https://news.mongabay.com/2024/01/amazonia-in-flames-unlearned-lessons-from-the-2023-manaus-smoke-crisis-commentary/

MONGABAY
NEWS & INSPIRATION FROM NATURE'S FRONTLINE

Amazonia in flames: Unlearned lessons from the 2023 Manaus smoke crisis (commentary)

Commentary by Lucas Ferrante, Philip M. Fearnside on 17 January 2024

- *In 2023 the city of Manaus, in central Amazonia, found itself covered in dense smoke from burning rainforest, with levels of toxic PM 2.5 particulates even higher than those experienced that year during the pollution crisis in New Delhi, India.*
- *The governor of Brazil's state of Amazonas, where Manaus is located, blamed the neighboring state of Pará for the smoke, a politically convenient theory we show to be false.*
- *The fires responsible for the smoke were south of Manaus in an area of Amazonas impacted by the notorious BR-319 highway, where a proposed "reconstruction" project would have disastrous environmental consequences by opening vast areas of rainforest to the entry of deforesters.The BR-319 highway project is a top priority for politicians in Amazonas, who take pains not to admit to the project's impacts. The project's environmental license is not yet approved, and the Manaus smoke crisis should serve as a warning as to how serious those impacts would be.*
- *This text is a commentary and does not necessarily reflect the views of Mongabay.*

From September to November 2023 Manaus, a city located in the relatively intact forest area in the central part of Brazilian Amazonia, was surprised to find itself under a dense cloud of smoke, with undeniable impacts on human health and the quality of life in the city. Manaus is also the focus controversy surrounding a planned highway construction project that would rebuild and pave BR-319, connecting Manaus to Porto Velho in the state of Rondônia in Brazil`s "arc of deforestation," specifically in the "AMACRO" region.

"AMACRO" stands for the states of Amazonas, Acre and Rondônia, and the area around the junction of these states has become one of Brazil's main deforestation hotspots in recent years. BR-319 was built by Brazil's military dictatorship in 1972-1973 but was abandoned by the Ministry of Transportation in 1988 because the cost of maintenance was unjustifiable. Since 2015 a so-called "maintenance" program has progressively improved the road, making it passable during the dry season, but a planned "reconstruction" and paving project has not yet received environmental approval. Obtaining approval and federal funding for this project is a major political priority in Manaus, the capital city of Brazil's state of Amazonas. The environmental consequences of the planned project would be devastating as BR-319 and associated planned side roads would open approximately half of what remains of Brazil's Amazon forest to the entry of deforesters (see here, here, here, here, here, here and here). Politicians in Manaus take great pains to avoid any recognition of the project`s likely impacts (e.g., see here, here, here and here). The smoke crisis in Manaus was therefore politically inconvenient.

The governor of the state of Amazonas (Wilson Lima) and the Secretary of the Environment (Eduardo Taveira) stated that the pall of smoke over Manaus in 2023 was not from Amazonas, but rather from the state of Pará. Although it is politically convenient to blame the neighboring state for the fires that produce the smoke, the data presented here indicate that the smoke that hung over Manaus came mainly from fires in the state of Amazonas, south of the city, and, therefore, reflected the advance of agriculture and ranching in this area.

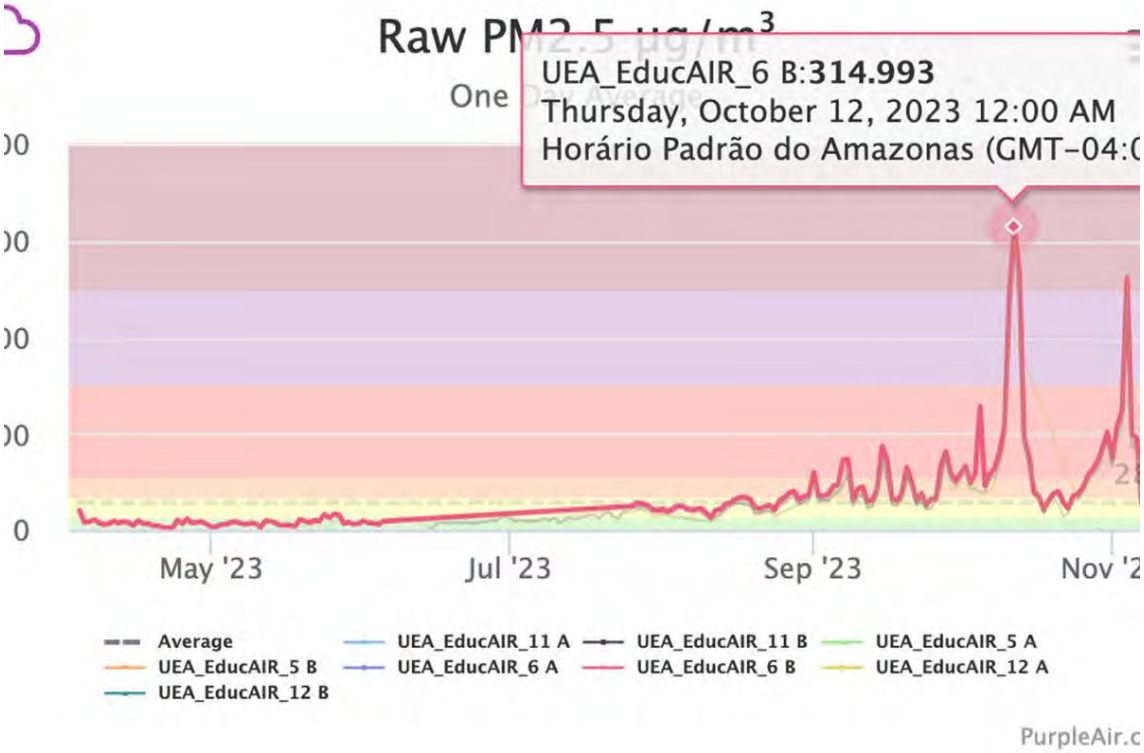

Figure 1. Particulate matter levels in Manaus for the PM 2.5 size class (the worst for human health) as measured by sensors of the State University of Amazonas (UEA).

Manaus is used to having clean air, except for the pollution generated by the urban population itself. However, on October 12, 2023, the air in Manaus had a PM 2.5 particulate content of 314.99 micrograms per cubic meter of air (µg/m³) (Figure 1), a level even worse than the 2023 crisis in New Delhi, India, where this value reached 306 µg/m³. The maximum value considered acceptable by the World Health Organization is 15 µg/m³. From September 2023 until the beginning of the rainy season in December the population of Manaus was living with smoke and had to resume using the masks they had abandoned since the COVID-19 pandemic. Events like this are very rare in Manaus, in contrast to what is routinely experienced by the inhabitants of Brazil's "arc of deforestation," where smoke on this scale is normal during several months of the year and has negatively affected people's life expectancy.

The fires closest to Manaus were, for the most part, located south of the Amazon River (Figure 2).

Figure 2. Fires in the Manaus region on October 9, 2023.

In a "normal" year, the smoke from fires in this area would not reach Manaus, instead being carried to the west towards Peru. But 2023 was not a "normal" year. Two types of El Niño (eastern and central) caused a major drought in the Manaus region, increasing the number of fires. In addition to El Niño, Amazonia was under the effect of the phenomenon known as the "Atlantic dipole" (see here and here). The dipole results from formation of a patch of warm water in the tropical North Atlantic and a patch of colder water in the South Atlantic. The dipole is evident in Figure 3.

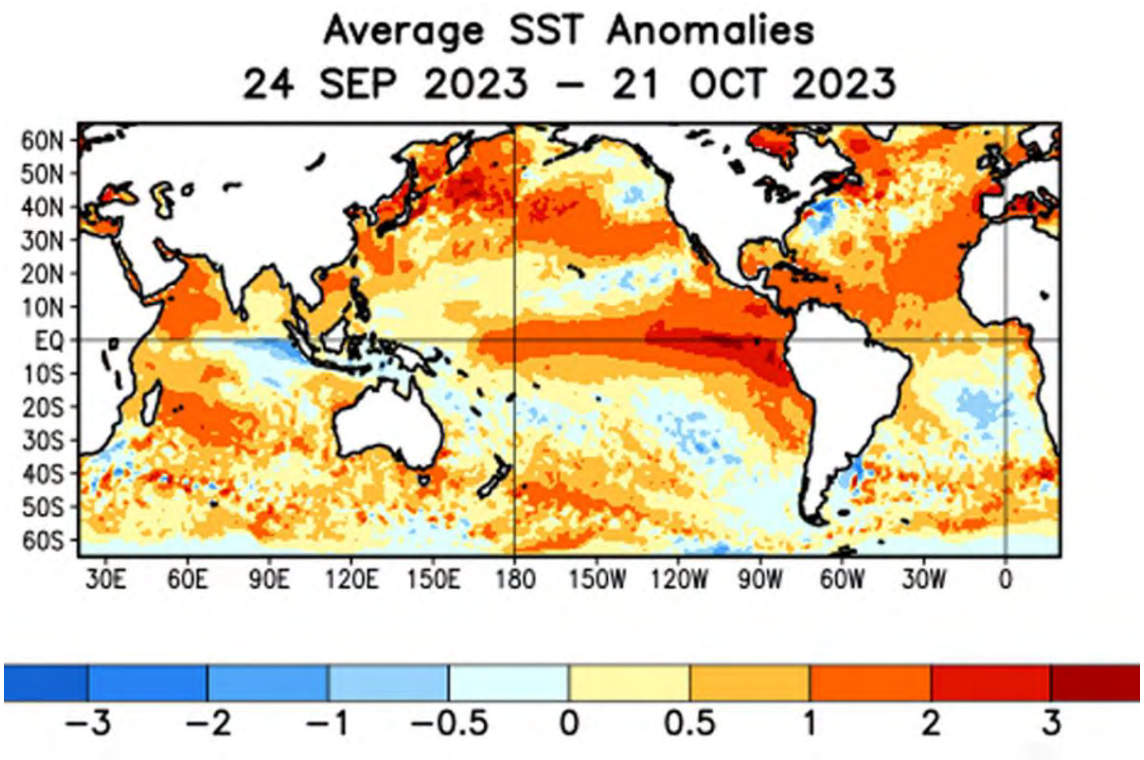

Figure 3. Average sea surface temperature (SST) anomalies over the world's oceans from September 24 to October 21, 2023.

An Atlantic dipole can cause a wind pattern different from normal, with a reversal of wind direction. This happened during the disastrous Atlantic dipole in 2005, when the southwestern Amazon was hit by a severe drought, causing forest fires in Acre and southern Amazonas, and Manaus was hit by gusts of wind coming from the west, which felled areas of forest.

The prevailing winds in Manaus blow from east to west as a result of the Earth's rotation and the effect of air movement to meet the intertropical convergence zone (ITCZ). The ITCZ is a line that follows the latitude where radiation from the sun hits the Earth's surface directly, heating the air and causing this air to rise, thus pulling air from both the southern and northern sides. The exact wind direction depends on the season, which determines the position of the ITCZ. To arrive in Manaus, these prevailing winds pass over the large area of forest with little deforestation, located north of the Amazon River.

Data from the ATTO (Amazon Tall Tower Observatory) confirm the role of fires near Manaus in explaining the large smoke spike in the city. The ATTO is a 325-m tower located east of Manaus, near the Uatumã River, where INPA and partners from Germany have been monitoring atmospheric data since 2015. The highest peak in Manaus was on October 12, 2023, with PM 2.5 particles at 314 µg/m³ in the southern part of the city, as measured by sensors of the State University of Amazonas (UEA). On the same date, the ATTO recorded 141 µg/m³ (Figure 4). Even if we consider that the smoke that was at the ATTO on October 10th (the ATTO's highest record) took 2 days to reach Manaus, Manaus still exceeds the ATTO's highest peak by more than 110 µg/m³. Therefore, the smoke from Pará did

not explain the peak in Manaus, even if all the smoke detected at the ATTO subsequently reached the city.

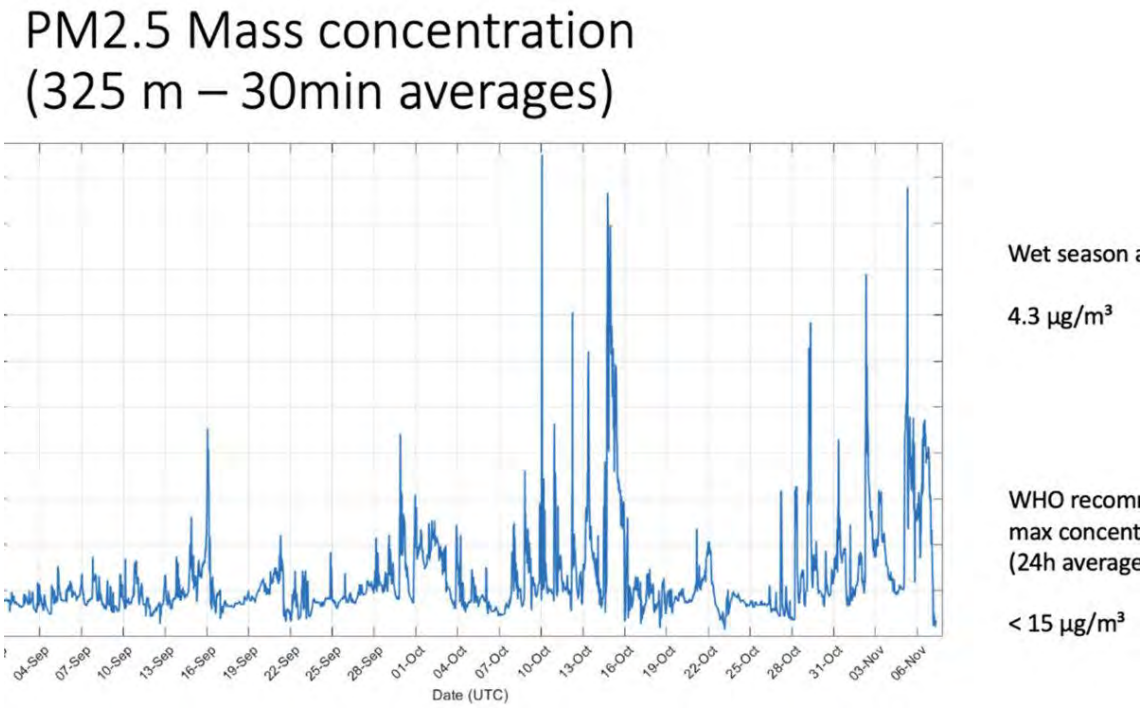

Figure 4. PM 2.5 particulates measured at the ATTO tower.

In addition, the UEA sensors in Santarém registered the first peak after October 12th, only occurring on the 13th, reaching 205 µg/m³ — a level much lower than the maximum in Manaus. If the smoke from Pará were responsible for the smoke levels in Manaus, the peak in Pará would have to be one or more days in advance and not a day later, and the quantity of particulates would have to be much higher there than that recorded in Manaus.

The wind map for October 29th produced by the National Institute of Meteorology (INMET) shows Manaus in the middle of a large area of practically still air (Figure 5).

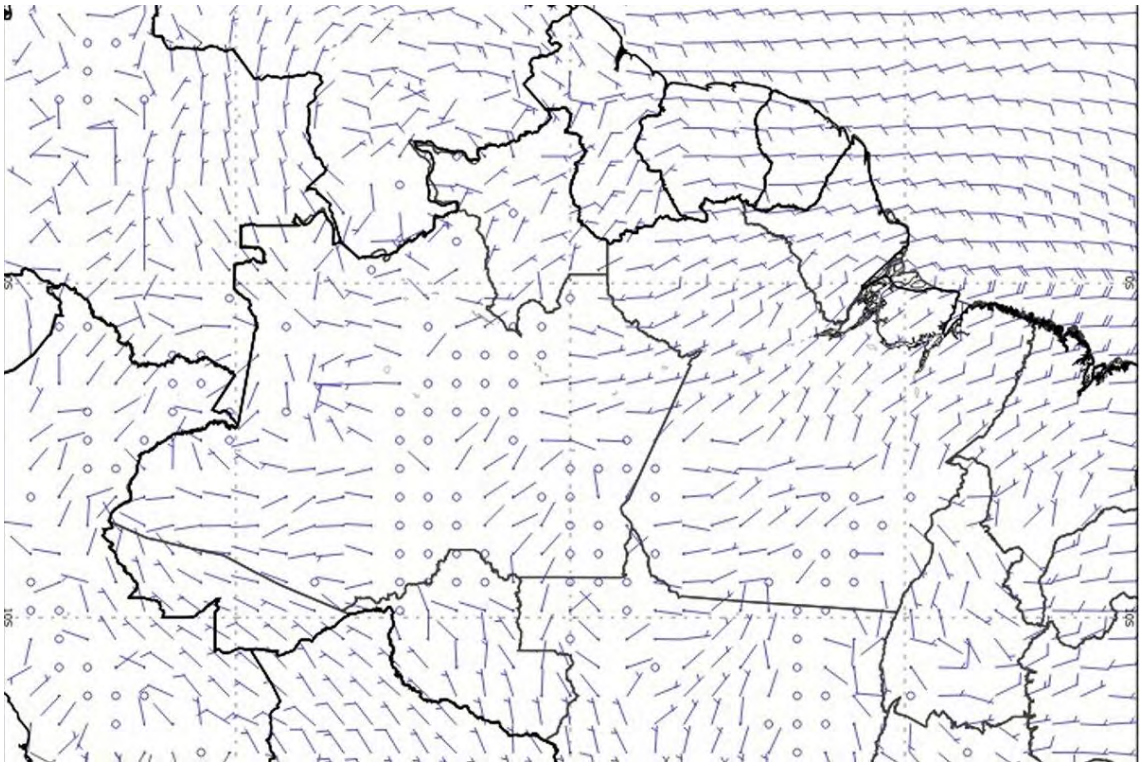

Figure 5. Arrows show the flow of winds and circles show the absence of atmospheric circulation on October 29, 2023 (INMET).

This pattern subsequently changed to a configuration closer to normal, with winds blowing from east to west on November 9, 2023 (Figure 6). On that date, Manaus presented better air quality indices and the sky was clean and clear.

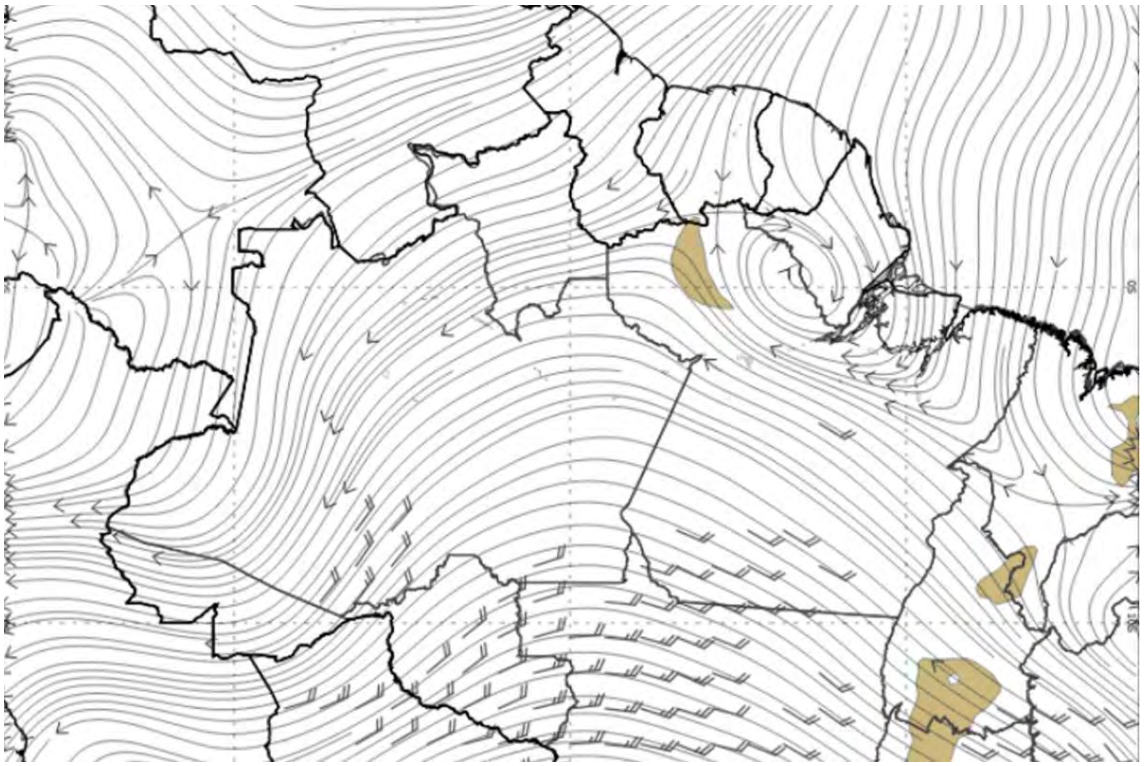

Figure 6. Winds on November 9, 2023, indicating a change in the pattern, with air from Santarém arriving in Manaus, via INMET.

Particulate-emission and air-quality data show a large smoke patch coming from the region south of Manaus, which was clearly separated from the patch over Santarém, Pará (Figure 7).

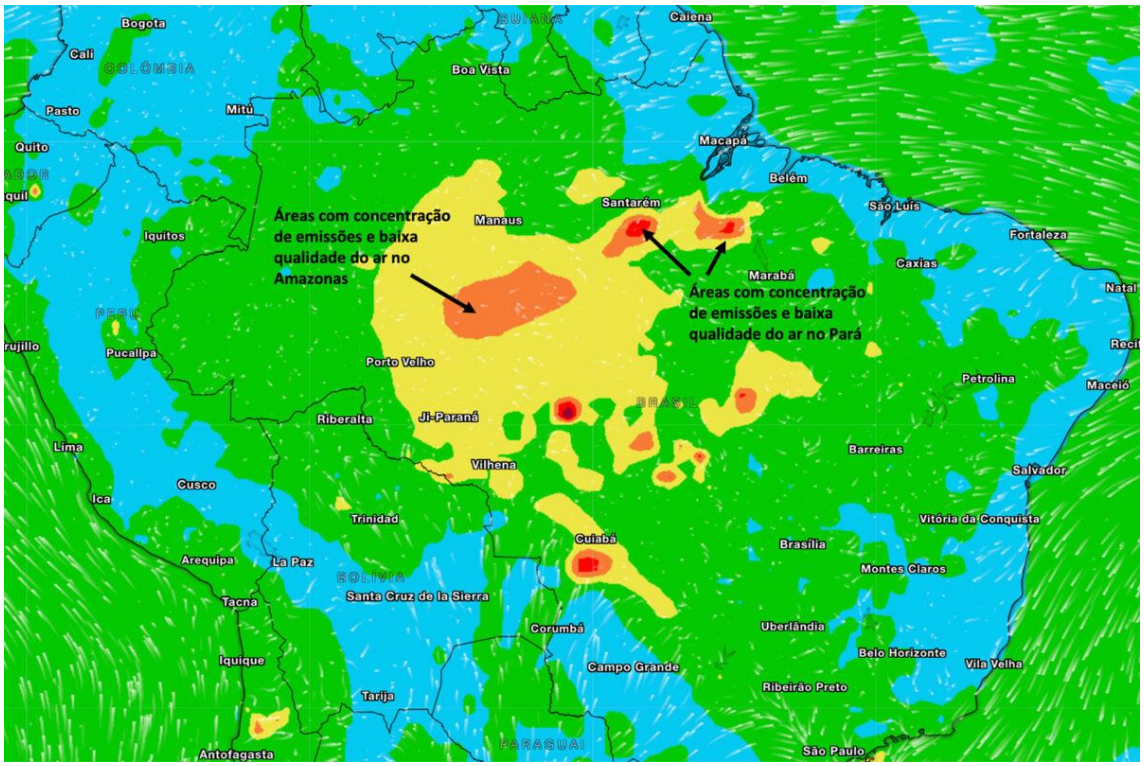

Figure 7. METEORED data showing emission concentrations and low air quality

over the central and eastern Amazon. Warm colors indicate greater particulate concentrations and colder colors indicate areas with lower concentrations (Image taken from METEORED on November 3, 2023.

The image for November 3rd indicates fires in the municipalities of Autazes and Careiro, and at other locations southeast of Manaus (Figure 8). The municipality of Autazes, which is known for deforestation and forest fires, was noteworthy in the 2023 fires. The Electronic Environmental Surveillance System (SELVA), at the State University of Amazonas (UEA), indicated that the smoke in Manaus was coming from the fires south of Manaus, rather than originating in Pará. On the other hand, some researchers at the National Institute for Space Research (INPE) highlighted the impressive amount of smoke over Pará and thought that this could be being transported to Manaus, in addition to the smoke produced by fires around the city.

However, in relation to the images they had of the smoke peak on November 6, 2023, these researchers pointed out that: "After the smoke 'burst' through the limits of the scale, the equipment and the Modis sensor could not identify what was smoke and what was cloud." INMET data corroborate the presence of clouds over the region, where Manaus recorded rain from 8 am until 2 pm on November 7th. The Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) in Manaus indicated that the burning at sites south of Manaus was the origin of the smoke cloud that covered the city, but when the IBAMA headquarters in Brasília was asked about the origin of the smoke, the spokesperson did not answer the question, only giving a list of the agency's actions to combat fires throughout the Amazon.

UEA data show that, of the university's 14 air-quality measurement stations distributed in the municipality of Manaus, the station farthest east of the city (the direction from which winds would come from Pará) had the lowest daily levels of particulates, and the highest levels were for the 4 stations further south of Manaus, which would receive the greatest impact from smoke coming from locations along the BR-319 highway (Figure 8). We cannot ignore the fact that the smoke from Pará can reach some parts of the state of Amazonas, since the atmosphere is fluid; however, the data show that it is not possible to attribute the cloud of smoke that hovered over Manaus from September to November 2023 to the fires in Pará.

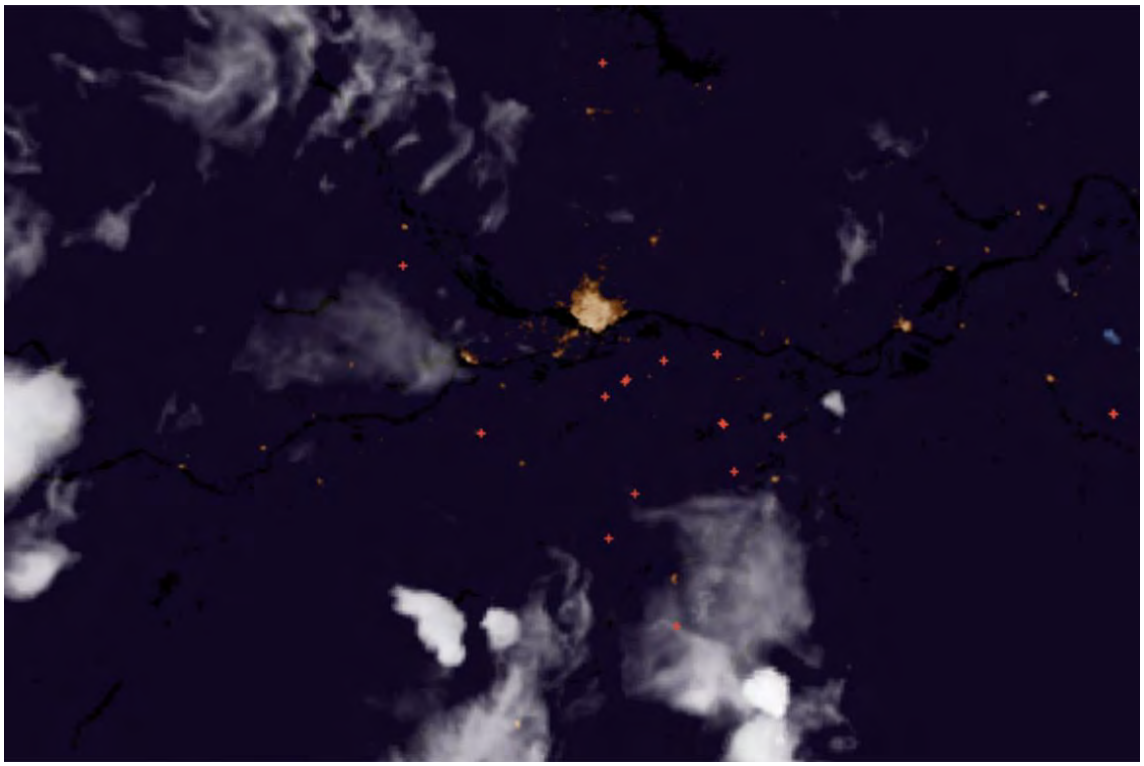

Figure 8. Image of alerts from the "Queimadas Project" reference satellite, from the National Institute for Space Research (INPE), on November 3, 2023. Fire hotspots appear in the municipalities of Careiro and Autazes, a region impacted by the BR-319 highway.

As an aggravating factor, smoke affects drought in a way that would reinforce the severity of the smoke crisis in Manaus. Excess smoke inhibits rainfall, an important discovery of LBA (Large Scale Biosphere-Atmosphere Program in the Amazon), which is based in Manaus at the National Institute for Research in Amazonia (INPA) since 2002. To form rain, water vapor in the air needs to condense around a "cloud condensation nucleus" (CCN), that is, some particle, such as soot in smoke. When the number of particles is very large, the droplets that form are too small to fall to the ground as rain. This forms a positive feedback loop, where smoke increases, inhibits rain and prolongs the drought, leading to more fires and more smoke. On the other hand, when the end of the smoke peak begins, the feedback would have the opposite effect, with less and less smoke, more rain and fewer fires.

The areas south of the Amazon River, where the fires were generating the smoke that was reaching Manaus, have been receiving actors migrating from the notorious "AMACRO" region (the deforestation hotspot around the junction of the states of Amazonas, Acre and Rondônia) via the BR-319 highway. This is just the beginning, as the impact would be much greater if the BR-319 highway is rebuilt and paved. The cumulative area of deforestation in the Manaus area is much smaller than the areas already deforested in the AMACRO region. The population of Manaus is quite innocent regarding the risks and impacts of deforestation that can be generated by the BR-319 highway, as the lack of paving is a factor that has contributed to the environmental protection of the Manaus area. Deforestation and fires in the

AMACRO region are on a scale that is essentially unimaginable for the population of Manaus (Figure 9).

Figure 9. Fire in the AMACRO region in August 2022 (Photo: Nilmar Lage/Greenpeace, August 30, 2022).

The proposed reconstruction of the BR-319 highway would bring processes and actors from the AMACRO region to the Manaus area and to all areas already connected to Manaus by road, such as the state of Roraima, via the BR-174 highway. Vast areas of primary forest would also be opened by planned roads that would connect to BR-319, such as AM-366, which would provide access to the Trans-Purus region, west of the Purus River (see here, here and here). These impacts can be expected to have repercussions on Manaus, with smoke similar to the levels that plague the AMACRO region every year. Smoke over the AMACRO region and over Pará and northern Mato Grosso is common, but beginning in September 2023 there was also an enormous patch of smoke in the state of Amazonas over the BR-319 highway and Trans-Purus area (Figure 10), which is an entirely new feature. Manaus is receiving a small warning of the impact expected if BR-319 is rebuilt.

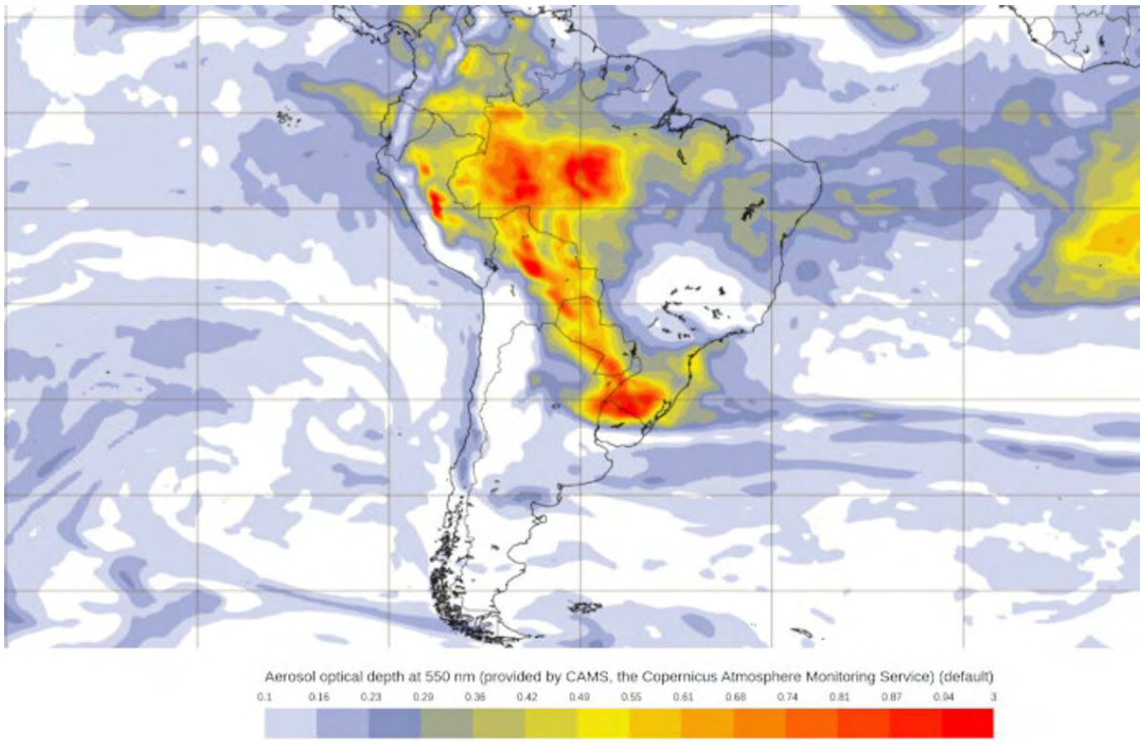

Figure 10. Smoke on September 20, 2023, showing a large patch of smoke in the state of Amazonas over the BR-319 highway and Trans-Purus region. Note also that the patches of smoke over Pará and Amazonas are separate, indicating that the smoke in Amazonas was not transported from Pará as claimed by the governor of Amazonas. (Image from INMET).

This text is updated from a version in Portuguese published by Amazônia Real.