



**Woodwell
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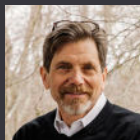
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Newsletter • March 2021
woodwellclimate.org

Striking similarities in a vision for US global change research



Dr. Philip Duffy
President & Executive
Director



The Global Change Research Act (GCRA) of 1990 mandates a program of federally-sponsored research to “assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change.” Although the GCRA mandates that the US research program “provide usable information on which to base policy decisions relating to global change,” historically the program has focused instead on fundamental science—understanding how the climate system works and how humans are disrupting it. The immediacy of climate change impacts highlights the urgency of policy action, however, and a new report from the National Academy of Sciences (NAS) emphasized the need for the research agenda to be designed to inform those policies. The result is a set of recommendations that largely mirror our Woodwell Climate Research Center’s own approach.

Among other things, the GCRA requires a 10-year strategic plan to guide the federal research program. Not surprisingly, the Trump Administration did not release a plan as scheduled in 2020. In response to this, the National Academy of Sciences (NAS) decided to write a short report suggesting a vision for US global change research—not a full strategic plan—and release this in time to inform actions by the Biden administration. I contributed to this document, which was written over the past year, briefed to White House on Friday, March 12, and released

to the public on Tuesday, March 16. Dr. John Holdren reviewed a draft, and the effort was led by our colleague Dr. Jerry Melillo at MBL (just a couple of miles down Woods Hole Road).

In addition to emphasizing the need for policy-relevant research, the committee calls for a research program “commensurate with the scope, scale, and urgency of the challenge.” The present research program is funded at the level of nearly \$2.5B/yr. While this fits Everett Dirksen’s definition of “real money,” this amount is far less than we spend on many other programs and far less than the annual cost of climate-related disasters. In my view the scale of the overall program is clearly deficient, as is funding available for understanding really important threats like extreme weather, feedbacks and tipping points.

Furthermore, there is very little work on the human toll of climate change—translating changes in the physical work into socioeconomic terms. This means assessing for example how climate change affects food scarcity, water scarcity, human health, migration, political instability, and so on. This understanding is needed both to help us understand what is at stake, and also to help decision-makers prepare for what’s coming. Very little of this critically-important work is happening, partly due to funding limitations and partly because there are real institutional barriers to doing the sort of cross-disciplinary work needed. I strongly support the

Above: Field spraying in southwest Michigan.

committee's recommendation that the US research program be expanded in scope to include a strong focus on understanding socioeconomic consequences of climate change.

Additional key recommendations include research into "reflecting sunlight," sometimes known as "geoengineering." In theory this could counteract some of the effects of increased atmospheric greenhouse gases. No one loves this idea, and many consider it repellent. As we continue to argue over rearranging deck chairs, however, carbon dioxide continues to accumulate in the atmosphere, and previously unthinkable options become increasingly imaginable.

Finally, the committee recommends research into developing the capability to independently measure national greenhouse gas emissions. The Paris climate agreement relies upon self-measured and self-reported national emissions. This weak verification regime was partly a political necessity, but in truth we lack the ability to independently measure other nations' greenhouse gas emissions with any meaningful accuracy. With satellite and in-situ measurements, however, and lots of computer horsepower, we could do much better.

The similarities between this report's recommendations and our priorities at Woodwell are striking: a motivation to inform policies and decisions, and a focus on understanding societal risks, on extremes thresholds and tipping points, and on measurement of greenhouse gas emissions. One might argue that the shared element of my involvement makes this resemblance not entirely coincidental. Even so, the acceptance of these priorities by the NAS committee and the interest expressed by the White House and Federal agencies is a nice endorsement of Woodwell's agenda.

What happens next? Every presidential administration has discovered that implementing change within the federal government requires persistence, knowing where the levers are, and buy-in from on high. This administration's commitment to climate change vastly exceeds that of any before it—if there's ever been a moment for change, this is it. So there's reason to feel some optimism about prospects for a bigger and broader federal research program. Regardless of what happens (or doesn't) in Washington, here at Woodwell Climate we'll continue to have outsized impact focusing on the most important unsolved problems in climate science, and putting that understanding to work in the real world.

Thanks as always for your interest and support.

Seeding new scientific investigations with broad publication of 28-year water quality record

by Michael Graca

Buzzards Bay Coalition Communications Director



Nearly thirty years ago, the Buzzards Bay Coalition founded the Baywatchers Monitoring Program. The monitoring program forges a unique partnership involving local citizen scientists, professional scientists, and two internationally renowned

research institutions—Marine Biological Laboratory and the Woodwell Climate Research Center. Now, the first 28 years' worth of Baywatchers' water quality data has been published in the international scientific journal, *Scientific Data*. Publication will improve access to the information for researchers around the world who may use it to develop new insights into protecting Buzzards Bay and other coastal waterways.

"It's gratifying to see the Baywatchers data published, and it's exciting to think about how it may inspire new studies," said Dr. Rachel Jakuba, science director of the Coalition and the lead author of the journal article. "We hope getting this data out in an open-access, peer-reviewed journal will encourage scientists to use it to test new hypotheses and develop new insights into Bay health."

Coalition staff and citizen scientists (residents who have been trained) collect water quality information at more than 200 stations around the Bay each summer, from May through September, managed by Tony Williams, the Coalition's director of monitoring programs. Data document the effects of nitrogen pollution including low oxygen that threatens marine life. Water samples are analyzed at the MBL in Woods Hole, under the direction of Woodwell Center Senior Scientist Dr. Christopher Neill and MBL senior laboratory technician Richard McHorney. Baywatchers is one of the largest, and longest-running water quality monitoring programs in the country.

"Baywatchers data directly influence policy by documenting impaired waters, making the public aware of long-term water quality trends, and importantly, documenting how water quality improves when communities upgrade water infrastructure, like fixing antiquated wastewater treatment plants," said Dr. Neill,



a long-time collaborator on the project. “They also show the Bay’s waters are warming rapidly.”

Baywatchers data have been used to identify nearly 30 bodies of water around the Bay that do not meet federal standards under the Clean Water Act, evaluate wastewater discharge permits, support the development of targets for reduction of nitrogen pollution, develop strategies for reaching those goals, and increase public awareness and generate support for actions to control nutrient pollution and improve water quality.

“Over the past 30 years, the Coalition has prioritized our commitment to comprehensive water quality monitoring above all else—placing sound science at the core of our work and successes in restoring and protecting the Bay. It is a function that continues to develop as we expand the density of our monitoring stations, parameters measured, methods for collection, and scientific collaborations. Making our entire dataset available through peer-reviewed

publication is an important step and I’m indebted to the many scientists, citizens, and funders who got us to this milestone.” said Buzzards Bay Coalition President Mark Rasmussen.

Williams, who oversees the program’s operation and conducts quality assurance on the data, said the involvement of many partners is key to its success. “We couldn’t do this without the dedication of both staff at our partner research institutions and the local residents who go through the training to become citizen scientists,” he said.

The greatest threat to the health of the Bay is nitrogen pollution. The main sources of nitrogen are private septic systems and underperforming wastewater treatment plants. Nitrogen pollution promotes algae growth, eliminates the eelgrass that provides fish and shellfish habitat, and can kill fish and shellfish directly by reducing dissolved oxygen levels.

In the 1980s, the Bay’s declining water quality and threatened coastal habitats

highlighted the need for restoration and protection efforts and for reliable data to guide that work. The newly established Coalition recognized early on that consistent, long-term data on water quality data could spur actions to improve the Bay’s environment and collaborated with the Buzzards Bay National Estuary Program to initiate the Baywatchers Monitoring Program.

For the first fifteen years of the program’s history, lab analyses were overseen by Dr. Brian Howes of UMass Dartmouth’s School of Marine Science and Technology before the lab analyses were moved to the Marine Biological Laboratory, initially under the direction of Dr. Hugh Ducklow.

The Baywatchers Monitoring Program has been funded by the Buzzards Bay Coalition primarily through contributions from the organization’s members and private foundations, legislative support from the Commonwealth of Massachusetts, the Buzzards Bay National Estuary Program, and the EPA.

Woodwell women in STEM

by Anabelle Johnston
Communications Intern

Despite great strides towards educational and employment equity, women today account for only 28% of the STEM workforce. Among the many barriers women face are lack of role models in the field and limited awareness of the diverse ways in which STEM careers can unfold.

“People often focus on one path through science—from PhD into academic science,” explains Chief Communications Officer Dr. Heather Goldstone. “But there are far more opportunities than that. There’s not just one way to be a woman in science.”

Women at Woodwell Climate are paving various pathways into the scientific world. Through outreach and mentorship, Woodwell Climate supports women at various stages of their scientific careers. This Women’s History Month, scientists and staff spoke about their experiences in climate science.

At all stages of their career, the women of Woodwell Climate Research Center are exploring and making space for new possibilities in the scientific world. Instead of a linear path through science, they present the potential for exploration.



Dr. Andrea Castanho

Dr. Andrea Castanho also pursued a career in science against many odds. While her family expected her to become an engineer, she insisted on pursuing physics as an undergraduate as well. Castanho decided to let passion inform her work and guide her research, applying physics to environmental questions. Originally from Brazil, Castanho took time off after completing her postdoctoral research in Boston. Eventually, she came to realize that the work brought her genuine fulfillment, and returned to the scientific community which welcomed her with open arms.

Her main research interest is to understand the impact of climate change in tropical forests. Studies have shown that the climate in the Amazon and Caatinga (a seasonally dry tropical forest in a semiarid region in northeast of Brazil) is changing. Using global climate models, Castanho wants to understand how the predicted future climate scenarios can affect the remaining tropical forests. She also investigates the impact of land use change on global carbon flux measurements.



Dr. Jennifer Watts

Dr. Jennifer Watts always knew she wanted to become a scientist. Growing up in Minnesota, Watts was fascinated by agriculture and the environment from a young age. During high school, Watts worked at a USDA soil lab, gaining experience in the field before transferring to a community college during her senior year to gain access to science classes not offered in her district.

“I always knew that I had the desire to be a scientist,” says Watts. “It was difficult at that point in my life because I didn’t have the resources. I didn’t have a lot of role models who could guide me through the process.”

Now, as a key member of the Woodwell Climate Arctic team, Watts serves as that role model for many young scientists. Combining fieldwork with remote sensing, Watts tracks climate change driven landscape changes and carbon emissions in the Arctic-boreal region.



Monica Caparas

Similarly, Monica Caparas took a non-linear path to her position as a Woodwell Climate research assistant. As a first-generation college student, Caparas did not have any frameworks for preparing for a career in scientific research. It was not until modeling effects of climate change on the global water cycle with her undergraduate mentor that Caparas began to imagine a scientific career. “Going into college, I didn’t know what research was. Even today, I’m still learning what the career - and life- of a researcher can look like and what I want it to be for myself,” Caparas explains.

After majoring in mathematical geophysics, Caparas returned home to Las Vegas to become a professional dancer and aerialist. After a few years, she found that she missed working with climate models and belonging to a scientific community. Returning to the work she began as an undergraduate, Caparas now utilizes climate models to project global water scarcity and changes in agricultural yield as a part of the Woodwell Climate Risk team.



Kathleen Savage

Intersectional solutions and tools lay at the heart of research associate Kathleen Savage’s work. After studying boreal and temperate forest greenhouse gas fluxes in the Northeast and Canada, Savage began collaborating with other scientists to employ research methods that she now utilizes in forests across the world.

Savage has developed methodologies for continuous greenhouse gas flux measurements and data quality protocols, which she has taught to scientists and students as far away as the Democratic Republic of the Congo. Savage does not believe the strict PhD pathway is necessary to contribute meaningfully to climate science. “Climate science consists of many little pieces of a puzzle and everyone can do their part to contribute to the overall picture,” says Savage.

Natalie Baillargeon

External Affairs Coordinator Natalie Baillargeon also hopes to bridge the gap between the physical and societal impacts of climate change. Baillargeon began her journey as a scientist as a Polaris Project student in 2018 and 2019. Before heading out to the field in her second year, she interned with the Woodwell Communications team, writing policy briefs and drafting social media copy. “That summer was paramount for me because I got to not only be a scientist and conduct fieldwork, but I also got to be a science communicator and policy advocate,” Baillargeon explains.

In developing both research and communication skills, Baillargeon is preparing to provide economic, ecological, and policy-based solutions. She believes that the multifaceted nature of climate change requires an all hands on deck approach. The polarization and politicization of science hurts everyone, though often disproportionately impacts low-income communities and people of color. Baillargeon’s unique position and experience allows her to approach climate change from many different angles, and she encourages others to think similarly.



Dr. Alex Naegele

Like Caparas, Dr. Alex Naegele did not transition straight into the professional science world after graduation. Naegele served in the Peace Corps in rural Morocco, developing community-based climate change adaptation strategies. She collaborated with many local and international organizations to understand the direct impact of climate change, which led her to further pursue science-based solutions as a member of Woodwell's Risk team. "There was a gap between the science and the community side of things," Naegele explains.

This experience brought climate justice to the forefront of Naegele's work and mind. For Naegele, climate resilience planning requires an understanding of how society both impacts and is impacted by climate change. She is grateful for her experience working directly with those affected by the physical hazards that climate change poses, as this work solidified her belief that climate change is an intersectional issue requiring intersectional and interdisciplinary solutions.



Workshop aims at improving Arctic-boreal carbon budgets

by Anabelle Johnston
Communications Intern

The Arctic-boreal zone contains a massive amount of carbon, most of it in permafrost soils that have been frozen for hundreds to thousands of years. Because this carbon is vulnerable to thaw with climate warming, understanding the role of the Arctic-Boreal region in global carbon feedback loops is key to preparing for and mitigating climate change. To understand if this large region is a carbon sink or source, scientists have developed multiple methods of modeling carbon fluxes, each with their own set of assumptions and challenges.

In October 2020, Woodwell Climate Research Center organized a workshop that virtually brought together 145 international experts in Arctic-boreal carbon cycling, atmospheric science, remote sensing, and ecosystem modeling. Funded by the Gordon and Betty Moore Foundation, the workshop aimed to identify recent progress, future priorities, and the largest sources of uncertainty in Arctic-boreal carbon budgets. The workshop took place over five days and included three core themes: 1) full examination of regional carbon dioxide

flux models, 2) improving understanding of methane uptake and emissions from terrestrial and aquatic systems, 3) accounting for the impacts of ecosystem disturbances on carbon dioxide flux. Dr. Sue Natali opened the week with a plenary session, Drs. Anna Virkkala and Brendan Rogers led the modeling session, Dr. Jennifer Watts led the aquatic and terrestrial session, and Dr. Rachael Treharne closed the week with a session on disturbances co-lead by Dr. Brendan Rogers. Erin MacDonald coordinated the workshop behind-the-scenes.

Drs. Virkkala and Rogers provided an overview of three primary modeling methods: statistical and machine learning models used to upscale field observations, ecosystem process models, and atmospheric inversion models. "These various methods have historically been conducted in isolation, as field researchers, data scientists, atmospheric scientists, and process modelers employ techniques that apply most directly to their work. However, when compared, the models often produce dramatically different carbon estimates," says

Above: Thawing coastal permafrost. / photo by Chris Linder



Virkkala. These disparities lead to uncertainty over the accuracy of these budgets, challenging both the present understanding of the amount of carbon being released from high latitude regions and the efficacy of the Arctic-Boreal region as a carbon sink in coming years.

The workshop also identified and aimed to address the major causes of variability in carbon dioxide and methane flux budgets from high latitude wetland and aquatic environments. One of the causes of budget discrepancies is a lack of interaction and dialog between science communities representing terrestrial vs. aquatic and bottom-up (scaling up measurements taken by field scientists over specified landscapes) vs. top-down (airborne greenhouse gas measurements taken over a large region) approaches.

“We often work within our own specialized research areas, and, because in reality Arctic science is so interdisciplinary, this may limit our ability to reduce uncertainty in our understanding of carbon budgets under current and future climate conditions. The goal of this workshop was to get everyone in the same room to discuss

differences in research approaches and reach a consensus about how to work more closely across science communities to address pressing knowledge gaps,” said Dr. Jennifer Watts.

The workshop also addressed the limited representation of disturbances such as wildfire, pests and pathogens, ground-ice melt, lake drainage, and land use change in carbon budget estimates. “These dynamic disturbance events are occurring at an ever-increasing rate across the high latitudes and are critical for being able to understand the role of these systems in global carbon budgets”, said Dr. Rogers. After presenting the role of various disturbances across the Arctic-Boreal zone, the session focused on knowledge and data gaps with the intent of producing a priority list and an expert assessment article.

“Despite the clear importance of disturbance events, they are usually side-lined when we collect data in the field or from satellites. Finding ways to address that scarcity of data, but also to integrate disturbances into climate models in the meantime, is a key challenge for high latitude scientists,” explained Dr. Treharne.

Woodwell Climate hopes to reduce uncertainty going forward through upcoming projects such as Arctic MaPS: An Arctic Carbon Monitoring and Prediction System, an interactive web-based platform that compiles field observations and geospatial data to visually present changes occurring within high latitude ecosystems supported by the Moore Foundation.

“By explaining the science in simple terms and using interactive images and maps, we hope to reach a broader range of audiences to better inform the public, students, and policymakers about how rapid warming in the Arctic is changing the complex and unique Northern environments,” said MacDonald.

Following this workshop, participants plan to produce a comprehensive study that examines and compares various flux models, and makes recommendations for expanding Arctic in situ monitoring networks. Additionally, researchers will continue hosting workshops to collaborate across previously isolated scientific communities, and to communicate the state-of-the-art science with policy makers.

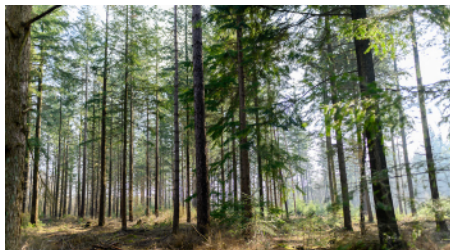
Above: Participants in a workshop session.

Fund for Climate Solutions awards climate research projects

by Heather Goldstone
Chief Communications Officer

The Fund for Climate Solutions has awarded six grants in its latest semi-annual funding competition, bringing the total awarded to thirty three grants, and \$3.66 million. Founded in 2018, the Fund enables Woodwell Climate scientists to pursue their boldest

ideas more quickly and nimbly than they could through traditional funding routes. This round of grantees features multiple projects leveraging novel technologies to gain important insights into carbon cycling around the globe.



The role of managed forests and wood products in reaching net zero greenhouse gas emissions in the U.S.

Submitted by: Dr. Richard Birdsey, Dr. Andrea Castanho, and Kathleen Savage

Carbon absorption and storage by forests is essential to reducing greenhouse gas emissions and achieving the goal of net zero emissions by mid-century. However, there is controversy centering on whether it is more effective to let forests grow to their full capacity to store carbon in trees and soils, or to manage forests more intensively to store carbon in harvested wood products, such as mass timber. This work will directly address this debate by developing rigorous inventories and projections of carbon storage by different U.S. forest ecosystems under varying management and harvest scenarios. The project promises critical insight into the past and prospective role of forests and the forest sector in our national carbon budget and climate goals.

Quantifying thermally driven plant stress along forest edges in the Brazilian Amazon

Submitted by: Drs. Michael Coe, Marcia Macedo, and Paulo Brando

The impacts of deforestation—dramatically reduced biodiversity and carbon storage, and increased local surface temperatures—are not limited to cleared areas. Adjacent forests may experience heat stress and degradation that impairs their ability to move water through the system and sequester carbon. One recent study estimated that forest edge degradation could increase the carbon footprint of deforestation by a third. This project will blend on-the-ground measurements with cutting edge drone measurements of the forest canopy and newly available satellite data to delve into the processes and ramifications of forest edge degradation, on scales ranging from individual trees to entire landscapes.

Building capacity to monitor and manage climate impacts on nitrogen pollution and carbon cycling in Cape Cod rivers

Submitted by: Drs. Max Holmes and Marcia Macedo

Climate change is altering the flow of rivers, with potentially profound effects on the coastal waters they feed. Nowhere is this more true than on Cape Cod, where nitrogen from septic systems and fertilizer run-off have degraded coastal ecosystems. For five years, the Cape Cod Rivers Observatory has monitored water quality in several Cape Cod rivers. This has yielded important insights, but measurements of the amount of water flowing through those rivers is needed to calculate their full impact on coastal waters—and that data currently is available for only one river. This project will initiate long-term discharge monitoring on four additional rivers, significantly expanding our ability to understand the interacting effects of climate change and human activity on coastal ecosystems.



Rapid soil carbon assessment

Submitted by: Dr. Jonathan Sanderman

Interest in the potential of soil carbon storage as a climate solution has grown exponentially in recent years. But the majority of emerging protocols and markets rely on models—not measurement—of soil carbon, making it difficult to gauge how effective they are. There is an urgent need for accurate, low-cost soil carbon monitoring technologies that can be deployed widely. This project addresses that need, leveraging newly available handheld scanner technology in conjunction with ongoing work to develop open-source data analysis tools. The goal is to test whether a field-deployable soil carbon measurement system can be accurate enough for carbon market applications.

The Fund for Climate Solutions is donor-supported. If you are interested in learning more about contributing to the Fund for Climate Solutions, please contact Chief Philanthropic Officer Leslie Kolterman at lkolterman@woodwellclimate.org or (617) 939-6284.



Developing an Indigenous partnership for climate change adaptation in interior Alaska

Submitted by: Dr. Sue Natali

The Arctic is warming at least twice as fast as the rest of the globe, setting off dramatic changes with devastating impacts on local communities. Alaska residents know better than anyone how their environment is changing. However, there is an urgent need for partnerships between Arctic communities and scientists to guide and implement relevant environmental monitoring and climate risk assessment. The project will substantially expand Woodwell's collaborations with Arctic Indigenous communities by partnering with the Tanana Chiefs Conference (TCC), an Alaska Native nonprofit organization, which is a consortium of 42 Athabascan tribes across Interior Alaska.



Autonomous low-cost automated aquatic methane measurement systems

Submitted by: Kathleen Savage, Dr. Marcia Macedo, Dr. Sue Natali, Dr. Glenn Bush, and Paul Lefebvre

Lakes, ponds, and wetlands—both natural and human-made—can be significant sources of the powerful greenhouse gas methane. But the variability of these emissions over time and across relatively small geographic areas has made it difficult to produce reliable global estimates of these emissions. This project will help address the need for accurate, high-resolution data on methane emissions from aquatic systems by developing novel, automated measurement systems. These innovative sensors build on Woodwell's decades of technical expertise, and promise to advance our understanding of carbon dynamics in aquatic ecosystems in the same way that our work in temperate forests did over 20 years ago.



In the news: highlights

Dr. Christopher Schwalm was quoted by VOA Russian Service in their coverage of a recent study showing AMOC slow-down: The Gulf Stream has slowed to record levels. Why is this important and what can we expect?, Mar 6

Dr. Marcia Macedo is quoted in *Science Magazine*: First Brazilian-made satellite watches the Amazon, Mar 5

Dr. Jennifer Francis was interviewed numerous times on the effects of the polar vortex, particularly on Texas, resulting in quotes in several top tier news outlets—and contributing to Woodwell Climate being mentioned in over 700 news stories the week of Feb 15.

Nasdaq.com: A Climate Black Swan: The Lessons Learned from Uri, Mar 11

The Hill: Average Arctic Ocean temperatures in February warmer than past two decades, Mar 8

Newsweek: Disrupted Polar Vortex Leads to Winter Temperature Anomalies Across Earth, Mar 3

Bloomberg: Bloomberg Green: Climate Lessons of the Texas Freeze, Feb 26

Al Jazeera: In extreme Texas cold, Green New Deal turns into hot potato, Feb 20

CBS News: Climate change and record cold: What's behind the arctic extremes in Texas, Feb 20

Yahoo News: In a state that once sang 'Freeze a Yankee,' the myth of an invincible Texas crumbles, Feb 20

NatGeo: Same force behind Texas deep freeze could drive prolonged heat waves, Feb 18

Vox: Scientists are divided over whether climate change is fueling extreme cold events, Feb 18

BBC: Weird weather: Why is there snow in Texas?, Feb 18

The Guardian: Heating Arctic may be to blame for snowstorms in Texas, scientists argue, Feb 17

LA Times: Texas blackouts show the power grid isn't ready for climate change, Feb 16

Bloomberg: How the Warming Arctic Helped Drive a Deep Freeze Into Texas, Feb 16

NBC Boston: How the Polar Vortex Brought Extreme Cold as Far South as Texas, Feb 16

Dr. Sue Natali was quoted in a story about the Arctic team's GEC work on Sputnik News: Scientists Arrive at Clues to Mysterious Emergence of Giant Craters in Siberia, Feb 27

Dr. Rich Birdsey's recent *Nature Climate Change* paper was written up on *HuffPost Italia*: Le foreste sotto attacco non riescono più a trattenere il carbonio (di F. Sellari), Feb 26

Dr. Phil Duffy was quoted in *Inside Climate News* and *The Scientist*, commenting on a new study showing that the Atlantic Meridional Overturning Circulation (AMOC) is at its weakest in a millennium: Climate Change is Weakening the Ocean Currents That Shape Weather on Both Sides of the Atlantic, Feb 25; Atlantic Circulation Weakest in More Than a Millennium: Study, Feb 26

Research by Dr. Sue Natali is referenced in an article on The Arctic Institute: The Global Carbon Budget and Permafrost Feedback Loops in the Arctic, Feb 25

Woodwell's partnership with Wellington Management is mentioned in *Business Wire*: Wellington Management Expands Private Investing Capabilities with New Climate-Focused Senior Investors, Feb 24

Dr. Bill Moomaw co-authored a piece for *The Conversation* arguing that keeping trees in the ground is an effective, low-tech way to slow climate change: Keeping trees in the ground where they are already growing is an effective low-tech way to slow climate change, Feb 22

Drs Skee Houghton and Wayne Walker's carbon work and expertise are referenced in a *Global Policy Journal* article: The Ruddiman Hypothesis: A Debated Theory Progresses Along Interdisciplinary Lines, Feb 24

Dr. Phil Duffy was quoted in *Financial Times*' Climate Graphic of the Week piece on the polar vortex: Climate graphic of the week: Polar vortex sends Texas into deep freeze, Feb 21

Dr. Jonathan Sanderman is quoted extensively in an article about soil carbon potential in *The Guardian*: Soil carbon: what role can it play in reducing Australia's emissions?, Feb 20

Dr. Skee Houghton is cited in an *Earth Island Journal* article about surprising natural carbon sinks: Finding Carbon Sinks in Unlikely Places, Feb 1

Katie Hunt covered the latest paper from the gas emission craters hunting team on CNN and Dr. Sue Natali is quoted: Climate change may be behind the massive craters forming in Siberia, Feb 17

cover: Flux tower installed in the Yukon-Kuskokwim Delta (Alaska) in October 2019. / photo by Chris Linder

Donations play an important role in securing the future of Woodwell Climate Research Center's work—and help safeguard the health of our planet for generations to come.

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