

A new growth and yield simulator for the Norwegian forests

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ForestPotential – final seminar
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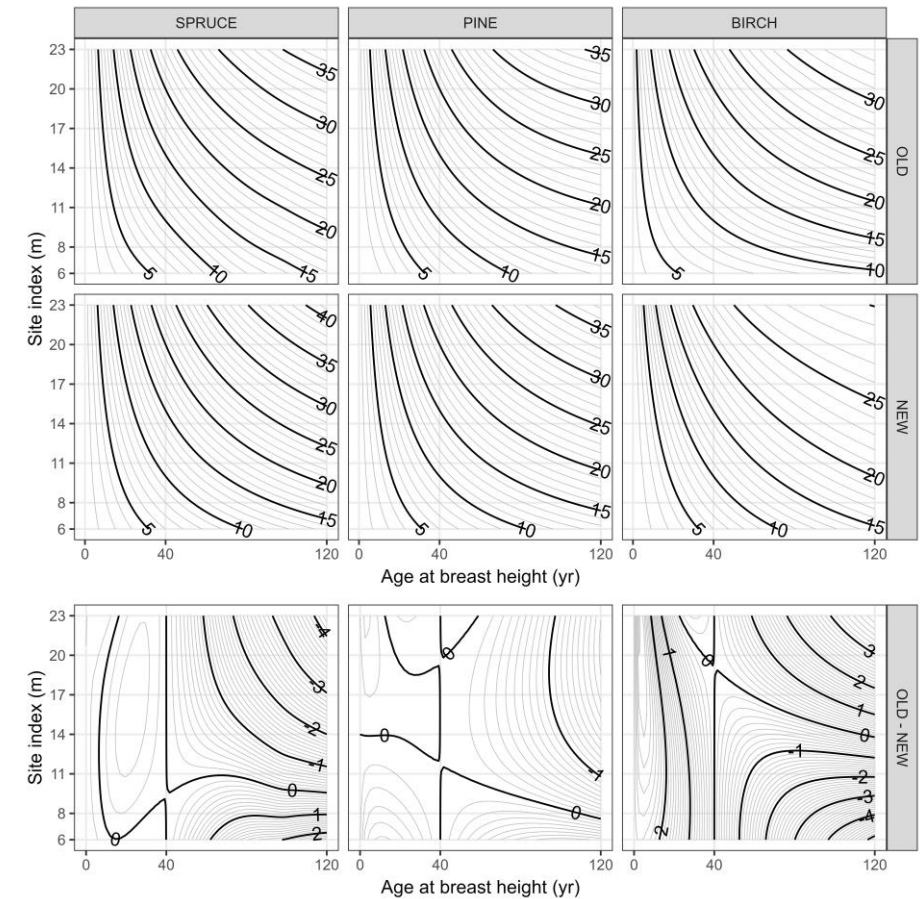
Background

- What is a growth and yield model/simulator?
 - Predict forest stand development under different treatment schedules
 - A collection of models: growth models, mortality models, allometrical models, economical models, etc.
- Used in forest planning (long term)
 - Optimization
 - Maximize net present value (NPV)
 - Subject to constraints

MOTIVATION: Need a modern and updated forest stand simulator to replace GAYA

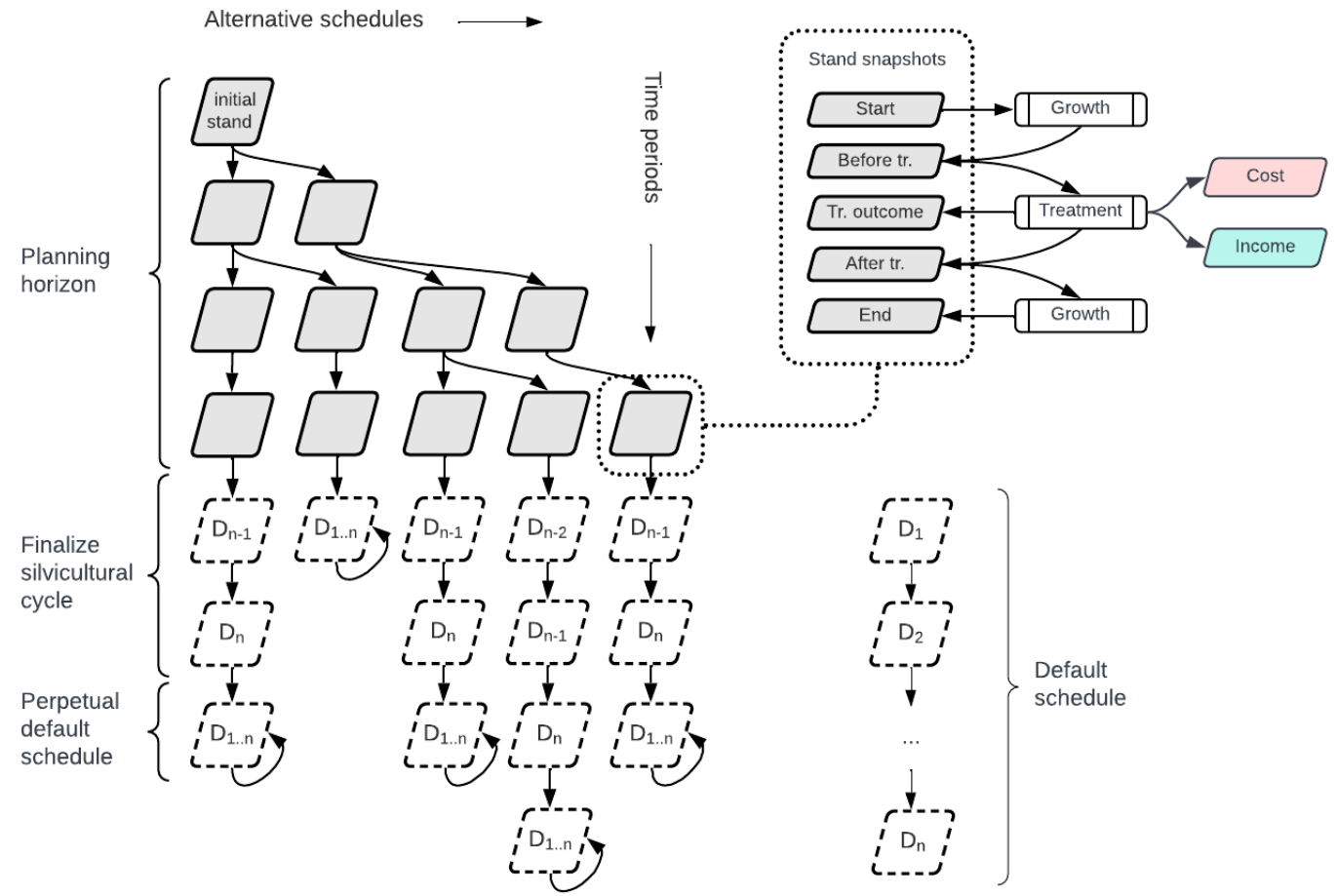
The “new GAYA”

- Written in **C++** in a more maintainable fashion
- Updated dominant height models
- Stronger **carbon** accounting component
- **Yasso15** soil carbon model
- Albedo model
- Updated economical assumptions
- Timber value calculated using a **taper model** and a log length optimization
- Integrated with the J optimizer

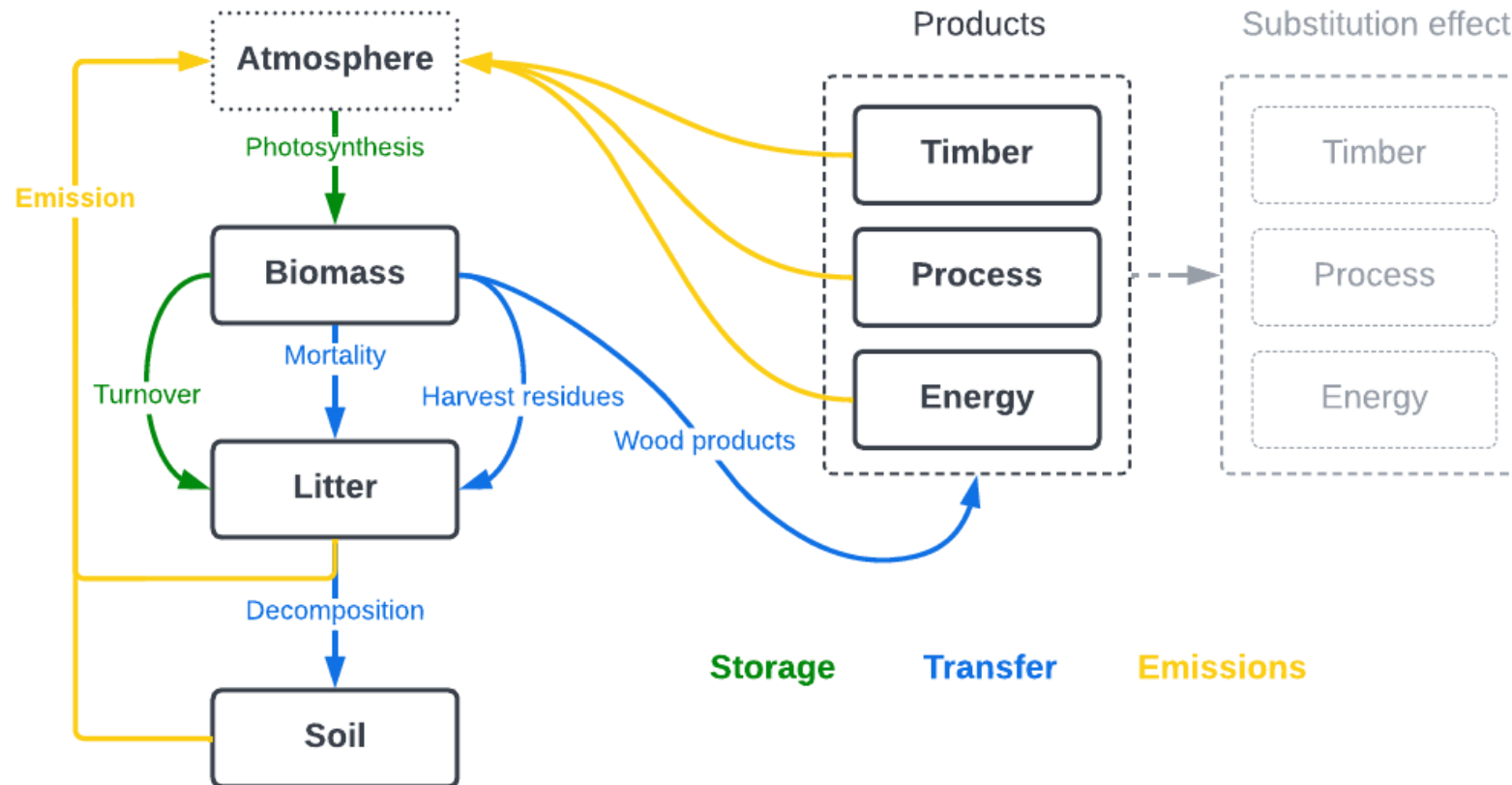


Alternative schedules

- Start with a forest stand with variables measured/estimated in the present:
 - Age, dominant height, mean diameter, species composition, etc.
- Branch new schedules by applying different **treatments** (or no treatment) in each of the following periods
 - Different types of thinning or final harvest

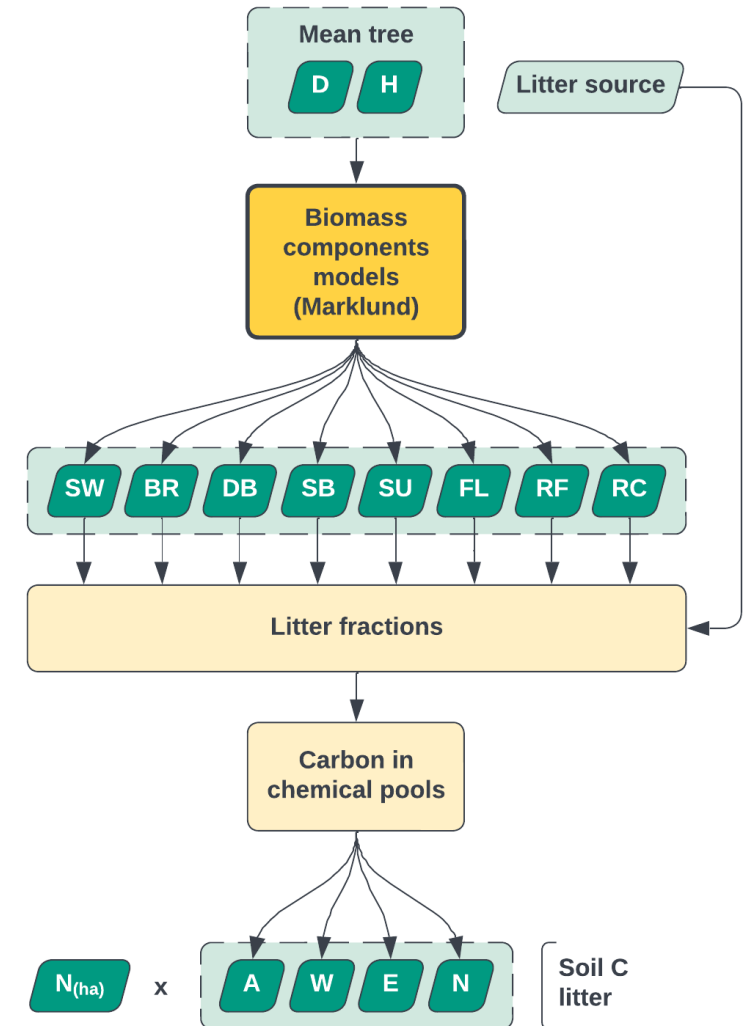
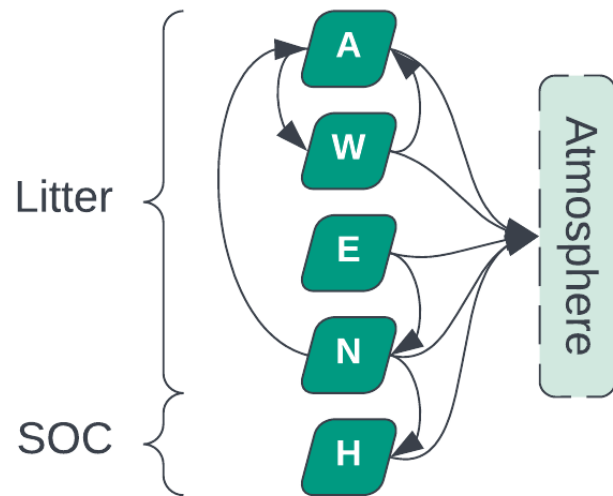


Carbon accounting



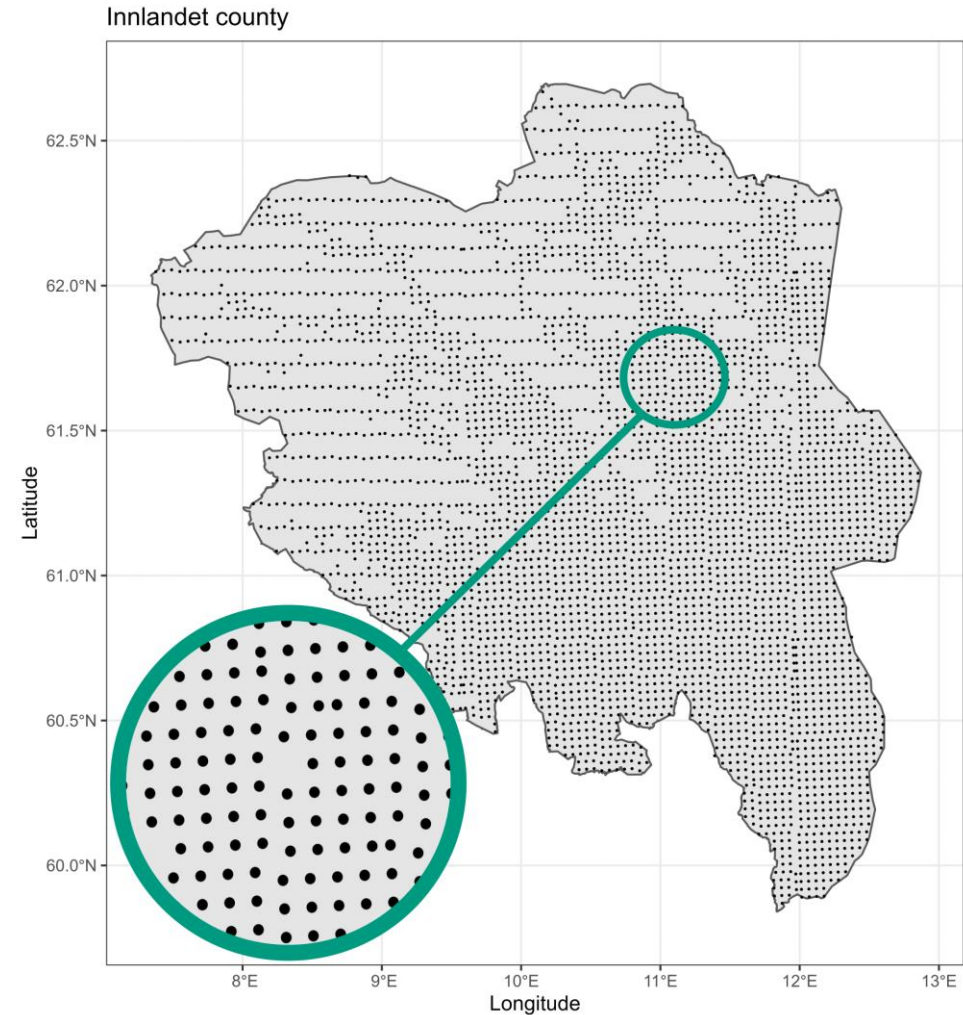
Soil carbon model: Yasso15

- Chemical pools: cellulose (**A**), water soluble compounds (**W**), wax-like compounds (**E**), lignin-like compounds (**N**), humus (**H**)
- Decomposition process

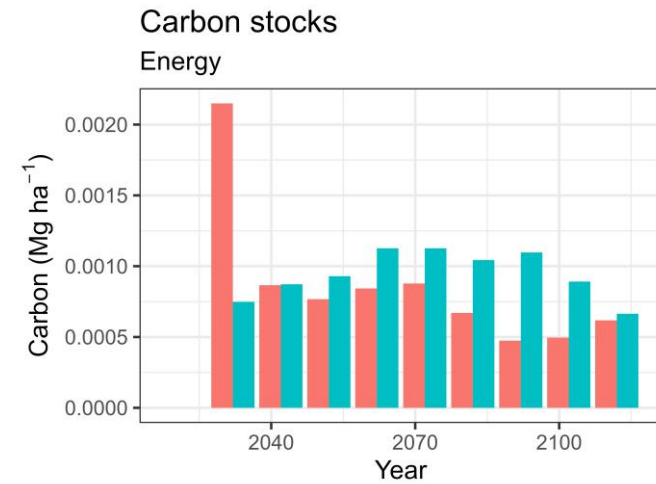
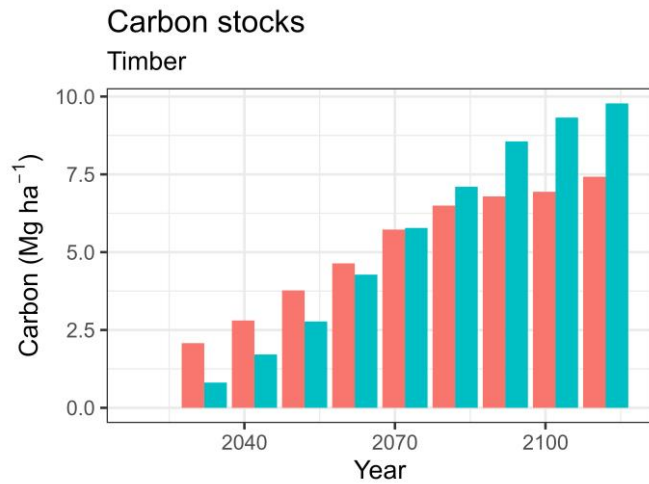
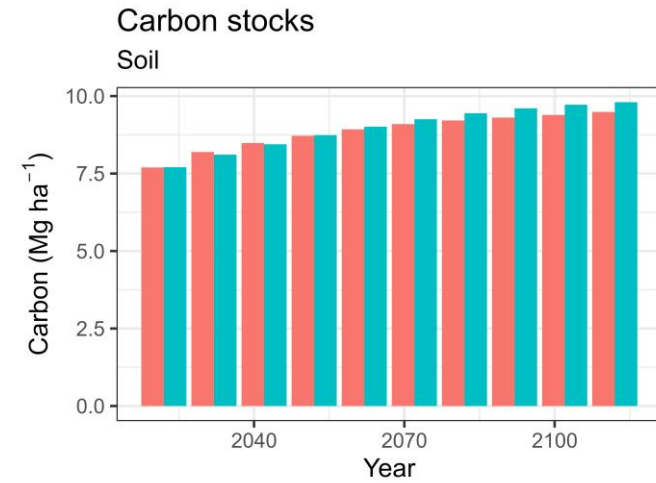
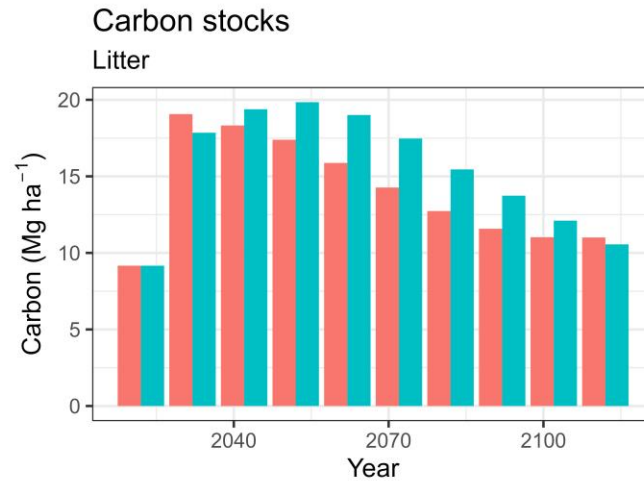
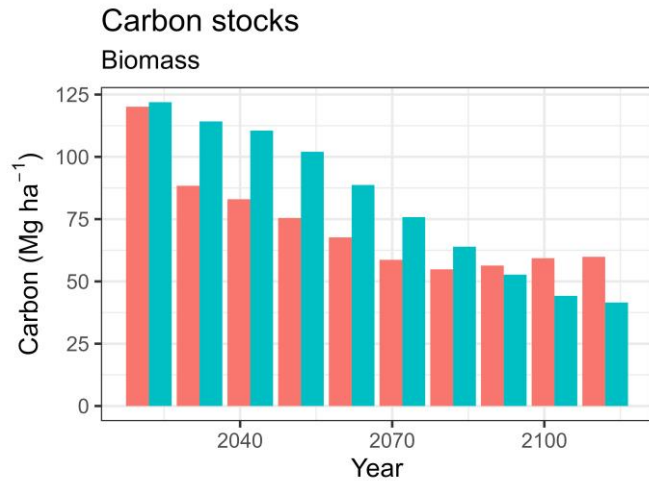


Case study

- Innlandet county
- 2372 NFI permanent plots
- Two optimization problems
 - Faustman: $\max(\text{NPV})$
 - ISA: $\max(\text{NPV}) + \text{nondeclining harvest levels}$
- Look at the carbon variables

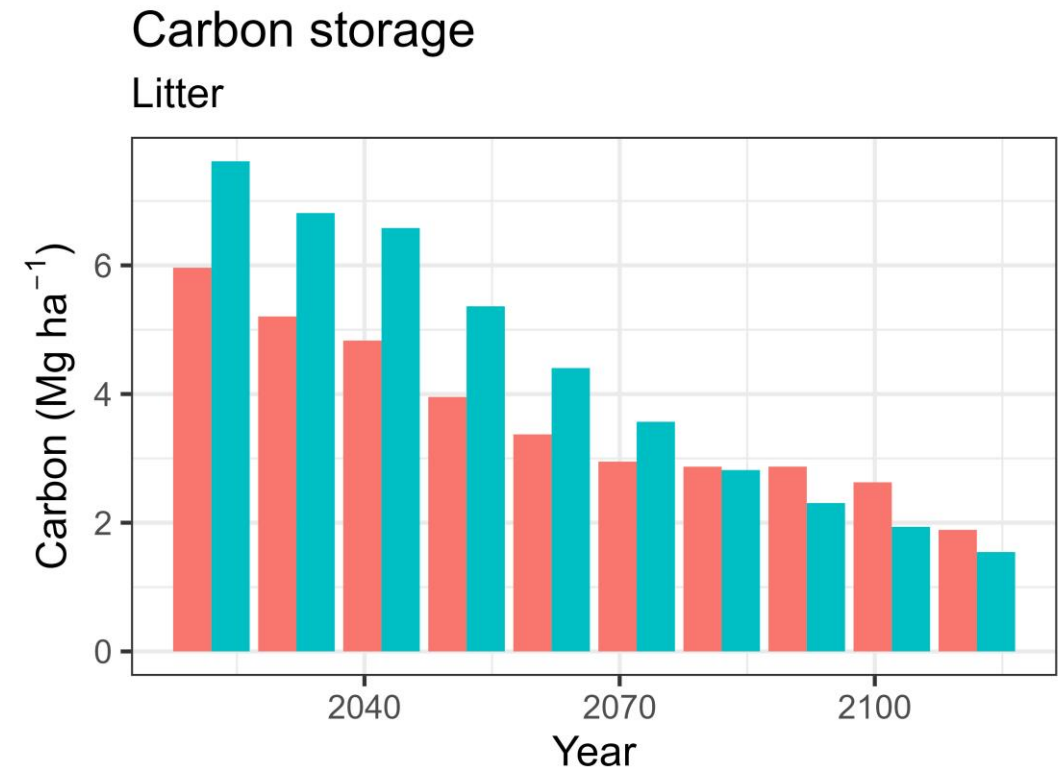
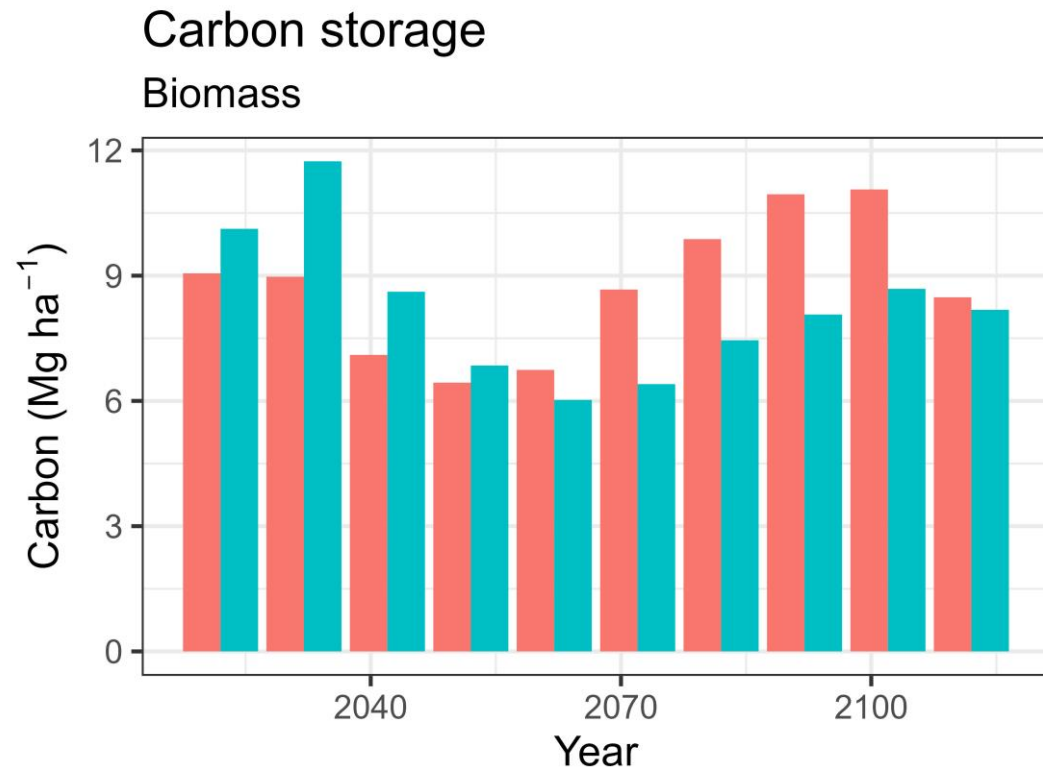


Carbon stocks



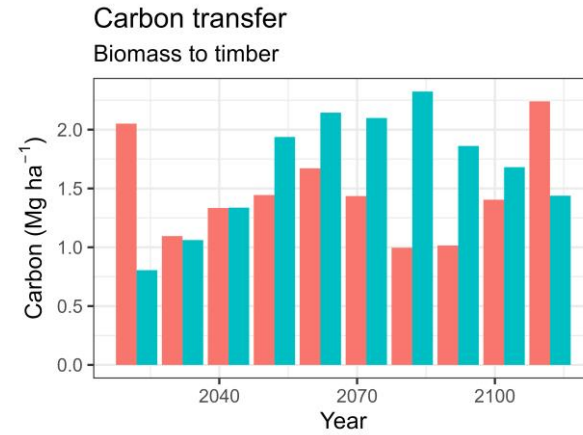
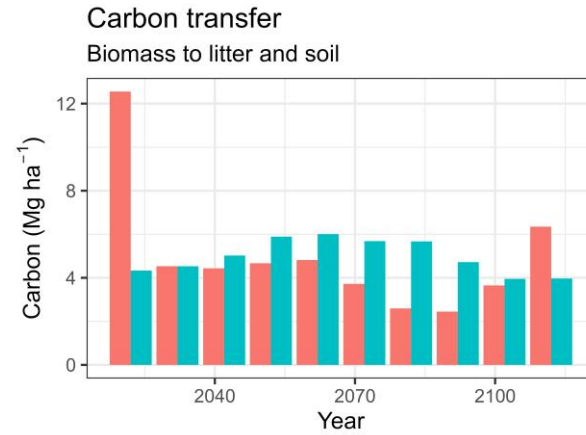
FAUSTMAN
ISA

Carbon sequestration

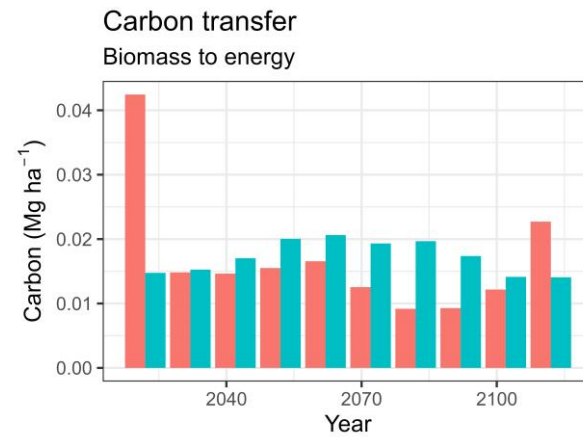


FAUSTMAN ISA

Carbon transfer

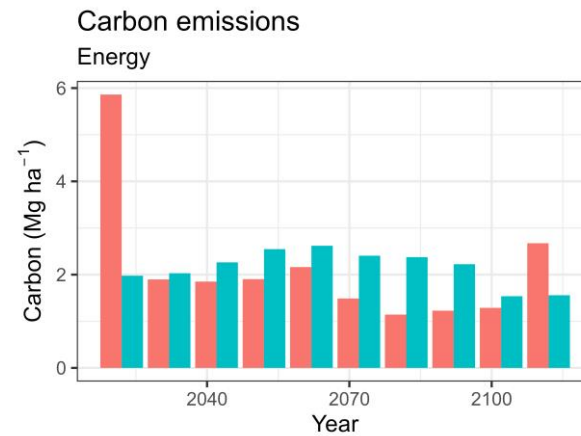
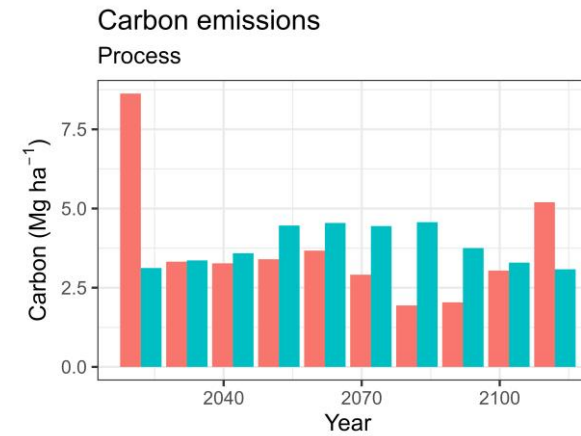
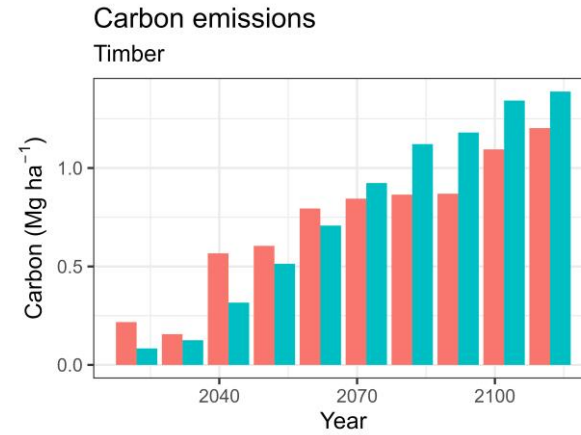
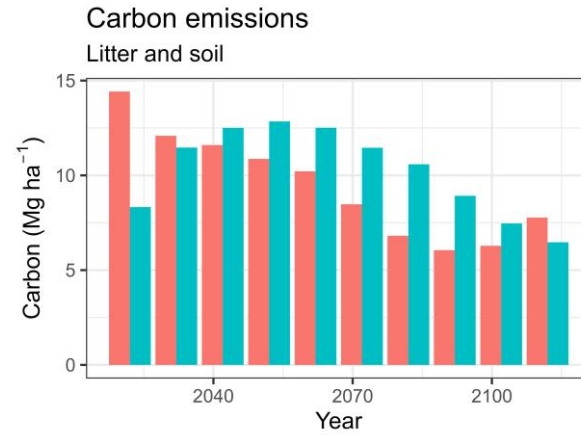


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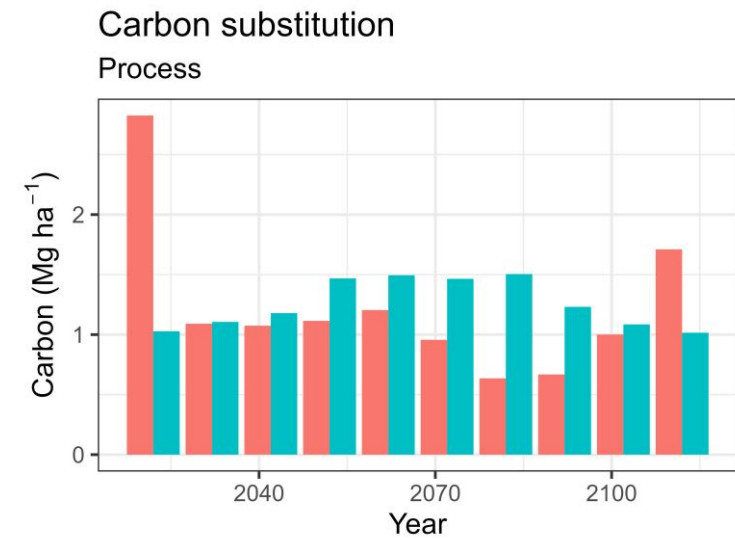
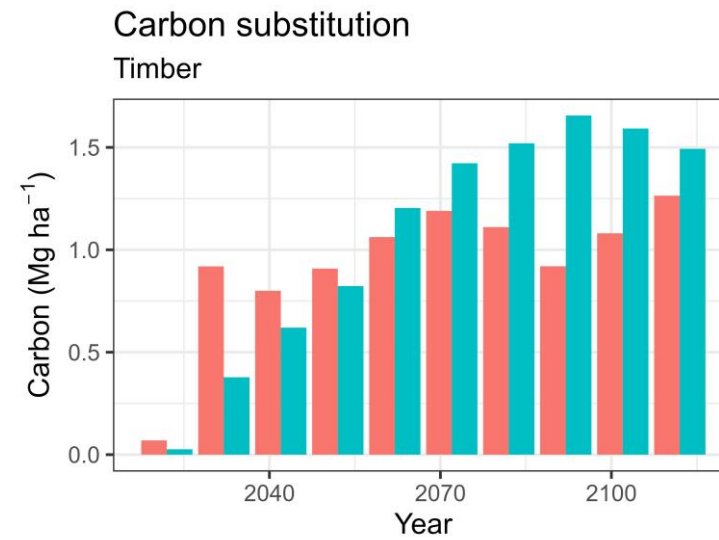
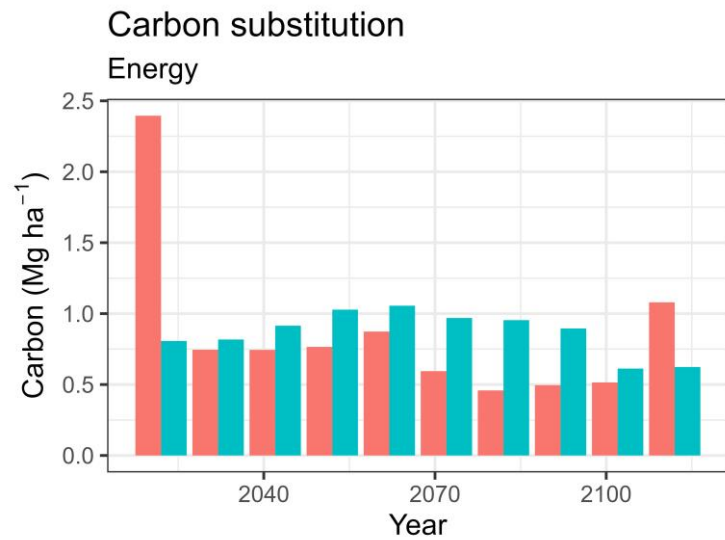


Carbon emissions

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ISA

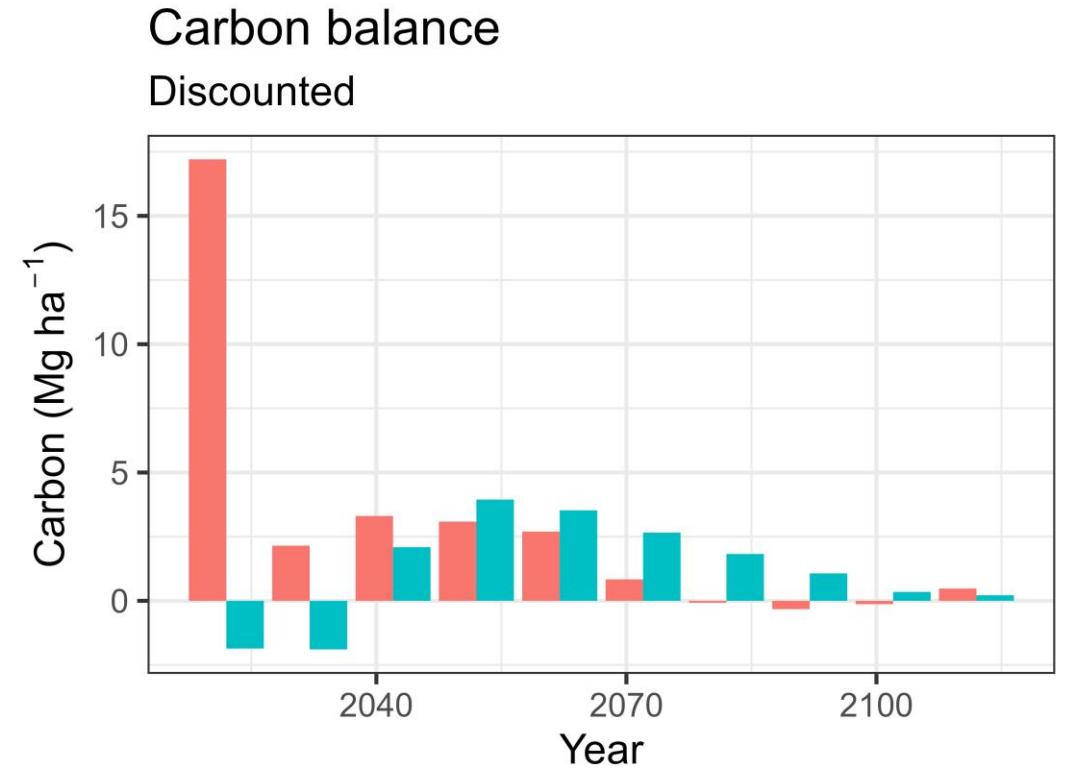
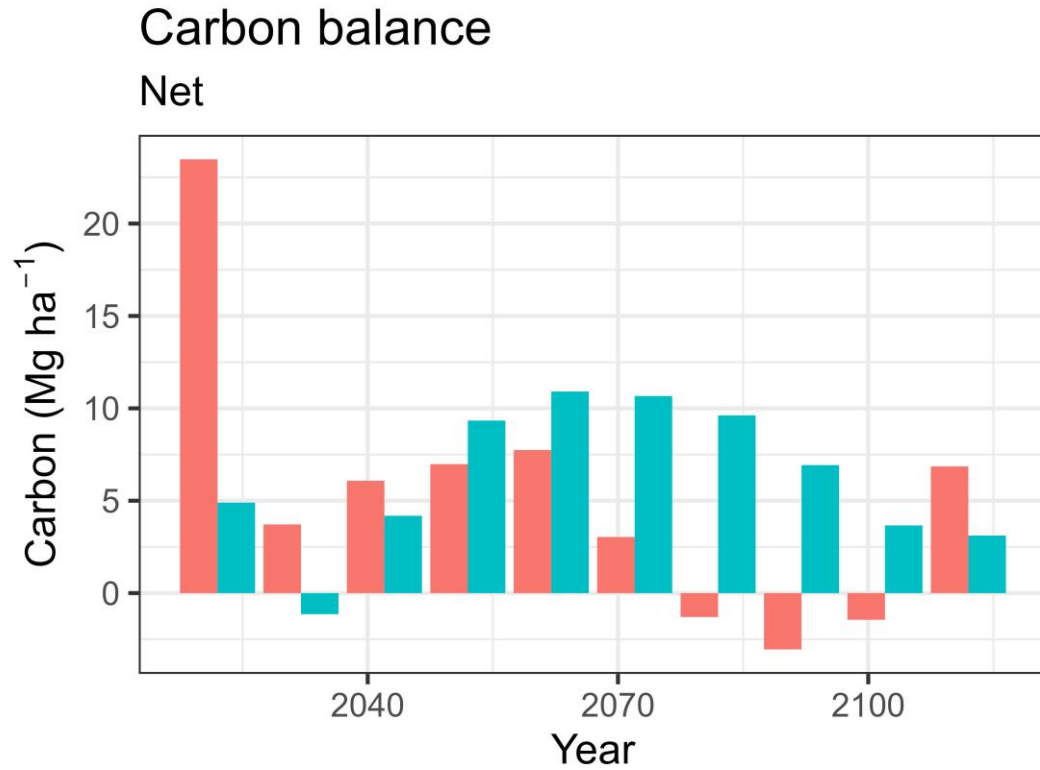


Carbon substitution



FAUSTMAN ISA

Carbon balance (Emissions – Storage)



FAUSTMAN ISA

Conclusion

- Developed a stand-alone forest growth and yield simulator tailored for the Norwegian forests
- Applications:
 - Forest planning
 - Large scale analyses
 - Teaching
- Next:
 - Integrate risks: bark beetle, wind damage, root rot, etc

Thank you!

