CARBON INTENSITY FROM OFFSHORE PRODUCTION

Greenhouse gas emissions from fossil fuel production in the Gulf of Mexico far exceed standard estimates

Photo taken from a Mooney airplane of a gathering and processing central hub facility surrounded by satellite production facilities. *Image Courtesy of Paolo Wilczak.*

MITIGATION OPPORTUNITY

Fix excess methane (CH_4) emissions from shallow-water central-hub facilities to drastically reduce carbon intensity across the basin.

New research observed greenhouse gas emissions from oil and gas production across the Gulf of Mexico that significantly exceed estimates, elevating the entire basin's **carbon intensity** to more than twice official inventories (Figure 1). The increased carbon intensity is driven primarily by large methane emissions from production in the shallow waters of the Gulf of Mexico.

Although shallow-water production has been in decline since the year 2000, new drilling continues. As long as production endures or expands at high-emitting sites, the carbon intensity of Gulf fuels will remain elevated. Decisions about expanding production in the region legally depend on assessments of the climate impact of new growth.

Central-hub facilities—which, with satellite production platforms, dominate shallow waters—are more likely than other types of platforms to be methane super-emitters. Central hubs are expected to endure decommissioning trends. Therefore, mitigation efforts should focus first on these super-emitters.

Promising mitigation pathways:

- Replace venting with efficient flaring of methane byproducts.
- Refurbish or repair dilapidated equipment.
- Decommission (plug and abandon) irreparable sites.

Mitigation efforts like these in the Gulf's shallow waters could reduce the climate impacts of Gulf oil and gas production significantly.

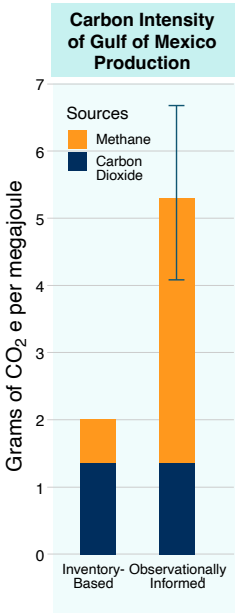

Figure 1

OPERATIONS IN THE GULF

The Gulf of Mexico is the largest offshore fossil fuel production basin in the United States. Four broad types of platforms operate in the Gulf.

1) In shallow waters, small production platforms
2) In shallow waters, larger "central-hub" multi-platform complexes that collect oil and gas from small production platforms for processing
3) In shallow to mid-depth waters, mid-size platforms for production and processing
4) In deep to ultra-deep waters, generally newer, high-volume platforms for production and processing that flare methane

This study combined new airborne observations with previous surveys and inventories to estimate the climate impact of current production, gathering, and processing of both oil and gas in the region. Observations included all major onsite greenhouse gas emissions, including carbon dioxide from combustion and methane from losses and venting.

MEASURING CARBON INTENSITY

Carbon intensity (CI) measures grams of CO_2 equivalent of greenhouse gas emissions (CO_2 and CH_4) per megajoule of energy produced (oil and gas). A lower CI reflects a fuel with lower climate impacts per unit of energy delivered. Therefore measuring CI facilitates basin comparisons and supports more informed mitigation choices.

However, CI typically does not incorporate observations, which have frequently shown underestimates in CH_4 emissions. CI allows for linking CH_4 to both oil and gas production, which is important because CH_4 can be emitted from operations focused on oil production.

This study outlines a method for evaluating the CI of fossil fuel production accounting for all direct production emissions (CH_4 and CO_2) from both oil and gas, using observational data, and resulting in greater accuracy.

KEY FINDINGS

Observed methane emissions exceed inventories, elevating the carbon intensity of the basin to over twice the official inventories.

- Mean observed methane emissions in federal and state waters are 3X and 13X higher than inventories, respectively.
- Methane emissions are of particular concern because they have greater global warming potential than carbon dioxide, especially in the short term. They should be the first focus of mitigation efforts.

The carbon intensity of oil and gas production varies widely across the Gulf.

- Carbon intensity is extraordinarily high in shallow federal and state waters, where production rates are moderate and methane drives the majority of emissions. The observed shallow water carbon intensity far exceeds that of both deep water Gulf of Mexico production and typical global oil production.
- In contrast, carbon intensity is low in deep waters, where combustion emissions dominate the climate impact and production is high. Observational data of carbon dioxide from this study is generally consistent with inventories, suggesting that combustion is well-represented in the federal inventory.

Central hub processing facilities are the primary contributor to excessive shallow-water production emissions.

- High-emission events from these facilities are frequent and can be attributed to cold venting, emissions associated with tanks, and other pieces of equipment.

WHAT'S HAPPENING AT CENTRAL HUBS?

Central hubs are most responsible for the gap in reported emissions. While the precise causes of excess emissions are not yet known, this research produced key observations and potential avenues for further research.

- **The airborne survey confirmed frequent high-emission events from cold-venting and emissions from other equipment.** While intended to be infrequent, cold venting appears to be persistent where present. Lack of metering, faulty meters, or underreporting by operations could explain why observations exceed inventory accounting.
- **This class of facility tends to be older** and may have experienced bankruptcy on multiple occasions. Maintenance and controls may be poorly implemented.
- **Observed emission rates vary between central hubs and do not correlate with production rate** or other simple predictive indicators, including age of facility. The decoupling from production rate could be due to the multiple supply chain roles hubs play. Additionally, as hubs centralize production from multiple satellites, they could at times be handling volumes outside their optimal capacity.

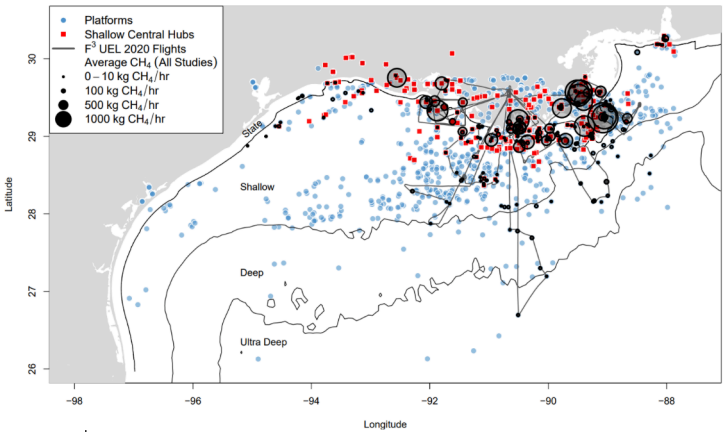

Figure 2. *The map shows methane emissions from offshore oil and gas platforms in the Gulf of Mexico collected from airborne measurements in August 2020 and measurements from all previous field studies. The goals were to study emissions of CH_4, CO_2, and NO_x, gather a representative sample from the Gulf's diverse oil and gas system, and collect extensive data from super-emitters.*

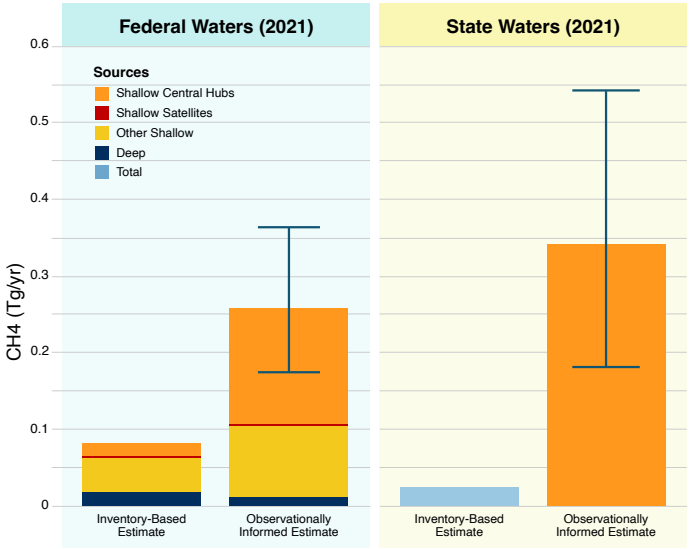

Figure 3. *This figure shows total CH_4 emissions compared between observational data and inventories for federal waters and state waters. Total observed emissions are estimated from resampling observations by platform category. The inventory estimates, adjusted for the year 2021, were calculated from the 2017 Gulfwide Offshore Activities Data System for federal waters and from 2019 values reported in the 2021 greenhouse gas inventory for state waters. Observed state water emissions are estimated only for central hubs because the hub-satellite system dominates state water infrastructure and the data is most complete for those platforms.*

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ABOUT THE PROJECT

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