ESA-CCI products to support
RECCAP-2 and the Global Stocktake

The Regional Carbon Cycle Assessment and Processes phase-2 overview and recent work

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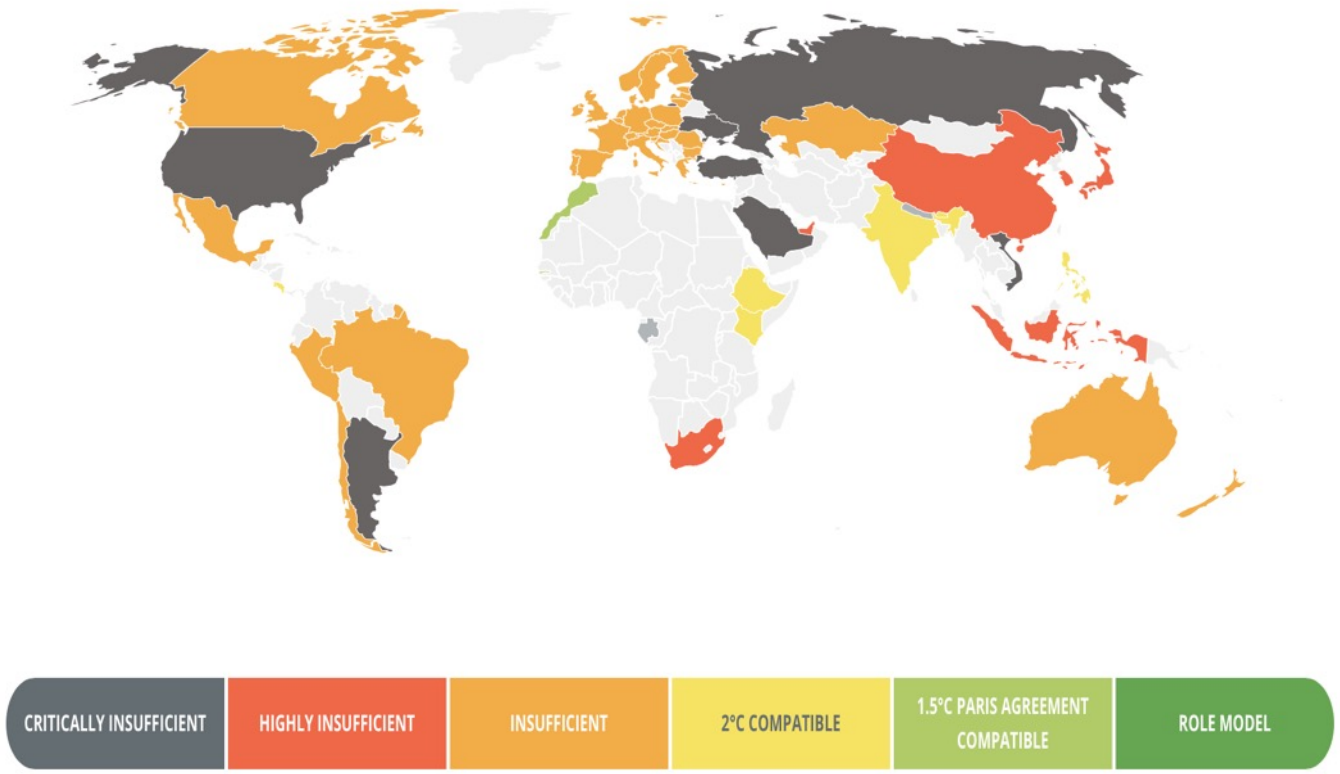
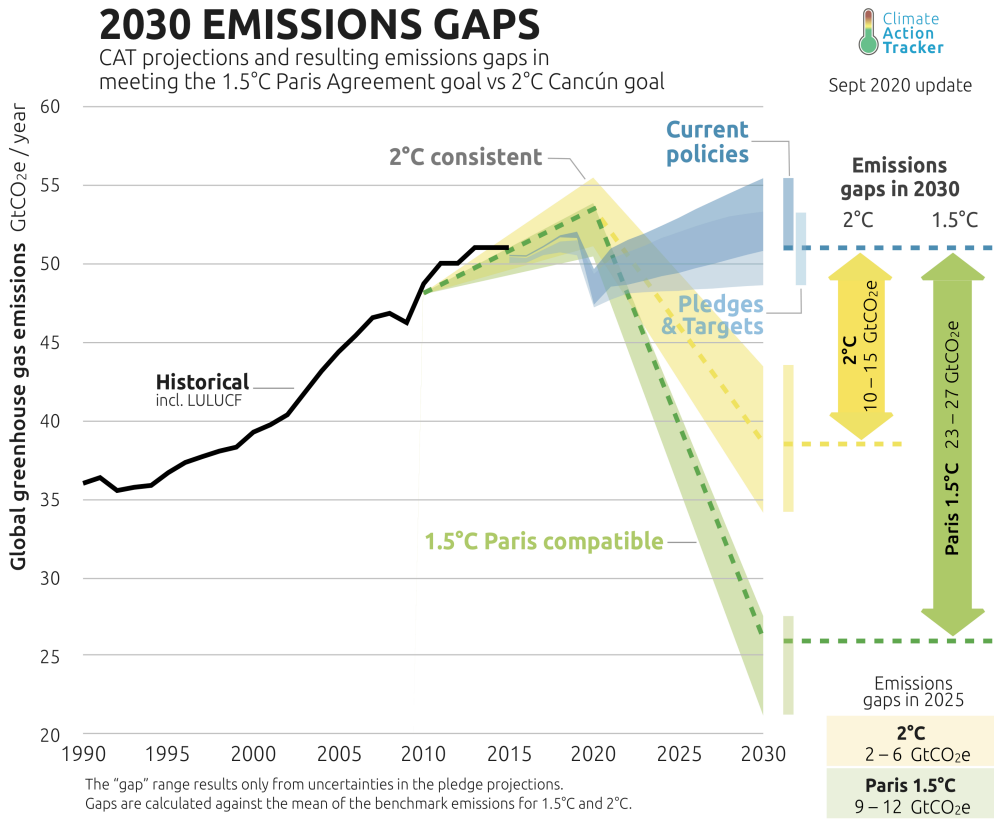
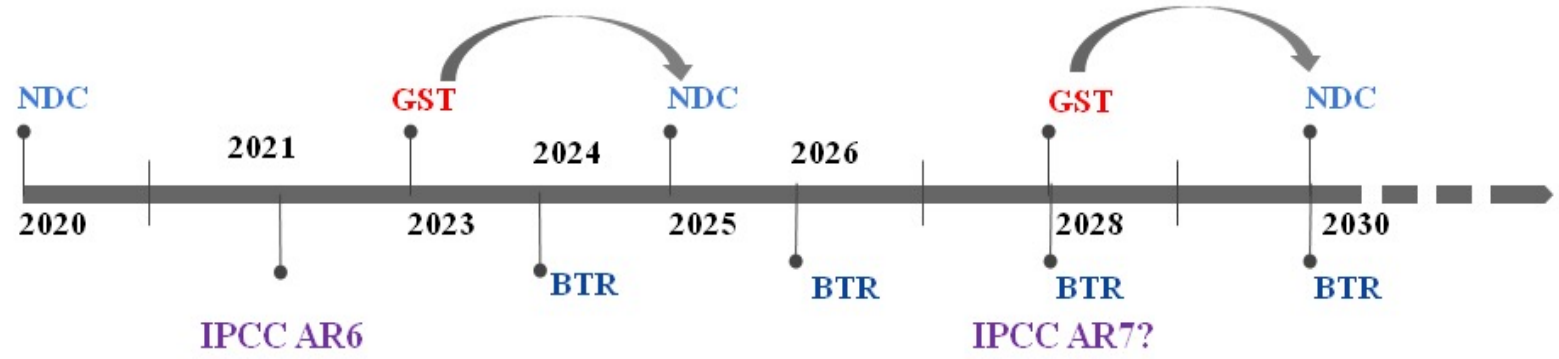
Current policies lead to a 3°C warming





Global stock take in 2023



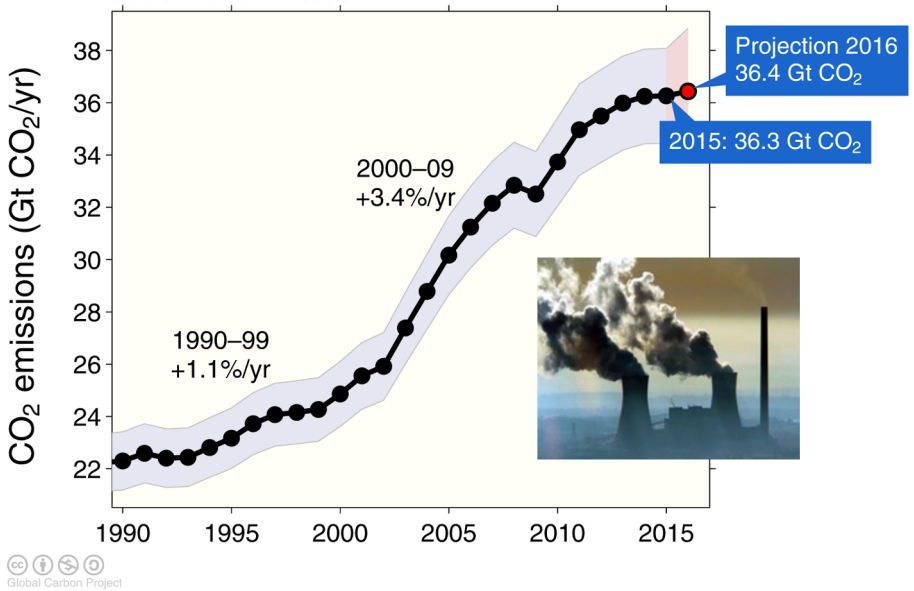
NDC: Focus on Mitigation, Adaptation on voluntary basis (every 5 years)
GST: assess the collective progress against long term targets (every 5 years)
BTR: GHG inventories - Track progress of NDC implementation (mitigation and financial support)
IPCC AR: Assessment Reports about knowledge on climate change, its causes, potential impacts and response options

Perugini et al. 2021

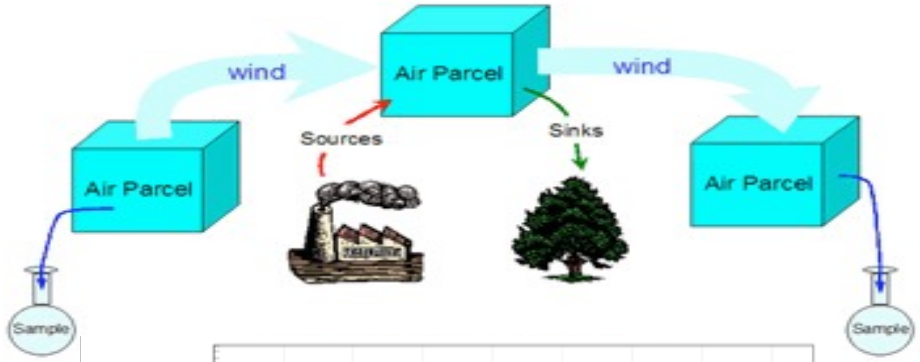
- The GST shall include information about **mitigation and adaptation processes**, and the **means of implementation and support**, based on the best available science and the equity concept.
- The process should inform Parties whether the **cumulated efforts** of all the Parties is in track with the "well-below 2°C" trajectory, thus providing indication on how to enhance and update their actions at national level and through cooperation.
- The outputs of the GST should, thus, provide indication of opportunities and challenges for **enhancing action and support**.
- The process needs to be **transparent**, in the light of **equity and best available science** and it is strictly Party driven, although external experts are invited to participate to support the process.

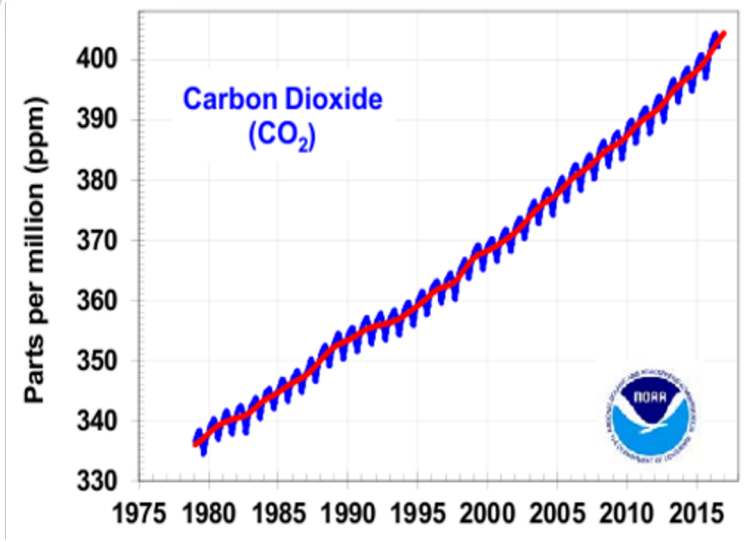
Bottom-up and top-down

CO2 emissions and sinks:
by bottom-up inventories : energy use data, biomass and soil C stock change



CO2 sinks : fixed prior emissions from inventories & concentration measurements and transport models





Deng, Zhu et al. , ESSDD, 2021

Introduction of Inversions

CO2 : 6 in-situ inversions to 2019
Same prescribed fossil fuel emissions ; only the land flux is optimized
1979-2019
[2014-2019 = 6 OCO2 inversions]

CH4 : 17 inversions to 2017*
Separation of sectors in priors in most of them
2000-2017 = 9 in-situ inversions & 2 combined inversions
2009-2017 = 8 satellite inversions (GOSAT)

N2O : 3 inversions to 2017*
2000-2017 = 3 in situ inversions

Data from Global carbon project publications

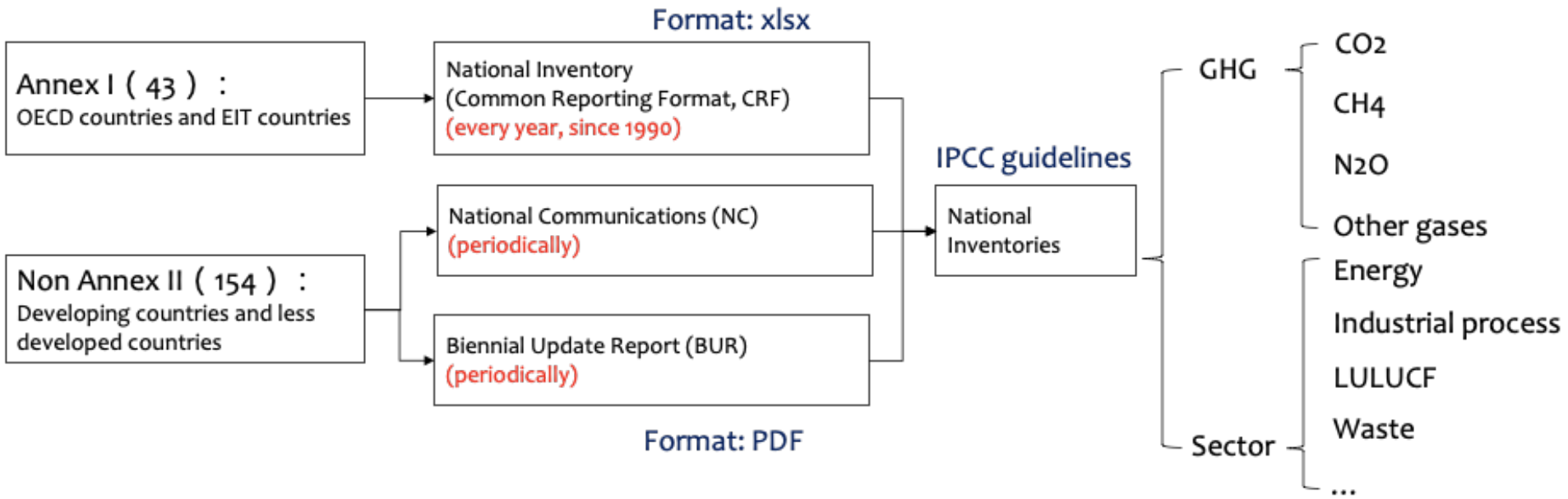
- work will be updated with the new inversions of CH4 and N2O up to 2020,

Compilation and harmonisation of National Inventories

Submitting national inventories periodically to UNFCCC - commitment of the parties

「All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall:(a)Develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties……」

Format: xlsx



Deng, Zhu et al. , ESSDD, 2021

Grouping of sectors from National Inventories to match inversions

Gas	Super sectors in this study	Inversions	Inventories
CO2	Net Land Flux	Total - Fossil	Net emissions - (Energy + Industrial Processes)
CH4	Total anthropogenic	Fossil + Agriculture & Waste + Biomass Burning	Energy + Industrial Processes + Agriculture + Waste + Biomass Burning
	Fossil (including oil, gas, coal)	Fossil	Energy + Industrial Processes - Biofuel Burning*
	Agriculture & waste	Agriculture & waste	Agriculture + Waste
N2O	Anthropogenic	Total - pre-industrial inland waters - pre-industrial soil emissions	Agriculture + Waste direct + anthropogenic indirect emissions (AIE)* (= anthropogenic N leached to inland waters + anthropogenic N deposited from atmosphere) + energy and industry

Deng, Zhu et al. , ESSDD, 2021

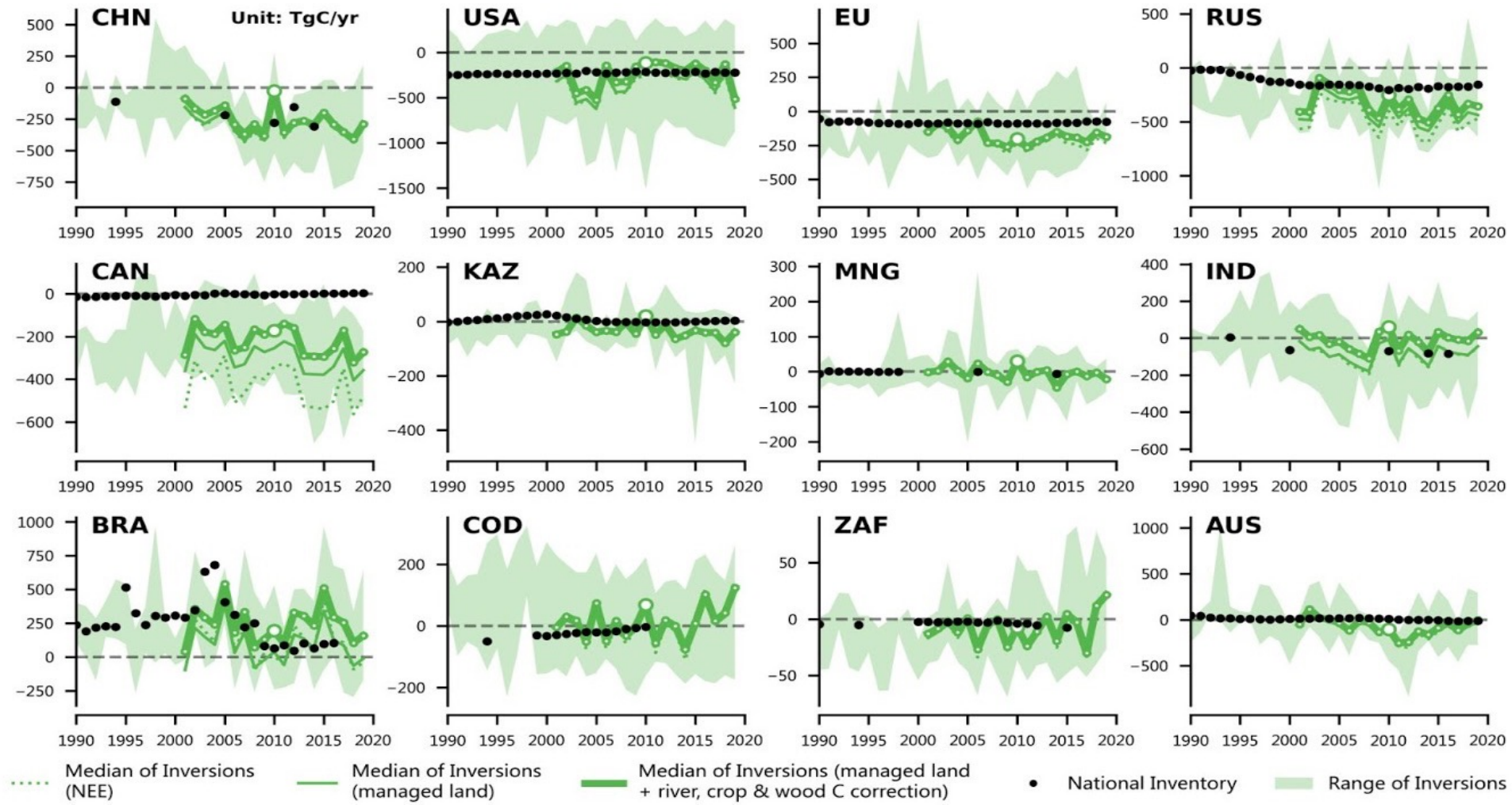
Selected countries

Gas	Sector	Country List
CO2	Net Land Flux	CHN, USA, EU*, RUS, CAN, KAZ, MNG, IND, BRA, COD, ZAF, AUS
CH4	Anthropogenic	CHN, IND, USA, BRA, RUS, EUR, IDN, PAK, ARG, IRN, MEX, AUS
	Fossil including oil, gas, coal	CHN, RUS, USA, EUR, IRN, IND, IDN, GULF, KT, VEN, NGA, MEX
	Agriculture & waste	CHN, IND, BRA, USA, EUR, PAK, IDN, RUS, ARG, THA, MEX, BGD
N2O	Anthropogenic	CHN, BRA, IND, USA, COD, EUR, IDN, MEX, COL, SDN, AUS, VEN

Deng, Zhu et al. , ESSDD, 2021

CO_2 – terrestrial flux LULUCF (sink = negative values)

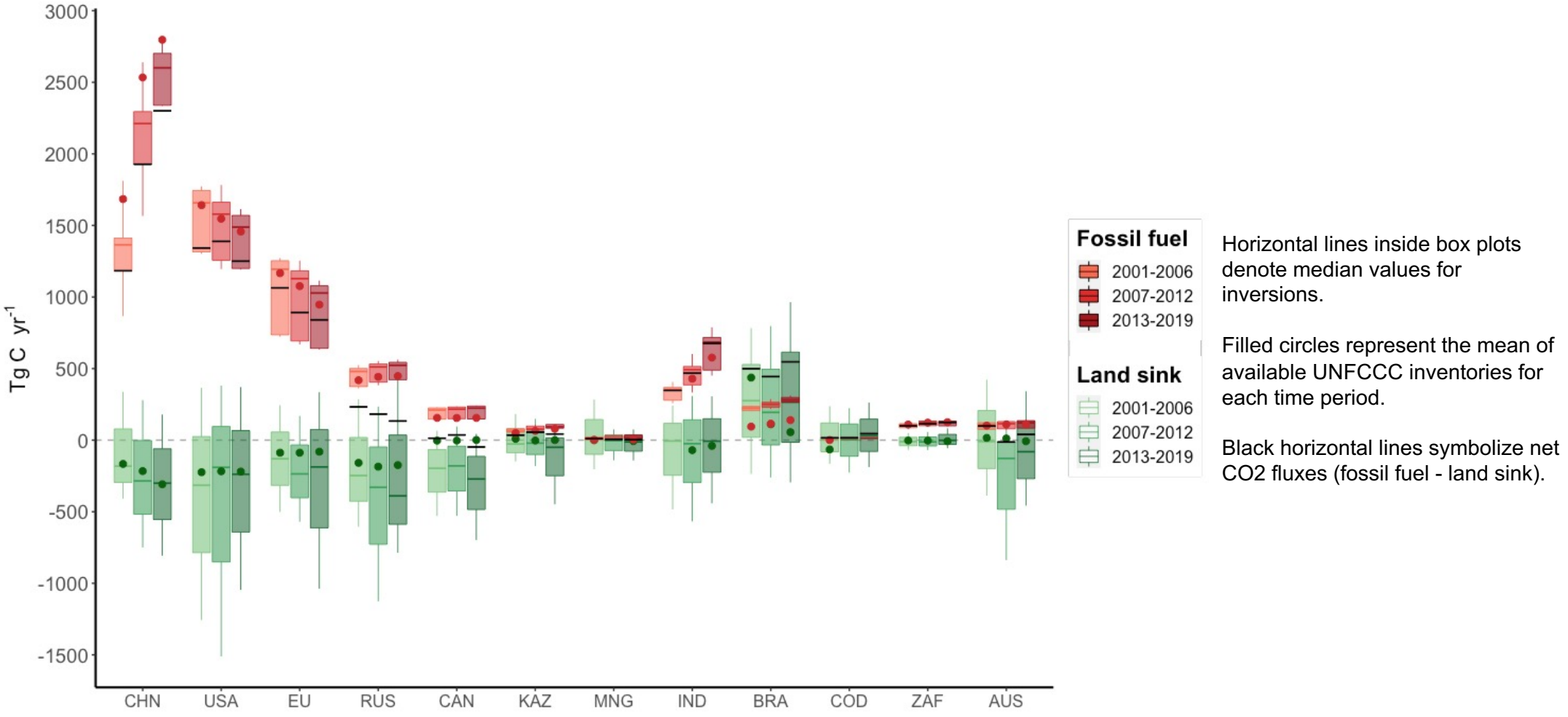
Tg



● Inventories ■ Range of CO_2 inversions

Deng, Zhu et al. , ESSDD, 2021

CO2 Emissions and sinks from Top fossil CO2 Emitters



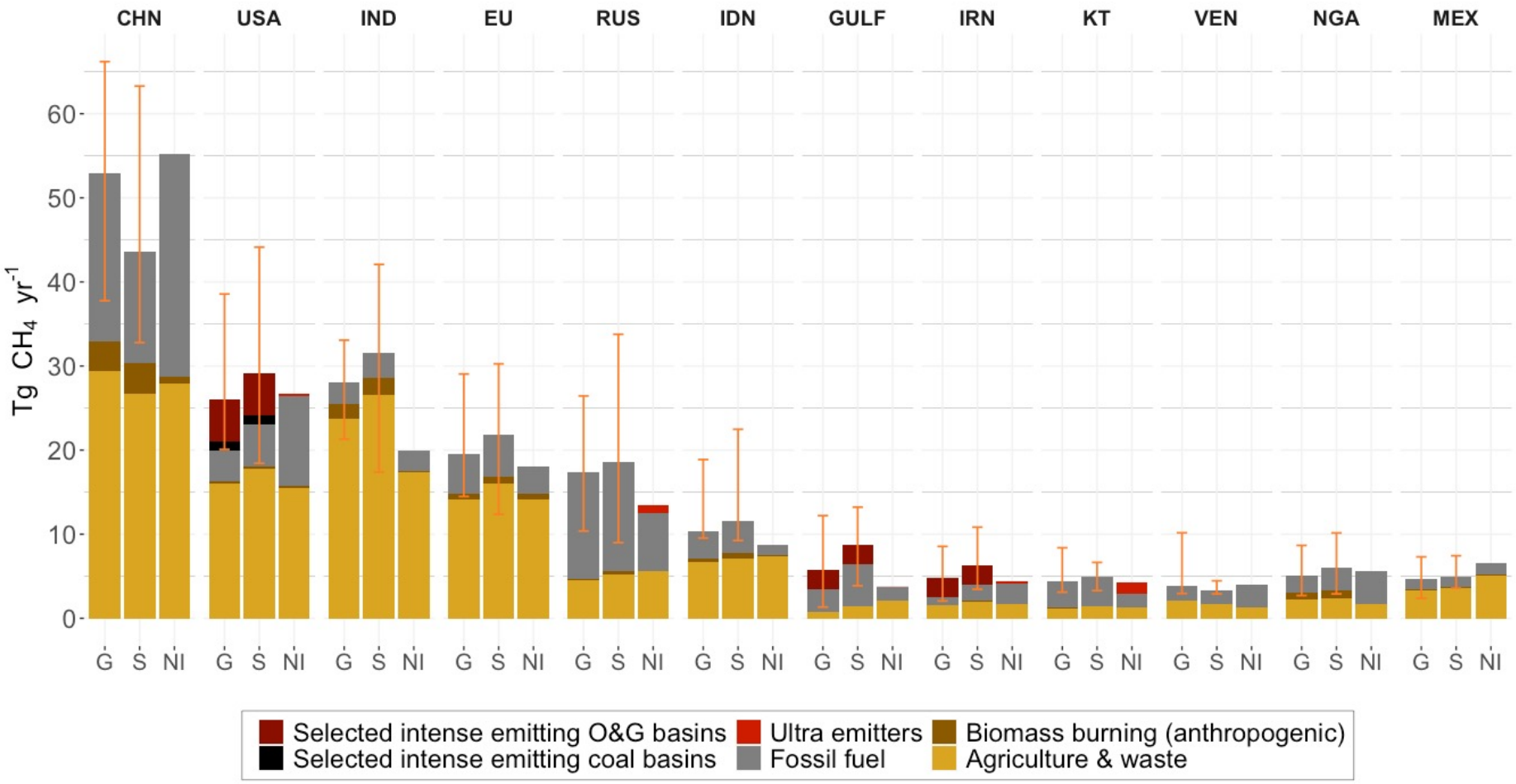
Horizontal lines inside box plots denote median values for inversions.

Filled circles represent the mean of available UNFCCC inventories for each time period.

Black horizontal lines symbolize net CO2 fluxes (fossil fuel - land sink).

Deng, Zhu et al. , ESSDD, 2021

Summary CH4 anthropogenic inversions (last 5 years)



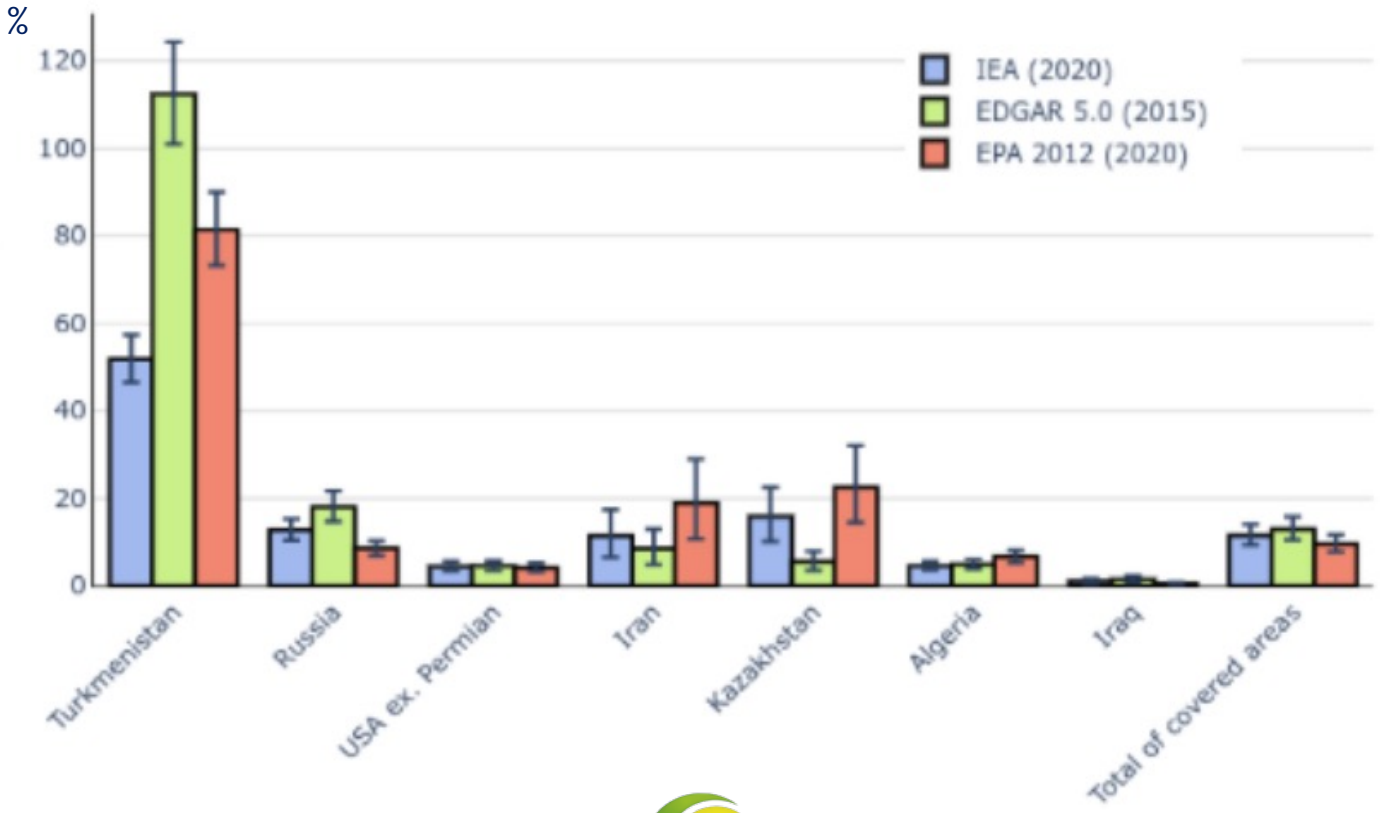
Ultra emitters assumed not captured by UNFCCC inventories / basins emissions assumed as part of inversions fossil emissions

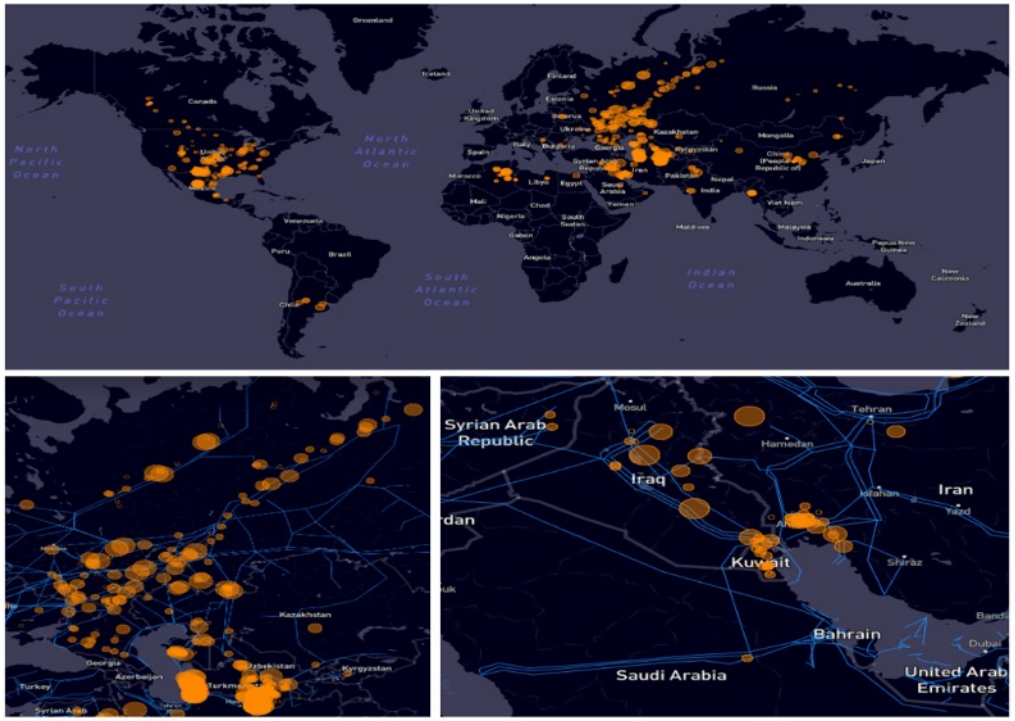
CH_4 – Resolving discrepancies using ultra emitters TROPOMI inversion (> 20 tCH4 per h)

(assuming they are seen in the total emissions by global inversions but may be missed by inventories)

Ultra emitters as a fraction of national inventories

Lauvaux et al. in prep

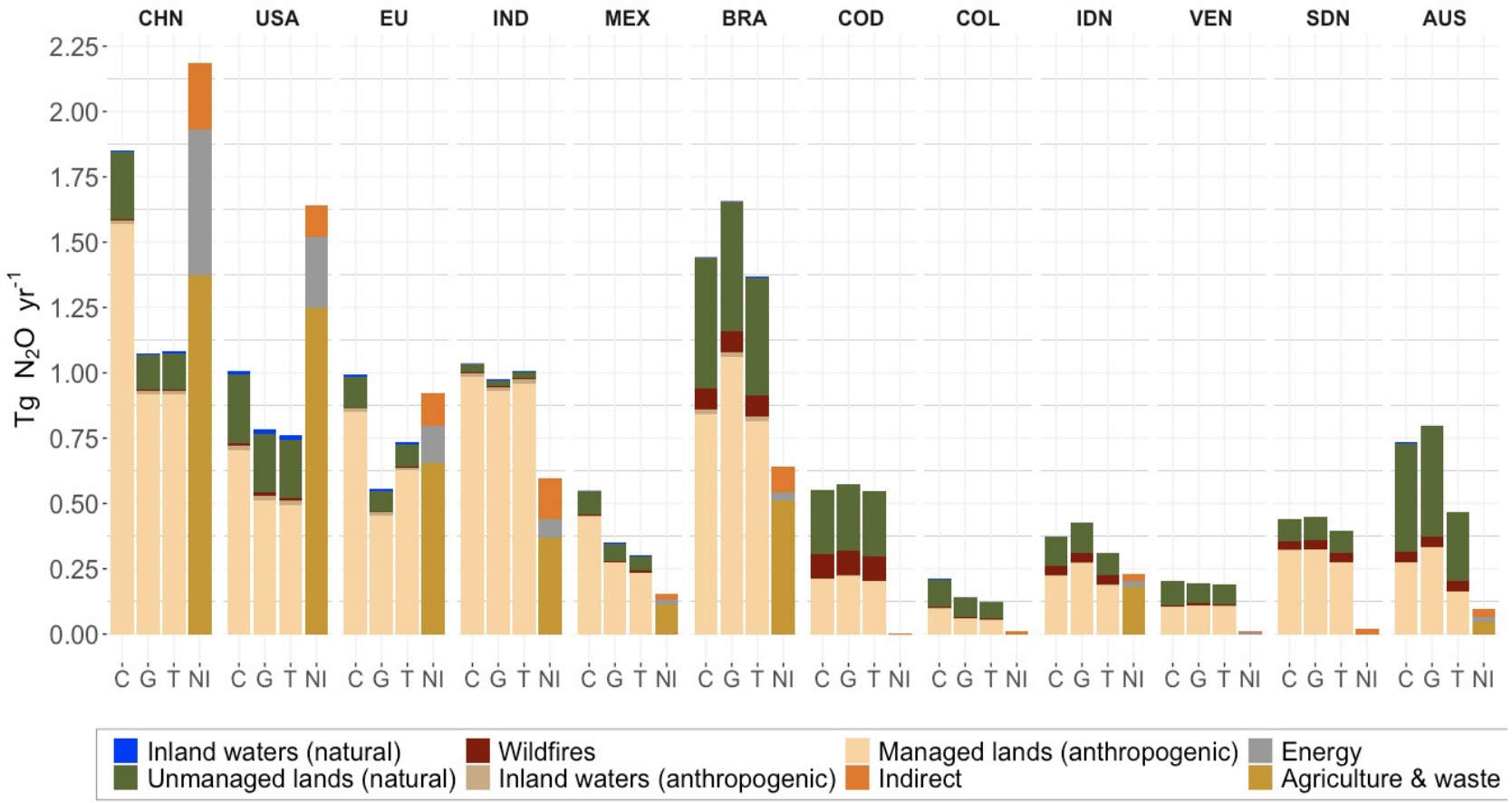




KAYRROS ENLIGHTENING ENERGY

LSCE

Summary N2O anthropogenic emissions (last 5 years)



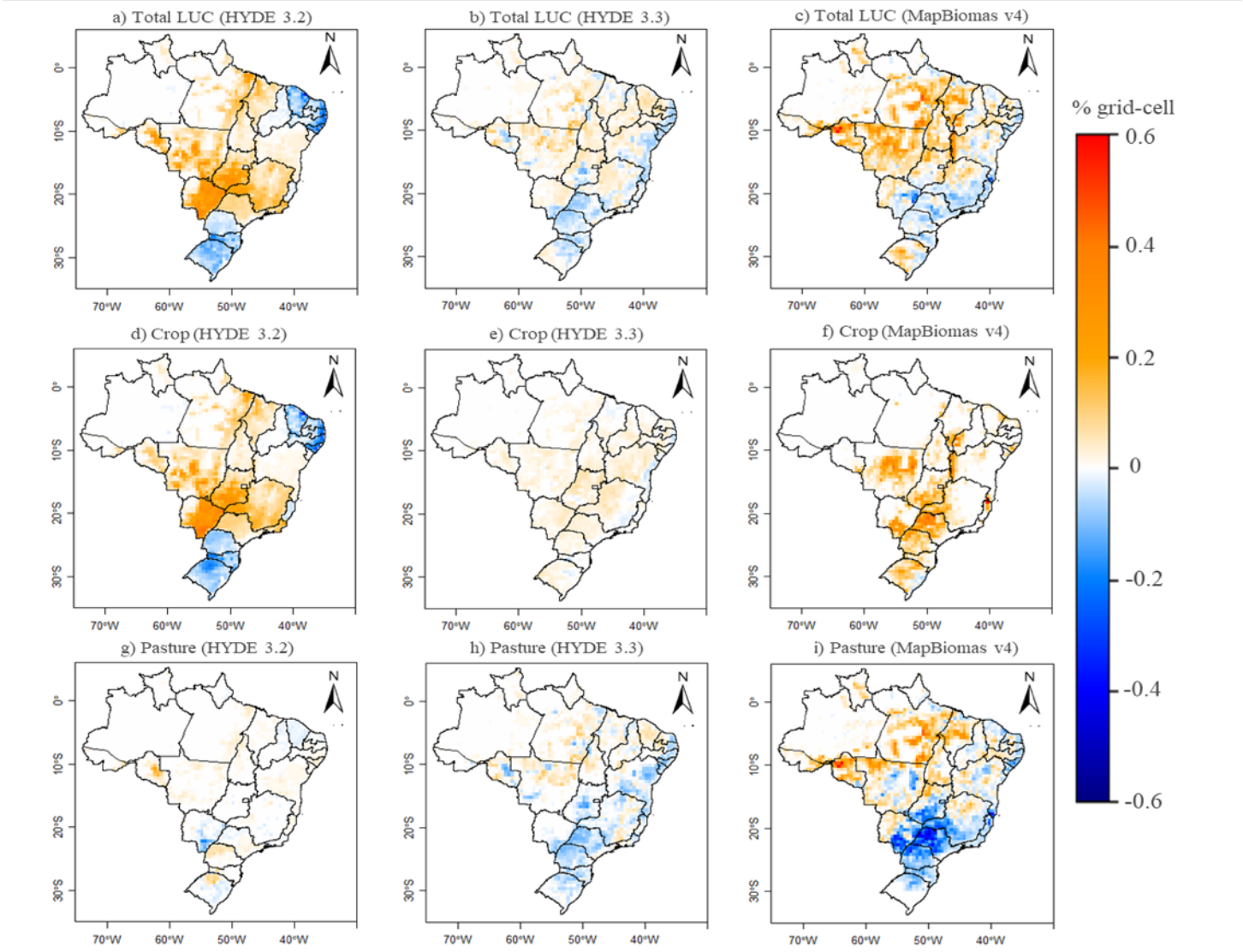
- Note the overlooked importance of natural emissions (including fires in BRA and IDN) in tropical countries

Deng, Zhu et al. , ESSDD, 2021

A multi-data assessment of land use and land cover emissions from Brazil during 2000-2019

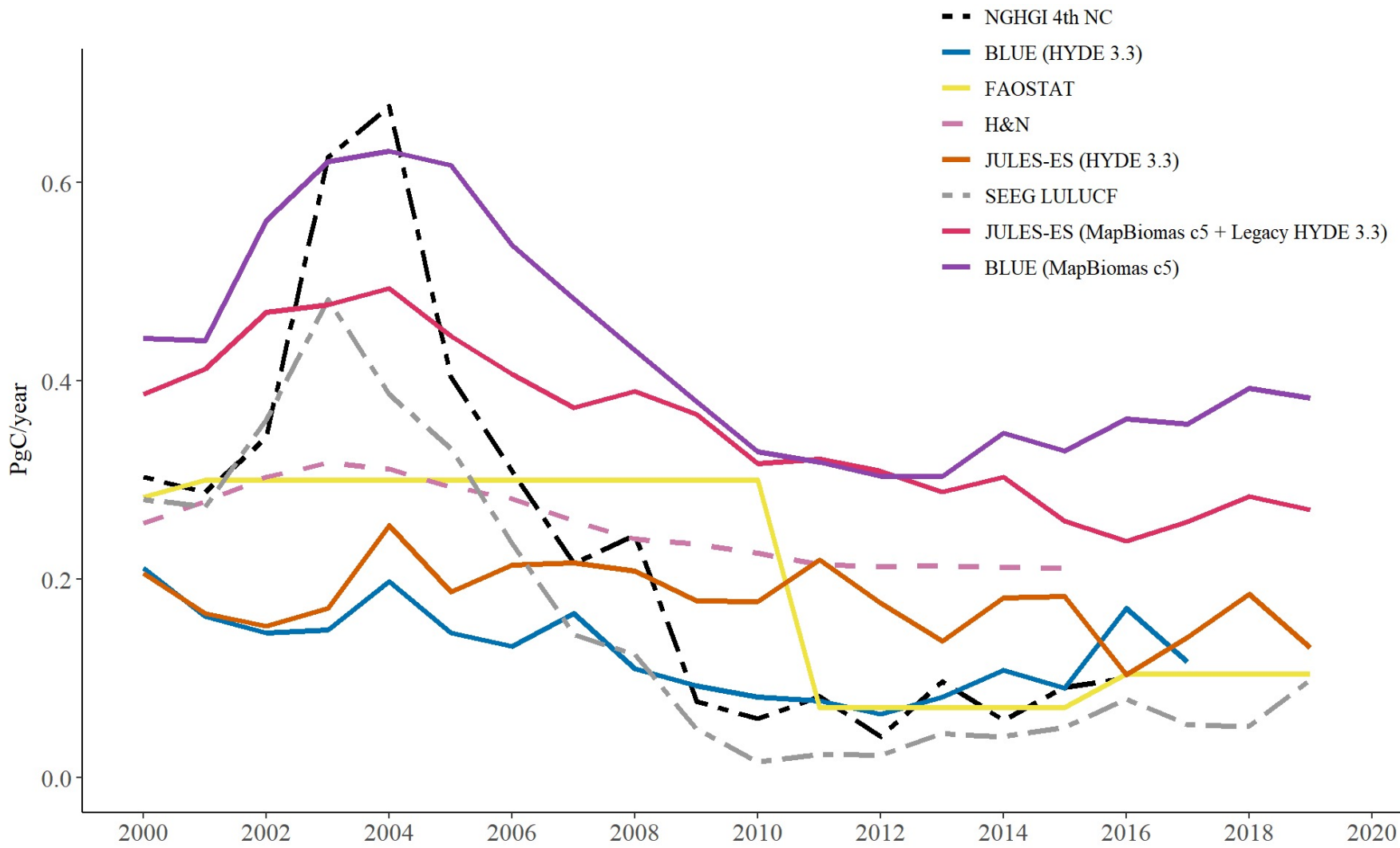
- New GCB assessment using HYDE3.3 based on multi-annual ESA CCI LCC

- Although HYDE 3.3 shows lower area change than HYDE 3.2, it shows spatial patterns similar to MapBiomas



Rosan et al. , ERL, 2021

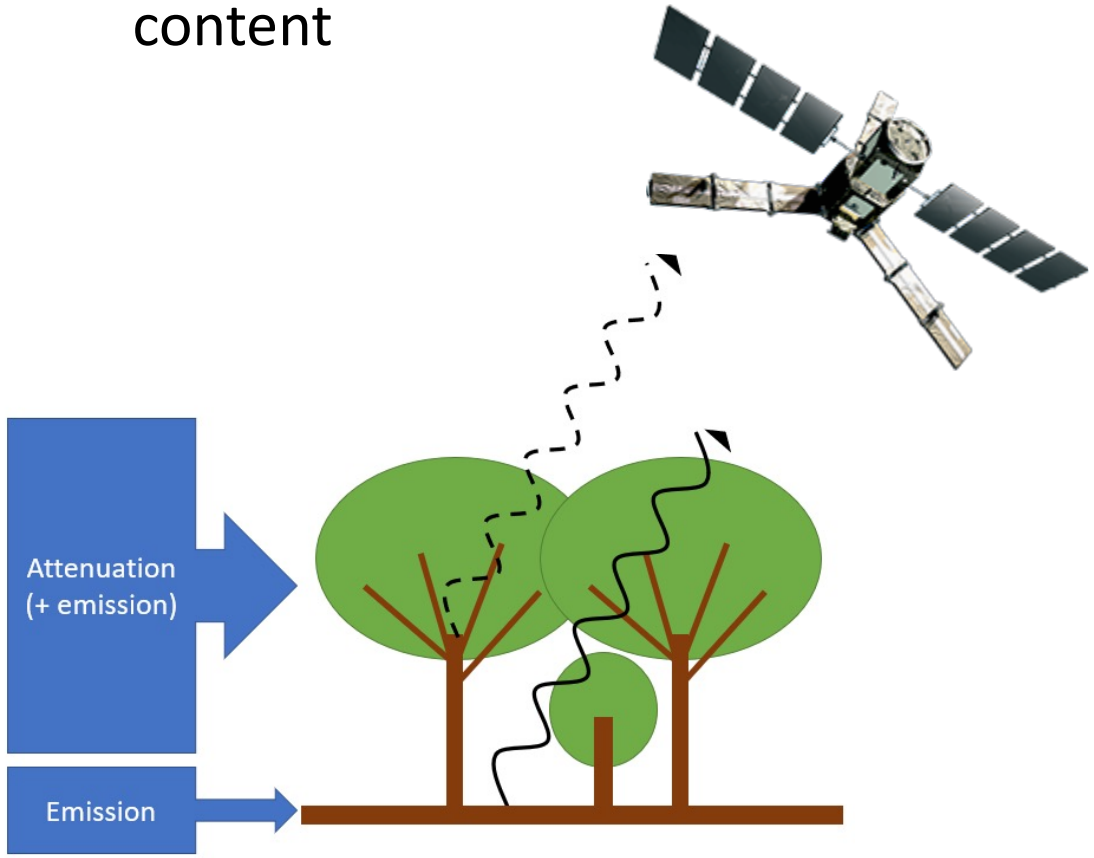
Reconciling temporal trends

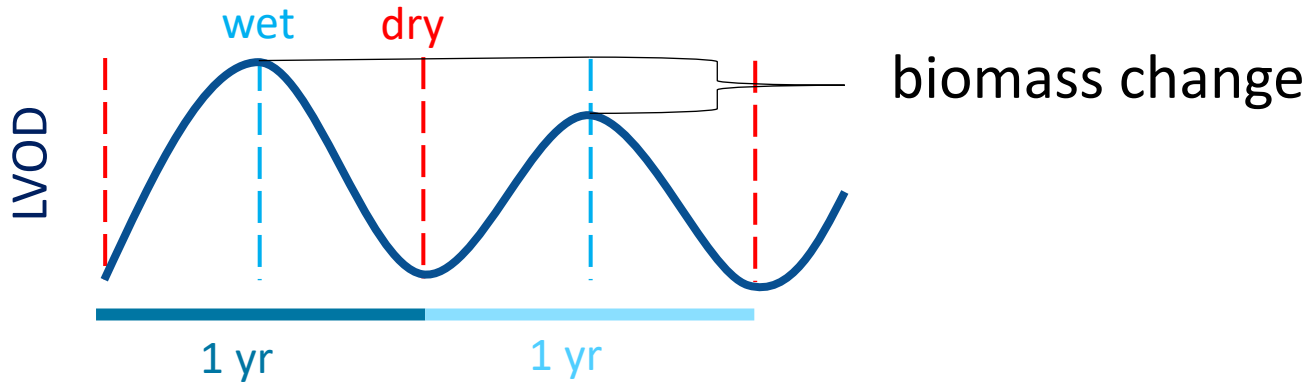


Rosan et al. , ERL, 2021

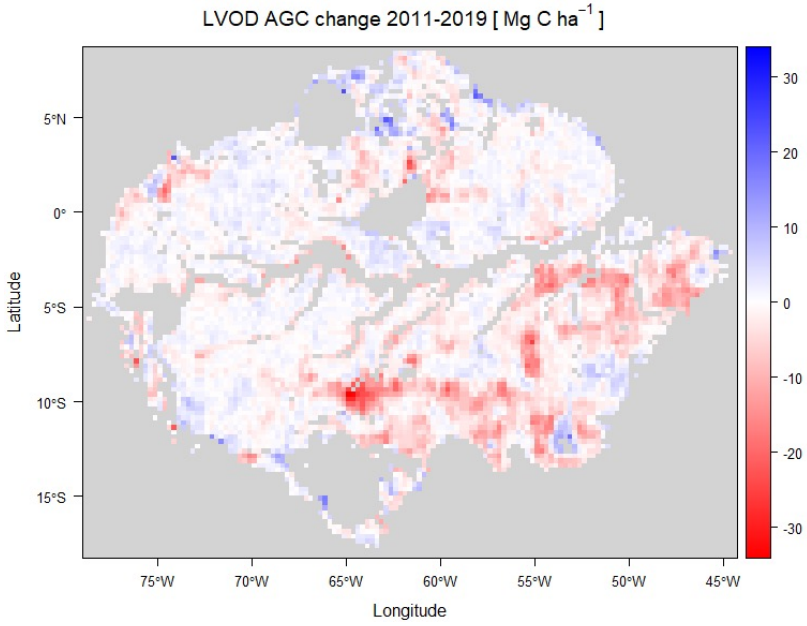
Amazon biomass change & processes

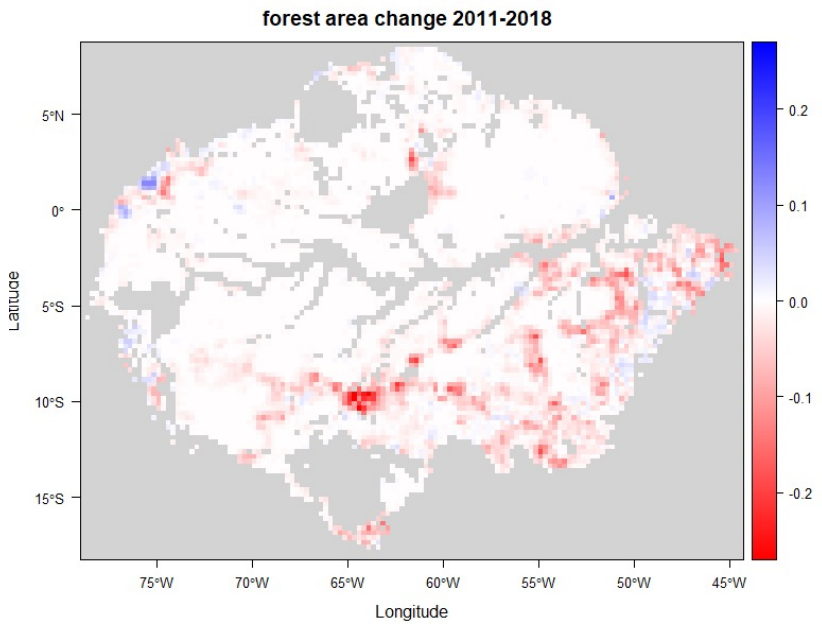
- SMOS measurements of L-band microwave emissions @ 25km can be used to derive L-VOD which is not fully attenuated even by high biomass
- How much is attenuated depends on the amount of vegetation but also on its water content

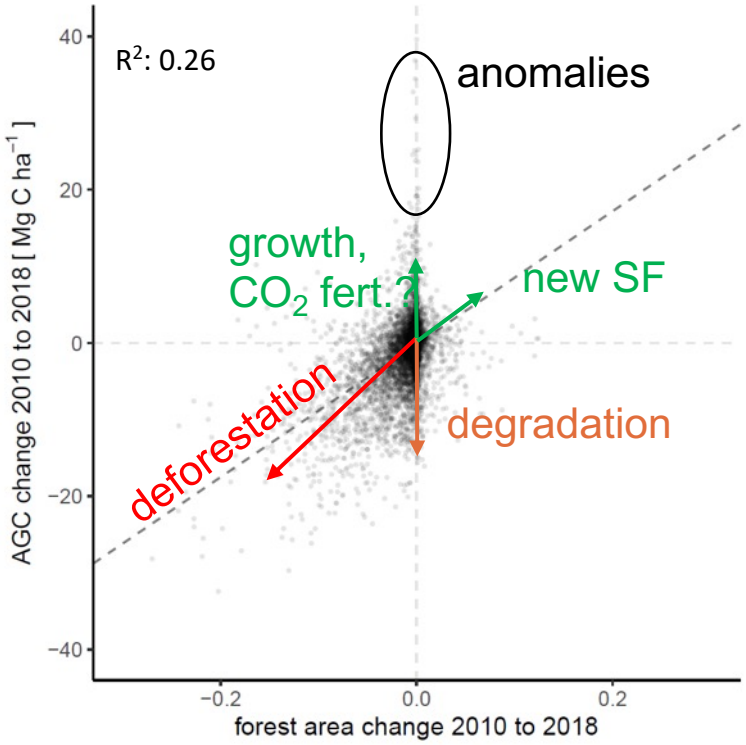




Amazon Stocktake using LVOD







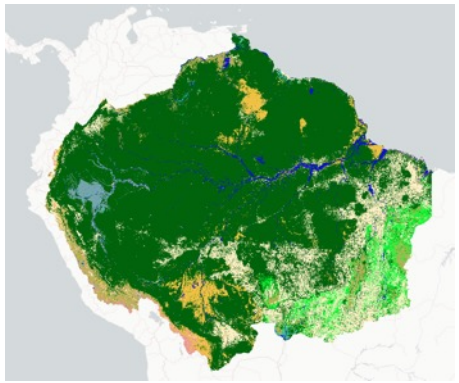
What processes are represented within LVOD biomass change?

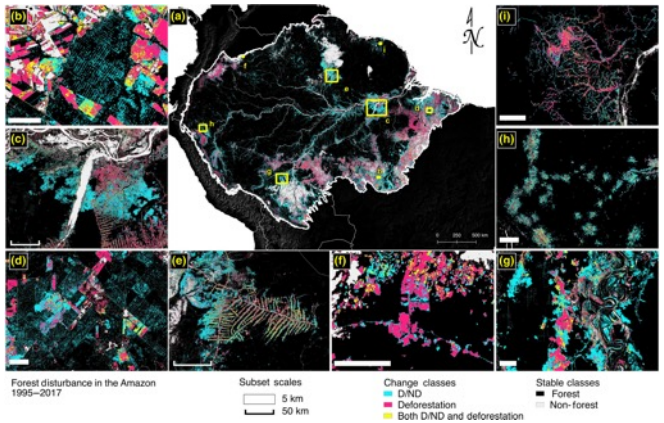
Biomass change = change in intact forests + secondary forest growth + deforestation + forest degradation

Fawcett et al. , in prep

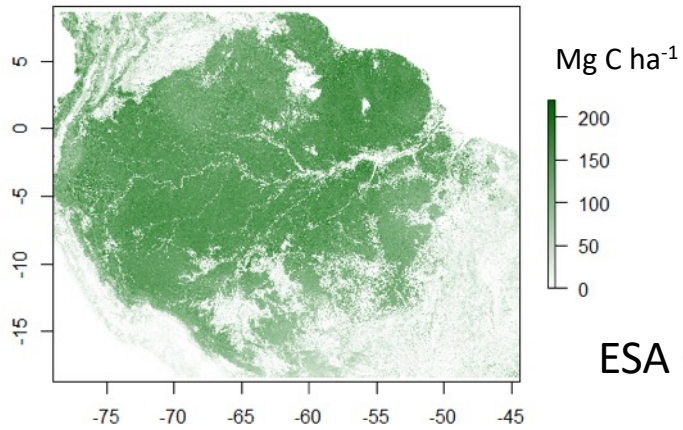
Biomass change model

High resol. land cover /disturbance maps





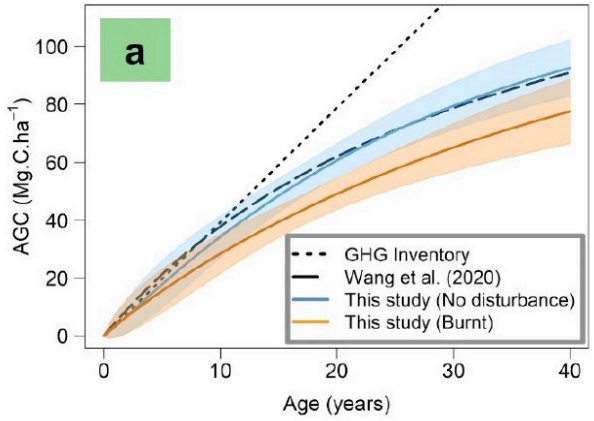
reference high resolution (100 m) biomass map



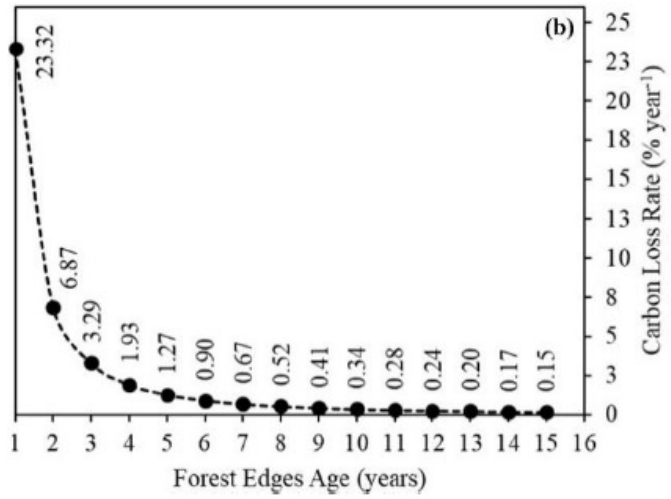
ESA CCI (2017)

Biomass loss and gain functions:

SF growth



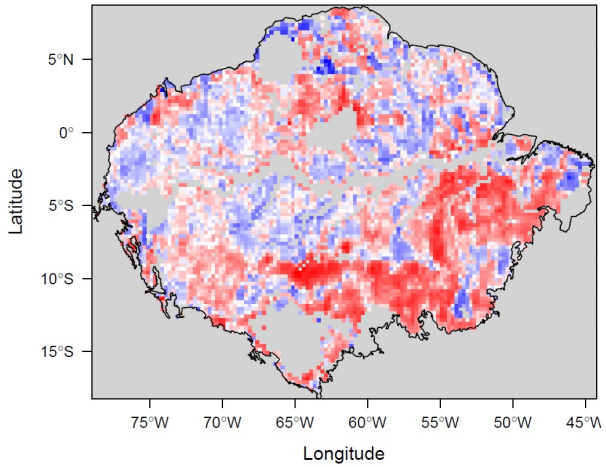
Edge biomass loss



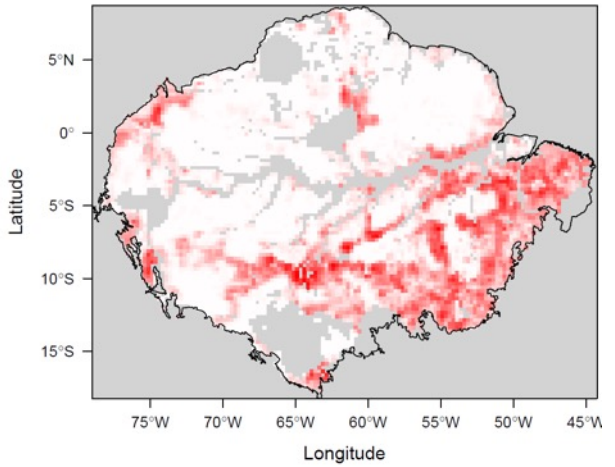
Fawcett et al. , in prep

Cascading effects of deforestation

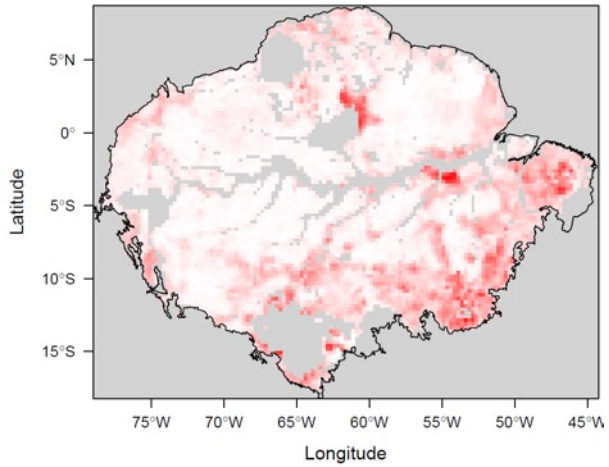
LVOD net AGC change



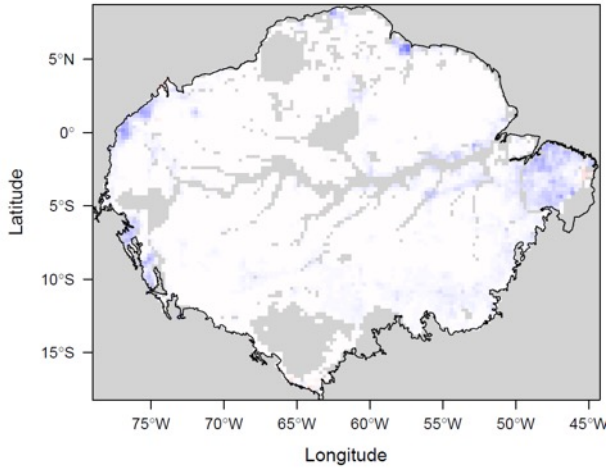
deforestation net AGC change

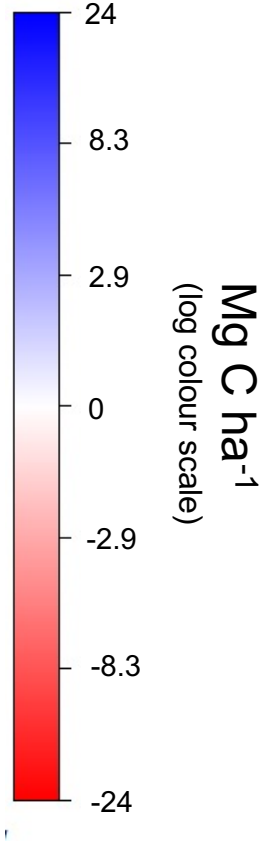


degradation net AGC change



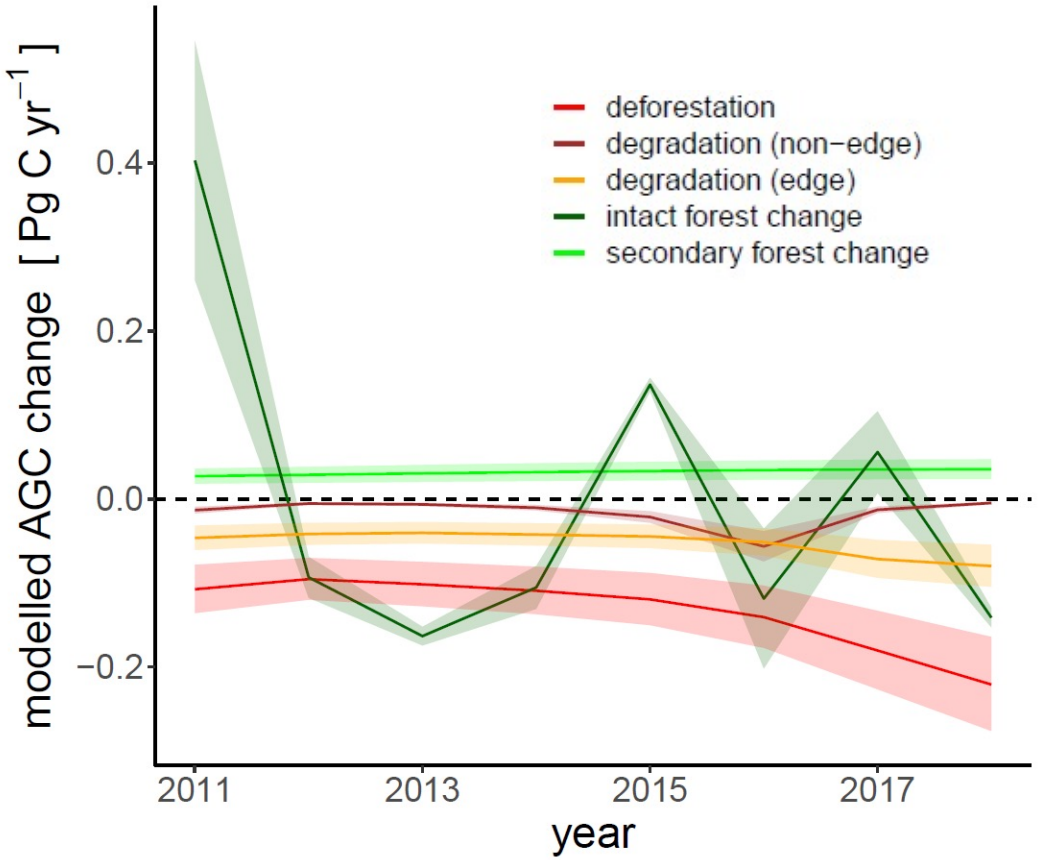
SF growth AGC change





Fawcett et al. , in prep

Pessimistic assessment of current state of Amazon C -balance



- Increase in deforestation and associated edge degradation since 2012
- Fire degradation peak in 2016
- Fluctuations of IF biomass inferred from LVOD

Fawcett et al. , in prep

Summary

- Compilation and harmonisation of National Inventories
- Grouping of sectors from National Inventories to match inversions
- Reconciliation of bottom-up NI with atmospheric inversions for CO_2, CH_4, N_2O
  - CO_2 - Land sink is in reasonably good agreement between the two approaches
  - CH_4 – Identified and resolved discrepancies for ultra emitters
  - N_2O - Inversions tend to produce higher emissions than inventories

- Improved representation of LUC over Brazil adopting ESA CCI LCC
- Reconciliation GCB with GHGI
- Using L-VOD and ESA CCI Biomass to diagnose & attribute carbon dynamics in the Amazon
  - Cascading effects of deforestation on the Amazon C-balance
  - Pessimistic assessment of current state of Amazon C-balance