champion with their large partner organizations. That's the CO_2 equivalent of 20 homes going 100% solar for 20 years, except this CO_2 savings didn't cost money. It made money.

Lastly, there is a strong case to be made that we can deploy our vast forests, grasslands, and coastal marshes in service to natural carbon sequestration, in a variety of forms. At its most basic level, this means designing strategies to preserve our mature forests, grasslands, and wetlands, with their rich soil carbon reserves, in the face of continued climate change.

Listening to the stories of those whose lives have already been destroyed by climate change I have to wonder: How bad will it have to get for us to recognize that climate change represents a clear and present threat, and to act decisively to protect ourselves and the natural resources that we all depend on?

As a climate scientist, I'm heartened by recent polls showing that nearly 3 in 4 Americans are concerned about global warming, and support a range of policy options to address it (Leiserowitz et al., 2018). 72% of Americans think that global warming is happening, 62% understand that it is mostly human-caused, and 72% of Americans think that global warming is important to them

personally. On policy options, 68% of Americans support a carbon tax, and 82% support tax rebates for energy efficiency and solar panels. The path forward is clear.

And as a mother to four young children, I'm heartened by the sea of young people demanding that we not squander their chances for climate stability.

I urge this committee to center the robust findings of climate science in making critical policy decisions about our nation's natural resources by:

1) moving to protect these resources, and the communities that depend on them, from the suite of ongoing, well-established climate change impacts

2) ensuring that our use of federal lands is geared towards advancing climate solutions, rather than expanding the scope of the climate change problem.

References and resources (listed in the order that they appear)

2014-2017 coral bleaching event:
Eakin, C.M., et al., Unprecedented three years of global coral bleaching 2014–17. Sidebar 3.1. [in State of the Climate in 2017]. Bulletin of the American Meteorological Society, 99(8), S74–S75, 2018.
https://coralreefwatch.noaa.gov/satellite/analyses_guidance/global_coral_bleaching_2014-17_status.php
Hughes, T.P. et al., Spatial and temporal patterns of mass bleaching of corals in the Anthropocene. *Science*, 2018.
https://www.climate.gov/news-features/understanding-climate/unprecedented-3-years-global-coral-bleaching-2014–2017

Ocean warming:
Cheng, L., et al., How fast are the oceans warming? Observational records of ocean heat content show that ocean warming is accelerating, *Science*, 363. doi: 10.1126/science.aav7619, 2019.

Hurricane records:
https://www.weather.gov/lch/2017harvey
https://www.weather.gov/mhx/Florence2018
https://weather.com/storms/hurricane/news/2018-08-28-lane-hawaii-tropical-cyclone-rainfall-record-one-year-after-harvey

Fourth National Climate Assessment:
USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 186 pp.

On wildfires and climate change:
Abatzoglou, J.T. and A.P. Williams, Impact of anthropogenic climate change on wildfire across western US forests. Proceedings of the National Academy of Sciences, 2016.

Sea level rise:
Sweet, W.V., R.E. Kopp, C.P. Weaver, J. Obeysekera, R.M. Horton, E.R. Thieler, and C. Zervas, 2017: *Global and Regional Sea Level Rise Scenarios for the United States*. NOAA Technical Report NOS CO-OPS 083. NOAA/NOS Center for Operational Oceanographic Products and Services.

Regional impacts of climate change:
Hsiang. S et al., Estimating economic damages from climate change in the United States. *Science*, 2017.
Climate Impact Lab (http://www.impactlab.org/research/estimating-economic-damage-from-climate-change-in-the-united-states/)

DOD reports on climate change:
https://archive.defense.gov/pubs/150724-congressional-report-on-national-implications-of-climate-change.pdf?source=govdelivery
https://partner-mco-archive.s3.amazonaws.com/client_files/1547826612.pdf

Energy efficiency scorecards by state:
https://aceee.org/sites/default/files/publications/researchreports/u1808.pdf

Energy burdens in the low-income southeastern US households:
https://aceee.org/fact-sheet/southeast-low-income-series

US greenhouse gas emissions for 2018:
https://rhg.com/research/preliminary-us-emissions-estimates-for-2018/

Climate polling results:
http://climatecommunication.yale.edu/visualizations-data/ycom-us-2018/
http://climatecommunication.yale.edu/publications/climate-change-in-the-american-mind-december-2018/

Leiserowitz, A. et al. Climate change in the American mind: December 2018. Yale University and George Mason University. New Haven, CT: Yale Program on Climate Change Communication, 2018.