Satellite measures pollution from east Asia to North America

March 17 2008

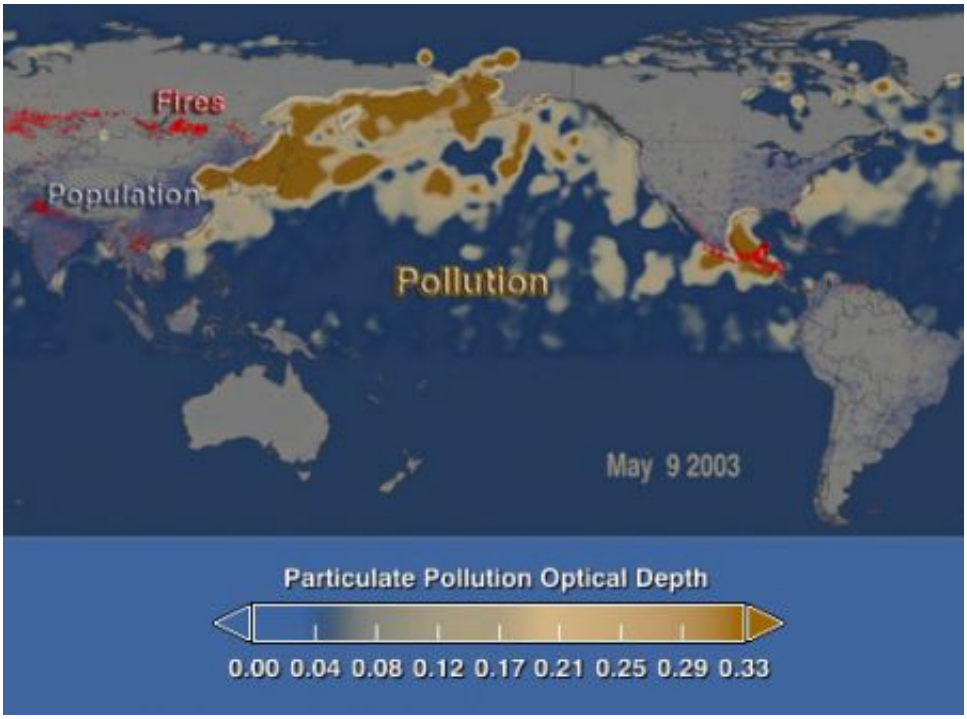

Image credit: NASA

In a new NASA study, researchers taking advantage of improvements in satellite sensor capabilities offer the first measurement-based estimate of the amount of pollution from East Asian forest fires, urban exhaust, and industrial production that makes its way to western North America.

China, the world's most populated country, has experienced rapid

industrial growth, massive human migrations to urban areas, and considerable expansion in automobile use over the last two decades. As a result, the country has doubled its emissions of man-made pollutants to become the world's largest emitter of tiny particles called pollution aerosols that are transported across the Pacific Ocean by rapid airstreams emanating from East Asia.

Hongbin Yu, an associate research scientist of the University of Maryland Baltimore County working at NASA's Goddard Space Flight Center in Greenbelt, Md., grew up in China and taught there as a university professor, where he witnessed first-hand and studied how pollution from nearby power plants in China affected the local environment. Early this decade, scientists began using emerging high-accuracy satellite data to answer key questions about the role tiny particles play in the atmosphere, and eventually expanded their research to include continent-to-continent pollution transport. So Yu teamed with other researchers to take advantage of the innovations in satellite technology and has now made the first-ever satellite-based estimate of pollution aerosols transported from East Asia to North America.

The new measurements from the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on NASA's Terra satellite substantiate the results of previous model-based studies, and are the most extensive to date. The new study will be published this spring in the American Geophysical Union's *Journal of Geophysical Research-Atmospheres*.

"We used the latest satellite capabilities to distinguish industrial pollution and smoke from dust transported to the western regions of North America from East Asia. Looking at four years of data from 2002 to 2005 we estimated the amount of pollution arriving in North America to be equivalent to about 15 percent of local emissions of the U.S. and Canada," Yu said. "This is a significant percentage at a time when the

U.S. is trying to decrease pollution emissions to boost overall air quality. This means that any reduction in our emissions may be offset by the pollution aerosols coming from East Asia and other regions."

Yu and his colleagues measured the trans-Pacific flow of pollution in teragrams, a unit of measurement of the mass of pollution aerosol (1 teragram is about 2.2 billion pounds). Satellite data confirmed 18 teragrams -- almost 40 billion pounds -- of pollution aerosol was exported to the northwestern Pacific Ocean and 4.5 teragrams – nearly 10 billion pounds -- reached North America annually from East Asia over the study period.

Yu points out, however, that the matter of pollution transport is a global one. "Our study focused on East Asian pollution transport, but pollution also flows from Europe, North America, the broader Asian region and elsewhere, across bodies of water and land, to neighboring areas and beyond," he said. "So we should not simply blame East Asia for this amount of pollution flowing into North America." In fact, in a model study published last November in the Journal of Atmospheric Chemistry and Physics, Mian Chin, also a co-author of this study and an atmospheric scientist at NASA Goddard, suggests that European pollution also makes a significant contribution to the pollution inflow to North America.

"Satellite instruments give us the ability to capture more accurate measurements, on a nearly daily basis across a broader geographic region and across a longer time frame so that the overall result is a better estimate than any other measurement method we've had in the past," said study co-author Lorraine Remer, a physical scientist and member of the MODIS science team at NASA Goddard. The MODIS instrument can distinguish between broad categories of particles in the air, and observes Earth's entire surface every one to two days, enabling it to monitor movement of the East Asian pollution aerosols as they rise into the lower

troposphere, the area of the atmosphere where we live and breathe, and make their way across the Pacific and up into the middle and upper regions of the troposphere.

Remer added that the research team also found that pollution movements fluctuate during the year, with the East Asian airstream carrying its largest “load” in spring and smallest in summer. The most extensive East Asian export of pollution across the Pacific took place in 2003, triggered by record-breaking wildfires across vast forests of East Asia and Russia. Notably, the pollution aerosols also travel quickly. They cross the ocean and journey into the atmosphere above North American in as little as one week.

“Using this imaging instrument, we cannot determine at what level of elevation in the atmosphere pollution travels. So, we do not have a way in this study to assess the degree of impact the pollution aerosols from China have on air quality here once they cross over to North America. We need improved technology to make that determination,” said Remer. “Nevertheless, we realize there is indeed impact. For example, particles like these have been linked to regional weather and climate effects through interactions between pollution aerosols and the Sun's heat energy. Since pollution transport is such a broad global issue, it is important moving forward to extend this kind of study to other regions, to see how much pollution is migrating from its source regions to others, when, and how fast,” said Remer.

Source: Goddard Space Flight Center