Characterization factors development at a land management practice level

Learnings from a forestry case study for land use impact assessment on climate change

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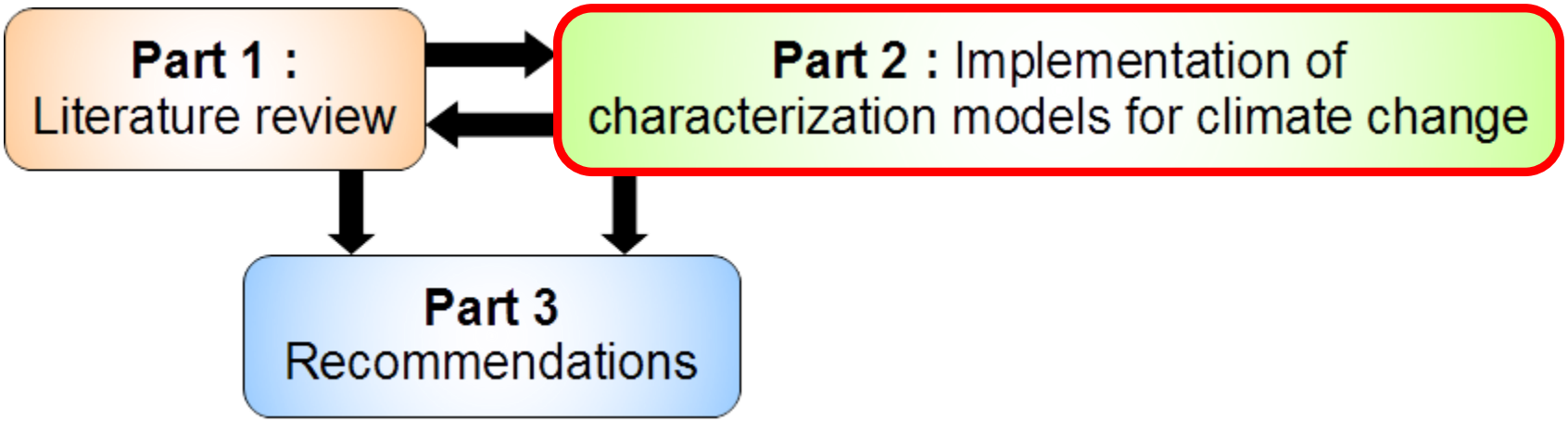
research group for environmental life cycle & sustainability assessment

Introduction

- *Context*: Methodological recommendations
  - *Scope*: LCA studies of energy generation from wood

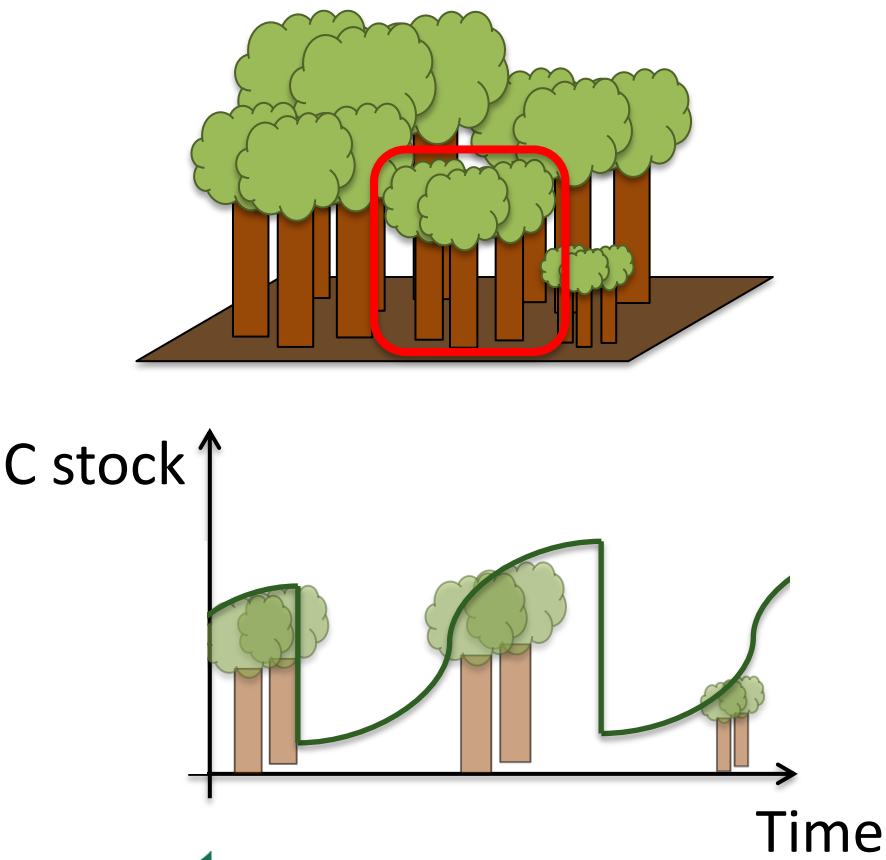


- Scope of this presentation
  - Focus on carbon sequestration & climate change
  - Feedback on land use CF development

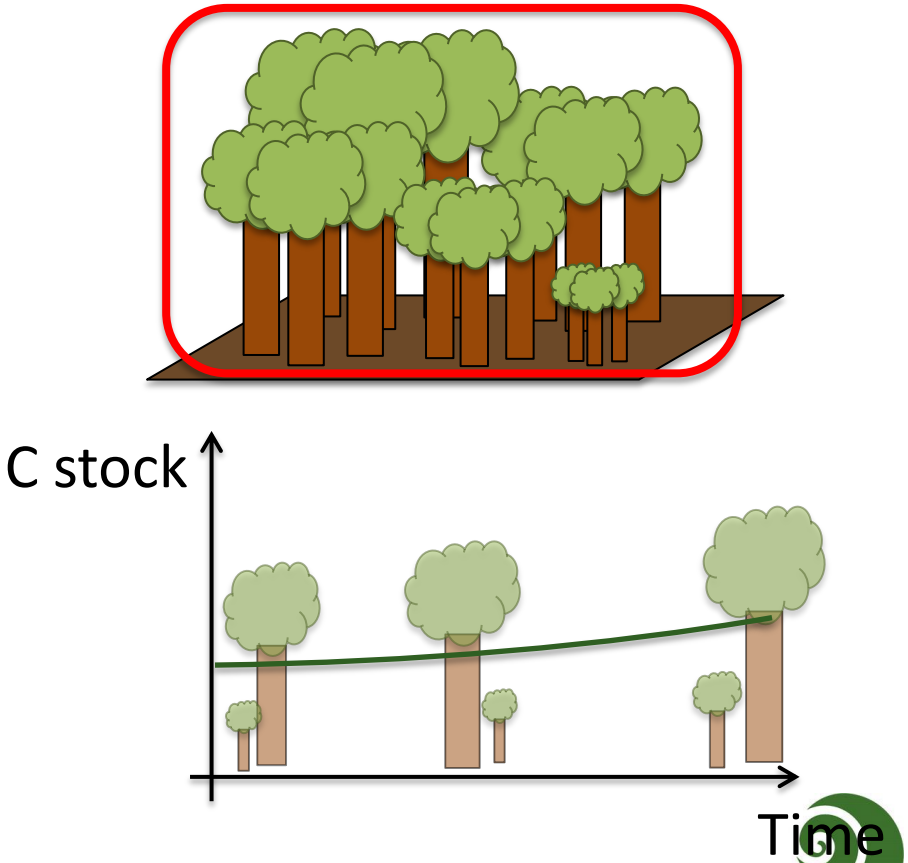
Materials & Methods (1/3)

- Carbon stock description in forestry systems

Stand-level approach



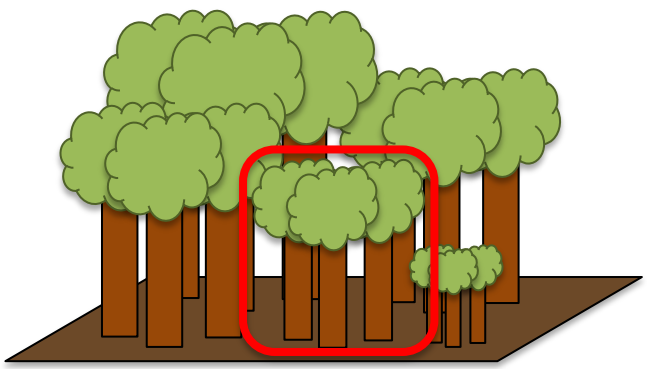
Landscape-level approach

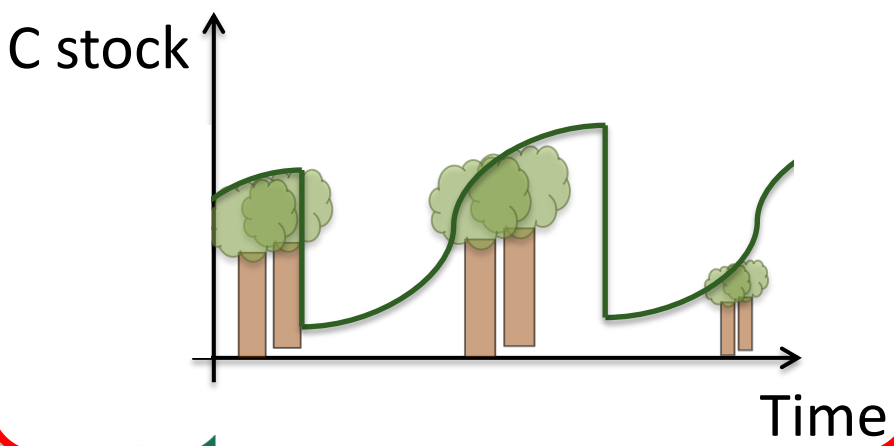


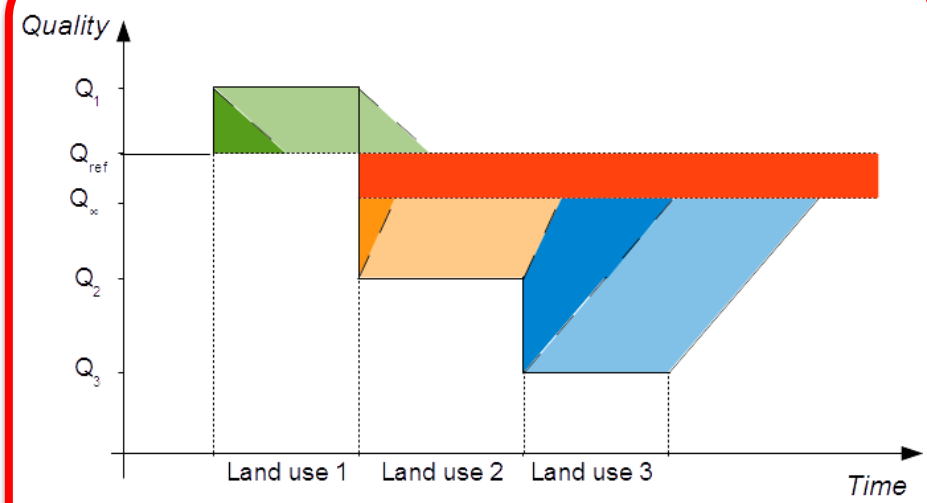
Materials & Methods (1/3)

- Carbon stock description in forestry systems

Stand-level approach







Stand-level approach:

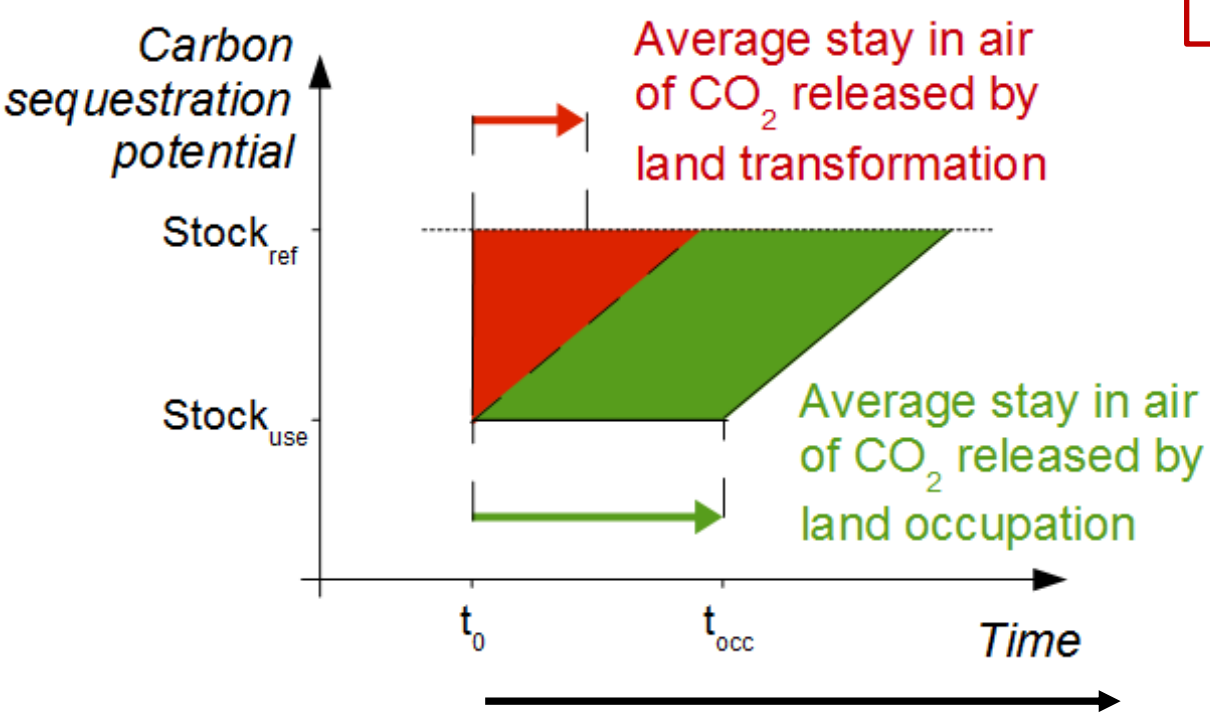
→ Most suitable approach for the land use framework

→ Most suitable approach for distinguishing practices

Materials & Methods (2/3)

Carbon Sequestration potential → Climate Change

1st model considered: *Müller-Wenk & Brandão (2010)*



Transformation $CF_{ref \rightarrow use}$

$$\frac{44}{12} \cdot \frac{\text{Red area}}{157 \text{ yrs}}$$

Occupation CF

$$\frac{44}{12} \cdot \frac{\text{Green area}}{t_{occ} \cdot 157 \text{ yrs}}$$

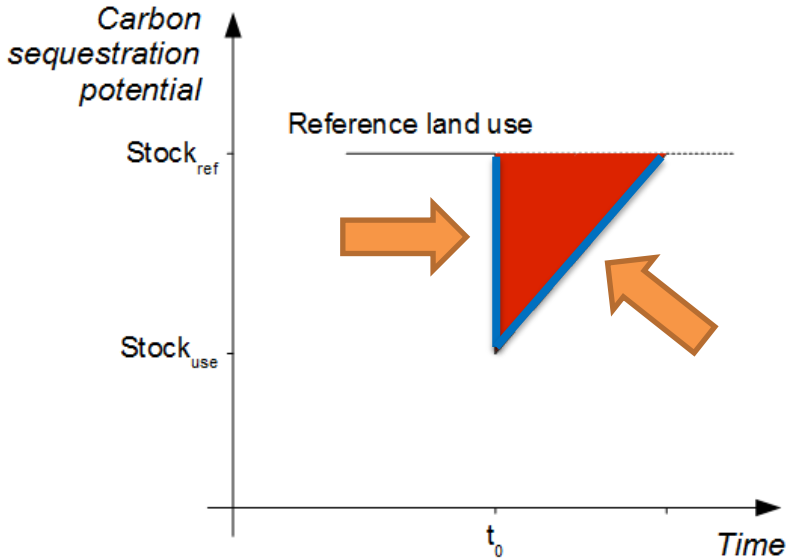
"Average stay" in air of fossil CO_2: 157 years

Materials & Methods (3/3)

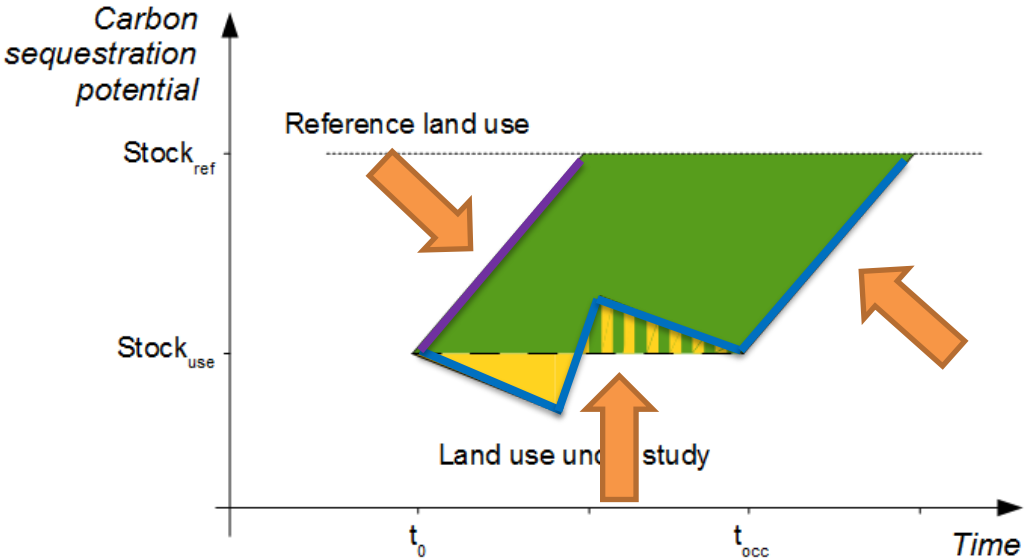
Carbon Sequestration potential → Climate Change

2nd model considered: *Dynamic approach*

Transformation $CF_{ref \rightarrow use}$



Occupation CF



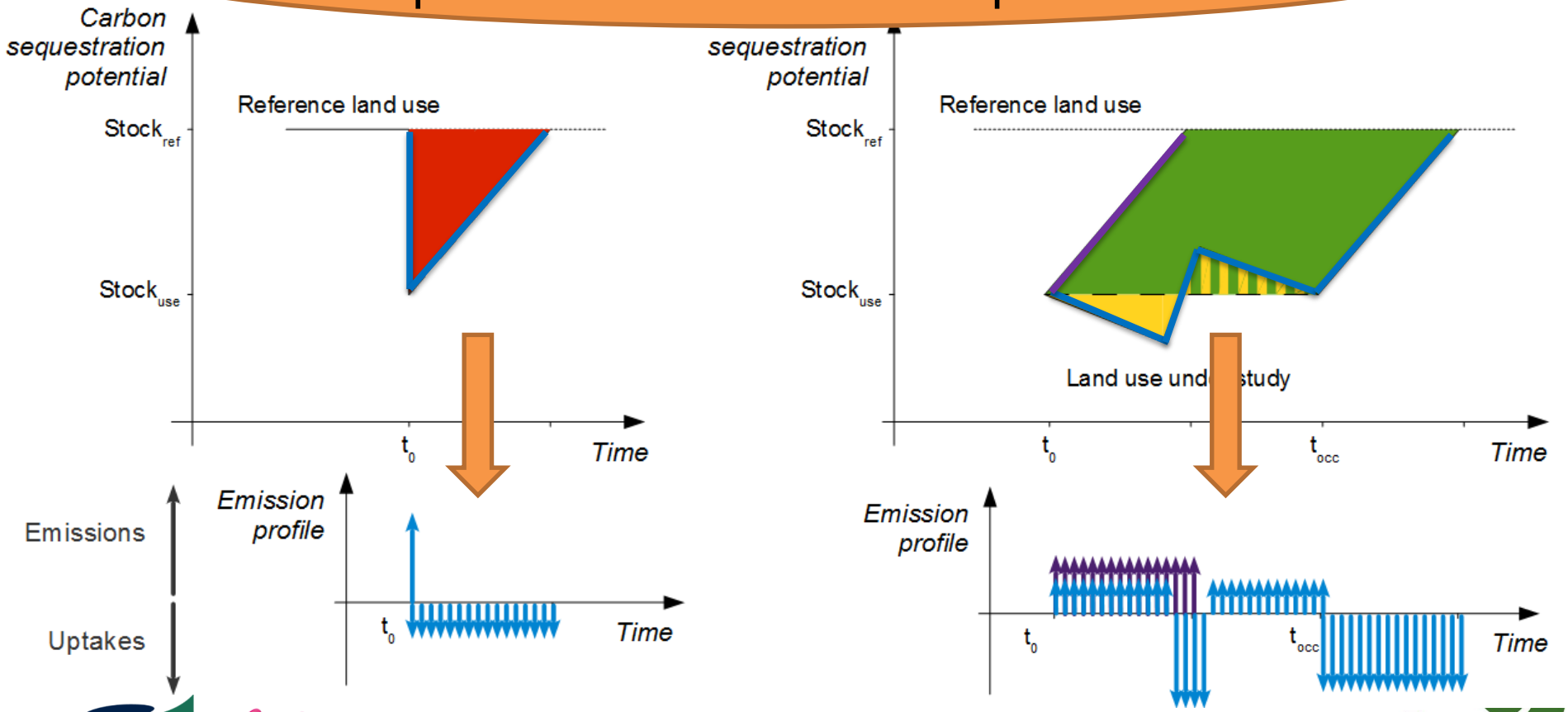
Defining **direct** and **avoided** processes

Materials & Methods (3/3)

Carbon Sequestration potential → Climate Change

2nd model considered: *Dynamic approach*

Deriving these **direct** and **avoided** processes into emission profiles



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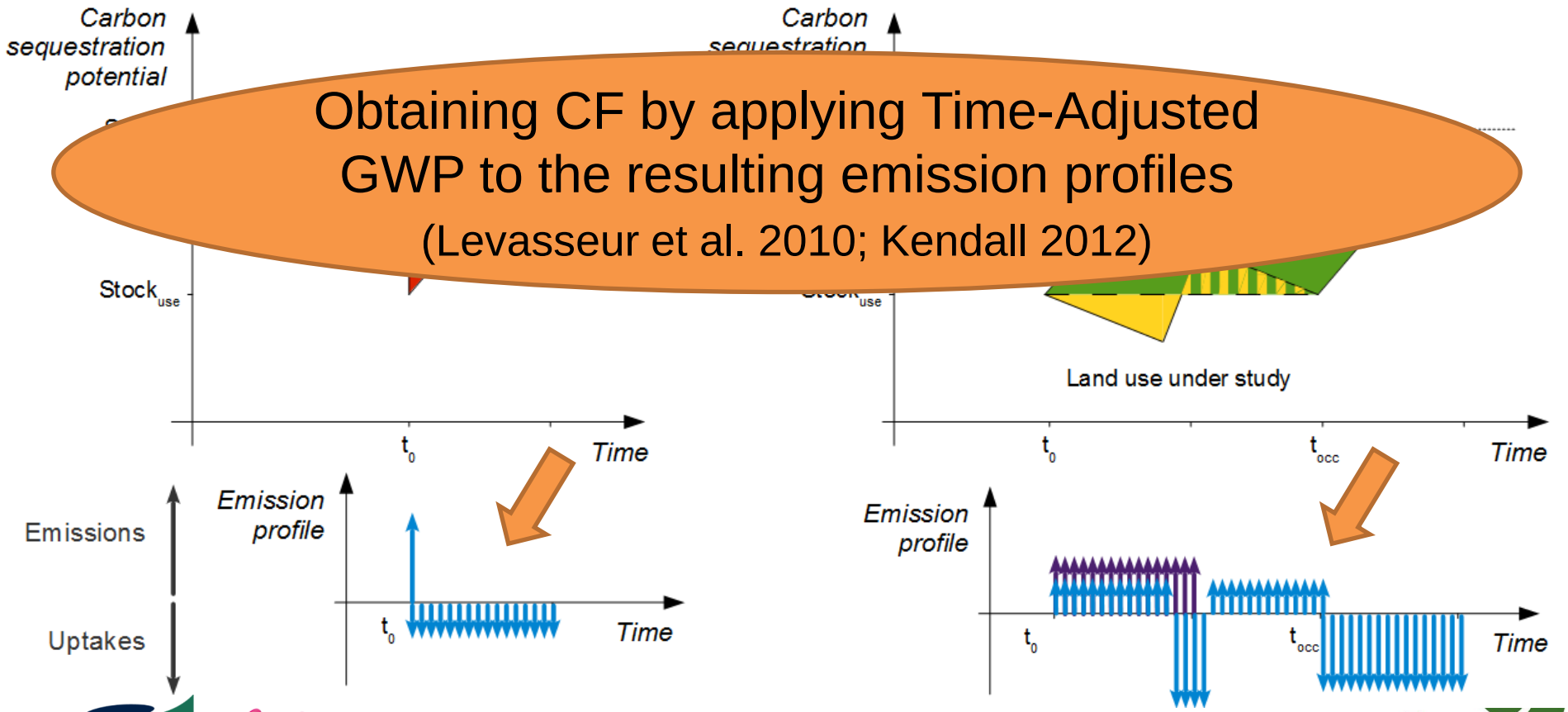
Materials & Methods (3/3)

Carbon Sequestration potential → Climate Change

2nd model considered: *Dynamic approach*

Transformation $CF_{ref \rightarrow use}$

Occupation CF



Obtaining CF by applying Time-Adjusted GWP to the resulting emission profiles

(Levasseur et al. 2010; Kendall 2012)

Data sources

- Species considered

Species	Management description
Eucalyptus	Short Rotation Coppice, with or without residue harvesting
Birch then oak	Natural relaxation

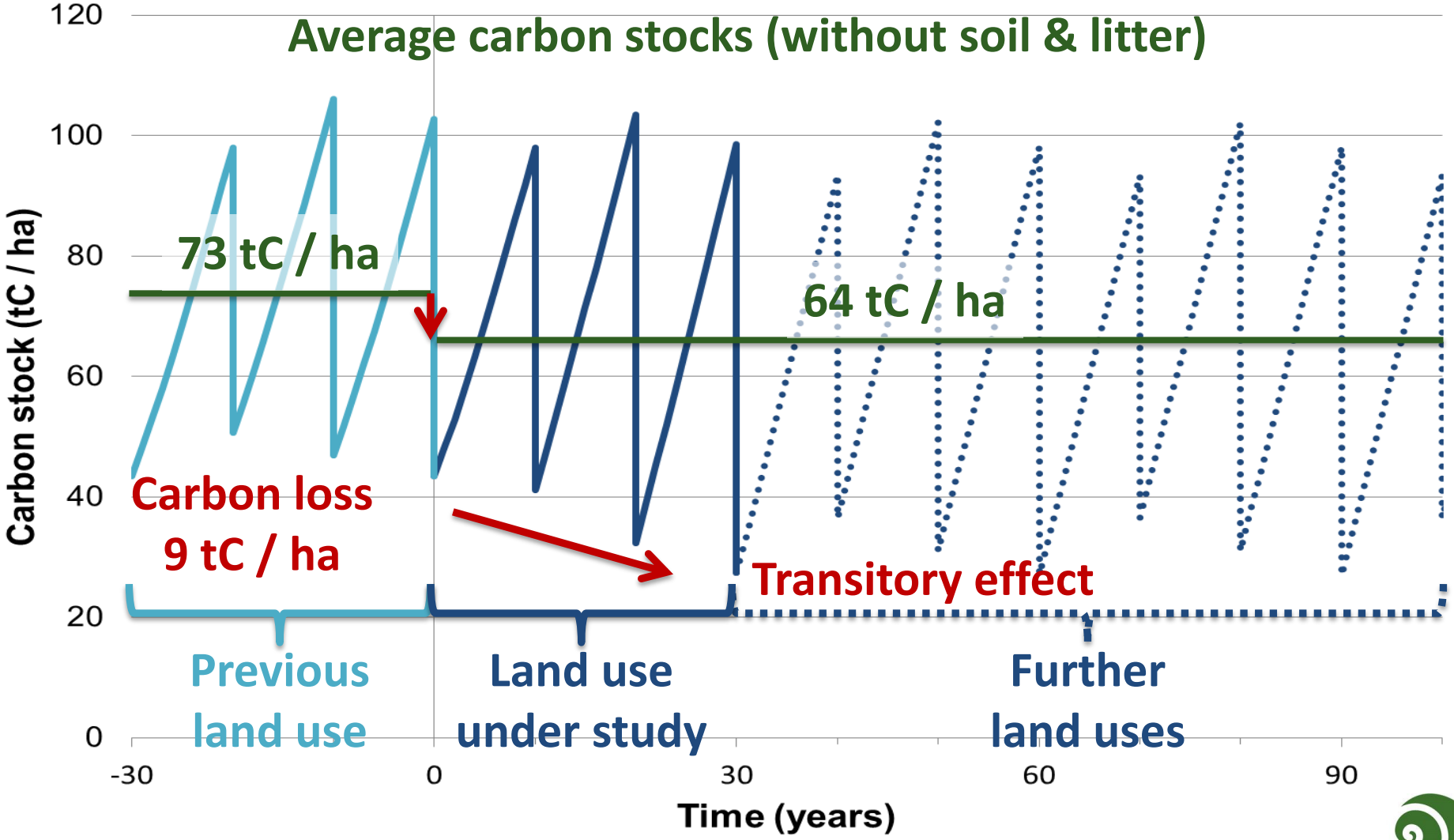
Not presented here:
- Douglas-fir
- Chestnut

- Carbon dynamics

Compartment	Eucalyptus	Natural relaxation
Stemwood	Dendrometric model	Description from CNPF expert statements
Standing biomass & roots	Expansion factors	
Dead biomass	Exponential decay	
Litter & soil	Not considered due to lack of data	

Real C dynamics & land use framework

Eucalyptus, transformation without to with residue harvesting



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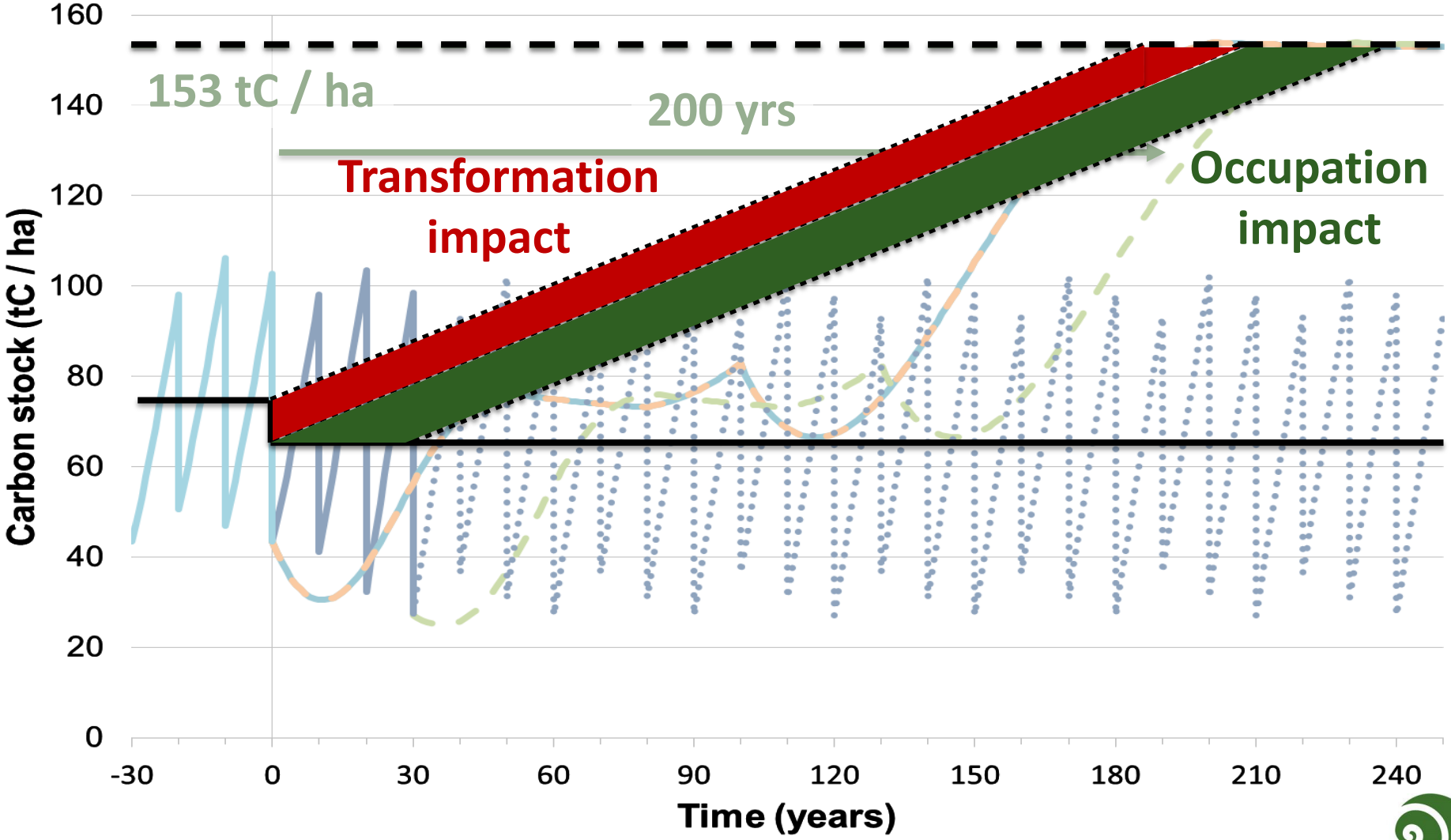
Real C dynamics & land use framework

Eucalyptus, transformation without to with residue harvesting



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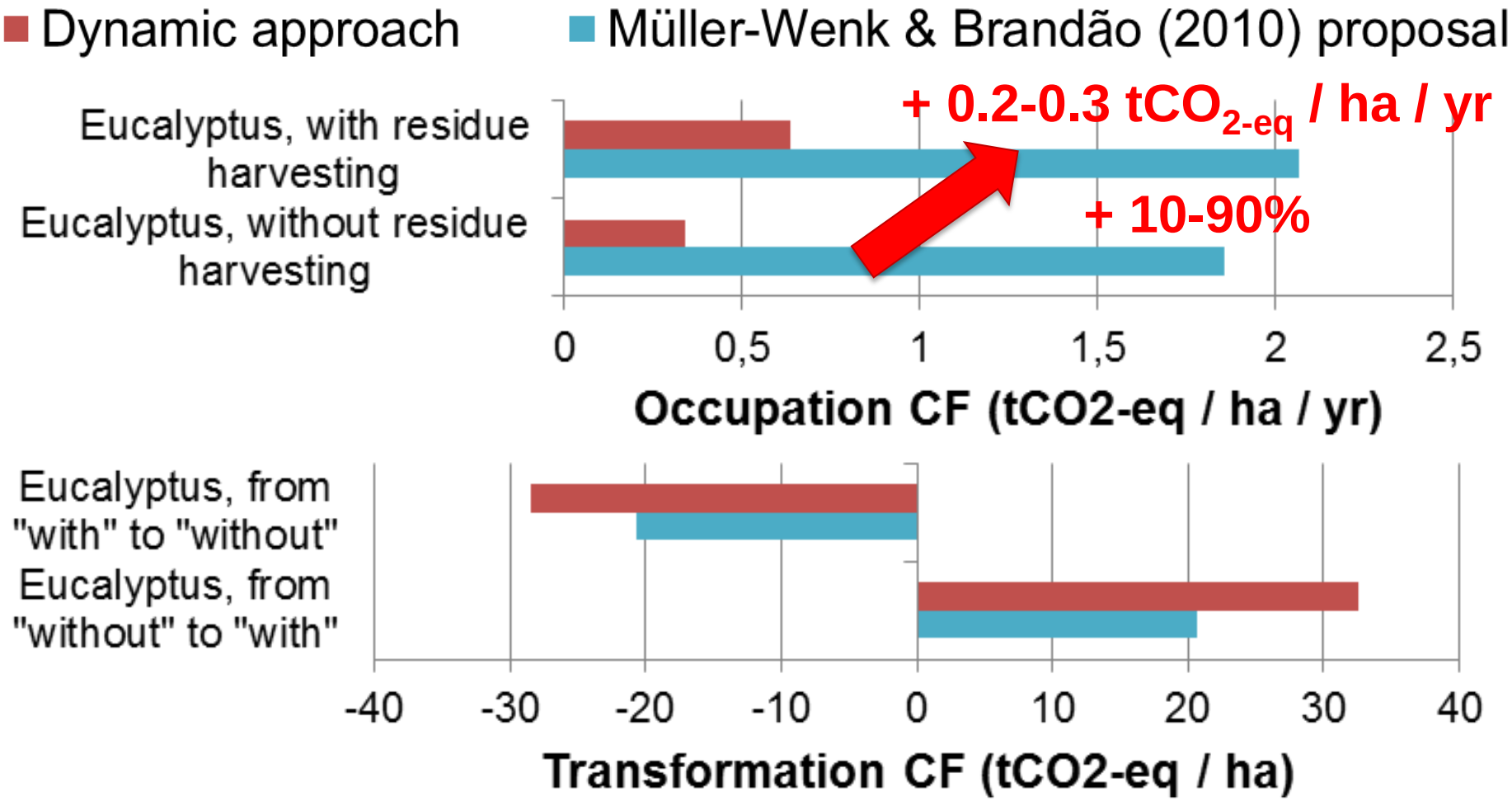
Developing CF (1/4)



Developing CF (2/4)

- Everything at hand to calculate CF…

- But some questions raised

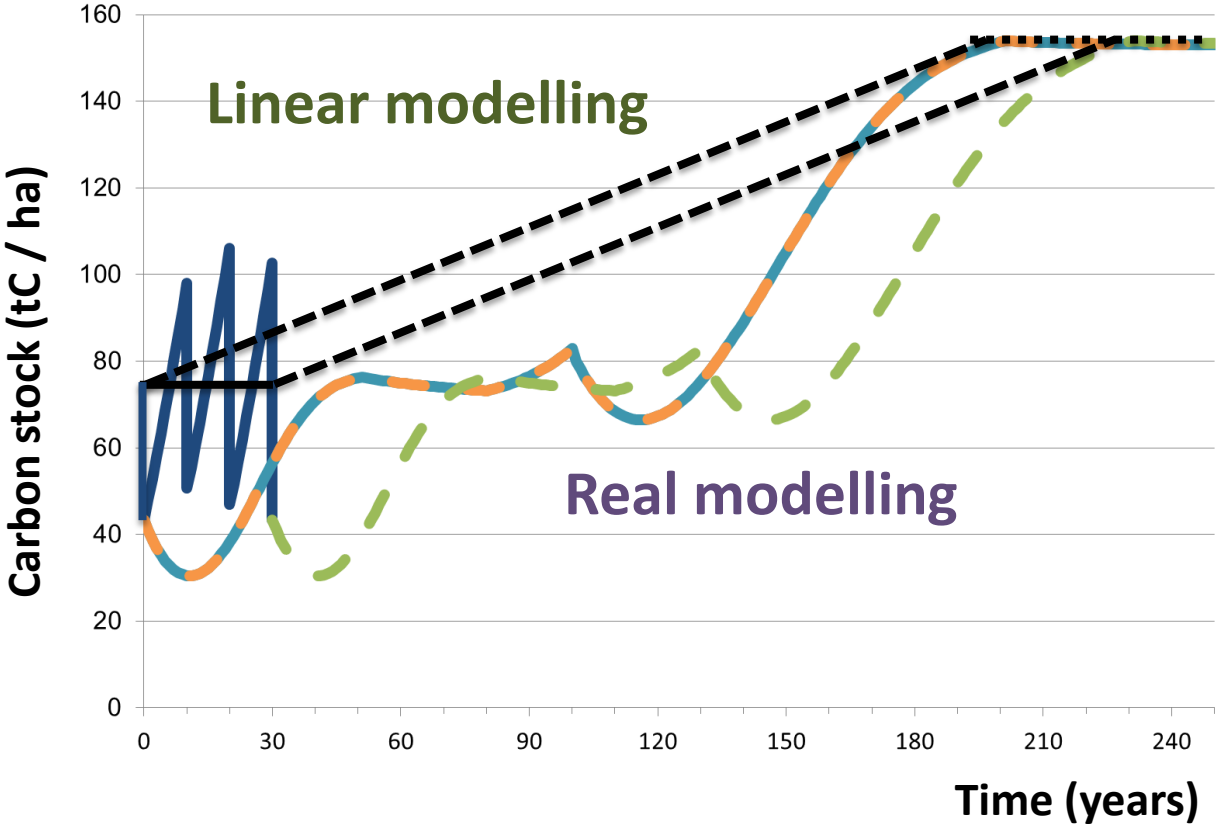
  - Matching real dynamics and framework modelling
    - Linear *vs.* real dynamic modelling
    - Temporal boundaries: historical *vs.* causal modelling
    - "No transformation time" assumption

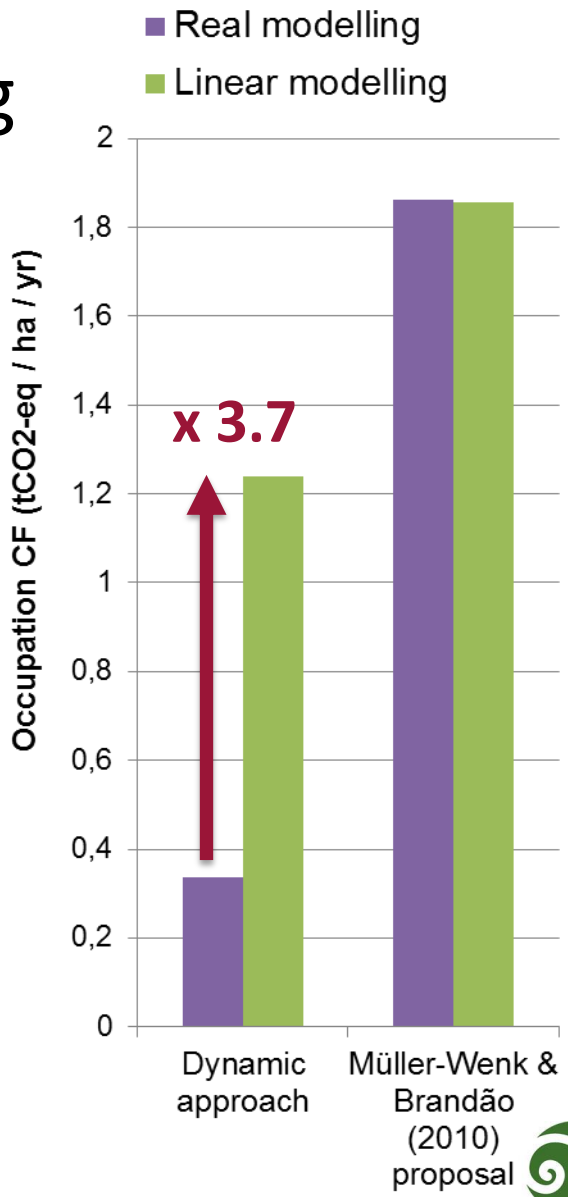
  - Developing CF for consequential approaches

Developing CF (3/4)

- **Real** vs. **linear** dynamic modelling

Eucalyptus, occupation, without residue harvesting





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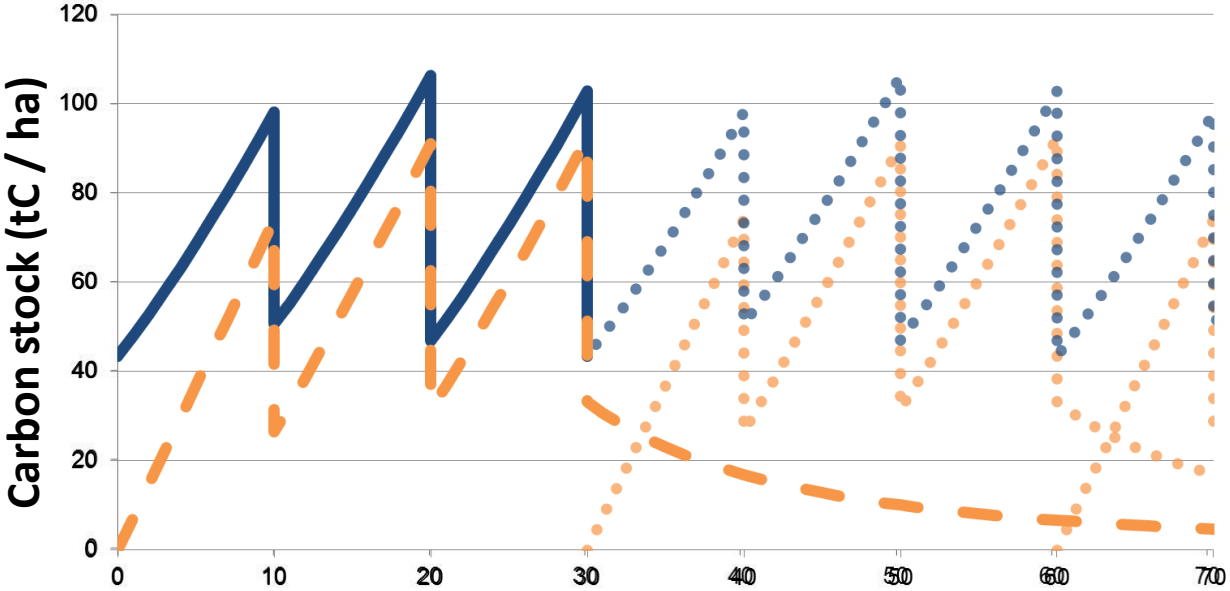
Developing CF (4/4)

- **Historical** vs. **causal** modelling

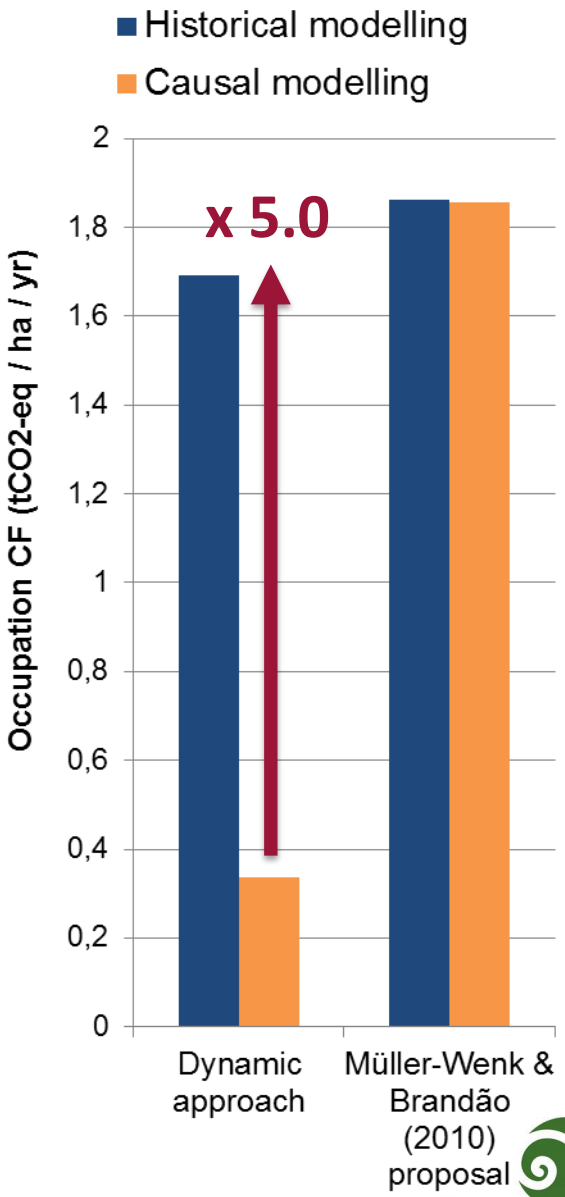
Eucalyptus, occupation, without residue harvesting

Historical "macro-level" modelling



Causal "stand-level" modelling

Time (years)



Take-home messages

- Land use framework **suitable** at a land management practice level
- A classical trade-off in LCA
  - Müller-Wenk & Brandão (2010) proposal
    - Simple and easy to use method
  - Dynamic approach
    - More scientifically valid(?) but more challenging to apply
- Perspectives
  - Consequential modelling and land use framework
  - Integration of soil & litter

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Thank you for your attention!

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