Better models of atmospheric 'detergent' can help predict climate change
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Earth's atmosphere has a unique ability to cleanse itself by way of invisible molecules in the air that act as minuscule cleanup crews. The most important molecule in that crew is the hydroxyl radical (OH), nicknamed the "detergent of the atmosphere" because of its dominant role in removing pollutants. When the OH molecule chemically interacts with a variety of harmful gases, including the potent greenhouse gas methane, it is able to decompose the pollutants into forms that can be removed from Earth's atmosphere.

It is difficult to measure OH, however, and it is not directly emitted. Instead, researchers predict the presence of OH based on its chemical production from other "precursor" gases. To make these predictions, researchers use computer simulations.

In a new paper published in the journal *PNAS*, Lee Murray, an assistant professor of earth and environmental sciences at the University of Rochester, outlines why computer models used to predict future levels of OH—and, therefore, how long air pollutants and reactive greenhouse gases last in the atmosphere—have traditionally produced widely varying forecasts. The study is the latest in Murray's efforts to develop models of the dynamics and composition of Earth's atmosphere and has important implications in advancing policies to combat climate change.

"We need to understand what controls changes in hydroxyl radical in Earth's atmosphere in order to give us a better idea of the measures we need to take to rid the atmosphere of pollutants and reactive greenhouse gases," Murray says.

Building accurate computer models to predict OH levels is similar to baking: Just as you must add precise ingredients in the proper amounts and order to make an edible cake, precise data and metrics must be input into computer models to make them more accurate.

The various existing computer models used to predict OH levels have traditionally been designed with data input involving identical emissions levels of OH precursor gases. Murray and his colleagues, however, demonstrated that OH levels strongly depend on how much of these precursor emissions are lost before they react to produce OH. In this case, different bakers follow the same recipe of ingredients (emissions), but end up with different sizes of cake (OH levels) because some bakers throw out different portions of batter in the middle of the process.

"Uncertainties in future predictions are primarily driven by uncertainties in how models implement the fate of reactive gases that are directly emitted," Murray says.

As Murray and his colleagues show, the computer models used to predict OH levels must evaluate the loss processes of reactive precursor gases, before they may be used for accurate future predictions.

But more data is needed about these processes,
Murray says.

"Performing new measurements to constrain these processes will allow us to provide more accurate data about the amount of hydroxyl in the atmosphere and how it may change in the future," he says.


Provided by University of Rochester


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