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UC Santa Barbara Scientist Studies Methane Levels in Cross-Continent Drive

After taking a rented camper outfitted with special equipment to measure methane on a cross-continent drive, a UC Santa Barbara scientist has found that methane emissions across large parts of the U.S. are higher than currently known, confirming what other more local studies have found. Their research is published in the journal Atmospheric Environment.

Methane is a potent greenhouse gas, stronger than carbon dioxide on a 20-year timescale, according to the Intergovernmental Panel on Climate Change, though on a century timescale, carbon dioxide is far stronger. "This research suggests significant benefits to slowing climate change could result from reducing industrial methane emissions in parallel with efforts on carbon dioxide," said Ira Leifer, a researcher with UCSB's Marine Science Institute.

Leifer was joined by two UCSB undergraduate students on the road trip from Los Angeles to Florida, taking a primarily southern route through Arizona, New Mexico, Texas, Louisiana, and along the Gulf of Mexico. They used specialized instrumentation, a gas chromatograph, to measure methane. The device was mounted in the RV, with an air ram on the roof that collected air samples from in front of the vehicle.

"We tried to pass through urban areas during nighttime hours, to avoid being stuck in traffic and sampling mostly exhaust fumes," Leifer said. "Someone was always monitoring the chromatograph, and when we would see a strong signal, we would look to see what potential sources were in the area, and modify the survey to investigate and, if possible, circumnavigate potential sources."

The researchers meandered slowly through areas of fossil fuel activity, such as petroleum and natural gas production, refining, and distribution areas, and other areas of interest. The wide range of sources studied included a coal-loading terminal, a wildfire, and wetlands.

The team analyzed the data in conjunction with researchers at the University of Bremen, Germany, who analyzed inventories and satellite data from the Scanning Imaging Absorption Spectrometer for Atmospheric Chartography (SCIAMACHY) instrument onboard the European Space Agency's (ESA) ENVISAT satellite to confirm the finding of strong methane sources in regions of fossil fuel activity. The surface measurements found methane levels increased as the researchers moved toward Houston, and then decreased as they continued westward –– the same trend observed in satellite data spanning the continent.

Previous methane studies have focused primarily on large-scale airborne data, which were challenging to separate from local sources, according to Leifer. In fact, clear identification of individual sources often could not be conducted, requiring computer models and other surface measurements.

The team compared maps of estimated methane emissions based on data from the International Energy Agency of the U.S. Department of Energy with satellite methane maps. They found that, in some cases, to explain observed higher methane concentrations required higher emissions than current emission maps present, particularly in large regions of fossil fuel industrial activity. In other cases, though, they could rule out that wetlands such as swamps may have been important. In such cases, separating wetland methane contributions from fossil fuel industrial contributions was not possible with their approach, Leifer said, "This is a topic we are investigating further through new research," he added.

"Methane is the strongest human greenhouse gas on a political or short timescale, and also has more bang for the buck in terms of addressing climate change," said Leifer. "This research supports other recent findings suggesting that fugitive

emissions from fossil fuel industrial activity actually are the largest methane source. This clearly indicates a need for efforts to focus on reducing these methane emissions."

The researchers found the highest methane concentrations in areas with significant refinery activity, and in California in a Central Valley region of oil and gas production. Methane levels near refineries were not uniform, varying greatly from spot to spot and at different times. Nighttime concentrations were dramatically enhanced when the winds died down, forming a calm, shallow atmospheric layer near the surface, according to Leifer.

Perhaps the most surprising discovery was made in the Los Angeles area, where the study highlighted the importance of geologic methane emissions in the North Los Angeles Basin, centered on the La Brea Tar Pits. Rough estimation of emissions from the data suggests 10-20 percent of the methane emissions from Los Angeles could be natural geologic, influenced by the vast number of abandoned wells throughout the area.

This study was supported by a National Science Foundation Rapid Response Grant, by NASA and ESA, as well as JAXA, the Japanese Space Agency. Support also came from the Department of Energy, through the Gulf of Mexico Hydrates Research Consortium, the University of Mississippi, the University of Bremen, and the German Aerospace Center (DLR) Space Administration.

According to Leifer, these results illustrate the need for satellite technology to further this type of research and also to provide guidance to decision makers. "We are working with methane data from the Japanese satellite, GOSAT, to continue these investigations," Leifer said. "We look forward to when new tools, like ESA's CarbonSat and NASA's HyspIRI spacecraft, are in orbit to help, as well as results from a new joint NASA/ESA airborne campaign, COMEX, with University of Bremen researchers to improve further methane satellite designs." COMEX will test different airborne remote sensing technologies for application to methane observations.

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