# Professor says harmful byproducts of fossil fuels could be higher in urban areas

October 22 2007

Nitrogen oxides, the noxious byproduct of burning fossil fuels that can return to Earth in rain and snow as harmful nitrate, could taint urban water supplies and roadside waterways more than scientists and regulators realize, according to research published Oct. 20 in the online edition of the journal *Environmental Science and Technology*.

The three-year study, led by Emily Elliott, a professor of geology and planetary science in the University of Pittsburgh's School of Arts and Sciences, recommends that urban areas and roadways be specifically monitored for nitrogen deposition. Nitrogen oxides can contribute to a wide variety of environmental and health ills. Nitrate—which forms when exhaust from vehicles and smokestacks oxidizes in the atmosphere—is an important contributor to acid rain and can result in stream and soil acidification, forest decline, and coastal water degradation.

Elliott and her colleagues conducted the first large-scale application of a method for determining the source of atmospheric nitrate on rain and snow samples from 33 precipitation collection sites across the Midwestern and Northeastern United States, including Pennsylvania. The sites belong to the National Atmospheric Deposition Program (NADP), a cooperative of private organizations and U.S. government agencies that analyzes precipitation for chemicals such as nitrogen, sulfur, and mercury from more than 250 sites in the United States, Puerto Rico, and the Virgin Islands.

Although vehicles are the single largest source of nitrogen oxides in this region, the researchers found by analyzing the stable isotope composition of nitrate that the primary source of nitrate in their samples were stationary sources, such as power plants and factories, located hundreds of miles away. Stationary sources pump pollutants high into the atmosphere where they can be transported for long distances before falling to the ground. Vehicle exhaust is released close to the ground and more likely deposited over shorter distances near roadways. Most monitoring sites in the NADP network are deliberately located in relatively rural settings away from urban, industrial, or agricultural centers.

The amount of nitrate pouring over the cities and busy roadways thick with vehicles could be higher than monitoring data at most NADP sites reflect, and it is possible that a significant amount of this atmospheric nitrate finds its way into sensitive water supplies, such as the Ohio River or Chesapeake Bay. In aquatic ecosystems, excess nitrate can promote an overgrowth of oxygen-consuming algae and lead to an oxygen deficiency in the water known as hypoxia. Hypoxia kills marine creatures and creates “dead zones” akin to the lifeless area of the Gulf of Mexico at the mouth of the Mississippi River. Determining the fate of major sources of nitrogen emissions is necessary to develop sound regulatory and mitigation strategies for both air and water quality, Elliott said.

“Our results highlight the need to improve our understanding of the fate of vehicle emissions—one way we can do this is by expanding monitoring networks to include more urban sites,” Elliott said, adding that both vehicle and stationary sources are major contributors to air pollution in the region studied.

Elliott said that future research will further characterize the isotopic ratios of nitrogen oxides from various emission sources and quantify how these values change during transport and with different emission controls. She is looking for industrial partners who can provide samples from smokestacks for analysis. Additionally, Elliott is interested in establishing an urban precipitation monitoring site in Pittsburgh to assess pollution sources that contribute to nitrate deposition in the Pittsburgh region.

Source: University of Pittsburgh