

Practical Assignment - Air quality in the city of São Paulo

Objective: practice accessing and analyzing air quality data available in São Paulo.

Activity

This activity aims to assess the air quality of the city of São Paulo through the concentration of ozone and aerosols (PM 2.5) obtained by measurements from stations of the Environmental Company of the State of São Paulo (CETESB). These stations measure the real-time concentration of various pollutant gases and particulate matter in the atmosphere, in addition to other meteorological parameters. They play a very important role in assessing air quality in several cities in the state of São Paulo, but mainly in the capital, where the situation is routinely critical due to the high level of pollutants emitted mainly by vehicles. These measurements are translated into an Air Quality Index that feeds "public digital clocks" spread throughout the city (Fig. 1).



Figure 1 - Air Quality Index on São Paulo's "public digital clocks".

For the analyses that will be discussed here, we will use data from the stations *Parque D. Pedro II* (near Av. do Estado, downtown) and *Ibirapuera* (inside the park), which can be obtained directly from the CETESB website: <https://cetesb.sp.gov.br/ar/dados-horarios/#>. A map showing the location of CETESB stations can be accessed at their website (Fig. 2).

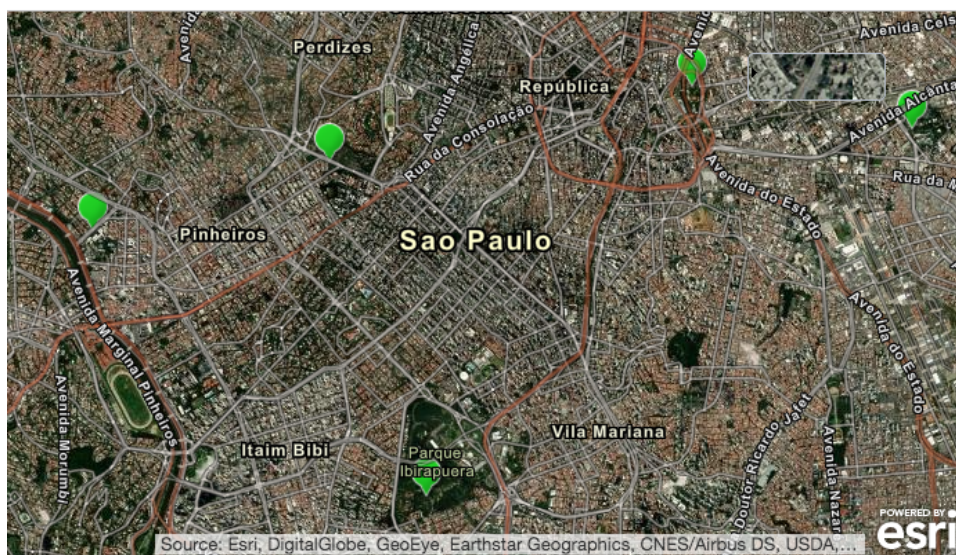


Figure 2 - Map showing some of CETESB stations in the city of Sao Paulo. (<https://servicos.cetesb.sp.gov.br/qa/>).

Part 1. We will analyze the ozone concentration as a function of the incidence of solar radiation at the Parque D. Pedro II station (Group 1) and IPEN (Group 2). On the CETESB website, choose 12/July/2019 and collect data on the hourly average ozone concentration ("Air quality" button on the website), and the hourly average of UVA ($315 \leq \lambda \leq 400$ nm) solar radiation ("Meteorological parameters" button). Make a plot showing the evolution of radiation and ozone throughout the day. Explain your observations. Should the maximum Ozone concentration be simultaneous with the maximum UV incidence? Why?

Next collect ozone data from the Ibirapuera station for the same day and compare with data from Parque D. Pedro II (Group 1) or IPEN (Group 2) station. It will help if you plot both curves together. In which station would you expect to observe more Ozone? Why?

Part 2. Now, let's look at the PM_{2.5} concentration, which is the fraction of aerosols that most cause health issues. For Parque D. Pedro II (Group 1) or IPEN (Group 2), collect PM_{2.5} for 12/July/2019 (a Friday), for 10/July/2020, and 07/July/2022 (also Fridays, different years!). We want to have an idea of the typical concentration in Winter, so this time, choose the column for "the 24h average" instead of the "1h average". Make a plot comparing both sites. What is the average difference in concentration between the two days? How do you explain the observed differences? Is it day-to-day variability, or is there something else? If you want to be sure about the meteorological conditions, you could compare the global solar radiation for both days, for instance.

[Extra]: Perform the same analysis for ozone concentration in 2019 and 2020 at Parque D. Pedro II (Group 1) or IPEN (Group 2). Based on the explanation you gave above for PM_{2.5}, do you expect the ozone concentration to follow the same trend as PM_{2.5}? Explain your reasoning. If needed, you can look up other pollutants on the CETESB website.