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Climate
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Month in Review • January 2022
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Chasing fire

A team of scientists drove across Brazil to understand how fire, agriculture, and deforestation interact in three forest ecosystems

Sarah Ruiz, Science Writer

In August, amidst the fire season, a team of scientists from Woodwell Climate Research Center and the Amazon Environmental Research Institute (IPAM) embarked on a trip to Mato Grosso, Brazil to follow state military firefighters as they battled blazes across three different biomes—the Cerrado, Pantanal, and Amazon.

Fires can take many forms in Brazil, some ignited accidentally and some intentionally. Some biomes have evolved with fire disturbance, while others would never see a fire if not for human encroachment. Regardless, out of control fires can pose a danger to human health and livelihoods, biodiversity, and carbon stocks. Brazil's firefighters must use every tool at their disposal to protect people and forests.

Satellite data is one such tool that can help with fire detection and research into fire impacts or trends, but it's not always accessible in a useful form for firefighters. Dr. Manoela Machado, a Postdoctoral Research at Woodwell, organized the joint expedition to gather information on regional firefighting strategies, and how science and data might better support fire brigades.

"We're trying to be the bridge between these very important ends, the satellite detection of active fires and the people fighting fires on the ground," Machado says.

What they found over 10 days of chasing smoke signals, walking across hot coals, negotiating passage across private lands, and dousing flames, was that fighting fires requires grit and strategy, and that suppressing flames before they burn out of control—preventing them before they ignite where possible—is the only way to prevent serious damage.

The Cerrado

The Cerrado, also known as the Brazilian savanna, is a vast wooded grassland that has evolved in conjunction with wildfire. In the wet season, the region is extremely productive, building up biomass in the form of grasses, shrubs, and other plants that become flammable as the dry season moves in. Fires typically stay low to the ground, burning through built up fuels, and allowing fire-adapted species to sprout back up just days after a disturbance.

The team began their journey in the Cerrado at Chapada dos Guimarães, where firefighters were already hard at work trying to tame a fire that was spreading from property to property. It was moving fast and had been hard for the group to locate as they drove around the area, following satellite signals— as well as literal smoke signals— to get their heading.

By the time the team arrived, the day was cooling off, which gave the firefighters an edge over the flames. In the Cerrado, firefighting is like an intense game of chess played out over the landscape, with elements including hills, wind direction, dry creek beds, roads, and downed trees forming the pieces.

"They're interpreting the landscape and interpreting the wind so they know which direction the fire is spreading," Dr. Machado said of the firefighters in Chapada dos Guimarães. "As the night was approaching they were working in a dry river, blowing off the leaves and creating a natural firebreak. Then as the heat diminished, they were monitoring to make sure the firebreak worked."

Although fire in the Cerrado is a natural phenomenon, it is usually sparked by lightning storms much closer to the rainy season. In the middle of the dry season, this fire represents a shift away from the biome's natural regime. Humans are influencing fire regimes both by increasing burn frequency, and by excluding fire completely, which builds up fuel and causes a catastrophic fire when it eventually ignites.

Both conditions can be dangerous to the environment as well as critical infrastructure. The fire in Chapada dos Guimarães had melted irrigation hoses to a nearby orchard and came dangerously close to power lines. Fires spread fast in the dry season and can incur high costs for residents of the region without the quick, strategic thinking of the firefighters.

"Speed and efficiency of firefighters in detecting and reaching an occurrence of fire is crucial," Dr. Machado said. "That's the part we're working closely with them and satellite data providers to improve."

The Pantanal

The team's second destination was the Transpantaneira Road which cuts through the Pantanal wetlands— the world's largest tropical wetland. The landscape is a mosaic of grassland and marsh dotted with islands of forest. From December to March,

the region floods with nutrient-rich sediments. Even in the dry season, the water usually doesn't completely recede.

There are occasional natural fires here. Native grasses grow tall and wild in the rainy season and, together with planted pastures, become fuel during the dry season. When that fuel builds up over seasons and the region experiences a prolonged drought, the fires that spark can be massively destructive. Pantanal fires are made additionally challenging because of the variety of fuels available, and the existence of peat soil which can burn and spread beneath the surface of the ground.

The group from Woodwell and IPAM arrived in the Pantanal just in time for this year's first major fire. Ignited from a backfiring tractor, the flames spread rapidly across dry grass. When they reached patches of forest, they shot all the way up to the crown of the trees, where the wind fanned embers out across the landscape.

The Pantanal experienced a record-breaking year of fires in 2020, and residents and firefighters were worried about seeing history repeat. Here, firefighting also requires working strategically with the landscape to hem in the flames, but the brigade was largely unable to fight the fire directly because of its size and intensity. "A 15 foot flame is impossible to fight using any techniques on the ground," Dr. Machado said.

Instead, they had to monitor the fire's path and shape the landscape to remove fuel and slow it down. Dr. Machado grabbed a heavy 20 liter backpack of water herself, and helped in spraying down scorched earth to cool it enough to walk over—an important step called "rescaldo," done post-combat to make sure flames won't re-ignite.

Being close to such intense flames made clear the destructive force of fire to the team. "You could hear the forest screaming from the green leaves," Dr. Machado said. "It sounded like a broken instrument." IPAM communications analyst Bibiana Garrido recalls watching animals flee the heat and smoke.

"We saw a lot of birds and small insects trying to run. The first day we went to a family farm that was burning and as we stood on the ashes, little animals started walking up our legs trying to get away from the heat."



above left: Fire in the Pantanal. / photo by Illuminati Filmes
above: A local man riding a bicycle near a Cerrado fire. / photo by Illuminati Filmes

The Amazon

“This is the place after hope dies,” Dr. Rattis said after watching fires burn unopposed through the Amazon rainforest. The team had driven north from the Pantanal to Apiacás and the frontier of deforestation in the Amazon.

Here in the rainforest, fires are never natural and almost always set intentionally. Fire is a step in the transition process from forest to agricultural land and is often used by land-grabbers. At its edges, where trees run up against farms and pastureland, the Amazon is degraded and drier. Land grabbers will set fires in the understory to weaken it further to facilitate conversion. After valuable timber is removed, that area is burned again to clear

the land for agriculture. Burning set to clear existing pasture can also sometimes escape into standing rainforest, exacerbating the damage.

The flames here are not the multi-story fires of the Pantanal; the greater danger comes from the people, who actively try to scare fire brigades out of the area. Though land grabbing is illegal, the law is rarely enforced here. The fires were set on purpose, and the culprit made no attempts to hide his actions— even driving up to the fire brigade in an ostentatious yellow truck.

“It’s so serious that firefighters cannot work to kill the fires in some areas,” Dr. Rattis said. “It’s too dangerous.”

In some cases, firefighters only feel safe combating the flames when there is enough media attention on the area to create public outcry. Without that, the firefighters said, they wouldn’t have enough support to oppose the hostile— often armed— land grabbers.

The most effective way to fight fires in the Amazon is to prevent them by removing the pressure to deforest in the first place. Strategies like providing financial incentives and technical support to landowners that don’t deforest, detection and rapid response to deforestation using satellite imagery, and establishing new protected areas have been proven effective at reducing deforestation and could be scaled across the region.

Improved enforcement of existing laws too, could go a long way to getting fire under control. Agencies like the Brazilian Institute of Environment and Natural Resources (IBAMA), the Chico Mendez Institute for Biodiversity Conservation (ICMBio) and military firefighting brigades are largely underfunded in the current administration.

Without strong policies that aim to get out ahead of deforestation, Dr. Machado says reacting to fires as they happen simply won’t be enough.

“The problem with the Amazon fire crisis is not fire detection, it’s not how fast brigades can allocate the teams, it’s not the equipment they have in the trucks, it’s the deforestation process. As long as we have the deforestation process, we are going to have deforestation fires.”



Methane craters documentary highlights rapid Arctic warming

Arctic Sinkholes, a new film from PBS NOVA, features Woodwell's research

by Sarah Ruiz
Science Writer

Tune in to PBS NOVA on February 2 to watch *Arctic Sinkholes*, an original documentary that explores the hidden dynamics of thawing permafrost and the emissions it releases. The documentary features Woodwell Arctic Program Director, Dr. Sue Natali, alongside other prominent climate scientists working to better understand how climate change is impacting the Arctic.

The film centers on the 2014 discovery of methane craters in the Arctic. These features of the landscape are formed as permafrost thaws, and trapped greenhouse gasses expand, pushing the soil up. When the pressure becomes too great, these bubbles of earth can explode suddenly, creating massive craters on the Arctic landscape and releasing a burst of atmosphere-warming gasses.

“There’s a lot of discussion about carbon dioxide and its relationship to climate, but the impact of methane coming out of the Arctic is potentially enormous,” says NOVA Co-Executive Producer Julia Cort. “Making accurate predictions about the future depends on good data, and *Arctic Sinkholes* reveals what scientists have to do to get that data, as they try to measure an invisible, odorless gas that’s underground in some of the most remote and challenging environments in the world.”

To better understand the extent and significance of these craters, Dr. Natali and Woodwell Senior Geospatial Analyst, Greg Fiske, devised a method of mining satellite imagery data for key

characteristics that would indicate a recent explosion. A sudden shift from vegetation to water, for example—often, craters quickly fill up with rain, becoming lakes that obscure their own origins.

Outgassing from the craters themselves represents only a small subset of the larger potential emissions from permafrost thaw. Current estimates show that thawing permafrost could contribute as much to warming this century as continued annual emissions from the United States.

Methane craters make evident the speed at which the Arctic is warming, and the changes permafrost thaw is causing on the landscape. In their research, Dr. Natali and Fiske uncovered other impacts of permafrost thaw—slumping ground, sinkholes, and coastal erosion are destabilizing the ground on which many Arctic communities are built.

“These abrupt changes that are occurring in this once-frozen ground are happening faster than we expected,” said Dr. Natali. “And that is not only going to accelerate warming, but also affect the lives of millions who make their home in the Arctic.”

Future research will work towards more precise estimates of permafrost thaw emissions and a better understanding of the changing Arctic.

Arctic Sinkholes premieres Wednesday, February 2, 2022 at 9pm ET/8C on PBS and will be available for streaming online at pbs.org/nova and on the PBS video app.





Woodwell's Dr. John Holdren to receive NAS Public Welfare Medal

The National Academy of Sciences most prestigious award recognizes “extraordinary use of science for the public good.”

by Heather Goldstone
Chief Communications Officer

The National Academy of Sciences (NAS) announced Wednesday that it will present its 2022 Public Welfare Medal to Dr. John Holdren, president emeritus and senior advisor to the president of Woodwell Climate, in recognition of his long-running service to science, particularly his role as science advisor to former US President Barack Obama. This is the National Academy's most prestigious award, honoring “extraordinary use of science for the public good.” Previous recipients include Dr. Anthony Fauci, Dr. Norman Borlaug, Bill and Melinda Gates, Alan Alda, and Carl Sagan.

Our most heartfelt congratulations to John. It is a well-deserved honor—the latest in a long list. He holds seven honorary doctorates. He was an early recipient of the MacArthur Fellowships in 1981, chaired the executive committee of the Pugwash Conferences on Science and World Affairs and accepted the Nobel Peace Prize on behalf of the group in 1995, sat on the President's Council of Advisors on Science and Technology under President Bill Clinton, and served as president of American Association for the Advancement of Science. He holds the distinction of being the longest-serving

presidential science advisor since World War II. To name only a few highlights.

The National Academy's announcement notes that, as President Obama's science advisor, John “helped coordinate U.S. responses to the H1N1 flu and Ebola outbreaks, the Deepwater Horizon explosion and oil spill, and the Fukushima nuclear disaster.” He was also instrumental in shaping the Obama administration's Climate Action Plan.

John served as President and Executive Director of Woodwell Climate Research Center (then Woods Hole Research Center) prior to joining the Obama administration. He continues to serve as Senior Advisor to the President of Woodwell Climate, is a research professor in Harvard University's Kennedy School of Government, and co-directs the Science, Technology, and Public Policy Program in the School's Belfer Center for Science and International Affairs. The Belfer Center's Arctic Initiative works in close collaboration with Woodwell's Arctic Program to elevate policy issues related to ongoing, rapid Arctic change.

Putting science to work for the greater good is Woodwell Climate's mission, and John exemplifies it. The Public Welfare Medal will be presented on May 1 during the Academy's 159th annual meeting. We will all be celebrating with John in spirit, if not in person.

Seeing the Dangers Ahead

How Regulators and Advocates Can
Harness Physical and Financial Risk
Data to Tackle the Climate Emergency



February 1 • 1-2 PM ET
February 15 • 1-2 PM ET
March 1 • 1-2 PM ET



In the news: highlights

Dr. Sue Natali was quoted in a piece in *The New Yorker* entitled “The Great Siberian Thaw.”

Dr. Jen Francis was quoted in 2021 perspective pieces on extreme weather and climate change in *The Boston Globe* and *El Salto*. She was also interviewed on *CBC’s The Homestretch* about the connection between climate change and a recent cold spell in Calgary.

Dr. Mike Coe was quoted in an *EcoAmericas* article about an EU bill to ban importing goods from newly deforested land.

Dr. Ludmila Rattis was quoted in a *Brasil de Fato* story about unexpected flooding in Pará and its links to climate change (Portuguese).

Dr. Christopher Neill urged against habitat fragmentation in his column published in the *Falmouth Enterprise*, relating findings of Tom Lovejoy’s Biological Dynamics of Forest Fragments Project to recent developments in Falmouth.

Dr. Sue Natali was quoted in a Minneapolis Institute of Art story about her and Dr. John Schade’s collaboration with artist Aaron Dysart for his *Latitude* installation this past winter, which visually represented data from carbon flux towers.

Dr. John Holdren was interviewed on TVOntario’s *The Agenda with Steve Paikin*: A Sleeping Giant: Why Permafrost is a Climate Threat.

Woodwell’s physical risk work was mentioned in the announcement of a new research collaboration between Wellington Management and the MIT Joint Program on the Science and Policy of Global Change (picked up by several outlets, including *MarketScreener* and *ESG News*). That partnership will focus on transition risk.

A “Behind the Paper” story on Nature Portfolio’s Ecology and Evolution Community describes a trip enabled by Joseph Zambo in Mbandaka, and provides the context and significance of the recently published *Nature Communications* article co-authored by Zambo and Dr. Glenn Bush.

Dr. George Woodwell’s influence is mentioned in Yale School of the Environment’s reminiscence of Dr. Tom Lovejoy.



CONGRATULATIONS to Emeritus Director David Hawkins, Director of Climate Policy, Climate & Clean Energy Program at the Natural Resources Defense Council (NRDC), on being elected to the newest class of AAAS Fellows, awarded by the American Association for the Advancement of Science (AAAS) “in recognition of scientifically and socially distinguished achievements.”

Seeing the dangers ahead

How regulators and advocates can harness physical and financial risk data to tackle the climate emergency

Join the State Energy & Environmental Impact Center, Woodwell Climate Research Center, and the Massachusetts Office of the Attorney General for a three-part virtual event series that will provide essential information and tools to help regulators and advocates understand the latest available public and private data about physical, financial, and transition climate risks, how regulators might address key data gaps, and how to harness climate risk data for government decision-making.

Join us for the remaining two virtual Zoom events with high-profile guests.

Part II — Risky Business An Essential Introduction to Climate Financial Risks and the Role of Regulators

FEBRUARY 15, 2022 • 1-2 PM ET

Climate change affects all areas of our economy. Regulators and advocates need to understand the financial risks of climate change—economic impacts that may arise from the physical impacts of climate change and climate change mitigation efforts—and how those risks will affect our communities and the economy. As the world’s central banks have increasingly identified, these risks present systemic threats to the world’s

financial markets. Regulators have a role to play in ensuring that the market has an adequate understanding of these risks. The private sector also has an essential role to play in producing and disclosing data on climate financial risks and companies’ approaches to addressing those risks.

Part III — Toward Equity and Resilience Harnessing Climate Risk Information for Better Decisionmaking

MARCH 1, 2022 • 1-2 PM ET

REGISTER

Learn more and register at:
woodwellclimate.org/seeing-dangers

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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