September 2022

The role of the International Methane Emissions Observatory in Strengthening National Greenhouse Gas Inventories

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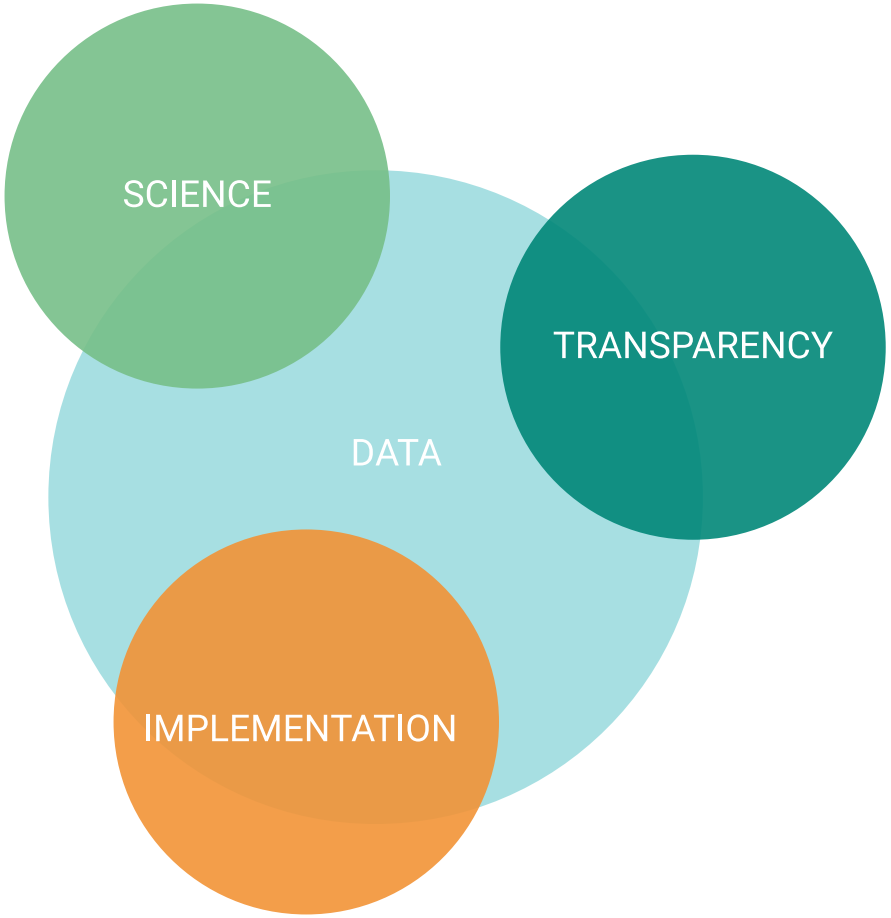
Chair – IMEO Scientific Oversight Committee

UN environment programme 50 1972-2022

IMEO interconnects better data with action on transparency, science, and implementation

Close the knowledge gap
peer-reviewed studies and data reconciliation.



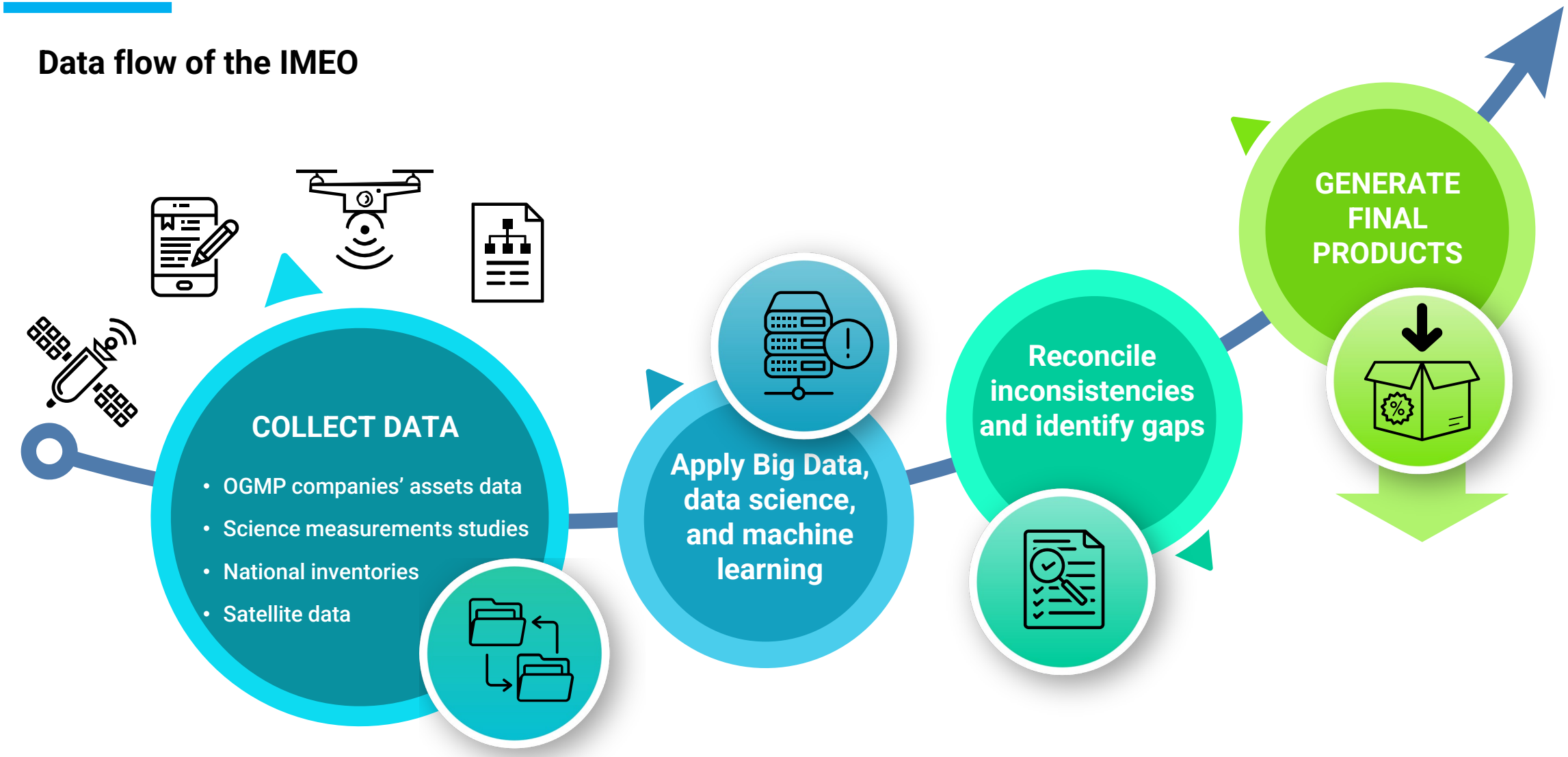
Provide accurate, unbiased and up-to-date information on methane emissions

Raise awareness and increase the capacity of governments to pursue **science based-policy options** to manage methane emissions.

GHG emission estimates are increasingly being able to be effectively constrained in a policy relevant way at regional and country scales using readily-available methane emission measurement-based approaches. i.e., fluxes derived from satellite remote sensing data (supported by airborne-based approaches and tower networks).

IMEO an integrated emissions data hub providing **actionable** data

Data flow of the IMEO

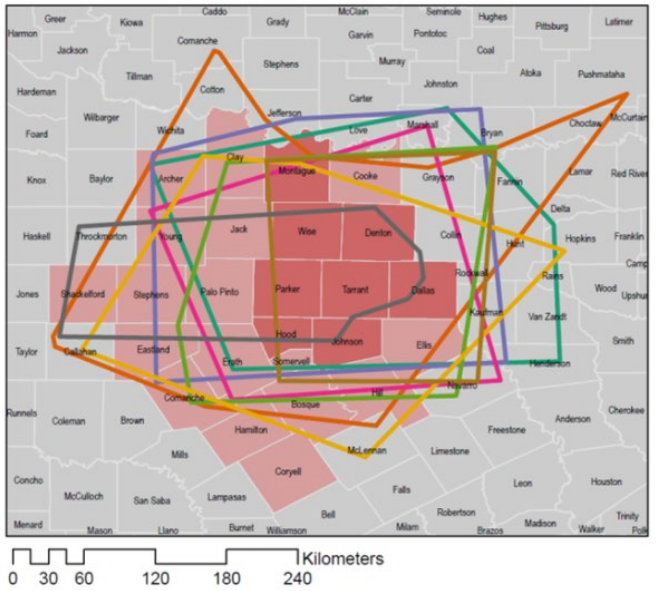


Integrating Inventory and measurement-based emissions provides very useful data

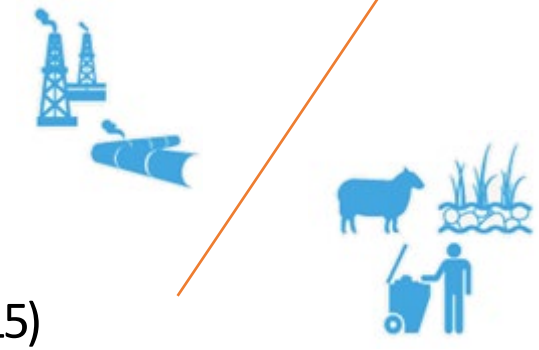
Example: Barnett Shale synthesis work: Robust, complementary approaches

Regional-level

Replicate mass balances

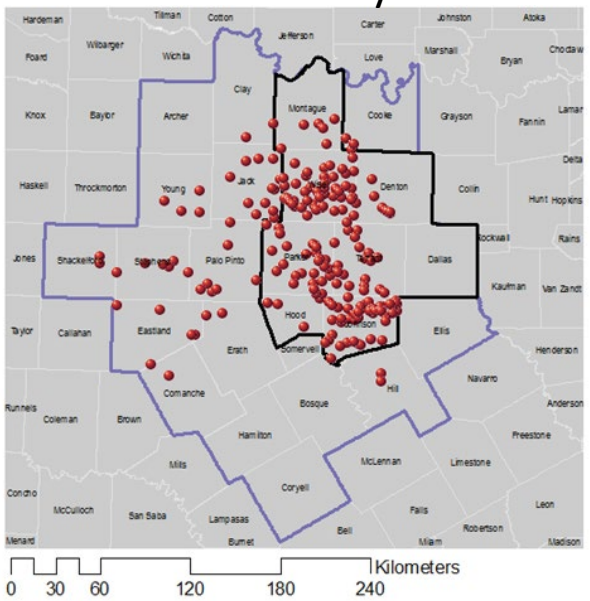


Accurate attribution

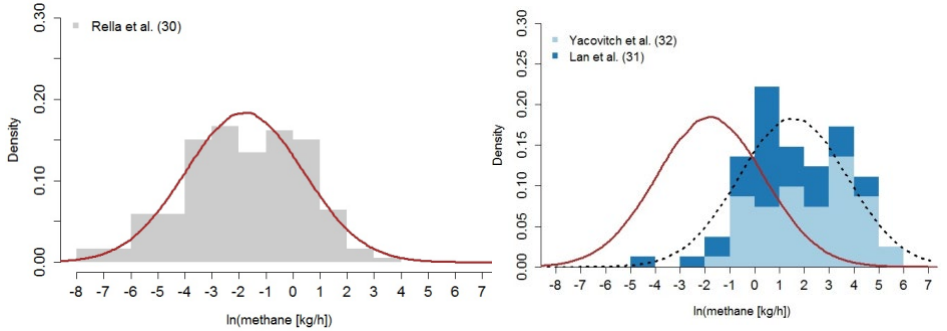


Inventory

Accurate facility counts



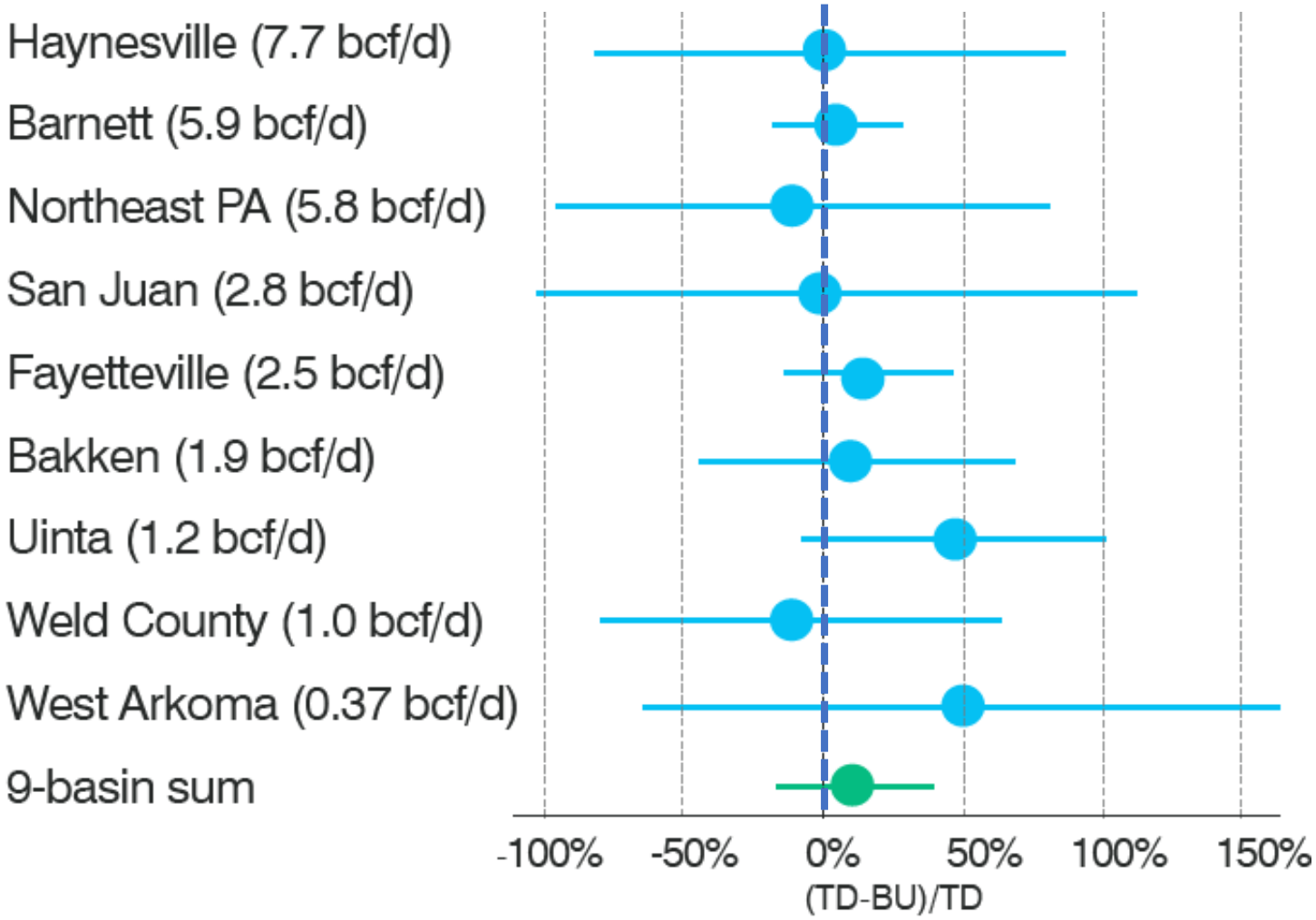
Representative emission factors



Zavala-Araiza et al. *PNAS* (2015)

Successful reconciliation of oil and gas methane emissions in the US

Basin level bottom-up emissions estimates agree with top-down measurements



Alvarez et al. *Science* (2018)

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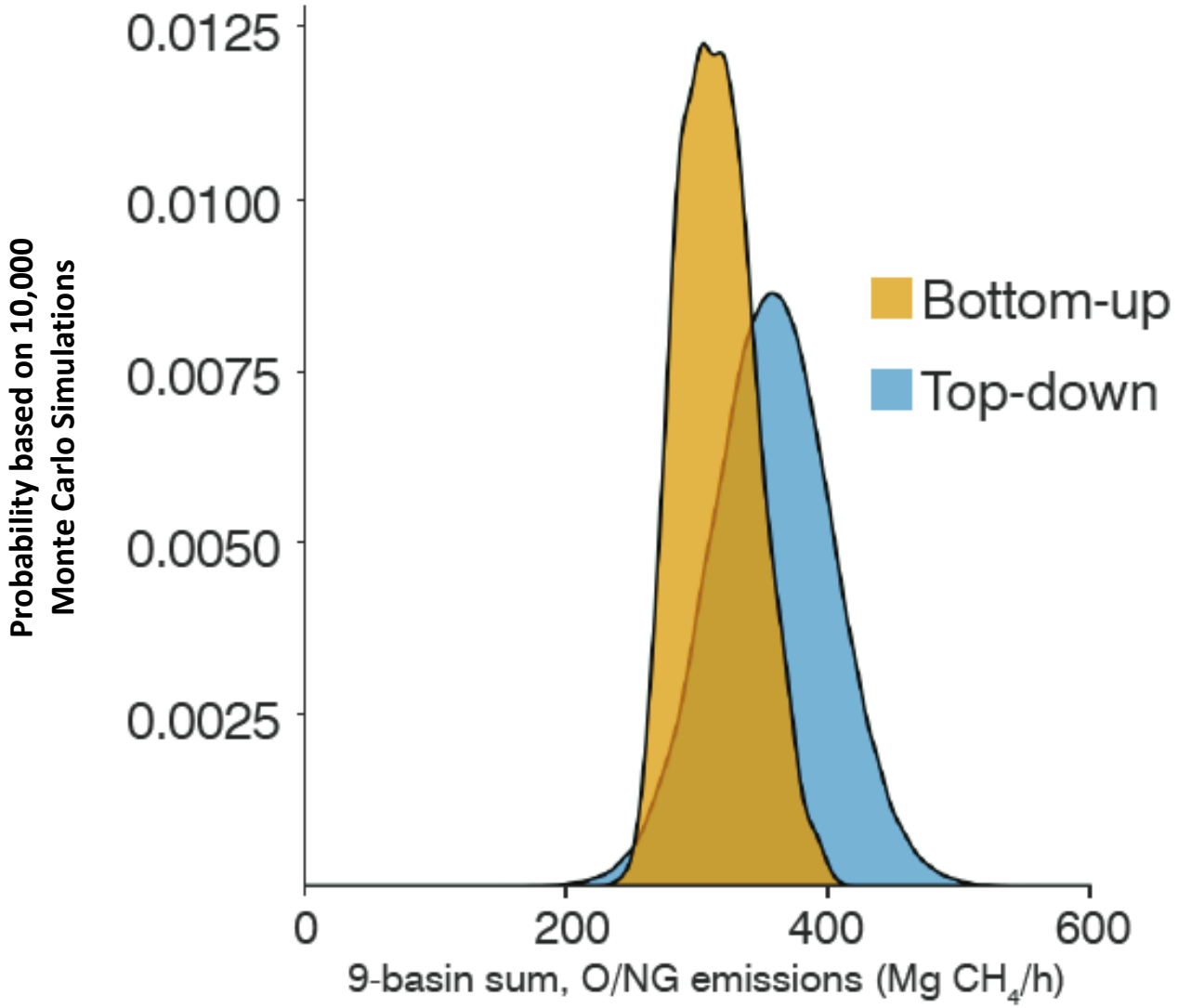


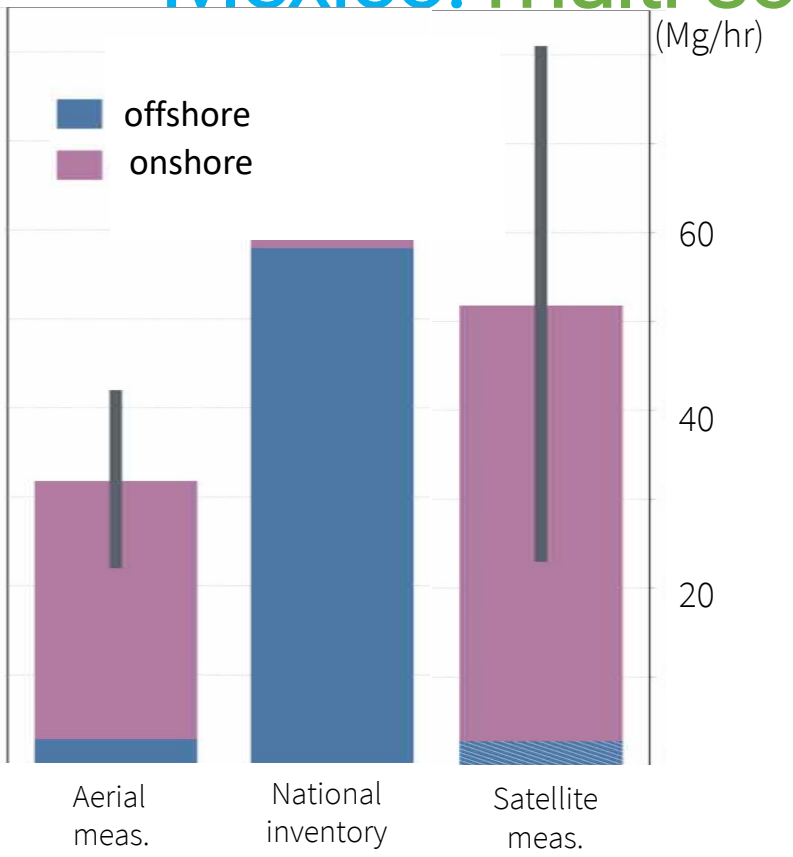
Alvarez et al. *Science* (2018)

Successful reconciliation of oil and gas methane emissions in the US: keys to achieving convergence

- **Replicate Measurements**: Reduce uncertainty of regional-level estimates
- **Attribution**: Stoichiometry (e.g. C_1:$C_{2)}$ often allows differentiation between fossil and biogenic GHG sources (e.g. methane)
- **Accurate Activity factors**: Inventory-based estimates require accurate facility counts
- **Emissions Distribution Characterization**: accurate characterization of emission factors:
  - Sampling must capture low-probability, high-emitting sources
  - Magnitude and frequency of high-emitting sources
- **Co-occurring estimates**: Align spatial and temporal domains of top-down and bottom-up estimates.

Alvarez et al. *Science* (2018)

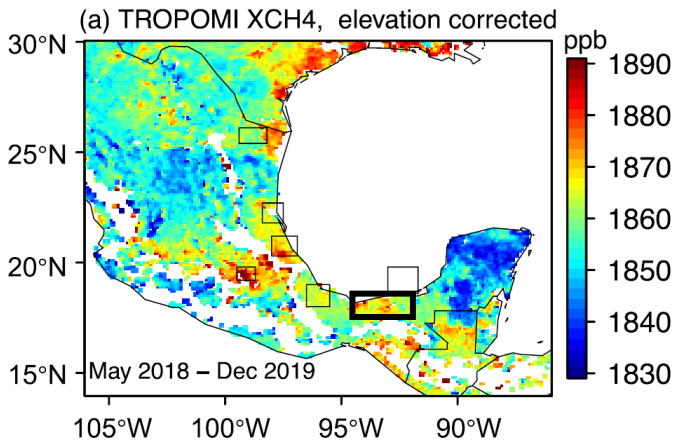
Mexico: multi-scale empirical data can guide mitigation

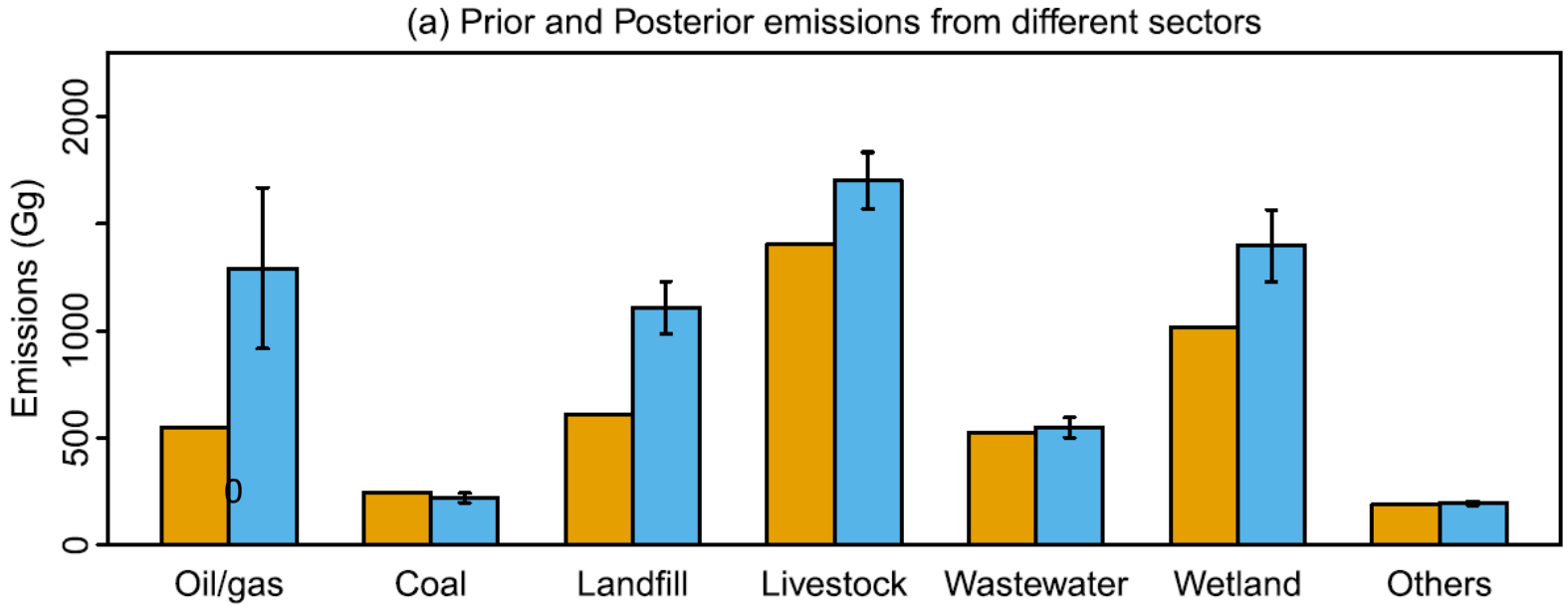


Offshore emissions are significantly overestimated by current inventories while onshore emissions are significantly underestimated.

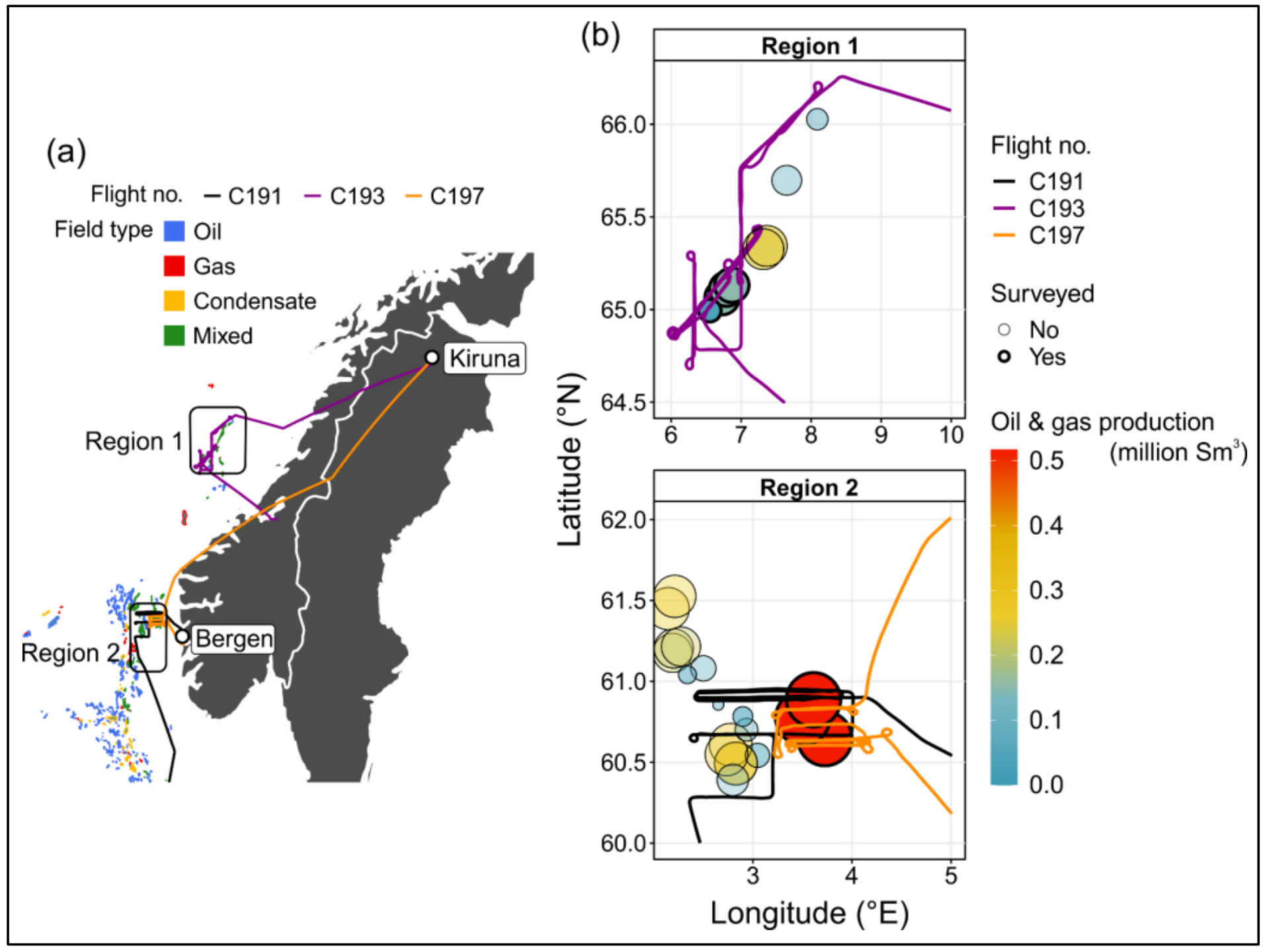
Oil and gas emissions are 2 times higher than national inventory (loss rate of 4.3%).

One basin (Sureste) is responsible for 50% of national O&G emissions.





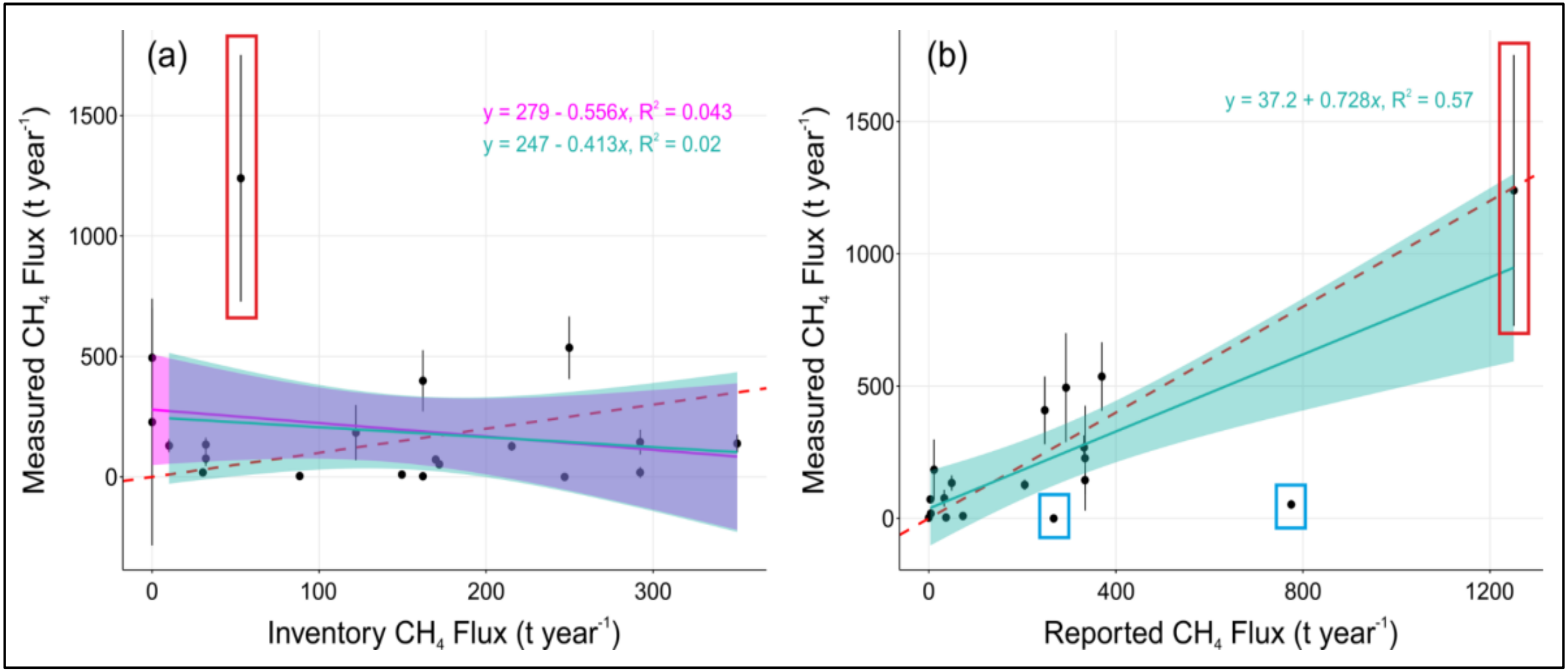
(Source: Shen, et al. 2021; Zavala-Araiza et al. 2021)



Norway Offshore O&G production

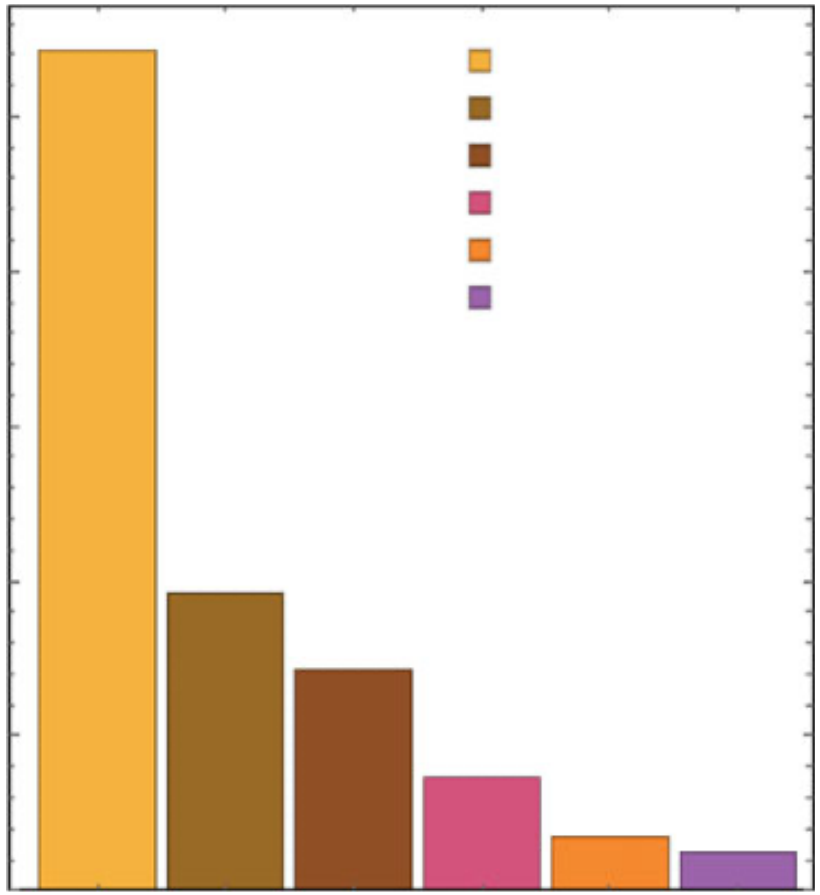
Foulds et al. 2022

Norway Offshore O&G Methane Emissions



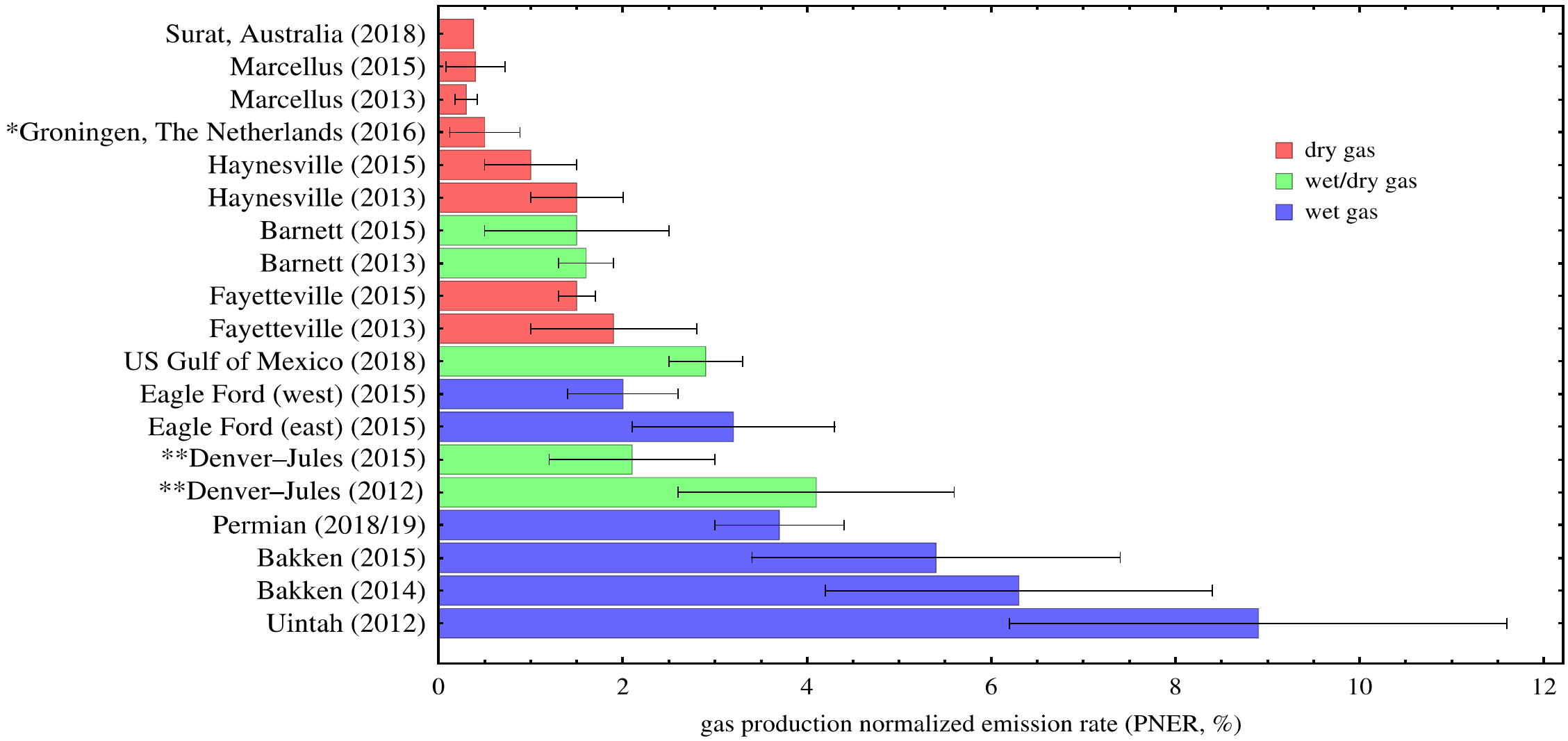
Foulds et al. 2022 preprint

Methane emissions Surat Basin, New South Wales, Australia



Neininger et al. 2021

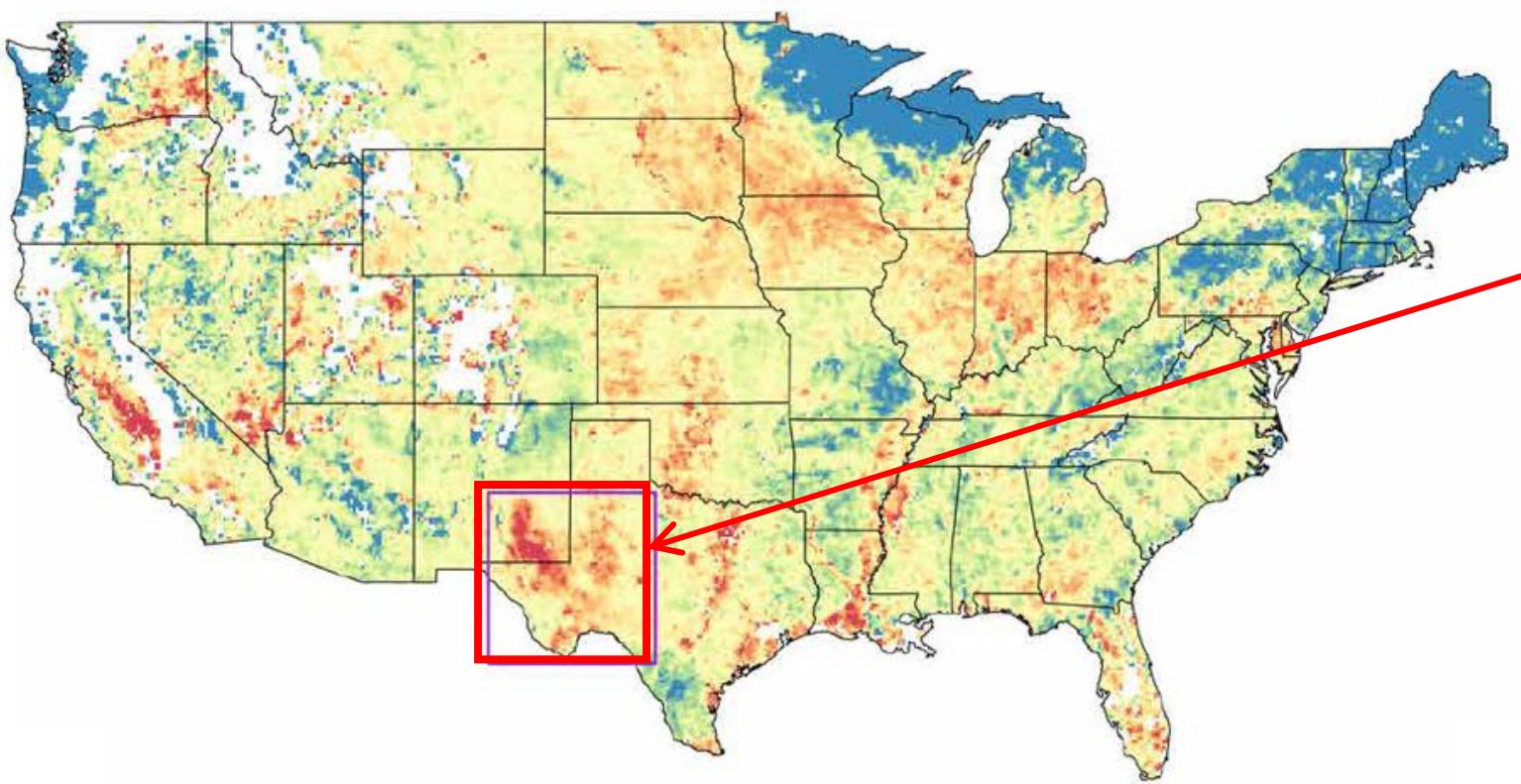
Methane Emissions across O&G Basins

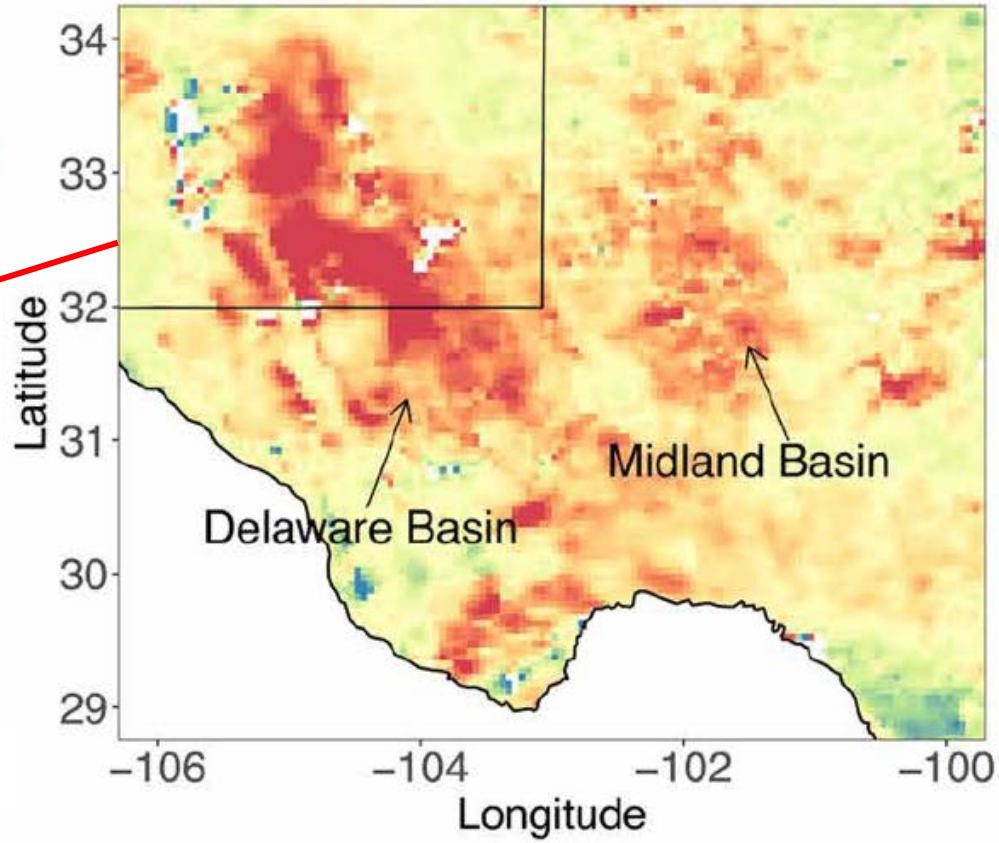


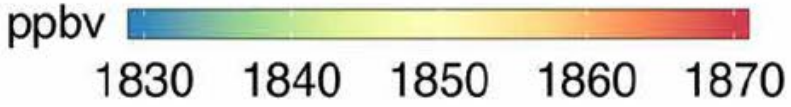
Neininger et al. 2021

Satellite observations quantify Permian methane emissions

TROPOMI methane data averaged from May 2018 – March 2019

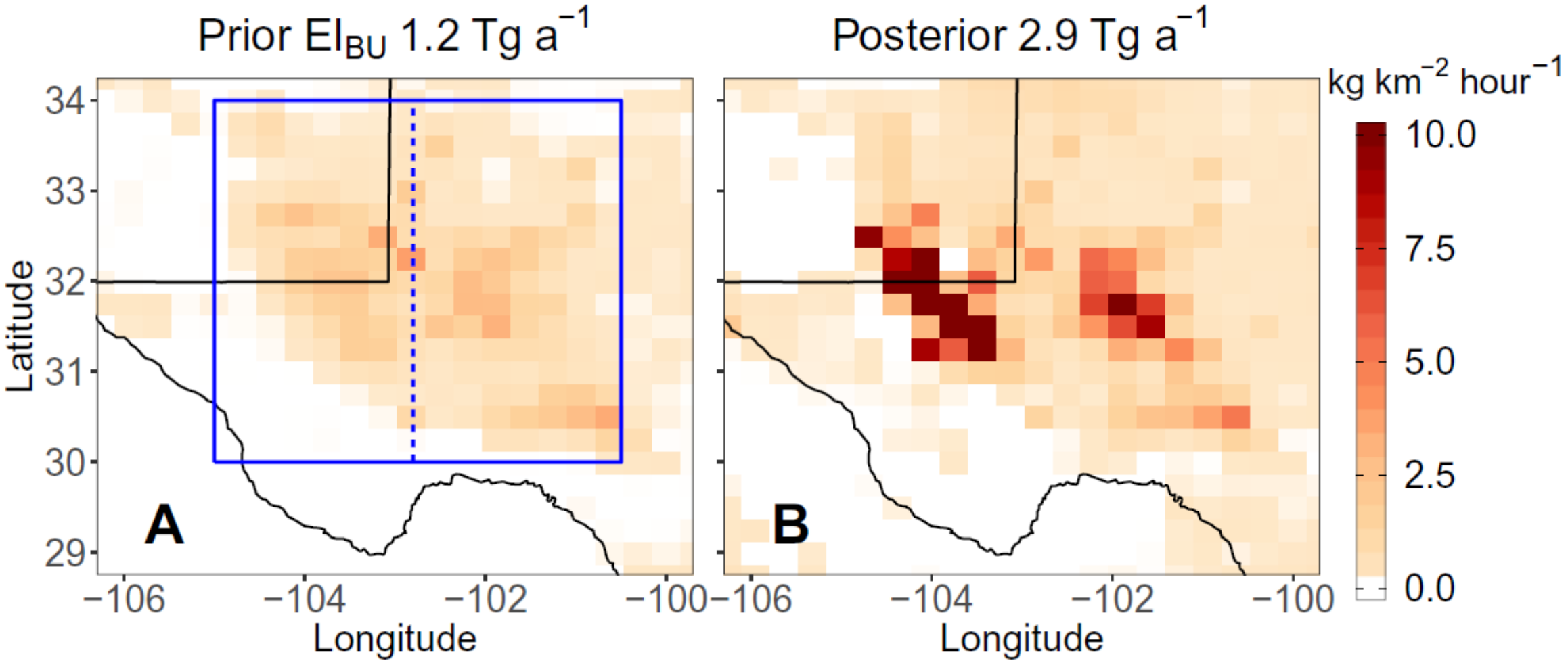






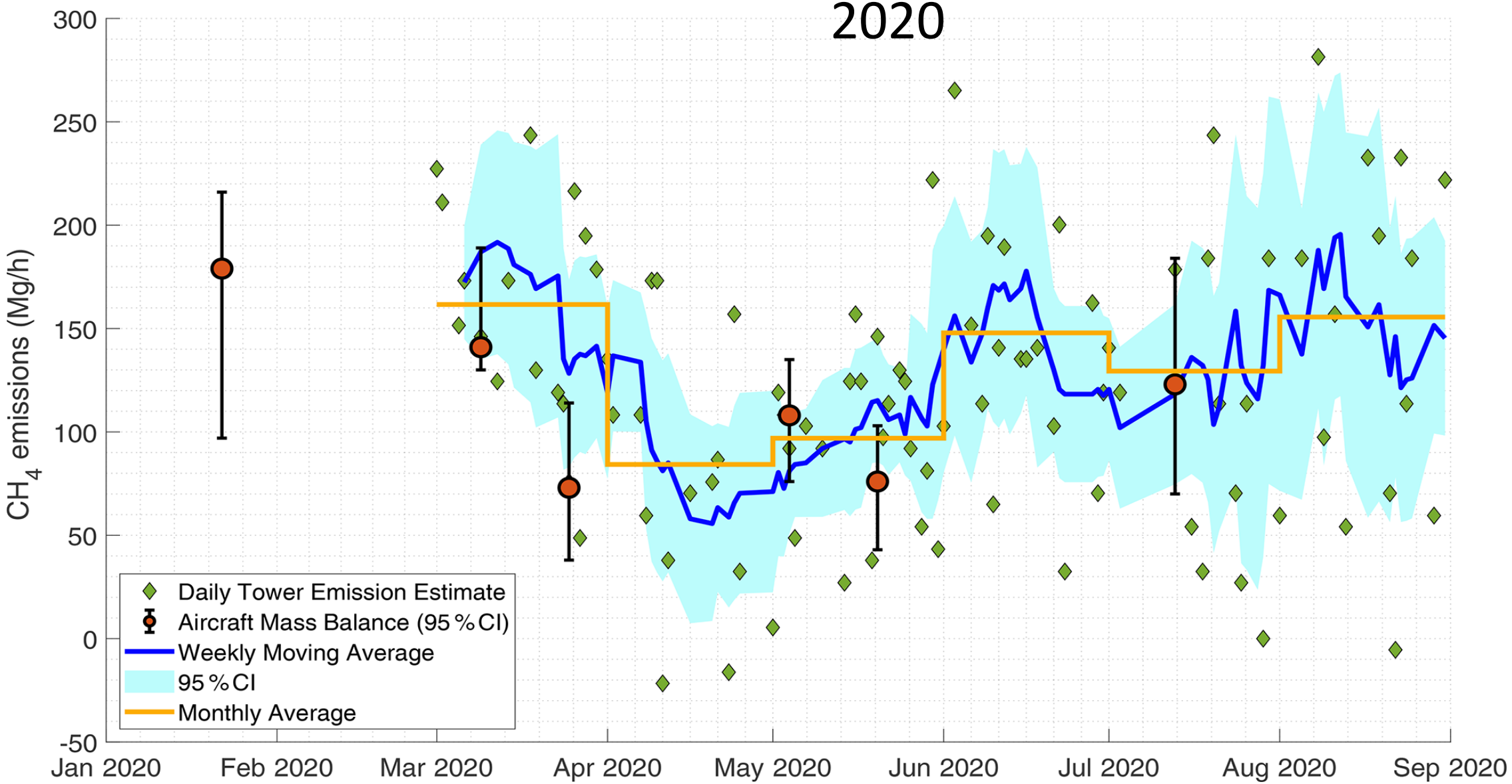
Zhang et al. (2020) Science Advances. **6**: eaaz5120

TROPOMI data reveal high methane emissions from the Permian Basin



Zhang et al. (2020) Science Advances. **6**: eaaz5120

Permian Basin Methane Emissions Trends 2020



Lyon et al. 2021., https://doi.org/10.5194/acp-21-6605-2021

GHG Satellite Revolution is Underway

MethaneSAT

Mission Objective

- Provide **policy-relevant/actionable GHG data**

Mission Overview

- Regular monitoring of regions accounting for > 80% of global oil & gas production
- Designed to detect, quantify, and track ***area emission*** rates as well as those from ***point source emissions***
- **Flux data** product available immediately – data publicly available free of charge
- High level of precision & small pixel size ***- Detection threshold 5 kg CH_4/h/km²***
- Targeting satellite
- **Near real time flux data product** availability – fully automated flux data product
- Philanthropically funded
- Partnering with New Zealand
-

MethaneSAT℠

Oil and Gas Methane Partnership (OGMP) 2.0 Reporting Levels

Level 1

Venture/Asset Reporting
- Single, consolidated emissions number
- Only applicable where company has very limited information

Level 2

Emissions Category
- Emissions reported based on IOGP and Marcogaz emissions categories
- Based on generic emissions factors

Level 3

Generic Emission Source Level
- Emissions reported by detailed source type
- Based on generic emissions factors

Level 4

Specific Emission Source Level
- Emissions reported by detailed source type using specific emissions and activity factors
- Based on direct measurement or other methodologies

Level 5

Level 4 + Site Level Measurement Reconciliation
- Direct measurement methodologies at a site or facility level*, typically through sensors mounted on a mobile platform
- Reconciled with Level 4

* on a representative sample of facilities

GOLD STANDARD:

Integrates "bottom-up" source-level reporting, with independent "top-down" site-level measurements for the majority assets

Conclusions

1. Improved accuracy with greater spatial resolution would allow countries/interested parties to better characterize methane emissions sources and take credit for progress both individually and collectively.

2. Efficient abatement requires accurate characterization of emission sources, initial assumptions without measurement-based data would point to the wrong methane sources to target for abatement (e.g., Mexico: discrepancy between onshore/offshore emissions).

3. Atmospheric observations of GHG concentrations alone are not sufficient to drive change. For example, data products limited to analysis of concentrations/enhancements and not fluxes are not actionable.

4. The International Methane Emissions Observatory (IMEO) is developing an integrated data hub of methane emissions, bringing together multi-scale data from industry (reported based on measurement-based guidelines), inventories, satellite remote sensing and studies from the academic community.

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THANK YOU

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