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This is our moment



Dr. Philip Duffy
President & Executive
Director



This fall's climate extremes—including wildfires in the western US and hurricanes in the North Atlantic—drive home that climate change is here, is disruptive, and is not going away. When George Woodwell testified in the US Senate in 1986, climate change consequences like increased wildfire activity were purely hypothetical. In 1995, when the Intergovernmental Panel on Climate change found that “the balance of evidence suggests a discernible human influence on global climate,” a careful statistical analysis was necessary to reveal a human influence in meteorological observations. Now, in 2020, the consequences of climate change are not only obvious, but are becoming severely disruptive and are affecting people economically and psychologically. And, as I recently said in public, this is not the new normal—it will continue to get worse.

It is disastrous and outrageous that decades of warnings by scientists have been systematically ignored. It is inexcusable that even now, high government officials *continue* to question a human role in the events which are beginning to transform our planet and our lives^[1].

These recent events make it clear that we should not be asking ‘can we afford to stop climate change,’ but ‘can we afford NOT to stop climate change.’ And they may help drive home the importance and urgency of the work we do here at Woodwell Climate Research Center. Even with all of the other weighty events in the news these days, people seem more focused than ever on the dangers of climate change. Furthermore, social science research shows that climate related extreme events are more effective than anything else in getting people to recognize the reality and seriousness of climate change. Now is a powerful moment to talk about our work and its value—while people are focused on climate change.

Given that climate change is hitting us over the head, and given that we all know that the #1 thing we need to do is to reduce greenhouse gas emissions to the atmosphere, it is logical for folks to ask ‘Why do we need more climate science?’ Here are a few examples of the continued need for climate science and what we are doing to meet it:

- Much of our work at Woodwell Climate is, in fact, about reducing greenhouse gas emissions. A key focus of the Tropics program, for example, is reducing emissions from deforestation in the Amazon and Congo Basins.

- “You can’t manage what you can’t measure.” Work at Woodwell Climate focuses on making better measurements of carbon as it moves into and out of the atmosphere. This is foundational to managing these movements of carbon, a critical step in managing climate change.
- We also work to advance ‘Natural Climate Solutions’ (NCS)—using management of forests, wetlands, etc. to remove CO₂ from the atmosphere. This acts to reverse climate change and is essential to limiting global warming to an acceptable level. We continue to be leaders in this space, with two of our scientists recently co-authoring an important new paper in *Nature*.
- A warming Arctic, on the other hand, makes climate change worse by emitting greenhouse gases from thawing permafrost and wildfire. That makes the hill we have to climb to control climate change much higher. Our work aims to understand how much higher, and to communicate that to policy makers. Without this understanding, we risk working hard to implement climate policies which are insufficient to meet the challenge.
- If it weren’t obvious already, recent fires in the western US prove that we are going to need to figure out how to cope with consequences of climate change. This is much less expensive and disruptive if we actively prepare rather than merely reacting post-disaster. Our Risk Program informs that paradigm shift by making quantitative projections of risk from important climate-related perils—fire, flood, hurricanes, and so on.

Despite everything else which is clamoring for our attention, climate change remains the most important challenge of this century. And it is urgent, because the longer we delay the less likely more benign outcomes become. The coming decade will be pivotal in terms of determining our future. We have a lot to do, and not much time. Thanks as always for your interest and support.

^[1] “We have a lot to learn about what causes changes in the climate, and we’re not there yet,” Dan Brouillette, US secretary of Energy, September 21, 2020.

Major grant launches new project to advance global soil science

by Miles Grant

Director of Publications & Media Relations

Farmers around the world could see major advances in soil testing capability thanks to a new grant from the US Department of Agriculture's granting body, the National Institute of Food and Agriculture (NIFA), to Woodwell Climate Research Center, OpenGeoHub and the University of Florida. The \$999,702 grant will launch the Soil Spectroscopy for the

Soil spectral analysis estimates soil properties using light absorbance measurements calibrated to conventional reference measurements, like wet chemistry soil tests. There's global recognition that soil health is critically important for improving food production, understanding climate change and prescribing solutions, but access to high quality soil testing is limited

in many countries. Access to a high-quality spectral calibration library will improve evidence-based decision-making in many fields, including sustainable soil management, food security and nutrition, and climate adaptation and mitigation.

"Machine learning is critical for this analysis because its algorithms can efficiently find patterns in this large and complex dataset, thus extracting the most possible information out of the infrared spectra," said Sanderman.

Soil Spectroscopy for the Global Good will provide a globally applicable spectral library and predictive capability. Scientists will build out a global reference database, apply new statistical modeling techniques, and, importantly, develop a simple web-based end-user interface. That will allow a range of stakeholders, including farmers, soil analysis laboratories, government agencies, to tap into a huge soil data collection that uses machine learning to estimate a range of soil properties critical to agronomic management. Users will only need relatively-cheap soil spectroscopy

equipment and an internet connection to get results that previously would've required multiple expensive tests that take days to complete.

Soil Spectroscopy for the Global Good will collaborate with other international working groups, like the Global Soil Partnership GLOSOLAN spectroscopy working group, part of the United Nations' Food and Agriculture Organization (FAO) and the IEEE spectroscopy standards working group, to fulfill this vision. The team's goal is to have a functioning platform within two years.

The USDA NIFA funding comes from its Food and Agriculture Cyberinformatics Tools (FACT) program.



Global Good project, an effort to greatly increase the availability of high quality data and analysis tools to help farmers optimize their soil management strategies.

"Soil Spectroscopy for the Global Good is an effort to bring soils into the big data era, with potentially huge benefits for food production, public health, and climate science," said Woodwell scientist Dr. Jonathan Sanderman. "By automating the data analysis and making the entire system free and openly available, we can make this accessible to a global audience and do a world of good with it."

Above: soil samples ready for carbon analysis

Study highlights climate mitigation potential of natural forest regrowth

by Miles Grant

Director of Publications & Media Relations



Allowing forests to grow back has much greater carbon storage potential than previously recognized, according to a landmark new study by a team of researchers including Woodwell Climate Research Center scientists Drs. Richard Houghton and Wayne Walker. The study, which maps potential aboveground carbon accumulation rates for forest regrowth across the globe, concludes that natural forest regrowth should be regarded alongside other measures like large-scale tree-planting as a critical nature-based approach to mitigating climate change.

Published in the journal *Nature*, the work synthesizes results from 256 previous studies (selected from a review of over 11,000 studies) and contains more than 13,000 measurements from locations worldwide. The result is a first-of-its-kind, global, 1km resolution map that highlights areas with the greatest carbon returns from the first 30 years of natural forest growth.

“While there has been much in the news recently about how management actions—like initiatives to plant a trillion trees—could be employed to reduce the accumulation of carbon in the

atmosphere through increased storage on land, this paper points to the significant role that Mother Nature has to play in mitigating climate change if we simply allow forests to regrow on their own,” said Dr. Walker, Woodwell’s Carbon Program Director.

The study finds that default rates of carbon accumulation from the IPCC may underestimate rates attributable to natural forest regrowth by 32% on average. It also highlights how potential carbon accumulation rates vary widely—up to 100-fold—based on factors like climate, soil, and slope. The analysis provides a much-needed benchmark for assessing the potential of forest regrowth as a climate mitigation strategy, alongside essential actions like the decarbonization

“Among the pathways currently considered for natural climate solutions, natural forest regeneration (or reforestation) is comparable in terms of carbon emissions to avoiding deforestation (or conservation). Natural regeneration is also lower in cost than planting trees and has the potential to help rebuild natural biodiversity,” said Dr. Houghton.

Amazon stakeholders share perspectives at Climate Week NYC

by Anabelle Johnston

Communications Intern

Amazon forests play a critical role in sustaining life on Earth; they produce essential water vapor, host an immense diversity of plant, animal, and insect species, and act as a major natural carbon sink. Any viable solution to global climate change requires conservation of the Amazon forest.

Deforestation occurs across the entire region, but to differing extents and for different reasons. Land in the Amazon can be divided into four broad categories: large farms, small farms, Indigenous territories and protected natural areas, and undesignated lands. Stopping deforestation requires strategies that address the needs of those who inhabit, use, and manage the diverse areas. Additionally, scientists are working to map the ecological, social, and economic potential of undesignated lands to properly advocate for conservation.

In partnership with IPAM Amazônia (Amazon Environmental Research Institute), Woodwell Climate Research Center has developed a plan to increase global food security and well-being while decreasing deforestation. After 25 years of work in the field, Woodwell Climate hosted a Climate Week NYC webinar to underscore the importance of collaborative effort and give a platform to leaders with experience on the ground. The webinar highlighted the specific needs of each stakeholder group while advocating for a common goal.

Michael Coe, Director of Woodwell’s Tropics Program, and IPAM Amazônia Executive Director André Guimarães spoke with Chairman of the Brazilian Agribusiness Association Marcello Brito about the establishment of incentives for large farmers to restore and conserve forests on private property.

Soy farming and cattle ranching are leading drivers of deforestation in the Amazon, and agribusiness is a critical part of Brazil's economic development, noted Brito. But, rather than an adversarial approach, the next step, Brito believes, "is to invest in the [growing] agro-environmentalist sector." Woodwell Climate and IPAM Amazônia are advocating for financial incentives to spur this investment, simultaneously supporting and reforming the industry.

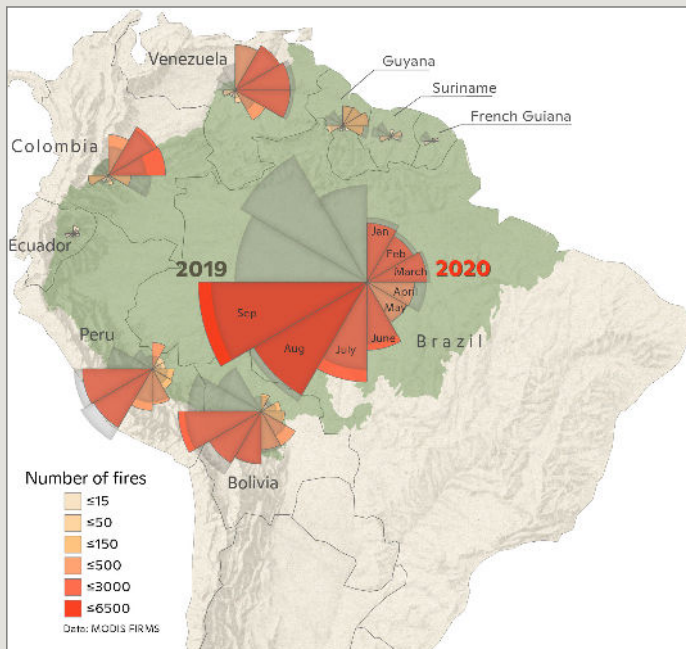
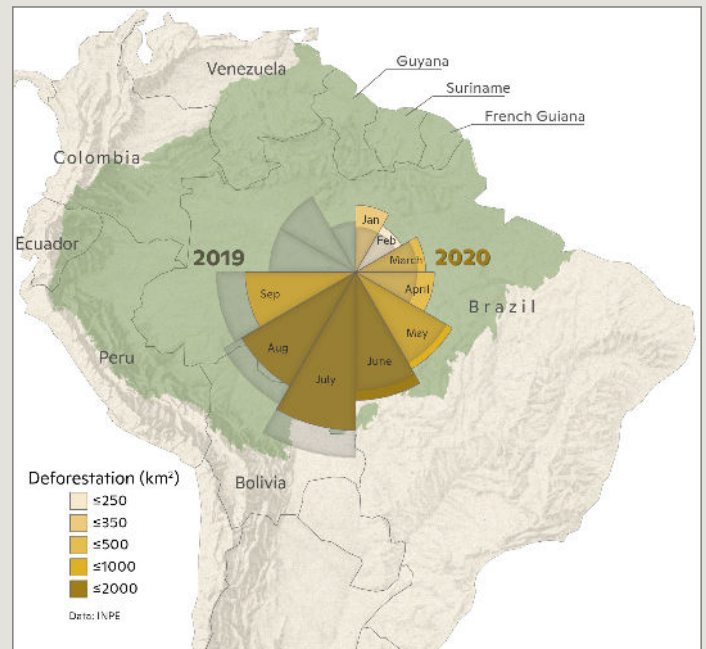
Already, assistance from climate scientists has proven economically advantageous for small farmers, who

have received technological support and guidance to increase both the output and sustainability of their businesses.

"We were working without assistance, and didn't even know where to start, so IPAM brought technical assistance to all farmers in the vicinity of the Trans-Amazon highway," says small farmer and entrepreneur Felisbela Maria Costa Santos. "With the arrival of IPAM, the region became a big success. IPAM brought renewal, and a new kind of agriculture. They brought financial support, but more than that they brought us the knowledge we have today."

Woodwell Climate and IPAM Amazônia scientists provide technical knowledge and assistance to engage and empower Indigenous communities while quantifying the importance of forest protection to climate stability. Scientists support sustained action against climate change spearheaded by organizations such as Associação Kanindé, an association that supports the Indigenous communities in Rondonia state, Brazil. Across the Amazon, illegal invasions have led to forest degradation and burning within Indigenous Territories.

Continued on next page



Amazon Deforestation and Fire Outlook

Amazon forests absorb and store roughly a tenth of human carbon dioxide emissions each year, but this critical carbon sink is threatened by deforestation and degradation of forest health. Deforestation in the Brazilian Amazon declined by 70% between 2004 and 2014. In recent years, however, deforestation has increased and fires have followed as people burn the trees they've recently cut down.

In 2019, deforestation jumped to the greatest rates in over a decade and fires did also, despite it being a relatively wet year. In 2020, deforestation has dropped to somewhat less than last year's extent, but is still above average, and fires are up over this time last year. In addition, it is an extraordinarily dry year for much of the eastern Amazon, which could cause large and long-lasting fires if they escape into standing forests.

Building on the deforestation and fire data released regularly by Brazilian

government scientists, we present an analysis of the carbon footprint of this year's deforestation as well as where deforestation is happening and an analysis of the current climate conditions—key information for identifying fire risk hotspots and shaping solutions.

LEARN MORE

For additional analysis and maps visit [woodwellclimate.org/amazon](https://www.woodwellclimate.org/amazon)

Walela Suruí, a law student and Indigenous activist of the Paiter Suruí people, spoke to the audience of the Climate Week NYC event to urge public action. “We have been fighting this fight for 500 years. We will not stop now. We will not give up now. Our hope is that more people will join us in the fight. That they understand the importance of standing forests. That they understand the importance of protecting the rights of Indigenous people—and Indigenous people themselves. So I want to take the opportunity to ask those of you watching to join with these communities—not only Indigenous people but all communities who fight for standing forests, and who understand its importance to people that live there and to the world.”

Why has no new record-minimum Arctic sea ice extent occurred since September 2012?

by Miles Grant

Director of Publications & Media Relations



Arctic sea-ice extent has flirted with a new record summer minimum every year since the smallest coverage occurred in September 2012, but nearly every summer the pace of retreat abruptly ceased. A new study finds a large-scale

shift in weather patterns that may explain not only this behavior, but that is also connected with extreme summer heatwaves in Eurasia and North America.

One of the clearest indicators of human-caused climate change is the rapid decline in Arctic sea ice. In only 40 years, half of the summer coverage has vanished. Four records were broken since 2000, the most recent in September 2012, and no new records have been set since.

“Ever since the record-smashing summer of 2012, Arctic scientists have watched melt seasons unfold with bated breath: will this year break the record again? Will this year bring the long-anticipated sea-ice-free summer?” said Dr. Jennifer Francis, Woodwell Climate Research Center senior scientist and lead author of the study. “And almost every August, the rate of ice loss came to a screeching halt, averting a new record minimum. But why?”

Francis and co-author Bingyi Wu found clues: an abrupt atmospheric shift occurred during August/early-September that brought low sea-level pressure, cloudiness, unfavorable wind conditions for ice reduction, and reduced heat exchange between the Arctic and areas farther south.

“We also noticed a coincident increase in extreme summer weather events—especially heatwaves—in Eurasia and North America during the summers when ice loss slowed abruptly,” said Francis. “Could they be connected?”

They investigated a possible mechanism linking these unusual behaviors with the rapidly diminishing spring snow cover in northern Eurasia and North America through its effects on the wind patterns around the northern hemisphere.

“Accumulating greenhouse gases affect the Earth’s climate in sometimes unforeseen, counter-intuitive ways. We must do everything in our power to reduce emissions of greenhouse gases, accelerate efforts to remove carbon from the atmosphere, and prepare for more surprises ahead,” Francis said.

Fuels, not fire weather, control carbon emissions from boreal forest fires

by Miles Grant

Director of Publications & Media Relations



The amount of available fuel is the biggest predictor of how much carbon will combust in boreal forest fires, according to the surprising findings of a new study published in *Nature Climate Change* by a team of researchers that included Woodwell Climate Research Center scientist Dr. Brendan Rogers. Fire weather—such as drought conditions, temperature, or rain—and the time of year a fire burns have traditionally been considered the leading indicators of carbon combustion, but researchers found the carbon stored below-ground in soil organic matter was the most important predictor of how much carbon a fire will release.

“These data show that two fires of the same size can have very different carbon emissions. Boreal forests are anything but homogeneous, and available fuels have a huge influence. It’s an important advancement for our ability to understand and predict how intensifying boreal fire regimes impact the global carbon cycle and influence carbon budgets,” said Dr. Rogers.

The team surveyed the vast Western Boreal’s diverse forest conditions by analyzing field data collected from 417 burn sites in six eco-regions in Canada and Alaska between 2004-2015. They measured the carbon released from

Above: Dr. Brendan Rogers collecting samples from a burned boreal forest.

each site, and examined available fire weather data from the time of the fires. The vegetation patterns they uncovered were complex—soil moisture, tree species composition, and stand age at the time of fire all interacted to predict combustion amounts. For instance, highly flammable black spruce was generally a strong predictor of carbon emissions, and black spruce tended to occupy poorly drained and older forests. Weather patterns preceding and during the fire, however, did not offer much explanatory power.

“In these northern forests, soil, not trees, can account for up to 90 percent of carbon emissions, so we expected that these organic soils would be a significant driver,” said lead author Xanthe Walker

of the Center for Ecosystem Science and Society at Northern Arizona University. “But we were surprised that fire weather and the time of year a fire starts proved to be poor indicators of carbon combustion. It’s really about the fuels that are there when a fire starts.”

“That said, we know that fire weather is still a major determinant of when and where fires burn, as evidenced by this past summer’s record fire season in Siberia. It’s one of the reasons we’re so concerned about rapidly increasing temperatures in these high latitude ecosystems,” said Dr. Rogers. “A major next step is to predict how fires will interact with warming to change forest composition, as well as to better

understand how and where fires lead to long-term permafrost degradation. We also hope to use this information to create carbon vulnerability maps for fire managers that could help them prioritize lands for carbon protection.”

This work was supported by funding from the NASA Arctic Boreal and Vulnerability Experiment (ABOVE), the National Science Foundation RAPID program and Bonanza Creek LTER, the Natural Sciences and Engineering Research Council of Canada, the Government of the Northwest Territories Cumulative Impacts Monitoring Program; Polar Knowledge Canada’s Northern Science Training Program; and Vidi grant support from the Netherlands Organization for Scientific Research (NWO).

In the news: highlights

ONGOING WILDFIRE COVERAGE

We Know How to Stop the Fires. *New York Times* op-ed by Marcia Macedo and Valéria Paye Pereira of the Kaxuyana people, a policy expert and activist based in Brazil, October 2

What Made This a Record Fire Season? It Started With Lightning. *New York Times* quotes Phil Duffy, October 2

How climate change affects wildfires, like those in the West, and makes them worse. *ABC News Radio* interview with Phil Duffy, September 30

The jet stream is bringing fire weather to the West and a chill to the East. *National Geographic* quotes Jennifer Francis, September 29

We know climate change set the conditions for Oregon fires. Did it stoke the flames too? Oregon Public Broadcasting interviews Jennifer Francis, September 21

Climate change hits the poor hardest. Here’s how to protect them. In the *World Economic Forum* blog, McKinsey Global Institute post mentions Woodwell’s role in their research. October 14

A Farewell To Ice Fishing? Climate Change Leads To Less Lake Ice. WBUR quotes Max Holmes. October 8

Takeaways from the Arctic Tundra. In the *Arctic Institute* blog, Anneka Williams post mentions her work with The Polaris Project, October 6

Forest degradation outpaces deforestation in the Brazilian Amazon: Study. *Mongabay* quotes Wayne Walker. October 5

From bearberry to vinca, make groundcovers your friend. *Portland Press Herald* (Maine) mentions our partnership with the Native Plant Trust on the Yard Futures Project, October 5

Permafrost, A Time Capsule from the Ice Age, Is Thawing. Connecticut Public Radio interview with Sue Natali, October 2

Fierce rainstorm strikes Charleston, a reminder of how climate change has amped up weather. Charleston Post & Courier (SC) quotes Jennifer Francis, September 25

Why slow-moving storms like Beta are especially dangerous. *ABC News* quotes Phil Duffy, September 22

Colossal crater found in Siberia. What made it? *National Geographic* quotes Sue Natali, September 23

The Warming Climates of the Arctic and the Tropics Squeeze the Mid-latitudes, Where Most People Live. *InsideClimate News* features Jennifer Francis, September 23

Warming shrinks Arctic Ocean ice to 2nd lowest on record. *Associated Press* quotes Jennifer Francis, September 23

Arctic Sea ice melts to a second-place finish at annual minimum. *Mongabay* quotes Jennifer Francis, September 22

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