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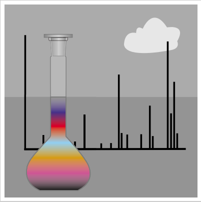

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What are the Sources of Aerosols during Haze Events in China?

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Air-borne aerosols have an influence on human health and the global climate. Very high concentrations of particulate matter with a diameter <2.5 µm ($PM_{2.5}$) are frequently observed in Central and East Asia during winter. In China, such haze episodes often result in exceedances of the Chinese pollution standard for $PM_{2.5}$ of 75 µg m^{-3} by up to a factor of 10, which cause poor visibility and air quality and increase in respiratory diseases. To define strategies to reduce $PM_{2.5}$ concentrations, the factors governing its abundance and composition have to be elucidated.

During severe pollution episodes in January 2013, aerosols were collected on quartz filters in four major cities of China, *i.e.* Beijing, Xi'an, Shanghai and Guangzhou. Here, we show results from Beijing as one example. For a unique chemical analysis, several chromatographic and mass spectrometric techniques were combined. The two most important methods were a newly developed offline application of aerosol mass spectrometry, which identifies major aerosol components and their general emission processes, and measurement of the radioactive carbon isotope ^{14}C (radiocarbon) with accelerator mass spectrometry, which allows the distinction of emissions from fossil sources (mainly traffic and coal burning) and non-fossil sources (mainly biomass burning and natural aerosol emissions).

All measurement data were evaluated using several statistical models and interpreted in two different ways due to the complexity of the atmospheric processes. First, the combination of all methods allowed quantification of the inorganic and organic composition as well as the contribution of seven main sources of aerosol emission or formation. Second, emphasis was laid upon a detailed source apportionment of the organic aerosol using radiocarbon analysis as the key method for a deeper understanding of the role of fossil-fuel usage and biomass burning for the bad air quality.

Both approaches showed that haze events in China are driven to a large extent by so-called secondary aerosols, which were formed in the atmosphere by oxidation of gaseous precursors, rather than by direct aerosol emissions. This suggests that the reduction of precursor gases from fossil-fuel combustion and biomass burning, which form secondary aerosols, is as important as the decrease of direct aerosol emissions for air quality improvement in China.

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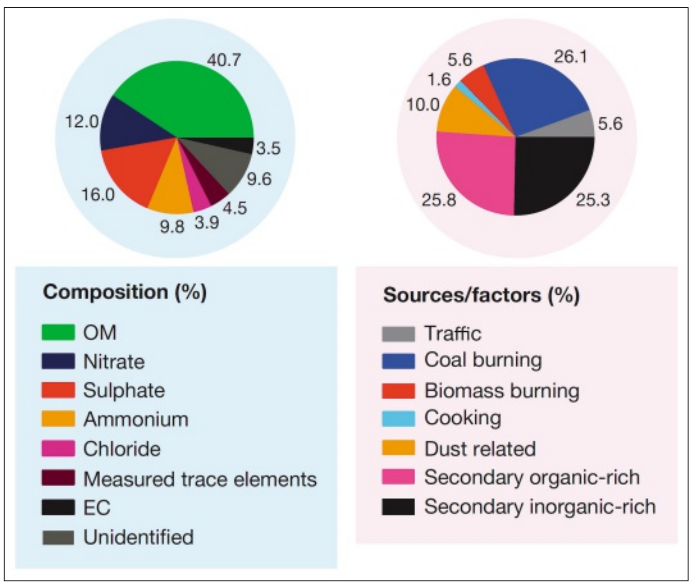
Beijing (here at Tiananmen Square) is one of the Chinese cities with severe air quality problems during haze events in winter. Photo by Paul Scherrer Institute.



Chemical composition and source apportionment of fine aerosols at Beijing during the high pollution event in January 2013. OM and EC define organic matter and elemental carbon, respectively. Modified from Huang *et al.*, *Nature* **2014**, *514*, 218.

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