Air quality in Aveiro (Portugal): Influence of sea breezes and surrounding industry

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The Sea-Breeze (SB) phenomenon, a recognized mesoscale circulation pattern, impacts air quality in coastal cities (Di Bernardino et al., 2021). The SB acts as a lid that limits the vertical mixing of air and the dispersion of pollutants. Furthermore, it causes the dragging of pollutants landward during night. Therefore, the study of the air quality-SB relationship is crucial for the air quality legislation applicable to such cities, since they are affected by particle and gas emissions from distant sources. The main objective of this study is the analysis of pollutant concentration during day and night in a coastal city, as well as the chemical analysis of particles by size.

The sampling campaign was carried out at the campus of the University of Aveiro (Portugal) (40°37'57.3"N 8°39'32.9"W) during five weeks of May to June 2021. Several sampling instruments were used: i) a High Volume PM10 sampler type cascade (MCV model IC-CAV) for collecting filters in 6 stages (≥ 10 µm, 10 – 4.9 µm, 4.9 – 2.7 µm, 2.7 – 1.3 µm, 1.3 – 0.61 µm, ≤ 0.61 µm) during 168 h; ii) a Scanning Mobility Particle Sizer spectrometer (TSI-SMPS Model 3938) to measure the particle number concentration between 8 and 310 nm in 110 channels; iii) a gas analyser Horiba APOA-370 to measure O_3, NO, NO_2 and CO and; iv) a weather station to monitor some meteorological variables. Additionally, a carbon and organic content analysis was conducted on the PM10 filters. Finally, everyday backward trajectories of air masses for a 24-hour duration at 500, 1000 and 1500 m over Aveiro were obtained to corroborate the procedence of air masses.

The results indicated a clear difference between day and nights periods. During the day, westward winds were predominant, while eastward winds prevailed at night (Figure 1). It is noteworthy to highlight the high concentrations recorded during the nighttime period due to the transport of pollutants from inland Portugal, which are carried by the SB towards the ocean, implying poor air quality in the studied city. The maximum hourly concentration during night was 33,000 particles cm^{-3} while during day was 12,800 particles cm^{-3}.

The next step will be to jointly analyze the chemical and physical data from the sampling, examining size distributions to determine aerosol sources.

a)

b)

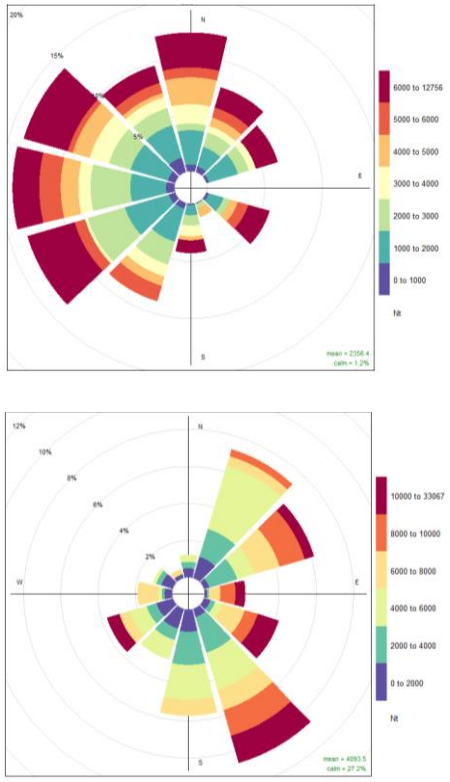

Figure 1. Polar plot concentration during; a) day; b) night. To the W lies the Atlantic Ocean, and to the E, the mainland of Portugal. Colour scale indicates the particle number concentration per cm^{-3}.

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