

Forest monitoring to promote sustainability in the 21st century

Zoltán Somogyi



NAIK ERTI, Budapest
somogyiz@iif.hu



Mit Gott!
SYLVICVL TVRA OECONOMICA,

Ober
Hauswirthliche Nachricht und Naturmäßige

Anweisung

Der
Wilden Baum-Zucht

Nebst
Gründlicher Darstellung/

Wie zu förderst durch Göttliches Bewenden dem allenthalben und insgemein einreißenden

Grossen Holz-Mangel/

Vermittelt Sae-Pflantz- und Verlesung vielerhand Bäume zu prospiciren/
durch also durch Anpflanz und Wiederwachs des so wohl guten und schnell anwachsenden, als andern geschickter
und nützlichen Holzes, ganz oder edelere Holz-Charakteren, Pflanz und Dreier andern Holzarten, sich auch brauchbar zu
machen; Sessels von Saamen-Schumen und wie der wilde Baum-Saamen zu säen, der Grund und Boden zum Saamen
richten, solche Saat zu bewahren (stehlen), auch der jungen Anflug und Wiederwachs zu beobachten. Daraus das künftige Nutzen, Nutzen,
oder Schutzen Oberwand Unter-Holz anzuhalten und zu vermehren, welchen bezirhet die Art der Holz- und auch Holz-
Hölzer deren Eigenschaften und was begehret Holz für Saamen reise, auch wie man mit fremden Saamen-Gewächsen sich zu
verhalten, ferne wie das Holz zu schneiden, zu verlesen, zu kochen und sonst zu nutzen.

Alles zu nothdürftiger Versorgung des Haus-Bau-Bratt-Berge und Schmelz-Berufs/
und wie eine immerwährende Holz-Darung Land und Leuten/ auch jedem Haus-Wirthe vornehmlichen großen
Aufnahmen/ pflichtlich und nützlich zu erziehen und einzuführen.

Worben zugleich eine gründliche Nachricht von den in Churf. Sächs. Landen

Gefundenen Turff

Dessen Natürlich Beschaffenheit/ grossen Nutzen/ Gebrauch und nützlichen Verkohlung,
Aus Vorbe zu Beförderung des allgemeinen Bestens begehret

Von
Hans Carl von Carlowitz/

Königl. Pol. und Churf. Sächs. Cammer-Rath und Ober-Berg-Präsidenten.



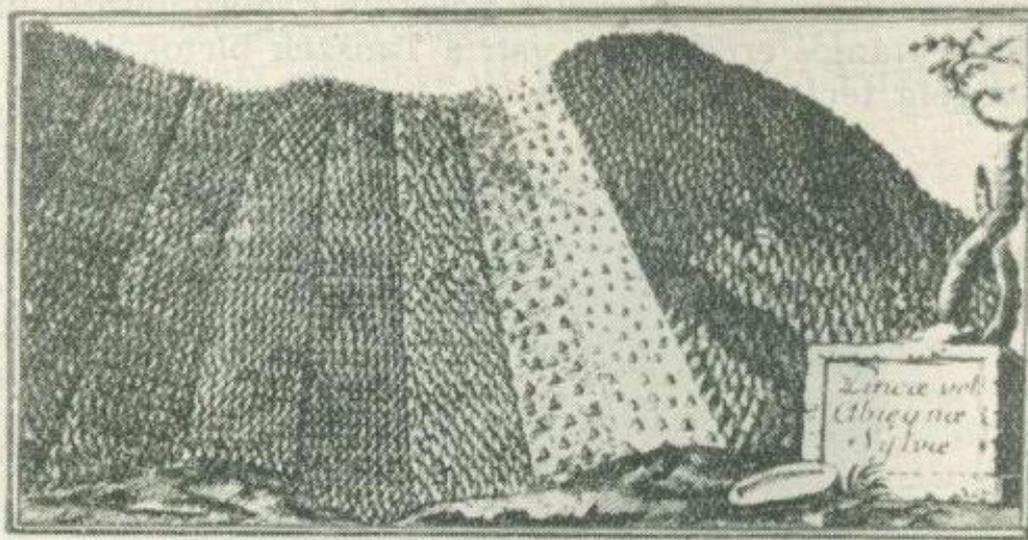
Mit Königl. Pol. und Churf. Sächs. allergnädigsten PRIVILEGIO.

LEIPZIG/

verlegt Johann Friedrich Braun 1713.

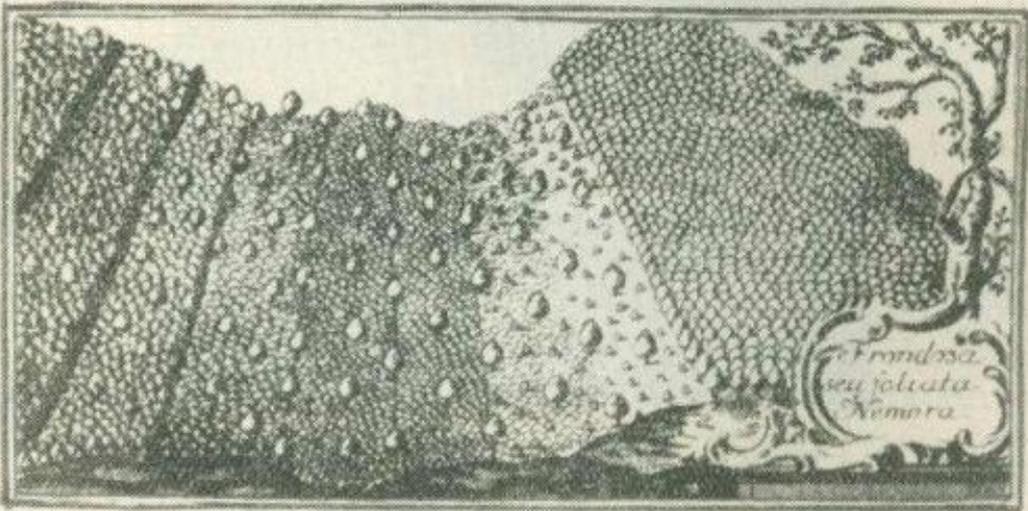
„sustainability“
is an old concept
in forestry ...

(at least since 1713)



Utriusque Ordinis, Sylvæ

*Hæc huc descriptam methodum et Annorum seriem distributa in perpetua
tempora de Anno in Annum succidi durareque poterunt.*



*Frondosa
seu foliata
Nemora*

*... in the sense of
„sustained yield”
of wood*

*that required
area / volume /
growth
monitoring*

Forest Europe monitoring:

35 quantitative *analytical* + **17** non-quantitative *indirect* country-level indicators

| | C1 | C2 | C3 | C4 | C5 | C6 | Part A | Part B |
|---------------------|--|---------------------|----------------------|--------------|----------------------|--------------------------|--|---|
| | Forest resources and global carbon stock | Health and vitality | Productive functions | Biodiversity | Protective functions | Socio-economic functions | Overall policies, institutions and instruments for sustainable forest management | Policies, institutions and instruments by policy area |
| Russian Federation | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲🌲 |
| North Europe | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲🌲 |
| Central-West Europe | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲🌲 |
| Central-East Europe | 🌲🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 |
| South-West Europe | 🌲🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲 |
| South-East Europe | 🌲🌲🌲 | 🌲🌲 | 🌲🌲 | 🌲🌲 | 🌲🌲🌲 | 🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 |

from 🌲 to 🌲🌲🌲🌲🌲

lack of theory, inappropriate indicators, inconsistencies, lack of data, too many data, oversimplified approach ...: „in need of revision”

EFI-coordinated study, 2013

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| Central-West Europe | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲 | 🌲🌲🌲🌲 |
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from 🌲 to 🌲🌲🌲🌲🌲

”

It Is Too Late For Sustainable Development

Dennis Meadows

Smithsonian Institution
Washington, DC; February 29, 2012

”

Is it??

***In our increasingly complex world,
it is necessary to reconsider:***

What is "sustainability"?

What is "forest"?

What to "monitor"?

Definitions of sustainability of complex systems

~~„Abcd efghij kl mnop qrs tuvwx yzab cdefghijk
lmno pqrst uvxyza bcd efg hijkl mn opq rstu
vwxyzabcd efghijkl mn opqrs tuv wxyza bcdef
ghijklmno pstuvw raldshj ljsad lasd xyzabcd egijkl
asdasd sldkj sldakejs.”~~

... are often narrative, inappropriate tools

*(Analytical) sustainability of complex systems
is a quantitative feature*

Annual Allowable Cut (AAC): $\mathcal{H} \leq I_{net}$

BUT: AAC and the indicator $\mathcal{H} / I_{net} \leq 1$

only work if calculated for a longer period

*Simple annual statistics or „statistics A / statistics B“
(e.g. carbon footprint, many Forest Europe indicators)
are poor sustainability indicators*

A simple generalized requirement that can handle complex system behaviour:

$$\Sigma U \leq \Sigma C$$

for any relevant period of time

U: utilization

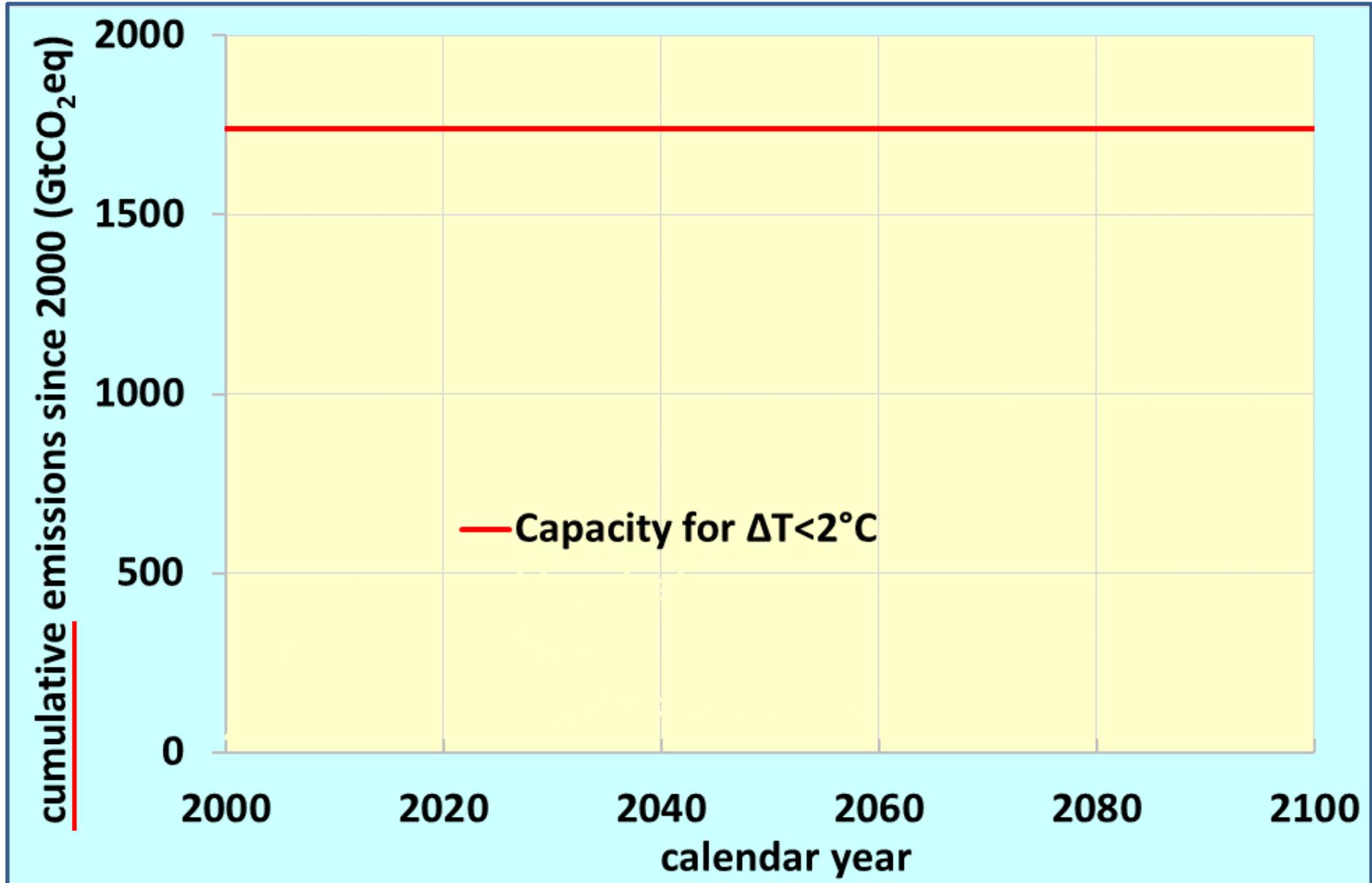
$$C = C_{non-ren} + C_{ren} + \Delta C$$

C_{non-ren}: non-renewable (e.g., volume of a primary forest)

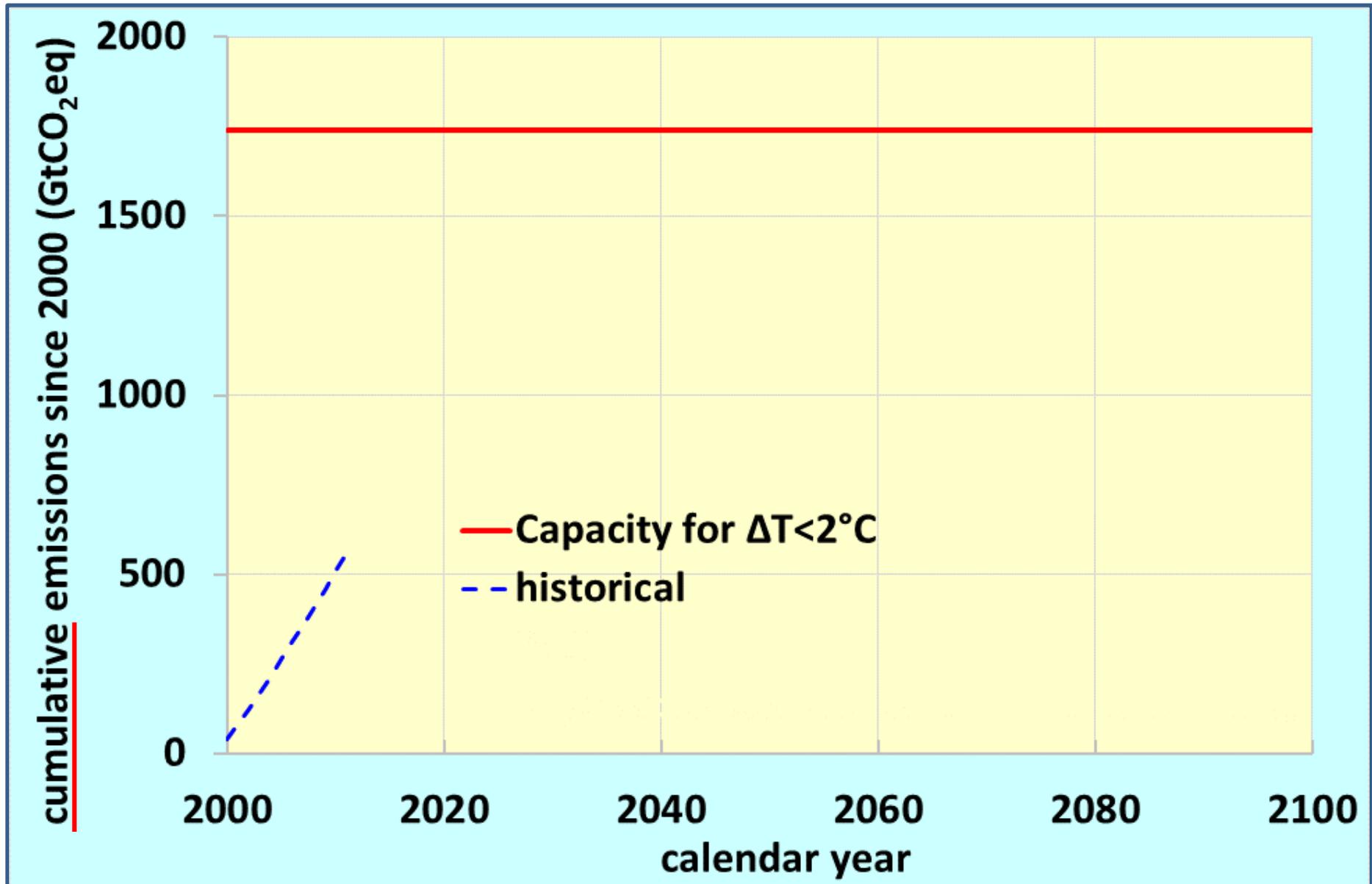
C_{ren}: renewable (e.g., regrowth)

*ΔC: G - L = gains - losses due to non-utilization related events
(e.g. afforestations and natural disturbances)*

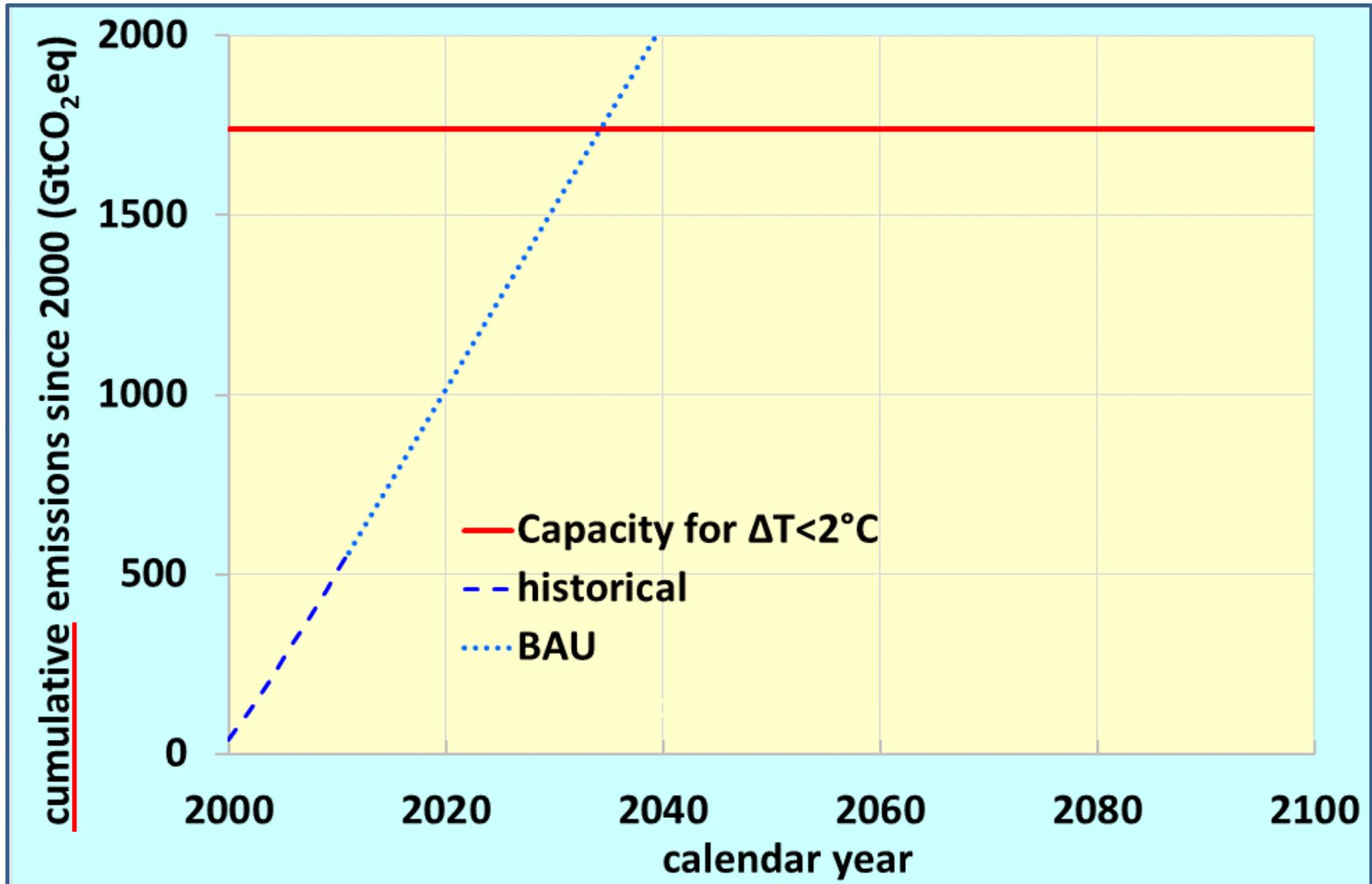
Cumulative CO₂ emissions should be related to the finite absorption capacity of the air



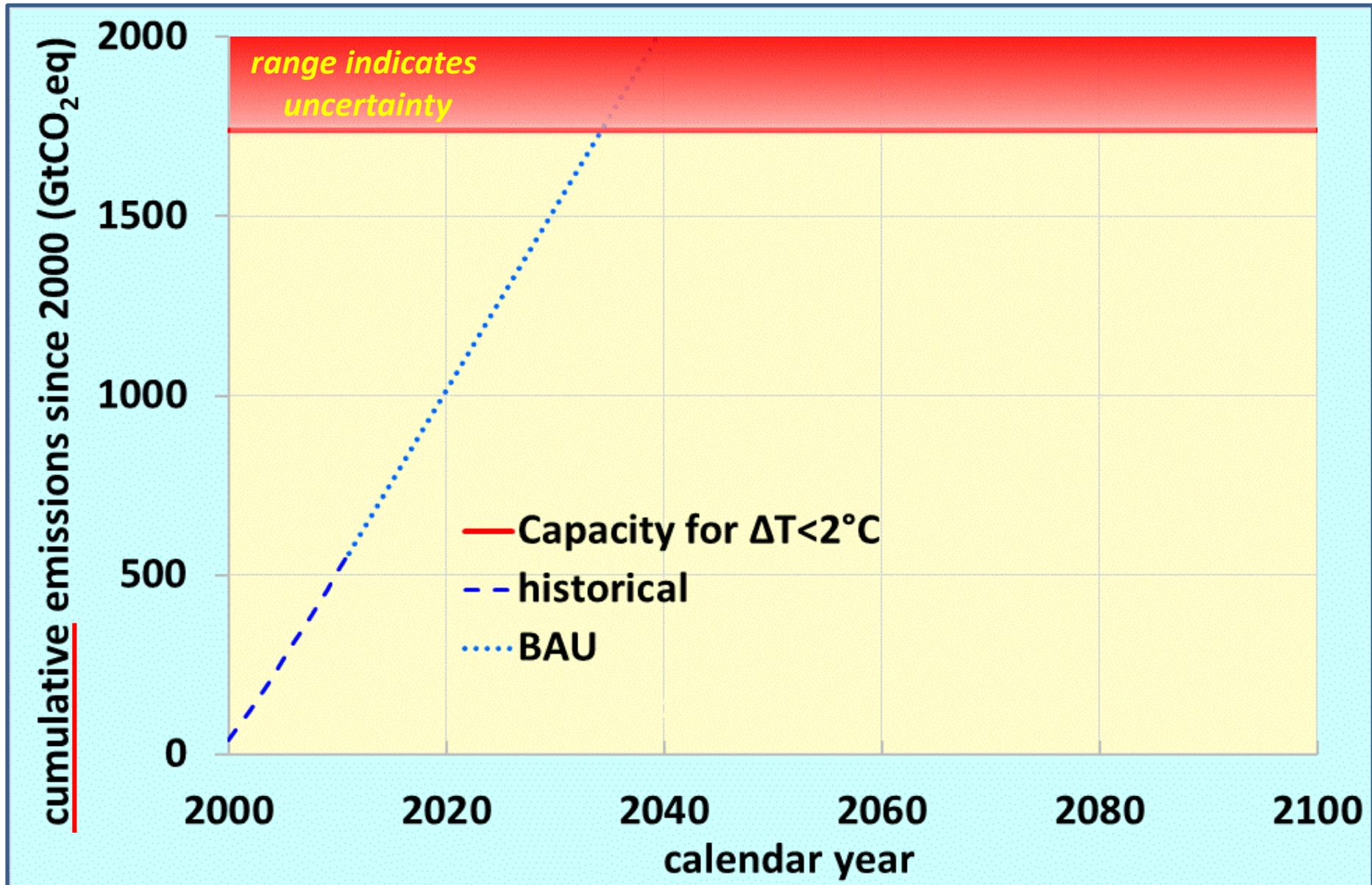
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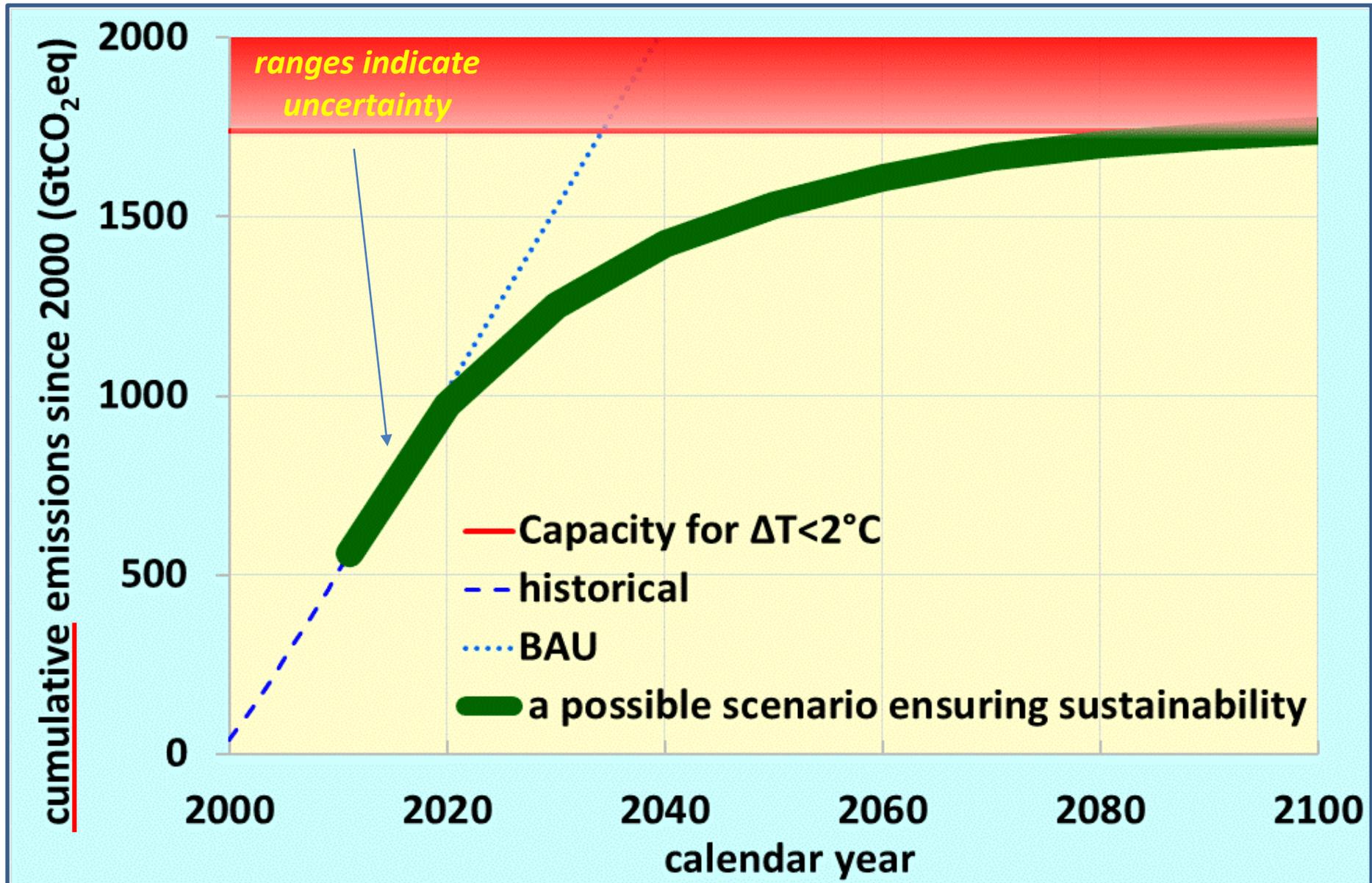
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Indicator: ΣU does not leave the path limited by ΣC
(„*staying on the road*”)

What is "forest"?

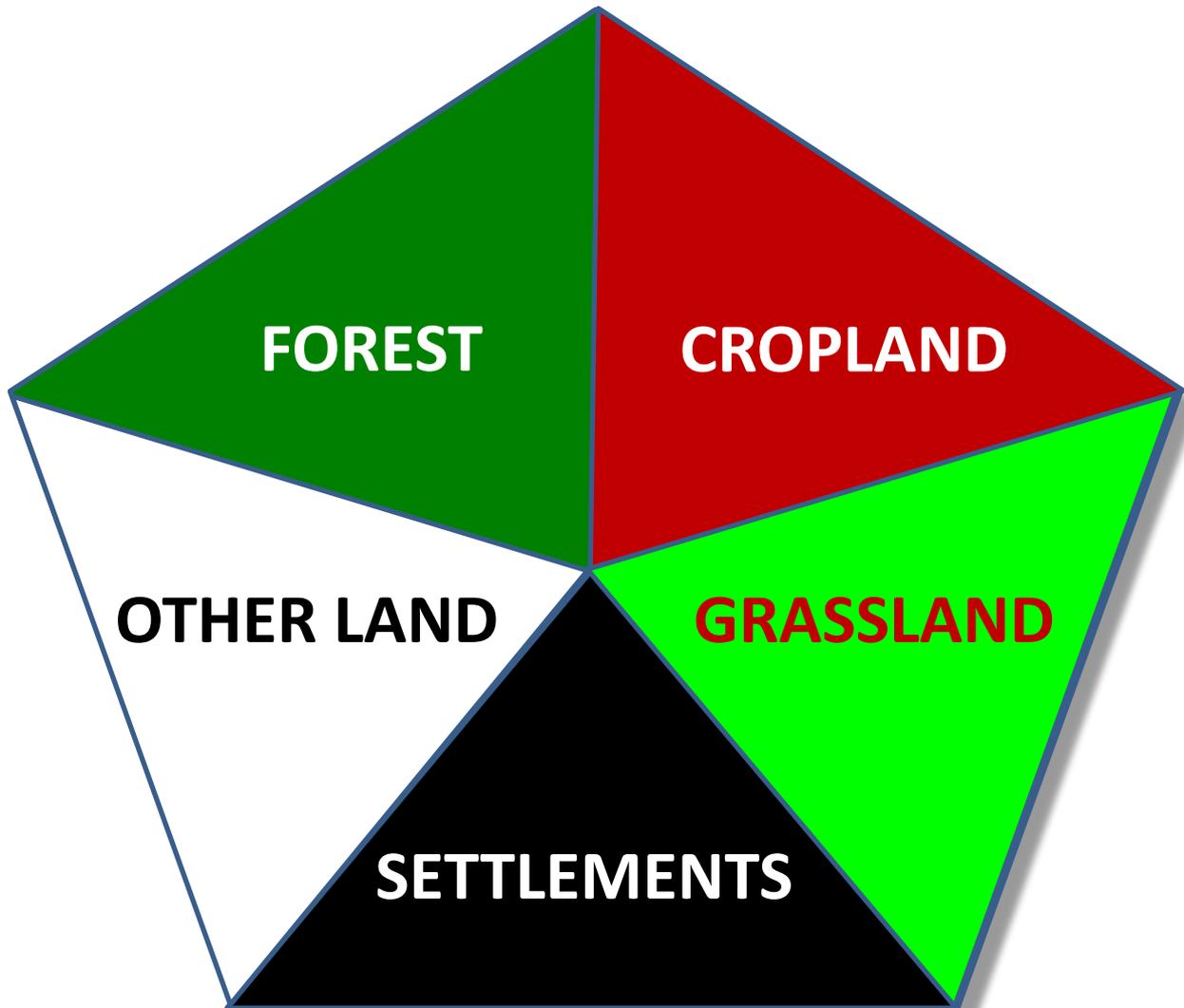
source of traditional and „*new*“ *values for local, global and future use*

e.g. carbon storage and sink

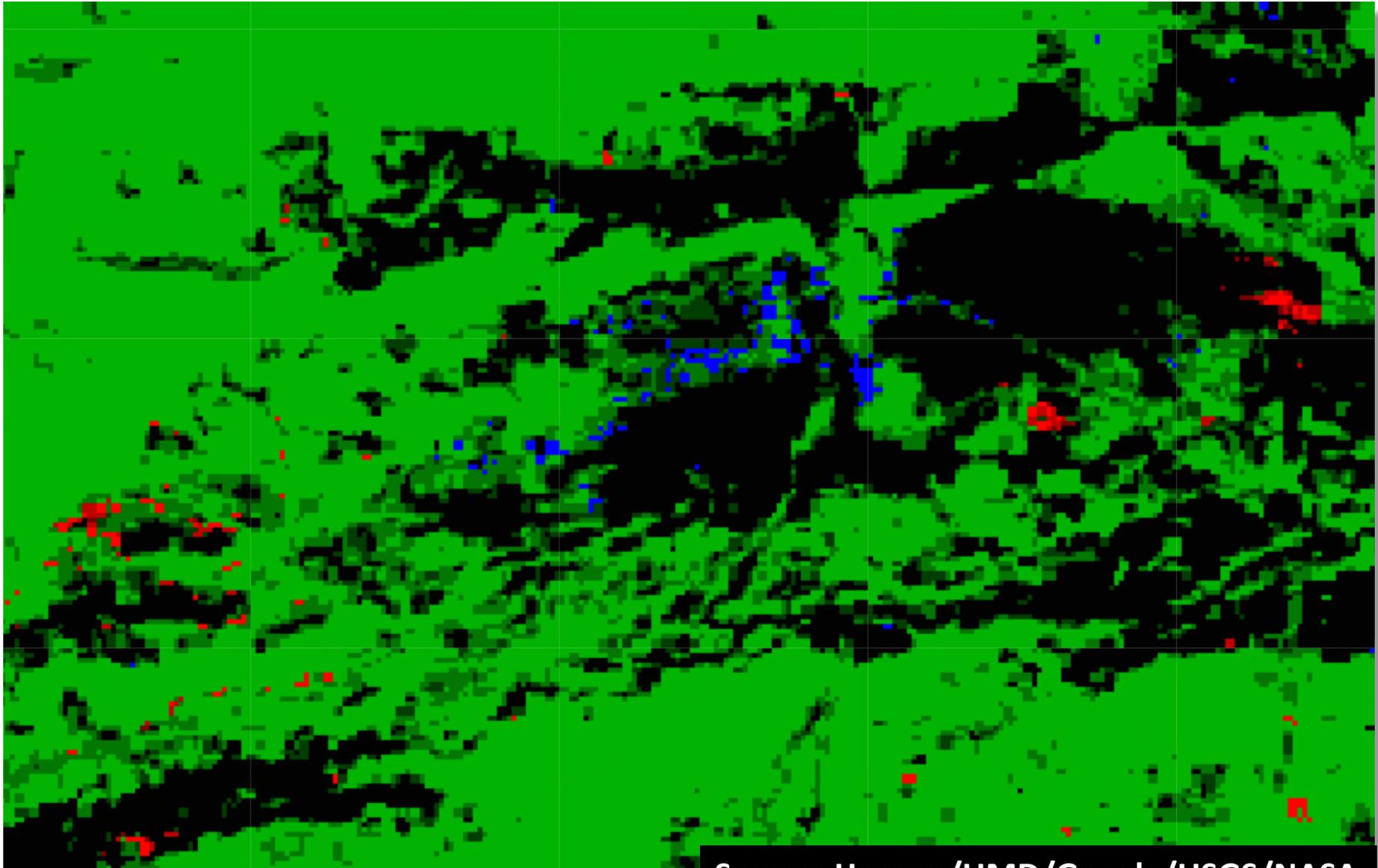
one of the many land uses

*land use changes: frequent, accelerating,
have different roles in the carbon cycle*

Land use happens as a complex, continuously evolving matrix



Detected *recent* **increase (afforestations)** and **losses (deforestations)** of forest cover in Northern Italy



Source: Hansen/UMD/Google/USGS/NASA

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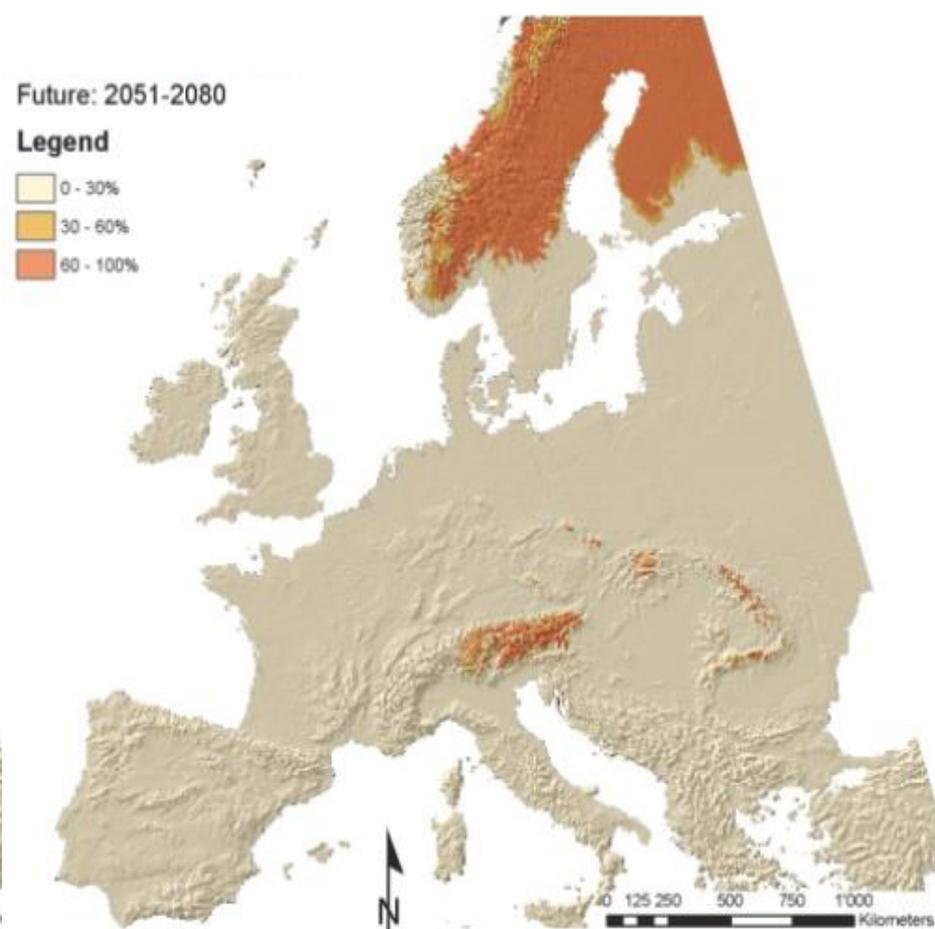
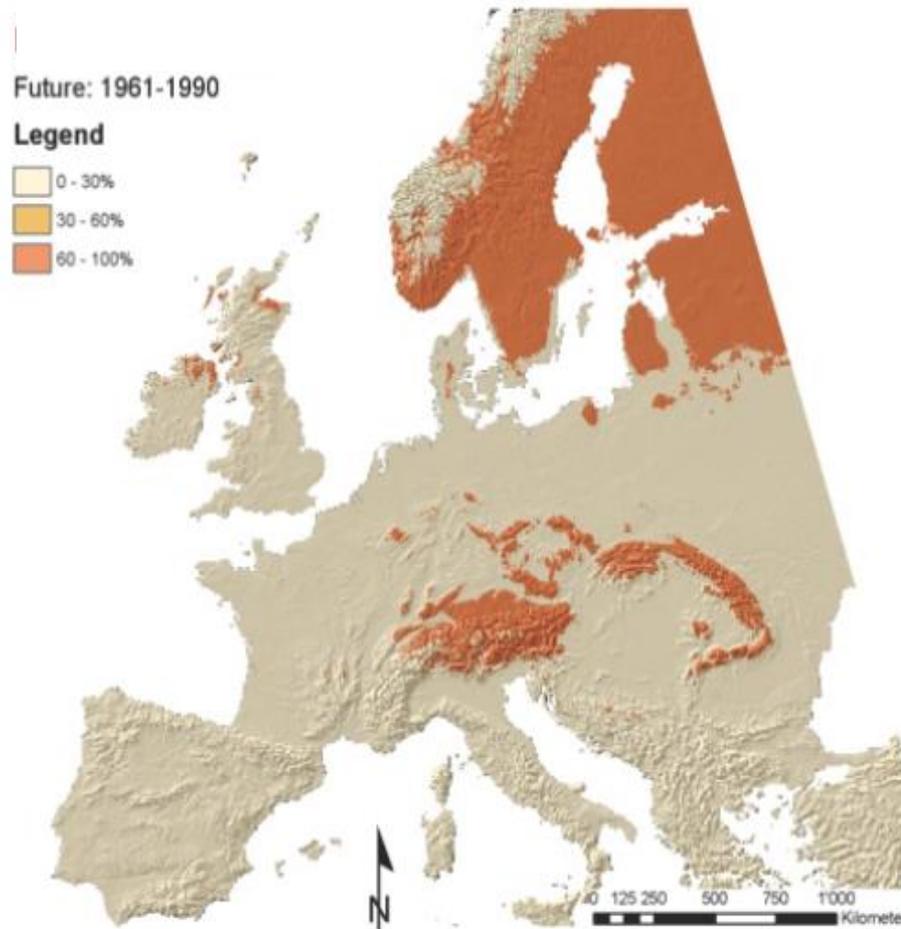
potentially increasingly changing

due to climate change

Possible *long-term* change of habitat suitability *Norway Spruce (Picea abies)*

past

in just 90 years

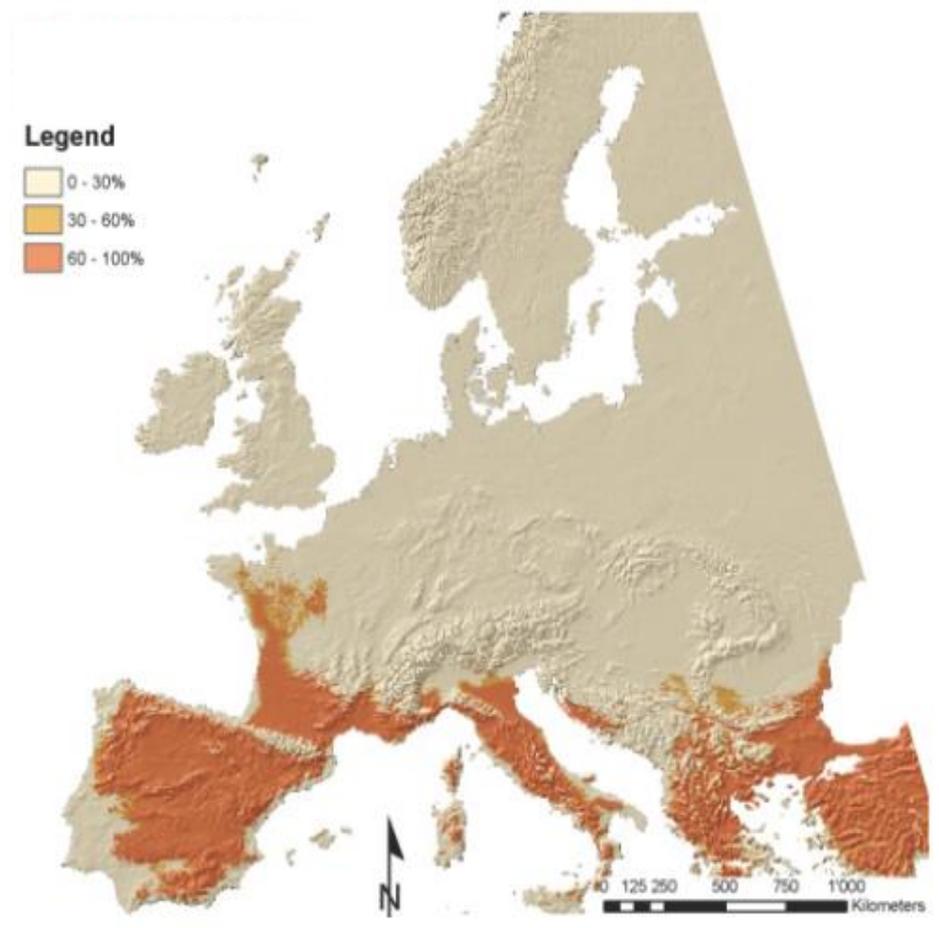
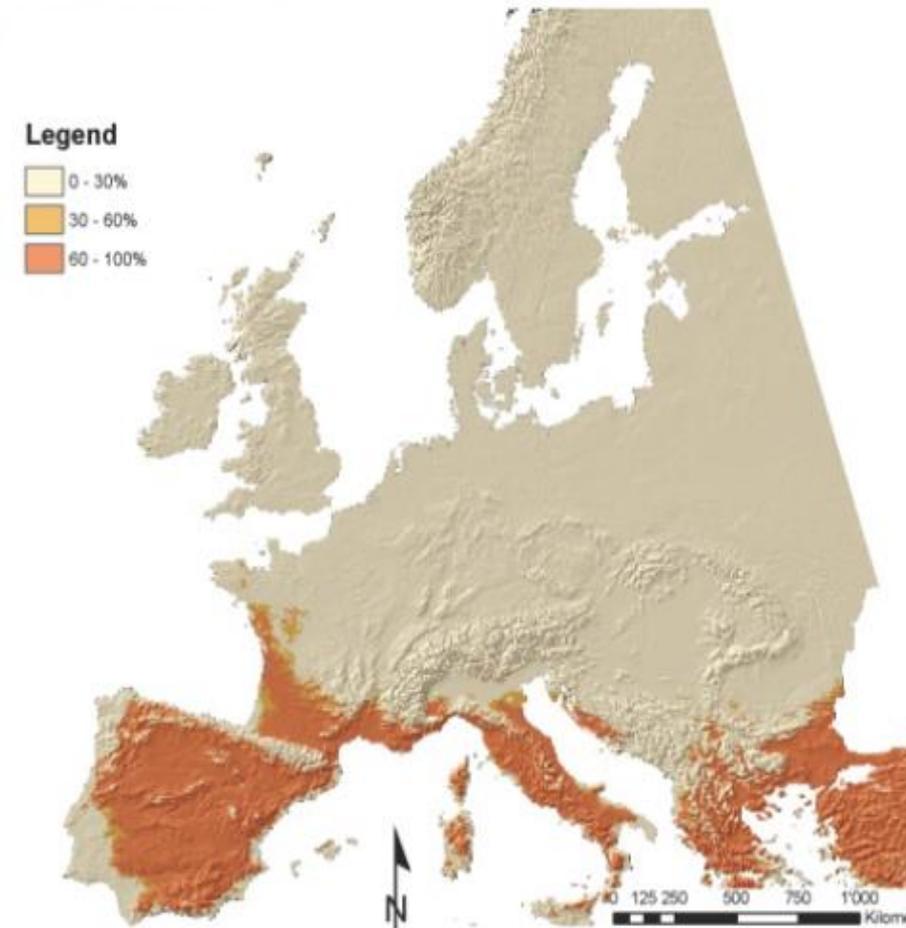


Possible *long-term* change of habitat suitability

Quercus ilex

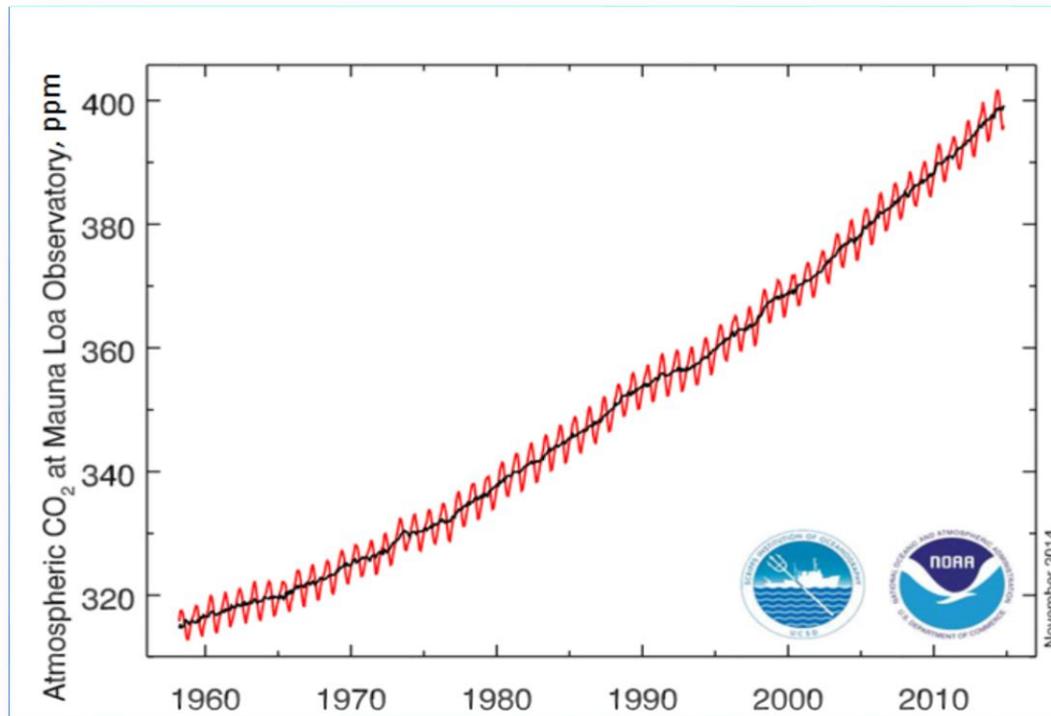
past

in just 30 years



What to monitor?

- many but not all Forest Europe indicators?
- forest changes and *health as affected by climate change?*
- variables relevant for *the* global carbon cycle, UNFCCC, EU! (method: standardized by IPCC)



Required information in GHG inventories: for specific sub-categories

even if they sometimes include many small patches

➤ afforestations

➤ deforestations

➤ managed (existing) forests

(+ natural disturbances for voluntary

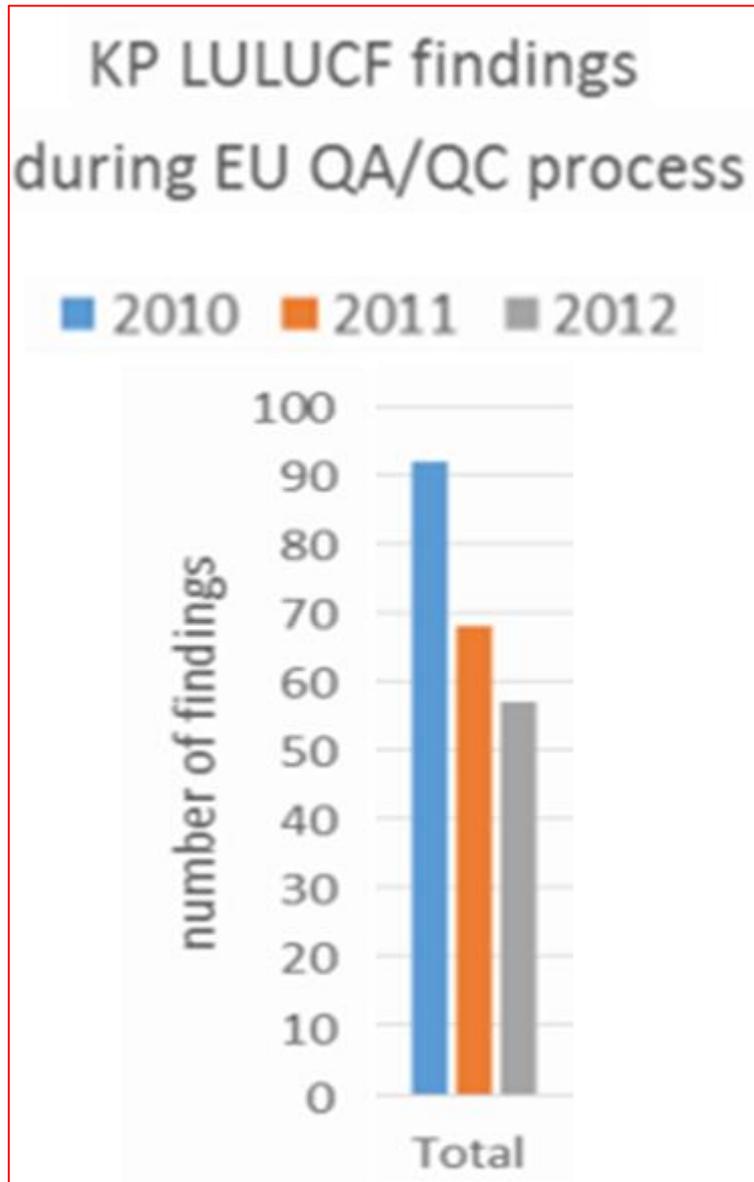
exclusion of emissions)



Required information in GHG inventories: *stock changes* of carbon pools

- above-ground biomass
- below-ground biomass
 - stock or growth rate + harvest + mortality;*
 - biomass burnt (to also estimate non-CO₂ emissions)*
- deadwood
- litter
- soil
- harvested wood (for energy / wood products)

There is still a lot of room to improve...



Number of problematic issues relating to KP-LULUCF in 2013
12 MS (from EU28), 3 MS (from EU15), total of 41 issues

JRC, Oct 2014

Criteria for monitoring of analytical sustainability - 1

- clear idea about **what to sustain**
(e.g. climate / temperature)
- clear idea about **relevant** variables linked to utilization and capacities
(e.g.: emissions and absorption capacity)
- clear idea about the **time dimension**
(e.g.: until we can still avoid adverse effects)

Criteria for monitoring of analytical sustainability - 2

- **clear theory** of evaluating estimates
(e.g. complex understanding of the carbon cycle)
- **practicable, well planned and cost-effective**
data collection
(e.g. for optimized greenhouse gas inventory)

Any non-analytical approaches?



A non-analytical approach: monitoring naturalness

- **what is „natural“?**
- **what and how to monitor? (bioindicators?)**
- **how to interpret monitored variables? what does „naturalness“ indicate?**
- **under what conditions does it also indicate „optimal“ level of services and products?**

The momentum of developing monitoring systems must be sustained

- **further research** is clearly needed
- **theory** should not be neglected
- **scope** to broaden but also limit based on carefully defined **priorities**
- **combined use** of analytical and non-analytical approaches?

**Proper 21st century
forest monitoring can,**

**if its results are properly
published and publicized,**

inform, allow implementation and

**promote sustainability
in a broad sense**

