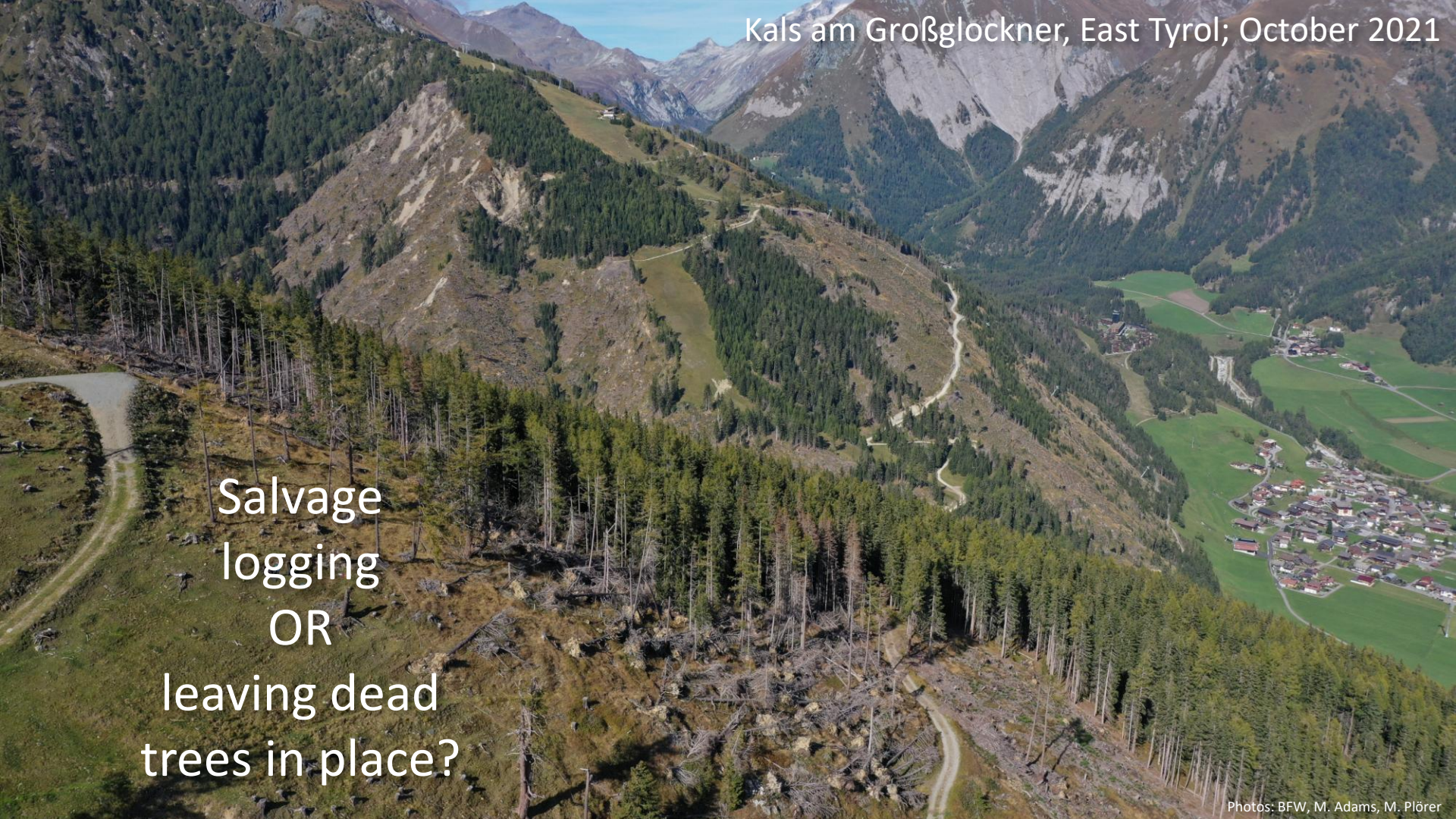
BFW AUSTRIAN RESEARCH CENTRE FOR FORESTS

Interreg Alpine Space — Co-funded by the European Union — MOSAIC

IMC Innsbruck 2025 International Mountain Conference

Wind-disturbed forests: A nature-based solution for risk reduction against snow avalanche release?

Leon J. Bührle, Tommaso Baggio, Marc Adams, Lukas Winiwarter, Emanuele Lingua, Andreas Stoffel, Matteo Garbarino, Milan Kobal, Thomas Marke, Peter Bebi & Michaela Teich


Kals am Großglockner, East Tyrol; October 2021
Salvage logging OR leaving dead trees in place?
Photos: BFW, M. Adams, M. Plörer

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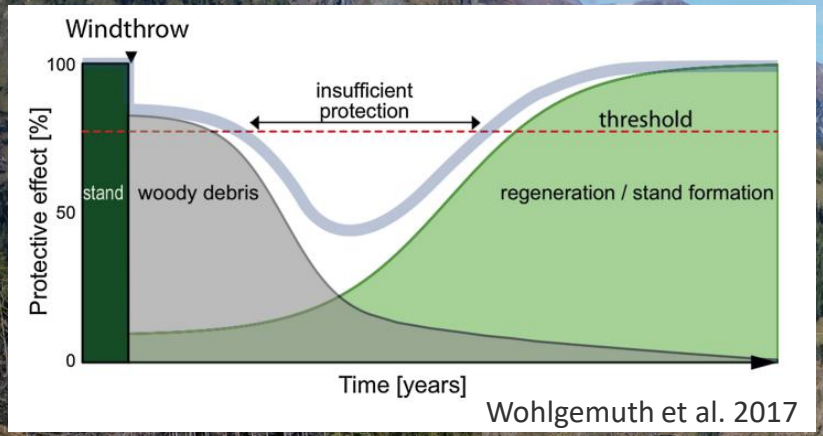


Wohlgemuth et al. 2017

Kals am Großglockner, East Tyrol; October 2021

Salvage logging OR leaving dead trees in place?

Photos: BFW, M. Adams, M. Plörer

Developing a tool for assessing the protective effect

- **Objectives:**

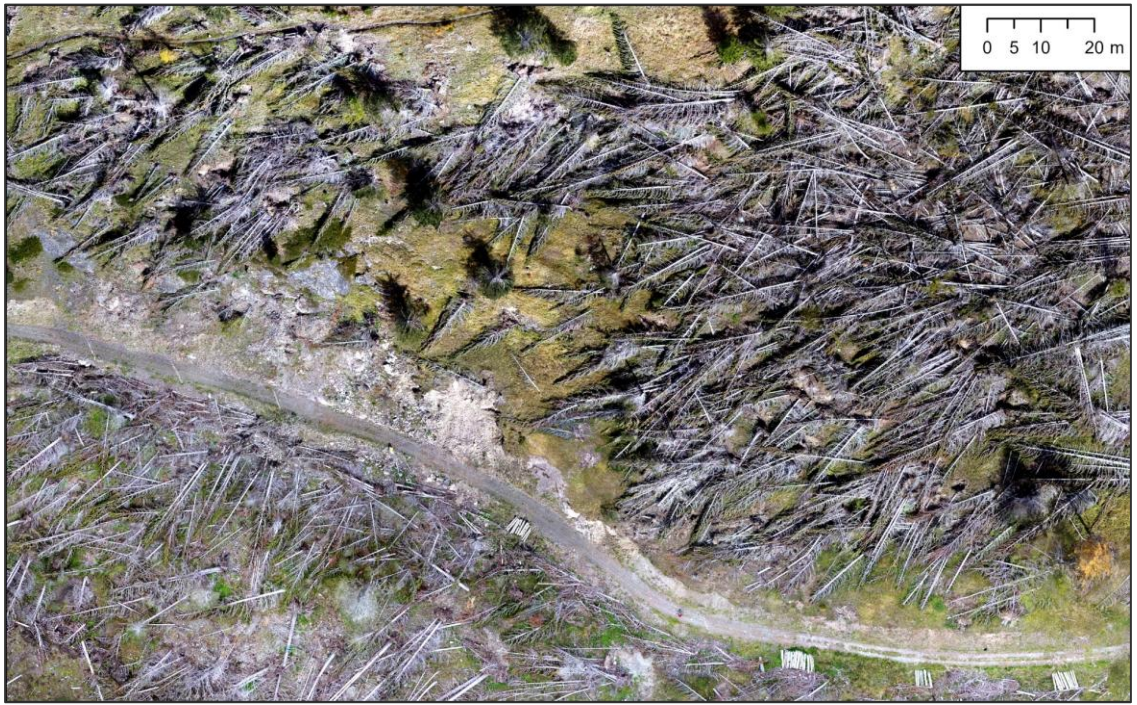
➢ Objective, easy-to-apply, automatic tool

➢ Open-source

- **Required input data:**

➢ Dense point cloud from drone

➢ Reference DTM



Franza, Veneto (IT)

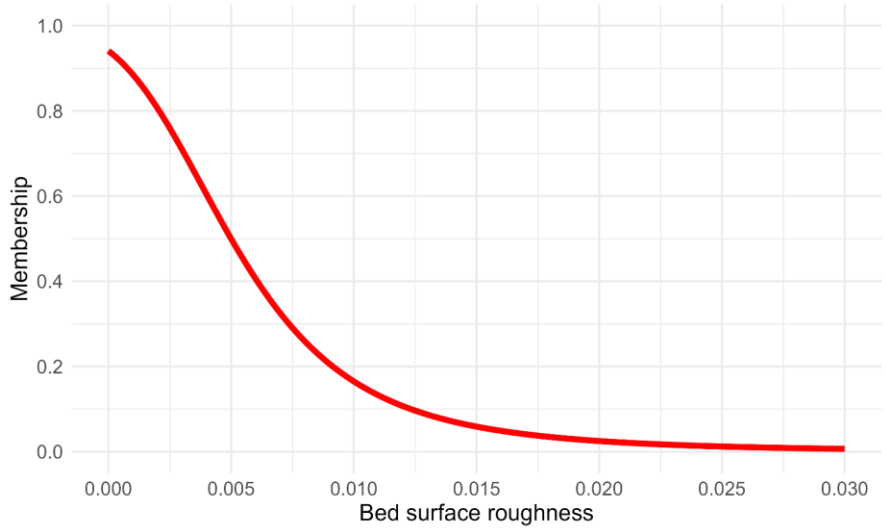
Deadwood as roughness element to prevent avalanche release

Roughness - Snow as smoothing factor

Roughness - Redistribution of snow by wind

Parameters for determining potential release areas (PRAs)

Roughness of winter terrain



Modified from Veitinger et al. (2016)

Parameters for determining potential release areas (PRAs)

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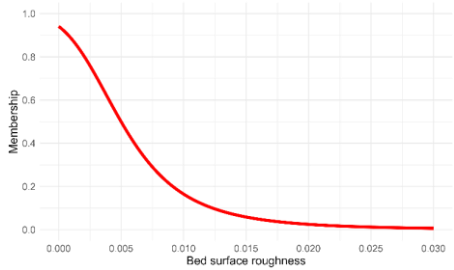
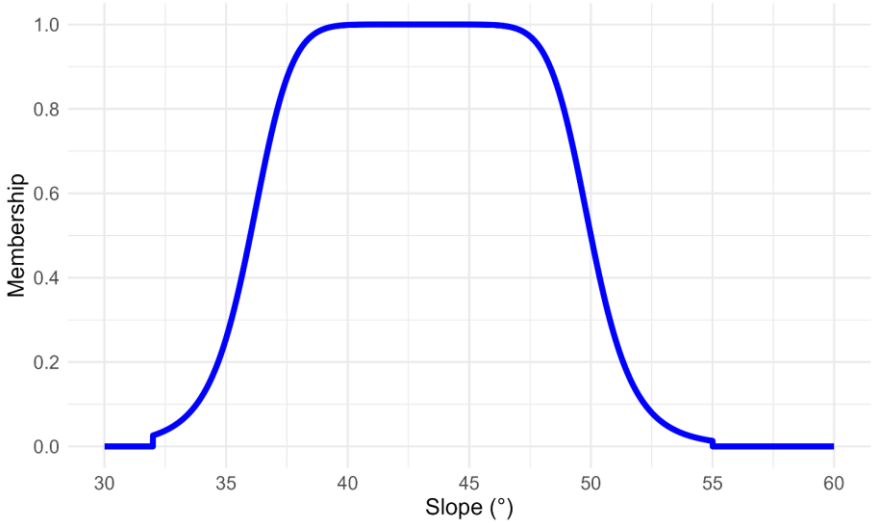


Slope



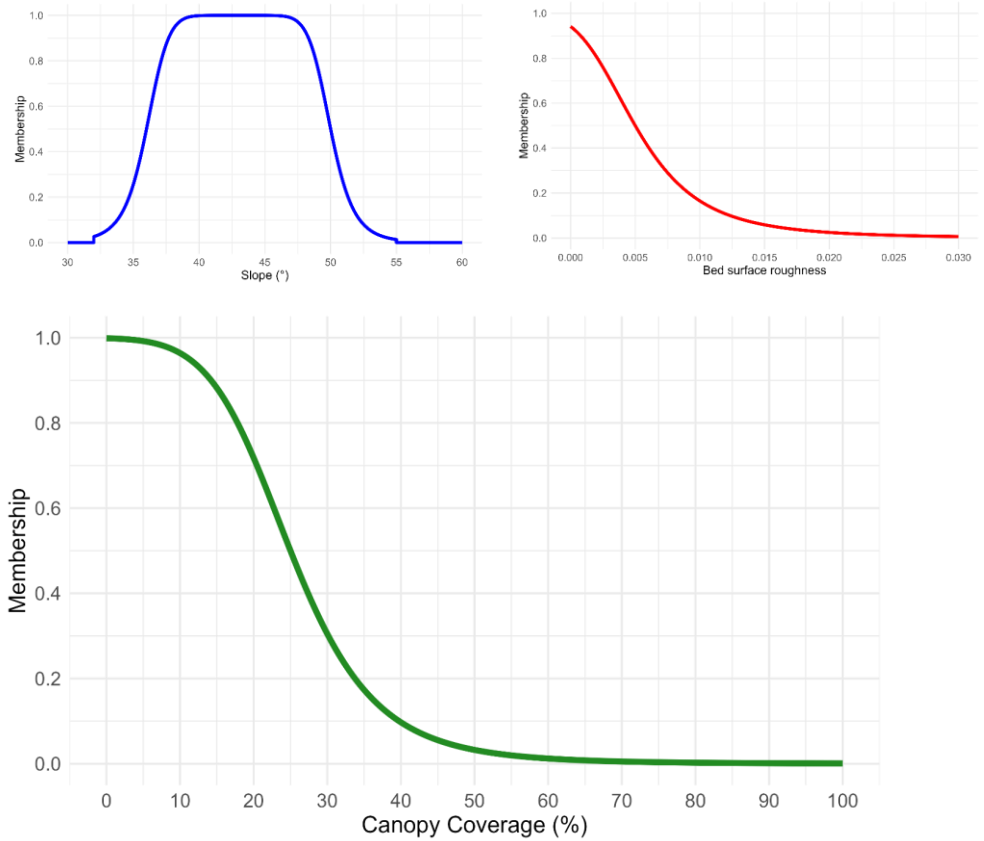
Modified from Veitinger et al. (2016)

Parameters for determining PRAs

Roughness of winter terrain

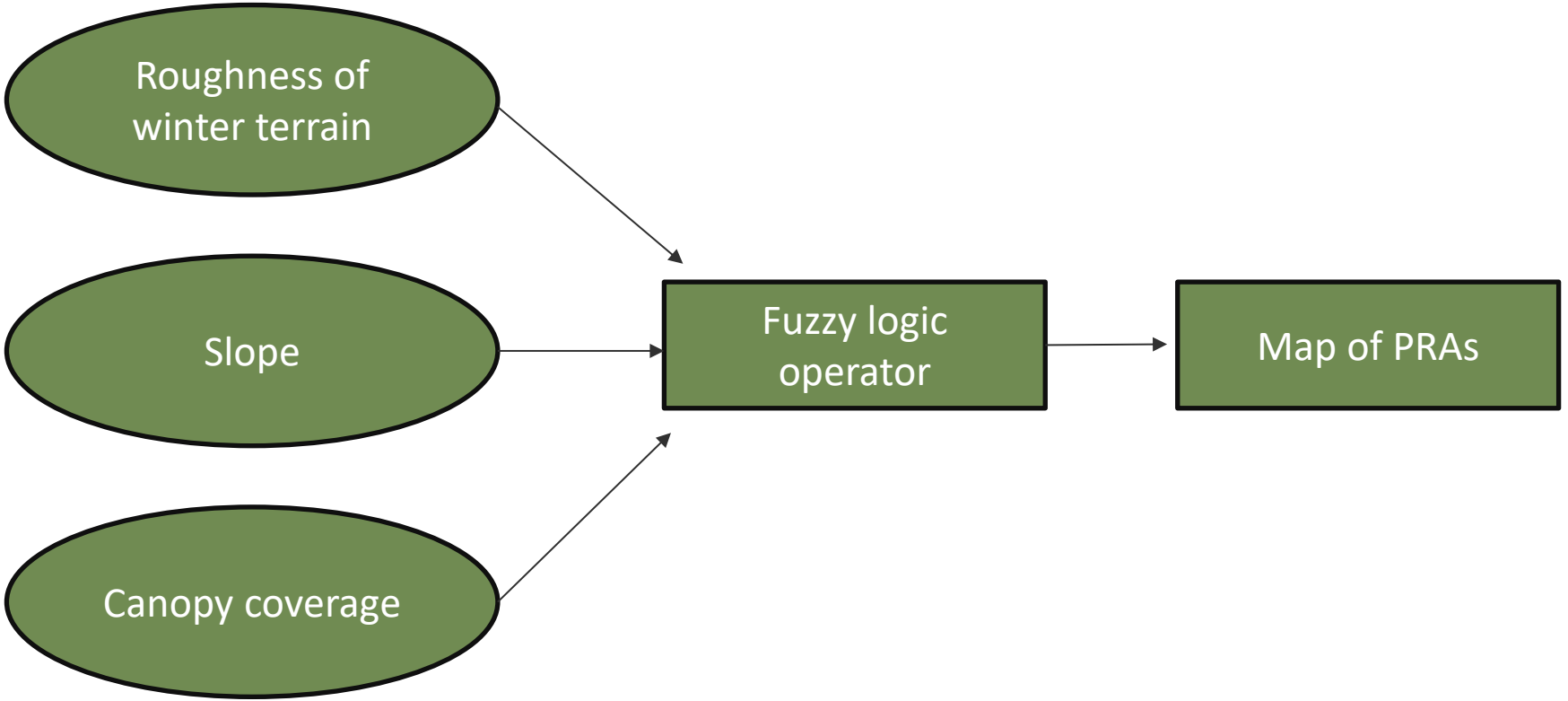
Slope

Canopy coverage



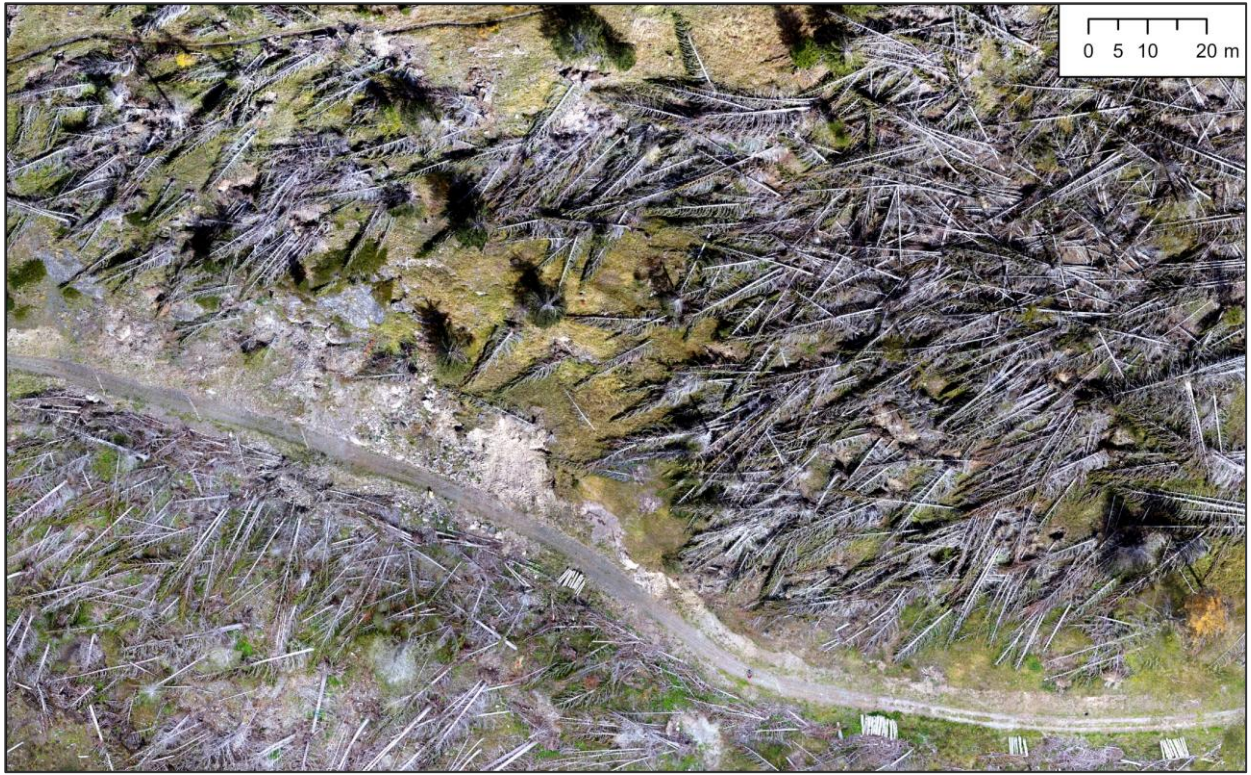
Modified from Toft et al. (2024)

Parameters for determining PRAs



Modified from Veitinger et al. (2016), Toft et al. (2024)

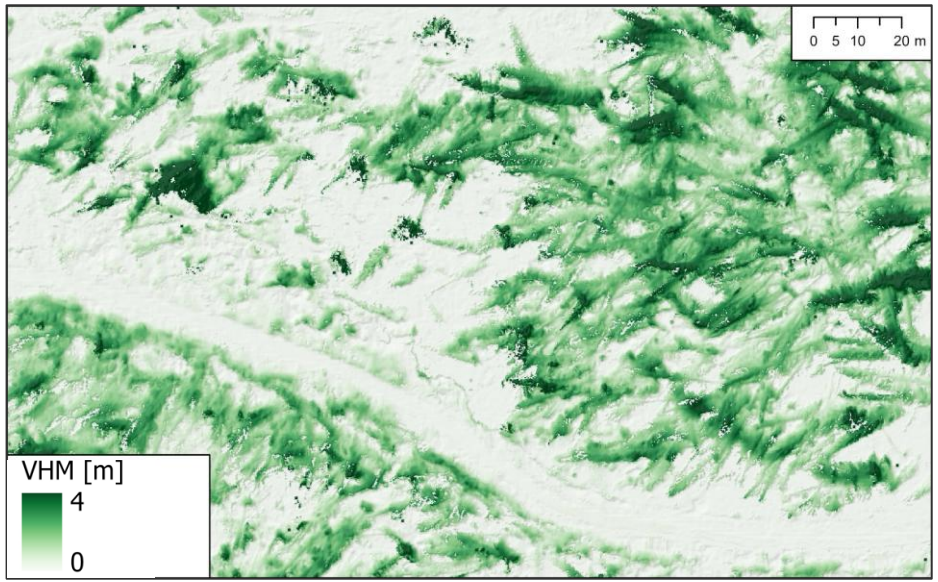
Drone survey



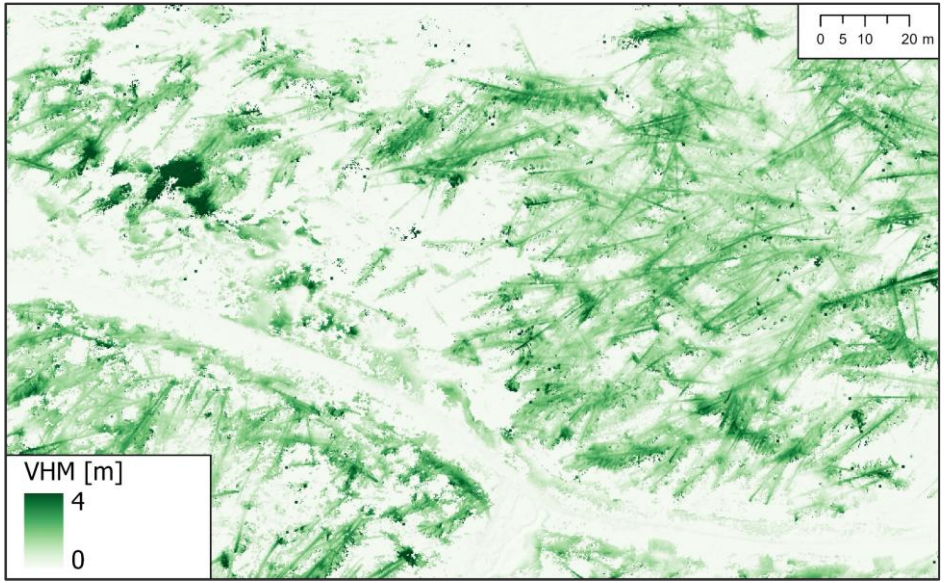
Roughness of winter terrain

Franza, Veneto (IT)

Deadwood structure (VHM) derived from drone data



Low-cost drone2019 (photogrammetry)



Laserscanning drone 2025

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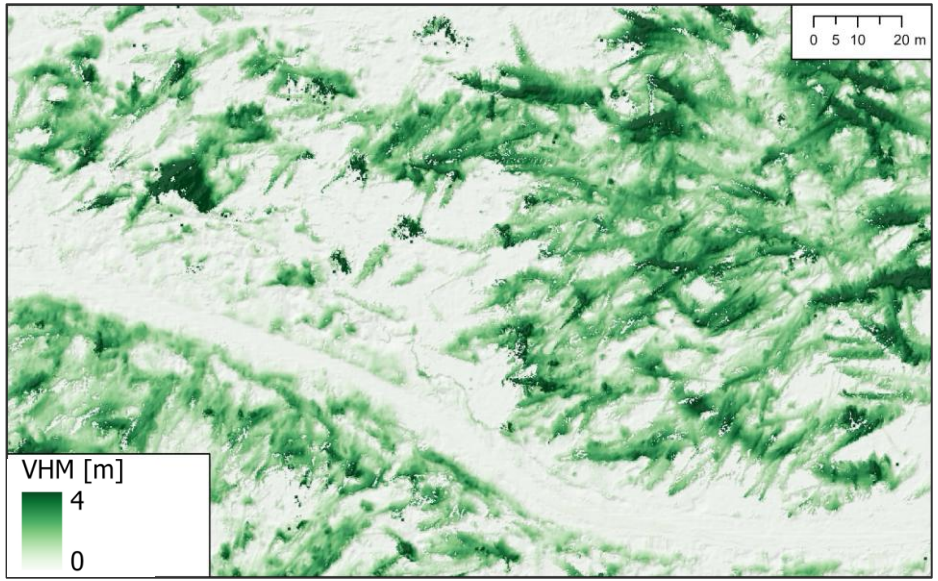
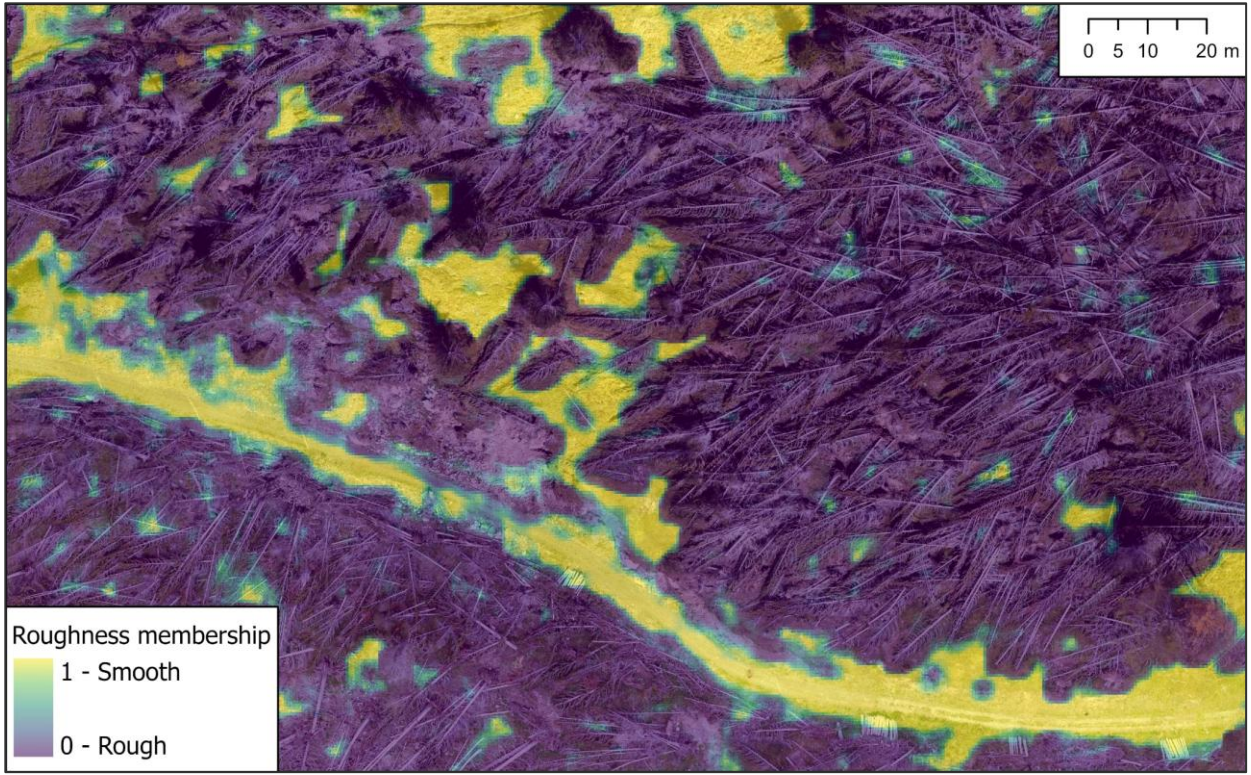


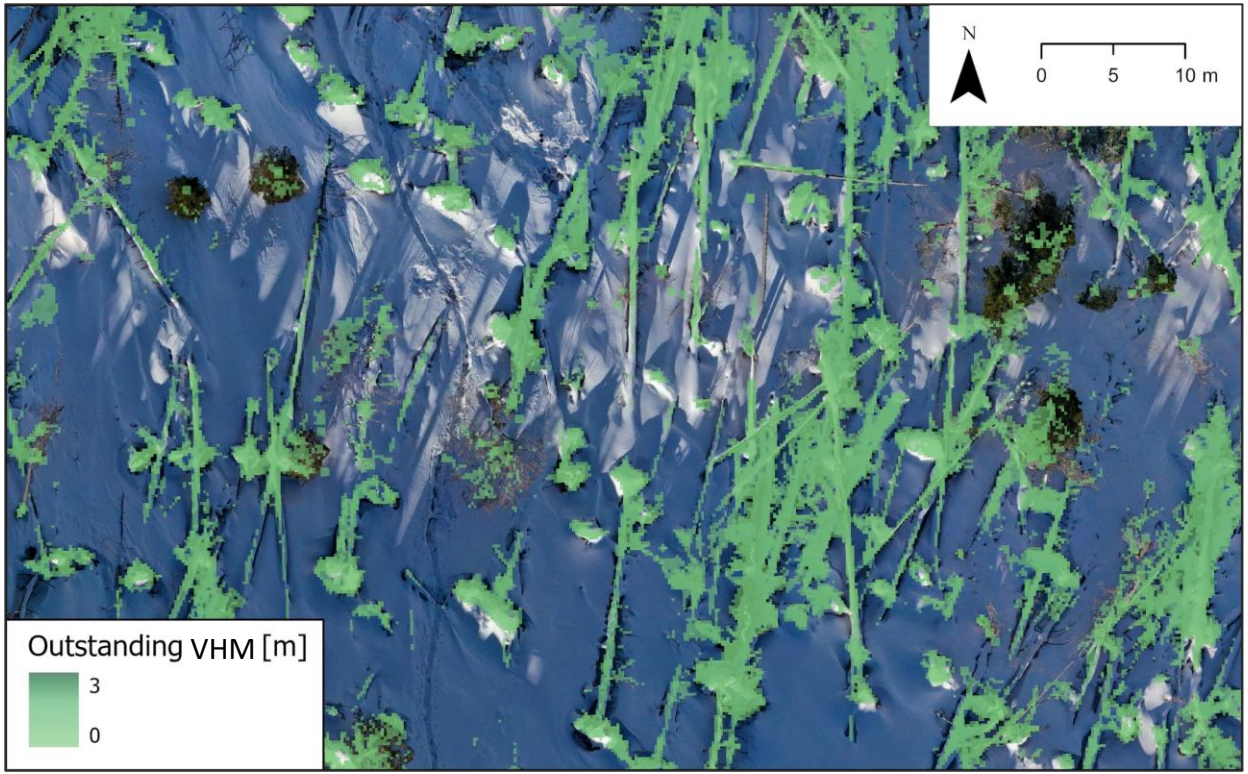
Low-cost drone2019
(photogrammetry)

Roughness Membership without snow



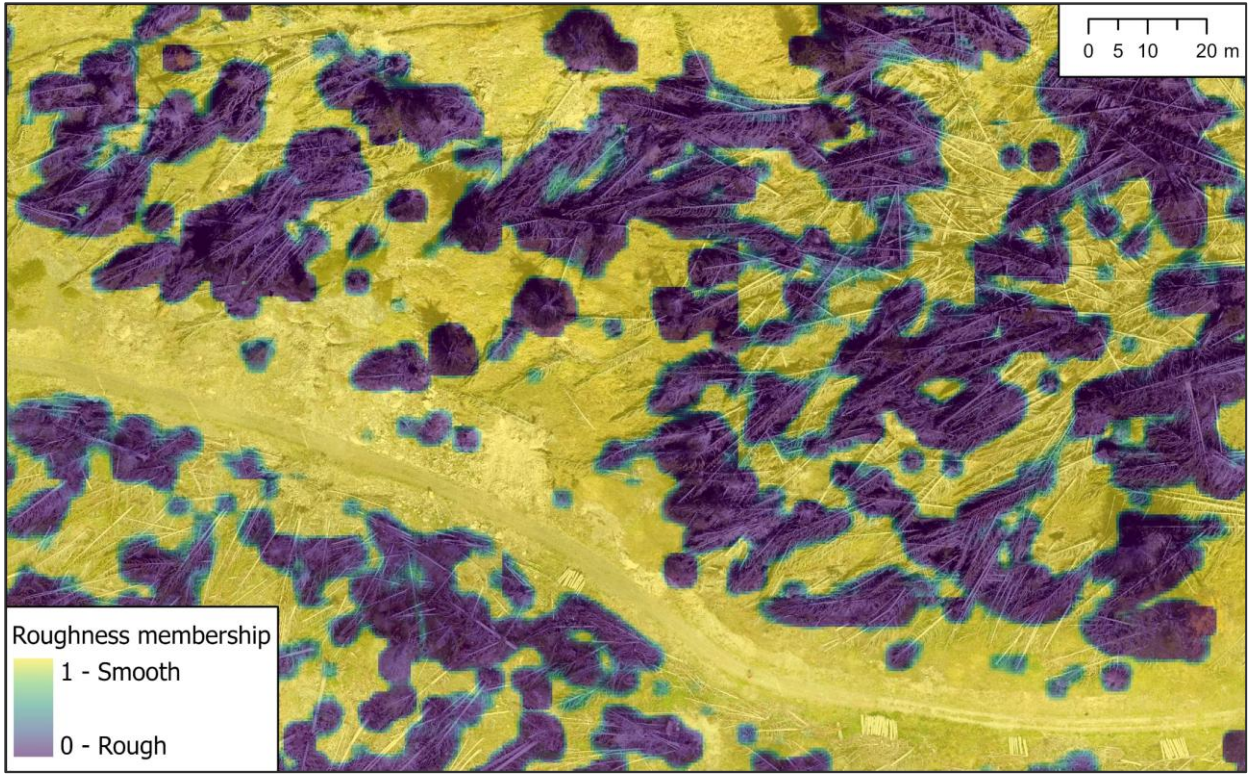
Roughness

Modelled winter terrain compared to snow-on orthophoto (0.7 m snow)



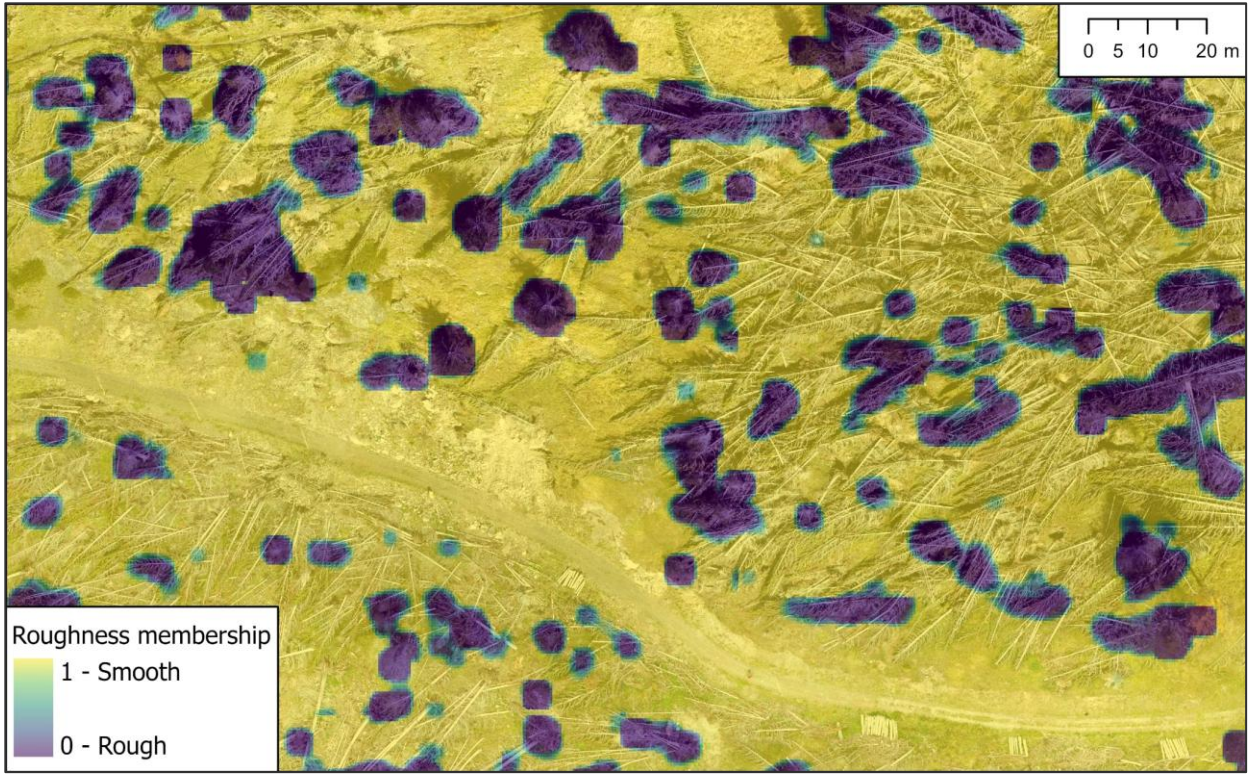
Roughness of winter terrain

Roughness Membership with 1 m snow depth (2y return period)



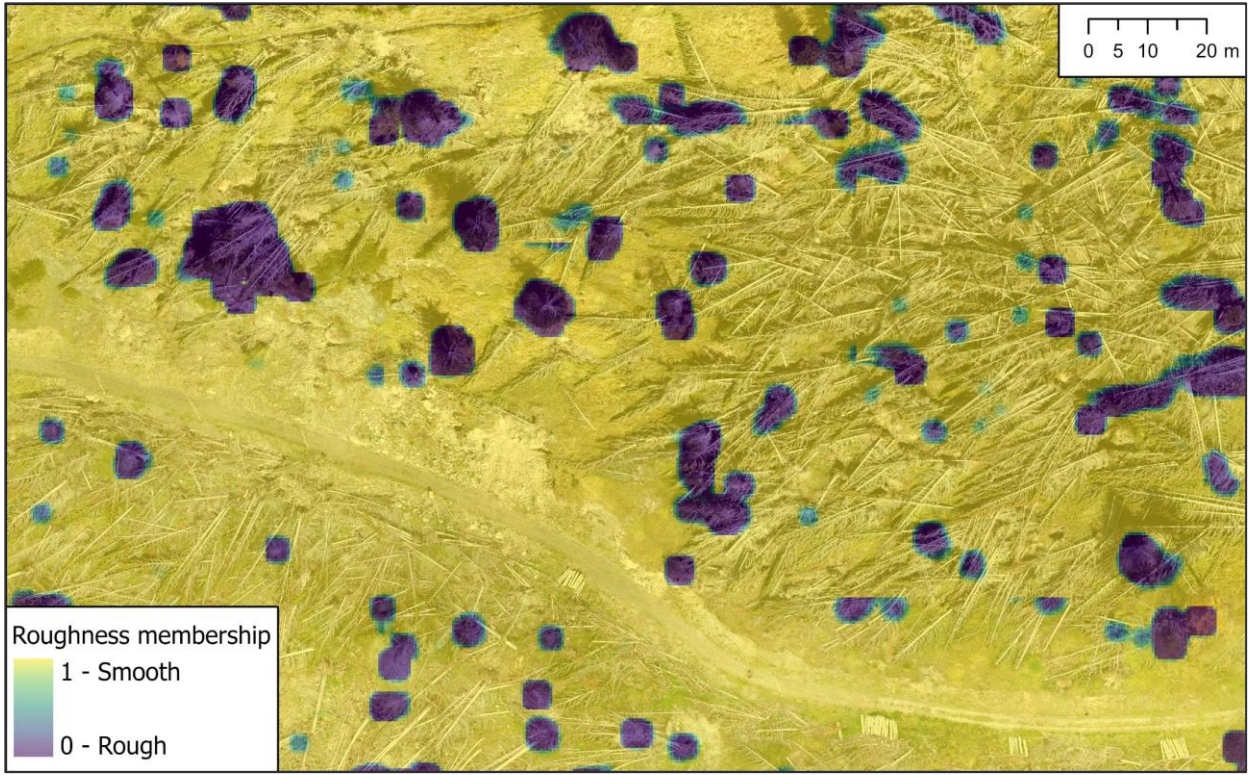
Roughness of winter terrain

Roughness Membership with 1.5 m snow depth (10y return period)



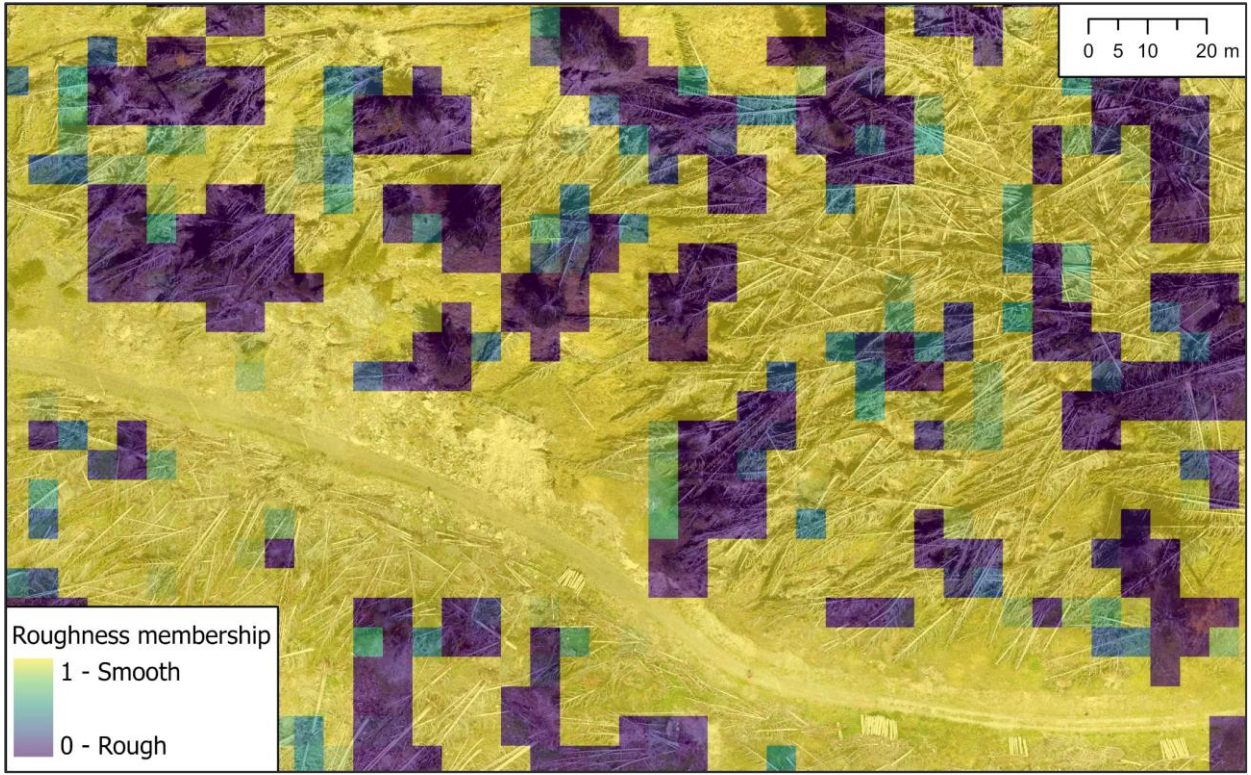
Roughness of winter terrain

Roughness Membership with 2 m snow depth (40y return period)



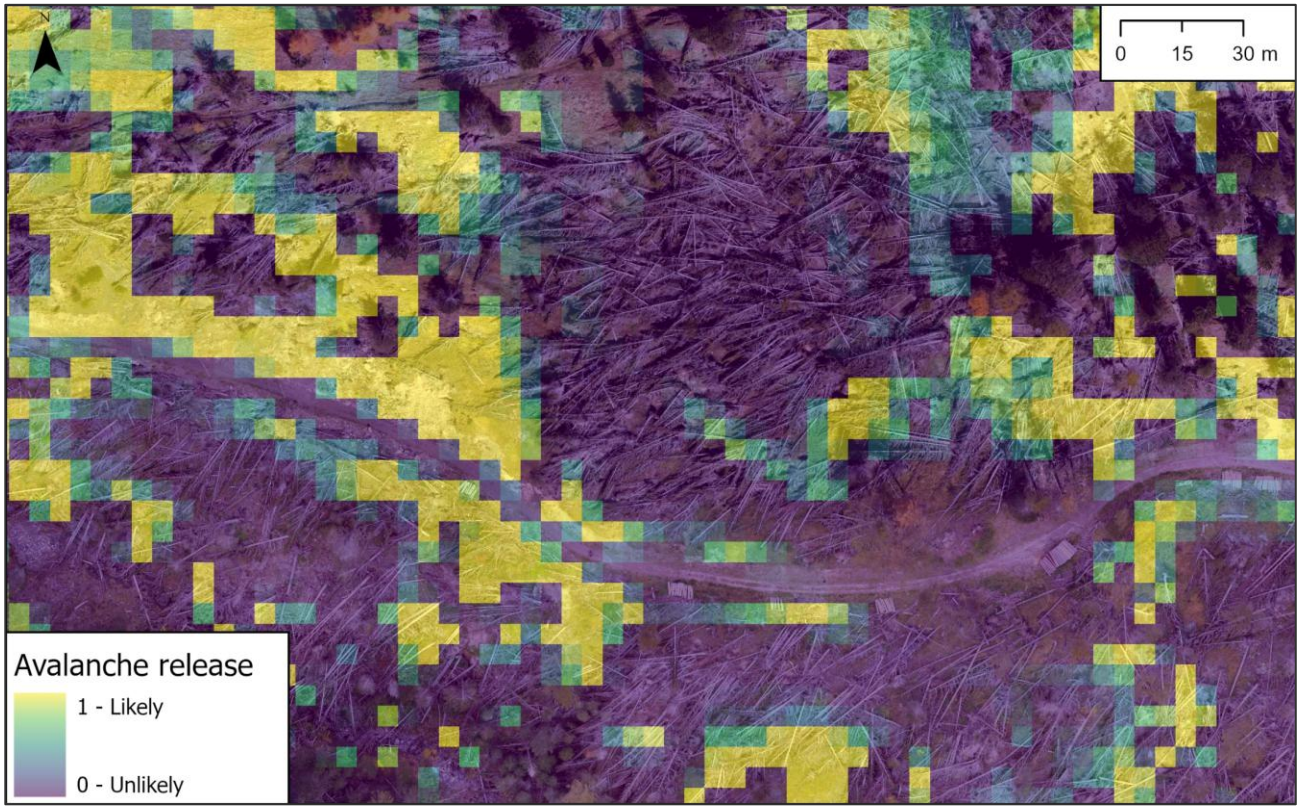
Roughness of winter terrain

Aggregation of roughness membership (2 m snow depth)



Roughness of winter terrain

PRA map with 2 m snow depth(40y return period)



Roughness of winter terrain

Slope

Canopy coverage

Franza Veneto

Applications and conclusions

- Applications

➢ Assess and monitor the protective effect of wind-disturbed forest

➢ Prioritization of post-disturbance management

➢ Implementation into ALS-surveys for large-scale analysis

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- Applications
  - ➢ Assess and monitor the protective effect of wind-disturbed forest
  - ➢ Prioritization of post-disturbance management
  - ➢ Implementation into ALS-surveys for large-scale analysis

- Conclusions
  - ➢ Low-cost drones are suitable for providing good estimations
  - ➢ Lying deadwood mostly prevent frequent avalanches (return period 30 y)
- Outlook: Integration into avalanche modelling

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Thanks for listening!

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Toft, H. B., Sykes, J., Schauer, A., Hendrikx, J., and Hetland, A.:AutoATES v2.0: Automated Avalanche Terrain Exposure Scale mapping, Natural Hazards and Earth System Sciences, 24, 1779–1793, https://doi.org/10.5194/nhess-24-1779-2024, 2024.

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