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This year in climate, 2021

A look back at a turning point year for climate change

Sarah Ruiz, Science Writer

Earth image by Greg Fiske, Senior Geospatial Analyst

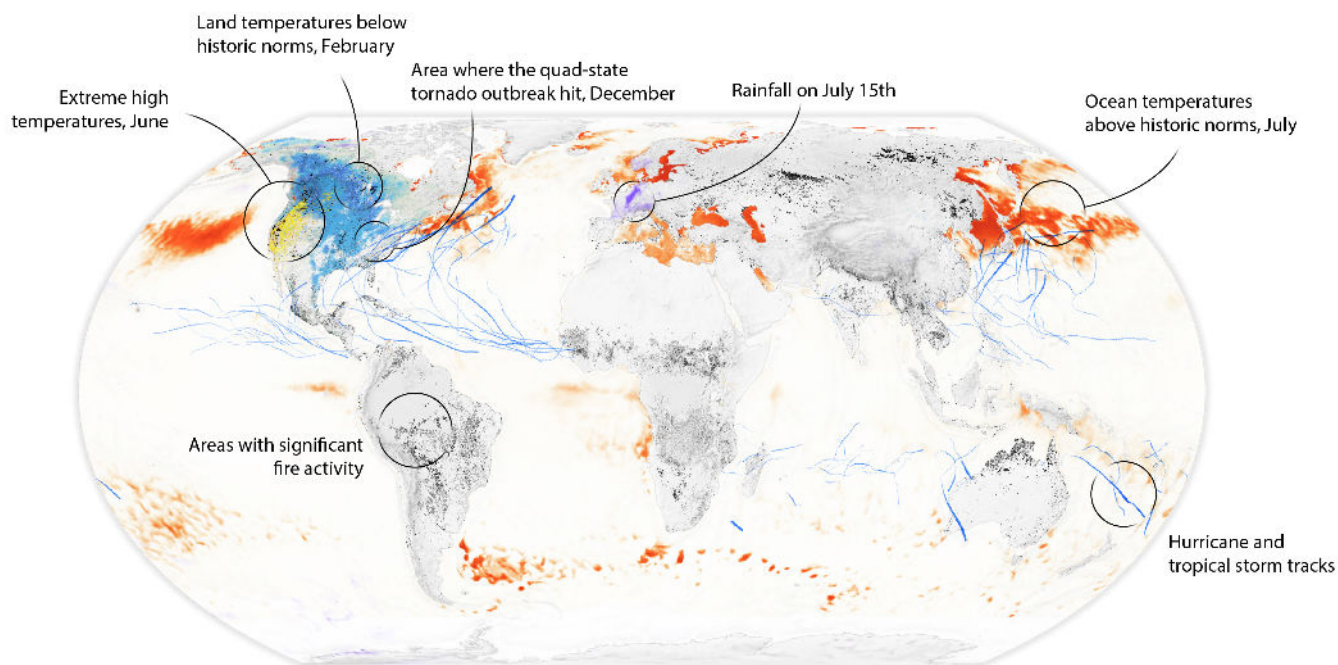
Maps by Carl Churchill, Cartographer



As another year passes with mounting emissions, we take stock of the big moments for climate change in 2021, from extreme weather events to steps forward on policy. Here's a look back at a potentially pivotal year for climate change:

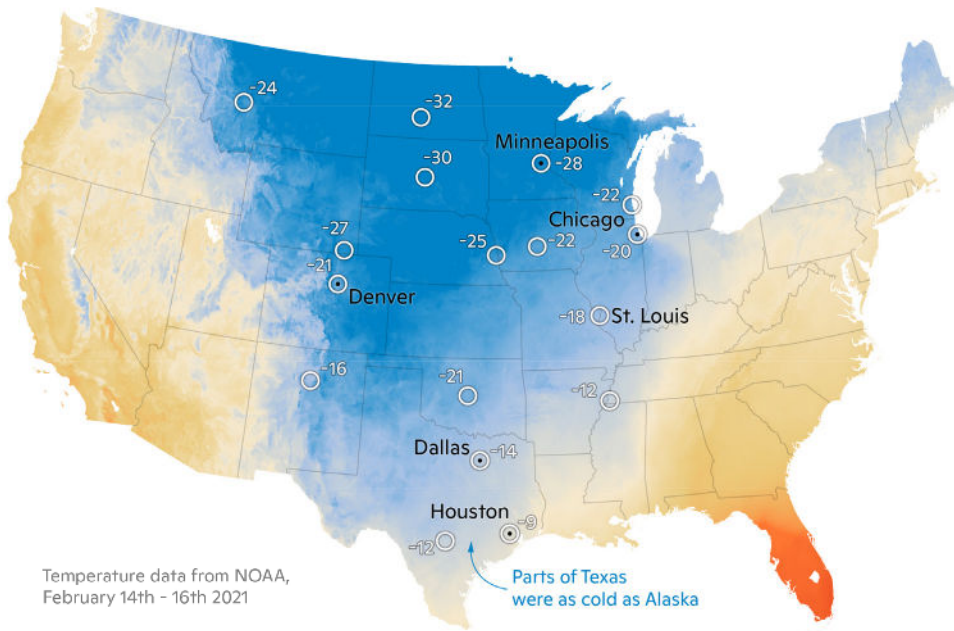
Climate change is now front and center due to deadly weather

This year, the clear repercussions of climate change were impossible to ignore. Climate change worsens extreme weather, making Earth's formerly reliable systems much more unpredictable. Widespread extreme weather events in 2021 had deadly consequences for the people caught in their paths.



Data sources:

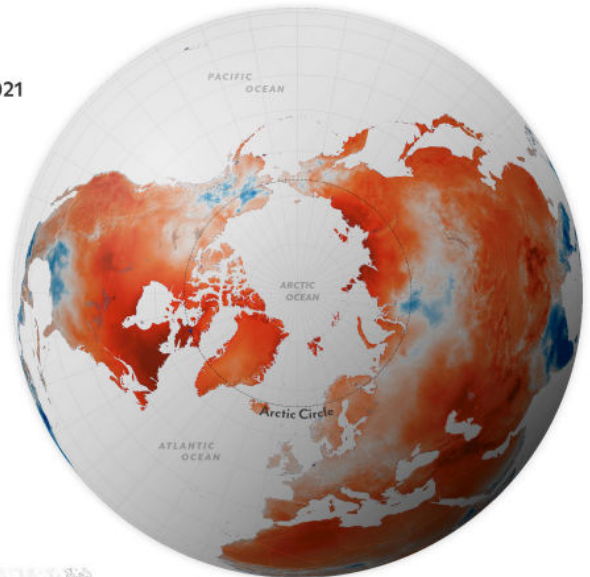
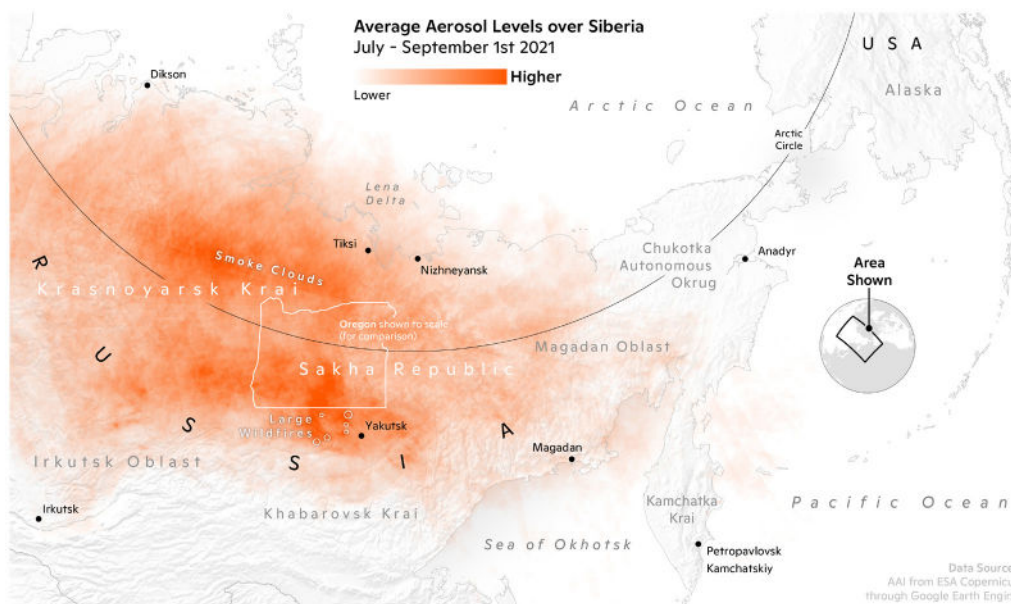
Fires from NASA Earth Observatory, MODIS. Hurricane and tropical storm tracks from IBTrACS, RMSC. Precipitation from NOAA GFS. Sea Surface Temperature Anomalies from Coral Reef Watch. Land temperature and land temperature anomalies from NASA Earth Observatory, MODIS.



Temperature Anomaly Jan-Sep 2021



In the summer, temperatures swung in the extreme opposite direction as a heat wave settled over the Pacific Northwest, breaking records. Temperatures neared 120 degrees Fahrenheit, melting power cables, buckling brick roads, and causing sudden deaths to spike across the region. This phenomenon was also caused by a wavering jetstream that allowed an intense and persistent high-pressure system to trap the heat over the Northwest.



Hotter than average weather also led to record fires this year. In Siberia, the return of the fire season to the boreal forests brought with it blazes larger than concurrent fires in Greece, Turkey, Italy, the U.S. and Canada combined. Drought in Brazil, paired with rising deforestation rates, led to increased fires in the Amazon.

And finally, just this month the Midwestern U.S. was hit by a devastating string of tornadoes, more severe than usual for this time of year, marking the deadliest December tornado outbreak in history. Tornadoes are tricky to study, so an understanding of how their prevalence will fluctuate with climate change is not yet clear, but the conditions fostered by a warmer atmosphere are amenable for tornado formation.

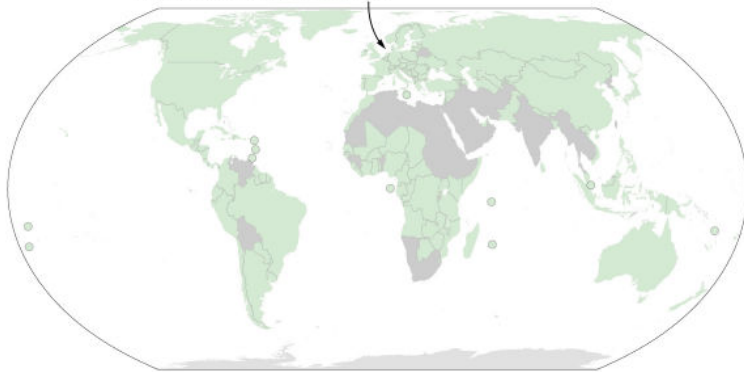
Increased awareness has led to increased momentum

The undeniable severity of the climate impacts of 2021 has enforced the urgency of cutting emissions. This year, climate action began building the momentum it should have had two decades ago, with more than half of Americans concerned or alarmed about the issue, and governments and private sector organizations across the globe stepping up their commitments to tackling it.

In November, Glasgow, Scotland hosted the 26th annual COP—hailed by some as our “last, best, hope” for successful international cooperation on Climate Change. Although the larger negotiations were not as ambitious as necessary to confidently limit warming to 1.5 degrees Celsius, several steps still pushed the world forward. The conference opened with a pledge from 141 nations to end deforestation by 2030, accompanied by \$19 million from governments and private sector groups—a large portion of which was dedicated to supporting Indigenous groups.

140 countries have made COP26 pledges

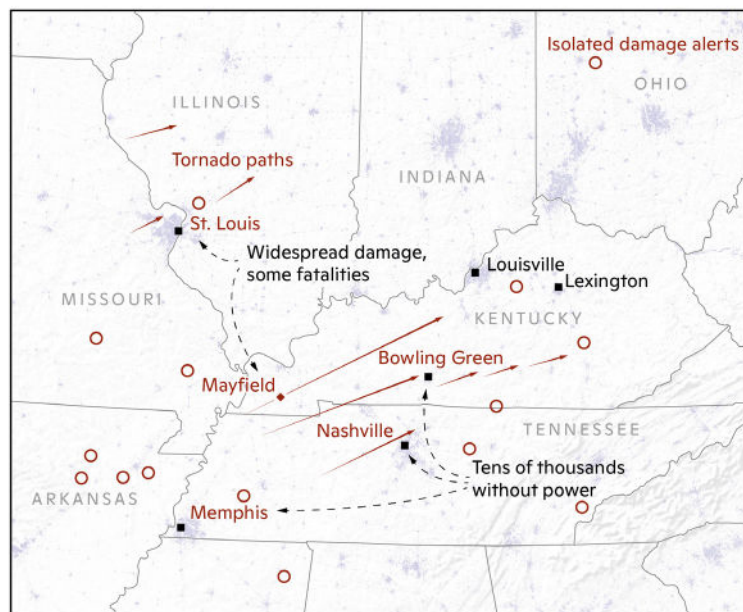
The EU has collectively made a pledge as well as all member states.



Earlier in the year, the U.S. Securities and Exchange Commission (SEC) made a request for public comments on a potential requirement for companies to disclose climate risk to their investors. With the impacts of climate change becoming more immediate, the demand for greater certainty around personal risk has grown. The SEC’s inclusion of climate risk in its regulations indicates a broader acknowledgement of the need to prepare for the changes to come. The new presidential administration in the U.S. also signaled its intent to address climate in its first 100 days, staffing up with science and policy advisers and calling an Earth Day summit with leaders from 40 nations.

Quad-State Tornado Event, December 10th - 11th 2021

Data from the National Weather Service.
Locations an approximation.



What to watch for in 2022

So what can we expect as we enter another year?

As long as emissions continue at their current pace, so too will warming and its consequences. Storms, fires, and extreme temperature swings will become a more frequent fixture next year and into the future.

On the international stage, next year’s COP will be one to watch. Nations are expected to return with even more ambitious targets than agreed upon this year. The timelines for formal climate action will accelerate. In the U.S. we can expect to see a ruling from the SEC in early next year.

To match demand for more information on climate risk, Woodwell will be spearheading a collaborative climate risk coalition. The goal of the coalition is to produce an annual climate risk assessment for policymakers to aid future decision-making. Woodwell is also continuing its work conducting risk analyses for climate-related heat, flooding, and fire at the municipality level in several new cities. In 2022, Woodwell will be leading the push for more, transparent climate risk analyses.

2022 will also be a year of expanded research into the impacts of climate change, particularly the rapidly warming Arctic. Woodwell projects will expand our understanding of emissions from thawing permafrost and the behavior of Arctic fires, as well as impacts on extreme weather events. Researchers will also be working closely alongside Indigenous communities to both understand how climate change is impacting vulnerable communities, and support them to take part in climate solutions.

Arctic communities and infrastructure under threat from thawing permafrost

by Sarah Ruiz
Science Writer

The Arctic has warmed twice as fast as the rest of the globe in the last two decades. In this region where the ground in some places is literally made of ice, rapid warming poses a serious threat to the lives, livelihoods and infrastructure of Arctic communities. A new review led by Dr. Gabriel Wolken from the University of Alaska, Fairbanks and Woodwell Associate Scientist Dr. Anna Liljedahl details the biggest hazards that could result—and in some cases already have—from permafrost and glacial thaw.

The paper was released as a special addition to the National Oceanic and Atmospheric Administration's Arctic Report Card, an annual report on the status of the Arctic region. In it, the authors outline what we know, and the much larger gaps in our knowledge, about how thawing permafrost and melting glaciers are impacting Arctic communities.

Ice holds the Arctic together. An estimated 23 million square miles of land in the Northern hemisphere is permafrost, soil that traditionally stayed frozen solid year-round. When it begins to thaw, the land slumps, which can cause sinkholes, erosions, and landslides. Retreating glaciers can also destabilize mountain slopes. When collapsing glaciers or mountainsides fall into a nearby water body, they can set off a chain of cascading hazards, including outburst floods, debris flows, and even tsunamis.

Events like these have already been documented, with serious impacts on Arctic residents, yet research and monitoring of these hazards have been lacking.

“Houses are already collapsing, communities are already being impacted by permafrost thaw and having to adapt, including in some cases, to relocate. That’s been happening for a decade, at least, and it’s not getting the attention it should be,” says Woodwell Arctic Program Director Dr. Sue Natali, who also contributed to the Report Card.

And there is vast potential for unstable Arctic ground to have far-reaching global impacts. The collapse of an oil tank in Norilsk, Russia was partly attributed to the extremely warm conditions of 2020. Roads, pipelines, and shipping lanes are all at risk from thaw-related hazards.

“It’s not only affecting someone living near a glacier or on permafrost, it also extends farther than that,” Dr. Liljedahl says. “It includes national security. And we do not have broad-scale hazard identification and detection across the Arctic, or near



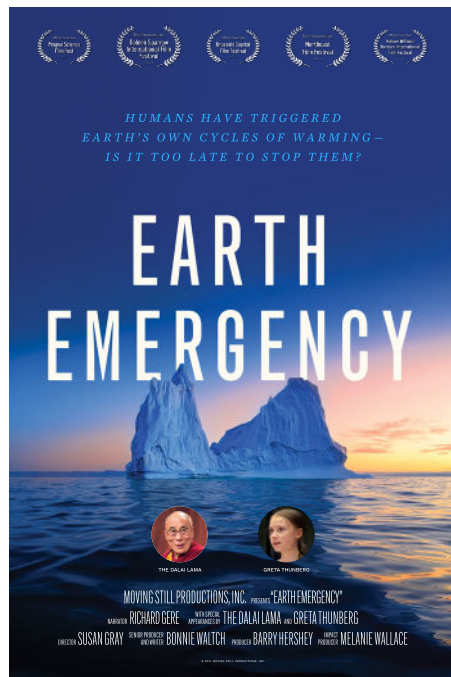
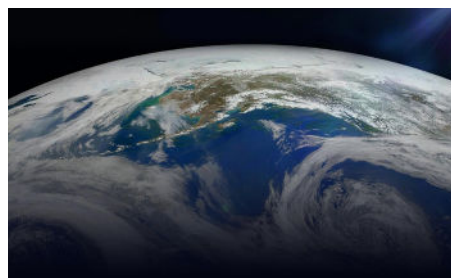
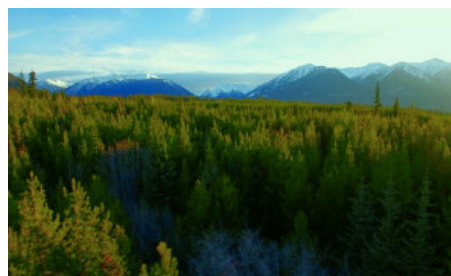
real-time tracking of permafrost thaw and unstable slopes. We can do a lot more in utilizing the vast amounts of remote sensing imagery and observations made by people living in permafrost and glacier-affected landscapes.”

What’s desperately needed, Dr. Liljedahl says, are early warning systems that can alert residents of imminent threats, especially ones designed in tandem with the communities being affected. But, without more research and widespread monitoring of permafrost and unstable slopes, building such a system would be nearly impossible—akin to taking precautions against a volcanic eruption without knowing where the volcano is.

The behavior and rate of thaw is also likely to change as climate change progresses. Permafrost itself releases emissions when it thaws and that accelerates the warming process, increasing the urgency for the necessary systems to be put into place.

“The rate of hazard formation and the combined effects of these hazards is much higher than it has been in the past, which will make it more challenging to respond to without accelerated efforts to monitor and map these hazards, and develop cohesive response plans,” says Dr. Natali.

above: A leaning fire hydrant in Point Lay, Alaska, which experienced a complete water system failure due to permafrost collapse in 2021. / photo by G. Hagle



New documentary explores the feedback loops amplifying global warming

by Sarah Ruiz
Science Writer

Earth Emergency, narrated by Richard Gere, premieres Wednesday, December 29 on PBS

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*, a new documentary to air on PBS, 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 film's producers, *Earth Emergency* features several Woodwell Scientists including founder Dr. George Woodwell, Arctic Program Director Dr. Sue Natali, Tropics Program Director Dr. Mike Coe, and President Dr. Philip Duffy.

The film uses captivating illustrations and graphics, stunning footage, and interviews with leading scientists to examine the crucial role feedback loops play in climate change. It conveys the urgency of stopping these cycles, letting natural systems remove carbon and preserving the delicate balance necessary to maintain Earth's temperature. Narrated by Richard Gere and featuring the Dalai Lama and Greta Thunberg, *Earth Emergency* premieres on Wednesday, December 29, at 8:00 p.m. ET.

"Most people I know or encounter haven't even heard of feedback loops or tipping points," says Greta Thunberg.

"But they are so crucial to understanding how the world works. We have such lack of respect for nature and for the environment. We just think that things will work out in the end. But we cannot solve the climate emergency without taking these feedback loops into account and without really understanding them. So that is a crucial step."

Earth Emergency focuses on four feedback loops—explaining how warming in forests, permafrost, the atmosphere, and the poles work together to accelerate dangerous, amplifying cycles. The film was presented recently to the Members of the UK House of Parliament, and as part of HRH Prince of Wales' Terra Carta Action Forum in Glasgow during COP26. The Smithsonian Museum of Natural History also held a summer film and discussion series based on the film.

Earth Emergency will stream simultaneously with broadcast and be available on all station-branded PBS platforms, including PBS.org and the PBS Video app, available on iOS, Android, Roku, Apple TV, Amazon Fire TV, Android TV, Samsung Smart TV and Chromecast. The film will also be made available to astronauts on the International Space Station. For more information, check local listings on PBS.org and the PBS Video app.

In the news: highlights

Dr. Glenn Bush and Joseph Zambo were quoted in a *Washington Post* feature on the need to measure and preserve Congo's peatland and forest carbon.

Rafe Pomerance co-authored an op-ed for *The Hill* calling for the annual Arctic Report Card to address solutions, as well as indicators of change.

Dr. Jen Francis was quoted in several stories about the deadly tornado outbreak in the southeastern US, including a widely syndicated piece from *The Guardian*. She also appeared in a story in *Vogue* about the impacts of climate change on the fashion industry.

National Geographic wrote about the debate surrounding wood pellets exported to UK/EU and cited the Woodwell Climate–Chatham House report. An updated version of Justin Catanoso's story about that report (Dr. Rich Birdsey and Dr. Wayne Walker quoted) appeared on French *Mongabay*.

Dr. Max Holmes spoke with (former board member) Steve Curwood about the importance of tropical forests on *Living on Earth*.

Dr. Anna Liljedahl was quoted in a widely syndicated *Reuters* story about the 2021 Arctic Report Card.

A report on the importance of community-held territories in global carbon sequestration released by Rights and Resources Institute, Woodwell Climate (Dr. Wayne Walker), and Rainforest Foundation US garnered significant international coverage, including *Agence France Press*, syndicated by *Le Monde*, *La Presse*, and Radio Canada.

Dr. Wayne Walker was quoted in *Grist's* coverage of pledges to end deforestation announced at COP26.



Our *Beyond 1.5* virtual series wrapped up earlier this month. If you missed any—or want to watch any again—they are found collected together in a playlist on our YouTube channel: youtube.com/WoodwellClimateResearchCenter.

Woodwell earns Platinum Seal of Transparency

by Sarah Ruiz
Science Writer

This year, GuideStar, an organization that provides trusted information on non-profits for donors, updated their rating of Woodwell Climate Research Center from a Gold Seal to a Platinum Seal of Transparency.

This is the organization's highest award, granted to non-profits that are exemplary in transparency surrounding their goals, strategies, and indicators of success and are the most widely used symbol of transparency for non-profits in the U.S.



Woodwell Climate had previously earned a Gold Seal in 2019.

This honor certifies Woodwell as an organization with a strong commitment to accountability and a proven track record of achieving our organizational goals. The Platinum Seal means that donors can be confident that their donations are affecting positive change, directly contributing to Woodwell's mission of combating climate change.

"As donors weigh where to invest their philanthropic dollars to solve the climate emergency, they want to be sure that they

are supporting a well-run organization with sound finances and governance. Woodwell Climate's Platinum Seal of Transparency with GuideStar, combined with our 4-star rating from Charity Navigator, provide that assurance," said Woodwell's Acting President and Executive Director Dr. Max Holmes.

To contribute to Woodwell Climate Research Center, visit woodwellclimate.org/give. Other options include incorporating Woodwell Climate in your will or estate plans, contributing from your IRA tax-free, and gifts of securities or real estate. To discuss those or other options, contact Leslie Kolterman, Chief Development Officer, at 508-444-1584 or lkolterman@woodwellclimate.org.

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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