



Harmonizing land-use fluxes from global models and national inventories

Giacomo Grassi, Joint Research Centre, European Commission

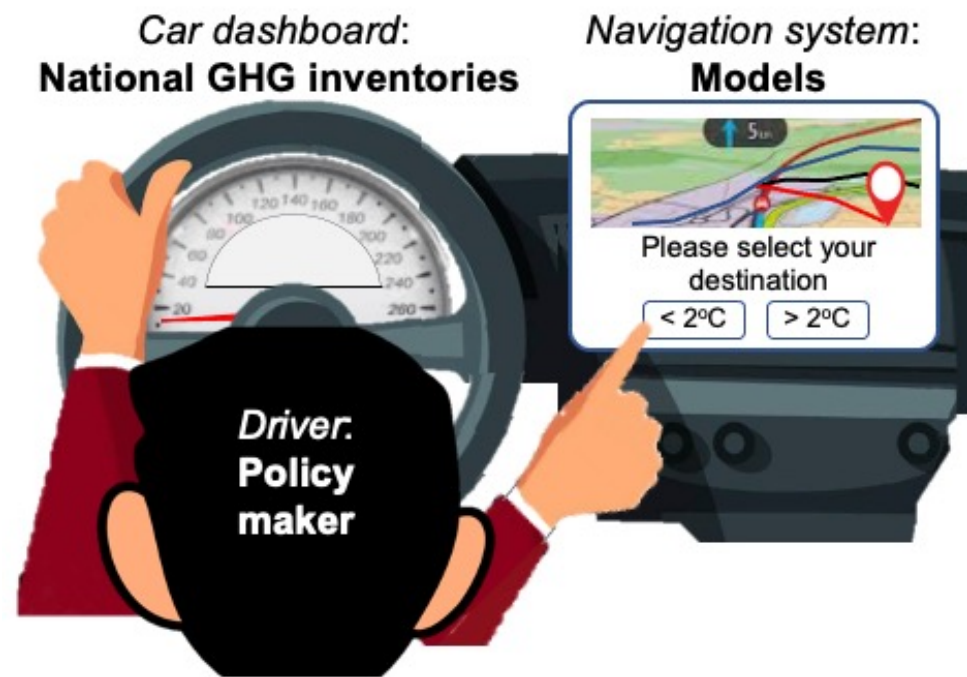
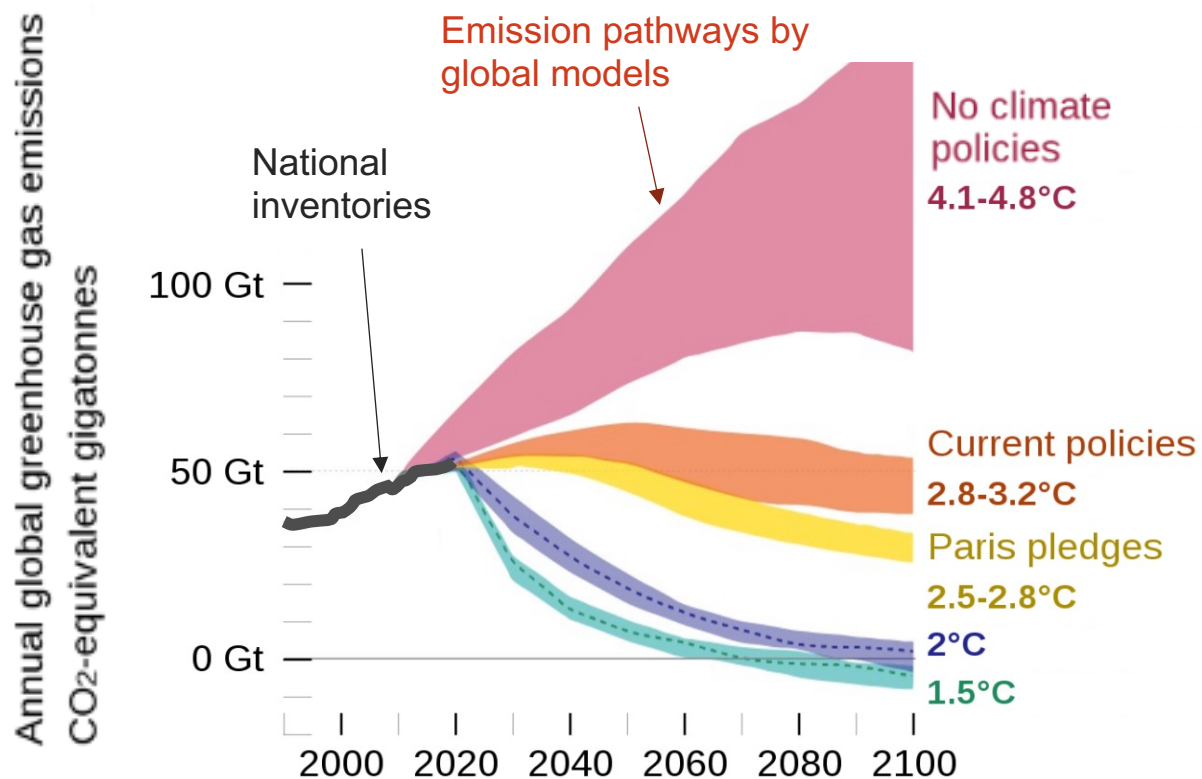
With contribution from many scientists from the Global C Budget and the GHG inventory communities

OUTLINE

- The context: the Paris Agreement's global stocktake
- The problem: large gap on land use CO₂ fluxes models vs. inventories
- The solution: reconciliation is possible
- Conclusions and way forward

THE CONTEXT

Paris Agreement: holding global warming to well-below 2°C requires reaching a **balance** between anthropogenic GHG emissions and removals



The collective climate progress is assessed by the **Global stocktake**

The **Global Stocktake** every 5 years assesses the collective progress towards the well-below 2°C target “*in the light of the best available science*”

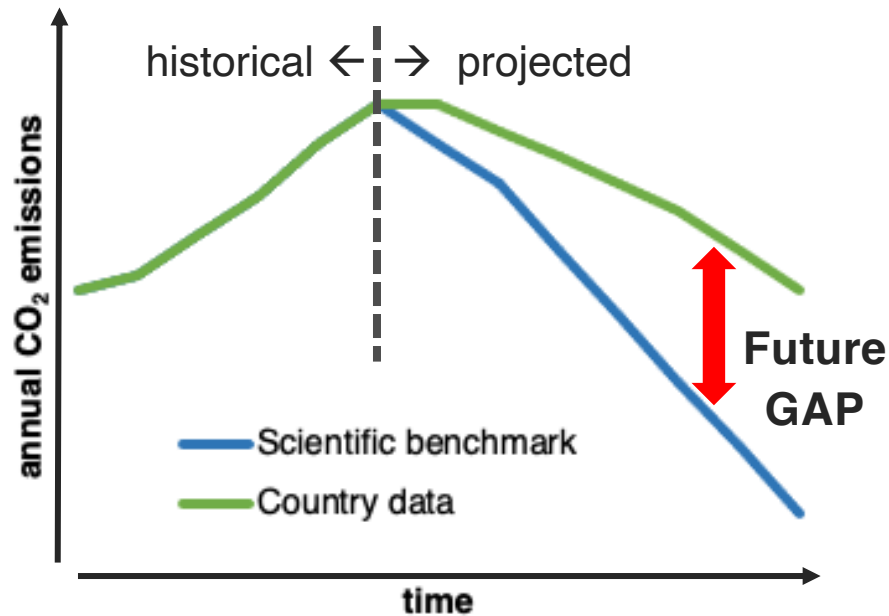
Inputs: - Aggregated countries' GHG data
- IPCC and other scientific data



compared to assess
the future “gap”



**Increased
climate ambition**



The 1st Global stocktake
will conclude at COP28

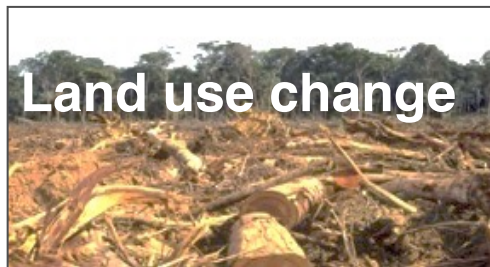
Why land use CO₂ fluxes are important?

The Global Carbon Budget:



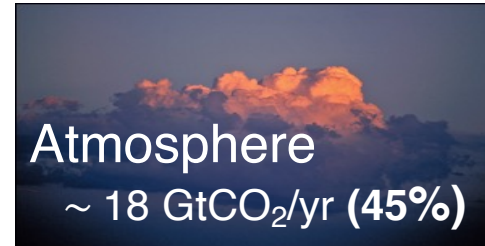
~ 35 GtCO₂/yr (88%)

+

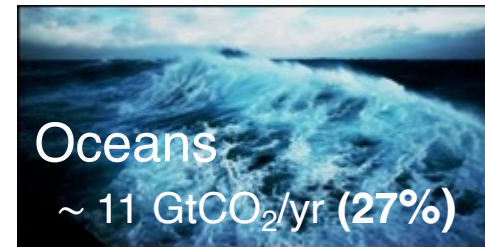


~ 5 GtCO₂/yr (12%)

Bookkeeping models



Atmosphere
~ 18 GtCO₂/yr (45%)



Oceans
~ 11 GtCO₂/yr (27%)

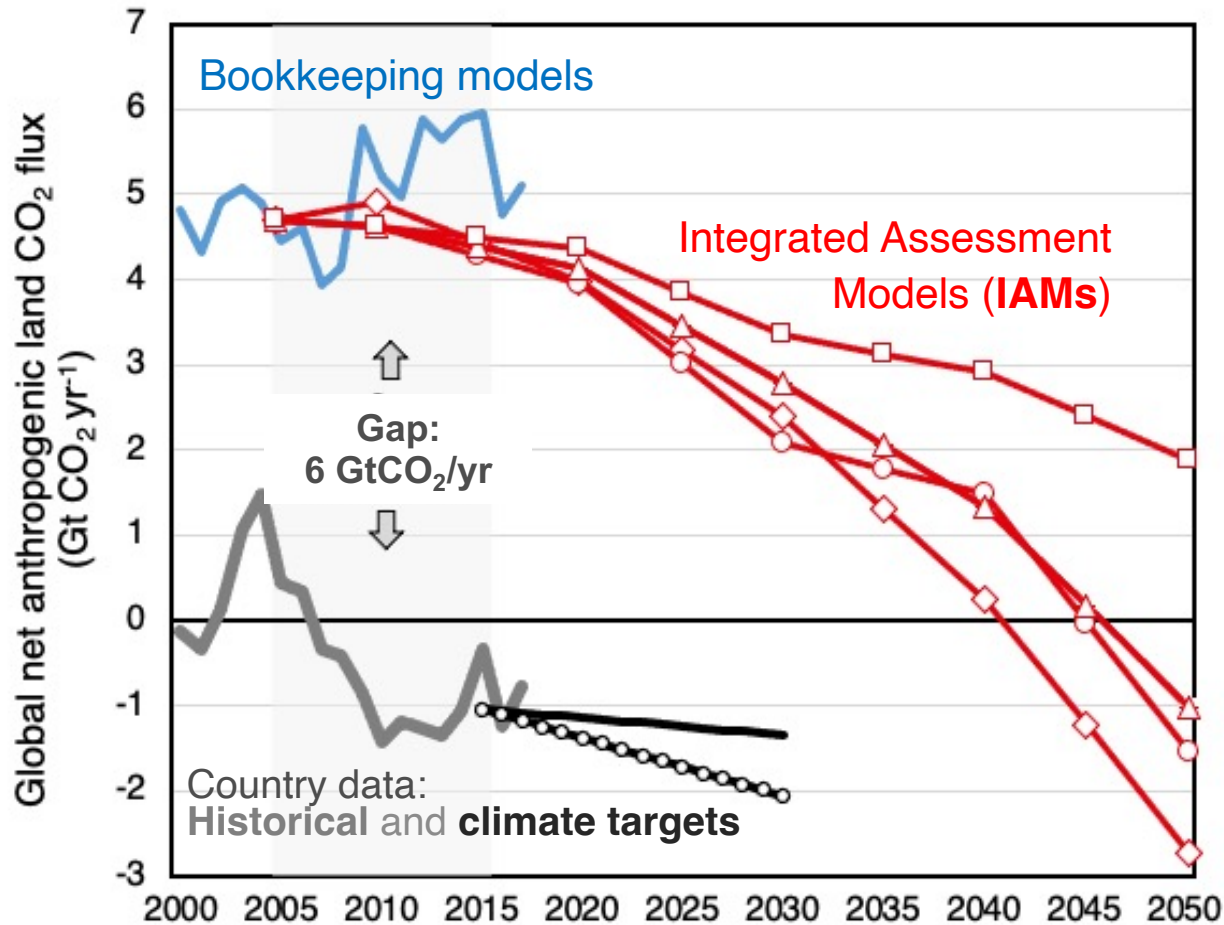


Land (mostly forests)
~ 11 GtCO₂/yr (28%)

Dynamic Global Vegetation Models (DGVMs)

THE PROBLEM

Large gap on land-use CO₂ flux (**LULUCF**) models vs. countries



The Washington Post

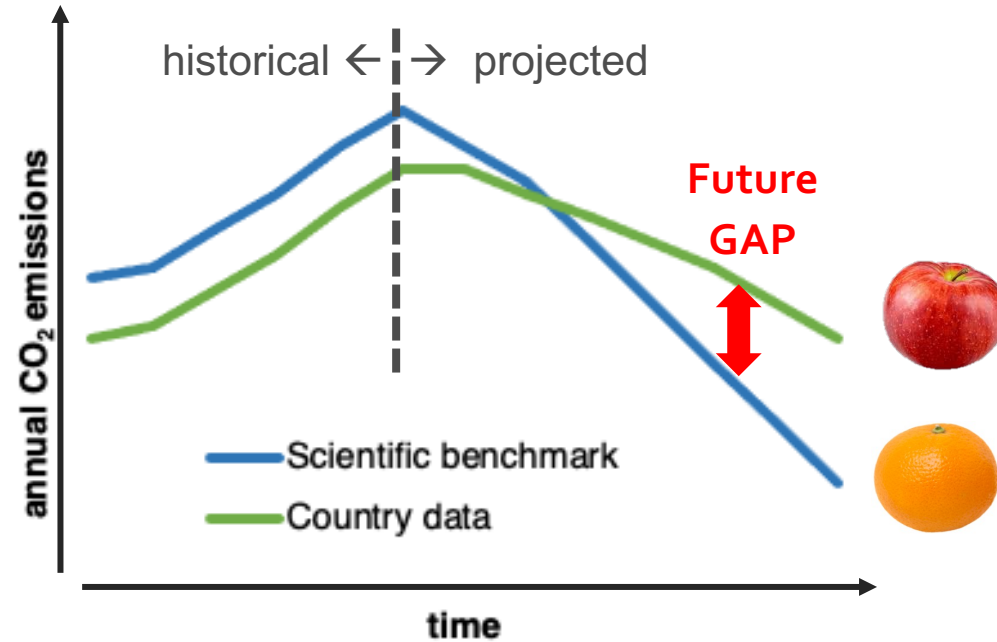
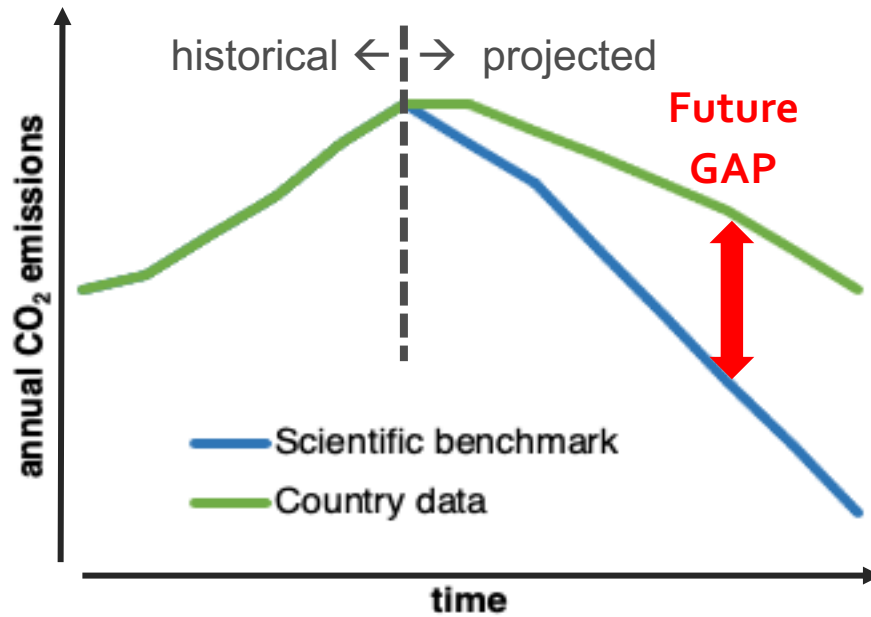
April 2021 Climate and Environment
The giant accounting problem that could hamper the world's push to cut emissions

Nov 2021
Countries' climate pledges built on flawed data,

This large gap is confusing policy makers:

- Is this gap a problem?
- Can we trust country LULUCF data?
- Why do we have this gap?
- Can we reconcile the difference?

Is this gap a problem?



If not addressed, countries' progress may look better than it is

The Global stocktake requires **comparability**

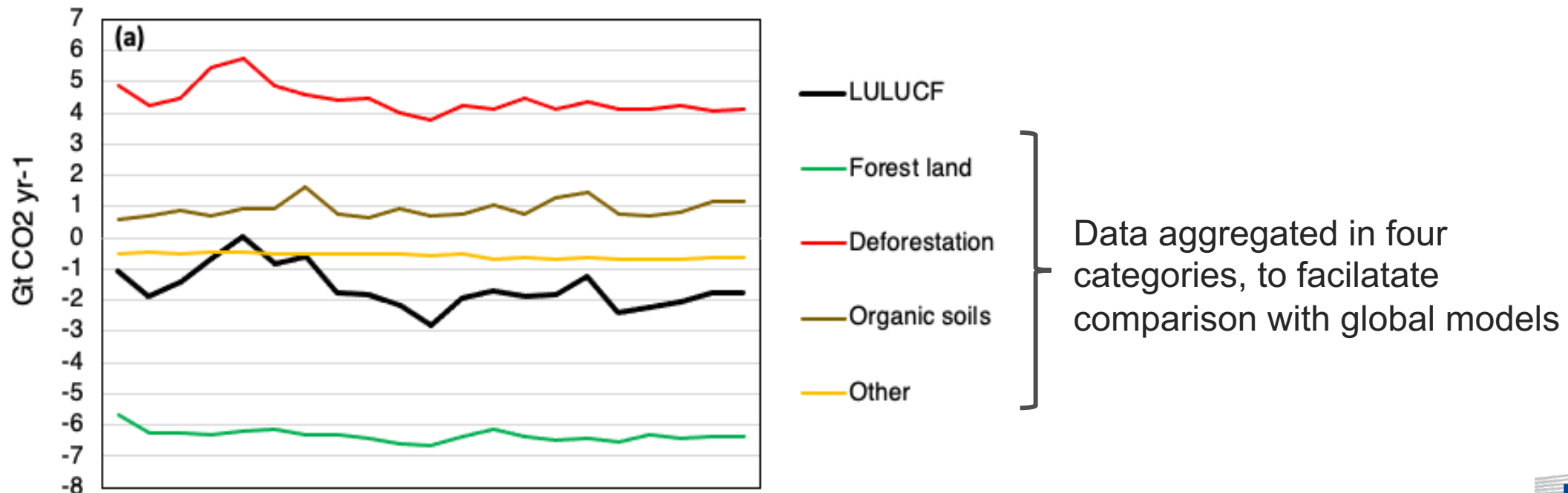


Can we trust country LULUCF data?

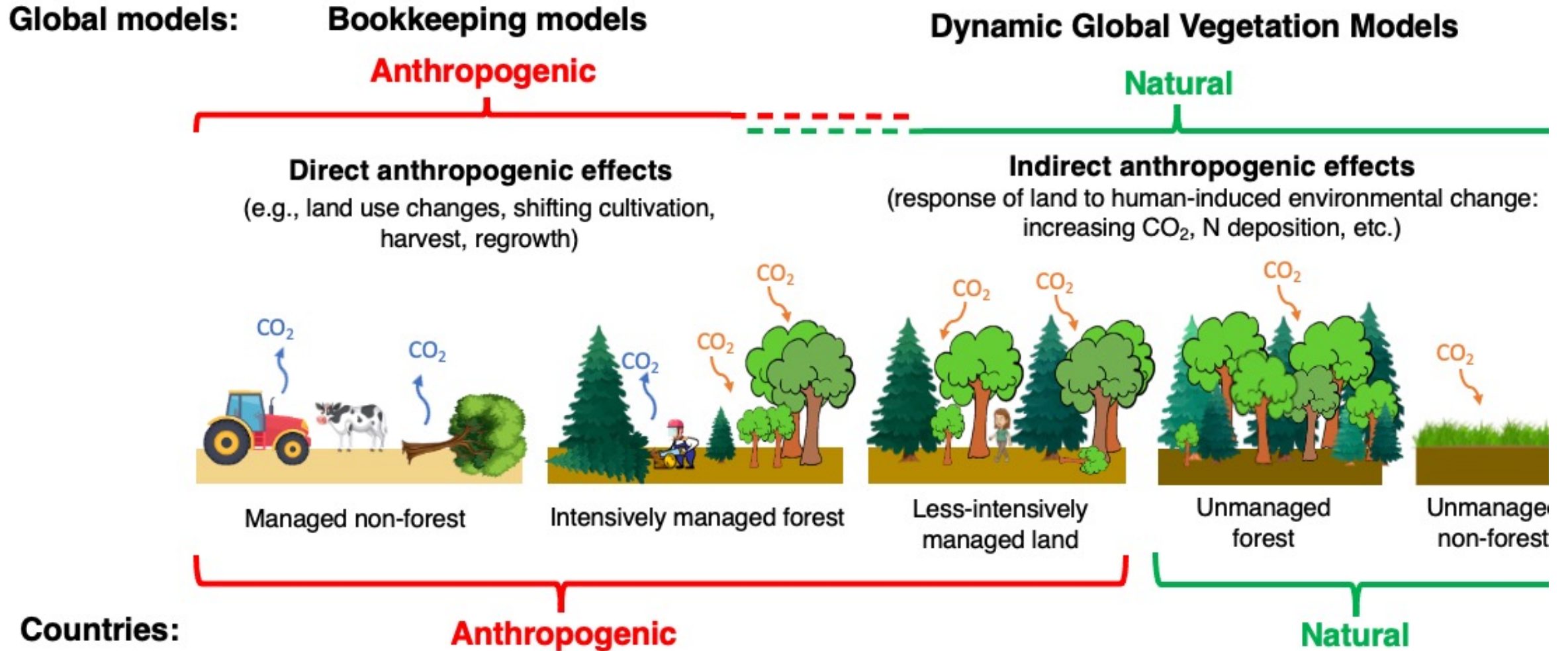
Carbon fluxes from land 2000–2020: bringing clarity to countries' reporting

Giacomo Grassi¹, Giulia Conchedda², Sandro Federici³, Raul Abad Viñas¹, Anu Korosuo¹, Joana Melo⁴, Simone Rossi⁵, Marieke Sandker⁶, Zoltan Somogyi⁷, Matteo Vizzarri¹, and Francesco N. Tubiello²

- Most complete and disaggregated collection of country LULUCF data (185 countries)
- Quality/quantity of country LULUCF data improved, but many gaps still remain
- Relevant global LULUCF net sink, mostly due to forests

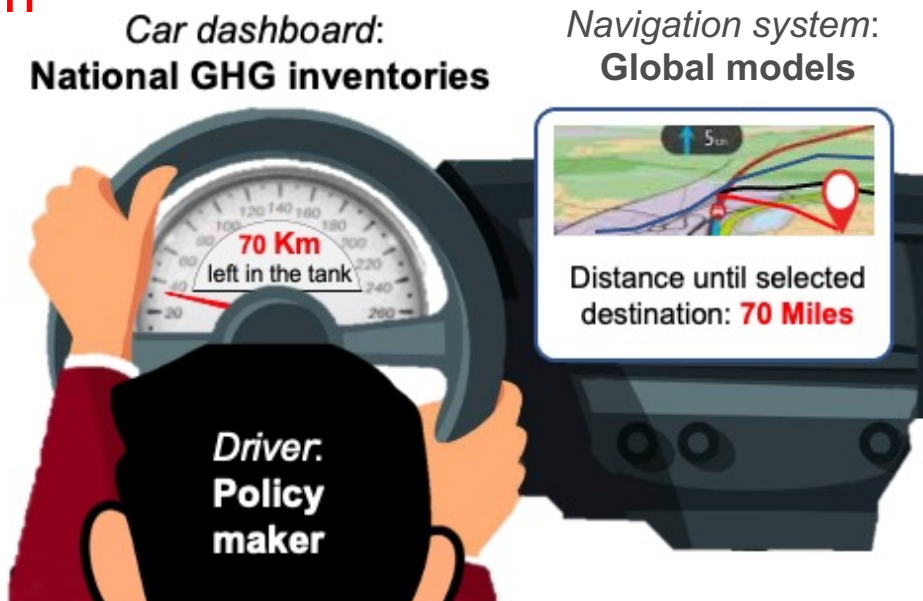


Why do we have this gap? Mostly due to different definitions of anthropogenic forest sink



The two approaches were developed for different scopes – both valid in their context, but **not comparable**

The problem



The gap in global land-use CO₂ fluxes by global models and national inventories is like if a *navigation system* uses **miles** and the *dashboard* **km**.

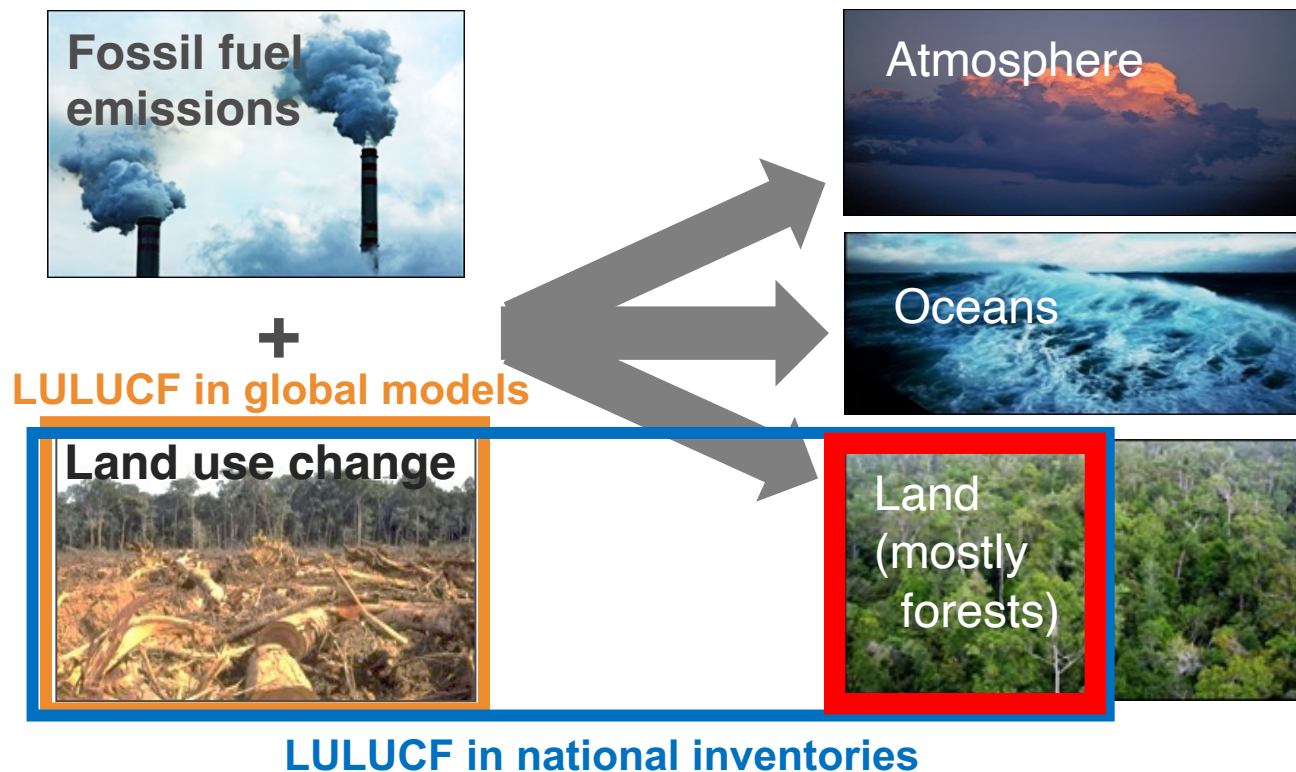
This mismatch may confuse the driver

The solution



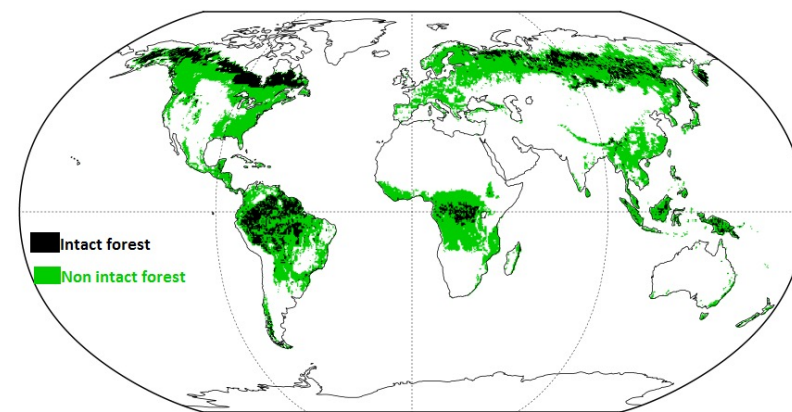
Translating the *navigation system* is easier than changing the car dashboard

Can we reconcile the difference?



Harmonising the land-use flux estimates of global models and national inventories for 2000–2020

Giacomo Grassi¹, Clemens Schwingshackl², Thomas Gasser³, Richard A. Houghton⁴, Stephen Sitch⁵, Josep G. Canadell⁶, Alessandro Cescatti¹, Philippe Ciais⁷, Sandro Federici⁸, Pierre Friedlingstein^{9,10}, Werner A. Kurz¹¹, Maria J. Sanz Sanchez^{12,13}, Raúl Abad Viñas¹, Ramdane Alkama¹, Selma Bultan², Guido Ceccherini¹, Stefanie Falk², Etsushi Kato¹⁴, Daniel Kennedy¹⁵, Jürgen Knauer¹⁶, Anu Korosuo¹, Joana Melo¹, Matthew J. McGrath⁷, Julia E. M. S. Nabel^{17,18}, Benjamin Poulter¹⁹, Anna A. Romanovskaya²⁰, Simone Rossi²¹, Hanqin Tian²², Anthony P. Walker²³, Wenping Yuan²⁴, Xu Yue²⁵, and Julia Pongratz^{2,17}



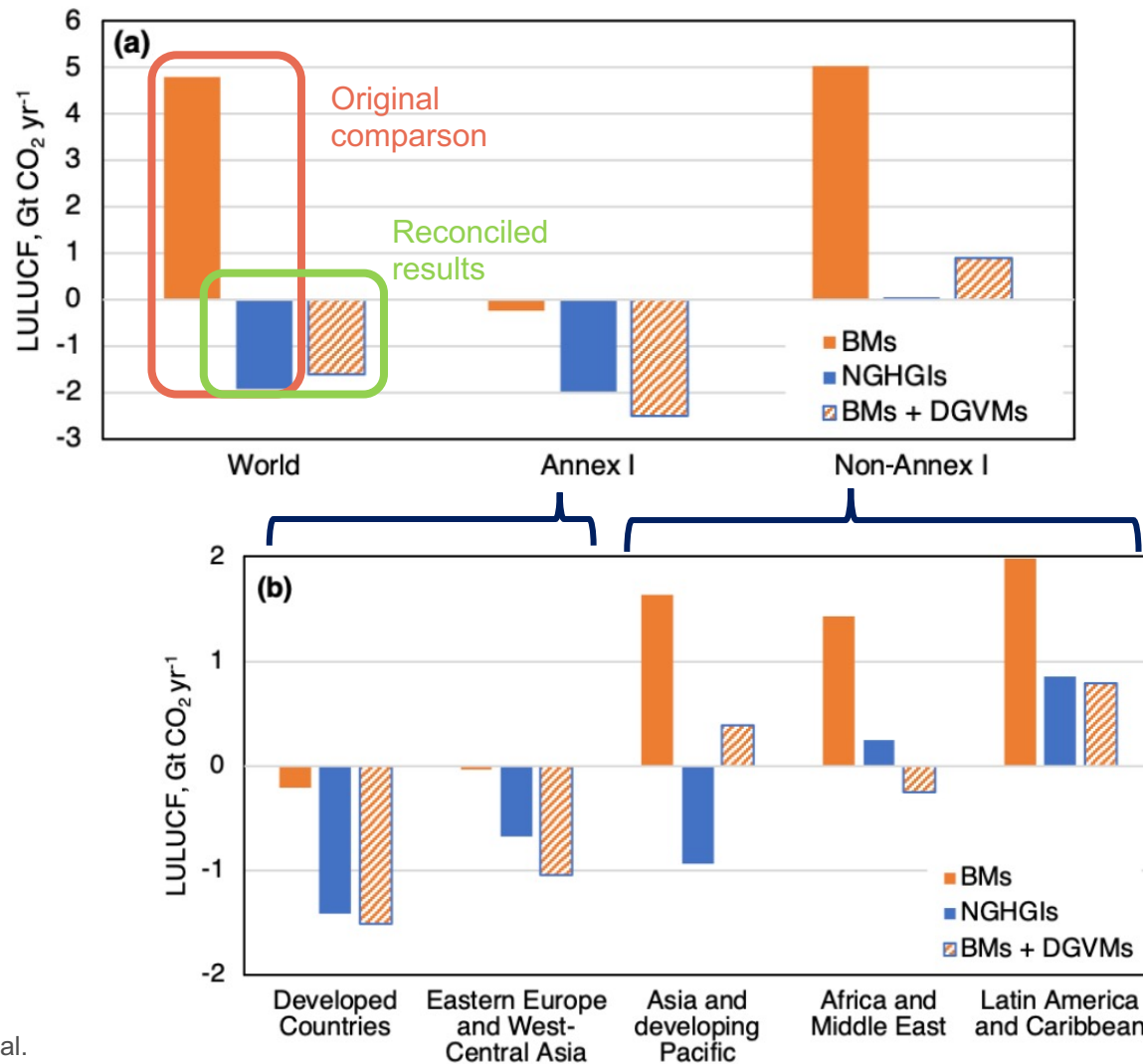
Countries' managed forest area estimated as "non-intact", unless country maps were available
Overall $\approx 80\%$ of forest area is "managed"

Approach to **reconcile the gap**: add the CO₂ sink considered 'natural' by 17 DGVMs and 'anthropogenic' by countries to the anthropogenic forest flux by 3 bookkeeping models (or subtract it from the globally aggregated countries' emissions)

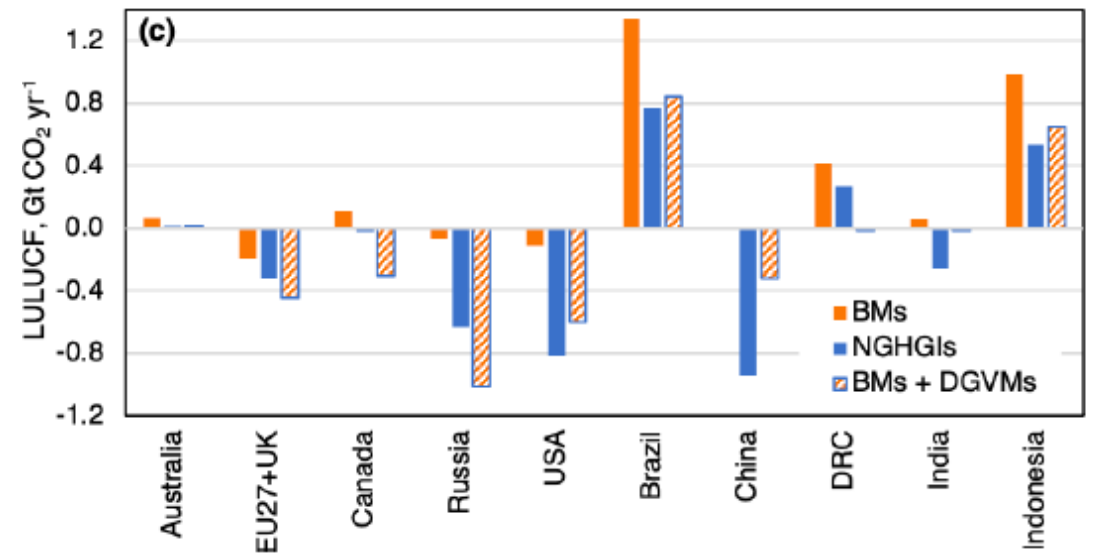
(the models' results used in this study are the same as in the Global C Budget 2022)

THE SOLUTION

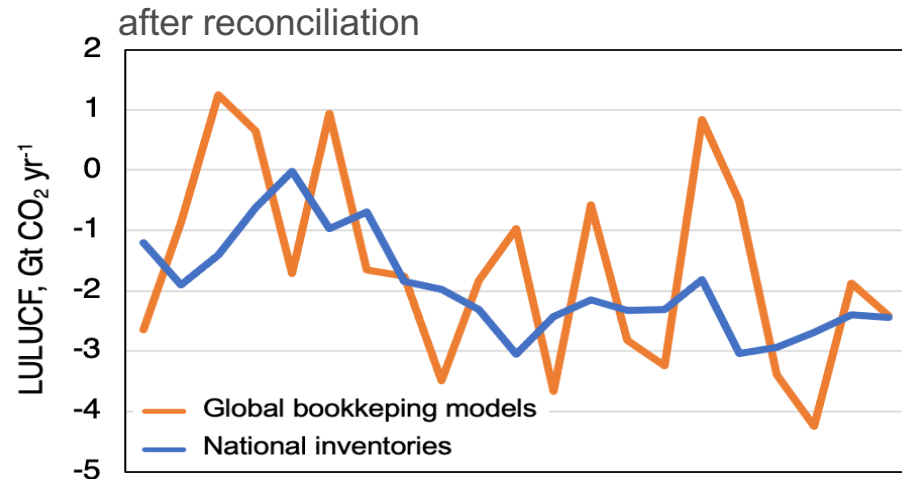
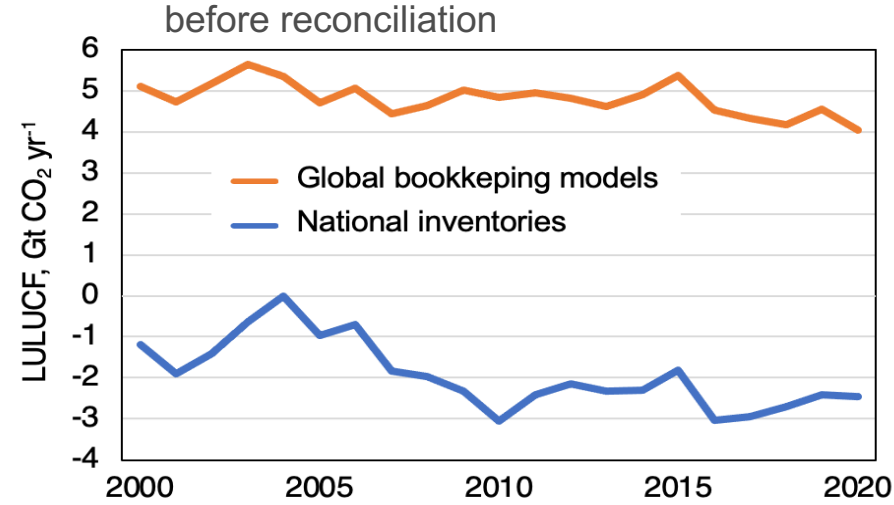
Averages 2000-2000:



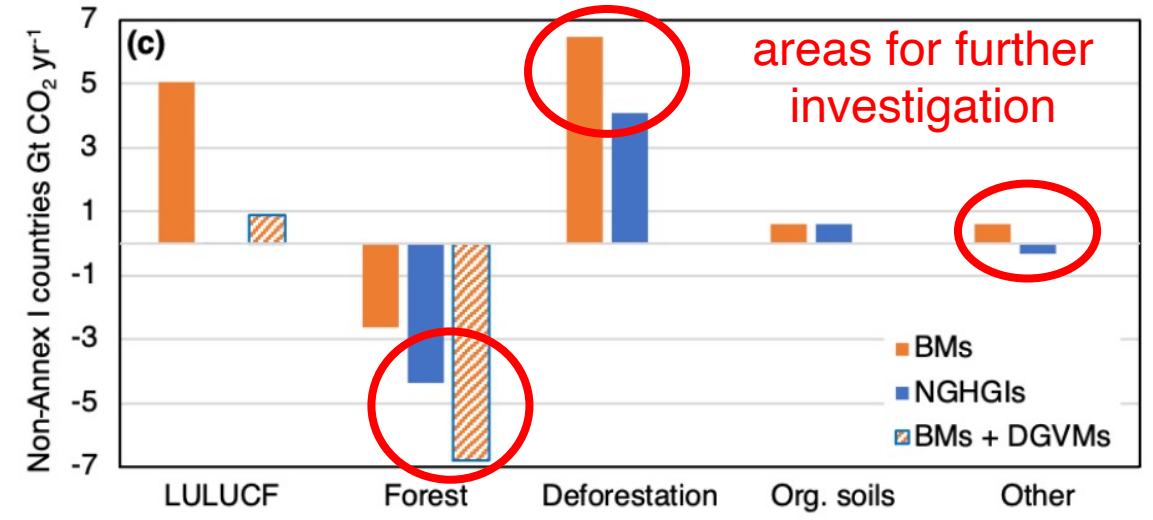
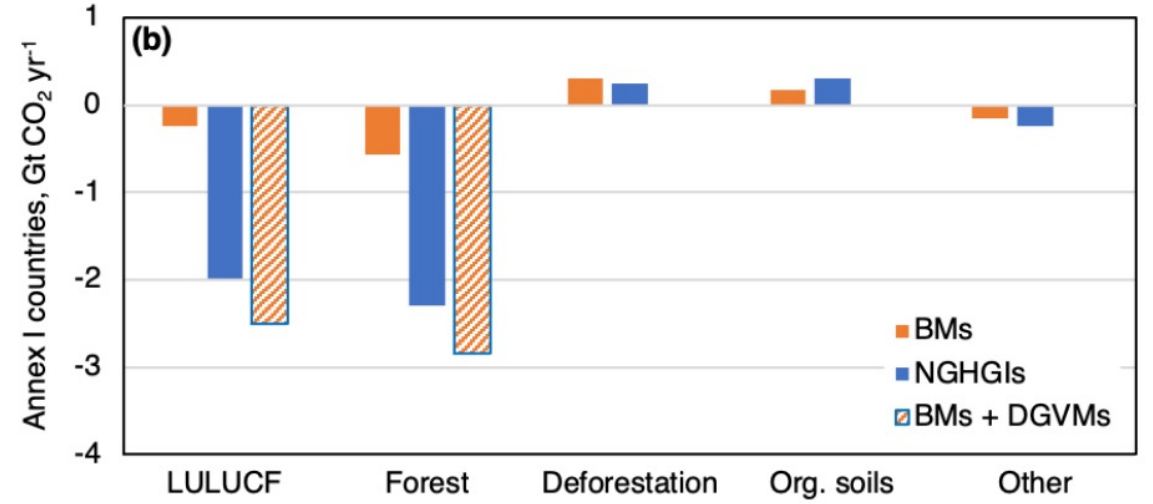
→ Blueprint for comparing anthropogenic land-use fluxes at various levels



Global trends are similar:

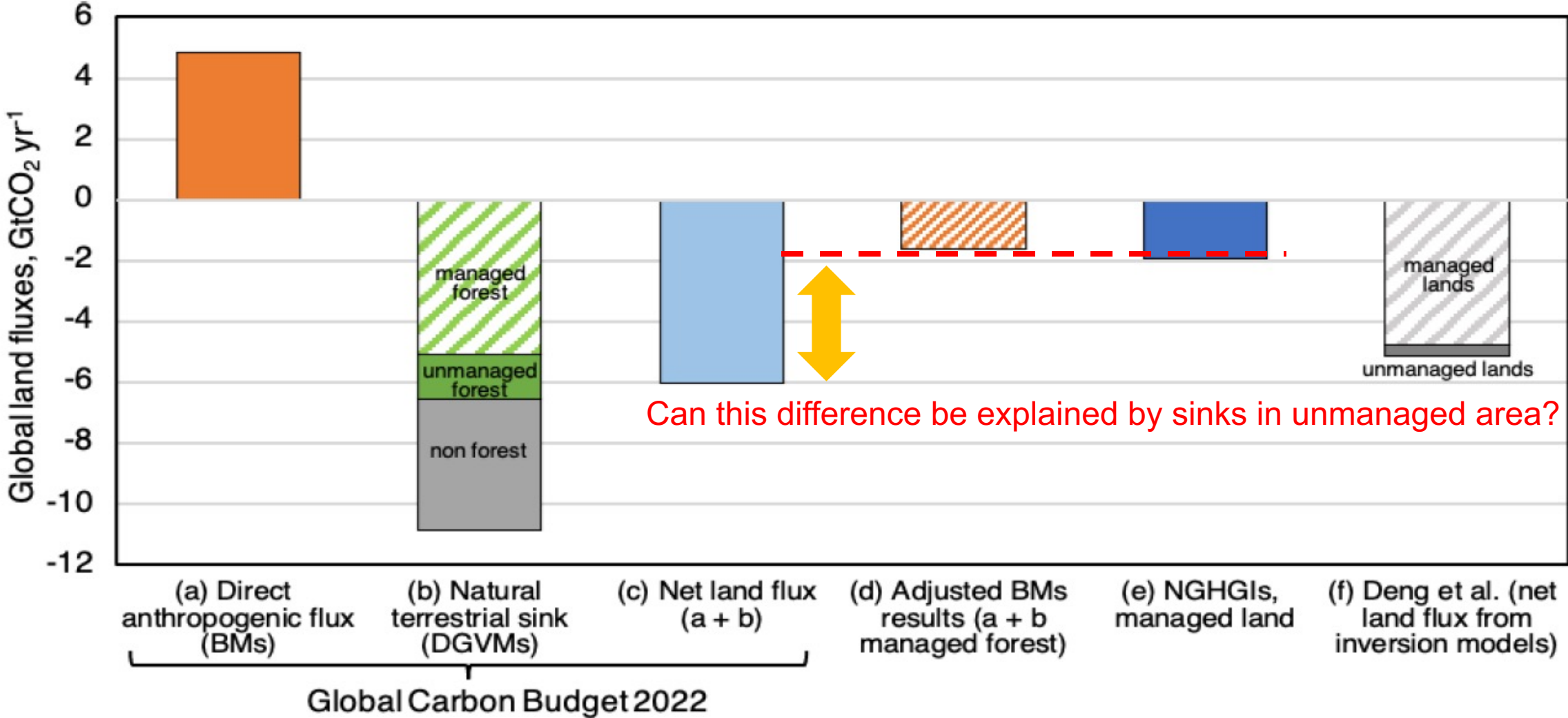


Comparison by land use (aver 2000-2020):



Where our results stands in the Global C budget?

Averages 2000-2000:



Issue now well acknowledged

Science:



Global Carbon Budget 2022



IPCC AR6 SPM Synthesis report: *“Global databases make different choices about which emissions and removals occurring on land are considered anthropogenic. Most countries report their anthropogenic land CO2 fluxes including fluxes due to human-caused environmental change (e.g., CO2 fertilisation) on ‘managed’ land in their national GHG inventories. Using emissions estimates based on these inventories, the remaining carbon budgets must be correspondingly reduced.”*

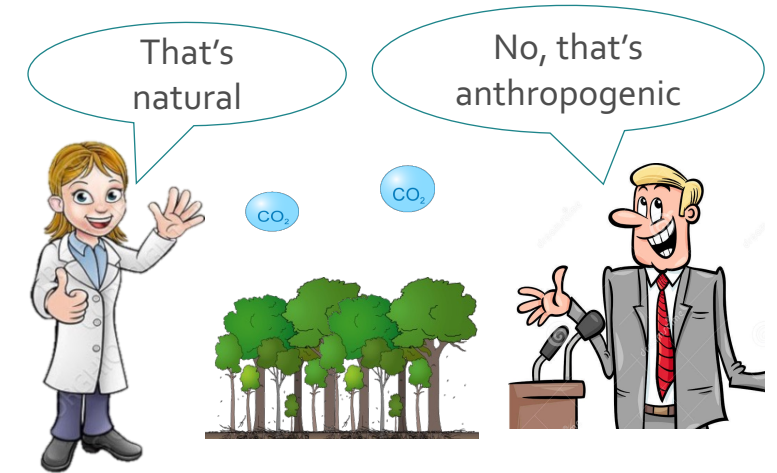
Policy:



UNFCCC’s synthesis report for the Global Stocktake: *“adjustments should be made where any comparison between LULUCF data reported by countries and the global emission estimates of the IPCC is attempted.”*

Conclusions and way forward

The main reason of the LULUCF gap between countries and global models is understood (different definitions of anthropogenic forest sink), and can be largely reconciled.



Other differences exist, and a lot of work is still to be done:

- **Countries** → greater transparency and completeness of estimates, definitions/area of managed lands, more clarity of LULUCF within climate targets
- **Global models** → better representation of land management/age dynamics, results disaggregated to be comparable to countries, etc..

Next steps: further increase comparability, operationalize the comparison, assess the implications.

Reconciling land use fluxes from countries and from models is key for increasing confidence in land use CO₂ fluxes at country level and for assessing collective progress under the Paris Agreement.

If you don't measure (or you don't trust your measure),
you don't manage



Thank you!

