Carbon in the woods - From seed to end of life and beyond!

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CAR-ES meeting
October 7 - 2021

Photo: Lars Högbom if not stated otherwise

Deadwood are alive

I have two main purposes with this presentation:

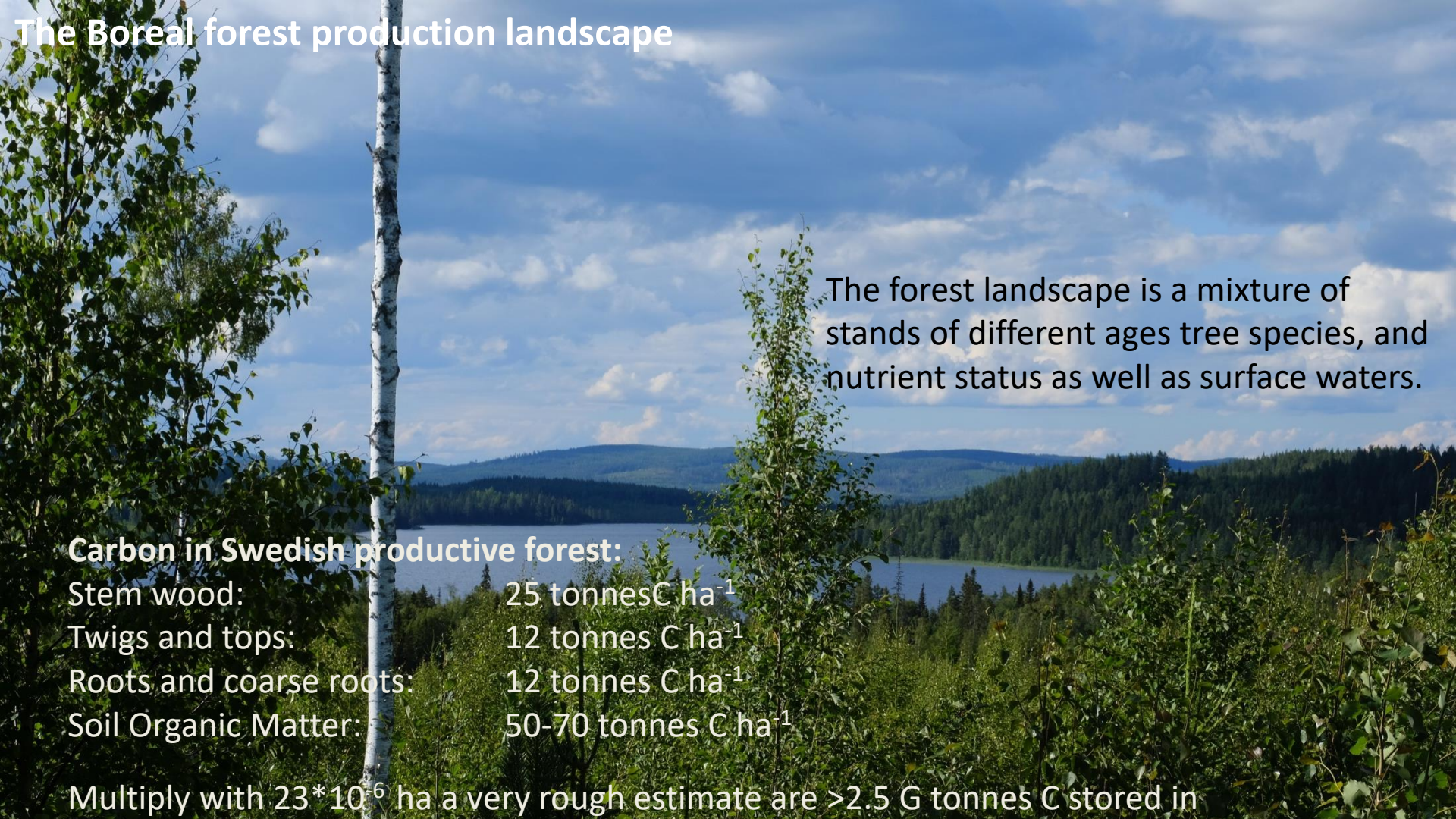
1 – To make a short overview on forest carbon with focus on soil carbon and decomposition
2 – To present some new LCA thoughts
3 – To take a chance to be a bit philosophical

Statement 1: Trees like most living organism on planet Earth are depending on carbon both as an energy source and as building materials. Trees take up and store carbon when they live and metabolise and releases carbon when they decompose.

Statement 2: Soils are the ultimate place for storing ecosystem carbon

Statement 3: “What a drag is is getting older” The only good thing of being older is that you don’t have to worry about your next research grant.

The Boreal forest production landscape



The forest landscape is a mixture of stands of different ages tree species, and nutrient status as well as surface waters.

Carbon in Swedish productive forest:

Stem wood:	25 tonnesC ha^{-1}
Twigs and tops:	12 tonnes C ha^{-1}
Roots and coarse roots:	12 tonnes C ha^{-1}
Soil Organic Matter:	50-70 tonnes C ha^{-1}

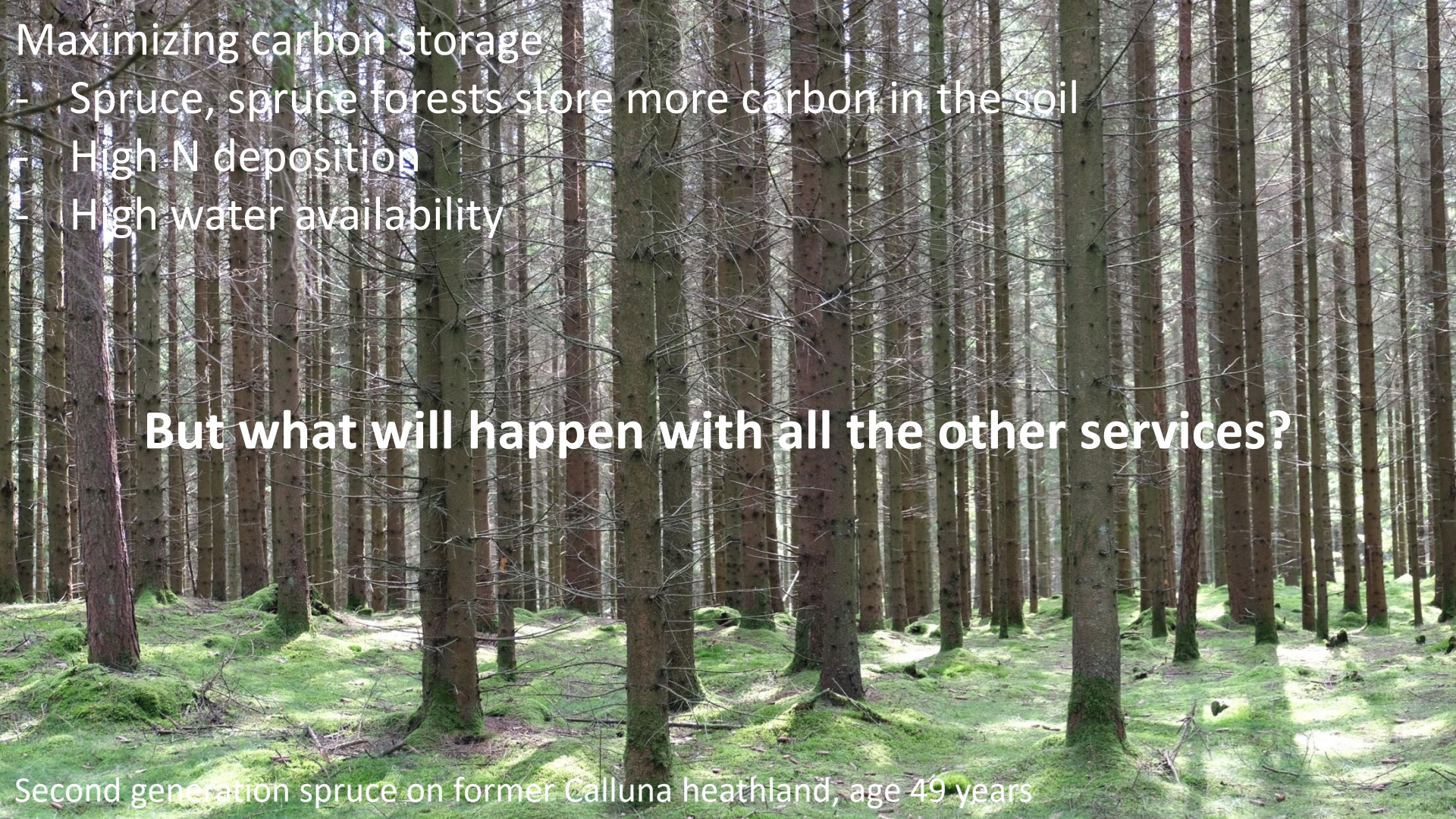
Multiply with $23*10^{-6}$ ha a very rough estimate are >2.5 G tonnes C stored in

Trees

Trees is the dominant life form on the planet. It has been estimated that plants store 450 Gt C, of which trees constitute the lion’s share.

The day after planting!

After 1000 years – the Ramkvilla oak



Maximizing carbon storage

- Spruce, spruce forests store more carbon in the soil
- High N deposition
- High water availability

But what will happen with all the other services?

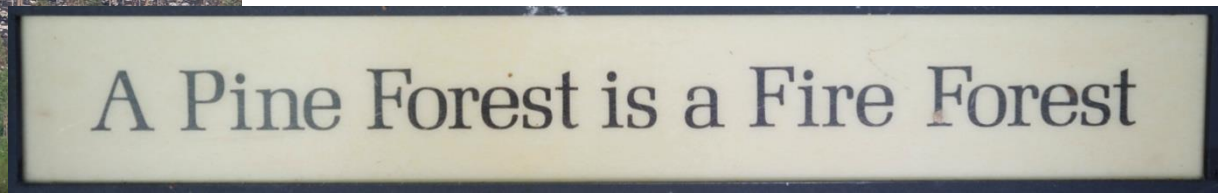
Second generation spruce on former Calluna heathland, age 49 years

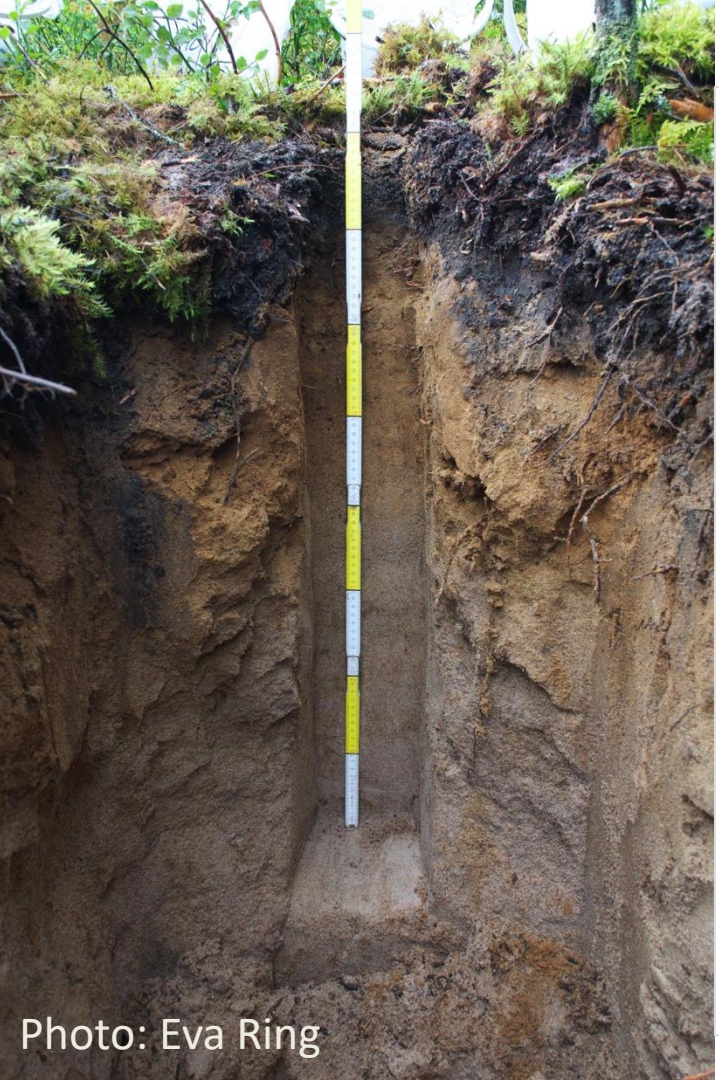
Non-Woody Products

Forest fires

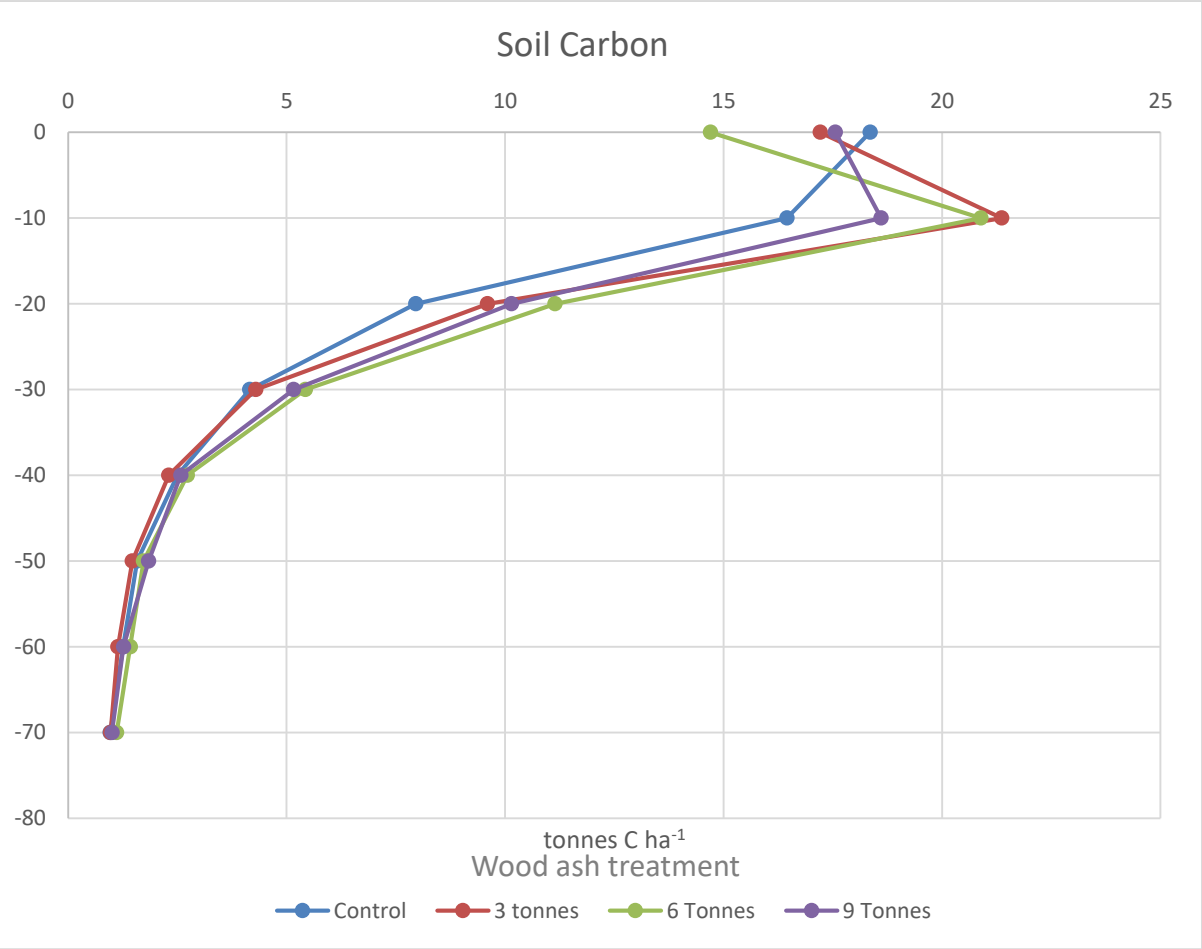
Forest fires is common although fires has been suppressed during the last 100-years.

Pines usually survive fires
This tree established after the fire 1670, and survived fires in 1729, 1753, 1809, and 1888

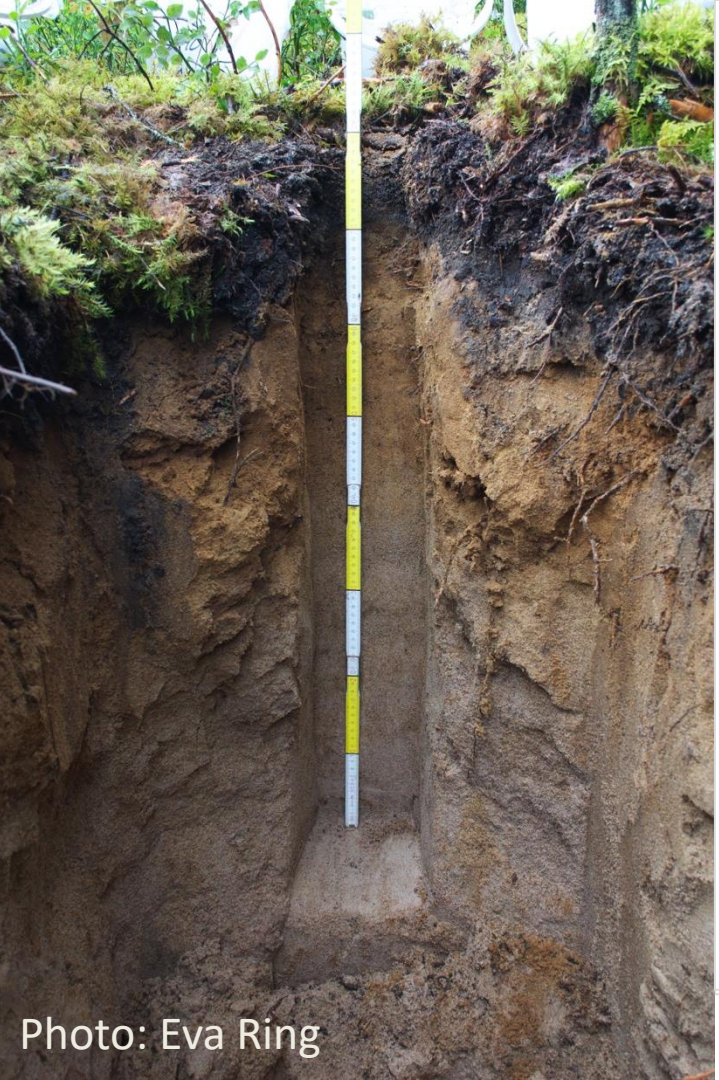


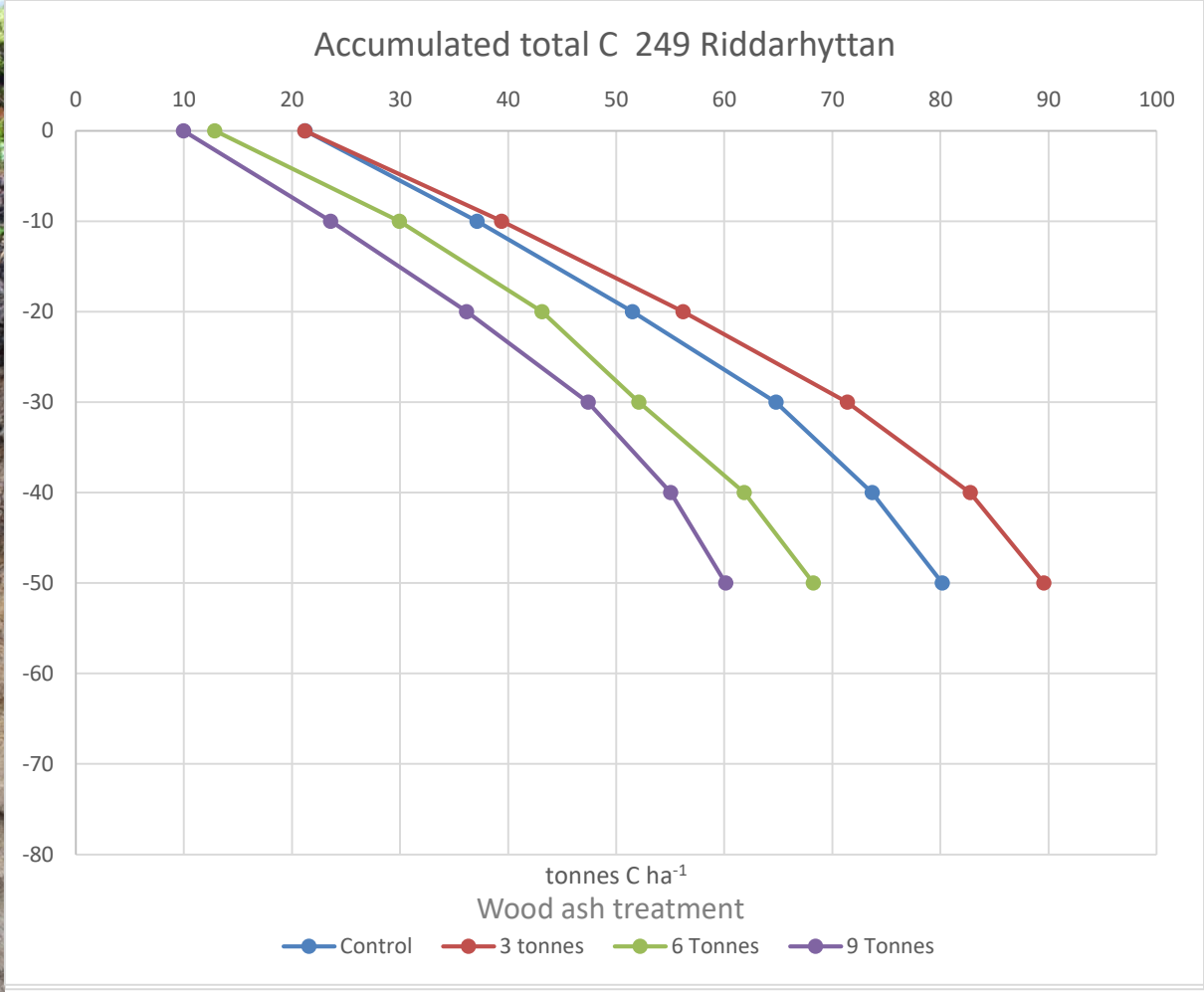


Experiment 250 Riddarhyttan



Högbom et al. (202x) In Prep





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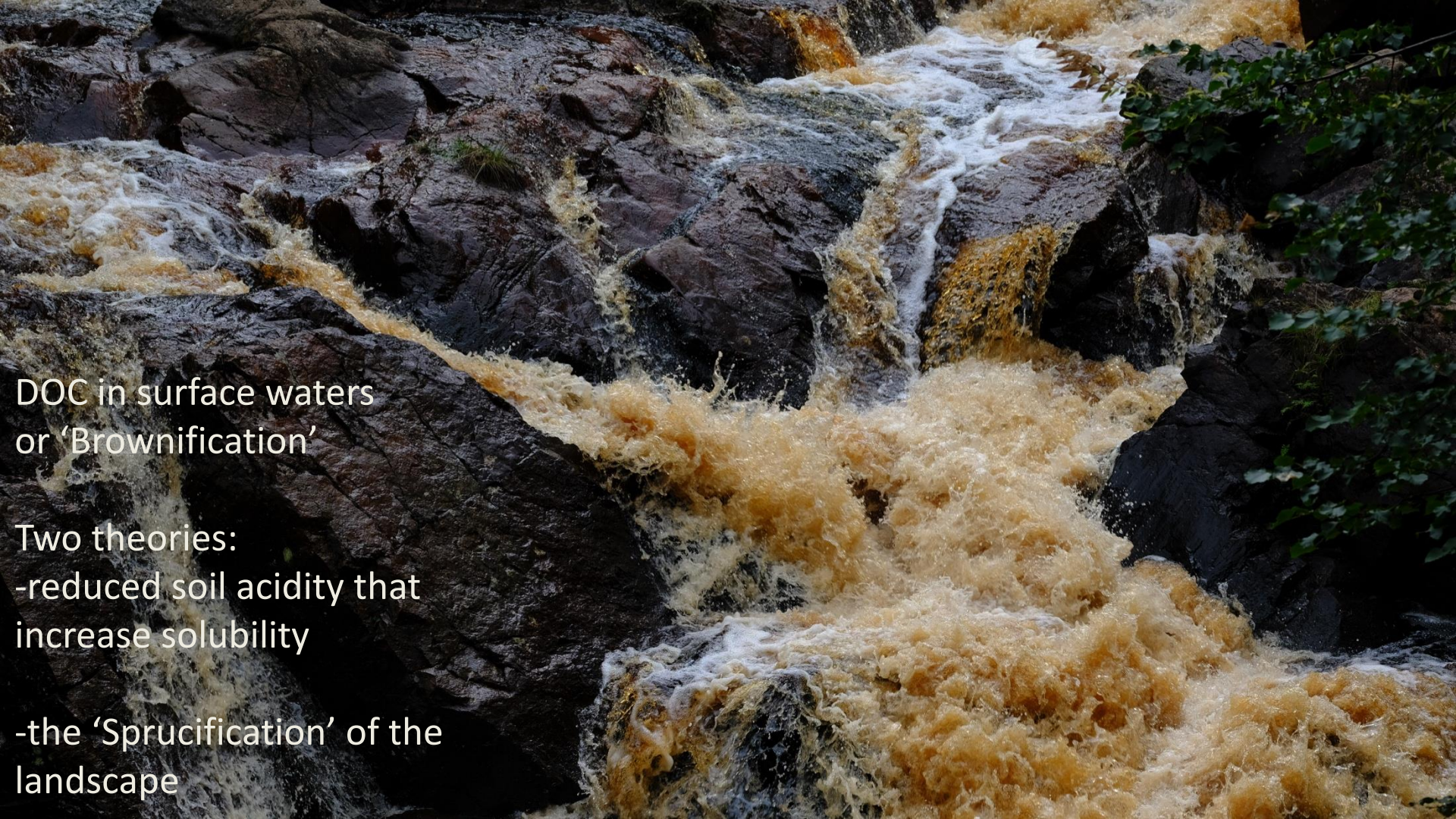
Fungi and soil carbon

There are and more evidence suggests the importance of fungi for forming soil organic matter

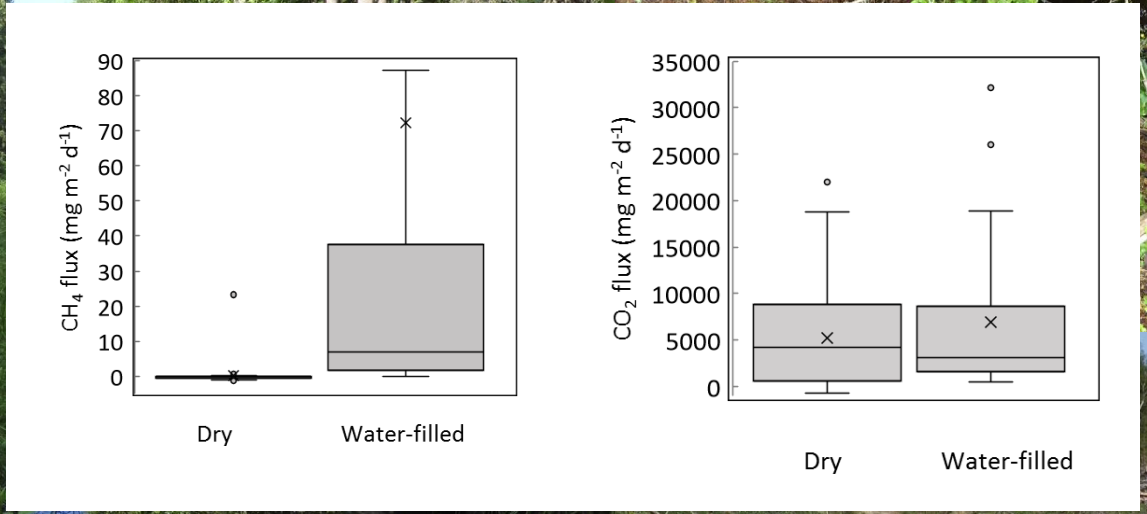


DOC in surface waters
or ‘Brownification’

Two theories:
-reduced soil acidity that increase solubility

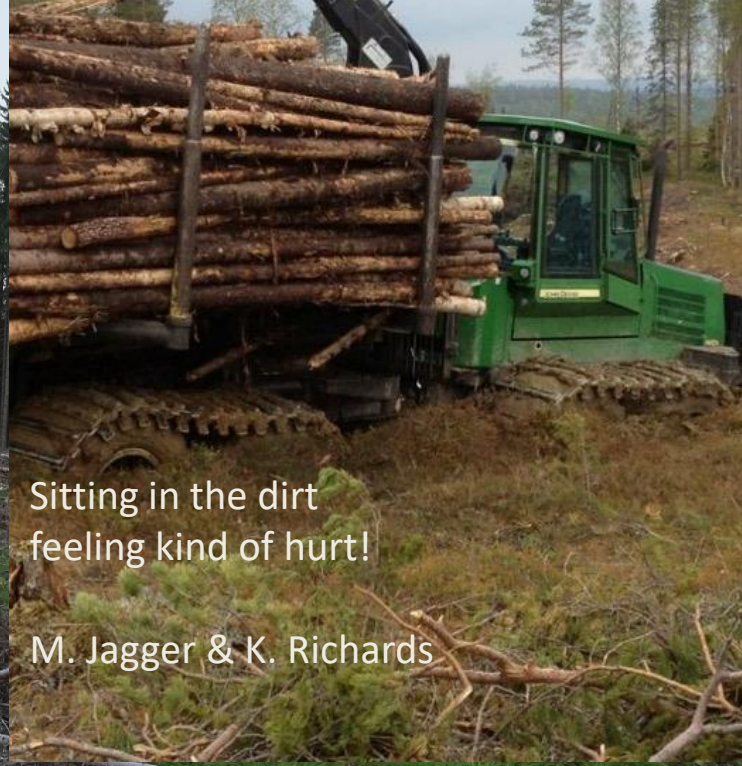
-the ‘Sprucification’ of the landscape

Green house gas emissions from ditches



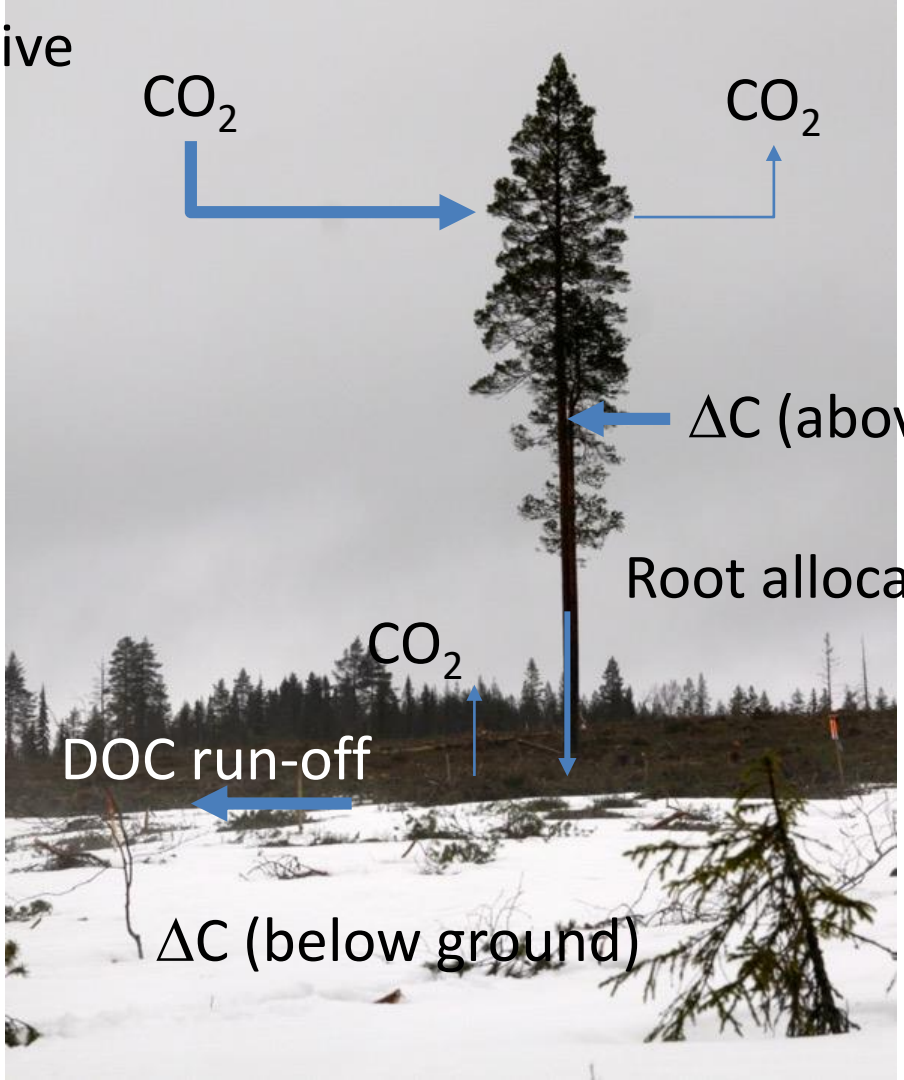
Photos: Micheal Peacock

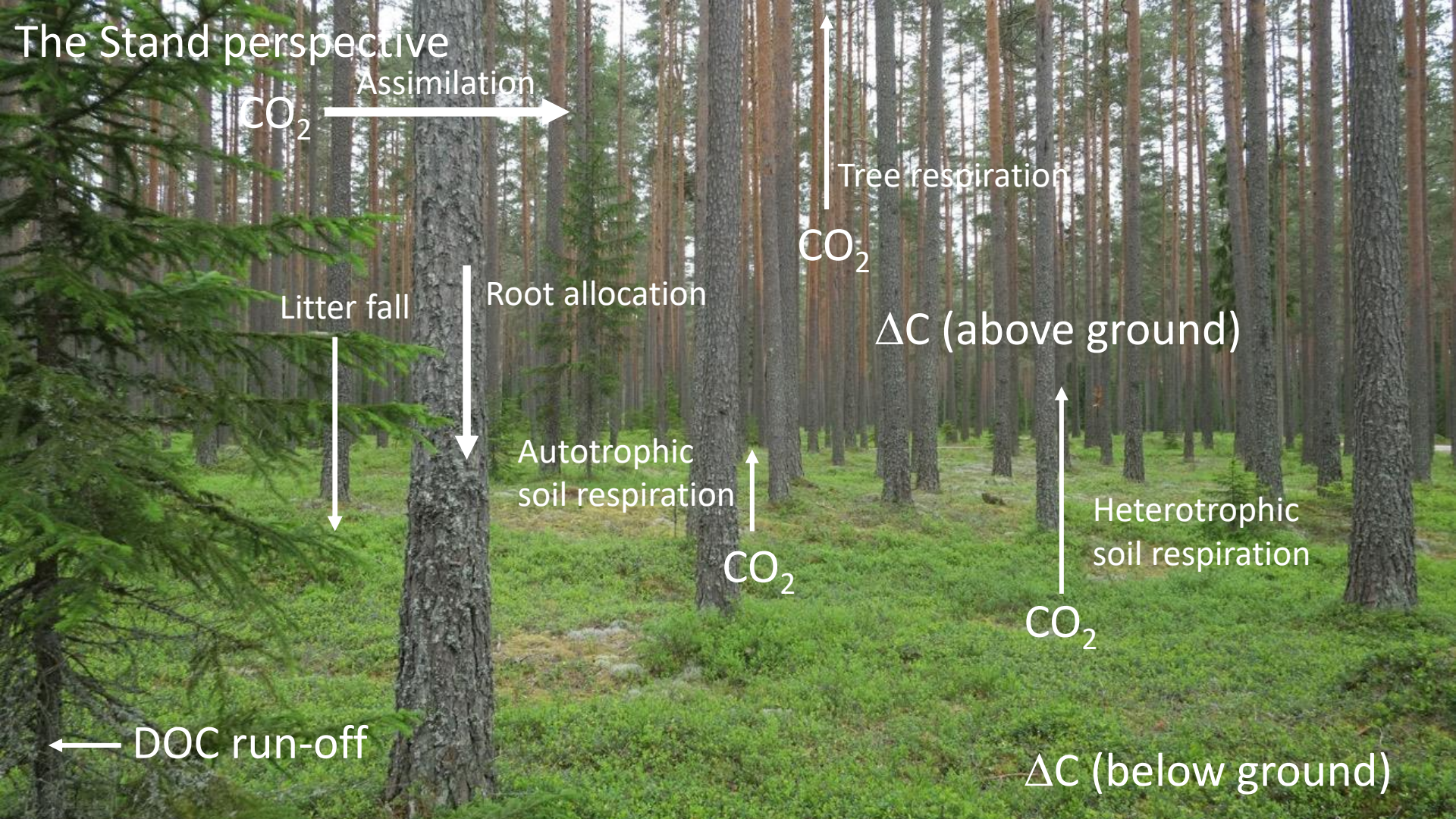
Peacock et al. (2021) Biogeoscience, in Press



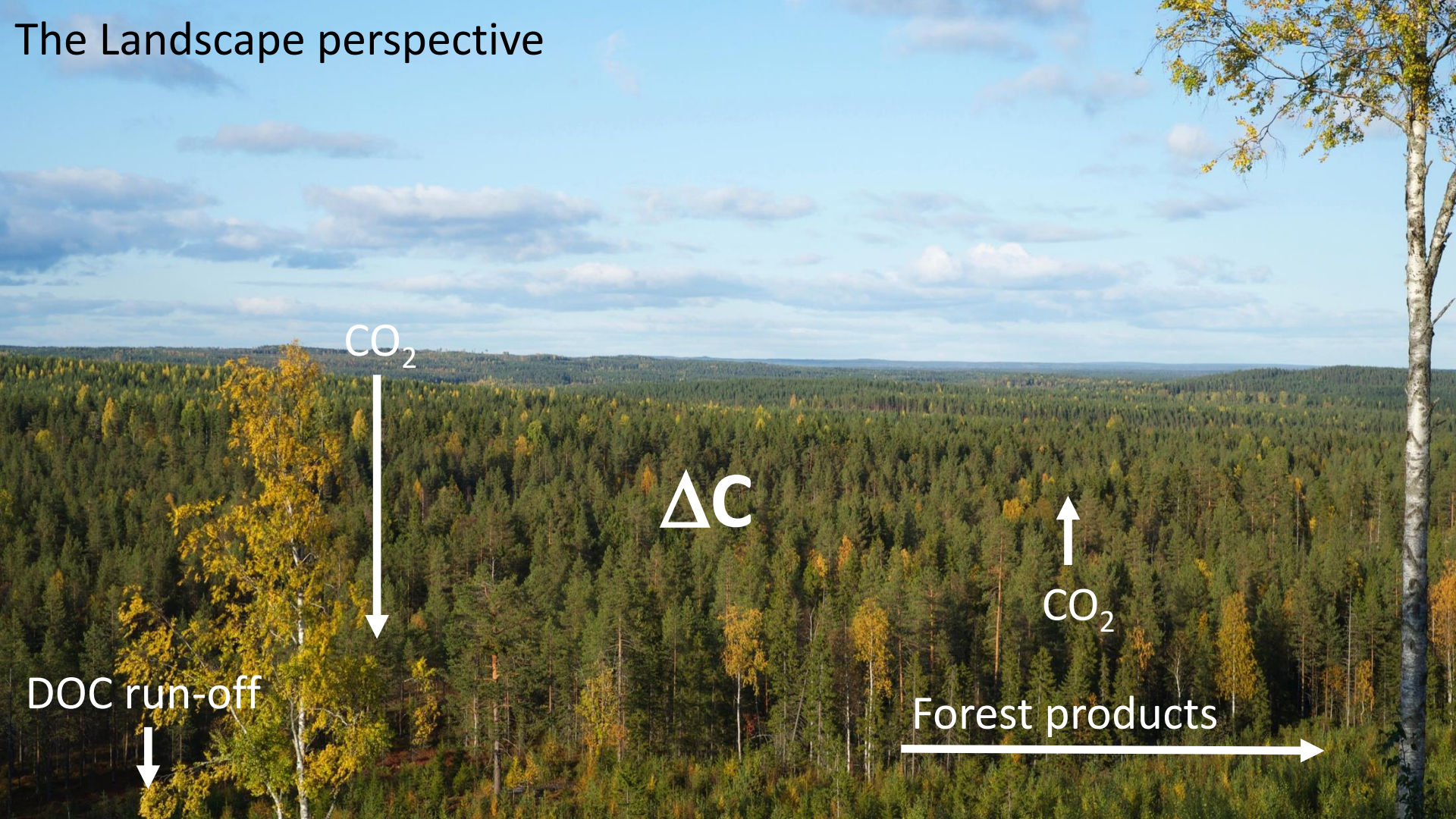
Practical application?

The Tree perspective




The Stand perspective
CO_2
Assimilation
Tree respiration
CO_2
Litter fall
Root allocation
ΔC (above ground)
Autotrophic
soil respiration
CO_2
Heterotrophic
soil respiration
CO_2
DOC run-off
ΔC (below ground)

The Landscape perspective




From Precision …

Our LCA approach

- Cradle-to-gate, no attempt to estimate any substitution effect
- Landscape approach – trees of all ages are included. Assuming a even age distribution.
- The products produced during year X bear the burden/get the credit of all the forestry operations and carbon flows that occur that year

PRODUCT CATEGORY RULES (PCR)
DATE 2020-10-27

BASIC PRODUCTS FROM FORESTRY

PRODUCT CATEGORY CLASSIFICATION: UN CPC 031

PCR 2020:05
VERSION 1.0

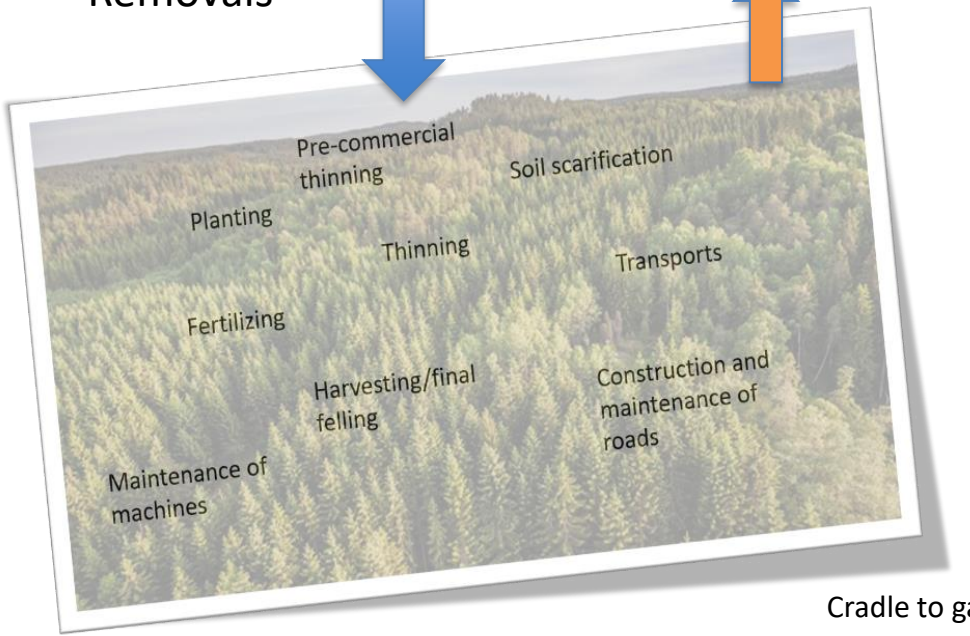
VALID UNTIL: 2024-10-27

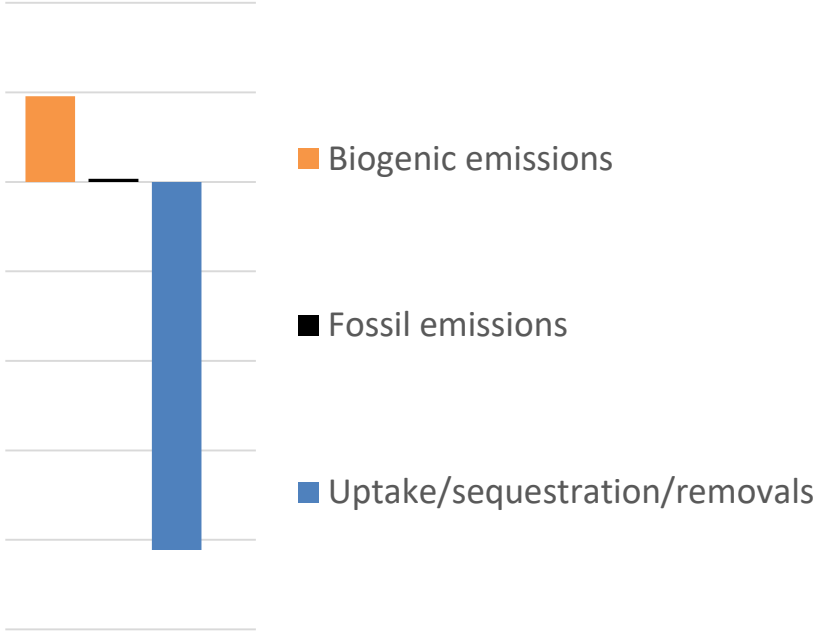
Global Warming Potential (GWP) results

per kg dry produkt, cradle-to-gate

Uptake
Sequestration
Removals

Decomposition





Cradle to gate => Emissions during the use phase & end-of-life are not included.

Reflections – summary

- Don’t forget the soils
- Fungal effect on soil organic matter
- Ditches emit GHG
- The importance of a landscape approach

THANK YOU FOR THE ATTENTION