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Climate
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Month in Review • May 2022
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Woodwell workshop brings Indigenous firefighters to Brasília

A week-long workshop encourages knowledge sharing between Indigenous Brazilian fire brigades

Sarah Ruiz Science Writer

On March 28, 2022, firefighters from Indigenous communities across Brazil gathered in Brasília, the country's capitol, for a week-long geography and cartography workshop. The workshop, a collaboration between the Coordination of Indigenous Organizations of the Brazilian Amazon (COIAB) and the Amazon River Basin (COICA), IPAM Amazônia, and Woodwell Climate Research Center, walked participants through the basics of using Global Information Systems technology to monitor and manage their own lands and forests.

Forests and native vegetation on Indigenous lands have been sustainably managed for millennia, and studies have found Indigenous stewardship of forests is an effective measure for preventing deforestation and degradation. Escaped fires can present a threat to forests, and many Indigenous communities have their own brigades that work on detecting and preventing runaway fires. In some places, prescribed burns are used as a tool for shaping and cultivating the land.

Participants attended from Indigenous lands located in a variety of Brazilian landscapes—from the Cerrado to the heart of the Amazon. Despite differences, participants found learning from other Indigenous communities extremely valuable.

“People came with a variety of skill sets,” said Woodwell Water Program Director Dr. Marcia Macedo. “What was most meaningful for participants was seeing other people like them, who do the same work and are also Indigenous people, already dominating material, knowing how to make the maps, and helping others. It gave them confidence that they could also figure it out.”



After a day of introduction to the core concepts of GIS and mapping, participants headed out to Brasília National Park to test their newfound skills. They visited burned areas from both an escaped fire and a prescribed burn, compared the two, marked GPS points, and took pictures. The data gathered on the field trip was used over the next few days to practice making maps.

“The goal was to not only teach the theory and help them understand the steps for making maps, but also mainly to develop the skills for them to be able to apply to their own lands on their own time,” said Woodwell postdoctoral researcher, Dr. Manoela Machado who helped organize the event.

The workshop also fostered discussions about the complexity of management when fire can be both a threat and a tool. Because fire manifests differently in different biomes, well-managed fires look different for each community.

“On the final day, we had a discussion of values. Is fire good or bad? For whom—ants, forests, human health?” said Dr. Machado. “You can’t just criminalize fire if it’s a part of traditional knowledge and used as a tool for providing food, for example. So it’s a complex issue.”

Dr. Machado hopes the conversations will continue. She says the goal would be to host this workshop again to expand its reach, potentially beyond Brazil to include participants in other Amazonian countries.



Nitrogen retaining soil property protects tropical streams from impacts of agricultural intensification

Sarah Ruiz Science Writer

A recent paper from Woodwell's Tanguro Ranch Research Station has quantified a property locked into Brazil's deep tropical soils that protects streams and rivers from the effects of fertilizer leaching and runoff. The study, led by Dr. Alexandra Huddell, a graduate student at Columbia University at the time of the study and now a postdoctoral fellow at the U.S. Environmental Protection Agency, estimated that, if well managed, Amazonian soils could continue to hold back excess nitrogen from reaching surface waters for many years, allowing for increased crop yields with relatively little impact on the surrounding ecosystem.

In temperate croplands—the midwestern U.S. breadbasket for example—some of the nitrogen in fertilizer that isn't taken up by plants is converted



Quick facts

Some soils in the Amazon rainforest contain deep stores of nitrogen in the form of nitrate (NO_3^-), accumulating at a depth of 6-20 feet. Soil retains the ability to store large amounts of nitrate even after land is converted from forest to agriculture.

A new paper quantified the mechanism, a chemical characteristic of highly weathered clay soils called anion exchange capacity, which captures negatively charged nitrate ions as water passes through the positively charged soil. As a result, very little nitrate seeps into groundwater and surface streams from these soils even when croplands receive nitrogen fertilizer.

If well stewarded, many of Brazil's Amazon croplands have a built-in buffer against water pollution that could potentially last decades. This is crucial for increasing crop production using fertilizer to reduce pressure for new deforestation, without the added consequence of nitrogen pollution of freshwater ecosystems that accompanies increased fertilization on croplands in other parts of the world.

to nitrate. Nitrate moves rapidly through soil and into groundwater, streams, and rivers. Excess nitrate threatens drinking water and causes algal blooms that can lead to low oxygen levels in lakes and coastal waters of oxygen.

But studies of the soils in Tanguro showed a very different dynamic. At Tanguro, the nitrate was sticking to the soil, not moving down towards groundwater and streams. Dr. Huddell's study quantified the mechanism that led to such a stark difference between Tanguro's soils and those of temperate cropland regions.

"We often think about increased agricultural intensification leading to

decreases in local water quality, and this is an interesting case study of why that is not happening as quickly in Brazil," said Dr. Huddell.

The difference is due to a molecular property inherent in the soil called "anion exchange capacity."

Clay soils like the ones under the croplands of Tanguro and much of the Amazon rainforest form over millennia of intense weathering in the hot, wet climate, Huddell explained. Weathering produces minerals that impart positive charges to tiny soil particles. Nitrate, a negatively-charged ion (anion) then adheres to the positively

charged soil. Most temperate zone soils are less weathered and have more negatively charged particles that repel nitrate—allowing it to move quickly to groundwater and streams.

Tanguro's soils extend ten or more meters deep and have a large capacity for binding nitrate. That inherent property of the soil does not change when a forest is converted to agriculture.

"The mineral and structural composition of the soil don't change much during conversion from forest to cropland, so the nitrate-retaining property is still present," Woodwell Senior Scientist and co-author of the study, Dr. Christopher Neill says.

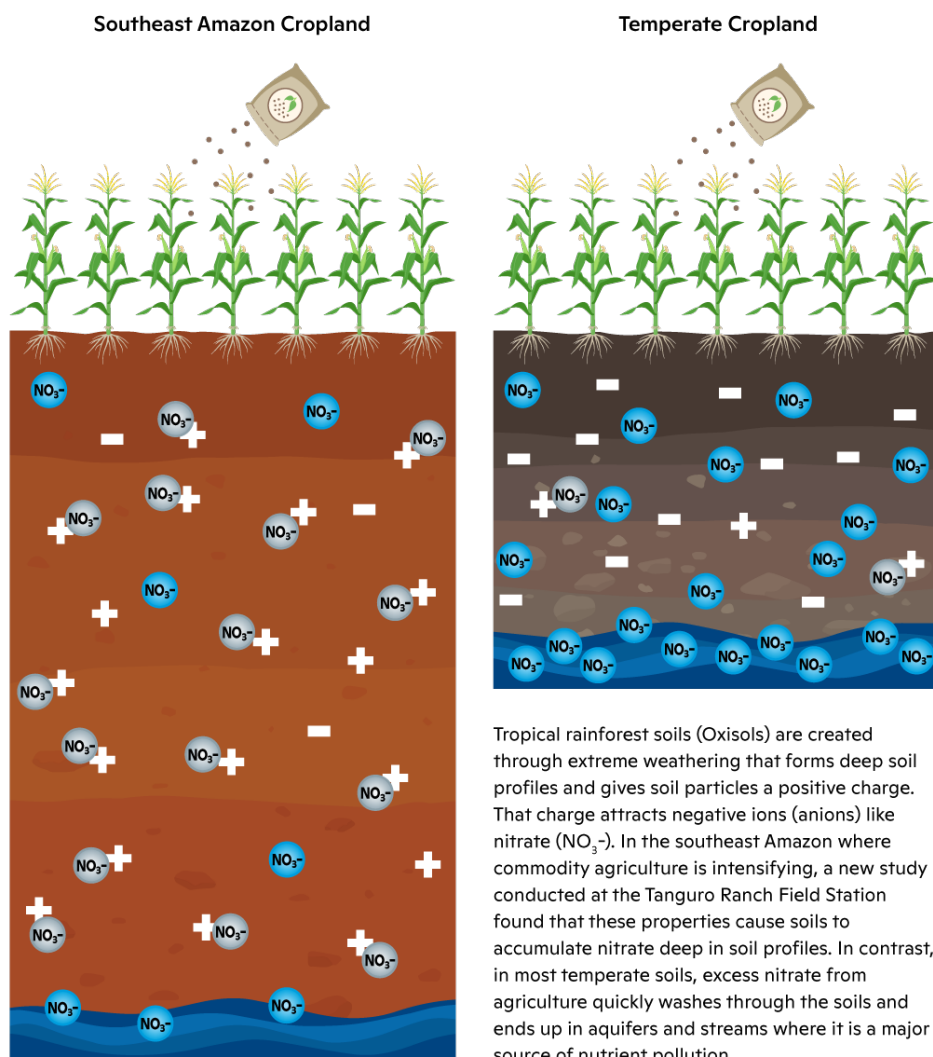
Dr. Huddell calculated that in this region, that capacity could last potentially for decades based on laboratory measurements. The precise timing will depend on factors like how much fertilizer is applied to croplands, whether water flows through some pores in the soil more than others and therefore bypasses portions of this anion exchange capacity, or if soil compaction at the surface reduces the water's infiltration into the soil.

This finding has implications for slowing deforestation. Increasing crop yields on already converted land could increase Brazil's agricultural output without destroying more of the Amazon Rainforest—a vital carbon sink. But intensification of fertilizer use only makes sense if it does not come at the expense of healthy freshwater ecosystems.

"If soils are well managed, you have this natural asset to keep the nutrients out of the water in ways we don't have in the temperate zone," Dr. Neill says. "We can likely intensify with more fertilizer use up to some level, and that will allow more food to be grown on less land, which could spare additional forest, but we need to better understand what those fertilizer limits are."

Further investigation at Tanguro will test the limits of this capacity to narrow down the true size of this buffer.

Nitrate Sticks to Southeast Amazon Cropland Soils



Fires, heatwaves get an early start this year

In some places, an extreme summer has already begun

Sarah Ruiz Science Writer

Springtime in the Northern hemisphere is a momentary respite for many places—a pause before the heat of summer and potential for drought and fire. This year, however, summer arrived early, bringing with it scorching temperatures and out-of-control fires that have made national and international headlines.

Record March-April heatwave sweeps India and Pakistan

Portions of India and Pakistan already have experienced record-setting heat. Unseasonably warm weather began in March, when India recorded the hottest monthly temperatures that the country has seen in the past 122 years—hitting an average maximum of 33.1 degrees Celsius (91.6 Fahrenheit). The heatwave continued with the third hottest April on record. The hottest time for India is typically May and June, before the monsoon season begins.

In addition to the early start of summer temperatures, this heat wave is particularly concerning for its scope. The heat has settled over most of India as well as parts of neighboring Pakistan for two months.

“The most shocking part for me has been the geographical extent and the duration,” said Woodwell Assistant Scientist, Dr. Zach Zobel in an interview with CNBC.

The heat-related death toll in Maharashtra state, the second most populous state in India, has already reached 25. Heat waves like this one become particularly dangerous when humidity is high—preventing the human body from cooling itself through sweat and evaporation.

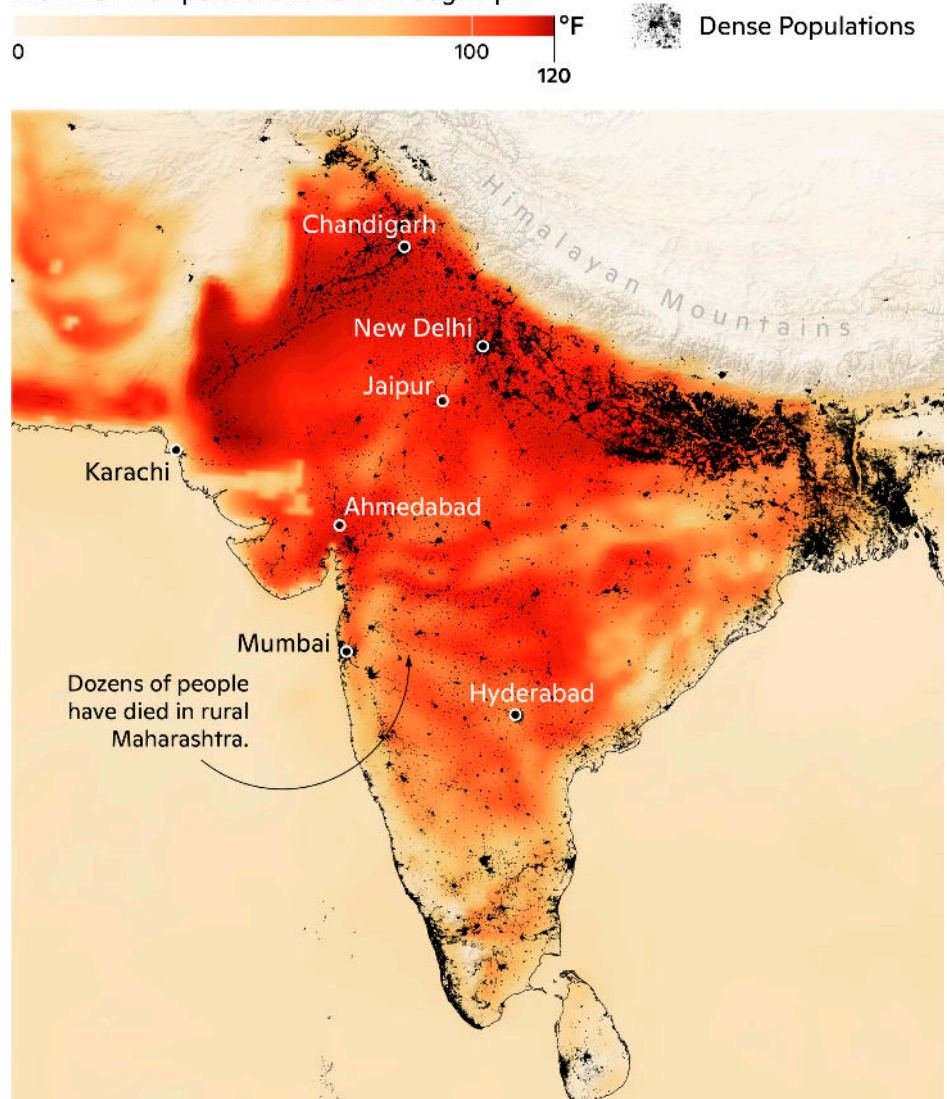
Earlier and more intense heat waves also have the potential to disrupt India’s crop yields, particularly wheat, which is vulnerable to hot, dry weather. As climate change progresses unchecked, extreme heat waves like this one will become more and more common.

Megafires in New Mexico forcing evacuations

On the other side of the globe, rising temperatures have resulted in a rash of destructive fires well before the usual summer season. The state of New Mexico

Extreme Temperatures Cut Spring Short for Millions.

Maximum Temperature in 2022 through April



Data from NOAA CFS (V2)

is currently fighting 20 separate fires in 16 counties. Two, the Hermit's Peak and Calf Canyon fires, recently merged into the state's second-largest wildfire on record, which has been burning now for more than a month.

The merged "megafire" has destroyed at least 276 structures and forced the evacuation of nearly 13,000 residences.

New Mexico is used to a fire season that starts in May or June. Climate change is making out-of-season fires more common and big fires were seen this year in Colorado and California as early as December and January. The United Nations declared a global wildfire crisis in February.

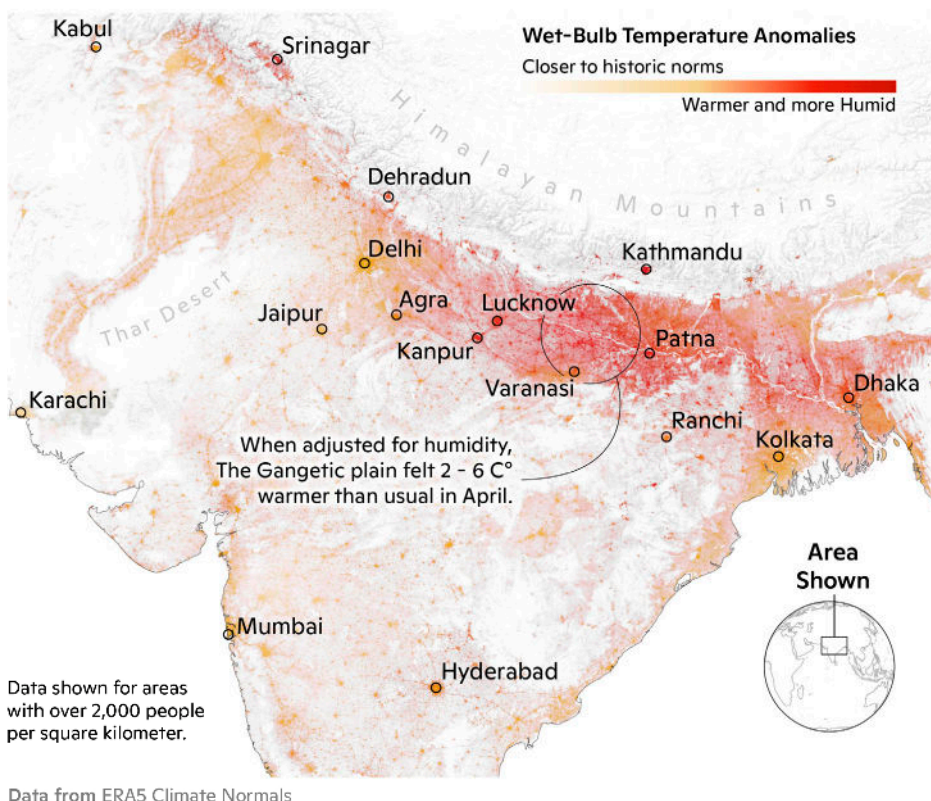
Climate change is warming and drying out western U.S. states, increasing the number of "fire weather days." This has made fire management harder, limiting the possible timeframe for prescribed burns that reduce fuel loads. Intense winds also played a large role in fanning the New Mexico fires, one of which began as a prescribed burn that escaped.

Heat rising, summers lengthening with climate change

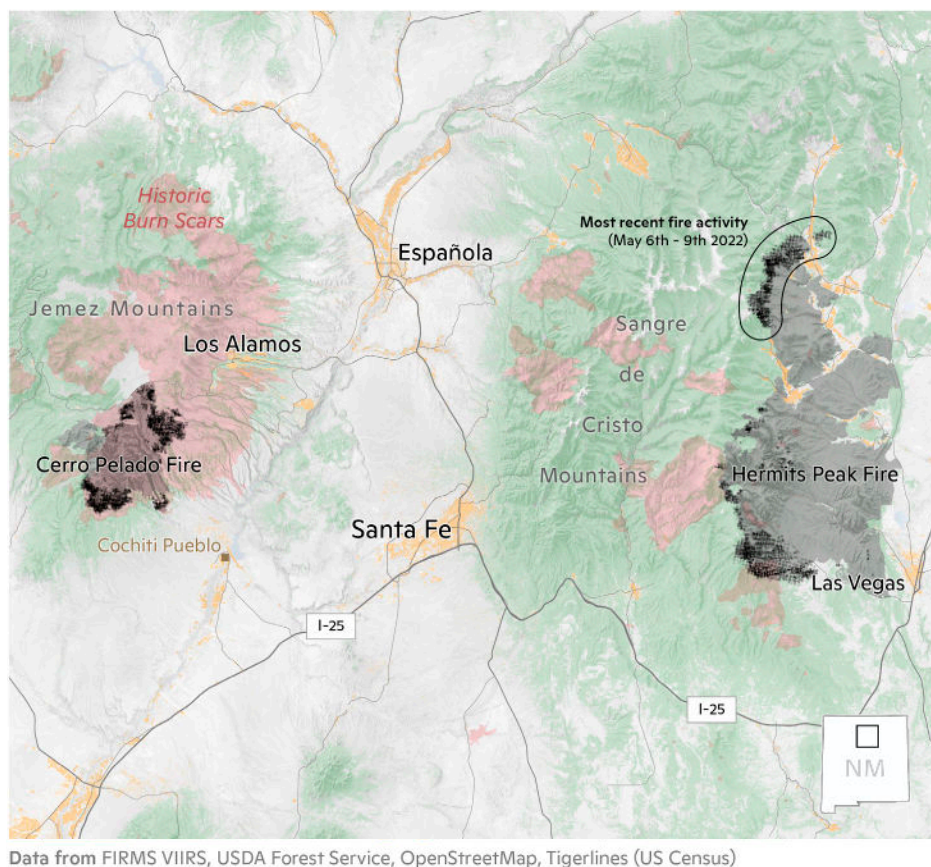
As temperatures rise, the risks from deadly heat waves and wildfire are growing. Fire seasons and extreme heat seasons are lengthening, frequently starting earlier and ending later, giving the land no time to recover from dry winters or the prior year's heat. The response to both the fires in New Mexico and heat in India and Pakistan is the same—rapidly reducing global emissions by 15% every year to hit the IPCC target of 1.5 degrees of warming.

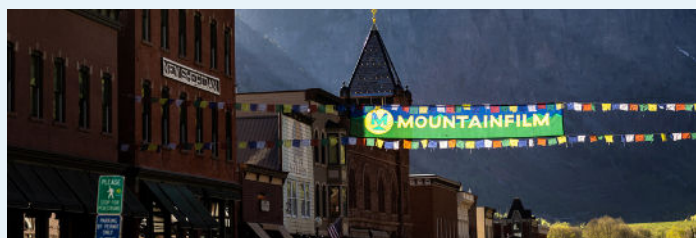
"There is no question that heat waves are made worse by fossil fuels and climate change everywhere in the globe," said Dr. Zobel. "India and Pakistan are two of the hottest places in the world and will likely continue to see heat waves of this magnitude and worse over the next several decades."

An Extreme Spring Heatwave puts Millions at Risk



High Winds and Heat Drive Wildfires in Northern New Mexico





Woodwell @ Mountainfilm

We're proud and excited to be Mountainfilm Festival this weekend as their nonprofit partner. Woodwell and Mountainfilm share a passion for spreading ideas that can make the world better. Learn more about this year's festival in Telluride, CO, and After the Fest Online at www.mountainfilm.org.



Permafrost Pathways Panel Q&A

Join us for a virtual panel Q&A to learn more about Permafrost Pathways from the project leaders at Woodwell Climate Research Center, the Arctic Initiative at Harvard Kennedy School, the Alaska Institute for Justice, and the Alaska Native Science Commission. To learn more and register, visit www.woodwellclimate.org/pathways-q&a.

In the news: highlights

Dr. Phil Duffy got a shoutout in an *E&E News* article spotlighting "climate and energy wonks" in President Biden's Office of Science and Technology Policy.

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

Dr. Jen Francis and *Miami Herald* reporter Alex Harris talked about the effects of climate change on the hurricane season.

Alaska Native News quoted Dr. Wayne Walker on the importance of the Tongass National Forest as a natural climate solution, which was followed up by an *E&E News* article highlighting the protection of roadless areas in the forest.

An article from the Skoll Foundation described new research by Woodwell and the Rights and Resources Initiative that will explore the scope of carbon capture in community forest lands.

An article from IPAM Amazônia about the latest achievements of the CONSERV project was published this week on *eCyc/e* (Portuguese).

CNBC quoted Dr. Zach Zobel on what surprised him the most about India's record-setting heat wave in a widely-syndicated article. He was also quoted by *Financial Times* on the extreme heat.

Cosmos Magazine interviewed Dr. Brendan Rogers about boreal wildfires, and how fire management can reduce greenhouse gas emissions. *The Canadian Press'* story on the research continues to gain traction, and has appeared in over 80 outlets.

Woodwell Board member Izabella Teixeira was quoted in a *Washington Post* article covering beef production in the Brazilian Amazon.

WCVB interviewed the filmmakers of *Earth Emergency* as the documentary, which features Woodwell scientists, gains popularity, with now over a million views.

An article from IPAM Amazônia shares the latest achievements of the CONSERV project.

Dr. Mike Coe was quoted in an *EOS* article on a recently-published study he co-authored, which described the climate benefits of forests beyond carbon sequestration.

Dr. Jen Francis was quoted in a *New York Times* Climate Desk answer to a reader question about climate change and extreme cold weather events.

Many news outlets covered a study co-authored by Dr. Brendan Rogers about North American boreal forest wildfires and their emissions, including *ABC News* and *MSN*. *EurekAlert!* and *Phys.org* quoted Dr. Rogers about the need for funding to keep carbon in boreal forests, and *The Canadian Press* drove home his points on closing carbon accounting loopholes from wildfires and the cost-competitiveness of such strategies.

Along with Robin Bronen (Alaska Institute for Justice), Darcy Peter was interviewed by KTOO of Alaska Public Media about the goals of Permafrost Pathways, her personal experiences witnessing climate change, and how science can support needed policy change.

The Arctic Institute gave an overview of Permafrost Pathways in an article this week, noting its importance especially in supporting Indigenous communities' adaptation to climate change.

On NPR's *Living on Earth*, host and Woodwell emeritus Board member Steve Curwood recalled his inspiration for starting the show—a conversation with Woodwell Climate founder Dr. George Woodwell about global warming and thawing permafrost.

Reuters cited Woodwell experts in an article about climate change impacts in Denali National Park, the fastest-warming U.S. national park over the past half-century.

cover: During a week-long workshop in Brasília on the applied use of GIS technology, participants visited recently burned landscapes. / photo by Manoela Machado

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