Reconciling land carbon fluxes from global models and country inventories

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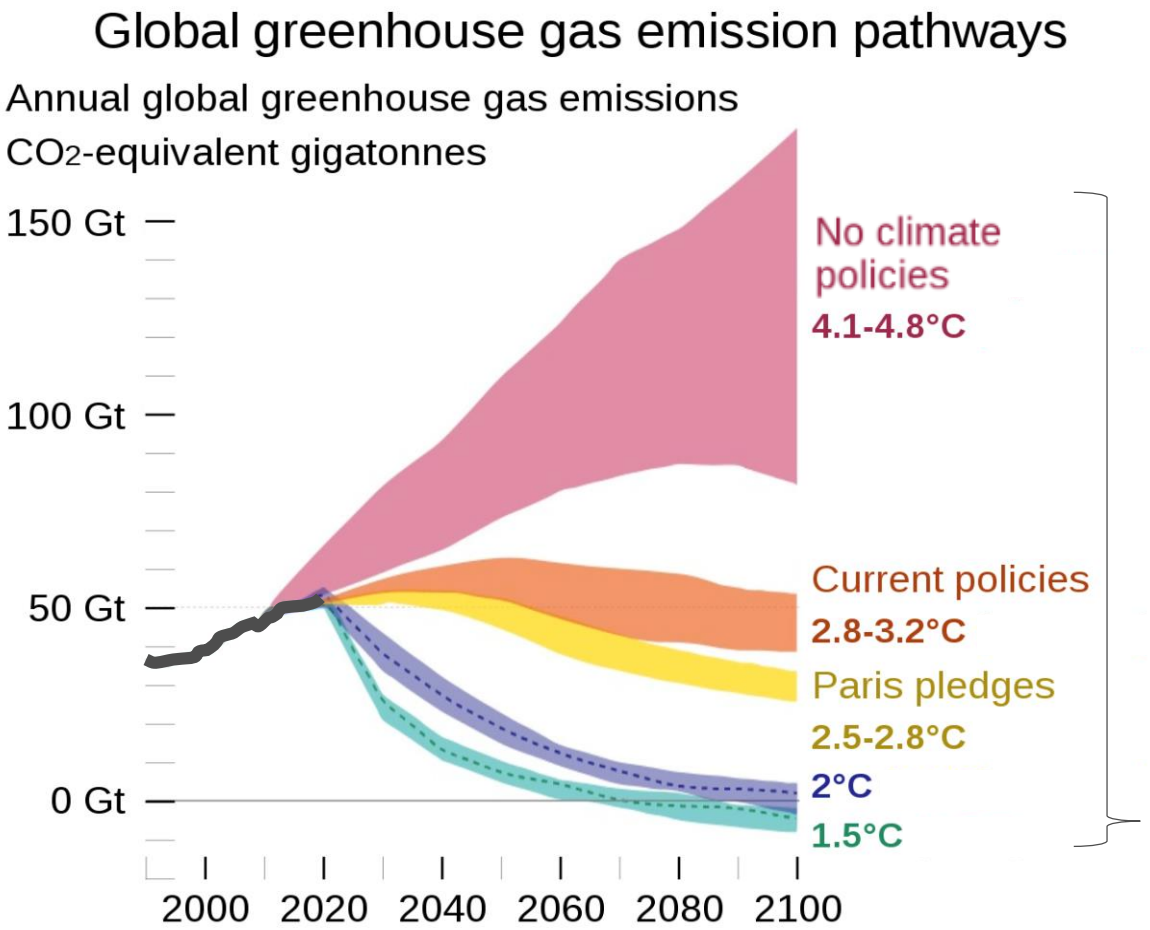
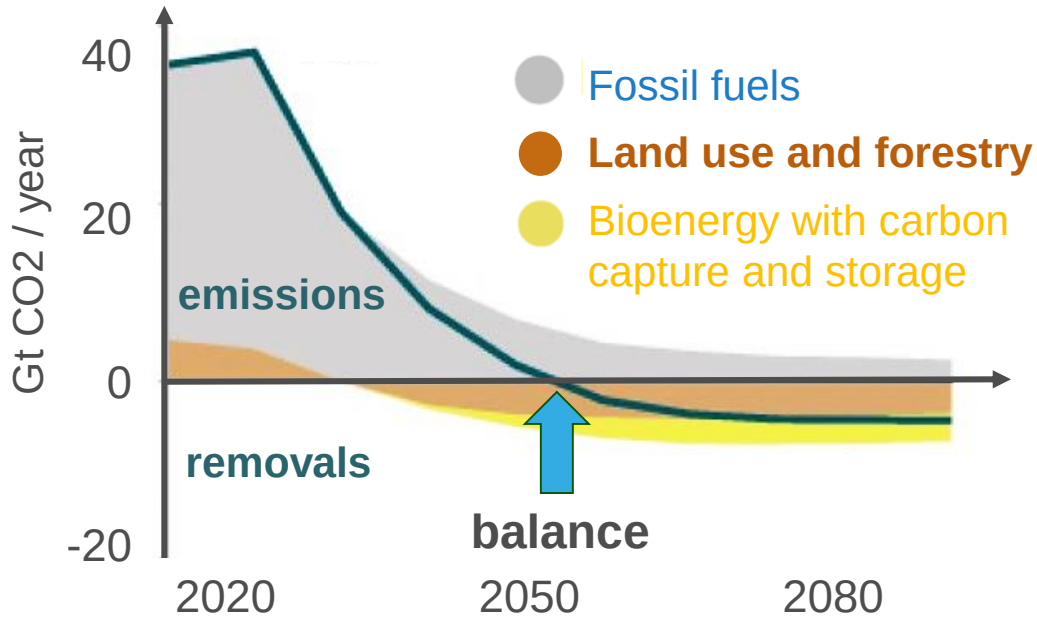
JRC LULUCF workshop 2022

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

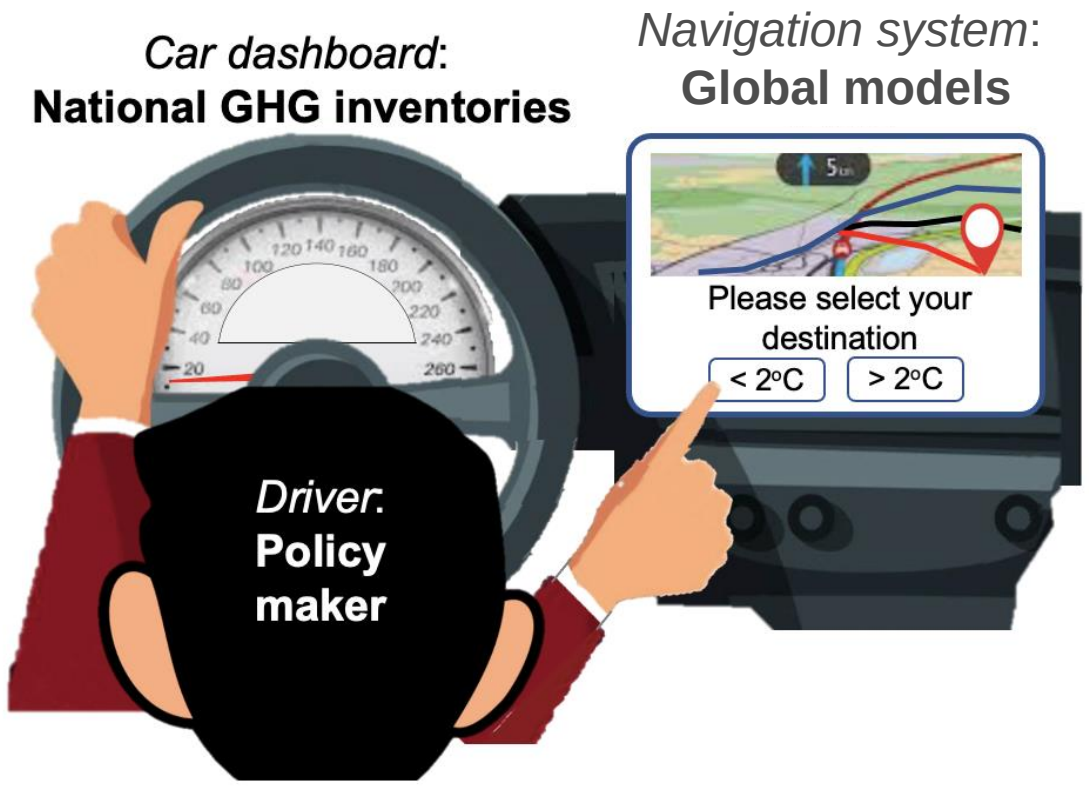




= Historical emissions from **National GHG Inventories**

European Commission

The context



National GHG inventories provide key information for climate policy and for assessing compliance toward the Paris Agreement, like the car dashboard for the driver.

Global models describe the historical emissions and the future pathways to reach specific temperatures, like the navigation system provides routes to reach specific destinations.

Once a destination is selected, the driver uses the navigation system to check that he/she is on track.

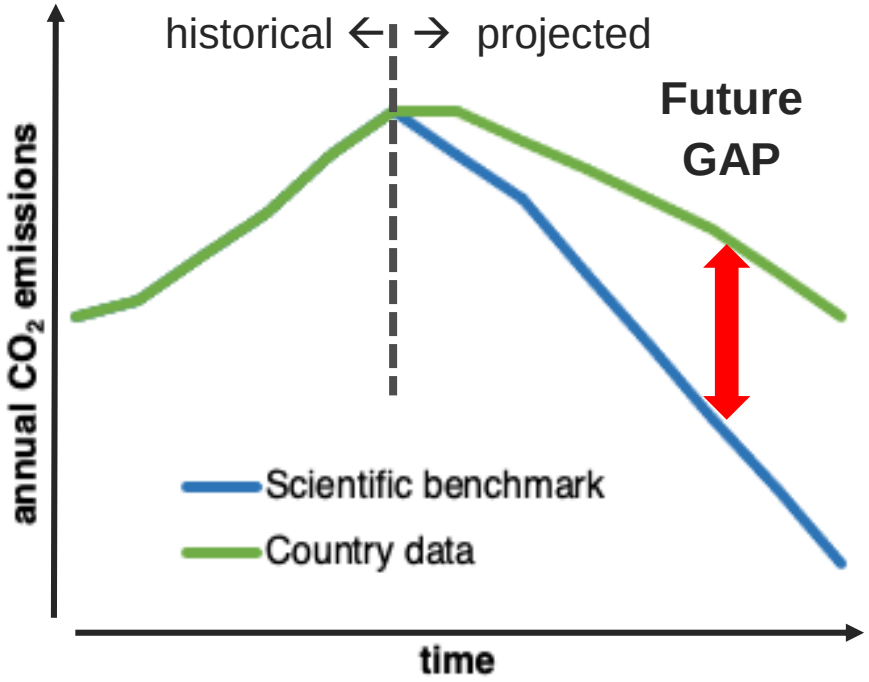
(by Giacomo Grassi)

European Commission

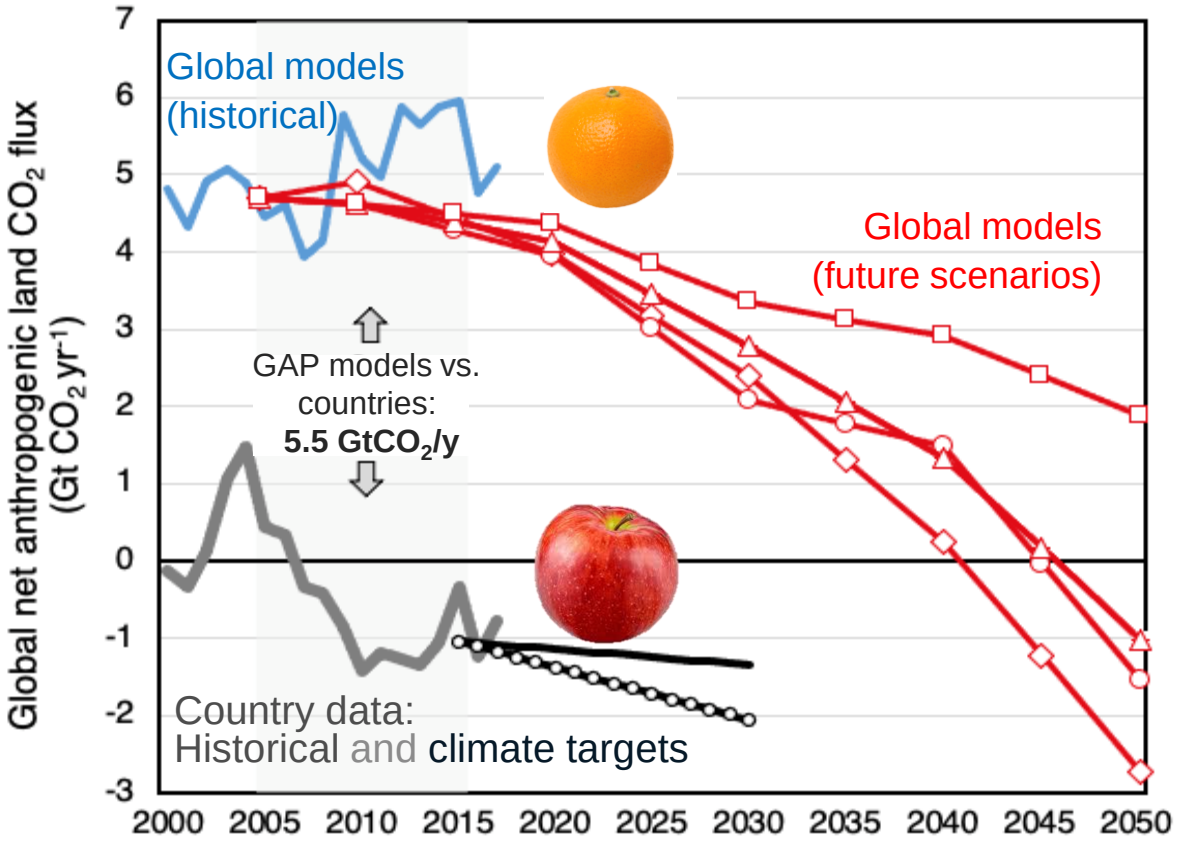
The Global Stocktake every 5 years assesses the collective progress towards the < 2°C target "in the light of the best available science"

Inputs: a) Aggregated countries' GHG data
b) IPCC and other scientific data

→ compared to assess the future "gap" → Increased climate ambition



Large gap on land-use CO_2 flux between models (IPCC) and countries



The Washington Post

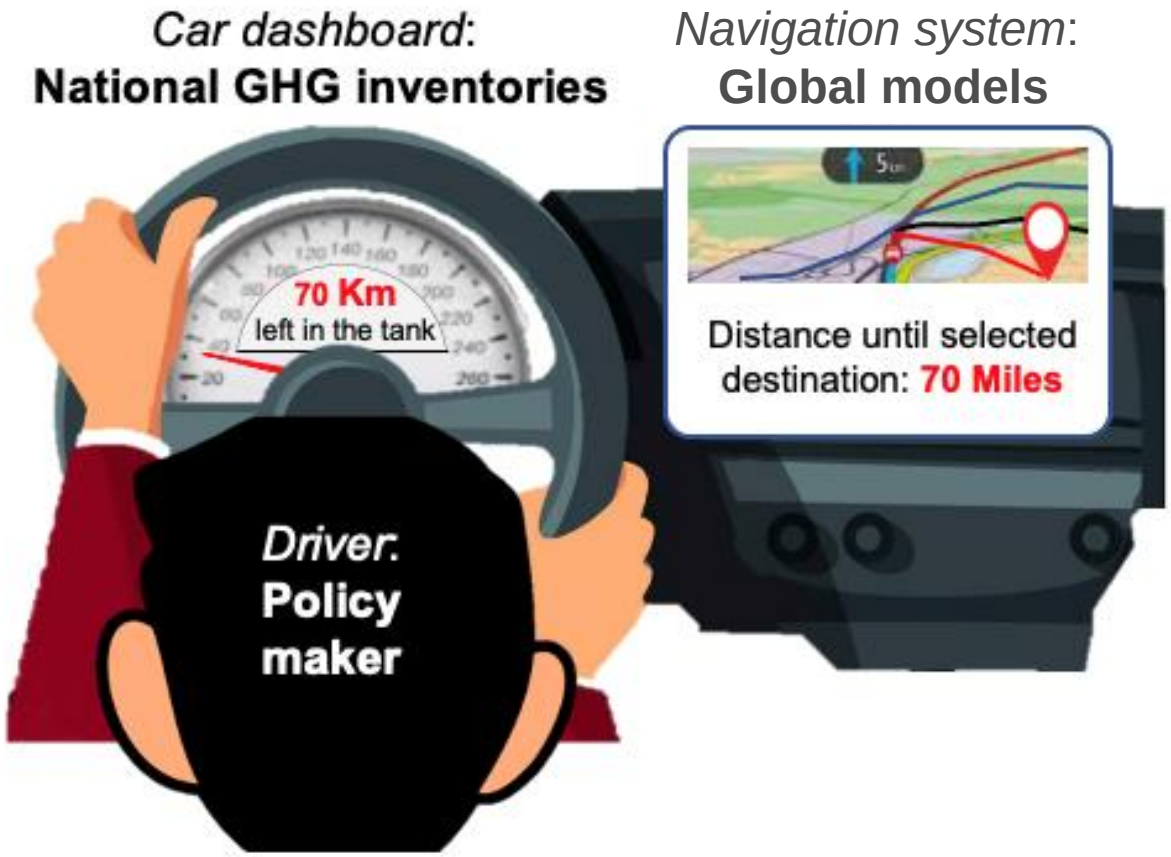
Climate and Environment

The giant accounting problem that could hamper the world's push to cut emissions

This large gap confuses policy makers: can global models (and IPCC) be used to assess historical and pledged climate progress?

(Grassi et al. 2021)

The problem



The gap in global land-use CO_2 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

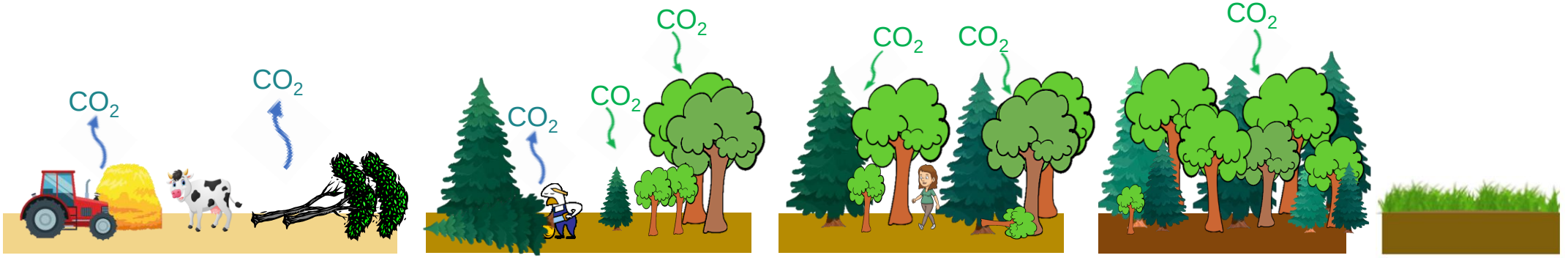
Most of the gap due to different definitions of anthropogenic forest sink

Global models: **Bookkeeping models (BMs)** **DGVMs**

Anthropogenic **Natural**

Direct anthropogenic effects
(e.g. land use changes, shifting cultivation, harvest, regrowth)

Indirect anthropogenic effects
(response of land to human-induced environmental change: increasing CO_2, N deposition, etc.)



Managed non-forest | Intensively managed forest | Less-intesively managed land | Unmanaged forest | Unmanaged non-forest

Countries: **Anthropogenic (in NGHGIs)** **Natural**

Two approaches developed for different scopes – both valid in their context, but **not directly comparable**

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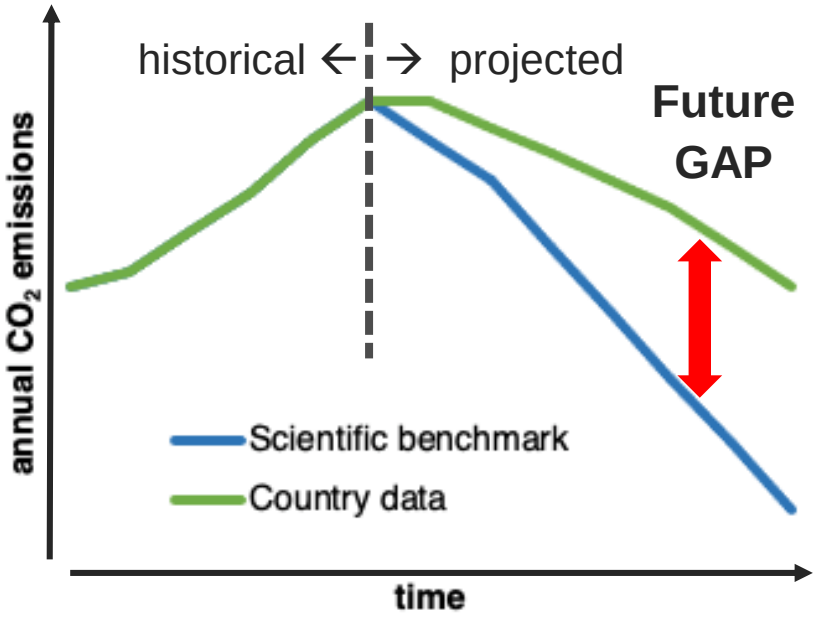
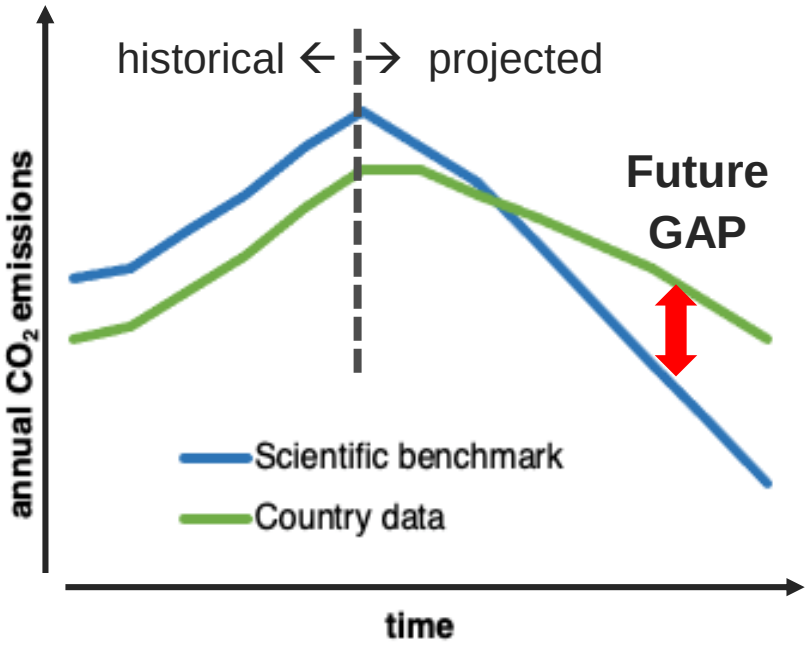
compared to assess the future "gap"

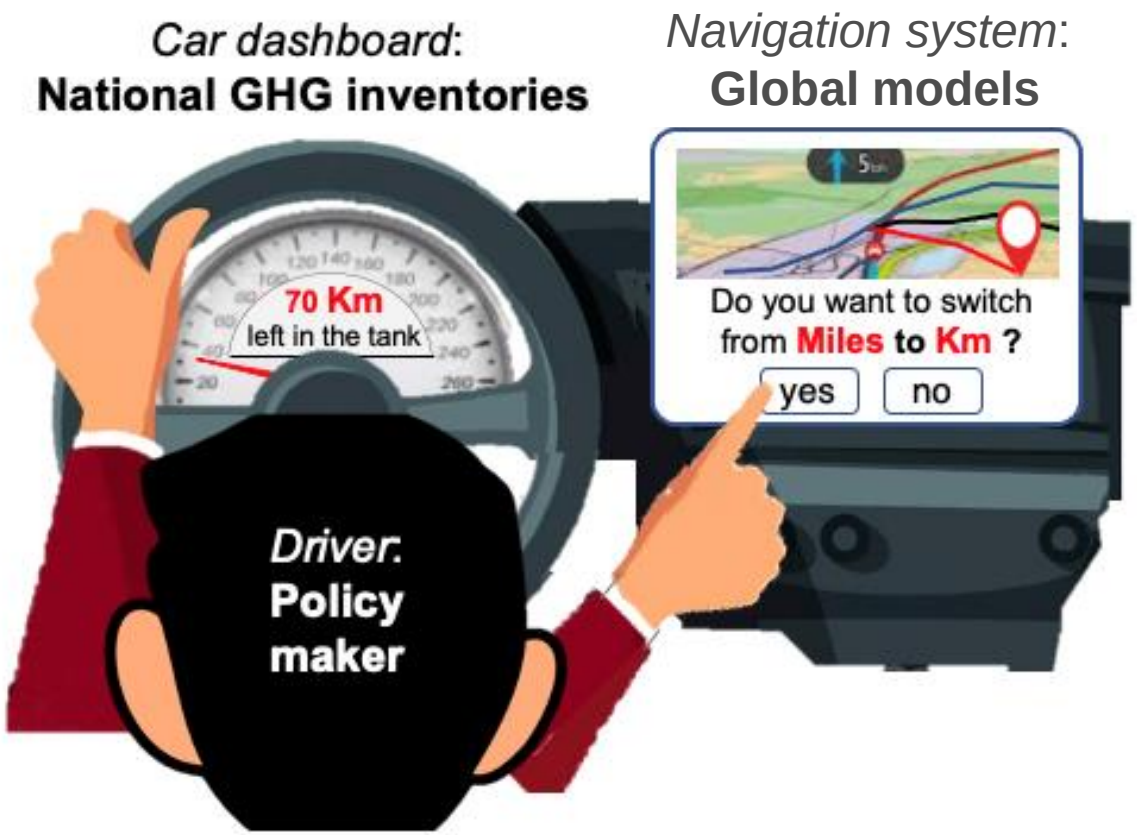
Increased climate ambition





Comparability is needed

The proposed solution

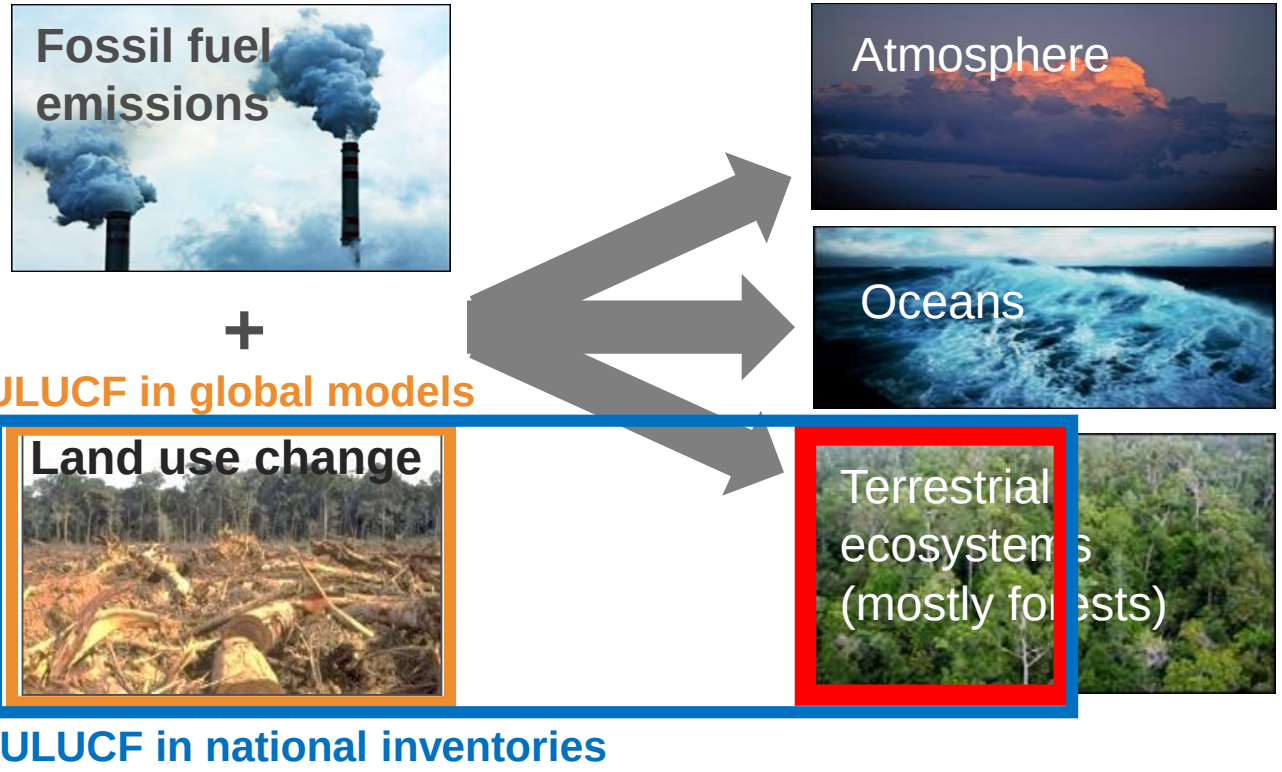


Changing National GHG inventories is impractical as changing the car dashboard.

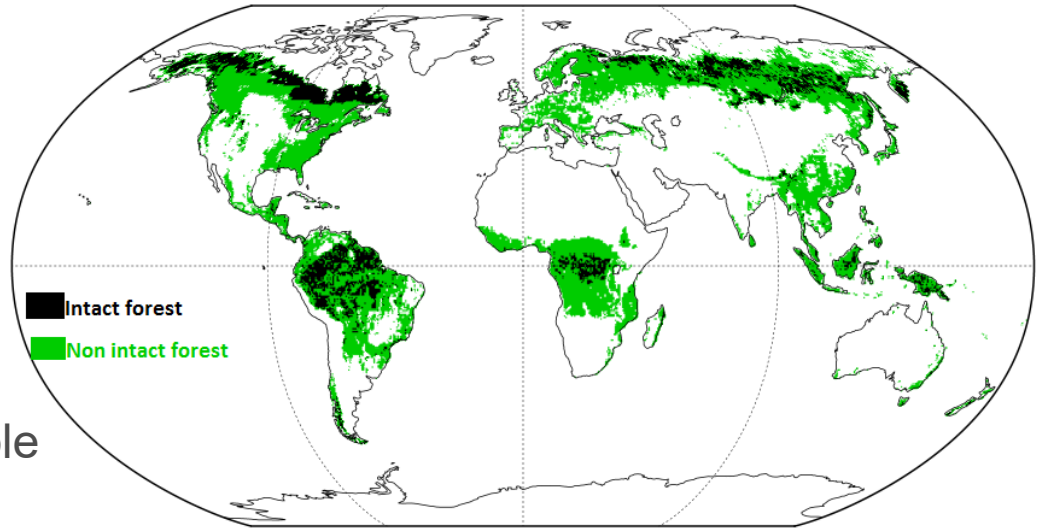
Changing the unit of the navigation system to match the dashboard would be easier.

Likewise, ‘adjusting’ model results would be a pragmatic short-term fix to ensure a more accurate assessment of the collective climate progress.

Approach to reconcile global models and national inventories

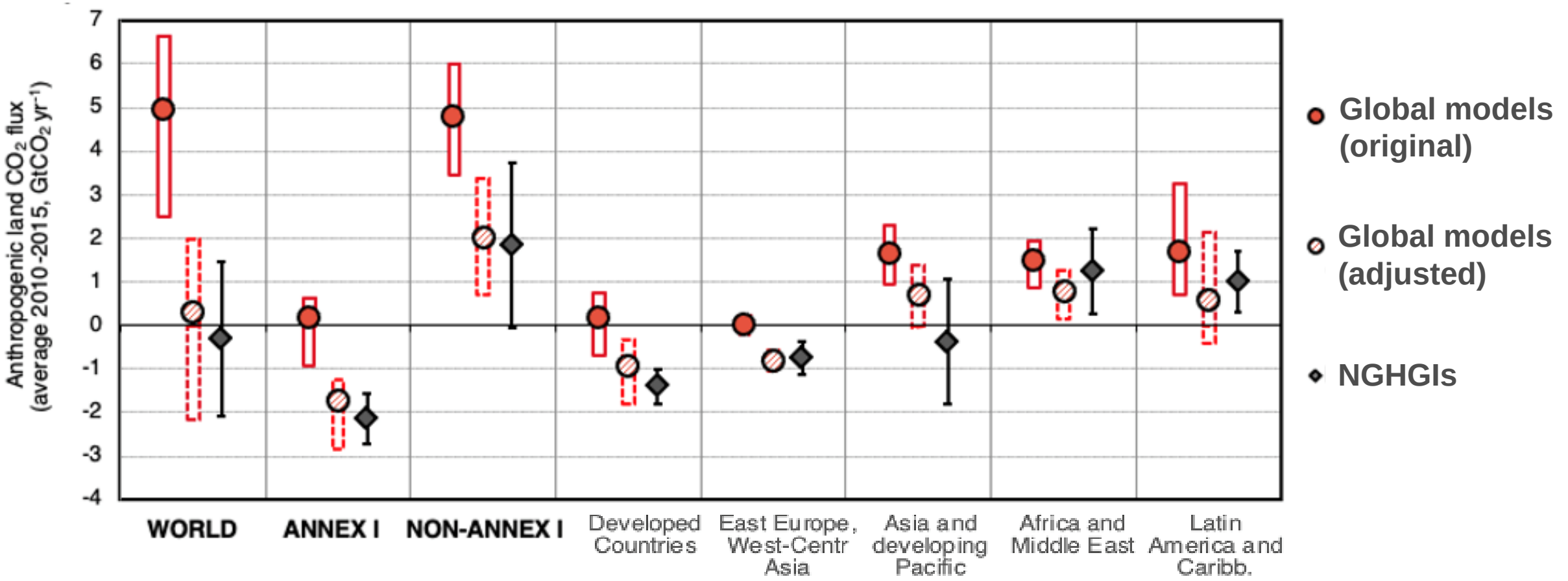


We add **the CO_2 sink on countries' managed forest area which is considered 'natural' by models** (estimated by DGVMs) to the original **anthropogenic land use flux from BMs,** disaggregated to make it comparable to NGHGIs



Countries' managed forest area estimated as "non-intact", unless country maps were available

Adjusting the global models' anthropogenic land CO_2 fluxes to the NGHGIs approach



By summing *all* models' fluxes over the *same* area used by NGHGIs, GHG fluxes become comparable

Issue acknowledged at the highest levels

Science:

Global Carbon Budget 2021

IPCC Summary for Policy Makers AR6 WGIII

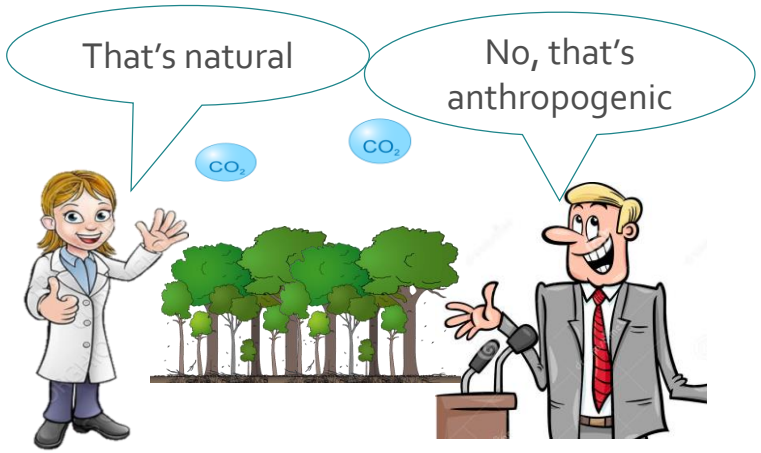
"There is a large gap of ~5.5 $GtCO_2$ yr^{-1} globally on land fluxes between global models and national GHG inventories. The gap reflects differences in how anthropogenic forest sinks and areas of managed land are defined."

Policy:

UNFCCC's synthesis report for the Global Stocktake:

"Adjustments should be made where any comparison between land-use data reported by countries and the global emission estimates of the IPCC is done"

CONCLUSIONS



- **Science/policy silos** led to different approaches to estimate the anthropogenic forest CO_2 sink
- Most of the difference is due to how fluxes are labeled (anthropogenic *vs*. natural). **Reconciliation is possible.**
- Needed improvements:
  - **Models**: better representation of land management processes, more disaggregated results
  - **NGHGIs**: more transparency (description of processes included, map of managed lands), more complete estimates (non-forest land uses, soils), especially for developing countries.
- This work helps increasing trust on land use CO_2 fluxes and **assessing the countries' collective progress under the Paris Agreement's Global stocktake**

Thank you!