

# Mapping for Health

By Kelly Mills

*New Approaches to  
Old Challenges*



With the advent of Google satellite maps and global positioning devices for cars, people can now use technology to view a street online or get directions while driving—but that is not all spatial mapping can do.

Researchers in public health have been using technology such as Geographic Information Systems (GIS) for some time to better understand environmental factors influencing health. Faculty at the School are creating new ways of combining geography and health data, and as improvements in

technology make information more available and more relevant to understanding disease, we will likely see more breakthroughs in the ways geographic information is combined with other data to analyze and prevent risks to health.

## GEOGRAPHIC TECHNIQUES SHED LIGHT ON OBESITY

Associate professor **Michael Jerrett**, considered one of the leaders in geography and epidemiology, is collaborating with other researchers to examine some of the most pressing health problems of our time. For one study, he and colleagues are examining the relationship between obesity and the built environment using geographical data. Intervening during childhood is critical, says Jerrett, because obesity is rising rapidly around the globe, and 80 to 85 percent of those who are obese at age 18 remain obese for their lifetime. He is looking at access to parks and other space for physical activity

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## Mapping for Health, continued

and proximity to healthy food options to see if there are links between these geographic factors and the development of childhood obesity. Using a sample of 11,500 children, his team has been able to map the home address of each child and examine whether the neighborhood offers activity and healthy food access. Jerrett is also examining other factors, such as air pollution, to see if these have a significant impact on obesity as well.

### ZEROING IN ON AIR POLLUTION, ASTHMA

Another study that uses geographic data is the Fresno Asthmatic Children's Environment Study (FACES), which aims to determine the effects of pollution on children with asthma. Originally funded by the California Air Resources Board as part of its effort to study vulnerable populations, the study is led by School of Public Health professors **Ira Tager**, **S. Katharine Hammond**, **John Balmes**, **Kathleen Mortimer**, and **Mark van der Laan**, along with **Helene Margolis** of the EPA and **Fred Lurmann** of Sonoma Technologies.

Because Fresno is an EPA Supersite, detailed information is available on chemical monitoring of the environment. Researchers selected a sample of children ages 6 to 11 living within a 20-kilometer radius of the Supersite. They added the EPA information to extensive monitoring of indoor and outdoor areas of 87 of the children's homes and to detailed monitoring of some of the schools using mobile trailers.

"The goal," says Tager, "is to characterize the spatial distribution of air pollution in that community, so that through modeling we can assign air pollution exposures to each child for every day of the five years we are following the child."

Children in the study also wear GPS devices for a two-week period, so that they can be tracked to help refine the models. The children are studied in all seasons of the year, the air pollution distribution is characterized, and from all the data collected personal exposures and responses to daily changes in air pollution can be assessed. "That information will

help us understand what the relationship is between how they responded to daily changes in air pollution and the growth of their lungs, and the severity or lack thereof of their asthma over the period of time we are following them," explains Tager.

In another asthma study, Oakland Kicks Asthma, Tager works with graduate student **Sheryl Magzamen** and professors Balmes and Jerrett as part of the CDC's Controlling Asthma in American Cities Project. The study has added a very extensive asthma surveillance system in schools. Magzamen is using the home address data from the study and looking at the geographical distribution of asthma in relation to a number of social and environmental characteristics. Currently she is examining proximity to freeways, but she plans to add other demographic information, such as indices of poverty and housing. Using sophisticated mapping and statistical analysis, the team hopes to determine which population-level factors are influencing asthma severity and occurrence.

## Ensuring the Safety of Biofuels

With the rush by scientists, venture capitalists, policy makers, and engineers to develop biodiesel and other alternative fuels, most public discussion of the subject centers on the methods and feasibility of producing a given fuel and the issues related to switching to different sources of energy. However, any breakthrough in biofuels could have unintended consequences—for the health of the population and for the environment.

**Tom McKone**, adjunct professor of environmental health sciences, currently conducts research for the California Environmental Protection Agency on the impacts of alternate fuels. He is also working with other UC researchers to establish a component of the Energy Biosciences Institute (EBI) to ensure that the alternative fuels it develops constitute an improvement, not a hazard. McKone and colleagues are building a framework to look at the whole cycle of biofuels—from production to storage to transport to use—to assess the potential impacts on things like communities and biodiversity.


"One of the reasons we want to develop biofuels is they can be carbon neutral: You burn them and then the plants grow back. But you want to make sure that biofuels really are carbon-neutral, because some agricultural processes deplete carbon out of the soil," says McKone.

Another concern is that while biofuels may be helpful in dealing with global warming, there is the possibility they could create a public health dilemma. Methanol, for example, is more efficient to make, but it has a higher toxicity than gasoline, and causes blindness at low doses.

McKone and researchers from the campus's Department of Civil and Environmental Engineering, the Energy and Resources Group, and Lawrence Berkeley Laboratories are developing a framework to measure the impact of new fuels in other areas as well. Switchgrass, one possible source for biodiesel, might

be grown using pesticides that would adversely impact neighboring communities. And the processes of removing the fuel from the source and transporting it to various regions both have potentially harmful impacts. Fuel storage is another major problem: For example, MTBE was found to disperse more easily than other gas additives, and leaking has seriously contaminated ground water.

"People are bothered by what they see as our negativity," McKone laughs. "But history is full of examples—from nuclear power to DDT—of unintended impacts of new discoveries."

McKone and others in the group hope to serve as sentinels in the process, to guide the new technologies and ensure advances in alternative energy don't create a new set of hazards. 



### NEW WAYS OF TRACKING DISEASE

The methods developed in Oakland Kicks Asthma can be used by researchers in other regions of the country. The CDC is currently providing funding to many researchers to contribute to environmental public health tracking. In response to congressional concerns, the CDC has taken steps to develop better public health surveillance for a range of diseases, and environmental diseases are crucial to this effort. One part of the surveillance effort is to create a state-based network to link the environmental data about air pollution to health outcomes on an ongoing basis. Whereas most studies are developed for a finite period, this infrastructure would follow and monitor climate change, water quality, and season-related issues such as high temperatures with health.

Balmes and others are working on methods for this tracking. For example, Balmes is collaborating with Tager on linking the survey data from Oakland Kicks Asthma with environmental exposure information such as traffic data. Balmes is also replicating the surveillance system of Oakland Kicks Asthma in Fresno and other areas, which will make it possible to study the impact on asthma of other environmental factors more specific to that region—pesticide exposures, for example. This can be done using Geographic Information Systems (GIS) techniques: Addresses can be geocoded and then assigned exposures using software based on distance from fields. Since pesticide use is tracked, this information can be linked to outcomes.

“The national system tracks asthma by following hospitalizations,” says Balmes. “That is only tip of the iceberg. Most kids with asthma aren’t hospital-

ized. Using the school-based survey approach, we can pick up asthma that doesn’t lead to hospitalizations—which is the bulk of asthma.”

If these methods are successful, it will mean new ways of tracking asthma and of examining the possible links between pesticide exposures and asthma. Fresno also provides an interesting area of study, because, as Hammond points out, “It is a kind of mini-lab for global warming: It is drier, hotter, and more polluted than other areas.” Understanding asthma in Fresno may yield clues to future health problems presented by climate change from global warming.

### SPATIAL ANALYSIS GIVES INSIGHT INTO EFFECTS OF GAS EXPOSURE

Adjunct professor of epidemiology **Michael Bates** is combining survey data with spatial analysis to study the health effects of hydrogen sulfide gas. Populations exposed to the gas often raise concerns about possible health effects, particularly because of the gas’s strong “rotten eggs” odor. “Worry about a bad smell in itself can generate symptoms,” says

1990s Bates carried out preliminary studies of the Rotorua population using data from the New Zealand national health care system. These studies suggested that exposure to the gas may have some effects.

Now Bates and colleagues are beginning work under a grant from the National Institute of Environmental Health Sciences (NIEHS) to conduct a five-year study of Rotorua residents. The study is a collaboration among researchers from a number of schools, including Balmes from UC Berkeley and several investigators from UC Davis, Stanford University, and the Wellington School of Medicine in New Zealand. They plan to study the impact of hydrogen sulfide on the nervous system, the respiratory system, and the eyes, using a battery of medical tests. The researchers are currently developing detailed study protocols, and will recruit 1,800 people for the project. They will also survey participants about residential and employment histories. These data will be linked to results of detailed modeling of the distribution of hydrogen sulfide concentrations across the city to determine levels of exposure for participants.

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Bates, noting that this makes it harder to understand the health risks of exposures. While the gas is highly acutely toxic, most people receive only sporadic, relatively low-level exposures, through proximity to places like sewage treatment plants, oil refineries, and large-scale animal feeding operations.

However, the New Zealand city of Rotorua has a steady exposure to hydrogen sulfide gas. The town was built on a geothermal field, complete with geysers and boiling mud pools. One of the main geothermal emissions in the city is hydrogen sulfide. Since Rotorua has the largest population in the world with relatively high exposure to hydrogen sulfide, it is an ideal site for studying possible health effects of long-term exposure to the gas. In the

“The idea is to be able to create a longitudinal exposure profile for each one of the participants,” says Bates.

Since there are many communities in the United States and elsewhere exposed to hydrogen sulfide, it is important to understand whether there are any health effects. There has even been speculation that global warming and climate change might result in greater levels of the gas in our environment, so knowing whether or not the gas is harmful over time may become increasingly important. 6