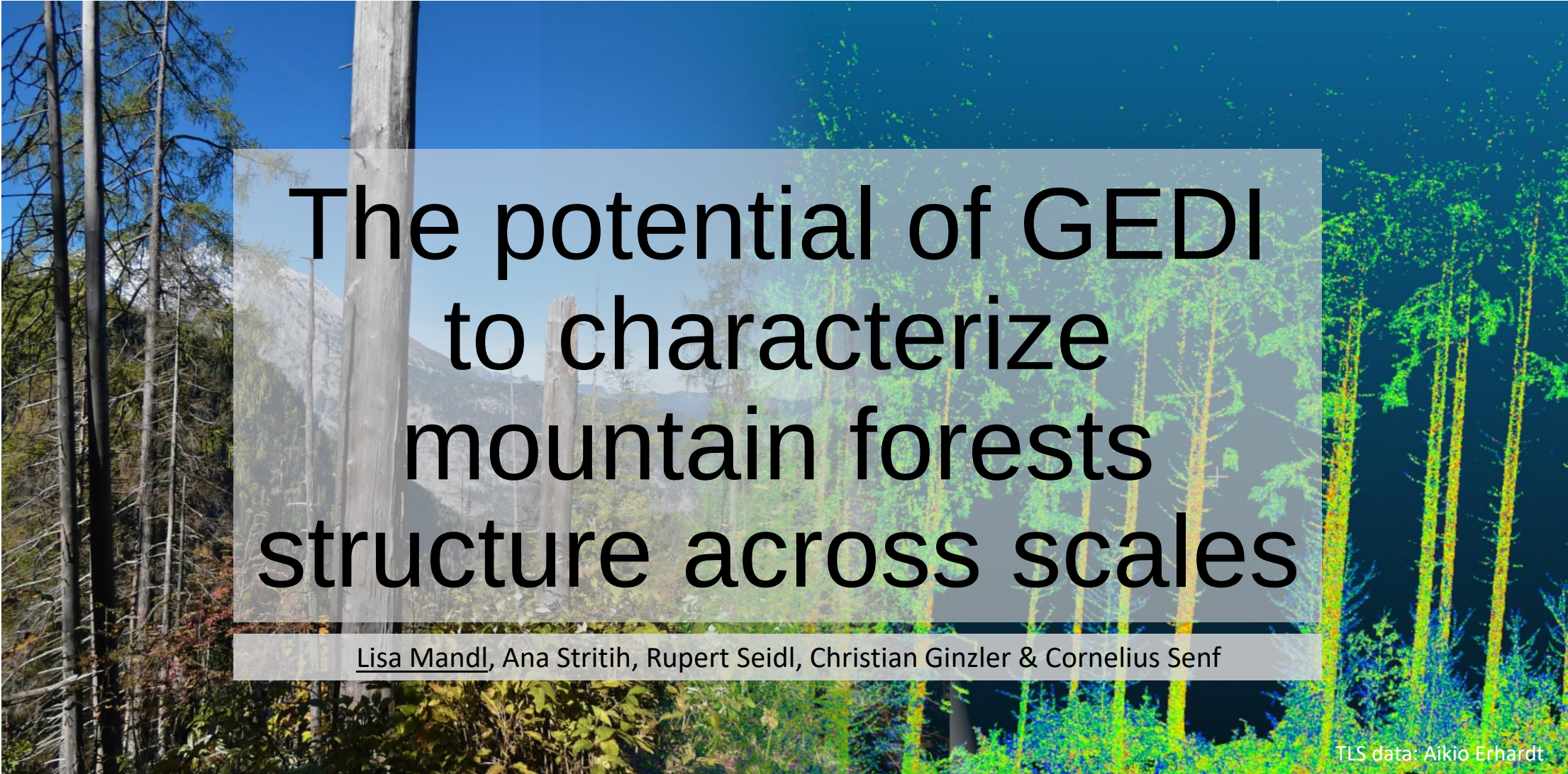


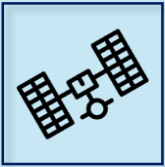


The potential of GEDI to characterize mountain forests structure across scales

Lisa Mandl, Ana Stritih, Rupert Seidl, Christian Ginzler & Cornelius Senf

TLS data: Aikio Erhardt

– Global Ecosystem Dynamics Investigation



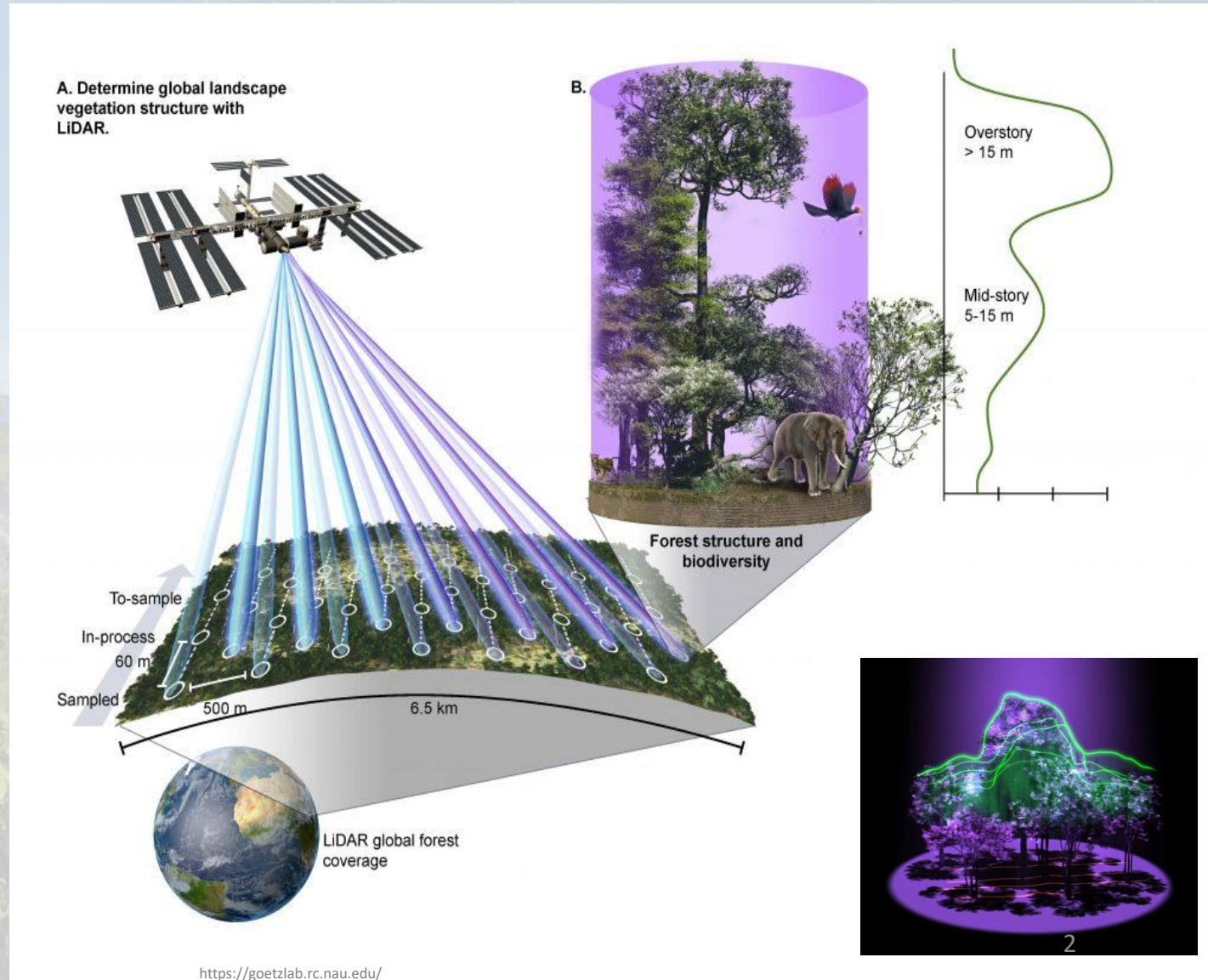
High resolution laser ranging of Earth's forests and topography from the International Space Station (ISS)



Samples radial footprints of 25 m diameter every 60 m along eight data tracks that are 600 m apart

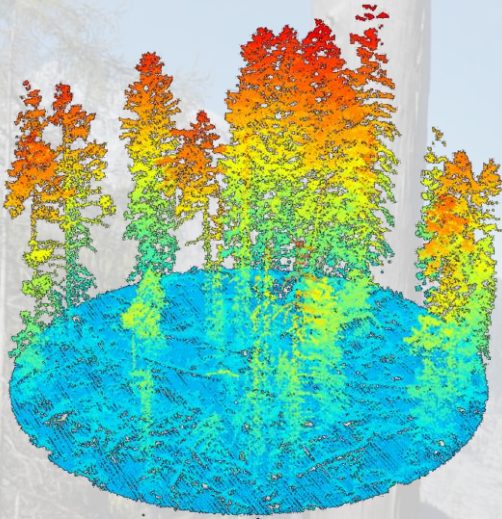


Produces “ready-to-use” metrics (e.g. height percentiles, PAI, FHD, cover,...)



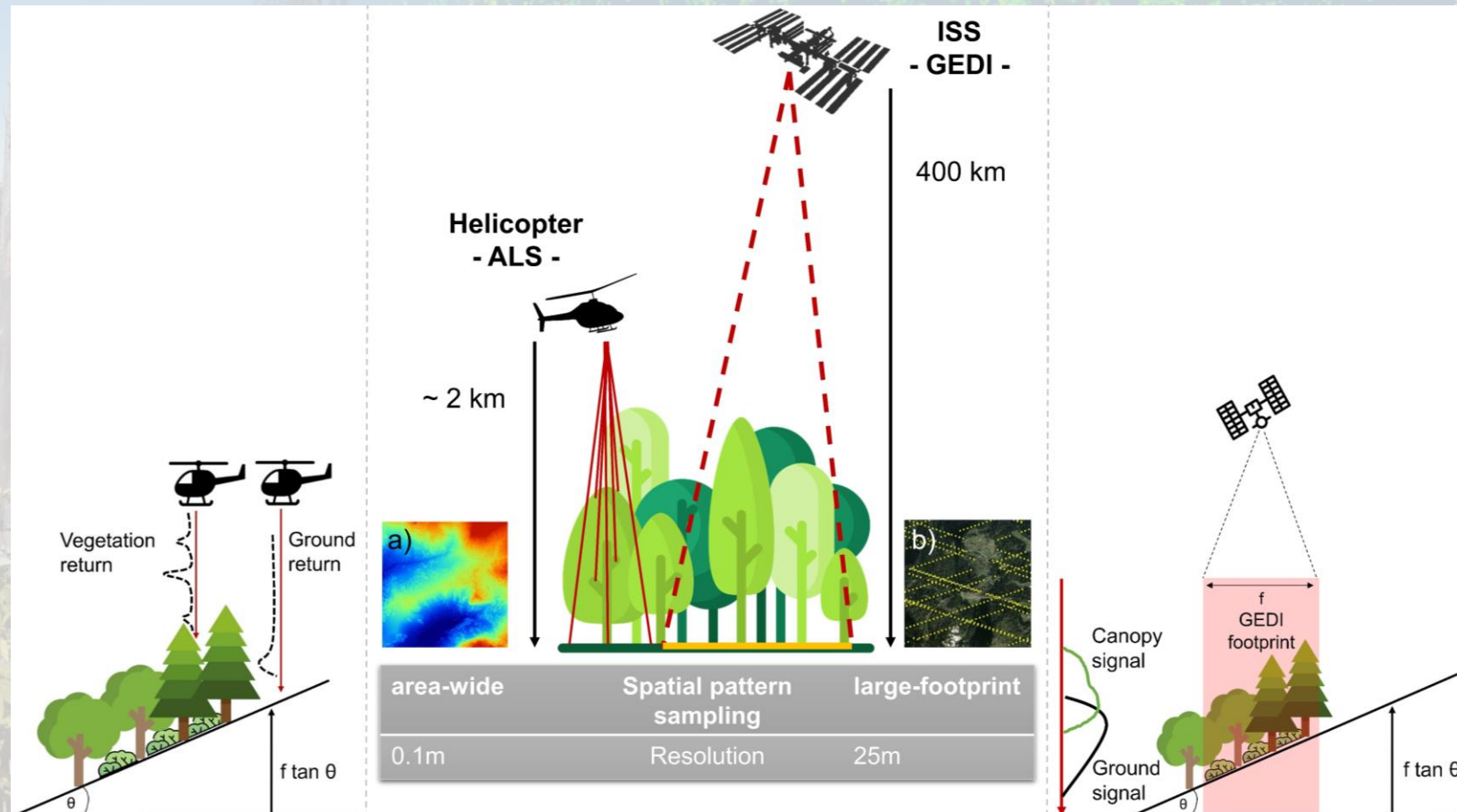
Reference data

→ Airborne laser scanning (ALS) from Berchtesgaden and Davos as benchmark

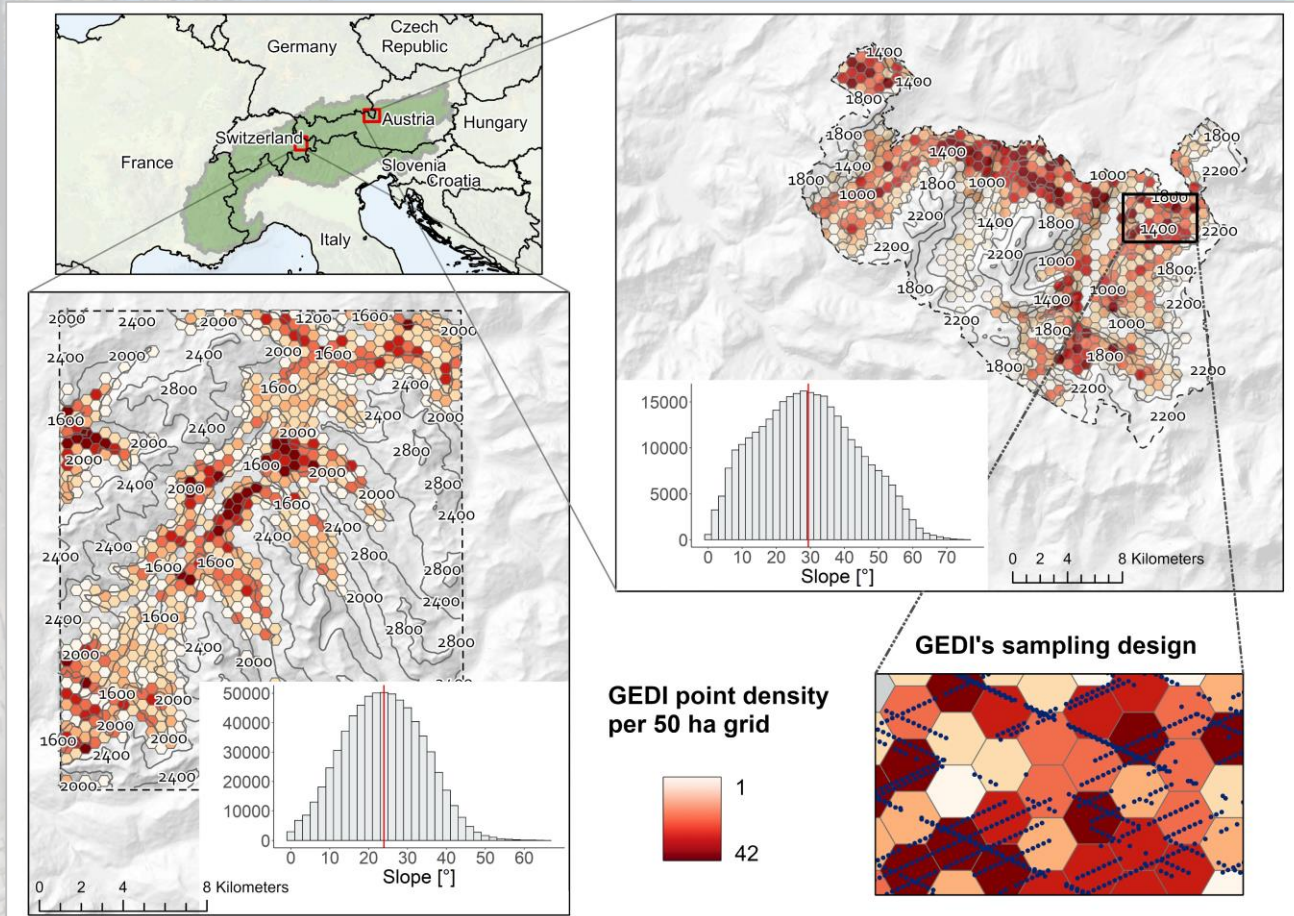


?

„How well does GEDI estimate forest structure in mountain landscapes compared to airborne LiDAR?“



Study sites



Berchtesgaden



Davos



Study design

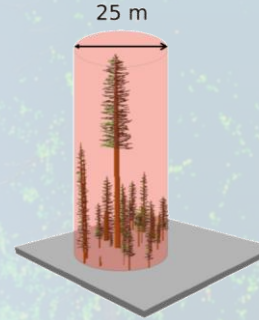
Classification of forest structural metrics according to Atkins et al. (2018):

Group	metrics
Height	Height percentiles (RH 50, RH 98)
Area & density	Plant Area Index (PAI)
Heterogeneity	Foliage Height Diversity (FHD)
Cover & openness	Total canopy cover, understory cover



Computed / derived for ALS and GEDI data

a)



Plot-level assessment

Statistical modeling of relationship between GEDI and ALS using standardized major axis regression (SMA)

Stratified to:

- Slope 
- Time since ALS acquisition
- Forest type

b)

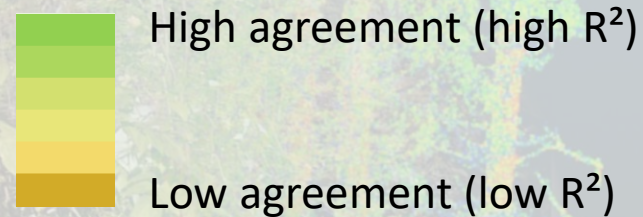
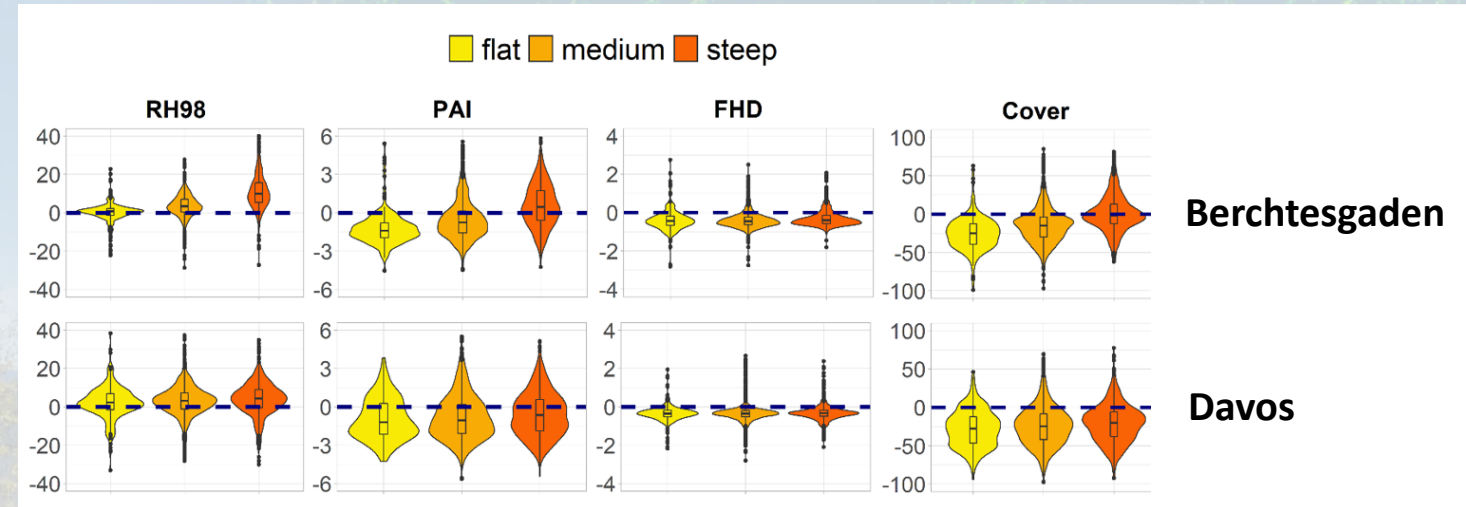


Landscape-level assessment

- Comparison between GEDIs sampling approach and wall-to-wall ALS data
- Comparison of aggregated GEDI and ALS metrics
- Mapping of ecosystem functions and services for applied ecology

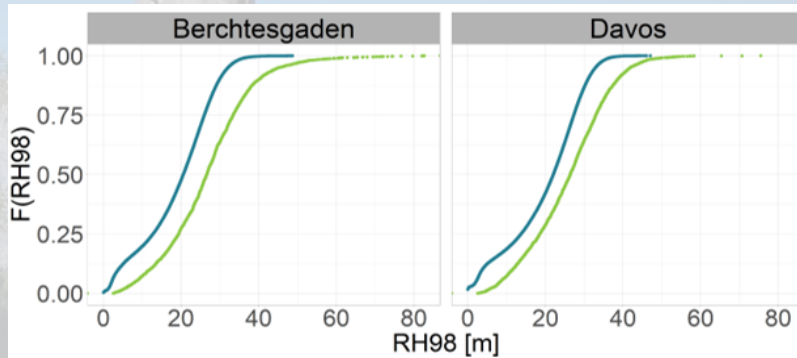
Results – Plot level

	Slope (R^2)			
	$< 15^\circ$	$< 35^\circ$	$> 35^\circ$	
# GEDI footprints	302	1491	1010	
RH98	0.50	0.55	0.29	Berchtesgaden
PAI	0.44	0.34	0.11	
FHD	0.37	0.41	0.26	
cover	0.58	0.46	0.20	
# GEDI footprints	322	2218	979	
RH98	0.45	0.38	0.28	Davos
PAI	0.18	0.15	0.11	
FHD	0.33	0.29	0.22	
cover	0.31	0.24	0.18	



Results – Landscape level

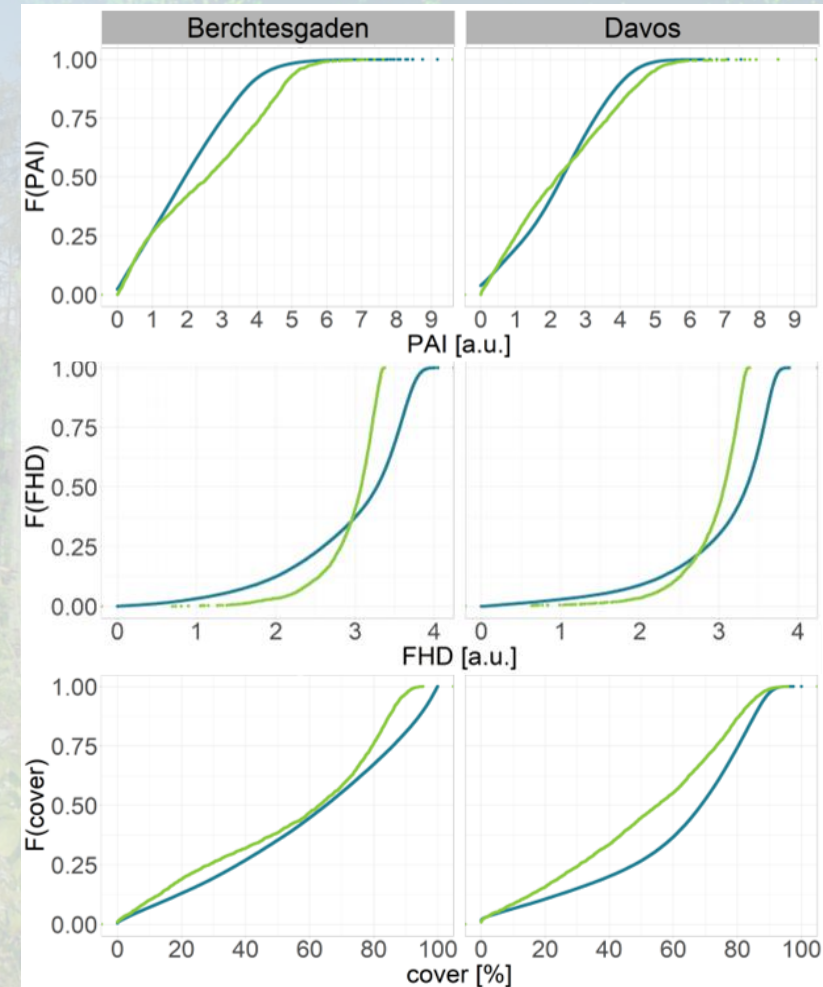
Horizontal forest structure



ALS

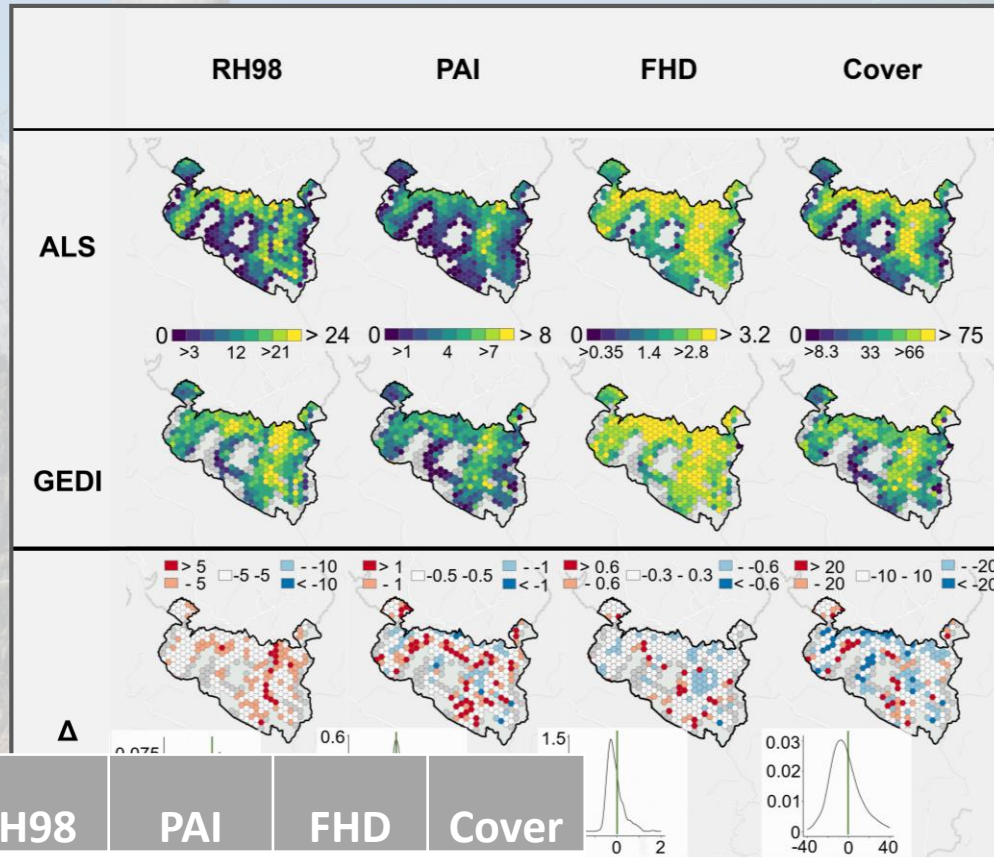
GEDI

Vertical forest structure

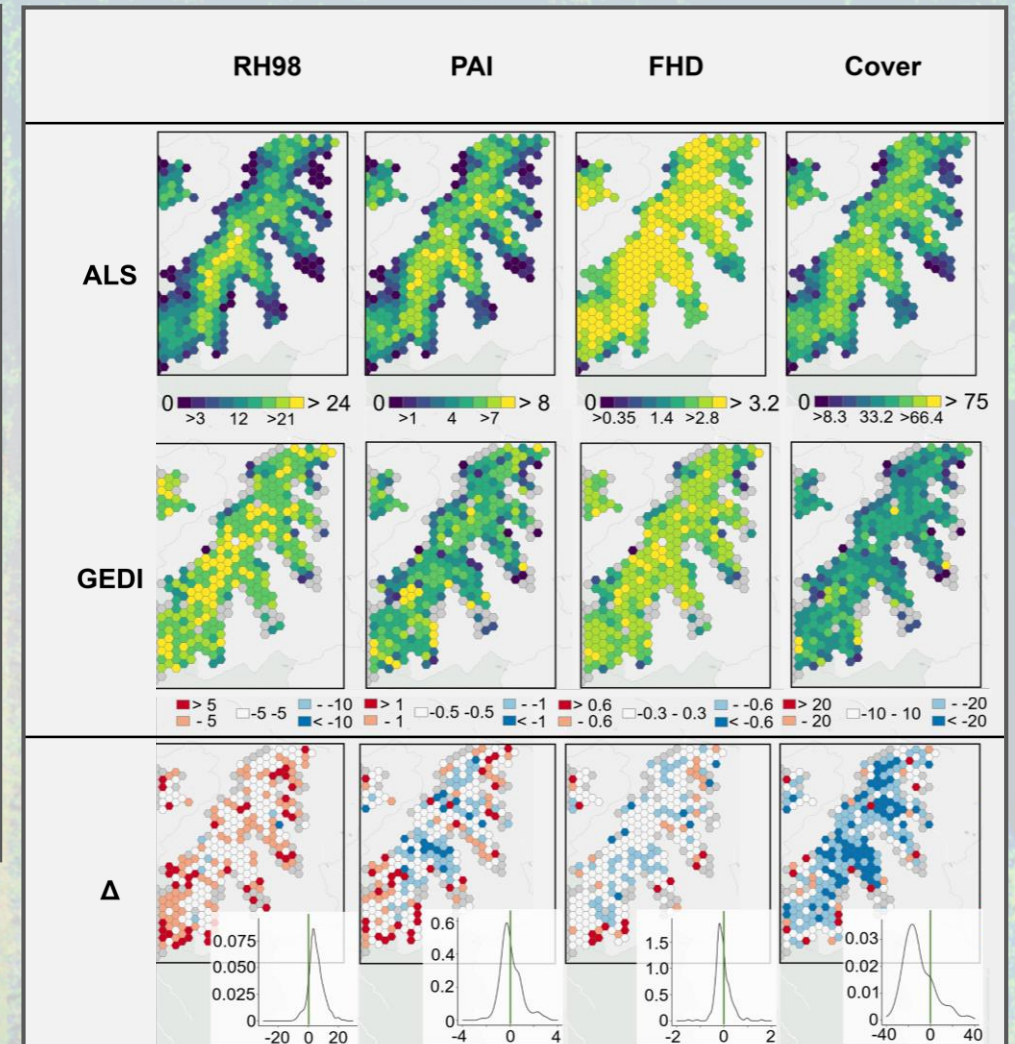


Results – Landscape level

Berchtesgaden



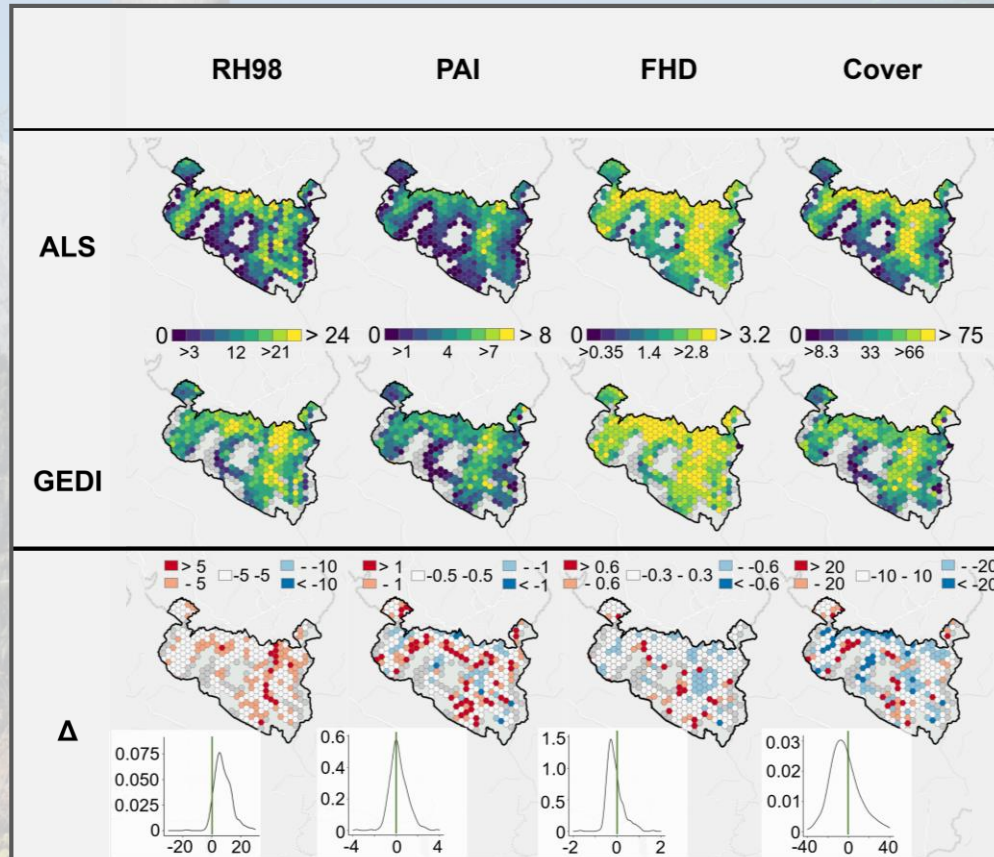
Davos



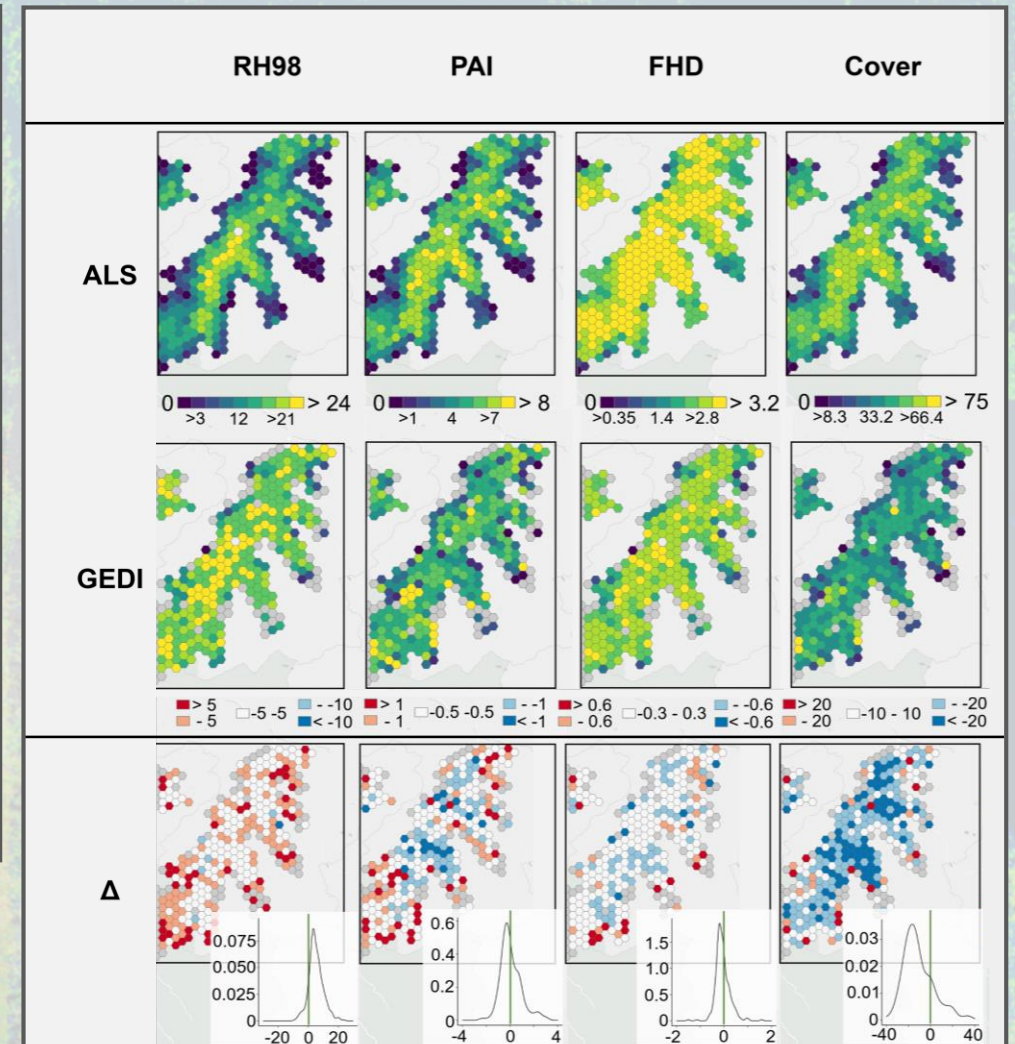
R^2	RH98	PAI	FHD	Cover
Berchtesgaden	0.73	0.68	0.71	0.54
Davos	0.79	0.63	0.71	0.51

Results – Landscape level

Berchtesgaden



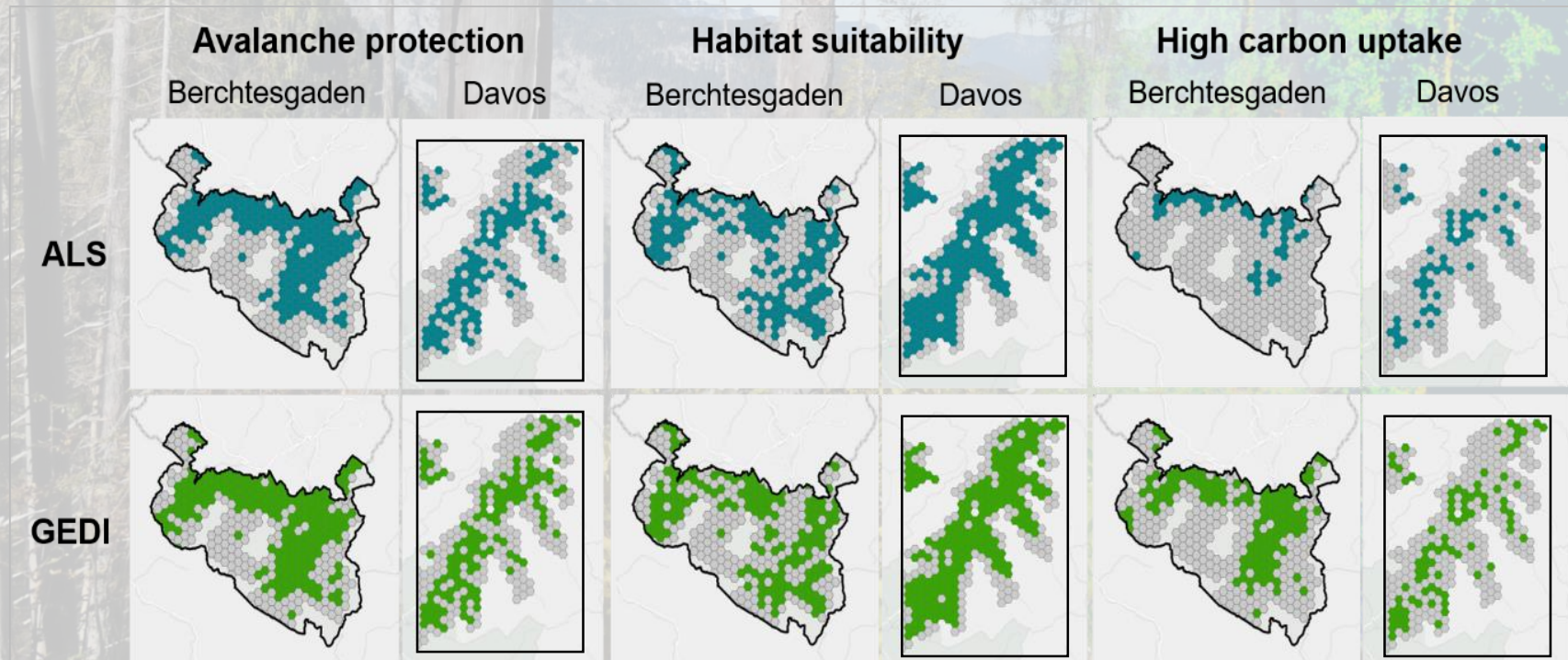
Davos



Results – Landscape level

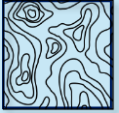
Ecosystem functions	Criteria	Reference
Avalanche protection	Cover > 50% AND height > 5 m	(Frehner et al., 2005)
Habitat suitability for capercaillie	FHD > 2 AND cover == [40; 70]	(Suter et al., 2002; Graf et al., 2013)
High carbon uptake & storage	RH98 > 75 th percentile AND PAI > 75 th percentile	Site-adaptive thresholds

Ecosystem service indicator	Berchtesgaden		Davos	
	GEDI	ALS	GEDI	ALS
Avalanche protection	51%	48%	37%	36%
Habitat suitability for capercaillie	41%	41%	58%	58%
High carbon uptake and storage	30%	17%	25%	15%



Take home messages

Agreement
between ALS
and GEDI



Topographically complex terrain hampers the use of GEDI at the plot scale



Correction algorithms do exist but require either ALS data or high-resolution DEMs



Landscape level estimates are much more accurate, which make GEDI a useful tool for landscape analysis



GEDI is highly suited for assessing and mapping ecosystem functioning and services



Scale matters!



Applied level

Landscape level



Plot level

Further information

Remote Sensing in Ecology and Conservation
Open Access

ZSL
LET'S WORK
FOR WILDLIFE

RESEARCH ARTICLE

Spaceborne LiDAR for characterizing forest structure across scales in the European Alps

Lisa Mandl^{1,2} , Ana Stritih¹, Rupert Seidl^{1,2}, Christian Ginzler³ & Cornelius Senf¹

¹Ecosystem Dynamics and Forest Management Group, School of Life Sciences, Technical University of Munich, Munich, Germany

²Berchtesgaden National Park, Berchtesgaden, Germany

³Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Zurich, Switzerland



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<https://doi.org/10.1007/s10980-023-01597-y>

ORIGINAL PAPER



Alternative states in the structure of mountain forests across the Alps and the role of disturbance and recovery

Ana Stritih  · Rupert Seidl · Cornelius Senf



[10.1007/s10980-023-01597-y](https://doi.org/10.1007/s10980-023-01597-y)

Thank you!

Contact

Lisa Mandl



Technical University of
Munich
Ecosystem Dynamics and
Forest Management Group



lisa.mandl@tum.de



[@_lisamandl](https://twitter.com/_lisamandl)