

1. Motivation





- Figure 1: EPA breakdown of Methane sources (202 • Methane, while not the most abundant greenhouse gas (12% of US gas emissions in 2021), is 28 times better at trapping radiation then CO2 over 100 years (EPA, 2023)
- Actual atmospheric measurements of emissions from oil and gas are 2 times the amount reported by the EPA (Alvarez et al., 2018)
- It is possible that methane has a seasonal pattern that if better understood can help in mitigation efforts and future policy

2. Methodology

TROPOMI (tropospheric monitoring instrument) is an instrument aboard the Sentinel 5P satellite that takes different atmospheric measurements each day



the Sentinel 5p in space (ESA, 2017)



nian Basin [shaded in light grey] in New Mexico and Texas (IEEFA, 2021

- Download data for 2018 to 2022
- Using Matlab, produce maps that show methane mole fractions in ppb for:
- Average column concentration on a seasonal timescale
- Average seasonal and Winter minus Summer column methane concentration enhancement for the Permian basin

Does TROPOMI show a Seasonal Pattern in Methane Concentrations in the Permian Basin? Najah Israel¹, Kenneth Davis², Zachary Barkley², Yunsong Liu² ¹George Mason University, ²Penn State University



- LA. Houston
- Enhancements means that a background amount was subtracted from each season's average mole fraction enhancement in ppb for the Permian basin
- The background selected was a 1x1 coordinate in the middle of New Mexico that did not have any significant methane sources
- It is expected that the enhancements will be related to emissions **CH4 TROPOMI Enhancement Difference 2022** 35.0[°] N



When the difference between Winter and Summer is mapped, it becomes clear that during the winter the Texas portion of the Permian basin has a higher methane mole fraction by ~20-37 ppb on average in 2022

- 2022)
- needed

results

Alvarez, R. A et al.: Assessment of methane emissions from the U.S. oil and gas supply chain, Science, https://doi.org/10.1126/science.aar7204. 2018 EPA, 2023: Overview of Greenhouse Gases. Accessed 13 June 2023, https://www.epa.gov/ghgemissions/overview-greenhouse gases#methane

ESA, 2023: TROPOMI data via NASA getdisc. Accessed 10 June 2023, https://tropomi.gesdisc.eosdis.nasa.gov/data/S5P_TROPOMI_Level2/S5P_L2__CH4____HiR.2/

IEEFA, 2021: Pioneer, other independents top supermajor production in Permian Basin. Accessed 26 July 2023, https://ieefa.org/articles/ieefa-us-pioneer-other-independents-top-supermajor-production-permian-basi

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4. Conclusion

• TROPOMI (in 2022) shows a pattern of methane mole fractions increasing from spring to winter in the Texas portion of the Permian basin • This pattern is seen across multiple years (2019-

• It is possible that this difference in pattern between the New Mexico and Texas portion of the basin is due to differences in state regulations, but further research would be

5. Future Work

Compare bottom-up inventories to TROPOMI

• Figure out if the difference in patterns across state boundaries is due to policy by looking at other basins in each state



ESA, 2017: Sentinel 5p Operations. Accessed 14 June 2023, https://www.esa.int/Enabling_Support/Operations/Sentinel-5P_operations

7. Acknowledgments

8. Appendix

Scan QR code to see figures from 2019-2022