VERIFY General Assembly

Summary and key messages from synthesis and deliverables

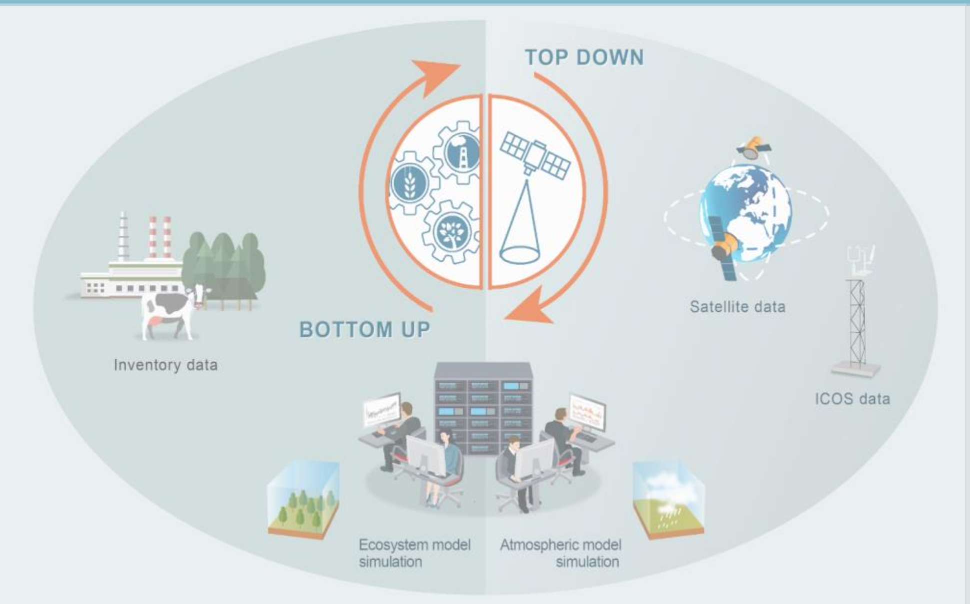
WP5 and WP6

May 9th, 2022

Paris, France

Team: VUA, CICERO, LSCE, EC-JRC, RIVM

Acknowledging all VERIFY consortium and outside contributors



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776810

Contents

- Key scientific results over the project duration
- Remaining deliverables issues (if any)
- Next steps (if relevant)

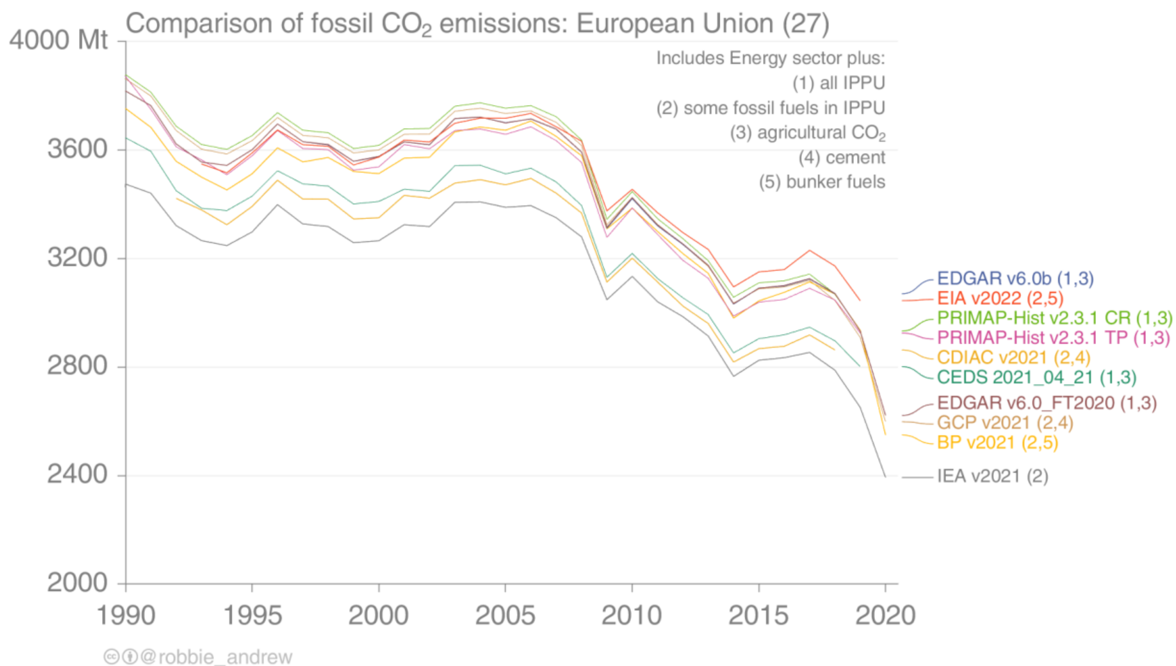
WP5
KEY SCIENTIFIC RESULTS OVER THE PROJECT DURATION

T5.1 Reconciliation of bottom-up emission estimates, Robbie Andrew (CICERO, Norway)
T5.2 & T5.3 Reconciliation of bottom-up and top-down observation-based GHG budgets (scientific publications), Roxana Petrescu (VU Amsterdam, The Netherlands
T5.4 Past trends, annual drivers analysis and short-term predictions of emissions, Robbie Andrew (CICERO, Norway)
T6.2 Annual GHG budget fact sheets for China (Philippe Ciais, LSCE France)

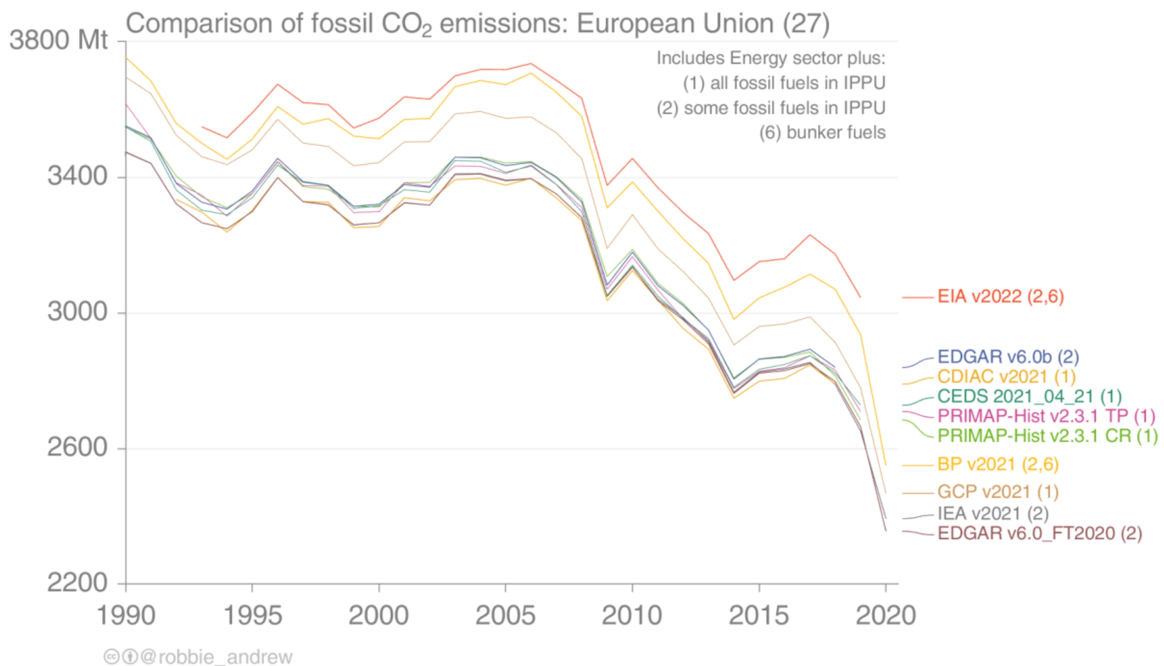
T5.1 Reconciliation of bottom-up emission estimates

- Datasets have different system boundaries
- Harmonising helps with this, partially
- Moving beyond system boundaries, we can start to investigate differences

EU27 CO_2 EMISSIONS: 'RAW'

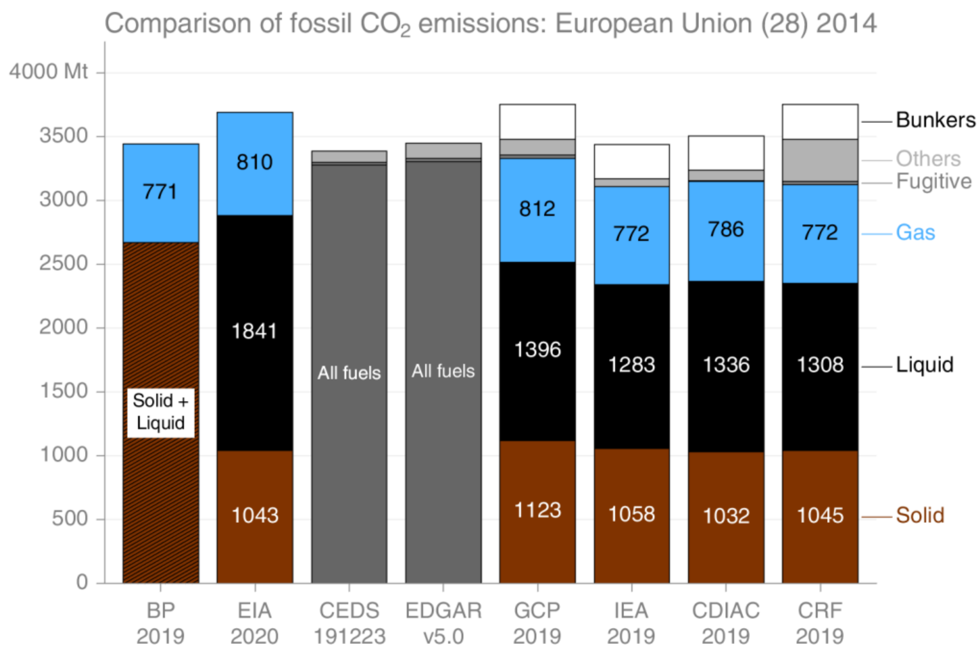


EU27 CO_2 EMISSIONS: 'HARMONISED'



- During the project we have explored the reasons for differences between the global emissions datasets, with a focus on the EU
- Extensive communication with the dataset providers

COMPARISON CHARTS:
A QUICK WAY INTO FURTHER INVESTIGATION



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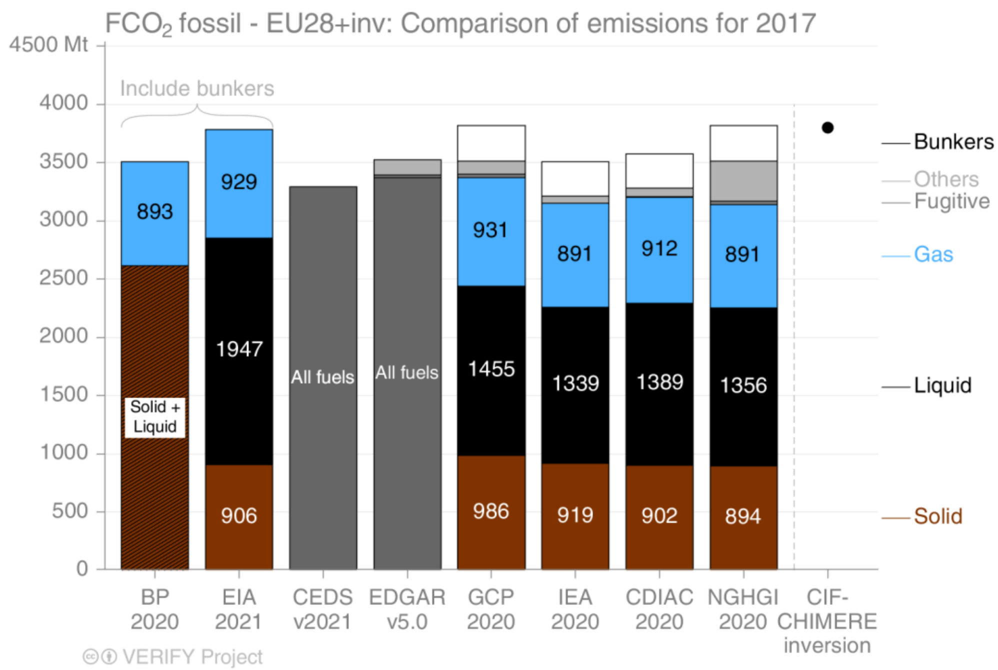

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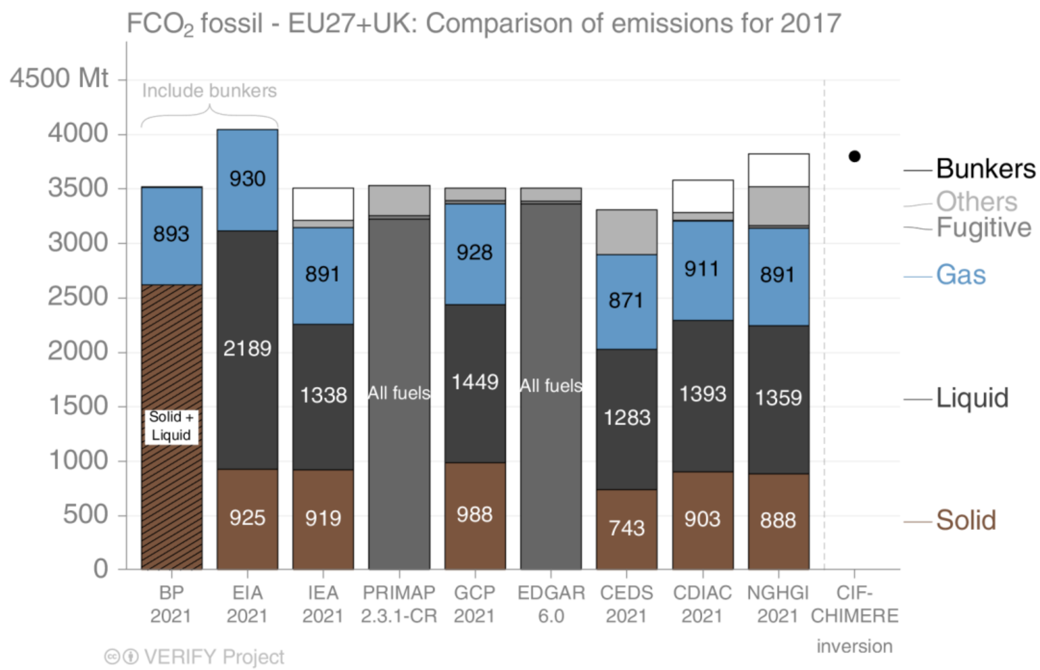
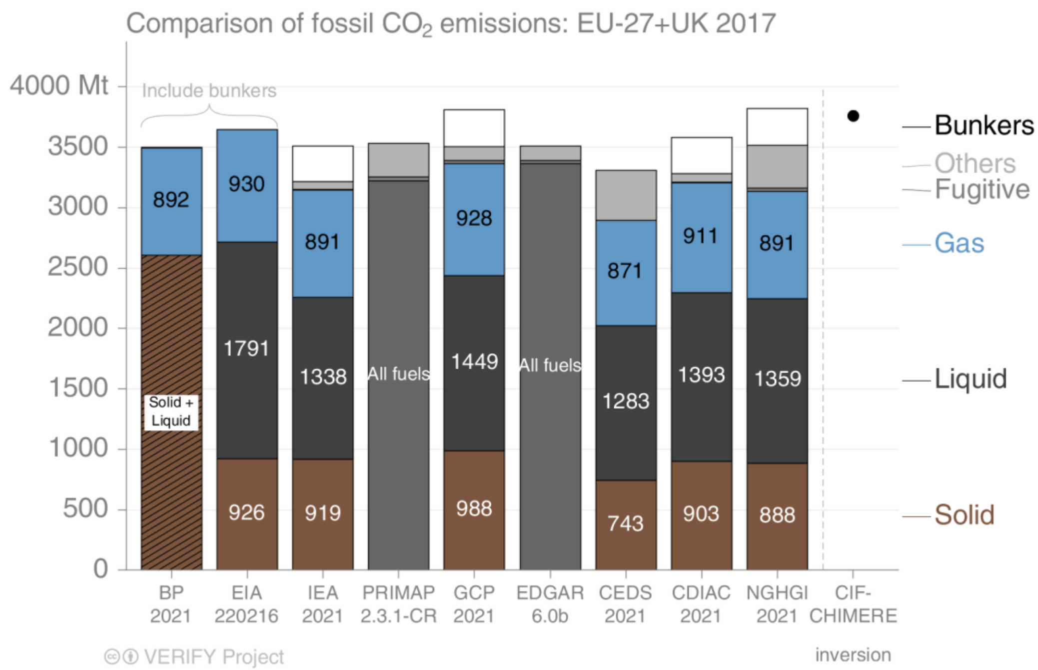
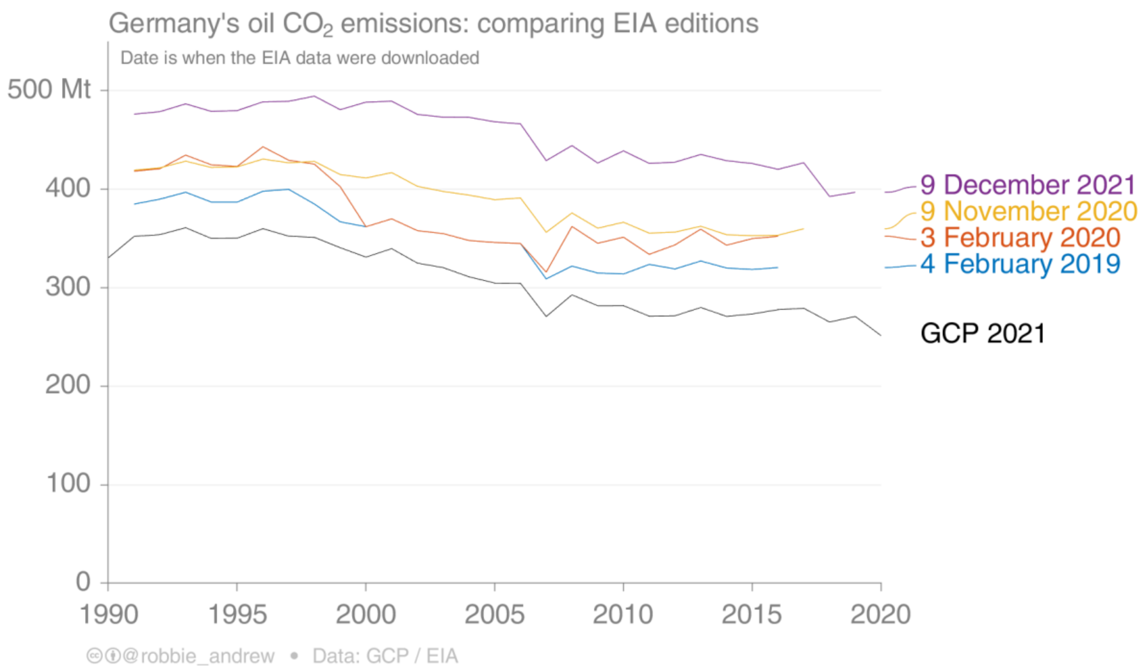


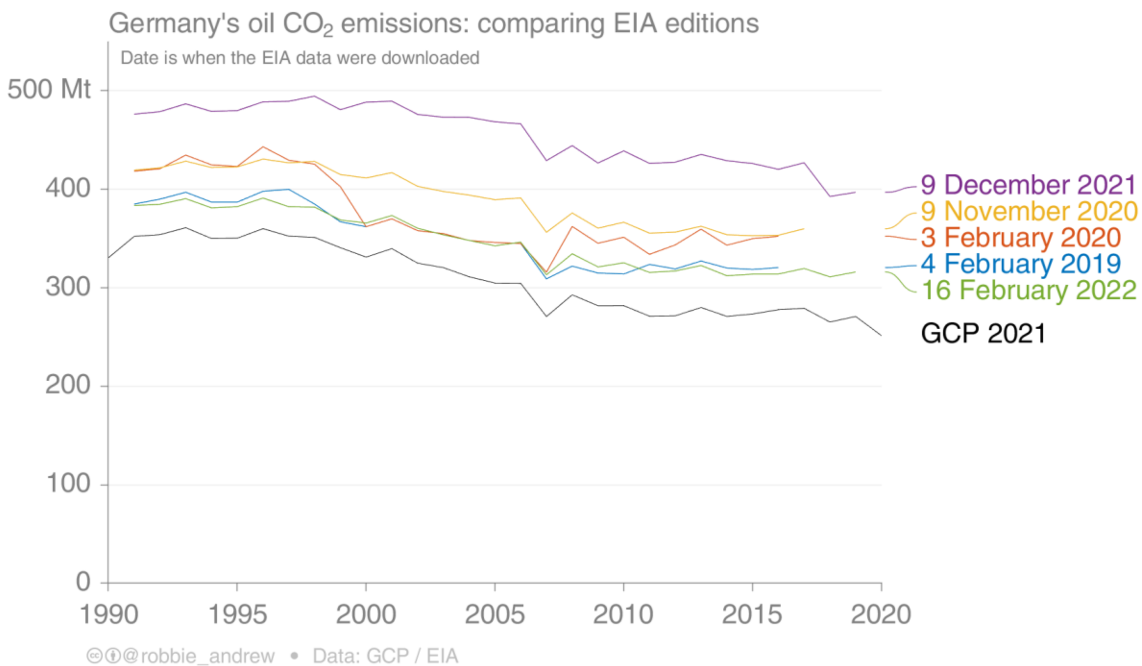
COMPARISON CHARTS:
A QUICK WAY INTO FURTHER INVESTIGATION



EXAMPLE: EIA ESTIMATES OF GERMANY'S OIL CO_2



EXAMPLE: EIA ESTIMATES OF GERMANY'S OIL CO_2



SOME OUTCOMES

- Findings of errors fed back to
  - CEDS: solid fuels in Estonia, Germany
  - PRIMAP-hist: double-counting in Annex 1 countries, inflated fugitive
  - EIA: double-counting of oil products
  - CEADS: omitted LNG, incorrect cement
  - CDIAC: omission of global stock changes of coal

Earth Syst. Sci. Data, 12, 1437–1465, 2020
https://doi.org/10.5194/essd-12-1437-2020

Open Access Earth System Science Data

A comparison of estimates of global carbon dioxide emissions from fossil carbon sources

Robbie M. Andrew

CICERO Center for International Climate Research, Oslo 0349, Norway

Correspondence: Robbie M. Andrew (robbie.andrew@cicero.oslo.no)

Received: 13 February 2020 – Discussion started: 3 March 2020
Revised: 27 May 2020 – Accepted: 29 May 2020 – Published: 29 June 2020

Abstract. Since the first estimate of global CO_2 emissions was published in 1894, important progress has been made in the development of estimation methods while the number of available datasets has grown. The existence of parallel efforts should lead to improved accuracy and understanding of emissions estimates, but there remains significant deviation between estimates and relatively poor understanding of the reasons for this. Here I describe the most important global emissions datasets available today and – by way of global, large-emitter, and case examples – quantitatively compare their estimates, exploring the reasons for differences. In

T5.2 Reconciliation of bottom-up and top-down observation-based GHG budgets (and T5.3 scientific publications)

D5.2, D5.3, D5.4. and D5.5. (4 reports M12, 24, 36, 48)
Reconciliation of bottom-up and top-down methods at sub-national scales

T5.3 Regular assessments of the full GHG balance of EU countries and ecosystems
(M6-M48), **Lead: VUA**

D5.9, D5.10 Scientific review articles on multi-gas GHG budgets (M24, M48), VUA Open access and peer-reviewed publication (Earth System Science Data) compiling and quantifying GHG budgets for European countries, including the application to verification of UNFCCC inventories

VERIFY AND WP5 PROGRESS

Earth Syst. Sci. Data, 12, 961–1001, 2020
https://doi.org/10.5194/essd-12-961-2020

Published D5.9 (based on the 1st report D5.2)

European anthropogenic AFOLU greenhouse gas emissions: a review and benchmark data

Ana Maria Roxana Petrescu[1], Glen P. Peters[2], Greet Janssens-Maenhout[3], Philippe Ciais[4], Francesco N. Tubiello[5], Giacomo Grassi[3], Gert-Jan Nabuurs[6], Adrian Leip[3], Gema Carmona-Garcia[3], Wilfried Winiwarter[7,8], Lena Höglund-Isaksson[7], Dirk Günther[9], Efisio Solazzo[3], Anja Kiesow[9], Ana Bastos[10], Julia Pongratz[10,11], Julia E. M. S. Nabel[11], Giulia Conchedda[5], Roberto Pilli[3], Robbie M. Andrew[2], Mart-Jan Schelhaas[6], and Albertus J. Dolman[1]

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[4]Le Laboratoire des Sciences du Climat et de l'Environnement LSCE, Gif-sur-Yvette CEDEX, 91191, France
[5]Food and Agriculture Organization FAO, Statistics Division, 00153 Rome, Italy
[6]Wageningen University and Research (WUR), Wageningen, 6708PB, the Netherlands
[7]International Institute for Applied Systems Analysis (IIASA), 2361 Laxenburg, Austria
[8]Institute of Environmental Engineering, University of Zielona Góra, Zielona Góra, 65-417, Poland
[9]Umweltbundesamt (UBA), 14193 Berlin, Germany
[10]Department of Geography, Ludwig Maximilian University of Munich, 80333 Munich, Germany
[11]Max Planck Institute for Meteorology, 20146 Hamburg, Germany

Earth Syst. Sci. Data, 13, 2363–2406, 2021
https://doi.org/10.5194/essd-13-2363-2021

The consolidated European synthesis of CO_2 emissions and removals for the European Union and United Kingdom: 1990–2018

Ana Maria Roxana Petrescu[1], Matthew J. McGrath[2], Robbie M. Andrew[3], Philippe Peylin[2], Glen P. Peters[3], Philippe Ciais[2], Gregoire Broquet[2], Francesco N. Tubiello[4], Christoph Gerbig[5], Julia Pongratz[6,7], Greet Janssens-Maenhout[8], Giacomo Grassi[8], Gert-Jan Nabuurs[9], Pierre Regnier[10], Ronny Lauerwald[10,11], Matthias Kuhnert[12], Juraj Balkovič[13,14], Mart-Jan Schelhaas[9], Hugo A. C. Denier van der Gon[15], Efisio Solazzo[8], Chunjing Qiu[2], Roberto Pilli[8], Igor B. Konovalov[16], Richard A. Houghton[17], Dirk Günther[18], Lucia Perugini[19], Monica Crippa[9], Raphael Ganzenmüller[6], Ingrid T. Luijkx[9], Pete Smith[12], Saqr Munassar[5], Rona L. Thompson[20], Giulia Conchedda[4], Guillaume Monteil[21], Marko Scholze[21], Ute Karstens[22], Patrick Brockmann[2], and Albertus Johannes Dolman[1]

Earth Syst. Sci. Data, 13, 2307–2362, 2021
https://doi.org/10.5194/essd-13-2307-2021

Published D5.3

The consolidated European synthesis of CH_4 and N_2O emissions for the European Union and United Kingdom: 1990–2017

Ana Maria Roxana Petrescu[1], Chunjing Qiu[2], Philippe Ciais[2], Rona L. Thompson[3], Philippe Peylin[2], Matthew J. McGrath[2], Efisio Solazzo[4], Greet Janssens-Maenhout[4], Francesco N. Tubiello[5], Peter Bergamaschi[4], Dominik Brunner[6], Glen P. Peters[7], Lena Höglund-Isaksson[8], Pierre Regnier[9], Ronny Lauerwald[9,23], David Bastviken[10], Aki Tsuruta[11], Wilfried Winiwarter[8,12], Prabir K. Patra[13], Matthias Kuhnert[14], Gabriel D. Oreggioni[4], Monica Crippa[4], Marielle Saunois[2], Lucia Perugini[15], Tiina Markkanen[11], Tuula Aalto[11], Christine D. Groot Zwaaftink[3], Hanqin Tian[16], Yuanzhi Yao[16], Chris Wilson[17,18], Giulia Conchedda[5], Dirk Günther[19], Adrian Leip[4], Pete Smith[14], Jean-Matthieu Haussaire[6], Antti Leppänen[20], Alistair J. Manning[21], Joe McNorton[22], Patrick Brockmann[2], and Albertus Johannes Dolman[1]

Earth Syst. Sci. Data, 12, 1–29, 2020
https://doi.org/10.5194/essd-12-1-2020

Published D5.1

A comparison of estimates of global carbon dioxide emissions from fossil carbon sources

Robbie M. Andrew
CICERO Center for International Climate Research, Oslo 0349, Norway

SUMMARY OF D5.2, D5.3, D5.4. AND D5.5

What was the aim of all reports?

reconciling the differences between bottom-up and top-down emission estimates, providing a assessment of persistent differences and their potential causes

Did we achieve this?

YES and Not yet...

YES

- Great collaboration/networking between all partners
- Unique collection of BU and TD estimates, during the last 4 years
- We published assessments of these differences for EU27+UK
- Individual countries have been studied as well:

see individual country plots on

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

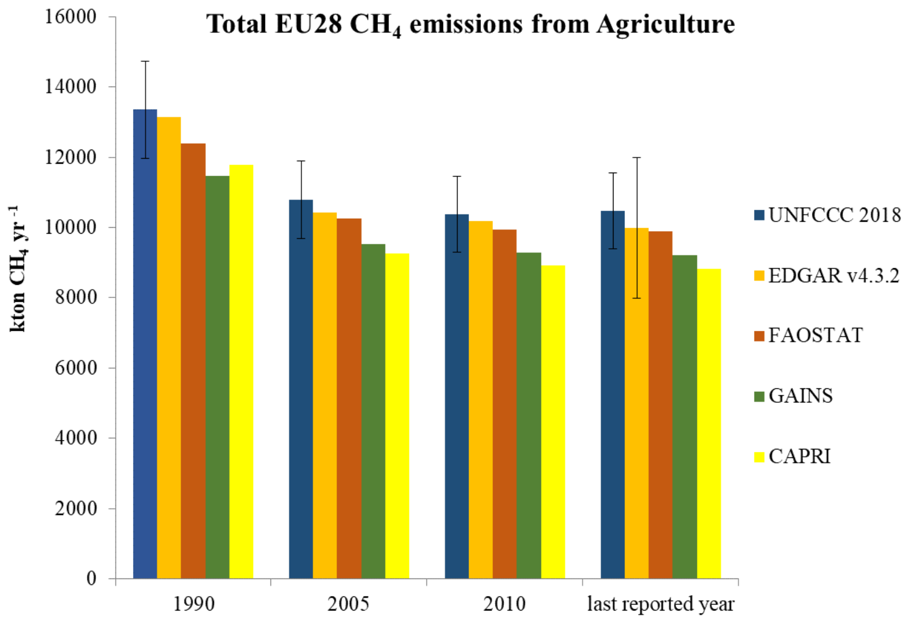
- We identified differences between data sources and explained some...

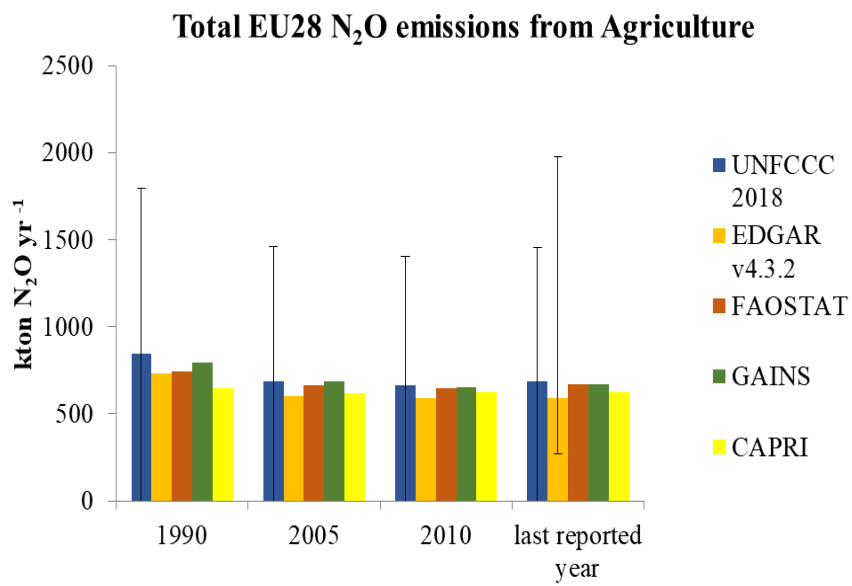
History and progress of research

We started like this:

D5.2 a 'proof of concept' and a first compilation of pre-VERIFY data (three GHGs for AFOLU)

CH_4 and N_2O from Agriculture



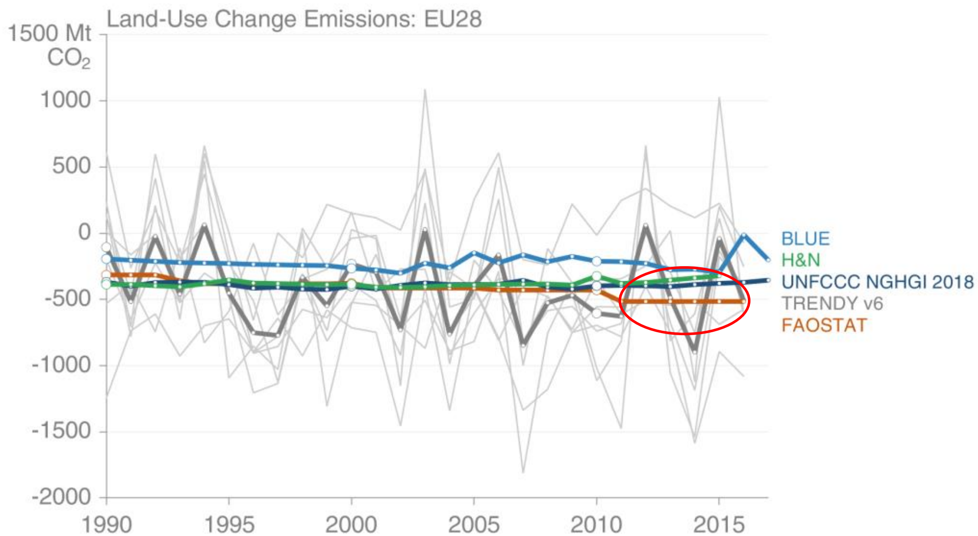


v2018

WHAT ISSUES WE IDENTIFIED BACK IN 2019? AGRICULTURE

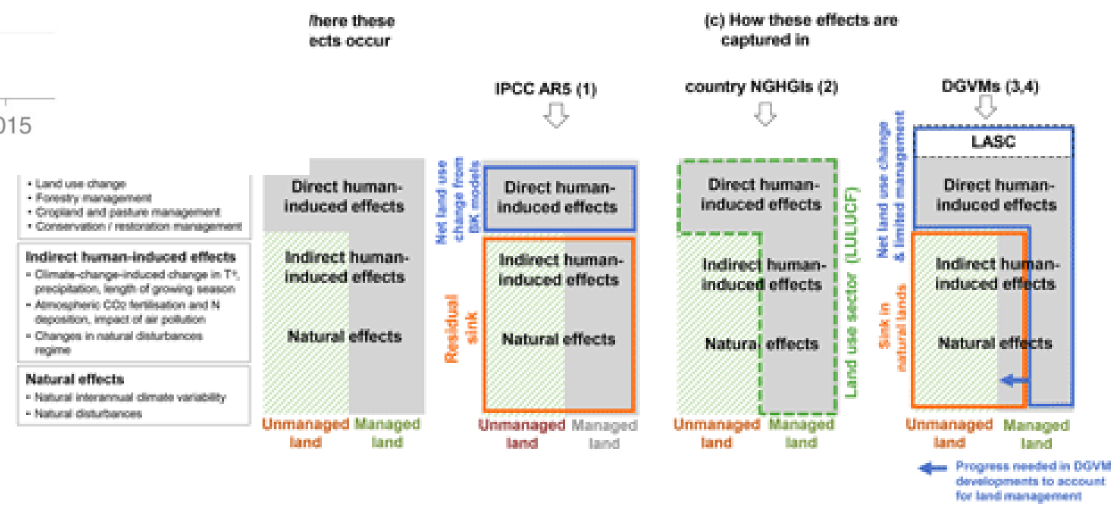
- All inventory-based data sources are consistent with each other:
  - they capture well recent emissions reductions
  - they mainly use default EFs from IPCC 2006 guidelines
- Small differences pertain to:
  - use different versions of the same AD
  - some use expert judgment EFs (EDGAR)
  - the choice of the Tier method for calculating emissions (the Tier level a country applies depends on the national circumstances, which explains the variability of uncertainties among the sector itself as well as among EU countries)

HISTORY AND PROGRESS OF RESEARCH CONT.



CO_2 from LULUCF

Consistent BU estimates except for highly climate variability in DGVMs



(1) In IPCC AR5, the residual sink is inferred as a difference between FF emissions + net land use – growth rate – ocean uptake, and thus matches the observed CO_2 growth rate by construction. In this method, a bias on net land use change is transferred to the inferred residual sink.
(2) In NGHGI, the LULUCF C balance only covers direct management actions and does not match the CO_2 growth rate. Any difference with the CO_2 growth rate can be attributed to errors in NGHGI estimates and / or fluxes on unmanaged lands.
(3) In DGVMs, net land use change includes a source corresponding to the loss of additional sink capacity (LASC). Some models include limited land management (wood harvest, crop harvest). Nonmodeled management from forestry, cropland and pasture management, conservation / restoration management, being in the grey area part of the orange box.
(4) DGVMs have parameterizations and structural uncertainties, and their net land flux does not match the global CO_2 growth rate, leading to a global BIM (budget imbalance).

LULUCF

- Within the UNFCCC practice, each country uses its own specific method to estimate the CO_2 fluxes.
- We need to distinguish between direct and indirect effects on land use emissions especially for the purpose of reconciling land-related emissions from global datasets and NGHGI.

https://essd.copernicus.org/articles/12/961/2020/

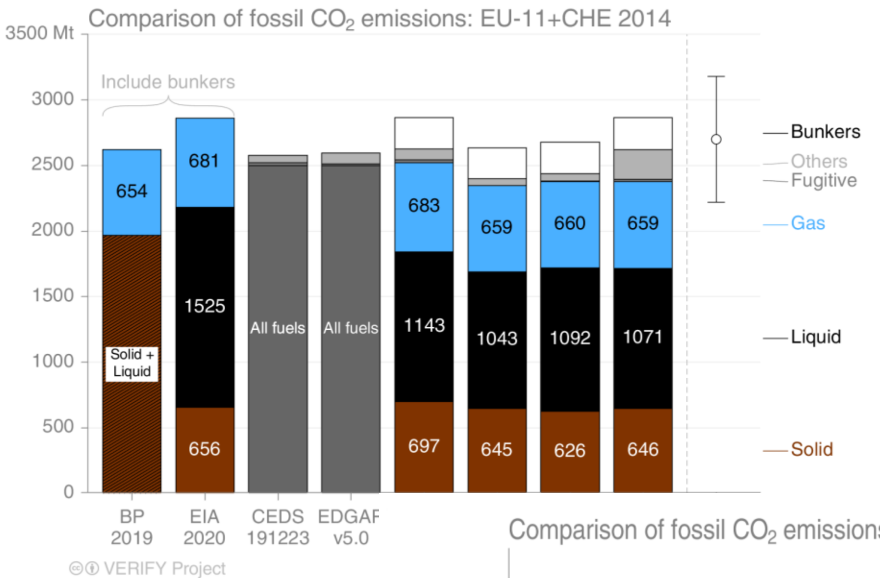
General remarks:

- When independent inventories agree well for a sector, does not necessarily mean that the estimate is better in the sense that it is closer to real emissions (agreement across inventories = the different inventories used the same methodology and activity data sources).
- Countries should use, whenever possible, global inversions to provide additional constraints for the verification and reconciliation purposes.

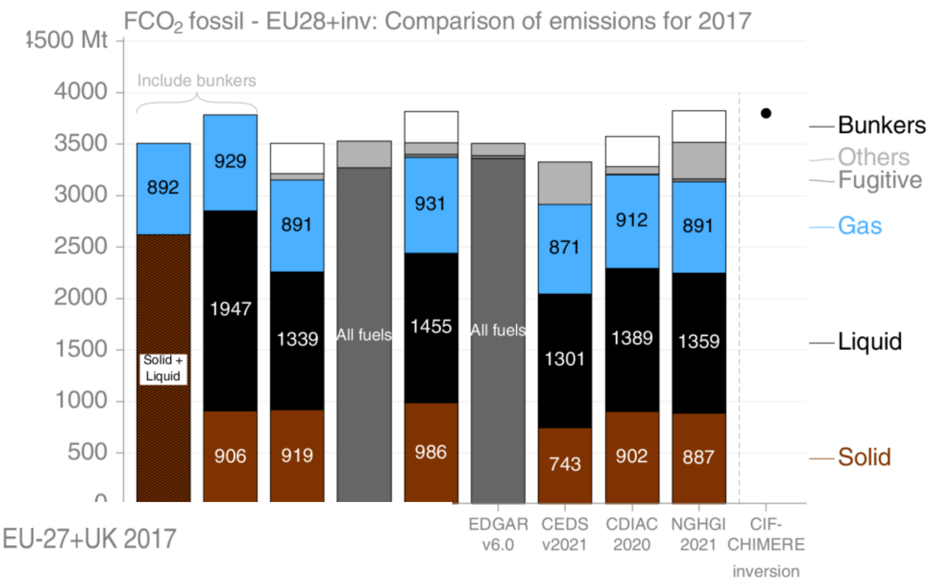
- For the next 3 years these conclusions remained and formed the basis of all reports...and were confirmed even if more data was added to the analysis...

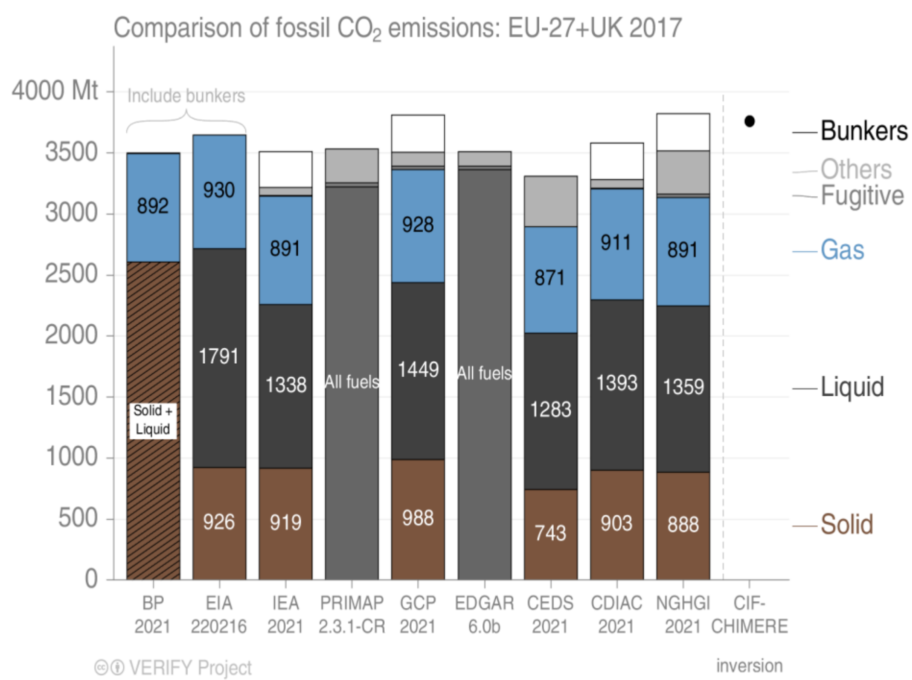
D5.3, D5.4 AND D5.5: THE CONSOLIDATED EUROPEAN SYNTHESIS OF THE THREE GHGS

v2019



v2020





v2021

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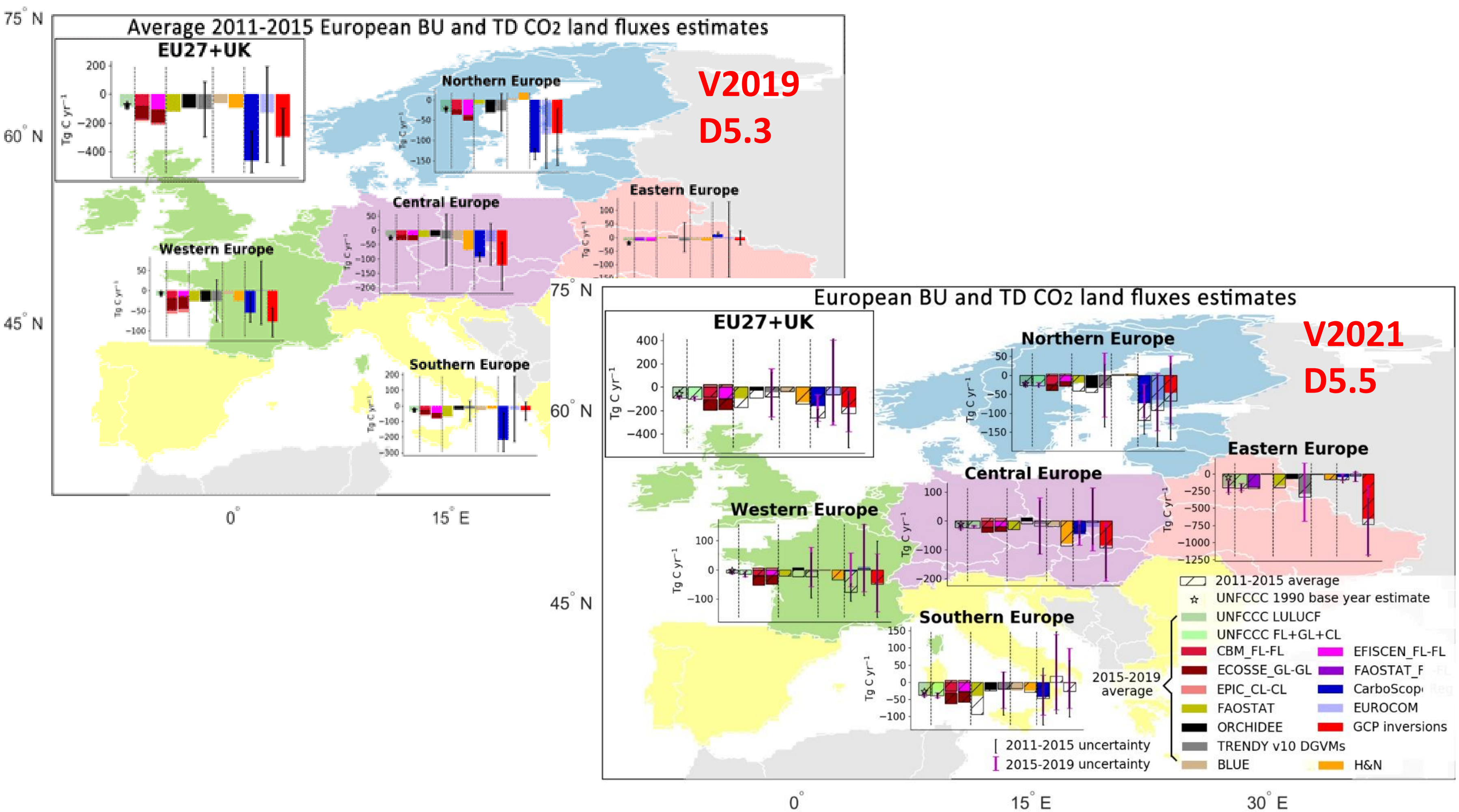
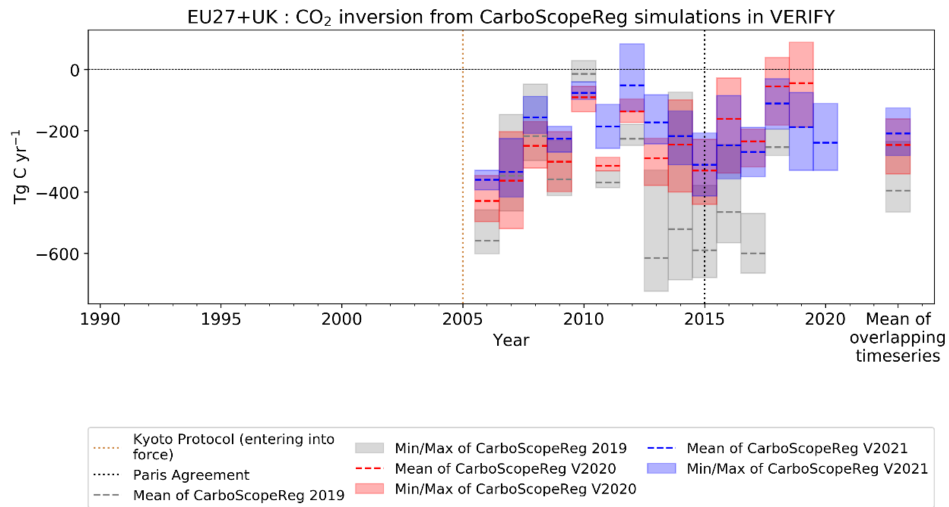
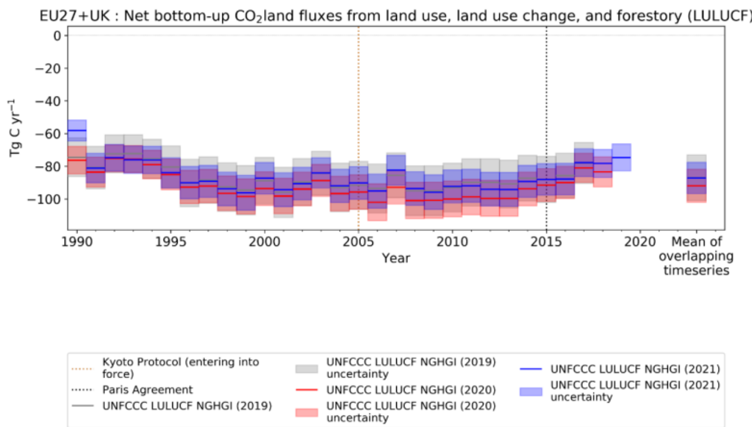
D5.3, D5.4 AND D5.5: THE CONSOLIDATED EUROPEAN SYNTHESIS OF CO_2LAND
V2019, V2020 AND V2021

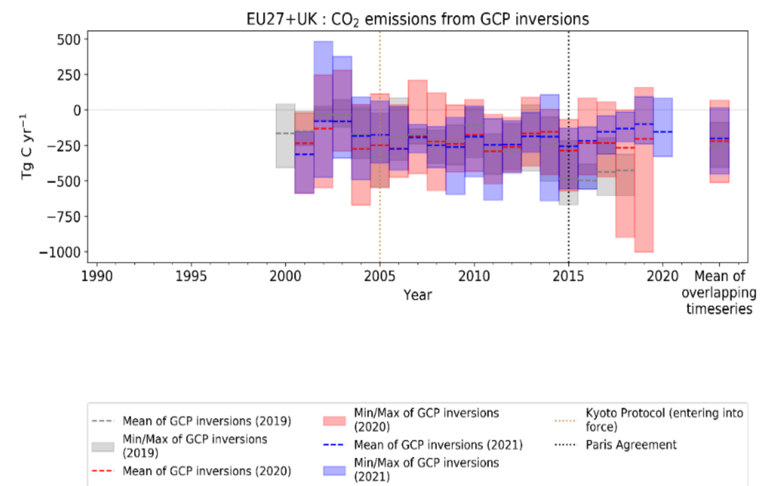


SOME COMPARISONS…



CSR (2006-2017)
v2019: -394 Tg C
v2020: -231 Tg C
v2021: -207 Tg C
UNFCCC: -89 Tg C



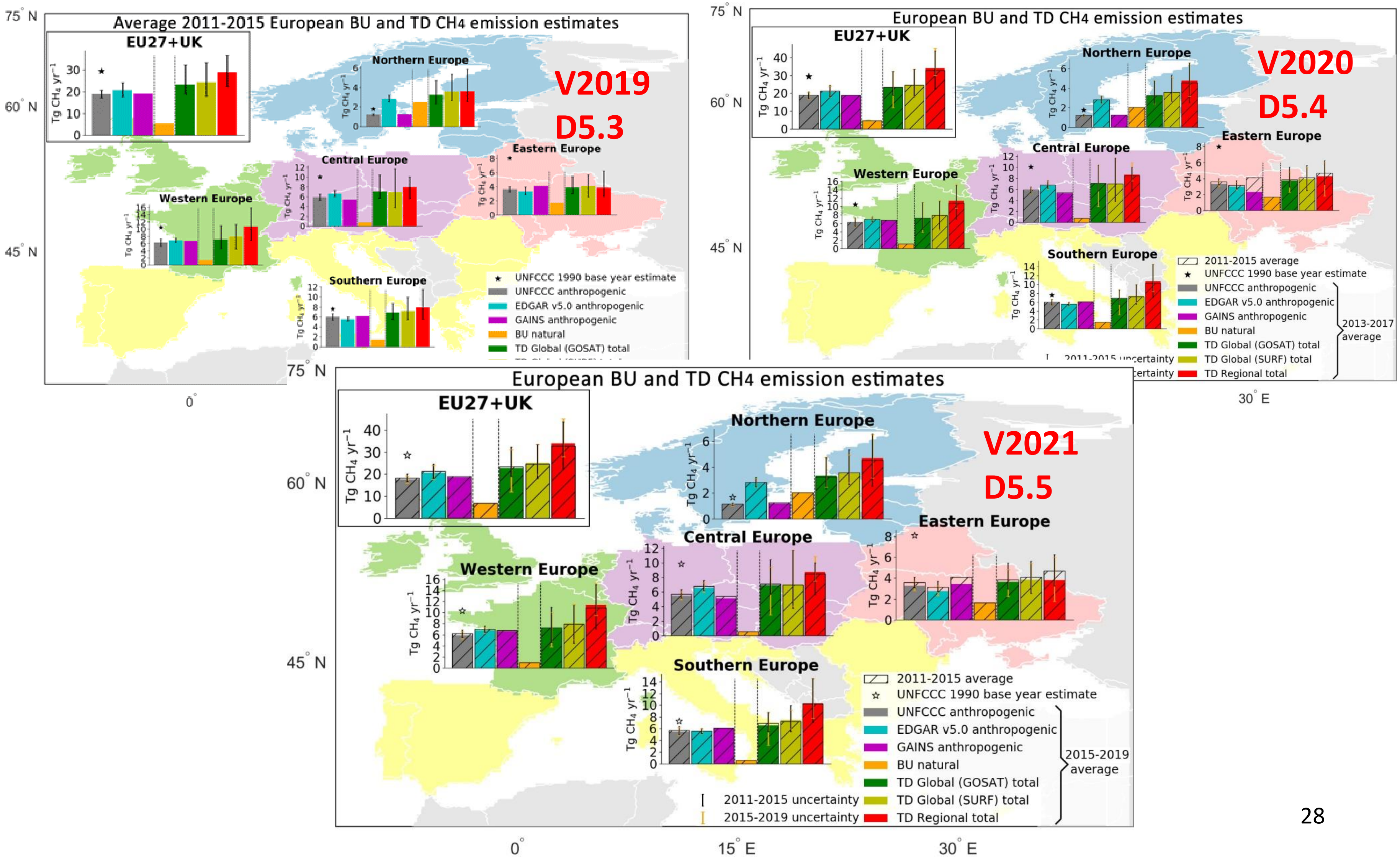


Reported NGHGI uncertainties for total LULUCF:
v2019: 16%, v2020: 11% and v2021: 24%..last revised by Bradley Matthews (UBA Vienna) to 18%

Also GCP revised estimates getting closer the UNFCCC (2001-2018) estimate
v2019: -249 Tg C
v2020: -220 Tg C
v2021: -201 Tg C
UNFCCC: -89 Tg C

D5.3, D5.4 AND D5.5: THE CONSOLIDATED EUROPEAN SYNTHESIS OF CH_4

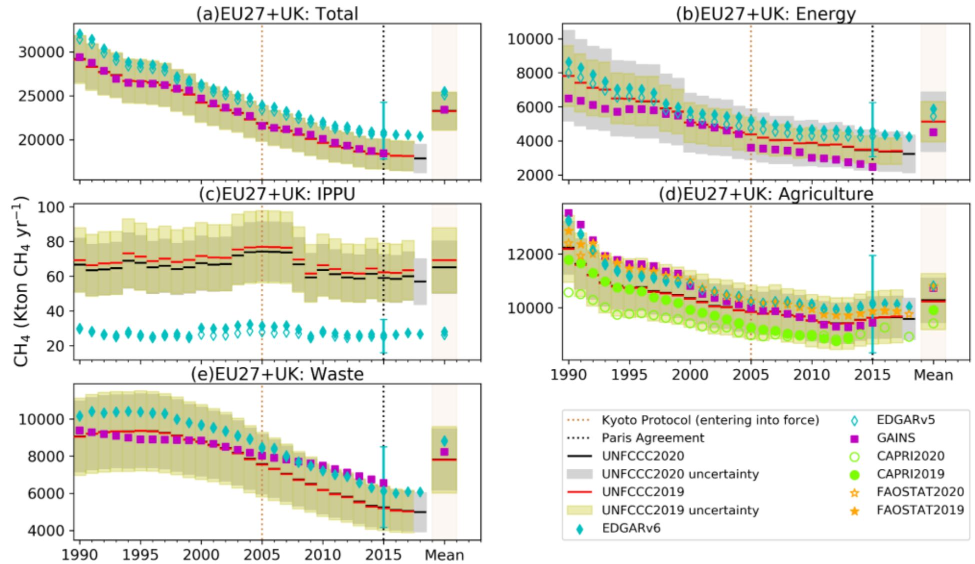
V2019, V2020 AND V2021



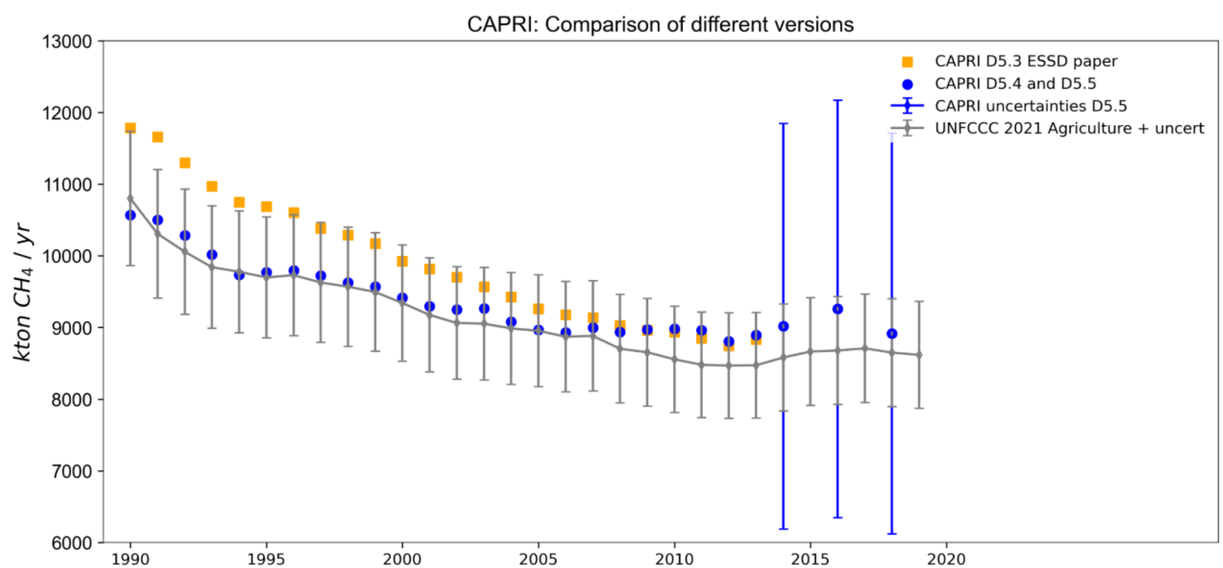
SOME COMPARISONS

CH_4 emissions from v2019 and v2020

Slightly revised UNFCCC estimates/uncertainties

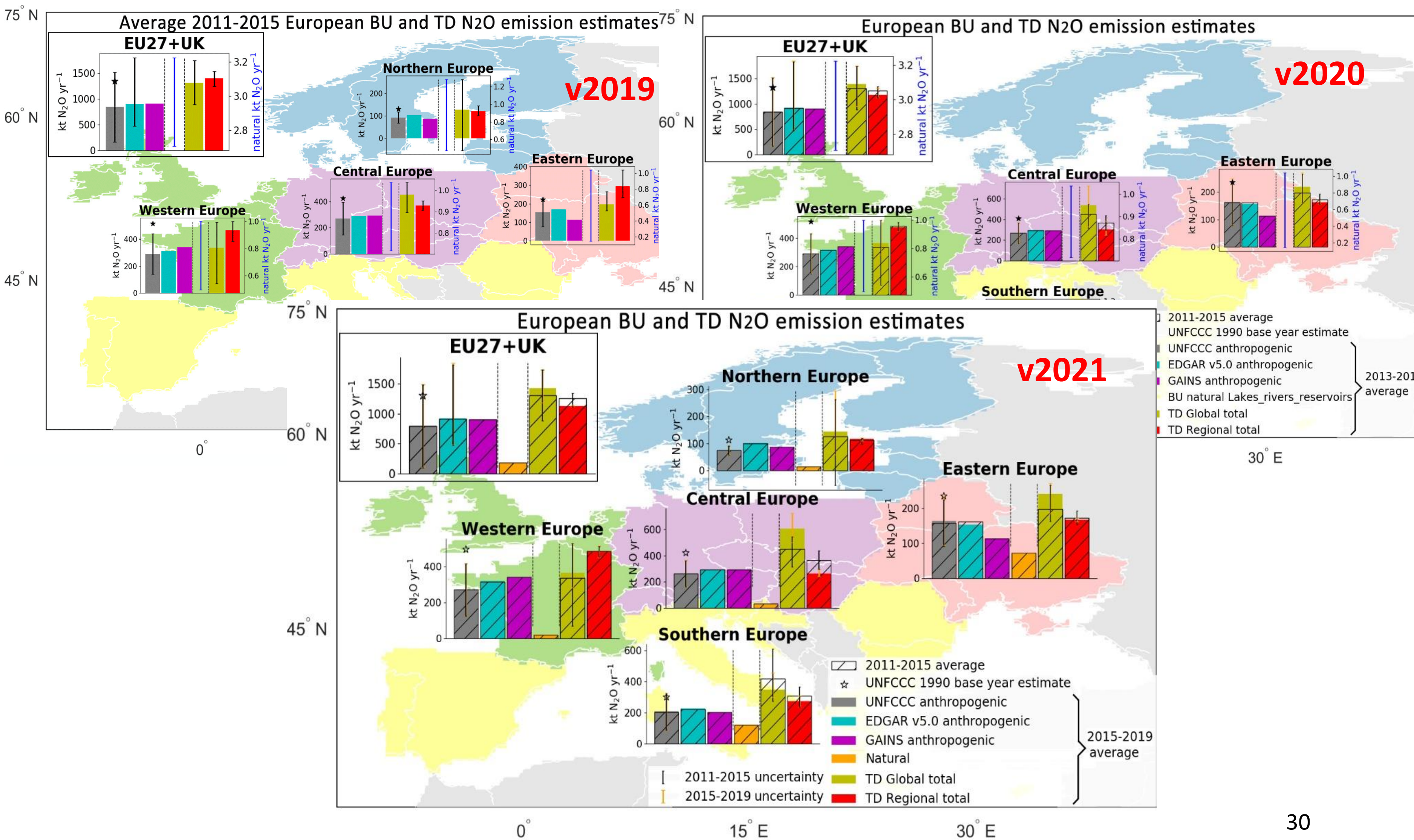


Average for same period 1990-2018
CAPRI: 9.4 Tg CH_4
UNFCCC: 9.1 Tg CH_4



D5.3, D5.4 and D5.5: The consolidated European synthesis of N_2O

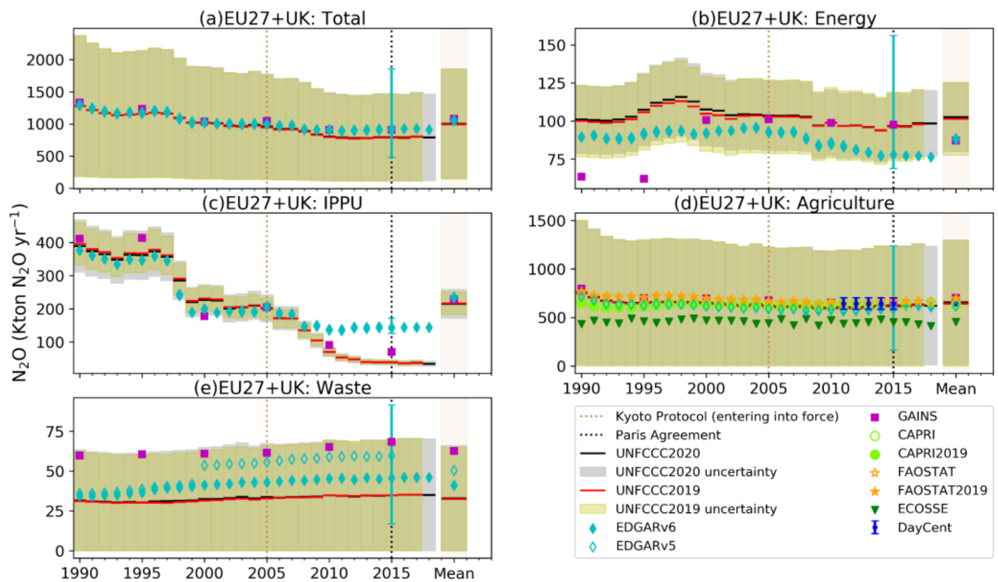
v2019, v2020 and v2021



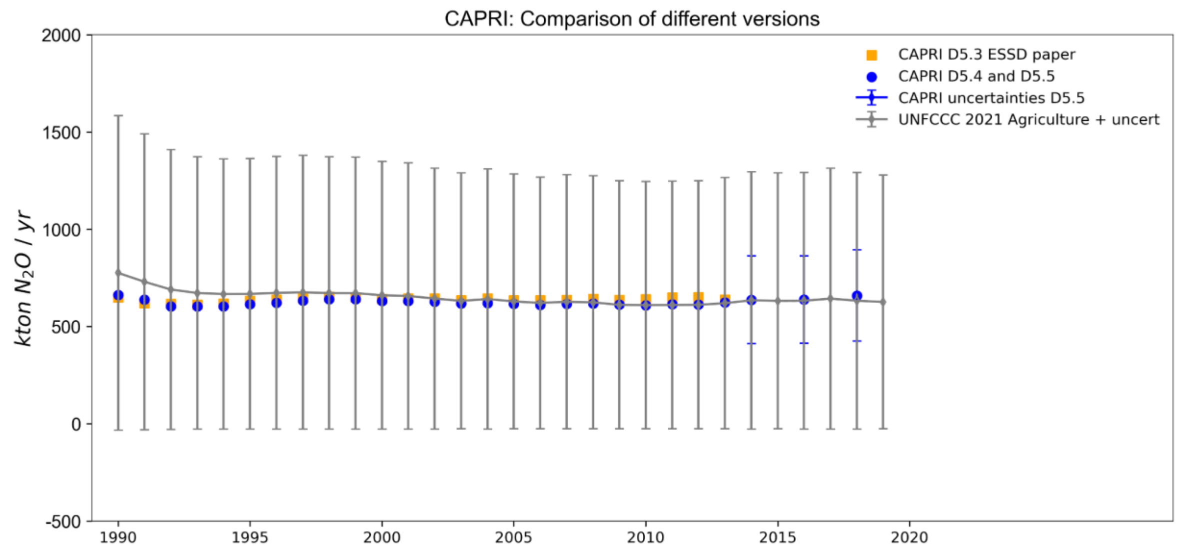
SOME COMPARISONS

N_2O emissions from v2019 and v2020

Not much revision of UNFCCC emissions/ uncertainties



Average for same period 2000-2018
CAPRI: 624 kton N_2O
UNFCCC: 650 kton N_2O



CONCLUSIONS

Fossil CO_2

- Improvement of inversion systems for fossil emissions - uncertainties

Land CO_2

- Bottom-up models show larger (climate) variability (i.e. ORCHIDEE, DGVMs)
- The top-down ensemble estimates of CO_2 show still large variability
- LULUCF: reduce the gap between inventories and models by defining common definitions in land use reporting

CH_4

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

N_2O

- Large gap between inversions and BU estimates not caused by natural emissions, seasonality (N fertilization) not represented in NGHGI

Under development: Quantification and inclusion of lateral fluxes, CIF

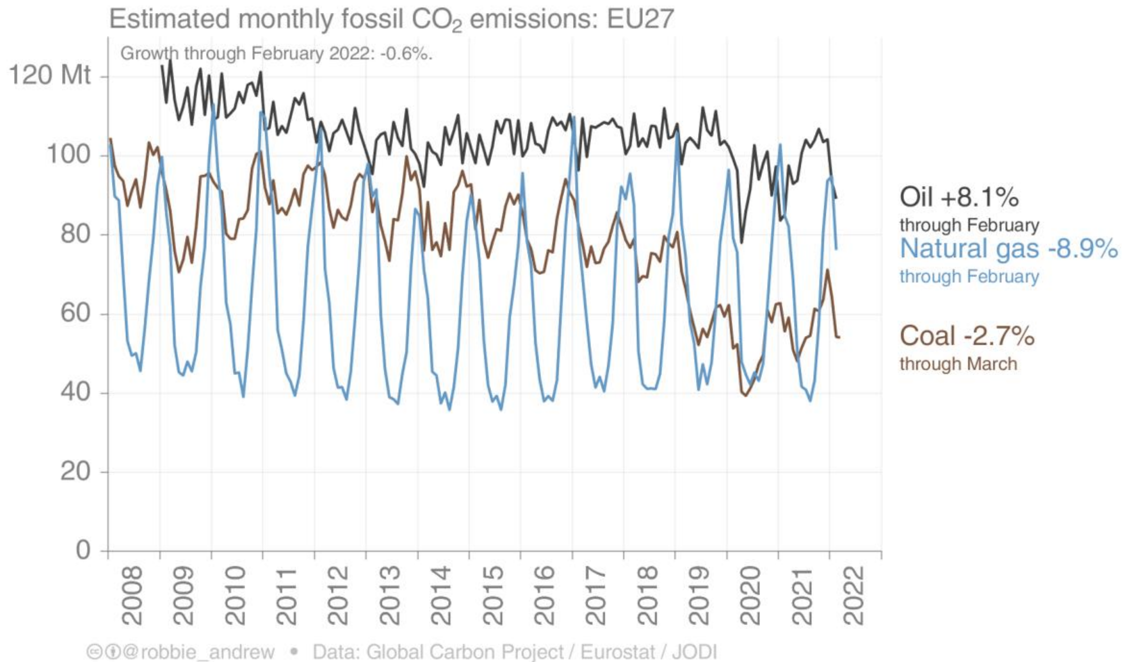
NOT YET...

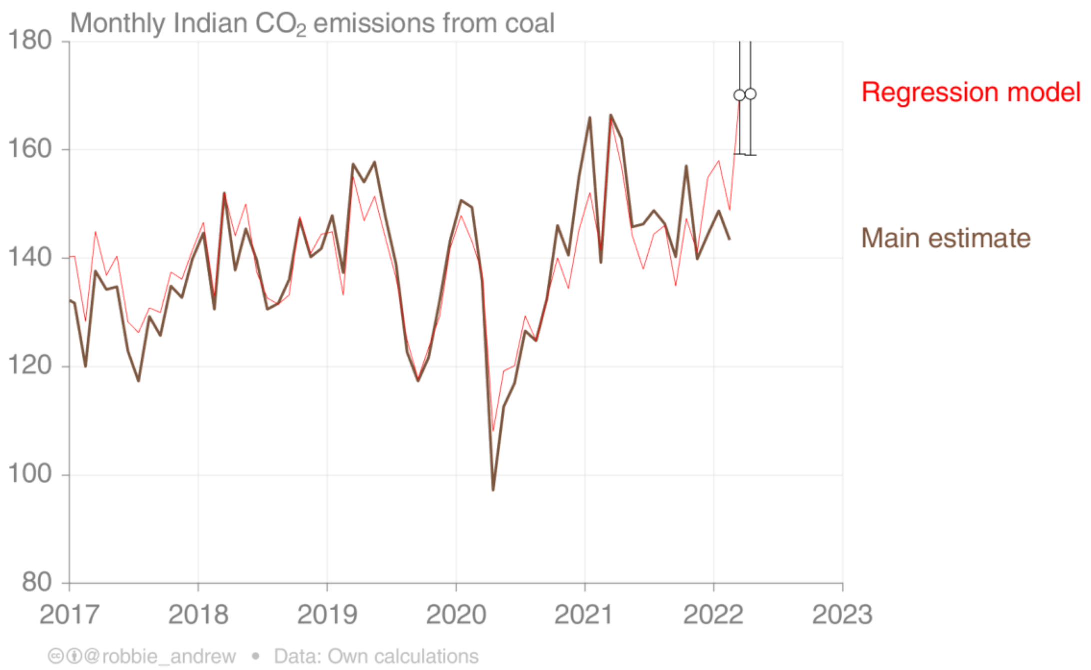
- We identified and explained some differences, especially those belonging to different versions of the scientific results but communities still need to agree on the same approach (anthropogenic/natural, definitions LULUCF etc.)
- Input to the 1st GST and last synthesis (for 2021) – to be continued in $CoCO_2$
- Inventory agencies will report on inconsistencies found at country level

DON'T MISS TOMORROW'S NETWORKING MEETING!!

- Revision of UNFCCC uncertainties (CH_4 and N_2O)

T5.4 Past trends, annual drivers analysis and short-term predictions of emissions




Monthly Indian CO_2 emissions from coal
180
160
140
120
100
80
2017
2018
2019
2020
2021
2022
2023
@robbie_andrew • Data: Own calculations
Regression model
Main estimate

STATUS OF WP5 AND WP6 DELIVERABLES

D5.4	Third report - Reconciliation of bottom-up and top-down methods at sub-national scales	STICHTING VU	30 Nov 2020	November 2021
D5.5	Final report - Reconciliation of bottom-up and top-down methods at sub-national scales	STICHTING VU	30 Nov 2021	finalized
D5.8	Final - Fact sheets with national observation-based GHG Budgets from project results	CICERO	31 Dec 2021	-
D5.10	Second and final scientific review article on multi-gas GHG budgets	STICHTING VU	31 Jan 2022	work in progress
D5.12	Relationships between climate anomalies and natural/anthropogenic GHG budgets variability	CEA	31 Jan 2021	
D5.13	Analysis of recent extreme events' impacts on GHG budgets anomalies	CEA	30 Nov 2020	-
D6.5	Report (fact sheet) on the observation-based to Indonesia	RIVM	31 Jul 2021	work in progress
D6.6	Knowledge transfer workshop with US, China, Indonesia	JRC	31 Jul 2021	-
D6.7	Workshop illustrating the GHG verification internationally based on example outside of Europe	JRC	31 Jul 2021	-
D6.9	Final version of VERIFY Database and data-management infrastructure	CEA	31 Aug 2021	-
D6.10	Report on the legacy of the VERIFY Database and data-management to future operations	ICOS ERIC	31 Aug 2021	-
D6.11	Report on the future operational transition of the VERIFY observation-based GHG monitoring system	ECMWF	30 Nov 2021	-
D6.12	Online update of national emission inventory and observation-based GHG budget trends and NDC mitigation targets	JRC	31 Jul 2021	finalized
D6.13	Online representation of the geographic distribution of GHG emissions and sinks uncertainties and how targeted new observations will help to reduce them	JRC	30 Nov 2021	work in progress

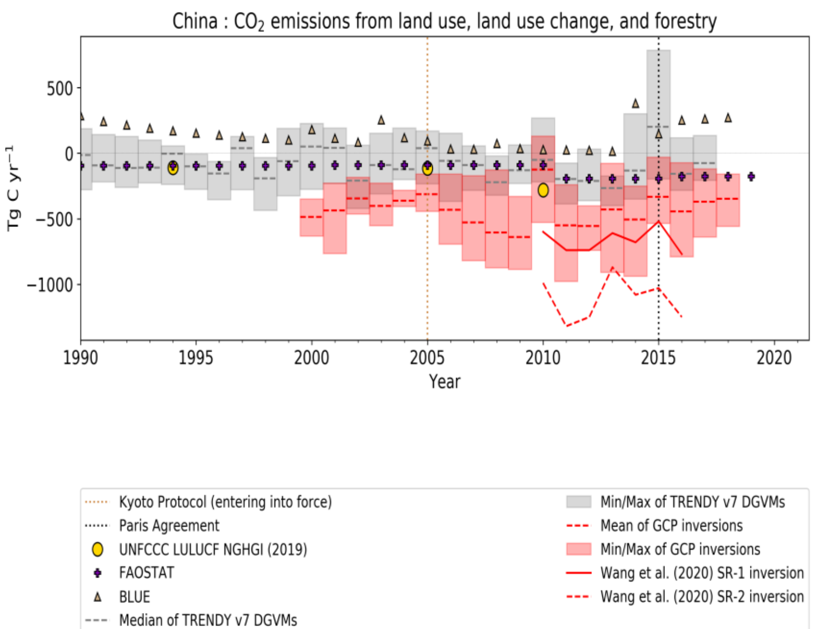
NEXT STEPS

- Last synthesis (2021 included) to be hosted by the $CoCO_2$ project
- Together with $CoCO_2$ develop methodological input to the first GST exercise
- 3 proposals participated to the Horizon Europe global forcers call
- VERIFY contributors to the European chapter of RECCAP2

T6.2 Annual GHG budget fact sheets for US, China, Indonesia based on the methodology of Task 6.1

- China facts sheets

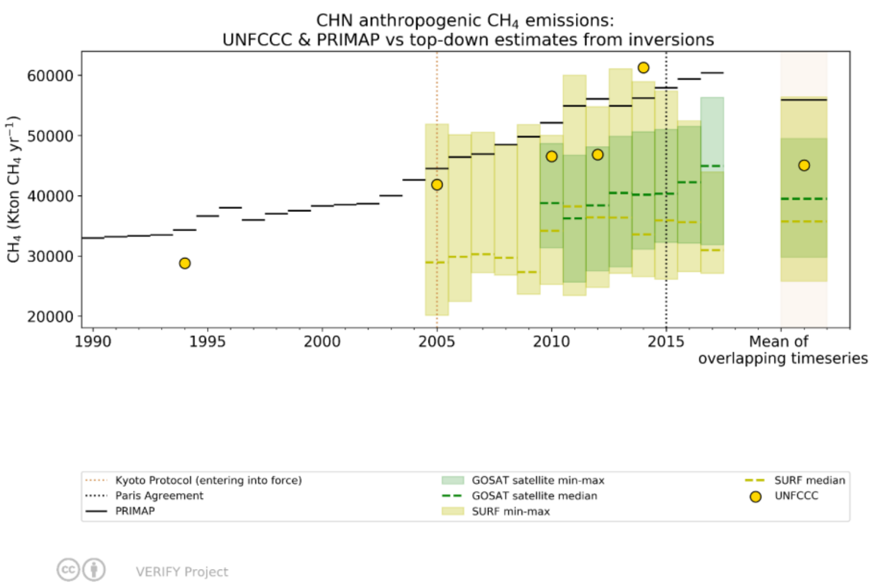
The methodology from VERIFY was applied to China



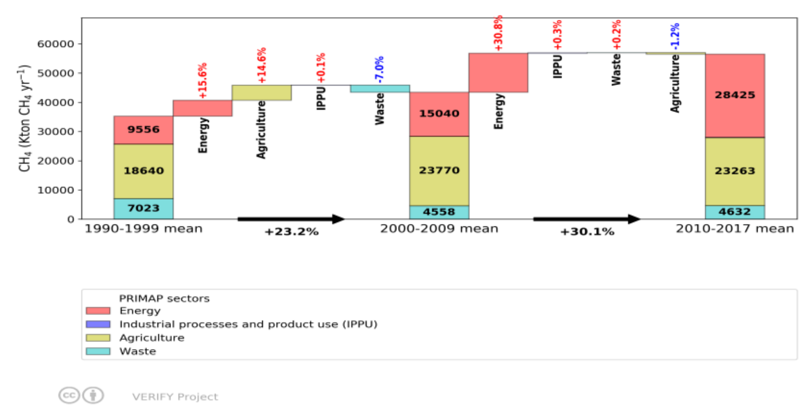
- Larger land CO_2 sink by inversions that carbon storage change by land models and inventories
- Agreement improved when accounting for lateral fluxes

T6.2 Annual GHG budget fact sheets for US, China, Indonesia based on the methodology of Task 6.1

- China facts sheets

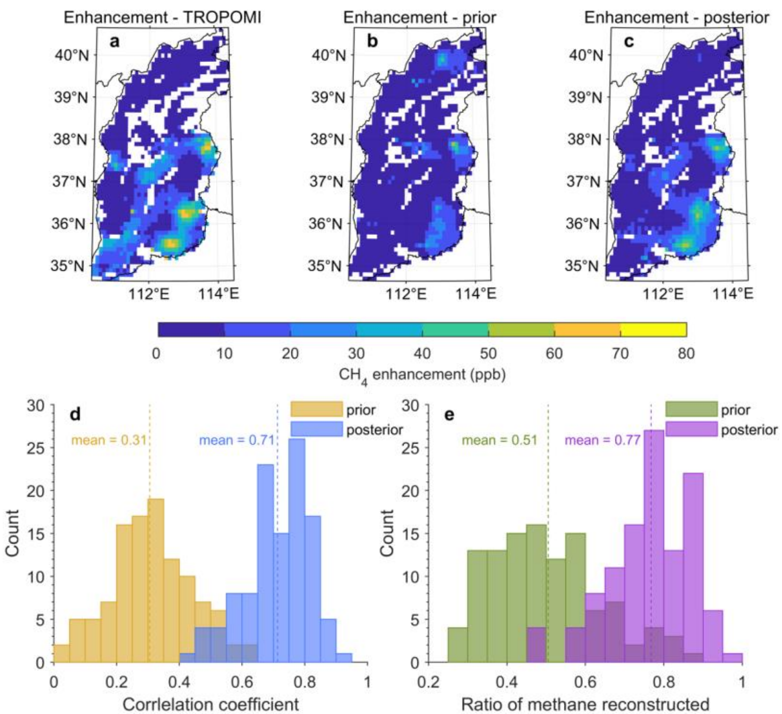


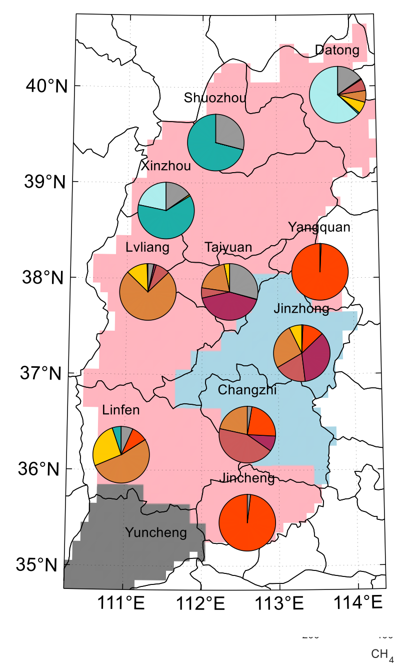
- For CH_4 an upward trend of emissions consistent between GOSAT and in-situ stations based inversions
- But large disagreement of inversions and between Inventories for sectors
- Trend of emissions in inventories domianted by the energy sector

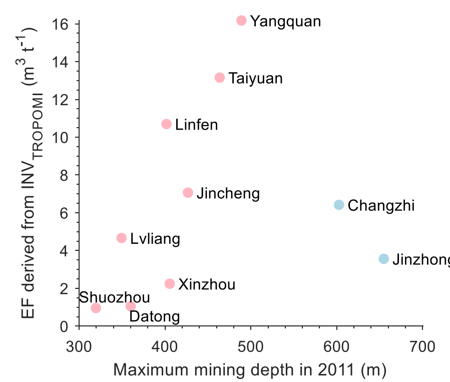


T6.2 Annual GHG budget fact sheets for US, China, Indonesia based on the methodology of Task 6.1

- Very high resolution inversions were performed over the Shanxi basin using TROPOMI data
- Emissions of 8.5 ± 0.6 Tg CH4 y-1 consistent with EDGARV6
- Correlation between coal seam depth and emission rates at prefecture level







Thank you for your attention.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776810

VERIFY General Assembly

Summary and key messages from synthesis and deliverables

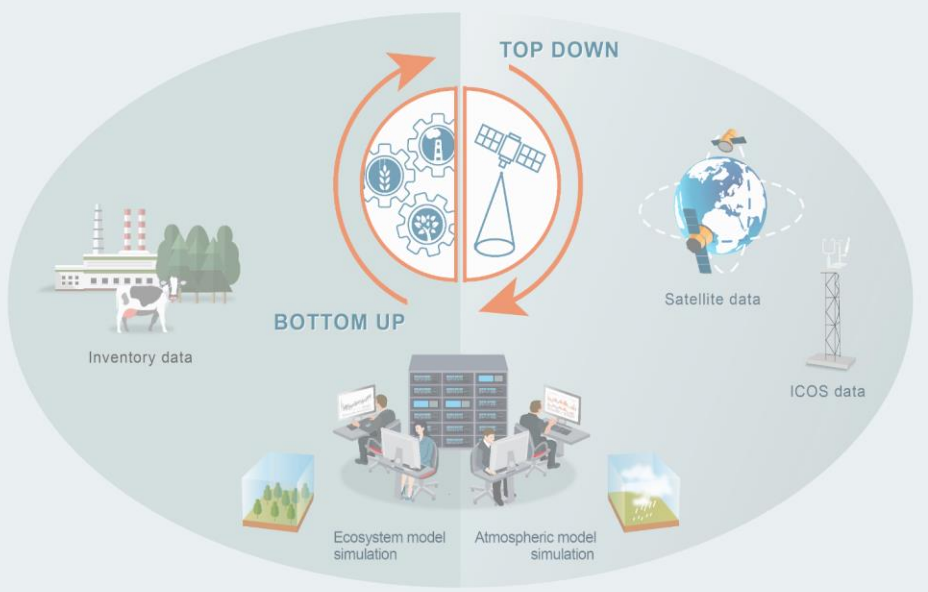
WP5 and WP6

May 10th, 2022

Paris, France

Team: VUA, CICERO, LSCE, EC-JRC, RIVM

Acknowledging all VERIFY consortium and outside contributors



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776810

WP5 CONT.
KEY SCIENTIFIC RESULTS OVER THE PROJECT DURATION

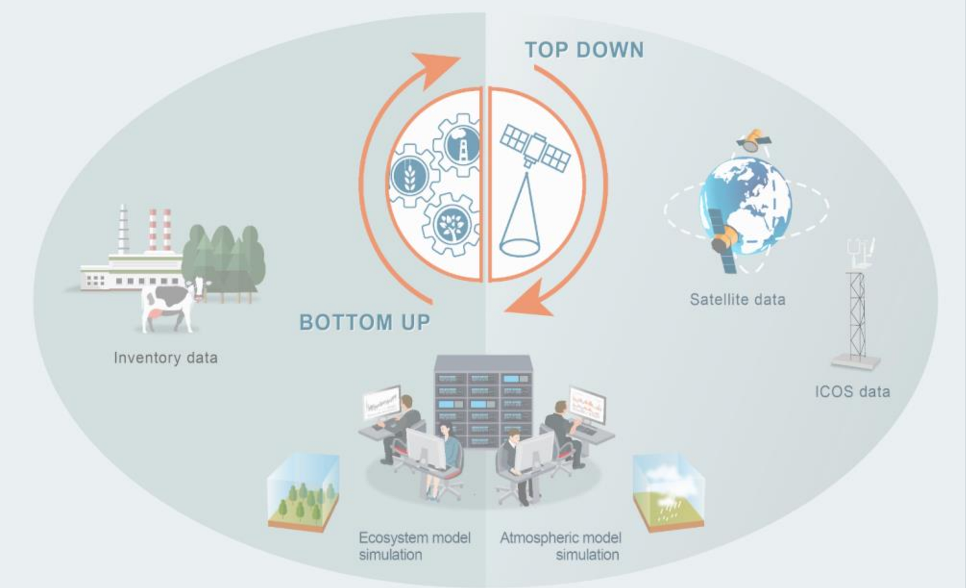
T5.5 Drivers behind ecosystem carbon fluxes in Europe (Matthew McGrath, LSCE, France)

VERIFY General Assembly

May 9th -11th , 2022

T5.5. Drivers behind ecosystem carbon fluxes in Europe

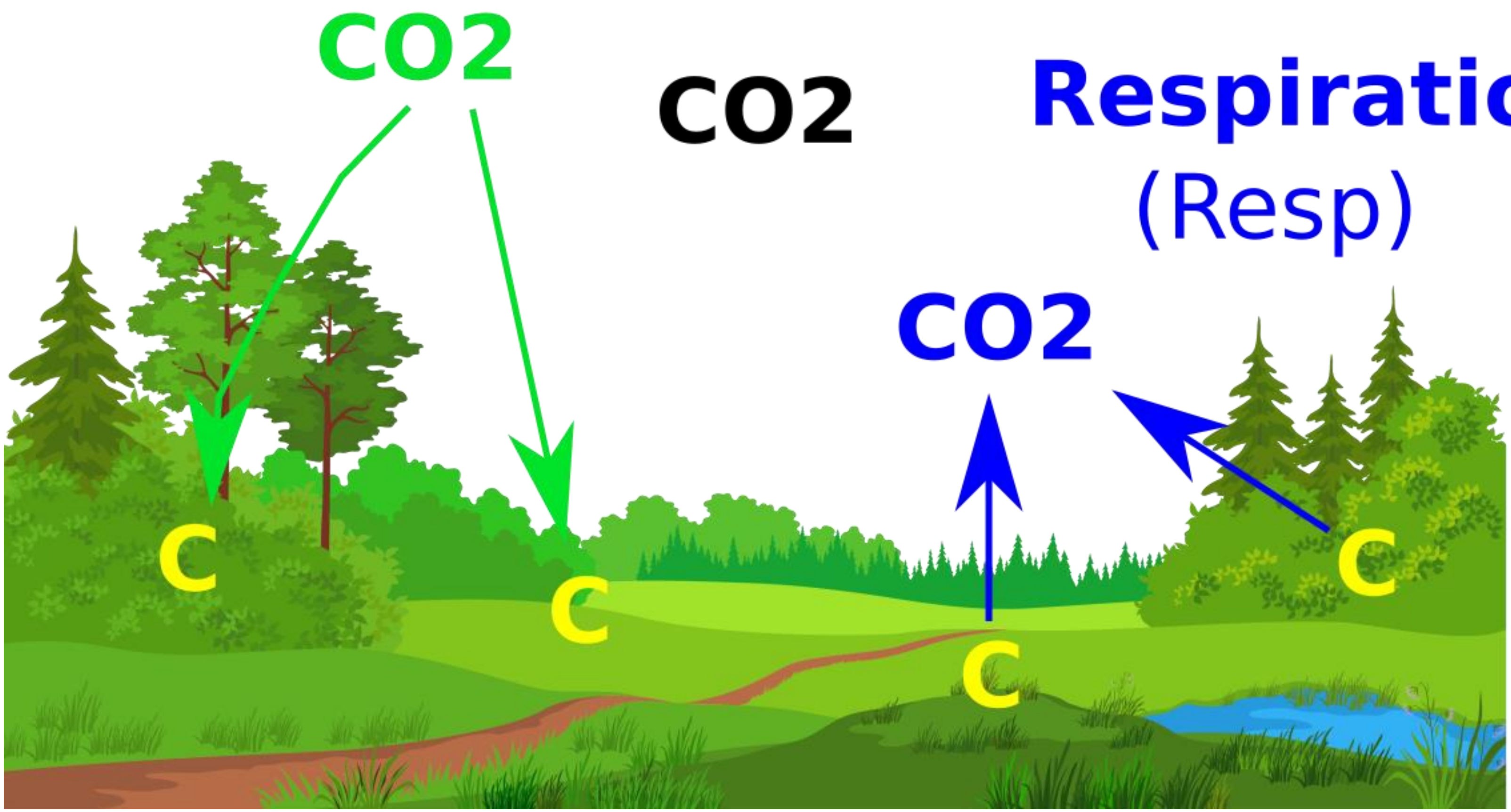
M. McGrath, P. Peylin, P. Ciais



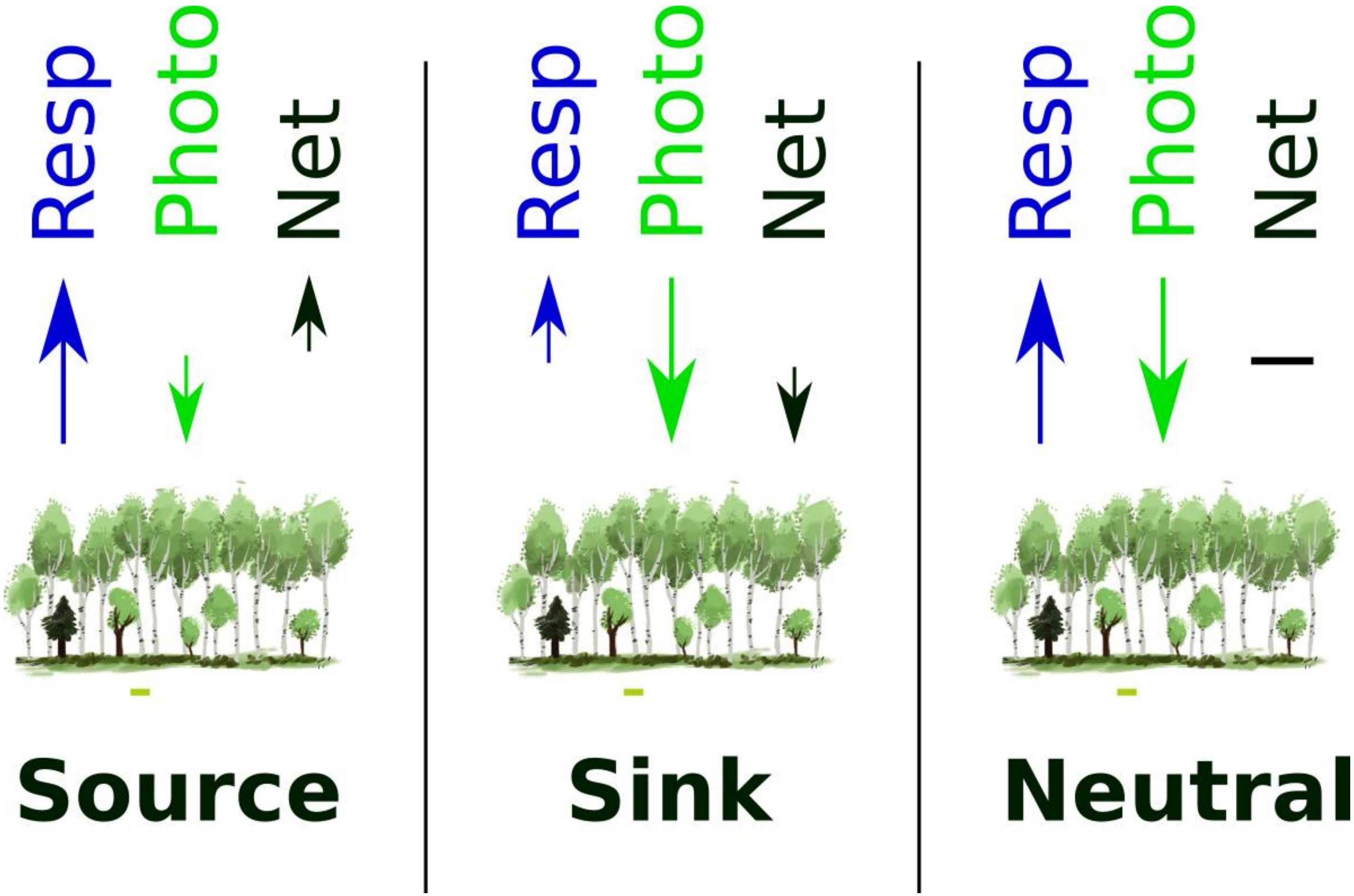
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776810

NET CARBON FLUXES

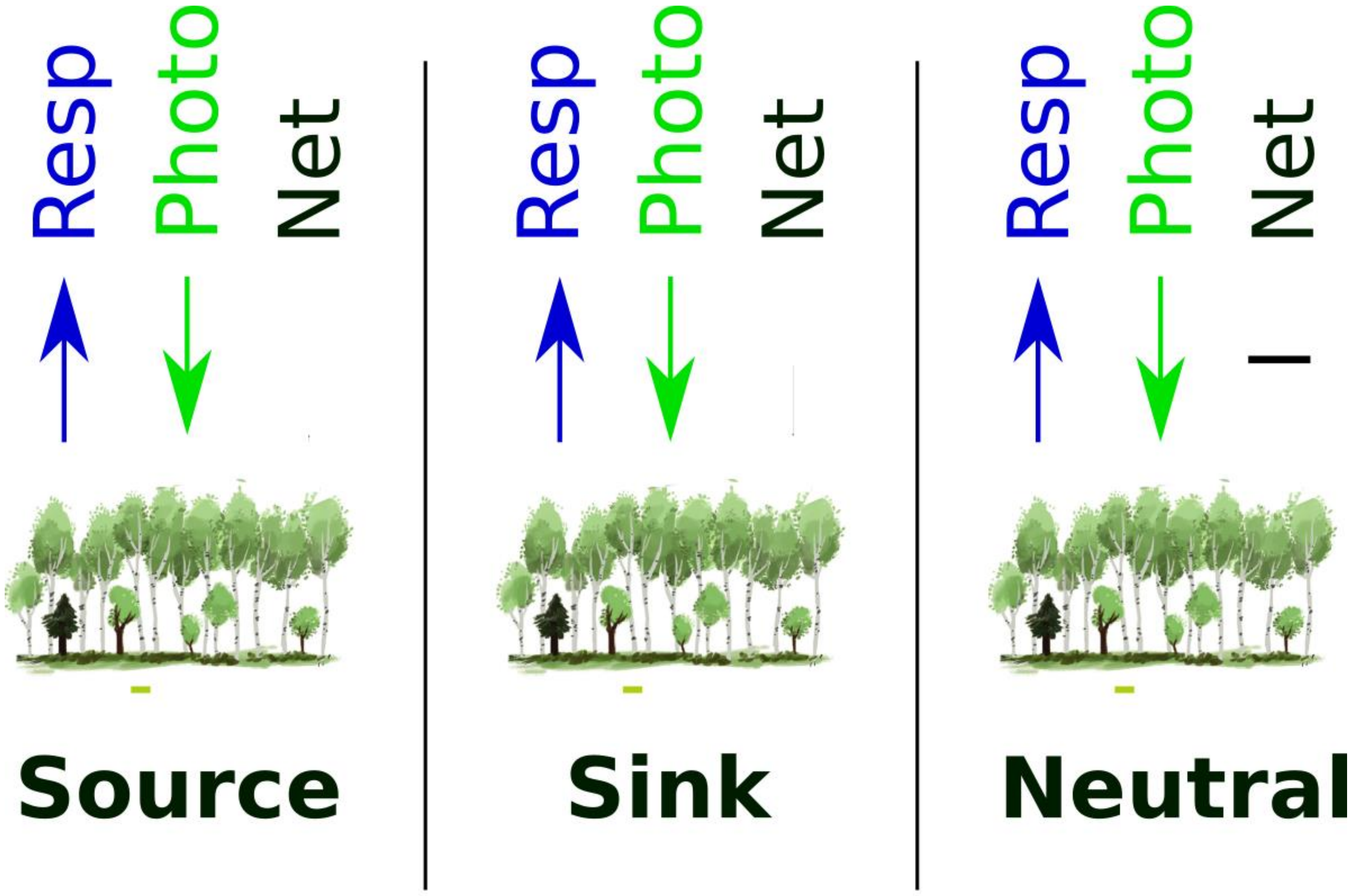
Photosynthesis (Photo)



Net carbon fluxes

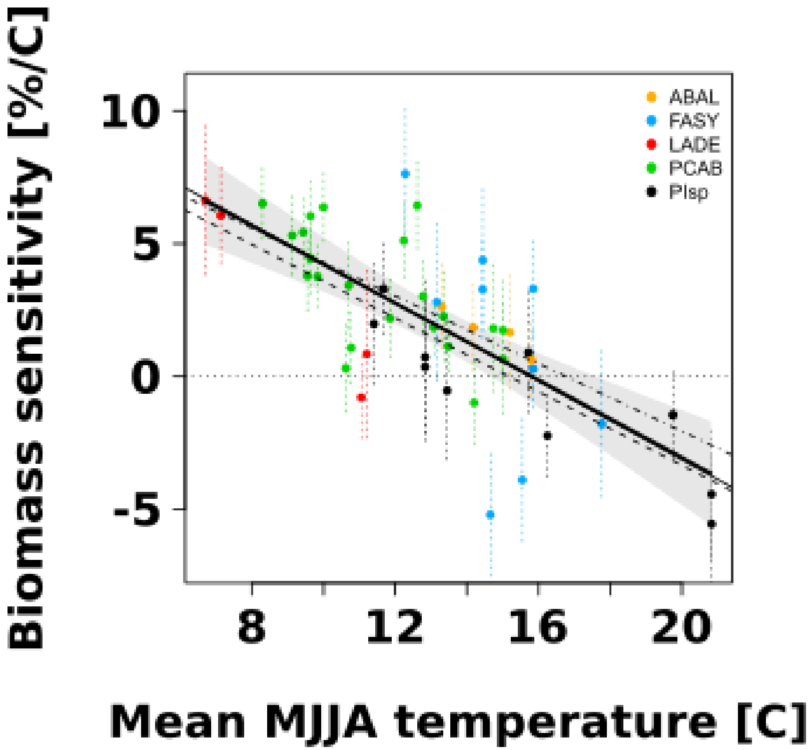


NET CARBON FLUXES - REAL



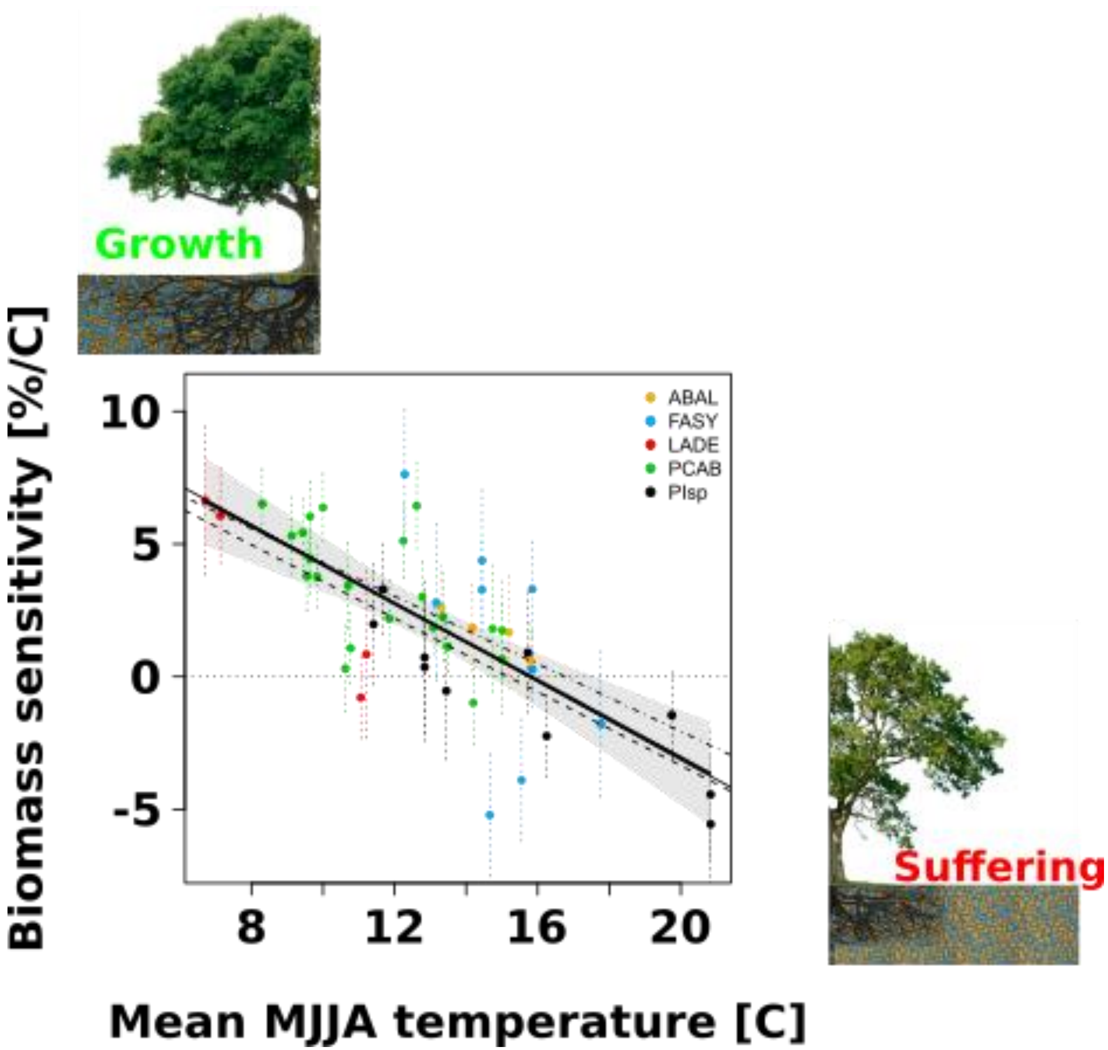
Residual of two large fluxes!

MOTIVATION – CONT.



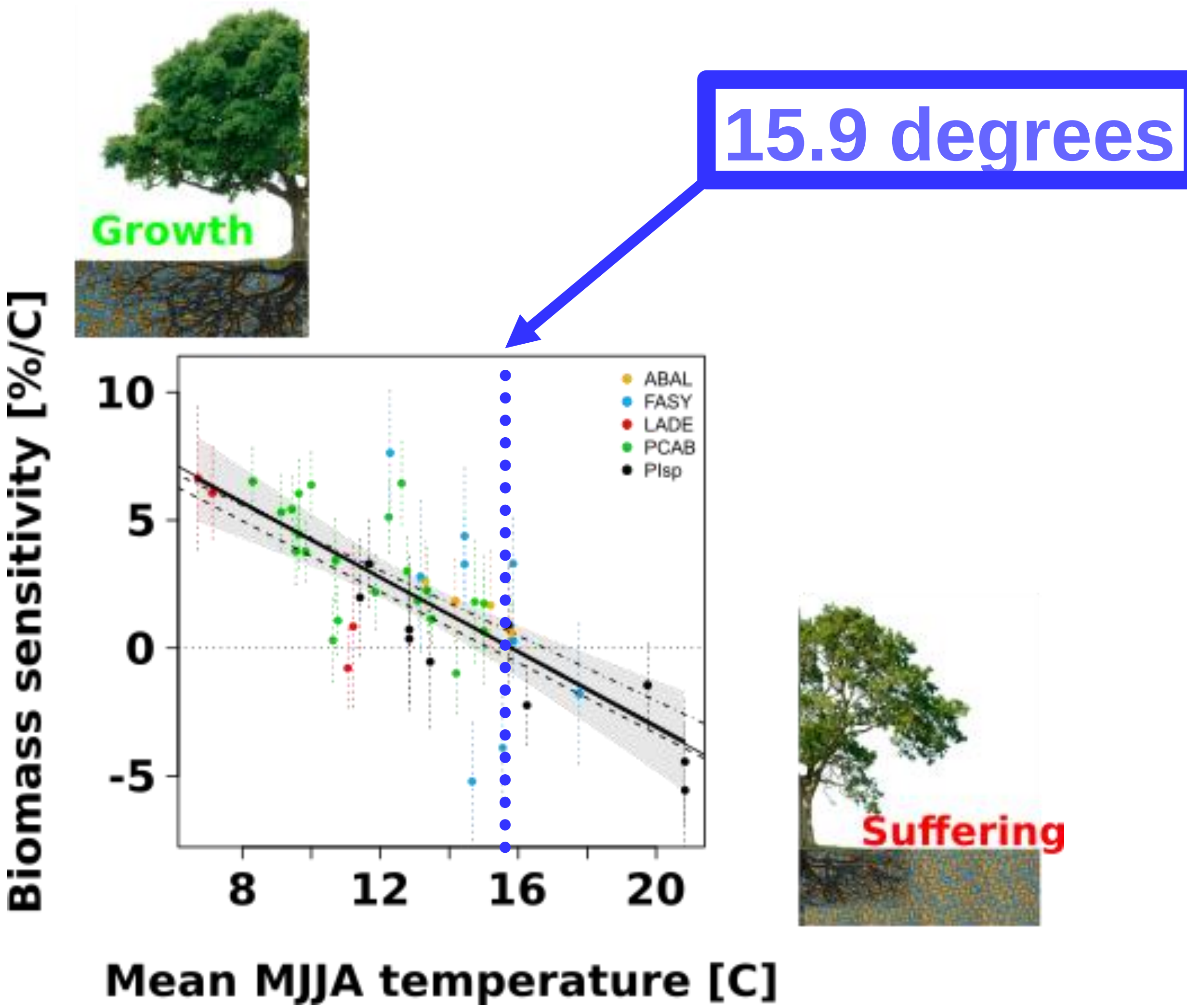
Klesse et al. (2018)

MOTIVATION – CONT.



Klesse et al. (2018)

MOTIVATION – CONT.

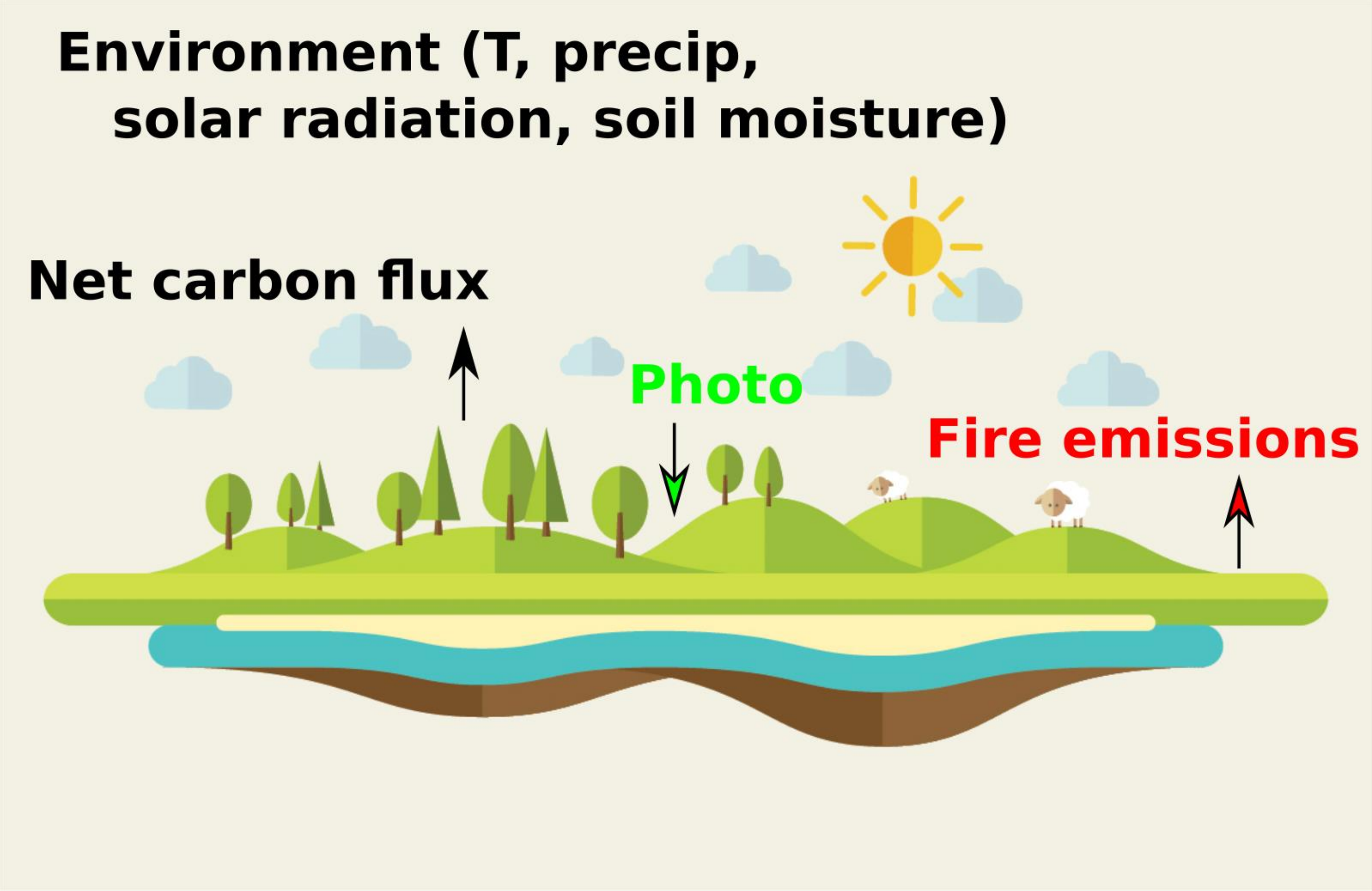


Klesse et al. (2018)

QUESTIONS

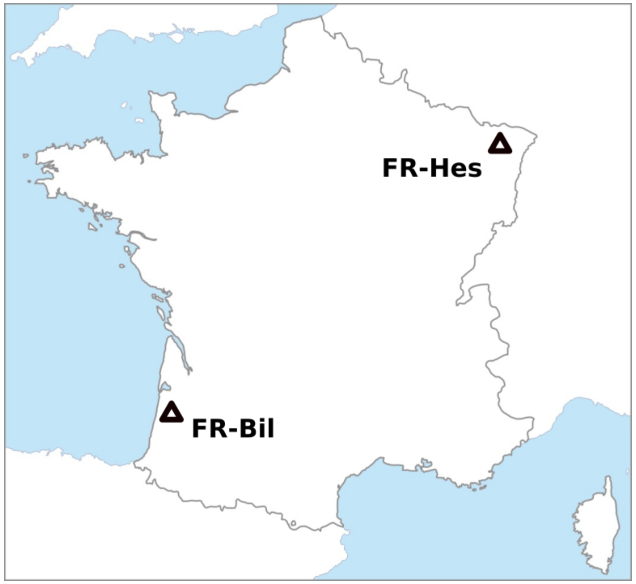
- Does the same 15.9 degree threshold exist for non-forested sites in Europe?
- Does the same 15.9 degree threshold exist in commonly-used wall-to-wall products (maps)?

DATASETS


Environment (T, precip,
solar radiation, soil moisture)
Net carbon flux
Photo
Fire emissions

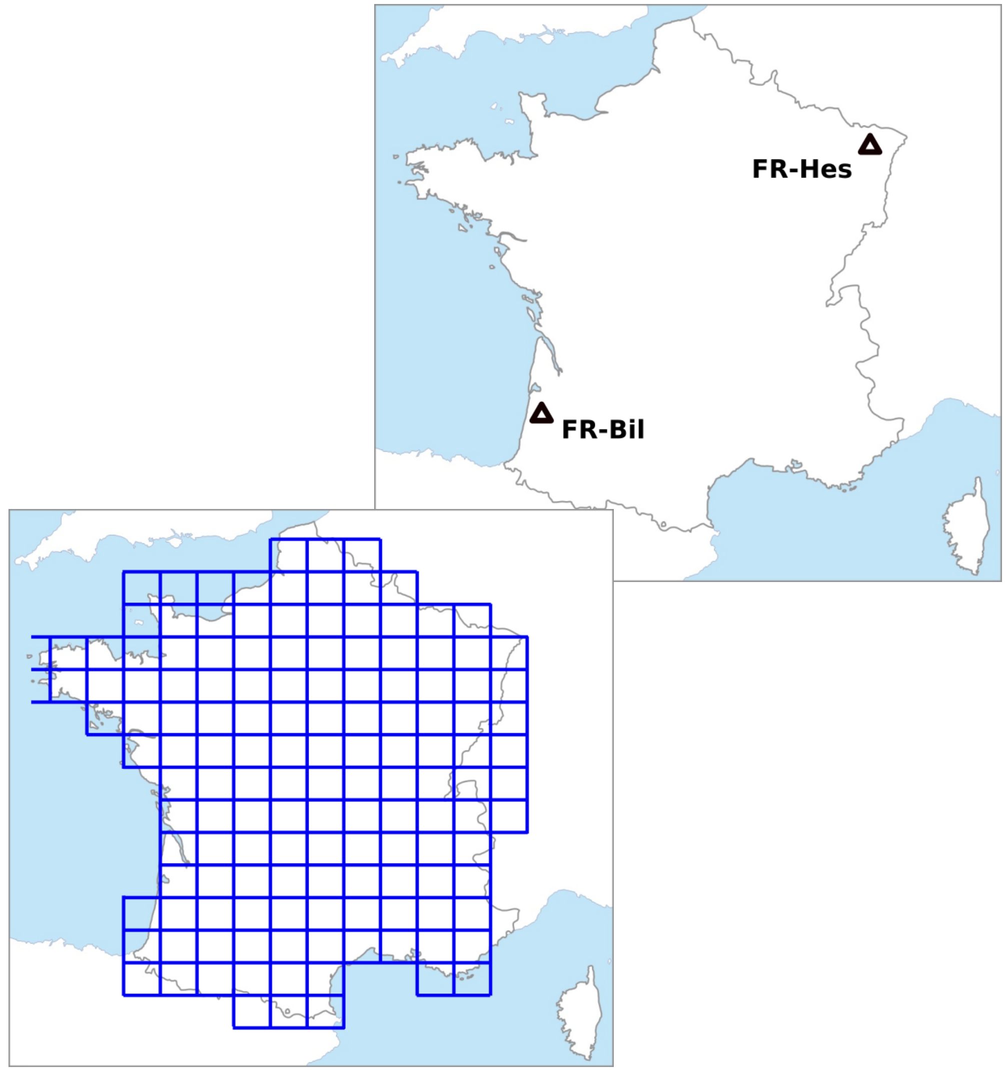
DATASETS - SCALES

- **FLUXNET sites**



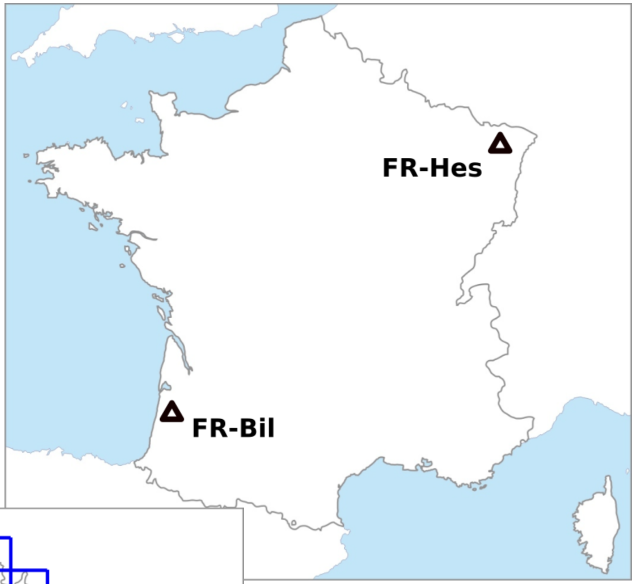
Datasets - Scales

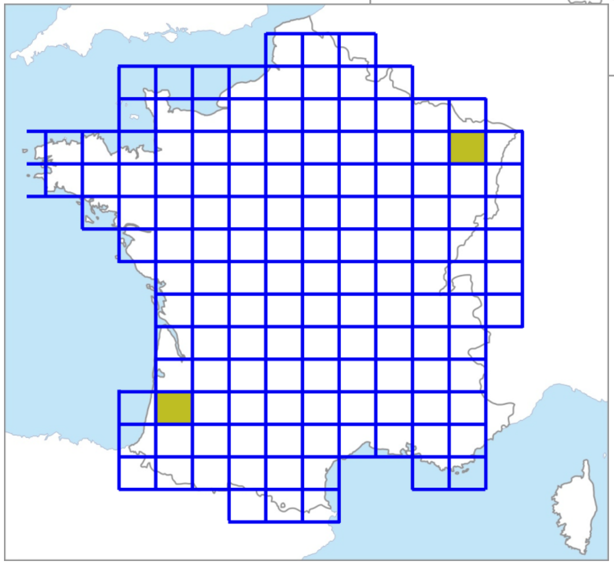
- **FLUXNET sites**
- **Gridded pixels**



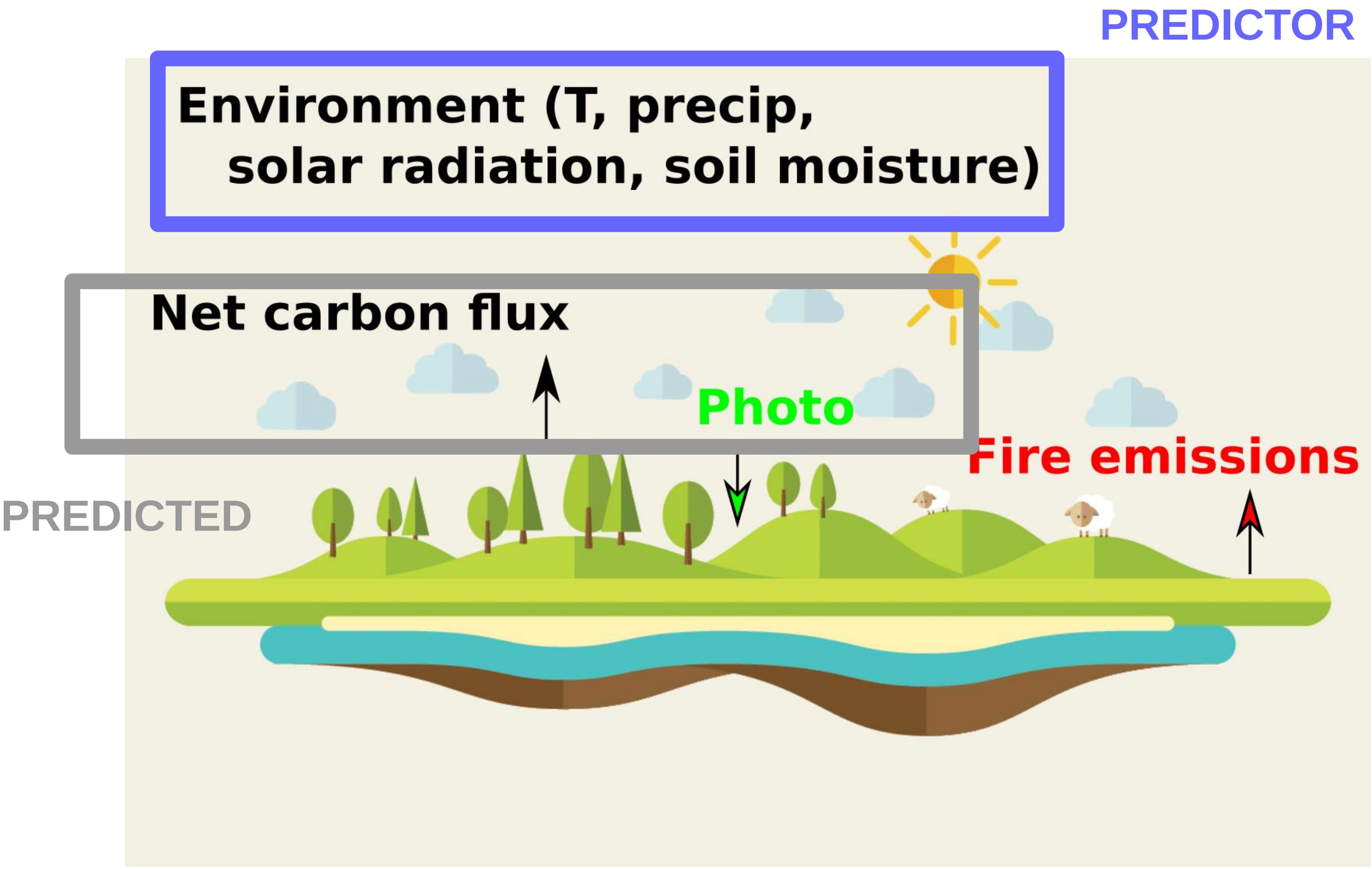
DATASETS - SCALES

- **FLUXNET sites**
- **Gridded pixels**
- **FLUXNET pixels**





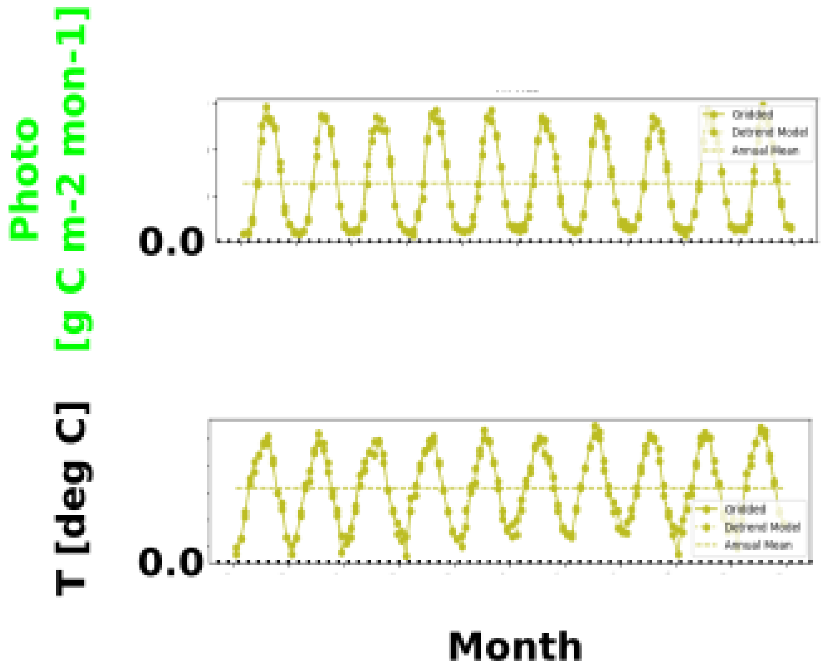
DATASETS - SCALES



ALGORITHM

FLUXNET site

1. Original timeseries
(T, Photo)



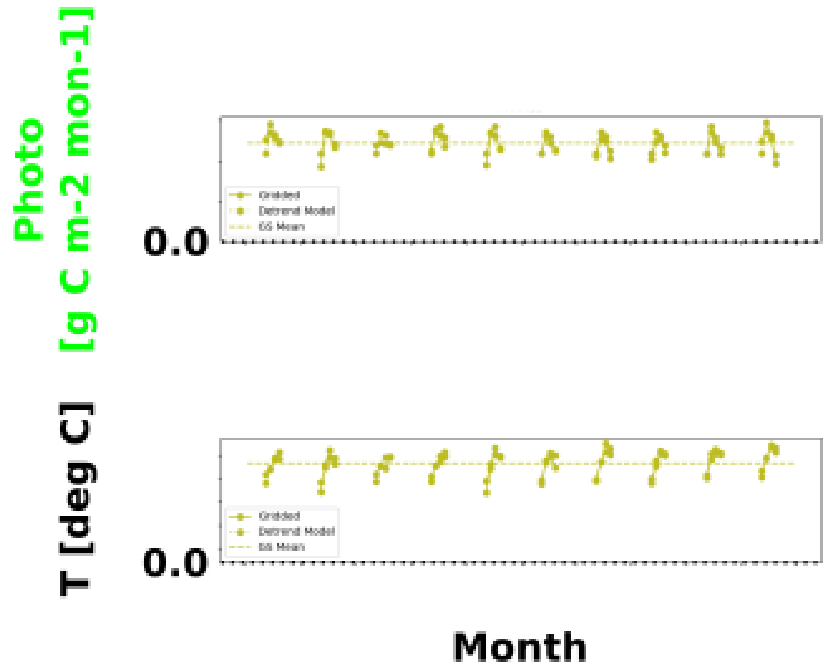
ALGORITHM

FLUXNET site

1. Original timeseries
(T, Photo)

↓

2. Growing season



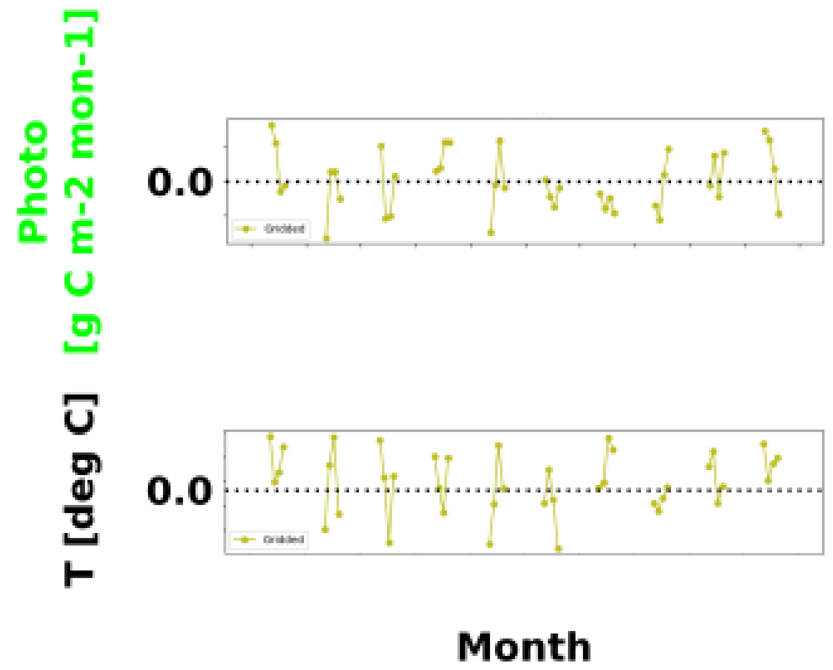
ALGORITHM

FLUXNET site

1. Original timeseries (T, Photo)

2. Growing season

3. Detrend



ALGORITHM

FLUXNET site

1. Original timeseries (T, Photo)

↓

2. Growing season

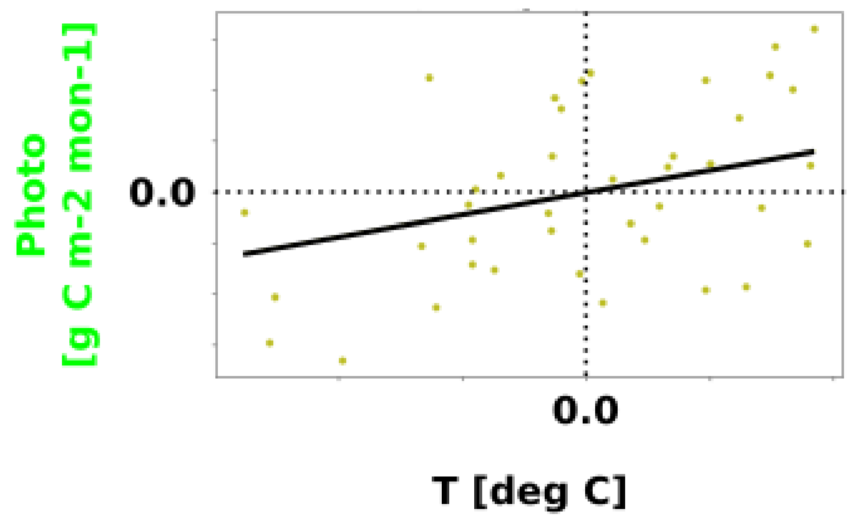
↓

3. Detrend

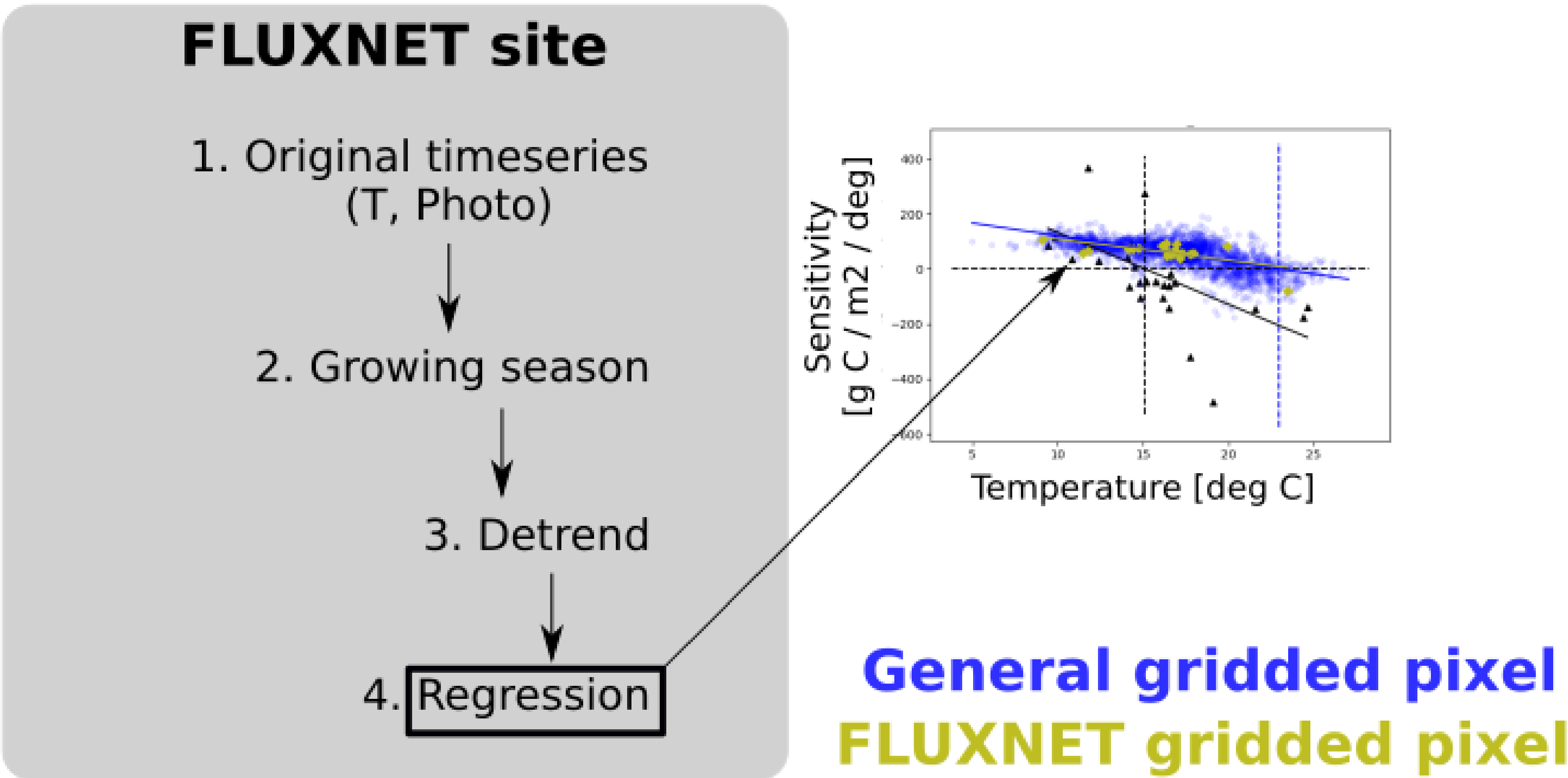
↓

4. Regression

Slope (sensitivity) = 43.1



ALGORITHM

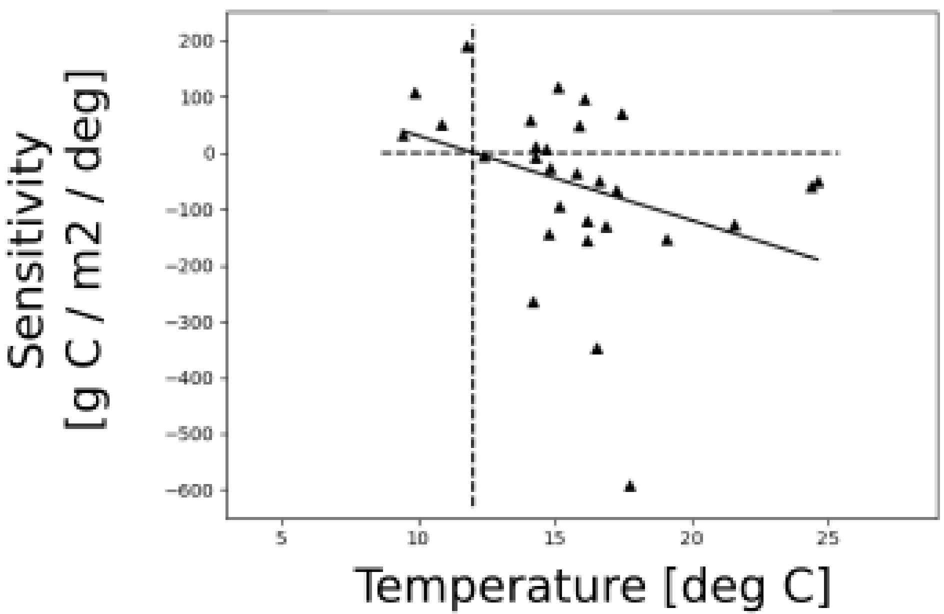


FLUXNET site
1. Original timeseries (T, Photo)
2. Growing season
3. Detrend
4. Regression
Sensitivity [g C / m2 / deg]
400
200
0
-200
-400
5
10
15
20
25
Temperature [deg C]
General gridded pixel
FLUXNET gridded pixel

ADDITIONAL STEPS

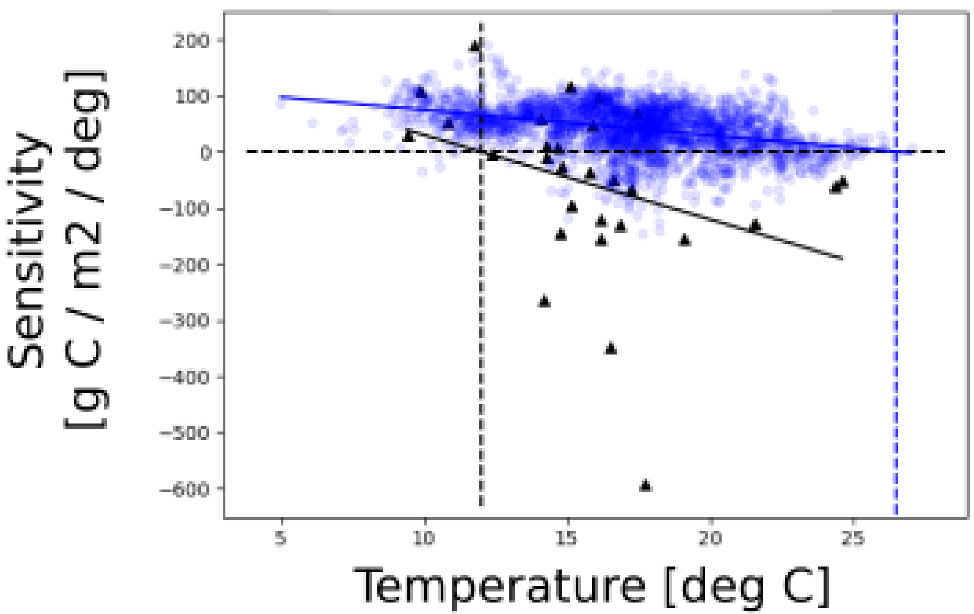
- Filter gridded pixels
- Calculate variance inflation factors
- Determine which predictor is the controlling variable for each pixel/site

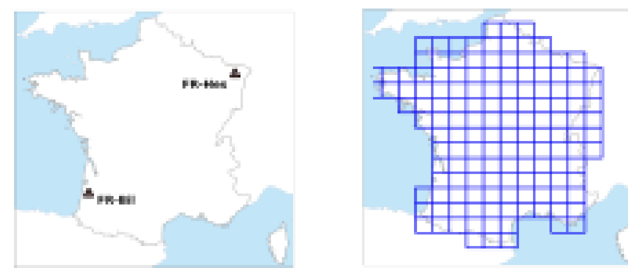
PHOTOSYNTHESIS RESPONSE TO TEMPERATURE



FLUXNET site - 12 degrees

PHOTOSYNTHESIS RESPONSE TO TEMPERATURE

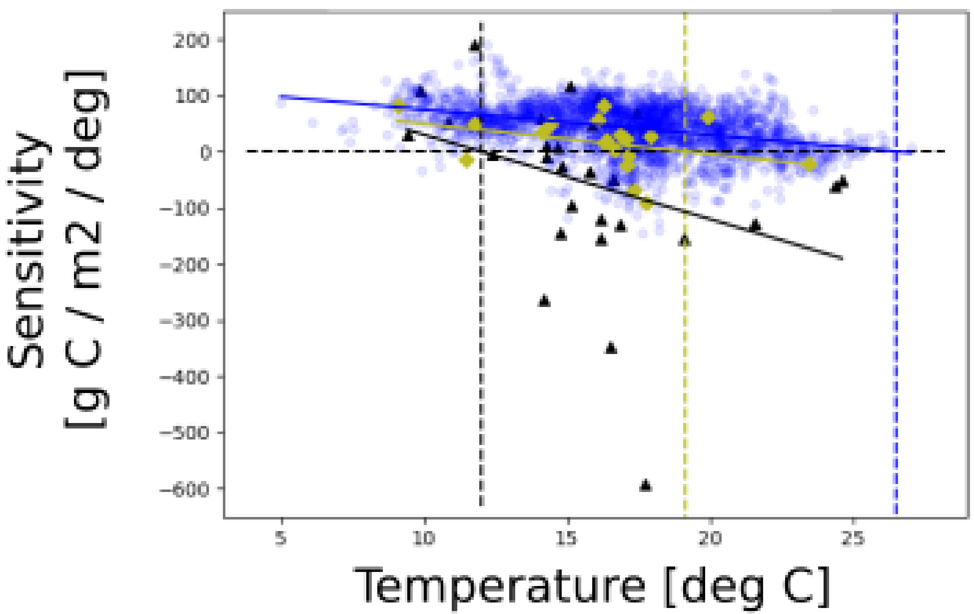


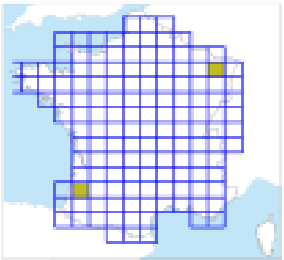


FLUXNET site - 12 degrees

General gridded pixel - 26.5 degrees

PHOTOSYNTHESIS RESPONSE TO TEMPERATURE





FLUXNET site - 12 degrees

General gridded pixel - 26.5 degrees

FLUXNET gridded pixel - 19 degrees

WP6

KEY SCIENTIFIC RESULTS OVER THE PROJECT DURATION

T6.1 Annual GHG fact sheets for the EU as a whole (Greet Janssens-Maenhout, EC-JRC, Italy)

T6.2 Annual GHG budget fact sheets for US, China, Indonesia (Philippe Ciais, LSCE France and Paul Ruyssenaars, RIVM, The Netherlands)

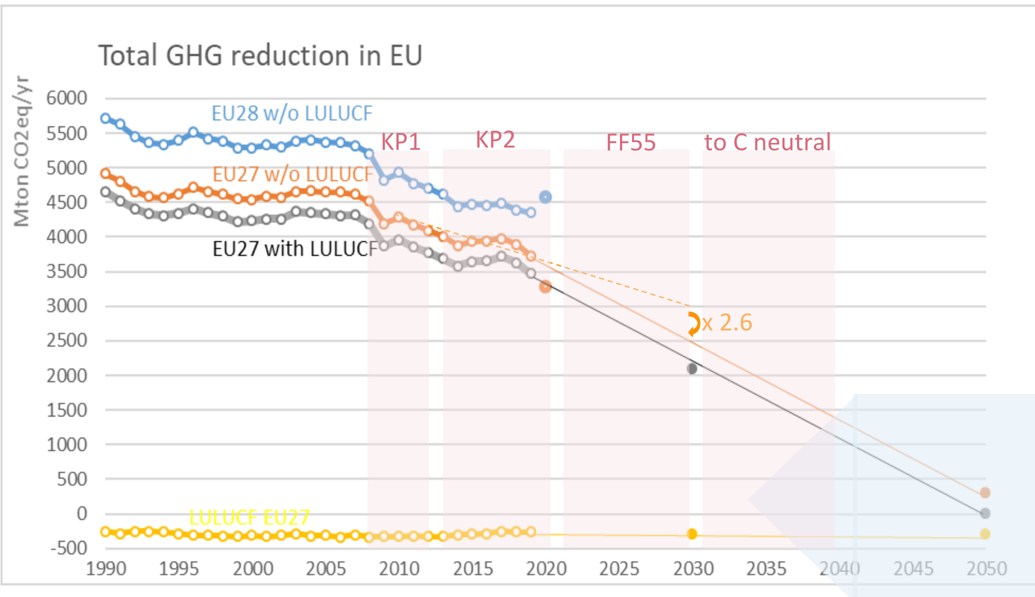
T6.4 Online visualization of the trends of GHG emissions from sources and sinks and progress towards reduction targets (NDCs) (Roxana Petrescu, VU Amsterdam, The Netherlands)

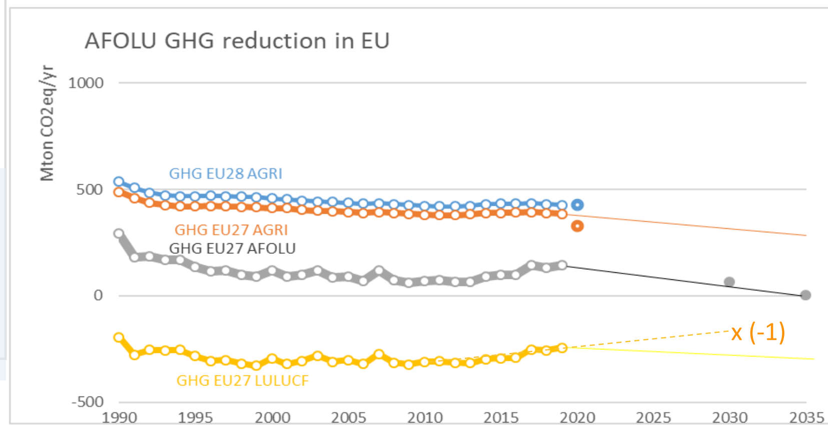
T6.5 Online visualization of regional GHG budgets uncertainties and how new observations could reduce them (Roxana Petrescu, VU Amsterdam, The Netherlands)

T6.3 Establishment of the project-level data and information infrastructure (Philippe Peylin, LSCE, France)

T6.1 Annual GHG fact sheets for the EU as a whole (what for?)

- starting from ETS, adding ESD & later LULUCF under mitigation targets:
  - More holistic but more uncertain!
  - Problem in linking incentives and carbon tax
- Acceleration (x2.6) of GHG reduction is needed (REPowerEU)
- Climate-neutral land use by 2035 needs a reversing of the declining carbon sink





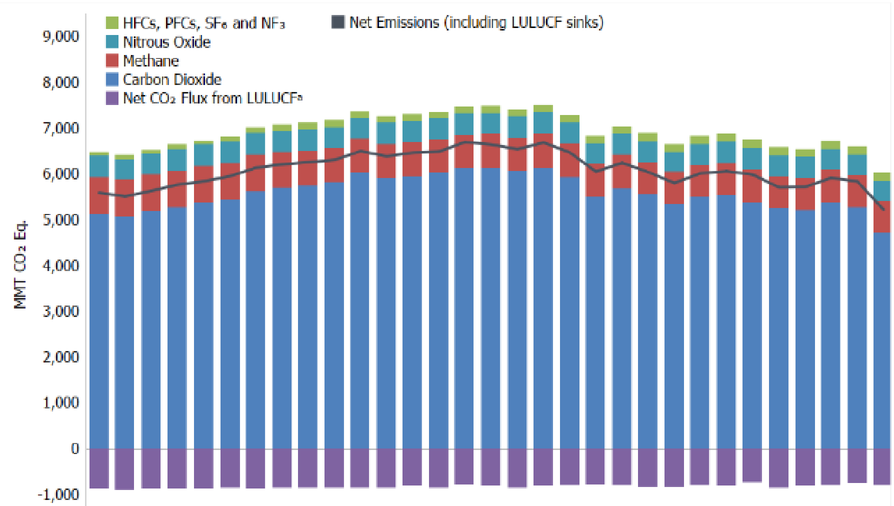
T6.2 Annual GHG budget fact sheets for US, China, Indonesia based on the methodology of Task 6.1

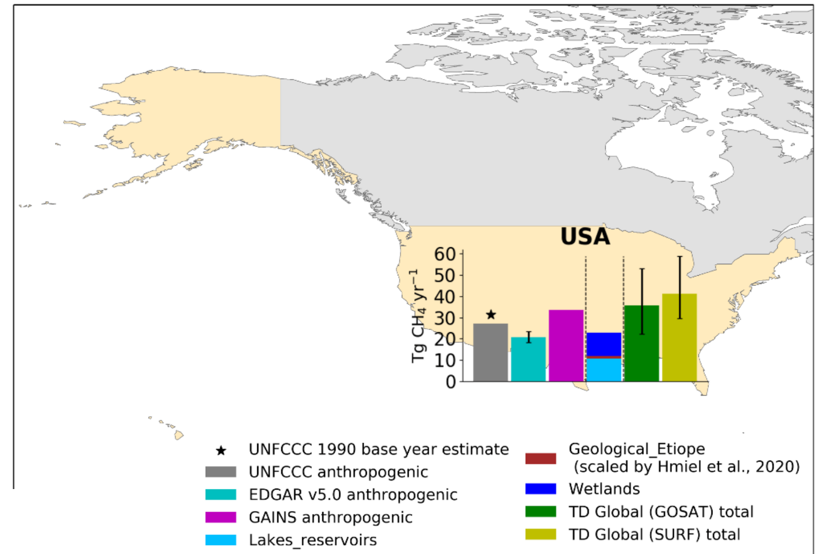
Closed workshop (May 2021) with USA, China and Indonesia (research community + natinal inventory compilers)

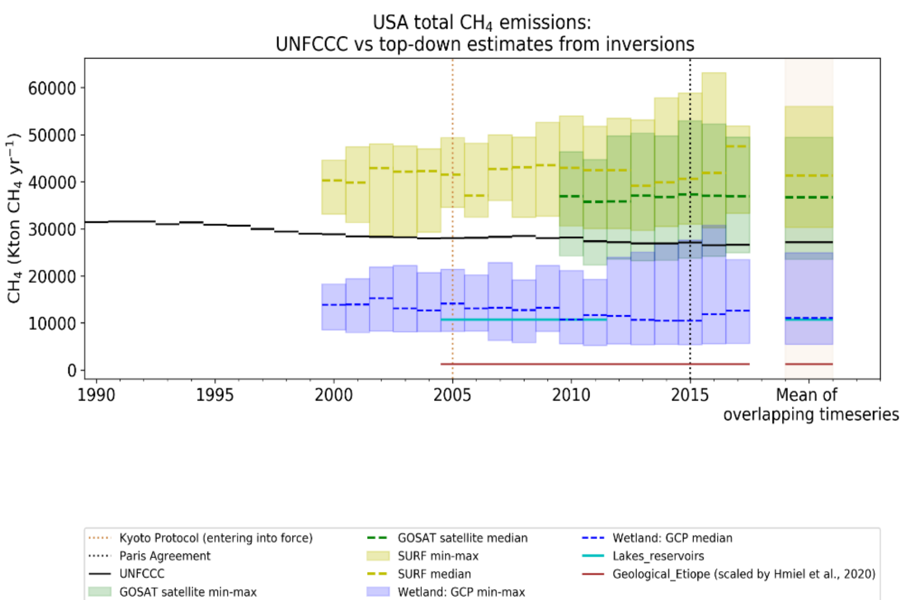
International AFOLU GHG workshop (November 2021) with CEOS/CGMS, GFOI, GEO, GCOS, GOFC-GOLD

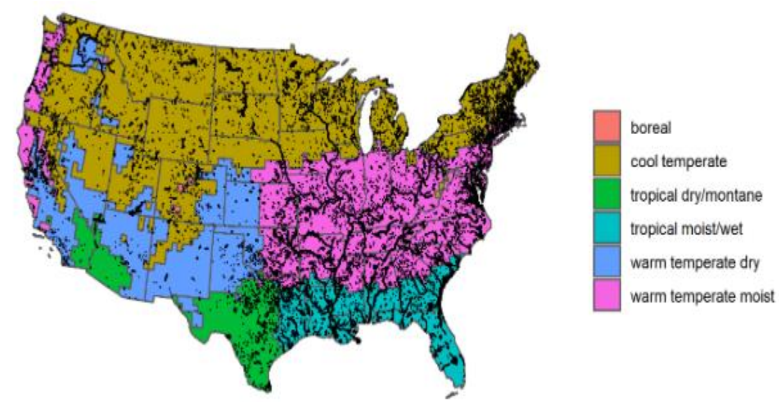
Data sets and standards, Policy needs and user requirements, C cycle community, research needs, MVS system

T6.2 Annual GHG budget fact sheets for US based on International methodology of Task 6.1



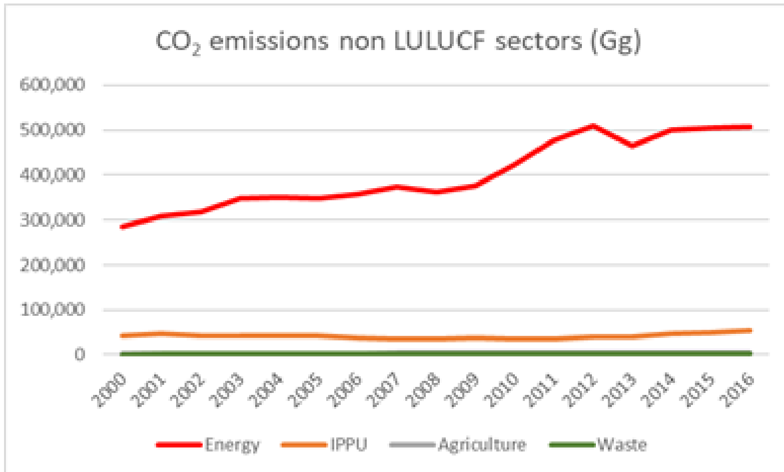




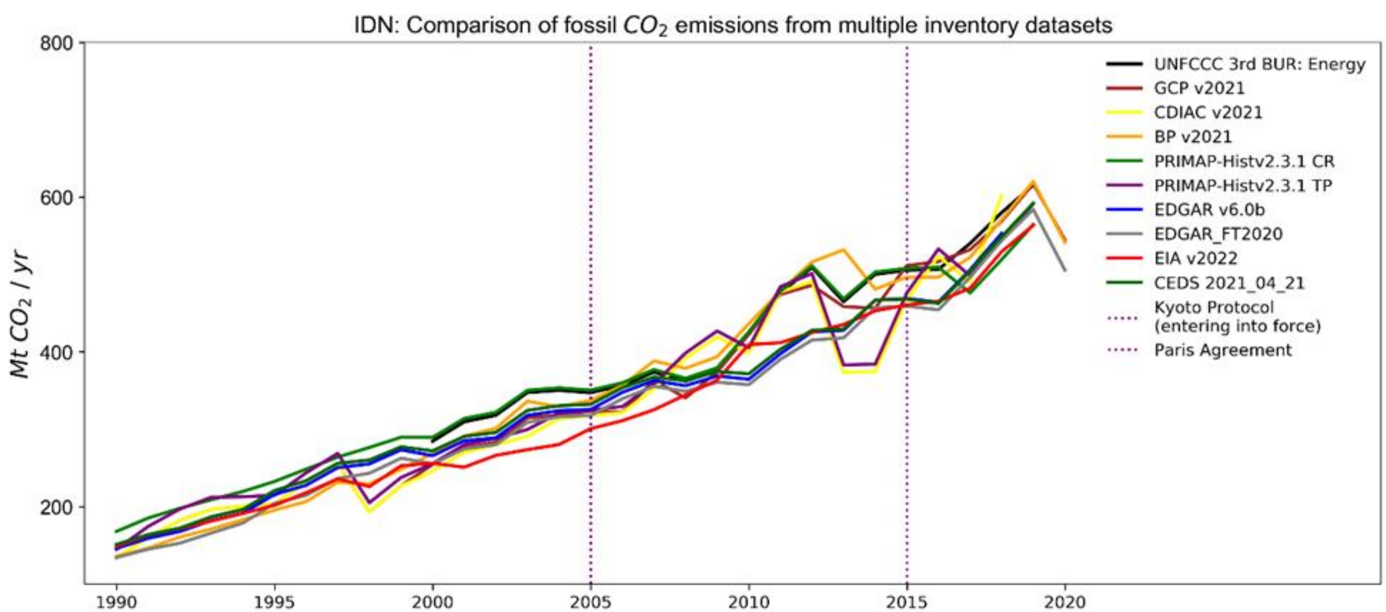


T6.2 Annual GHG budget fact sheets for Indonesia based on the methodology of Task 6.1

Fossil CO_2



2nd BUR
Trend: +10.6%/yr growth
Energy predominant sector



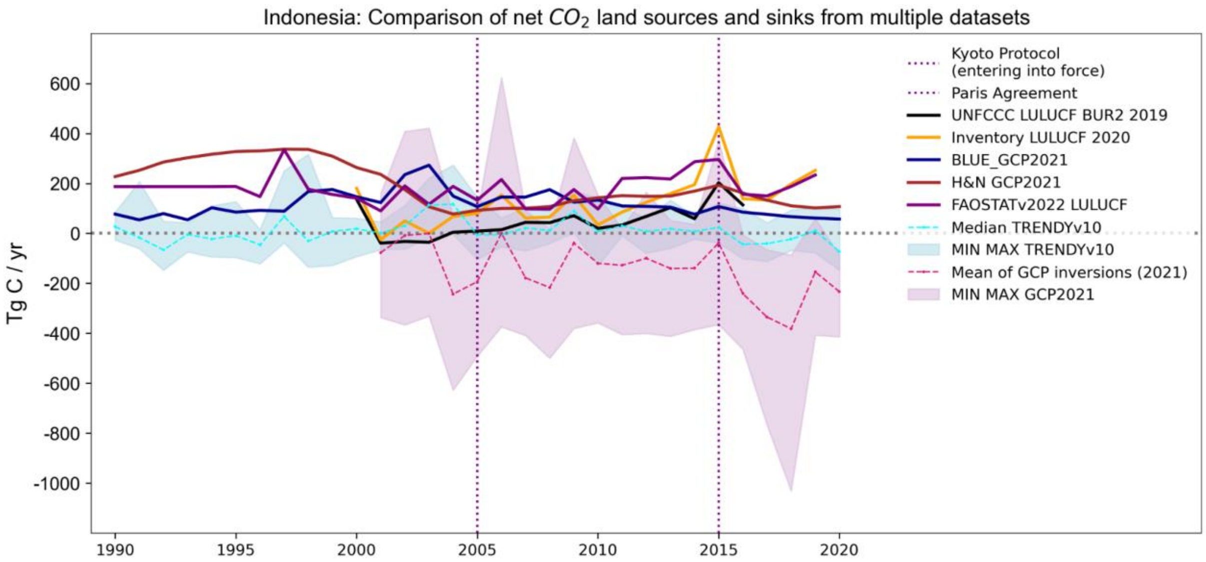
3rd BUR (+2017-2019)
trend comparable
Inventory values at upper end of the range

T6.2 Annual GHG budget fact sheets for Indonesia

CO_2 land

2[nd] BUR & most recent 2020 inventory indicate net (substantial) emissions, increasing trend

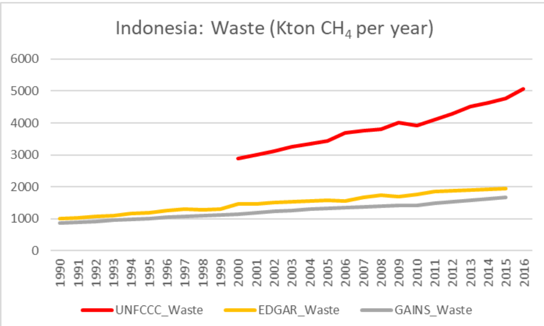
Forest and peat fires included

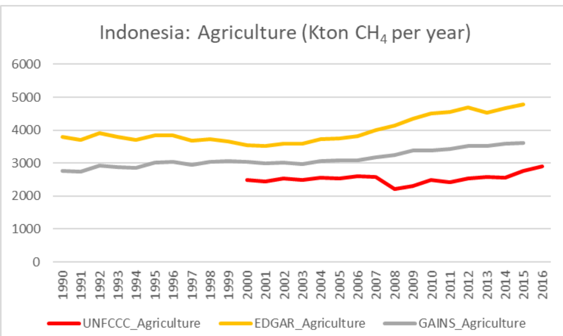


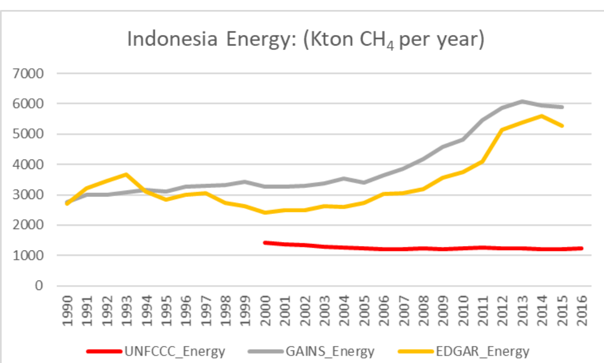
GCP2021 inversion/TRENDYv10 DGVMs: Net small emissions/sink

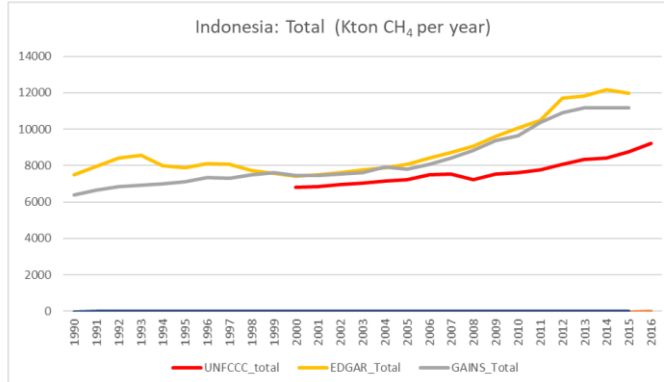
T6.2 Annual GHG budget fact sheets for Indonesia

CH_4

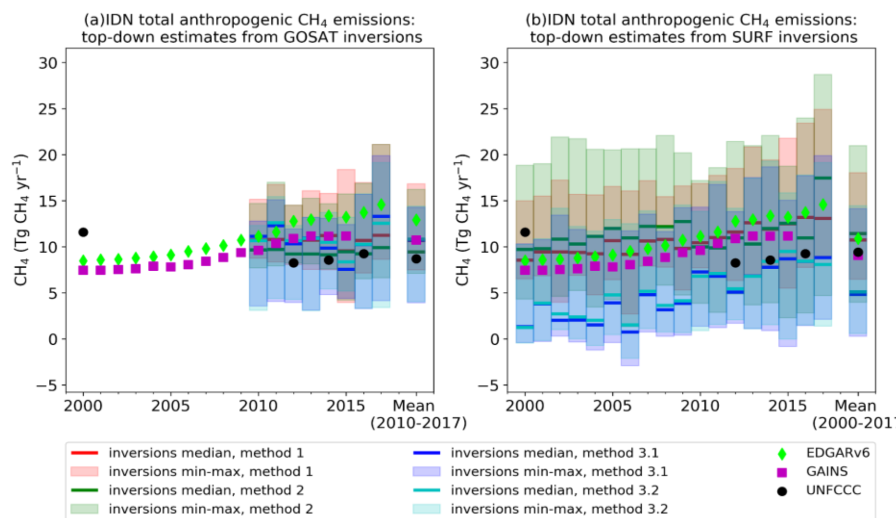






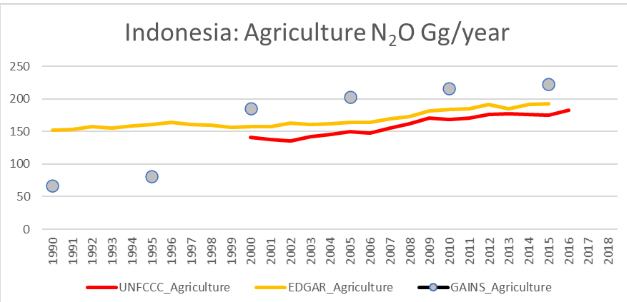


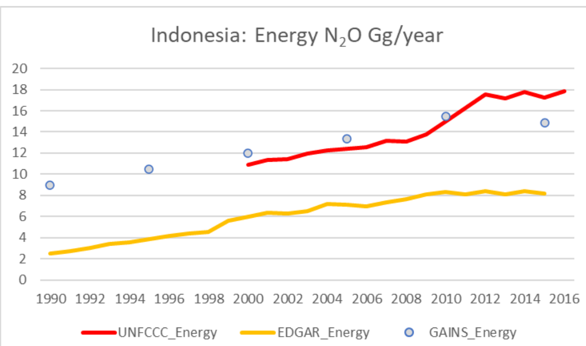
Inversions match well the trends of the inventories and BU sources

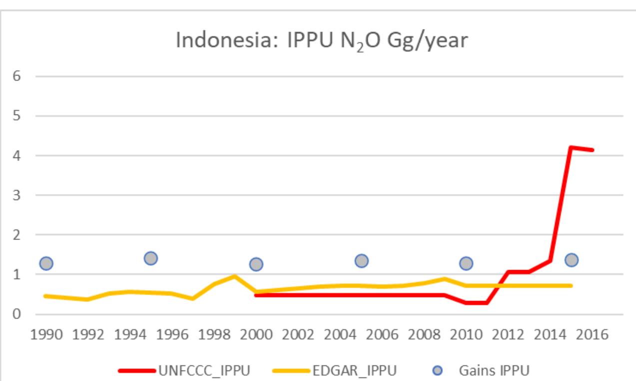


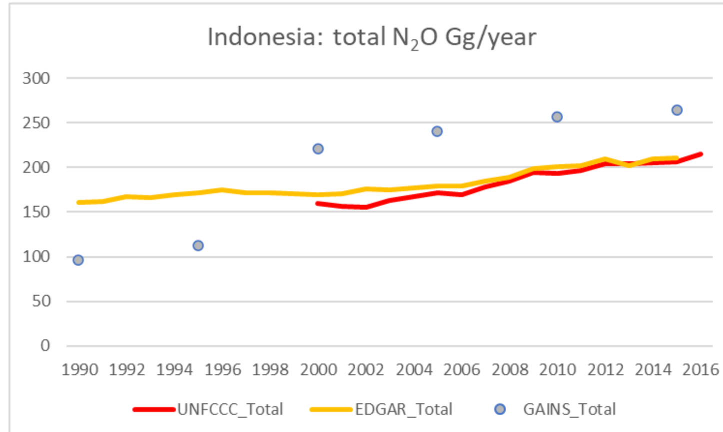
T6.2 ANNUAL GHG BUDGET FACT SHEETS FOR INDONESIA

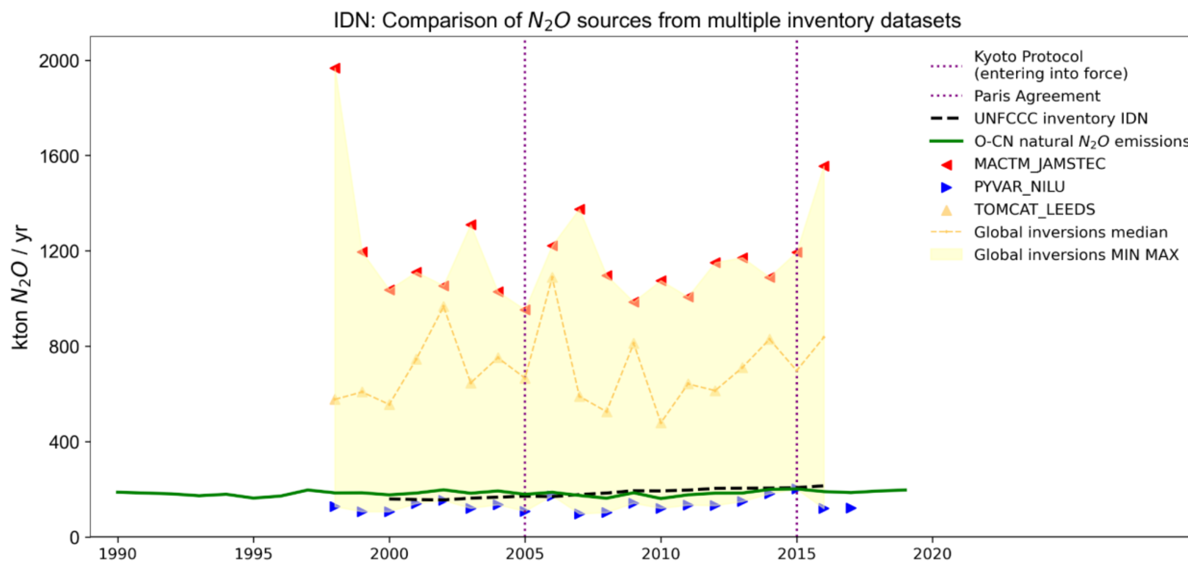
N_2O











CONCLUSIONS INDONESIA FACTSHEETS

- Check datasets (draft) factsheet D6.5 and 3rd BUR;

- For CO_2 land, substantial differences between inversions/DGVM's and inventories

- mismatch of TD observations and BU estimates are for biomass use explained in the delayed effect of consumption due to international trade, which plays an important role.

- BU estimates of biomass fires are not very reliable (and show large changes over the years – related to change in methodology)

- Inversions suggest an underestimation of both CH_4 and N_20 emissions in the inventory

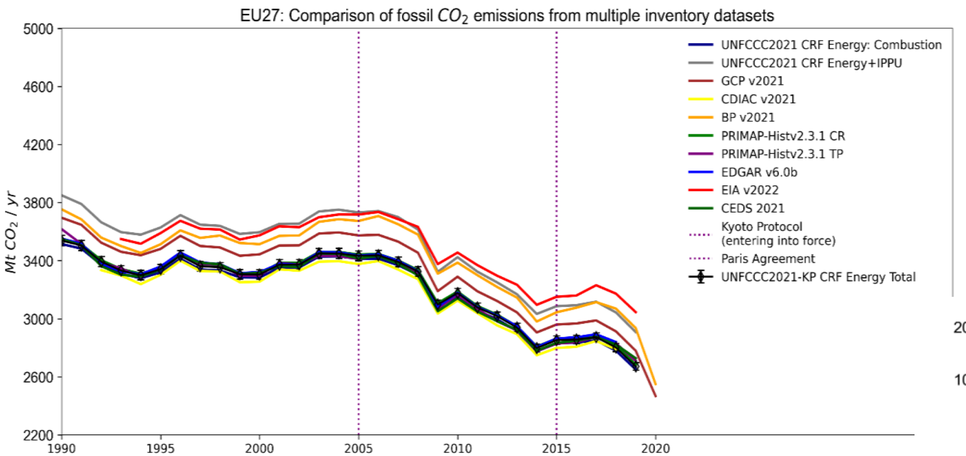
- N_2O data are not collected regularly and are therefore highly variable

T6.4 Online visualization of the trends of GHG emissions from sources and sinks and progress towards reduction targets (D6.11)

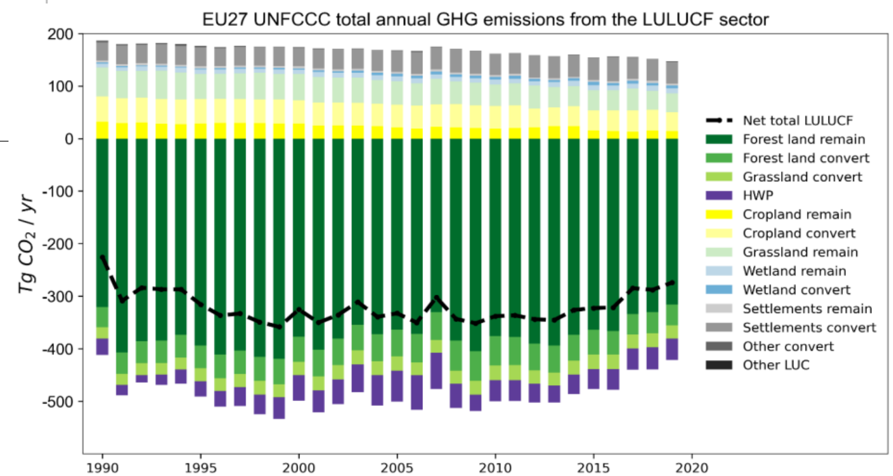
- Where do EU27 and three case study countries USA, China and Indonesia stand in terms of their current GHG emissions?

- How about performance towards meeting their reduction targets?

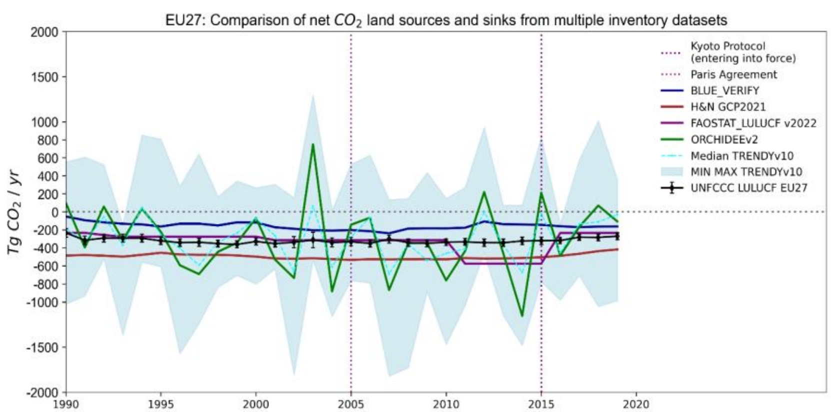
Observation-based estimates – EU27

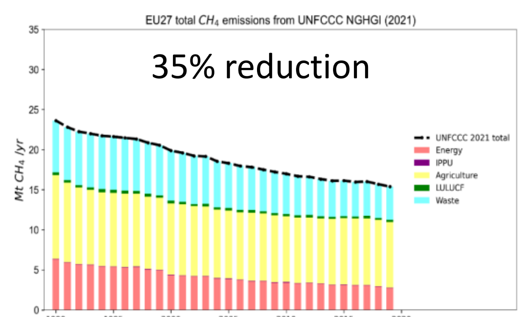


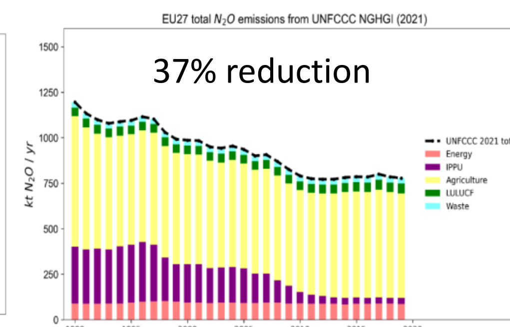
net reduction of 27 % in 2019 compared to 1990.
KP1: 12%
KP2: under evaluation in 2022, expected 25%



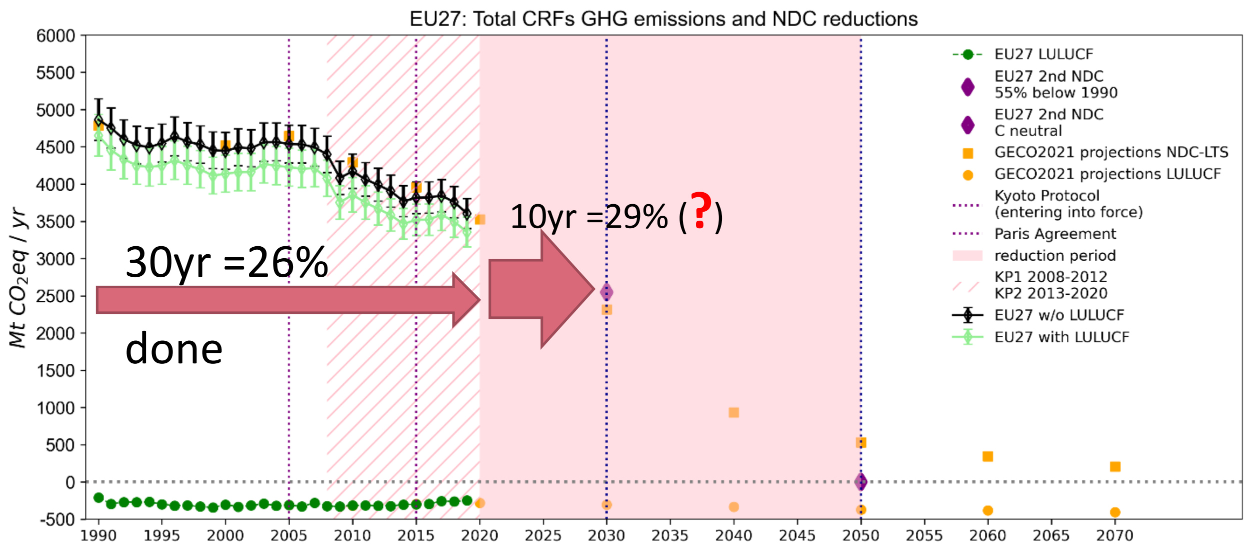
small sink increase of 16 % in 2019 compared to 1990.
Decreasing trend is mainly due to aging forest, increased harvest rates and disturbances







NDCs EU27 TOTAL AND AFOLU

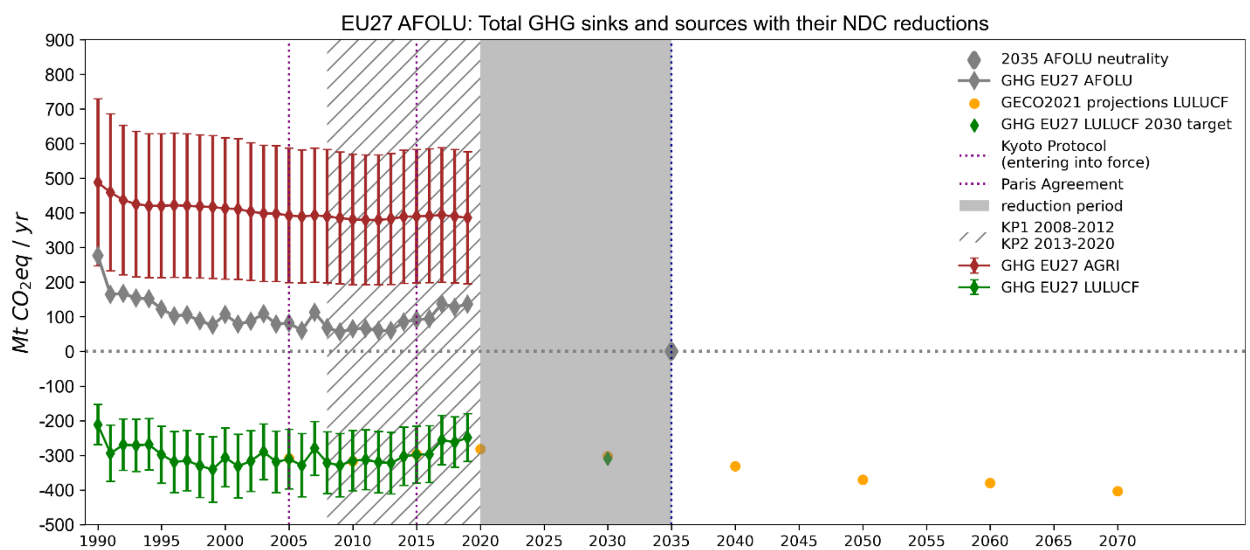


- EU27 pledge from its 2nd NDC to reduce emissions 55 % below 1990 levels and achieving climate-neutrality in 2050.

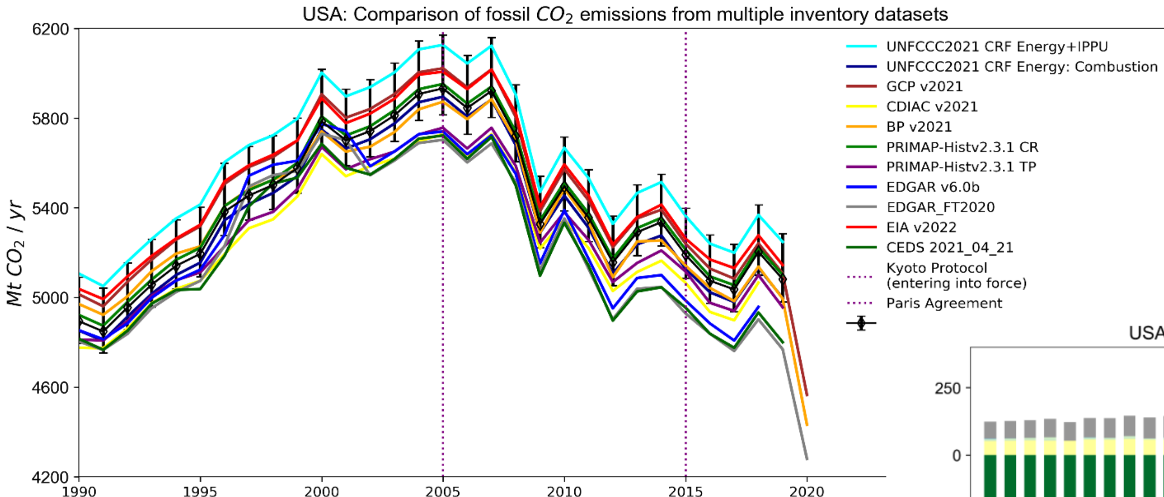
- End 2019 EU27 reduced 26%, ~1% / yr ...remains 29% till 2030 (~3% / yr)?

- revised LULUCF regulations including the target of 310 Mt CO_2eq sink by 2030 and AFOLU climate neutrality by 2035

~140 Mt reduction needed to reach 0 in 2035 for AFOLU

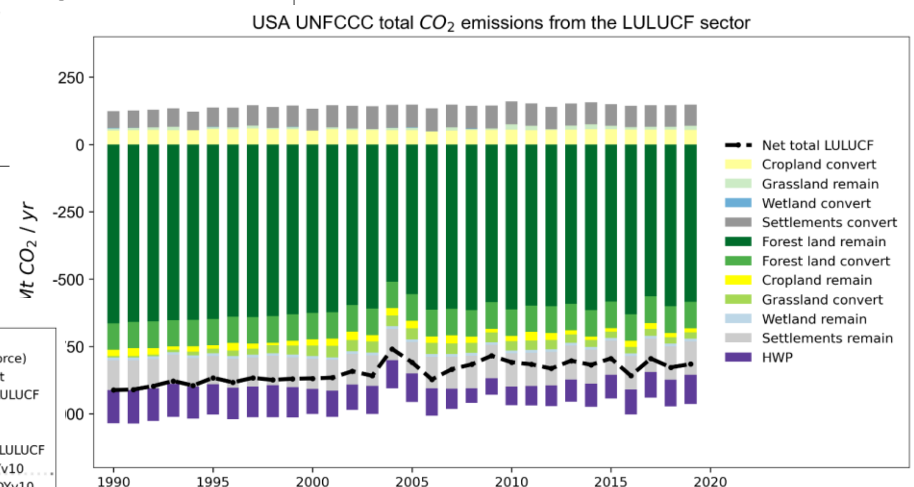


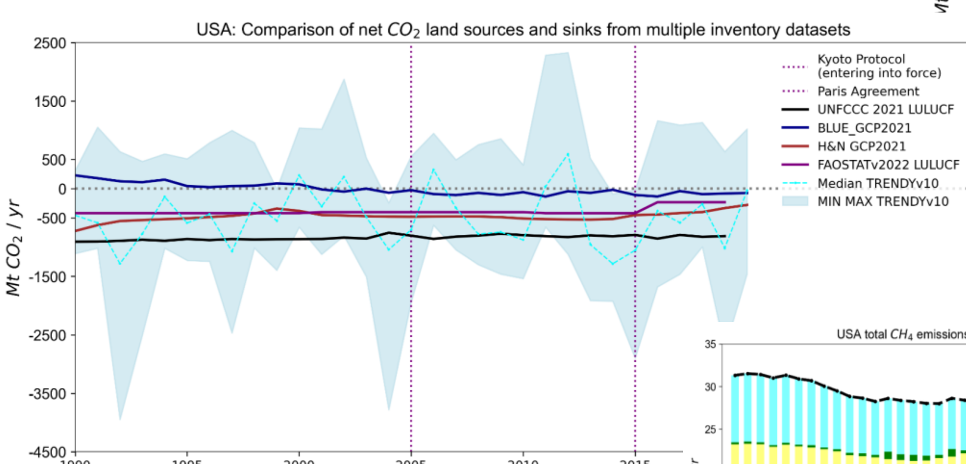
OBSERVATION-BASED ESTIMATES – USA

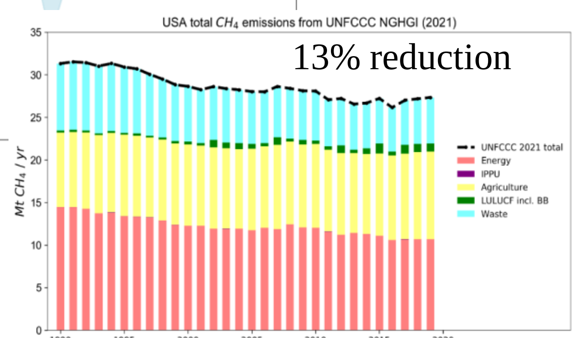


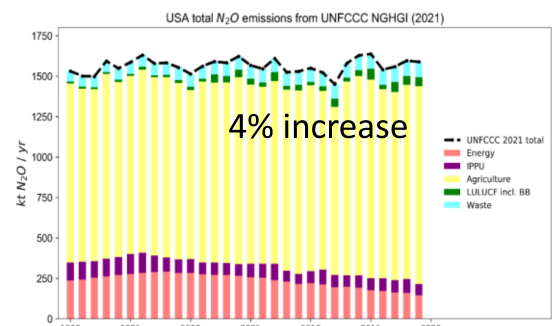
steep decrease (14 % in 2019 compared to 2007) due to the 2008-2010 economic crises.

In 2019 the LULUCF sink decreased with 11 % compared to 1990.

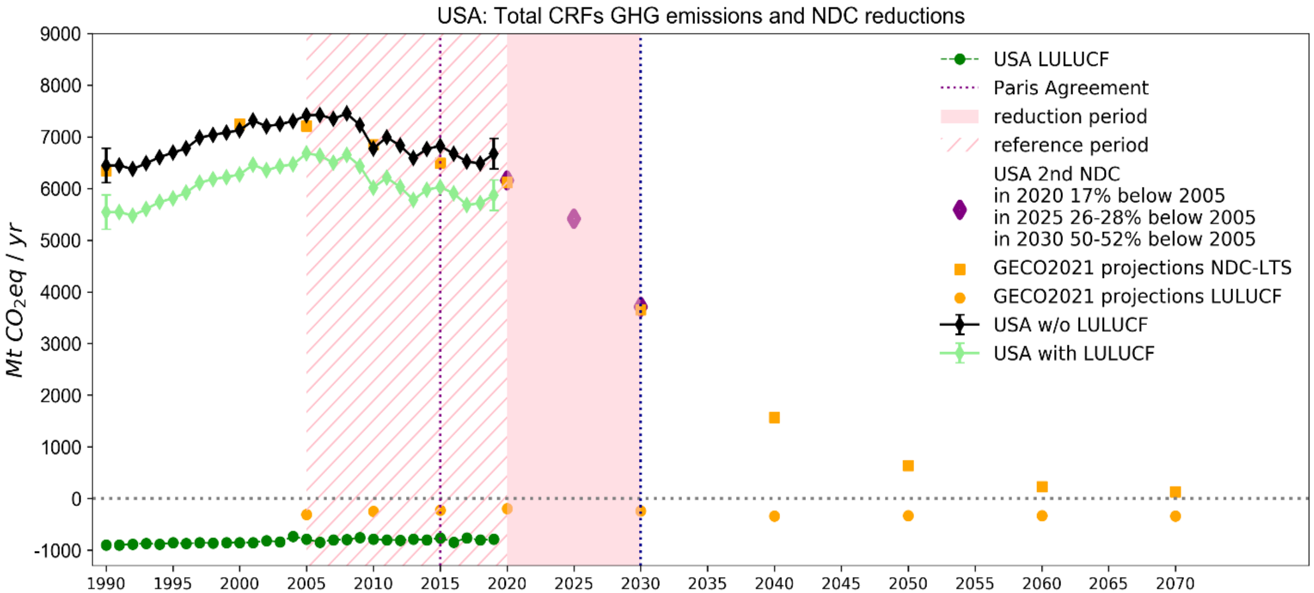






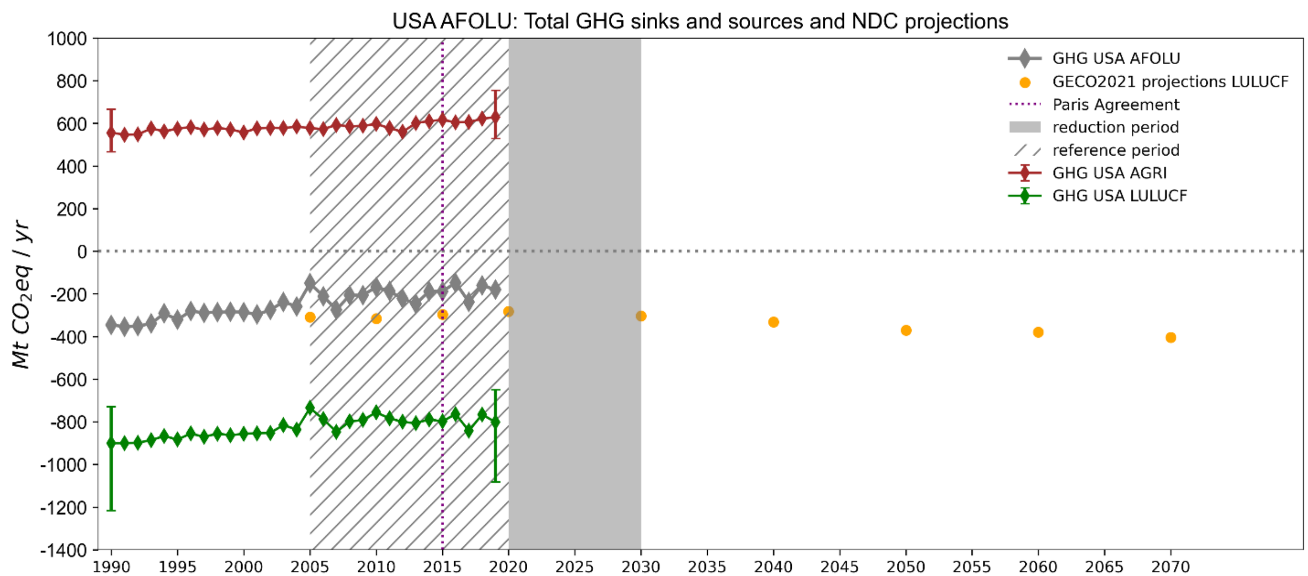


NDCs USA TOTAL AND AFOLU

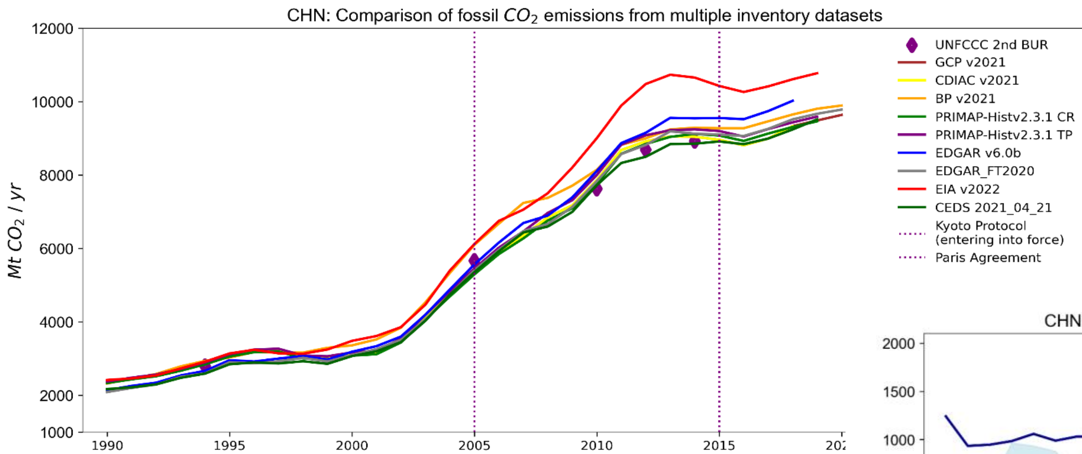


- United States is setting an economy-wide target of reducing its net greenhouse gas emissions by 50-52 % below 2005 levels in 2030.
- They surpassed its 2020 target with 17% below 2005 and expected to decrease 26-28% up to 2025

- Agriculture contributes 9.6% of total GHG emissions
- Soil management larger contributor of N_2O (75%)
- LULUCF C stock offsets total GHG emissions by 12% in 2019

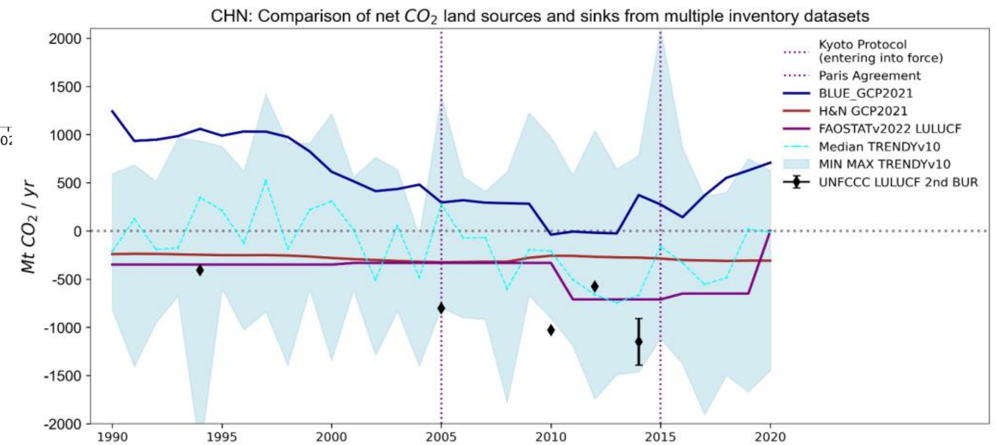


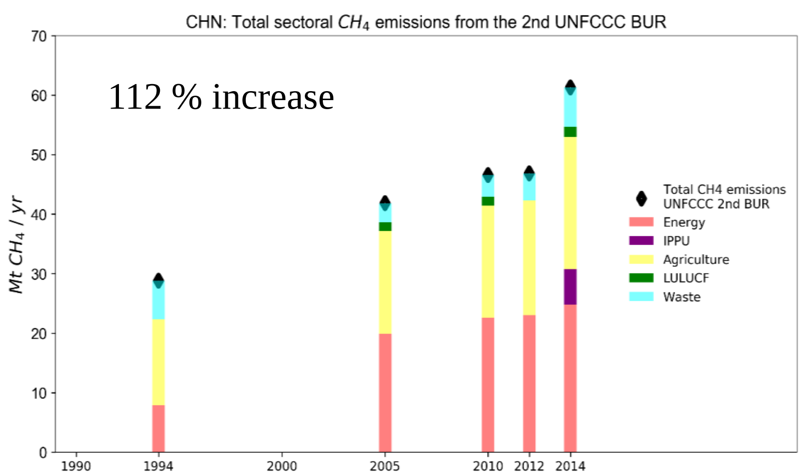
OBSERVATION-BASED ESTIMATES – CHINA

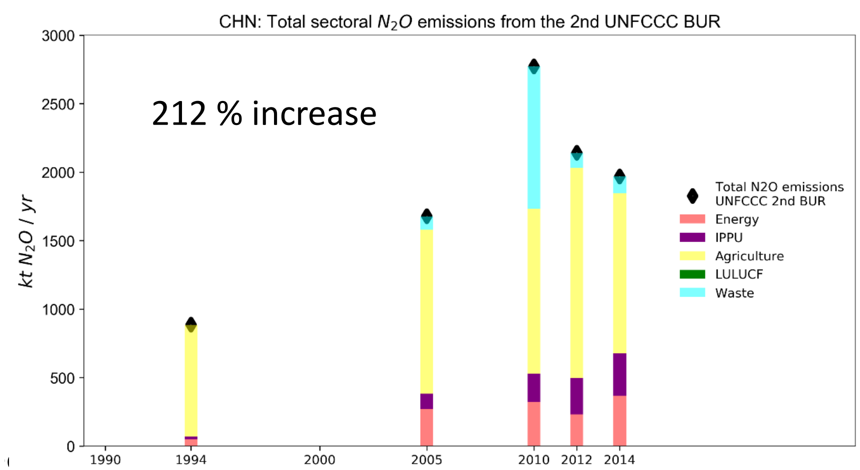


China plans to reach its peak of CO_2 emissions by 2030

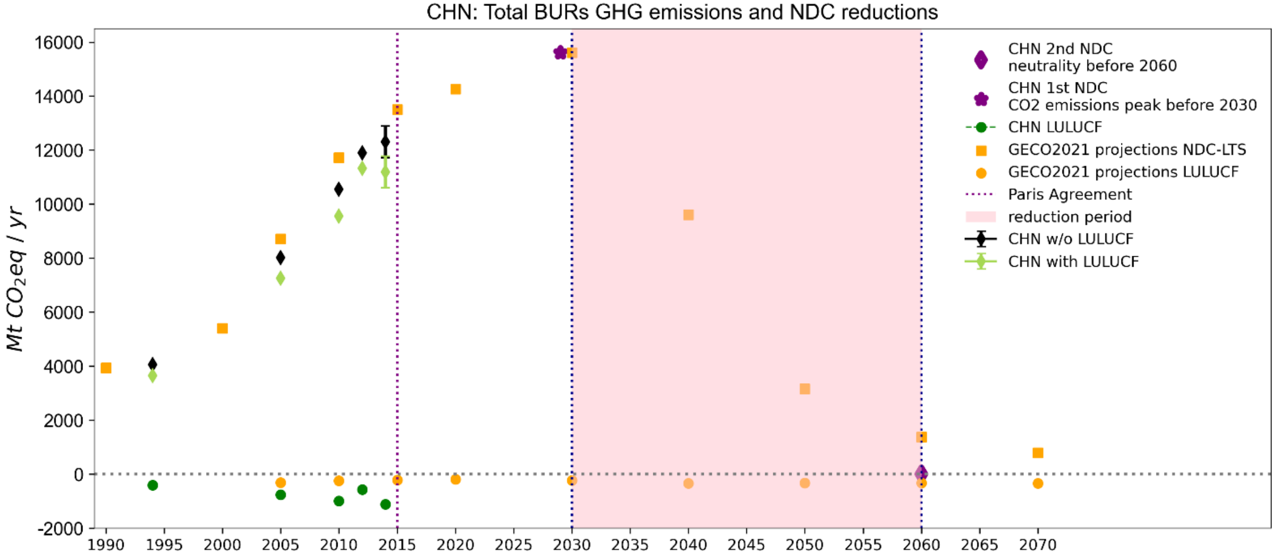
C sink in China tripled in 2014 (+183 %) compared to 1994







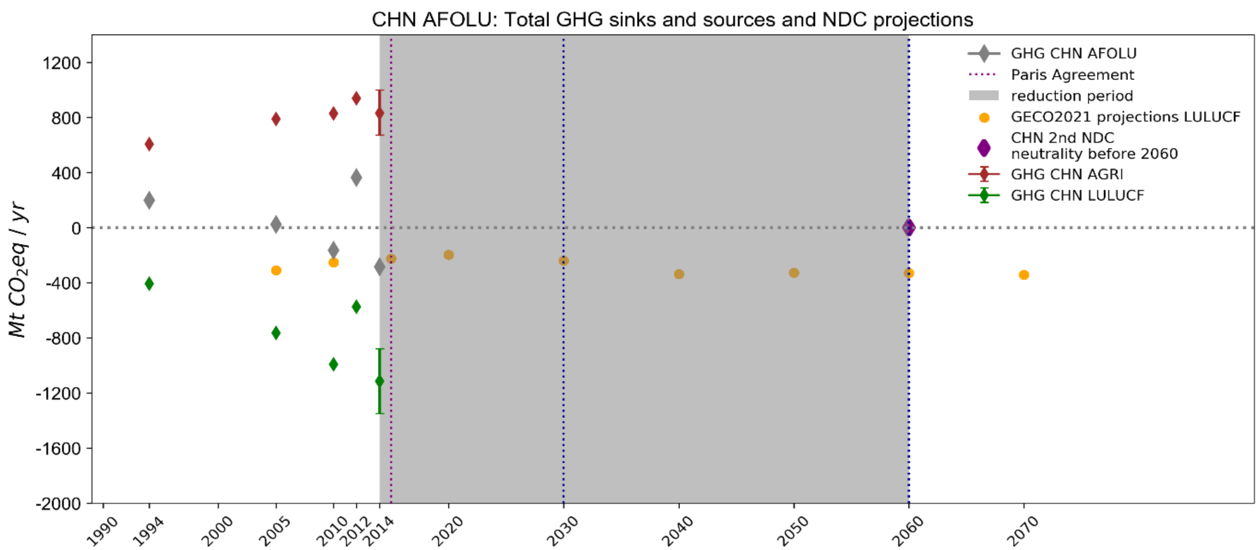
NDCs CHN TOTAL AND AFOLU



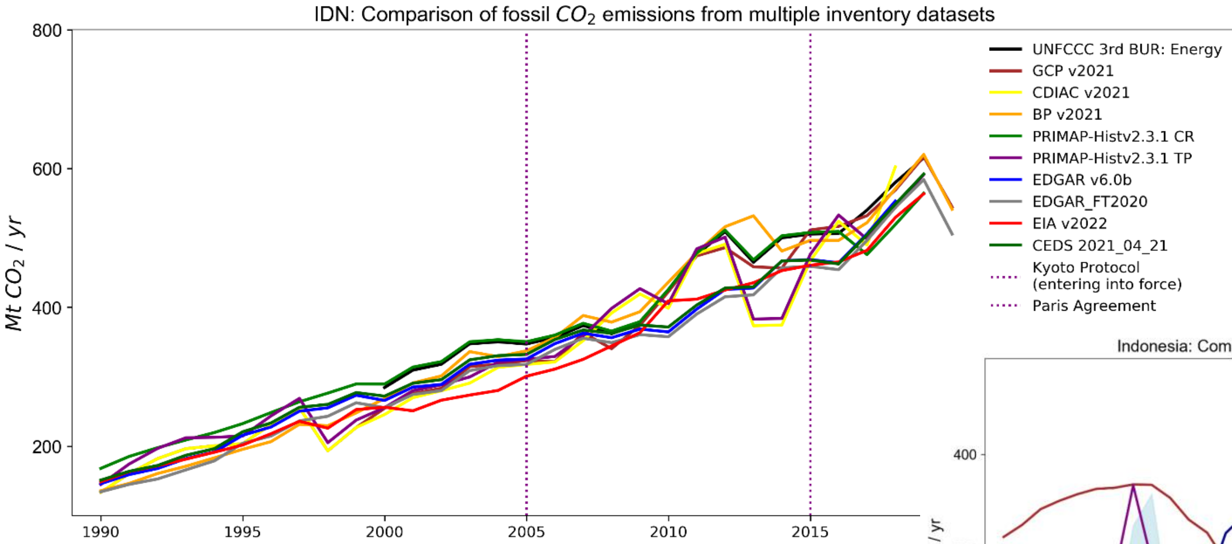
CHN aims to have CO_2 emissions peak before 2030 and achieve carbon neutrality before 2060;

Not clear if neutrality refers to CO_2eq or only CO_2!!!

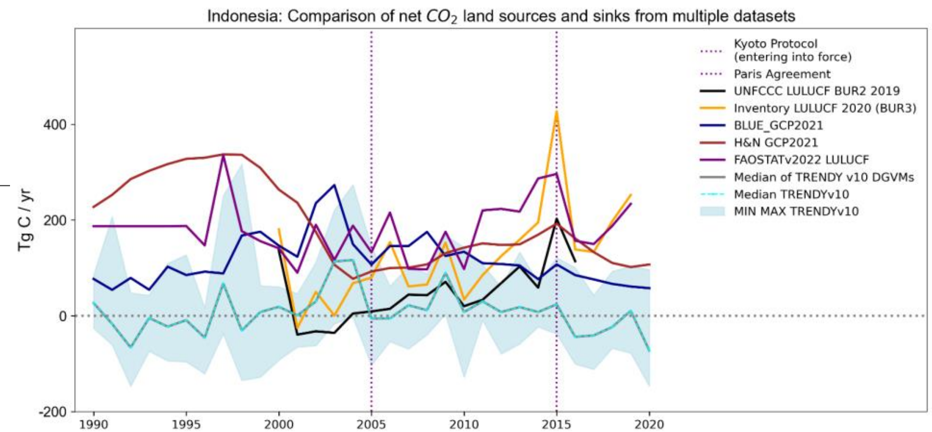
- China commits to reductions for the AFOLU sector by measures of reduces chemical fertilizers, green technologies and improved livestock productivity, energy-saving tech
- Large afforestation areas

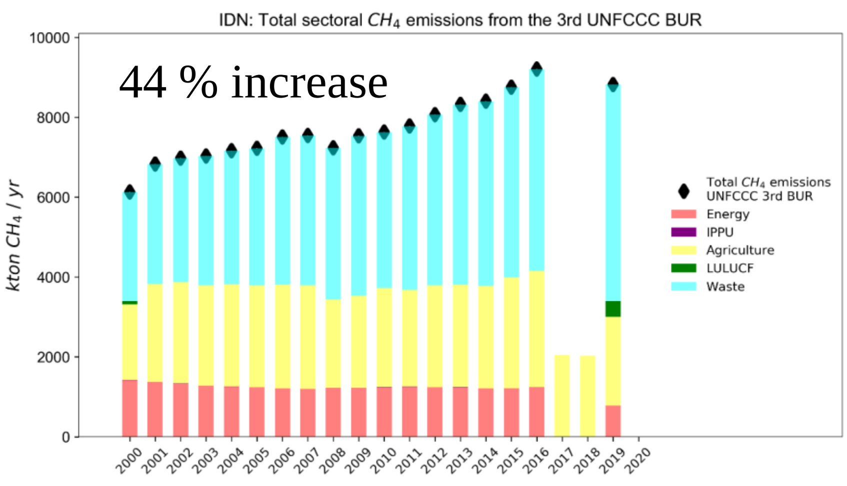


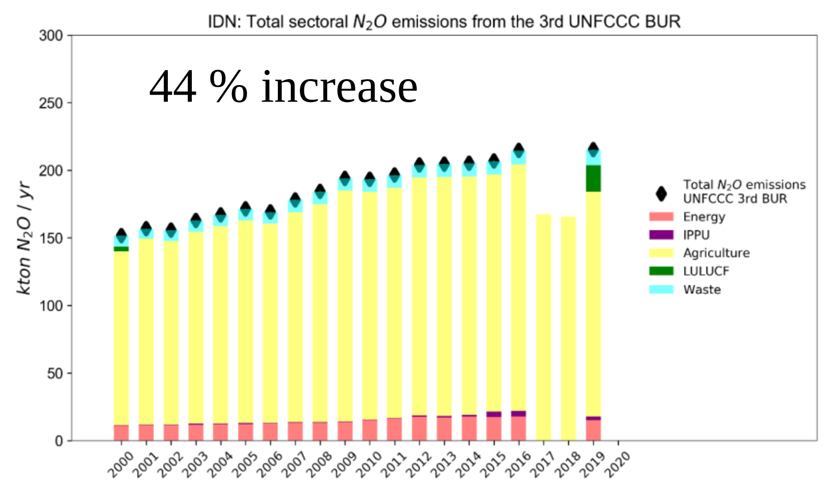
OBSERVATION-BASED ESTIMATES – INDONESIA



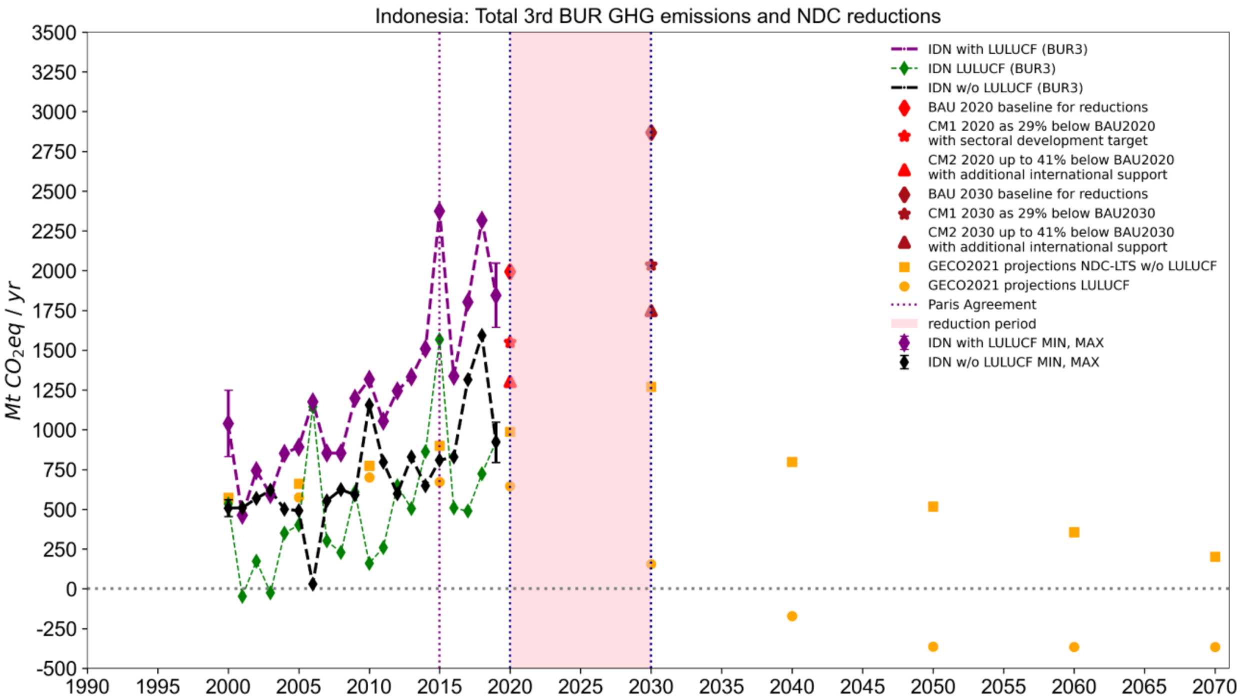
The IDN UNFCCC 2021 3rd BUR Energy emissions trends show a constant increasing trend (116%)





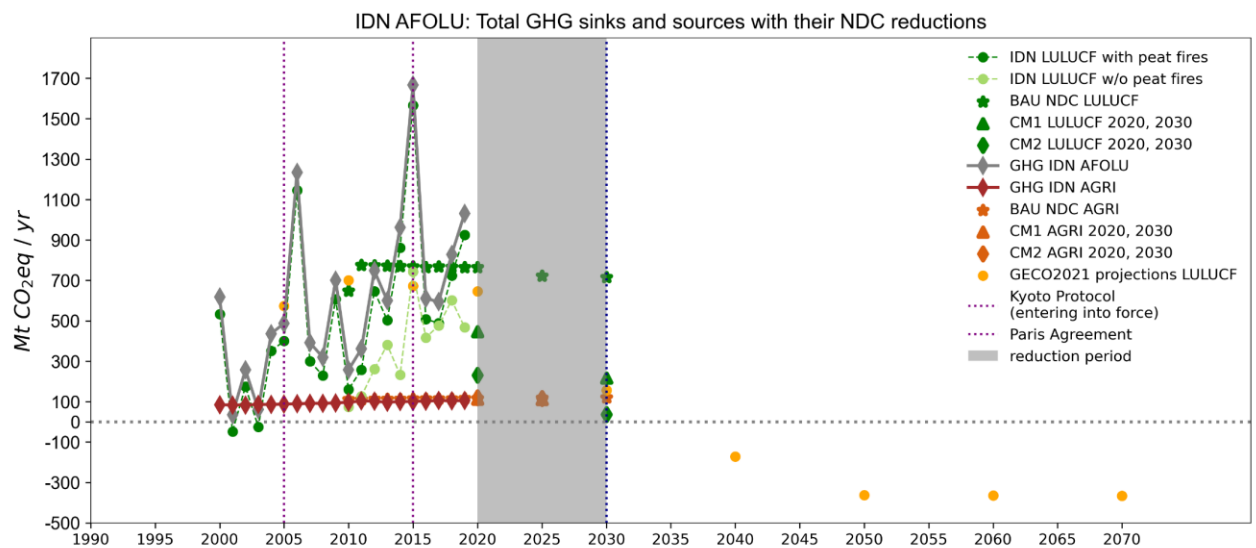


NDCs IDN TOTAL AND AFOLU



CM1 (29% reduction) and CM2 (up to 41% reduction) from BAU

Inventory fluctuations include fires



CM2 LULUCF reduction very ambitious: 36 Mt CO_2eq in 2030! (in 2020 BAU = 764 Mt CO_2eq)

CONCLUSIONS

- Very different NDC targets between the 4 case studies
- EU27 reduced in the last 30 years 26% (2019 compared to 1990), remains 29% to be reduced in less than 10 years !!!
- Agriculture and LULUCF (AFOLU) will bear the burden of meeting next targets (neutrality in 2035)!

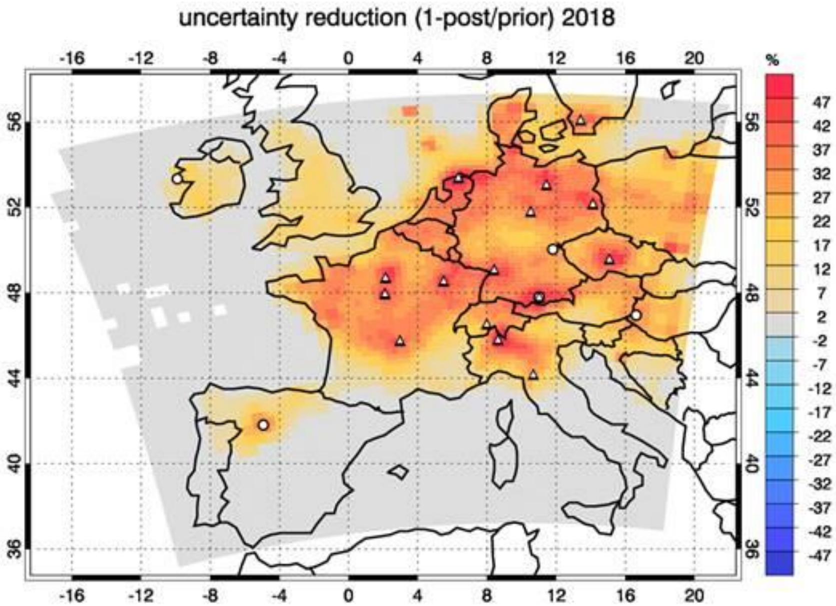
- USA is on the right path to meeting targets in 2030 (base year 2005 !)
- CHN and IDN are still to reach their maximum emissions

T6.5 Online visualization of regional GHG budgets uncertainties and how new observations could reduce them (D6.12)

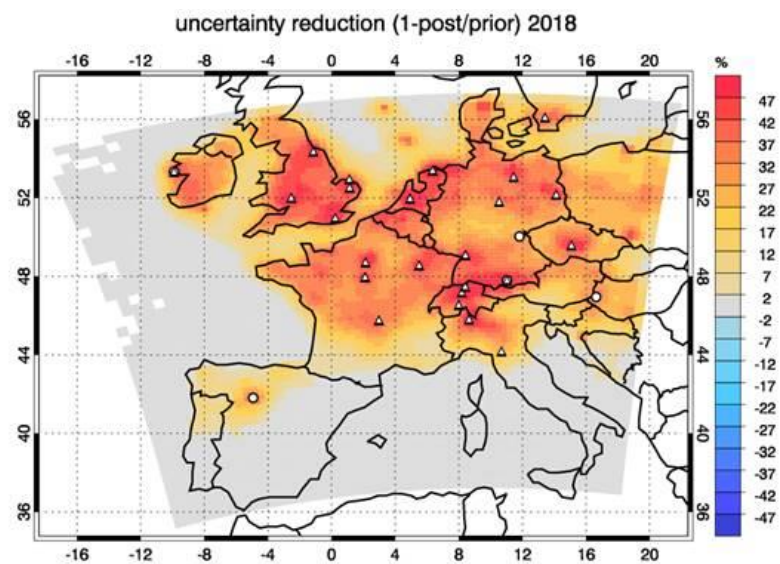
- Provide policymakers the knowledge on where in Europe extra efforts such as additional measurements and/or more accurate GHG accounting infrastructures would best reduce the EU-scale GHG budget uncertainty.

- The sensitivity of the existing network based on the source-receptor relationships calculated in WP2-4

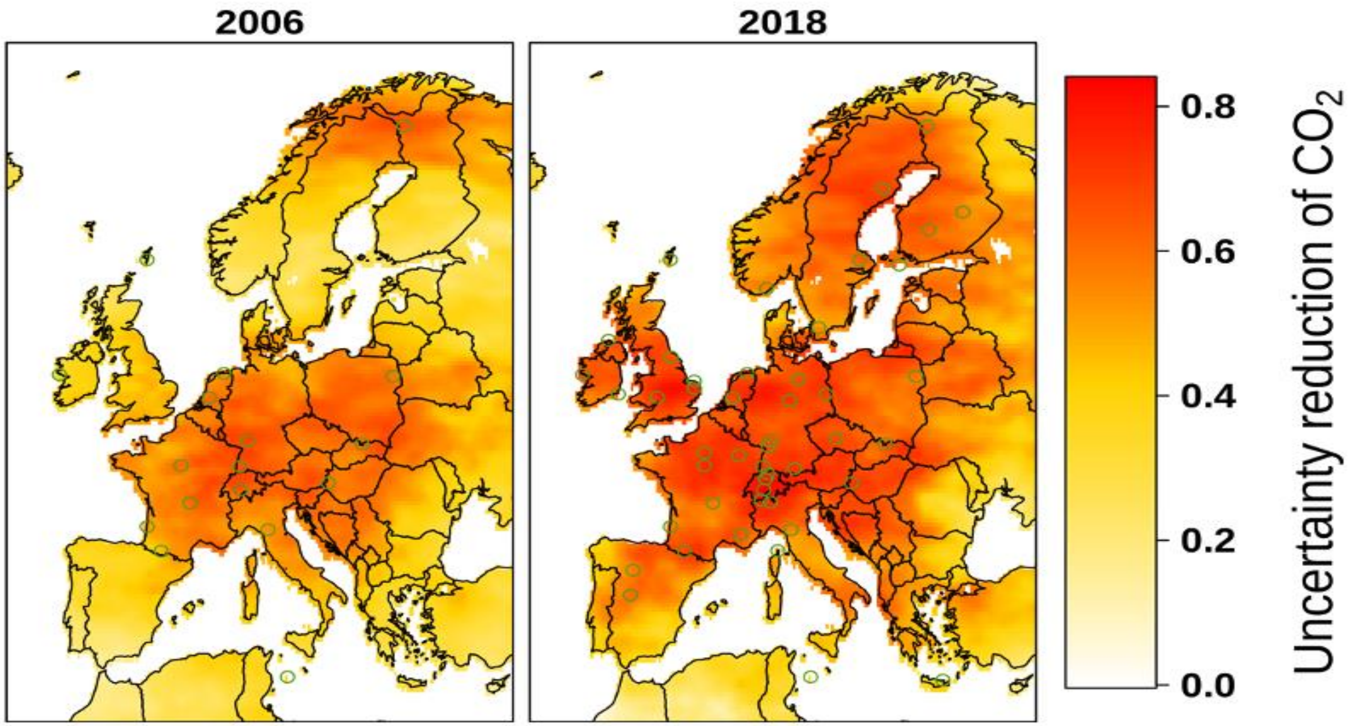
CH_4



FLEXINVERT uncertainty reduction maps computed as (1-post/prior) for 2018 with two <u>different sets of observation stations</u>.



CO_2



CarboScopeRegional uncertainty reduction maps computed as (1-Δpost/Δprior) for 2006 and 2018 using Monte Carlo approach on prior errors.

T6.3 Establishment of the project-level data and information infrastructure

Thank you for your attention.

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