IMPACT PROFILE
RESEARCH AT THE UNIVERSITY OF MARYLAND

ZHANQING LI

Particles in the Atmosphere

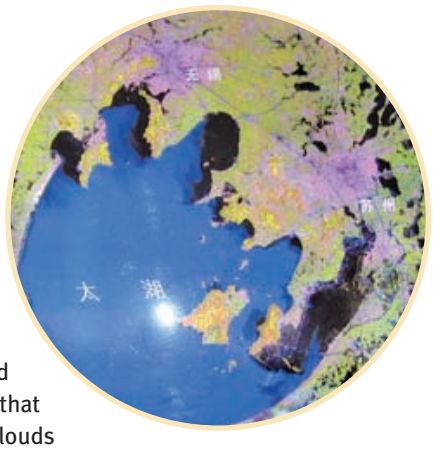
Anyone who lived in China two decades ago and returned today would be struck by its transformation. Factories and cityscapes are rapidly replacing countryside. "Such change, in pace and extent, is probably unprecedented in human history," says Zhanqing Li, a professor of atmospheric and oceanic science with a joint appointment in the Earth System Science Interdisciplinary Center. "China has almost become the manufacturer for the entire world."

As industry and cities grow, China's impact on the environment is also growing. The nation is a major and increasing source of aerosols—small particles in the atmosphere, which can affect weather and climate, both locally and globally. Aerosols in Asia can travel across the Pacific all the way to the United States in the course of a week.

Transport of Aerosols

IMPACT PROFILE

ZHANQING LI



Satellite data can track aerosol emissions to some extent, but to really understand the atmosphere in a given place, researchers need close-range observations. "Satellites can never tell you exactly and directly what's going on. Going from satellite observations to geophysically meaningful information requires many steps," Li says.

A satellite signal at any given point blends information about the atmosphere, land surface and cloud cover. "You need to decompose that information into its components," says Li. To see a complete picture, Li concluded it was crucial to collaborate with Chinese researchers and gather information on the ground. For the last two years, he has led an international cooperative study called East Asian Tropospheric Aerosols: An International Regional Experiment, or EAST-AIRE.

Since the project began, with partial funding from NASA and the National Science Foundation, the international team has set up 28 sites around China for analyzing aerosols. The researchers have conducted two month-long, intensive observation campaigns from the ground and two airborne campaigns that gather data using aircraft and satellites.

Li and his coworkers have been studying aerosols in China's troposphere, the portion of the atmosphere that extends 10 kilometers into the sky. Unlike the higher-level stratosphere, which is relatively uniform around Earth, the troposphere varies from place to place, with most aerosols staying within about 2 kilometers of where they are emitted. The aerosol constitution over China is unlike that anywhere else, reflecting the particulars of its geography, industry and energy use. Collecting "ground-truth information" helps Li calibrate satellite data and improve its interpretation.

Aerosols consist of soot, sulfuric acid, various kinds of organic matter, pollen, ammonia, sea salt, and mineral particles from soil. All these natural and man-made particles can affect climate by blocking solar radiation and by affecting cloud formation and precipitation. With support from NASA, the National Oceanic and Atmospheric Administration, the Department of Energy and the National Science Foundation, Li has studied aerosols for years attempting to understand their climatic impact.

From the 1960s through the 1980s, solar radiation reaching the ground in China declined 21 percent, sunny hours decreased 10 percent, and visibility decreased by 35 percent. Cloud cover remained the same over that time, so aerosols rather than clouds must have been responsible for the change, Li argues. Through EAST-AIRE, Li and his coworkers can directly quantify the reduction in solar radiation reaching the ground when aerosol levels increase.

Because of the large amounts of solar energy blocked by aerosols, Li hypothesizes that the particles may be reducing the productivity of farmland. He is collaborating with agricultural scientists in China to test whether this is true.

With less solar energy reaching the ground, more stays in the atmosphere, and that is likely to affect weather. Li is working with other scientists to see how aerosols might affect monsoons and other weather patterns.

Besides influencing the amount of heat in the atmosphere, aerosols are key to understanding cloud formation and precipitation. Clouds form when water droplets condense around aerosol particles. Given the same amount of water in the atmosphere, increasing the number of particles leads to clouds with smaller water droplets. Such clouds tend to last longer in the sky, with water droplets not large enough to fall. In China the trend has been toward increasingly dry weather in the north and increasingly wet weather in the south. Li believes that the increase in aerosols in the atmosphere may at least partially account for this trend. Aerosols could make clouds less likely to precipitate in the north but, in the south, where water is plentiful, aerosols may be seeding more clouds that produce rain.

All the data produced by EAST-AIRE are freely available online, giving a worldwide team of researchers opportunity to pursue what Li calls his main objective—"to understand how human activities affect climate by changing environmental conditions." —*Karin Jegalian*

UNIVERSITY OF MARYLAND

Impact Profile is a supplement to *Impact*, a quarterly research digest from the University of Maryland. To learn more about research at Maryland, go to www.umresearch.umd.edu.

Produced by the Office of University Publications for the Vice President for Research, University of Maryland.