

*Developing decision support systems to estimate future  
ecosystem service provisioning in forests*

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*Balancing ecosystem services - challenges and opportunities*

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# Planning of future ecosystem service provisioning

Background

Methods

Case 1: Timber

Case 2: Recreation

Case 3: Biodiv.

Case 4: Protection

Limitations

Summary

- Increasing portfolio of **biodiversity and ecosystem services (BES)**
- Conversion towards mixed forests
- Increasing **climate change** impacts on forests expected
- **Disturbance** regimes are likely to intensify
- **Volatile** wood prices

→ **Highly complex future planning situation**

# Simulation models supporting planning

Background

Methods

Case 1: Timber

Case 2: Recreation

Case 3: Biodiv.

Case 4: Protection

Limitations

Summary

- **Forest models** as tools to estimate future developments of forest ecosystems

Real  
Forest



Virtual  
Forest



# Simulation models supporting planning

Background

Methods

Case 1: Timber

Case 2: Recreation

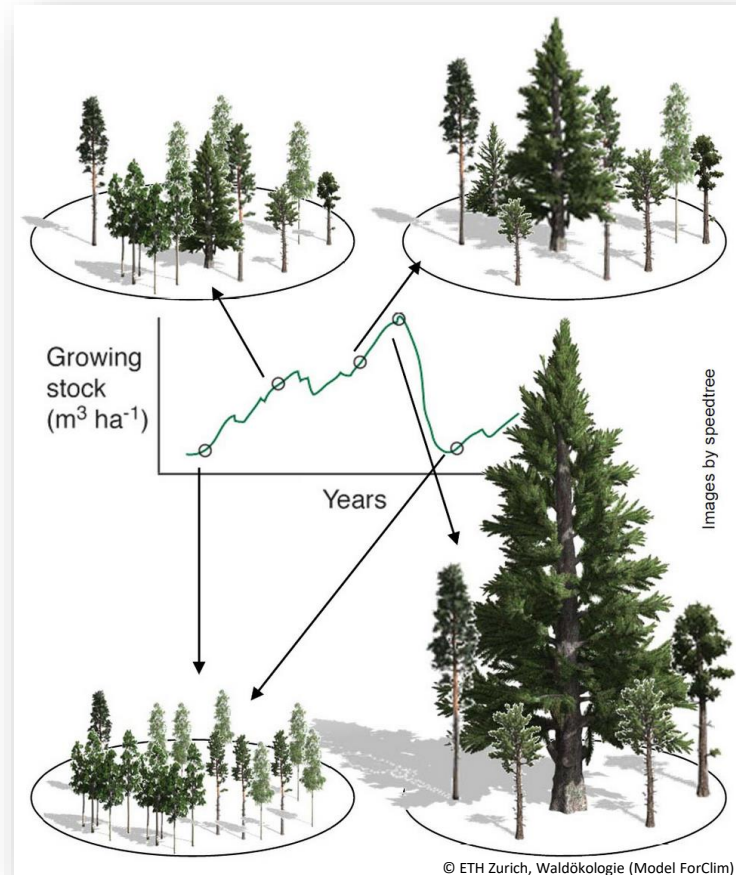
Case 3: Biodiv.

Case 4: Protection

Limitations

Summary

- **Forest models** as tools to estimate future developments of forest ecosystems
- Different scenarios can be analysed, e.g. **climate change, forest management, etc.**



Real  
Forest

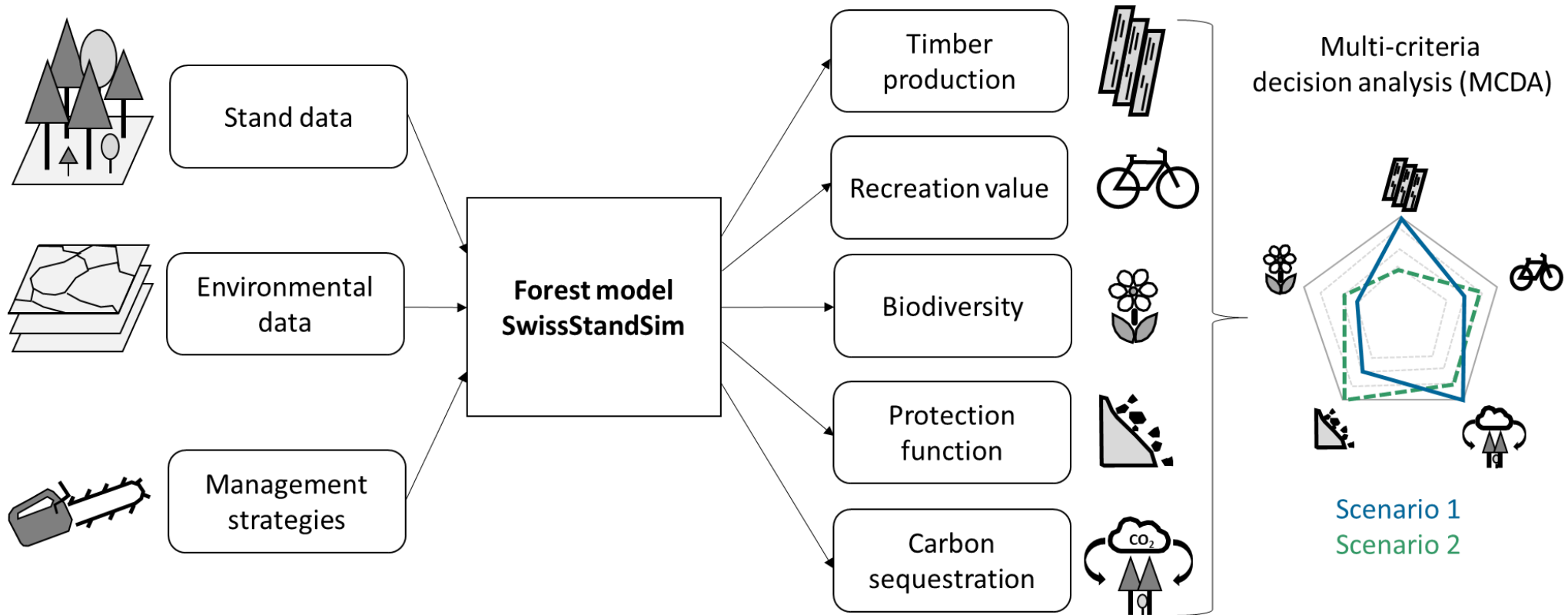


Virtual  
Forest



# Simulation models supporting planning

## Decision support system (DSS) for ecosystem service provisioning by forest enterprises (SessFor project at WSL)



# Four example case studies of ecosystem service provisioning

Background

Methods

Case 1: Timber

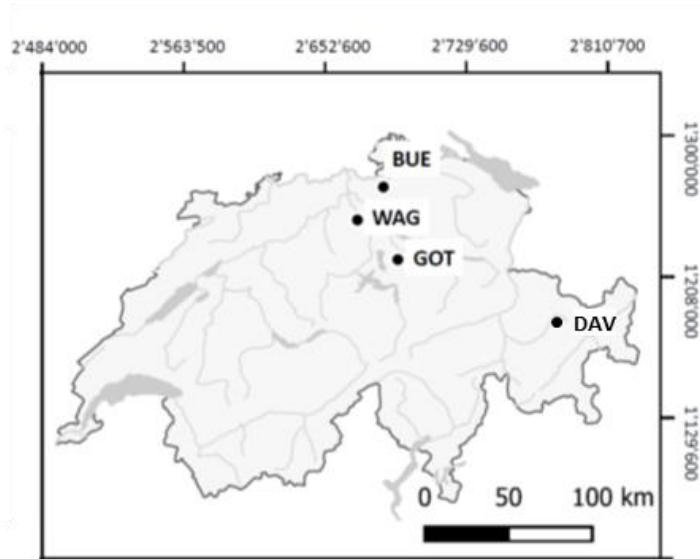
Case 2: Recreation

Case 3: Biodiv.

Case 4: Protection

Limitations

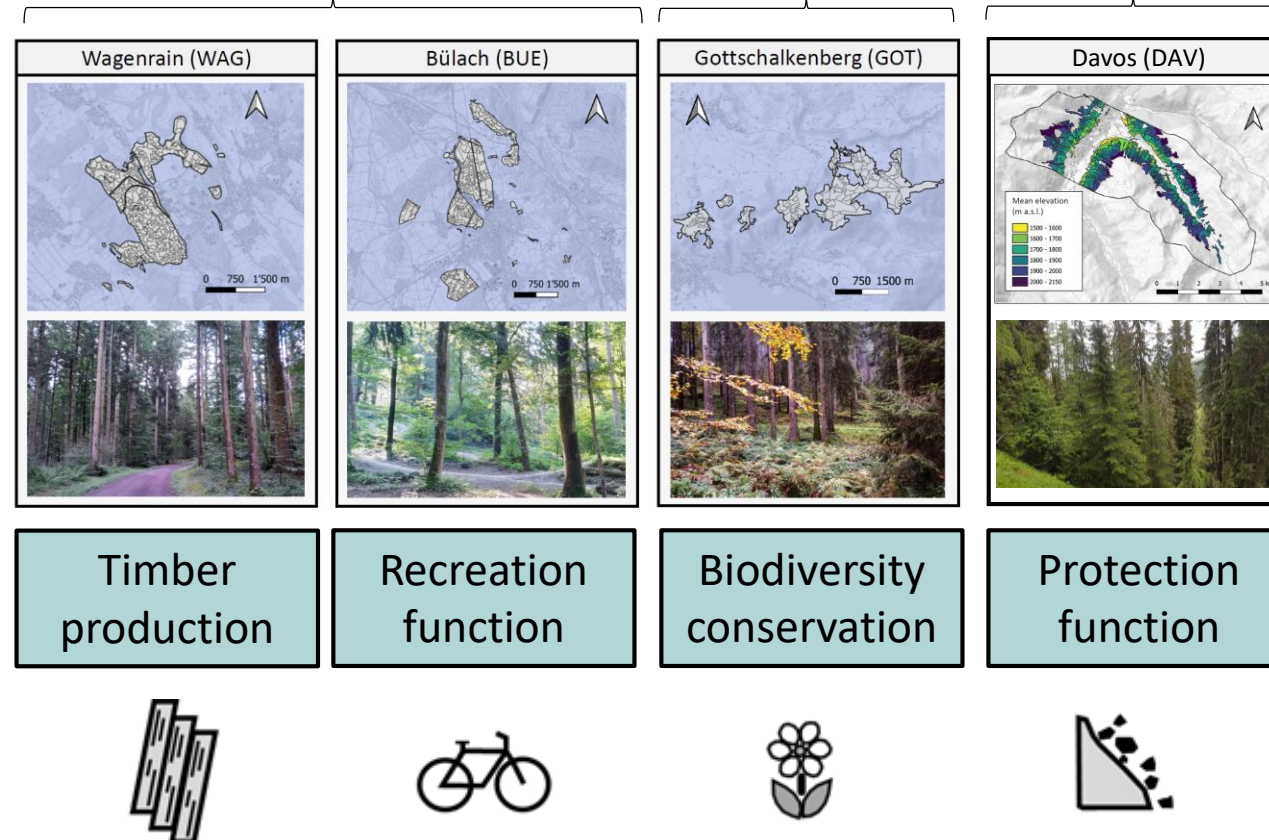
Summary



## Lowlands

## Pre-Alps

## Central-Alps



# Case Study 1 (WAG): Timber production

Background

Methods

Case 1: Timber

Case 2: Recreation

Case 3: Biodiv.

Case 4: Protection

Limitations

Summary

- Enterprise of ca. 400 ha size
- Located in lowland region of Switzerland
- Dominated by spruce, beech and oak
- Main questions:
  - How does **timber provisioning** develop in the future?



# Case Study 1 (WAG): Timber production

Background

Methods

Case 1: Timber

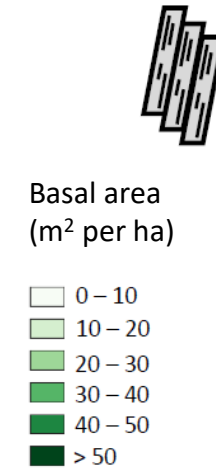
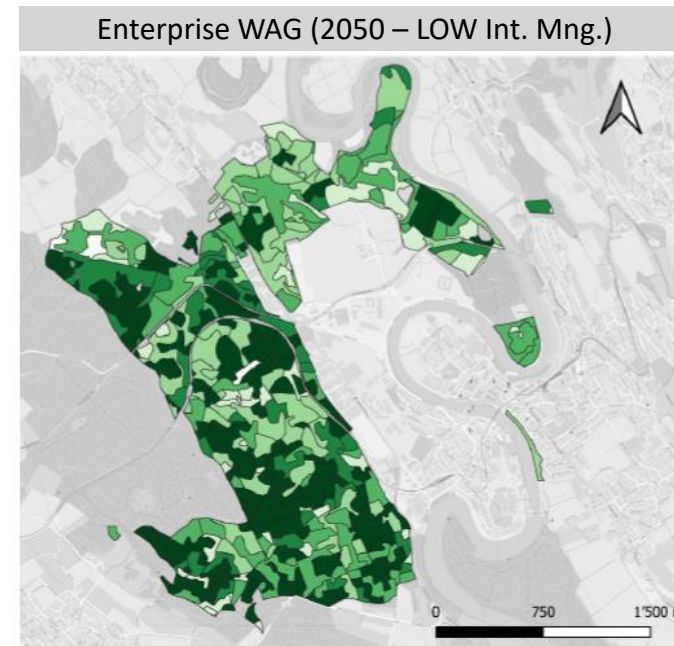
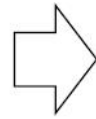
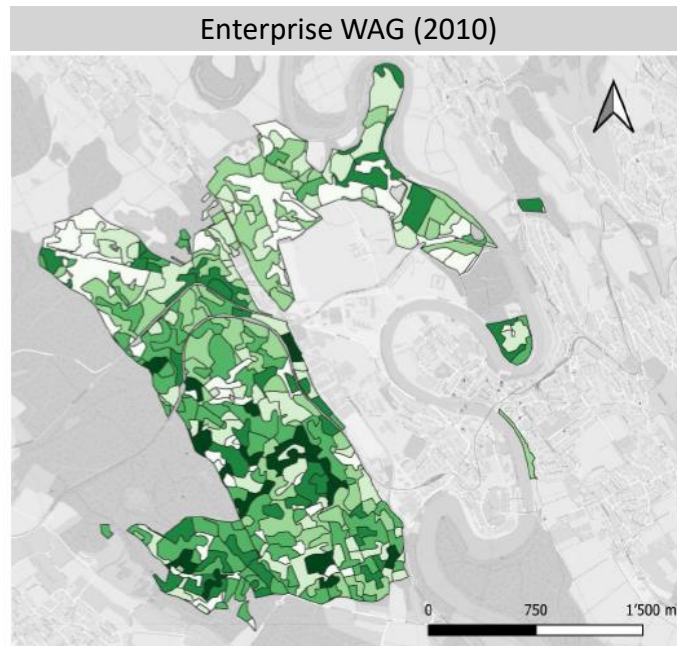
Case 2: Recreation

Case 3: Biodiv.

Case 4: Protection

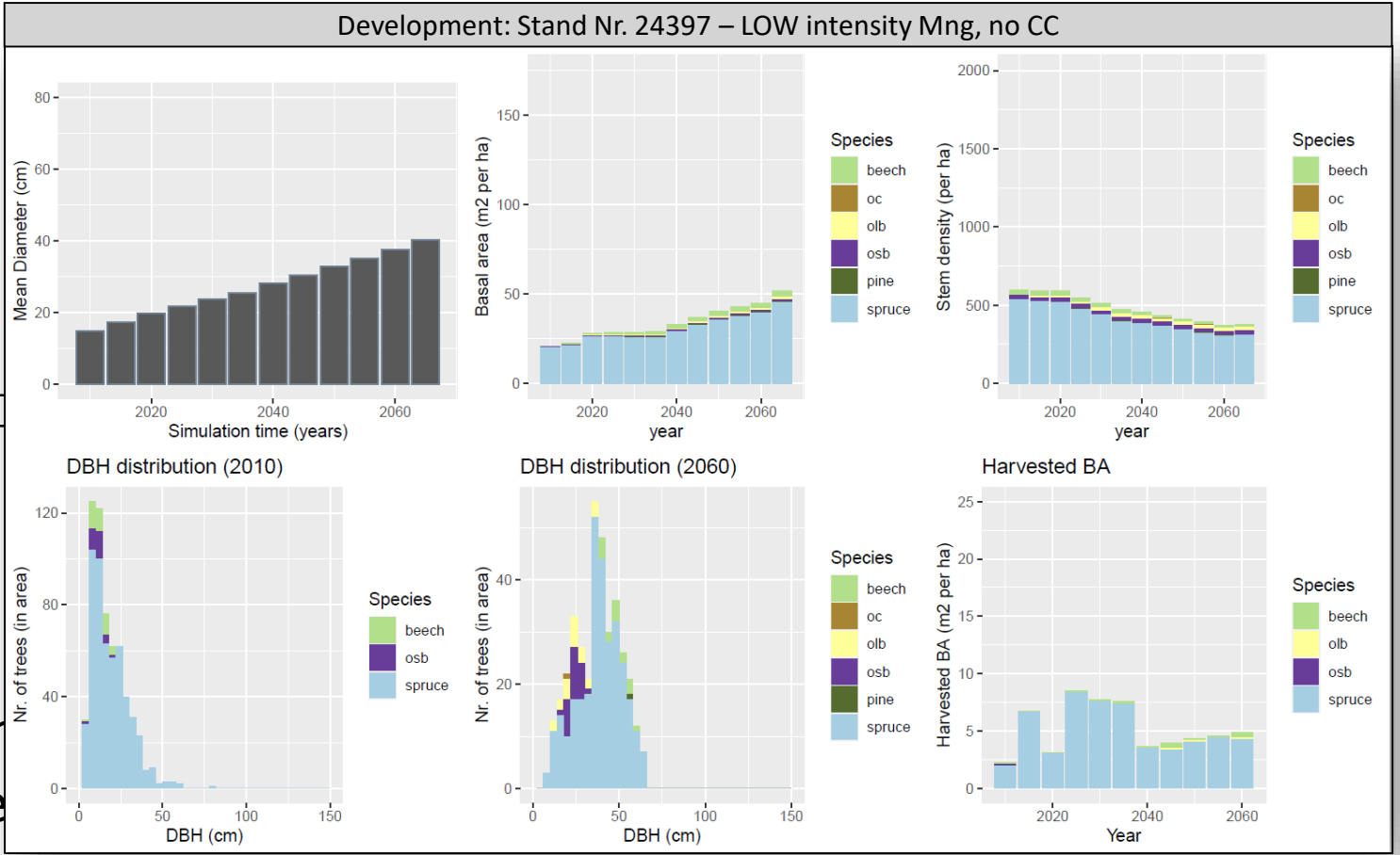
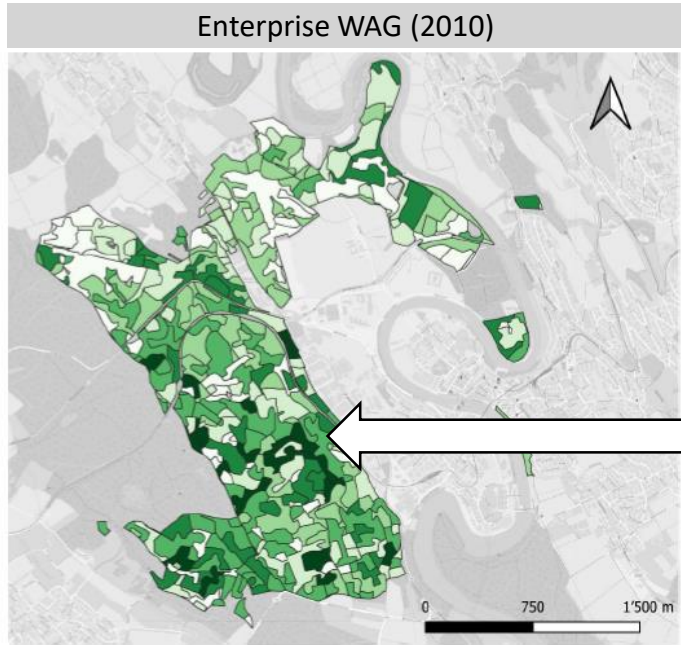
Limitations

Summary



Main finding: general increase in standing stock under current management, even under climate change scenarios (in absence of disturbances)

# Case Study 1 (WAG): Timber production



Main finding: general increase in stand diameter  
under climate change scenarios (in absence of management)

# Case Study 2 (BUE) Recreation function

Background

Methods

Case 1: Timber

Case 2: Recreation

Case 3: Biodiv.

Case 4: Protection

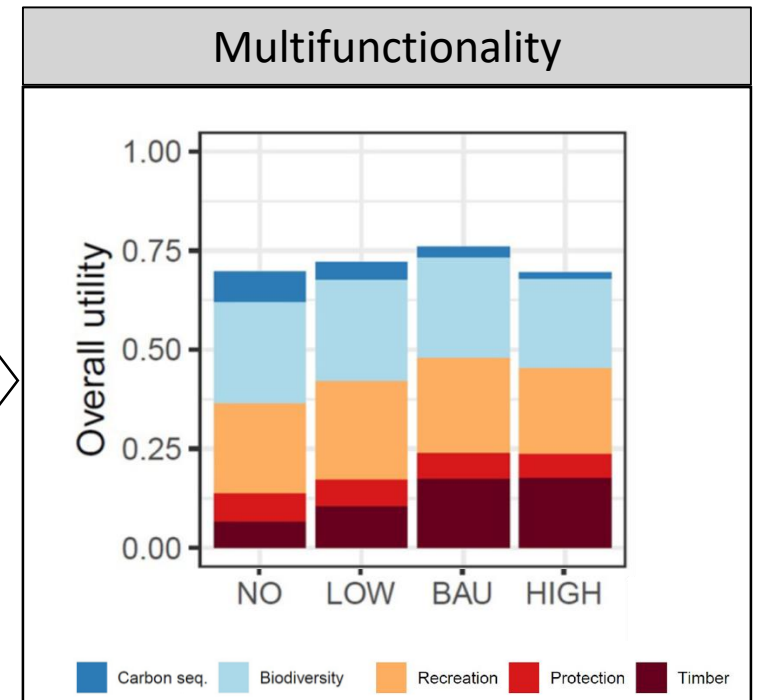
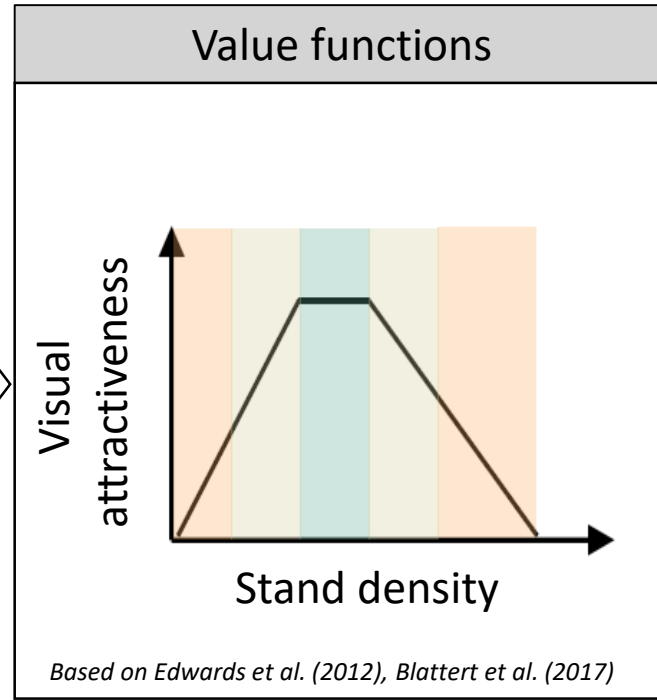
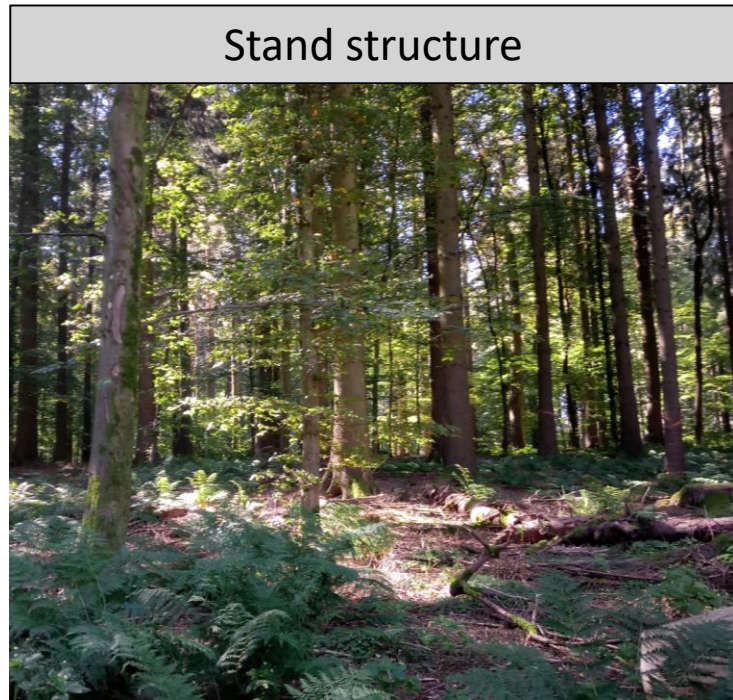
Limitations

Summary

- Enterprise of ca. 500 ha size
- Located in lowland region of Switzerland
- Dominated by broadleaved tree species
- Main question:
  - How does management affect the **recreational value** for forest visitors?



# Case Study 2 (BUE) Recreation function



Main finding: recreational value developed best under current management intensity (BAU)

# Case Study 3 (GOT): Biodiversity conservation

Background

Methods

Case 1: Timber

Case 2: Recreation

Case 3: Biodiv.

Case 4: Protection

Limitations

Summary

- Enterprise of ca. 450 ha size
- Located in Northern Pre-Alps
- Dominated by spruce
- Main questions:
  - Which synergies and trade-offs occur between **biodiversity conservation** and other ecosystem services?



# Case Study 3 (GOT): Biodiversity conservation

Background

Methods

Case 1: Timber

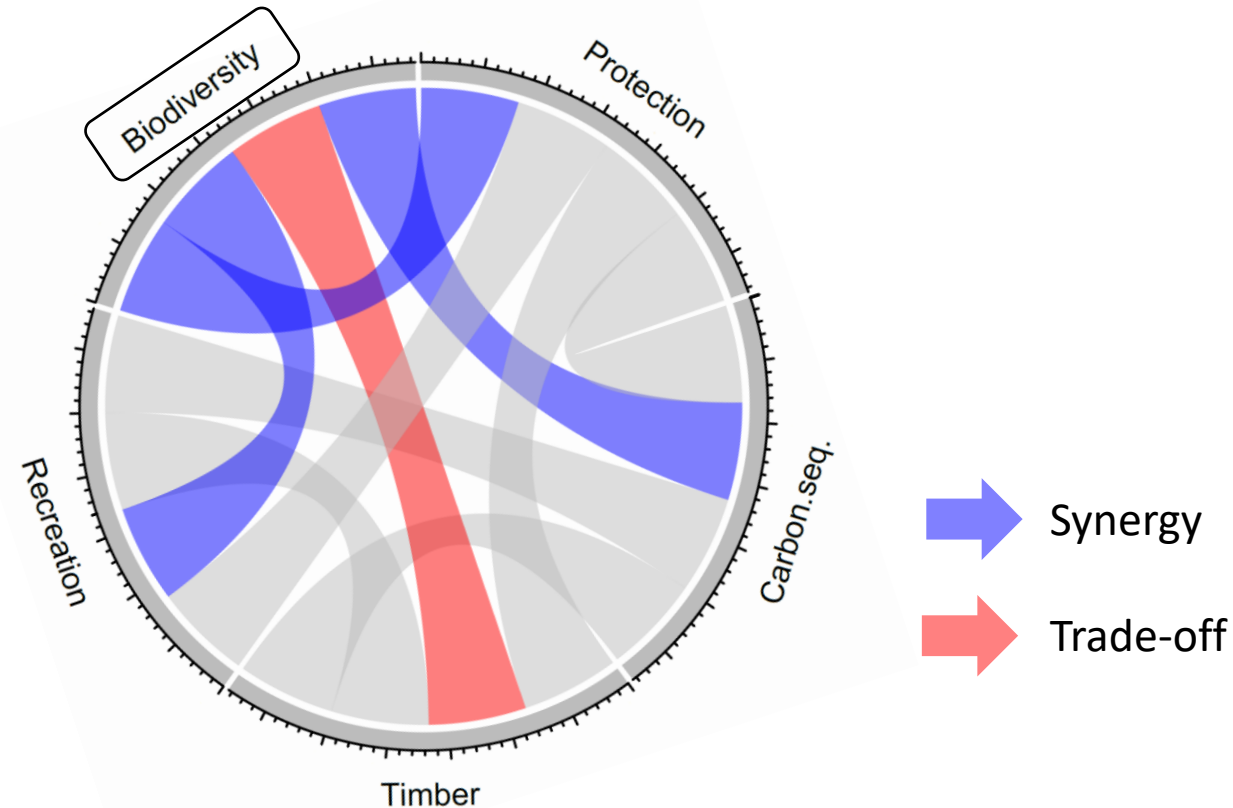
Case 2: Recreation

Case 3: Biodiv.

Case 4: Protection

Limitations

Summary



Main finding: lower management intensity increased biodiversity indicators (deadwood and habitat trees), but trade-off with timber use

# Case Study 4 (Davos): Protection function

Background

Methods

Case 1: Timber

Case 2: Recreation

Case 3: Biodiv.

Case 4: Protection

Limitations

Summary

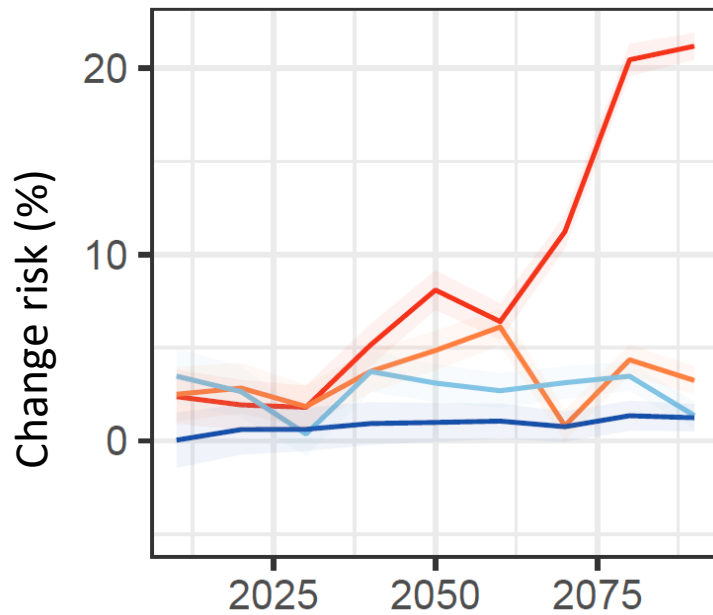
- Enterprise of ca. 1300 ha size
- Located in Eastern Central Alps of Switzerland
- Dominated by spruce and larch
- Main questions:
  - How does the **risk for large disturbances** develop under **future climate change?** (main concern for **protection function**)



# Case Study 4 (Davos): Protection function



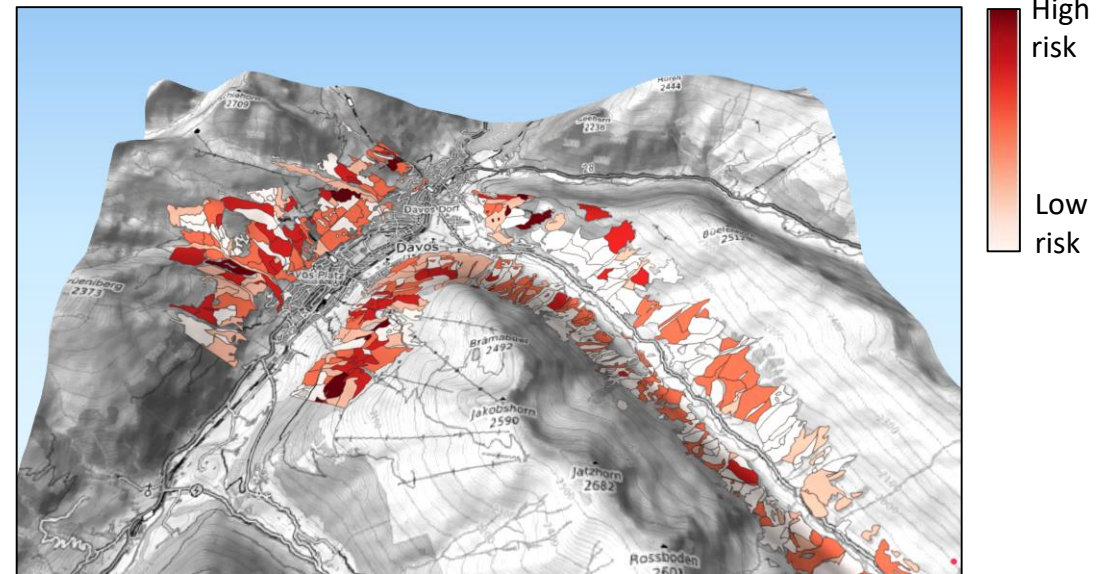
## Bark beetle disturbance risk



Climate Scenarios:



## Example: Map of disturbance risk



# Limitations

Background

Methods

Case 1: Timber

Case 2: Recreation

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Case 4: Protection

Limitations

Summary

- **Extrapolation effects**, particularly under ‘high impact’ climate change scenarios
  - Limits of forest models
- **Restricted spatial resolution** of inventory data
  - Potential of using remote sensing
- Currently system in a prototype stage: **no ‘real-time’ analysis** and interactive user interface
  - High computational demand



## Decision support system (DSS)

- Effect of alternative management strategies and climate change scenarios
- Evaluate multifunctionality (overall utility) and trade-offs between BES
- ➔ Helps forest managers by providing **science-based decision support** for developing **long-term strategies** aiming at a balanced ecosystem service provisioning

# Thank you for your attention!

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Nachhaltige Forstwirtschaft, WSL

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