University of Natural Resources
and Applied Life Sciences
Dept. of Forest and Soil Sciences

Multi-purpose management of mountain forests in a changing climate.

Challenges & prospects

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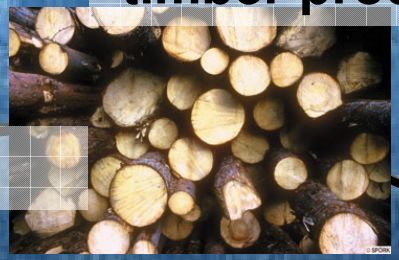
content

- **Central European mountain forests**
  - multiple functions & pressures
- **climate change impacts**
  - observed impacts
  - model projections
- **adaptation & mitigation**
  - a case study at management unit level
- **conclusions, outlook**

the framework for forest management in Central Europe

... from sustainable yield to sustainable forst management (SFM)

timber production



climate protection

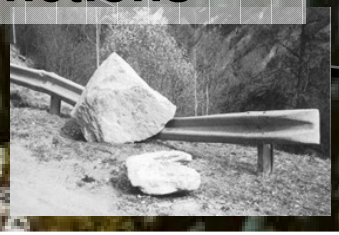
forest health

biodiversity

water-resources

hunting

protective functions



habitat

recreation

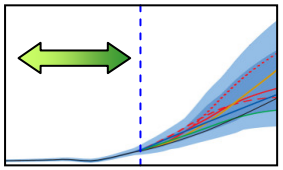
Austrian forests: at the intersection of...

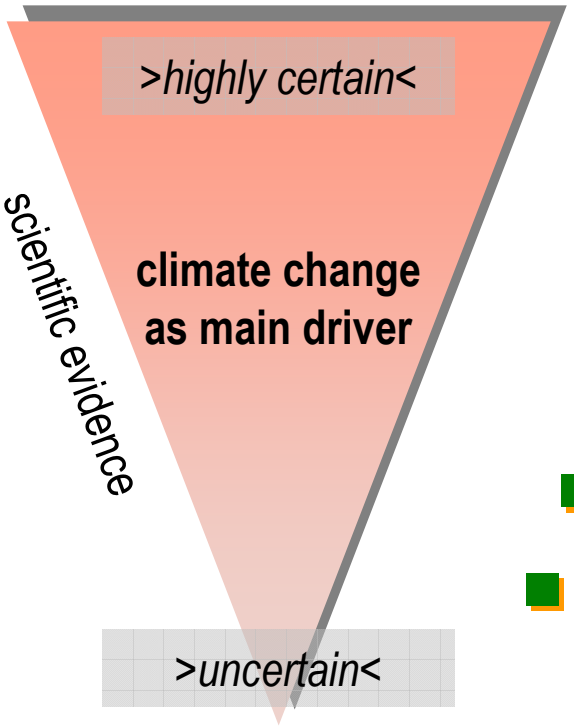
- **importance for society & economy**
  - 47.2% of Austria is forest (3,9 mill. ha)
  - ~170,000 forest owners
  - timber production: 19.1 mill. m^3 u.b. (2006)
  - rank 5 in global sawn wood export (FAOSTAT 2001)
  - 110.000 forest sector employees
  - non-timber services important (e.g., protective function is 1st priority on ~30% of forest area)

- **climate change**
  - particularly strong climate change signal in mountain regions
  - longevity of trees / production cycles
  - long lead times of adaptation measures
  - multiple additional pressures (e.g., land use)

observed impacts of climate change

empirical evidence in Central European forests



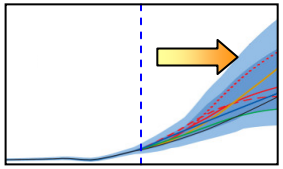


- (positive) growth trends in European forests
- increasing bark beetle infestations in mountain forests
- new invasive (pest) species
- increase in damage from biotic disturbances
- upward shift in timber line
- increase in damage from abiotic disturbances (e.g., storm)

- manifold interactions between drivers of ecosystem processes
  - challenges to disentangle factors post hoc
  - challenges to implement integrated scenario analysis

autecological stress loads on tree species

potential future climate change impacts (i)



climate stress

- very high
- high
- medium
- low
- very low
- non-forest land

methods & material

(-) static projection
(-) spatial data: AFI-plots
(-) SRES scenario: A1B
(-) climate: ECHAM5

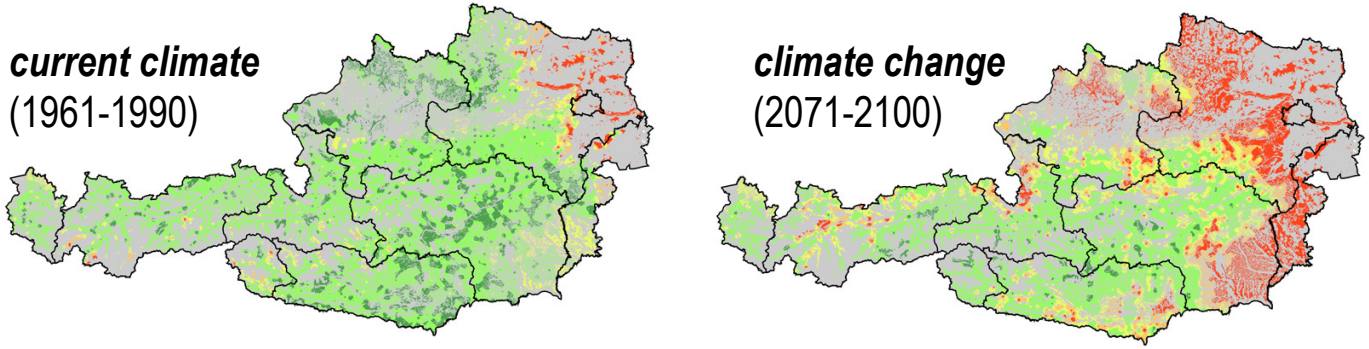
2007 in cooperation with:

ÖBf Österreichische Bundesforste AG

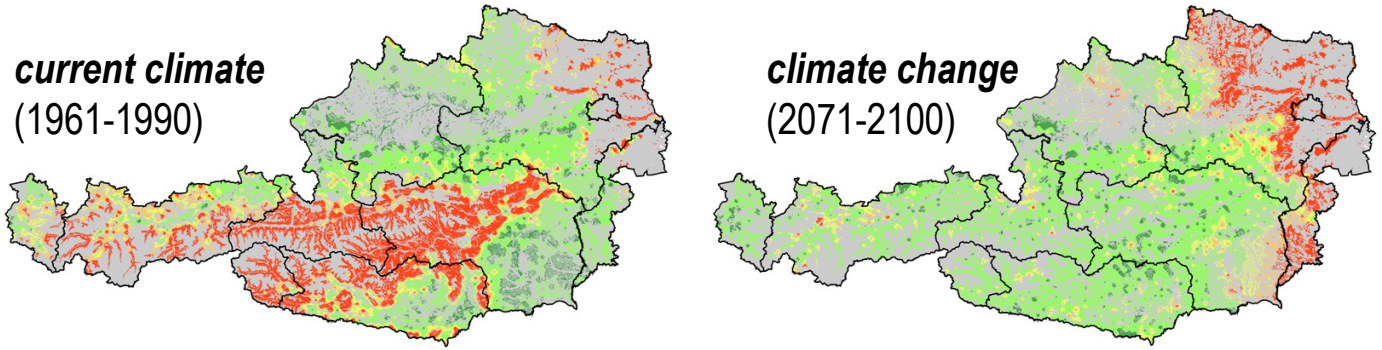
WWF for a living planet

[Steiner & Lexer, 1998]

Norway spruce *(Picea abies)*

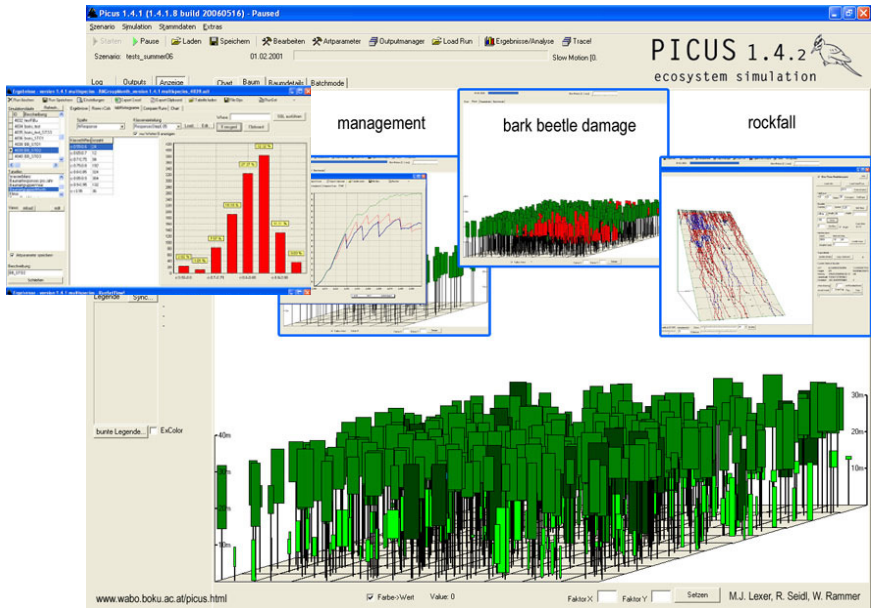


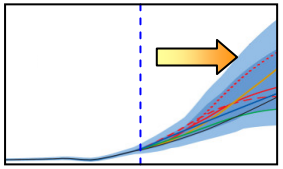
European beech *(Fagus sylvatica)*



natural forest dynamics (PNV)

model predictions of impacts (ii)

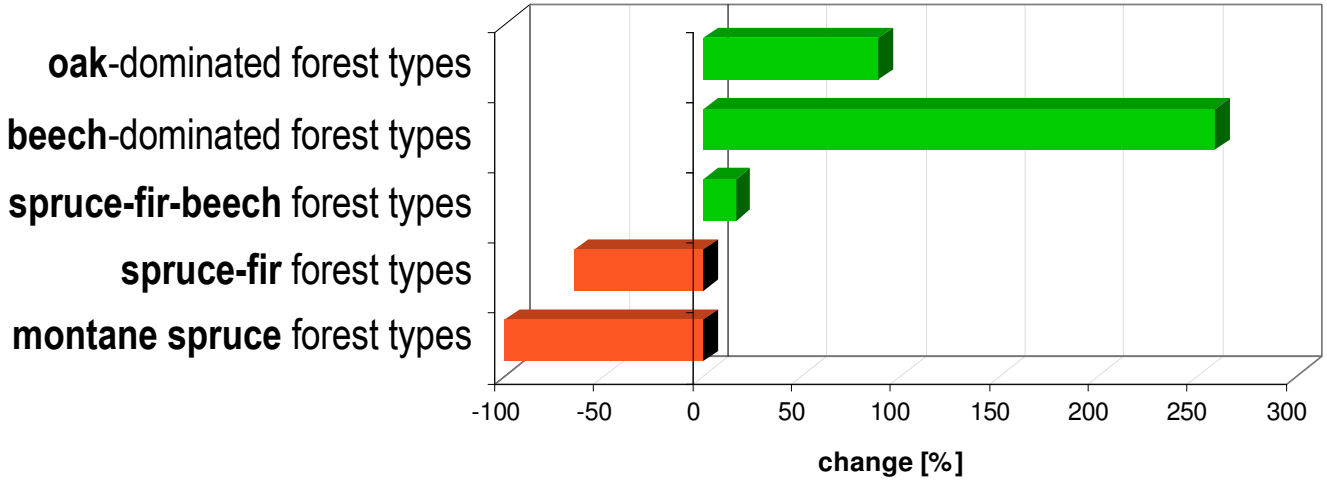




methods & material

(-) dynamic simulation: forest ecosytem model PICUS v1.2
(-) spatial data base: Austrian Forest Inventory (AFI)
(-) SRES scenario: IS92a (2071-2100)
(-) climate: ECHAM4, statistically downscaled

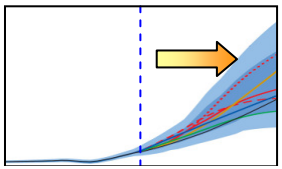
Simulated changes in potential natural vegetation under climate change



[Lexer et al., 2001]

biotic disturbances (bark beetles)

model predictions of climate change impacts (iii)

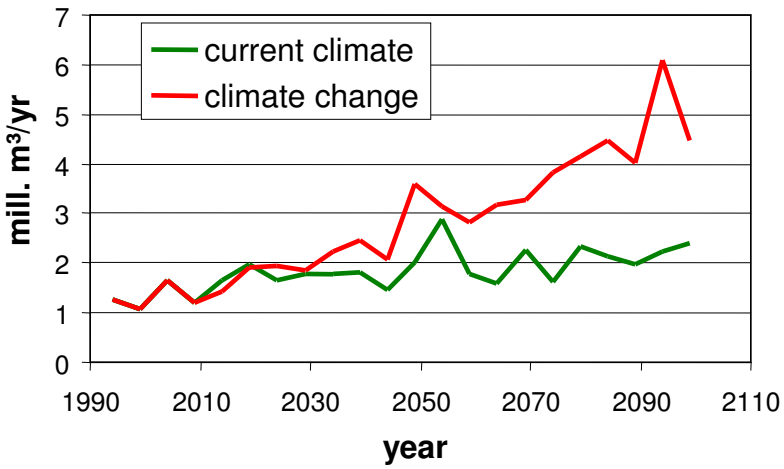


methods & material

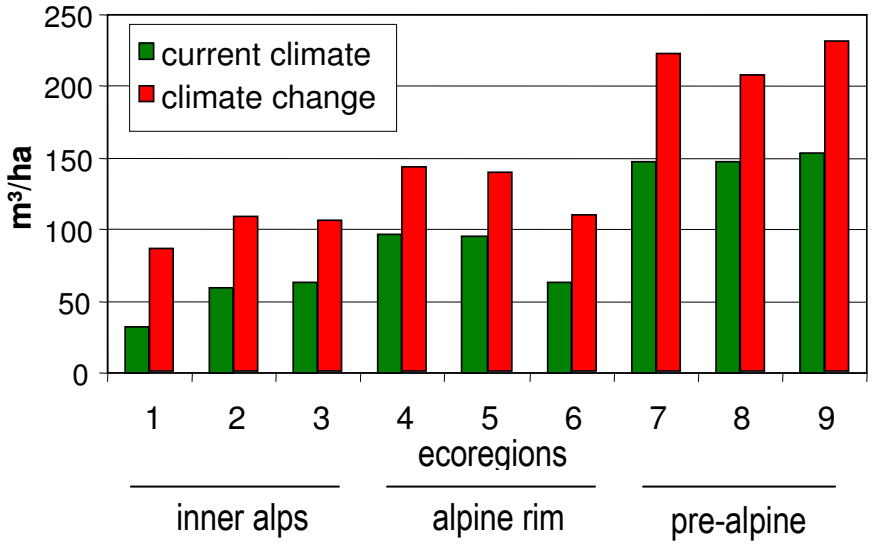
(-) dynamic simulation: large scale scenario model EFISCEN
(-) included: spruce bark beetle disturbance module
(-) spatial resolution: provinces x forest ecoregions
(-) SRES scenario: B1 (+2.4 °C)
(-) climate: ECHAM4

in cooperation with EUROPEAN FOREST INSTITUTE

temporal development (Austria)



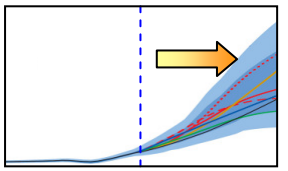
spatial distribution (ecoregions, cum. damage)



[Seidl et al., 2007 (subm.)]

adaptation and mitigation in SFM

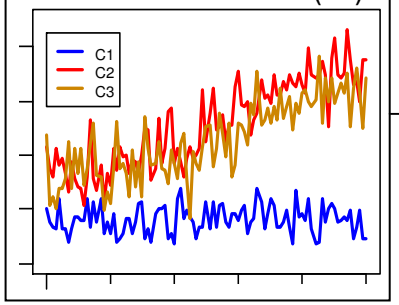
a case study for a forest management unit in Austria (iv)



Management (3x)

- MS1: Norway spruce ACF (BAU)
- MS2: Norway spruce CCF
- MS3: mixed forests ACF

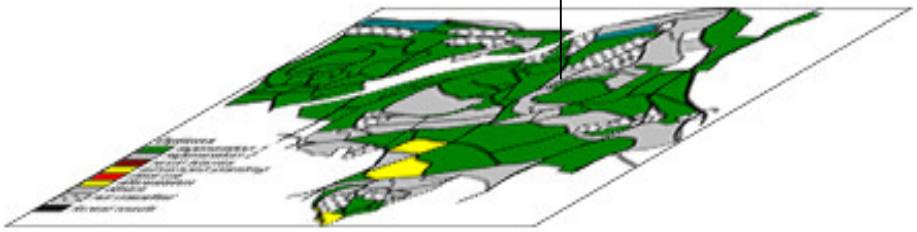
Climate scenarios (3x)

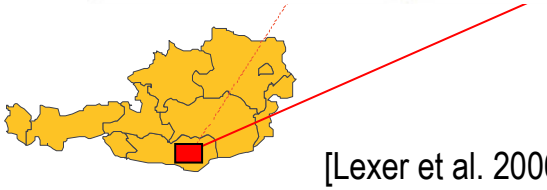


simulation model

PICUS 1.4.1

ecosystem simulation





TIMBER PRODUCTION

- standing stock
- increment
- harvest
- contribution margin
- NPV
- disturbances
- ...

Wood Products Model

C-STORAGE

- in situ
- wood products
- bioenergy
- opportunity costs
- ...

BIODIVERSITY

- deadwood
- species richness
- naturalness
- ...

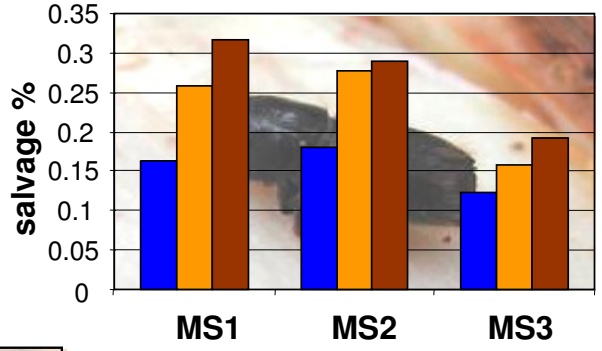
[Lexer et al. 2006, Seidl et al., 2007a, Seidl et al., 2007b]

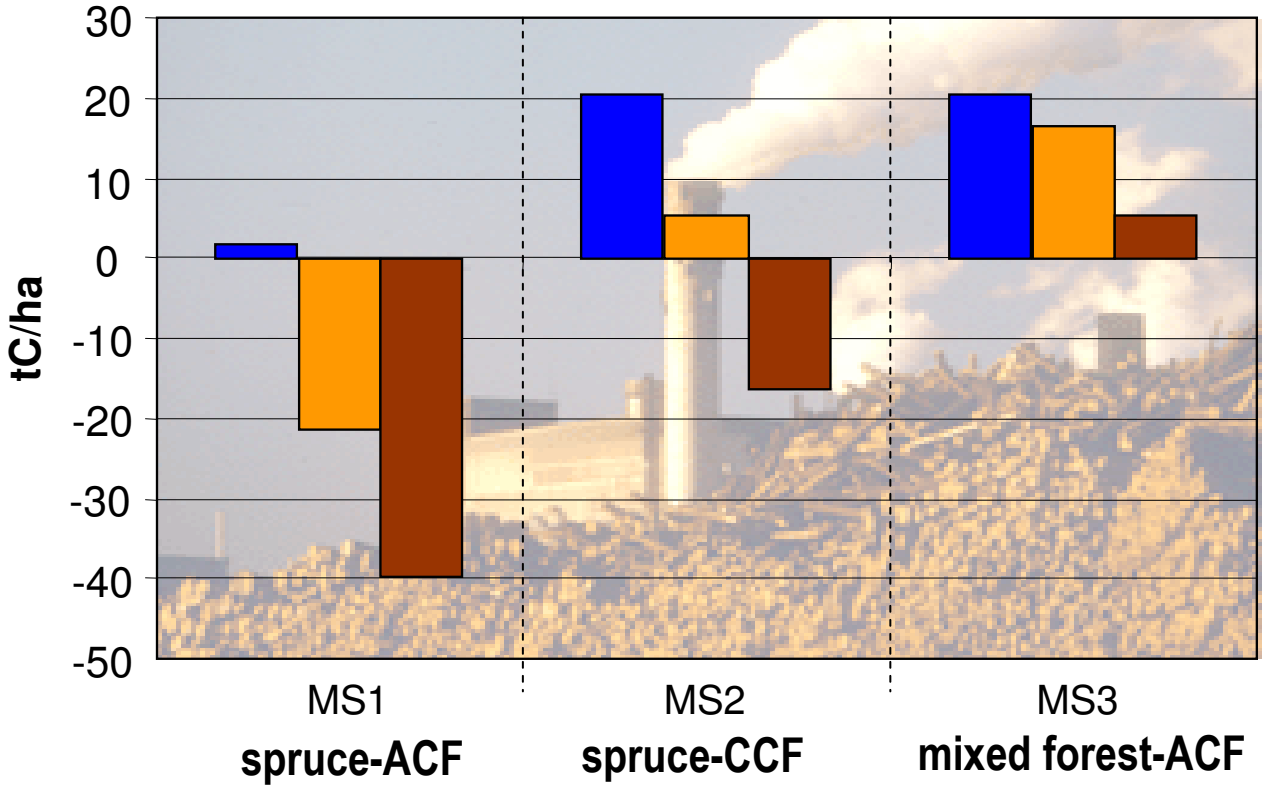
Salvage of bark beetle infested timber

&

C-Storage in the forest

„flow summation“ over 100 years

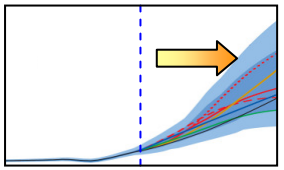




C1 (current)

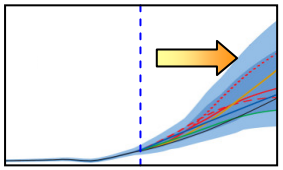
C2 (ECHAM4)

C3 (HADCM2)



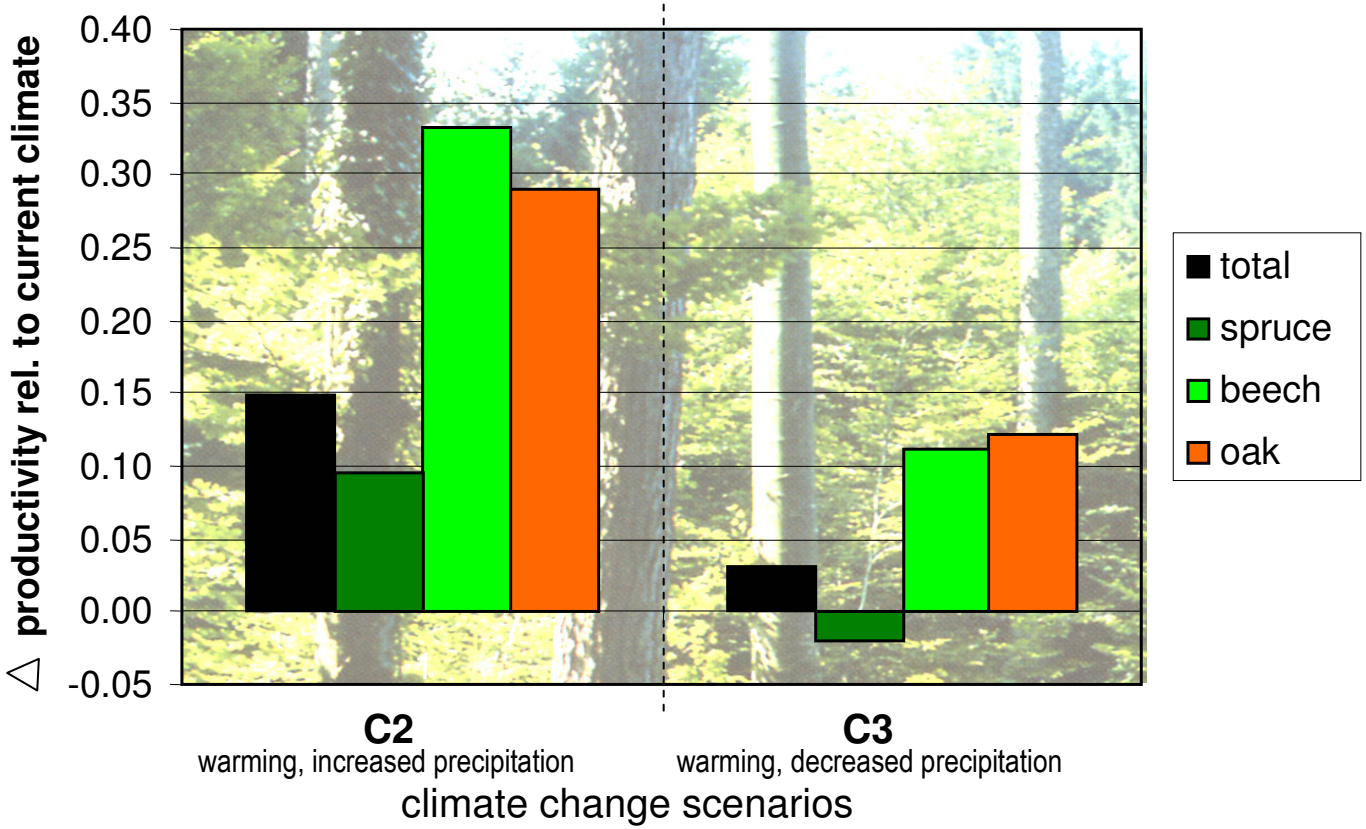
Adaptation options and forest growth

a case study for a forest management unit in Austria (iv)



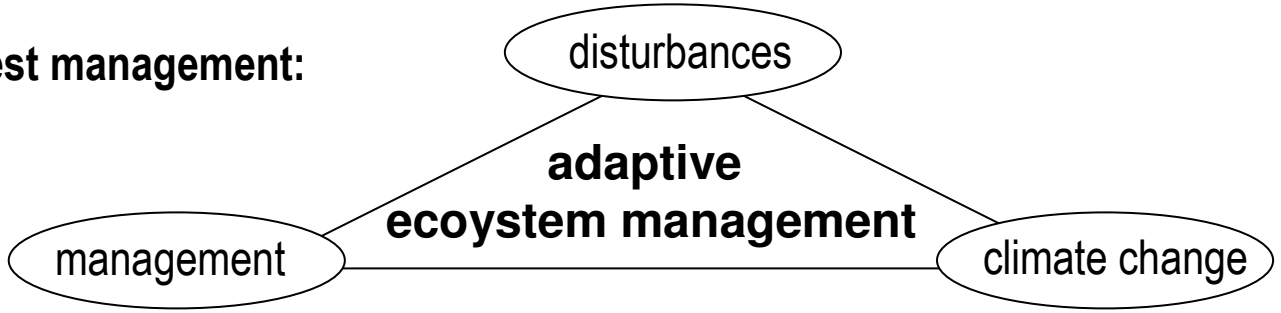
increment changes under climate change (compared to current climate)

MS3: Mixed forests (Picea abies, Fagus sylvatica, Quercus robur)



conclusions, outlook

- **key issue in forest management:**



- strengthen predictive capacity under climate change for decision support
- intensify research to understand interactions, feedbacks and trade-offs
- integrate mitigation and adaptation objectives under the umbrella of SFM
- disentangle conflicts between adaptation and other objectives (e.g., Natura2000)
- integrate owners / stakeholders in development and analysis of adaptive management options

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Thank you!

more information:

www.wabo.boku.ac.at/picus.html

www.wabo.boku.ac.at/waldbau.html

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