



Impact of wildfires and meteorological conditions on PM_{2.5} pollution in a Brazilian mining city



Ana Luz Damasceno¹, Amanda Ribeiro¹, Taciana Toledo¹

¹ Department of Sanitary and Environmental Engineering, Federal University of Minas Gerais, Belo Horizonte, Brazil

Introduction

- In september of 2024, a large occurence of wildfires in the state of Minas Gerais generated a critical air quality situation in the municipality of Congonhas, a city surrounded by mining activities.
- This study aimed to evaluated the data from a low cost monitoring station to understand the behavior of particulate matter concentrations and the influence of meteorological conditions and wildfire occurences.

Methods

Denifition of the investigation period: August 24th to September 14th

Use of air pollution data collected by the low-cost monitoring station “Kunak Air Pro”, from the company ACOEM

Use of wildfire data wildfire data from the National Institute of Spatial Research of Brazil (INPE)

Organization of the data into hourly and daily averages to generate time series for the PM_{2.5} concentration

Pearson correlation analyses between meteorological variables and the PM_{2.5} concentration as well as between the number of fire hotspots and the PM_{2.5} concentration

Comparison between the low-cost station data and the data from the nearest automatic monitoring station from the official network

Use of HYSPLIT backward trajectory model to analyze the behavior of the air masses that reached the monitoring stations and compare with the fire hotspots location

Results

- There were significant increases in pollution levels between September 1st and 7th, with levels exceeding WHO guidelines by up to 483%;
- Moderate positive correlation ($R = 0.47$) between the number of fire hotspots in Minas Gerais and the PM_{2.5} daily average concentration;
- Medium-large negative correlation ($R = -0.58$) for humidity, moderate positive correlation ($R = 0.40$) for temperature and medium positive correlation ($R = 0.32$) for wind speed;
- As it is a mining city, strongly linked to emissions from resuspension, higher wind speeds tend to worsen air quality, but for this period the opposite was observed, demonstrating that the influence of wildfires was greater than that of industrial emissions;
- A very good correlation was observed between the data from the low cost and the oficial network monitoring stations;
- The HYSPLIT backward trajectory for 36 hours prior to September 5 at 14:00 (UTC-3) at a level of 100m above ground coincide with the location of some of the wildfire hotspots, reinforcing the possibility of the direction of particulate matter emissions from fire sources towards the municipality.

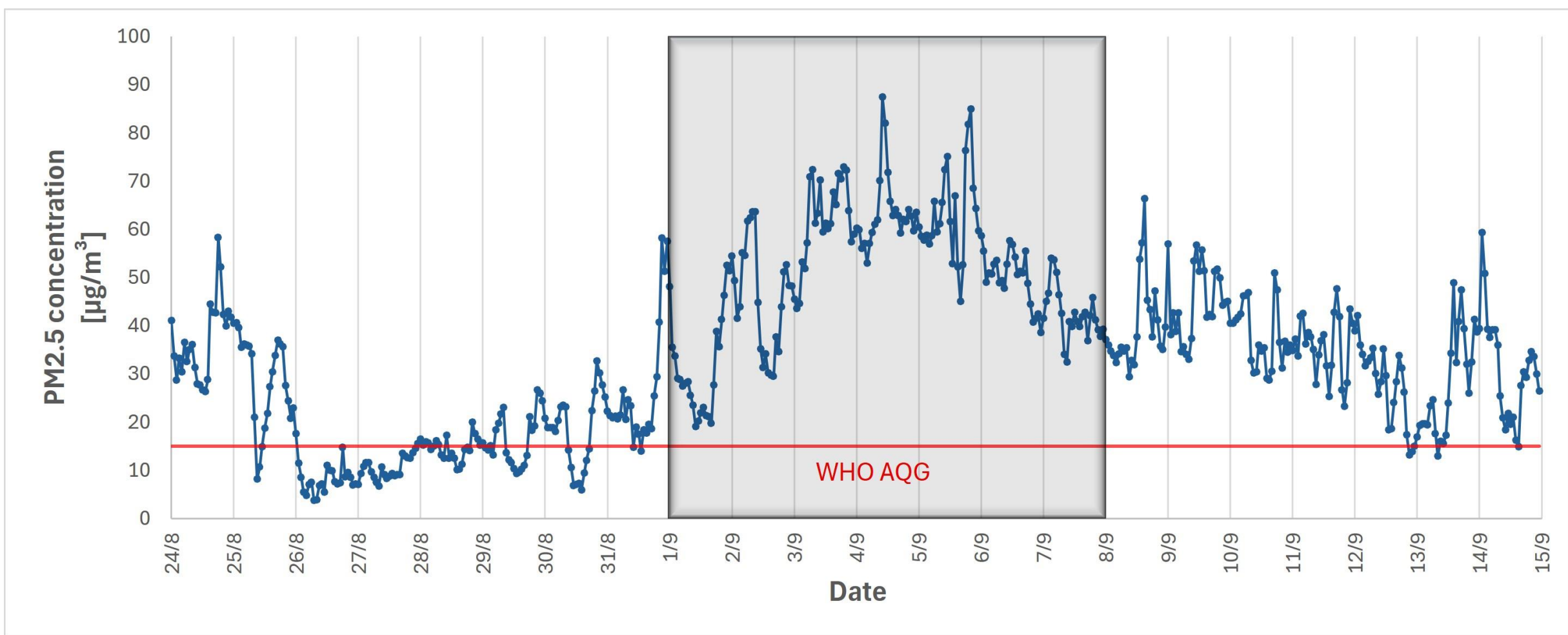


Figure 1: Time series for PM_{2.5} hourly concentration.

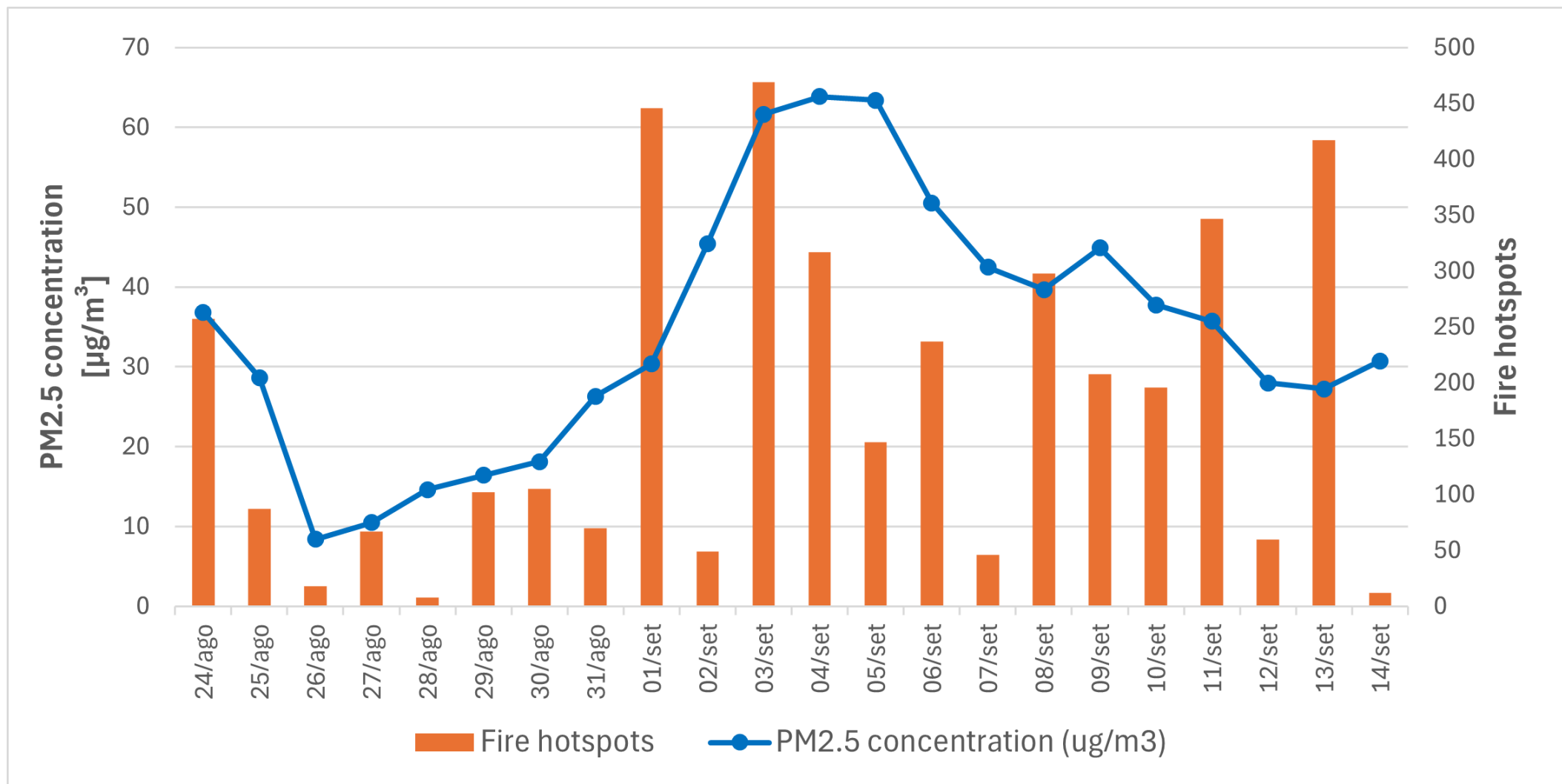


Figure 2: PM_{2.5} daily concentration and daily number of fire hotspots.

Pearson correlation	Mean Absolute Error	Root Mean Square Error	Mean Bias	Mean Absolute Error
0,8863	7,2088	10,6832	1,0593	8,84%

Figure 3: Statistical anaysis between the two stations' data.

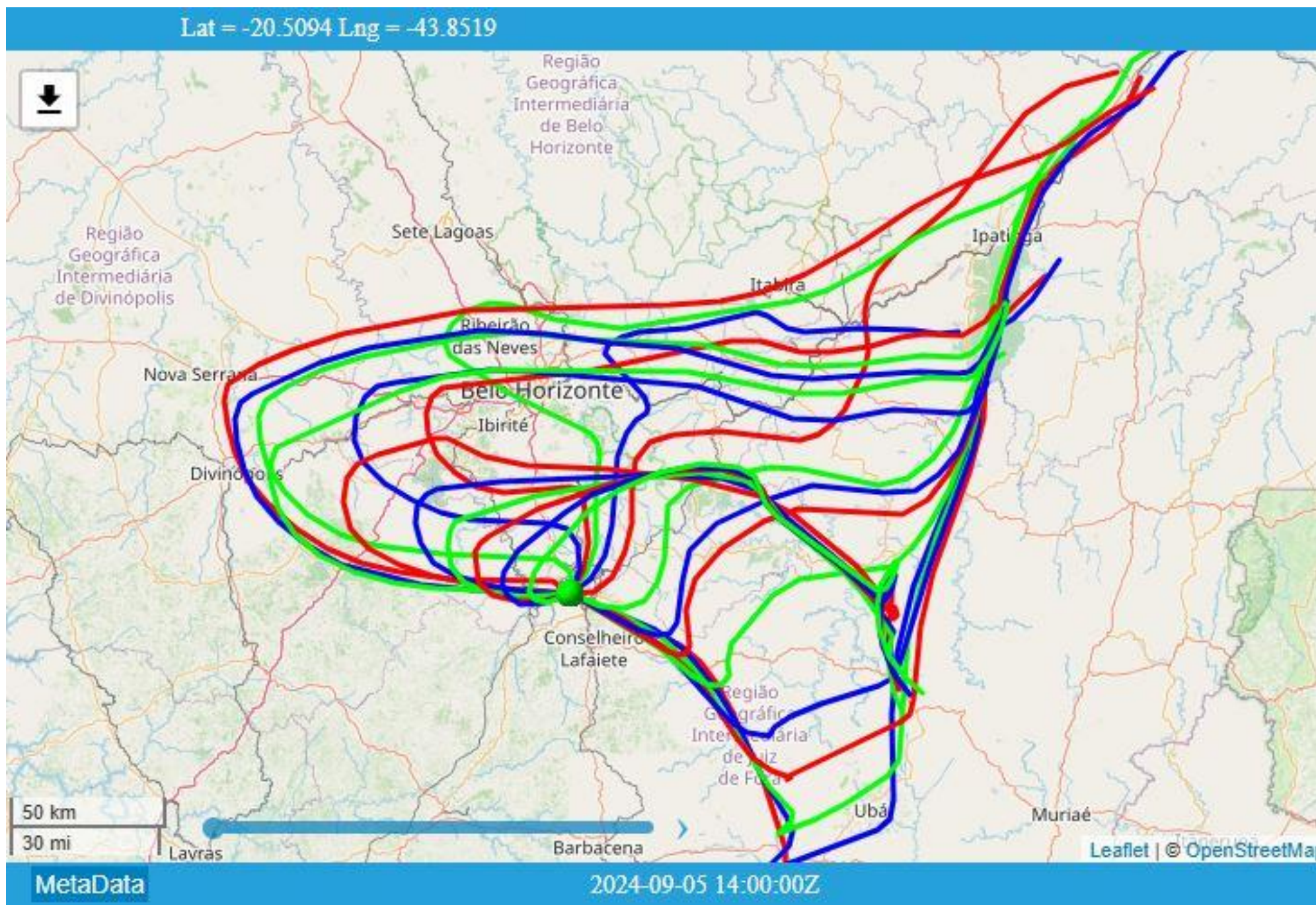


Figure 4: HYSPLIT 36h and 100m backward trajectory.

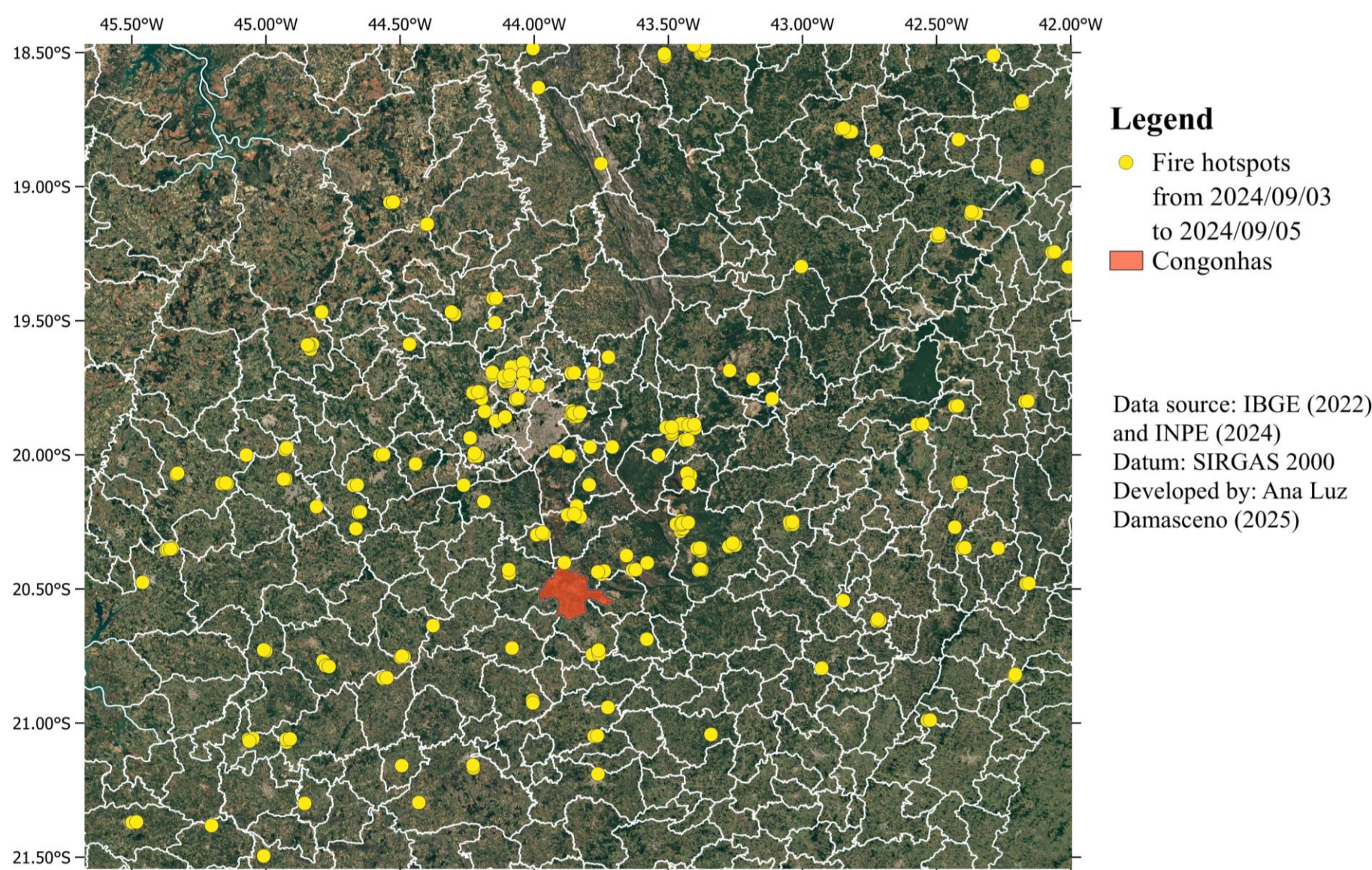


Figure 5: Fire hotspots from September 3 to September 5.

Implications

- Dry periods tend to favor the occurrence of wildfires and the rise in concentrations of atmospheric pollutants, which highlights the need for air quality monitoring during these periods;
- It is essential to continue studying and validating data obtained from low-cost stations, as they can make monitoring more feasible and accessible.

References and acknowledgements

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