Study shows Beijing haze linked directly to gaseous pollutants from traffic, industrial emissions

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Campus view of Peking University on clean and polluted days. Credit: Song Guo and Min Hu, Peking University.

(Phys.org) —A combined team of researchers from the U.S. and China has found a direct link between gaseous pollutants from motorized vehicles and industrial emissions and the thick haze that often covers the Chinese capital. In their paper published in the *Proceedings of the National Academy of Sciences*, the team describes their study which included taking air samples over a long period of time and what they found in analyzing the data.

Most people have heard of the air pollution problems going on in China—the country is home to 16 of the 20 most polluted cities in the world. Getting the most attention, has been Beijing, the country's capital and host of the 2008 summer Olympics. In this new effort the joint research team sought to better understand why Beijing, and perhaps other Chinese cities have such serious air pollution problems.

It doesn't take much looking to find that the pollution in Beijing comes mostly from cars, coal fired utility plants and other manufacturing and industrial operations. But, the team noted, taken together, they didn't appear to account for the level of haze that covers the city on a periodic basis. To learn more, they used new state-of-the-art equipment to take air samples from October to December of last year.

In studying the data, they found that the amount of fine particulate matter (the basis of haze) was more than was produced by the primary sources. Further study revealed that photochemical oxidation of gaseous pollutants was resulting in the formation of fine particulates, adding to the overall amount. Furthermore, they found that atmospheric conditions played a larger role in the development of heavy haze days than was previously thought. Wind, they noted, carried pollution from the south, where there are many coal fired plants, to the city, causing higher levels of haze. It also accounted for the cyclic nature of haze days in the city.

Also, the team noted that there were fewer heavy hazy days in the summer because the city gets more rain then which tends to clean the air.

The researchers believe their findings are likely applicable to other cities in China and suggest that the only way to solve the air pollution problems in that country is to reduce the amount of pollutants emitted into the air.

More information: Elucidating severe urban haze formation in China, *PNAS*, by Song Guo, DOI: 10.1073/pnas.1419604111

Abstract
As the world's second largest economy, China has experienced severe haze pollution, with fine particulate matter (PM) recently reaching unprecedentedly high levels across many cities, and an understanding of the PM formation mechanism is critical in the development of efficient mediation policies to minimize its regional to global impacts. We demonstrate a periodic cycle of PM episodes in Beijing that is governed by meteorological conditions and characterized by two distinct aerosol formation processes of nucleation and growth, but with a small contribution from primary emissions and regional transport of particles. Nucleation consistently precedes a polluted period, producing a high number concentration of nano-sized particles under clean conditions. Accumulation of the particle mass concentration exceeding several hundred micrograms per cubic meter is accompanied by a continuous size growth from the nucleation-mode particles over multiple days to yield numerous larger particles, distinctive from the aerosol formation typically observed in other regions worldwide. The particle compositions in Beijing, on the other hand, exhibit a similarity to those commonly measured in many global areas, consistent with the chemical constituents dominated by secondary aerosol formation. Our results highlight that regulatory controls of gaseous emissions for volatile organic compounds and nitrogen oxides from local transportation and sulfur dioxide from regional industrial sources represent the key steps to reduce the urban

PM level in China.