International methane product standards

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17/10/2023
CEOS-CGMS Working Group on Climate and GHG Task Team

Policy & commercial response to enable climate change action

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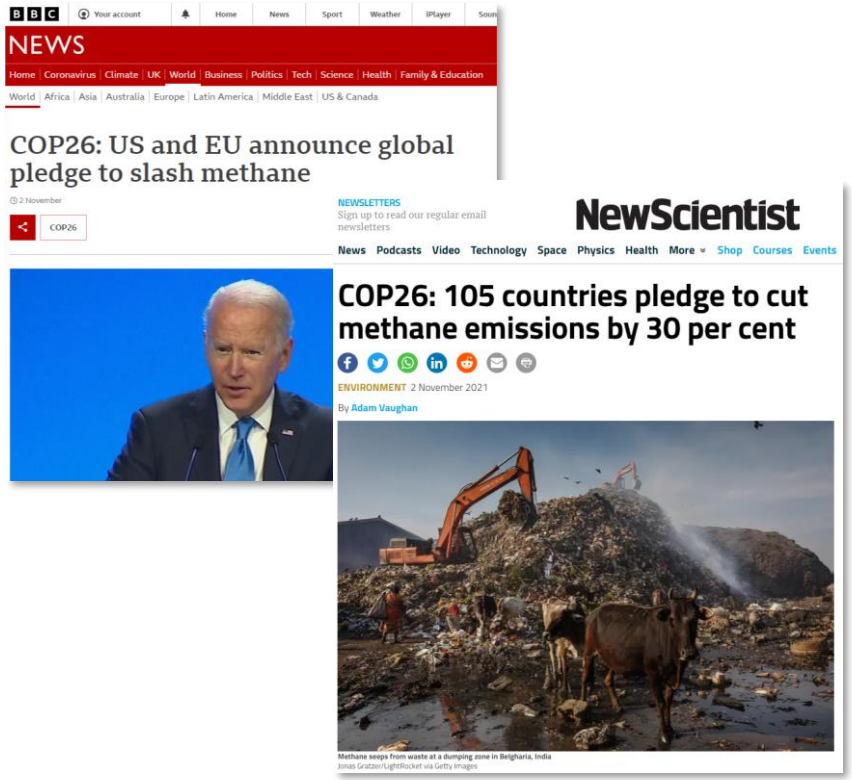
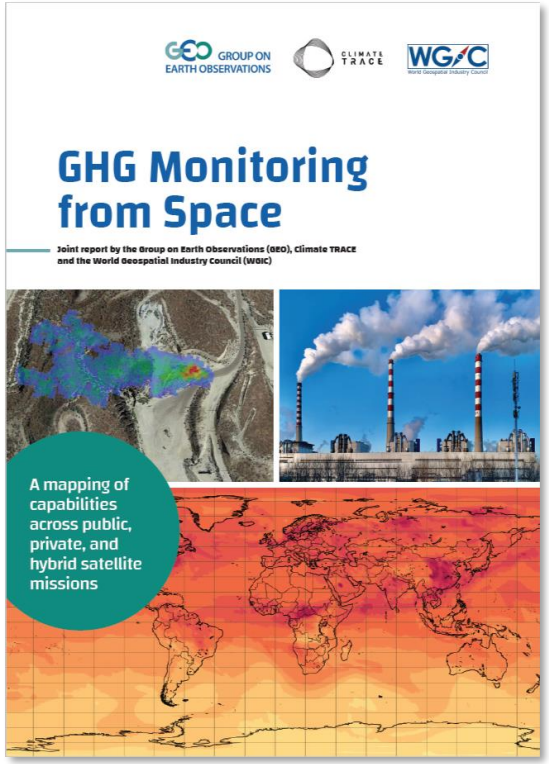
TCFD





- New and refined regulatory drivers form the basis of a business model
- Rapidly growing private satellite/product sector provide urgency for independent quality assurance

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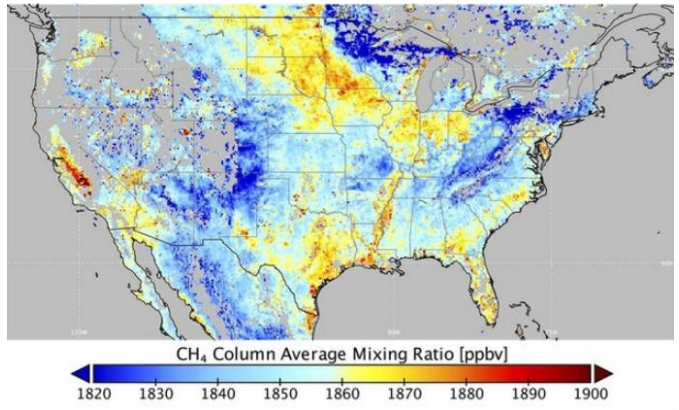
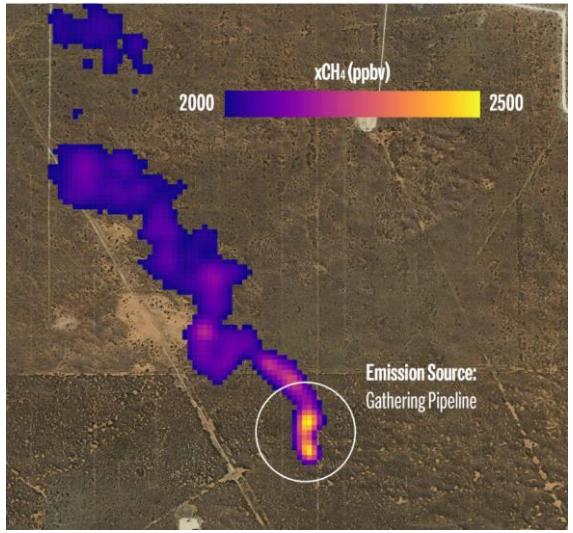
Methane standards suitable for all scales



DOI: 10.1038/s41598-020-57678-4



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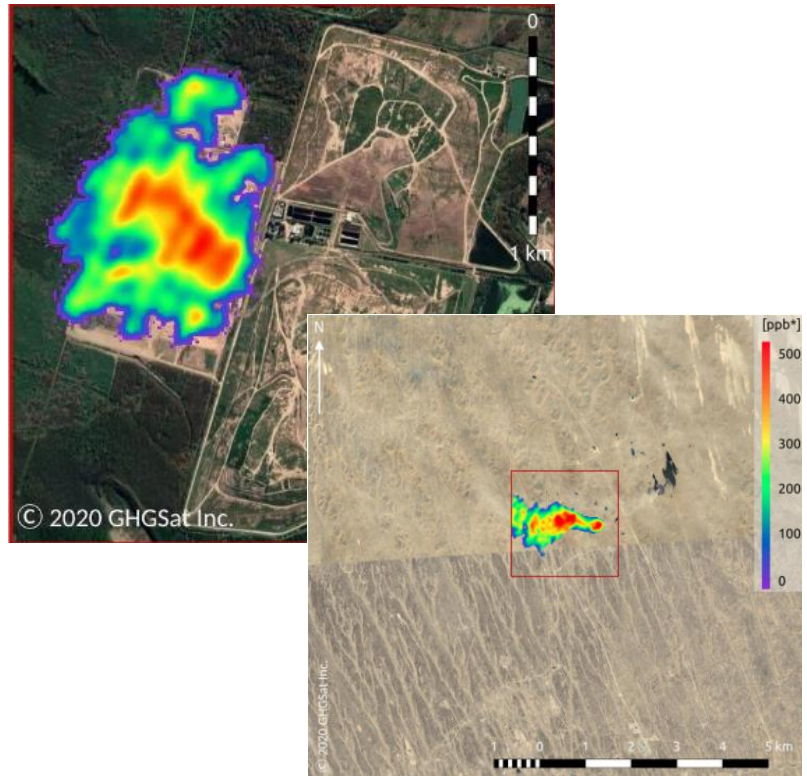

- Need to have standards across the spatial scales that allow synthesis and interoperability between sensors and applications

Modeling from satellite spectra to emissions data products

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Level 1 spectra / bands

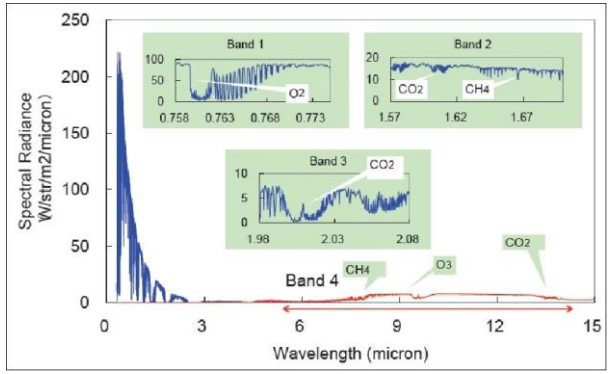

Image credit: JAXA

Level 2 concentrations

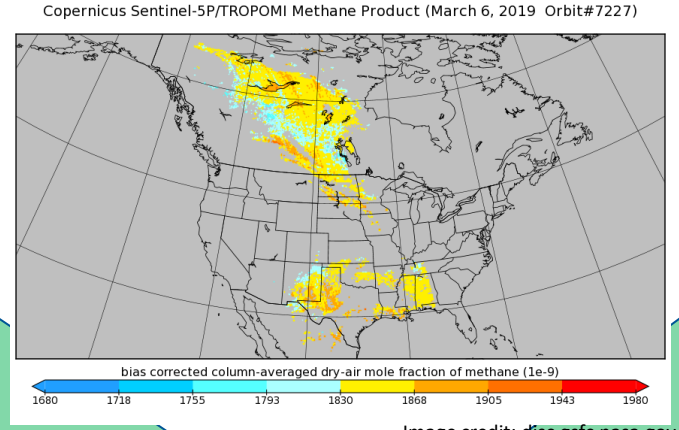

Image credit: disc.gsfc.nasa.gov

Level 4 flux & emission rates

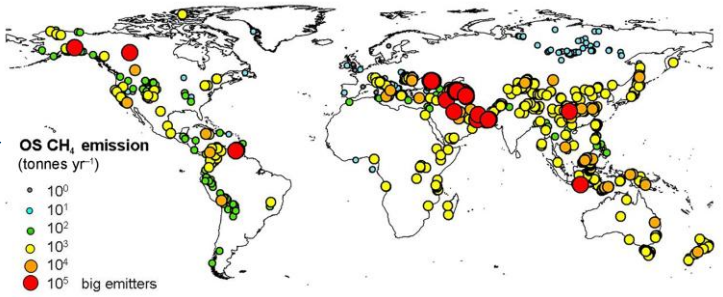

Image credit: 10.5194/essd-11-1-2019

Radiometric, Spectral & Geometric calibration
Sun and viewing geometry
Absorption coefficients
Forward model
Meteorology
Surface reflectance
Aerosol & SIF corrections
Validation bias correction

Band algorithms

Retrieval algorithms (optimal estimation)

Bayesian flux estimates models

Gaussian Plume Models

Transport model
Elevated level detection
Surface reflectance effects
Aerosols corrections

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Transparency & traceability from sensor counts to reported emissions

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Level 1 spectra / bands

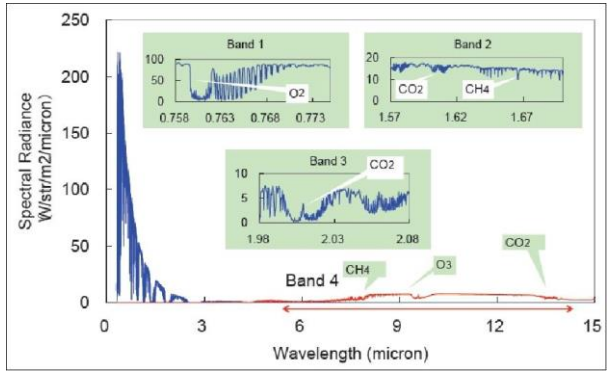

Image credit: JAXA

Level 2 concentrations

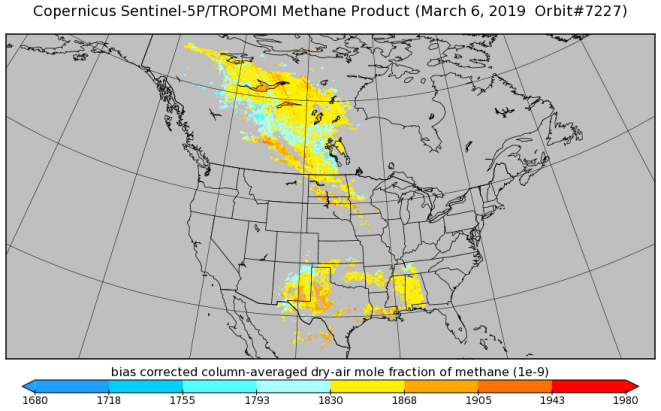

Image credit: disc.gsfc.nasa.gov

Level 4 flux & emission rates

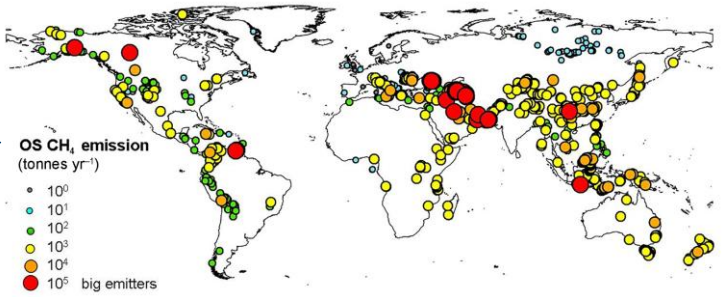

Image credit: 10.5194/essd-11-1-2019

Documentation

Metrology (calibration, characterization & uncertainties)

Algorithms & Processing

Calibration

Validation

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Adopting established quality assured principles & frameworks

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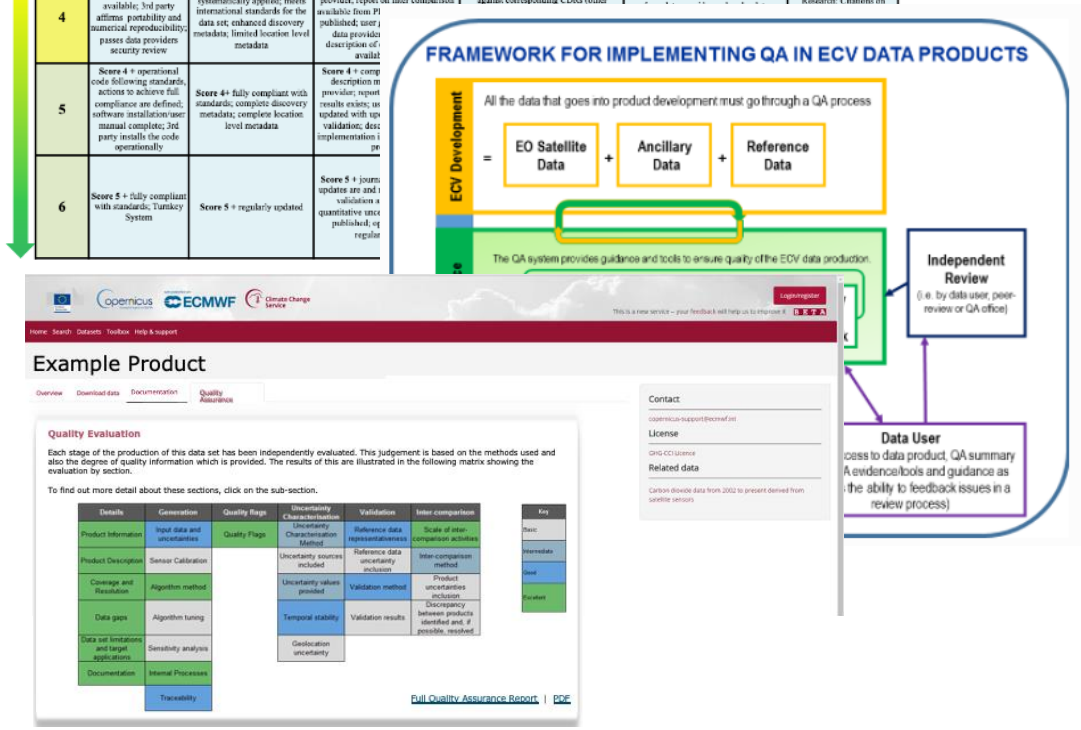
QA4EO Principle

"It is critical that data and derived products are easily accessible in an open manner and have associated with them an indicator of their quality, traceable to reference standards (preferably SI), to enable users to assess the suitability for their application (i.e. its fitness for purpose)."

Maturity	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARACTERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE
1	Conceptual development	None	Limited scientific description of the methodology available from PI	None	Restricted availability from PI	None
2	Research grade code	Research grade	Comprehensive scientific description of the methodology, report on limited validation, and limited product user guide available from PI; paper on methodology is sumitted for peer-review	Standard uncertainty nomenclature is identified or defined; limited validation done; limited information on uncertainty available	Data available from PI, feedback through scientific exchange, irregular updates by PI	Research: Benefits for applications identified DSS: Potential benefits identified
3	Research code with partially applied standards; code contains header and comments, and a README file; PI affirms portability, numerical reproducibility and no security problems	Standards defined or identified; sufficient to use and understand the data and extract discovery metadata	**Score 2 +** paper on methodology published; comprehensive validation report available from PI and a paper on validation is submitted; comprehensive user guide is available from PI; Limited description of operations concept available from PI	**Score 2 +** standard nomenclature applied; validation extended to full product data coverage, comprehensive information on uncertainty available; methods for automated monitoring defined	Data and documentation publically available from PI, feedback through scientific exchange, irregular updates by PI	Research: Benefits for applications demonstrated. DSS: Use occuring and benefits emerging
4	**Score 3 +** draft software installation/user manual available; 3rd party affirms portability and numerical reproducibility; passes data providers security review	**Score 3 +** standards systematically applied; meets international standards for the data set; enhanced discovery metadata; limited location level metadata	**Score 3 +** comprehensive scientific description available from data provider; report on inter comparison available from PI published; user [illegible] data provider description of [illegible] availat	**Score 3 +** procedures to establish SI traceability are defined; (inter)comparison against corresponding CDRs (other	Data record and documentation available	**Score 3 +** Research: Citations on
5	**Score 4 +** operational code following standards, actions to achieve full compliance are defined; software installation/user manual complete; 3rd party installs the code operationally	**Score 4+** fully compliant with standards; complete discovery metadata; complete location level metadata	**Score 4 +** comp description m provider; report results exists; us updated with up validation; desc implementation i pr			
6	**Score 5 +** fully compliant with standards; Turnkey System	**Score 5 +** regularly updated	**Score 5 +** journ updates are and t validation a quantitative unc published; op regular			



CEOS

QA4ECV

EDAP

EARTHDATA OPEN ACCESS FOR OPEN SCIENCE

GEOS ANALYSIS READY DATA

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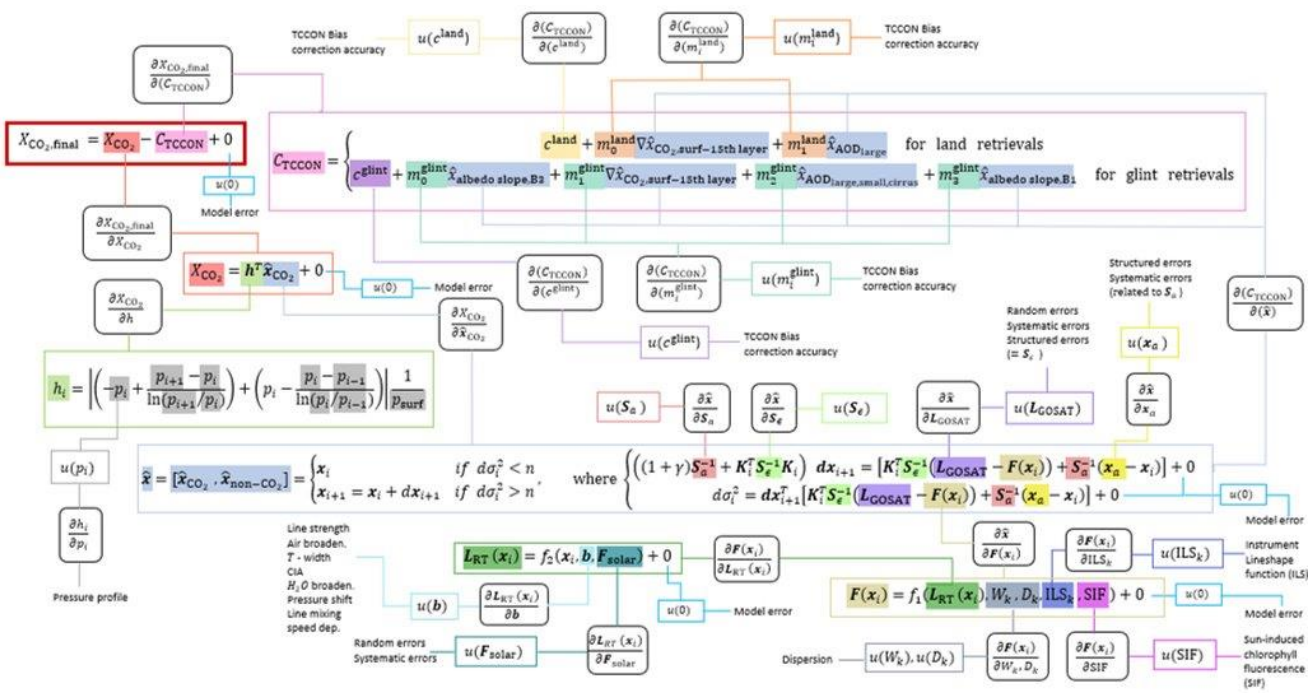
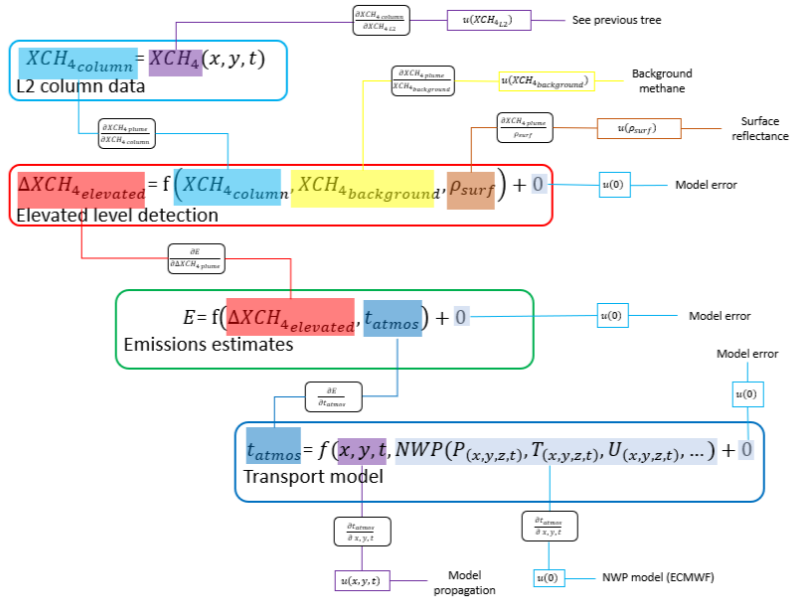
Transparent Process Description & Uncertainties





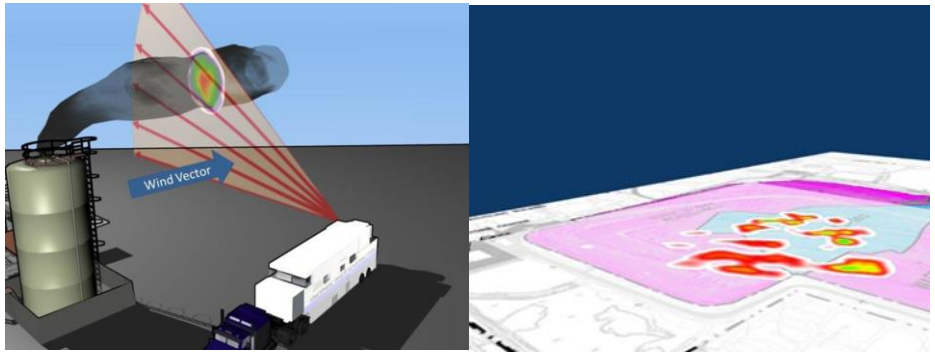
Following methods developed in NPL-led FIDUCEO and sister projects now encapsulated in CEOS-endorsed www.QA4EO.org

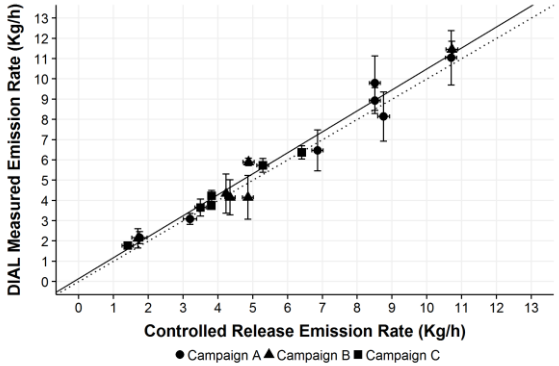
Product certification scheme Auditing & Validation

- Independent
- Evidenced Expert
- Funded by the product producer
- Accepted by the customer/sector
- Auditor training & certification
- Practitioners accredited by a professional body

- Validation builds on NPL in-situ traceable emissions monitoring capability.
- Reference measurement systems to characterise ground sources
  - Differential absorption lidar (DIAL)
  - Long term monitoring (FEDS)
  - Controlled release system (CRF)

https://doi.org/10.3390/rs9090956





Framework structure

- Partnership between scheme originator and professional body to enable an independent certified practitioner
- Produce assessed against a customer need/requirement – not a static standard
- Contract between product producer and customer/user
- Producer provides product, algorithm and metadata
- Customer provides requirements and need metrics
- Product rating made public

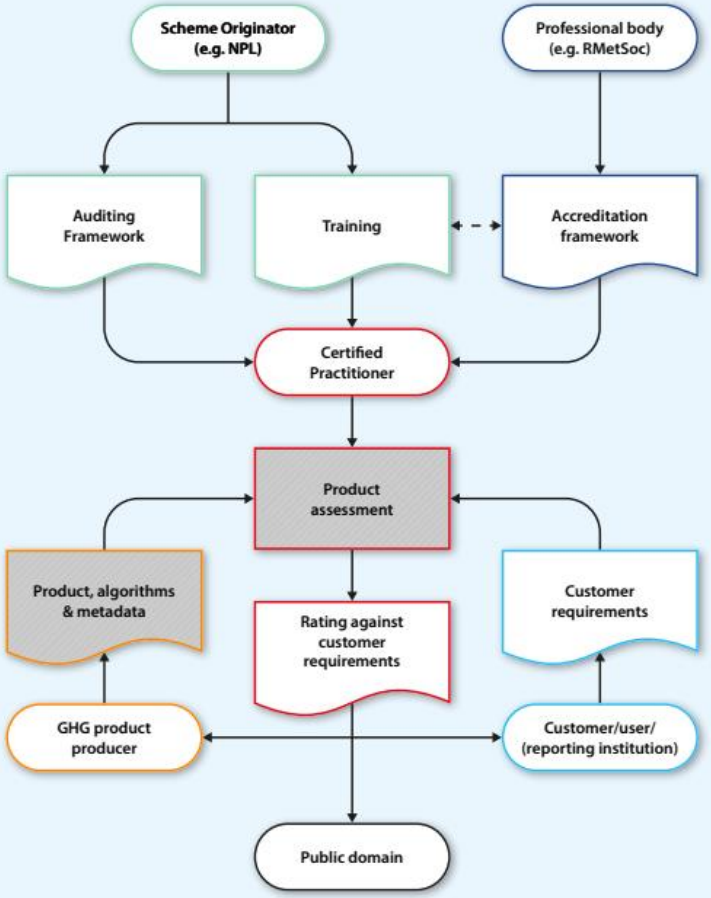


Figure 2. Framework flow chart. Actors (denoted by the terminator symbol) are colour coded against their responsibilities (documentation or process). Greyed steps are not in the public domain.

Summary

- The need for methane emission data is prescribed to response to government policy enacted to address the climate emergency
- Space Agency and Commercial satellite-derived products are part of the answer - but data confidence is key
- Confidence in trusted and reliable data is achieved through objective and independent assessment of products, from on-orbit measurement to fluxes/emissions to whether they are ‘fit-for-purpose’
- Underpinned by
  - transparency
  - traceability
  - independence
  - Evidenced QA

COP26: Rishi Sunak unveils commitment from companies managing $130 trillion to fight climate change

The Chancellor pledged to make the UK “the world’s first net zero-aligned financial centre”

By Emily Ferguson

November 3, 2021 9:31 am (Updated 10:54 am)

Next steps

- Develop consensus on the need for international methane standards
- Engagement with the community (CEOS is a key partner)
- COP28 Space Summit Statement - Space Agencies Leaders Summit Pledge
- UK-hosted methane standards workshop in Q1 2024 with recommendations brought to April 2024 CEOS SIT meeting
- Implementation developed in 2024-25
- International agreement for CEOS Plenary / COP30 in Q3 2025.

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