

Landsat at 50: How satellites revolutionized the way we see, and protect, the natural world

July 22 2022, by Stacy Morford



A river meanders through the Amazon Basin, seen from Landsat. Credit: NASA

Fifty years ago, U.S. scientists [launched a satellite](#) that dramatically changed how we see the world.

It captured images of Earth's surface in minute detail, showing how wildfires burned landscapes, how farms erased forests, and many other ways humans were changing the face of the planet.

The first satellite in [the Landsat series](#) launched on July 23, 1972. Eight others followed, providing the same views so changes could be tracked over time, but with increasingly powerful instruments. [Landsat 8](#) and [Landsat 9](#) are orbiting the planet today, and NASA and the U.S. Geological Survey are [planning a new Landsat mission](#).

The images and data from these satellites are used to track deforestation and changing landscapes around the world, locate [urban heat islands](#), and understand the impact of new river dams, among many other projects. Often, the results help communities respond to risks that may not be obvious from the ground.

Here are three examples of Landsat in action, from The Conversation's archive.

Tracking changes in the Amazon

When work began on the Belo Monte Dam project in the Brazilian Amazon in 2015, Indigenous tribes living along the Big Bend of the Xingu River started noticing changes in the river's flow. The water they relied on for food and transportation was disappearing.

The Xingu River's Big Bend after the Belo Monte Project



Upstream, a new channel would eventually divert as much as 80% of the water to the [hydroelectric dam](#), bypassing the bend.

The consortium that runs the dam argued that there was no scientific proof that the change in water flow harmed fish.

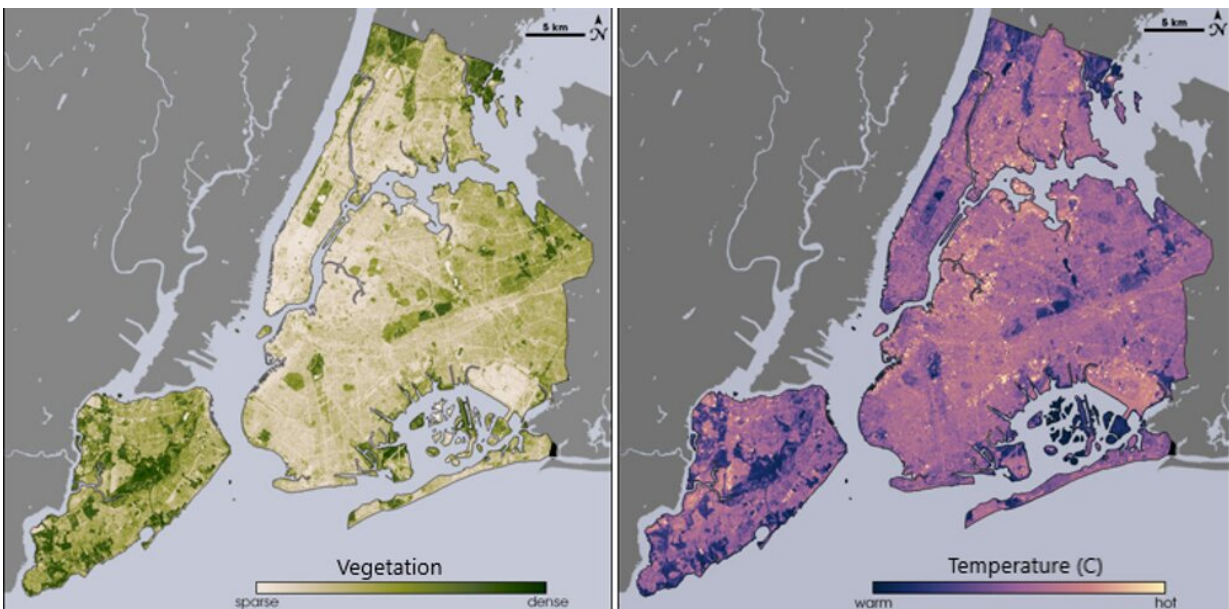
But there is clear proof of the Belo Monte Dam project's impact—from above, write [Pritam Das](#), [Faisal Hossain](#), [Hörður Helgason](#) and [Shahzaib](#)

[Khan](#) at the University of Washington. Using [satellite data](#) from the Landsat program, the team showed how the dam dramatically altered the hydrology of the river.

"As scientists who work with [remote sensing](#), we believe satellite observations can empower populations around the world who face threats to their resources," Das and his colleagues write.

It's hot in the city—and even hotter in some neighborhoods

Landsat's instruments can also measure [surface temperatures](#), allowing scientists to map heat risk street by street within cities as global temperatures rise.



Comparing maps of New York City's vegetation and temperature shows the cooling effect of parks and neighborhoods with more trees. Credit:

[NASA/USGS Landsat](#)

"Cities are generally hotter than surrounding [rural areas](#), but even within cities, some residential neighborhoods get dangerously warmer than others just a few miles away," writes [Daniel P. Johnson](#), who uses satellites to study the [urban heat island effect](#) at Indiana University.

Neighborhoods with more pavement and buildings and fewer trees can be 10 degrees Fahrenheit (5.5 C) or more warmer than leafier neighborhoods, Johnson writes. He found that the hottest neighborhoods tend to be [low-income](#), have majority Black or Hispanic residents and had been subjected to redlining, the discriminatory practice once used to deny loans in racial and ethnic minority communities.

"Within these 'micro-urban heat islands,' communities can experience heat wave conditions well before officials declare a heat emergency," Johnson writes.

Knowing which neighborhoods face the highest risks allows cities to organize cooling centers and other programs to help residents manage the heat.



Landsat's view of the Alligator River and refuge shows signs of ghost forests on the east side of the river. Credit: [NASA Earth Observatory](#)

The making of ghost forests

Satellites that scan the same areas year after year can be crucial for spotting changes in hard-to-reach regions. They can monitor snow and ice cover, and, along U.S. Atlantic coast, dying wetland forests.

These eerie landscapes of dead, often bleached-white tree trunks have earned the nickname "ghost forests."

[Emily Ury](#), an ecologist now at the University of Waterloo in Ontario,

used Landsat data to spot wetland changes. She then zoomed in with [high-resolution images](#) from Google Earth—which includes Landsat images—to confirm that they were ghost forests.

"The results were shocking. We found that more than 10% of forested wetland within the Alligator River National Wildlife Refuge [in North Carolina] was lost over the past 35 years. This is federally protected land, with no other human activity that could be killing off the forest," Ury writes.



An artist's rendering of Landsat 8. Credit: NASA/Goddard Space Flight Center Conceptual Image Lab

As the planet warms and sea levels rise, more salt water is reaching these areas, increasing the amount of salt in the soil of coastal woodlands from

Maine to Florida. "Rapid sea level rise seems to be outpacing the ability of these forests to adapt to wetter, saltier conditions," Ury writes.

Many more stories can be found in Landsat's images, such as an overview of the [war's effects](#) on Ukraine's wheat crop, and how [algae blooms have spread in Florida's Lake Okeechobee](#). Countless projects are using Landsat data to track global change and possibly find solutions to problems, from deforestation in the Amazon to the fires that have put Alaska [on pace for another historic fire season](#).

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