Future Forest Ecosystem Management and EU Forest Policy

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Our Work has Strongly Criticized
Each Iteration of the LULUCF Regulation

Of course, being a constant critic can suggest one only criticizes.

Many of our suggestions have eventually been adopted.

The "cap"- set limits on carbon credits in standing forests

Previously allocated very disproportionately across Member states

Had nothing (or very little) do with forests and forestry!

Cap was allocated based on 3.5% of base year emissions (1990)

Big emitters were "rewarded" with very large caps…

The size of the cap was, however, increased for CP2

And Flexibilities were added for CP3 (2021-2025)

And for CP4 (2026-2030), the cap has finally been eliminated!

We have been advocating this step since 2011!

(Our Work on the LULUCF Regulation)

The HWP Carbon Pool – carbon storage in wood products

Completely ignored in CP1

Only partially accounted (FRL) in CP2

Was argued that market forces were enough to favor long-lived HWPs

We argued this wasn't enough: the HWP carbon pool must be strictly accounted!

Now fully accounted as of CP3 (2021-2025)

We have been advocating this step since the beginning!

Breidenbach et al. Annals of Forest Science (2022) 79:2
https://doi.org/10.1186/s13595-022-01120-4

Annals of Forest Science

OPINION PAPER Open Access

Harvested area did not increase abruptly—how advancements in satellite-based mapping led to erroneous conclusions

Check for updates

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Abstract

Key message: Using satellite-based maps, Ceccherini et al. (Nature 583:72-77, 2020) report abruptly increasing harvested area estimates in several EU countries beginning in 2015. Using more than 120,000 National Forest Inventory observations to analyze the satellite-based map, we show that it is not harvested area but the map's ability to detect harvested areas that abruptly increases after 2015 in Finland and Sweden.

Keywords: Global Forest Watch, Landsat, Remote sensing, National Forest Inventory, Greenhouse Gas Inventory

1 Introduction

Using satellite-based maps, Ceccherini et al. (2020) report abruptly increasing harvested area estimates in several EU countries beginning in 2015. They identify Finland and Sweden as countries with the largest harvest increases and the biggest potential effect on the EU's climate policy strategy. In a response to comments (Palahí et al. 2021; Wernick et al. 2021) regarding the original study, Ceccherini et al. (2021) reduce their estimates markedly but generally maintain their conclusion that harvested area increased abruptly. Using more than 120,000 field reference observations to analyze the satellite-based map employed by Ceccherini et al. (2020), we confirm the hypothesis by Palahí et al. (2021) that it is not a harvested area but the map's ability to detect harvested areas that abruptly increases after 2015. While the abrupt detected increase in harvest is an artifact, Ceccherini et al. (2020) interpret this difference as an indicator of increasing intensity in forest management and harvesting practice.

Ceccherini et al. (2020) use satellite-based Global Forest Change (GFC) (Hansen et al. 2013) data to estimate the yearly harvest area in each of 26 EU states over the period 2004 to 2018. They claim that an increase of harvested areas will impede the EU's forest-related climate-change mitigation strategy, triggering additional required efforts in other sectors to reach the EU climate neutrality target by 2050.

2 Discussion

In their response to comments, Ceccherini et al. (2021) carry out a stratified estimate of harvested area for the combined area of Finland and Sweden with more than 5000 visually classified reference points based on manual interpretation, using high-resolution aerial images and Landsat data. They compare the time periods 2011–2015 and 2016–2018 to find a 35% increase in harvested area in the second period which is a considerable

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Article | Published: 01 July 2020

Abrupt increase in harvested forest area over Europe after 2015

Guido Ceccherini, Gregory Duveiller, Giacomo Grassi, Guido Lemoine, Valerio Avitabile, Roberto Pilli & Alessandro Cescatti

Nature **583**, 72–77(2020) | Cite this article

Abstract

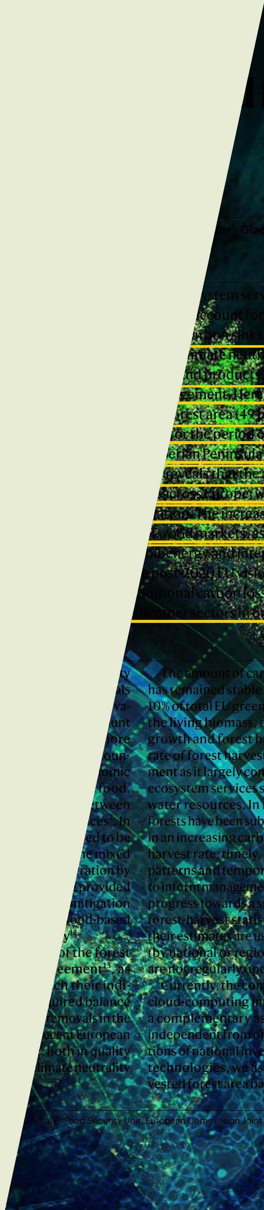
Forests provide a series of ecosystem services that are crucial to our society. In the European Union (EU), forests account for approximately 38% of the total land surface[1]. These forests are important carbon sinks, and their conservation efforts are vital for the EU's vision of achieving climate neutrality by 2050[2]. However, the increasing demand for forest services and products, driven by the bioeconomy, poses challenges for sustainable forest management. Here we use fine-scale satellite data to observe an increase in the harvested forest area (49 per cent) and an increase in biomass loss (69 per cent) over Europe for the

Europe’s Forest Sink Agenda

“***If such a high rate of forest harvest continues***, the post-2020 EU vision of forest-based climate mitigation may be hampered, and the additional carbon losses from forests would require extra emission reductions in other sectors in order to reach climate neutrality by 2050.” (*JRC*, Ceccherini et al. 2020)

These attach on forestry raises important questions about where the EU is currently headed…?

What do these statements mean with regard to bioeconomy agendas…?



Data Resources: Remote Sensing vs. Manual, On-Site Measurements

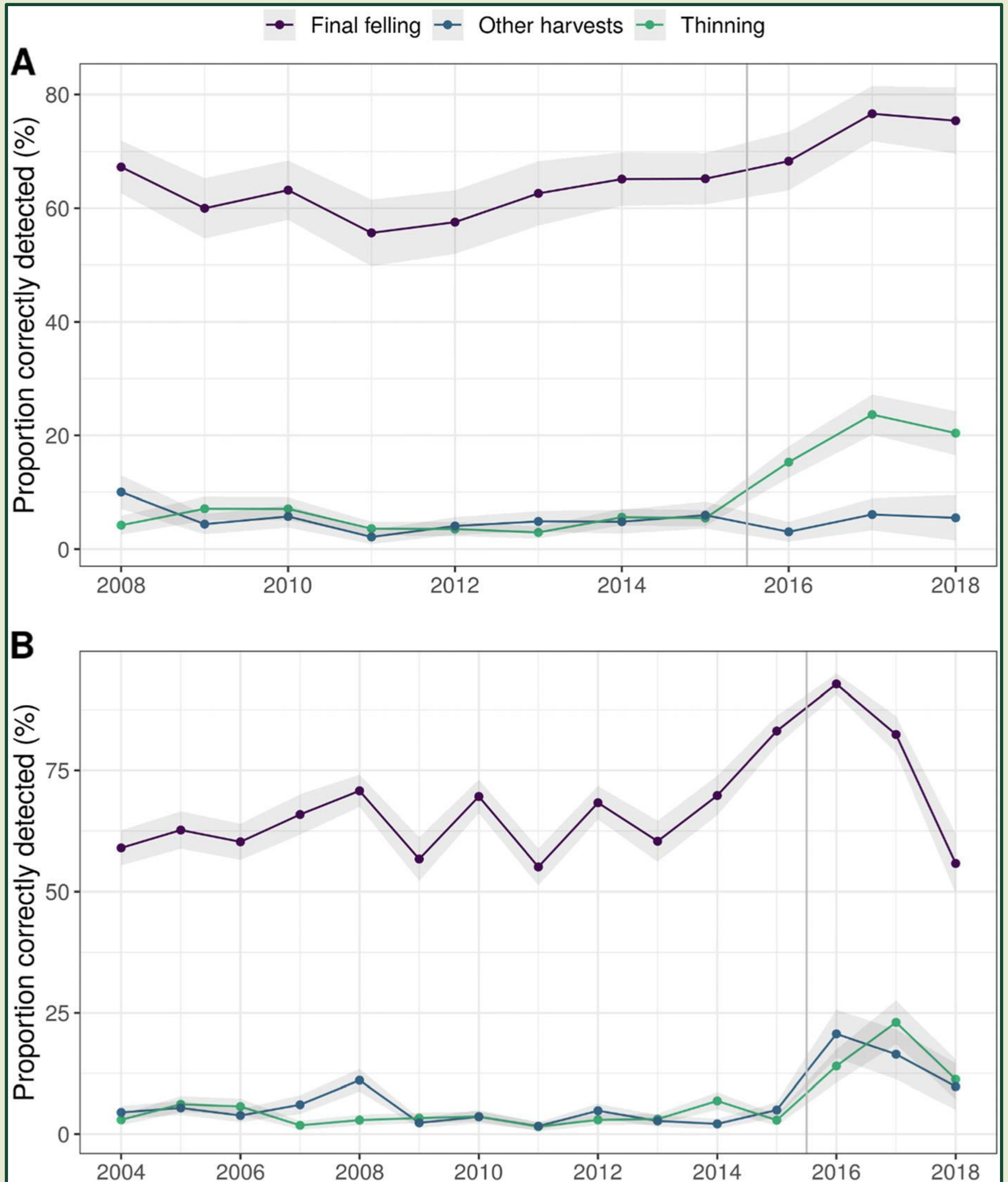
- **Our Data:**

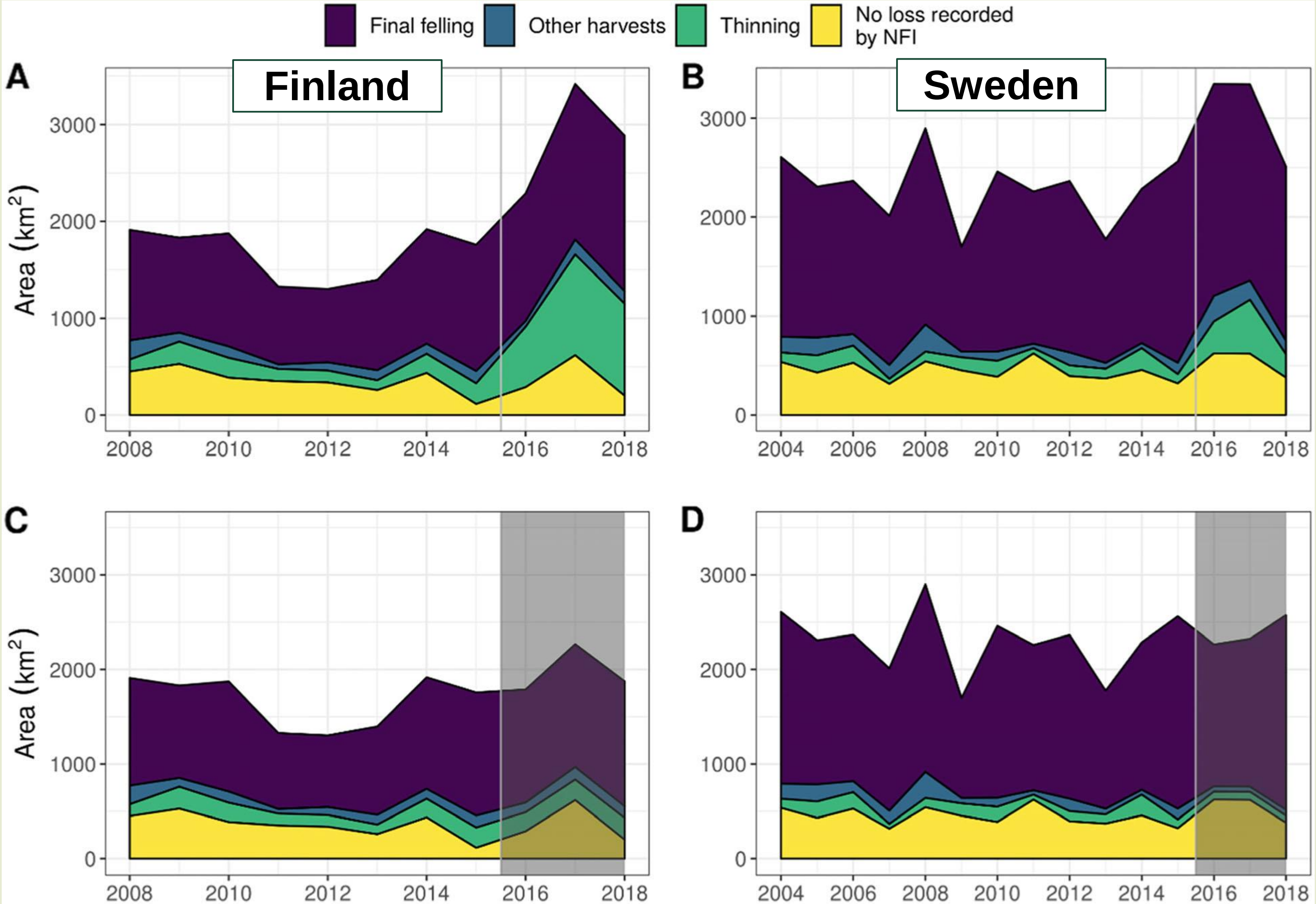
We employ more than 120,000 field observations from repeated measurements in 44,000 sample plots from the Finnish and Swedish national forest inventories (NFIs) as reference data. NFI data is gathered annually, and all plots are visited once every 5 years. Official data, based on the NFI’s, on net change are submitted to the UNFCCC as part of the country commitments under the Kyoto, Post-Kyoto and Paris Agreements, to reduce emissions.

- **Ceccherini et al.’s Data:**

Remotely sensed Global Forest Change (GFC) data, (Hansen et al., 2013), is derived from an Earth Observation Satellite circulating 705 kilometers above the planet’s surface. GFC researchers use algorithms to interpret the information contained in the reflections of electromagnetic waves. Both the image resolution and the algorithms used to interpret these reflections have changed (improved) over time.

Proportion of GFC Correctly Detected Areas

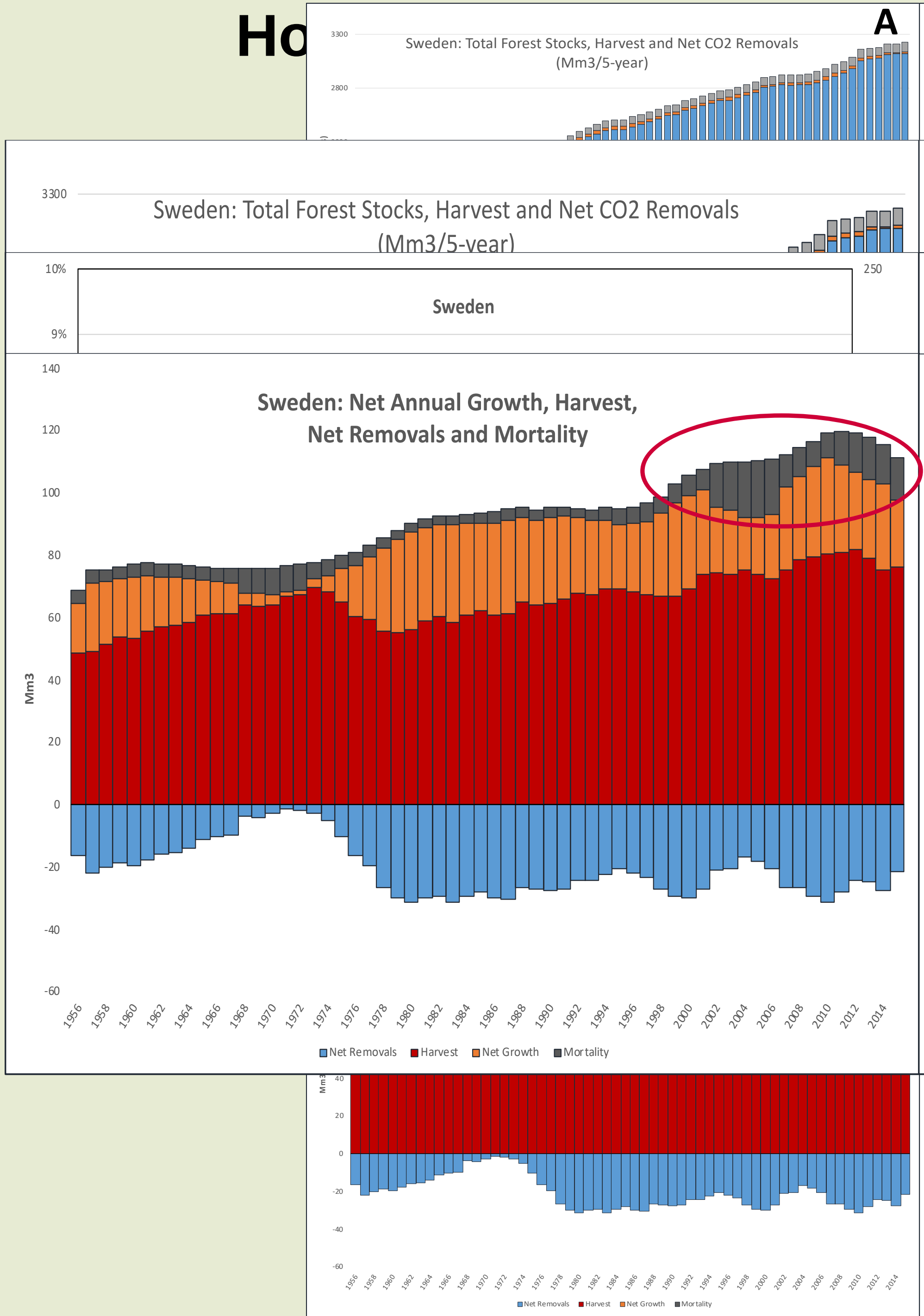




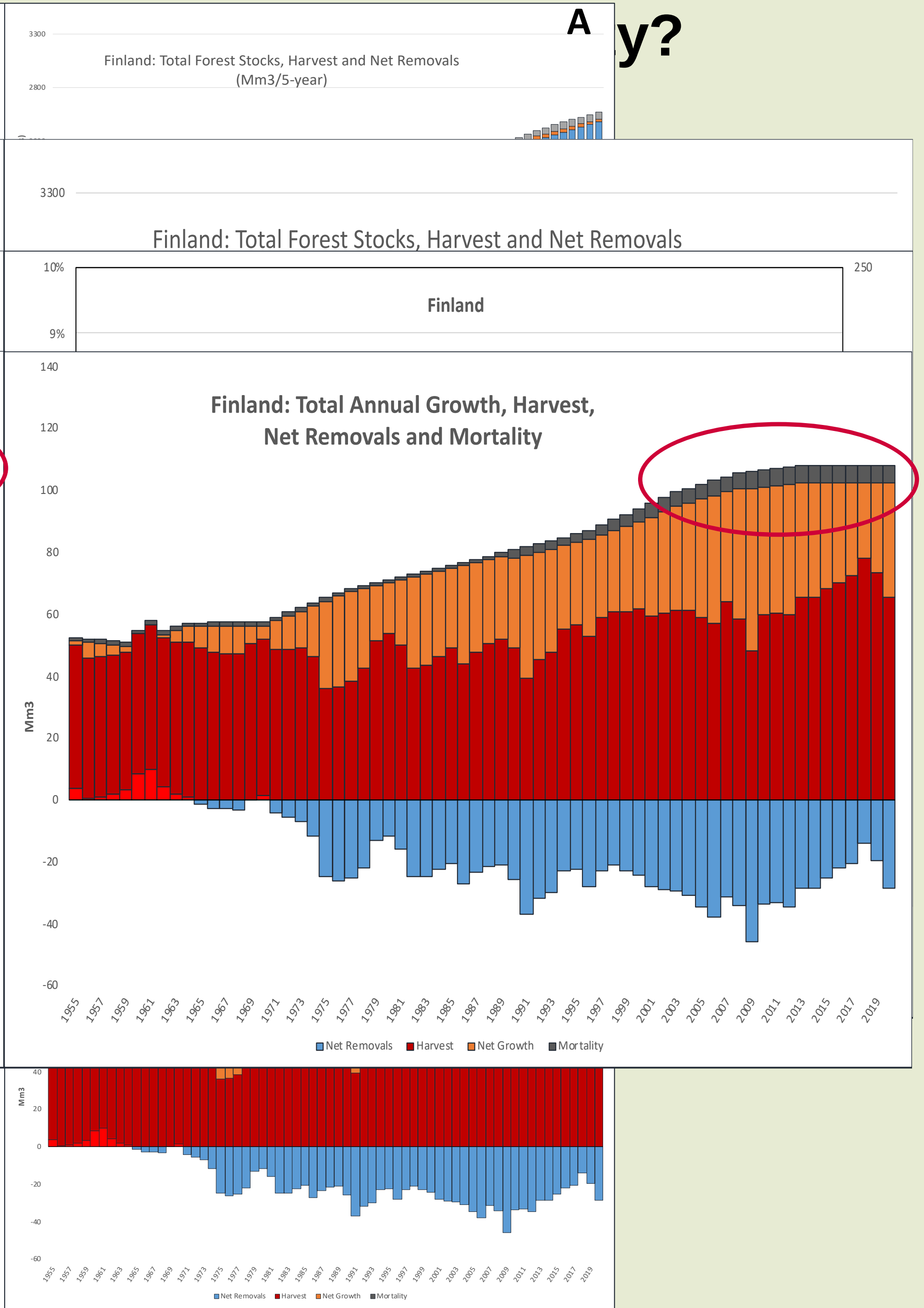
- Note: the GFC data used by the JRC overestimates harvest activity in Sweden and Finland by 851% and 188%, respectively.

(Breidenbach et al., 2022)

Ho y?



A
Sweden: Total Forest Stocks, Harvest and Net CO2 Removals (Mm3/5-year)
Sweden
Sweden: Net Annual Growth, Harvest, Net Removals and Mortality
Mm3
Net Removals
Harvest
Net Growth
Mortality



A
Finland: Total Forest Stocks, Harvest and Net Removals (Mm3/5-year)
Finland
Finland: Total Annual Growth, Harvest, Net Removals and Mortality
Mm3
Net Removals
Harvest
Net Growth
Mortality

Harvest DID NOT increase abruptly in the Nordic Countries!

JRC used GFC data: overestimates harvest activity in Sweden and Finland by 851% and 188%, respectively.

Harvest intensity is not, and should not be considered, the principal concern

What matters is not really "how much we harvest", but what use we make of that harvest

And, of course, the sustainable use of forest resources!

Of course, it is worth noting that the Nordic forestry sector has a long history of sustainable forest use!

Can European Commission Agendas Compromise JRC Scientific Research?

Political JRC & European Commission Goals

- LULUCF climate policy framework (Grassi role)
- Goal of centralizing Forest Monitoring at the EU level

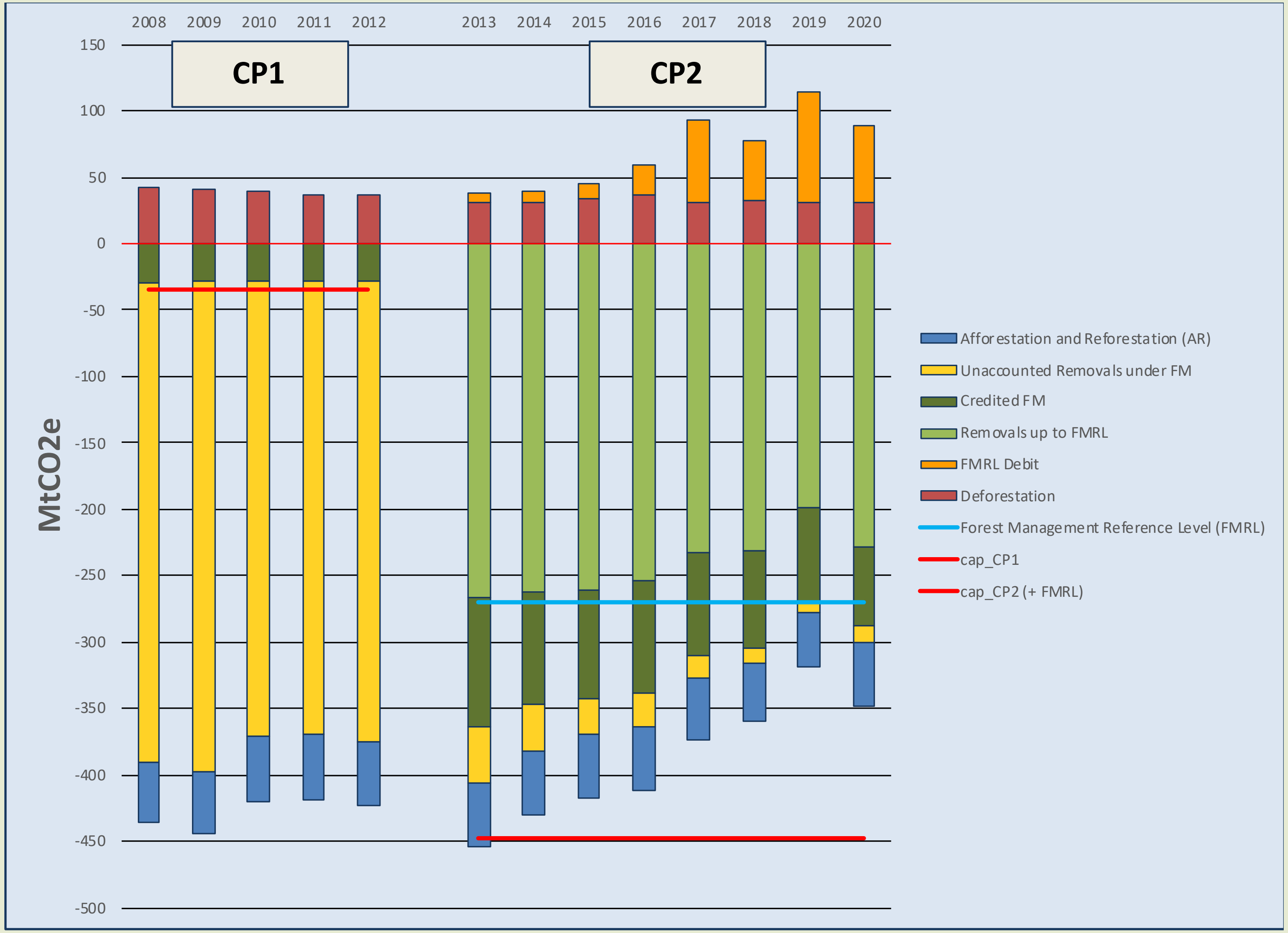
Why Did the JRC not Engage in more Consistent Validation of their Data?

- Can point to other forest-related JRC papers that demonstrate clear awareness of these data issues and the need for validation
- Many papers have previously been published on this GFC data problem:
  - McRoberts 2011; Næsset et al. 2016; ***Avitabile et al. 2016***; Ståhl et al. 2016; Baccini et al. 2017; Rossi et al. 2019; Astrup et al. 2019

Why Didn't the JRC simply *Retract* the paper?

- No Corrections have ever been made in the original *Nature* paper.
- The Authors' Reply to other Comments (2021) uses Landsat data to validate Landsat data and doubles down on ***similar*** findings (see Breidenbach et al., 2022)?

LULUCF Climate Performance in Europe (2008-2020)



- The Problem: over time, declining sink.
- What is the best way to solve this problem? (FRL?, cap?)
- Is this a Problem? Does it need to be solved…? (Substitution vs. sink?)

LULUCF Goals (Carrot or Stick?), the Forest Reference Level (FRL):

Currently, the EU removes approximately 288-350 MtCO_2e yr^{-1} from the atmosphere, or approximately 10% of 2020 emissions.

By 2030, LULUCF should remove 310 MtCO_2e yr^{-1}

By 2035, LULUCF should remove 480 MtCO2e yr^{-1} ?

And by 2050, LULUCF should remove 550 MtCO2e yr^{-1} ?

What are the most appropriate tools for achieving mitigation goals?

Should the principal focus really be:
‘to reduce the role of forestry?’

What Purpose does the FRL Serve?

Attempts to ensure that the net flux of emissions and removals from forests and forestry is negative.

Raising the carbon sink (net flux) is perceived to help reduce forest use intensity

Some may believe that raising the annual net sink will help protect biodiversity

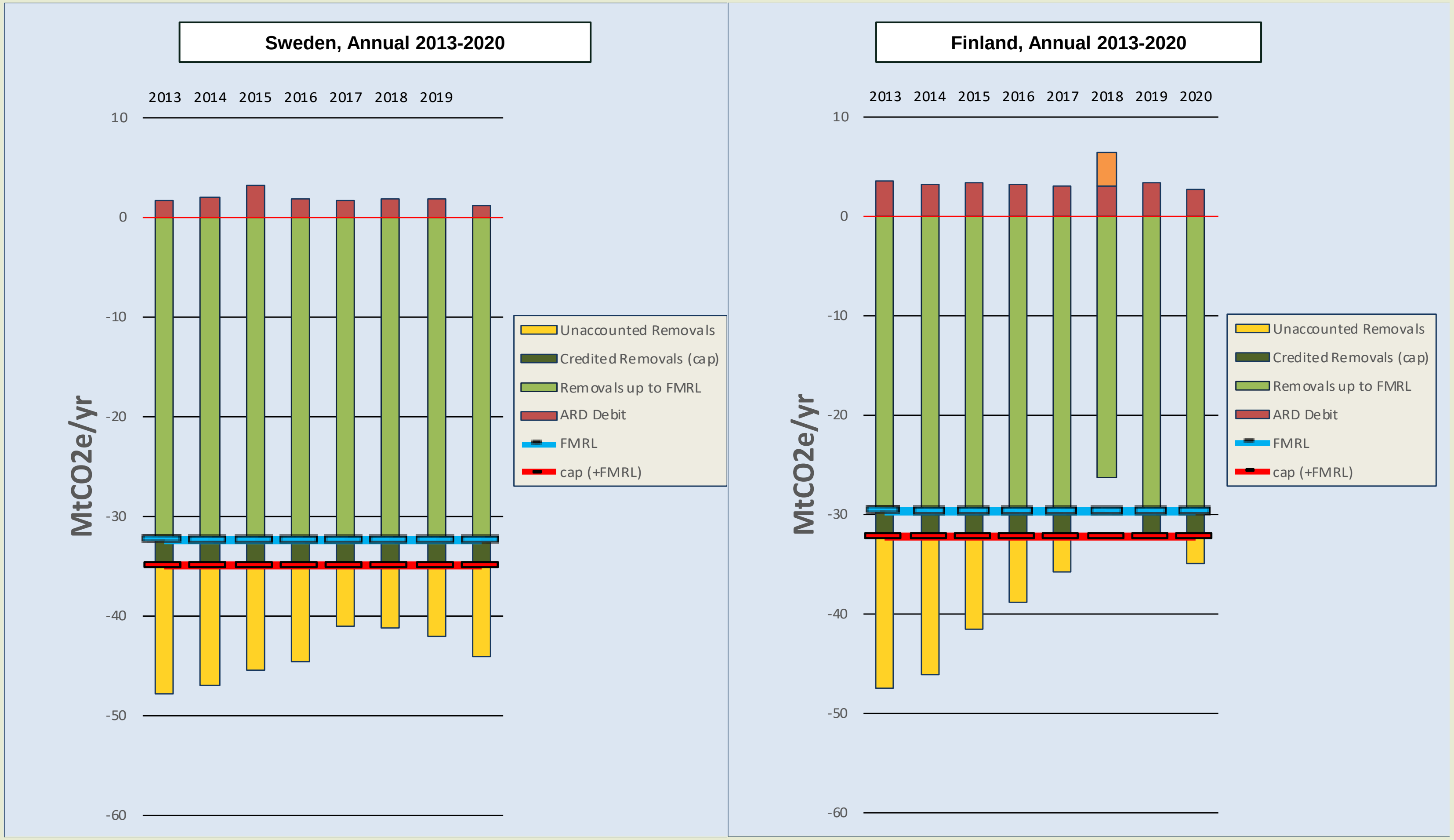
Protecting biodiversity requires leaving forest untouched. Requires set-asides, not productive forest lands.

May create problems for bioeconomy goals.

Questionable whether increased sink provides real mitigation benefits!
What about the Renewable Circular Bioeconomy?

What Effect have the cap and FRL had on Member state behavior?

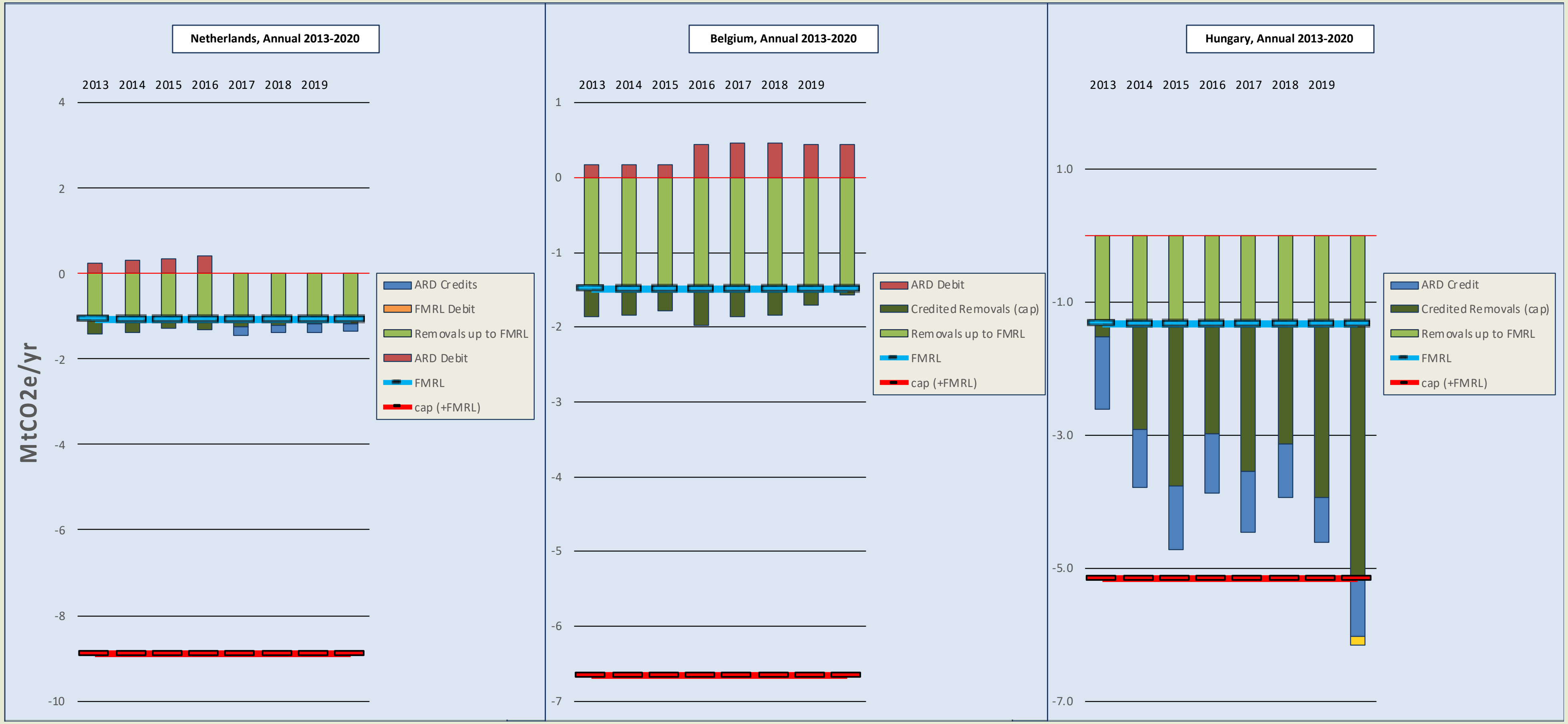
What message was the EU sending?



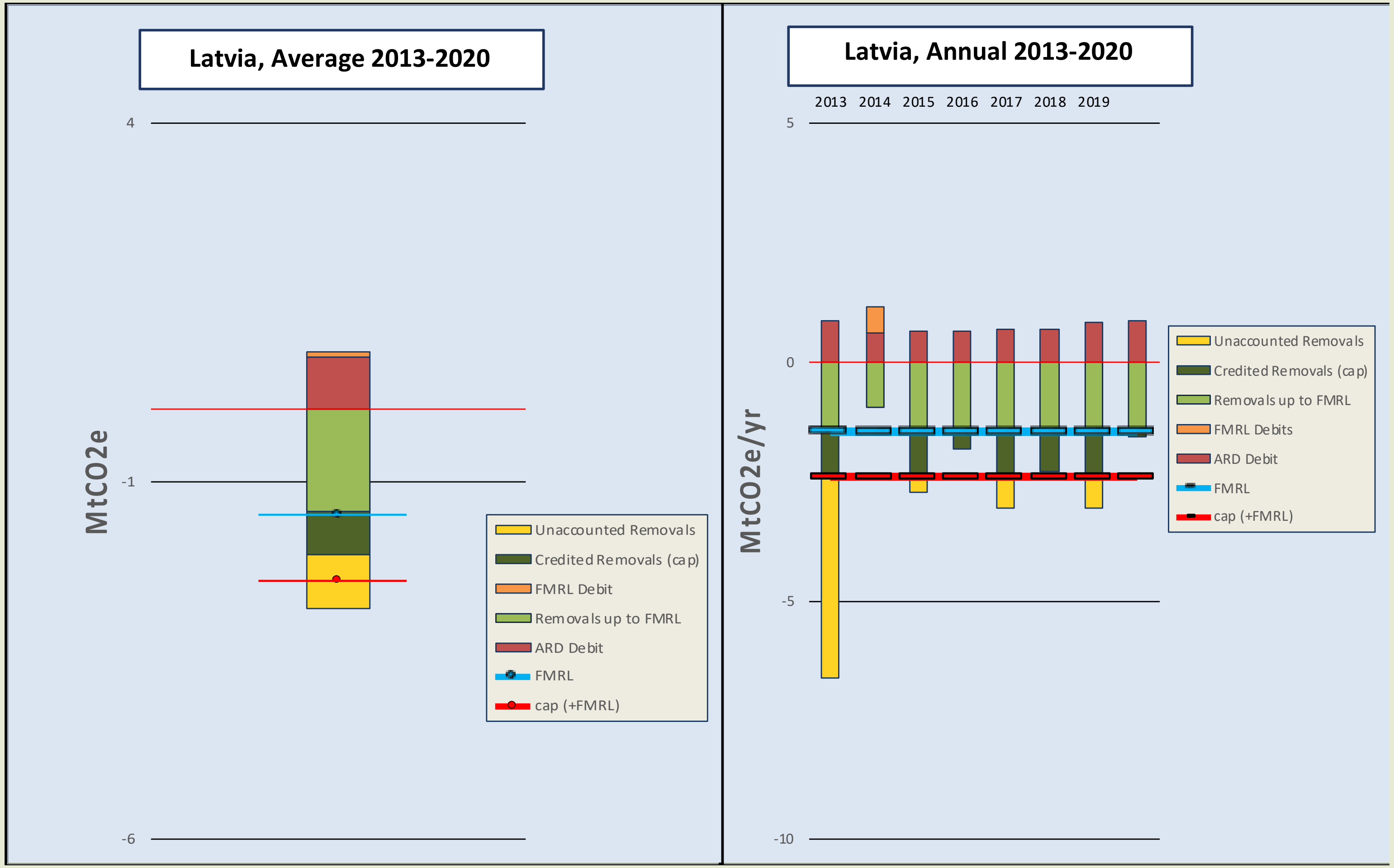
Bioeconomy Strategy vs. Focus on the Land Carbon Sink?

Can Sticks be Turned into Carrots?

Does the LULUCF strategy work for all Member states?

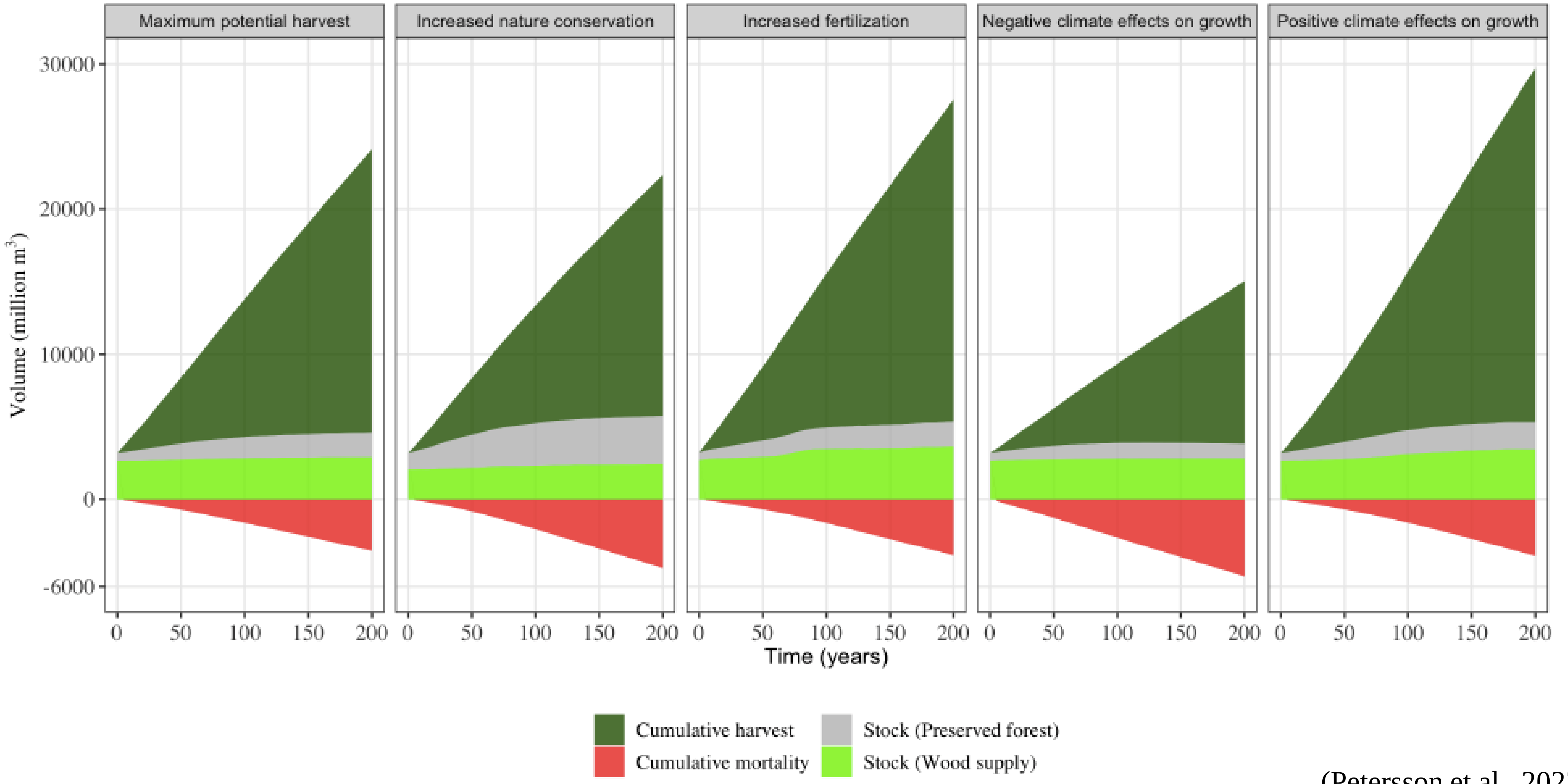


- Can LULUCF Policy Create "Positive" Incentives for All Member States?



Latvia, Average 2013-2020
4
-1
-6
MtCO2e
Unaccounted Removals
Credited Removals (cap)
FMRL Debit
Removals up to FMRL
ARD Debit
FMRL
cap (+FMRL)
Latvia, Annual 2013-2020
2013 2014 2015 2016 2017 2018 2019
5
0
-5
-10
MtCO2e/yr
Unaccounted Removals
Credited Removals (cap)
Removals up to FMRL
FMRL Debits
ARD Debit
FMRL
cap (+FMRL)

Maximizing harvest intensity vs. Increasing Conservation



(Petersson et al., 2022)

- Increasing harvest intensity also means we can plant more forest

Substitution Effects and the Potential Benefits of the Bioeconomy

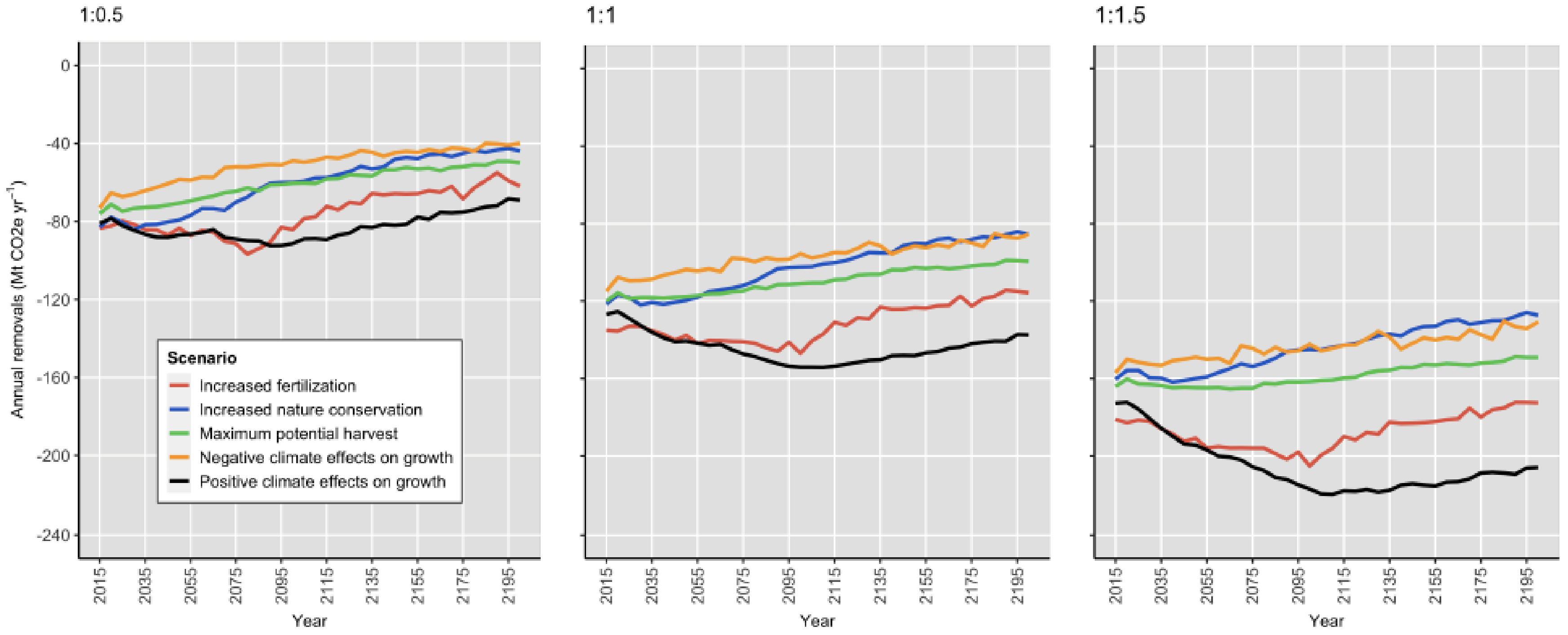


FIGURE 2 Total annual estimated net carbon sequestration and substitution, selected scenarios (2015–2195). The scenarios include changes in all carbon pools (see Table 2) and substitution for three different assumed substitution effects (0.5, 1 and 1.5 tonne CO_2e per m^3 stem wood)

(Petersson et al., 2022)

- Potential Advantages of Public Policy, Fertilization, CCS?
- Should policy focus instead on how we “use” forests?

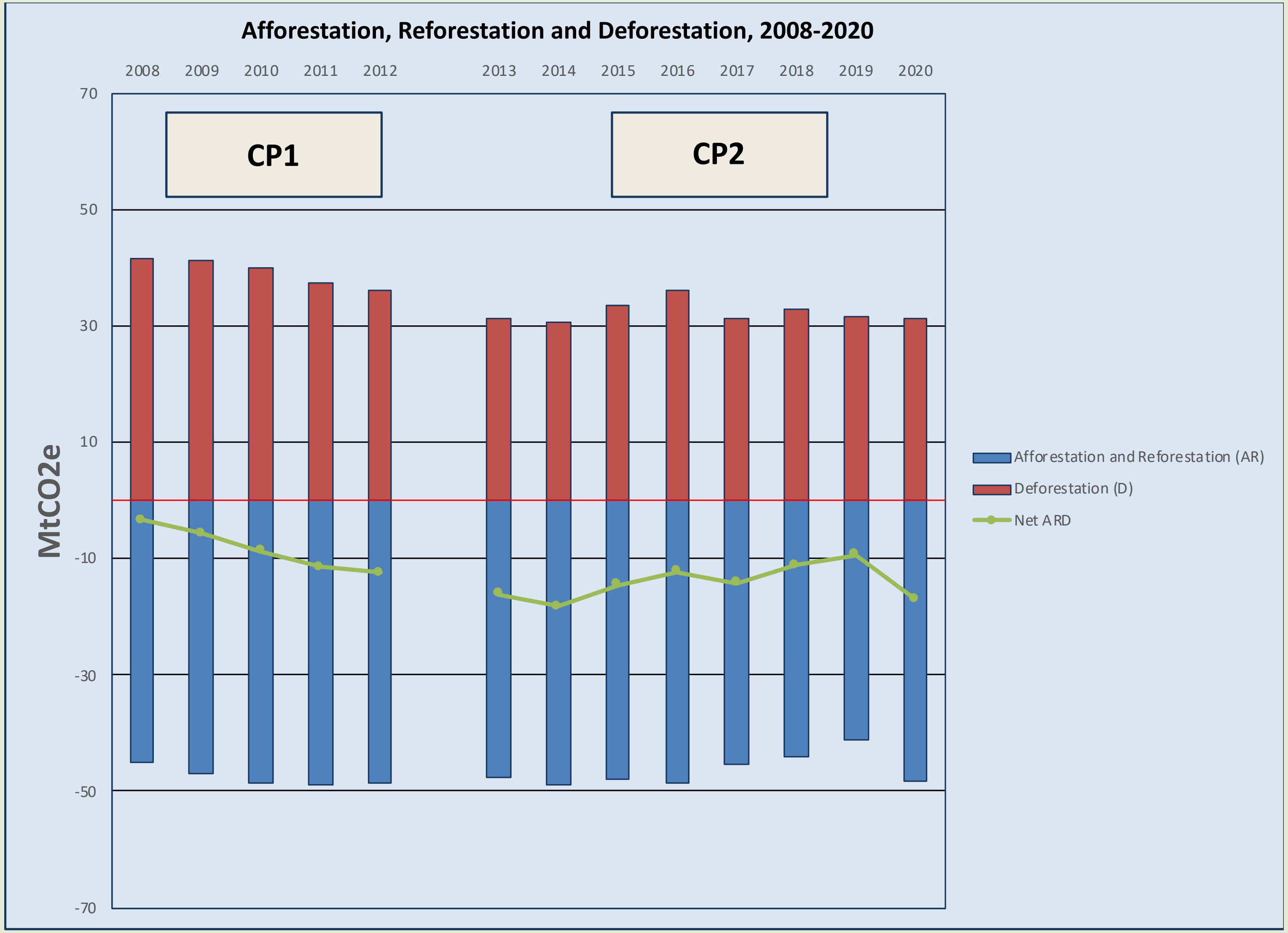
Why Mixed, Unaligned Incentives Matter

Incentives Faced by Forest Owners and National Governments (Parties) under the New EU LULUCF Policy Framework for Commitment Period 3 (2021-2030)

EU Managed Forest Land Framework			Party/Government perspective		Landowner perspective			
Scenario	Net Removals (From–To)	Accounting Options	Paris Agreement and NDC-based Incentives (1)	Promote Growth (G)/ Harvest (H)? (2)	Economic Drivers (3)	With Government Intervention & Incentives (4)	Logic (5)	Possible Mechanisms (6)
(1)	0 - FRL	Debits Only (Target/Commitment)	Standing Forest	G	HWP, Bioenergy	Standing Forests, HWP and Bioenergy	fully incentivized G/H	Carbon Price (Tax/ETS), carbon neutrality, CS Standing Forest Payments, HWP Carbon Pool incentives
(2)	FRL - cap	Credits Only	Standing Forest	G	HWP, Bioenergy	Standing Forests, HWP and Bioenergy	fully incentivized G/H	
(3)	Surplus beyond cap to Flexibility Limit	Credits can be transferred to LULUCF activities & ESR	Harvest for bioenergy, HWP not significantly different from Standing Forest	G/H	HWP, Bioenergy	Standing Forests, HWP and Bioenergy	fully incentivized G/H	
(4)	Flexibility Limt - Total MFL removal	Credits for HWP removals (only)	Harvest for HWP and Bioenergy (with cascading, preference for HWP)	H	HWP, Bioenergy	Harvest for HWP and Bioenergy (with cascading, preference for HWP)	Standing forests not incentivized H	+ Legislate Cascading

- The EU fails to consider incentives to land and forest owners.
- But, the EU framework is finally freeing up incentives for carbon offsetting potential (cap eliminated for CP4).

Should we focus Less on Forestry & More on Protected Forests?



Net ARD in 2020 represents only -16.9 MtCO_2e (MFL: -288 to 300 MtCO_2e)

Can these Dilemmas be Resolved?
What does a Carrot look like?

- If the problem is NOT harvest intensity:
  - What factors weaken the EU strategy and why has it failed to deliver increasing net removals?
- Are Mixed Incentives a Problem?
  - How are the investment strategies of land and forest owners affected by EU LULUCF policy? (cap, FRL)
  - What messages do FRLs send to bioeconomy aspirations?

- The EU LULUCF framework was written to govern Member states.
- NOT written to drive/propel micro-level action by land and forest owners.
- => land and forest owners and the motivations that drive them have, for the most part, been ignored.

- => the EU LULUCF Framework was ***not designed to mobilize*** forestry (sets limits: caps, FRL, compartmentalization).

Flexibilities may weaken the EU LULUCF Policy framework in unintended ways

1) The greater the flexibilities, the more the advantages of the ”Durban commitment” are minimized … (offsetting instead of increased ambition)

2) Flexibilities are clearly a good thing, as long as they are counted ”on top of the current national commitments”… (must be added to the commitment, not pursued in place of other strategies…

⇒ Floating Commitment is potentially the best strategy

Imaginative & *Inventive*
Climate Policy Frameworks

- Can a LULUCF strategy be based on positive incentives (i.e., what does a "carrot" look like)?
  - Full flexibility (no Pillars / no Compartmentalization)
  - No limits to tradability across sectors
  - Neutrality (no favoring individual strategies)
  - Floating Commitment (FRL equivalent)
    - Problem of where bioenergy is accounted!
    - Member states choose optimal strategy?
    - Eliminate the FRL. Remove all flexibility caps.
  - IPCC reports, Paris Agreement, importance of negative emissions!
  - Defend the Carbon Sink? Or the Renewable Circular Economy?

Where is EU Forest Policy really Headed?

- What Goals has the Green Deal Launched?
- Biodiversity Strategy for 2030
- Old Growth Forest Strategy?
- 30% for 2030? (10% with strict protections) – Across All Lands
  - Approx. 4% additional land (EU-wide)…
  - More for some Member states, less for others…
- What are the challenges?
- Can this be balanced with Bioeconomy Goals?

Thanks for Listening!

Comments Welcome (EllisonDL@Gmail.com)

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Debate on the Advantages of Forests for Cooling/Warming

In line with past findings, the IPCC's AR6 WGI report states, "land use and land cover changes over the industrial period introduce a negative radiative forcing by *increasing the surface albedo*. This effect has increased since 1750, reaching current values of about –0.20 Wm^2 (medium confidence)…"

There have been repeated findings across several decades that deforestation in the Norther Hemisphere across both the temperate and the boreal zone has led to cooling instead of warming.

Some of these articles date back to the early 90's (and may date even further back). Among some of the most recent findings are Lawrence et al. (2022), Windisch et al. (2021).

These findings are troubling because they do not sit well with the observational data on surface temperature change and other analyses of the role and impact of tree and forest cover.

There is clearly disagreement over the impact of forests on cooling/warming at both global and local scales.

Lawrence et al., (2022) – The Unseen Effects of Deforestation: Biophysical Effects on Climate

- ET
- Snow covered surfaces

The Boreal is "energy-limited", not "water-limited"!

Winter days are short or non-existent.

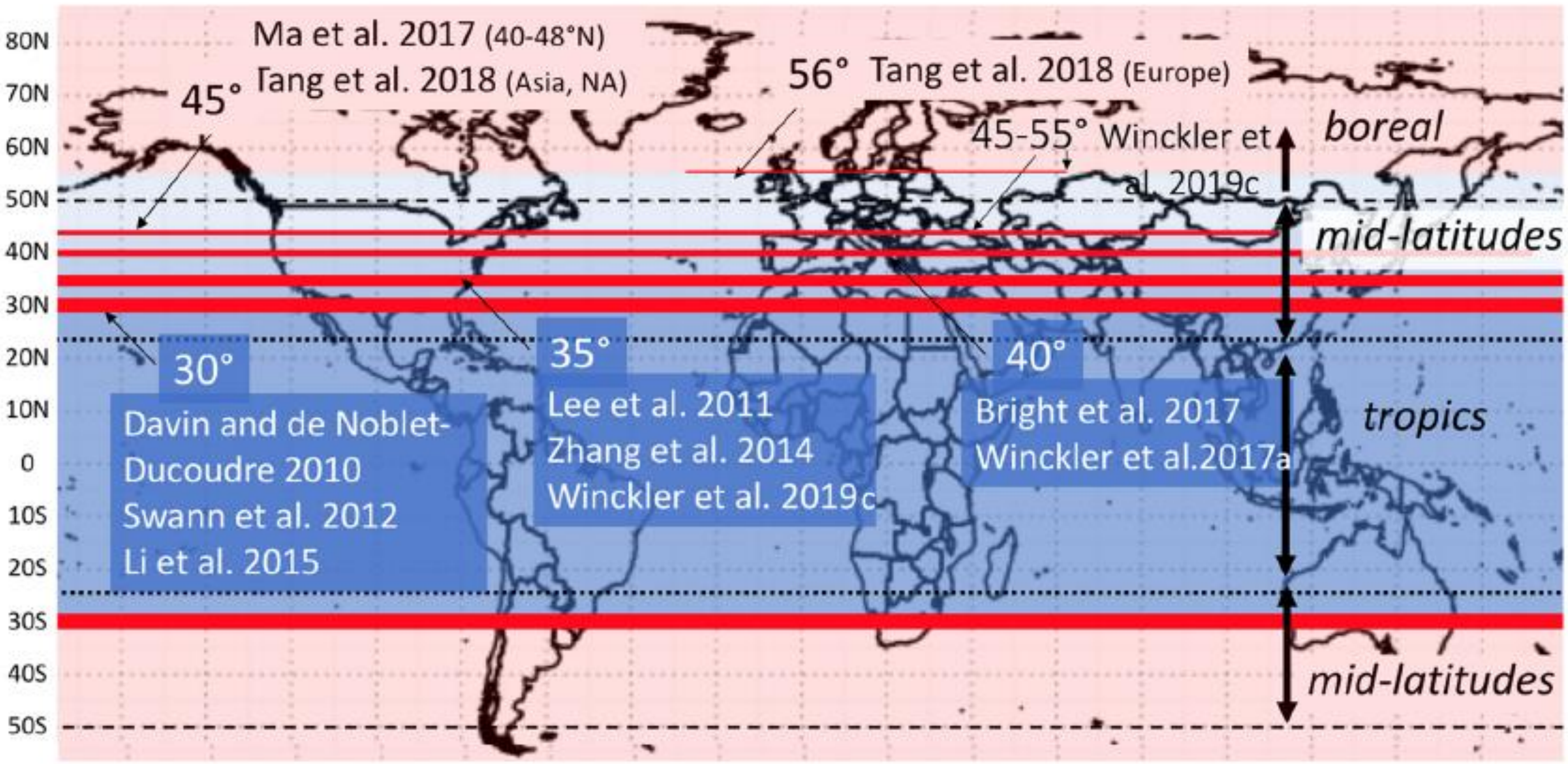

FIGURE 1 | Latitude of net zero biophysical effect of forests on local temperature varies from 30 to 56°N. Above the line, forest cover causes local warming; below the line, forest cover causes local cooling. The thickness of the line indicates the number of studies that show forest cooling up to that threshold. Data sources as indicated.

nature climate change

ARTICLES

https://doi.org/10.1038/s41558-021-01161-z

Check for updates

Prioritizing forestation based on biogeochemical and local biogeophysical impacts

Michael G. Windisch[1,2,3] ✉, Edouard L. Davin[1,4] ✉ and Sonia I. Seneviratne[1]

Reforestation and afforestation is expected to achieve a quarter of all emission reduction pledged under the Paris Agreement. Trees store carbon in biomass and soil but also alter the surface energy balance, warming or cooling the local climate. Mitigation scenarios and policies often neglect these biogeophysical (BGP) effects. Here we combine observational BGP datasets with carbon uptake or emission data to assess the end-of-century mitigation potential of forestation. Forestation and conservation of tropical forests achieve the highest climate benefit at 732.12 $tCO_2e\,ha^{-1}$. Higher-latitude forests warm the local winter climate, affecting 73.7% of temperate forests. Almost a third (29.8%) of forests above 56° N induce net winter warming if only their biomass is considered. Including soil carbon reduces the net warming area to 6.8% but comes with high uncertainty (2.9–42.0%). Our findings emphasize the necessity to conserve and re-establish tropical forests and consider BGP effects in policy scenarios.

Limiting global warming to +2 °C or even +1.5 °C above pre-industrial levels will require the removal of CO_2 from the atmosphere in addition to reducing CO_2 emissions to near-zero levels[1]. Land stewardship will play a crucial role in this endeavour, as recognized by the global scientific community in the special reports of IPCC on climate change and land[2] and on global warming of 1.5 °C (ref. [1]), as well as by 187 countries in their nationally determined contributions (NDCs), the main guiding framework to reach the targets of the Paris Agreement[3]. A range of studies has since estimated the land sector's capability, and especially regards forests, to take up carbon[4–6].

All these efforts rely on a profound change in land management. Most of the mitigation scenarios in line with limiting global warming to +2 °C or below depend on land-based mitigation measures (bioenergy with carbon capture and storage (BECCS) and reforestation/afforestation) to capture 200–400 $GtCO_2$ within this century[1,2]. Forestation (defined here to include both reforestation and afforestation) is recognized as the most cost-effective and land-intensive land-based CO_2 removal option assessed in the IPCC special reports[1,2]. The proposed large-scale land-cover transitions under current emission reduction goals of parties under the Paris Agreement will influence climate by taking up carbon from the atmosphere, a biogeochemical (BGC) effect, but will also exert a biogeophysical (BGP) influence by changing environmental variables such as surface albedo and land evapotranspiration[7]. The latter effect is mostly neglected by mitigation policy and is also absent in scenarios produced by integrated assessment models, despite studies exploring the combined BGP and BGC effects for more than two decades[8–10].

Depending on the type of land cover that is reforested or afforested, the regional background climate and the season, the cooling associated with the forest's carbon uptake is enhanced or counteracted by BGP effects. The lowered albedo of reforested and afforested areas acts against the cooling BGC impact. This effect is most pronounced in frequently snow-covered regions and can even lead to a net warming effect of forests in these conditions. Where newly established forests strengthen the evaporative capacity of the land, they cool the local environment by shifting the surface energy balance from sensible to latent heat. Especially at lower latitudes, this effect supersedes the warming of the lowered albedo, resulting in a net cooling of the local environment in addition to the carbon uptake, thus, enhancing the benefit of establishing and conserving forests[7,11].

Past studies compared the radiative forcing of BGP and BGC effects by assessing Earth System Model (ESM) experiments of global scale forestation or deforestation[8,9,12–15]. Here, we assess the importance of local BGP effects using two observation-based datasets of the local temperature response to land-cover transition produced by Bright et al. in 2017[16] and Duveiller et al. in 2018[17]. Instead of relying on the radiative forcing concept, which does not account for non-radiative processes such as changes in evapotranspiration and surface roughness[18], we translate the temperature-based BGP effect into a CO_2e (equivalent) metric. This metric uses the transient climate response to cumulative emissions (TCRE; ref. [19]) derived from Coupled Model Intercomparison Project Phase 5 (CMIP5) ESMs to convert from temperature to CO_2 emissions (Methods).

The BGC effect is determined by (1) the differences in above- and below-ground biomass carbon density between non-forest and forested vegetation of the IPCC Tier-1 biomass carbon density data[20] and (2) the soil organic carbon (SOC) response of the top 30 cm of soil to land-cover changes from or to forest[21] (Methods).

We note that our BGP CO_2e metric only encompasses local temperature changes, ignoring other local and non-local carbon effects: for instance, reduced impacts in several other parts of the world, such as associated with reduced sea-level rise or attenuated increase in some extreme events[1]. Given the constraint from remote sensing data, we do not quantify potential BGP effects that depend on the size of the land-use change, such as changes in precipitation patterns of large-scale forestation or deforestation[22,23]. For each increment of forest area gained or removed, the BGC effect progressively changes its impact on the global climate system while the CO_2e of the BGP effect measured per ha incrementally shapes the areal extent affected by BGP effects. The CO_2e metric proposed here is, thus, a tool to compare and prioritize single forest sites and their climate impact. BGP effects that emerge from the scale of a

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Principal causal pathways by which wetlands and TFVC (tree, forest and vegetation cover) influence temperature and the climate

- Carbon sequestration (& respiration)

Principal focus of UNFCCC

- Surface albedo effects
- Latent heat production (ET)
- Cloud production

Largely ignored by UNFCCC

⇒ Different studies focus on different causal pathways, little consistency across studies

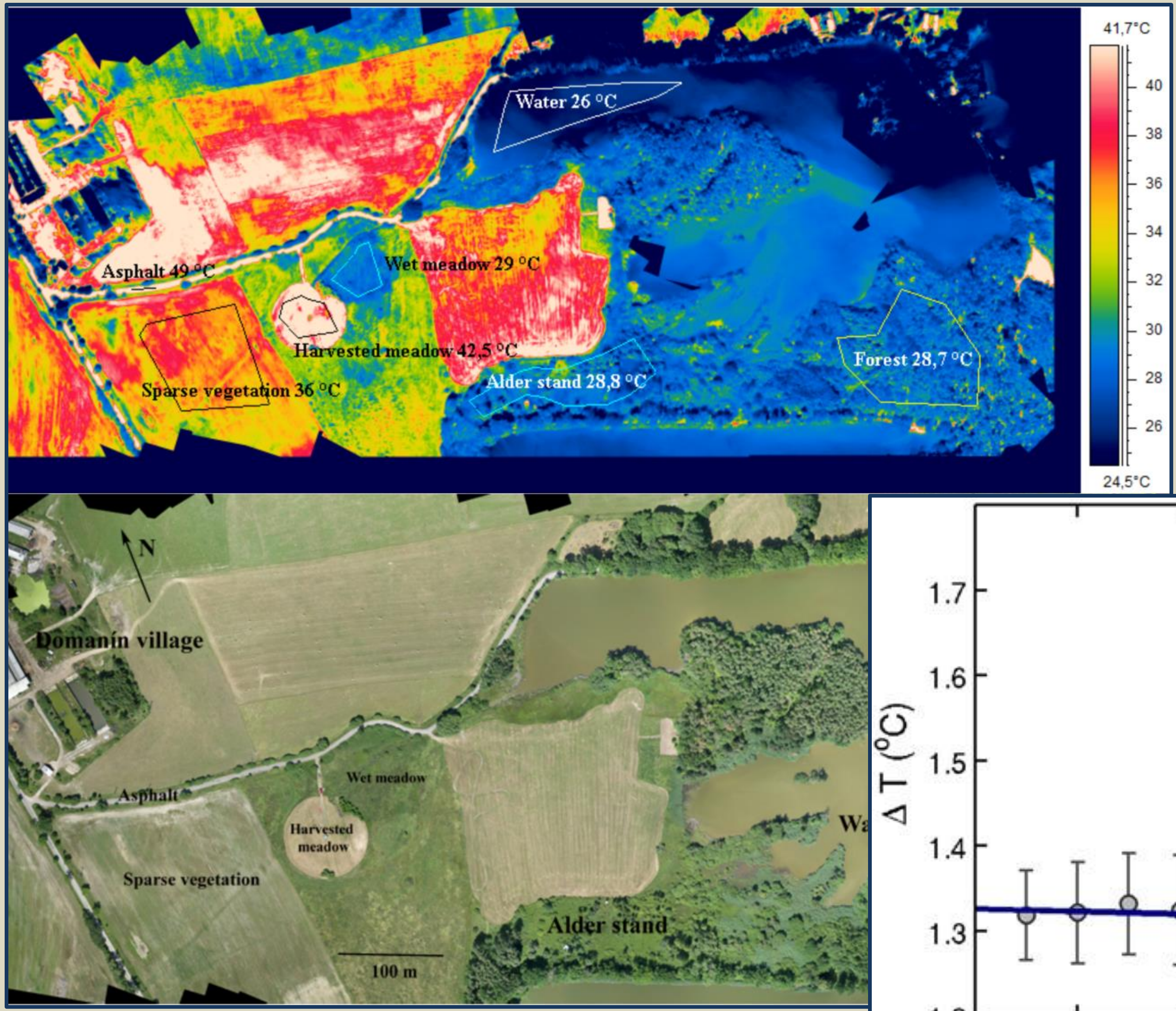
⇒ Almost no studies integrate cloud production with all the other causal pathways

- However, many of these studies are frequently sold as “net effects” models?

We Know ET Cools the Land Surface, But What does Albedo Tell Us?

EVAPOTRANSPIRATION

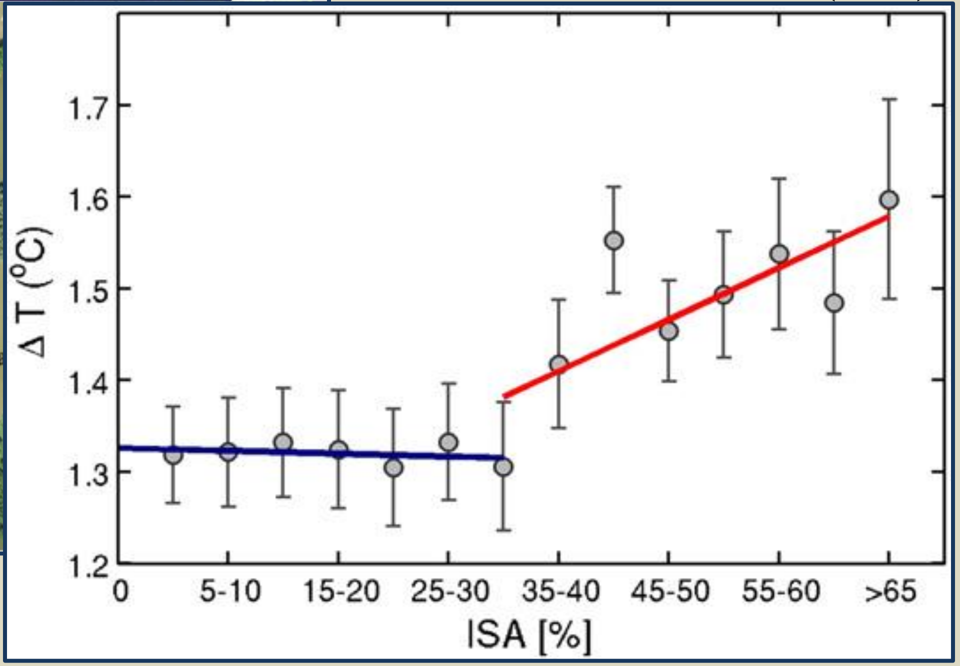
(ET)



(Pokorny, Hesslerova et al., 2013)

- Forest-water interactions ***dissipate solar energy***
- ***Transpiration and Evaporation*** require energy
- ***Surface cooling*** is the result.

Urban Areas above/below 35% Impervious Surface Area (ISA)



(Bounoua et al., 2015)

Global Energy Budget under Skies with Clouds

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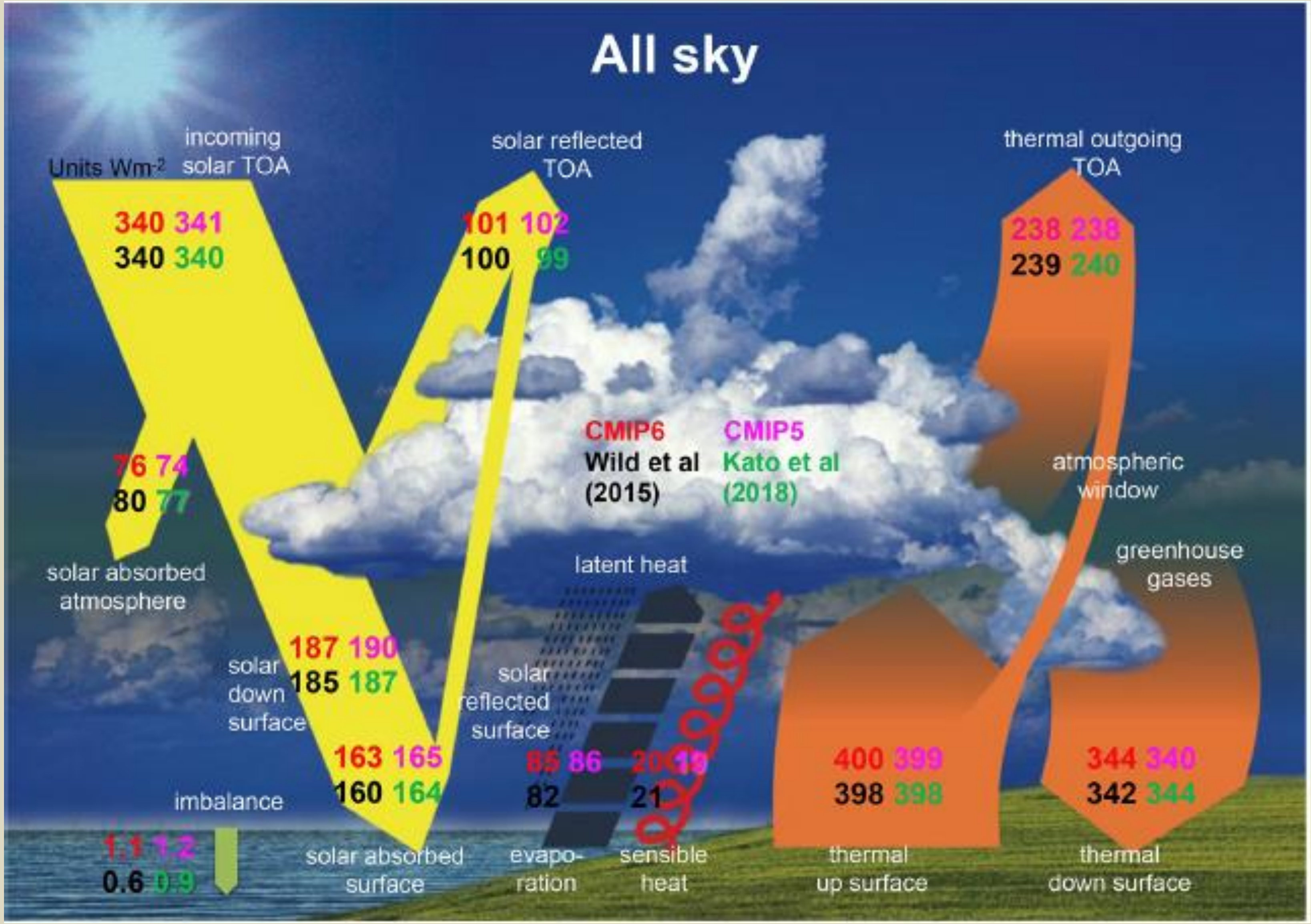


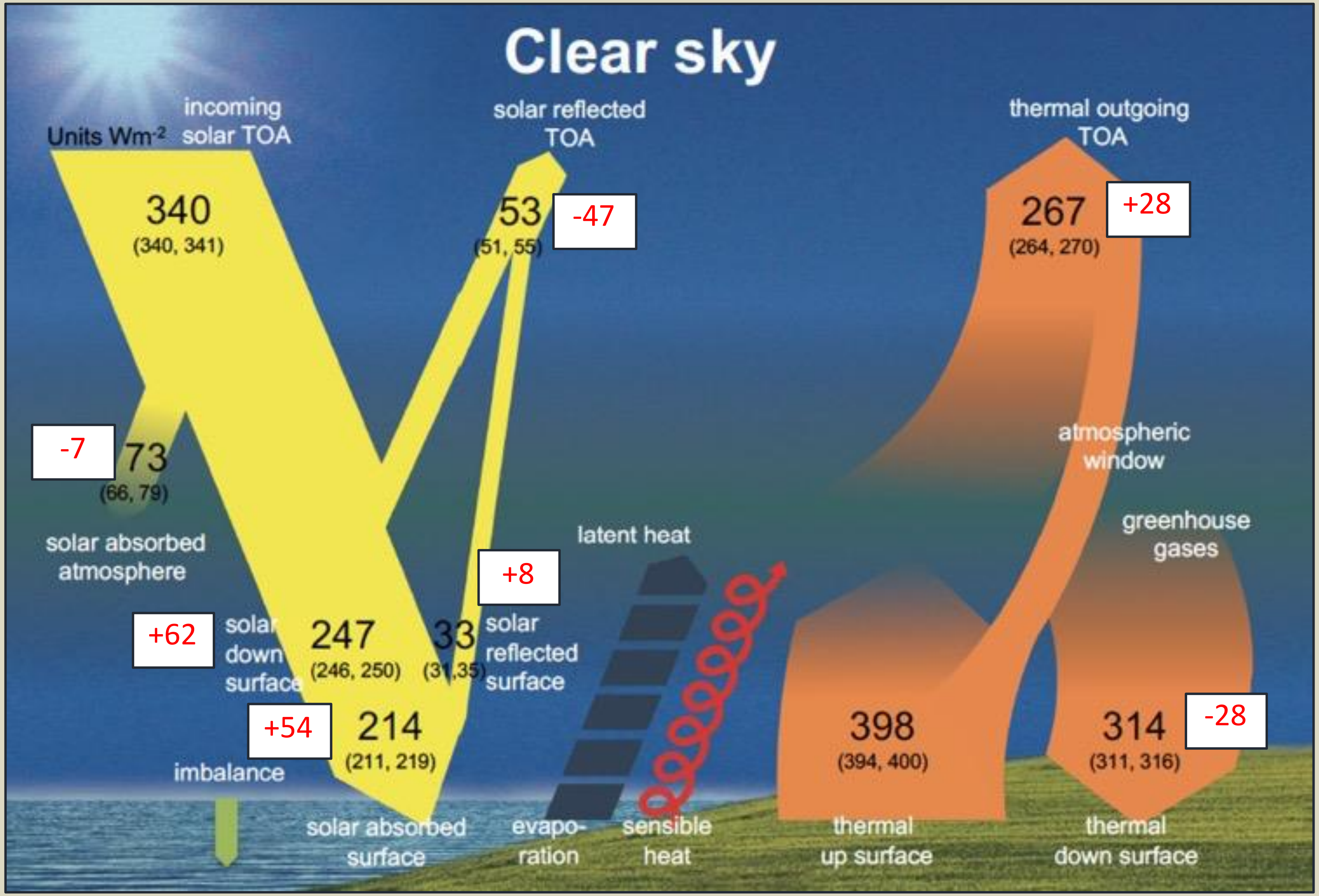
Wild et al., (2020)

Does terrestrial surface cooling (ET) lead to global cooling?

- Perhaps not, reduces outgoing LW radiation.
- **But ET does lead to cloud formation!**
- **And this increases top-of-cloud reflectivity (albedo)**

Global Energy Budget under Clear Skies

C L O U D F O R M A T I O N



- **This may be about as close as we can get to an estimation of the deforested state (i.e., without clouds).**
- The net result of the increase in the downward solar radiation flux and the increase in the upward thermal heat flux is equivalent to about **+20 Wm2**.
- Suggests that deforestation should bring significant warming (not cooling)
- The loss of cloud cover is important!

Numbers in red compare the clear sky to the energy budget with clouds.

Wild et al., (2019)

CLOUD FORMATION

How much of an impact could increased cloud cover have?

Estimated Effect of Increased Forest Cover on the Net Radiative Balance (EEI) and TFVC Drawdown	Estimated Historical Forest Cover Loss (FCL)		Formulas	Logic
	-40%	-50%	(FAO estimate)	cropland + urban settlement conversions
Land Latent Heat Flux (LHF, Wm^2)	38.0	38.0	(Wild, 2015)	Terrestrial Latent Heat Flux
Current Annual TFVC CO_2 Drawdown ($GtCO_2$ -eq yr-1)	-12.5	-12.5	IPCC AR6 WGIII Ch7	Annual TFVC Drawdown
Lost Latent Heat Flux (compared to 100% Forest Cover, Wm^2)	-25.3	-38.0	= (LHF/FC) * (1-FC)	Lost terrestrial latent heat flux (assuming all land can be converted)
Potential LHF (PLHF) with cropland conversion to forest (Wm^2)	10.1	15.2	= (x * .80) * (1 - 0.5)	Potential additional terrestrial latent heat flux assuming only agricultural land (80% of total loss) can be converted - Cropland LHF = 50% * forest LHF)
% Increase in Latent Heat Flux (assume 100% cropland conversion to forest, minus cropland ET Flux)	21%	29%	= PLHF/LHF	Potential % increase in LHF
Change in top-of-cloud OLW (assuming initial 28 Wm^2 OLW flux)	1.7	2.3	= (28 * (PLHF/LHF)) * .29	Estimated change in outgoing LW flux (adj. for 29% land cover) - increases in cloud cover reduce the OLW flux
Change in top-of-cloud OSW (assuming 64 Wm^2 outward reflectivity)	-3.9	-5.3	= -(64* (PLHF/LHF)) *.29	Estimated change in outgoing SW flux (adj. for 29% land cover) - increases in cloud cover increase the OSW flux
Estimated Change in EEI from change in cloud cover (Wm^2)	-2.2	-3.0	= SUM (ΔOLW + ΔOSW)	Potential Change in EEI from Increased Cloud Cover
Estimated Change in Total Annual TFVC Drawdown ($GtCO_2$-eq yr^{-1})	-8.3	-12.5	= (DD/FC) * (1-FC)	Potential Change in TFVC Drawdown from Increased TFVC

IPCC AR6 WGI Ch7: the EEI is estimated at 0.5 ± .185 Wm^2 (for the period 1971-2006), and 0.79 ± .27 Wm^2 for the period 2006-2018

These back-of-the-envelope calculations presumably overestimate factors such as reduced temperatures (with more TFVC), E over water bodies, magnitude, etc.