Ozone pollution in Germany falls thanks to lower nitrogen oxide emissions

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Credit: AI-generated image (disclaimer)

Summer is the ozone season: The harmful gas forms at ground level on hot, sunny days. In recent years, however, the rise in ozone levels over the summer months has not been as pronounced in Germany as it was previously. According to a new study, this is primarily due to a reduction in nitrogen oxide emissions. This trend can be observed across

Germany's southwestern regions in particular, while Berlin lags behind.

Nitrogen oxides (NOx) are among the precursors of ground-level ozone, which can irritate the eyes, nose and throat and aggravate respiratory conditions. The emissions are primarily produced during combustion processes in engines and industrial facilities. "Traffic is the most significant source of nitrogen oxide emissions in urban centers. In recent years, emissions have fallen significantly, partly due to improved vehicle exhaust values", explains lead author Noelia Otero (IASS Potsdam/FU Berlin). Together with her colleagues, Otero wanted to learn more about the effect of falling NOx emissions on the formation of ground-level ozone.

The researchers used long-term measurements of hourly ozone concentrations in conjunction with measurements of nitrogen oxide concentrations gathered at stations across Germany to determine the relationship between temperature and ozone over the period 1999 to 2008 and 2009 to 2018. The researchers discovered that warm temperatures caused ozone concentrations to rise more in the first period than in the second. This demonstrates that a reduction in emissions positively affects the formation of ozone.

As an example, the researchers compared data from measuring stations located at a town square in Wörth am Rhein (Rhineland-Palatinate) and on Nansenstraße in Berlin-Neukölln. In Wörth, nitrogen oxide concentrations declined by 35 % between the first and second periods, while in Berlin they sank by just 7.5 % in the second period. In Wörth, ozone concentrations sank in response to rising temperatures compared to the first period; this effect could not be observed in Berlin, however.

According to the researchers, these changes in ozone concentrations are likely to be driven not only by NOx emissions, but also by another ozone precursor: volatile organic compounds (VOCs), which derive from a

range of sources, including traffic, industry, solvents and even vegetation. "In the absence of long-term data on volatile organic compounds, further analysis with short-term measurements of a range of VOCs would be necessary to quantify their contribution to the observed changes," says co-author Tim Butler (IASS Potsdam/FU Berlin). The researchers also note the need for further reductions in NOx emissions in Berlin to reduce ozone pollution in summer.

More information: Noelia Otero et al, Temperature dependence of tropospheric ozone under NOx reductions over Germany, *Atmospheric Environment* (2021). DOI: 10.1016/j.atmosenv.2021.118334

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