METHANE RESEARCH

ATTRIBUTION FORMATS[1]

EDF staff co-authored | *EDF coordinated/funded* | IMEO papers *

CONTENT

OIL AND GAS SYSTEM

UNITED STATES (47)

"Excess methane emissions from shallow water platforms elevate the carbon intensity of US Gulf of Mexico oil and gas production" (*Proceedings of the National Academy of Sciences*, 2023)

"Empirical quantification of methane emission intensity from oil and gas producers in the Permian basin" (*Environmental Research Letters*, 2023)

"Inefficient and unlit natural gas flares both emit large quantities of methane" (*Science*, 2022)

"Methane Emissions from Natural Gas Gathering Pipelines in the Permian Basin" (*Environmental Science & Technology Letters*, 2022)

"Strong methane point sources contribute a disproportionate fraction of total emissions across multiple basins in the United States" (*Proceedings of the National Academy of Sciences*, 2022)

"Methane emissions from US low production oil and natural gas well sites" (*Nature Communications*, 2022)

"Closing the methane gap in US oil and natural gas production emissions inventories" (*Nature Communications*, 2021)

"Concurrent variation in oil and gas methane emissions and oil price during the COVID-19 pandemic" (*Atmospheric Chemistry and Physics,* 2021)

"New Mexico Permian Basin measured well pad methane emissions are a factor of 5–9 times higher than US EPA estimates" (*Environmental Science & Technology*, 2020)

"A national estimate of methane leakage from pipeline mains in natural gas local distribution systems" (*Environmental Science & Technology*, 2020)

"Methane Emissions from Offshore Oil and Gas Platforms in the Gulf of Mexico" (*Environmental Science & Technology*, 2020) *

"Airborne Assessment of Methane Emissions from Offshore Platforms in the U.S. Gulf of Mexico" (*Environmental Science & Technology,* 2020) *

"Observations of Methane Emissions from Natural Gas-Fired Power Plants" (*Environmental Science & Technology*, 2019)

"Aerial Interyear Comparison and Quantification of Methane Emissions Persistence in the Bakken Formation of North Dakota, USA" (*Environmental Science & Technology*, 2018)

"Assessment of methane emissions from the US oil and gas supply chain" (*Science*, 2018)

"Synthesis of recent ground-level methane emission measurements from the U.S. natural gas supply chain" (*Journal of Cleaner Production,* 2017)

"Rapid, vehicle-based identification of location and magnitude of urban natural gas pipeline leaks" (*Environmental Science & Technology*, 2017)

"Assessing the Methane Emissions from Natural Gas-Fired Power Plants and Oil Refineries" (*Environmental Science &Technology*, 2017)

"Super-emitters in natural gas infrastructure are caused by abnormal process conditions" (*Nature Communications*, 2017)

"Pump-to-Wheels Methane Emissions from the Heavy-Duty Transportation Sector" (*Environmental Science & Technology, 2016)*

"Quantifying, Assessing, and Mitigating Methane Emissions from Super-emitters in the Oil and Gas Supply Chain" (University of Arkansas, graduate dissertation, 2016)

"Aerial Surveys of Elevated Hydrocarbon Emissions from Oil and Gas Production Sites" (*Environmental Science & Technology*, 2016)

"Emissions of coalbed and natural gas methane from abandoned oil and gas wells in the United States" (*Geophysical Research Letters*, 2016)

"Methane emissions from the Natural Gas Supply Chain" (*in Environmental and Health Issues in Unconventional Oil and Gas Development,* Kaden and Rose, eds., 2016)

"Constructing a spatially resolved methane emission inventory for the Barnett Shale region" (*Environmental Science and Technology*, 2015)

"Direct and Indirect Measurements and Modeling of Methane Emissions in Indianapolis, Indiana" (*Environmental Science & Technology*, 2016)

"Reconciling divergent estimates of oil and gas methane emissions" (*Proceedings of the National Academy of Sciences*, 2015)

"Using Multi-Scale Measurements to Improve Methane Emission Estimates from Oil and Gas Operations in the Barnett Shale Region, Texas" (*Environmental Science & Technology*, 2015)

"Toward a Functional Definition of Methane Super-Emitters: Application to Natural Gas Production Sites" (*Environmental Science & Technology*, 2015)

"Integrating source apportionment tracers into a bottom-up inventory of methane emissions in the Barnett Shale hydraulic fracturing region" (*Environmental Science & Technology*, 2015)

"Airborne ethane observations in the Barnett Shale: Quantification of ethane flux and attribution of methane emissions" (Environmental Science & Technology, 2015)

"Methane emissions from leak and loss audits of natural gas compressor stations and storage facilities" (Environmental Science & Technology, 2015)

"Characterizing fugitive methane emissions in the Barnett Shale area using a mobile laboratory" (Environmental Science & Technology, 2015)

"Mobile laboratory observations of methane emissions in the Barnett Shale region" (*Environmental Science & Technology*, 2015)

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"Measuring emissions from oil and natural gas well pads using the mobile flux plane technique" *(Environmental Science & Technology, 2015)*

"Aircraft-Based Estimate of Total Methane Emissions from the Barnett Shale Region" *Environmental Science & Technology*, 2015)

"Direct measurements show decreasing methane emissions from natural gas local distribution systems in the United States" (Environmental Science & Technology, 2015)

"Measurements of methane emissions from natural gas gathering facilities and processing plants: Measurements results" (Environmental Science & Technology, 2015)

"Methane emissions from natural gas compressor stations in the transmission and storage sector: Measurements and comparisons with the EPA greenhouse gas reporting program protocol" (Environmental Science & Technology, 2015)

"Methane emissions from natural gas infrastructure and use in the urban region of Boston, Massachusetts" (Proceedings of the National Academy of Sciences, 2015)

"Methane emissions from process equipment at natural gas production sites in the United States: Pneumatic controllers" (Environmental Science & Technology, 2014)

"Methane emissions from process equipment at natural gas production sites in the United States: Liquid Unloadings" (Environmental Science & Technology, 2014)

"Assessment of methane emissions from oil and gas production pads using mobile measurements" (*Environmental Science & Technology*, 2014)

"A new look at methane and non-methane hydrocarbon emissions from oil and natural gas operations in the Colorado Denver-Julesburg Basin" (Journal of Geophysical Research: Atmospheres, 2014)

"Measurements of methane emissions at natural gas production sites in the United States" (Proceedings of the National Academy of Sciences, 2013)

"Methane Leaks from North American Natural Gas Systems" (*Science*, 2014)

MEXICO AND CANADA (8)

"Saskatchewan's oil and gas methane: how have underestimated emissions in Canada impacted progress toward 2025 climate goals?" (*Environmental Research Letters*, 2023)

"Sources and reliability of reported methane reductions from the oil and gas industry in Alberta, Canada" (*Elementa: Science of the Anthropocene*, 2022)

"Methane inventories, but not regulatory submissions, show major variations in methane intensity for Canadian oil and gas producers" (*Cleaner Environmental Systems*, 2022)

"A tale of two regions: methane emissions from oil and gas production in offshore/onshore Mexico" (*Environmental Research Letters*, 2021) *

"A gridded inventory of anthropogenic methane emissions from Mexico based on Mexico's National Inventory of Greenhouse Gases and Compounds" (*Environmental Research Letters*, 2020)

"La mitigación de las emisiones de metano en el sector hidrocarburos: la medida ausente del Reporte del IPCC sobre las consecuencias de un aumento de la temperatura media global de 1.5◦ C" (In *Voces y Visiones sobre el Reporte Especial del IPCC, 2019)*

"Methane emissions from oil and gas production sites in Alberta, Canada" (*Elementa: Science of the Anthropocene*, 2018)

"A high-resolution (0.1°× 0.1°) inventory of methane emissions from Canadian and Mexican oil and gas systems" (*Atmospheric Environment*, 2017)

EUROPE (11)

"High potential for CH4 emission mitigation from oil infrastructure in one of EU's major production regions" (*Atmospheric Chemistry and Physics*, 2023) *

"Quantification of methane emissions in Hamburg using a network of FTIR spectrometers and an inverse modeling approach" (*Atmospheric Chemistry and Physics*, 2023) *

"Quantification of methane emission rate from oil and gas wells in Romania using ground-based measurement techniques" (*Elementa: Science of the Anthropocene*, 2022) *

"Methane and ethane emission quantifications from onshore oil and gas sites in Romania, using a tracer gas dispersion method" (*Elementa: Science of the Anthropocene*, 2022)

"Quantification and assessment of methane emissions from offshore oil and gas facilities on the Norwegian continental shelf" (*Atmospheric Chemistry and Physics*, 2022) *

"CH_4 isotopic signatures of emissions from oil and gas extraction sites in Romania" (*Elementa: Science of the Anthropocene*, 2022) *

"Street-level methane emissions of Bucharest, Romania and the dominance of urban wastewater" (*Atmospheric Environment*, 2022)

"Mapping Urban Methane Sources in Paris, France" (*Environmental Science & Technology*, 2021) *

"Investigation of the Spatial Distribution of Methane Sources in the Greater Toronto Area Using Mobile Gas Monitoring Systems" (*Environmental Science & Technology*, 2020) *

"Methane mapping, emission quantification, and attribution in two European cities: Utrecht (NL) and Hamburg (DE)" (*Atmospheric Chemistry and Physics*, 2020) *

"Methane emissions in the Netherlands: The Groningen field" (*Elementa: Science of the Anthropocene*, 2018)

OTHER GLOBAL (10)

"Comparative Assessment of Methane Emissions from Onshore LNG Facilities Measured Using Differential Absorption Lidar" (*Environmental Science & Technology*, 2023) *

"Methane Leakage Measurement of Natural Gas Heating Boilers and Greenhouse Gas Emissions Accounting of 'Coal-to-Gas' Transition for Residential Heating in Rural Beijing" (*Environmental Science & Technology Letters*, 2022)

"Atmospheric methane isotopes identify inventory knowledge gaps in the Surat Basin, Australia, coal seam gas and agricultural regions" (*Atmospheric Chemistry and Physics*, 2022) *

"Temporal variation and grade categorization of methane emission from LNG fueling stations" (*Scientific Reports,* 2022)

"Measurement of methane emissions from CNG fueling stations in East China" (*Environmental Science and Pollution Research*, 2022)

"Isotopic signatures of major methane sources in the coal seam gas fields and adjacent agricultural districts, Queensland, Australia" *(Atmospheric Chemistry and Physics*, 2021) *

"Coal seam gas industry methane emissions in the Surat Basin, Australia: comparing airborne measurements with inventories" (*Philosophical Transactions of the Royal Society A*, 2021) *

"Improved Constraints on Global Methane Emissions and Sinks Using $\delta^{13}C\text{-}CH_4$" (*Global Biogeochemical Cycles*, 2021)

"Using global isotopic data to constrain the role of shale gas production in recent increases in atmospheric methane" (*Scientific Reports,* 2020)

"Methane: Greenhouse Effect, Emission Quantification & Control" (*Town Gas*, 2020)

SATELLITE-BASED QUANTIFICATION AND CHARACTERIZATION

(21)

"National quantifications of methane emissions from fuel exploitation using high resolution inversions of satellite observations" (*Nature Communications*, 2023)

"Satellite quantification of methane emissions and oil–gas methane intensities from individual countries in the Middle East and North Africa: implications for climate action" (*Atmospheric Chemistry and Physics*, 2023)

"Observation-derived 2010-2019 trends in methane emissions and intensities from US oil and gas fields tied to activity metrics" (*Proceedings of National Academy of Sciences*, 2023)

"Developing a spatially explicit global oil and gas infrastructure database for characterizing methane emission sources at high resolution" (*Earth System Science Data*, 2023)

"Satellite quantification of methane emissions and oil/gas methane intensities from individual countries in the Middle East and North Africa: implications for climate action" (*Atmospheric Chemistry and Physics*, 2023)

"Continuous weekly monitoring of methane emissions from the Permian Basin by inversion of TROPOMI satellite observations" *(Atmospheric Chemistry and Physics* Discussions, 2022)

"Methane emissions from China: a high-resolution inversion of TROPOMI satellite observations" (Atmospheric Chemistry and Physics Discussions, 2022)

"Satellite quantification of oil and natural gas methane emissions in the US and Canada including contributions from individual basins" (*Atmospheric Chemistry and Physics*, 2022)

"Quantifying methane emissions from the global scale down to point sources using satellite observations of atmospheric methane" (*Atmospheric Chemistry and Physics*, 2022)

"Satellites detect a methane ultra-emission event from an offshore platform in the Gulf of Mexico" (*Environmental Science & Technology Letters*, 2022)

"Quantifying methane emissions from the largest oil-producing basin in the United States from space" (*Science Advances*, 2020)

"Reconstructing and quantifying methane emissions from the full duration of a 38-day natural gas well blowout using space-based observations" (*Remote Sensing of Environment*, 2022)

"Satellites detect abatable super-emissions in one of the world's largest methane hotspot regions" (*Environmental Science & Technology*, 2022)

"Methane emissions in the United States, Canada, and Mexico: evaluation of national methane emission inventories and 2010–2017 sectoral trends by inverse analysis of in situ (GLOBALVIEW plus CH_4 ObsPack) and satellite (GOSAT) atmospheric observations" (*Atmospheric Chemistry and Physics*, 2022)

"Unravelling a large methane emission discrepancy in Mexico using satellite observations" (*Remote Sensing of Environment*, 2021)

"Satellite-based survey of extreme methane emissions in the Permian basin" (*Science Advances*, 2021)

"Multisatellite imaging of a gas well blowout enables quantification of total methane emissions" (*Geophysical Research Letters*, 2021)

"Satellite observations reveal extreme methane leakage from a natural gas well blowout" (*Proceedings of the National Academy of Sciences*, 2019)

"Satellite-observed Changes in Mexico's Offshore Gas Flaring Activity Linked to Oil/gas Regulations" (*Geophysical Research Letters*, February 2019)

"Monitoring global tropospheric OH concentrations using satellite observations of atmospheric methane" (*Atmospheric Chemistry and Physics*, 2018)

"2010–2016 Methane trends over Canada, the United States, and Mexico observed by the GOSAT satellite: contributions from different source sectors" (*Atmospheric Chemistry and Physics*, 2018)

AGRICULTURE

(6)

"Using the tracer flux ratio method with flight measurements to estimate dairy farm CH_4 emissions in central California" (*Proceedings of the National Academy of Sciences*, 2019)

"Estimation of methane emissions from the U.S. ammonia fertilizer industry using a mobile sensing approach" (*Elementa: Science of the Anthropocene*, 2019)

"Short-term methane emissions from 2 dairy farms in California estimated by different measurement techniques and US Environmental Protection Agency inventory methodology: A case study" (*Journal of Dairy Science*, 2018)

"Prediction of enteric methane production, yield, and intensity in dairy cattle using an intercontinental database" (*Global Change Biology*, 2018)

"High nitrous oxide fluxes from rice indicate the need to manage water for both long- and short-term climate impacts" (*Proceedings of the National Academy of Sciences*, 2018)

"Sampling Guidelines and Analytical Optimization for Direct Greenhouse Gas Emissions from Tropical Rice and Upland Cropping Systems" (*Carbon Management*, 2015)

COAL MINE METHANE

"China's coal mine methane regulations have not curbed growing emissions" (*Nature Communications*, 2019)

CLIMATE IMPACTS AND MITIGATION OF METHANE

(10)

"The value of early methane mitigation in preserving Arctic summer sea ice" (*Environmental Research Letters*, 2022)

"Acting rapidly to deploy readily available methane mitigation measures by sector can immediately slow global warming" (*Environmental Research Letters*, 2021)

"Designing an EU methane performance standard for natural gas" (*European University Institute*, 2021)

"Advancing scientific understanding of the global methane budget in support of the Paris Agreement" (*Global Biogeochemical Cycles*, 2019)

"A methane emissions reduction equivalence framework for alternative leak detection and repair programs" (*Elementa: Science of the Anthropocene*, 2019)

"Rapid and reliable assessment of methane impacts on climate" (*Atmospheric Chemistry and Physics*, 2018)

"Unmask temporal trade-offs in climate policy debates" (*Science*, 2017)

"Future methane emissions from the heavy-duty natural gas transportation sector for stasis, high, medium, and low scenarios in 2035" (*Journal of the Air & Waste Management Association*, 2017)

"Influence of Methane Emissions and Vehicle Efficiency on the Climate Implications of Heavy-Duty Natural Gas Trucks" (*Environmental Science & Technology*, 2015)

"Greater focus needed on methane leakage from natural gas infrastructure" (*Proceedings of the National Academy of Sciences*, 2012)

ASSESSMENT METHODS

(14)

"Estimating emissions of methane consistent with atmospheric measurements of methane and $\delta^{13}C$ of methane" (*Atmospheric Chemistry and Physics*, 2022)

"Applications of top-down methods to anthropogenic GHG emission estimation" (In *Balancing Greenhouse Gas Budgets*, 2022)

"Facility level measurement of offshore oil and gas installations from a medium-sized airborne platform: method development for quantification and source identification of methane emissions" (*Atmospheric Measurement Techniques*, 2021) *

"OGNet: Towards a Global Oil and Gas Infrastructure Database using Deep Learning on Remotely Sensed Imagery" (*arXiv preprint*, 2020)

"Reduction of Signal Drift in a Wavelength Modulation Spectroscopy-Based Methane Flux Sensor" (*Sensors*, 2022)

"A Wavelength Modulation Spectroscopy-Based Methane Flux Sensor for Quantification of Venting Sources at Oil and Gas Sites" (*Sensors*, 2022)

"Methane, carbon dioxide, hydrogen sulfide, and isotopic ratios of methane observations from the Permian Basin tower network" (*Earth System Science Data*, 2022)

"Conflicting estimates of natural geologic methane emissions" (*Elementa: Science of the Anthropocene*, 2021)

"Global geological methane emissions: an update of top-down and bottom-up estimates" (*Elementa: Science of the Anthropocene*, 2019)

"Gridded maps of geological methane emissions and their isotopic signature" (*Earth System Science Data*, 2019)

"Single-blind inter-comparison of methane detection technologies–results from the Stanford/EDF Mobile Monitoring Challenge" (*Elementa: Science of the Anthropocene*, 2019)

"Possible malfunction in widely used methane sampler deserves attention but poses limited implications for supply chain emission estimates" (*Elementa: Science of the Anthropocene*, 2016)

"Measurements of methane emissions from natural gas gathering facilities and processing plants: Measurement methods" (Atmospheric Measurement Techniques, 2015)

"Near-field characterization of methane emission variability from a compressor station using a model aircraft" (Environmental Science & Technology, 2015)

[1] Italicized publications denote studies coordinated by EDF, without EDF co-authors; asterisks denote studies coordinated by EDF under the auspices of IMEO