

1.047 The journey of C2-C5 alkane emissions from the oil and gas sector: atmospheric and air quality implications.

Early Career Scientist

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Abstract:

Oil and gas extraction has undergone a dramatic increase over the past century and, more recently, the advent of hydraulic fracturing has opened up new regions to extraction, particularly in the United States. This oil and gas extraction, and associated infrastructure, emit a variety of compounds including light alkanes (C₂-C₅) that have been shown to contribute to air quality degradation. Further, there is an observed ubiquitous increase in the atmospheric abundance of light alkanes in the Northern Hemisphere. Given this, it is critically important that we develop methodologies to estimate light alkane emissions with a rapidly evolving oil and gas industry. This is currently a challenge for emission inventories. Here we present results from three recent papers that quantify the role of the oil and gas sector on light alkane emissions at local, regional, and global scales. Our work on the global budget of ethane (C₂H₆) suggests that emissions of light alkanes in several major anthropogenic source regions, including the central and eastern U.S., Europe, Russia, and the Middle East, should be revisited. A closer look into the U.S. with updated oil and gas emissions was done using a nested high-resolution (0.5 degree x 0.667 degree) simulation to examine the contribution of this sector to the abundance of C₂-C₅ alkanes. Our model largely reproduces observed C₂ and C₄-C₅ alkane abundances over the U.S., based on a comparison to a large suite of surface observations, column measurements, and aircraft profiles. In contrast, simulated propane (C₃H₈) abundances are low over the central U.S. and we suggest that emissions from this sector need to be revisited. We also found that emissions of C₂-C₅ alkanes from the oil and gas sector make the largest contribution to secondary species production (e.g., ozone, peroxyacetyl nitrate, and several ketones) over the central U.S. compared to other regions.