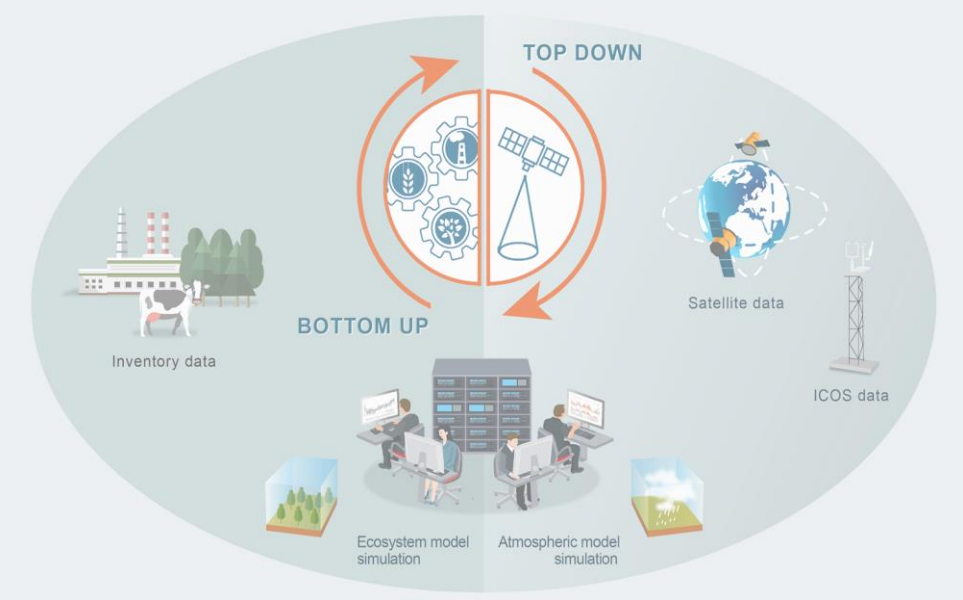
Exploring new verification tools: Insights from the Verify project

Lucia Perugini (CMCC)



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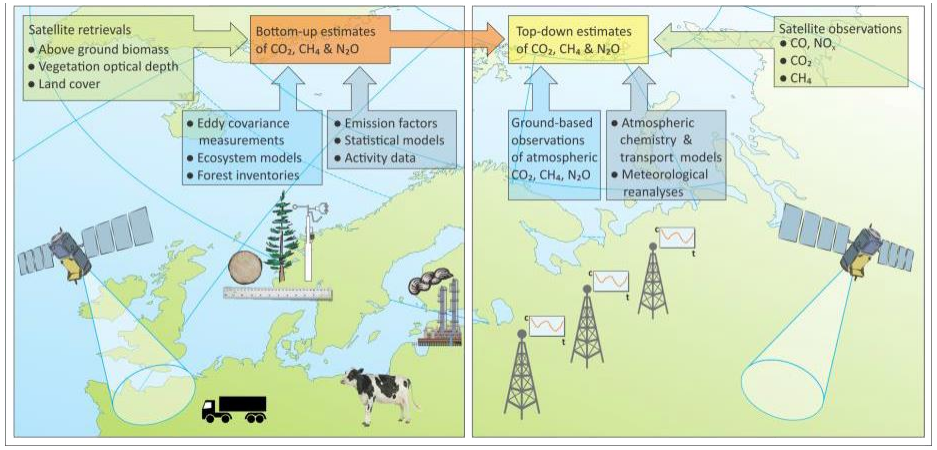
VERIFY Project

Aim:
Quantify more accurately C Stocks & fluxes of
CO2, CH4, and N2O across the EU

How:
Based on independent observations and modelling.

Why:
To support the Paris Agreement



Web site for more details
http://verify.lsce.ipsl.fr/

Project Duration:
48 month
End July 2022
Project Funding:
10 ME (2.5 ME/year)

Consortium Numbers
40 partners Institutes

Work Content Numbers
9 work-packages:
3-Verification science,
1-Inventories
1-Synthesis & Products
2-Policy relevance & Intl. program input

CoCO2
Prototype system for a Copernicus CO_2 service

Chapter 6.10.2.6:
PROCEDURES FOR INVENTORY COMPARISON TO ESTIMATES BASED ON ATMOSPHERIC MEASUREMENTS

2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Volume 1

General Guidance and Reporting

Edited by Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize S., Osako, A., Pyrozhenko, Y., Shermanau, P. and Federici, S.

Task Force on National Greenhouse Gas Inventories

WMO UNEP

TABLE 6.3 (NEW)
IMPLEMENTATION STEPS AND SHARE OF RESPONSIBILITIES BETWEEN PARTNERS

Step	Work package	Responsible group
1	Acquisition of GHG observations from a surface network (and when available, from aircraft and satellites) that has sufficient coverage of the country's emissions. The observation data have to be linked to the same calibration scale and be processed by the compatible routines across the network.	Observation /atmospheric modelling
2	Preparing gridded (spatially and temporally disaggregated) prior emissions data.	Gridded inventory
3	Preparing and operating the inverse model, other observation-based emission estimation methods.	Atmospheric modelling
4	Quality Assurance / Quality Control to the inverse model output.	Atmospheric modelling
5	Comparison, verification, and reporting. Production of final outputs and update of the GHG inventory improvement plan.	Inventory/ Atmospheric modelling

Verification systems in place in UNFCCC reporting:

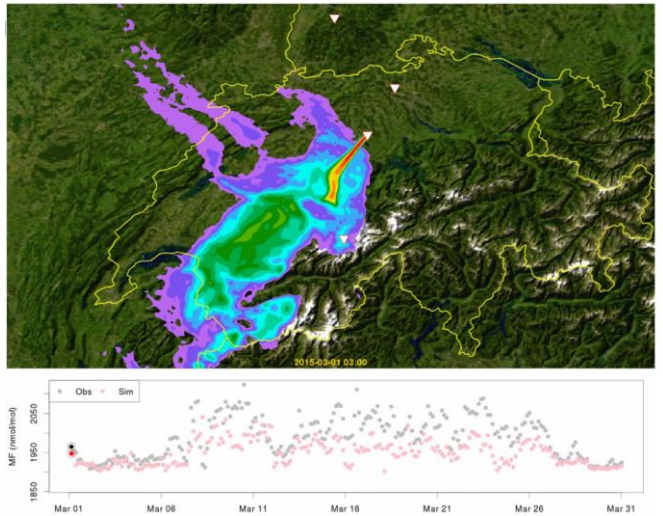
Switzerland (CH_4, N_2O, F-gases)

United Kingdom (CH_4, N_2O, F-gases)

Australia (CH_4, N_2O, F-gases)

United States (F-gases)

Inverse modelling/Top down estimations



- **Opportunities**

→Near real time measurements→tracking mitigation actions

→Source of independent and comparable data for verification

→Source of data for countries with

- **Limits**

→ energy and non-energy use of fuels/feedstock (e.g. in the chemical industry): energy or IPPU?

→ transport sector (emitted vs sold)

→ Anthopogenic nature for LULUCF sector emissions

→ Coarse resolution (problems with small countries)

VERIFY - FactSheets v1.26

How to use this site

Predefined set of Countries or Groups of countries

Select a preset

Countries

Select a country

Groups of countries (not mapped)

Select a group of countries

Species Types and Plots

Synthesis CO2land	None selected
Synthesis CO2fossil	None selected
Synthesis CH4	All selected (6)
Synthesis N2O	None selected

Display plots

Display all comments about plots

Selected Countries / Groups of countries

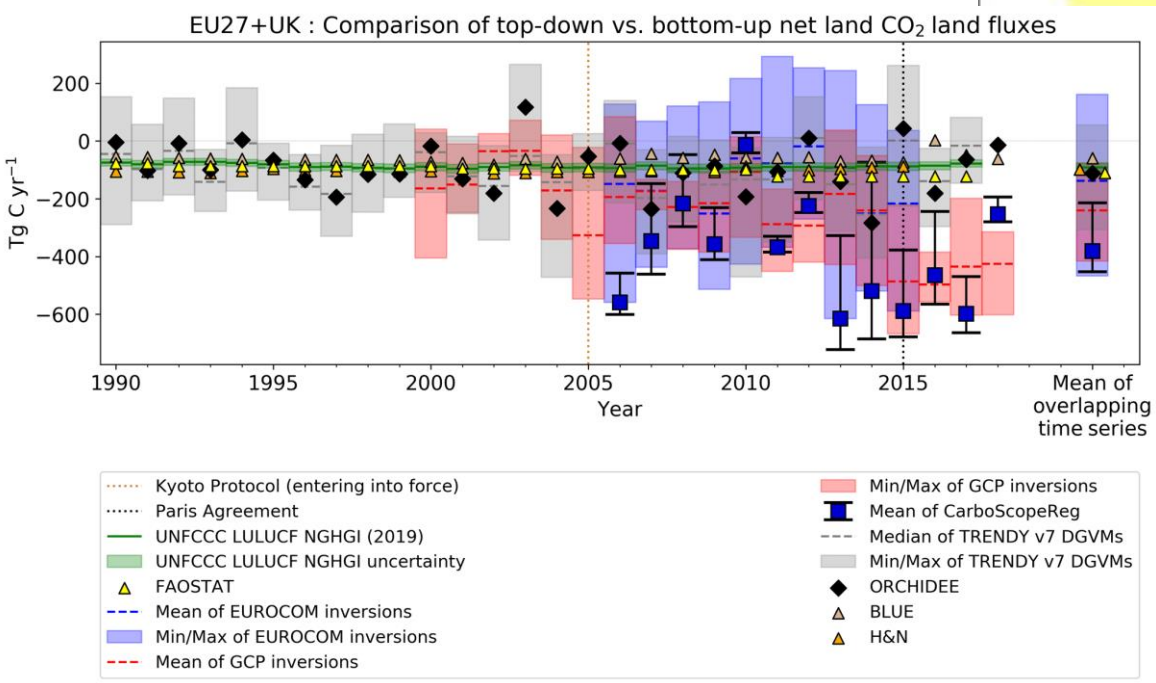
× EU-27+UK

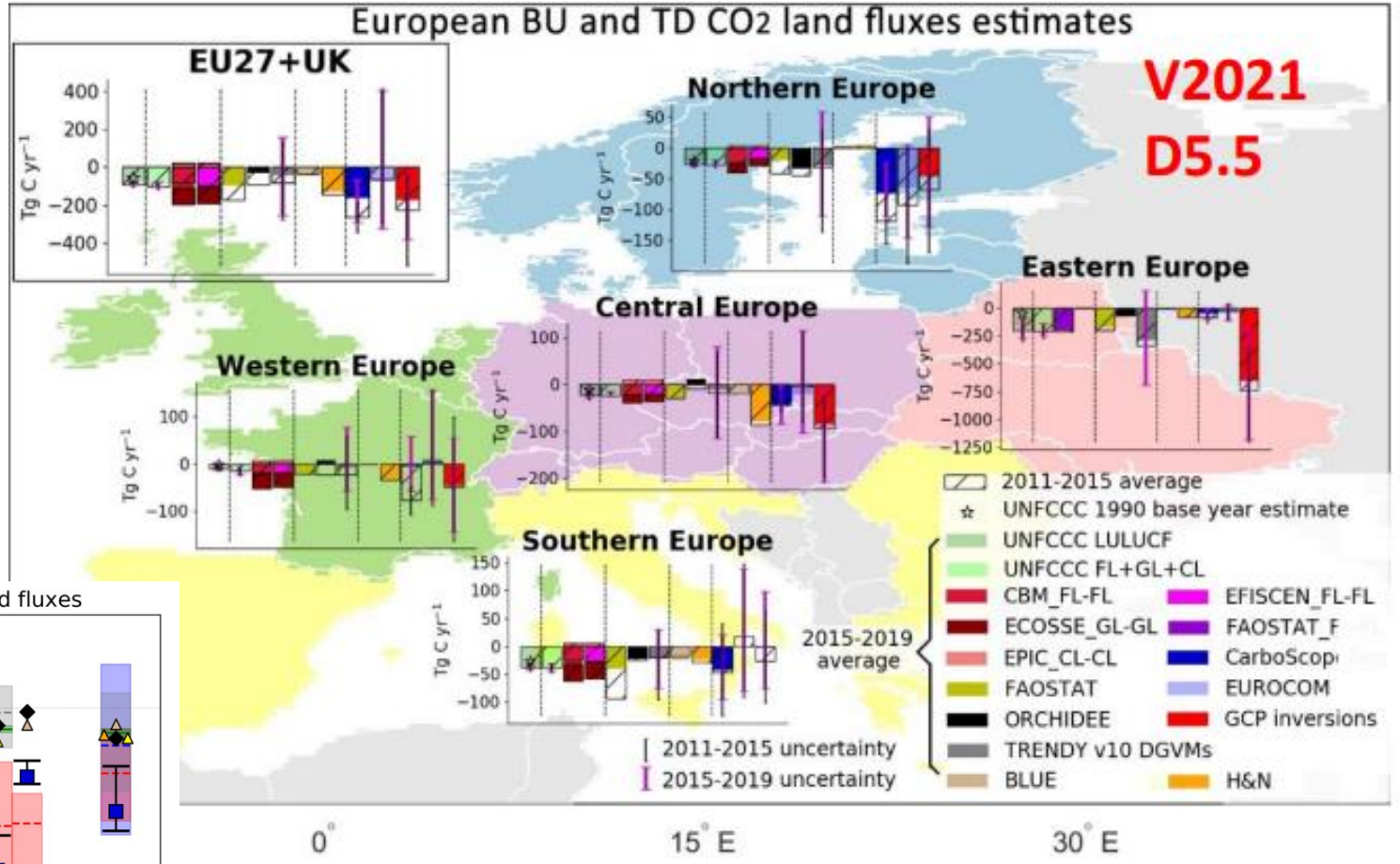
Display national inventory factsheets

Display observation-based summary factsheets

http://webportals.ipsl.jussieu.fr/VERIFY/FactSheets/

CO2 - Land





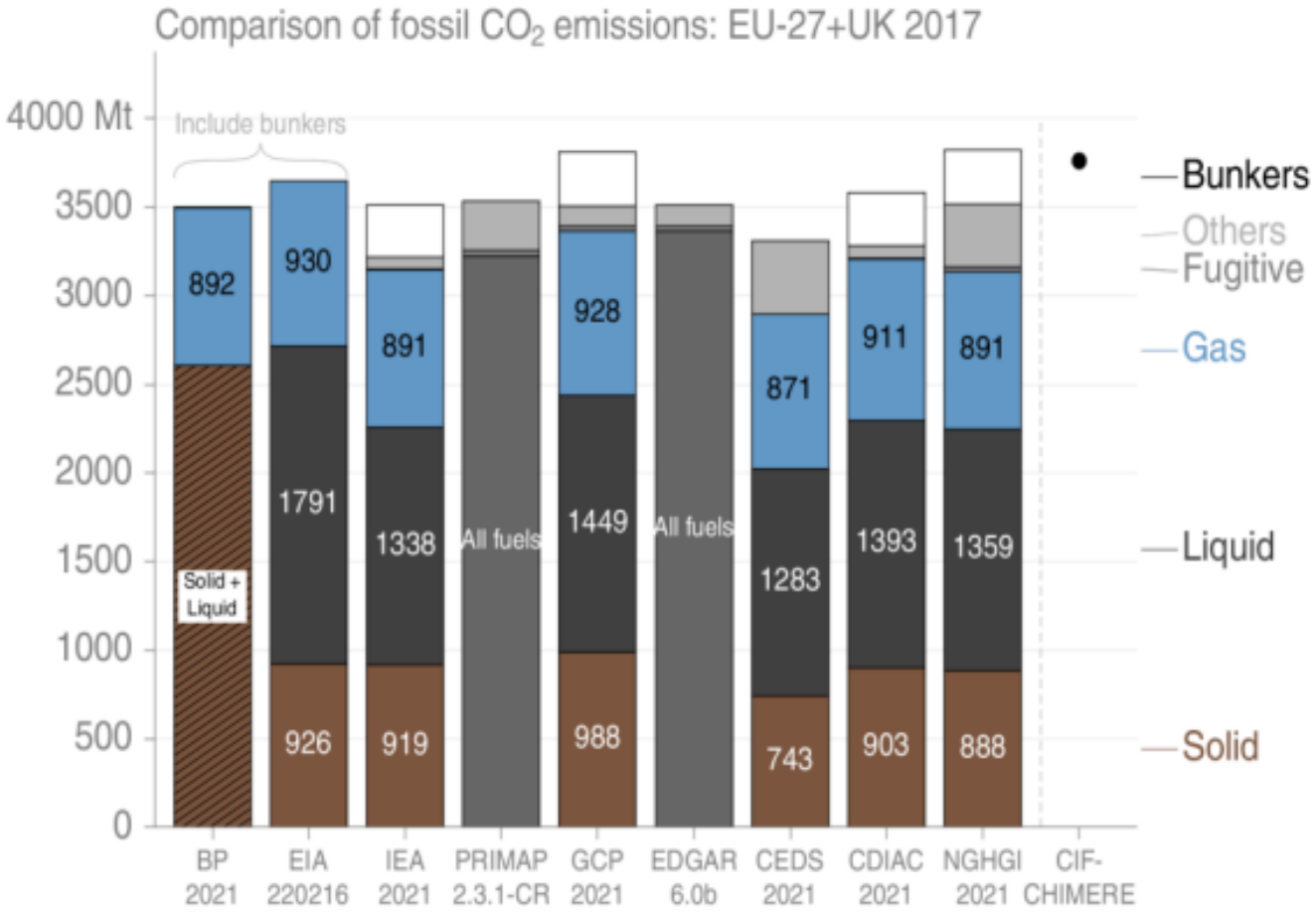
Bottom-up models show larger (climate) variability (i.e. ORCHIDEE, DGVMs)

Terminology!

Measuring seasonal variation of biogenic sinks→reduction in CO2 removals in summer due to drought ((Ramonet et al., 2020; Thompson et al., 2020)

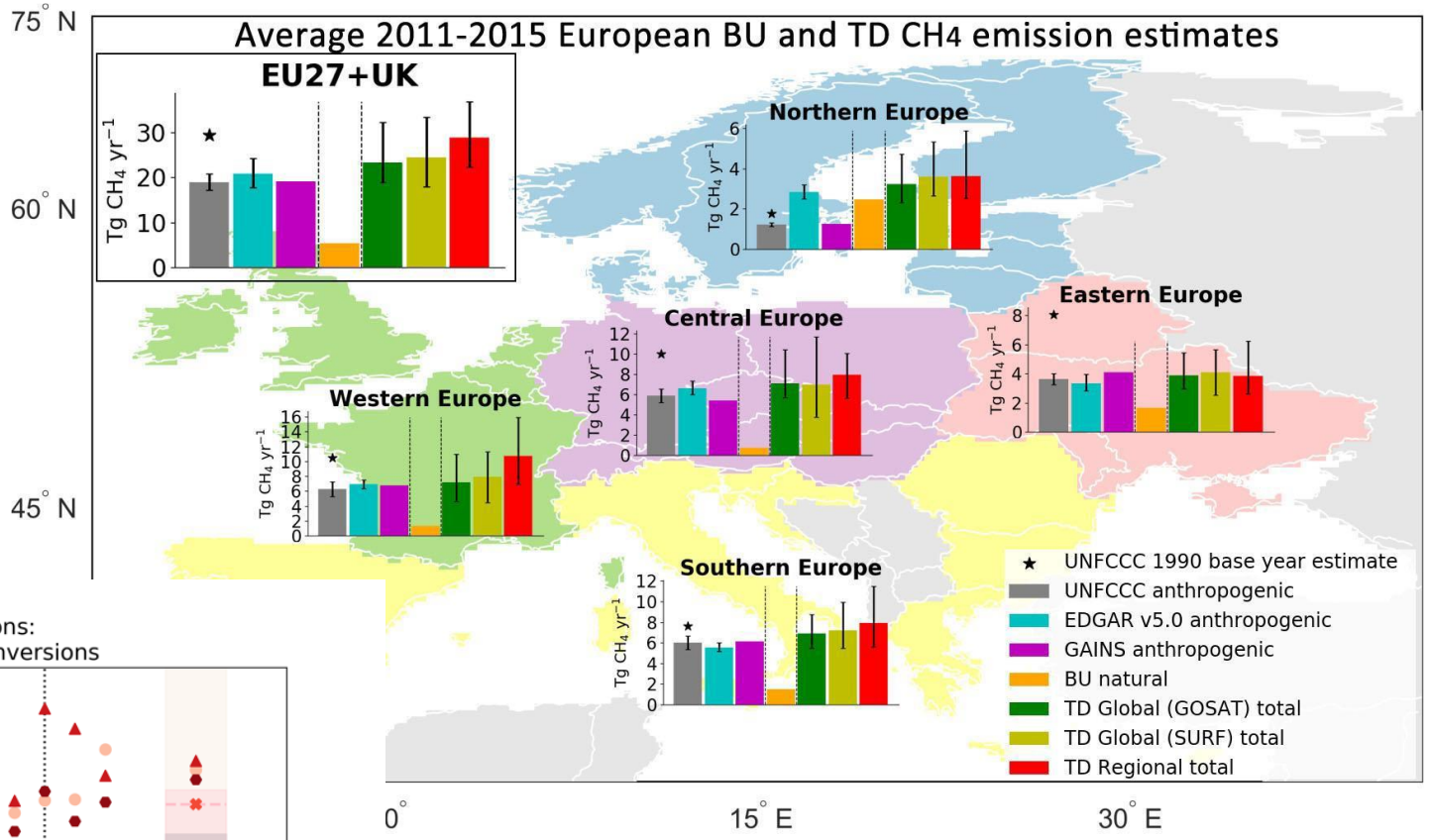
Petrescu et al 2021

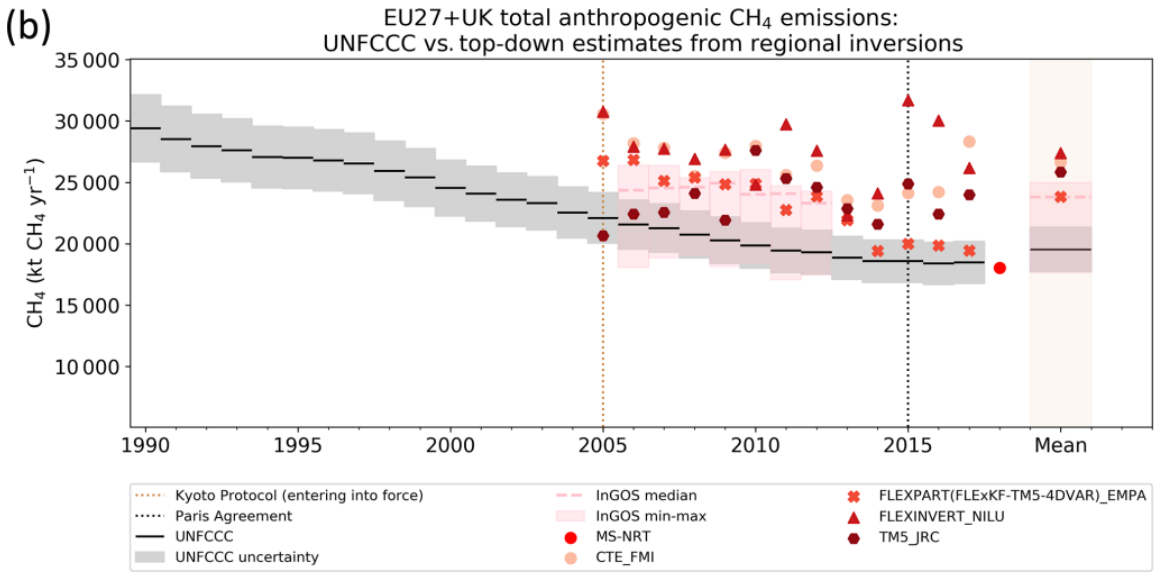
CO_2 FF



- Anthropogenic CO_2 emission inventories from combustion of fossil fuels show **the lowest uncertainty ranges.**
- Worldwide top-down methods for estimating anthropogenic emissions of CO_2 **may be more relevant because quality and availability of energy statistics**.
- Measurements in urban environments can be used to visualize the **effect of reduction measures** (Nicolini 2021)

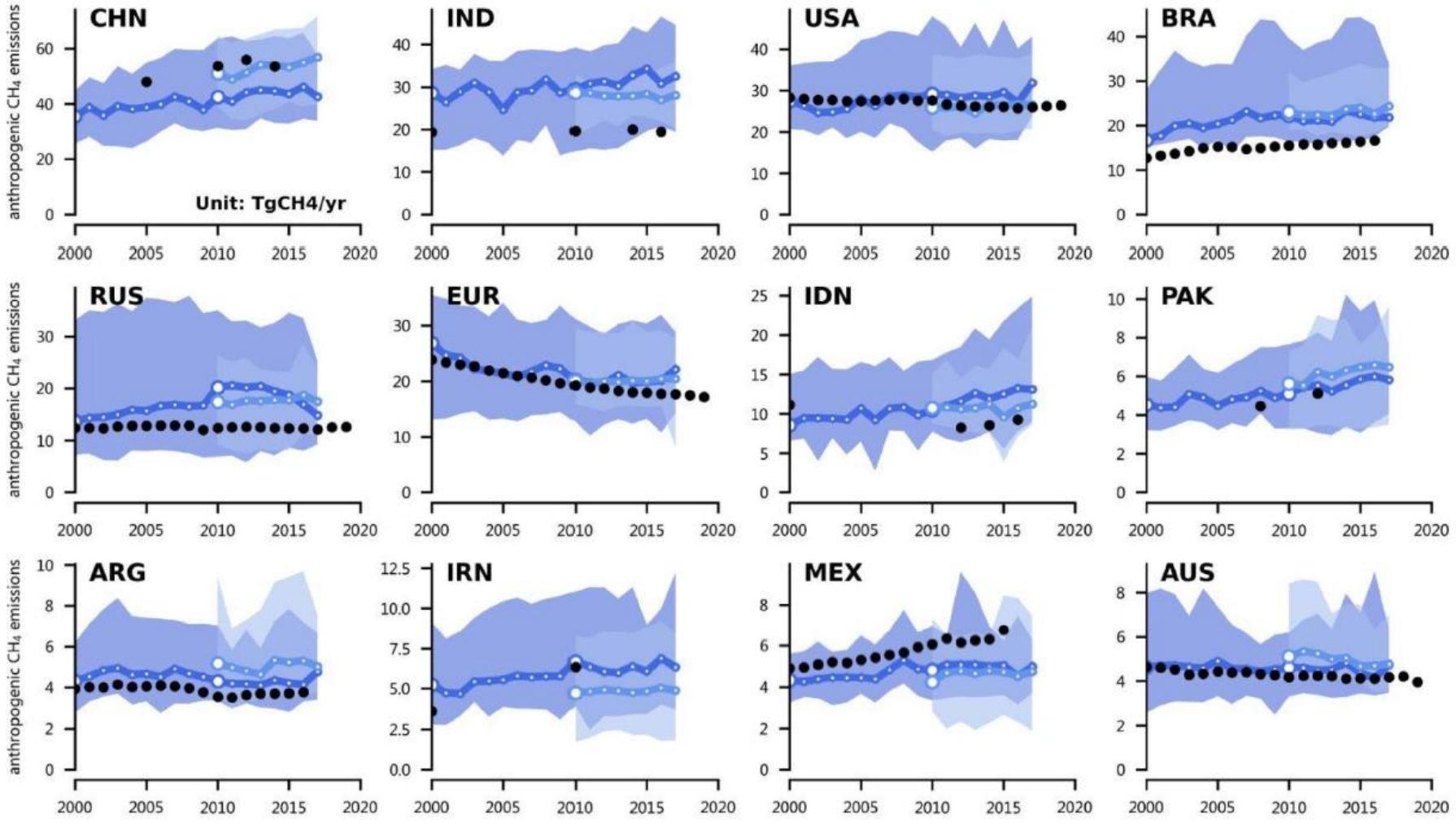
CH_4





- Large emissions from inversions: gap due to natural sources or underestimation of anthropogenic emissions, seasonality (wetlands) not represented in NGHGI
- Challenging the separation of emissions in specific source sector

Petrescu et al 2021

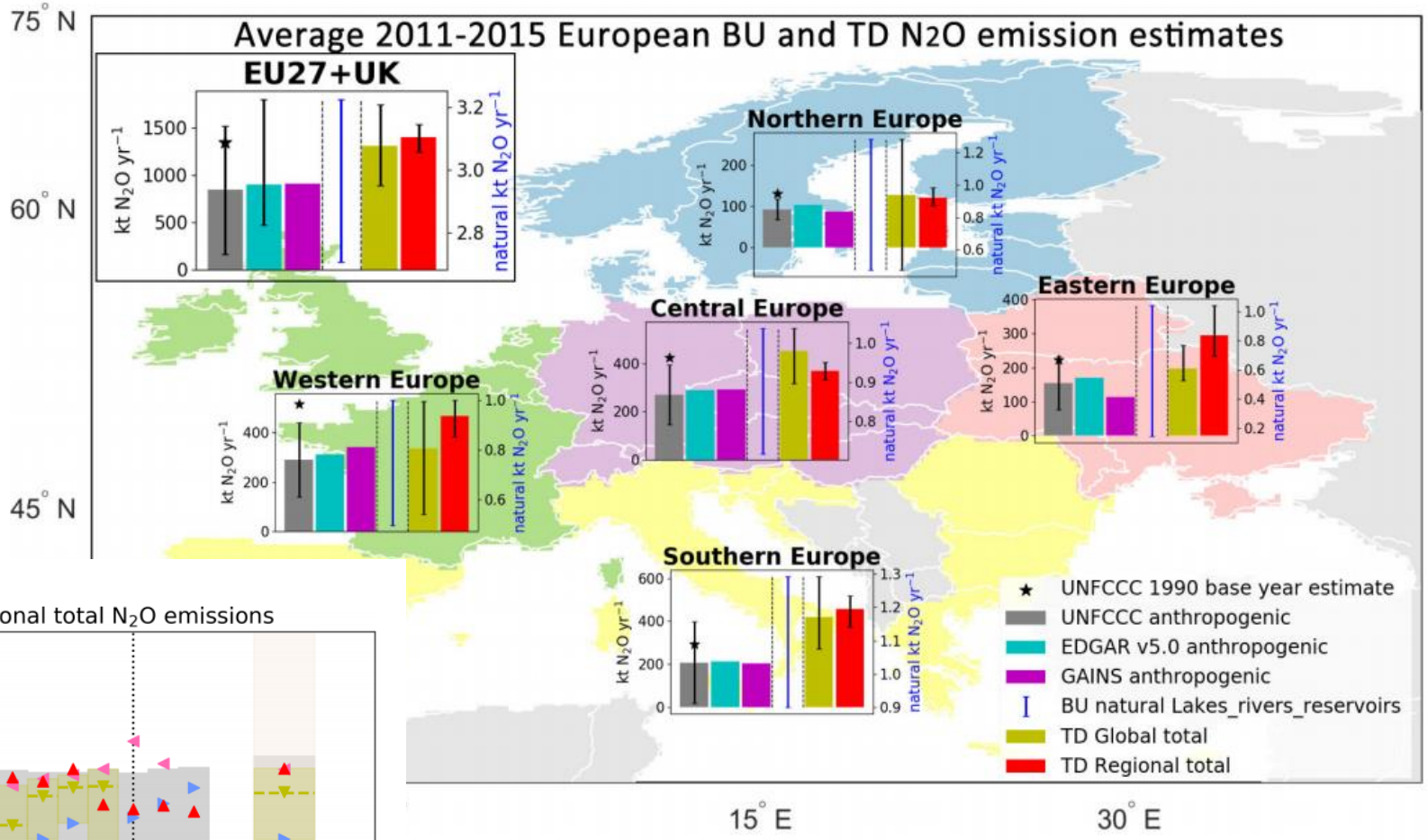


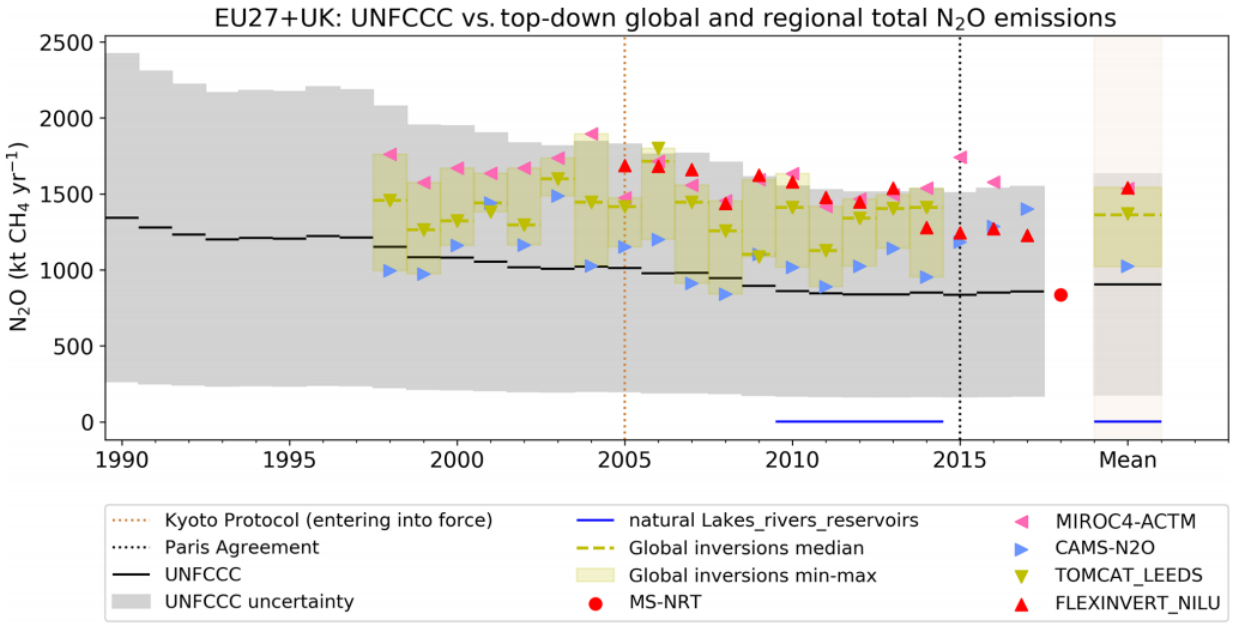
CH_4

General good agreement between both estimates and a remarkably well agreement for Europe.

Deng et al 2022

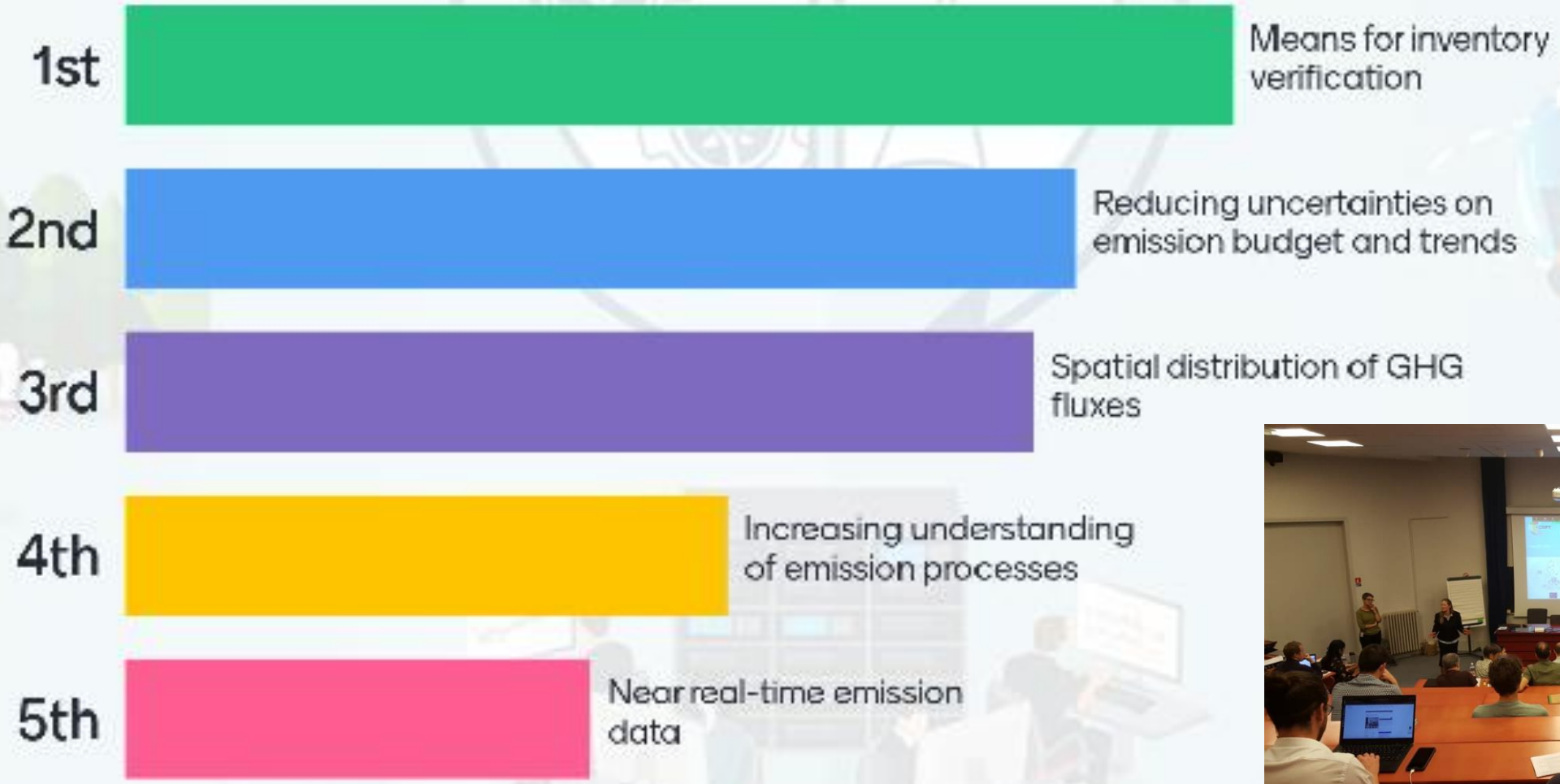
N_2O





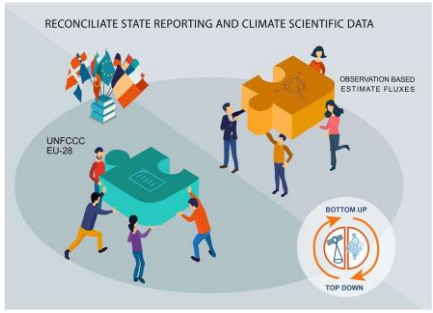
- Difficult to separate natural and anthropogenic origin on managed soils
- Large gap between inversions and BU estimates not caused by natural emissions, seasonality (N fertilization) not represented in NGHGI

3. Where do you see the largest assets of top down inverse modeling?



Paris 2022 – Verify third networking meeting

Conclusions



- **VERIFY** → first networking between inversion modelers (Community Inversion Framework) and inventory community
- **High potential for verification and near-real time measurement**
- **The spatial resolution** of current top-down models could be a limiting factor for the application of these instruments for verification purposes. **Categories and sectors** need to be identified. **Uncertainties** data should be provided.
- **Exchanges and collaboration between the inventory** and inverse modelling community is needed (verification cannot be based on published literature only)
- **Dissemination** of new tools is important (low awareness of availability of new tools)→"Inversion for dummies"
- **EYE-CLIMA, AVENGERS, PARIS**→ forthcoming HORIZON EUROPE projects are going to start this/next year→Ensure coordination **Community Inversion Framework**

Thank you for your attention!

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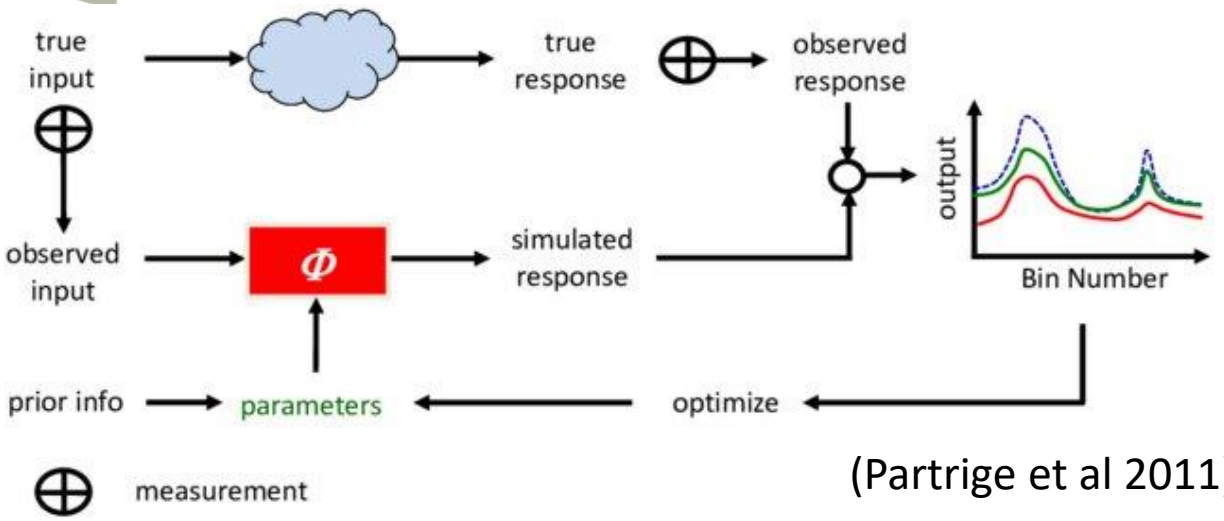
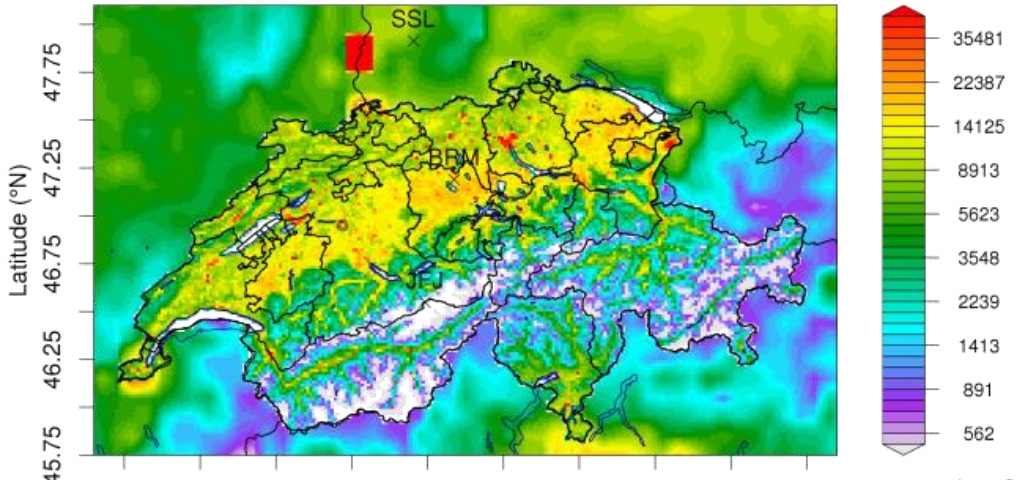
Inverse modelling



(Partrige et al 2011)

Inverse modelling (IM) frameworks utilise observed temporal and spatial patterns in atmospheric GHG and air pollutant concentrations to constrain initial (prior) estimates of emissions of respective species

A priori inventory



A posteriori difference