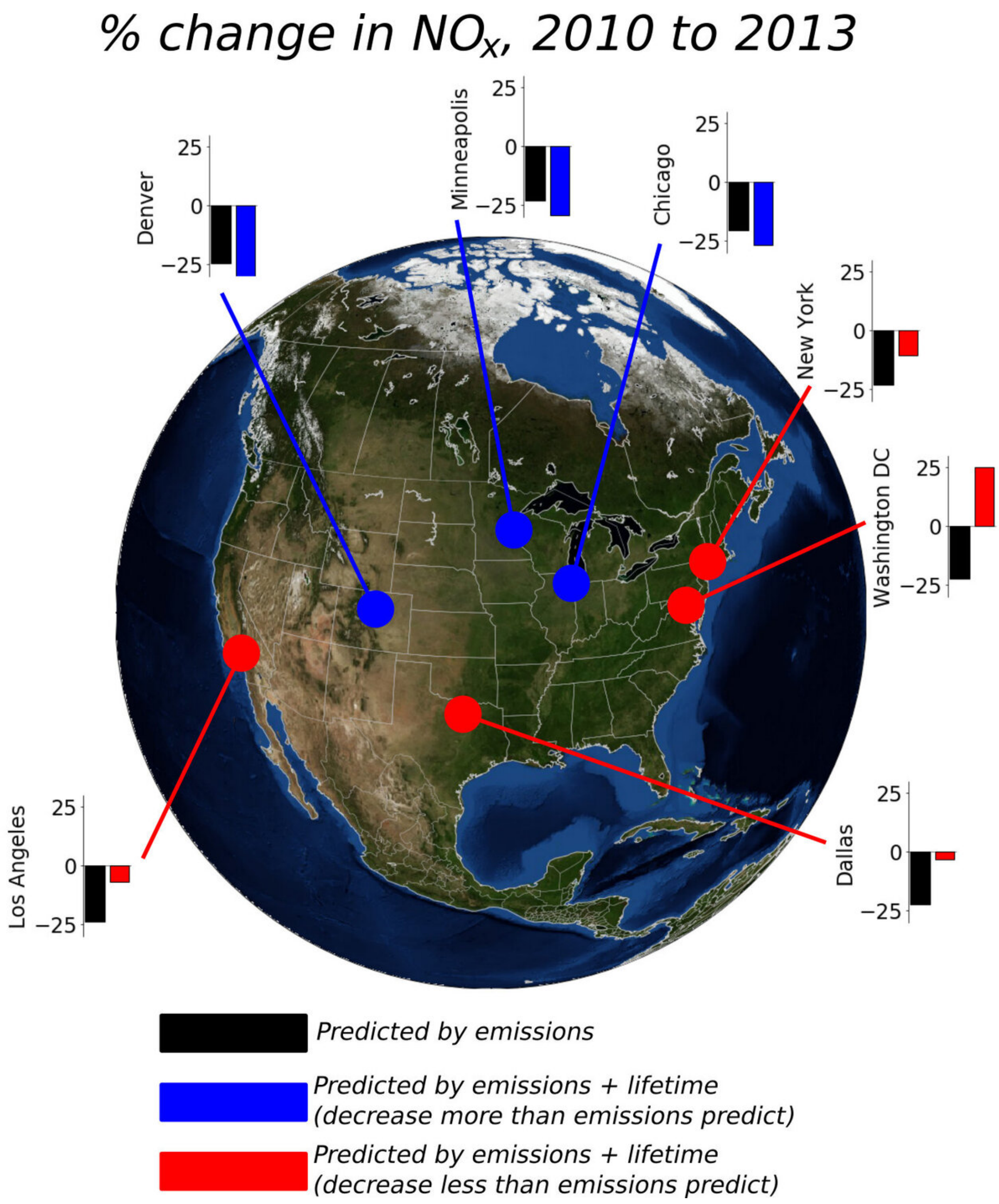
Satellite observations measure nitrogen oxide lifetimes above multiple North American cities

November 8 2019, by Bob Yirka



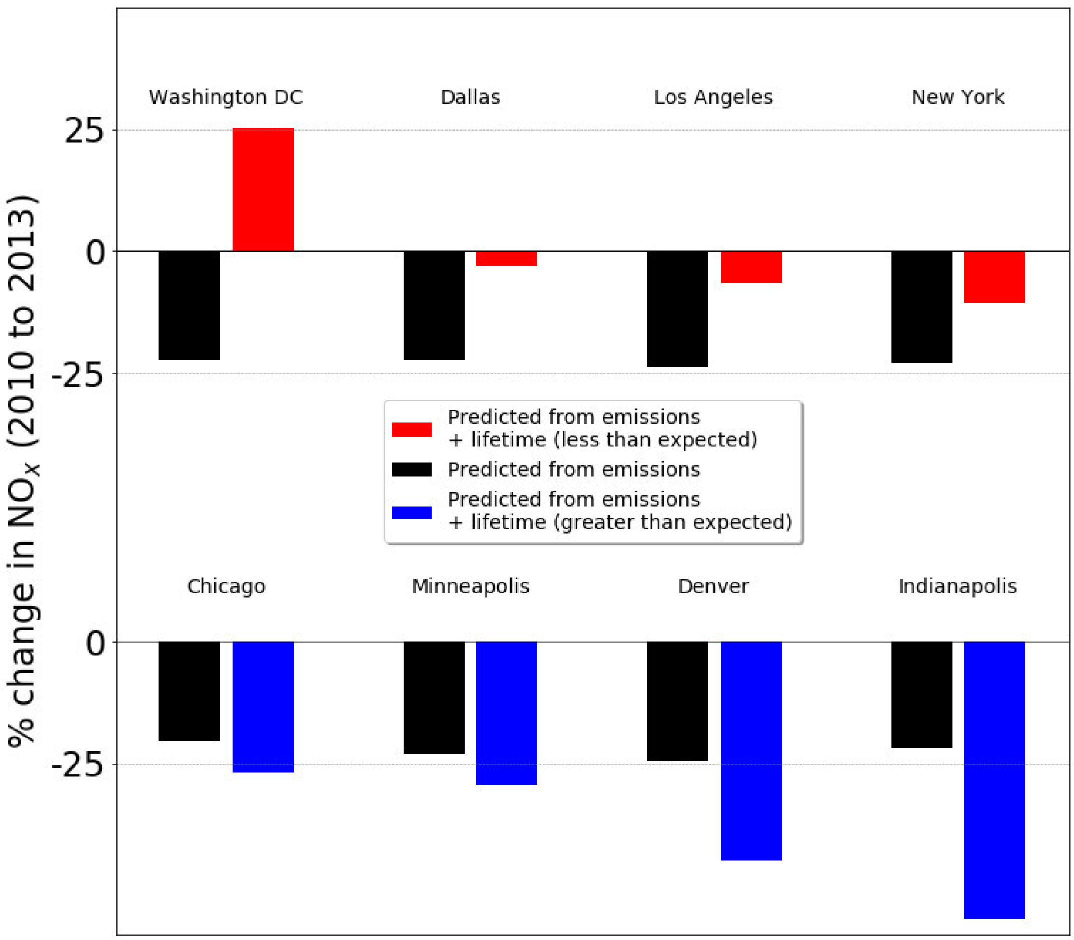
Changes in NO2 emitted to the atmosphere and changes in how fast it leaves the atmosphere (the lifetime). The lifetime varies in space (shown here) and time (shown in the paper). Credit: Joshua L. Laughner and Ronald C. Cohen

A pair of researchers at the University of California, Berkeley, has used satellite observations as a way to measure the lifetime of nitrogen oxide (NO_x) levels above multiple North American cities. In their paper published in the journal *Science*, Joshua Laughner and Ronald Cohen describe how they used a decade's worth of satellite imagery to measure NO_x levels over 49 American cities, and what they found.

Nitrogen oxides (primarily nitric oxide and nitrogen dioxide) are types of pollutants that make their way into the atmosphere after being emitted from cars and factories. They are considered noxious because they play a role in the production of surface-level ozone. And breathing ozone can lead to muscle constriction in the airways, resulting in wheezing, shortness of breath and coughing. Historically, measuring NO_x levels has been difficult because their lifetimes are impacted by other chemicals in the air. In this new effort, the researchers have found a way to get around this problem by using satellite imagery of American cities over the years 2005 to 2014.

The satellite imagery was useful because it came in the form of high-resolution ultraviolet-visible spectra, which allowed the researchers to "see" NOx levels at different points in time. They found that comparing pixels that were adjacent to one another and adding in wind data from other sources, allowed them to come up with a lifetime measurement of NO_x in all of the cities they were studying.

The researchers report that their lifetime NO_x measurements revealed that such levels decreased on average 40 percent across all the cities they looked at. They note that this finding did not indicate that all of the cities under study saw lifetime levels drop, some, in fact, saw increases. They suggest the differences they saw were likely due to different amounts of volatile organic compounds in the air over different cities, resulting in differing amounts of ozone production. They further report that they found that by the year 2013, NO_x was the determining factor leading to ozone production in all of the cities they studied. This, they note, suggests that continuing to reduce NO_x lifetimes should lead to less ozone production.



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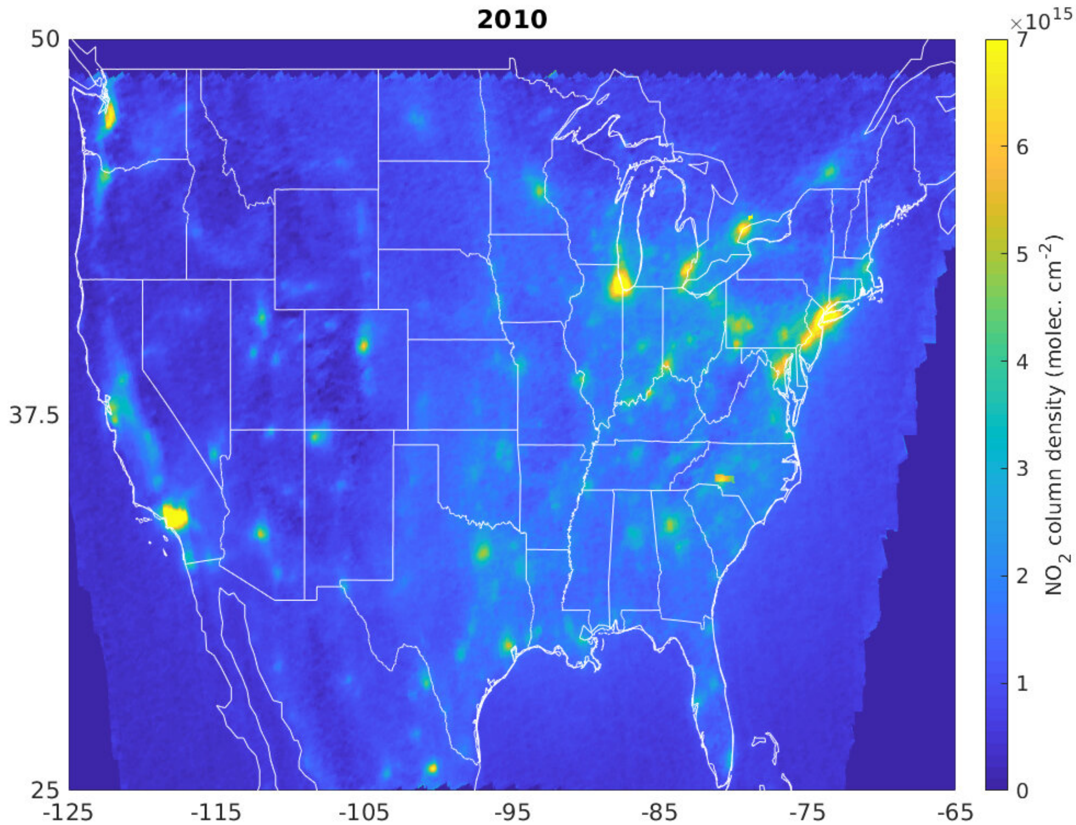

Column NO2 for summer 2010 from the Berkeley High Resolution analysis. The patterns reflect both the strength of emissions and the time for NO2 to react away to more stable molecules (the lifetime). Credit: Berkeley Satellite Group

More information: Joshua L. Laughner et al. Direct observation of changing NOx lifetime in North American cities, *Science* (2019). [DOI: 10.1126/science.aax6832](https://doi.org/10.1126/science.aax6832)