JANUARY 2021

WestFAST News

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Chair – Patrick Lambert; Federal Liaison Officer – Heather Hofman

The Climate Events of 2020 Show How Excess Heat is Expressed on Earth

NASA 1/14/21. By most accounts, 2020 has been a rough year for the planet. It was the warmest year on record, just barely exceeding the record set in 2016 by less than a tenth of a degree according to NASA's analysis. Massive wildfires scorched Australia, Siberia, and the United States' west coast – and many of the fires were still burning during the busiest Atlantic hurricane season on record.

"This year has been a very striking example of what it's like to live under some of the most severe effects of climate change that we've been predicting," said Lesley Ott, a research meteorologist at NASA's Goddard Space Flight Center in Greenbelt, Md.

Human-produced greenhouse gas emissions are largely responsible for warming our planet, adding excess heat to the Earth. Climate events like droughts, hurricanes, and fires are all different ways that we see heat expressed in Earth's system.

Credits: NASA's Goddard Space Flight Center/Scientific Visualization Studio/Katie Jepson

Decades of greenhouse gas emissions set the stage for this year's events

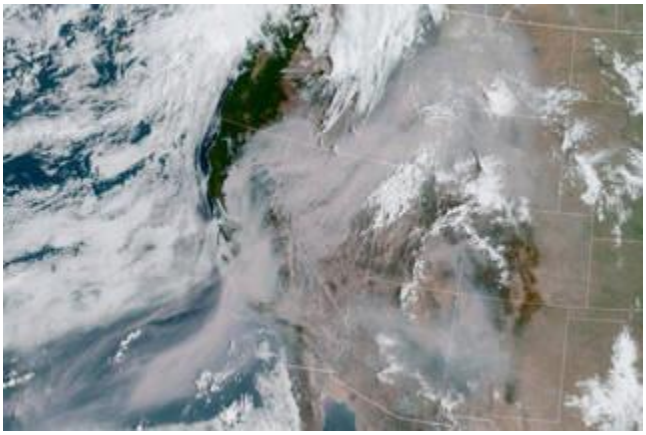
Human-produced greenhouse gas emissions are largely responsible for warming our planet. Burning fossil fuels such as coal, oil, and natural gas releases greenhouse gases – such as carbon dioxide – into the atmosphere, where they act like an insulating blanket and trap heat near Earth's surface.

"The natural processes Earth has for absorbing carbon dioxide released by human activities – plants and the ocean – just aren't enough to keep up with how much carbon dioxide we're putting into the atmosphere," said Gavin Schmidt, climate scientist and Director of NASA's Goddard Institute for Space Studies (GISS) in New York City.

Carbon dioxide levels have increased by nearly 50% since the Industrial Revolution 250 years ago. The amount of methane in the atmosphere has more than doubled. As a result, during this period, Earth has warmed by about 2 degrees Fahrenheit (just over 1 degree Celsius).

Climate modelers have predicted that, as the planet warms, Earth will experience more severe heat waves and droughts, larger and more extreme wildfires, and longer and more intense hurricane seasons on average. The events of 2020 are consistent with what models have predicted: extreme climate events are more likely because of greenhouse gas emissions.

Heat waves fanned the flames of extreme wildfires across the globe



Smoke from wildfires covered the western United States, as shown in this image captured by NOAA's Geostationary Operational Environmental Satellite 17 (GOES-17).

Credits: NASA Earth Observatory / Lauren Dauphin / Data from NASA's GEOS-5 and NOAA's GOES-17 satellite

Climate change has led to longer fire seasons, as vegetation dries out earlier and persistent high temperatures allow fires to burn longer. This year, heat waves and droughts added fuel for the fires, setting the stage for more intense fires in 2020.

The Australian bushfires that started in 2019 continued into 2020 due to sustained high temperatures, burning vast forested areas and sending smoke around the globe. The heat wave helped the fires grow rapidly, burning over 20% of the Australian temperate forest biome. Fire-induced thunderstorms called pyrocumulonimbus events resulted in smoke plumes that reached a record-breaking 18 mile (30 kilometer) altitude – crossing into the stratosphere. Smoke released from the bushfires circumnavigated the globe before returning to the skies over Australia.

Hundreds of wildfires burned throughout the western United States this past year, making it the most active fire season on record. Fires in Colorado grew quickly as heat waves enabled the fire to burn faster and hotter. In California, more than 650 fires were actively burning in late August; the largest of these – the August Complex Fire – burned over a million acres.

A heat wave hit the Arctic Circle this summer, with temperatures rising above 100 degrees Fahrenheit in some parts of Siberia. This heat wave triggered a wildfire outbreak that reignited “zombie fires” from the previous year.

Zombie fires can occur when fires burn in areas with permafrost, carbon-rich soil that typically stays frozen year-round. Zombie fires burn so deep in the permafrost layer that they can continue to smolder under a blanket of snow throughout winter and can reemerge in the spring.

Wildfires in the Arctic have long-term impacts on Earth’s climate system. Tundra and boreal fires release methane and carbon in these regions that have been accumulating for centuries into the atmosphere. Burning also creates the conditions for continued permafrost layer thaw, resulting in increased greenhouse gas emissions for years to come.

Earth is continuing to lose a key player in the fight against climate change: ice

This year wasn’t a record-breaker for ice loss at sea or on land. But ice plays a key role in regulating Earth’s temperature, and the overall trends show we’re continuously losing ice around the globe.

The planet is losing about 13.1% of Arctic sea ice by area each decade, according to sea ice minimum data from NASA and the National Snow and Ice Data Center in Boulder, Colorado. Studies of sea ice thickness have also shown that sea ice is a lot thinner than it used to be.

Sea ice floating in the Arctic acts like an insulating barrier, preventing the ocean from heating the atmosphere. Sea ice is also so bright that it reflects heat energy from the Sun away from Earth. Without sea ice, that energy would be absorbed by the darker ocean waters, leading to even higher sea surface temperatures.

The Arctic has lost over half of its summer minimum sea ice extent in the last few decades and the trend is still declining. In 2020, Arctic sea ice covered just 3.36 million square kilometers at its minimum.

Credits: NASA’s Scientific Visualization Studio / Data from DMSP’s SSM/I and SSMIS satellites

Each year, Arctic sea ice melts and regrows, reaching its minimum extent around mid-September and maximum extent in March. This year had the second lowest Arctic sea ice summer extent on record. Arctic sea ice also got a slow start regrowing this year due to warmer air temperatures, which doesn't bode well for the sea ice extent in 2021.

"When the ice has a slow start to regrow, it's hard to catch up," said Tom Neumann, glaciologist and Chief of the Cryospheric Sciences Lab at Goddard.

On land, the Greenland ice sheet is continuing to melt, and the record-breaking temperatures of 2020 didn't help. This year, 23.1 million square kilometers of Greenland's ice sheet (about 70 percent of the ice sheet's surface) reached the melting point. Glaciers and mountain ice caps in places like Alaska, South America, and High Mountain Asia are continuing to melt, contributing more than either Greenland or Antarctica to sea level rise, which affects coastal communities around the world.

The situation in the Arctic is a direct consequence of climate change – and a foreshadowing of what's to come in other places. "The Arctic is like the canary in the coal mine because the Arctic is warming faster than the rest of the planet," said Neumann. On average, the Arctic is warming three times faster.

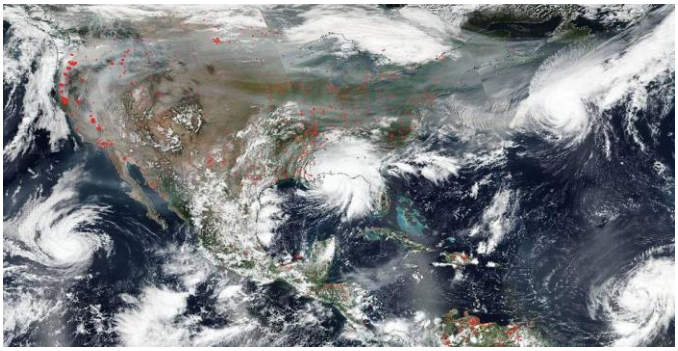
High sea surface temperatures intensified storms in the busiest Atlantic hurricane season

This year brought one of the busiest and most intense Atlantic hurricane seasons on record, with 30 named storms.

"We had more named storms than we've ever had before," said Jim Kossin, an atmospheric scientist with the National Oceanic and Atmospheric Association (NOAA) based in Madison, Wisconsin. More storms and a longer hurricane season are probably a result of regional conditions rather than global warming, Kossin said. However, climate change warms the ocean's surface and drives storm intensification – the change in windspeeds that, for example, raises a Category 4 storm to a Category 5. That warmer water at the surface acts like fuel, providing energy in the form of heat that the hurricane uses to intensify more quickly. This year's Atlantic hurricane season brought many examples of storms that intensified quickly: ten of the 30 named storms showed rapid intensification.

The planet is also seeing more slow-traveling hurricanes that stall, bringing prolonged rainfall to an area, likely as a result of climate change. Warmer air holds more water vapor (about 7% more water per 1 degree C of warming). The planet is warming at different rates around the globe, which can reduce the temperature and pressure gradients, thus slowing the winds that push hurricanes. That means storms are more likely to stall, bringing sustained high winds and dumping massive amounts of rain in one area. Hurricanes Sally and Eta – which respectively made landfall in Alabama in September and Central America in November – were prime examples.

"Global warming won't necessarily increase overall tropical storm formation, but when we do get a storm it's more likely to become stronger. And it's the strong ones that really matter," Kossin said.



This image captured by the NOAA/NASA Suomi NPP satellite on Sep. 15, 2020 shows intense wildfires in the west (red dots) and smoke drifting across the country while several hurricanes formed – including Hurricane Sally as it stalled over Alabama (center).

Credits: NASA Worldview, Earth Observing System Data and Information System

What does the future hold?

This year we experienced firsthand the ways that more heat is expressed on our planet. The large wildfires, intense hurricanes, and ice loss we saw in 2020 are direct consequences of human-induced

climate change. And they're projected to continue and escalate into the next decade – especially if human-induced greenhouse gas emissions continue at the current rate.

"This isn't the new normal," said Schmidt. "This is a precursor of more to come."

To help us understand and prepare for our planet's future, NASA observes and learns about Earth from space. By collecting a variety of data, NASA scientists are able to better understand how Earth operates as a system and create models to predict what the next decades will bring, providing information that helps decisionmakers around the world.

By Sofie Bates

NASA's Goddard Space Flight Center, Greenbelt, Md.

Resist-Accept-Direct (RAD)

A Framework for the 21st-century Natural Resource Manager

1/19/21. NPS / Emily Hassell

Cole et al. (2011) foresee "the future elimination of Joshua tree throughout most of the southern portions of its current range," thus invalidating a past premise of stability of the Joshua tree as a climax species.

Contact: Jeff Olson

The National Park Service and several federal land management agency partners recently published a report titled ***Resist-Accept-Direct (RAD)—A Decision Framework for the 21st-century Natural Resource Manager***. The report presents and explores a simple set of distinct management options that decision makers can consider when responding to ecosystems facing the potential for rapid, irreversible ecological change. In so doing, the report provides a framework that encourages natural resource managers to consider strategic, forward-looking actions, rather than structure management goals based on past conditions.

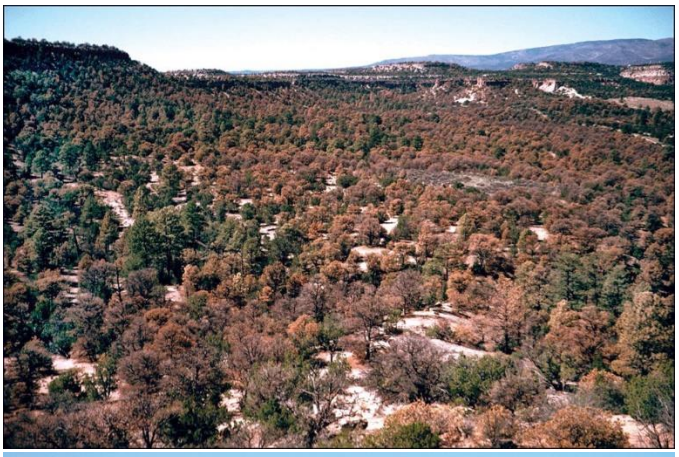
The natural world is always changing, as it cycles from summer to winter, from hot years to cool ones, and from dry decades to wet ones. Historically, careful study of these rhythms allowed people to understand and manage lands and waters to meet their needs. And for over a century, known past conditions have served as a baseline for conservation efforts including management of natural resources in parks.

But the past is no longer the guide it used to be. Today, climate change is rapidly altering environmental cycles and processes with new trends and phenomena, reshaping ecosystems in national parks and other protected areas. For example, changes driven by increases in heat and aridity across much of the National Park System include:

- large-scale tree loss in places like Sequoia and Rocky Mountain National Parks,
- increases in the extent of wildfire in Yosemite and other Western parks,
- migration of entire biological communities in places like Noatak National Preserve, and
- threats to the persistence of iconic species like the namesake trees of Joshua Tree National Park

Climate change will continue to affect ecosystems of national parks and other protected areas for decades to come, transforming landscapes in surprising ways. Thus, the National Park Service and other natural resource management agencies need to consider how to determine and achieve conservation goals in realistic and sustainable ways under conditions of rapidly changing environments.

The Resist-Accept-Direct (RAD) decision framework provides a simple tool that encompasses the entire decision space for responding to ecosystems facing the potential for rapid, irreversible ecological change. It assists managers in making informed, purposeful choices about how to respond to the trajectory of change, and moreover, provides a straightforward approach to support resource managers in collaborating at larger scales across jurisdictions, which today is more urgent than ever.



Piñon pines, normally evergreen, have reddish-brown foliage in October 2002. C. Allen, USGS

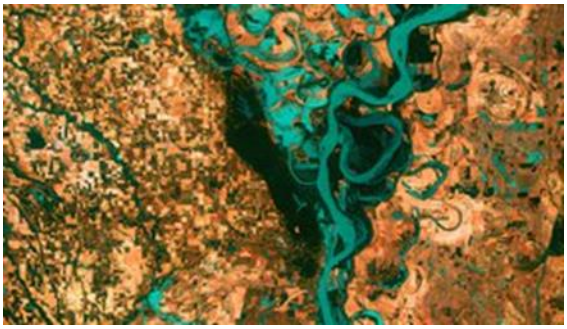
By May 2004, the dead piñon pines lost all their needles, exposing gray trunks and branches C. Allen, USGS

Multiple federal agencies, including the National Park Service, tribes, and others steward the East Jemez Mountains ecosystem of New Mexico, an ecologically transforming landscape where massive forest die-off is projected to occur more frequently in the future. The photos were taken from the same vantage point near Los Alamos, N.M. Forest drought stress is strongly correlated with tree mortality from poor growth, bark beetle outbreaks, and high-severity fire.

One Third of U.S. Rivers Have Changed Color

1/23/21. John R. Gardner, Xiao Yang, Simon N. Topp, Matthew R. V. Ross, Elizabeth H. Altenau, and Tamlin M. Pavelsky

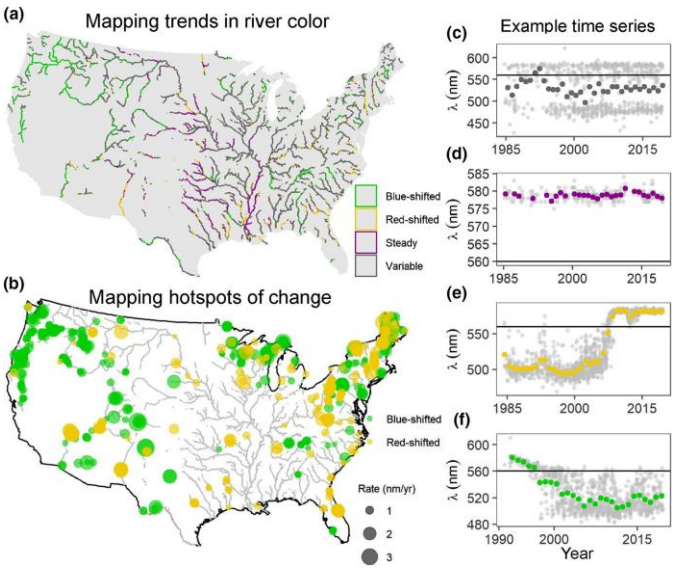
Rivers are among the most degraded ecosystems on Earth. The first map of river color from Landsat surface-reflectance data shows one third of U.S. rivers have changed color significantly over the last 35 years.



Rivers can appear different colors such as blues, greens, browns, and yellows. Water color is linked to water quality and can be related to the amount of sediment, algae, and dissolved organic carbon in water. Humans can therefore discern waters' suitability for use with our eyes. While we know many rivers are impaired globally, often due to poor water quality, the color of rivers has not been widely measured to investigate changes through space and time. Satellites act as "eyes in the sky" and regularly observe earth's large rivers.

Using satellite remote sensing records from 1984 to 2018, we measured the color of rivers across the USA. We found that large rivers have distinct seasonal patterns in color that change with river flow, and that the dominant color in one third of rivers has significantly changed. Observations of water color can pinpoint rivers undergoing rapid

environmental change and work toward continental-scale understanding of rivers.



we identified three dominant seasonal patterns in river color that were synchronous with long-term flow regimes, revealed that one third of large US rivers have significant shifts in color, and found evidence that hotspots of change are often located near dams and urban areas.

Key Points:

• ~15.9 million satellite observations over 35 years show USA rivers (>60 m wide) are dominantly yellow and green in color

• River color has three distinct seasonal patterns that are synchronous with flow regimes

• River color significantly changed over the last three decades in one third of large US rivers

Citation:

Gardner, J. R., Yang, X., Topp, S. N., Ross, M. R.. V., Altenau, E. H., & Pavelsky, T. M. (2021). The color of rivers. *Geophysical Research Letters*, *48*, e2020GL088946. https://doi.org/10.1029/2020GL088946

Read and download the publication here: https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2020GL088946

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Upcoming Meetings

Western States Water Council Spring 2021 (195th) Meetings
TBD: El Paso, TX, or Virtually via Zoom
March 23-25, 2021

Upcoming Events

WestFAST Webinar: The Reclamation Fund
February 17, 2021, at 10:00 AM MST

Other Federal News

NOAA 1/5/21. NOAA, The Ocean Foundation team up to advance ocean science

EPA 1/6/21. ICYMI: Why We're Ending the EPA's Reliance on Secret Science

USGS 1/7/21. Post-wildfire hazards in Colorado can be as dangerous as the fires themselves.

EPA 1/7/21. Newly released EPA plan will aid salmon survival in the Columbia River

EPA 1/12/21. EPA Invites 55 New Projects to Apply for WIFIA Loans to Improve Water Quality

ACOE 1/12/21. U.S. Army Corps of Engineers moves to eradicate invasive species

FWS 1/13/2021: Service Announces $7.4 Million in Grants to Help Protect Imperiled Species

NRCS 1/13/21. New Rule Improves Partner Flexibility in Regional Conservation Partnership Program

USDA 1/14/21. USDA Invests More than $46 Million to Protect Communities from Wildfires, Restore Forest Ecosystems and Improve Drinking Water

BLM/FWS 1/14/21. Interior releases decisions for the Northern Corridor to help support local communities while also protecting habitat and species

NOAA 1/14/21. 2020 was Earth's 2nd-hottest year, just behind 2016

ACOE 1/15/21. Corps partners with Flood Control District 10 to create predictive model to manage the Boise River

EPA 1/15/21. EPA Awards $11 Million Cooperative Agreement for National Environmental Education Training Program

NASA 1/18/21. Climate Change Shifting Earth's Rain Belt

BLM 1/19/21. Bureau of Land Management signs decision on Resource Management Plan for Western Alaska

DOI 1/19/21. SECRETARY BERNHARDT ANNOUNCES HISTORIC INCREASE FOR LAND WATER CONSERVATION FUNDING FOR ALL STATES AND TERRITORIES

NPS 1/22/21. The vulnerability of Earth's peatlands to climate change and disturbance

DOI 1/27/21. FACT SHEET: President Biden to Take Action to Uphold Commitment to Restore Balance on Public Lands and Waters, Invest in Clean Energy Future

People

BLM 1/5/21. Bureau of Land Management Names New Deputy State Director for Resources, Lands and Planning

BLM 1/8/21. The Bureau of Land Management names new Carson City District Manager

DOI 1/20/21. Interior Department Announces Members of Biden-Harris Leadership Team

EPA 01/27/21. EPA Welcomes Additional Members of . the Biden-Harris Leadership Team

FWS 1/19/21. The U.S. Fish and Wildlife Director Aurelia Skipwith Steps Down