Using NFI data and a tree growth model to evaluate the effects of climate change and climate change adaptation on the GHG balance of Austria's forest-based sector

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Austrian NFI data

- Inventory cycles of the Austrian NFI
  - 1961 – 1970
  - 1971 – 1980

  } temporary sample plots

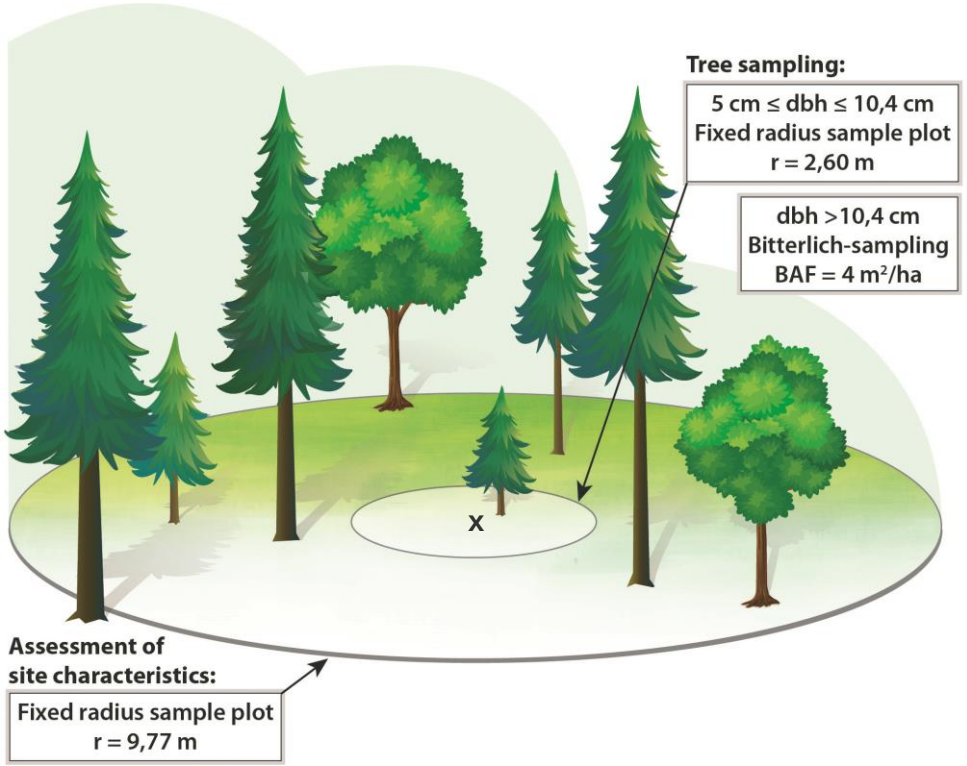
  - 1981 – 1985
  - 1986 – 1990
  - 1992 – 1996
  - 2000 – 2002
  - **2007 – 2009**

  } permanent sample plots

→ most recent NFI data provided initial conditions for the simulation runs with CALDIS-VB V0.1

Austrian NFI data

Approach to Forest Growth Projection and Biomass estimation



Sample plot of the Austrian NFI

CALDIS model

CALDIS-VB V0.1 (Ledermann et al., 2017)

- FVS-Type (Forest Vegetation Simulator – PROGNOSIS Model for stand development (Stage, 1973))
- Same model concept and parameterisation data as PROGNAUS (**PROGN**osis for **AUS**tria: Monserud and Sterba, 1996; Hasenauer, 2000; Ledermann, 2006)
- CALDIS-VB V0.1 – the climate sensitive follow-up version of PROGNAUS

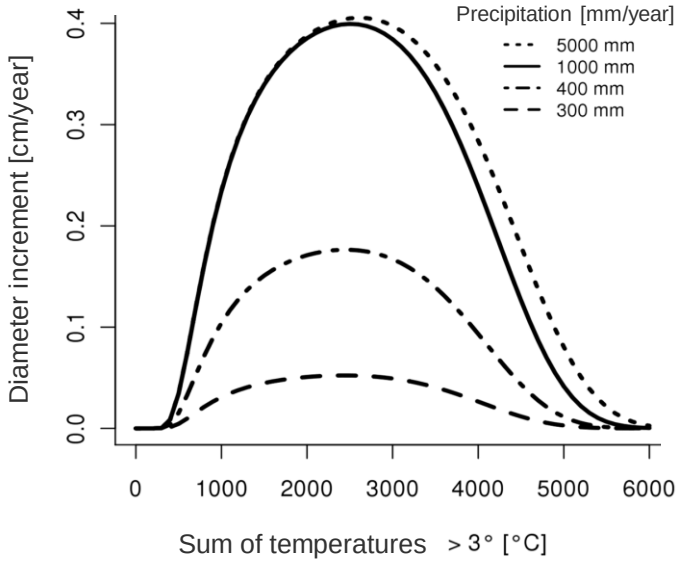
  - basal area increment model (precipitation, mean temp.)
  - height increment model (precipitation, mean temp.)
  - disturbance model (precipitation, mean temp., wind speed)
  - ingrowth model
  - competition induced mortality

Data source for model development: Austrian NFI 1981 – 2009

CALDIS model

CALDIS-VB V0.1 (Ledermann et al., 2017)

Example: basal area increment model for individual trees (Kindermann, 2010), model behaviour for a Norway spruce tree



$$\ln(BAI) = a + b \cdot SIZE + c \cdot COMP + s \cdot SITE + d \cdot CLIM$$

DBH, crown ratio

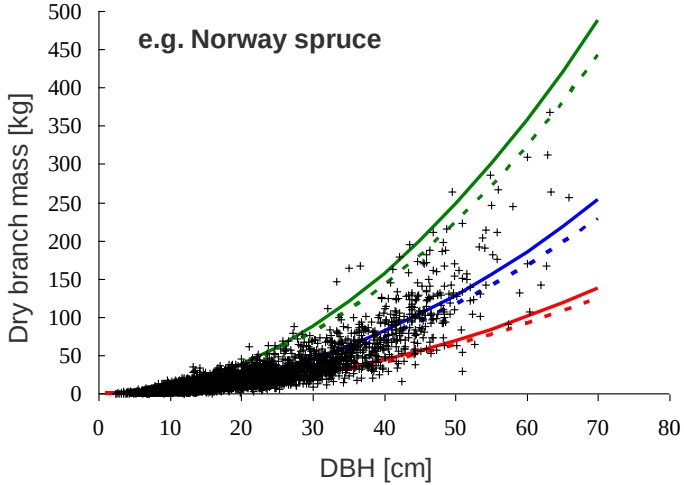
crown competition factor, basal area in larger trees

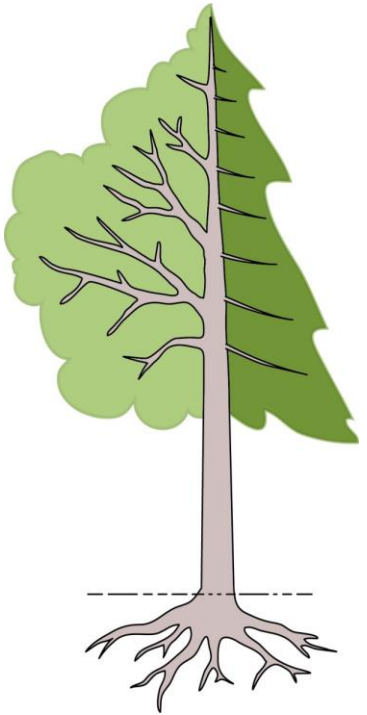
annual precipitation, mean annual temperature

elevation, slope, aspect, soil depth, soil moisture, soil type, position on the slope, vegetation type, growth district

Biomass estimation

Via specific biomass equations that have been used for the Austrian GHG inventory





Litter and soil

- Soil C Model YASSO
- YASSO needs
- C input
- Climate data (temperature, precipitation)

- YASSO provides
- trend of litter + soil C stocks

Project CAREFORPARIS

Analyzing the effects of climate change and climate change adaptation on the GHG balance of Austria's forest-based sector

- 6 scenarios of forest management/climate change were defined
- CALDIS-VB V0.1 was set up on the most recent NFI data (2007/2009)
- Development of each individual sample tree was projected using the stand and site information from the NFI plot on which the tree was located during the last NFI assessment in 2007/2009
- Projected tree characteristics were scaled up to plot- and country-level using routine procedures of the Austrian NFI

Scenarios

Forest management:
Business as usual

- Business as usual - RCP 4.5 and RCP 8.5

- Increased disturbances - RCP 8.5+

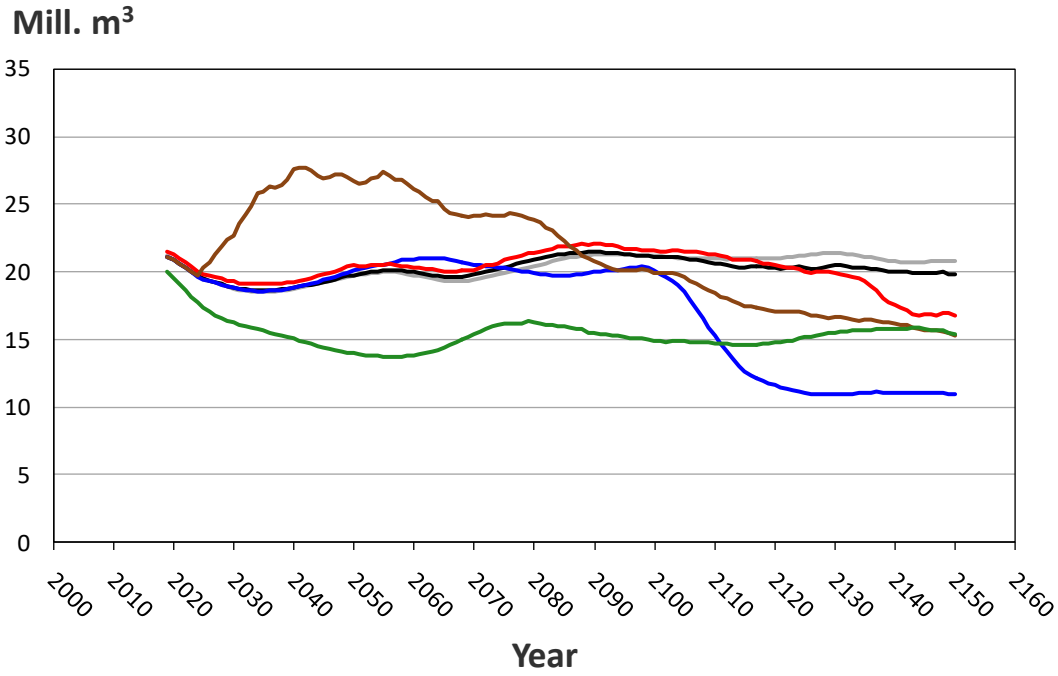
Forest management:
changed

- Shorter rotation cycles - RCP 8.5

- Shift to broadleaved trees - RCP 8.5

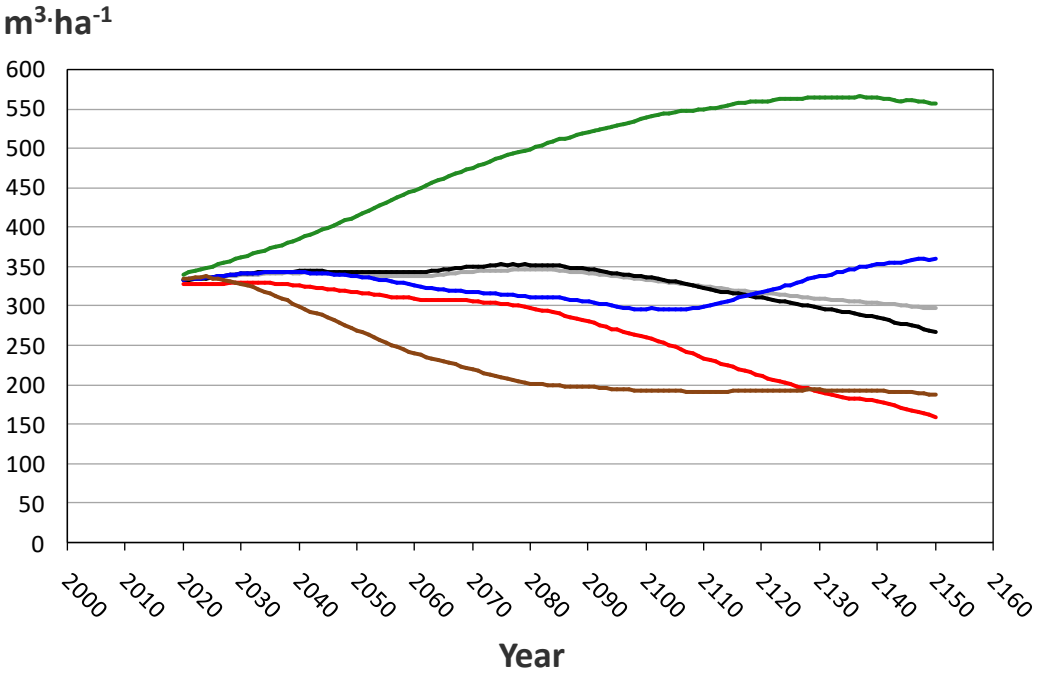
- Increasing growing stock - RCP 8.5

Annual cut



- Business as usual (RCP 4.5)
- Business as usual (RCP 8.5)
- Increased disturbances
- Shorter rotation cycles
- Shift to broadleaved trees
- Increasing growing stock

Growing stock



- Business as usual (RCP 4.5)
- Business as usual (RCP 8.5)
- Increased disturbances
- Shorter rotation cycles
- Shift to broadleaved trees
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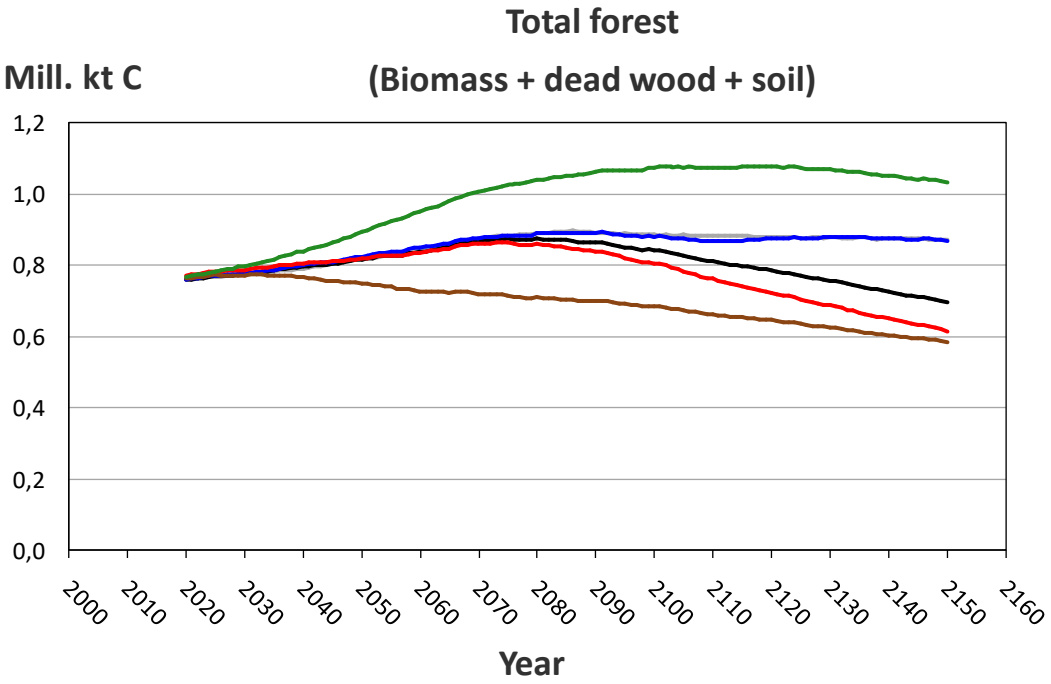
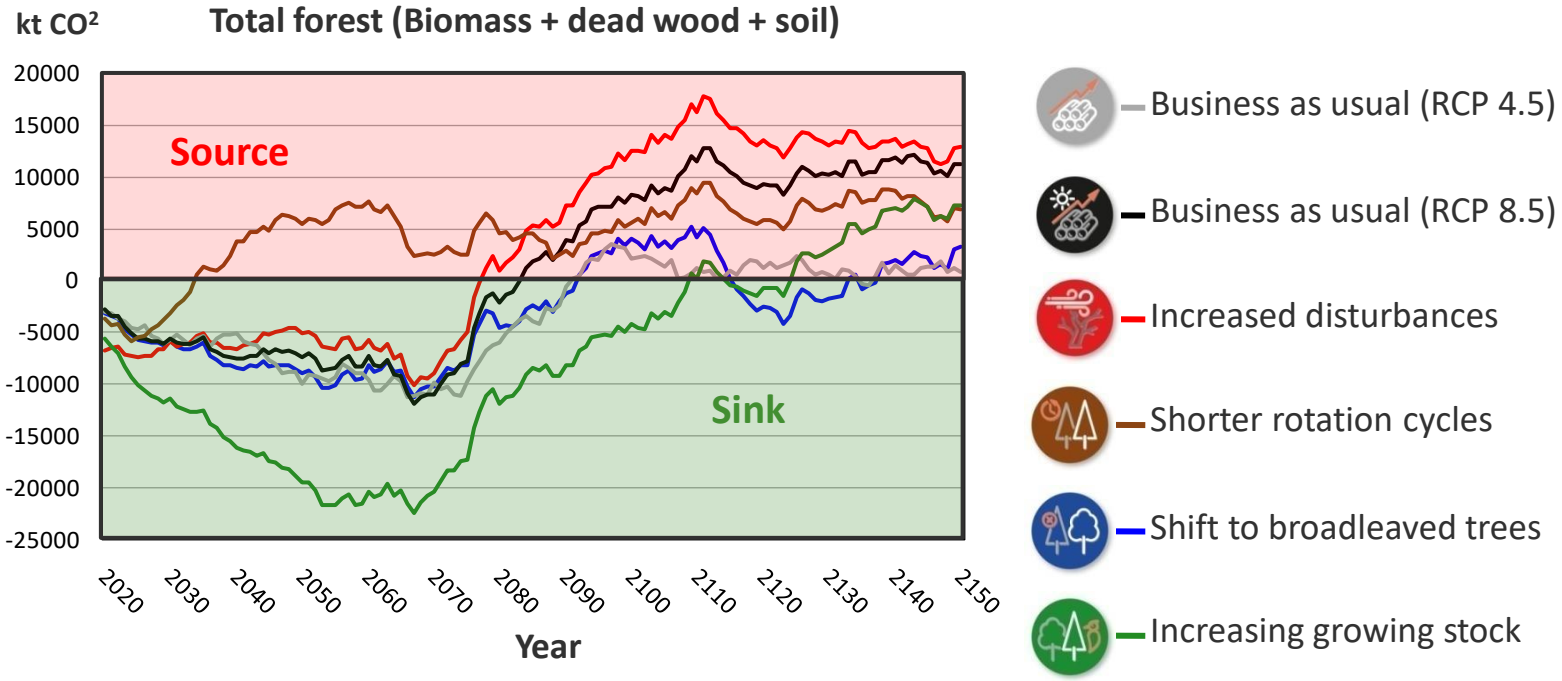
Carbon stock

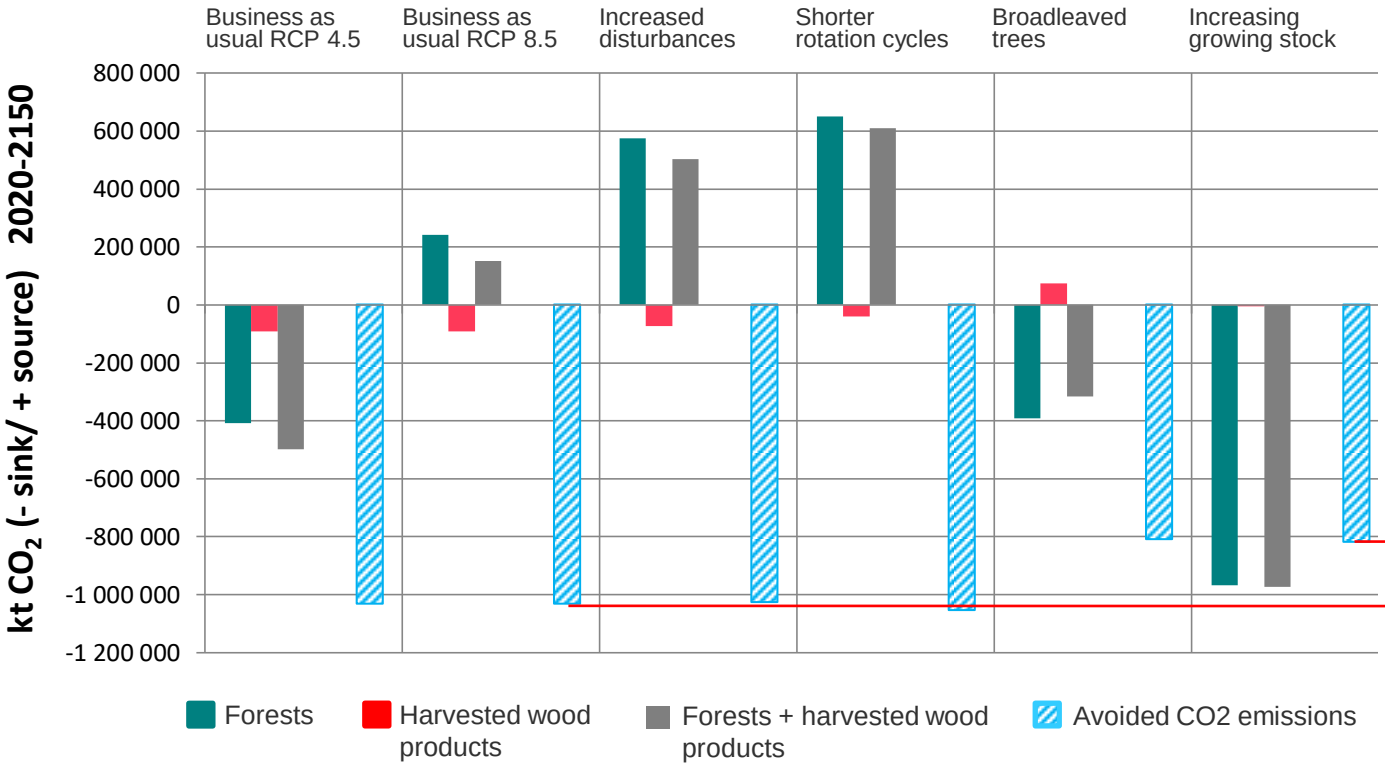


- Business as usual (RCP 4.5)
- Business as usual (RCP 8.5)
- Increased disturbances
- Shorter rotation cycles
- Shift to broadleaved trees
- Increasing growing stock

Change in carbon stock (sink/source)



Cumulated sink/source



- Increasing growing stock shows the best overall result
- Lower harvesting amount means:
- **Lower** avoided emissions
- **Additional emissions from fossil resources**

~200.000 kt CO_2

Picture | Filmstyle from „See Aural Woods“ (Luma.Launisch & Takamovsky)

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