LandscapeDNDC

How to consider forest regeneration in process-based models?

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Background

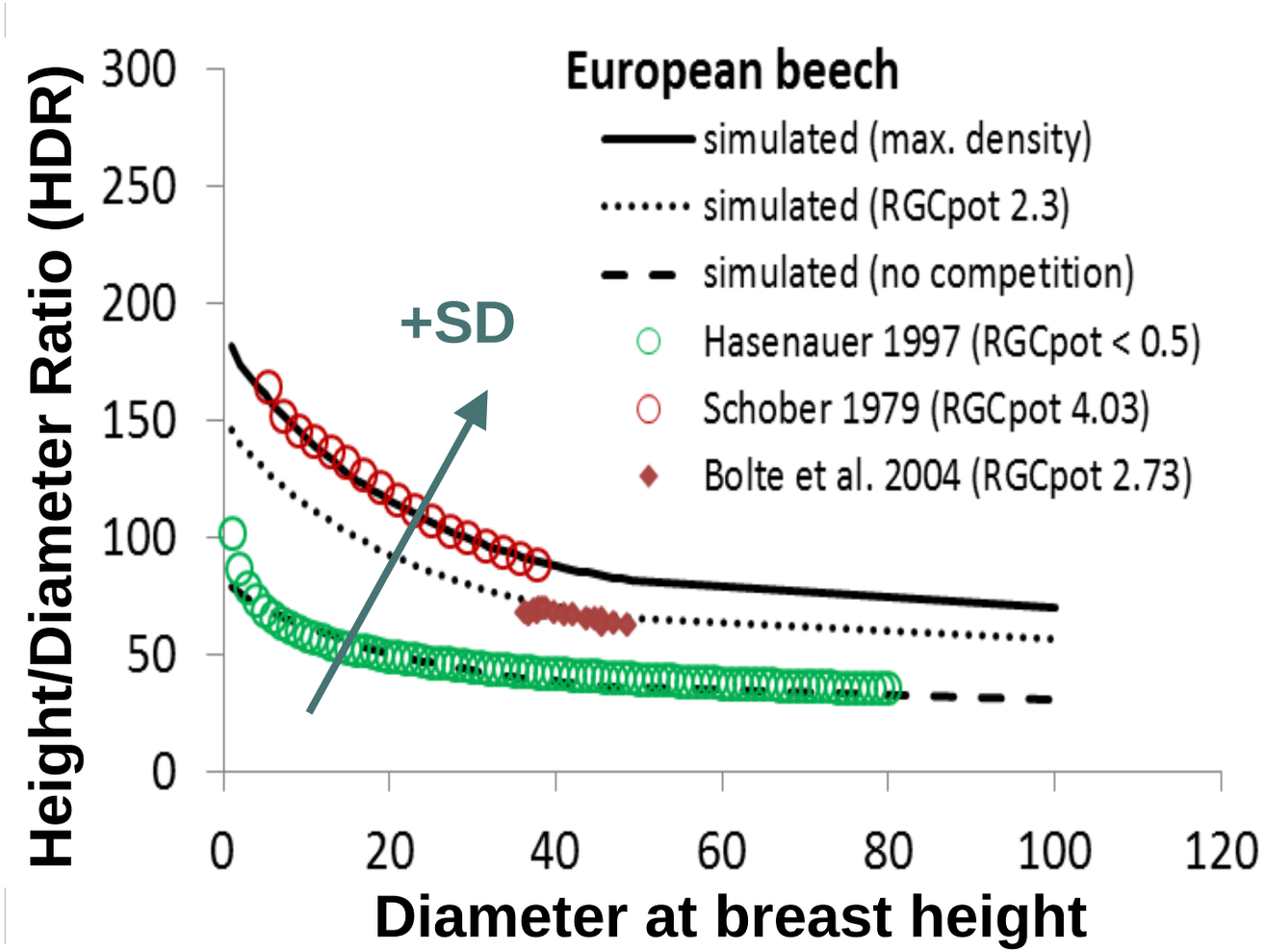
1. **Climate warming** changes site conditions
2. **Increasing disturbances** require premature regeneration

→ A successful **establishment** of new trees under partly or fully removed coverage is a major challenge for forest management … and forest models.

Challenges

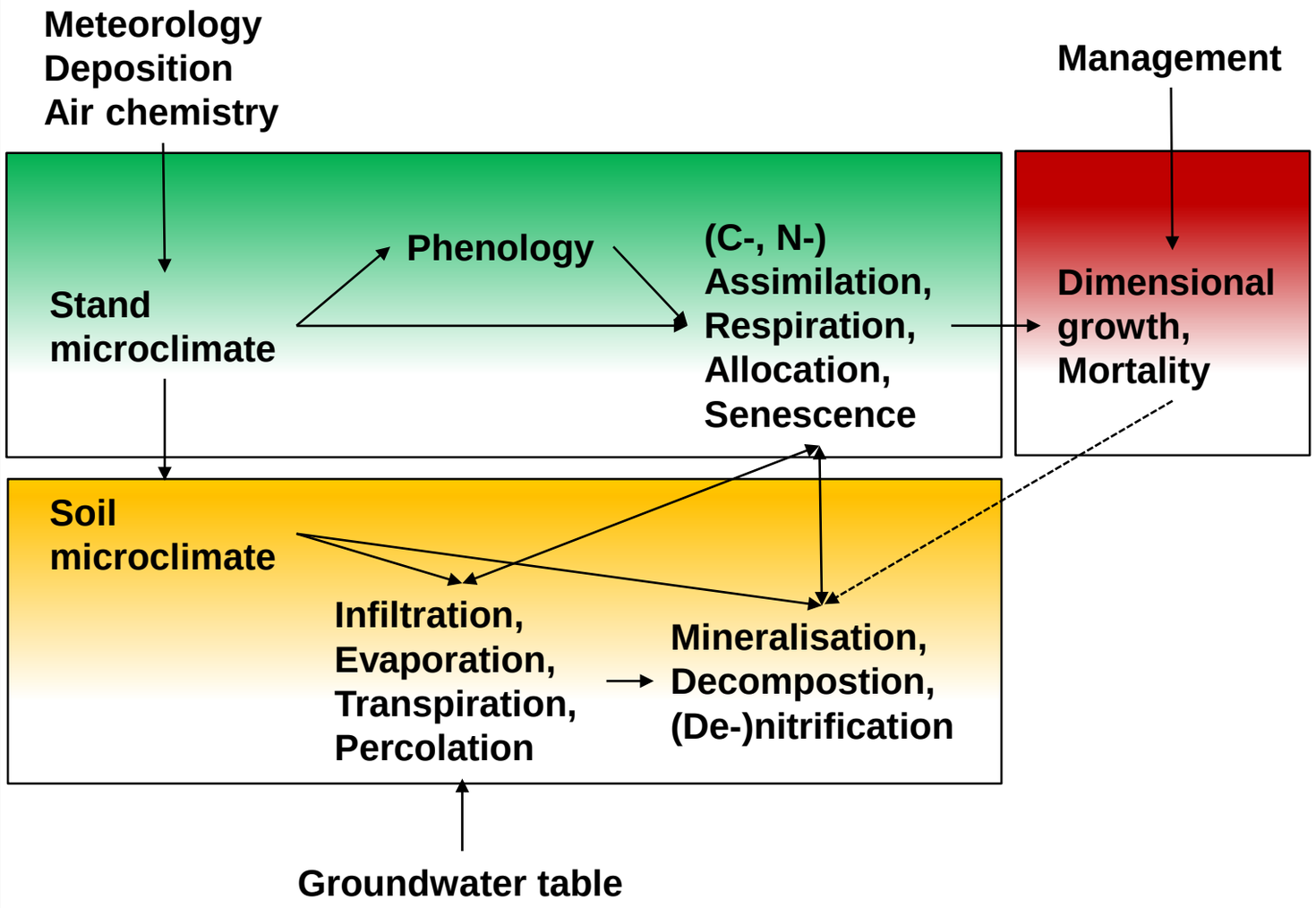
1. **Process-based models** are needed to capture climate-change and management (light) impacts on growth.
2. **Young development stages** represent a highly dynamic allometry that is not yet represented in such models.

Challenges



→ RGCpot = Ground coverage with crown-stem diameter ratio as for open-grown trees.

Model Approach



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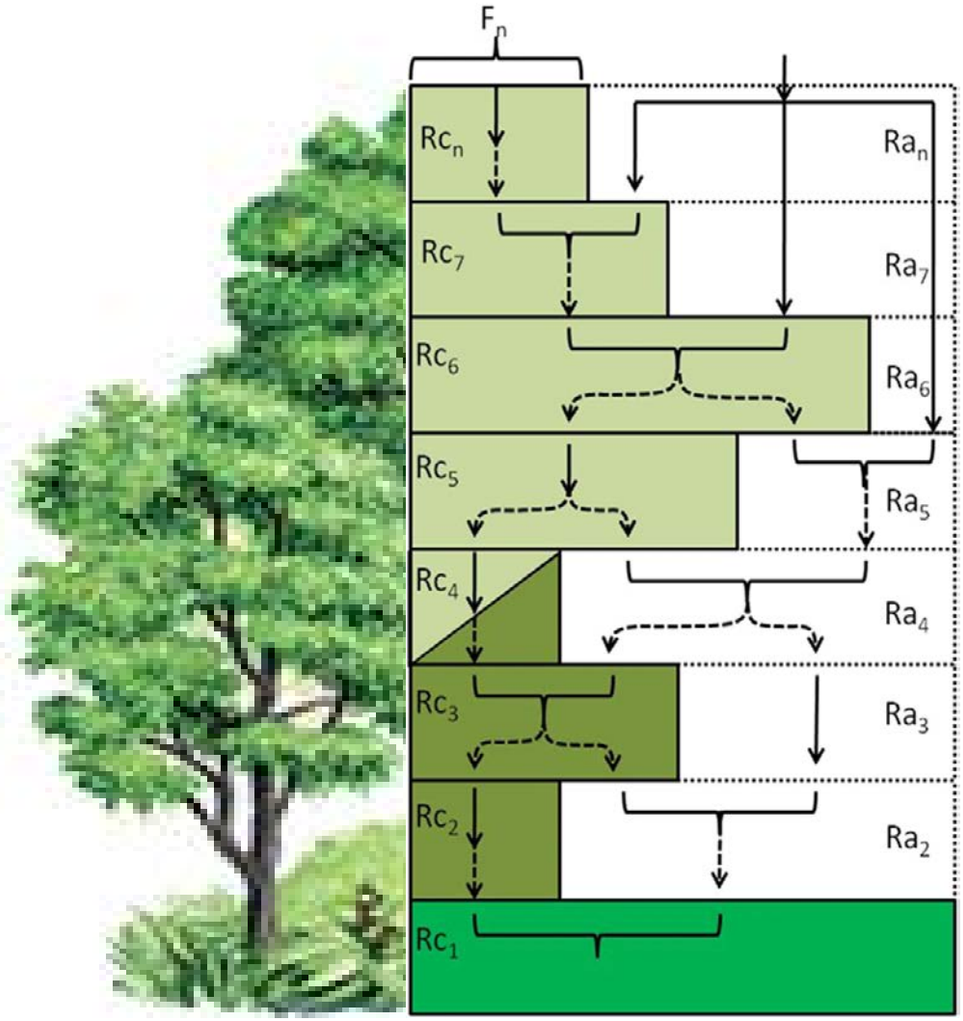
- Coupled ecosystem model
- Biogeochemical processes
- Modular process groups
- Sub-daily to daily time steps
- Variable canopy structure
- **One-dimensional representation of tree cohorts**
- Multi-purpose (focus on trace gas exchange)

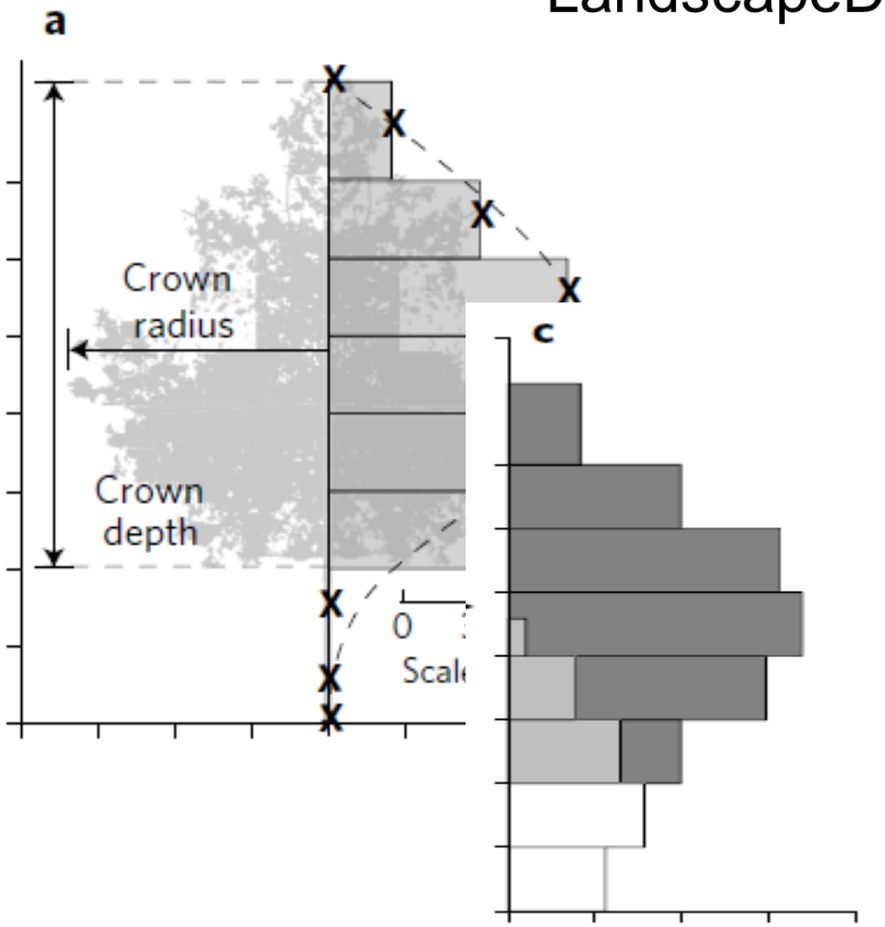
Haas et al. 2013 *(Landscape Ecol.)*

Model Approach

LandscapeDNDC

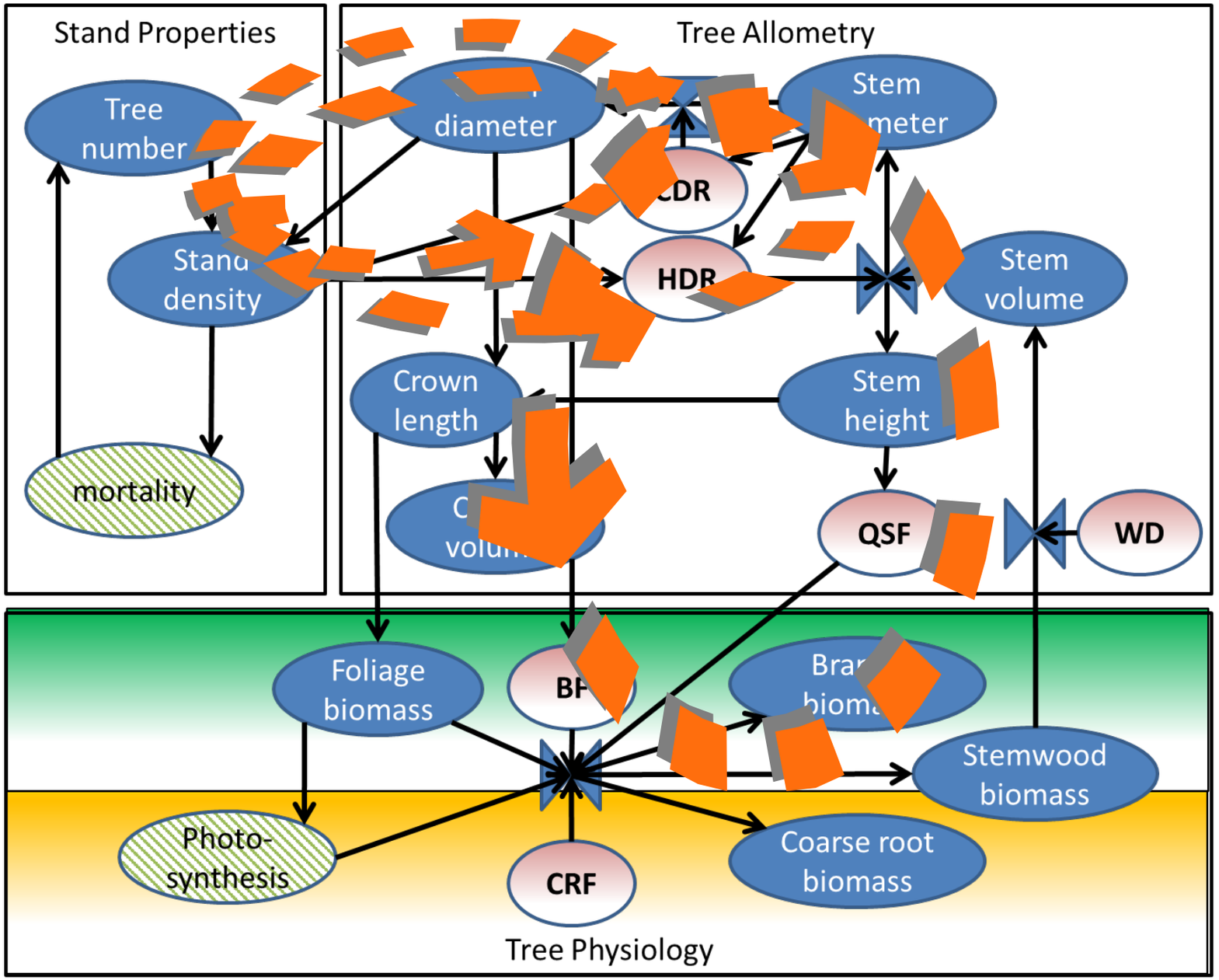


Grote et al. 2011 *(Forest Systems)*



Williams et al. 2017 *(Nature E&E)*

Model Approach - NEW



HDR: Height-/Diameter Ratio

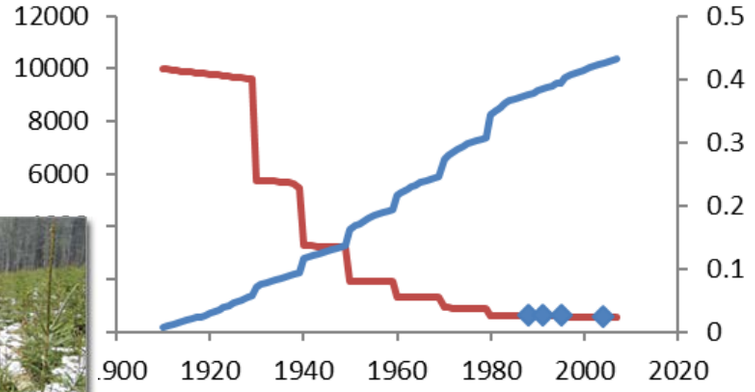
CDR: CrownR./Diameter Ratio

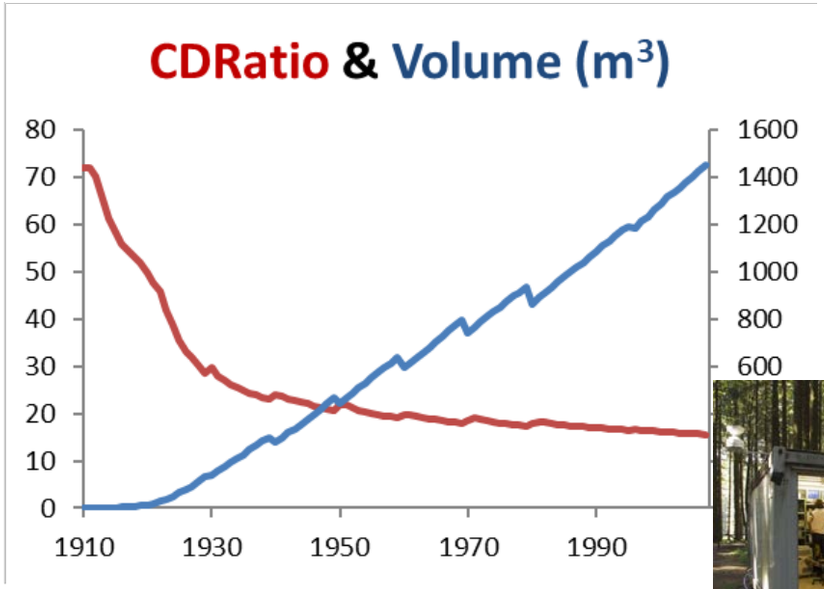
BF: Branch Fraction

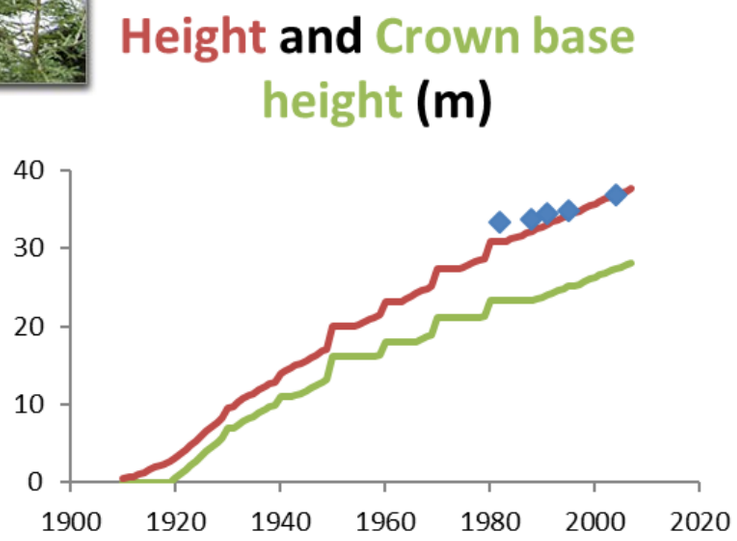
Grote et al. 2020 *(Forestry)*

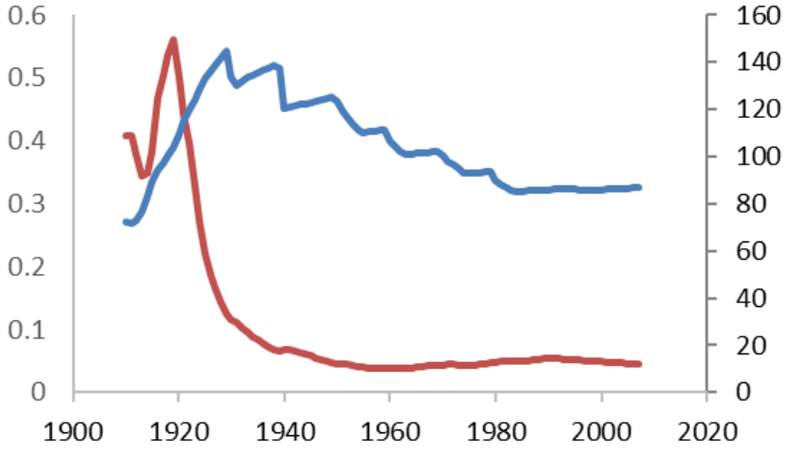
Evaluation: Long-term development without cover

Höglwald, 1910- 2007, spruce after spruce clearcut

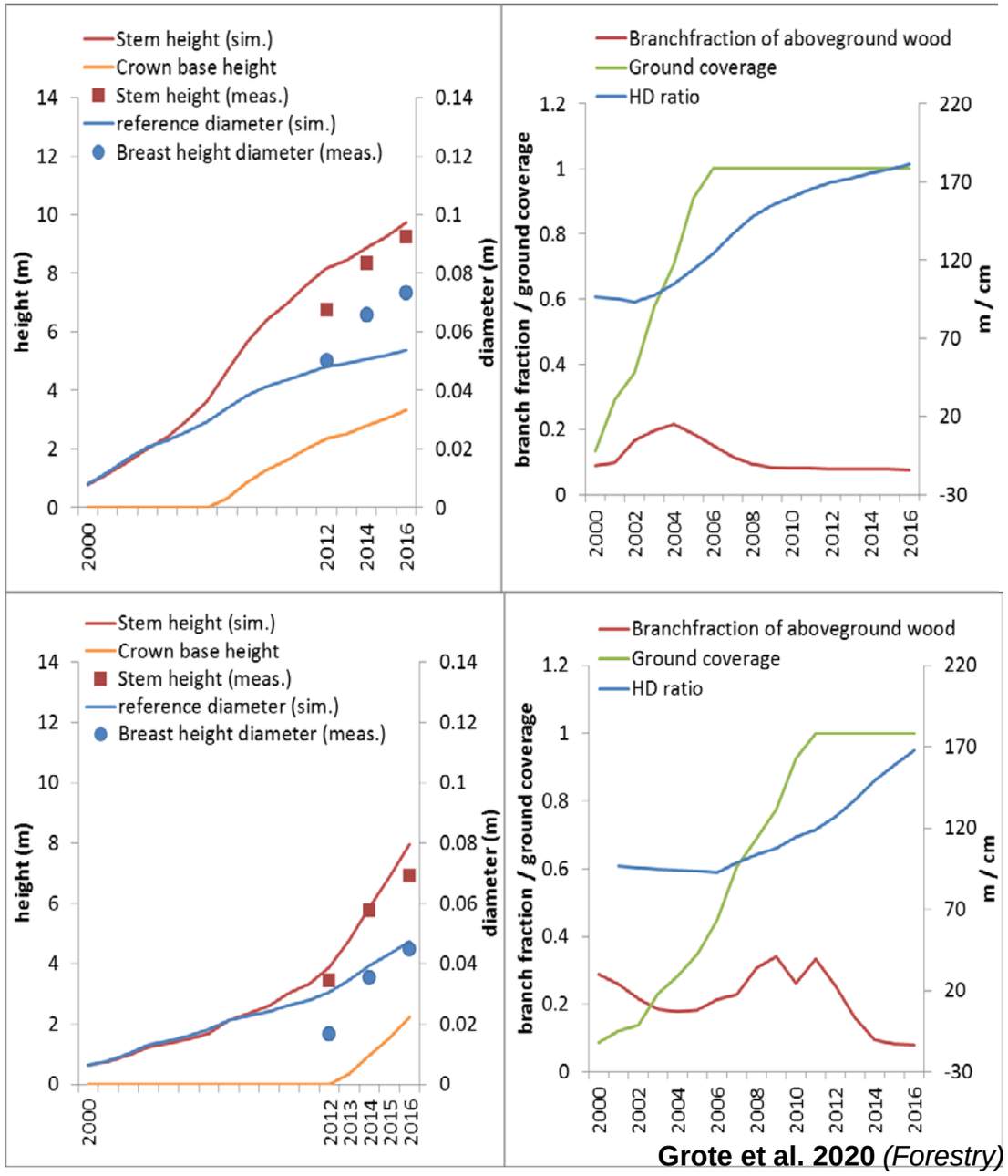








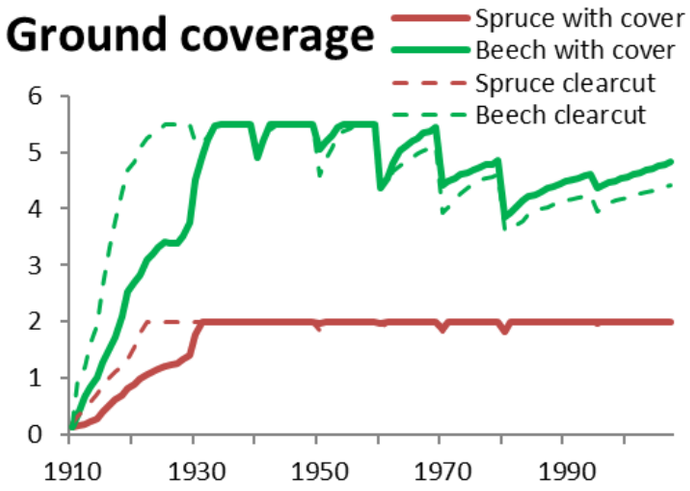
Evaluation: Development with and without cover

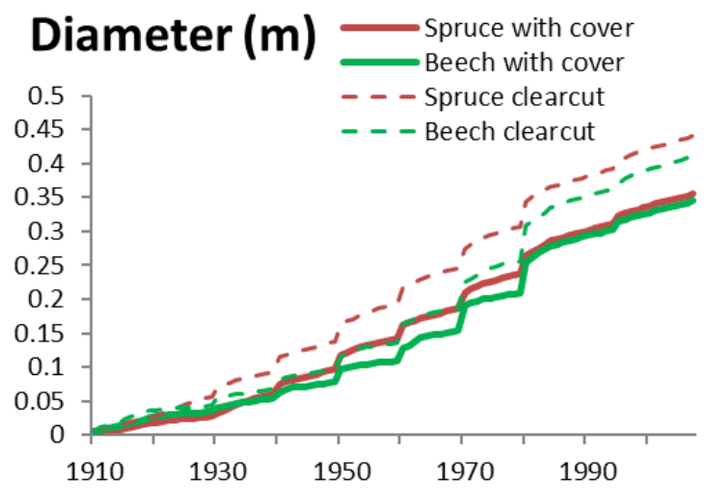


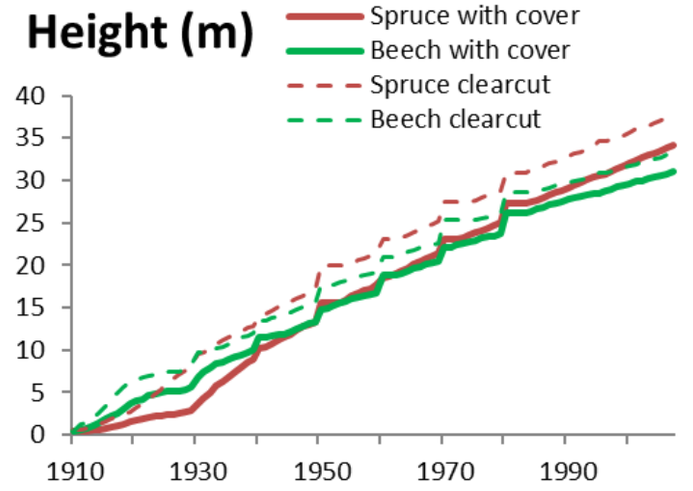
Grote et al. 2020 *(Forestry)*

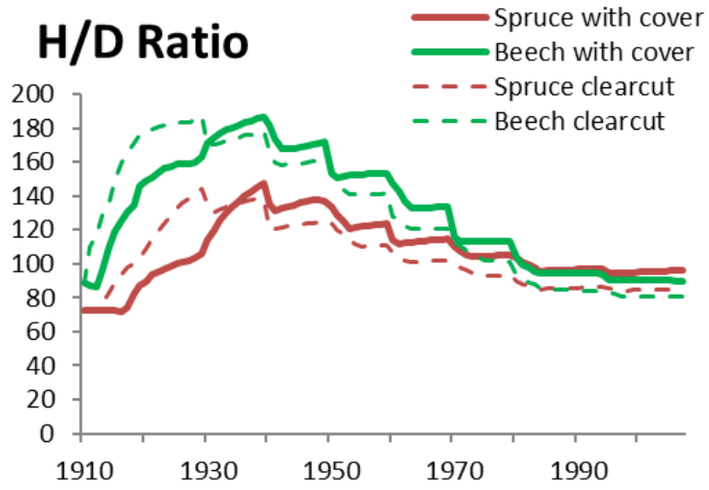
Scenarios: Development with and without cover

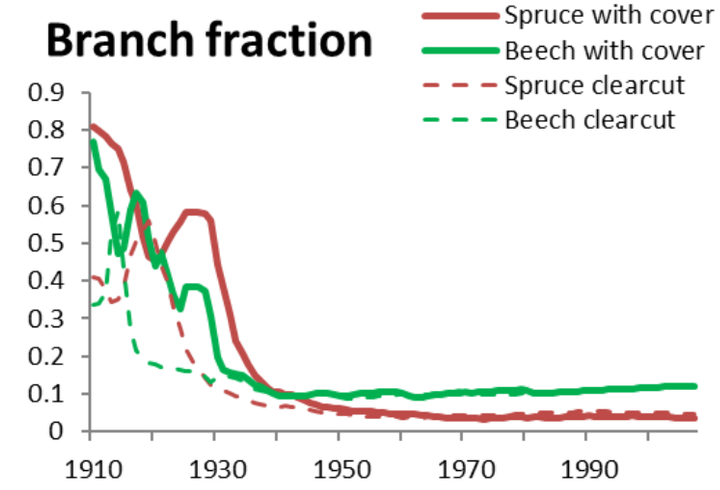
Höglwald, 1910- 2007, spruce or beech

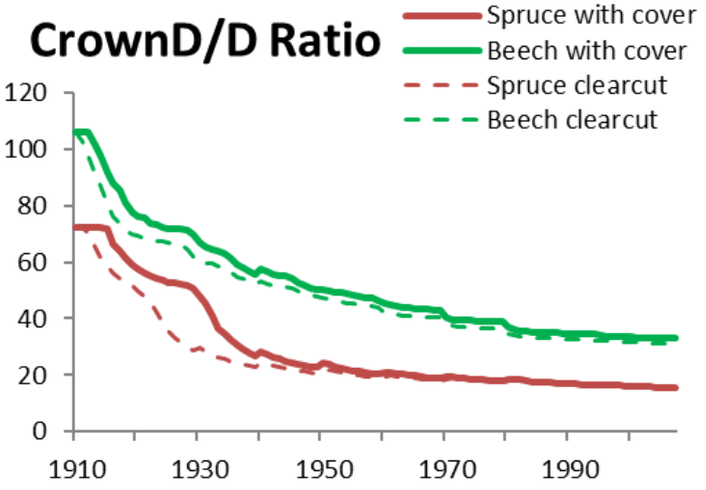








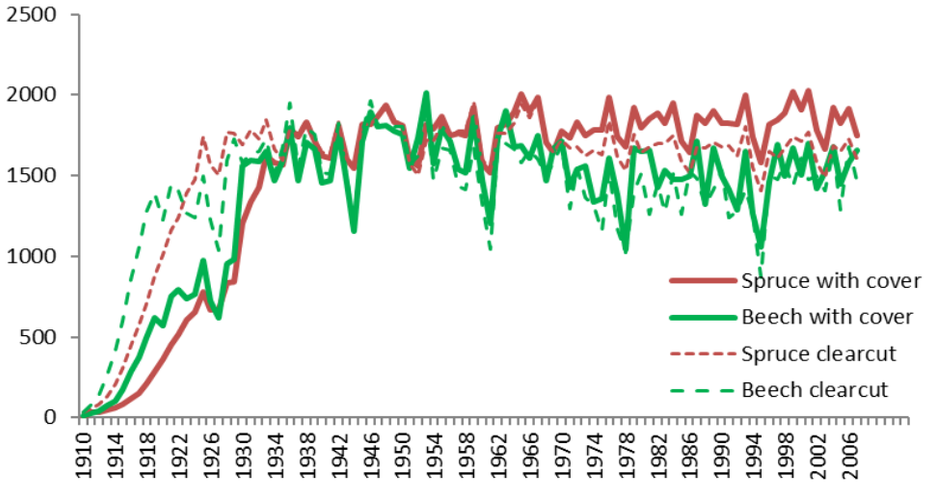




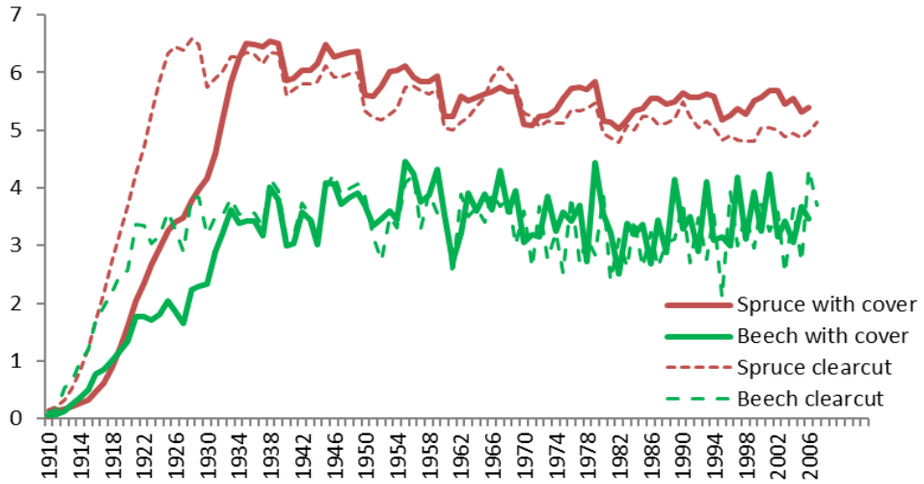
Scenarios: Development with and without cover

Höglwald, 1910- 2007, spruce or beech

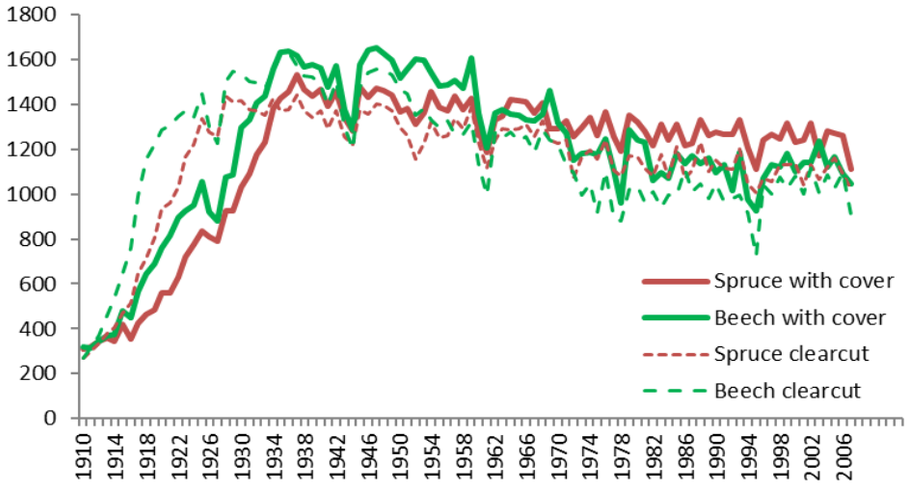
Gross Primary Production (gC m^{-2})



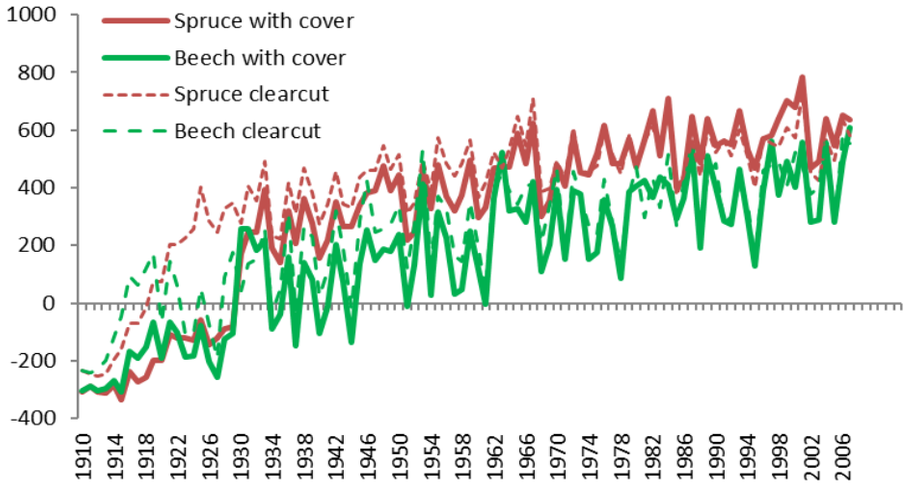
Leaf Area Index



Ecosystem Respiration (gC m-2)



Net Ecosystem Exchange (gC m^{-2})



NOTE: Only regeneration! NOT Overstorey

Conclusions

1. **The combination of a** process-based model with dynamic allometric equation yields realistic regeneration dynamics.
2. The approach enables **long-term matter balance** simulations considering regeneration.
3. Benefits of coverage are not fully accounted for yet (e.g. a frost and heat damages need to be considered).

Thank‘s for your time and interest!