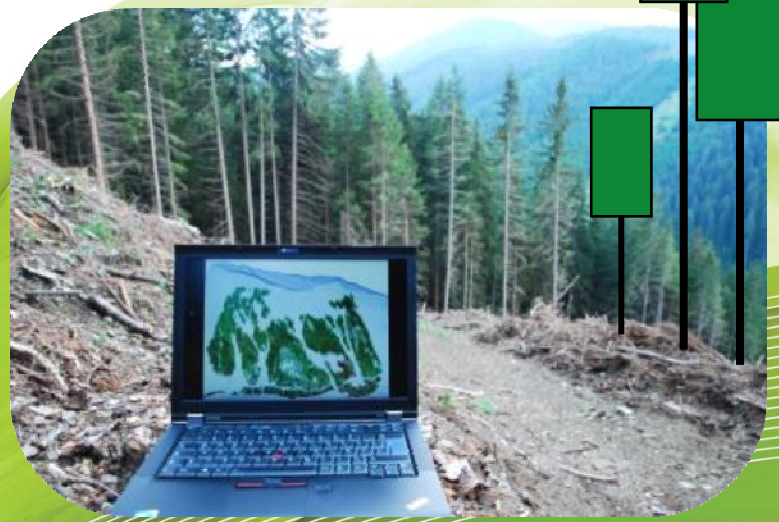
University of Natural Resources and Life Sciences, Vienna
Department of Forest and Soil Sciences

Simulation-based decision support for forest management under climate change.

An example from Austrian mountain forests



Manfred J. Lexer

AFORCE
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content

- background & expectations
- a forest simulation model
  - creating initial forest conditions
  - visualizing model output
- example: applying a forest simulation model
- decision support: fact or fiction?

background

- growing demands towards forest ecosystems & forest management
  - interest in various ecosystem services
  - by a variety of stakeholders
  - credible proof of sustainable forest management needed
  - uncertainties due to climate change
  - need for cost-efficient management (hesitant payments for ecosystem services)
- technological progress
  - computing power
  - remote sensing (air- & spaceborn) based inventories

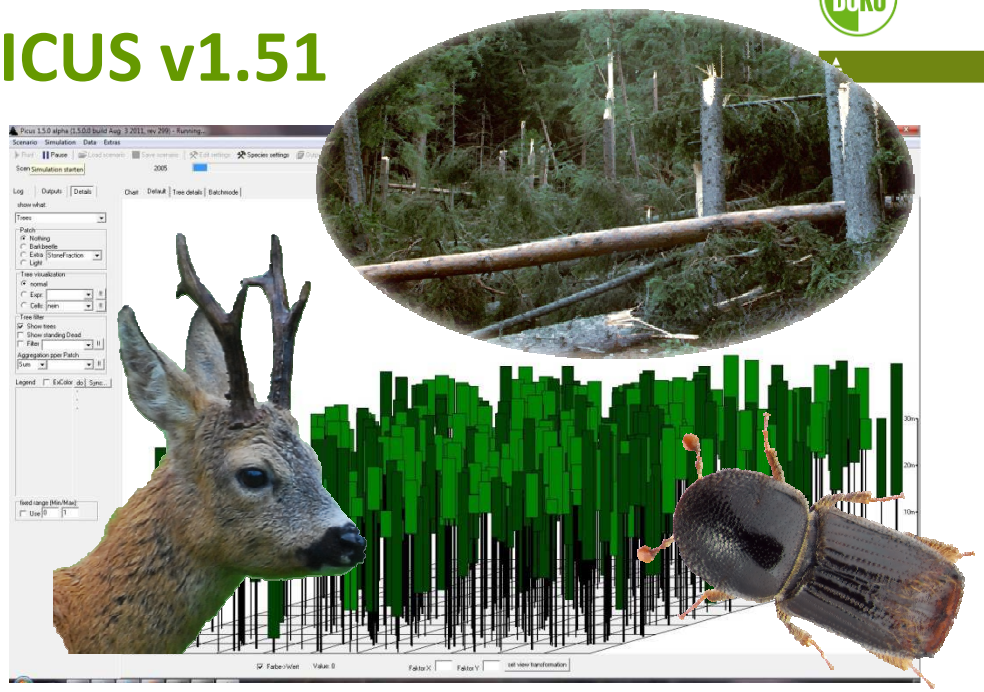
Expectations towards forest simulation models as decision support tools …

- projection of mid-/longterm forest development **AND** related ecosystem service provisioning
- virtual experiments to explore the interrelated effects of
  - management
  - climate change
  - disturbances
- virtual try-out of options without risk of failure
- accurate predictions of future forest values
- transparency and reproducability of management planning

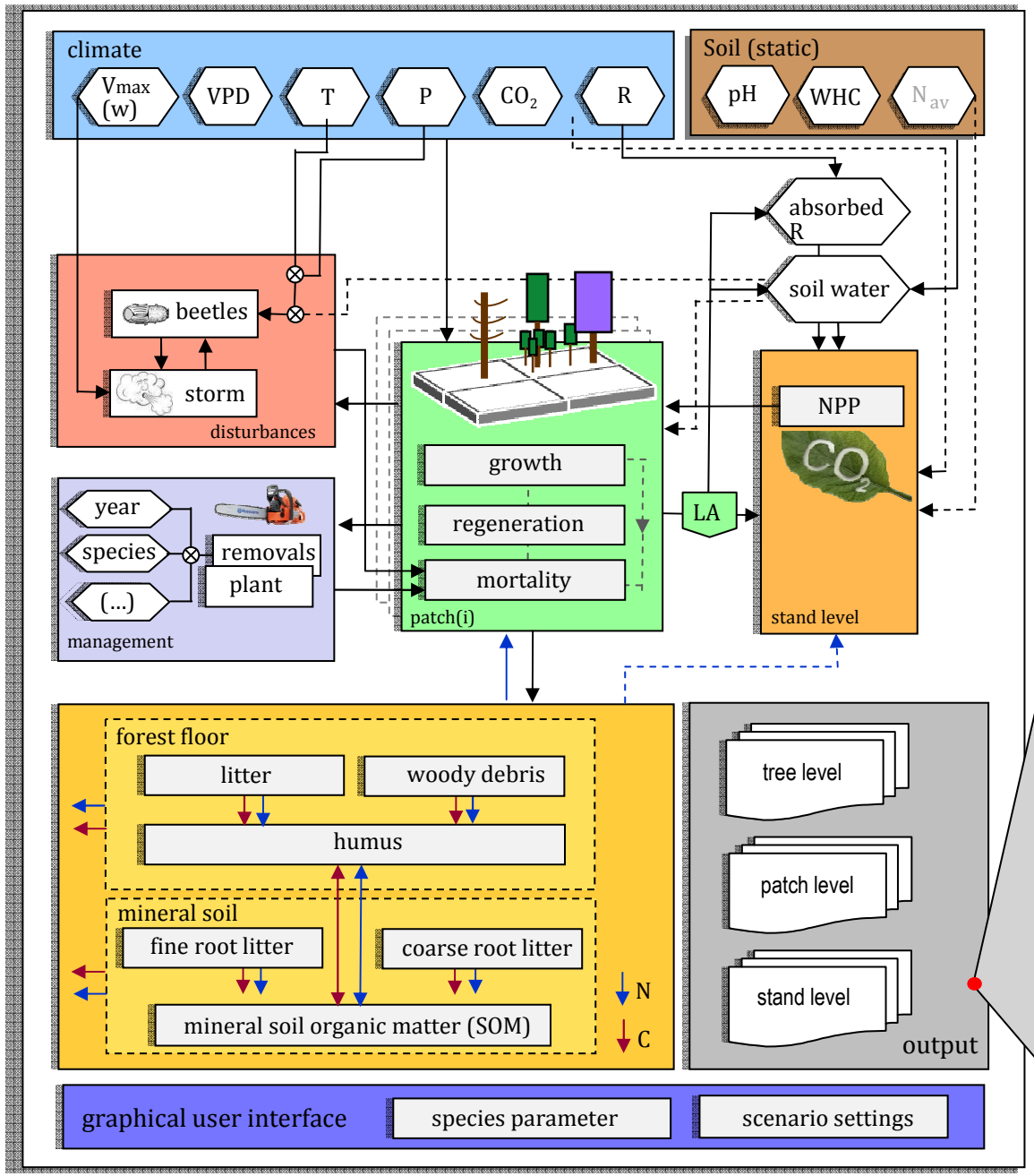
profile

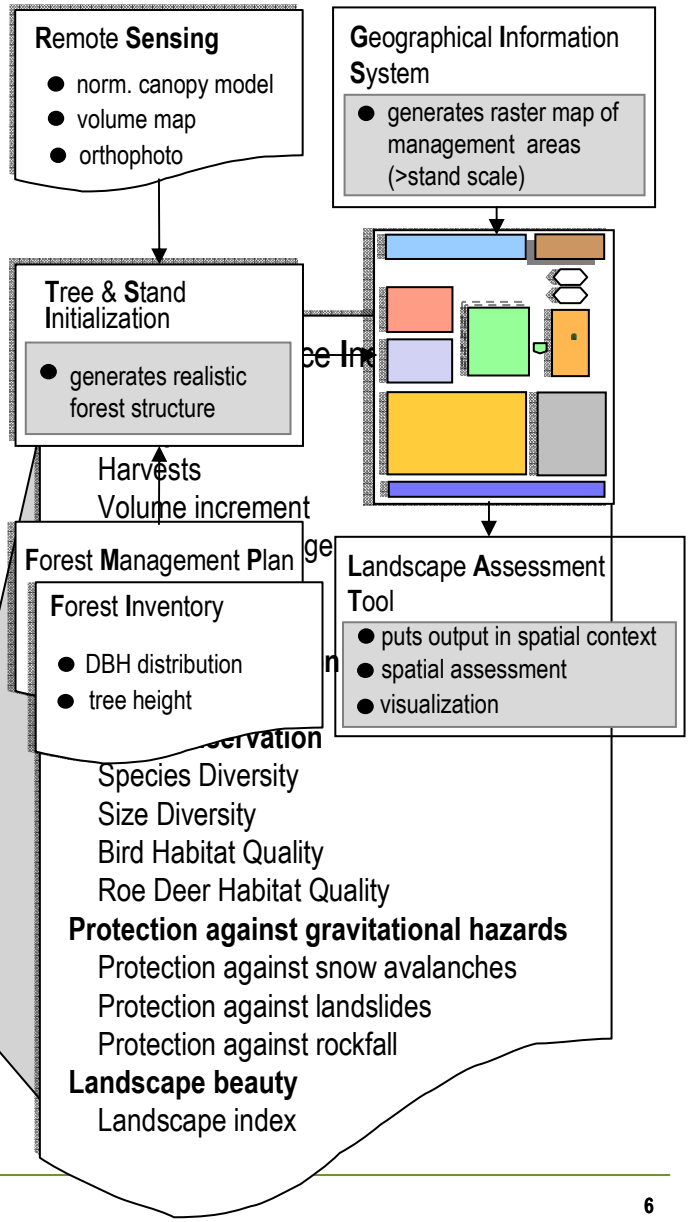
forest ecosystem model PICUS v1.51

- hybrid approach
  - patch x ITG x phys.prod. model
  - processes at tree & stand level
  - sensitive to climate
- spatial resolution 10 x 10 m
- tree population dynamics
  - growth
  - mortality
  - regeneration
- disturbance regimes
  - bark beetles
  - storm
  - browsing by ungulates
- can simulate up to 25ha forest area simultaneously
- output in annual time steps
- simulation period >100s years



model components

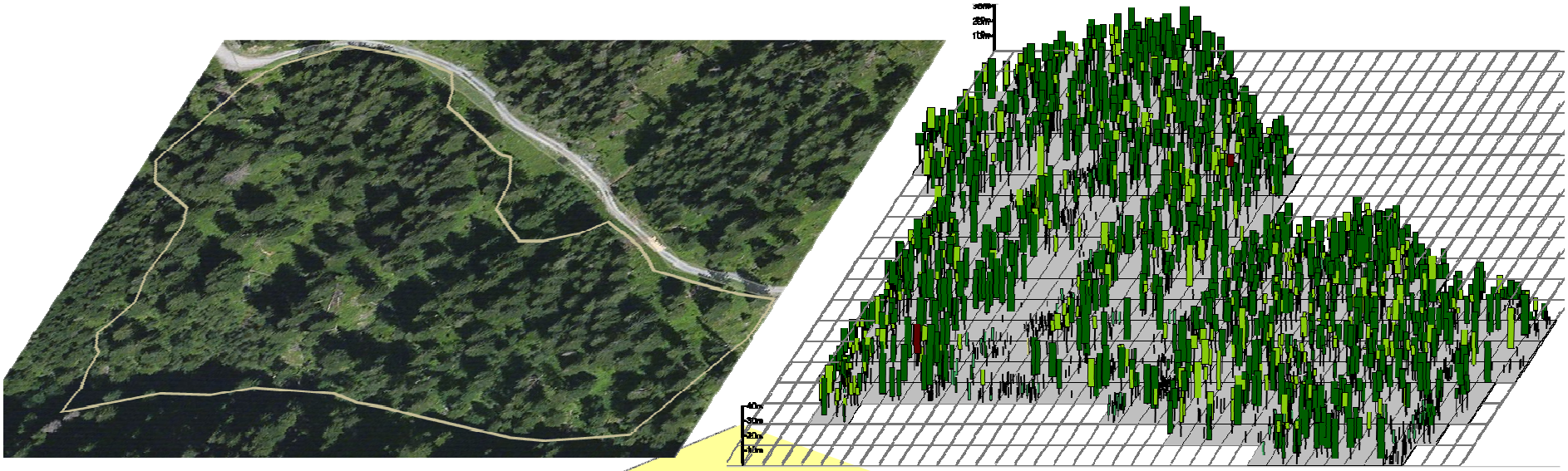




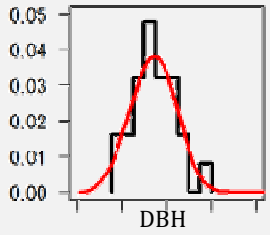
Initial state of a forest simulation

Combining management plan, forest inventory data & remote sensing

real forest → virtual (random)

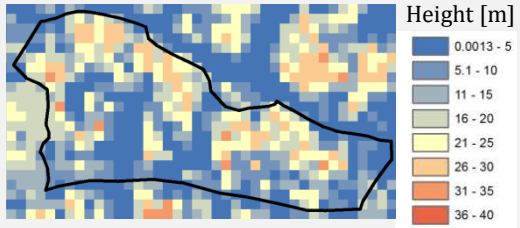


management plan & inventory



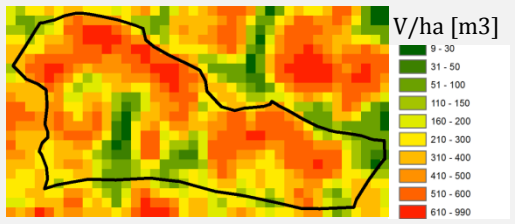
&

canopy model (LiDAR)

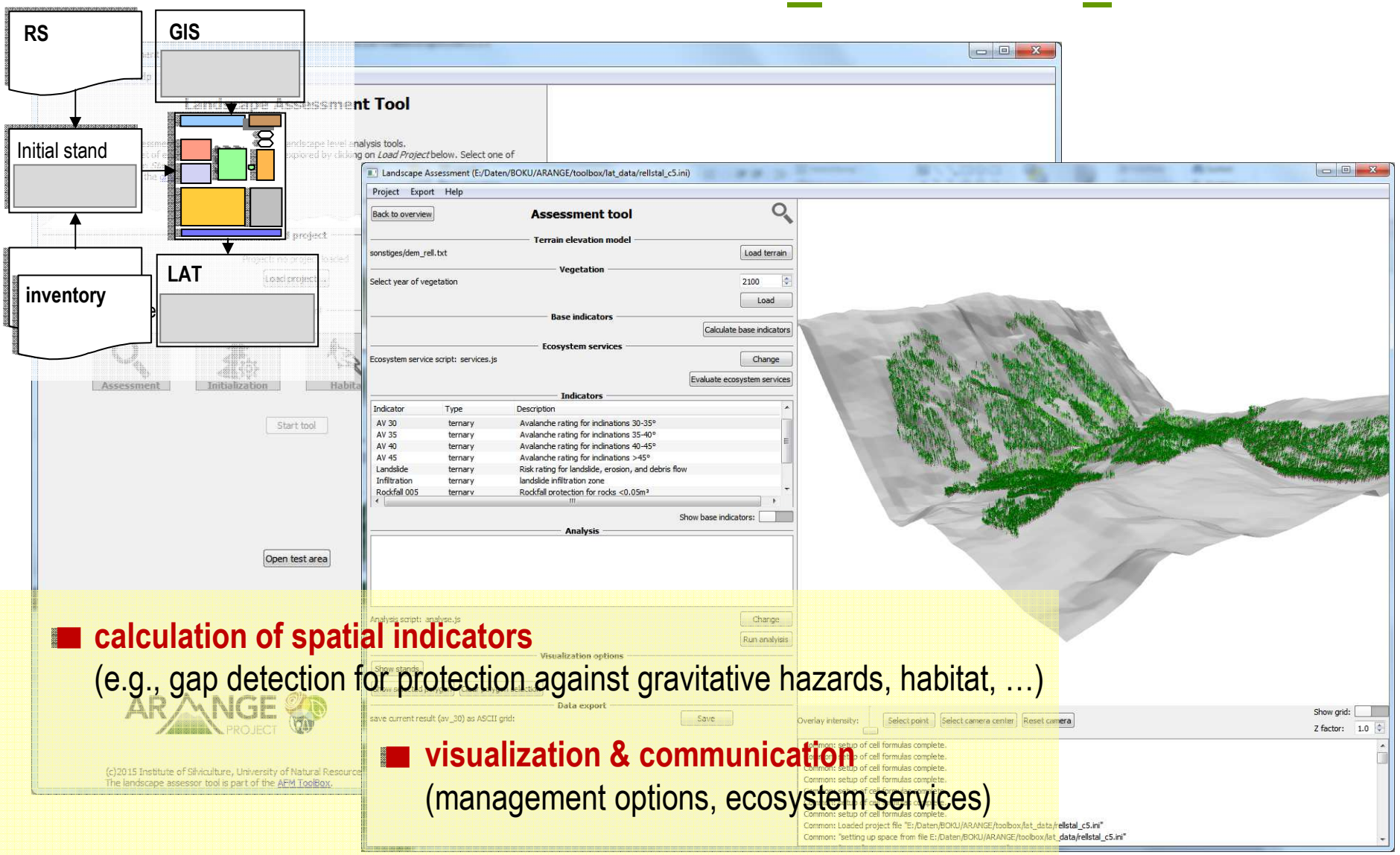


&

volume (LiDAR)



… loading output files into „Landscape Assessment Tool“



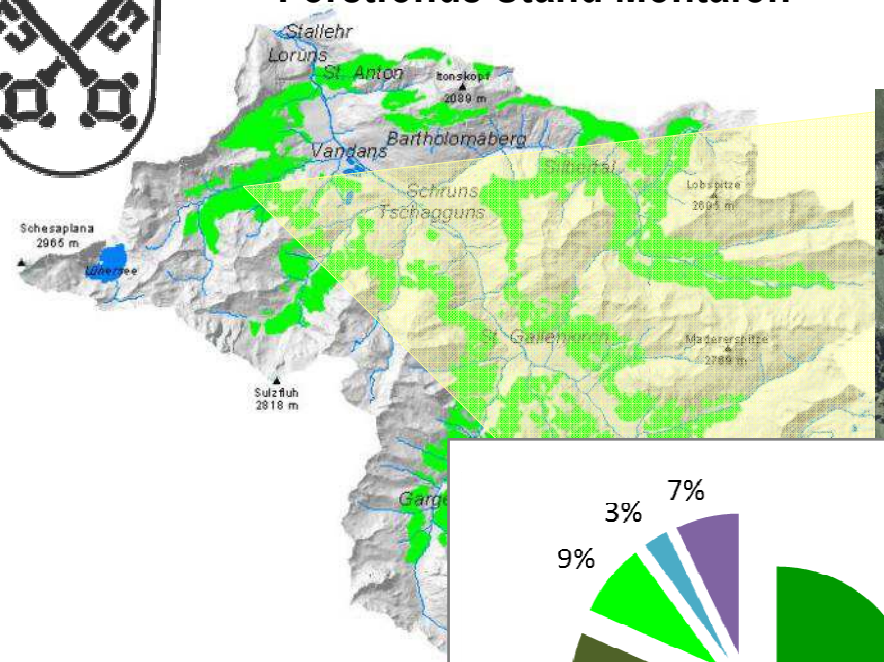
- **calculation of spatial indicators**
  (e.g., gap detection for protection against gravitative hazards, habitat, …)
- **visualization & communication**
  (management options, ecosystem services)


RS
GIS
Initial stand
inventory
LAT

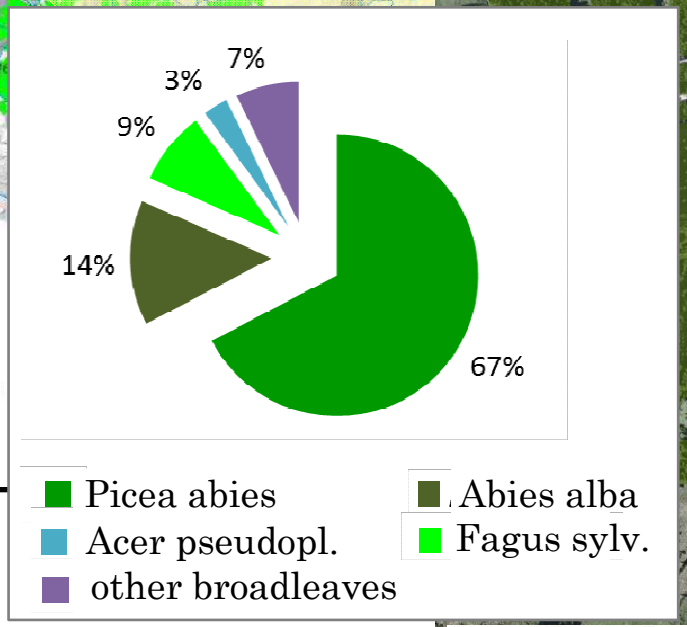
model application – example

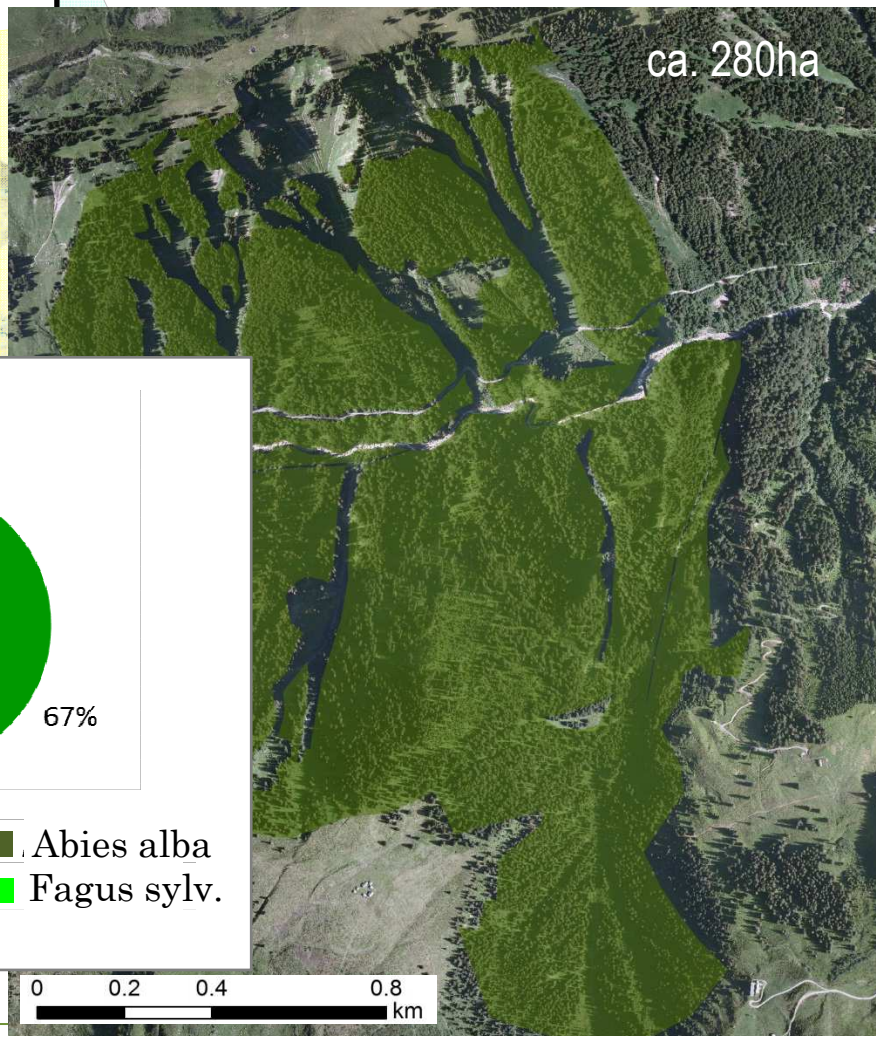
a catchment in the Eastern Alps in Austria

Forstfonds Stand Montafon

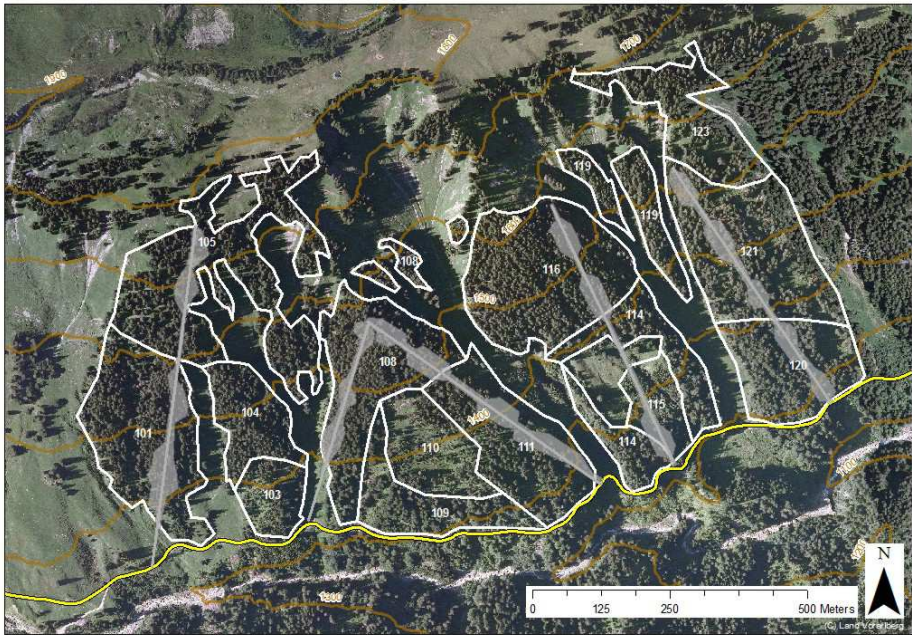


- community forest
- 8 municipalities
- established 1832
- 6800ha forest area

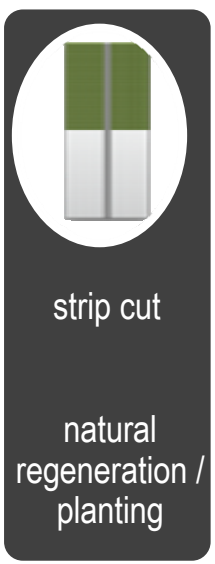


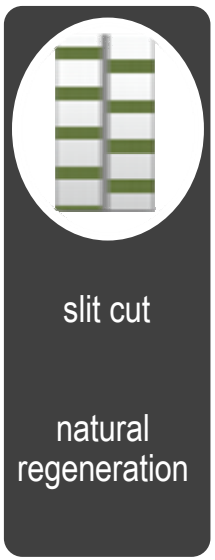


forest management
Business As Usual & alternatives



- skylines of 800-1200m length across slope (skyline yarding)
- current practice (BAU): patch cuts along skyline, natural regeneration
- **What happens to ecosystem service provisioning on the long run?**
  - **Continuing with current management?**
  - **What are effects of climate change?**

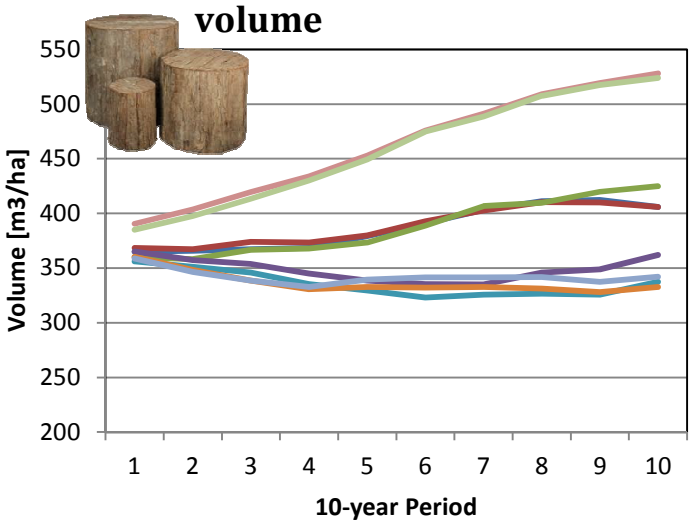


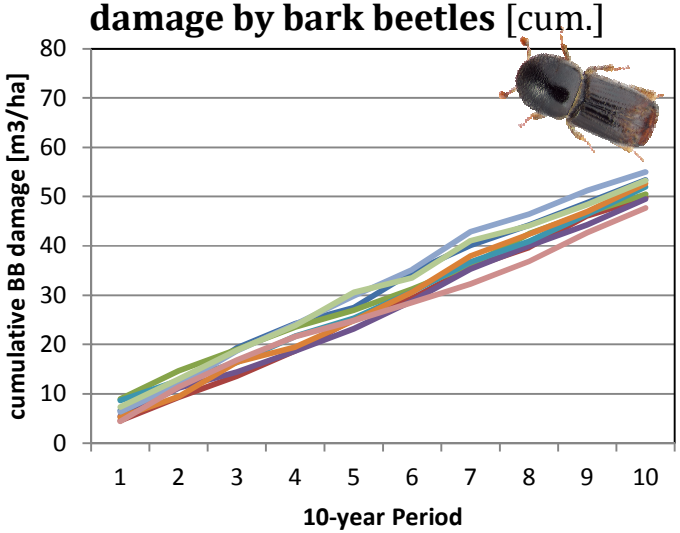


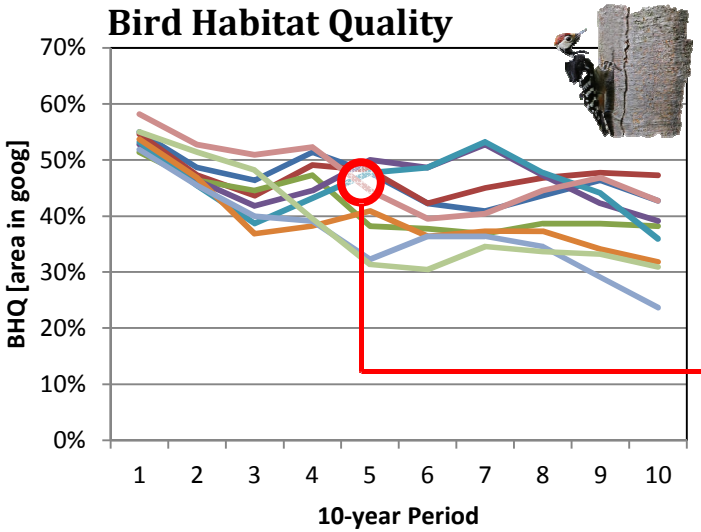
aggregating model output for interpretation

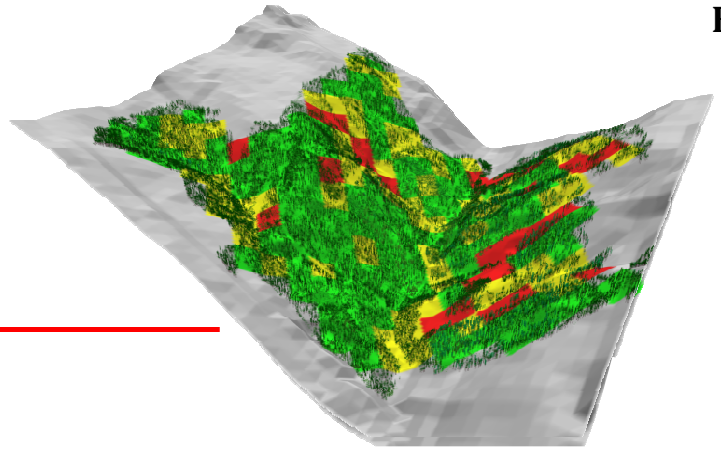
effects of management

[historic climate]









Bird Habitat Quality

- good
- moderate
- bad

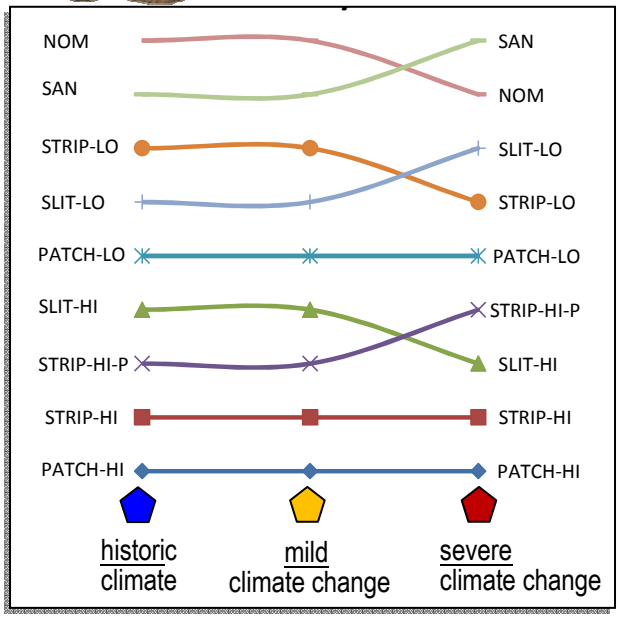
PATCH-LO [2050]

aggregating model output

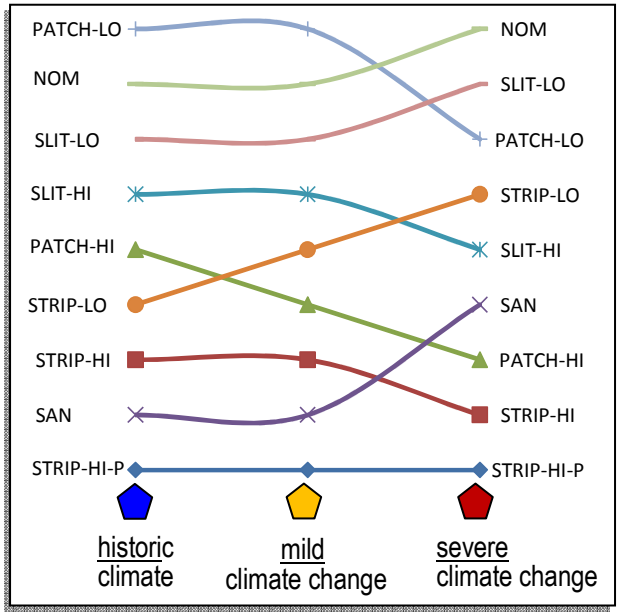
Effects of climate change

[period 2066-2100]

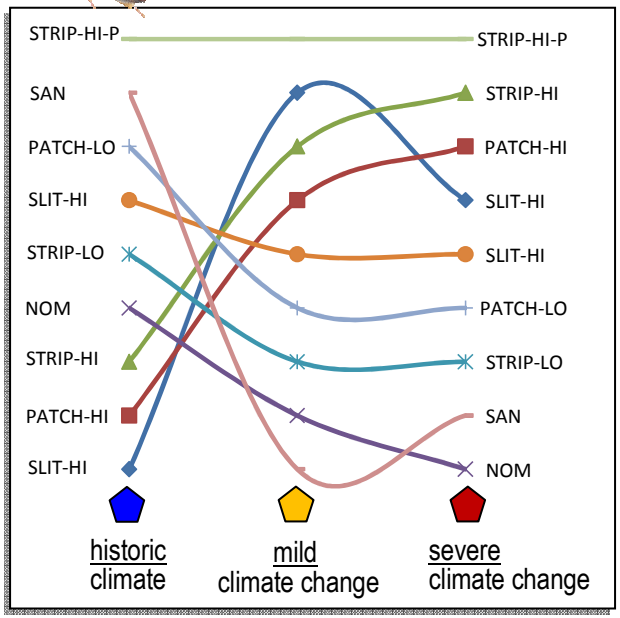
volume



Bird Habitat Quality



damage by bark beetles



Conclusions from model application:

- *disturbances drive development of forest structure and related ES provisioning*
- *partly huge trade-offs between ES (timber vs habitat & protection)*
- *partly synergies (habitat, protection)*
- *planting may be required to manage with shorter turn-over times*

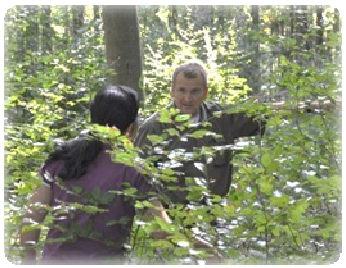
synthesis & conclusion

simulation-based decision support: fact or fiction?

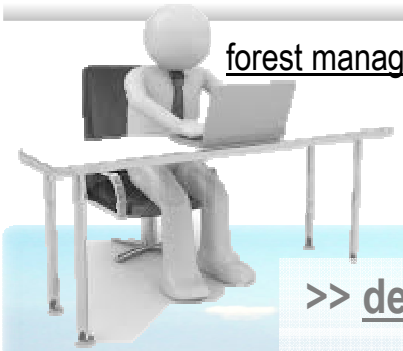
small-scale owner

„Which tree species are suitable in the future?"

>>need for operational guidance



>> simulation & analysis >> guidelines >> advice by extension services



forest manager

„How can I meet the demand of my stakeholders for ES?"

„What is the best plan for my unit?"

>> designing a strategy

>> optimizing a management plan

- demonstration cases by scientists

>> simulation & optimization & visualization

>> interpretation

- manager hires a consultant

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thank you!

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