

Aircraft based methane emission measurements for the oil and gas industry

Measuring methane emissions from Newfoundland and Labrador's offshore oil and gas platforms (supported by Offshore Emissions Reduction Fund)

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The purpose of this review was to:

1. Examine and review previous literature that involved measuring greenhouse gas emissions from offshore oil and gas platforms, and
2. Gain understanding on aircraft-based measurement methodologies, and
3. To collect data on measured methane (CH₄) emission levels from offshore platforms around the world.

Key findings

- The most common techniques to measure emissions from offshore platforms are via aircraft, or ship, and both methods involve measuring concentrations of gases around platforms, and feeding them into a model to estimate the emission rate
 - Within the literature, emissions estimates are calculated using three methods: Gaussian dispersion, mass balance, and Lagrangian.
 - For ship monitoring, navigation only downwind, or full circle around the sites to be observed.
 - For aircraft monitoring, regional scale, including box transects around all platforms to find the highest methane emitters in the region were used. For platform scale, close box or spiral starting from the lowest height possible up until the height that the plume stops, and facility based, vertically stacked downwind transects at a safe distance from emission source along with at least one upwind transect to capture upwind and downwind methane concentration were used.
 - Early genetic characterizations of natural gases should apply in all but novel circumstances, and would anticipate deep marine petroleum reservoirs to possess traditional thermogenic signatures of $\delta^{13}\text{C-CH}_4 > -55\text{‰}$ and $\text{C1:C2} < 100$.
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- Very high variability of CH₄ emissions among the different offshore platforms. From 157,680 to 3,128,371 kg CH₄ y⁻¹ in average at the site level.
- Seven publications with CH₄ emissions data from offshore platforms from 2014 to 2021.
- Methane emissions data from the North Sea (UK and Netherlands sides), Gulf of Mexico (US, and Mexico sides), and Asia.
- Methane emissions data were recorded from a ship (5) or an aircraft (2).
- Methane emissions data were reported at the site level (mean or/and median) or for a particular area.
- Three studies used the Gaussian dispersion model, and four used the mass balance method to estimate CH₄ emissions.

Reference	Year	Vessel	Method	Region	Value	Type	Unit	CommonUnits_kgCH4peryr	Number_Platforms
Riddick et al., 2019	2017	ship	gaussian	UK_North Sea	6.800	median	g CH ₄ / s	214,444.8	8
Riddick et al., 2019	2017	ship	gaussian	UK_North Sea	11.200	mean	g CH ₄ / s	353,203.2	8
Hensen et al. 2019	2018	ship	gaussian	NE_North Sea	8.100	mean	g CH ₄ / s	255,442.0	20
Yacovitch et al., 2020	2018	ship	gaussian	US Gulf of Mexico	18.000	mean	kg CH ₄ / hr	157,680.0	103
Yacovitch et al., 2020	2018	ship	gaussian	US Gulf of Mexico	5.300	median	kg CH ₄ / hr	46,428.0	103
Gorchov Negrón et al., 2020	2018	Aircraft	mass balance	US Gulf of Mexico	21.000	mean	kg CH ₄ / hr	183,960.0	
Gorchov Negrón et al., 2020	2018	Aircraft	mass balance	US Gulf of Mexico	3.400	median	kg CH ₄ / hr	29,784.0	
Gorchov Negrón et al., 2020	2018	Aircraft	mass balance	US Gulf of Mexico	0.530	total	Tg CH ₄ /yr	530,000,000.0	1,967
Zavala-Araiza et al. 2021	2018	Aircraft	mass balance	Mexico Gulf of Mexico	2,800.000	total	kg CH ₄ / hr	24,528,000.0	418
Zang et al., 2020	2012, 2014, 2017	ship	mass balance	Bohai Sea	0.026	total	Tg/year	26,000,000.0	4
Nara et al. 2014	2009	ship	mass balance	Malay	99.200	mean	g CH ₄ / s	3,128,371.2	8
Nara et al. 2014	2009	ship	mass balance	Malay	124.700	median	g CH ₄ / s	3,932,539.2	8
Nara et al. 2014	2009 to 2012	ship	mass balance	Borneo	14.700	mean	g CH ₄ / s	463,579.2	6
Nara et al. 2014	2009 to 2012	ship	mass balance	Borneo	16.900	median	g CH ₄ / s	532,958.4	6
Nara et al. 2014	2009 to 2012	ship	mass balance	Southeast Asia	0.100	total	Tg CH ₄ /yr	100,000,000.0	112

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- See also attached, the Zotero library and Excel files, and folder with publications.

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