Amazon Deforestation

New Mexico Supercomputer Challenge

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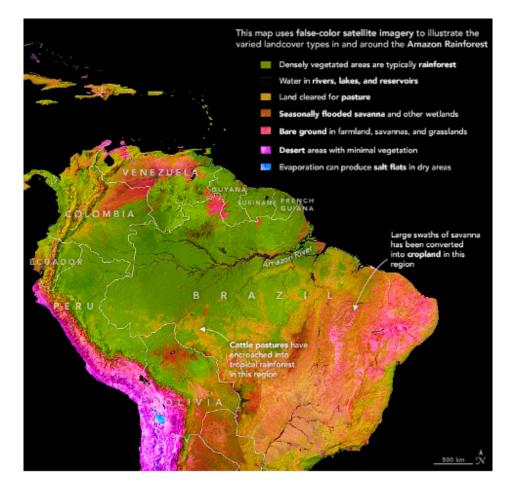**Natali Barreto Baca**

Problem

The Amazon Rainforest is critically important for human livelihoods, climate stability, and biodiversity conservation but remains threatened. Over the last decade, protections were put into place which increased the rate of deforestation in the Amazon. However, things changed in 2018, following the election of Brazil's president Jair Bolsonaro. The Bolsonaro administration loosened environmental protections, empowering ranchers to start taking land from the forest, bringing them into conflict with indigenous people who live in and around the forest and depend upon it for survival. Bolsonaro continues to scale back enforcement of environmental laws, pushes to open Indigenous land to commercial exploitation, and weakens existing environmental protections. Brazil's Congress considered bills that would legitimize illegal squatting and erode protections for Indigenous territories. Large deforestation inspires Indigenous protest movements across the country, and a coalition of Brazilian Indigenous rights groups petitions the International Criminal Court to investigate Bolsonaro for alleged crimes against humanity and genocide.

The Amazon Rainforest has long been a target of modern-day development. The canopy is ripped apart for timber, the earth scoured for minerals, and the land scorched to make way for ranching. Recent years there has been a peak in documenting historical and annual tropical forest loss with satellites. Now, a convergence of satellite technologies and analytical capabilities makes it possible to monitor deforestation in near real time, on the scale of days, weeks, or months, rather than years (3,4). This advance creates greater potential for near real time action and could play a key role in achieving local, national, and international forest, biodiversity, and climate policy goals.

Research

The Amazon basin is exceptional. It spans at least 6 million square kilometers (2.3 million square miles), nearly twice the size of India. It is home to Earth's largest rainforest, as well as one of the largest rivers in the world. The rainforest, which covers about 80 percent of the basin, is home to one-fifth of the world's land species, including many found nowhere else in the world. It is also home to more than 30 million people, including hundreds of indigenous groups and several dozen uncontacted or isolated tribes. The Amazon rainforest is also an enormous carbon sink (an area that draws down carbon from the atmosphere). It also pumps huge quantities of water into the air through a process called transpiration.

Mapping the Amazon Nasa Earth Observatory

The state of Rondônia in western Brazil, once home to 208,000 square kilometers of forest, (about 51.4 million acres), an area slightly smaller than the state of Kansas, has

become one of the most deforested parts of the Amazon. In the past three decades, clearing of the state's forests has been rapid: 4,200 square kilometers cleared by 1978; 30,000 by 1988; and 53,300 by 1998. In the years 2000-2018, 3,610,000 square kilometers of rainforest (all added up) have been cleared. By the start of this satellite time series from the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite, the frontier had reached the remote northwest corner of Rondônia. Intact forest is deep green, while cleared areas are tan (bare ground) or light green (crops, pasture, or occasionally, second-growth-forest).(6)
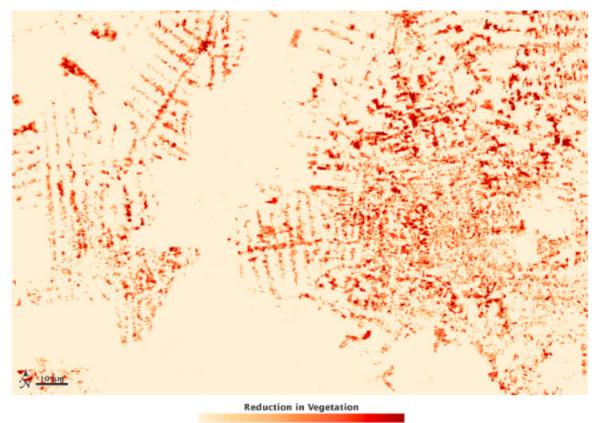

NASA map   July 18, 2012

Over the span of 12 years, roads and clearings pushed west-northwest from Buritis toward the Jaciparaná River. The deforested area along the road into Nova Mamoré expanded north-northeast all the way to the BR-346 highway.
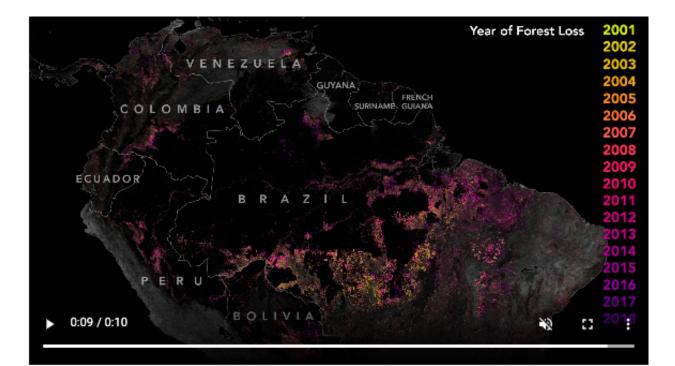
During the 1990s and 2000s, the Brazilian rainforest was sometimes losing more than 20,000 square kilometers (8,000 square miles) per year, an area nearly the size of New

Jersey. "It was open season on the rainforest back then," said Michael Coe, a senior scientist with the Woods Hole Research Center. "Ranchers, soy farmers, land speculators, loggers, and miners were coming to the frontier and clearing virtually anything they wanted."
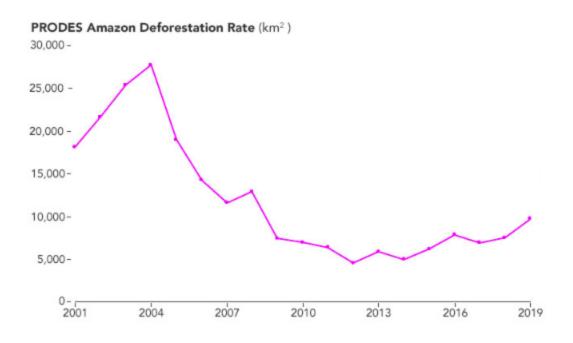

Reduction in Vegetation

light/none — moderate — severe

NASA map (large image) courtesy Robert Simmon and Reto Stöckli.

In 2004, following several years of particularly rapid deforestation, public pressure turned the tide. That was the year the Brazilian government adopted an aggressive policy called the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm). The government created a large network of national and state parks, established protected territories for indigenous groups, strengthened environmental enforcement agencies, made it more difficult to export goods produced on illegally deforested land, and strengthened satellite monitoring systems.

Year of Forest Loss

2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

NASA EARTH OBSERVATORY 2004-2009 LINK

AMAZON DEFORESTATION RATE
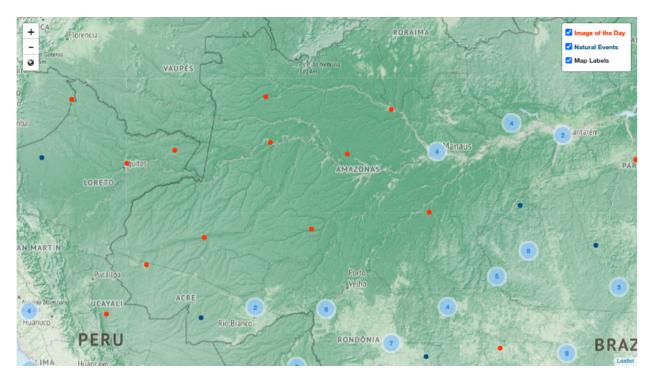
PRODES Amazon Deforestation Rate (km²)

November 18, 2019

As deforestation tactics in Brazil evolved, so have satellite monitoring systems. In addition to the shift toward smaller plots, one response to DETER and PRODES that scientists have detected is an increase of clearing during the rainy season, when clouds obstruct most satellite views of the rainforest. "There could be a benefit to incorporating more radar data into forest monitoring systems because radar can detect deforestation through clouds," NASA's Marshall Space Flight Center.
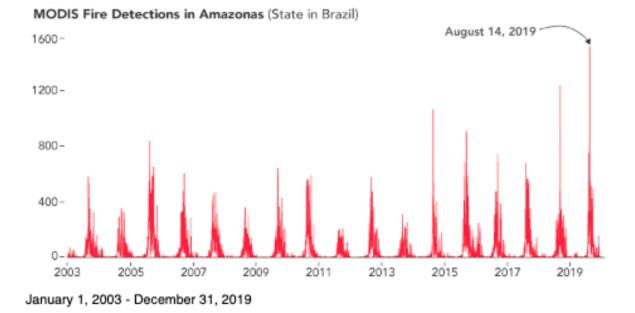
In August 2019, fires in the Amazon dominated the news, inspiring concern from presidents and prime ministers to pop stars to the Pope. As smoke darkened South American skies, people wondered: What caused the fires? Were they unusual? What did they mean for the rainforest? Scientists at NASA and other international agencies worked overtime to answer such questions, using the satellite and ground-based information available in real time. But the reality of science, statistics, and satellite observations is that understanding the causes and effects of a fire season takes time.

Earth with EO Explorer

[Earth with EO Explorer link](#)

Reflecting on a Tumultuous Amazon Fire Season

MODIS Fire Detections in Amazonas (State in Brazil)

January 1, 2003 - December 31, 2019

Solving the Problem

The impacts of deforestation in the Amazon basin carry many serious implications, many of which are already being felt. We will code models to analyze all the concerns for the Amazon deforestation that are raising grave concerns such as impacts on indigenous communities, animals and plants.

When fire outbreaks occur, it is hard to assess their extent or severity from the ground, but satellites can help and computational models. Satellites from NASA can detect hot spots associated with fires on a daily basis using computational models, data collection, data analysis, and satellite imagery. We can help to Reduce and Reverse Deforestation on the Amazon.

To work in this project, our team is collecting data to create simulations using the Starlogo Nova programming language. We will use NASA satellite imagery, the NASA's Earth Observatory website, My NASA DATA website, and different scientific websites to obtain important information to solve our problem.

[FIRMS NASA link](#)
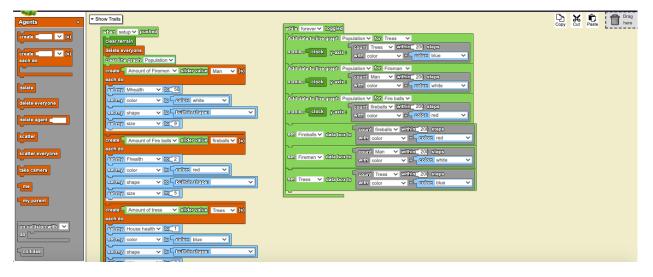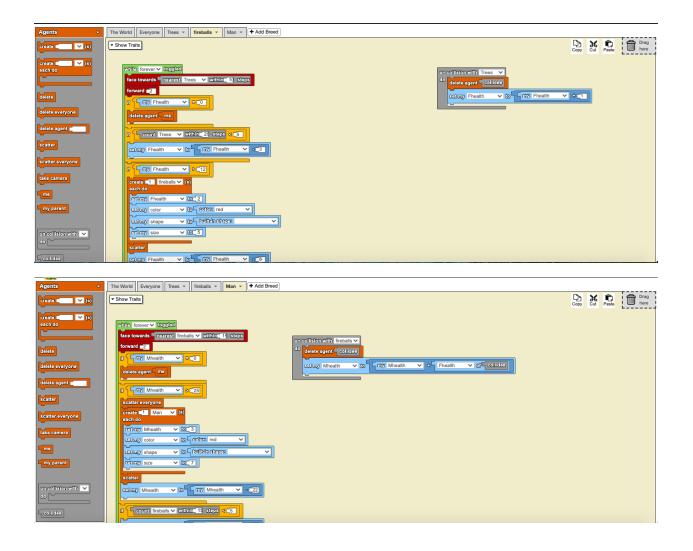
[MOIs satellite Nasa link](#)

Our Goals

1. Using satellites to monitor the fire on the Amazon Rainforest. Satellites record a variety of data that, when put together with other data sets, give us a multifaceted, well rounded, and increasingly accurate, view of the year's fires to prevent deforestation.
2. Using data analysis to monitor the fire on the Amazon Rainforest by offering greater access to higher visual NASA DATA.
3. Using computing simulations to understand the effects of deforestation on the Amazon Rainforest.

Conclusion

In conclusion the rainforest has rapidly been dissipating with time. Without the rain forest our biggest carbon sink would fully disappear. Without it we wouldn't have a lot of clean air. Without clean air lots of plants would start dying off, and soon enough there

won't be enough plant to filter out contaminated air. Later leading to un breathable air. In 2022 Brazil had a general election. Luiz Inacio was elected president. He previously served as Brazil's president from 2003 to 2010. Our major question with Luis Inacio is "Could Luis Inacio actually make a difference in the Amazon Deforestation or would he also be a leading problem like Jair Bolsonaro?" We are hoping for a major decrease in deforestation and a growth in the Amazon Rainforest. Whatever the outcomes are we will know with modern satellite technology.

We are using starlogo Nova to code. We added some pictures about our code.

References and Notes

1 J. Barlow et al., *Nature* **535**, 144 (2016).

2 M. Hansen et al Science **342**, 850 (2013).

3 J. Lynch, M. Maslin, H. Balzter, M. Sweeting, *Nature* **496**, 293 (2013).

4 A. K. Pratihast et al., *PLOS ONE* **11**, e0150935 (2016).

5 World of Change: Amazon Deforestation, NASA's Earth Observatory.

6 Tracking Amazon Deforestation from Above, NASA's Earth Observatory.

7 Mapping the Amazon, NASA's Earth Observatory.

8 Reflecting on a Tumultuous Amazon Fire Season, NASA's Earth Observatory.