

CLIMATE

# THE AMAZON PRODUCES 8% OF THE PLANET'S METHANE

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METHANE  
THE PLANET'S  
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## Most of the gas emitted in the biome comes from wetlands, but the rise in livestock farming and fires has increased emissions associated with human occupation

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**T**he production of methane (CH<sub>4</sub>) in the Amazon accounts for 8% of global emissions of this greenhouse gas, the second most abundant greenhouse gas after carbon dioxide (CO<sub>2</sub>). This figure remained stable between 2010 and 2018. Approximately three-quarters of the methane released in the region, which comprises nine countries and of which 60% is located in Brazil, was produced by the natural decomposition of biomass—essentially trees and vegetation—in wetlands that partially or totally flood over the course of the year. The remainder was emitted as a byproduct of two activities related to human occupation: fires (16% of the total) and cattle farming (11% of the total).

These figures are from an article published in the scientific journal *Communications Earth & Environment* in December 2021. “The Amazon is a major global source of methane, but our data indicate that the region has not contributed significantly to the recent increase in emissions,” explains the study’s lead author, Luana Santamaria Basso, a biologist currently on a postdoctoral fellowship at the Greenhouse Gases Laboratory (LAGEE) at the Brazilian National Institute for Space Research (INPE). Between 2010 and 2018, the Amazon emitted approximately 46 million tons of methane per year, according to the article.

Based on how much of the rainforest is located in Brazil, the country is responsible for 60% of the South American biome’s annual methane emissions: approximately 29 million tons. This equates to 5% of all methane emissions on the planet. “Although the Amazon should not be sin-

gled out as a villain in regard to global methane emissions, the article highlights that emission of the gas due to anthropic [human] activities in the region is greater in the most deforested areas than in the most preserved,” explains Luciana Vanni Gatti, a chemist, LAGEE coordinator, and coauthor of the study. She is also head of a thematic research project under the scope of FAPESP’s Research Program on Global Climate Change (PFPMCG), which monitors the methane balance in the Amazon.

In the last two decades, at least seven studies by international groups with distinct methodologies, including the use of satellite data, have reached very different values on methane production in the region. According to the article cited above, the amount of CH<sub>4</sub> released by the rainforest could vary from less than 10 to approximately 50 million tons per year. Furthermore, studies do not always consider the same geographical area. The article by Basso, Gatti, and colleagues estimated emissions for an area of 7.2 million square kilometers (km<sup>2</sup>), the most widely accepted size of the Amazon, which encompasses the nine countries in the region. Studies that considered similar geographical areas of between 6 and 8 million km<sup>2</sup> arrived at results with a similar order of magnitude; they indicated that from 30 to 47 million tons of methane are produced every year. A study that used an area of just 3.7 million km<sup>2</sup> estimated the amount of CH<sub>4</sub> released by the biome at just over 9 million tons per year.

Once known as swamp gas, methane is produced by the decomposition or decay of organic



matter in geological or biological processes. The former process includes the production of oil, coal, and natural gas. The latter process includes the fermentation of vegetation in wetlands, incomplete burning of biomass, putrefaction of organic waste in landfills, and above all, agricultural activities, such as food digestion by ruminants and, to a lesser extent, rice cultivation in paddy fields.

**A**ccording to data from an international survey published in the journal *Earth System Science Data* in July 2020, 62% of the 580 million tons of CH<sub>4</sub> emitted annually worldwide are attributed to anthropic activities, especially to farming ruminants, such as cattle, sheep, and goats. Microorganisms in these animals' stomachs ferment food during the digestive process, producing methane. By releasing stomach gases through their mouths, ruminants expel CH<sub>4</sub> into the atmosphere. "It's not flatulence that causes cattle to release methane. It is their burps," explains INPE agronomist Jean Ometto, who was not part of the study by his colleagues Basso and Gatti. "Investing in pasture quality is one way to reduce methane production by enteric fermentation."

The new article calculated the amount of CH<sub>4</sub> emitted in the Amazon based on concentrations in 590 air samples obtained during the study. A small plane was used to collect vertical atmospheric profiles twice a month, between 300 meters (m) and 4.4 kilometers (km) of altitude in four regions of the Amazon: 100 km north of

Alta Floresta in Mato Grosso, in the southeast; 40 km south of Santarém, in the northeast of Pará; 300 km east of Rio Branco in Acre, in the southwest; and Tabatinga and Tefé, in Amazonas, in the northwest. These same profiles were used in other studies by Gatti's group to calculate CO<sub>2</sub> emissions in the Amazon in the period (see *Pesquisa FAPESP issue no. 306*).

"High methane production in Amazonian wetlands is no surprise," says Philip Fearnside, a biologist from the Brazilian National Institute of Amazonian Research (INPA) who did not participate in the INPE study. "These estimates have increased recently, partly due to the discovery of substantial emissions by trees in wetland forests." The scientist notes that significant volumes of methane are also released from the reservoirs created by large hydroelectric plants built in the Amazon, such as the Balbina Dam in Amazonas and the Belo Monte Dam in Pará, both of which flooded vast areas of the rainforest. Rivers whose flow rates are controlled by dams are also sources of this greenhouse gas. Studies indicate that in Brazil, most of the methane produced by enteric fermentation in ruminants occurs outside the Amazon, where more than half of the country's 220 million head of cattle live. Brazil is home to more cattle than any other country in the world. "Currently, approximately 40% of them are raised in the Amazon, but this percentage is continuously growing," says Gatti.

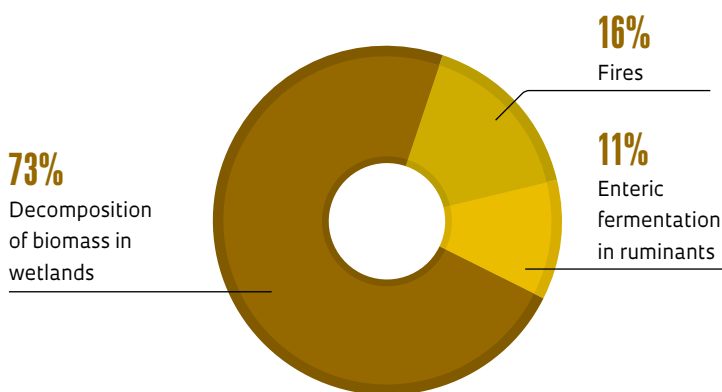
Although the contribution of forest fires and agriculture to methane production in the Amazon is still relatively modest, these activities

Human activities, fires, and cattle farming produce a quarter of the methane emitted in the South American rainforest



# Origins of methane in the Amazon

Processes that generated the greenhouse gas between 2010 and 2018



SOURCE BASSO, L. S. ET AL. COMMUNICATIONS EARTH & ENVIRONMENT. 2021

are having a growing influence as deforestation increases in one sector of the biome. In the southeast of the rainforest—the region most impacted by human occupation—cattle farming and fires are the source of 48% of total CH<sub>4</sub> emissions. In the northeast, natural methane production is up to three times higher than expected.

**G**lobal warming is caused by an increased concentration of greenhouse gases in the Earth's atmosphere compared to the preindustrial period of the mid-nineteenth century. These gases absorb energy and retain heat in the air that surrounds the globe. Since the industrial revolution, the average temperature of the

planet's atmosphere has increased by approximately 1.1 degrees Celsius (°C). Over the past 150 years, the cumulative contribution of methane to global warming has been approximately one-third less than that of carbon dioxide.

Due to this and other particularities of CH<sub>4</sub>, such as its short half-life in the atmosphere (approximately 12 years, while CO<sub>2</sub> has a half-life of 120 years), discussions on combating climate change have primarily focused on reducing carbon dioxide emissions. However, this has changed in recent years, and studies on methane have become increasingly prominent in scientific papers and in reports by the Intergovernmental Panel on Climate Change (IPCC). At the most recent United Nations Climate Change Conference (more commonly referred to as COP26) held in November 2021, Brazil was one of just over 100 countries that committed to reducing methane emissions by 30% by 2030. The country is the fifth-largest annual emitter of methane on the planet, behind only China, Russia, the USA, and India.

“Investing in the reduction of methane emissions could more quickly impact global warming and climate change,” says Ometto. The explanation is simple. Over a two-decade period, one kilogram of methane generates 80 times more heat in the atmosphere than the same amount of carbon dioxide. “CH<sub>4</sub> has a huge impact in the first few years after emission, but it remains in the atmosphere for a short time. In contrast, CO<sub>2</sub> has a milder effect on a yearly basis, but it lasts approximately 10 times longer,” explains Fearnside. The problem is that after going through a period of stability between 1999 and 2006, global methane emissions started to rise again. In September 2021, it reached the highest concentration in history, at 1,900 parts per billion. “In addition to the known sources, there could be other less understood processes associated with methane production. In our study, for example, we observed that there is a major source of methane in northeastern Amazonia that is as yet unidentified. We have not been able to determine where it's coming from,” says Basso. ■

## Project

Interannual variation of Amazon Basin greenhouse gas balances and their controls in a warming and increasingly variable climate – CAR-BAM: the Amazon carbon balance long-term study (No. 16/02018-2); **Grant Mechanism** Thematic Project; Global Climate Change Research Program; **Principal Investigator** Luciana Vanni Gatti (Inpe); **Investment** R\$4,436,420.43.

## Scientific articles

BASSO, L. S. *et al.* Amazon methane budget derived from multiyear airborne observations highlights regional variations in emissions. **Communications Earth & Environment**. Nov. 29, 2021.  
SAUNOIS, M. *et al.* The Global Methane Budget 2000–2017. **Earth System Science Data**. v. 12, i. 3. July 2020.

