1	LAT	LON	SCA	TRAC	DATE	DAY	MONTH	TIME PER GMT4	SAT	INST	CONF	VER	BT1	BT2	XBT	FRP	FI (C2-adapte
69779	-1.02551	-60.4782	0.39	0.36	Friday, September 15, 2023	Fri	Sep	12:00 - 18:00 PM	N	VIIRS	n	2.0NRT	337.17	301.14	319.16	5.31	LOW (FR
69780	-1.02516	-60.4778	0.58	0.7	Friday, September 15, 2023	Fri	Sep	12:00 - 18:00 PM	1	VIIRS	h	2.0NRT	367	294.91	330.96	32.79	LOW (FR
69781	-1.01301	-62.112	0.54	0.51	Sunday, September 3, 2023	Sun	Sep	12:00 - 18:00 PM	1	VIIRS	n	2.0NRT	330.27	296.07	313.17	1.79	LOW (FR
69782	-1.00805	-60.3748	0.39	0.36	Sunday, October 1, 2023	Sun	Oct	12:00 - 18:00 PM	N	VIIRS	n	2.0NRT	341.4	292.83	317.12	3.87	LOW (FR
69783	-0.98538	-61.9304	0.52	0.41	Thursday, September 14, 2023	Thu	Sep	12:00 - 18:00 PM	N	VIIRS	n	2.0NRT	332.68	301.19	316.94	4.01	LOW (FR
69784	-0.97423	-60.5545	1.02	1.01	Sunday, October 29, 2023	Sun	Oct	12:00 - 18:00 PM	Aqua	MODIS	50	6.1NRT	315.1	299.47	307.29	5.92	LOW (FR
69785	-0.97292	-60.5455	1.02	1.01	Sunday, October 29, 2023	Sun	Oct	12:00 - 18:00 PM	Aqua	MODIS	84	6.1NRT	332.18	300.17	316.18	24.8	LOW (FR
69786	-0.96747	-60.2204	0.53	0.42	Tuesday, October 3, 2023	Tue	Oct	12:00 - 18:00 PM	1	VIIRS	n	2.0NRT	337.8	294.81	316.31	50.77	MOD (50-
69787	-0.96685	-60.2248	1.02	1.01	Tuesday, October 3, 2023	Tue	Oct	12:00 - 18:00 PM	Aqua	MODIS	91	6.1NRT	341.19	291.55	316.37	40.06	LOW (FR
69788	-0.96571	-60.3843	2.63	1.56	Monday, September 4, 2023	Mon	Sep	12:00 - 18:00 PM	Aqua	MODIS	59	6.1NRT	316.76	299.51	308.14	37.15	LOW (FR
69789	-0.96524	-60.5519	0.43	0.46	Wednesday, September 27, 2023	Wed	Sep	12:00 - 18:00 PM	N	VIIRS	n	2.0NRT	332.13	298.59	315.36	14.97	LOW (FR
69790	-0.96466	-60.548	0.43	0.46	Wednesday, September 27, 2023	Wed	Sep	12:00 - 18:00 PM	N	VIIRS	n	2.0NRT	340.93	299.94	320.44	14.97	LOW (FR
69791	-0.96456	-60.5624	0.45	0.63	Monday, September 4, 2023	Mon	Sep	12:00 - 18:00 PM	1	VIIRS	n	2.0NRT	334.29	297.52	315.91	5.82	LOW (FR
69792	-0.96427	-60.561	0.43	0.38	Monday, September 4, 2023	Mon	Sep	12:00 - 18:00 PM	N	VIIRS	n	2.0NRT	345.23	305.23	325.23	5.86	LOW (FR
69793	-0.96397	-60.5483	0.43	0.46	Sunday, October 29, 2023	Sun	Oct	12:00 - 18:00 PM	N	VIIRS	n	2.0NRT	335.12	294.01	314.57	17.69	LOW (FR
69794	-0.96394	-60.5468	1.02	1.01	Sunday, October 29, 2023	Sun	Oct	12:00 - 18:00 PM	Aqua	MODIS	60	6.1NRT	315.05	299.29	307.17	5.89	LOW (FR
69795	-0.96338	-60.5444	0.43	0.46	Sunday, October 29, 2023	Sun	Oct	12:00 - 18:00 PM	N	VIIRS	n	2.0NRT	342.84	294.98	318.91	17.69	LOW (FR
69796	-0.96223	-60.3848	0.44	0.62	Monday, September 4, 2023	Mon	Sep	12:00 - 18:00 PM	1	VIIRS	n	2.0NRT	349.35	299.6	324.48	49.84	LOW (FR
69797	-0.96167	-60.381	0.44	0.62	Monday, September 4, 2023	Mon	Sep	12:00 - 18:00 PM	1	VIIRS	h	2.0NRT	367	305.42	336.21	49.84	LOW (FR
69798	-0.96163	-60.5447	0.53	0.5	Sunday, October 29, 2023	Sun	Oct	12:00 - 18:00 PM	1	VIIRS	n	2.0NRT	342.4	296.74	319.57	27.29	LOW (FR
69799	-0.95974	-60.381	0.44	0.62	Monday, September 4, 2023	Mon	Sep	12:00 - 18:00 PM	1	VIIRS	h	2.0NRT	367	301.65	334.33	114.85	HIGH (100
69800	-0.95916	-60.545	0.43	0.46	Sunday, October 29, 2023	Sun	Oct		N	VIIRS	n	2.0NRT	343.89	294.16	319.03	85.9	MOD (50-
69801	-0.95885	-60.384	0.43	0.38	Monday, September 4, 2023	Mon	S			VIIRS	n	2.0NRT	343.35	309.05	326.2	19.7	LOW (FR
69802	-0.95795	-60.3785	2.63	1.56	Monday, September 4, 2023	Mon				OIS	43	6.1NRT	312.98	297.68	305.33	24.9	LOW (FR
69803	-0.94709	-60.6233	0.36	0.58	Friday, October 27, 2023	Fri					n	2.0NRT	345.65	292.15	318.9	3.5	LOW (FR
69804	2.667	-59.446	2859	3559	Thursday, September 28, 2023	Th					74	1.0NRT	348.8	290.2	319.5	262.9	HIGH (100
69805	2.901	-61.002	2872	3477	Wednesday, October 4, 2023	W					98	1.0NRT	335.9	296.1	316	139.5	HIGH (100

Article on the Brazilian Amazon Region

The intense thermal sources that polluted the air in Manaus

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Translation of the article published in JCAM
6th December 2023 - during the celebration of National Rural Extensionist Day

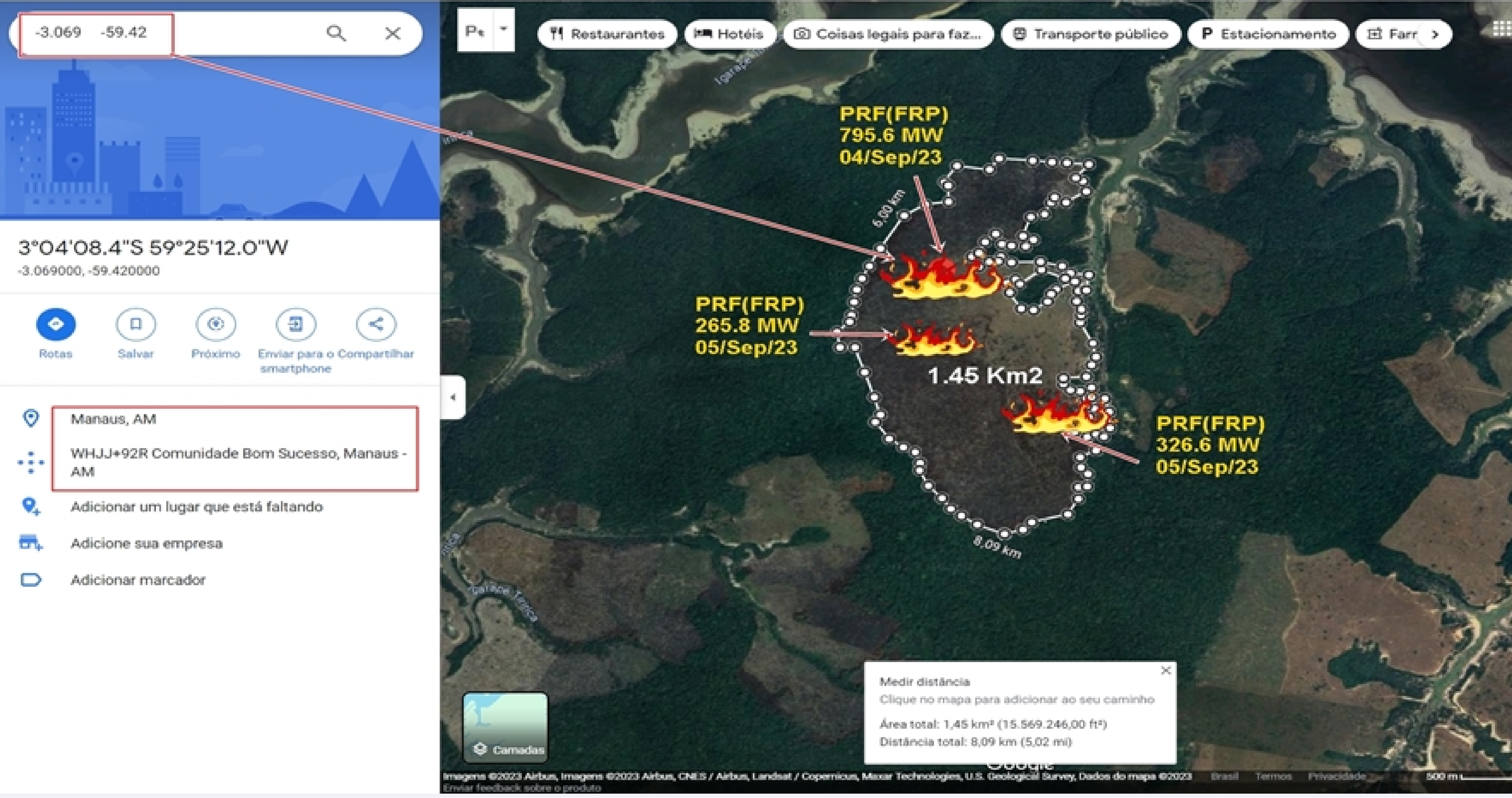

Figure 7: Burned Areas in the Rural Area of Manaus in September 2023

Source: NASA FIRMS, da Silva (2023) and Google Maps

On brazilian national rural extensionist day, this article reveals the geolocation and profile of the main active fire hotspots and thermal anomalies occurring in Manaus (Figures 7 and 8) that caused serious environmental damage and contributed to the deterioration of air quality between August and October 2023.

Today, 6th December 2023, marks the 75th anniversary of national rural extensionist day, created in 1948, made official by PL 2191/2007 and sanctioned as Law 12386 on 03 March 2011. Rural extension aims to ensure the quality production in the countryside and the rural extensionist is the key professional who helps farmers, especially smallholders, to overcome challenges such as access to credit, training and technical assistance.

According to ASBRAER, there are around 13,690 rural extensionists and 1,126 researchers serving 5,007 locations in Brazil <**https://www.asbraer.org.br/>**. Thus, ASBRAER could, together with UEA, INPA, UFAM and EMBRAPA, integrate efforts from federal, state and municipal authorities to help farmers on varying scales adopt sustainable practices. This support would be especially crucial in our region, where deforestation and burning on rural land are out of control, as evidenced in the latest articles published in the Jornal do Comércio do Amazonas (JCAM). Of the 2,274 thermal events considered intense or very intense, mentioned last week article <**https://tinyurl.com/yzsmcsnk>**, the majority (98.11%) occurred in cities outside of Manaus: Autazes (487; 21.42%), Itacoatiara (338; 14.86%), Careiro (222; 9.76%), Nova Olinda do Norte (209; 9.19%), Manaquiri (192; 8.44%), Borba (161; 7.08%), São Sebastião do Uatumã (73; 3.21%), Manacapuru (62; 2.73%), Anamã (61; 2.68%), Caapiranga (59; 2.59%) Careiro da Várzea (57; 2.51%), Presidente Figueredo (56; 2.46%), Maués (49; 2.15%), Urucurituba (46, 2.02%), among others.

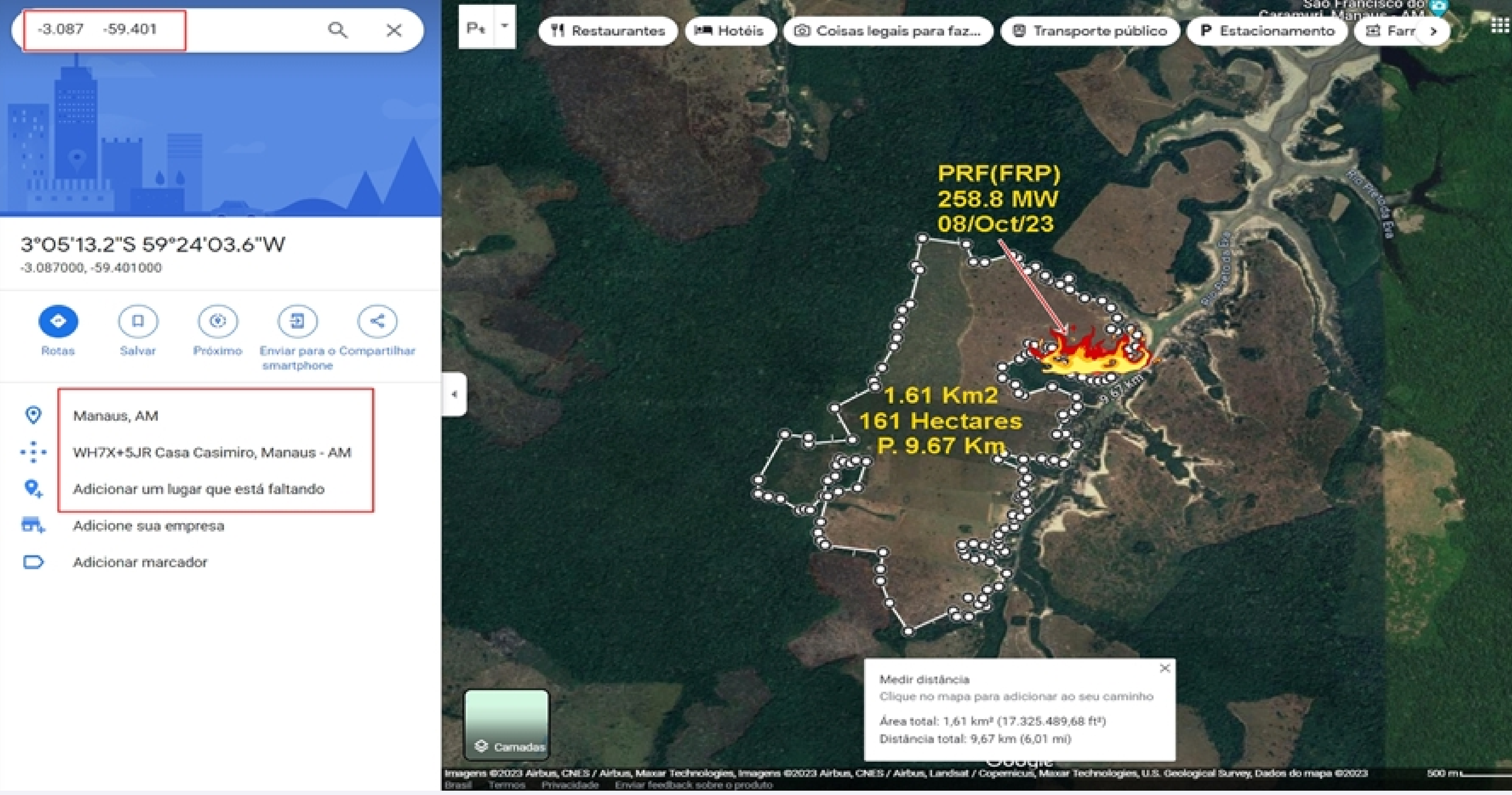

Figure 8: Intense active fire & destroyed areas in "Casa Casimiro" located in Manaus rural area - 08 October 2023

Source: NASA FIRMS, da Silva (2023) and Google Maps

This article starts with Manaus, the capital of Amazon, where the state's main policies emanate from. In terms of the number of outbreaks, Manaus ranked 15th among the 29 cities identified, recording around 43 records (1.89%). Of these, 17 (39.5%) occurred in green areas near destroyed areas, 10 (23.2%) in areas already destroyed by deforestation or burning, 9 (20.9%) in green areas near rivers, 4 (9 ,3%) in green areas and 3 (6.97%) in destroyed areas near rivers.

The preferred rivers or streams to drain products derived from the destruction of vegetation, such as charcoal and/or timber, are Igarapé Tiririca and Rio Preto da Eva. Thus, it is recommended to strengthen supervision and monitoring of these waterways.

The average and median Fire Radiative Power (FRP) of the 43 outbreaks were 198 MW and 155 MW, respectively. To give an idea of the power of these events, if this amount of energy were wisely generated by a solar power plant installed inland, with annual production of 198 MW and 15% efficiency, over the 8,760 annual hours of production, it would be enough to supply around 174 homes for a whole year. This would happen without polluting the air, without generating thermal discomfort and without the need to knock down or burn a single tree on site.

Now comes the most anticipated part, the location of these events. By analyzing each of the 43 records, it was noticed that only two (4.6%) occurred in an urban neighborhood of Manaus, while the majority (95.4%) occurred in rural areas of the city.

The outbreaks identified in Manaus are located in the East Zone, in the Puraquequara neighborhood. One of them occurred in a green area near a destroyed area, about 132 meters from Dona Fátima's farmhouse (Latitude -2.95216; Longitude -59.84298; FRP=111.4MW), while the other occurred in a green area located on an unknown side road, about 580 meters away from Dona Fátima's farmhouse (Latitude -2.95091 and Longitude -59.84805; FRP of 101.2 MW).
Regarding outbreaks in rural areas of Manaus, it was observed that the most critical region is the Bom Sucesso Community, 70 km from Manaus, with 32 cases (74.4%): 15 cases near Igarapé Tiririca with XFRP equal to 266 MW; 10 close to the Nossa Senhora do Nazaré Municipal School with XFRP equal to 176 MW; and 9 cases identified by Google Maps as "Casa Casimiro", near the Rio Preto da Eva, with XFRP equal to 187.63 MW. By the way, "Casa Casimiro" also appears in several destroyed areas in Amatari (Itacoatiara city) and in the city of Rio Preto da Eva. Therefore, more detailed analysis by the authorities is required to confirm whether this enterprise is linked to the intense burning and deforestation in these regions.
Another seven records occurred around BR174 road, two in the Pau Rosa region, two more in another region that Google Maps identifies as "Matel" and three occurred on an unknown side road.
The ten records with the greatest destructive power, in terms of FRP, occurred in the Bom Sucesso Community, as follows:
1) Near Igarapé (stream) Tiririca:
R1 and R2: latitude -3,069 and longitude -59.42, recorded about 70 km from the center of Manaus, on 04 september 2023, between 12pm and 6pm, with FRP equal to 795.6 and 642.3 MW, classified as very intense fires. In these cases, the confidence levels were 81% and 84%, respectively.
R3: latitude -3,069 and longitude -59,439, about 69 km from the center of Manaus, recorded with 81% confidence on 04 September 2023, between 12pm and 6pm, with FRP equal to 408.9 MW.
R4 and R5: latitude -3.07583 and longitude -59.41488 (FRP=326.6MW); latitude -3.07172 and longitude -59.42074 (FRP=265.8MW), recorded with 100% confidence, between 6:01pm and 11:59pm on 05 September 2023.
By analyzing records 1, 2, 4 and 5, it was observed, via Google Maps, that they occurred in a 145 hectare destroyed area, within a perimeter of 8.09 km, as shown in Figure 7, also available in the digital repository below.
2) In the areas of "Casa Casimiro"
R6 and R8: latitude -3,087 and longitude -59,382, green area near Rio Preto da Eva, with 74% and 77% confidence, over the period from 12pm to 6pm on 10 August 2023, with FRP values equal to 259.9 and 250.7 MW.
R7: latitude -3.087 and longitude -59.401, with 81% confidence, between 12pm and 6pm on 10 August 2023, with FRP equal to 254.8 MW. Here, it is important to note that the event occurred in an area with about 161 hectares destroyed near Rio Preto da Eva river, as shown in Figure 8, also available in the digital repository below.
3) Near the Municipality School Nossa Senhora de Nazaré
R9 and R10: latitude -3,124 and longitude -59,438, with an average of 69% confidence, between 12pm and 6pm on 04 September 2023, with FRP values equal to 248.9 and 245.8 MW.
Finally, it is necessary to improve transparency and collaboration between organizations, rural extensionists, research technicians to avoid uncontrolled repetition of deforestation and burning, which cause high rates of heat and air pollution in the region. The findings highlight the importance of improving surveillance, monitoring and intervention strategies as part of a long-term sustainable development plan, focusing on critical areas near Puraquequara suburb, BR174 road, Bom Sucesso Community and the identified waterways.
Note: the author thanks the staff at NASA/FIRMS, GPS Coordinate, Google Maps, Harvard University for their valuable platforms. The study details with articles, spreadsheet, geolocations, figures are available in the Harvard University Dataverse with DOI<https://doi.org/10.7910/DVN/UOZQ5O>.