



**Woodwell
Climate
Research
Center**



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Month in Review • June 2022
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Announcing new leadership to advance innovative climate science and policy initiatives

Dr. Max Holmes promoted to President and CEO; Dr. Phil Duffy to assume strategic leadership role upon completion of assignment in WHOSTP.

Heather Goldstone Chief Communications Officer

Woodwell Climate Research Center announced this month that Dr. Robert Max Holmes has been promoted to President and Chief Executive Officer, effective immediately. Dr. Holmes succeeds Dr. Philip Duffy, who has been asked to extend his assignment as Climate Science Advisor to the White House Office of Science and Technology Policy (OSTP).

“This is a win-win for Woodwell Climate Research Center and for climate progress writ large. This transition provides the strong, stable leadership Woodwell Climate needs during a period of growth and opportunity, as well as the deep policy engagement that advances our mission. We offer both Max and Phil our congratulations and full support,” said Dr. C. Gail Greenwald, Chair of the Woodwell Board of Directors.

Dr. Holmes joined Woodwell Climate in 2005. He has led several large river research networks, including Arctic Great Rivers Observatory, Global Rivers Observatory, Cape Cod Rivers Observatory, and most recently, Science on the Fly. He served as Deputy Director for five years prior to taking on the role of Acting President and Executive Director last August, when Dr. Duffy was invited to join the Biden administration’s climate policy efforts. Over the past ten months, he has led the Center through the most dramatic growth in its history, as well as the continuing challenges of COVID, and the transition to a long-term hybrid organization.



“I’m thrilled to be at the helm of this remarkable organization at this important moment,” said Dr. Holmes. “The urgency of addressing climate change has never been greater. We look forward to Phil’s return to Woodwell, but the nation and the world are incredibly fortunate to have him in the White House.”

Dr. Duffy was named Climate Science Advisor to the White House Office of Science and Technology Policy’s Climate and Environment Division in August, 2021. He is currently spearheading a portfolio of federal climate policy initiatives, and has been asked to remain at OSTP and take on the leadership of several critical priorities. He will assume a special strategic leadership role upon his return to Woodwell Climate.

“I am happy to have been offered the opportunity to continue to serve in Washington, and it is gratifying to see Woodwell continue to grow and thrive,” said Dr. Duffy.

Dr. Duffy’s assignment marks the second time Woodwell Climate’s leadership has been tapped by the White House for climate science guidance. Dr. John Holdren was president and executive director of the Center prior to becoming President Obama’s Chief Science and Technology Advisor and the Senate-confirmed Director of the White House Office of Science and Technology Policy. In 2017, he returned to serve as a Senior Advisor to the President of Woodwell Climate.

Tropical forests holding back 1 degree of warming

A study breaks down the mechanisms that make forests so valuable in combating climate change

Sarah Ruiz Science Writer

Forests are one of our best natural climate solutions for combating increasing global temperatures. A study from researchers at the University of Virginia and Woodwell Climate Research Center found that avoiding tropical deforestation could prevent more than 1 degree Celsius of atmospheric warming.

About 75% of that temperature change comes from the release of carbon stored in the large old growth forests. But there

is another 25% that comes from changes in the biophysical properties of forests.

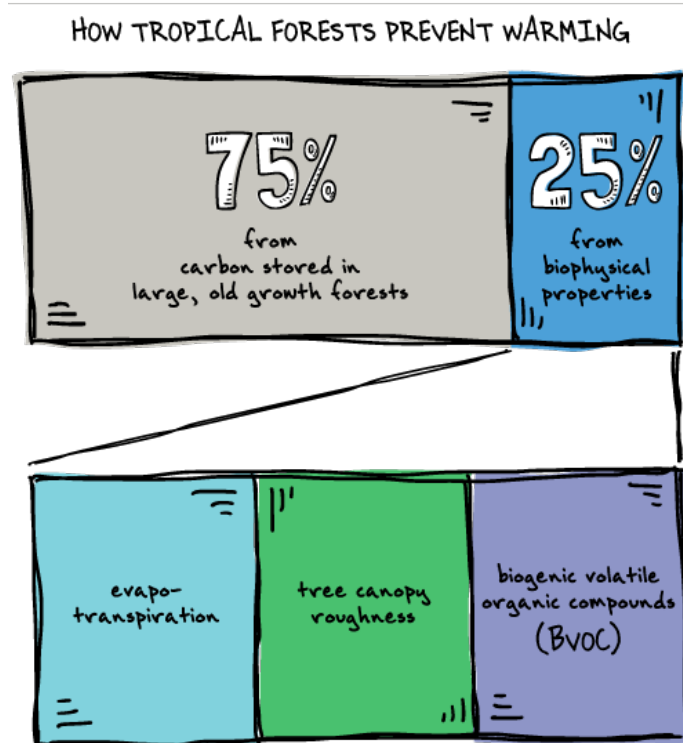
One important biophysical property is *evapotranspiration*. Through photosynthesis, plants release water vapor into the air that contributes to cooling near the ground and cloud formation higher in the atmosphere that reduces incoming solar radiation.

A second biophysical property is the *roughness of the tree canopy*, which disrupts air flow above the forest. The more uneven the canopy, the more turbulent the air, which disperses heat away from the surface. In the tropics, evapotranspiration and canopy roughness are high, which means that surface temperatures remain relatively low and dispersed throughout a deep atmosphere.

The picture gets more complicated when you factor in compounds called *biogenic volatile organic compounds (BVOC)* that forests naturally produce. These compounds can either contribute to cooling by encouraging the formation of clouds, or to warming by creating ozone and methane. In the tropics, the net effect of BVOCs is cooling.

Outside of the tropics, different biophysical effects dominate. In the Arctic, the ability of different surfaces to reflect energy plays a large role in regional cooling. Features like snow cover can dramatically impact the amount of reflection.

The study shows that protecting forests is vital to combating climate change. Forests are not only key to storing and sequestering carbon, but also to regional adaptation as temperatures rise. Their innate properties keep us cool.



New global study identifies opportunities for increasing carbon storage on land to mitigate climate change

A first-of-its-kind dataset offers a framework for climate-smart restoration and land management

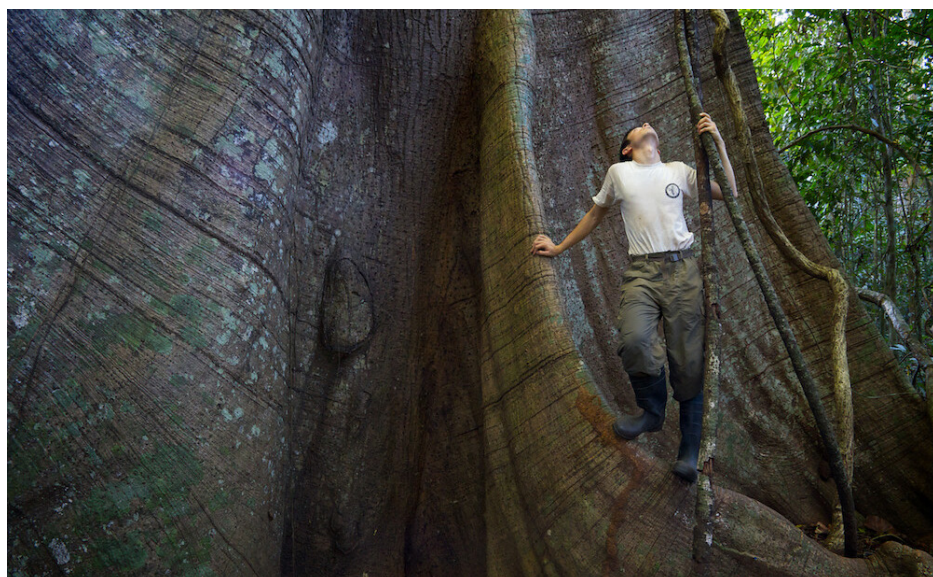
Sarah Ruiz Science Writer

A recent study, published in *Proceedings of the National Academy of Sciences* (PNAS), has quantified the unrealized potential of land-based carbon storage. A series of maps shows that both plants and soils have the potential to store 287 billion metric tons more across the globe—more than the current annual emissions of the European Union.

“From forests to soils, terrestrial ecosystems store enormous amounts of carbon globally, and are capable of storing even more,” said Dr. Wayne Walker, Carbon Program Director at Woodwell Climate Research Center and study lead author. “But realizing the untapped potential of land to aid in addressing the climate crisis means understanding how much storage space is available, where in the world that space is located, and what actions can be taken in those places to take advantage of the opportunity they offer as rapidly as possible. This study provides the data and conceptual framework for doing that.”

These findings reveal the significant potential for expanding land-based carbon capture globally through protection, restoration, and improved management of forests and other woody systems. Improved management of existing forests alone may offer more than 75% of the untapped potential, with the vast majority (71%) of it concentrated in tropical ecosystems.

“Forest stewardship represents the greatest opportunity for realizing carbon removal and storage in the near term,



and the urgency of the climate crisis demands that we prioritize these efforts,” said Peter Ellis, Director of Natural Climate Solutions Science at The Nature Conservancy and study co-author. “Our research shows that after safeguarding lands required for food production and human habitation, improved management of forests and other woody systems—particularly degraded forests across the global tropics—offers tremendous climate mitigation potential.”

The study is timely, coming on the heels of the Intergovernmental Panel on Climate Change (IPCC)’s Working Group III’s latest report, which focuses on the urgent need to reduce carbon emissions in order to limit future warming, and highlights the significant mitigation potential of natural and managed ecosystems given the opportunity they

offer to remove additional carbon from the atmosphere. While study results point to the significant opportunity that land offers as a natural climate solution based on what we know now, this work cannot stop there. Future research should build off these findings to support development of policies that take full advantage of the available land-based carbon sink.

“We anticipate these findings will prove valuable for many countries, since natural climate solutions figure heavily in delivering Paris Agreement commitments in most countries. However, these results must be combined with a range of other information to prioritize and effectively implement natural climate solutions,” said Bronson Griscom, Senior Director of Natural Climate Solutions at Conservation International.

Floodwaters are coming for Chelsea, MA. The city is meeting them head on.

Climate risk assessment from Woodwell is helping Chelsea shape its infrastructure and plan for a wetter future

Sarah Ruiz Science Writer

The city of Chelsea, Massachusetts persevered through the American Revolution and two great fires. Now its resilience is being tested by climate change, as rising sea levels and more intense storms have begun sending frequent flood waters into the city.

Woodwell Climate Research Center recently conducted a thorough analysis of flood risk in Chelsea, identifying where flooding is likely to increase with climate change. The picture it paints is one where the city's most vulnerable citizens get hit the hardest.

Located north of Boston where Chelsea Creek merges into the Mystic River and the Boston Harbor, Chelsea is vulnerable to two forms of flooding—storm surge from the harbor and extreme rainfall events. Currently, 15% of the city falls within an area of potential flooding. That number will more than double to 34% by 2081.

The return interval of high intensity flooding events will also increase. Scientists use the term “1-in-100 year events” to refer to the kind of large-scale flooding that has a 1% chance of occurring each year. Woodwell calculated that today's 1-in-100 year rainfall events could become three times as likely by mid-century, and 1-in-100 year storm surge events could be annual occurrences by 2081. That would be like the city of Chelsea experiencing flooding proportional to Hurricane Sandy every year.

Heavy industry, low incomes, high risk

Chelsea was settled on a salt marsh punctuated by five hills. The city was developed from the high ground down, and much of the marsh and wetlands around Island End and Chelsea Creek were filled in over the city's history. These low lying areas form the city's vulnerable floodplain.

According to Woodwell's analysis, that floodplain contains much of the city's vital industry. Two oil terminals sit on Chelsea's waterfront—the Chelsea Sandwich and Gulf Oil terminals. Here, petroleum, natural gas, and other petrochemicals are stored before being transported to their final destinations. The southeastern waterfront is also a designated port area for commercial shipping.

“Our waterfront has been industrial for 200 years and will continue to be industrial. But we're very concerned that industry and flooding aren't compatible,” says Karl Allen, a planner in Chelsea's Department of Housing and Community Development who worked with Woodwell on the analysis.

Affordable housing is also at risk. Much of the city's affordable housing was built in the 50's and 60's in the lowest-lying areas of the city, where marshes were filled in to create land for their construction. These communities are already familiar with bearing the burden of environmental damages—a rail line bisects the city through a designated environmental justice corridor. At only a few feet above sea level, the rail line serves as a major inundation pathway. Without adaptation measures, climate change will hit these lower income areas hardest.

Climate-proofing Chelsea

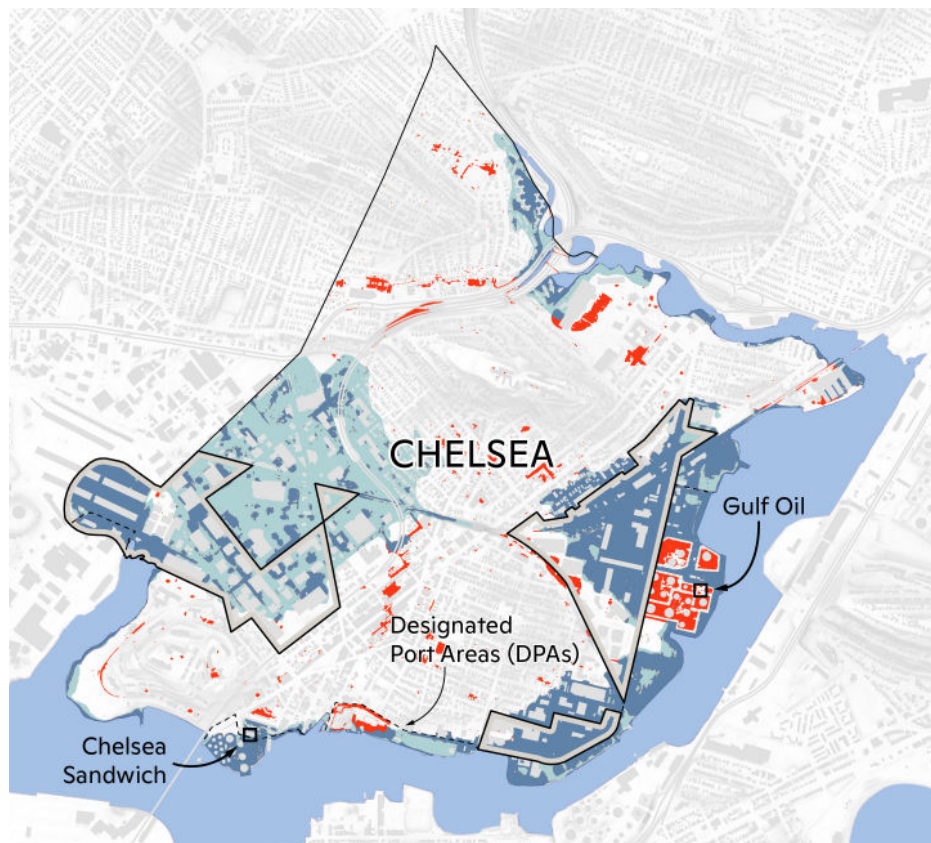
“I can say that the one thing that's been very common for municipal and state agencies is a sense of moving goalposts,” says John Walkey, the Director of Waterfront and Climate Justice Initiatives for GreenRoots. GreenRoots



Left: Giant tropical kapok tree. / photo by Benjamin Blonder (University of Arizona) (CC BY 2.0)

Above: Storm drain height measurements are taken with a laser by Dominick Dusseau to incorporate into flood risk models. / photo by Dominick Dusseau

Woodwell and FEMA flood modeling



is a community organization dedicated to improving urban environmental and public health in Chelsea. Walkey and Greenroots facilitated the collaboration between Woodwell and the city.

“We are now at the stage where climate processes are moving faster than our bureaucracy can,” said Walkey. That could have been a paralyzing realization, especially backed up with analysis results outlining the intensity of increased flooding. Instead, the City’s planning leaders have decided to confront the floodwaters head on, using the analysis to change the way they think about implementing routine infrastructure updates.

Of course, water doesn’t care where one municipality begins or ends; it will flow into any accessible space. The success of Chelsea’s adaptation measures will depend on collaboration with nearby localities—Everett, Revere, Boston. For example, there are plans in the works to construct a flood defense between Chelsea and nearby Everett that sits across the Island End River. Both cities hope this landscaped wall will protect the area from major flooding until at least 2070.

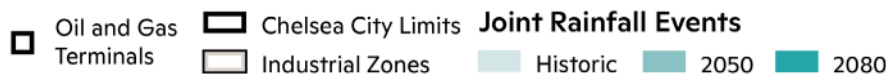
Having a thorough flood risk analysis also puts the city in a good position to lobby for adaptation on a larger scale. In mid-April, Woodwell and Chelsea hosted a briefing for the offices of Massachusetts Senators Ed Markey and Elizabeth Warren and Congresswoman Ayanna Pressley on the results of the flood analysis and the regional security issue it represents.

“Chelsea is facing a severe threat from climate change over the course of the next 50 years,” said Chelsea City Manager, Tom Ambrosino during the briefing. “So we are working hard to try to be prepared for it. But a lot of these projects are beyond our immediate capability.”

Chelsea is one city of hundreds

There are hundreds of Chelseas across the United States facing similar, and

Joint rainfall and storm surge 100-year flood extent



increasingly urgent, threats from flooding, drought, heat, or extreme weather. Many communities are scrambling to adapt as disasters hit, without knowing how much more change is on the horizon. Replicating climate risk analyses like the one in Chelsea could help them get a more specific picture of what they are facing.

“When you tell people well, ‘you’ve got to design for conditions in 2070’, they say ‘what does that mean? What kind of storm are we designing for?’” says Allen. “This analysis has given us a better understanding of what kind of disasters we’ll be looking at, and with what frequency, so we have a design target.”

Risk analyses are invaluable to a municipality’s ability to plan for the shifting goalposts of climate change. Yet the availability of these analyses is uneven. Cities with more resources are able to pay private companies for risk assessments, while non-profits like Woodwell work to fill in the gaps. The Center has already partnered with 14 communities in the U.S. and abroad to produce tailored analyses. But there are nearly 20 thousand municipalities in the U.S. alone. Each will experience their own unique version of climate change.

“It really highlights the need for a national climate service,” said Woodwell Research Associate Dominick Dusseau who worked on the analysis for Chelsea, “something that can provide a nationwide standard service, rather than a piecemeal thing.”

Woodwell’s analysis is a prototypical version of what could be possible with more uniform risk assessment services, as well as a model of successful community engagement. Woodwell will continue to grow its partnerships with individual cities, but the scope of climate change will require a larger, more coordinated response.

“We’re doing a lot, there’s just so much more to do,” says Dusseau.



Strengthening policies for standardized climate risk disclosure

Woodwell comments on the SEC’s proposed rule, “Enhancement and Standardization of Climate-Related Disclosures for Investors”

The following was provided to Vanessa A. Countryman, Secretary of the United States Securities and Exchange Commission, on June 17, 2022.

Thank you for this opportunity to comment on the rulemaking on climate risk disclosures for issuers of public securities.

The Woodwell Climate Research Center is a scientific research organization that works with a worldwide network of partners to understand and combat climate change. We bring together hands-on research experience, and 37 years of policy impact to find societal-scale solutions that can be put into immediate action by policymakers and decision makers. Scientists from Woodwell work in more than 20 countries on six continents, collaborating with a wide range of partners, including national, subnational and local governments, nonprofit organizations, universities, and private sector companies in the investment, financial, banking, and agricultural sectors. Woodwell’s Risk Program models climate change hazards and related socioeconomic impacts to help develop a more resilient economy and society.

Woodwell commends the SEC for addressing the full scope of climate risk-including transition risks as well as Scopes 1, 2, and 3 emissions. Woodwell’s research in this area, however, is primarily on physical climate risk and our comments will focus specifically on that.

We believe that this draft rule represents a strong step in the right direction, toward greater investor awareness of material risks posed by climate change

driven hazards. There are several areas in which we believe the proposal could be strengthened further.

A standardized approach for physical climate risk assessments

Woodwell supports the proposal to require registrants to include climate-related disclosures under Regulations S-K and S-X, and to require the disclosure of physical climate risks, including “harm to businesses and their assets arising from acute climate-related disasters such as wildfires, hurricanes, tornadoes, floods, and heatwaves.”

The SEC notes that “various software tools and ... climate consulting firms are available to assist registrants” in assessing their physical climate risk. The proposal lacks, however, standardized guidelines for these assessments (e.g. require certain methodologies to be followed such as scenarios, types of flooding, or which return periods to use). Without this structure, some of the above-mentioned climate-consulting firms will provide results that registrants want to hear, instead of results that investors need to make informed decisions. Indeed, in the current marketplace some climate-consulting firms have overpromised potential clients detailed results that are beyond what climate models can realistically provide.

Define flood hazard areas, but not with FEMA maps

To provide robust insight into the risk of climate change driven flooding, the SEC should require registrants to define a flood hazard area. Without guidance on this question, there is a possibility that a registrant uses a standard that underestimates climate change-driven flood risk.

The SEC should not, however, rely on FEMA defined flood maps. FEMA does not include future climate risk so it does not make sense to use a FEMA standard that does not match the definition of climate-related risk.

FEMA maps do not even fully capture the present flood risk. 75 percent of FEMA’s Flood Insurance Rate Maps are more than 5 years old, and 11 percent have not been updated since the 1970s or 1980s. This means that many current flood maps are based on a past climatology, not even the present one. FEMA also does not model stormwater systems which is a huge omission of risk in urban spaces.

Additionally, flooding often occurs outside of flood hazard boundaries set by FEMA. During Hurricane Harvey, which hit Houston in 2017, 75 percent of damaged residential buildings were outside of the 100-year FEMA flood extent and 50 percent of damaged residential buildings were outside the 500-year FEMA flood extent. During Hurricane Sandy in 2012 which hit New York City, 50 percent of the buildings damaged were not in FEMA flood zones.

Disclosure of the maps and software tools that were used is also important. Each tool has its own benefits and drawbacks and anybody relying upon the registrant’s assessment of climate risk should be able to take into account the tools that were used.

Require Address-Level Location Data

The SEC asks whether registrants should provide location data at the zip code level. We believe that for effective physical climate risk assessment, address data should be provided for locations with a material climate risk. This is especially true for climate change driven flood risk, where two addresses on the same street might have different risk exposure. In that situation, zip code level data would be effectively useless.

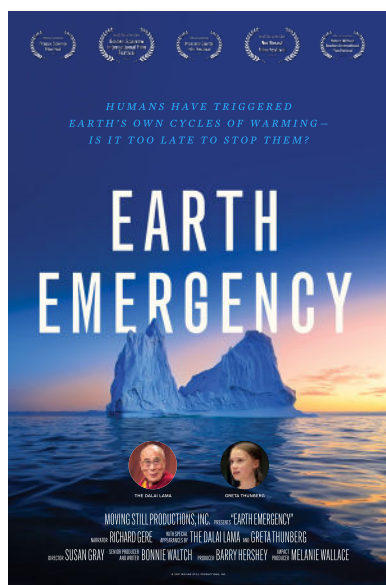
Proposed Time Horizons

In the interest of standardization and cross-comparability of risk assessments, time horizons must be consistent for all registrants. The topology of “short,” “medium,” and “long term,” with time horizons of 1 year, 10 years, and 30

years respectively, is apposite. These horizons are well-aligned with scientific best practices: seasonal to long-term weather forecasts are already routinely performed by state and federal agencies and match the one-year horizon, the continued emergence of decadal scale climate model simulations as a robust predictive tool matches the ten-year horizon, and the baseline definition of what constitutes climate (time-averaged weather over 30 years) matches the 30-year horizon. Unambiguous definitions are foundational here. A scenario where registrants from the same economic sector use varying time horizons for “short term” would preclude an honest comparison and degrade investors’ ability to assess risk. This must be avoided.

In addition to risk horizons based on future time periods the SEC should require risk assessments relative to warming levels. Climate policy is fundamentally linked to warming outcomes, the Paris Accord value of 2°C is an example. Today we are already in a 1°C world with a 50 percent chance of breaching 1.5°C over the next 5 years. The differences in climate risk profiles between these warming levels, and relative to even higher warming levels that are highly plausible outcomes by mid-century, are significant. Quantifying these temperature-indexed risk profiles will provide both registrants and investors with a robust knowledge base for investment decisions. As scientific best practice routinely uses warming levels in physical risk assessment, we recommend the SEC, in addition to applying a uniform set of “short,” “medium,” and “long term” time horizons, mandate risk assessments for the current warming level and the two next higher levels. As of today, this means using warming levels of 1°C, 1.5°C, and 2°C.

We deeply appreciate the SEC’s leadership in pushing the issue of climate risk disclosure forward.



Earth Emergency screening in Woods Hole

Woodwell Climate presents a free screening of *Earth Emergency* at MBL's Cornelia Clapp Auditorium in Woods Hole, MA, on July 27 at 6 pm EDT. The film will be followed by a panel discussion with Dr. Max Holmes, Woodwell President and CEO, Dr. Jen Francis, Acting Deputy Director and Senior Scientist, Dr. Marcia Macedo, Water Program Director, and another scientist TBA.

While climate change is now a broadly recognized phenomenon, the environmental feedback loops that are amplifying and accelerating the process are less well understood. *Earth Emergency* explains how warming caused by human activity is setting

in motion Earth's own natural warming mechanisms, releasing additional greenhouse gases into the atmosphere, and further heating up the planet.

Originating from a conversation between Woodwell Distinguished Visiting Scientist Dr. William Moomaw and the producers, *Earth Emergency* features several Woodwell scientists, including founder Dr. George Woodwell, Arctic Program Director Dr. Sue Natali and Past President Dr. Philip Duffy.

WHEN July 27, 6 pm EDT
WHERE Cornelia Clapp Auditorium
 (formerly Lillie Auditorium)
 7 MBL St., Woods Hole, MA

In the news: highlights

EurekAlert!, *Phys.org* and *SciDev.net* quoted Dr. Wayne Walker on the results of a study by multiple Woodwell scientists exploring the potential for carbon storage on land.

Dr. Walker was also quoted in articles on the study from around the world, including *la Repubblica* and *la Repubblica Green and Blue* (Italian), *Scinexx* (German), and *Infobae* (Spanish).

The *NAU Review* mentioned Dr. Brendan Rogers in an article about a newly funded project to better understand reburning of boreal ecosystems.

The Wanderer covered a field trip of Old Hammonctown Elementary students to Cuttyhunk, describing a salt marsh exploration activity led by Kate Armstrong.

An article by Chris Linder on *OutdoorPhotographer.com* about his approach to science photography includes an image of his from a trip to the field with Woodwell scientists.

Dis-leur! referenced recent Woodwell research on forests as a natural climate solution in their article on the Pyrénées Ariégeoises (French).

An article from *The Scientist* covered a study recently published in *Nature Climate Change*, quoting study co-author Dr. Brendan Rogers on the implications of Earth system model results.

Alison Smart and Spencer Glendon were featured on the *My Climate Journey* podcast discussing their climate journeys, what motivated them to work in this space, and what led them to create Probable Futures.

A *Dialogo Chino* article on the soy trade quoted Dr. Ludmila Rattis on how soybeans from different producers get mixed together in the current supply chain.

Dr. Rachael Treharne was quoted on the relative permanence of thawing permafrost in an article from Stockholm University.

This week's "Permafrost Pathways Panel Q&A" event was featured in a panel discussions roundup from the *Boston Globe*.

Yahoo Finance and *Bloomberg News* articles on Wellington's CEO Jean Hynes mentioned Wellington's partnership with Woodwell.

A short article from *Folha da Manhã* highlighted a meeting between Woodwell scientists and the mayor of Alpinópolis in Brazil, who learned about our work from Dr. Ludmila Rattis (Portuguese).

Mongabay covered recent research by Woodwell Climate and Wild Heritage Project scientists and its implications for logging and roads in Tongass National Forest.

SouthCoastTODAY published an article on water sampling in Buttonwood Brook, a 5-year project for which Woodwell provides nutrient analysis of water samples.

Dr. Ludmila Rattis was quoted in an article from *Correio Braziliense* covering a satellite internet program launched by Elon Musk and Brazilian President Jair Bolsonaro, which they say will both connect rural schools and monitor the Amazon (Portuguese).

Dr. Sue Natali was interviewed on WCAI's *The Point* on the impact of Arctic warming.

Amazônia Real published the final two articles—on land use change and the implications for conservation—in a series co-authored by Dr. I Foster Brown on Serra do Divisor National Park in Acre, Brazil (Portuguese).

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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