Beijing Olympics Pollution Clampdown Study Reveals Importance of Climate- Neutral Air Quality Laws

Scripps researchers find marked differences between east and south Asian black carbon emissions, enhanced by 2008 games

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Scripps Institution of Oceanography, UC San Diego researchers say carefully balanced mitigation of air pollution is necessary to keep greenhouse effects in check after an analysis of east Asian air sampled during and after the 2008 Summer Olympics in Beijing.

Soot and other forms of the particulate air pollutant black carbon vary in their ability to cause global warming, meaning that the effects of pollution control campaigns will vary based on which sources of pollution are targeted. Black carbon is a major component of soot - produced in diesel exhaust, wood-burning and other activities - and is increasingly viewed as a major contributor to global and regional warming. American and Korean scientists behind the analysis found that fossil fuel-based soot particles ejected into the atmosphere are more efficient at trapping sun's heat than soot particles produced by biomass burning.

The difference comes from the relative amount of sulfates intermingled with each type of black carbon. Brightly surfaced sulfate particles are often produced during the burning of coal and other fossil fuels but can have a mitigating effect against global warming by reflecting solar radiation instead of absorbing it. Removal of sulfate pollution without corresponding removal of black carbon could exacerbate global warming by diminishing their net cooling effect.

Results of the National Science Foundation-funded study appear in the July 25 online issue of the journal *Nature Geoscience*.

"In-situ sampling of air can give us practical insights into mitigation of climate change," said Scripps climate and atmospheric scientist Veerabhadran Ramanathan, the study's lead researcher.

Scripps scientists joined colleagues from Seoul National University, University of Wisconsin and University of Iowa during the Cheju ABC Plume-Monsoon Experiment (CAPMEX), named for the Korean island located southeast of Beijing that served as the project's base. In 2008, the researchers collected air samples using unmanned aircraft and ground-based air intake instruments. They compared the east Asian air with south Asian air sampled in earlier campaigns. Samples came from aerosol plumes over Shanghai and the Yellow Sea that contained black carbon from sources ranging from wood-burning kitchen stoves in rural areas to urban traffic exhaust and ship exhaust.

The experiment was timed to the 2008 Summer Olympics so the researchers could position sampling instruments downwind of Beijing during and after the city enacted tough anti-air pollution measures for the benefit of athletes and spectators. The measures manifested themselves in CAPMEX data but the researchers also said that emissions control measures enacted two to three years before the Olympics and a greater-than-average amount of rainfall during the games also influenced the pollution levels that were sampled.

"There remains uncertainty as to the absolute importance of these three factors, but they all play non-trivial roles," said study co-author Greg Carmichael, who is Karl Kammermeyer Professor, Department of Chemical & Biochemical Engineering at the University of Iowa.

The researchers found that urban sources that dominated the samples from the Beijing plume generated the highest ratio of black carbon to sulfates and thus had the greatest atmospheric warming potential. From the Shanghai plume, which contains black carbon from regions that use less fossil fuel, and the Yellow Sea plume, which captured emissions from ships that tend to use low-quality, sulfate-rich fuels, the ratio was much smaller.

The delineation of sources could be used to guide future air pollution control in Southeast Asia, said Ramanathan.

"As we reduce sulfate pollution, we must reduce black carbon by even a larger percentage," said Ramanathan. "Targeting fossil fuel black carbon would gain us even more mitigation potential."

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