

UK-hosted Methane Standards Workshop overview and way forward

CEOS WG climate GHG TT virtual meeting

Paul Green & workshop steering committee
11/03/2024

Overview

- Successful workshop 26-28 Feb
- 31 speakers
- 74 registered, 62 in person – typically 10 or so online at any one time.
- Thanks for attending / engaging and encouraging the community to participate.
- Many people travelled a long way.



Agenda – Mon 26th Feb

Monday 26 February

11:45	Registration and Lunch
12:30	Housekeeping
12:45	Welcome NPL Welcome – Pete Thompson, NPL UKSA welcome and motivation – Paul Bate, UKSA DESNZ overview – Paul Monks, DESNZ
13:25	Workshop Objectives Paul Green, NPL
13:55	National / international regulations and IMEO initiatives US regulation – EPA – Dan Cusworth, CarbonMapper EU regulation – Kalyani Ramanan, University of Edinburgh IMEO initiatives – James France, IMEO
14:40	Break

15:10	Perspectives: CEOS & Corporate Reporting and discussion CEOS perspective – SIT chair – Osamu Ochiai, JAXA CEOS perspective – GHG TT – Yasjka Meier, ESA CEOS perspective – AC-VC – John Worden, JPL
15:50	Corporate reporting perspective and discussion Steve Spittle, GlobalTrust
16:20	In-situ emissions monitoring and regulations and discussion Convenor: Rod Robinson, NPL
17:30	Welcome Drinks Reception – Bushy House, NPL
19:30	Workshop Dinner – The King’s Head 123 High Street, Teddington, TW11 8HG

Agenda – Tues 27th Feb

Tuesday 27 February

08:30	Registration and Refreshments
09:00	Welcome and day plan Paul Green, NPL
09:10	Space Agencies' perspectives ESA perspective – Angelika Dehn / Claire MacIntosh, ESA US GHG Centre perspective – Argyro Kavvada, US GHG Centre JAXA perspective – Osamu Ochiai, JAXA Chinese perspective – Dongxu Yang, IAP Korean perspective – Hayoung Park, SNU
09:50	Mission-specific perspectives TROPOMI capability – Ilse Aben, SRON Super-emitters – GHGSat – Jason McKeever, GHGSat Super-emitters – CarbonMapper – Dan Cusworth, CarbonMapper Super-emitter – MethaneSat – Luis Guanter, UPV / EDF Super-emitter – Non-dedicated missions – Javier Gorrone, UPV
10:30	Break
11:00	Standards tenets and discussion Convenor: Paul Green, NPL
12:00	Terminology and Nomenclature and discussion Convenor: Annmarie Eldering, NIST

13:00	Lunch
14:00	Standards for concentration / Enhancement / L2 methods and discussion Convenor: Angelika Dehn, ESA
15:00	Standards for emissions estimates / flux / L4 methods and discussion Convenor: Paul Palmer, University of Edinburgh
16:00	Break
16:30	Validation: controlled release, TCCON / COCON, standards and discussion Convenor: Jon Helmore, NPL Convenor: Dan Zimmerle, CSU
17:30	Close of 2nd day

Agenda – Weds 28th Feb

Wednesday 28 February

08:30	Registration and Refreshments
09:00	Consensus recommendations and discussion Steering committee
10:15	Terminology & nomenclature review and discussion Steering committee
11:15	Break
11:45	Next steps and consensus plan Steering committee
12:30	AOB Sarah Glencross, NPL
12:45	Closing remarks Beth Greenaway, UKSA
13:00	Lunch
14:00	Close of day 3 & workshop

Recommendations - Standards definitions

- Definitions: Best practise is 'voluntary' & compliance statements are open to interpretation. Standards are specific, allowing an objective Y/N compliance statement.
- The evolution is assumed to be 'best-practise' > community(-accepted) standard > CEOS adoption > CEN/ANSI/ISO formulation when sufficiently mature.
- A standard will be focused on methods and reporting, not a static threshold performance basis.
- Any standard should be agile enough to allow evolution of methods in an immature field.
- The evolution of the standard should consider back-comparability.
- Early compliance to the standard seen as a mark of rigorousness and trust. Compliance not *required* to operate in field. Graded compliance (Gold/Silver/Bronze) expected. Should encompass a 'minimum viable' to 'ideal' scale to maximise pragmatism.
- A defined set of a limited number of metrics to judge a product
- Defined to prevent the misuse of data (intentional or otherwise) and foster good use. Standards can also be misused, so need to be explicit.

Recommendations – CH₄ product standards

- Need standards to suit use cases. Some underlying standard/best practise on product and metadata content, with specific focus on facility scale emissions for:
 - Alert
 - Super emitter quantification (for regulation)
 - Time-averaged emission (per facility/basin)
- Need agreed terminology. Use existing definitions and taxonomy in remote sensing and GHG monitoring, as no need to reinvent the wheel. Concentrate on plume identification and quantification (L3 > L4) as driven by new technology and legislation/regulation.
 - Identified terms/concepts: background, separation of plume origin, source and attribution concepts, source rate error & contributors, probability of detection vs detection limit. Different/simpler terminology for different use cases. System probability of detection curve vs individual detection metric.
- Clear separation of measured quantities (concentration/enhancement) and non-measured quantities (e.g. wind) – measured quantities need traceability

Recommendations – CH₄ product levels

- Define the L1 / L2 / L3 / L4 data product & metadata requirements.
- L1 not critical development area as radiometric/spectroscopic standards exist.
- Concentration (dry mole fraction) is well defined but need work for other L2 quantities.
- L3 – the delineation of plumes from a concentration/enhancement ‘map’ a key development area for best practise and approach standards.
 - Define sub-level process and define required metadata reporting per sub-level. e.g. max enhancement, background discrimination, wind direction sanity check, surface reflectance masking etc.... AI trained on x, human inspection/expert opinion against protocol y etc.
- L4 – emission/flux estimates from a L3 selection or direct from L2 a key development area for best practise and approach standards.
 - Define sub-level process and define required metadata reporting per sub-level. E.g. plume origin location uncertainty, define underlying assumptions (human or coded). QC has strong expert judgement element. Source attribution (to a facility/component) dependant on database quality. Wind products and treatment key area of development.
- Define core L3/L4 metrics – 90% detection limit, plume rejection criteria, quantification method comparison

Recommendations – Metadata, uncertainties & transparency

- The standards should ensure relevant metadata critical to reaching a given product level is included in the product. The standard should stipulate the essential elements.
- A breakdown of major contributors to the uncertainty is required. Need to define ‘major contributors’ and be pragmatic in over-stipulating evidently minor contributors.
- Many missions/products have detailed documentation on metadata and uncertainties so effort may be to signpost and define form.
- Transparency and reproducibility of products up the process chain is key for science users. Allows user verification of product. Some SA missions are exemplar in this regard, but commercial providers may have propriety information limitations. Definitions of fully public transparency against closed-door expert review may provide a solution.
- The standard should be accompanied by a public data sandbox of (selected) data to allow users the opportunity to work with the data and generate trust through hands-on reproducibility and algorithm permutations. Is the CEOS cal/val portal a viable location for this sandbox?
- Comparability at key stages of the process required – propose L1 / L2 / L3 / L4 data product definitions to enable.

Recommendations – validation

- Validation is an essential element.

Recommendations – aspects not in the standard (for now)

- Timescale / persistence / sampling towards total emissions aggregation – what is a large enough sample, how many samples?
- Framework for forward model bias estimates

Near-term (workshop) timeline

- IWGGMS abstract deadline – 7th 15th March
- Overview presentation for CEOS WG climate GHG TT meeting – Mon 11th March
- Draft Recommendations & timeline summary slide deck share with (key) workshop participants by 22nd March
- Presentation to CEOS SIT – 9th April (15 mins on schedule)
- Circulate draft workshop report to participants – mid- late-April (after CEOS SIT including any points raised)
- IWGGMS 20 presentation 29-31 May – outline recommendations and way forward
- Finalise workshop report late-May – publish? a DOI would be useful. CEOS/NPL/other?

Standards development timeline

- CEOS SIT – April 2024
- Initial outlines defined by end of May – what contributions needed from who.
- IWGGMS 20 presentation 29-31 May – outline recommendations and way forward
- Ask for initial standards inputs June-July-August from <10 key stakeholders
- Review meeting July? Webex
- Initial standards outlines – Sept 2024
- CEOS technical meeting – Sept 2024
- IPCC workshop - ??
- IMEO workshop – late 2024 - TBD
- COP29 - ??
- COP30 – adoption by CEOS

Initial workflow

- Review sister standards from ground-based methane monitoring
- Collate all existing best practise documentation & initiatives (CEOS L1 & L2 / medusa etc.)
- Start best practise methodology document
 - Define outline (started) – product(s), audience/user,
 - Generalised workflow
 - Define Lx data definitions
 - Define key metrics (at each stage/level) [research commonalities and differences]
 - Define key ancillary data and assumptions [research commonalities and differences]
 - Define review team (NPL, NIST, CarbonMapper, GHGSat, IMEO, Harvard, JPL-EMIT..) for May 2024 timescale.