



Co-ordinated by
ECMWF



CoCO2

Prototype system for a
Copernicus CO₂ service

MONITORING HUMAN CARBON DIOXIDE EMISSIONS

CoCO₂ User activities and the Decision Support Blueprint

**City Workshop: Supporting city-scale GHG
inventories - opportunities and challenges**

26/05/2023

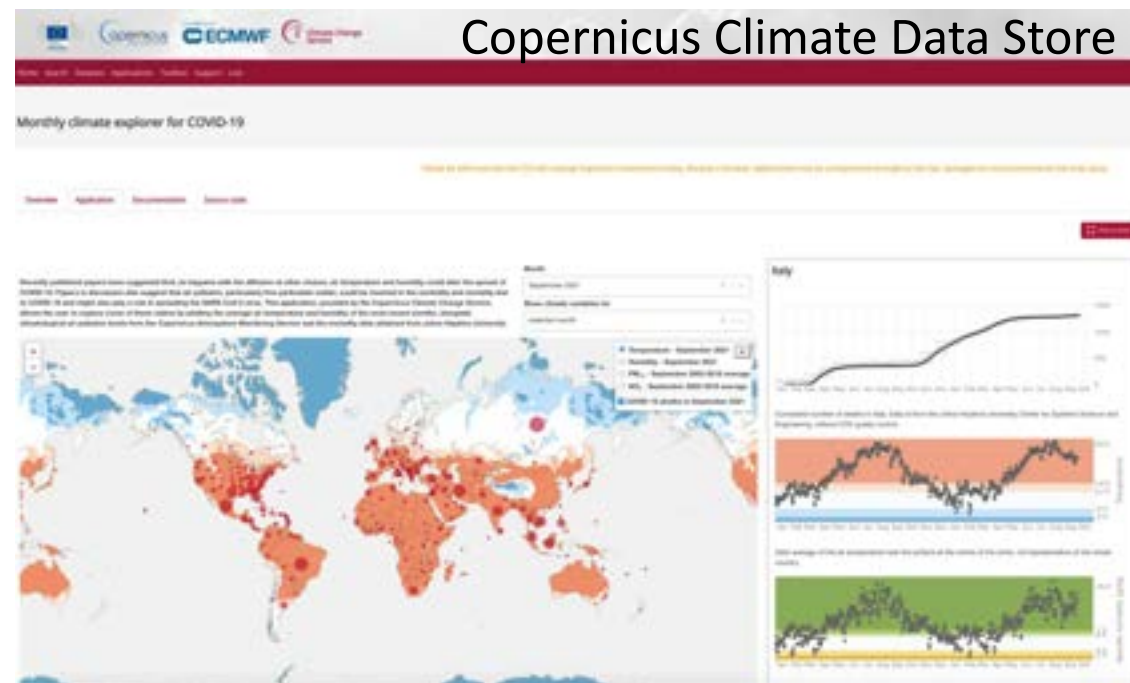
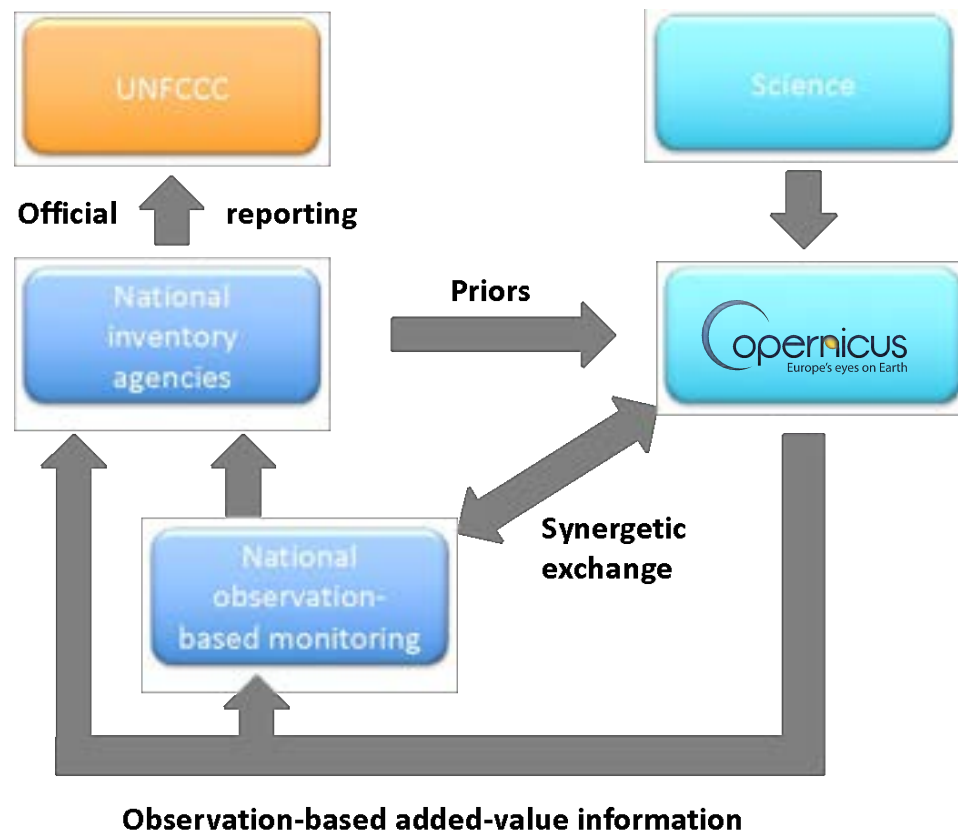
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User engagement for co-designed user services



International standard for Urban GHG Monitoring and assessment



WP8 Objectives

- Identify User Community and User Needs to serve UNFCCC national submissions, in a policy-oriented framework.
- Design a set of information products that can meet user needs and provide an outline for a **Decision Support Blueprint**.
- Produce syntheses of CO₂ and CH₄ observation-based emission estimates
- Compile a catalogue of satellite hot-spot detection studies for CO₂ and CH₄

Who are our users?

- UNFCCC, national inventory agencies, national policy makers, ...
- IPCC, scientific bodies, Copernicus CAMS,...
- City authorities (local governments)
- City initiatives and stakeholders (Covenant of Mayors, C40, ICLEI)



What we do for users

For National Users

- Yearly CO₂ & CH₄ budget reports: assessing and weighing consistent evaluations of the UNFCCC-reported estimates against the observation-based evidence produced in the CoCO₂ project (and VERIFY)
- Multiple efforts to build competence with verification activities (**Decision Support Blueprint**)



Link to new EU funded project: CORSO, AVENGERS, EYE-CLIMA and PARIS

- Participation in different groups and initiatives
 - IPCC 2006 and Refinement 2019
 - IPCC Expert Meeting on Use of Atmospheric Observation Data in Emission Inventories (2022)
 - UNFCCC (COPs, SBSTAs)
 - GEO
 - WMO (IG³IS and GHG global monitoring infrastructure)
 - ICOS Science Conference
 - RECCAP2, GEIA

For Sub-National Users: catalogue of studies, targeted workshops !





Current verification activities involving users

- The **verification** ensures reliability of the inventory estimates, for their intended purpose
- In the IPCC Guidelines, verification includes both **inventory-based comparisons** and **observation-based comparisons**
- Independent verification can **complement** inventories and **support** the improvement of both models and inventories
- A careful comparison across independent inventory-based approaches can reveal causes of differences (Andrew 2020; Deng et al. 2022) and identify errors (e.g., CoCO₂ D8.1 on EIA estimate of oil).

Current challenges: to understand differences between observation-based and inventory-based emission estimates for the different GHGs.

Fossil CO₂ – quite certain with low uncertainties

Land CO₂ – highly uncertain inventories – system boundaries challenges – progress possible due to multiple approaches

CH₄ – uncertain inversions but still possible for verification – uncertain inventories



Ongoing work

Now:

- Identify, quantify and explain possible divergences between global inventories, atmospheric inversions, process-based models, and national inventories submitted to the UNFCCC.
- Building on and improving the methodological approach developed previously in the EU-funded VERIFY project's GHG syntheses (Petrescu et al., 2020, 2021a, 2021b, 2023 and McGrath et al., 2023).
- Focus on EU27 and few individual Member States (CO₂) and on EU27 and top global emitters (e.g., Brazil, China, DR Congo, Indonesia, Russia and the USA) for CH₄.

Next:

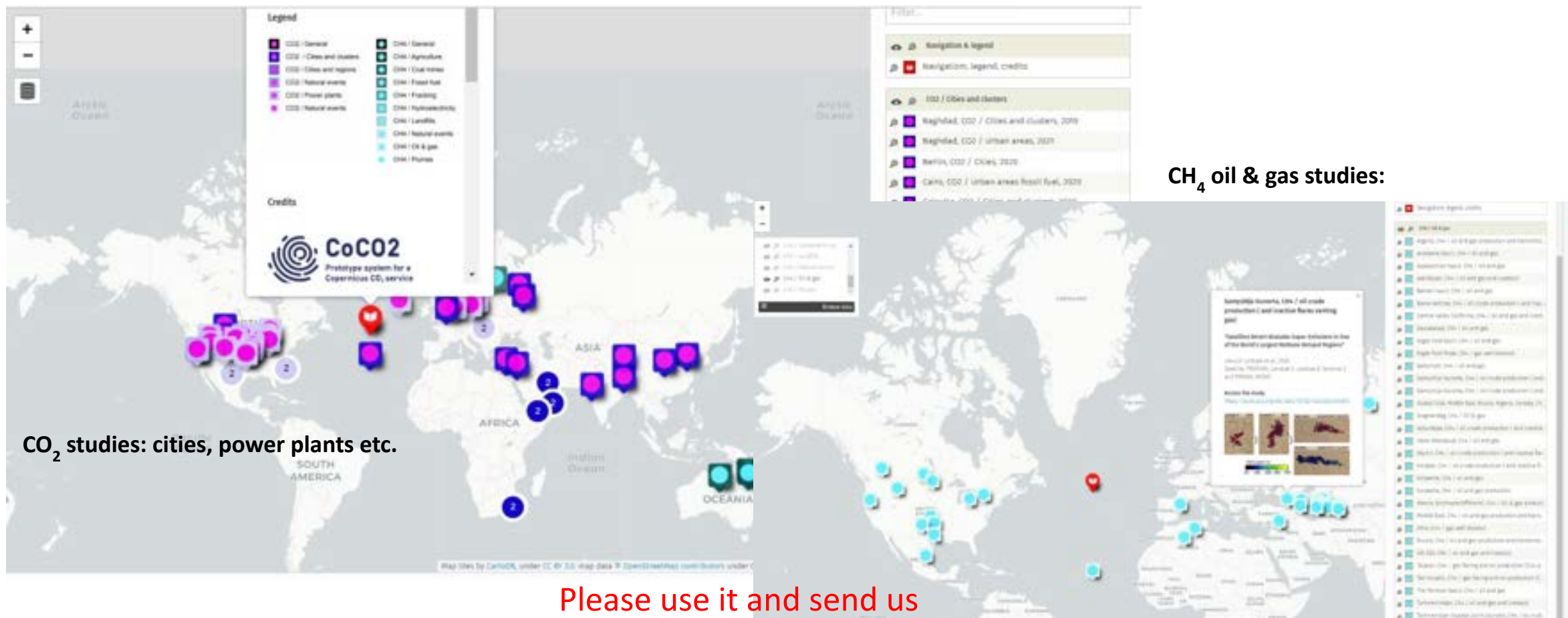
- Top-down, observation-based estimates are required by multiple stakeholders and at multiple scales to verify bottom-up emission estimates - set-up a yearly reconciliation exercise to support monitoring and verification activities.
- Systematic reconciliation and comparison often requires a close dialogue between analysts, data providers, and modelers – the Decision Support Blueprint, will outline potential mechanisms and tools to provide diverse, but targeted, information to the relevant users.



User engagement activities in CoCO₂

What we do for sub-national users

- For cities, regions: Hot spot emission detection studies | CoCO2: Prototype system for a Copernicus CO₂ service (coco2-project.eu)



Please use it and send us
your feedback!

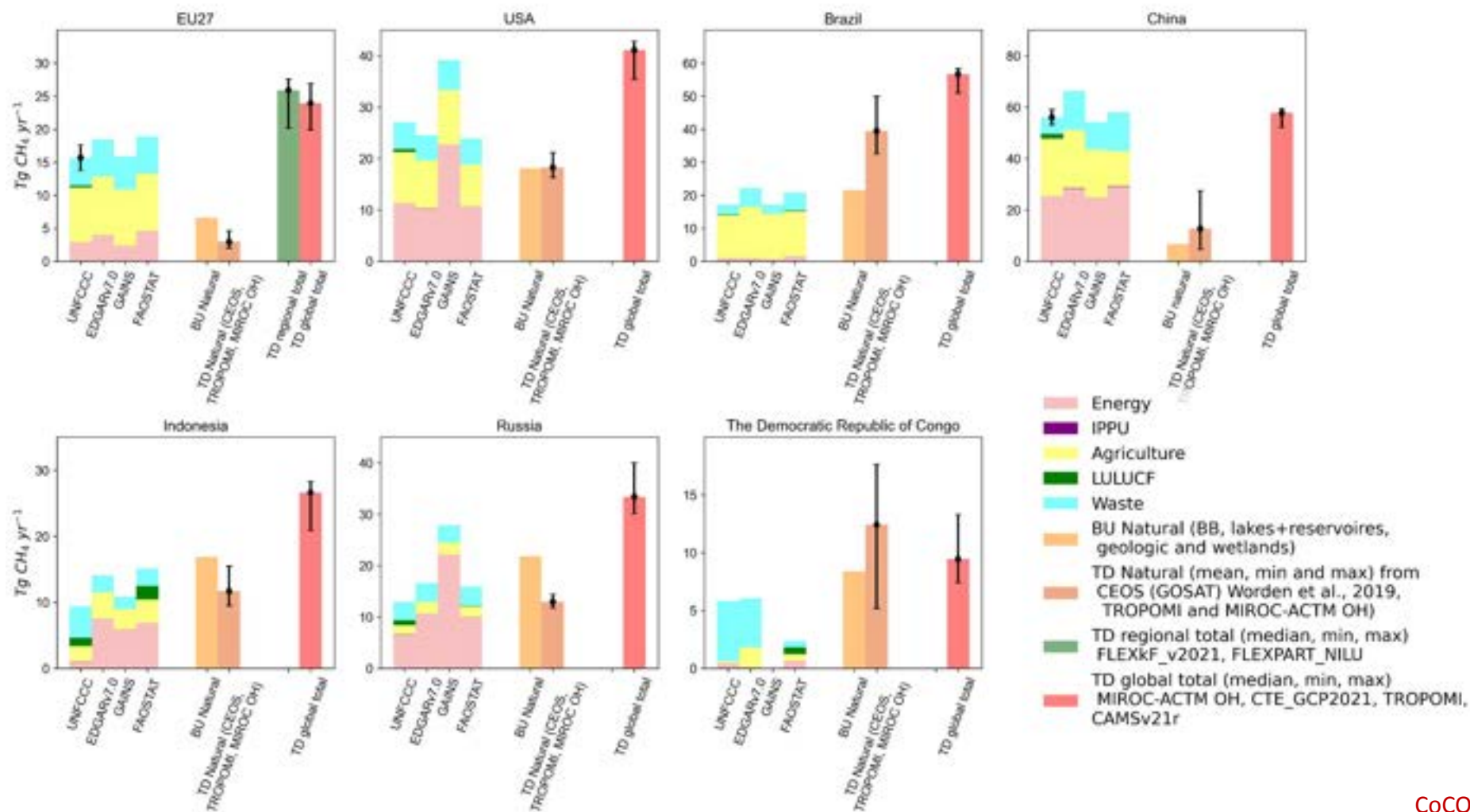


CH₄ budget comparisons

UNFCCC, TD and BU – preliminary results

What we do for national users

Total anthropogenic and natural CH₄ emissions from UNFCCC, other BU and TD estimates (average 2015-last available year)

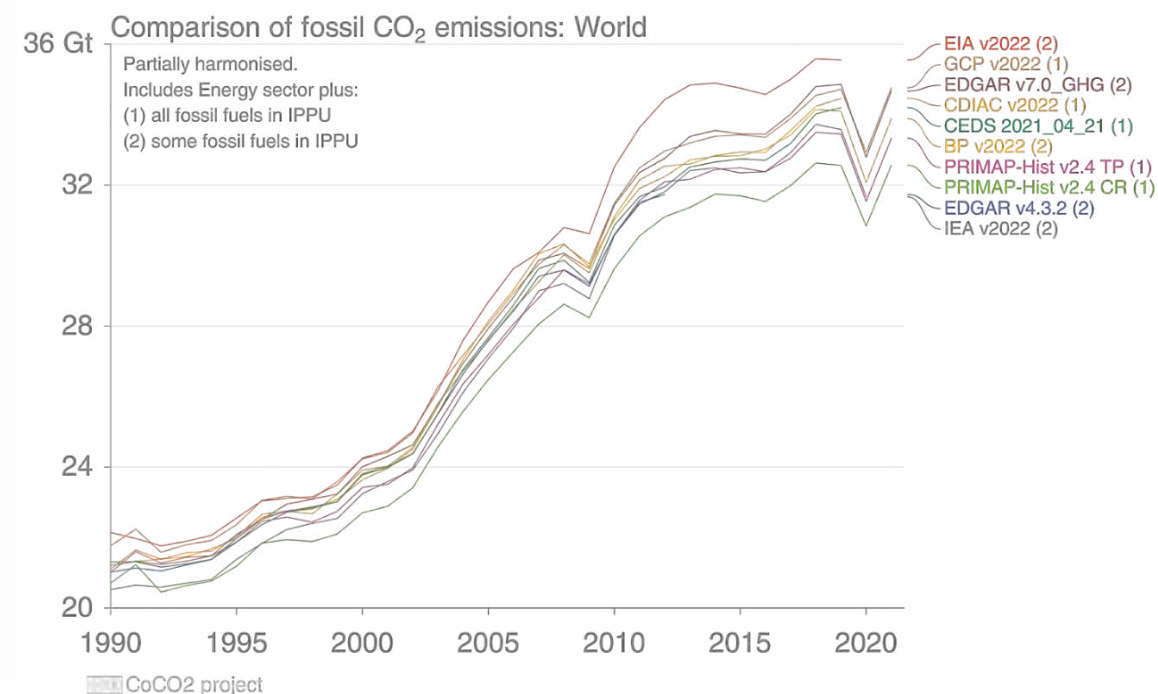
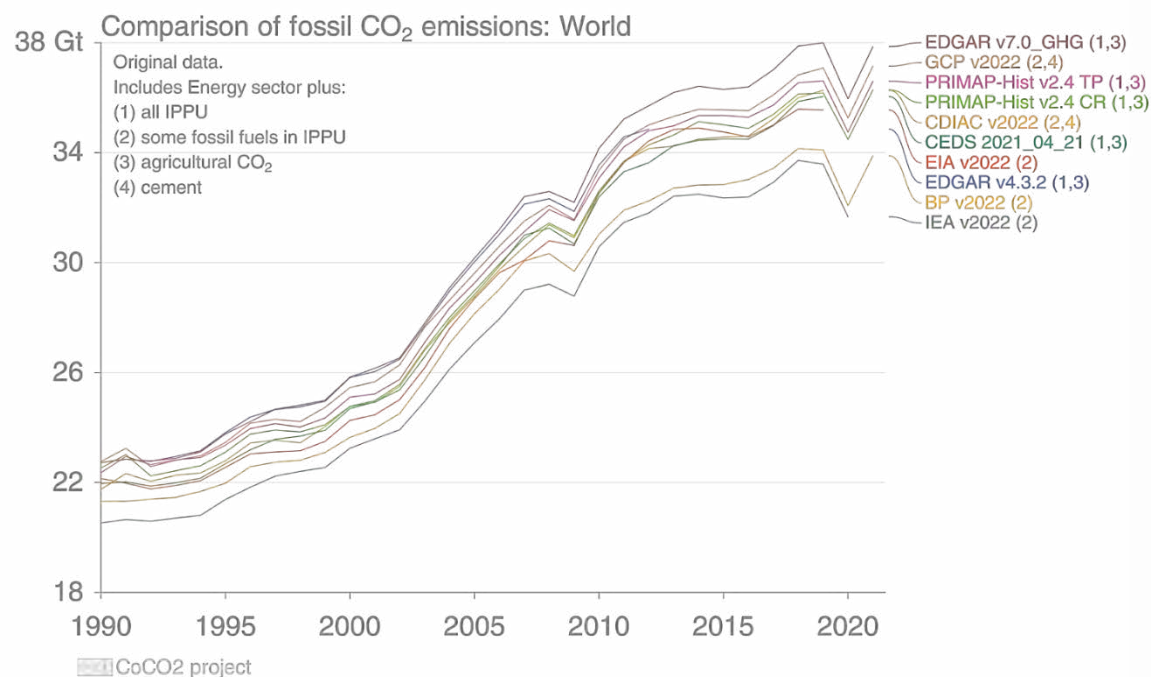


CoCO₂ CH₄ current work by A.M.R. Petrescu et al., (VU Amsterdam)



CO₂ budget comparisons – CO₂ fossil

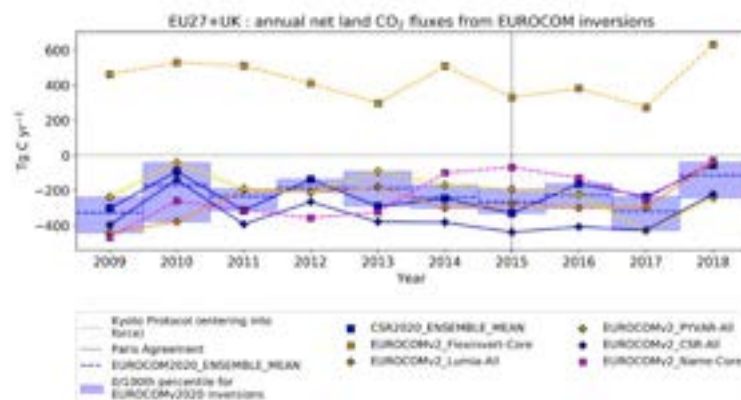
- **Left:** 'Raw' totals from these datasets have differing system boundaries, they don't all include the same set of emissions sources.
- **Right:** harmonized data as much as possible, but harmonization is limited by the disaggregated information presented by each dataset.
- Most datasets agree well within expected system boundary differences (Andrew, 2020).
- This exercise discovered that EIA's estimates were high, and investigation showed errors leading to double-counting. Globally, their correction led to a drop in EIA's estimates of fossil CO₂ emissions by about 1 Gt CO₂.





CO₂ budget comparisons – CO₂ Land

Comparisons between different versions of model ensembles and products continue...to compare we need **similar system boundaries**



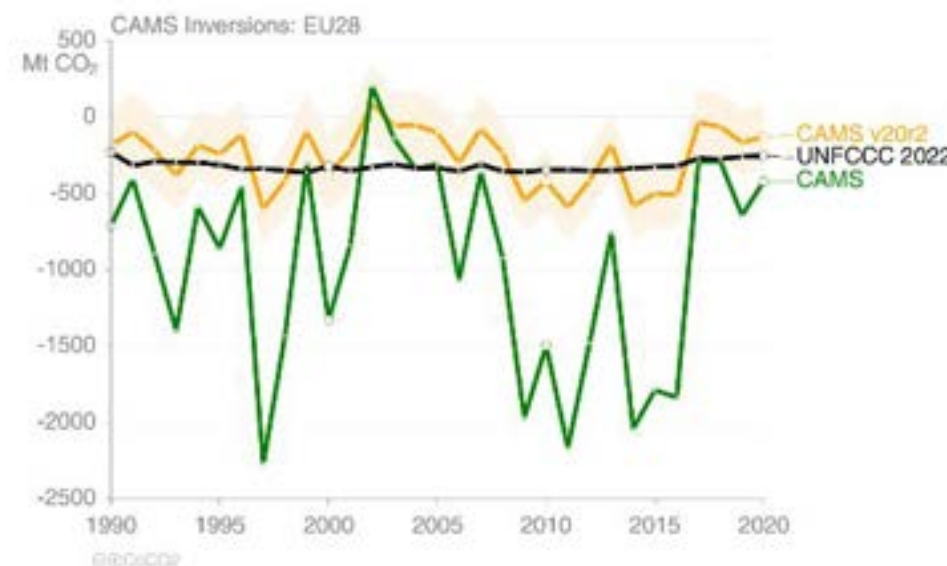
Comparison of different ensemble members help identify those which might need further investigation



Top-down CO₂ land



EUROCOM



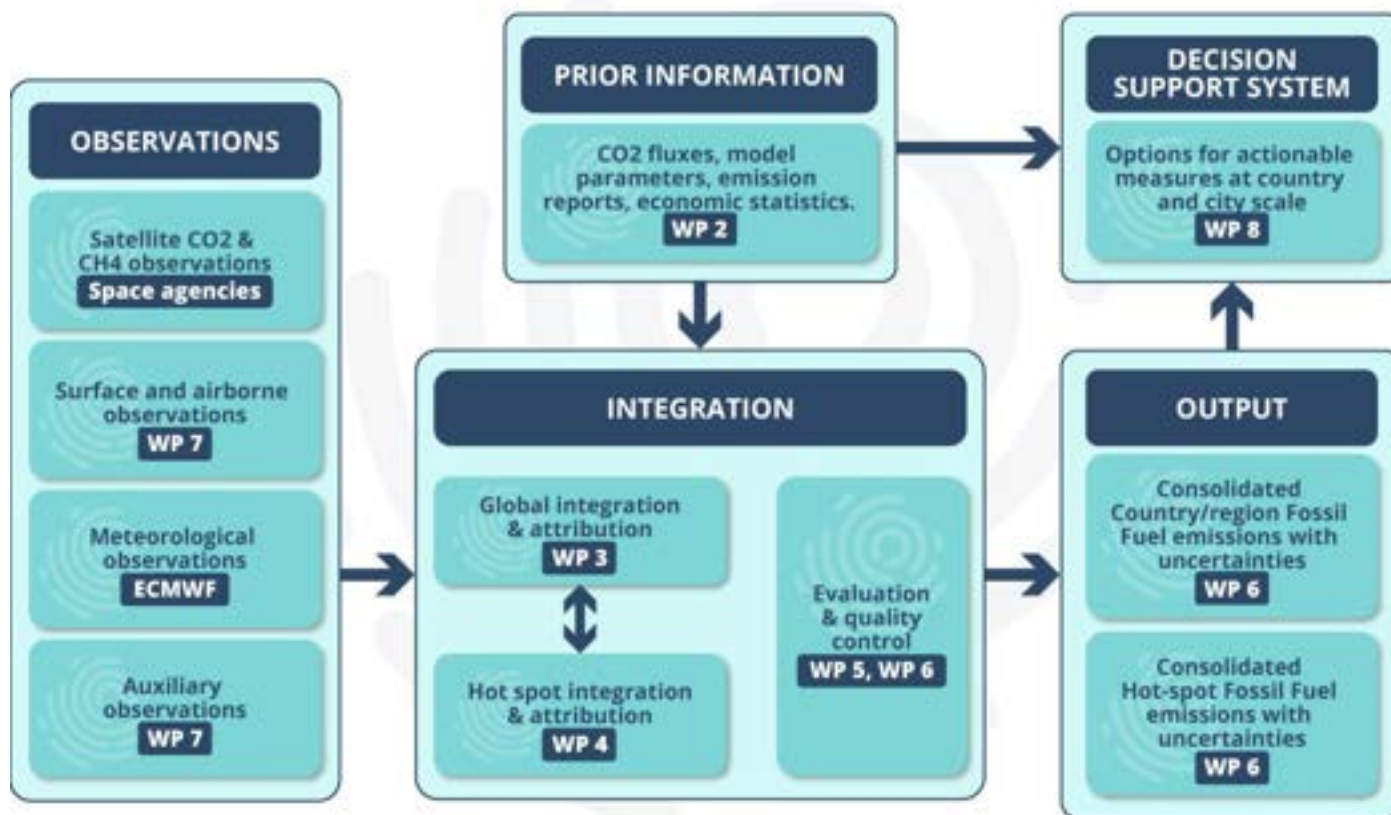
Adjustment of components (e.g., lateral fluxes) will enhance comparability between estimates



Orange CAMS with adjusted lateral fluxes



Decision Support System (DSS) blueprint



Background

What is and why do we need a CO₂MVS?

- A tool to help support user's verification activities, particularly with the influx of new space-based observations (such as through CO₂M).
- Components: **prior information** (e.g., initial emission estimates) and **observations** (e.g., meteorology, satellites - **inventory-based approach and inversion-based approaches**) that require **integration** (e.g., via models) to produce **outputs** (e.g., revised emission estimates), that are then condensed into a **decision support system** (e.g., user functions).



- IPCC Guidelines / Guidance
 - Already applied in UK and Switzerland, also elements in Australia, Germany, NZ, US, etc
- User processes in research projects
 - Past projects: CHE, VERIFY
 - Ongoing: CoCO2, EYE-CLIMA, AVENGERS, PARIS
 - US-based initiatives
- VERIFY Fact Sheets
 - Put all data on a common platform
- IPCC Expert Meeting on Verification
- Dialogues with national experts and domain experts





Decision Support System (DSS) blueprint

Preliminary recommendations

- Building a common knowledge base
 - What are the opportunities? What are the expectations? What are the limits?
- Communication
 - Very few know what we are talking about (even in expert communities)!
- Case studies
 - “Try by doing” – we will see this in the new EU projects (EYE-CLIMA, AVENGERS, PARIS, ICOS Cities, ...)
 - Country (or city) level activities (preparing for the influx of new data and methods)
- Further development of inversion modelling
- Graphical material and analysis tools
 - Example: Copernicus Atmosphere Monitoring Service (CAMS) <https://atmosphere.copernicus.eu/>
 - Access data to perform own analysis
 - Tools to (partially) perform certain types of analysis
- Collaboration
 - Across research projects, user communities, etc



Feedback

The CO₂,CH₄ studies map is available here:

[A Catalogue of published studies on hotspot detection of emissions for CO2 and CH4 | CoCO2: Prototype system for a Copernicus CO2 service \(coco2-project.eu\)](#)

The DSS is available here:

[Decision Support Blueprint \(preliminary\) WP8 | CoCO2: Prototype system for a Copernicus CO2 service \(coco2-project.eu\)](#)

The second CO₂ and CH₄ budgets report is available here:

<https://coco2-project.eu/node/360>

Please send us your feedback at:

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THANK YOU!

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