

EU-scale forest management simulations

Report from Task Group 4

September 18, 2019

Zvolen

TG4 in FORMASAM: Forest management at the European scale

- **Objective 7 (O7):** To foster exchange and discussion among modellers how different management practices are implemented in European-scale forest models.
- **Objective 8 (O8):** To translate the overall management scenarios developed in TG1 into concrete management settings for European-scale models.

TG4 in FORMASAM: Forest management at the European scale

- **Objective 7 (O7):** To foster exchange and discussion among modellers how different management practices are implemented in European-scale forest models.

✓ Ongoing + implementation done!

- **Objective 8 (O8):** To translate the overall management scenarios developed in TG1 into concrete management settings for European-scale models.

➤ Feedback needed!

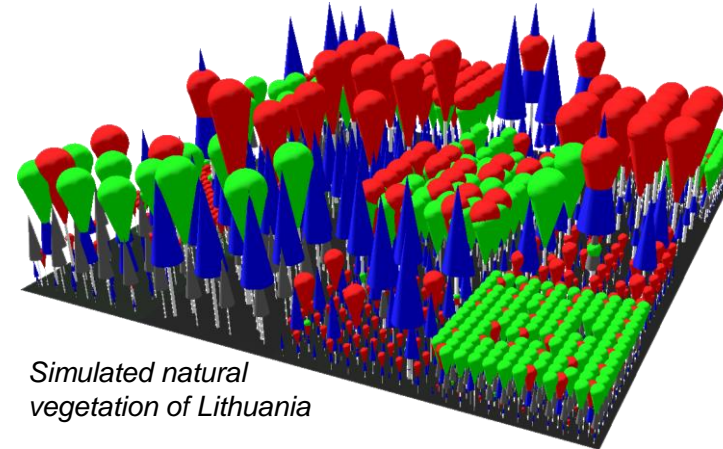
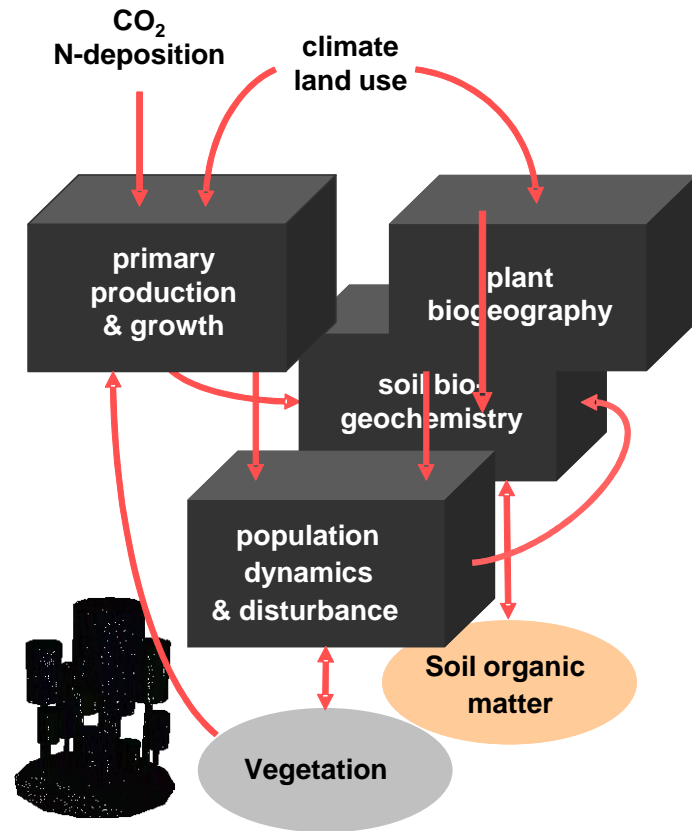
Models

- ORCHIDEE-CN-CAN
- LPJ-GUESS
- EFISCEN
- EFISCEN-space

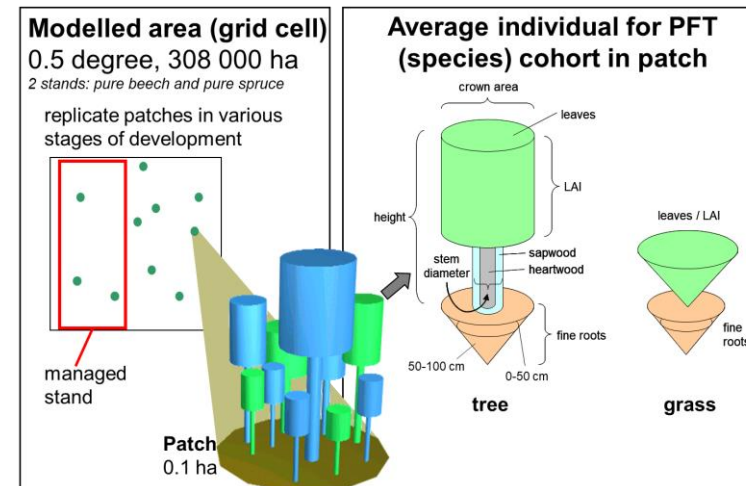
Required model development for simulating detailed forest management

- Reproduce current age-structure and tree species distribution in Europe
- Implement forest management strategies:
 - Thinning
 - Final harvest
 - Species selection
 - Natural regeneration

LPJ-GUESS Dynamic Global Vegetation Model



Simulated natural vegetation of Lithuania



History

PNV
Managed land (cropland, pasture)

Initiation

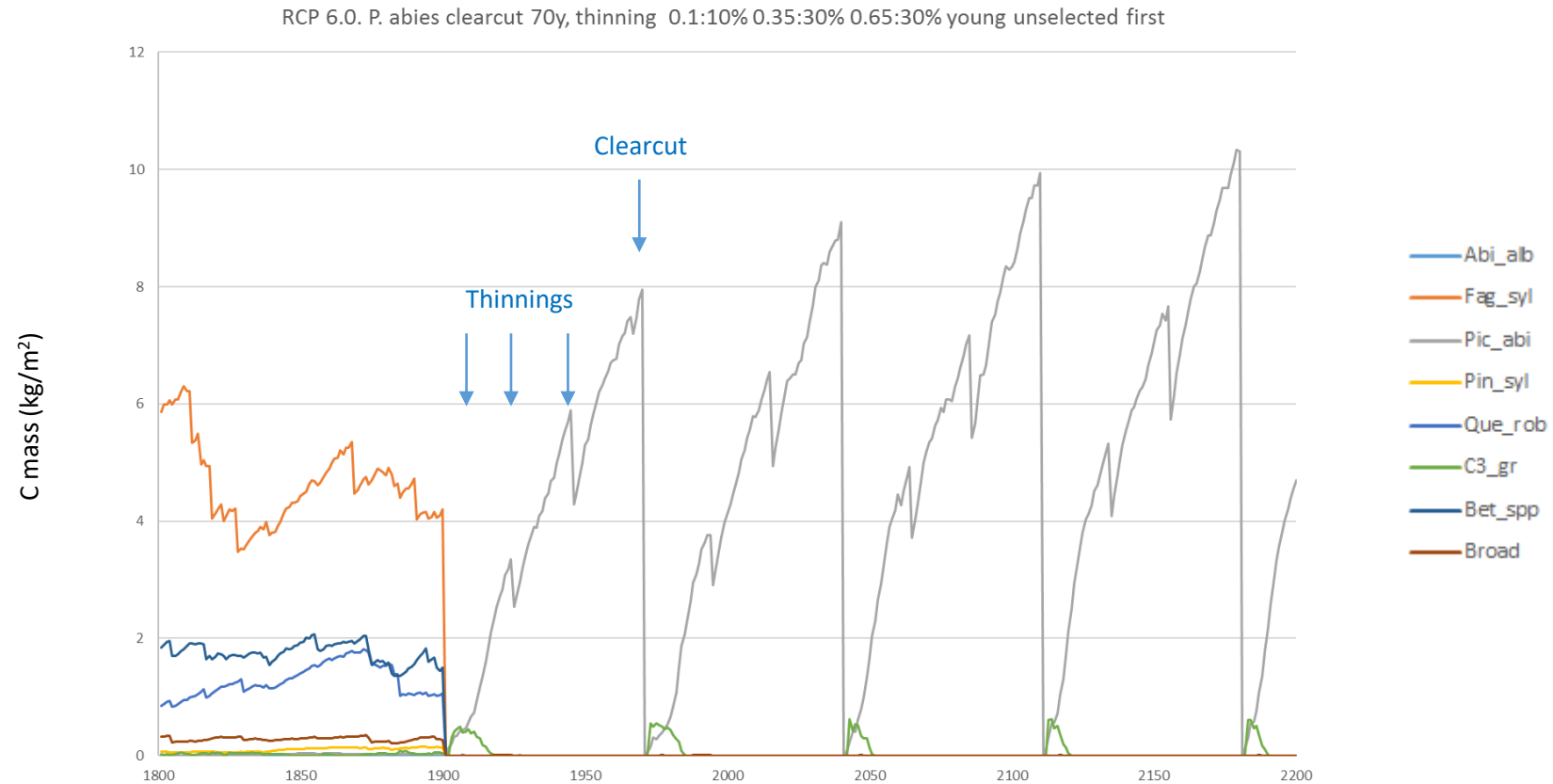
Clearcut, Planting
Cut unselected spp
Do nothing

Management

Thinnings, Clearcut
Continuous cutting, selected species
Reestablishment (selection, **all**, none spp)
Fire/disturbance suppression
N fertilisation

Management change

Change selection
Change thinning int.



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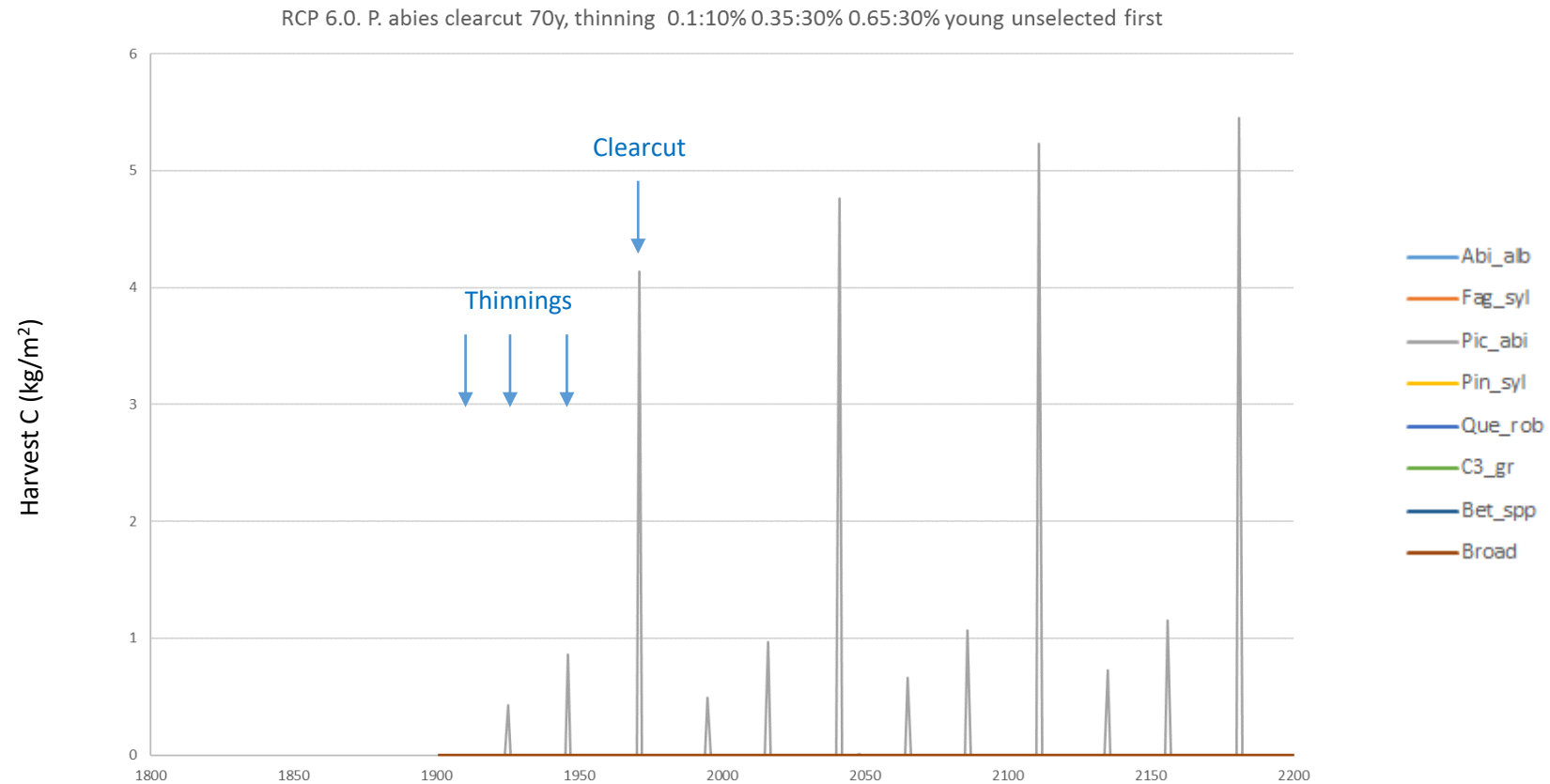
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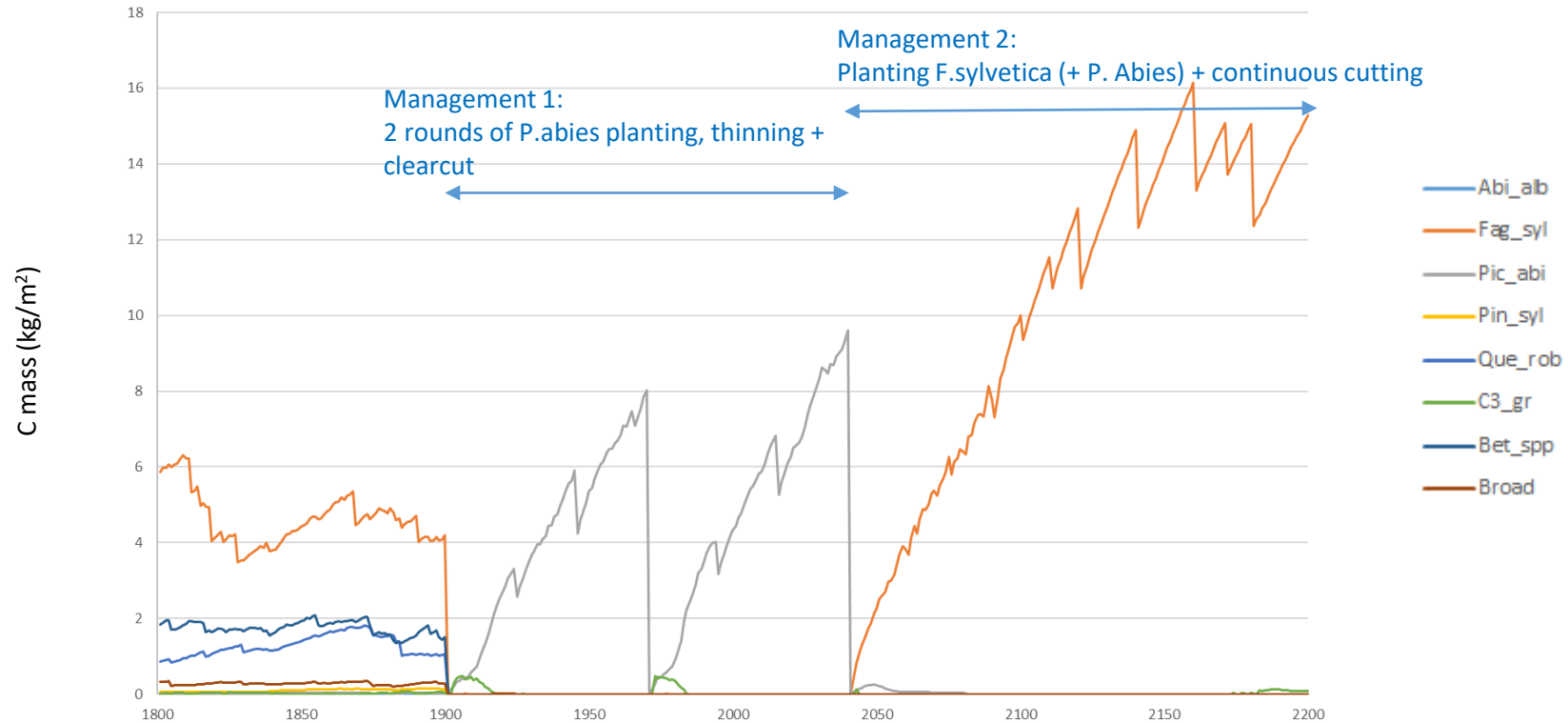
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RCP 6.0. P. abies clearcut 70y, thinning 0.1:10% 0.35:30% 0.65:30% young unselected first ->
Fagus(-Picea)continuous cutting



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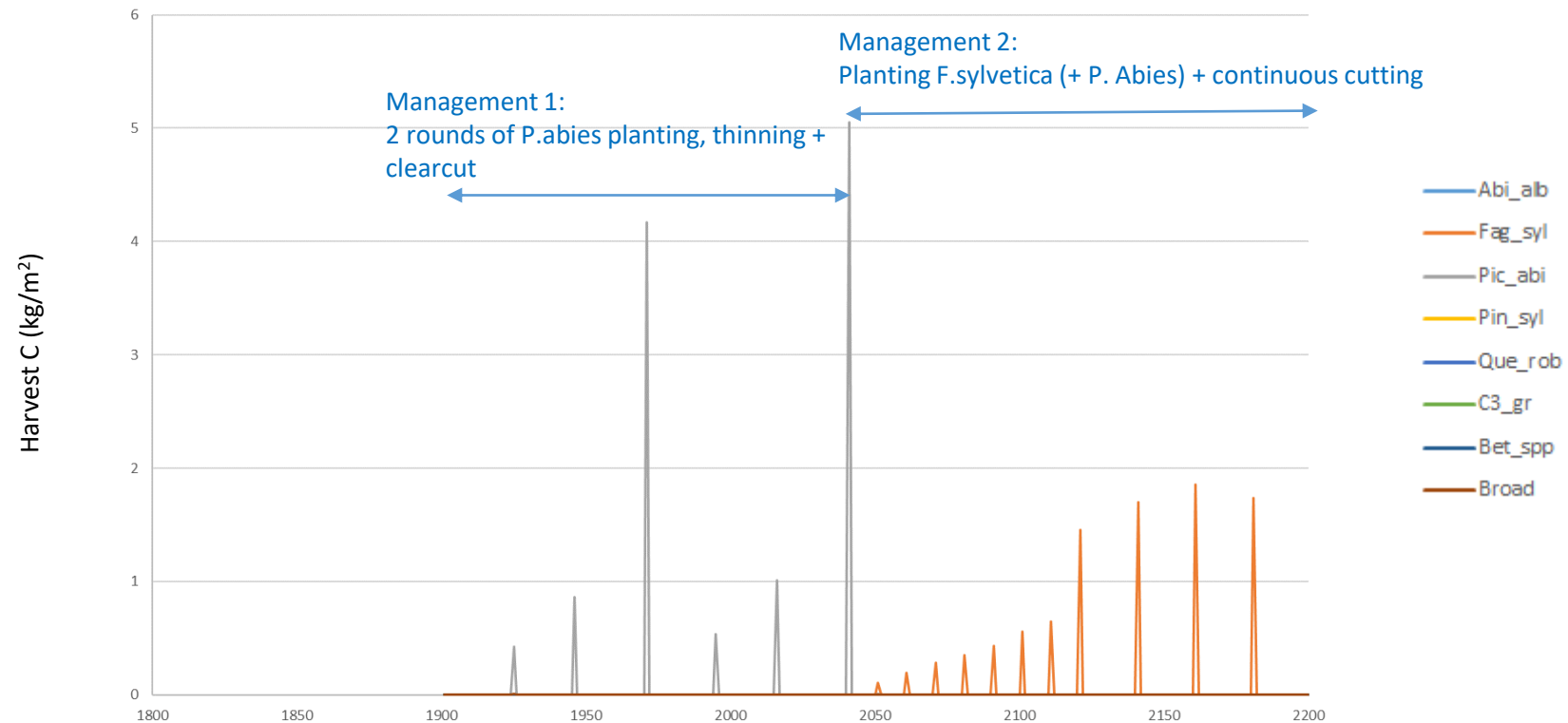
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Reconstructing current European managed forest

Age structure of tree functional classes (NE, ND, BE, BD) (Poulter et al. 2018):

Forest < 140 years reproduced as managed stands created in LPJ-GUESS from 1870 to 2010.

Forest > 140 years simulated as unmanaged PNV.

European tree species map (Brus et al. 2011):

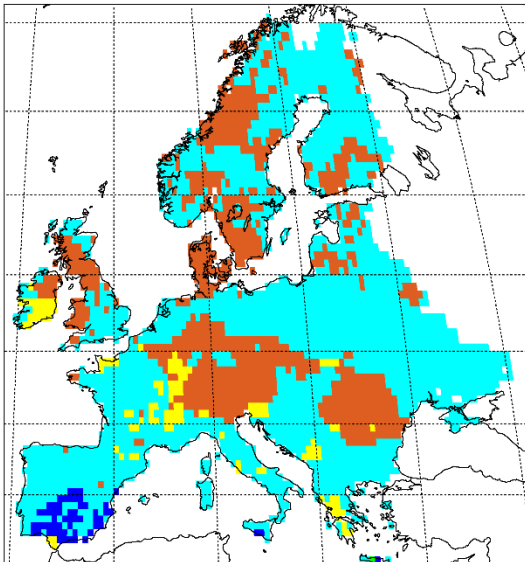
Dominant species/species group (area fraction) within the 4 PFT classes mapped to LPJ-GUESS
species/species mixes

17 European tree species used in LPJ-GUESS simulations (Larix decidua new addition)

Simulated tree species distribution in 2010

NE dominant PFT

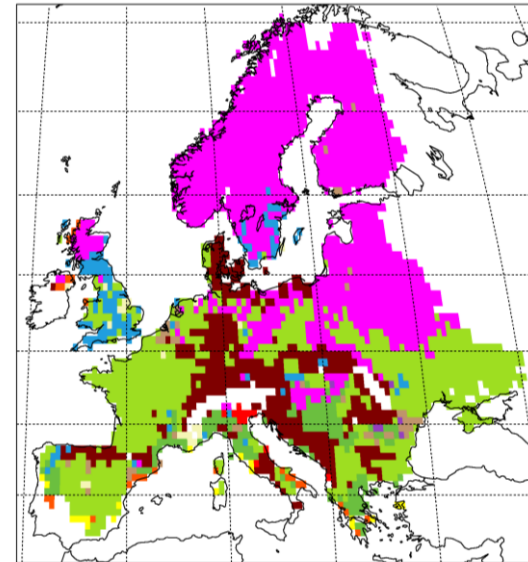
lai_1986-2015_forest_NE_maxpft.txt — max_pft_no



- Abi_alb
- Pic_abi
- Pin_syl
- Pin_hal
- Pin_syl&hal
- None

BD dominant PFT

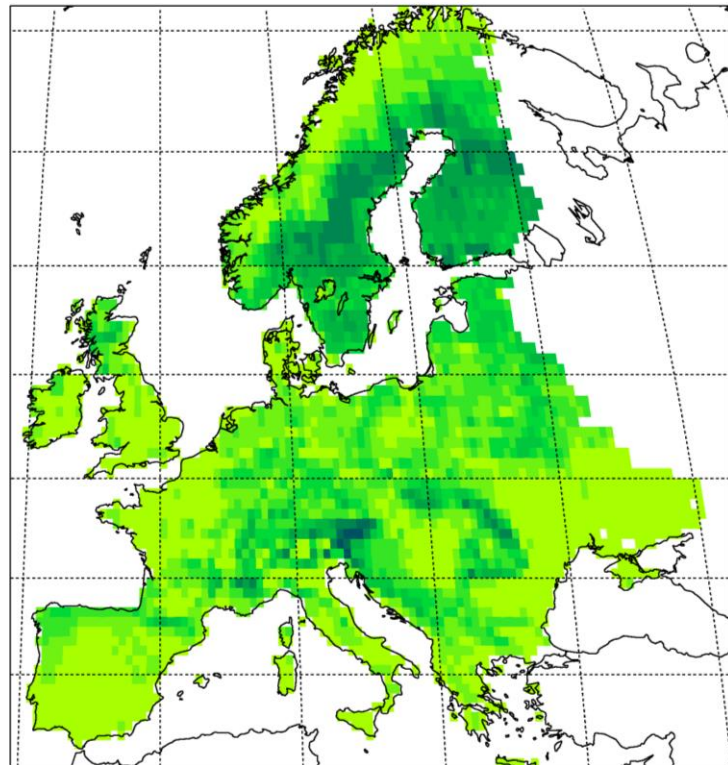
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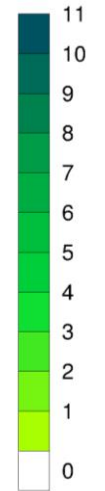
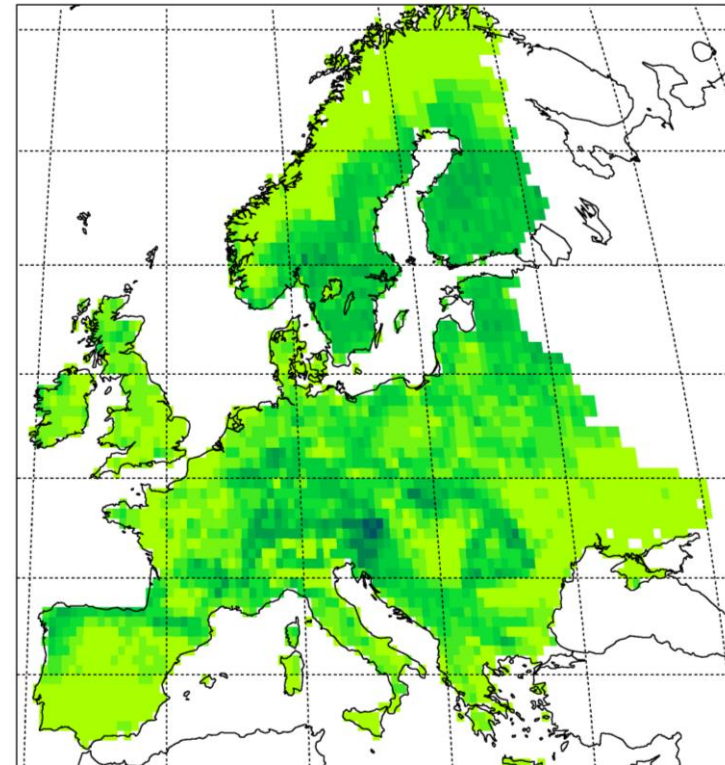
- Bet_pen
- Bet_pub
- Car_bet
- Cor_ave
- Fag_syl
- Fra_exc
- Pop_tre
- Que_pub
- Que_rob
- Til_cor
- Ulm_gla
- None

Total carbon and vegetation carbon pools 1970-2000

Total carbon (kg/m²)



Vegetation carbon (kg/m²)



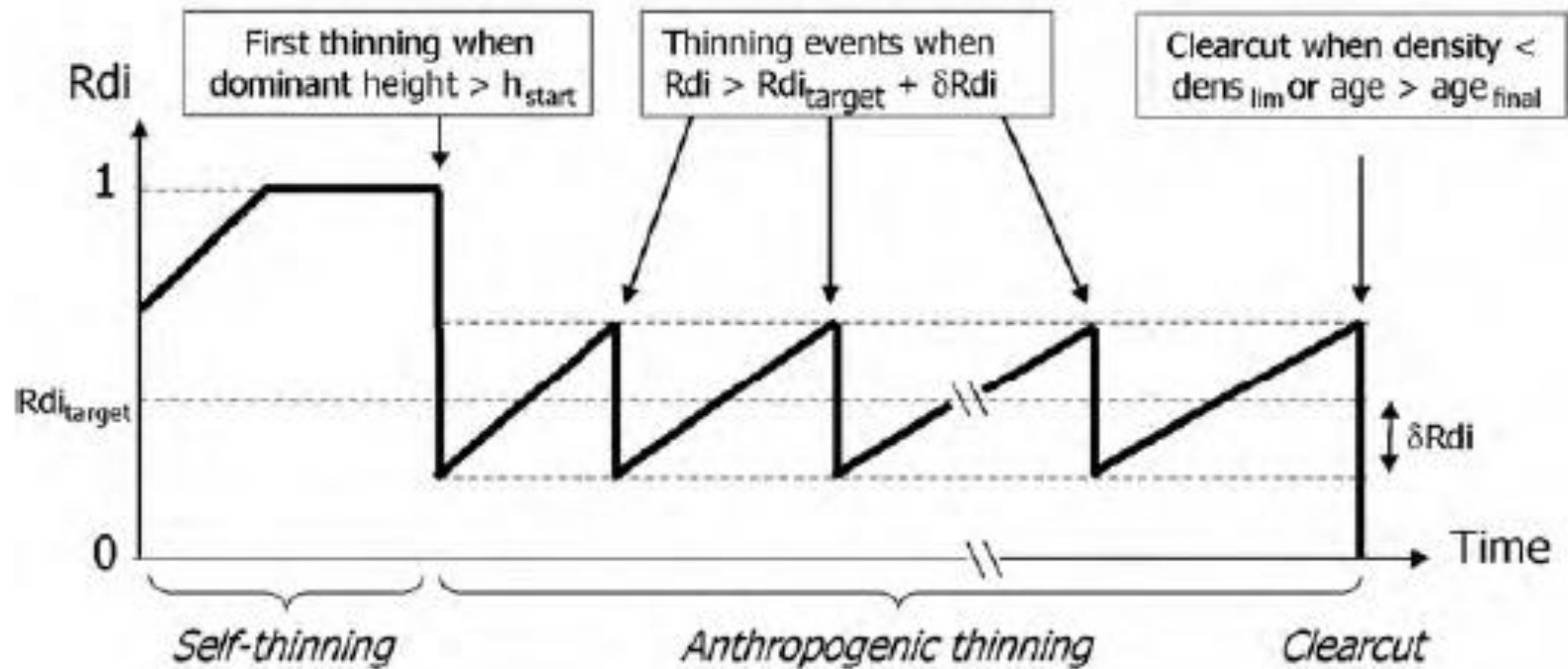
General thinning+clearcut for European forests

Reproducing management in ORCHIDEE (Bellassen et al. 2010) as detailed as possible.

Thinning determined by $RDI = \text{dens}/\text{dens_max}$

Final felling based on stand density

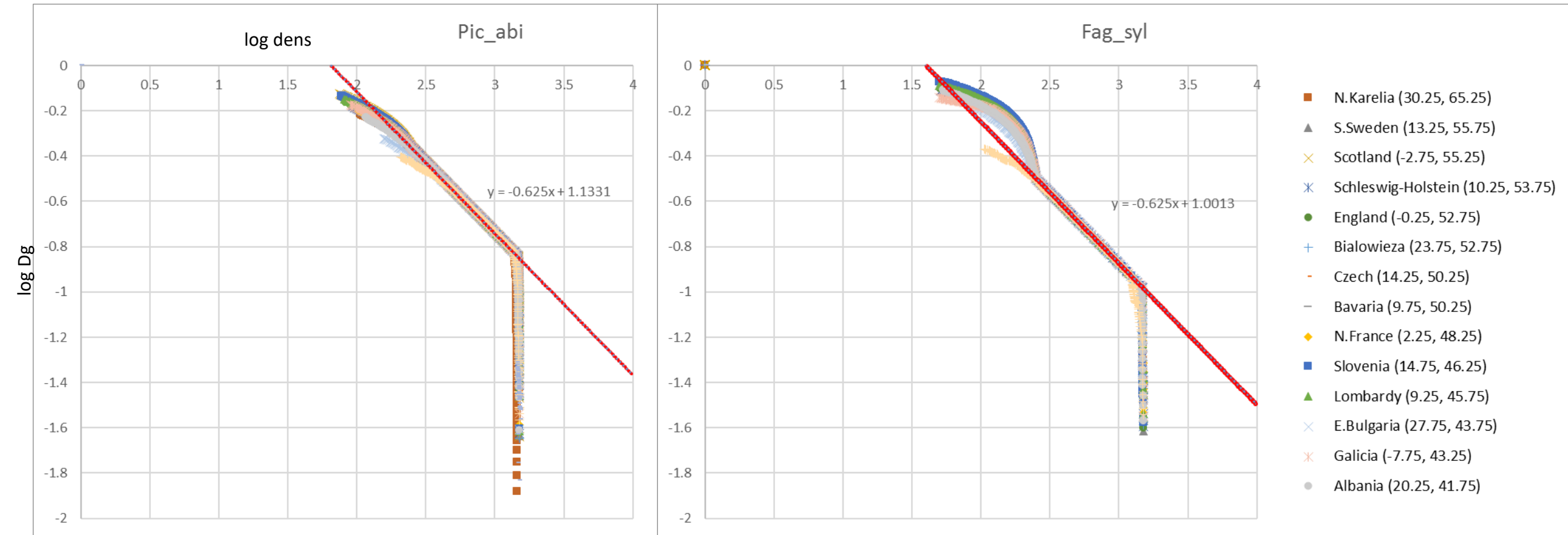
→ To create automated management



Self-thinning in LPJ-GUESS

Examples of results from short European gridlist

$$\log Dg = \frac{\log \alpha_{st}}{\theta_{st}} - \frac{1}{\theta_{st}} * \log dens$$



European-wide simulations with age-species structure and thinning/clearcut

Two climate scenarios: IPSL RCP 4.5 & 8.5, 0.5° resolution

Five management scenarios:

Harv: same tree species planted after clearcut

HarvNL: most common needle-leaf tree in the gridcell planted after clearcut

HarvBL: most common broad-leaf tree in the gridcell planted after clearcut

FreeDev1: PNV established after clearcut.

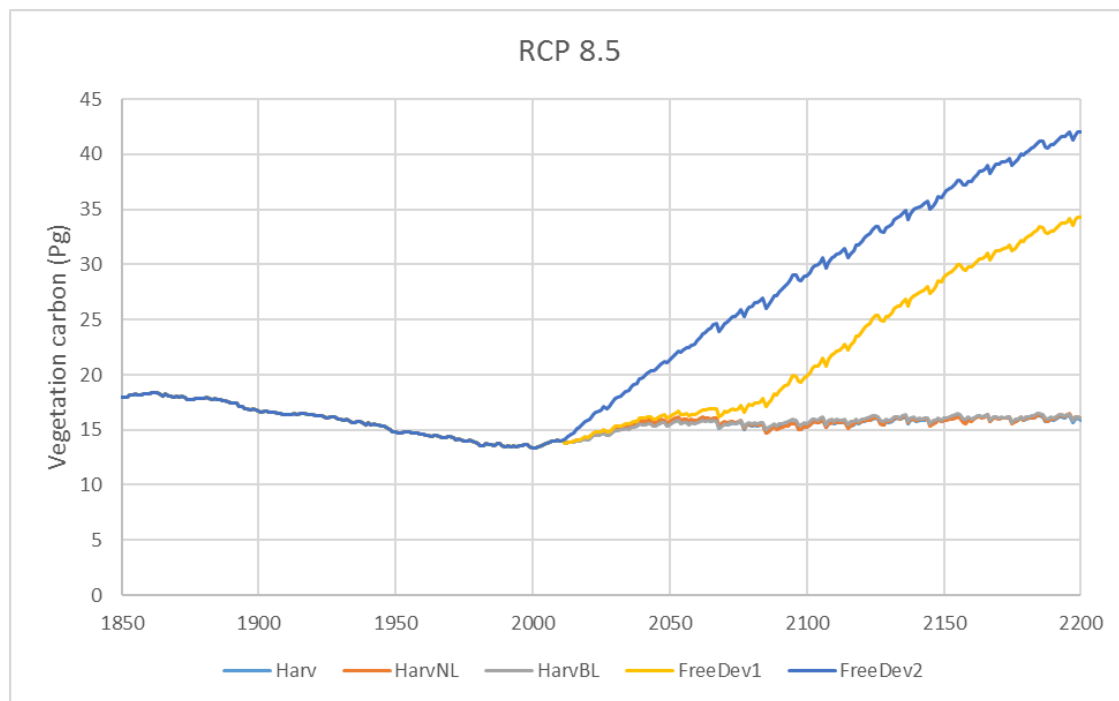
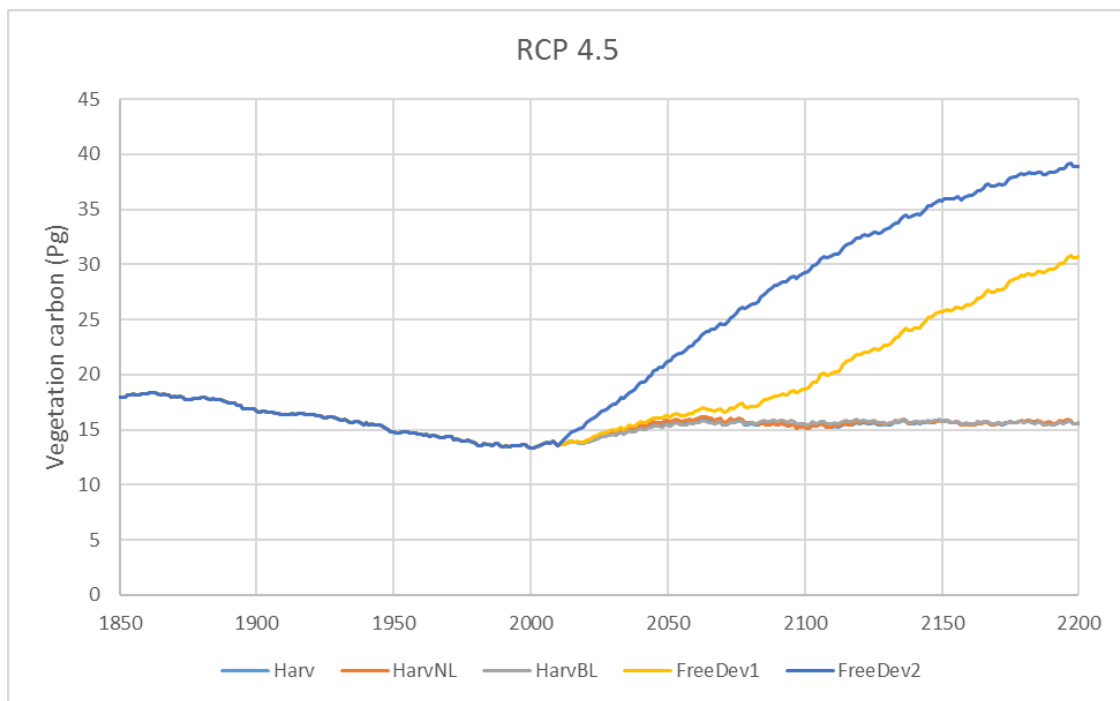
FreeDev2: forest left to free development instead of clearcut (when ready for final harvest)

Presented results:

Times series and 2070-2100 mean maps of total carbon and vegetation carbon pools, harvested wood carbon.

Runs until 2200 with recycled climate data to see long-term behaviour.

Vegetation carbon 1850-2200

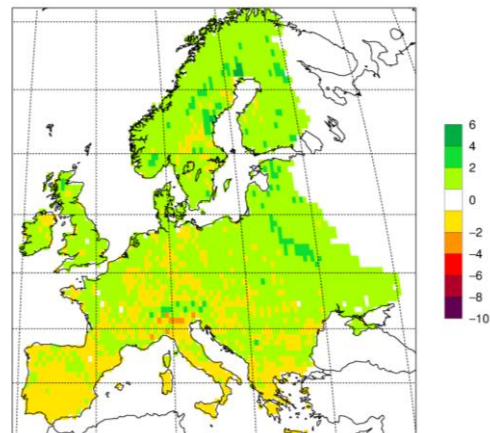
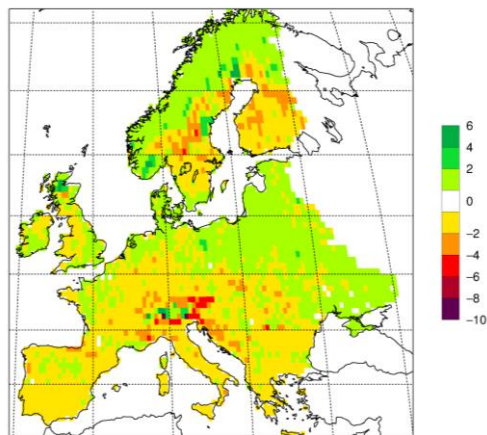


Difference in total carbon and vegetation carbon pools between 2070-2100 and 1970-2000 in **Harv** scenario

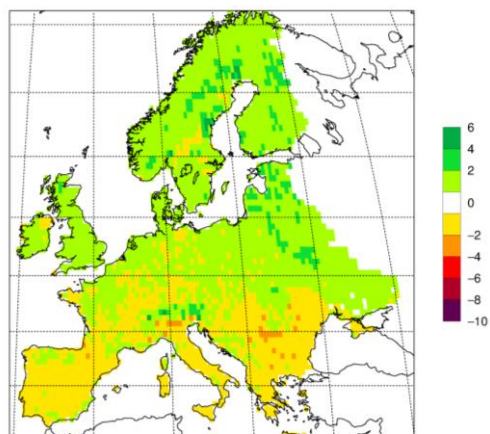
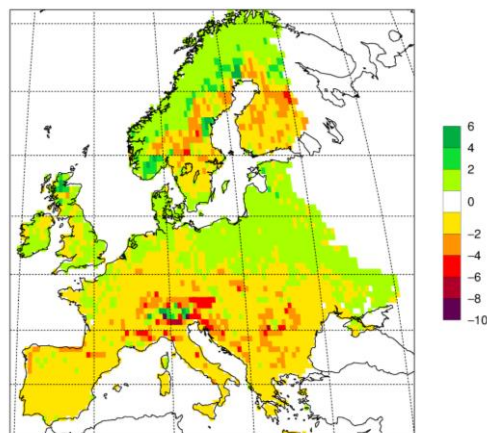
Total carbon (kg/m²)

Vegetation carbon (kg/m²)

RCP 4.5

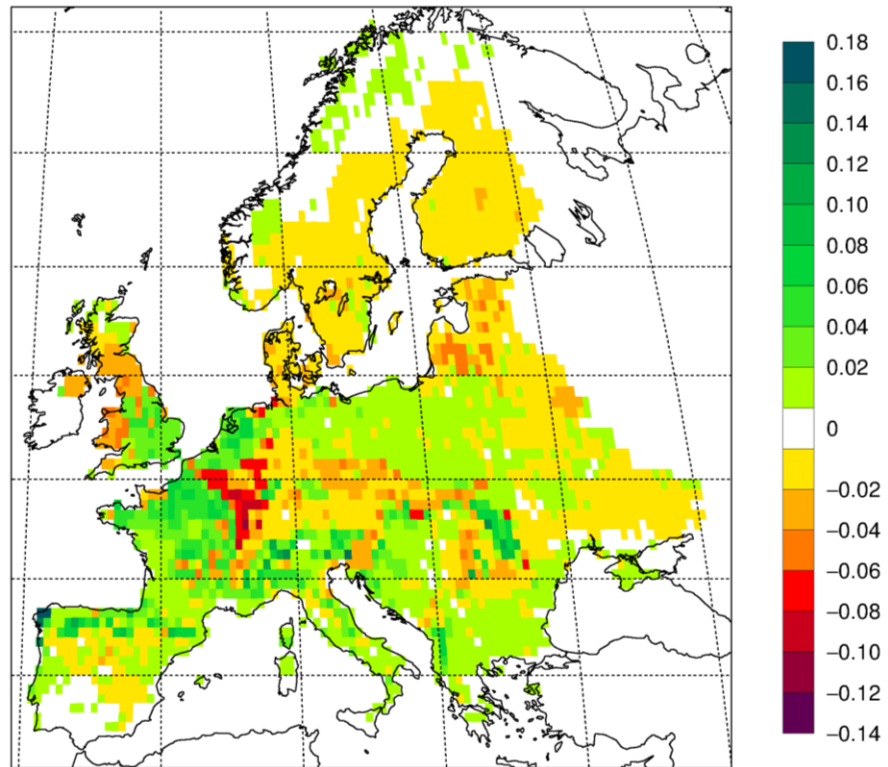


RCP 8.5

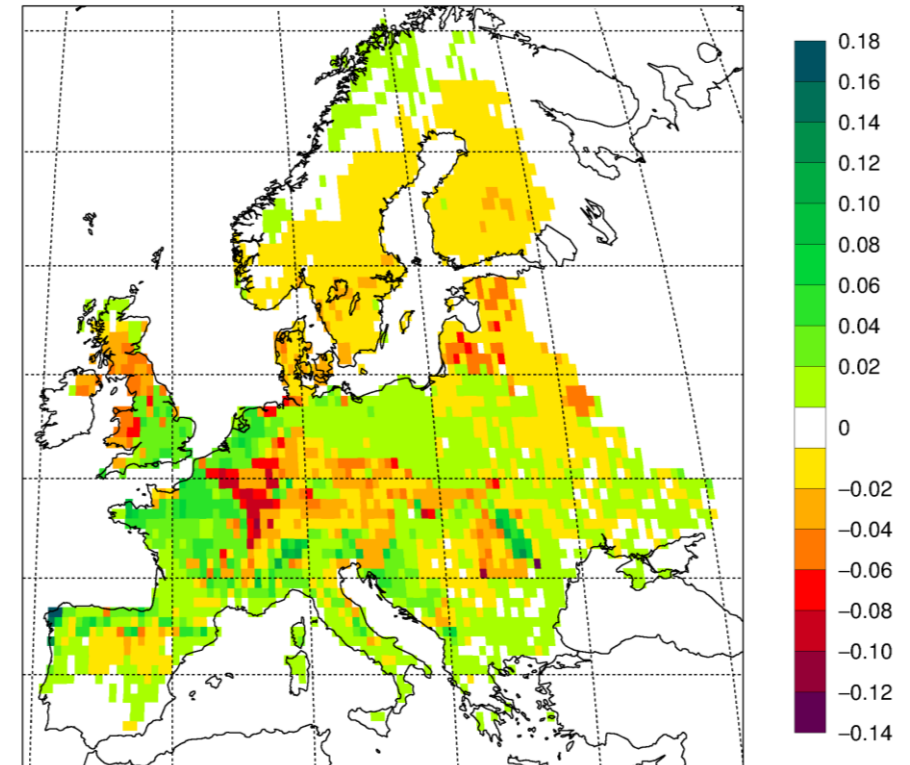


Difference in mean wood harvest carbon 2070-2100 ($\text{kg}/\text{m}^2/\text{year}$) between scenarios **HarvNL** and **Harv**

RCP 4.5

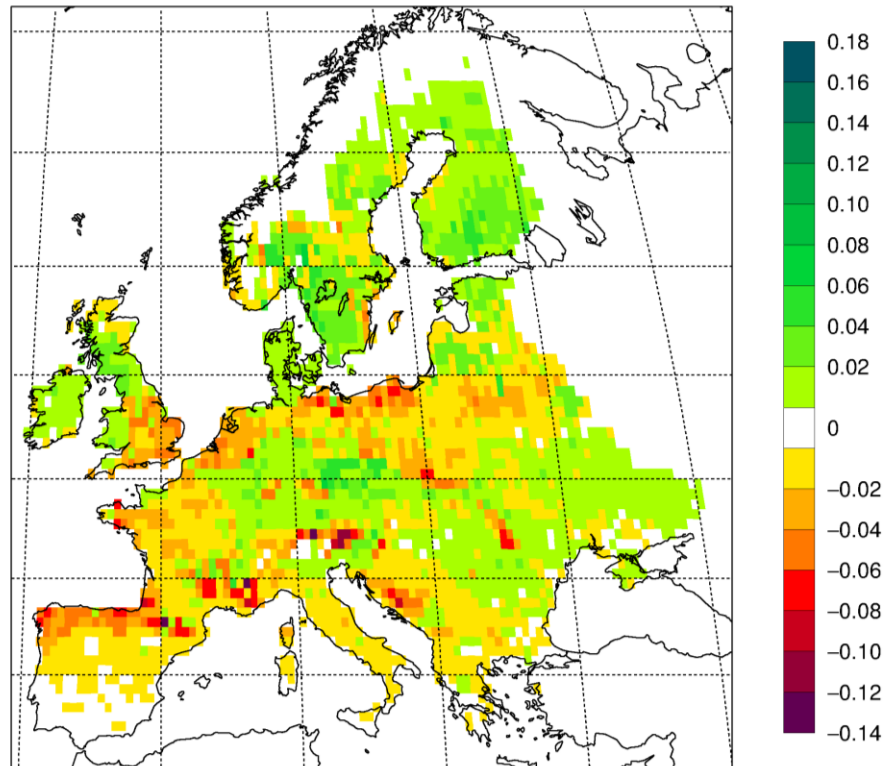


RCP 8.5

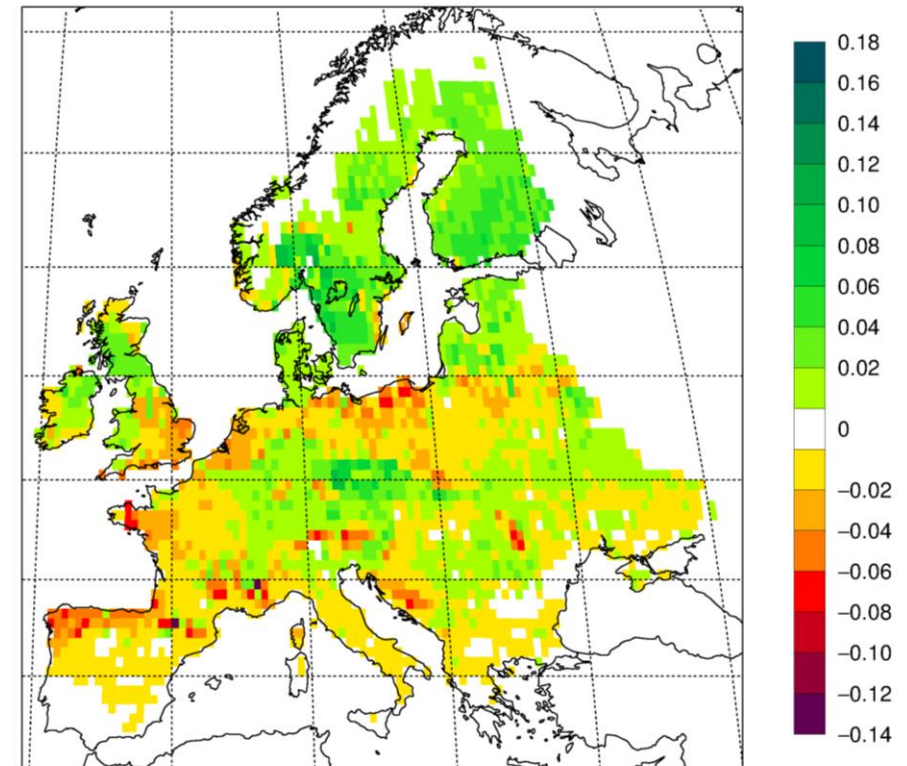


Difference in mean wood harvest carbon 2070-2100 ($\text{kg}/\text{m}^2/\text{year}$) between scenarios **HarvBL** and **Harv**

RCP 4.5



RCP 8.5



Next steps...

- Select optimal management, for which carbon pools to optimize?
- How to include different products in the optimization?
- ...