

The Amazon Burns

Dr Grant Kleeman

In 2019, fires raged across the Amazon basin. (See figure 1). So great was the destruction wrought by these blazes they represented one of the biggest environmental disasters of the decade. The accompanying worldwide media attention prompted a wave of global concern and focused attention on the valuable environmental services provided by the forests of the Amazon. It also initiated a debate about the fires' link to, and implications for, climate change.

Importantly, there was not just one large fire, but thousands of fires spread all over the Brazilian Amazon – in particular, along the southern edges of the rainforest where the encroachment of agriculture and grazing has resulted in the greatest rate of land cover change. The vast majority of fires were lit by cattle ranchers, loggers and speculators who want to clear and utilise the land.

Figure 1: One of the more than 70,000 fires that caused havoc in the Amazon Basin in 2019



Figure 2: Drone-based image of an Amazon blaze



Figure 3: Slash-and-burn land clearing



The geography of the Amazon Basin

The Amazon Basin of South America is vast. (See Figure 4). It covers about one-third of South America; spans eight countries and features a mosaic of intersecting and overlapping ecosystems. The Basin spans at least six million square kilometres (an area nearly twice the size of India) and is home to earth's largest rainforest. The forest, which covers about 80 per cent of the Basin, supports one-fifth of the world's terrestrial species, including many found nowhere else on earth. (See Figure 5). It is also home to more than 30 million people, including hundreds of indigenous groups and several dozen isolated tribes with limited, if any, contact with the outside world. The Amazon is drained by the world's largest river, as measured by the volume of flow, and the size of its drainage basin.

Despite its vast size, and its importance to the planet, there is still much to learn about the complexity of its contribution to earth's ecosystem services. Given that it is largely surrounded by mountainous plateaus, much of the basin is remote and difficult to access.

Figure 4: South America as seen from space. The vast swathe of the Amazon Basin still dominates the landcover of the northern two-thirds of the continent.



The Amazon rainforest's environmental services

The importance of the Amazon rainforest and the environmental services it provides extend well beyond the borders of Brazil. The rainforest is an enormous 'carbon sink'. It draws down carbon from the atmosphere and sequesters it in the soil and plants of the forest. Additionally, the plants transform un-sequestered carbon dioxide into oxygen, which is pumped back into the atmosphere. Up to 20 per cent of the earth's oxygen originates from the Amazon forests. Without this sink and oxygen-producing capacity, global atmospheric carbon dioxide concentrations would increase much more rapidly than they are already increasing, resulting in even higher temperatures. When the forest burns,

the stored carbon dioxide is released to the atmosphere thereby adding to the warming of the planet.

The Amazon also pumps vast quantities of moisture into the air through a process called transpiration. About half of this moisture falls as rain within the basin. The rest travels large distances to other parts of South America via 'atmospheric rivers' and contribute to the precipitation in these areas. As the forest is lost or fragmented this transfer of moisture is disrupted. Potentially, this could disrupt rainfall patterns across the continent.

Figure 5: Amazon jaguar



Land cover change in the Amazon

Over the past four decades, an extraordinary change has taken place in the Amazon Basin. Remote sensing reveals widespread deforestation associated with the expansion of agriculture and grazing. The scale and scope of this transformation are unmatched anywhere else in the world.

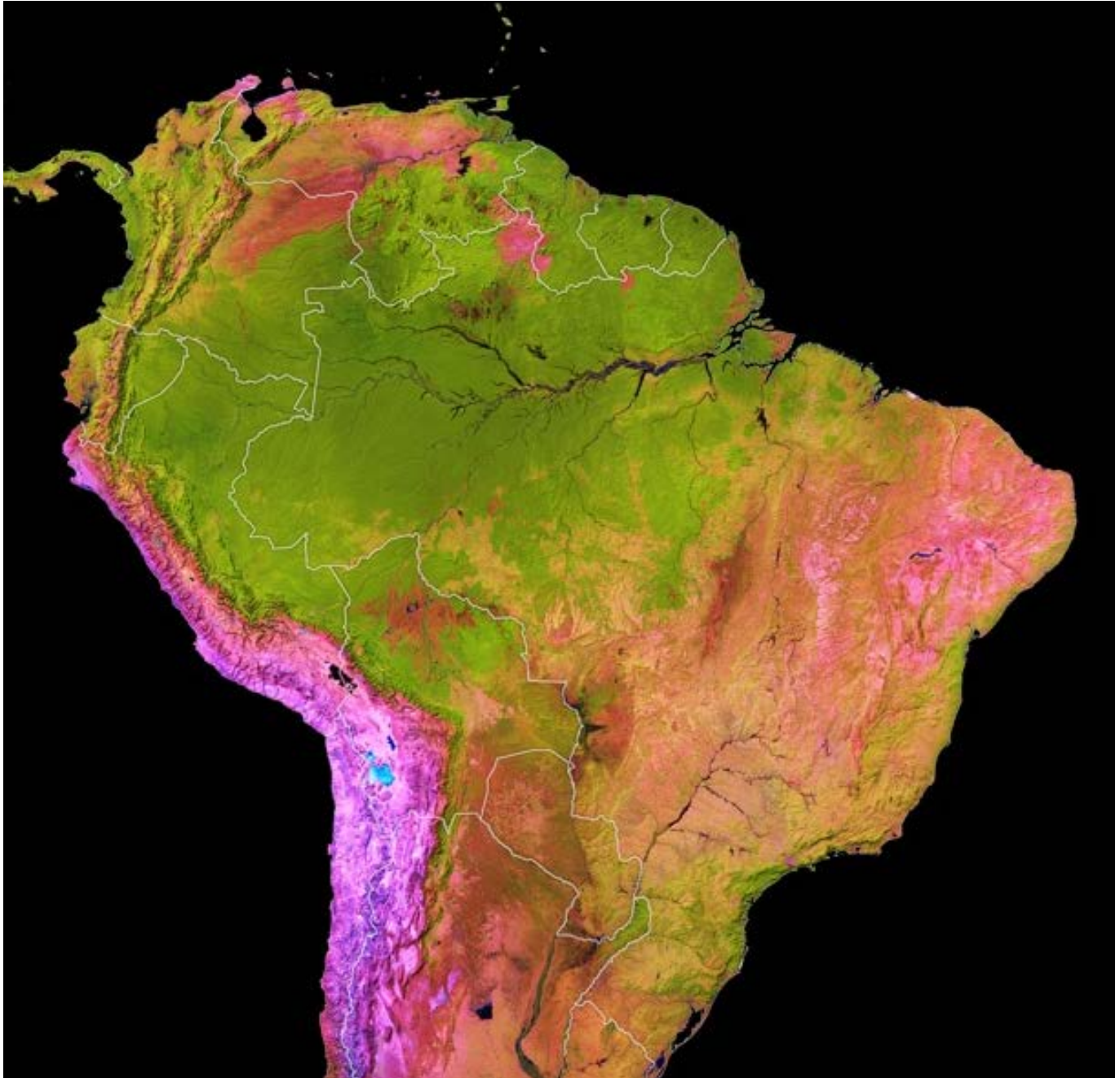
Figure 6, a false-colour satellite image of the Amazon and adjacent regions, highlights key differences in vegetation, moisture levels, and other surface features. The dark green areas show where forest—mostly tropical humid rainforests—thrive and have not been severely changed or degraded by human activity.

The lighter green areas are generally tropical savanna. These woodland-grassland ecosystems often have trees, but they are spaced widely enough that the canopy does not appear fully closed. While tropical savannas receive plenty of rain during the wet season, they typically have vegetation that can withstand the region's lengthy dry season. Rivers and reservoirs appear navy blue in the image. The brown areas are seasonally flooded wetlands.

Areas affected by human activity stand out in this image. Forest areas that were converted to pasture generally appear yellow. Savanna converted to cropland is generally pink, especially if fields are fallow or have exposed soil.

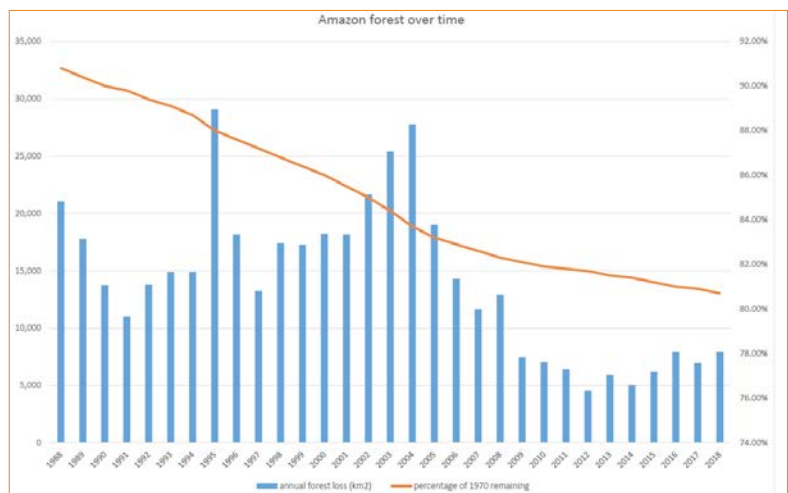
Deforestation often achieved through the use of fire, represents the single greatest threat to the Amazon

Figure 6: False colour image of South America



rainforest. **Figure 7 shows the trend in deforestation since 1970.** Almost 20 per cent of the pre-1970 forest cover had been lost by the end of 2018 – down from 4.1 million km² to 3,307,949 km². The rate of loss peaked in 1995 when 29,059 km² was lost. The average annual rate of loss in the period 2010–18 was a more modest 6,433 km². This reduction in the rate of loss can be attributed to a range of initiatives, some of which have been instigated by international entities such as the European Union.

RIGHT – Figure 7: The trend in deforestation since 1970



The clearing of the rainforest is typically done using slash-and-burn processes. The forest is first cleared using bulldozers during the wetter months of the year (November–June). The piles of felled trees are set alight as the dry season arrives (July–October). All too often these fires spread into the adjacent, uncleared rainforest where they are difficult to extinguish. While most countries in the Amazon have enacted laws against deforestation, these are rarely enforced. Much of the slash-and-burn activity is done illegally.

The inauguration of a right-wing, climate change denying president, Jair Bolsonaro, in January 2019, resulted in a relaxation of environmental protection measures. As a result, Brazil had more than 70,000 fire outbreaks in 2019, an 84 per cent increase on the same period in 2018. More than half of these fires were in the rainforests of the Amazon. Higher temperatures and a dryer than normal summer, both attributed to global climate change, increased the intensity of the fires.

It is increasingly evident that farmers have taken advantage of weaker enforcement of environmental regulations by authorities. Since Bolsonaro assumed the presidency, the environment agency has issued fewer penalties, and ministers have sided with those responsible for the clearing of the rather than the indigenous groups who live in the Amazon rainforest.

The incidence of fire in the Amazon is tracked by satellite imagery and data. While naturally occurring, fires do occur they are much less likely than in Australia for example. While increasing global temperatures play a role, 99 per cent of the fires in the Amazon basin are a result of human intervention, either on purpose or accidentally. Evidence supporting such a claim includes satellite imagery showing a relationship between the points of fire ignition and roads and existing agricultural areas. Very few fires start in remote areas of the Amazon basin.

The Amazon fires and climate change

Climate change can increase the frequency and severity of wildfires by raising temperatures and increasing the chances of drought. Both of these factors create the conditions whereby, once ignited, fires can spread very quickly over large areas of land. The Australian experience with fires in the Autumn–Summer of 2019 bears witness to this observation.

Deforestation, whatever its cause, contributes to climate change. Scientists fear that continued destruction of the Amazon could push it toward a ‘tipping point’,

after which the region would enter a self-sustained cycle of decline resulting in the conversion rainforest into savannah, a process that will release 200 billion tonnes of CO₂ into the atmosphere. As this occurs, temperatures will increase further and the environmental services of the Amazon forest will be greatly diminished to the detriment of the entire planet.

Indonesian fires

Sadly, it’s not only the Amazon that burnt in 2019. In Kalimantan, deep within the rainforests of Indonesian Borneo, illegal fires raged, spreading acrid smoke as far as Malaysia and Singapore.

These fires are driven by the world’s rapidly growing demand for palm oil, which is used in half of all supermarket products, from chocolates to shampoo. Despite its environmental impacts the oil palm industry thrives because of the money it generates. For farmers, the production of palm oil offers a higher standard of living. They afford to buy appliances such as televisions and refrigerators. The money earned from oil palm is four times greater than is possible from the growing of rice or the production of rubber.

To cash in on the palm oil boom, farmers are clearing land the fastest way they know, by burning. (See Figures 8 and 9). But they are not only burning the forest, they are also destroying the peatlands that lie beneath it. These peatlands are one of the world’s largest natural terrestrial carbon sink.

In the absence of human intervention, forests fires in Borneo were very rare events. Peat, which is made up of partially decaying plant material, acts like a giant sponge, soaking up excess water during the monsoon and staying damp to prevent fires during the dry season.

Figure 8: Burning rainforest, Indonesian Borneo



Figure 9: Palm oil plantation on land cleared of its rainforest



Figure 10: Bornean orangutan mother with young



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What is lost on those setting fire to the forest is an appreciation of their ecological importance. The forests are home to 15,000 species of plants, 420 types of bird and 222 mammals, many of which are only found in Borneo. The forest is home to pygmy elephants, clouded leopards, sun bears, mouse deer, flying fox bats, pangolins and the Bornean orangutan. The orangutan is now one of the most critically endangered species on earth. Just 50,000 live in the wild. (See Figure 10).

Like the rainforests of the Amazon Basin, the forests of Borneo have been adversely affected by the warming of the planet. The frequency and intensity of fire have increased even though the vast majority of these blazes have been deliberately lit. Like the deforestation taking place in the Amazon, the loss of forest cover diminishes the environment's capacity to sequester or store carbon and produce oxygen. It also diminishes the flow of moisture into the atmosphere.

* See Appendix 4 for Student Activities

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