Pollution plumes in Paris air are richer in gaseous aromatic compounds than in Los Angeles

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Los Angeles during the CALNEX campaign. © Daniel Lack, CIRES (NOAA, University of Colorado at Boulder)

What is the origin of the volatile hydrocarbons, other than methane, present in city air? Mainly gasoline-powered vehicles, according to a study carried out by a French-US team. The study also shows that the proportion of gaseous aromatic compounds in hydrocarbon emissions is two to three times greater in pollution plumes in Paris than in Los Angeles, even though the total quantity of hydrocarbons emitted in Los Angeles remains considerably greater than in Paris. The research is published in the journal *Journal of Geophysical Research*.

Volatile organic compounds (VOC), which include hydrocarbons (compounds made up solely of carbon and hydrogen), are major air pollutants as well as precursors of harmful compounds such as tropospheric ozone and secondary organic aerosols. In urban areas, there are many VOC emission sources from human activity, including the distribution, storage and burning of fossil fuels, as well as activities that make use of solvents. However, although these sources are well known, there is still no consensus as to their relative significance, even though such information is needed to measure their impact.

In 2009-2010, as part of the MEGAPOLI and CALNEX programs, an international team including scientists from France carried out two campaigns to study the main air pollutants, including VOCs, in the megacities of Paris and Los Angeles. Using ground-based gas chromatographs and a proton-transfer reaction mass spectrometer on board the French ATR-42 research aircraft, the team measured concentrations of these pollutants in pollution plumes in both cities.

By comparing the data obtained with other data already available for several European and US cities, the researchers first confirmed that in urban areas volatile hydrocarbons other than methane[6] (i.e. compounds containing 2-12 carbon atoms) are mainly produced by automobiles, a conclusion in line with previous findings. They also observed that the ratios of these hydrocarbons were identical in both cities (despite greater use of diesel in Europe than in the US), and that in Los Angeles the ratios did not vary at weekends, a period when there is a significant reduction in diesel-powered heavy goods vehicle traffic. They therefore concluded that gasoline engines are probably the main source of volatile hydrocarbons in both cities.

However, the researchers identified a distinctive feature of the Paris region with regard to volatile aromatic hydrocarbons[8] other than benzene. The study showed that the proportions of such compounds in

Paris air were two to three times greater than in Los Angeles or other European cities studied. Nonetheless, their concentration in Paris is only 1.5 times greater than in Los Angeles due to the greater overall volatile hydrocarbon pollution in the latter city. Why should there be such a considerable difference between the two cities? Volatile aromatic hydrocarbons other than benzene[9] are major components of gasoline. However, the concentrations of such hydrocarbons in gasoline differ from one country to the other. They are lower in California than in France due to more restrictive legislation. Although this may be part of the explanation, the reasons for the high volatile aromatic hydrocarbon content in pollution plumes in Paris as well as its impact on the formation of new organic particles remain to be understood.

More information: Emission ratios of anthropogenic VOC in northern mid-latitude megacities: observations vs. emission inventories in Los Angeles and Paris. Borbon, A., J. B. Gilman, W. C. Kuster, N. Grand, S. Chevaillier, A. Colomb, C. Dolgorouky, V. Gros, M. Lopez, R. Sarda-Estève, J. S. Holloway, J. Stutz, H. Petetin, S. A. McKeen, M. Beekmann, C. Warneke, D. D. Parrish, and J. A. de Gouw, *Journal of Geophysical Research*, Article first published online 27 February 2013. Volume 118, Issue 4. Pages 1585-2083. doi:10.1029/2012JD018235

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