The role of Forests in the Paris Agreement: expectations and scientific challenges

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OUTLINE

1. Introduction: the Global Carbon Budget
2. ***Forests no longer Cinderella***
3. ***Forest misunderstandings: Who claims the sink?***
4. How to turn the land mitigation promise into reality?

nature climate change

ARTICLES

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The key role of forests in meeting climate targets requires science for credible mitigation

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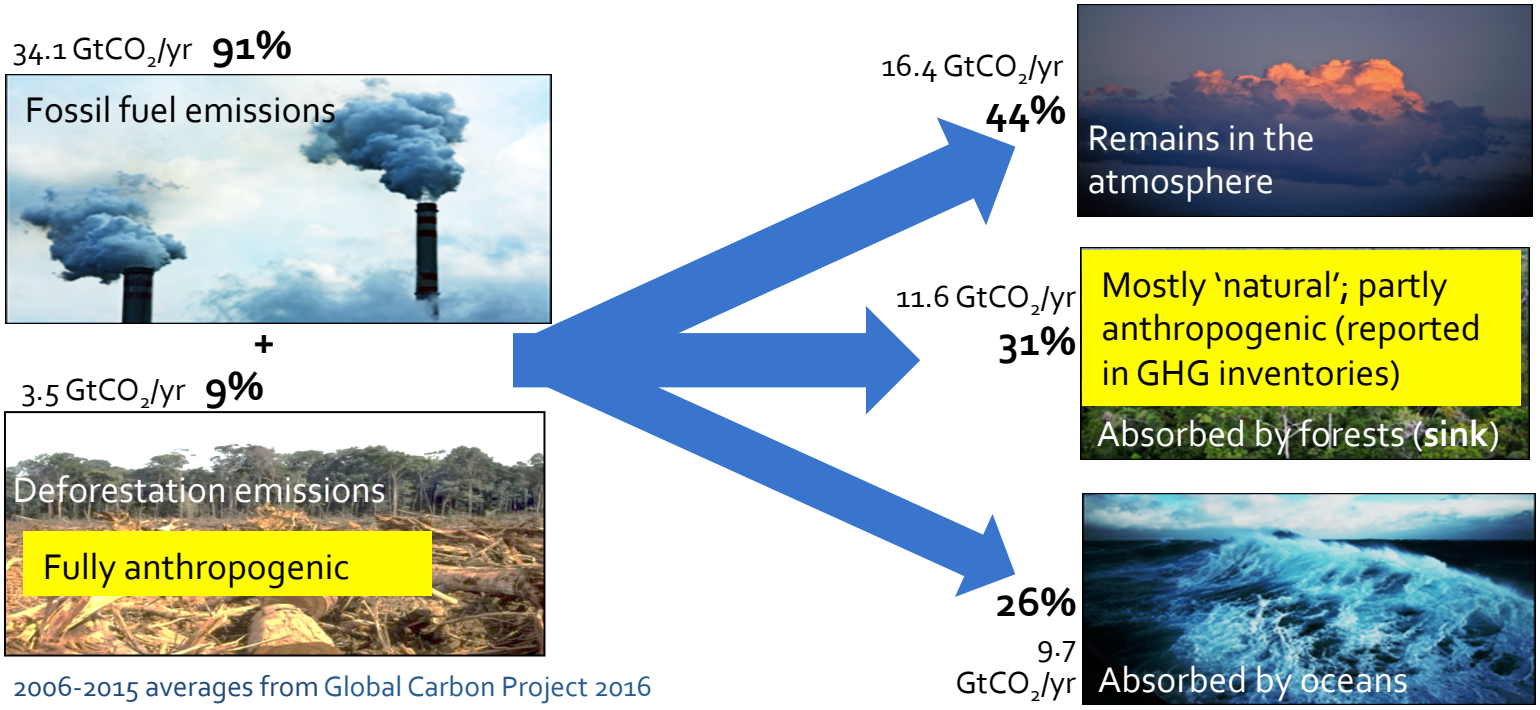
First step toward reconciling forest GHG estimates from countries *vs*. scientific studies → pre-requisite for a credible forests' contribution to the Paris Agreement

1. The Global Carbon Budget



2006-2015 averages from Global Carbon Project 2016

LULUCF (mainly forests) is part of the **problem** and part of the **solution**
(LULUCF: Land Use, Land Use Change and Forestry)

2. Forests no longer Cindirella ?

On the expected role of forests in countries' NDCs

Despite many studies suggesting a high mitigation potential from forests, due to its uncertainties and its special characteristics the LULUCF sector has often been treated separately and considered a secondary mitigation option under the UNFCCC,
like Cinderella excluded from the ball…

…has Cinderella finally joined the Paris ball?

Ahead of the Paris Conference, 187 countries (> 97% of global GHG emissions) have submitted their (Intended) **Nationally Determined contribution**, (I)**NDC**, most of which including LULUCF

The NDCs represented an important new source of LULUCF information, but the transparency of this information was not always adequate.

From UNFCCC INDC synthesis report:

"Many INDCs do not provide comprehensive information on the assumptions and methods applied in relation to LULUCF".

"A major area of uncertainty relates to the approaches used for estimating, projecting and accounting emissions and removals from the LULUCF sector".

METHODS

The following information was collected for each country:

a) ***Type of mitigation target,*** e.g. reference point (base yr of BAU scenario)

b) ***Modality of inclusion of LULUCF within the INDC***

c) ***Country's historical data*** **and** ***projections***, with the following priority:

- INDCs
- GHG inventories (GHGI), National Communications (if later than 2010), Biennial (Update) Reports (BR/BUR), other official country's documents
- FAO-Forest Resource Assessment (FRA 2015) to fill gaps

INDC CASE	Type of mitigation target*	Inclusion of LULUCF within the INDC	Countries with enough LULUCF information for this analysis**
1	Absolute target relative to base year	Generally treated as any other sector	Australia, Brazil, United States of America
2	Reduction relative to BAU scenario (often "unconditional" and "conditional" targets)		Afghanistan, Argentina, Benin, Cambodia, Central African Republic, Chad, Colombia, Congo, Democratic Republic of the Congo, Ecuador, Ethiopia, Gabon, Ghana, Guatemala, Guyana, Honduras, Indonesia, Kenya, Madagascar, Malawi, Mali, Mexico, Morocco, Namibia, Paraguay, Peru, Senegal, Uganda, Viet Nam, Zambia
3	Absolute target relative to base year	Special accounting rules	Canada, EU28, Japan, Kazakhstan, New Zealand, Norway, Russian Federation, Switzerland, Turkey, Ukraine
4	Intensity	Various approaches	Chile, China, India

*INDCs with 'policies and measures' were not considered

41 INDC (= **68 countries, ≈ to 78% of all-sectors net emissions in 2012), including all biggest forest countries (83% forest area)

We captured the variety of INDCs types, reflecting the different countries' circumstances

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QUESTIONS

The mitigation role of LULUCF may be quantified from different **'perspectives'**, each answering to different **questions**.

LULUCF mitigation 'perspective'		Question
A) **LULUCF INDC TREND:** net emissions expected in 2030 (for unconditional and conditional INDC)	→	*What **trend in emissions** expected to be "seen by the atmosphere" ?*
B) **LULUCF deviation from 'pre-INDC' scenario**	→	*What **additional LULUCF contribution** relative to a pre-INDC scenario?*
C) **LULUCF contribution to emission reduction as defined in the INDC,** based on: - the *way country expresses its INDC* (relative to a base year or a BAU scenario) - the *way LULUCF is included* (as any other sector or with special *accounting rules*).	→	***What do countries 'see' as mitigation**? E.g. if a country commits to reduce its emissions by **x**% relative to **y** (base year or BAU-scenario), **what fraction of x is attributable to LULUCF?***

We quantified different 'mitigation perspectives', reflecting the variety of INDCs types and the complexity of LULUCF accounting

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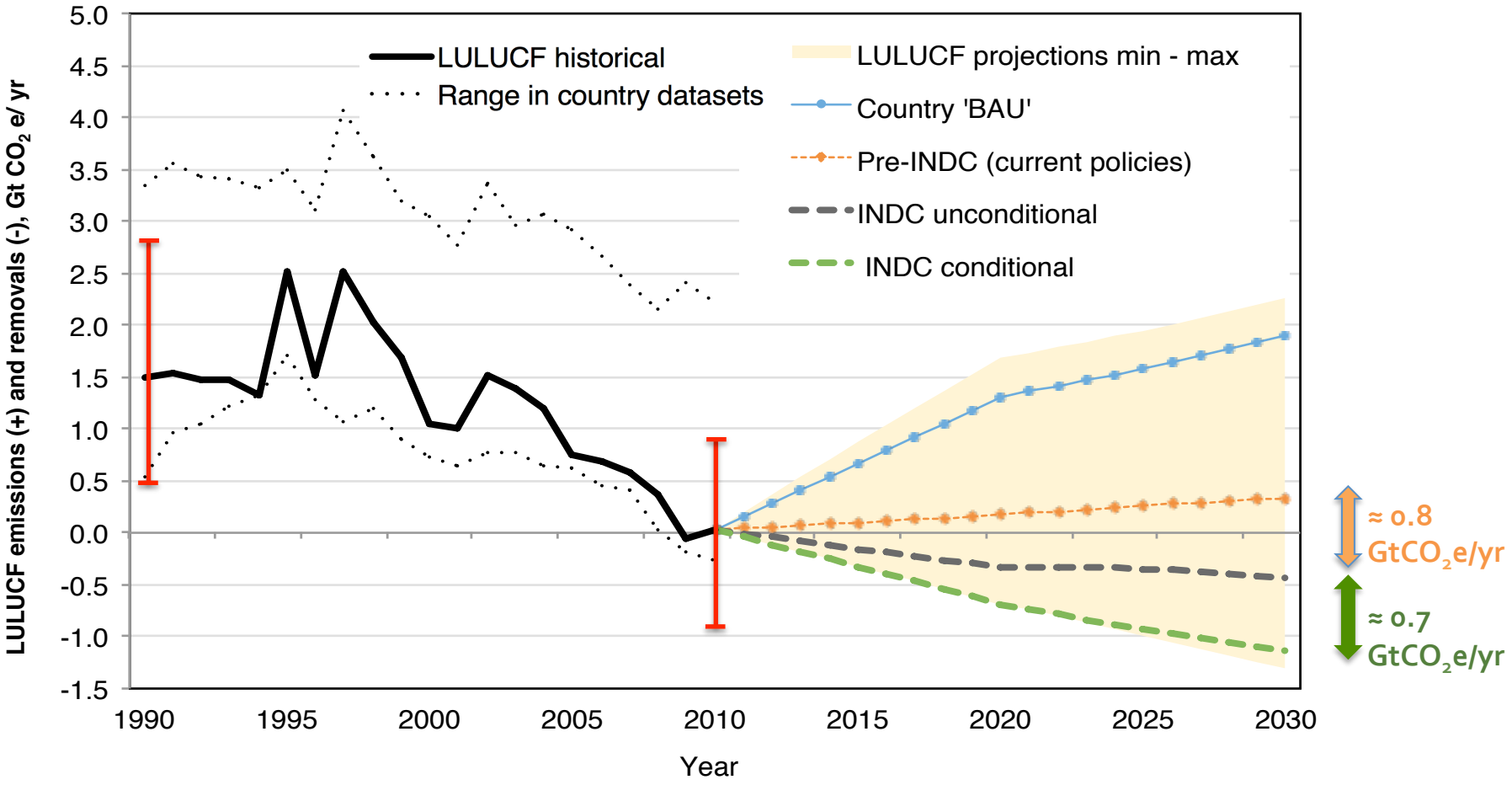
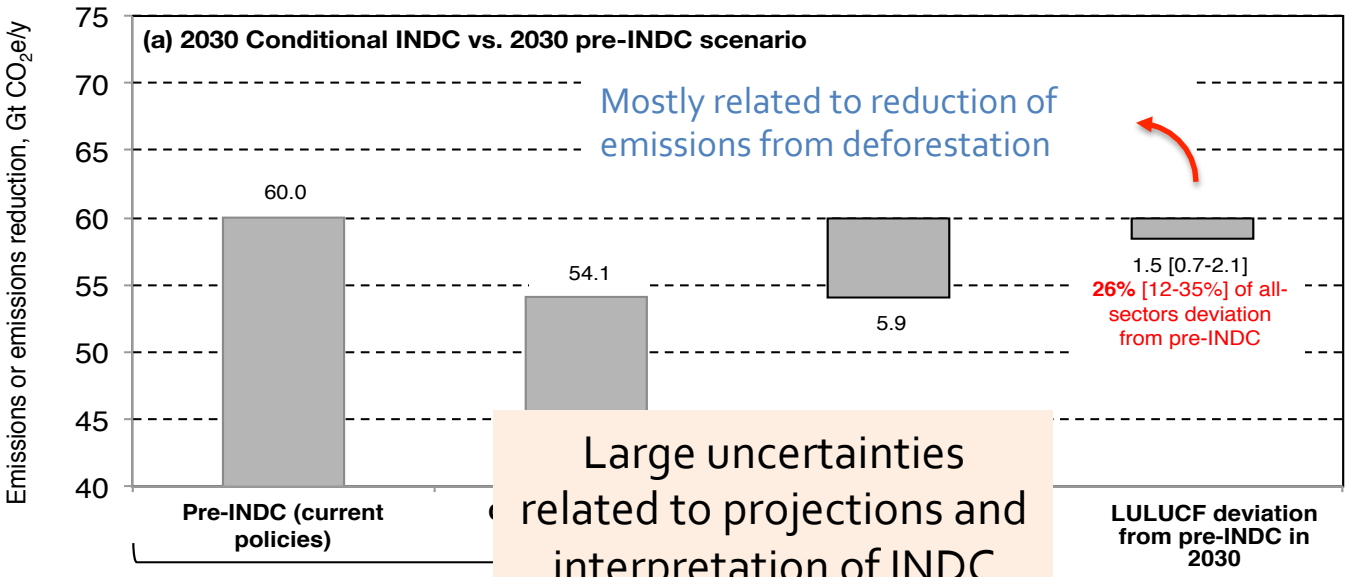
(A) Global trend of LULUCF net emissions, and future scenarios



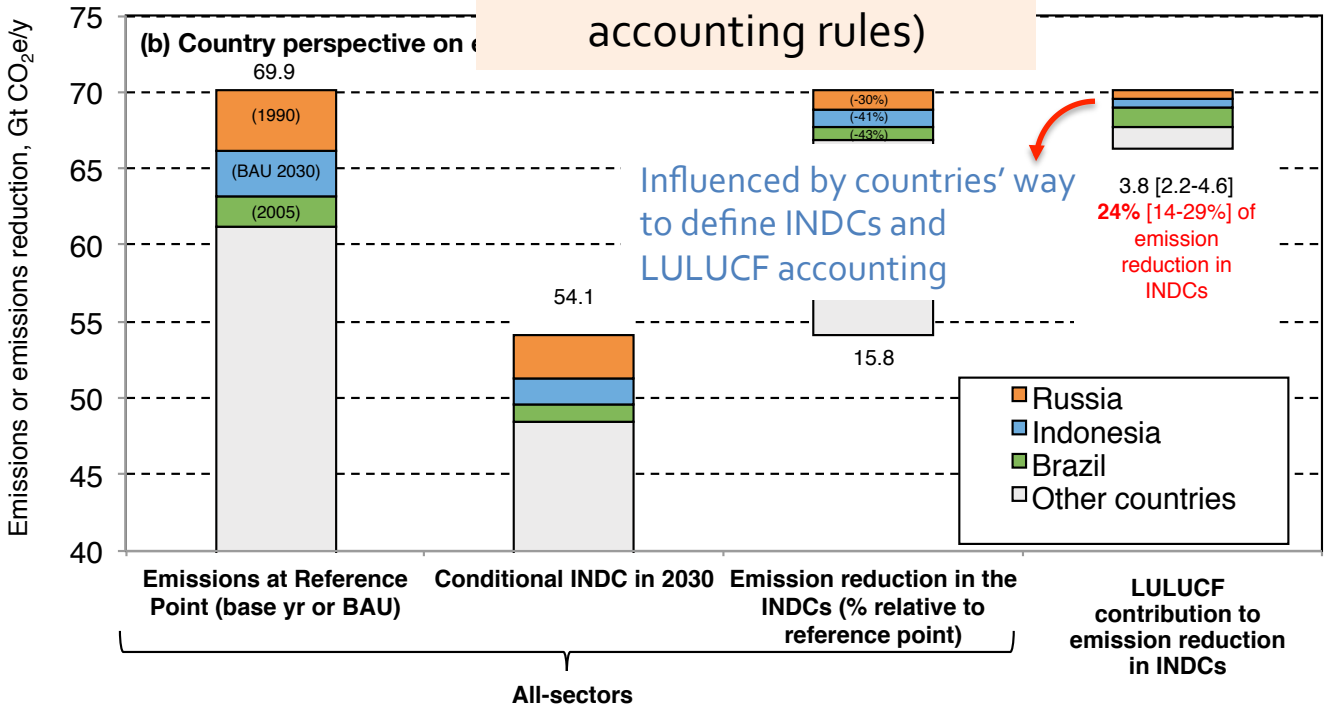
Large uncertainties (and incompleteness) exist in country GHG estimates

(B) Deviations from pre-INDC scenarios



Large uncertainties related to projections and interpretation of INDC information (including accounting rules)

(C) LULUCF contribution to emission reduction as defined in INDCs

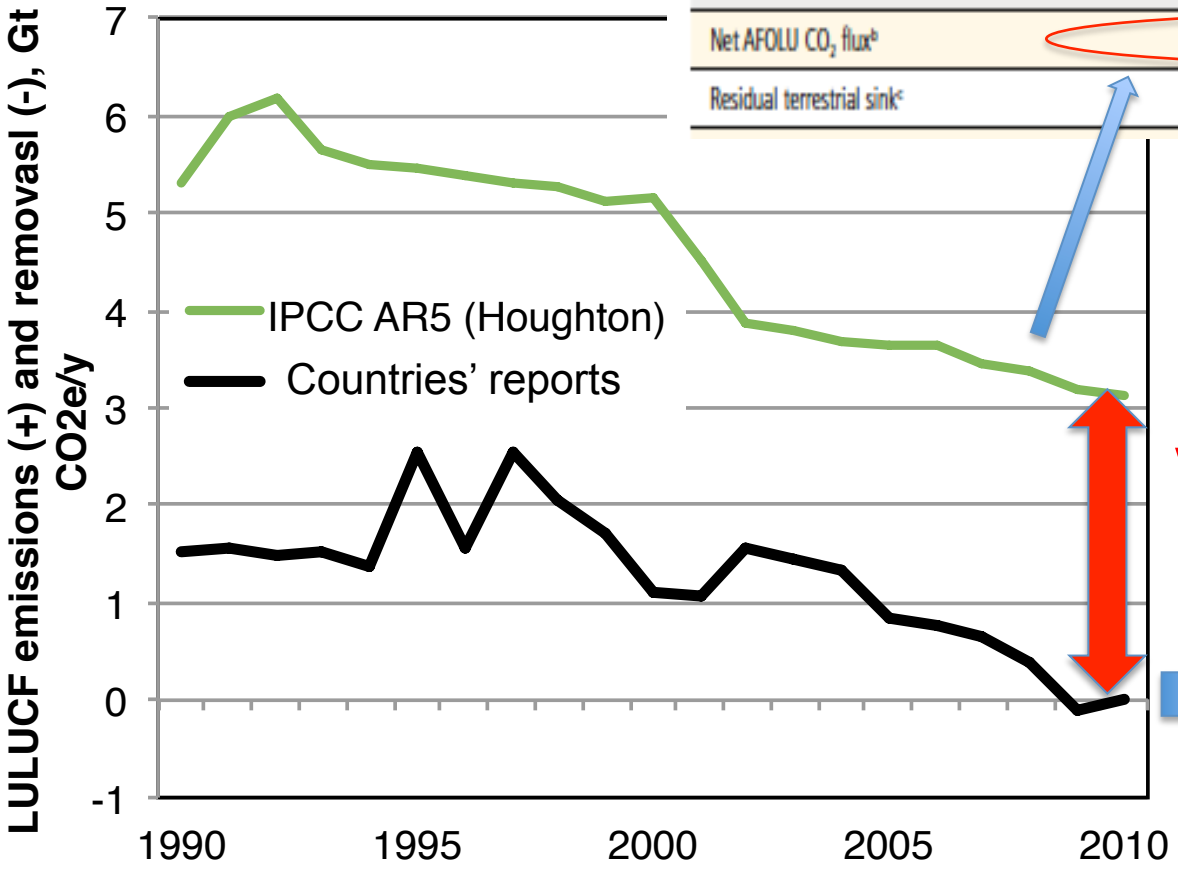


Overall, LULUCF expected to provide ≈ a quarter of *planned* global emission reductions

Globally, how country LULUCF estimates compare with other datasets ?

IPCC AR5, WG3, tab. 11.1

	1990–1999 GtCO$_2$/yr			2000–2009 GtCO$_2$/yr		
IPCC WGI Carbon Budget, Table 6.1[a]:						
Net AFOLU CO$_2$ flux[b]	5.87	±	2.93	4.03	±	2.93
Residual terrestrial sink[c]	–9.90	±	4.40	–9.53	±	4.40



WHY such big GAP?

Priority sources: INDC; GHGIs, recent NCs, BR/BUR, other country official docs; FAO-FRA only to fill gaps

Conclusions (Cindirella)

- The INDCs "mixed fruit salad" reflects the widely different countries' perspectives – unavoidable in a country-driven process.
- Assuming full implementation of INDCs, **LULUCF turns globally from a net source for 2000-2010 to a net sink in 2030**, and by then it is **expected to provide up to a quarter of planned countries' emission reductions**

→ apparently **Cinderella shined at the Paris ball**…

… **but:**

Large uncertainties associated to:

- **Transparency of land-related information in NDCs**
- **Country estimates**: why so different from IPCC AR5?

European Commission

3. Forest misunderstandings: Who claims the sink?

Scientific questions around the difference between GHG inventories and the IPCC AR5, and the assessment of progress towards the Paris Agreement's goals

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SPACE MISUNDERSTADINGS

CNN, September 30, 1999

Metrics mismatch causes NASA losing a $125 million Mars orbiter

The reasons is that one team spacecraft engineers used English units (pound-seconds), while the other team used more conventional metric (newton-seconds)

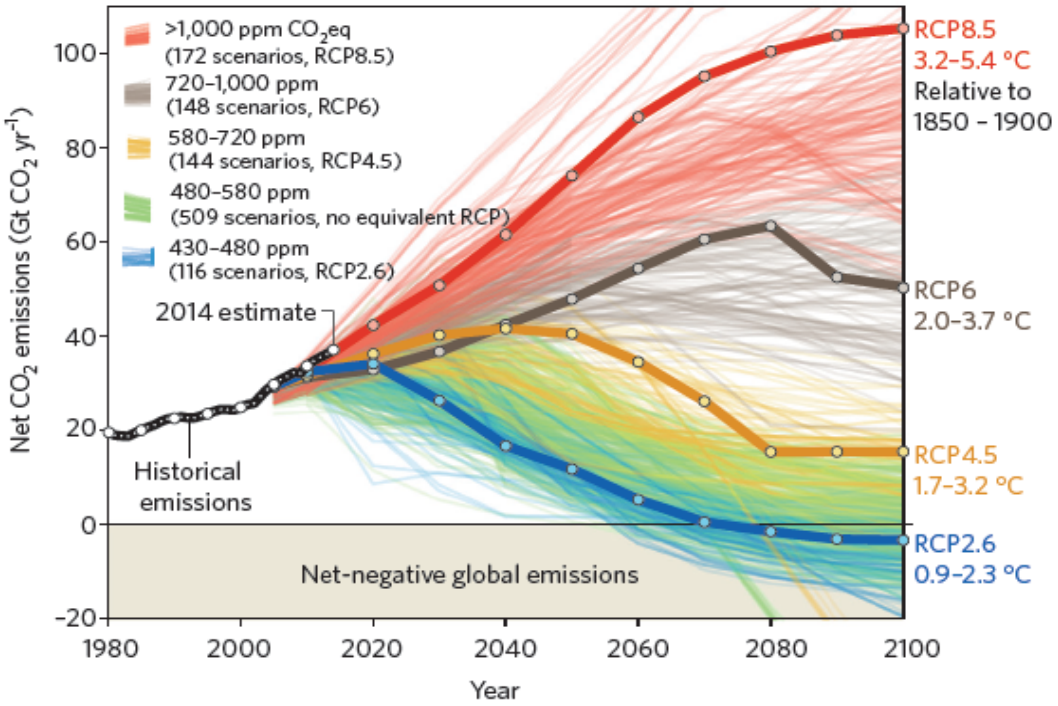
Paris Agreement (PA), Article 4

In order to achieve the long-term temperature goal (<<2°C), Parties aim to reach global peaking of GHG emissions as soon as possible (…), and to undertake rapid reductions thereafter in accordance with *best available science*, **so as to achieve a balance between *anthropogenic* emissions by sources and removals by sinks of GHG in the second half of this century**

Global Stocktake (GST)

The **GST** should highlight the state of the collective progress towards the goals of the PA, including the current "gap" between existing pledges and the emissions reduction required to achieve the PA's goals → it should drive **increasing ambition** with regular rounds of **new NDCs**

What the "best available science" (IPCC AR5) says?



Each Relative Concentration Pathway (RCP) include its own modeling of:

- **LULUCF**: assumed to capture the net land-related **direct anthropogenic flux**
- **Residual terrestrial sink**: difference between the modelled LULUCF and the total net flux of CO2 between the land and the atmosphere → assumed to be a **natural response** of primary or mature forests to environmental change

Why IPCC AR5 and country data differ? The case of developed countries

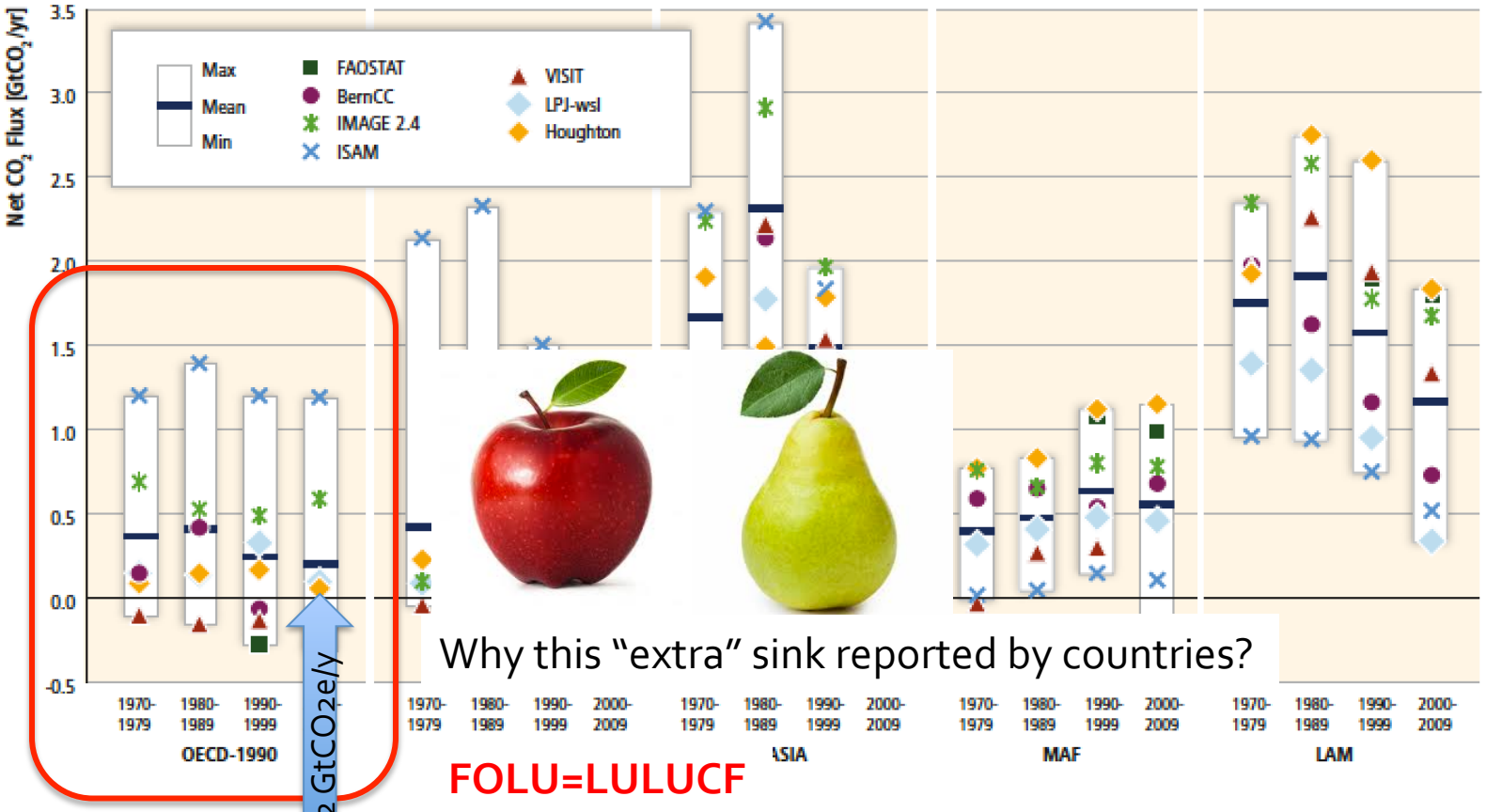


Figure 11.7 | Regional trends in n CO_2 fluxes from FOLU (including LUC). Houghton bookkeeping model approach updated to 2010 as in Houghton et al., (2012) and five process-based vegetation models up ed to 2 r et al., 2010); BernCC: (Stocker et al., 2011); VISIT: (Kato et al., 2011); ISAM: (Jain et al., 2013), IMAGE 2x Mi (FAOSTAT, 2013) include peatlands.

The term 'forestry and other land use' used here, is consistent with AFOLU in the (IPCC, 2006) Guidelines and consistent with LULUCF (IPCC, 2003).

WHAT and WHY is reported in countries' GHG inventories?

1992, UNFCCC (art 12.1): reporting GHGIs of anthropogenic emissions and removals

1997, KP: accounting of "direct-human induced" LULUCF activities after 1990

2001: UNFCCC asks IPCC methods "*to factor out direct vs indirect effects*"

2003, 2009: IPCC: "sorry, not possible to develop a widely applicable method". Conceptual distinction of effects proposed

Direct-human induced effects
- Land use change
- Harvest and other management

Indirect-human induced effects
- Climate change induced change in T°, precipitation, length of growing season.
- Human-induced CO2 and N fertilisation.
- Impact of air pollution (e.g. ozone, etc.).
- Changes in natural disturbances regimes

Natural effects
- Interannaul variability
- Natural disturbances

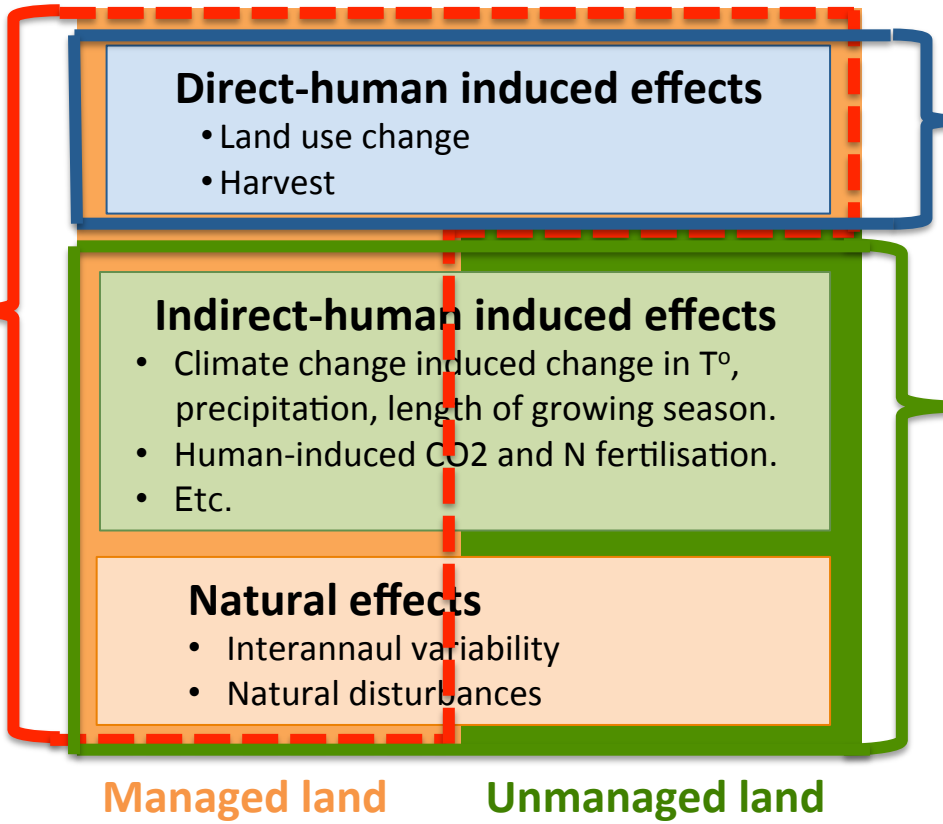
IPCC 2003 and 2006 Guidelines → Managed land adopted as proxy for anthropogenic emissions/removals → **GHG inventories report** net emissions *only* for managed land (as defined by the country), including **direct +** (in *most, but not all,* cases) **indirect effects**.

For **accounting** under **Kyoto** (Annex 1 countries), special **rules** were negotiated with the aim to filter the *reporting* to reflect better direct mitigation actions

So, who finally claims the forest sink?

GHG inventories
(following
IPCC 2006 Guidelines)

IPCC AR5
(Houghton and most
global models)



LULUCF

LULUCF reporting

Residual sink

Ultimately, **should the LULUCF part in the "balance" include only *direct* effect (as IPCC AR5) OR also *indirect* effects on managed land (as most country reporting)** ?

The Global Stocktake assessment of the "balance" will compare **globally-aggregated country data** to the science-based **2°C trajectory**. This requires:

a) Comparability

b) Completeness (as close as possible to "what the atmosphere sees globally")

Country "reporting" is a better basis than "accounting" for the balance:

- Greater comparability across countries. While reported estimates are broadly comparable, accounting rules reflect the country's view on its mitigation effort (e.g. in the NDCs), i.e. they are policy choices that *may be* complex and largely un-comparable across countries.
- Greater potential comparability between aggregated country data and global models (but this require models adapting their outputs, see later)
- Reporting is much closer to "what the atmosphere sees" (however, unmanaged land excluded)

How to make global model results comparable to country reporting?

Changing models (e.g. DGVMs) to mimic country reporting may be difficult (and make no sense), but disaggregating their outputs in a different way is feasible

E.g. IPCC AR6 could include this disaggregation:

		2000-2009	2010-2019	Up to 2100
LULUCF (direct human-induced effects)				
Residual sink (including indirect human-induced and natural effects)	**Managed lands**			
	Unmanaged lands			
TOTAL				

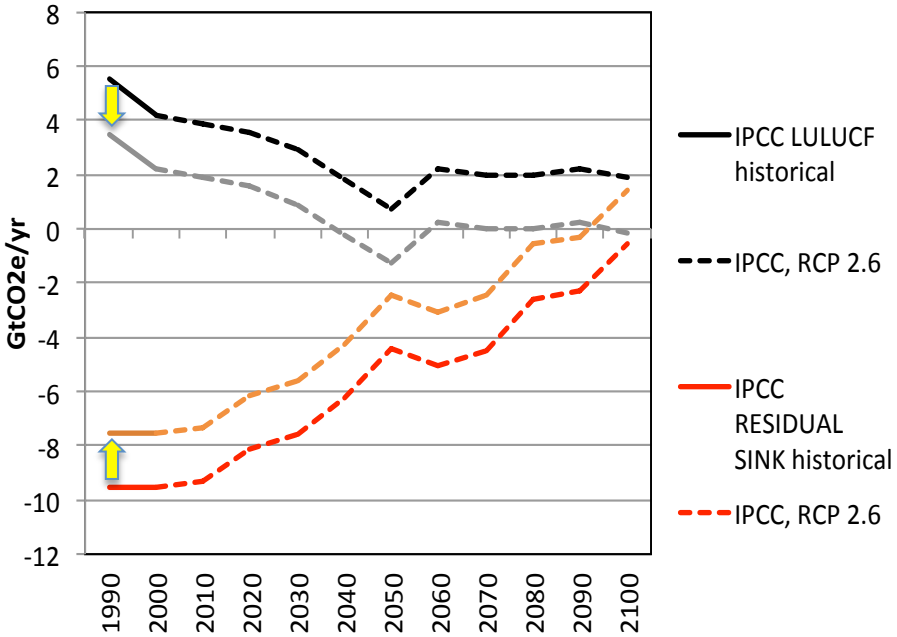
Comparable to country GHGIs

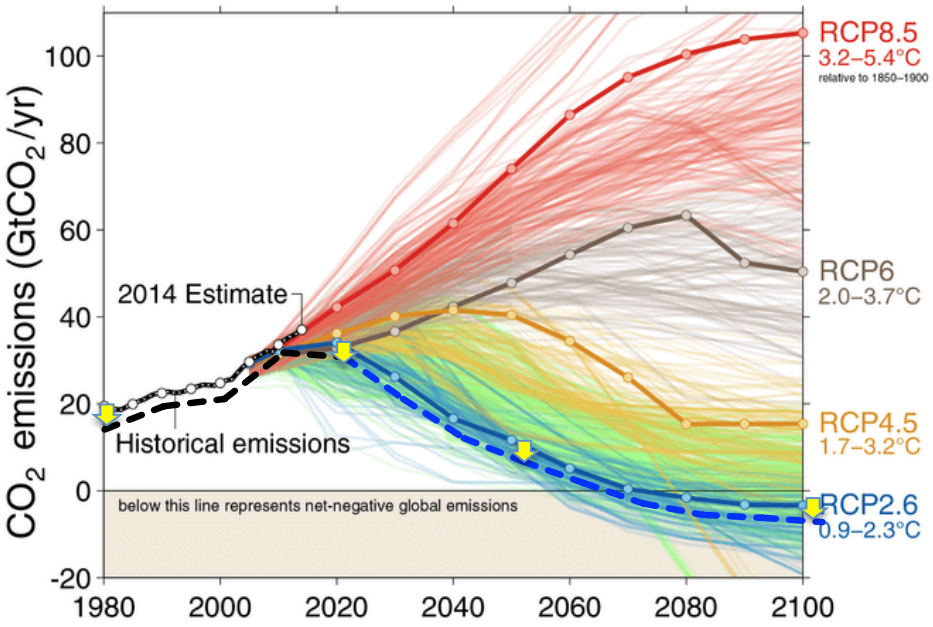
(**Grassi et al.** Towards reconciling anthropogenic forest sink estimates for the global stock take, in preparation)

What happens if LULUCF will include the "indirect human-induced" effects?

(as most o country reporting) → some sink shifts from the "residual sink" to LULUCF

Illustrative conceptual example of shifting 2 $GtCO_2/y$ in RCP 2.6:





The possible (small) shift of the 2°C trajectory may be largely "optical", i.e. not reflecting a real "additional required mitigation", but it anyhow affects the assessment and communication of the "balance" concept

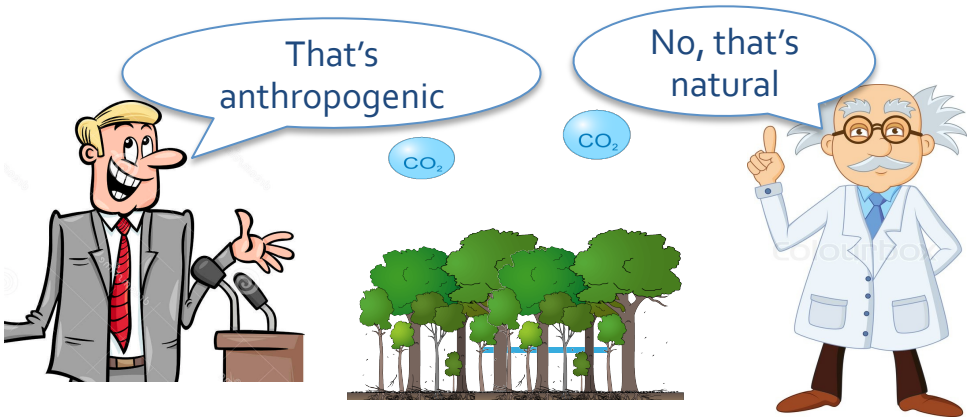
Conclusions

Large differences between IPCC AR5 *vs*. country reports also due to different views on what is "anthropogenic sink". So far, explainable by different scopes:

- IPCC-AR: global fluxes based on peer-reviewed science
- IPCC GL: standard methodologies for national-level GHG reporting.

However, the future GST requires comparability → without speaking the same language, progress towards the long term goals cannot be properly assessed.

Ultimately, will the LULUCF part in the "balance" include only *direct* effect (as IPCC AR5) OR also *indirect* effects (as country reporting?)



Suggested possible way forward

From IPCC AR side:

- The Special Report on Land (in 2019) should at least *acknowledge* the issue
- The AR6 (in 2022) should include:
  a) Global/regional LULUCF estimates at a level of **disaggregation as comparable as possible with country GHG reports,** both in terms of areas and of processes/effects
  b) Impacts when assessing the global "balance" (would the 2°C trajectory slightly change?)

From IPCC Methodological Guidance side: further clarify the managed land concept and the different processes/effects therein – ask countries to provide more **transparent information** on area and processes/effects captured in their GHGIs.

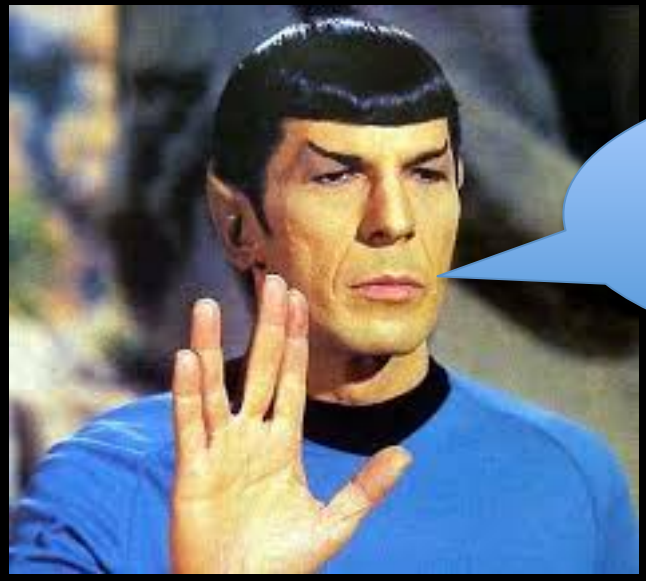
[Could countries consider to *voluntary* report also unmanaged lands ???]

4. How to turn the mitigation promise into reality?

Countries (especially developing ones) expect a key contribution from LULUCF in meeting their NDC targets, with a clear focus on forests.

Achieving this will require increasing the **credibility** of LULUCF mitigation, through:

- more **transparency in commitments** (NDCs) and in GHG inventories
- more **confidence in estimates** → improving GHG estimates and reconciling differences (close the gap) with IPCC → necessary also for the Global Stocktake and the assessment of the "balance"



CNN, December 15, 2023

Paris Agreement at risk.

A gap in CO_2 estimates for forests between IPCC and country reports causes the failure of the UNFCCC Global StockTake

Misunderstanding occurred on what is "anthropogenic removal"