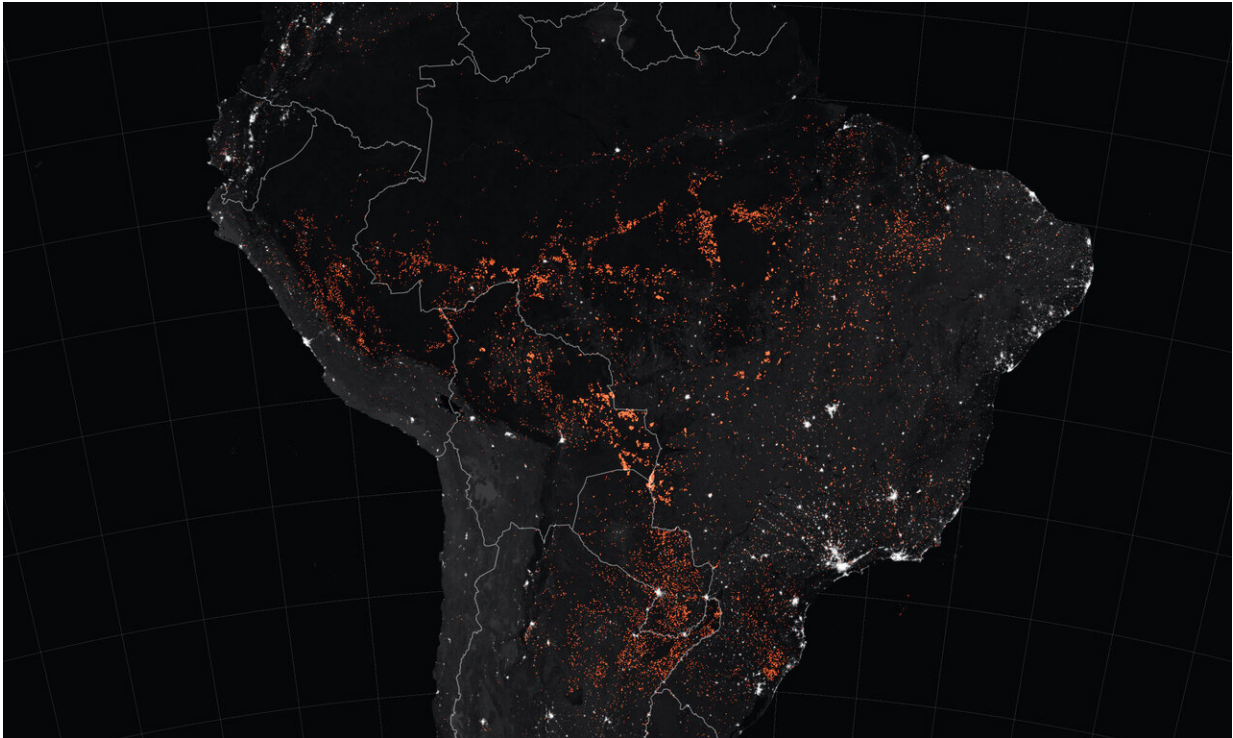


Inferno in the rainforest

September 9 2019, by Katherine Unger Baillie



Sensors on NASA satellites Terra and Aqua captured a record of thousands of points of fire in Brazil in late August. The fires pose a threat to the Amazon rainforest and to people living in and around it. Credit: NASA Earth Observatory

Fires in the Brazilian Amazon have reached the level of an international crisis. Since the start of the year, NASA satellites have detected more than 100,000 points of fire there. Though widespread slash-and-burn agriculture in the region means that some land is scorched every year, the scale of this year's fires is unusual, owing to a combination of

drought and human activity, and it has attracted attention from around the world.

Most people are familiar with the Amazon as home to myriad plant and animal species. Twice the size of India, the rainforest is home to an estimated 10% of the world's biodiversity. The fires may trigger a host of other far-reaching effects, including impacts on human health and the climate.

To gain insight into some of these less understood possibilities, and to dig into the science of how fire can transform environments, Penn Today spoke with scientists Reto Gieré and Alain Plante in Penn's Department of Earth and Environmental Science, who offered expertise on air pollution, carbon cycling, soil properties, agriculture, and ecology.

The Amazon isn't the world's only ecological hotspot on fire

The Brazilian Amazon fires have attracted global attention, including a pledge to help fight them from the G7 countries, but devastating fires are also affecting swaths of Africa and Southeast Asia, Gieré notes.

"NASA has impressive [satellite imagery](#) that shows these fire belts across the African continent," he says. "You can see them from space every year."

Similar [images](#) reveal large areas of Indonesia and Malaysia on fire. As in the Amazon, that burning is driven by a desire to deforest land for agriculture practices, particularly for palm oil plantations that are widespread in Southeast Asia.

Fire is a natural feature of the African savannah, as it is in areas with a

Mediterranean climate including parts of California and in boreal forest systems like Alaska and parts of northern Canada. Those ecosystems may bounce back relatively quickly from a burn. But Gieré underscores that many of the fires there stem from or are exacerbated by human activity, amplifying the range and impact.

Toxic fumes from the fires pose a threat to human health

All uncontrolled fires produce smoke and can release fumes that are harmful to breathe. But those occurring in the Amazon may be of particular concern because of what is fueling the flames. According to Gieré, out-of-control burns that engulf trees with a relatively high moisture content, as is typical of rainforest vegetation, can lead to what's known as incomplete combustion.

"Examples of compounds produced when plants are burned include toxic volatile organic species, carbon monoxide, and polycyclic aromatic hydrocarbons, or PAHs," says Gieré. "In particular, the higher the moisture content of the wood, the more PAHs will end up in the atmosphere, and many of these are carcinogens. So higher moisture can lead to more toxic emissions."



Smokes rises from the edges of a swath of rainforest in the state of Pará in northern Brazil. Fires occur annually in the Amazon, but not since 2010 have satellites detected so many. Credit: NASA Earth Observatory

A vast geographic area will feel the effects

"Very often the toxins attach themselves to solid particles like soot or mineral particles," Gieré says. "Depending on the meteorological conditions, these particles can be blown thousands of miles." [Photos from Sao Paulo, Brazil](#)—hundreds of miles from the fires—have shown how smoke rendered the daytime sky like night.

In addition, by creating a smoky haze, fires reduce the amount of solar radiation that can penetrate to the ground. As the sun's rays bounce off

the smoke, they increase heat in the atmosphere and hamper productivity of natural lands as well as agricultural lands.

"This has long-term effects and long-range effects," says Gieré.

Forest destruction in the Amazon has consequences for climate change

The Amazon rainforest is a huge "sink" for carbon. Its towering trees hold on to a vast reserve that might otherwise accelerate climate change. Below ground, however, the Amazon is a much less fertile place than equivalent soils in temperate or boreal forests. Decomposition happens so fast in the tropics that few nutrients and little carbon wind up in the ground.

That's why farmers cut down and then burn patches of forest; the fires introduce the nutrients that had been held by the trees into the soil. But that influx of fertility is temporary.

"Because of this lack of natural fertility in the soil, a few years after burning the land the fertility is exhausted, so farmers move on and burn the next spot," says Plante. "That's one of the factors contributing to deforestation in the Amazon."

This also means that a fire in the rainforest can cause the ecosystem to release most of its carbon in one fell swoop.

"What you're doing is essentially burping out a lot of carbon dioxide," Plante says. "And you're now missing the forest that used to suck more carbon dioxide out of the atmosphere in its normal process of photosynthesis. Over the long term, if the forest recovers, the carbon dioxide will get recaptured by trees. But that can take generations,

especially with fires at this scale."

Soil erosion may be one of the next big concerns

Once the [fire](#) has come through, the soils are vulnerable. "You're essentially taking a blanket off the ground," says Plante. When the trees are gone, the blanket is effectively removed, exposing the rainforest's soils to the elements. A strong rainstorm can cause massive erosion.

"Sediments can enter the streams and rivers, changing the turbidity of the water," says Gieré. "This change affects the ecosystem of the rivers and all animals and plants that live there, probably with long-term effects."

Provided by University of Pennsylvania

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