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Temporal patterns and trends of surface ozone concentrations over Portugal

Carla Gama, Alexandra Monteiro, Myriam Lopes, and Ana Isabel Miranda

Centre for Environmental and Marine Studies (CESAM), Department of Environment and Planning, University of Aveiro, Aveiro, Portugal

Tropospheric ozone (O_3) is a critical pollutant over the Mediterranean countries, including Portugal, due to systematic exceedances to the thresholds for the protection of human health. Due to the location of Portugal, on the Atlantic coast at the south-west point of Europe, the observed O_3 concentrations are very much influenced not only by local and regional production but also by northern mid-latitudes background concentrations. Ozone trends in the Iberian Peninsula were previously analysed by Monteiro et al. (2012), based on 10-years of O_3 observations. Nevertheless, only two of the eleven background monitoring stations analysed in that study are located in Portugal and these two stations are located in Porto and Lisbon urban areas. Although during pollution events O_3 levels in urban areas may be high enough to affect human health, the highest concentrations are found in rural locations downwind from the urban and industrialized areas, rather than in cities. This happens because close to the sources (e.g., in urban areas) freshly emitted NO locally scavenges O_3 . A long-term study of the spatial and temporal variability and trends of the ozone concentrations over Portugal is missing, aiming to answer the following questions:

- What is the temporal variability of ozone concentrations?
- Which trends can we find in observations?
- How were the ozone spring maxima concentrations affected by the COVID-19 lockdown during spring 2020?

In this presentation, these questions will be answered based on the statistical analysis of O_3 concentrations recorded within the national air quality monitoring network between 2005 and 2020 (16 years). The variability of the surface ozone concentrations over Portugal, on the timescales from diurnal to annual, will be presented and discussed, taking into account the physical and chemical processes that control that variability. Using the TheilSen function from the OpenAir package for R (Carslaw and Ropkins 2012), which quantifies monotonic trends and calculates the associated p-value through bootstrap simulations, O_3 concentration long-term trends will be estimated for the different regions and environments (e.g., rural, urban). Moreover, taking advantage of the unique situation provided by the COVID-19 lockdown during spring 2020, when the government imposed mandatory confinement and citizens movement restriction,

leading to a reduction in traffic-related atmospheric emissions, the role of these emissions on ozone levels during the spring period will be studied and presented.

Carslaw and Ropkins, 2012. Openair—an R package for air quality data analysis. *Environ. Model. Softw.* 27-28,52-61. <https://doi.org/10.1016/j.envsoft.2011.09.008>

Monteiro et al., 2012. Trends in ozone concentrations in the Iberian Peninsula by quantile regression and clustering. *Atmos. Environ.* 56, 184-193. <https://doi.org/10.1016/j.atmosenv.2012.03.069>