Committee on Earth Observation Satellites

CGMS

Common/good/best Practices for facility scale CH4 emission estimation

Paul Green, NPL / UKSA
with Data Foundation, UCLA-JIFRESSE & LLBL & wider GHG TT

Agenda Item 6.18

WGClimate
The Joint CEOS-CGMS Working Group on Climate

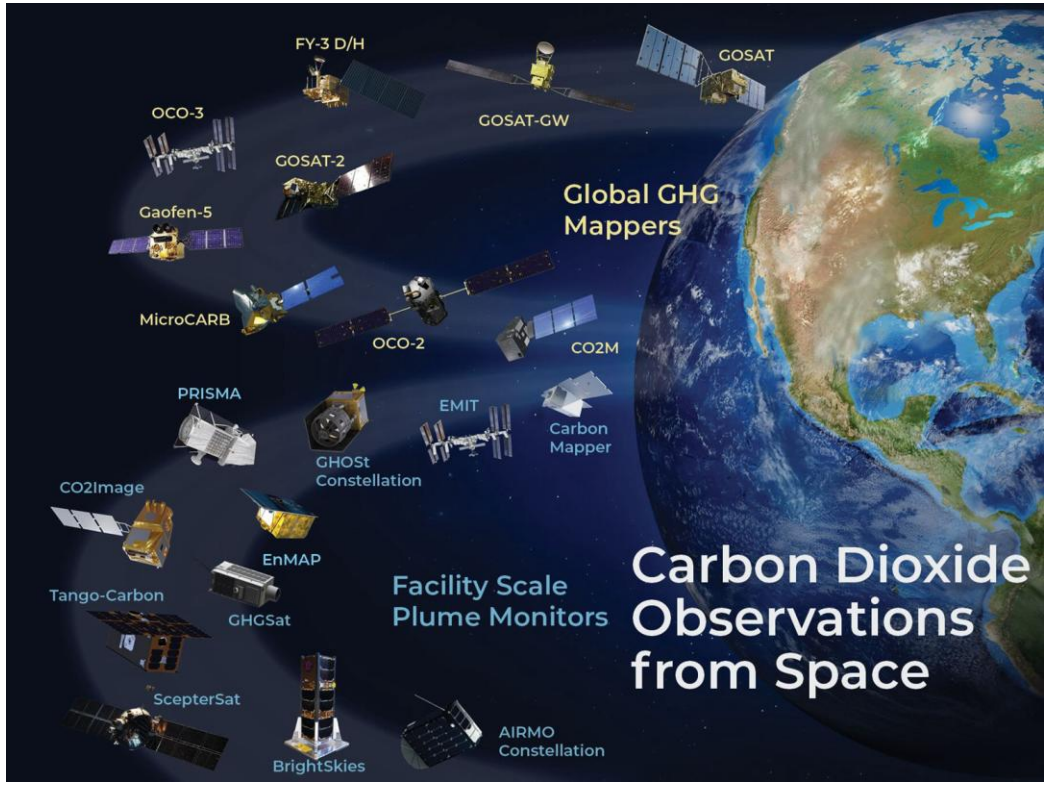
AC-VC #22

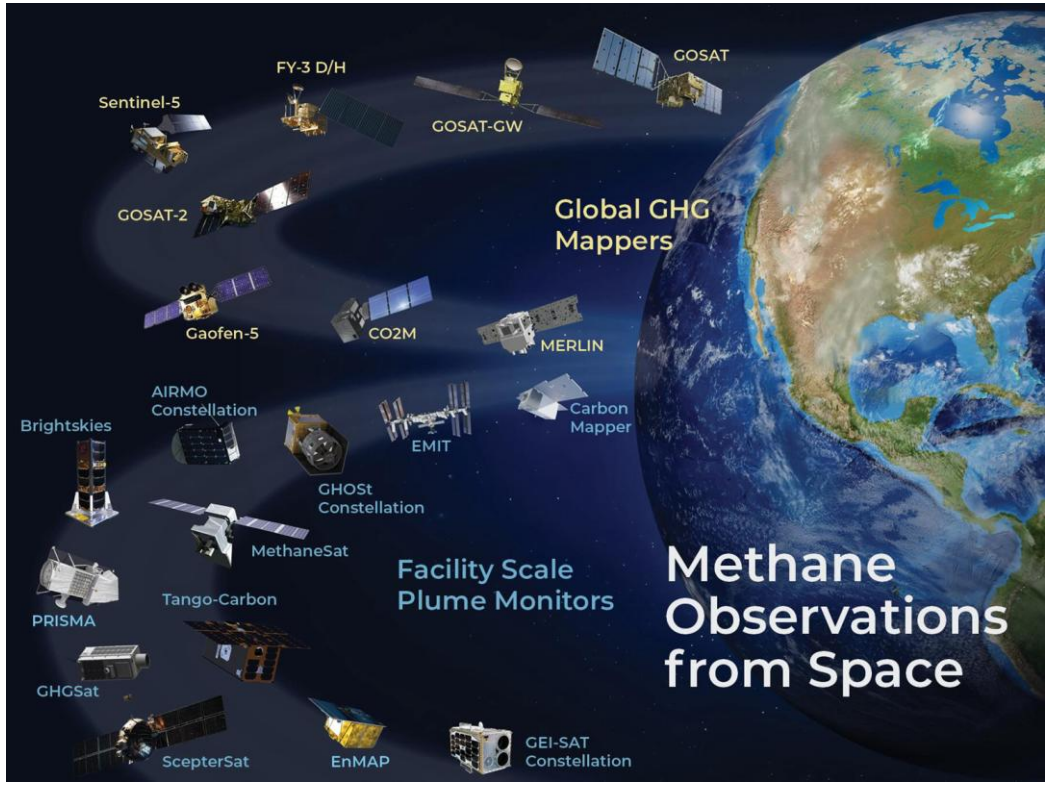
1 - 4 June, 2026
SRON, Leiden, NL

Motivation

- The Global Methane Pledge (now signed by 155 countries) seeks to reduce methane emissions by 30% between 2020 and 2030
- Fugitive emissions / high emitters (emissions t> 100 kg/hr) represent a substantial fraction of fossil and waste emissions. Estimated between 30% and 75% of O&G emissions in some US production basins.
- Public and New Space observations of CO_2 and CH_4 are increasingly being used to identify high emitters to improve production efficiency of drilling, support regulation, and are likely needed for a functioning reporting obligations and carbon market. Despite the current geopolitics, the need for data is increasing, not reducing.
- Currently there are 3 missions dedicated to facility scale emissions monitoring, with another 10 expected in few years – in addition to the products generated from public data.
- We need a set of “common” practices for reporting VVUQ and QA for facility scale emissions so that producers of these data know what is expected by the community and (new) users know how the data should be generated and reported so that it can be trusted

Growing constellation of GHG concentrations observations from the global to the facility scale





These are now being used to derive carbon dioxide and methane emission (flux) estimates on a range of spatial and temporal scales

New rules on Energy sector

EU agrees law to curb methane emissions from fossil fuel industry

Rules would require firms to report emissions, find and fix leaks, and limit wasteful venting and flaring

Flares burn off hydrocarbons such as methane at an oil and gas facility. Methane has more than 80 times the heating power of CO2 over a 20-year timespan. Photograph: David Goldman/AP

https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2021/0423(COD)&l=en

EPA United States Environmental Protection Agency

Search EPA.gov

Environmental Topics | Laws & Regulations | Report a Violation | About EPA

Controlling Air Pollution from the Oil and Natural Gas Operations CONTACT US

- Oil and Natural Gas Air Standards Home
- Basic Information
- Actions and Notices
- Implementation

EPA's Final Rule for Oil and Natural Gas Operations Will Sharply Reduce Methane and Other Harmful Pollution.

December 2, 2023 -- EPA has issued a final rule that will sharply reduce emissions of methane and other harmful air pollution from oil and natural gas operations — including, for the first time, from existing sources nationwide. The final action includes New Source Performance Standards to reduce methane and smog-forming volatile organic compounds from new, modified and reconstructed sources. It also includes Emissions Guidelines, which set procedures for states to follow as they develop plans to limit methane from existing sources. Oil and natural gas operations are the largest industrial source of methane pollution in the U.S.

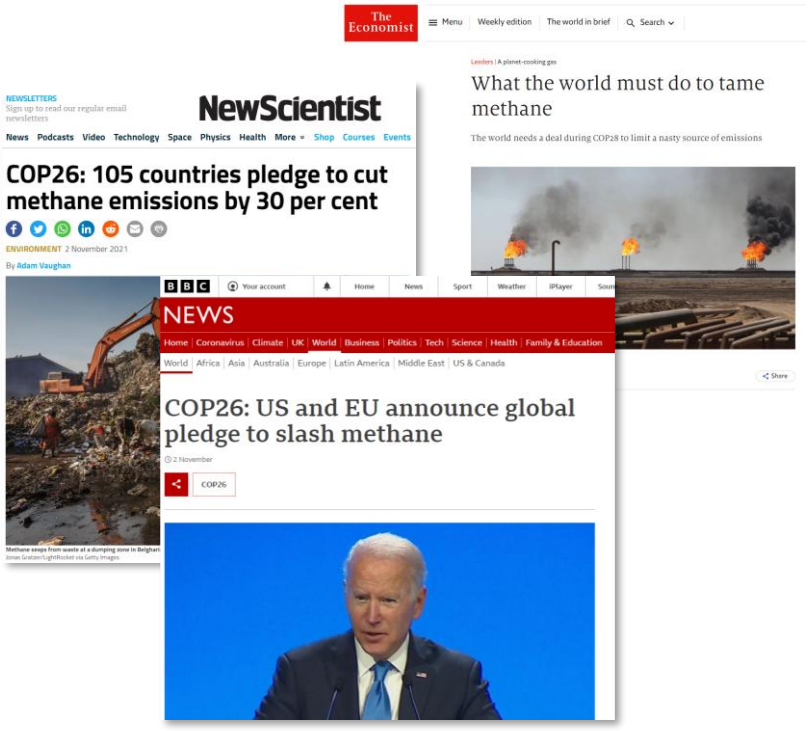
Methane is a climate "super pollutant" that is more potent than carbon dioxide and is responsible for approximately one third of current warming resulting from human activities. Rapid, sharp cuts in methane can generate near-immediate climate benefits and are a crucial addition to cutting carbon dioxide in slowing the rate of warming of Earth's atmosphere.

Regulatory Documents

- Final Rule and Regulatory Text (pdf) (5.9 MB)
- Regulatory Impact Analysis (pdf) (3.3 MB)
  - Supplementary Material for the Regulatory Impact Analysis: Report on the Social Cost of Greenhouse Gases (pdf) (8.8 MB)

https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-operations/epas-final-rule-oil-and-natural-gas

Corporate emissions and climate risk reporting

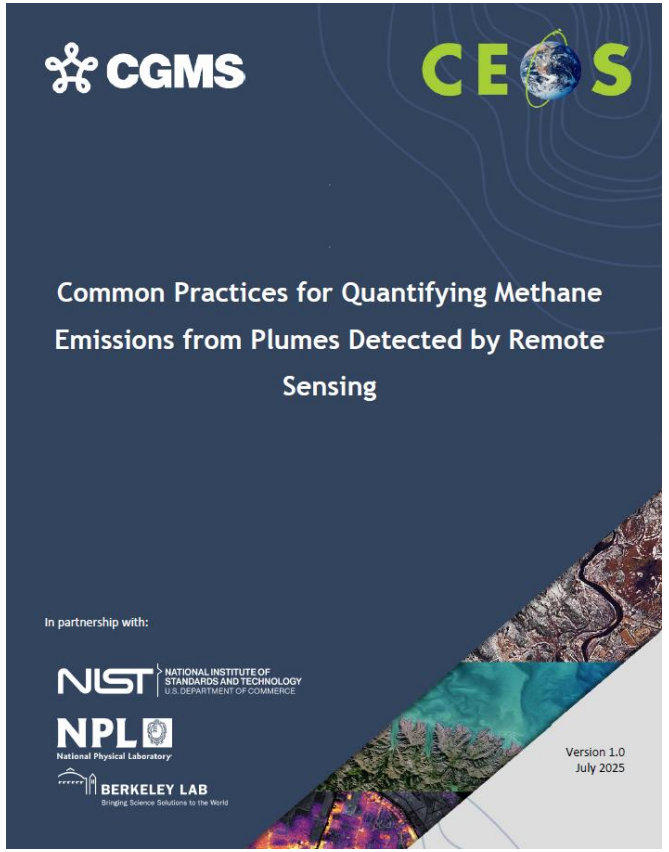


TCFD

Compulsory emissions & climate risk reporting for listed companies in US and UK, together with voluntary schemes to maintain market competitiveness aligned with customer climate expectations

Common practise structure & contributors

- Common practices intended users are
  - producers of these data (to know what is expected by the community)
  - users of these data (to understand how it should be generated and know how to use)
- Overall structure
  - Motivation, remit and timeliness
  - Common practise for L0 to L4
  - Validation current art
  - Quality assessment framework
- Integrates efforts across multiple agencies



Common practices for plume-detected methane emissions
May 2025 v0.4

Contributors

Section 2 contributing authors:

- Dan Cusworth, Carbon Mapper (key contributor to structure of the section)
- Jason McKeever, GHGSat
- Dylan Jervis, GHGSat
- Daniel Varon, Harvard
- Andrew Thorpe, NASA JPL, EMIT team
- Philip Brodrick, NASA JPL, EMIT team
- James Whetstone, NIST
- Riley Duren, Carbon Mapper
- Adam Brandt, Stanford University

Section 3 contributing authors:

- Adam R. Brandt, Stanford University

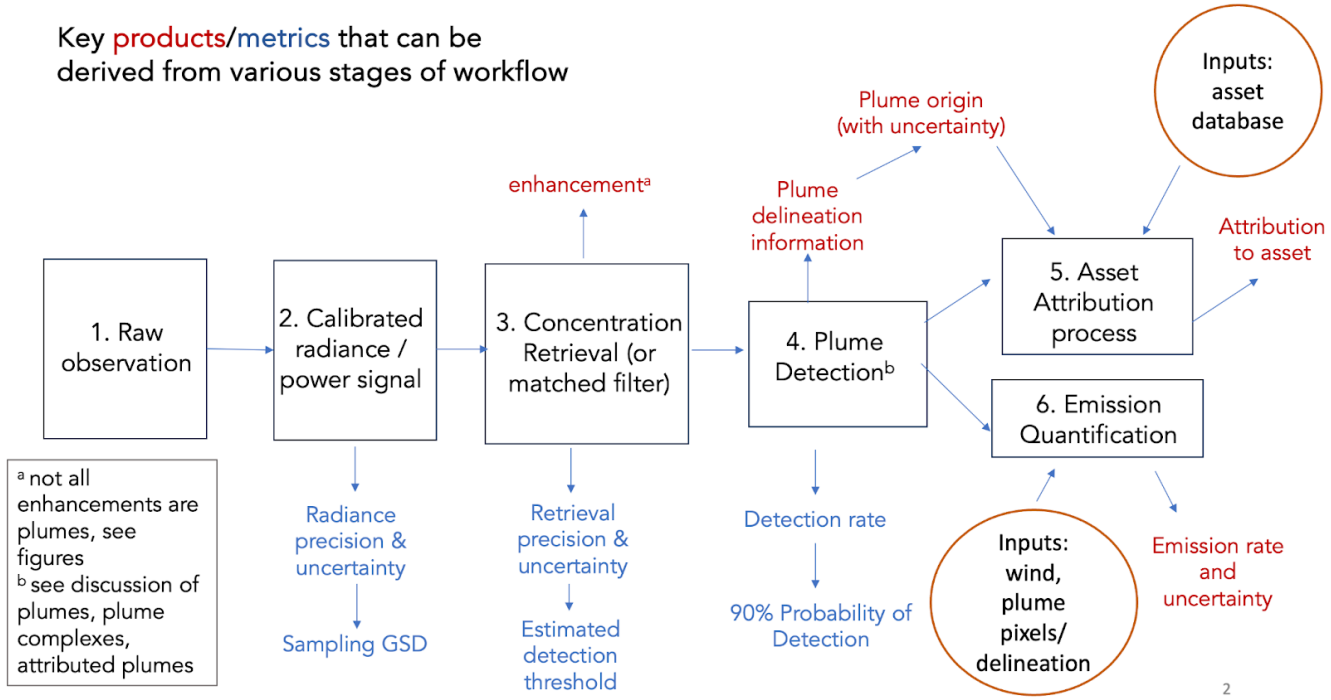
Section 4 contributing authors:

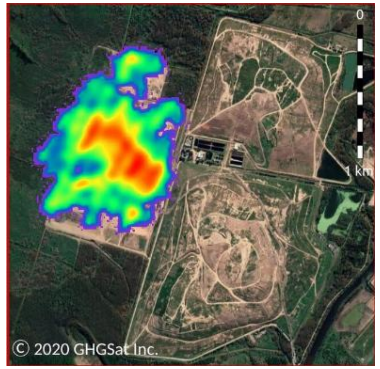
- Samuel E. Hunt, NPL
- Patrick Barker, NPL
- Jean-Christopher Lambert, BIRA-IASB
- Jaime Nickeson, SSAI/NASA GSFC
- Stephen Compernolle, BIRA-IASB
- Benjamin Poulter, NASA
- Angelika Dehn, ESA
- Sabrina Pinori, Serco
- Lidia Saavedra De Miguel, ESA
- Amy Beaton, Telespazio
- Gabriele Mevi, Serco
- Kevin Halsall, Telespazio

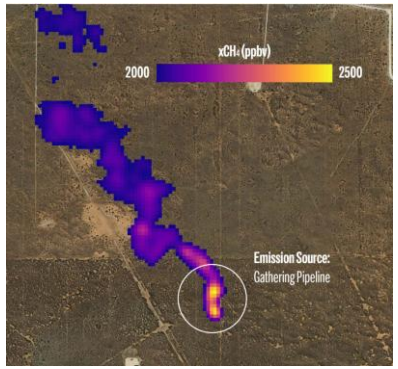
The authors would like to thank CEOS, CGMS and the wider Earth observation community who have provided feedback and assisted the development of this document.

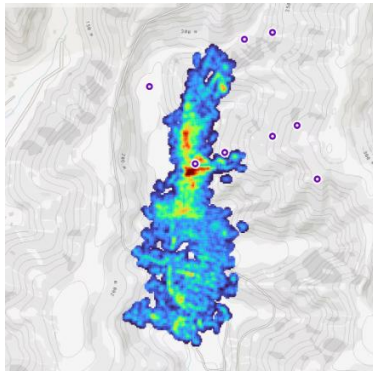
Workflow Common Practice

- At a high level, all practitioners use the same sequence of steps in their workflows
- The details of implementation vary, increasingly later in the process (from concentration/enhancement to emissions estimates)
- Later plume detection, delineation and emission quantification steps require a human in the loop









Credit (L-R):
GHGSat
MethaneSat
CarbonMapper

State of Practice for Validation – controlled release

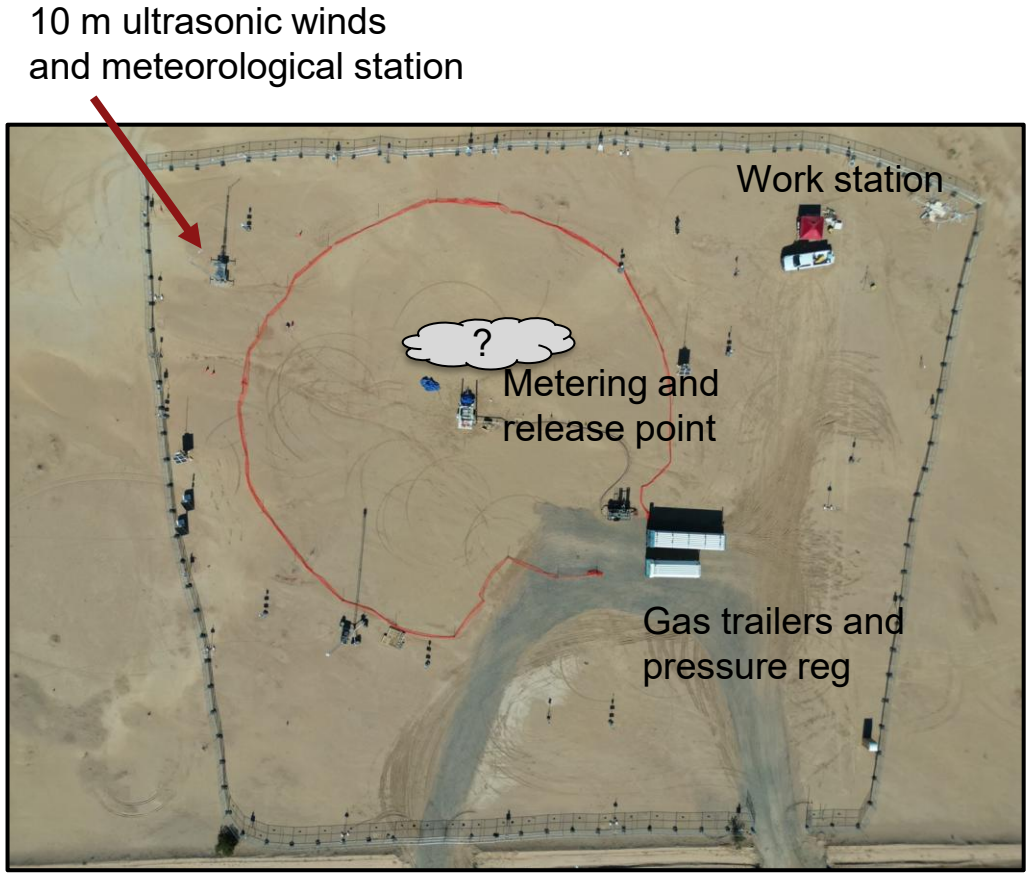
- Independent testing of space-based methane detection needed, including several new satellite programs launched last year
- Cooperative and single-blind controlled release tests, building on 5+ years of satellite, airplane and ground sensor tests
- Expanded participation to 12+ methane satellite platforms and 15 analysis teams

2024-2025

- 150 release (10-1500 kg/h) cooperative stage
- First single-blind stage “Phase 1” in Q1 2025, data unblinding Q2 2025

2026+

- Controlled flaring expt. Q2 2026
- Expanded extent and sophistication of CR



Credit: A Brandt Stanford tinyurl.com/stanford-methane
*Participants know location but not [on/off] or volume flow rate. Coriolis flow metering for leaks between 3 kg/h and 1500 kg/h

Quality Assessment framework

- Quality Assessment framework aligned with that developed within EDAP / CSDA for consistency across GHGs and other ECVs

Data Provider Documentation Review		
Product Information	**Metrology**	**Product Generation**
Product Details	Metrological Traceability Documentation	Atmospheric Column Retrieval Algorithm
Availability & Accessibility	Uncertainty Characterization	Geometric Processing
Product Format, Flags & Metadata	Ancillary Data	Mission Specific Processing
User Documentation		

Validation Summary
Atmospheric Column Validation Methodology
Atmospheric Column Validation Results
Geometric Validation Method
Geometric Validation Results

Key
Not Assessed
Not Assessable
Basic
Good
Excellent
Ideal
Not Public

Column Enhancement

Product Evaluation Matrix			
Data Provider Documentation Review			Validation Summary
Product Information	Metrology	Product Generation	
Product Details	Metrological Traceability Documentation	Emission Quantification Method	Emission Validation Methodology
Availability & Accessibility	Uncertainty Characterisation	Mission-Specific Processing	Emission Validation Results
Product Format, Flags & Metadata	Ancillary Data		
User Documentation			

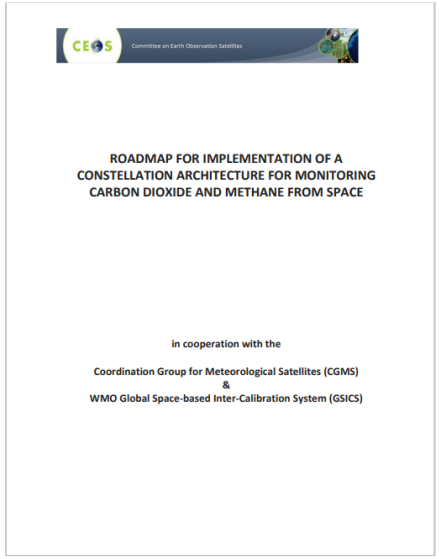
Key
Not Assessed
Not Assessable
Basic
Good
Excellent
Ideal
Not Public

Emissions

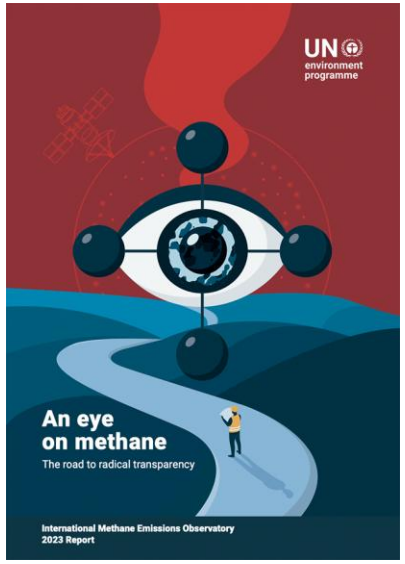
Best practice as an enabler

- Build on previous CEOS work on best practises in the public and new space domains and want to partner with key parallel programmes and stakeholders to add value as an underpinning framework to enable reporting in the public and commercial sectors

UNFCCC

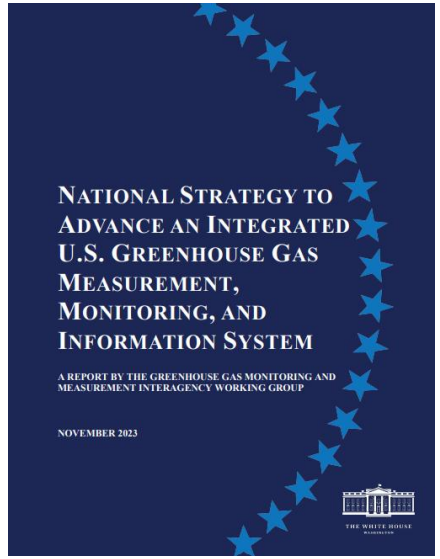


CEOS roadmap



UNEP IMEO

WMO G3W



US GHG Centre

COP30 & related engagement

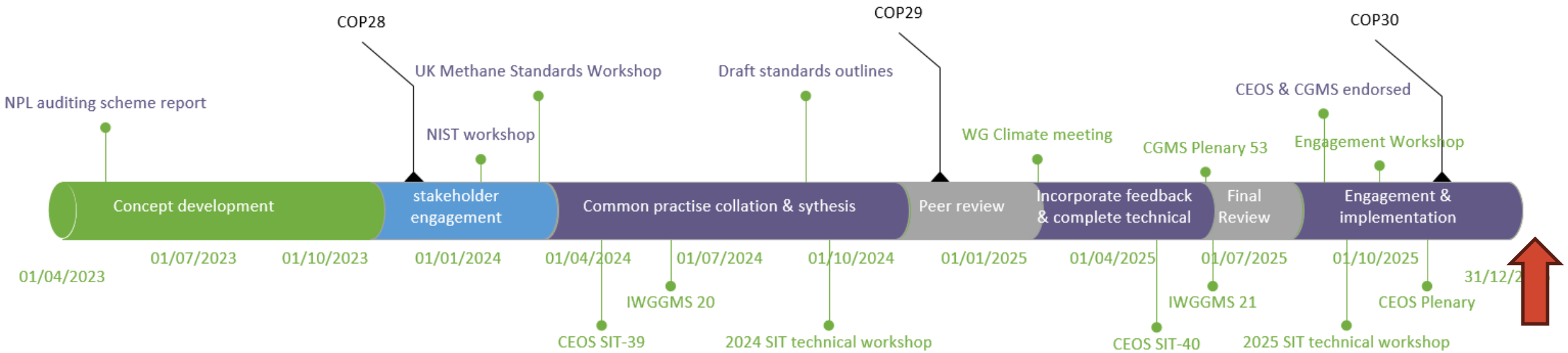
- Highlighted in the UK Methane Action Plan (published 29 October), a report outlining UK government's strategy to reduce methane emissions domestically and globally.

At COP30 in Belem, Brazil

- referenced in the first UN Global Methane Status Report 2025 released at COP30
- singled out as a highlight at the 2025 Global Methane Pledge Ministerial held on the 17 November 2025, with UK Minister for Climate
- Principles echoed in the Third Methane and Other Non-CO_2 Greenhouse Gases Summit co-hosted by Brazil, China, and the United Kingdom (DESNZ Secretary of State)
- referenced in the COP30 Earth Information Day (10 November) CEOS statement (63rd SBSTA)

v1.0 Progress and timeline

- 2024 – outline development & peer review
- 2025 – detailed completion, peer review & v1 finalization for Summer 2025
  - v1.0 endorsed by CEOS & CGMS in August 2025
  - Available at https://ceos.org/publications-key-documents/ and directly at https://zenodo.org/records/17047789



Implementation & engagement

Facility scale / Plume Detected emissions

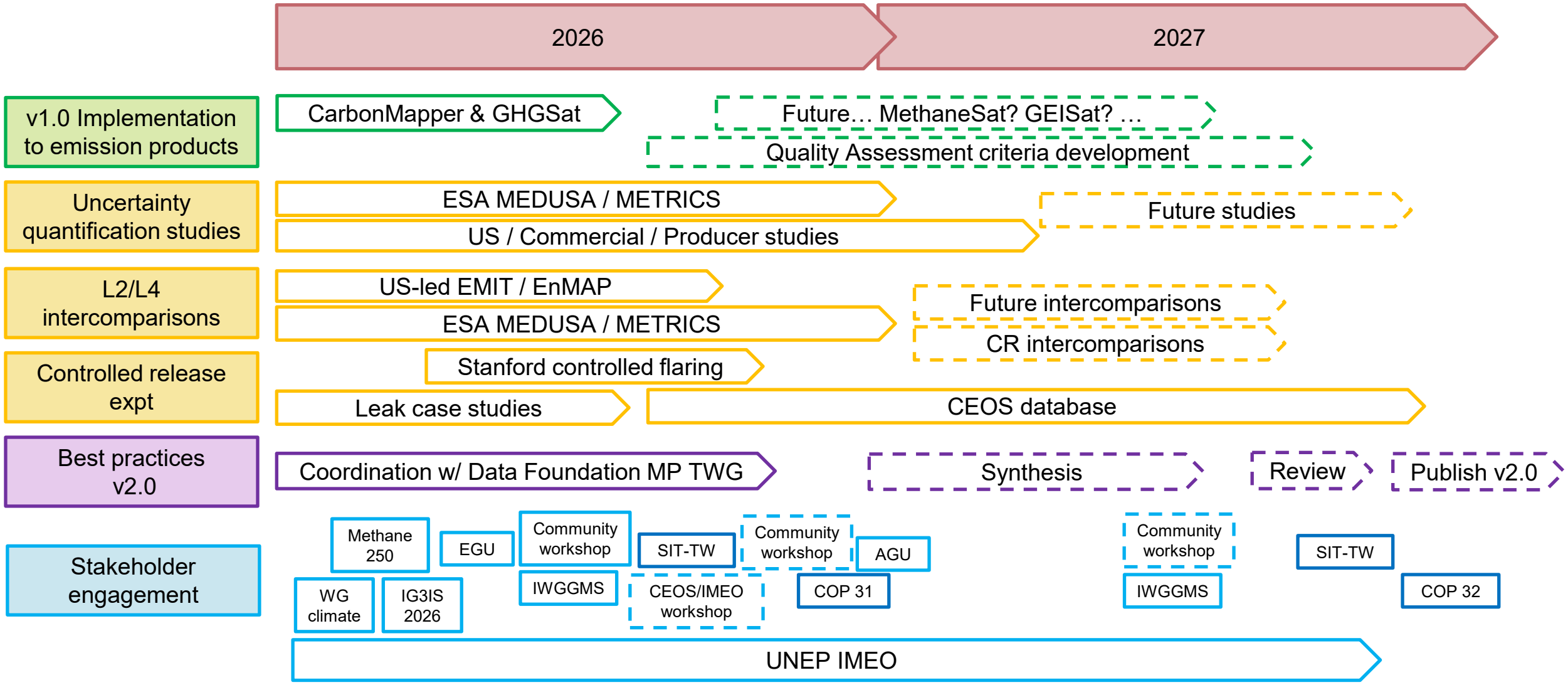
- Implementation plan to develop first adopters –two commercial producers engaged (GHGSat and CarbonMapper) with assessment against common practices underway (followed by others)
- Continued engagement with UNEP IMEO in their adoption within the MARS program and beyond

"With CEOS's common practices for satellite-derived plume emission estimates, we now have a shared language for satellite data—a foundation that enables efficient, meaningful exchange of plume-level information. IMEO will adopt these standards for all data providers contributing to our system, so we can continue to provide insights that help the world reduce methane emissions."
Giulia Ferrini Head of UNEP IMEO

- UN Climate & Clean Air Coalition (short-lived climate pollutants initiative) Global Methane Pledge – with representation at the CCAC 'Methane Action for People & Planet' conference in Mar/Apr 2026
- Representation at the IG3IS 'IG3IS Stakeholder Consultations and User Summit 2026' and 'Guidelines on facility-scale emissions of methane'
- Presentation at EGU 2026 (EGU26-4102)
- Represented at COP-30 via SBSTA statement, UNEP IMEO, ESA and GMP Ministerial engagement
- Highlighted in UK Govt Carbon Budget and Growth Delivery Plan Methane Action Plan

Discussion: Future work on v2.0, implementation, promotion, and encouraging uptake.

Plume-derived emissions (proposed) timeline



Next steps (in GHG TT roadmap)

Facility scale / Plume Detected emissions

- Co-ordination of controlled release validation alongside academic partners CR database
- Studies to follow up v1.0 recommendations (and identified gaps)
- L2 & L4 intercomparison exercises recommendations (EnMAP intercomparison)
- Towards v2.0 (in a few years) to maintain relevance in evolving ecosystem and incorporate on-going studies to more from 'common practice' to 'good practice'- activity progressed by AC-VC and GHG task team with Data Foundation MP TWG etc.

Area flux mappers

- Motivated to provide more useful and accessible routes to use in GST2 (2027), the focus is on a unified offering on country-scale emission estimates.
- Draws on existing initiatives OCO-MIP, RECCAP2 etc.
- Aim is to quantify, consolidate and (where possible) reduce uncertainties in estimates
- Existing finance sector interest alongside academic.
- CO2/CH4 may require different approaches – as at different levels of agreement and maturity.