Empirical quantification of methane emission intensity* from oil and gas producers in the Permian basin

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Science Question
- What is the methane intensity (loss rate) of the largest oil & gas producers in the Permian basin?
- How is methane intensity trending over time?

Analysis
- We utilize a series of aerial imaging spectrometer surveys of large CH_4 point source emissions ($\sim$10–10,000 kg CH4 hr^{-1}) related to oil & gas (O&G) production in the Permian Basin to enable comparison of company-level production-sector emission intensities.
- We calculate gas and total energy production normalized CH_4 emission intensities for several of the largest O&G operators in the Permian Basin accounting for $\sim$85% of production within the flight region.
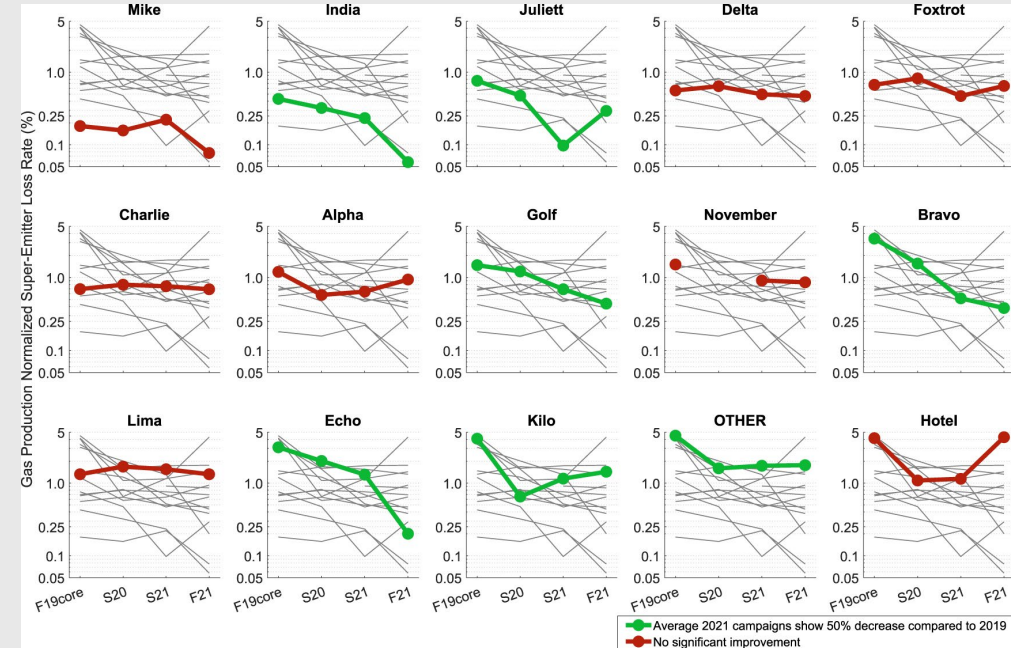
Results
- We find differences of more than an order of magnitude in emission intensity across operators, with nearly half demonstrating a $\geqslant$50% improvement in performance from 2019 to 2021
- Some operator intensities still exceed the gas-parity-with-coal loss rate of $\sim$ 2.7%

Significance
- In recent years, O&G operators have made public commitments to reducing their greenhouse gas emission intensity, yet little empirical information has been made available in the public domain to allow an accurate comparison of their emissions performance.
- New satellites offering open-source CH4 data with sufficient resolution and precision to attribute point source emissions to individual operators will offer improved insights in O&G intensity and trends
- The EPA's new Methane Emission Reduction Program and Colorado's proposed Methane Intensity Verification program in particular will benefit from sustained, operational intensity monitoring

Acknowledgements

Legend:
— Average 2021 campaigns show 50% decrease compared to 2019
— No significant improvement

Trends in gas production normalized super-emitter loss rate for each operator across all campaigns. Colored lines represent the labeled operator while grey lines represent the remaining ones. Vertical axes are logarithmically scaled, while the horizontal axes are non-linear with separation of approximately 9, 12, and 2.5 months between each of the campaigns in chronologic order. Green lines indicate which operators presented a 50% decrease in gas production normalized super-emitter loss rates from 2019 to the average of 2021 campaigns.

*conservatively, we report the "super-emitter" component of total intensity (total intensities are likely somewhat higher than shown here)