

Central Valley soil emissions a large source of state's nitrogen oxide pollution

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Russell Ranch experimental farm at UC Davis. Credit: Maya Almaraz

A previously unrecognized source of nitrogen oxide is contributing up to

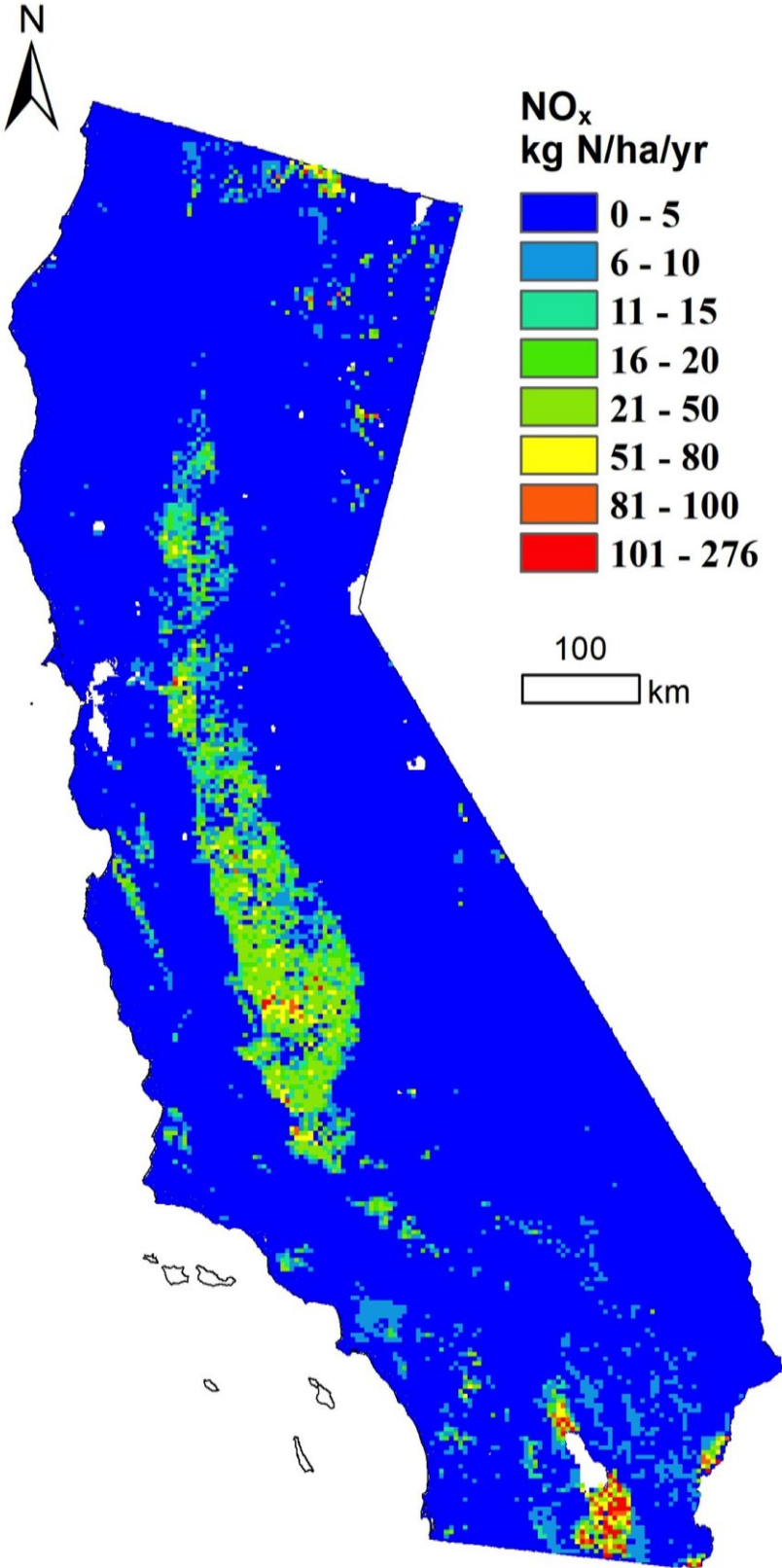
about 40 percent of the NO_x emissions in California, according to a study led by the University of California, Davis. The study traces the emissions to fertilized soils in the Central Valley region.

In the study, published January 31 in the journal *Science Advances*, the authors compared computer models with estimates collected from scientific flights over the San Joaquin Valley. Both the model and flight data suggested that between 25 and 41 percent of NO_x emissions comes from soils with heavy nitrogen fertilizer applications.

Rural smog source

Smog-forming nitrogen oxides, or NO_x, are a family of air-polluting chemical compounds. They are central to the formation of ground-level ozone and contribute to [adverse health effects](#), such as heart disease, asthma and other respiratory issues. NO_x is a primary component of air pollution, which the World Health Organization estimates causes 1 in 8 deaths worldwide.

Fossil fuels have long been recognized as a major contributor to NO_x pollution. Technologies like the catalytic converter have helped greatly reduce NO_x emitted from vehicles in urban areas. But some of the state's worst air quality problems are now in rural areas, particularly the Central Valley region, which is home to some of the poorest communities in California.

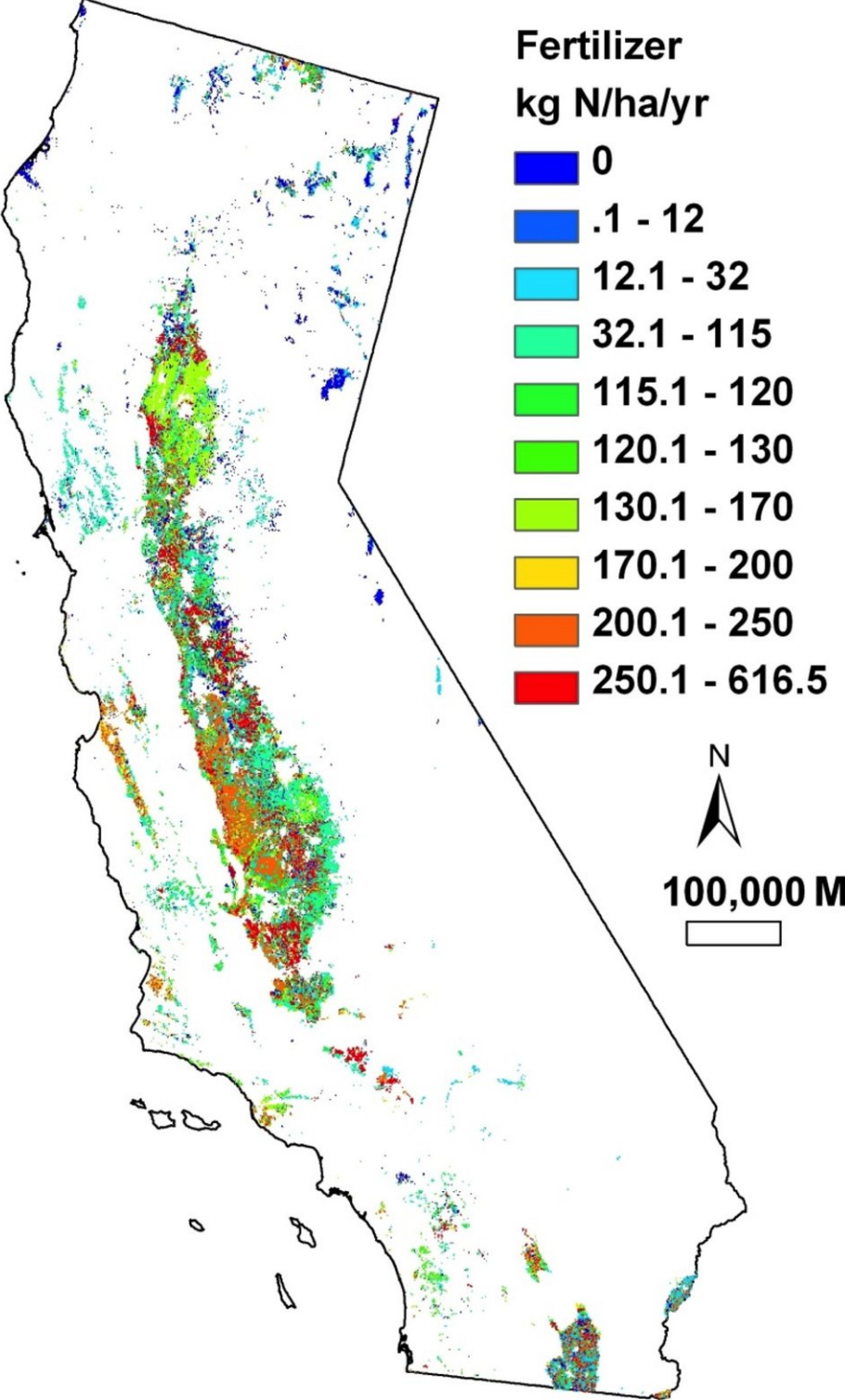


This map's colors indicate levels of NO_x emissions in California. Credit: UC Davis

More food, less pollution

The Central Valley is also one of the world's most highly productive agricultural areas. Roughly half of the fruits and nuts produced in the United States are grown there. This includes nearly all the nation's almonds, walnuts, raisins, avocados, and tomatoes.

"We need to increase the food we're making," said lead author Maya Almaraz, a National Science Foundation postdoctoral fellow in UC Davis Professor Ben Houlton's lab. "We need to do it on the land we have. But we need to do it using improved techniques."



This map's colors indicate areas of fertilizer applications in California. Credit: UC Davis

Potential solutions

The study suggests potential solutions for reducing NO_x soil emissions, primarily through different forms of fertilizer management.

Only about half of the nitrogen fertilizer applied to crops are used by the plant. But slow-release fertilizers that deliver nutrients in a way that more closely mimics nature have been shown to greatly improve nitrogen use efficiency of crops, reducing emissions of nitrogen in the environment.

Healthy soils programs that restore carbon in the soil can also help fight climate change and are likely to increase nutrient retention and cycling to crops.

And precision agriculture practices help improve water and fertilizer efficiencies, particularly in perennial crops, such as almonds.

Building upon work in motion

The state also began a program this year in which growers work in coalitions to gather information on efficient uses of nitrogen so they can evaluate how and where the state needs to manage [nitrogen](#) in agricultural areas. This work aims to reduce nitrate in the groundwater but it may have a double benefit in reducing NO_x emissions.

"Since this source of NO_x can remain local, largely in rural farming communities, we need to develop a kind of 'catalytic converter' for soils

and farms," said senior author Houlton, a professor with the UC Davis Department of Land, Air and Water Resources, and director of the John Muir Institute of the Environment. "It's critical that new policies focus on incentives to bring the latest nutrient management technologies to farms so that growers can produce food more efficiently, increasing their bottom line and improving rural health."

More information: M. Almaraz et al., "Agriculture is a major source of NO_x pollution in California," *Science Advances* (2018).

advances.sciencemag.org/content/4/1/eaao3477

Provided by UC Davis

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