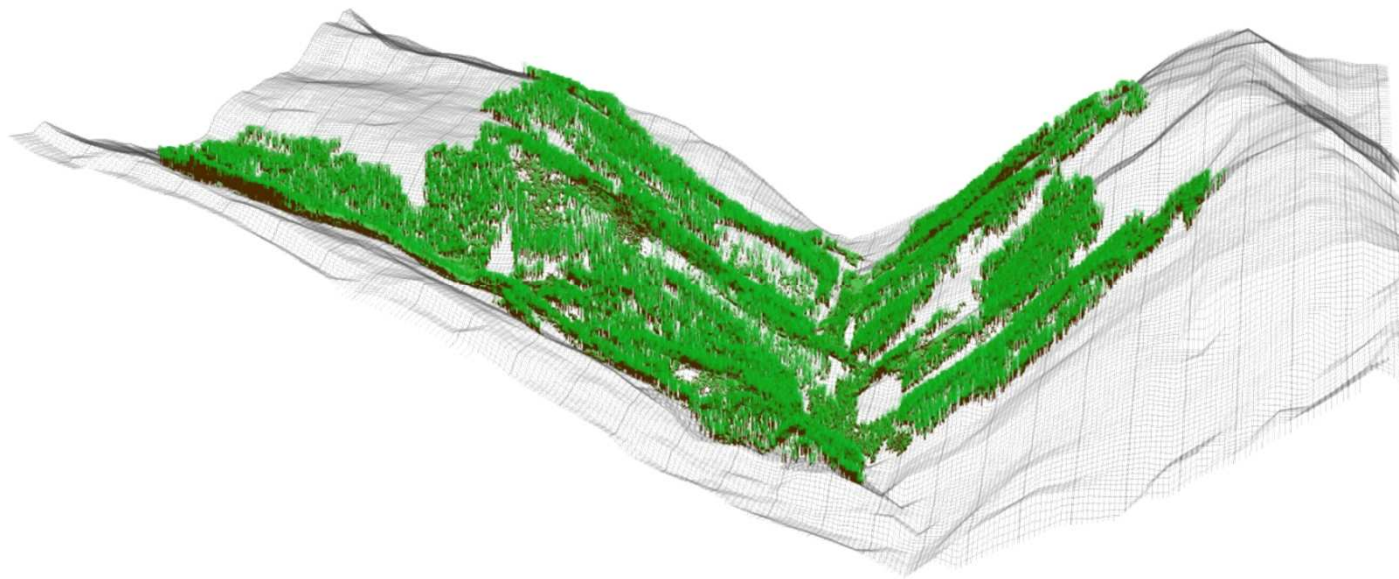




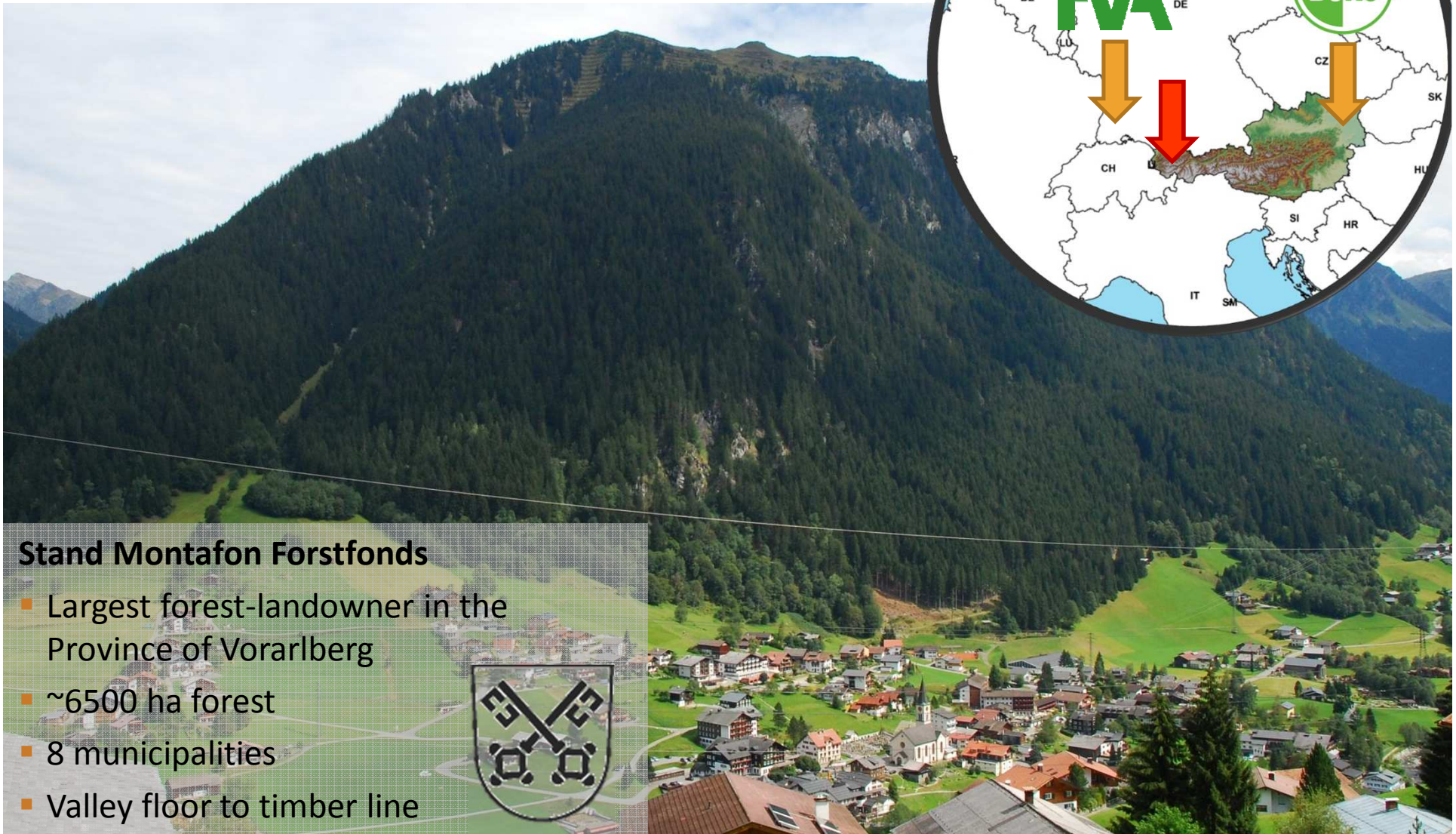
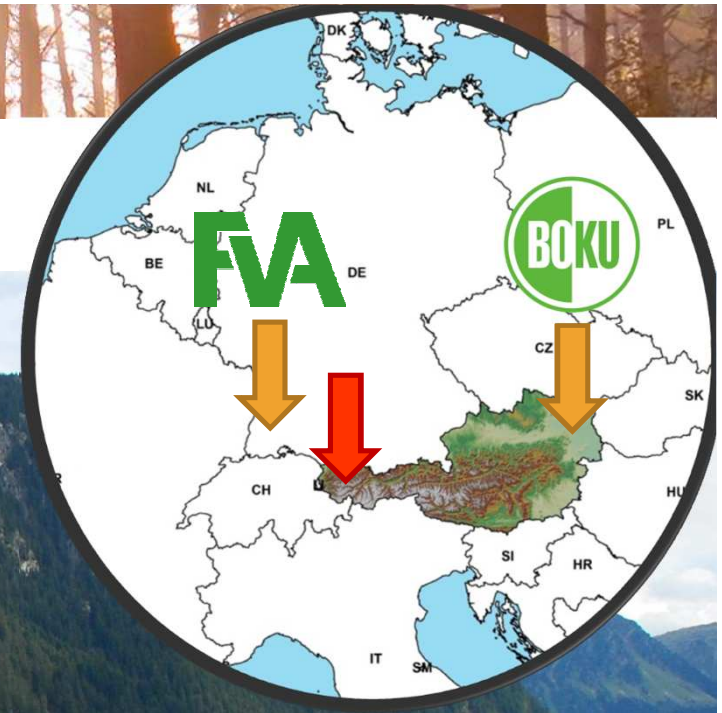
Management options and risk Montafon case study (3b1)

Michael Maroschek, Werner Rammer & Manfred J. Lexer



MOTIVE final meeting 10 APR 2013
Freiburg

Montafon case study



Stand Montafon Forstfonds

- Largest forest-landowner in the Province of Vorarlberg
- ~6500 ha forest
- 8 municipalities
- Valley floor to timber line



Mountain forest ecosystem services



Photo: Fparrel



Photo: Bayer. Forstverwaltung



Photo: Claude Morerod



Photo: Öbf

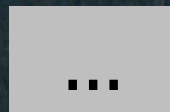


Photo: die wildbach



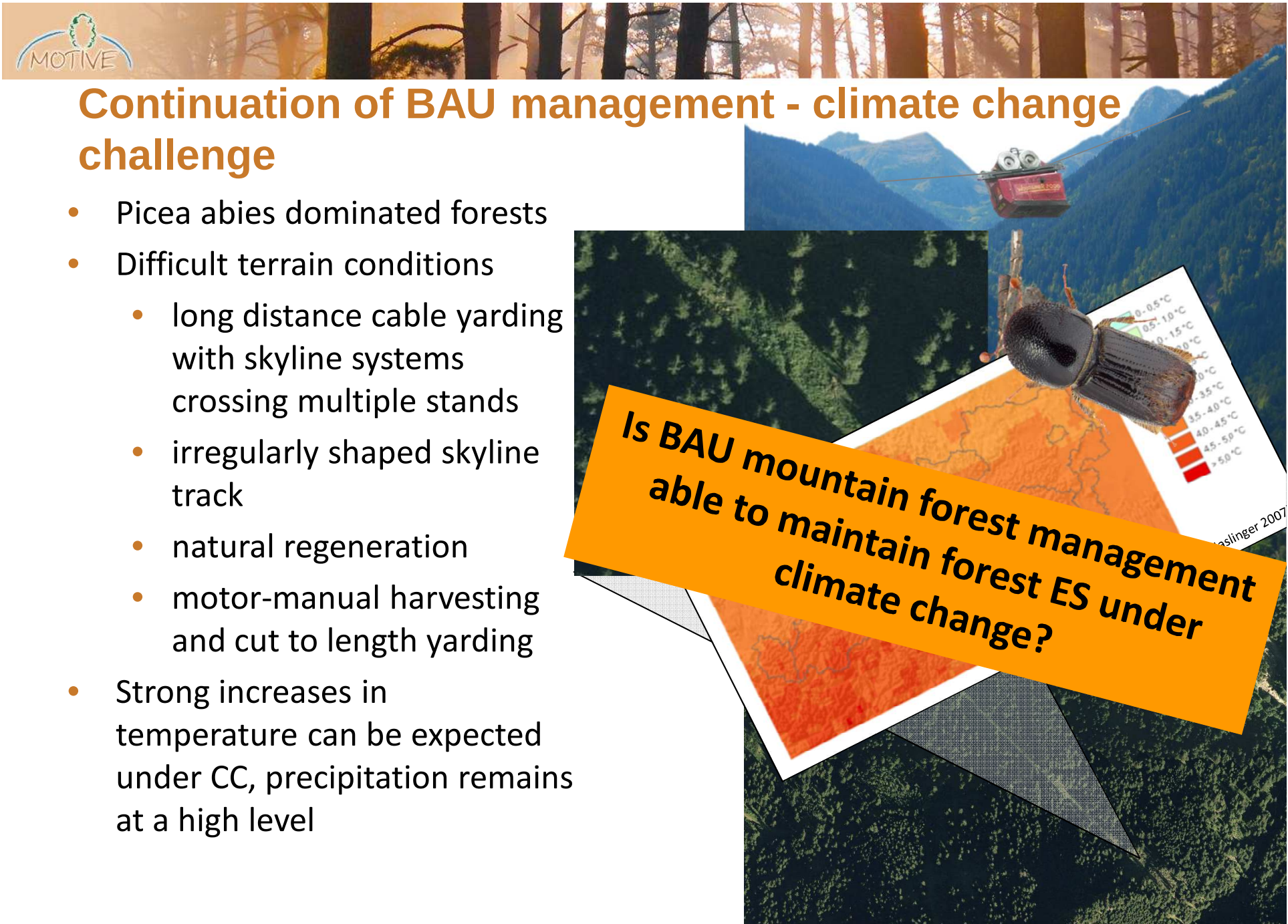
Photo: Stand Montafon



Photo: WSL



Photo: Öbf

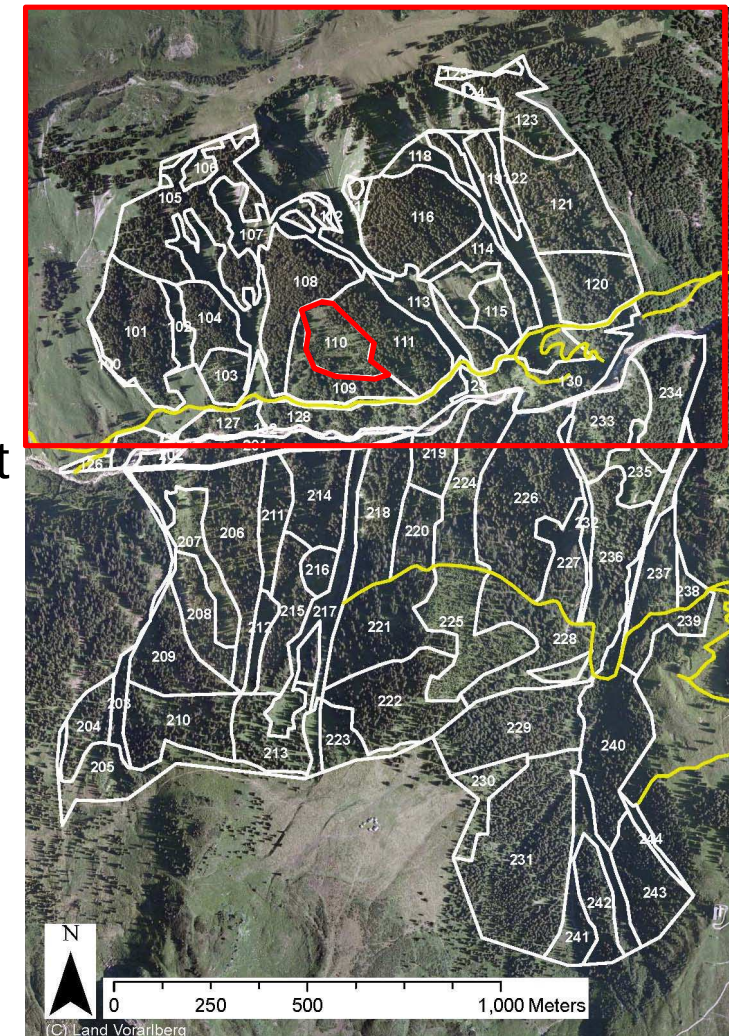




Detailed case study Rellstal valley

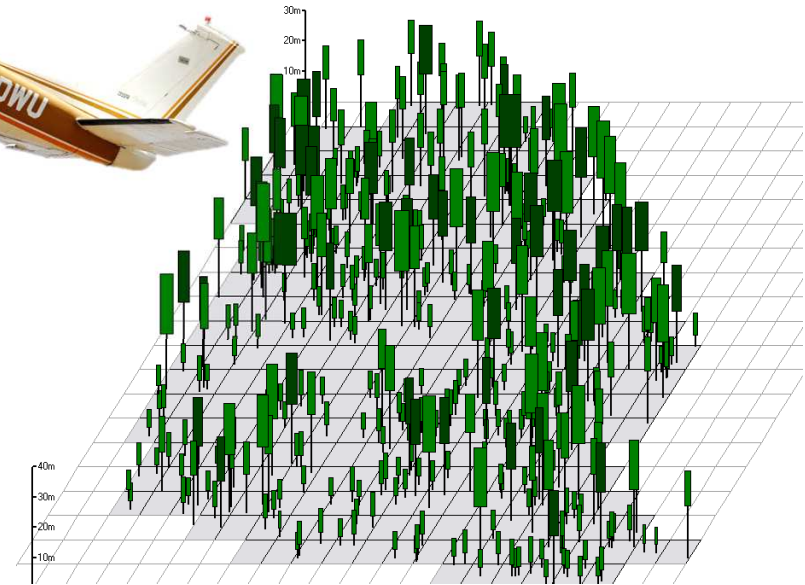
- 215 ha forests featuring north- and south-facing slopes on calcareous and crystalline bedrocks
- 53 mostly uneven-aged, Norway spruce dominated, stands (admixed Silver fir, beech, sycamore maple, common ash)
- 1160 m (valley bottom) to ~ 1800 m (current timberline)
- steep slopes (30-45°)
- The forest is embedded in a matrix of non-stockable gullies and avalanche tracks

	T [°C]	P [mm]
Current climate at 1200 m a.s.l.	5.4	1610

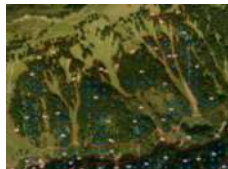




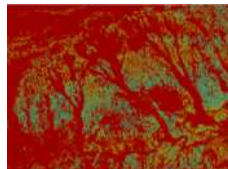
Mountain forest structure



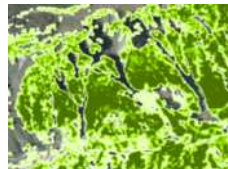
Field data



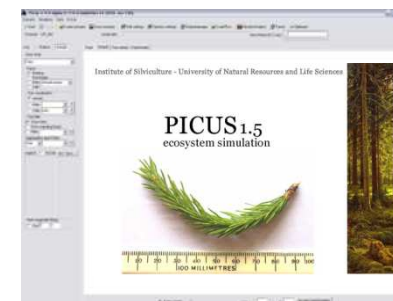
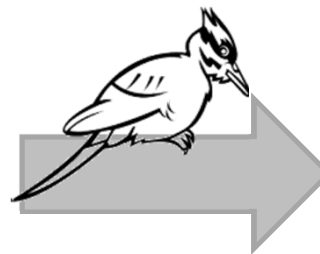
nCM



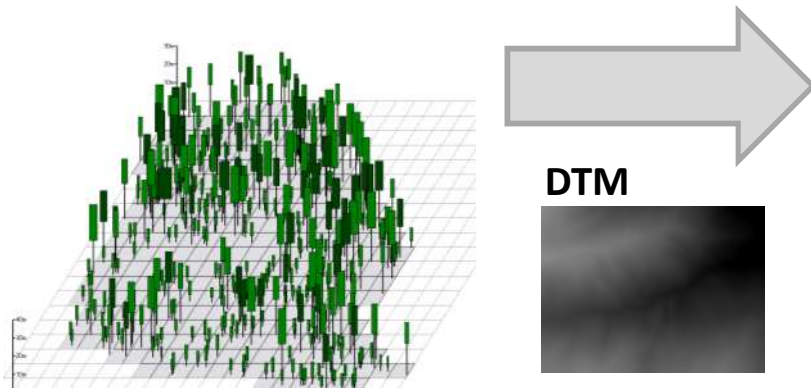
Volume



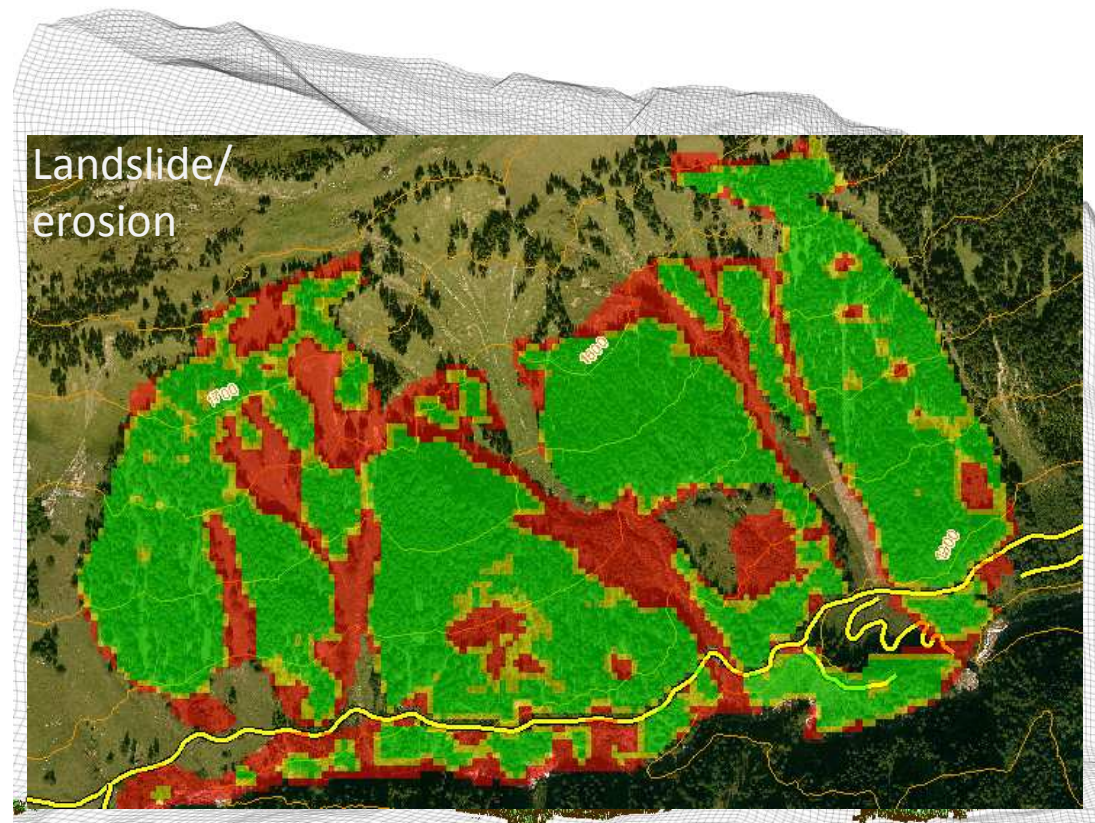
Hollaus et al. 2006; 2007



From stand to slope



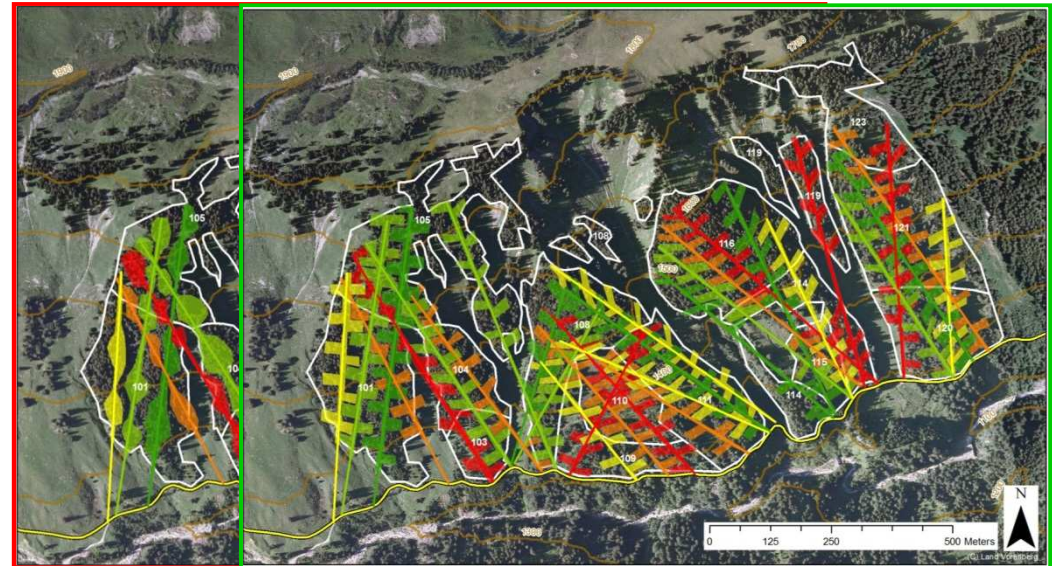
- Trees have coordinates within a stand
- A DTM is used to display a stand on the slope
- Stands have a spatial context
- Management can be planned spatially explicitly on the slope level using GIS
- Protective functions can be assessed on the slope level using an indicator based approach (adapted after Frehner et al., 2005)





Simulation Design

- PICUS v1.5
- 5 management scenarios
- 3 climate scenarios (baseline, B1, A1B)
- 90 years simulation period (2010-2100)



2010  2100

	BAU1	BAU2	AM3	AM4	AM5
Management description	patchy slit cuts	no management	patchy slit cuts	patchy slit cuts	fishbone shaped slit cuts
Management intensity	0.39% per year (250 years rotation)	-	0.39% per year (250 years rotation)	0.39% per year (250 years rotation)	0.5% per year (200 years rotation)
Regeneration	natural	-	natural + 25% L. decidua	natural + 25% L. decidua	natural + 25% L. decidua
Game management	browsing remains at current level	browsing remains at current level	browsing remains at current level	browsing pressure reduced by 50%	browsing pressure reduced by 50%

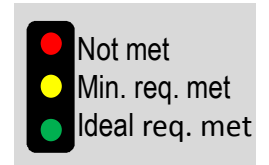


Results

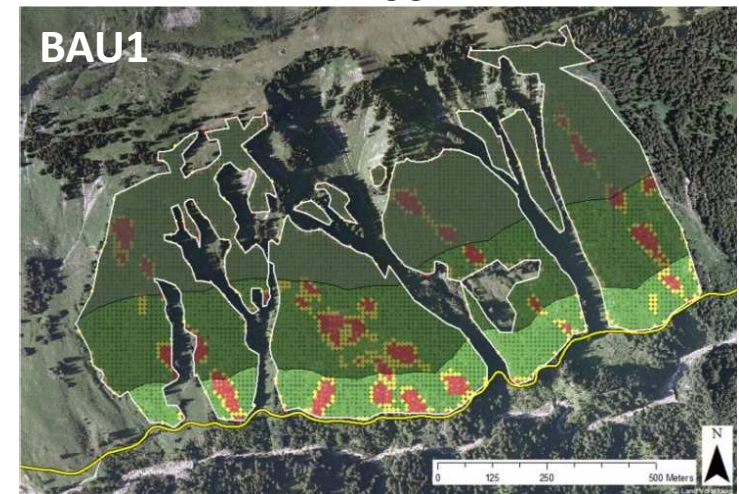
- Bark beetle damages reach 5-fold under A1B. AMs perform slightly better than BAU1.
- Significantly better protection against landslides/ erosion under AM5.
- Significantly better protection against snow avalanches under AM5.
- 17% more harvested timber under AM5.
- Standing volume increases under all management scenarios but least under AM5.
- Long lead-times have to be considered for the introduction of new species and for the promotion of mixed species by reducing browsing pressure (AM4 & 5)



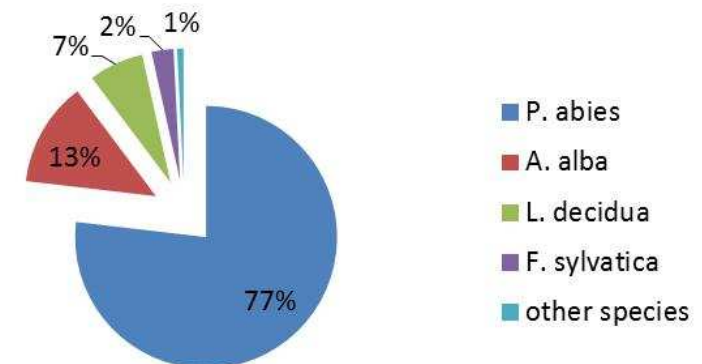
	T [°C]	P [mm]
BL	5.4	1610
A1B	+ 3.8	-9%



Landslide/ erosion 2100



Tree species shares (volume)



AM is able to maintain ecosystem services better than BAU under CC.

2010-2019

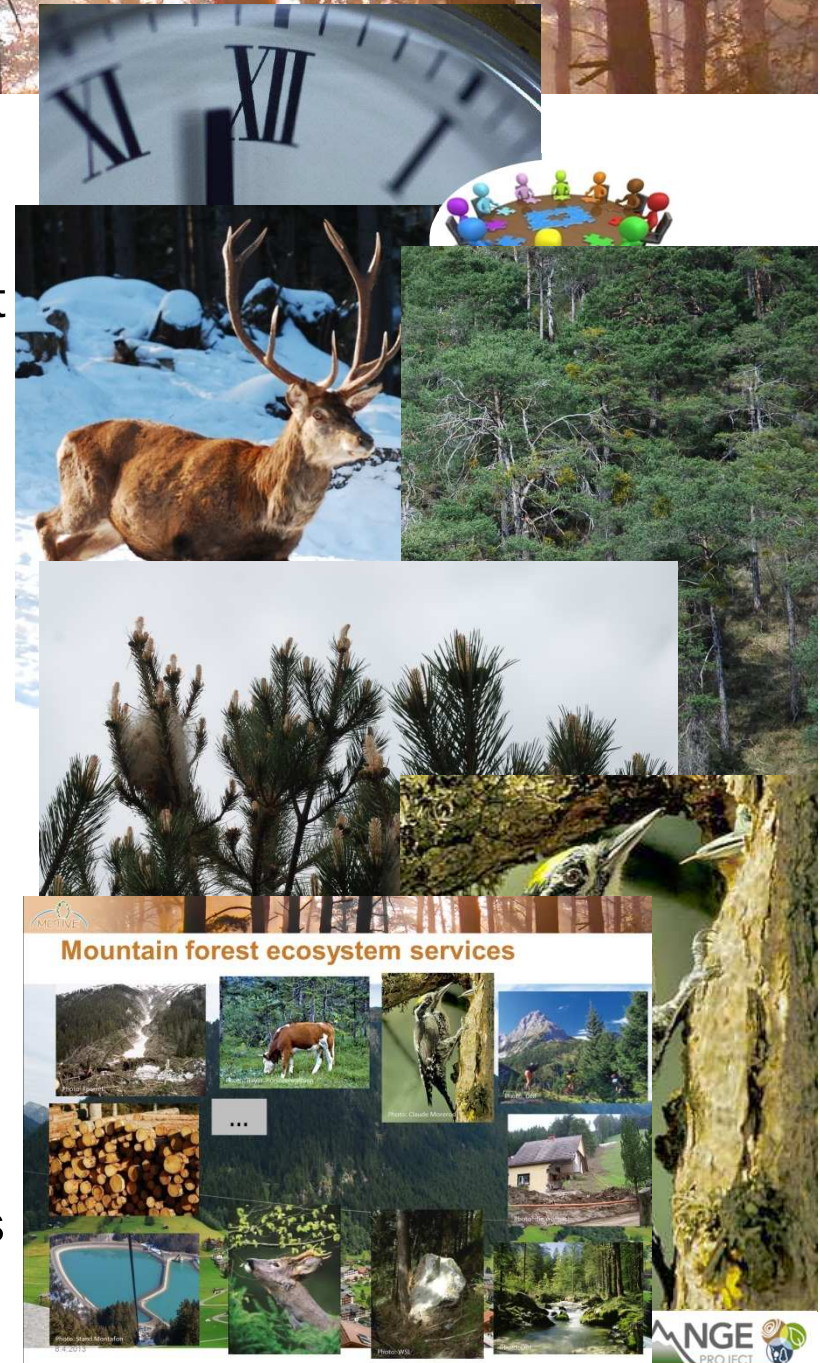
2020-2049

2049-2100



Where to go from here?

- Time-lags call for immediate action
- Improved game management is important for adaptation, still its implementation is doubted by local stakeholders.
- Local conditions are not directly transferable to other regions of the Alps, where negative impacts might be more pronounced due to limited soil water supply.
- There are further important disturbance agents in mountainous forest ecosystems
→ Research needed for other biotic and abiotic disturbances (and their interaction) under CC
- Tree species diversity vs. habitat suitability for protected species (e.g. Natura 2000 birds directive)
- Adaptation is needed, tradeoffs between ecosystem services have to be taken into account – often there will not be a one fits all solution.



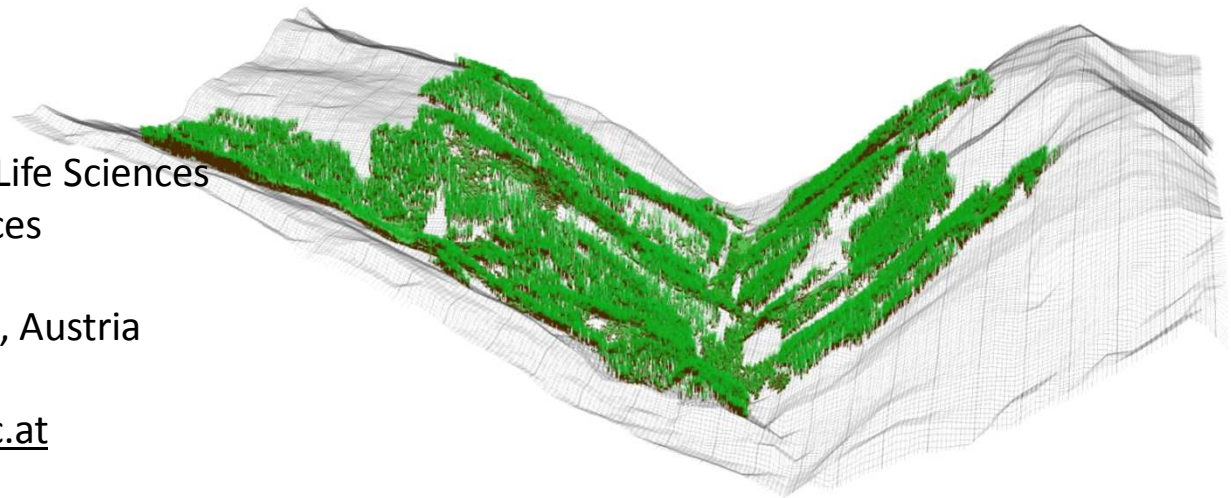


Thank you!



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Spatially explicit ES assessment

Concept adapted after Frehner et al. (2005)
for protective function against
gravitational natural hazards (snow
avalanche, rock fall, landslide/erosion,
flooding)

Slope is analyzed in a 10 x 10 m resolution.

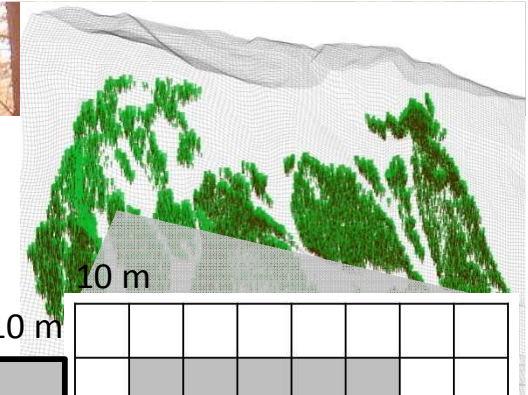
Indicators:

- Stem number
- Crown cover
- Gap length/ size

Results in three categories:

- requirements not met (red),
- minimal requirements met (yellow),
- ideal requirements met (green)

Hazard	Landslide, erosion	
Indicator	Gap area	Crown cover
Not met	> 600 m ²	< 40 %
Minimal	≤ 600 m ²	≥ 40 %
Ideal	≤ 400 m ²	≥ 60 %



Type A indicators
Moving window
• Stem number
• Crown cover

Type B indicators
Gap detection
• Gap size
• Gap orientation

