Satellite data show wildfire, soil emissions likely increasing air pollution in remote forests

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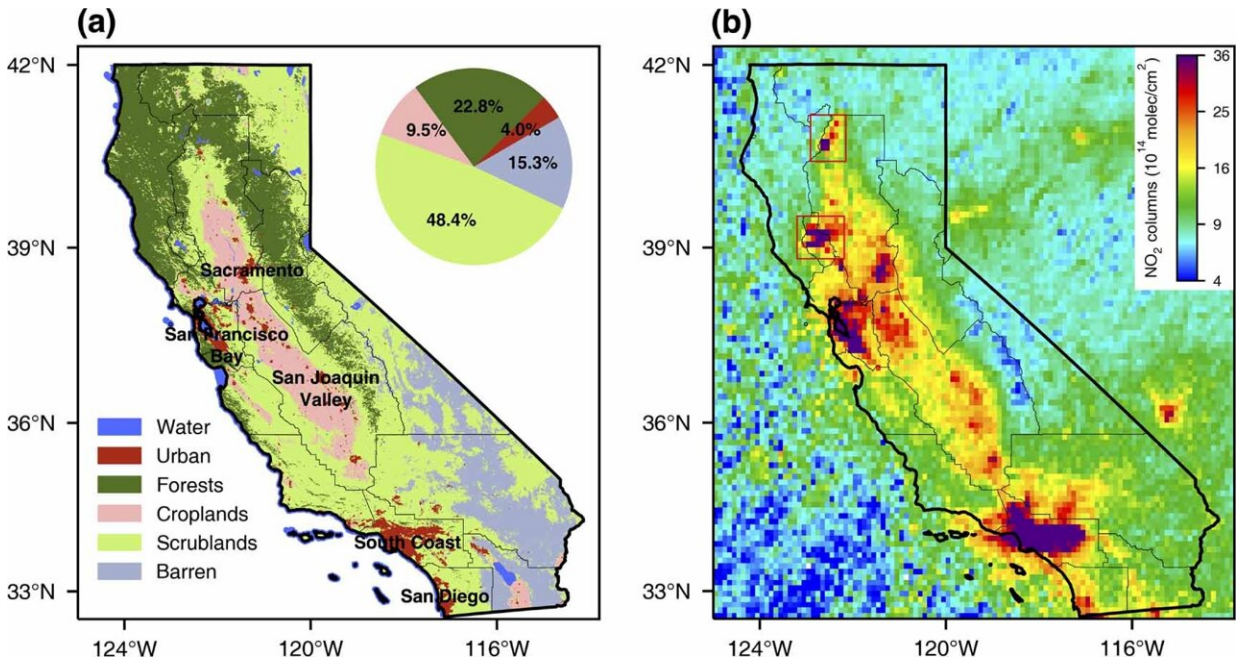

(a) Map of the MODIS land cover types across California. (b) June–September average TROPOMI NO_2 columns over California in 2018. The wildfire NO_2 hotspots are outlined in red rectangles. The borders within the maps represent the boundaries of the 15 air basins designated by CARB for regional management. Credit: *Environmental Research Letters* (2023). DOI: 10.1088/1748-9326/acec5f

Satellite data from across California's landscapes reveal an increase in

nitrogen dioxide levels in remote forest areas, and wildfire and soil emissions are likely the reasons why, according to a paper from University of California, Davis, published today in the journal *Environmental Research Letters*.

Nitrogen dioxide is short-lived in the atmosphere but plays a central role in the formation of the pollutants ozone and particulate matter, which can lead to respiratory issues and asthma in humans, as well as harm plants and crop yields.

The researchers looked at summertime surface and satellite concentrations of nitrogen dioxide between 2009 and 2020 and found that levels decreased by 2%–4.5% per year in urban areas across California, while rural concentrations remained relatively constant, and remote forests experienced an increase of roughly 4.2% per year.

"Forested areas show a steady, rapid rate of increase in summer," said bio-micrometeorologist Ian Faloona, who is senior author on the paper and a professor in the Department of Land, Air and Water Resources. "The trend is alarming."

To do the research, scientists examined surface nitrogen dioxide levels collected by the state and NASA's Aura satellite. They sorted areas of nitrogen dioxide in the atmosphere by surface temperature and soil moisture levels. A California database of fire incidents was also consulted to help place lands into one of five categories: urban, forests, croplands, scrublands and barren (little vegetation).

New sources to consider

Controls on internal combustion engines and other fossil fuel emitters have reduced levels of nitrogen dioxide in urban areas, where most air pollution monitors are placed. Continuous satellite data helped fill in the

picture in less monitored regions and found that effect is not mirrored in rural areas and remote forests. There, wildfires and emissions from soils, particularly agricultural soils with fertilizer use, correlate to an increase of nitrogen dioxide levels, Faloona said.

The findings could help inform future policy decisions as regulators seek additional decreases of the pollutant. As current emission management actions continue to reduce fossil fuel emissions, regulators will need to address other sources that have historically been overshadowed by traditional internal combustion sources.

Those will play an increasingly important role in future air quality policy. "Soils, and wildfires in particular, are really going to become steerers of the ship of our air pollution," Faloona said. "We have to put a lot of effort into curtailing the effects of wildfires and understanding better our emissions from agricultural soils."

Additional research needed

Areas of high fertilizer use can be a source of nitrogen dioxide emissions because microbes compete with crops for nitrogen, generating gaseous nitrogen compounds. But additional research will be necessary to further clarify the exact role wildfire and soil may play in the increase of ambient nitrogen dioxide.

"Our results point to opportunities for different sets of policies and technologies to assist in reducing nitrogen dioxide concentrations in rural and economically disadvantaged areas of California, but will require a concerted effort to better understand the exact environmental dependence of soil and wildfire emissions," the authors wrote.

More information: Yurun Wang et al, Satellite NO2 trends reveal pervasive impacts of wildfire and soil emissions across California

landscapes, *Environmental Research Letters* (2023). DOI: 10.1088/1748-9326/acec5f

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