



The Vaia storm in North Eastern Italy: facing an unprecedented disturbance in mountain forests of the Southern Alps

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ANNI



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DI PADOVA



Lingua E, Pirotti F, Grigolato S, Cavalli R, D'Agostino V, Marchi N,
Costa M, Motta R, Meloni F, Garbarino M, Marzano R

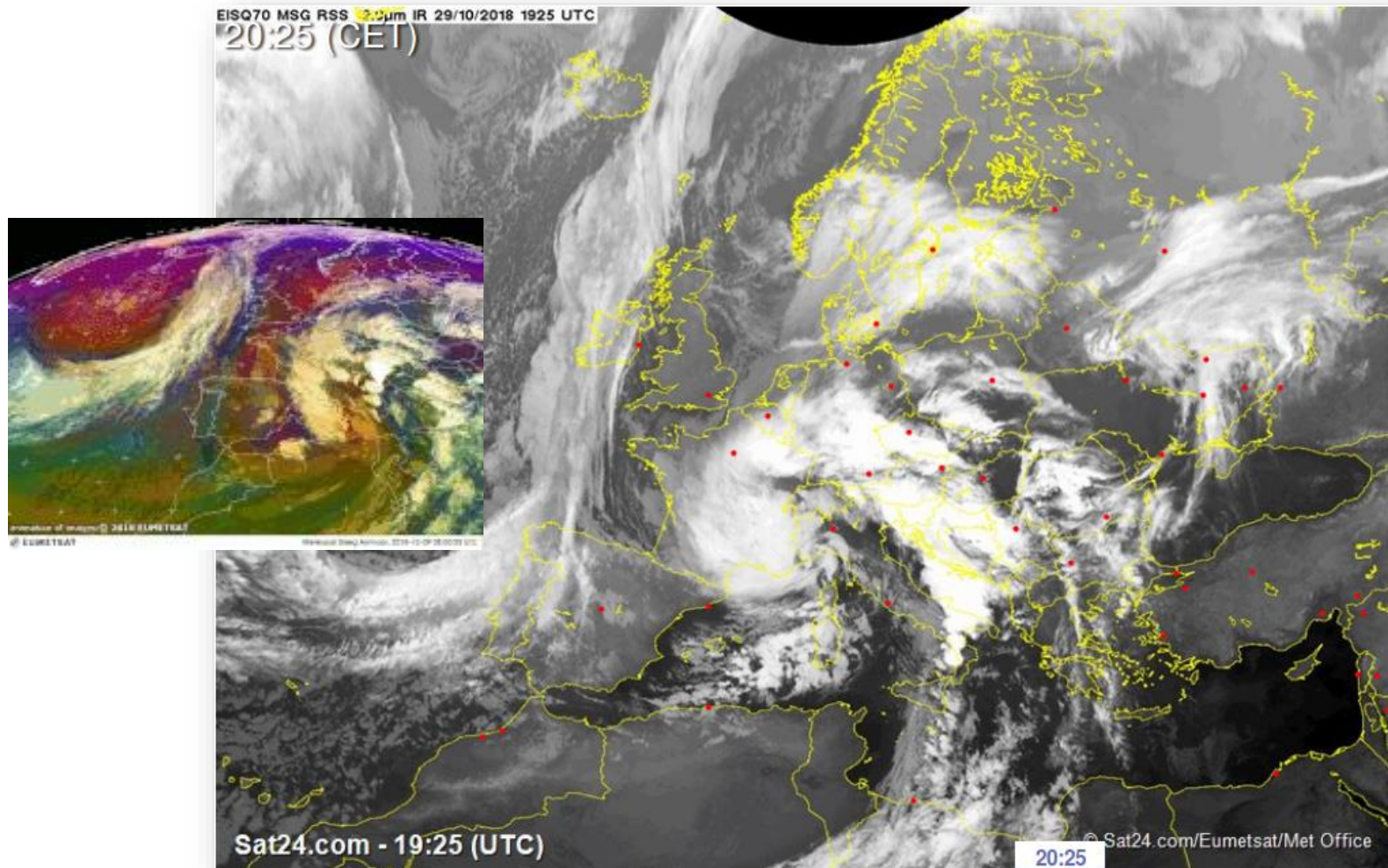
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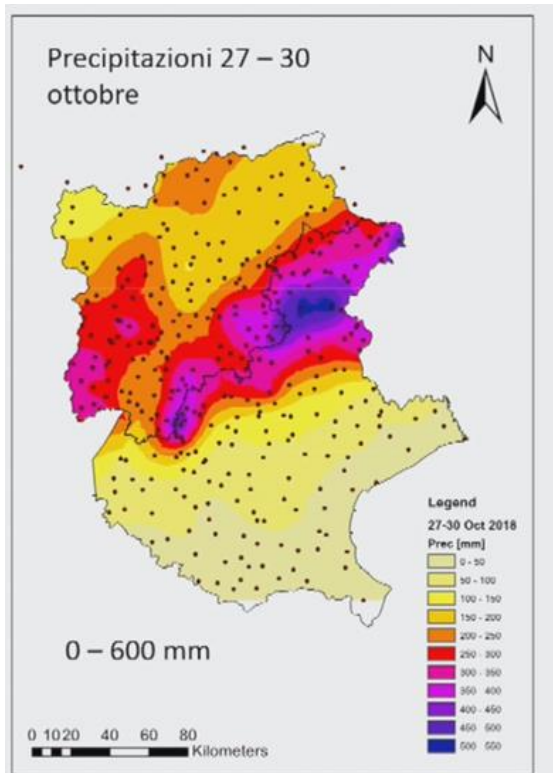
THE VAIA STORM



27-30 October 2018

Two phases

- **October 27-28**
high intensity rainfall
(average 335 mm; max 519 mm)
- **October 29-30**
high intensity rainfall
(average 198 mm; max 298 mm)
strong wind (close to 200 km h^{-1}) SE direction



Elaborazione: M. Borga - TESAF



Effects

I phase:

Landslides, debris flows, floods



Effects

II phase:

Windthrows



Neri, 2019

Damaged Areas of the Selected Storms

Areas derived using Biezer interpolation of ground points

Source: Refer to the Report Annex3

Legend

2004 Storm



- 1953 Storm
- 1967 February
- 1969 September
- 1972 November
- 1987 October
- 1990 Daria/Vivien
- 1999 Lothar
- 1999 Martin
- 2005 Gudrun
- 2007 Kyrill
- 2009 Klaus

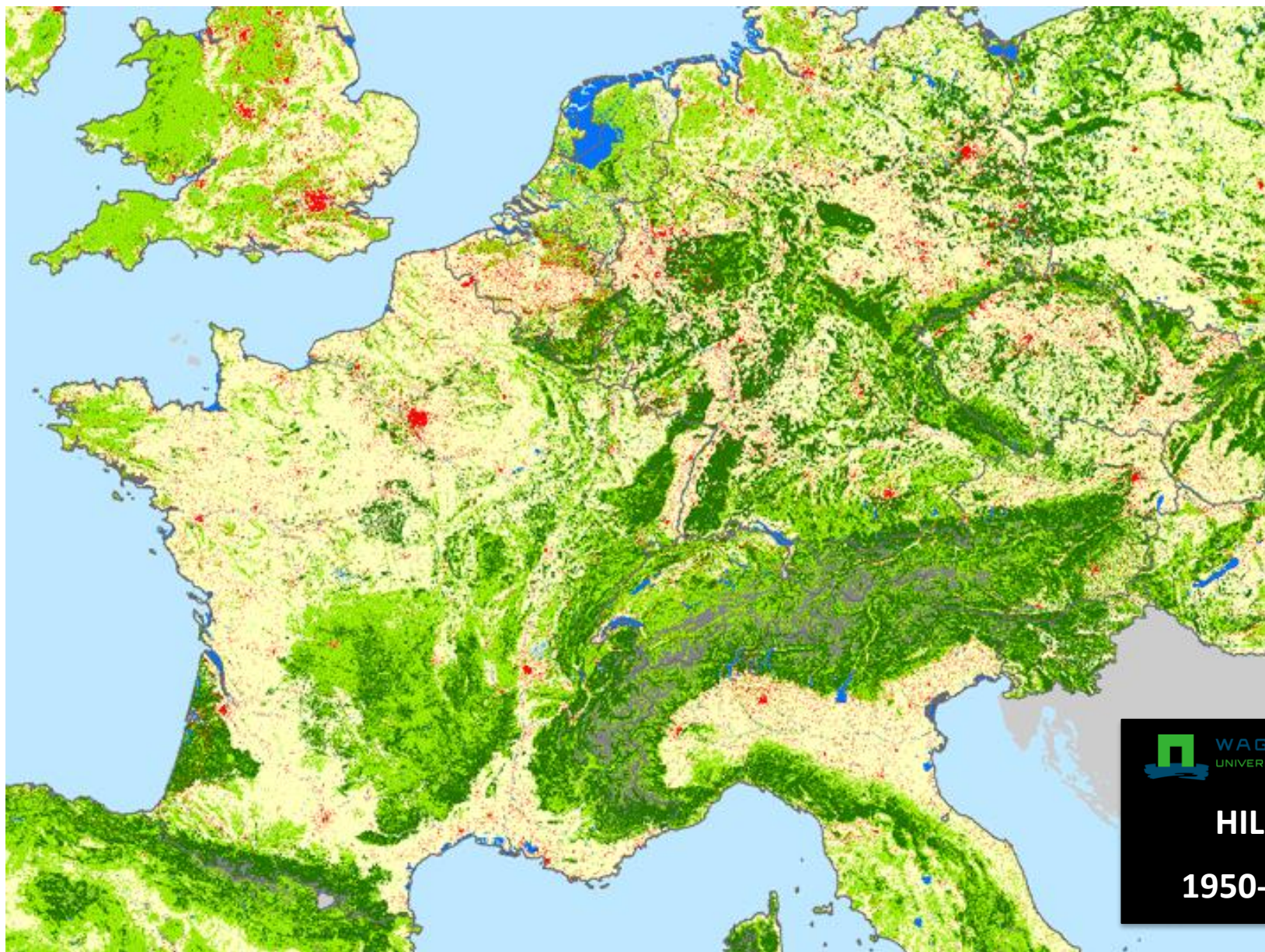
National Boundaries



Unprecedented disturbances?



Storm	Year	m ³
-	1966	≈ 700 K
Viviane	1990	≈ 100 K
Vaia	2018	≈ 8.5 M



 **WAGENINGEN**
UNIVERSITY & RESEARCH

HILDA

1950-2010

Fuchs et al. 2013, 2014, 2015

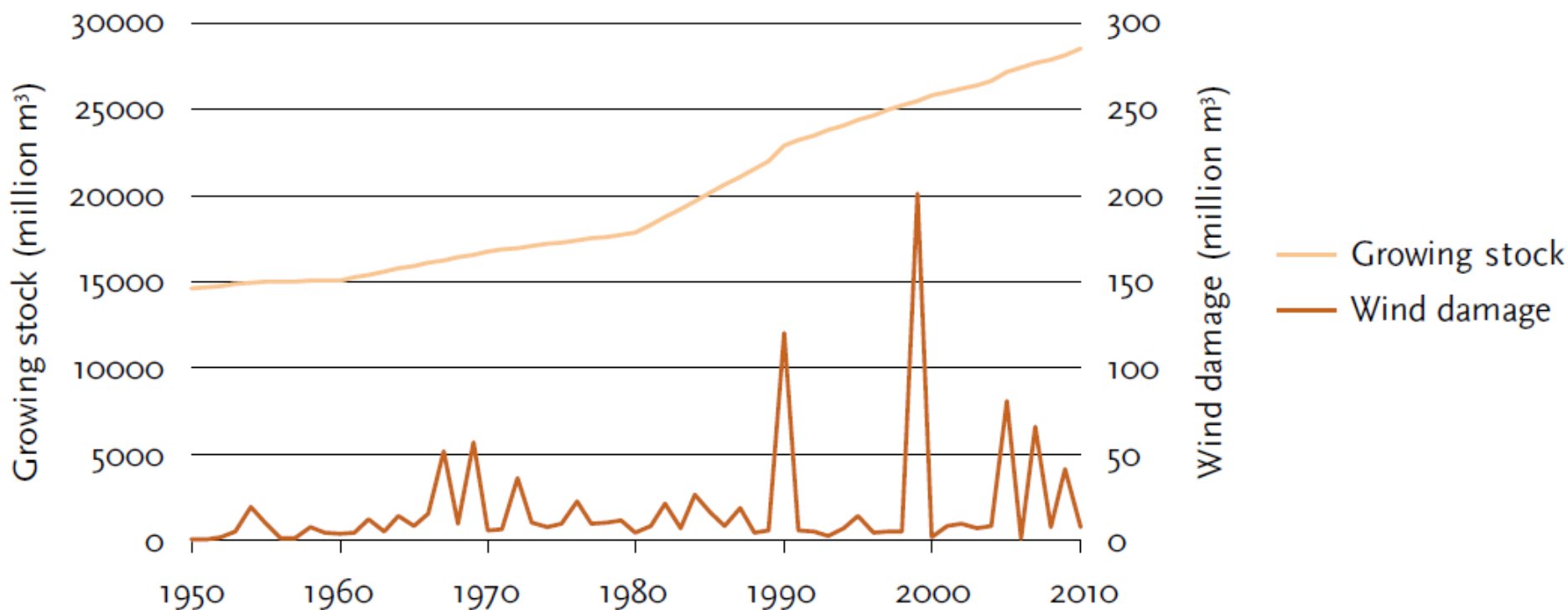
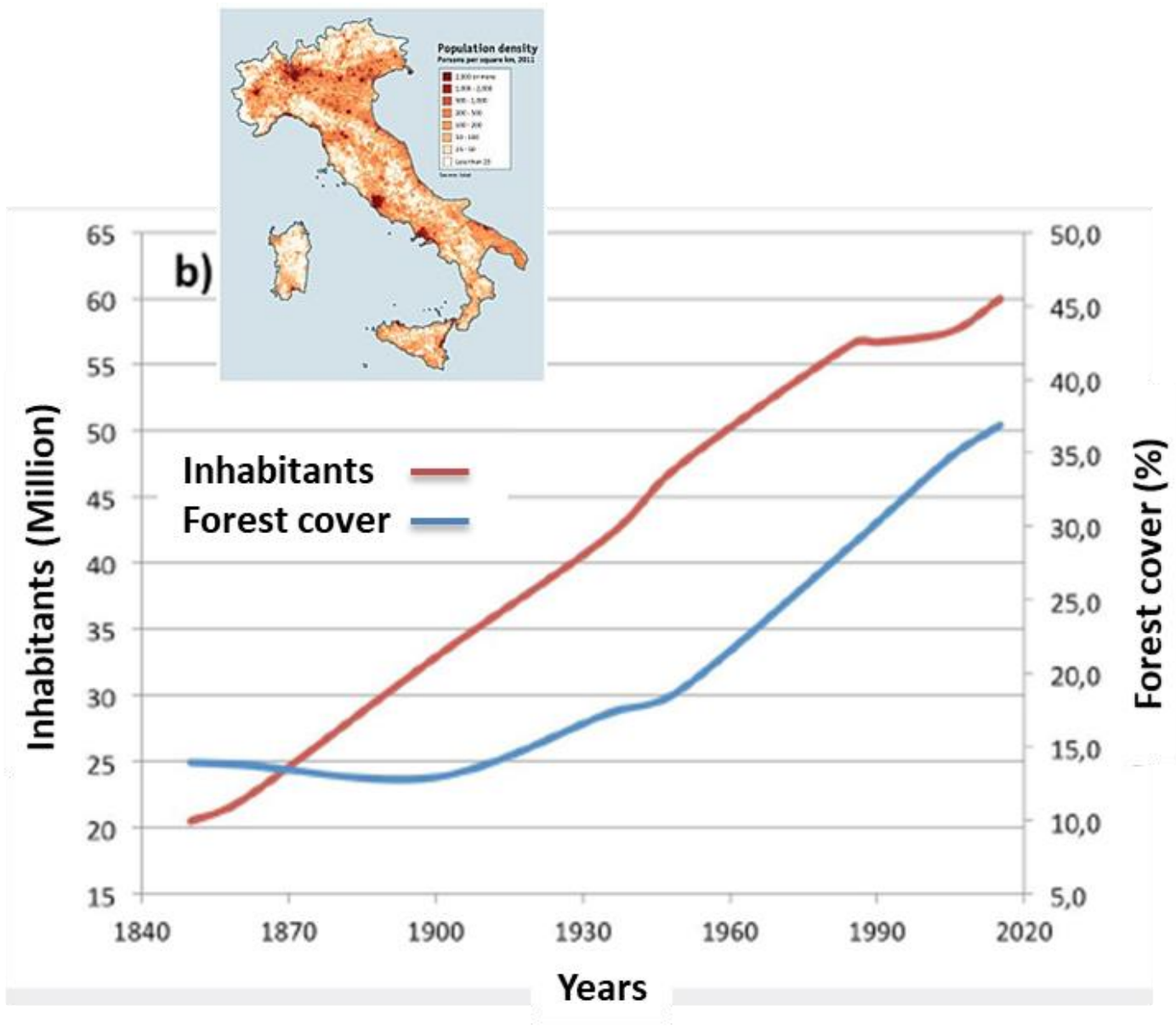


Figure 2. Development of growing stock and damage caused by storms in the period 1950–2010.





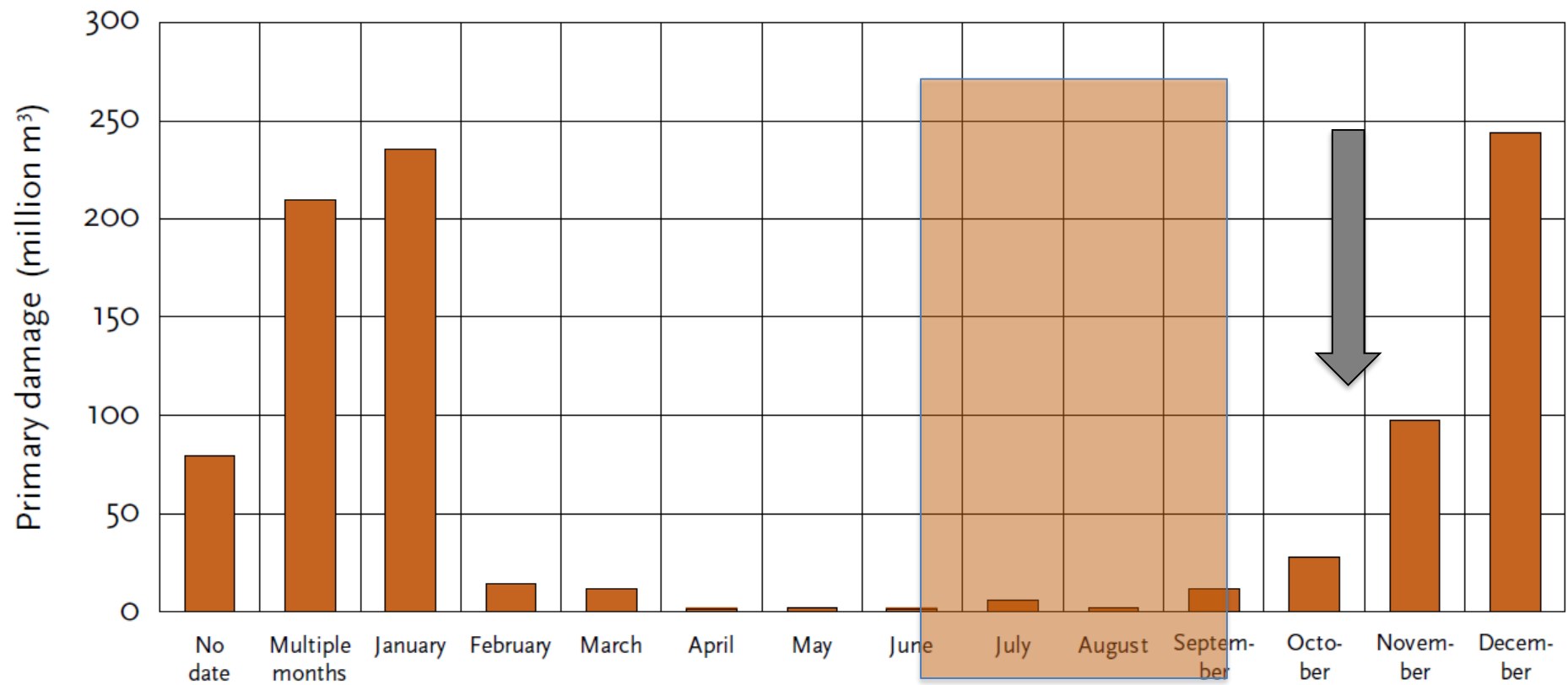


Figure 3. European storm damage to forests by month of the year. (Gardiner et al. 2010)





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Paola Favero



Mid-severity wind disturbance «Diffuse» windthrows



Feltre (BL)

**More than 60%
of urban trees**



Damage assessment

Identification of affected areas
Quantification of windthrown timber

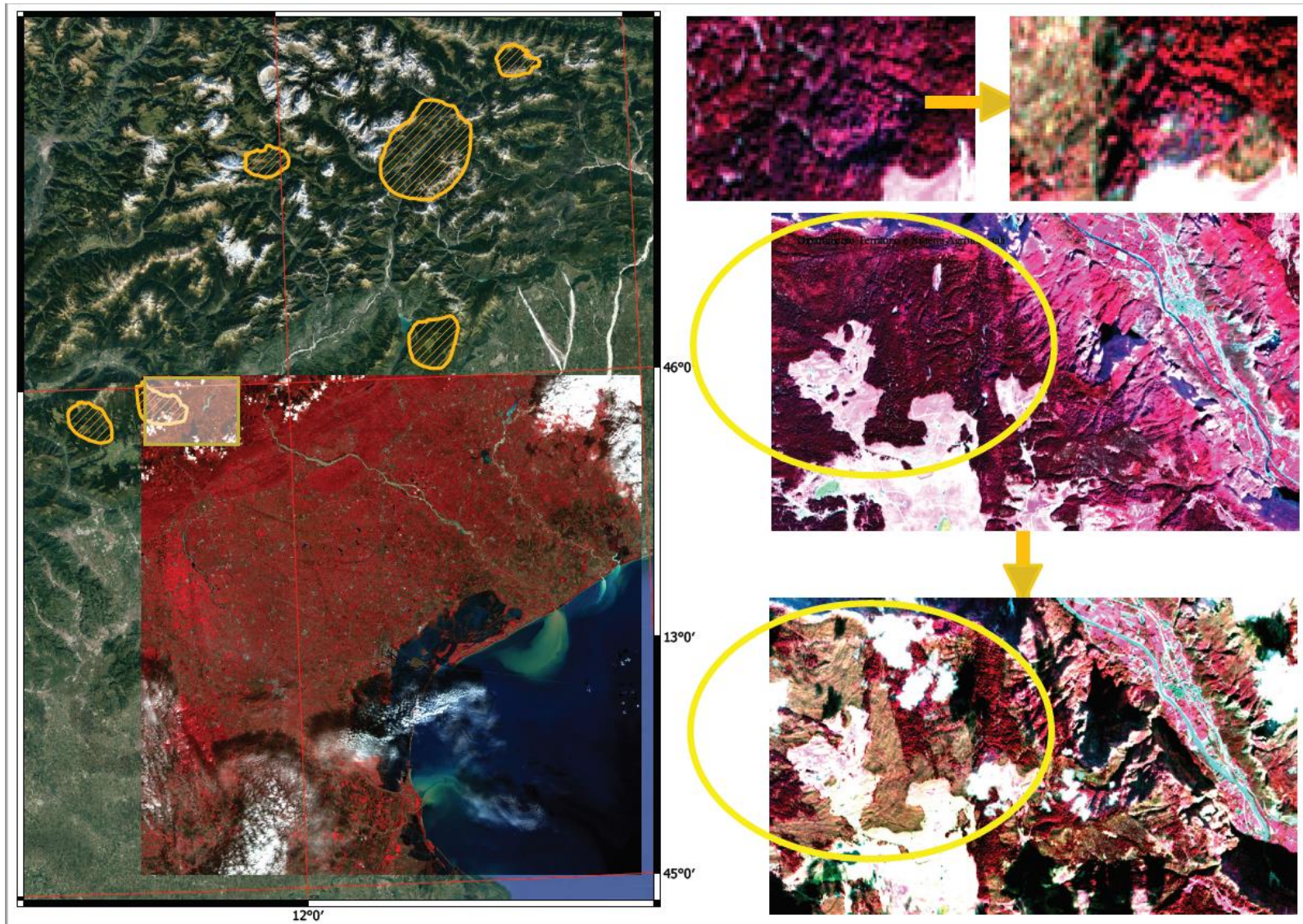
Criticalities

Accessibility
Communication
Severity assessment

CHALLENGE

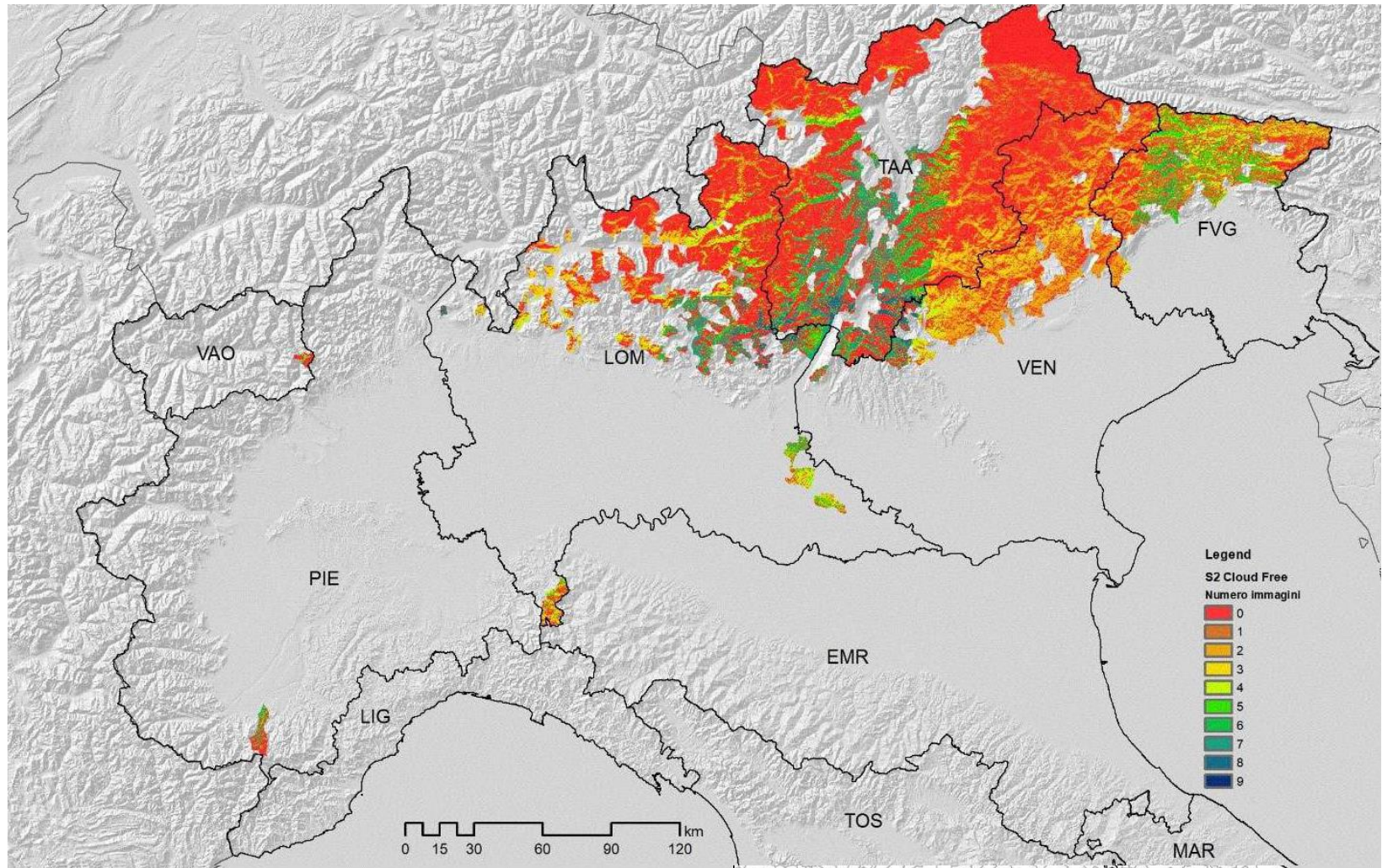


Damage assessment



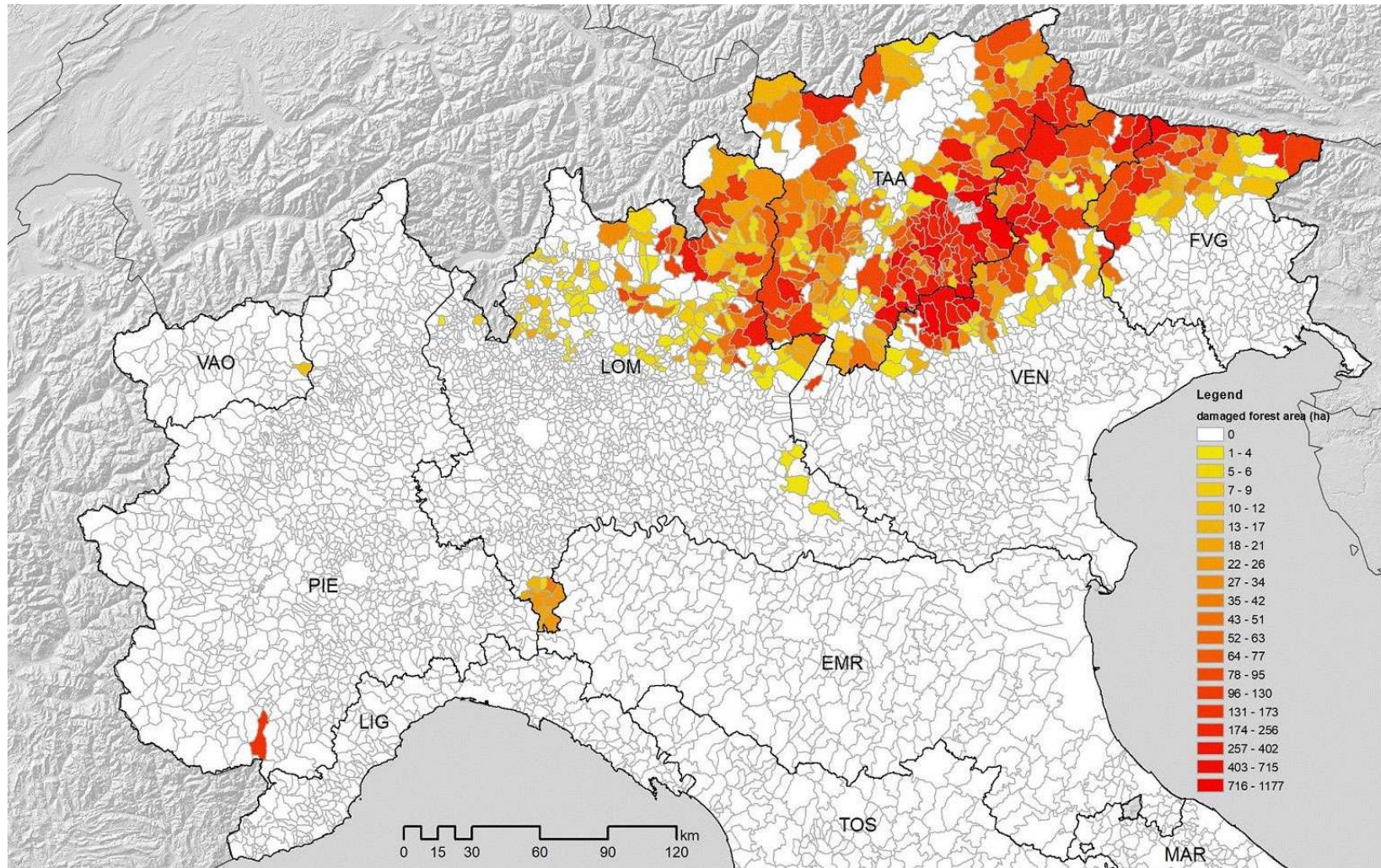
Damage assessment

Chirici et al. 2019



Damage assessment

Chirici et al. 2019



First estimation: 42.525 ha, corresponding approximately to 8.5 Mm³

Damage assessment

Affected Area identification

Visual assessment

Remote sensing

On demand data acquisition

Windthrown timber

Estimation from management plans

UNDERESTIMATION

Post-disturbance intervention

**Civil Emergency phase
(buildings, road networks,...)**



**Timber extraction
Salvage logging operations**

CHALLENGE



Timber extraction

Slope

Accessibility

Forest enterprises

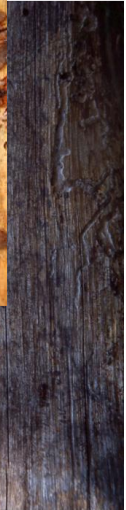
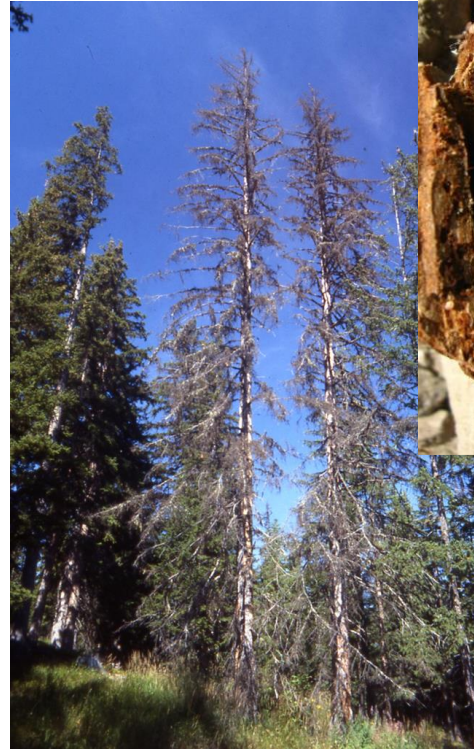
Mechanization

Safety issues



Bark beetles

Outbreaks in 3 years?



CHALLENGE

Considering Alpine countries (A, CH)
in the years following big storms,
damage by bark beetle 0.44-2 x windthrown timber (*Gregoire et al. 2015*)

Wood management

Market (€)

Storage

Preservation

No coordination



Afforestation

Why?

Where?

What?

How?



CHALLENGE





Crowd funding initiatives

Do we really need to artificially regenerate all the blowdowned stands?

Provenance

Mixed stands

Irregular / clusters

Shelter / fences

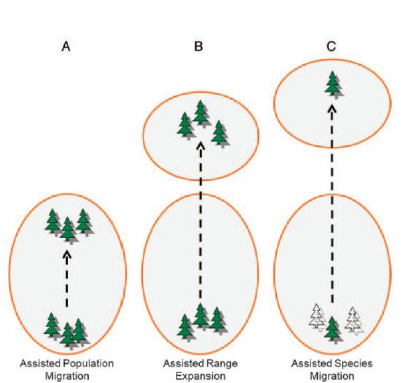


**Resilience and
resistance**

Preparing for Climate Change: Forestry and Assisted Migration

Mary I. Williams and R. Kasten Dumroese

Assisted migration
Altitudinal
Latitudinal





Ecosystem services



Protection forests



Veneto in ginocchio

I nostri boschi rasi al suolo

14

15

VAIA & Rockfall

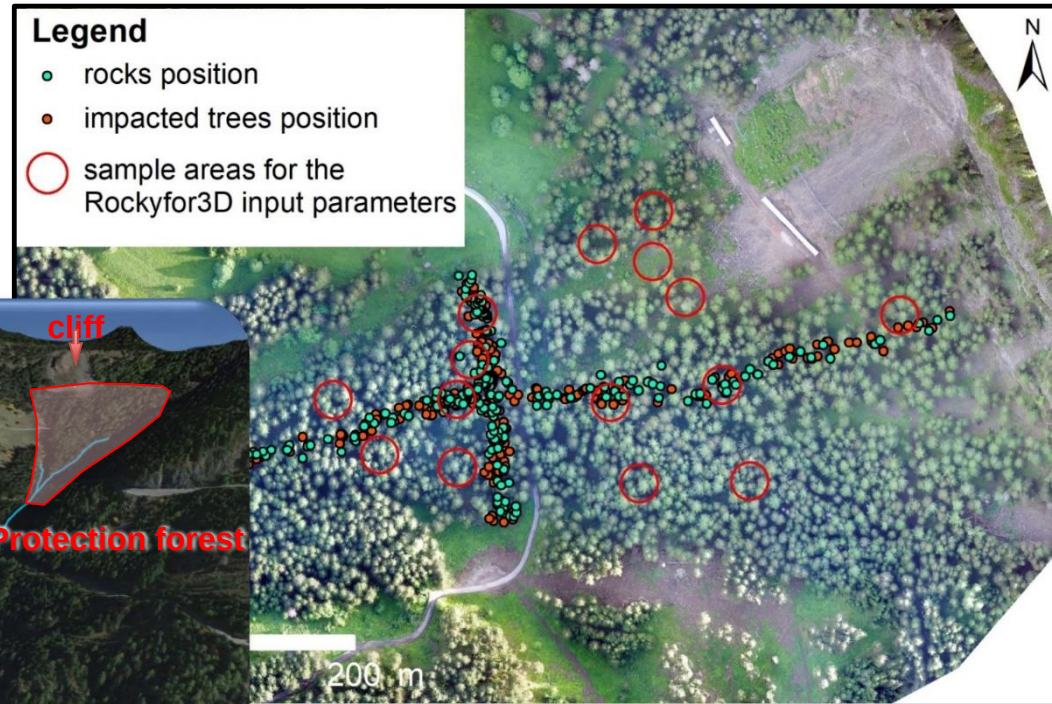
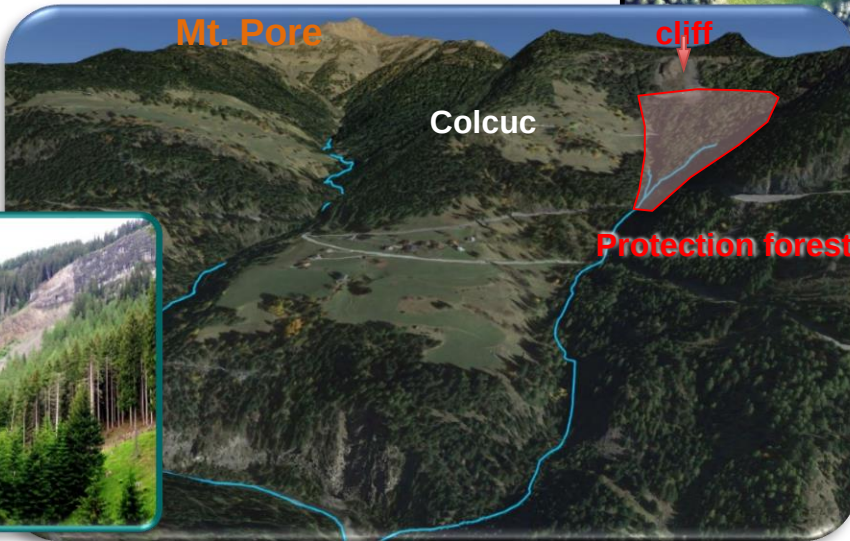


Case study

Interreg
Alpine Space



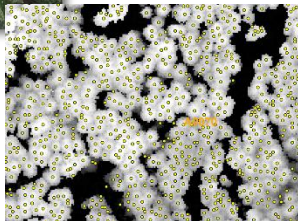
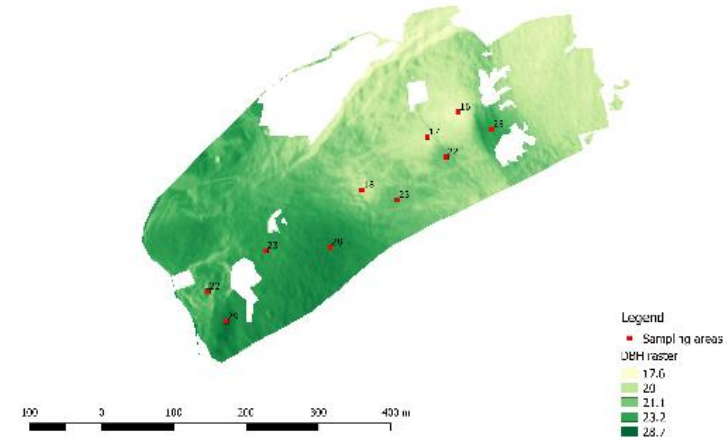
ROCK
the ALPS



Colle Santa Lucia (BL), NE Italy

Remote sensing

Interreg
Alpine Space



LiDAR

UAV



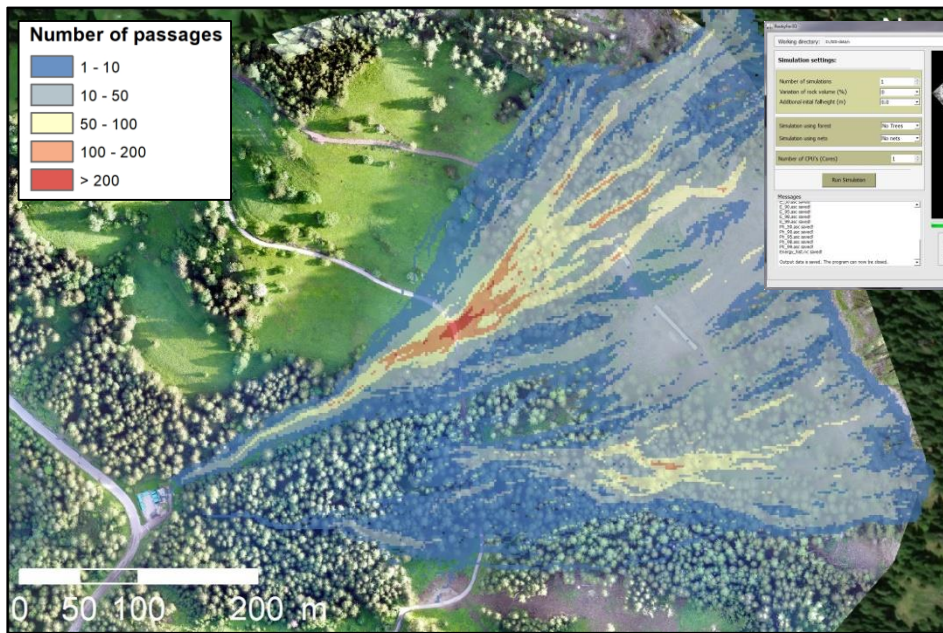
Rockyfor3D simulations



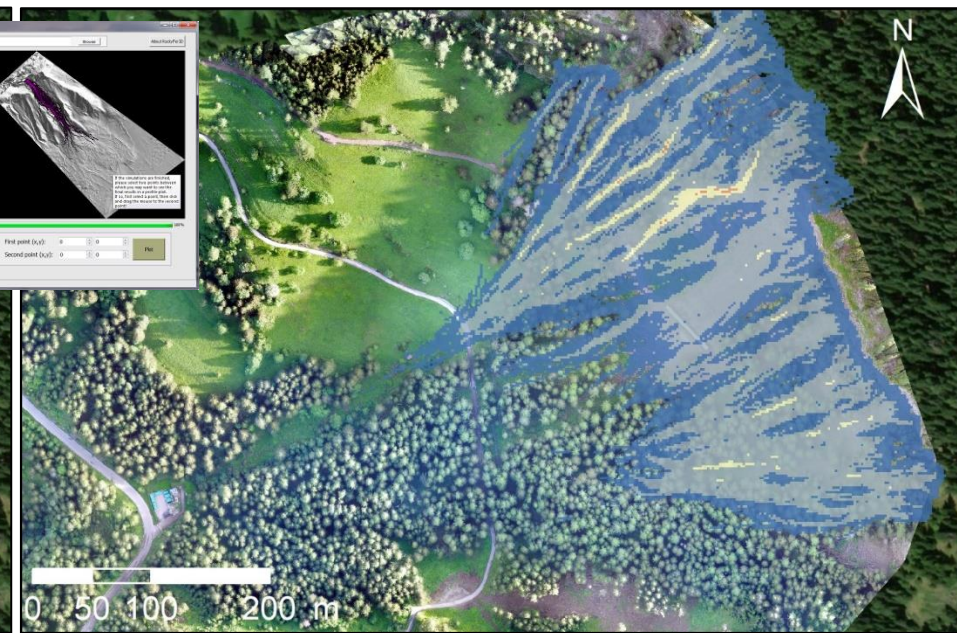
Protective effect

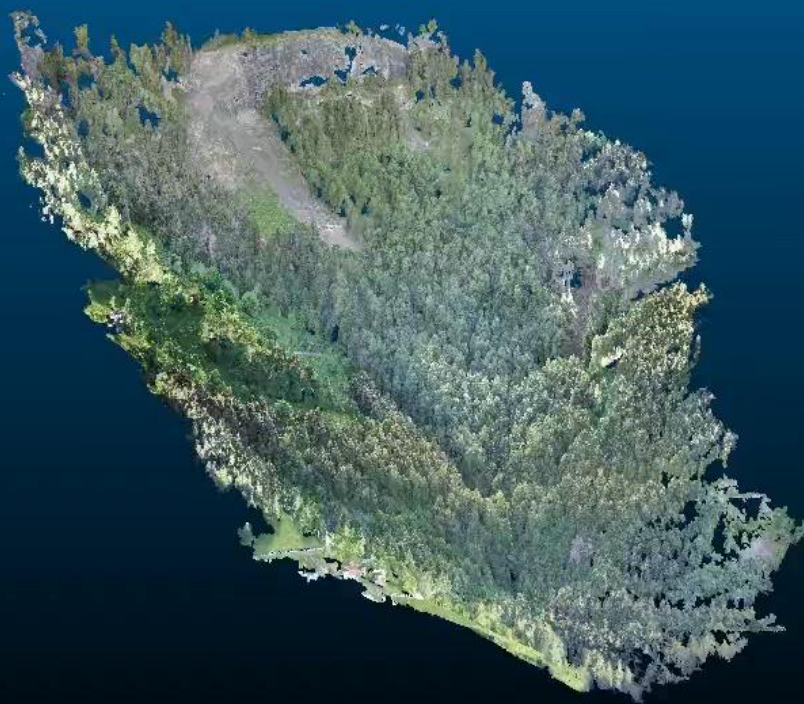
BARI (Barrier effect)
MIRI (energy reduction)
ORPI (overall protection)

Without forest



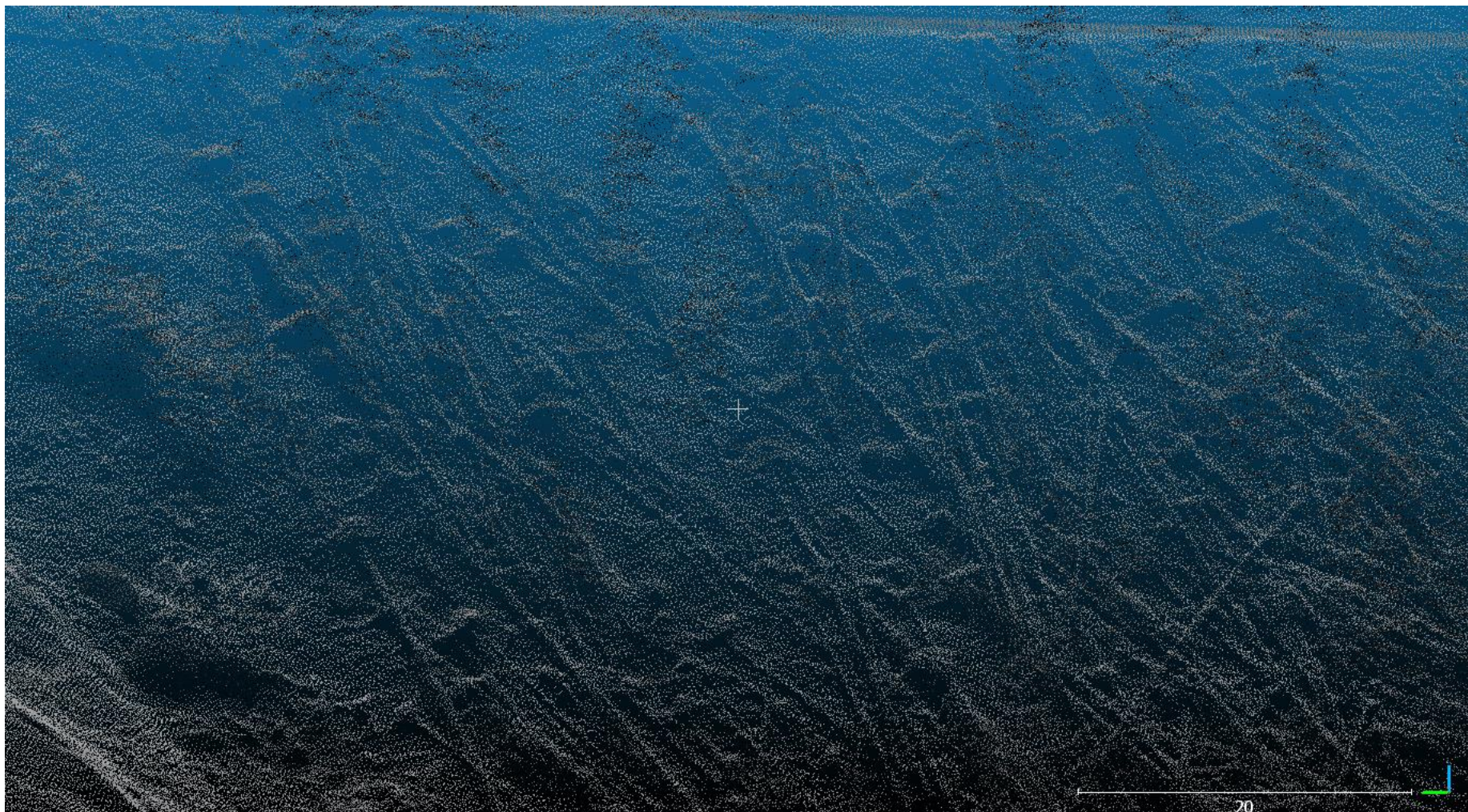
With forest





Interreg
Alpine Space



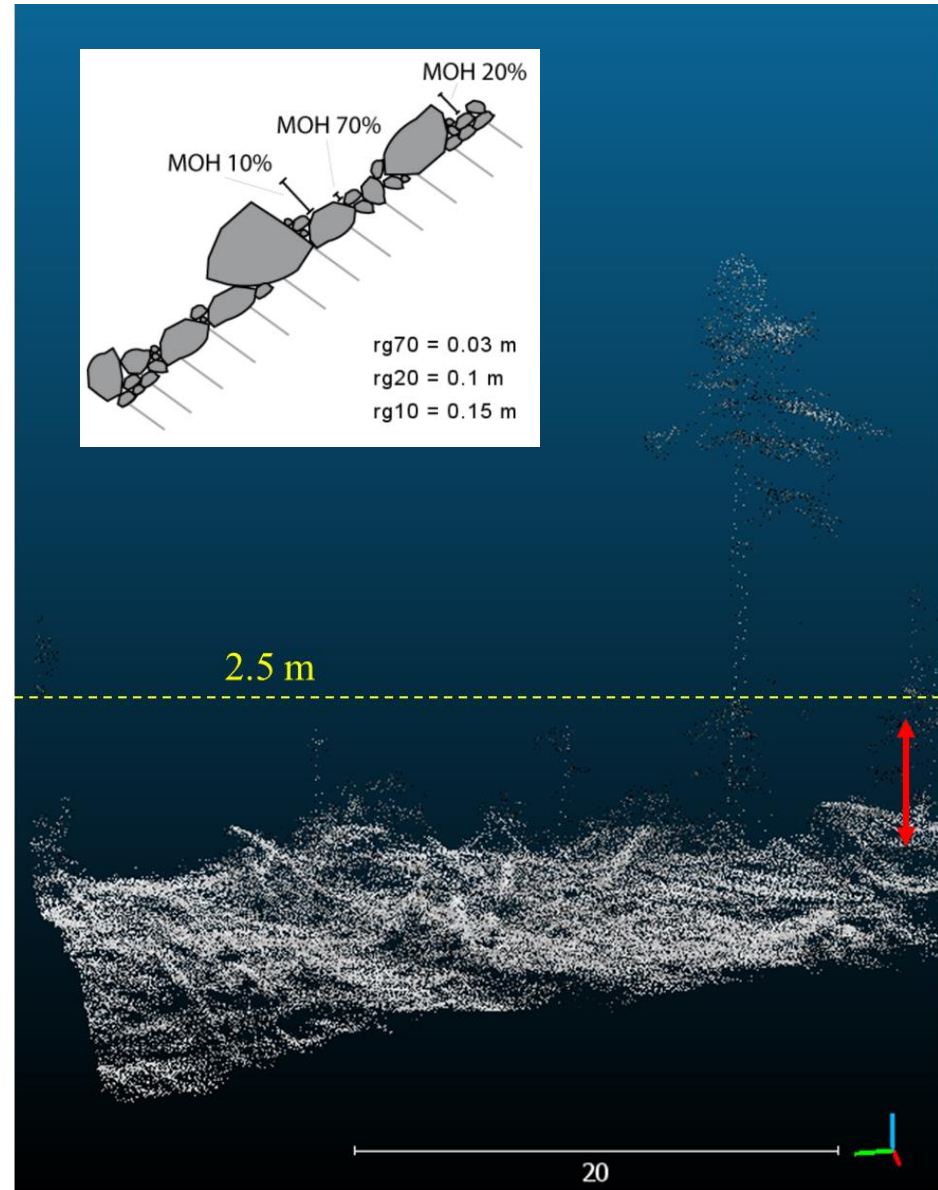


July 2019, 8pts m⁻²

Roughness estimation

- Point cloud normalised on ground (elevation -> height)
- All points above 2.5 metres were dropped
- RG values calculated as quantiles starting from above threshold

q10 { q20 { q70 }



Simulation scenario

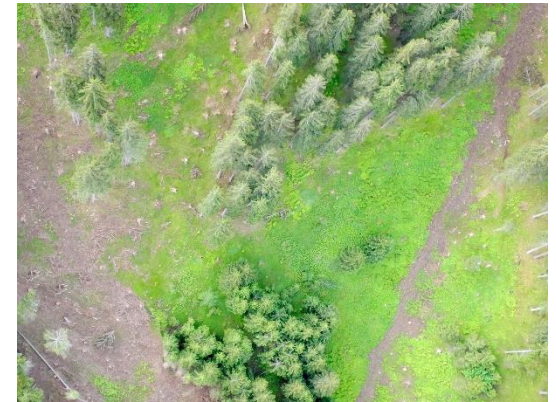
Protection forest pre-Vaia (summer 2018)



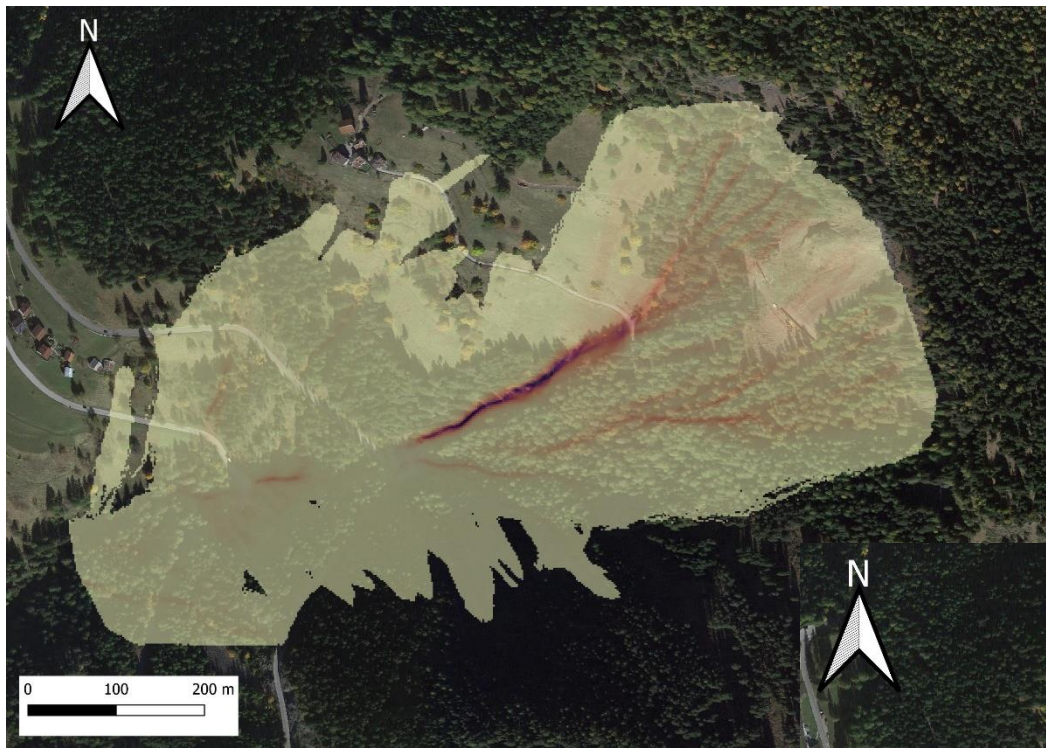
Post Vaia (Unsalvaged)



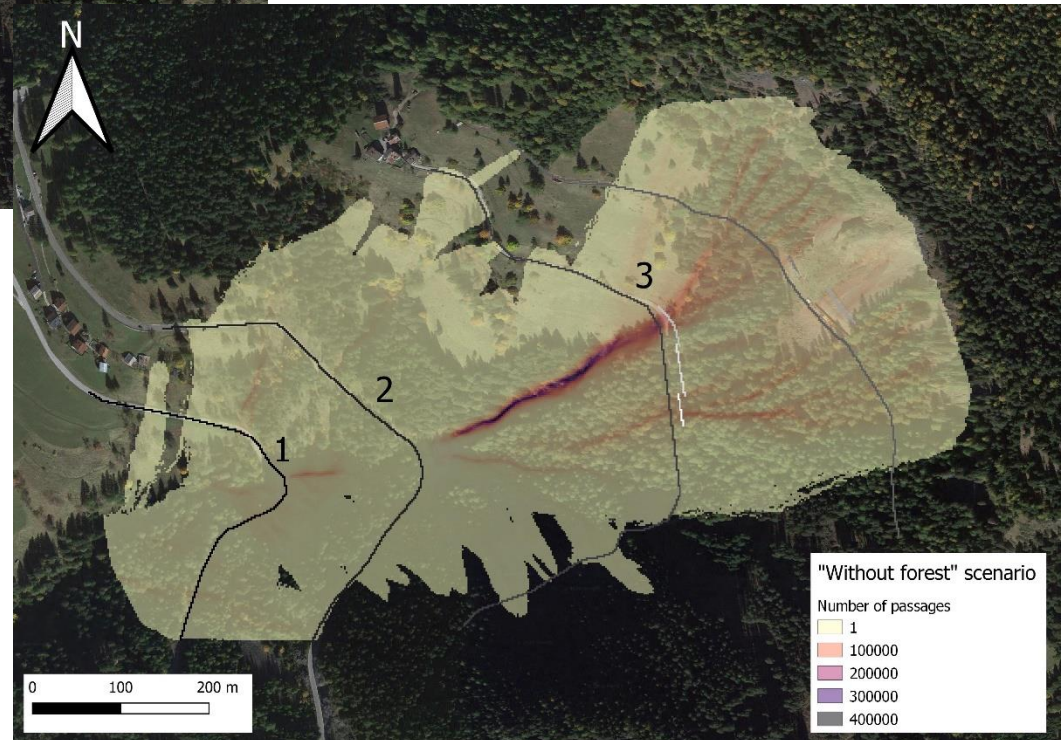
Post Vaia (Salvaged)

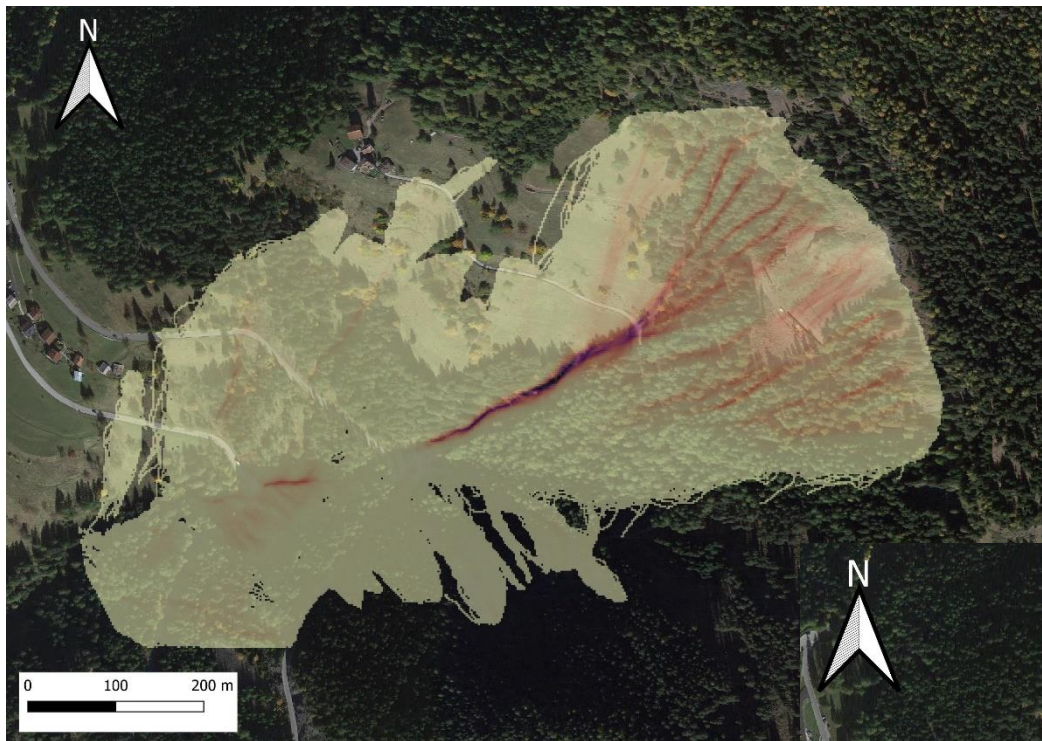


- 1000 simulations
- Rectangular blocks (appr. 1.2 m³)
- Rock volume variation: 50%
- Initial fall height: 5m

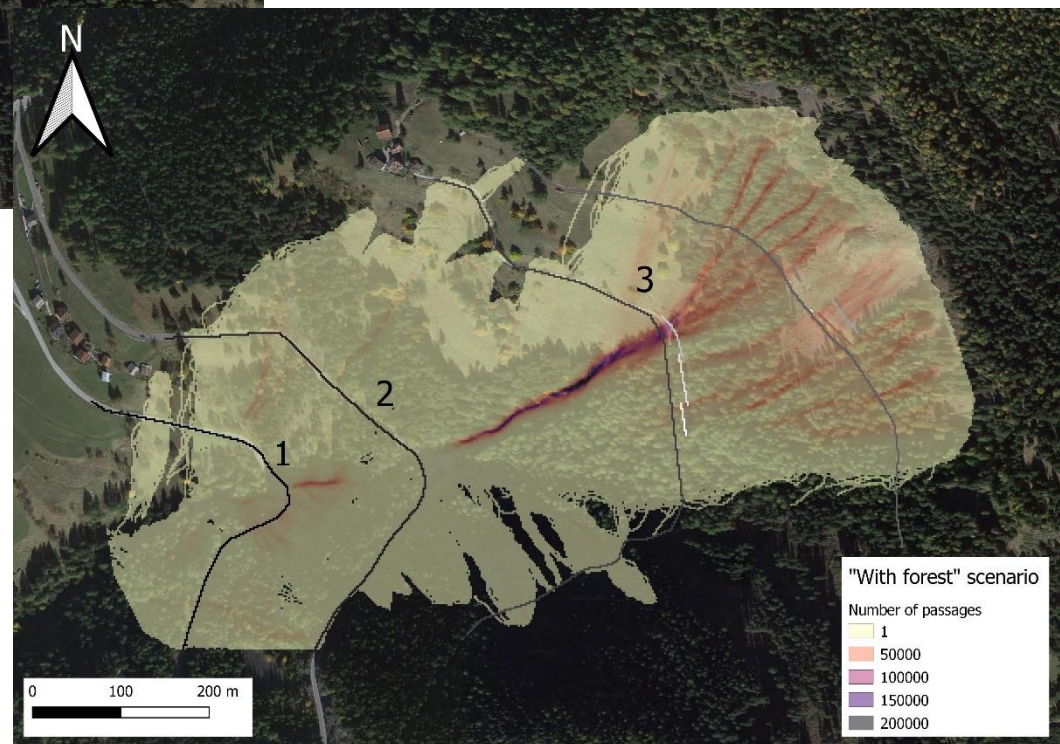


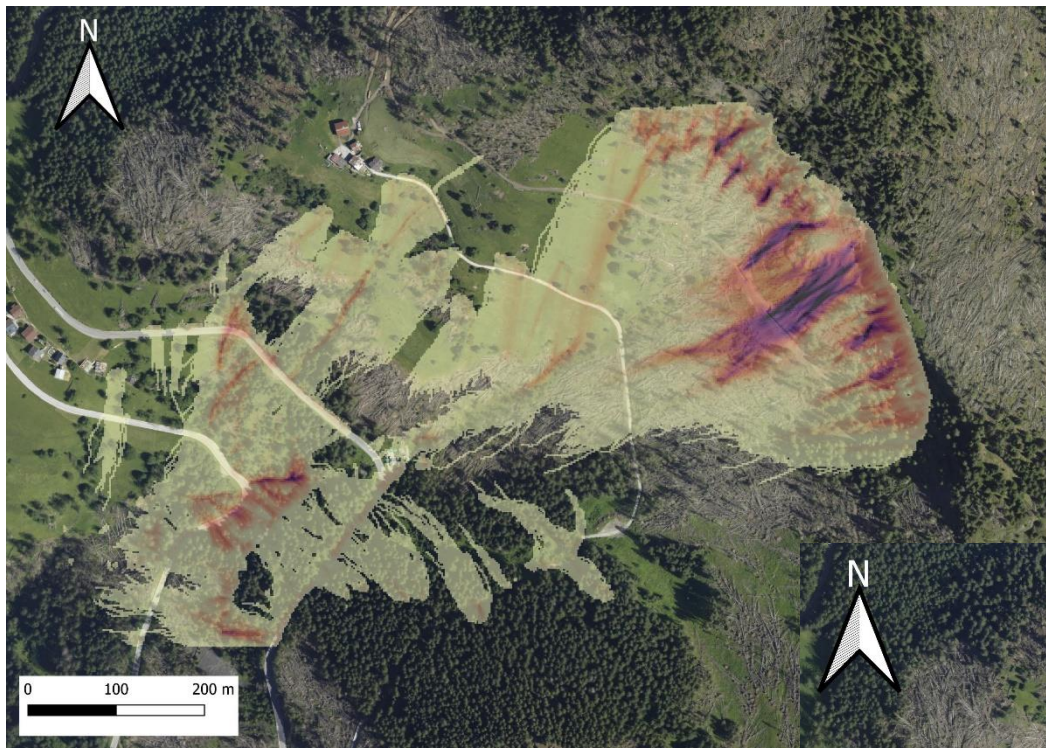
No forest



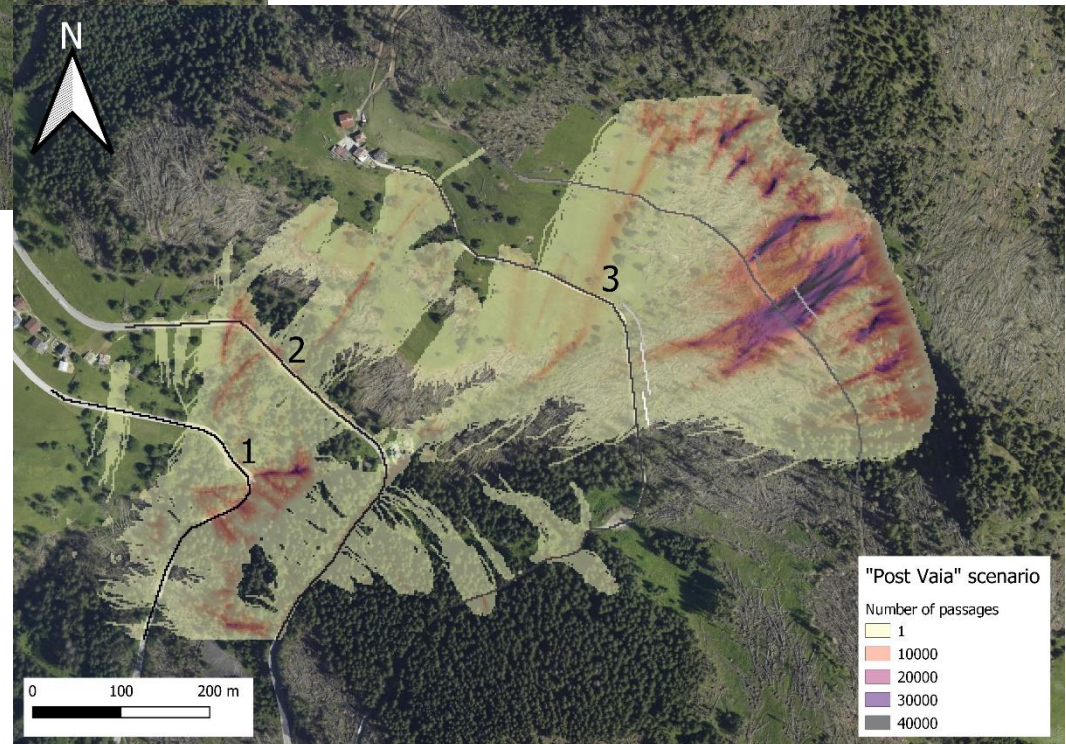


With forest



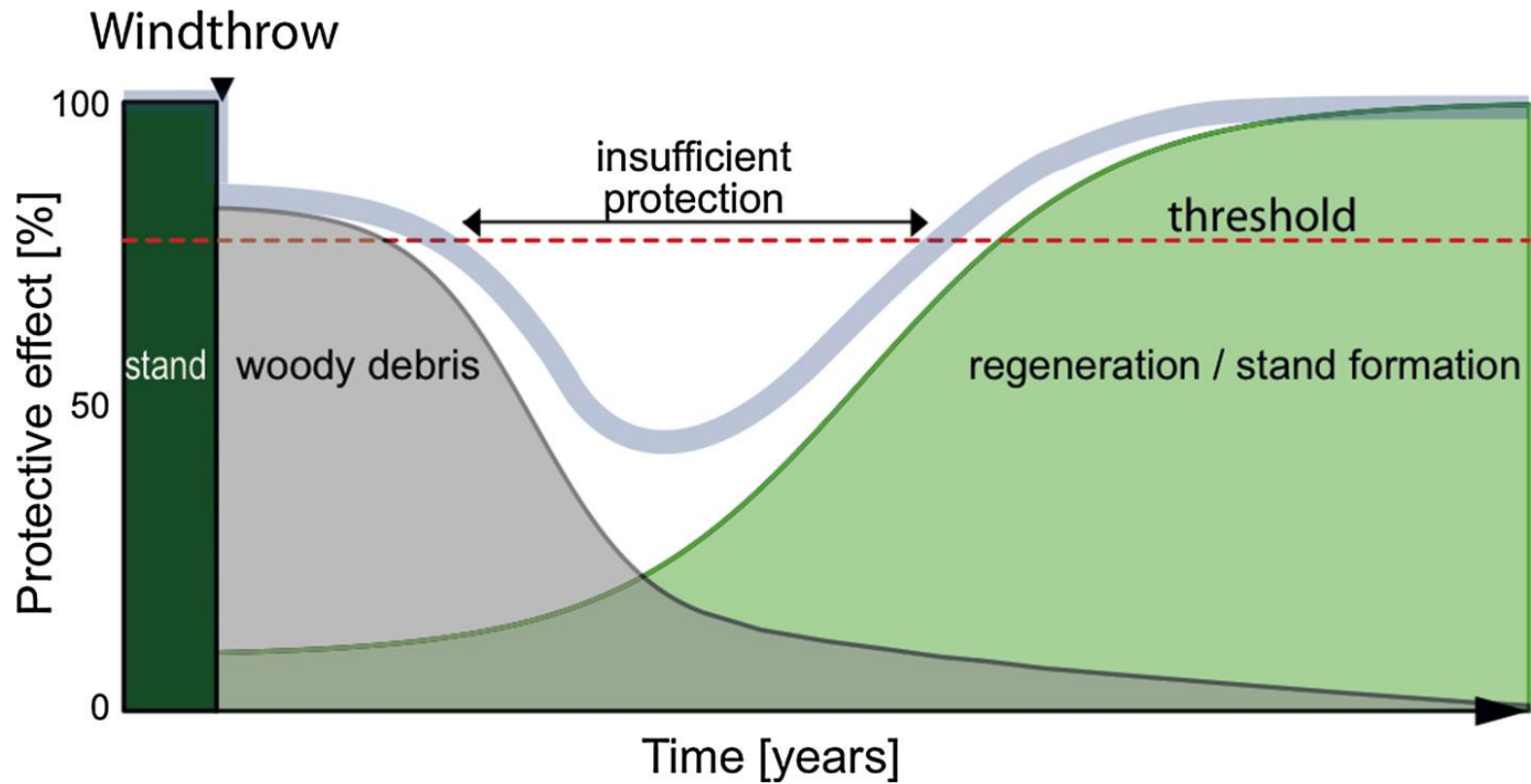


**With blowdown
timber unsalvaged**



Checkpoint	Scenario	BARI	MIRI	ORPI	Classification*
1	Pre Vaia	38.4	24.4	52.6	Medium PE
	Post Vaia	62.4	39.1	76	Medium PE
2	Pre Vaia	16.3	39.3	41.1	Low PE
	Post Vaia	26.5	57.9	59.8	Medium PE
3	Pre Vaia	45.5	10	54.4	Medium PE
	Post Vaia	92.6	52.1	98.1	High PE

* ≤ 50 = Low Protective Effect,
 between 50 and 90 = Medium Protective Effect,
 > 90 = High Protective Effect
(Dupire et al. 2016)



Wohlgemuth et al. 2017

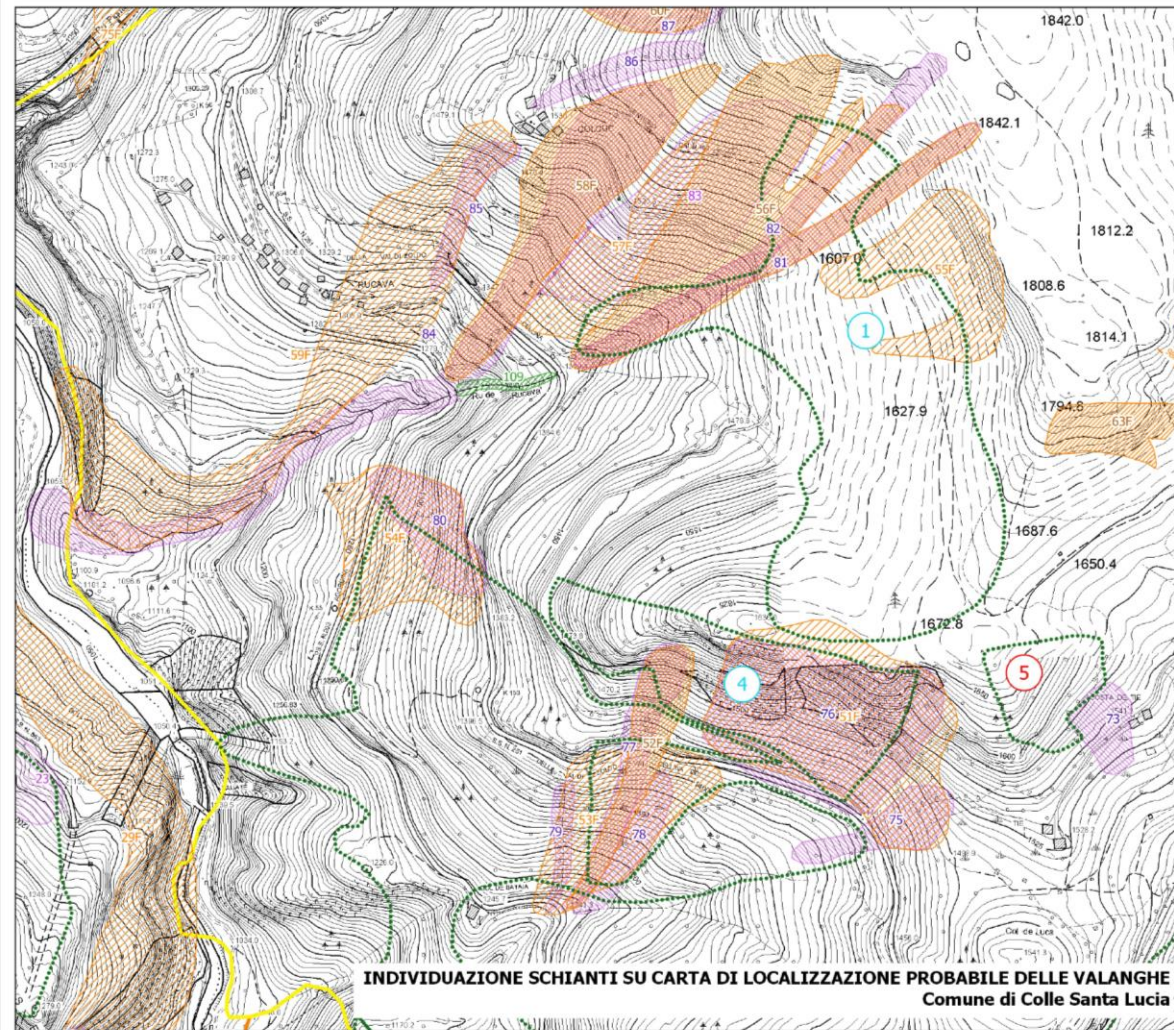
Avalanches



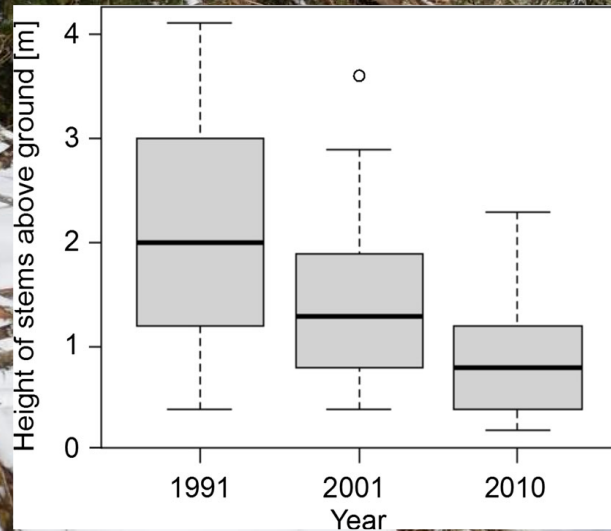
New release areas

High severity
windblown areas

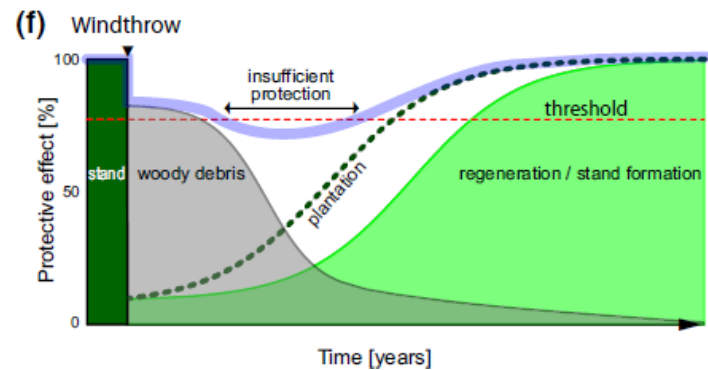
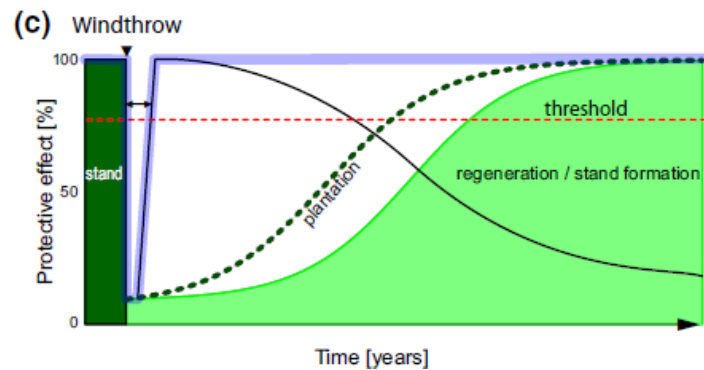
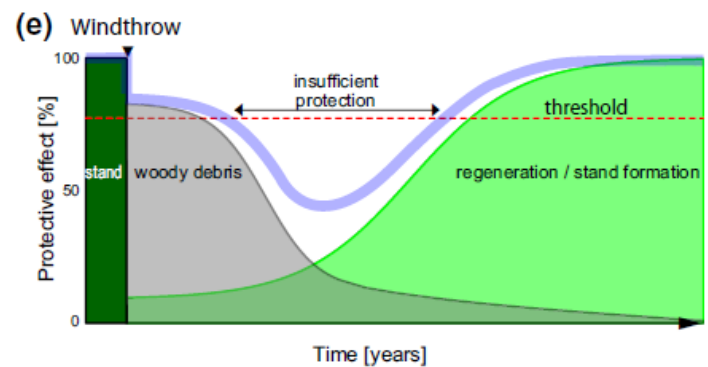
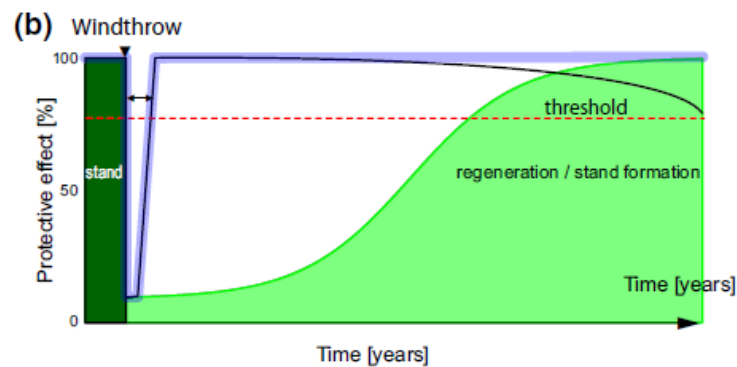
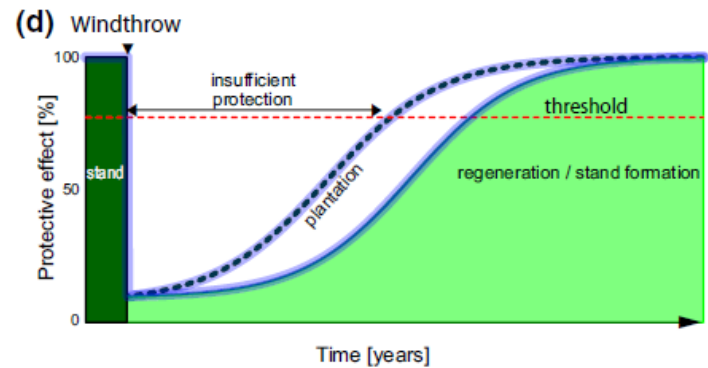
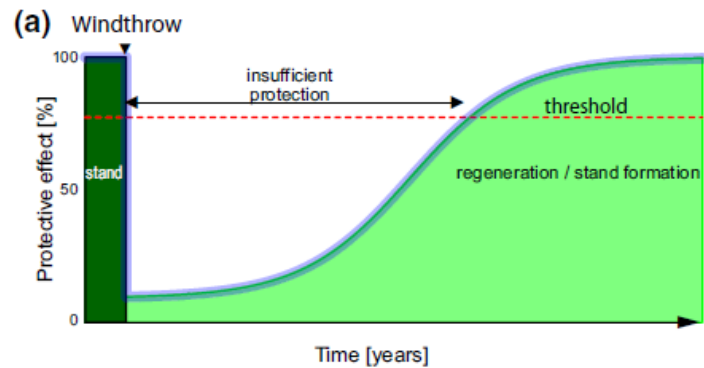
Slope $>29^\circ$



Slope 29°-35° delayed risk



Wohlgemuth et al. 2017

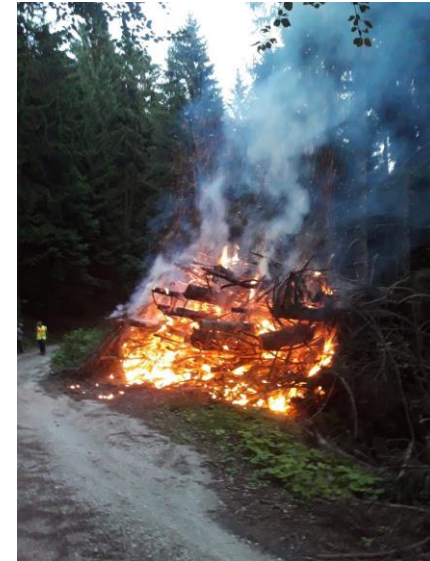
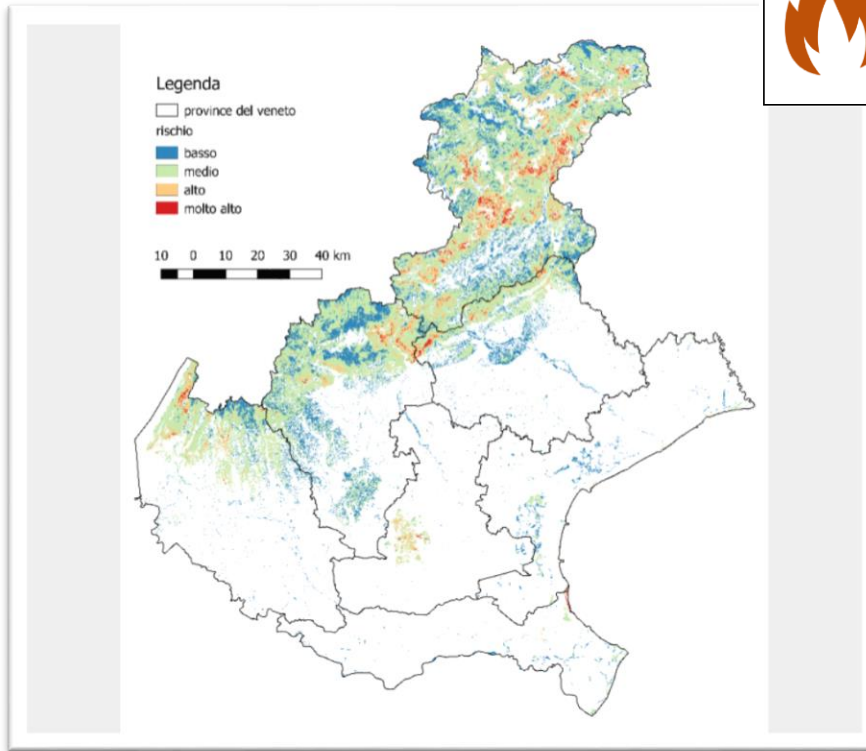


Wohlgemuth et al. 2017





Changes in fire risk



Fire risk maps 2018

Forest fuel models

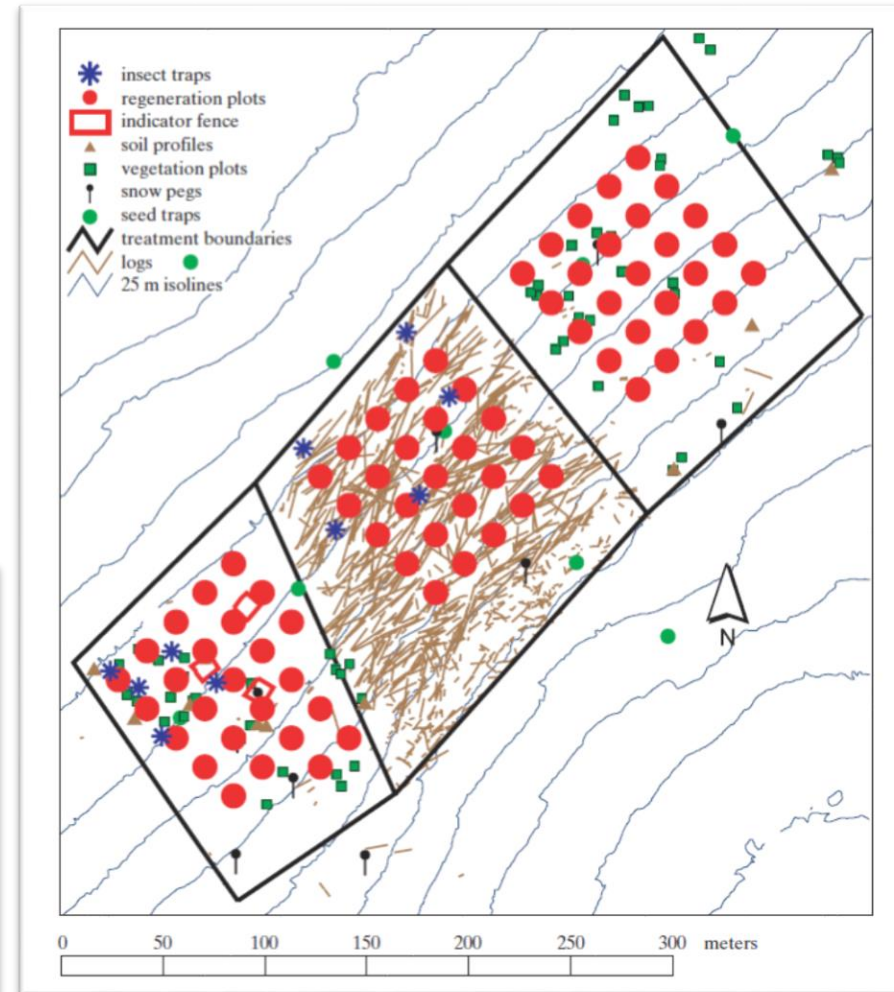
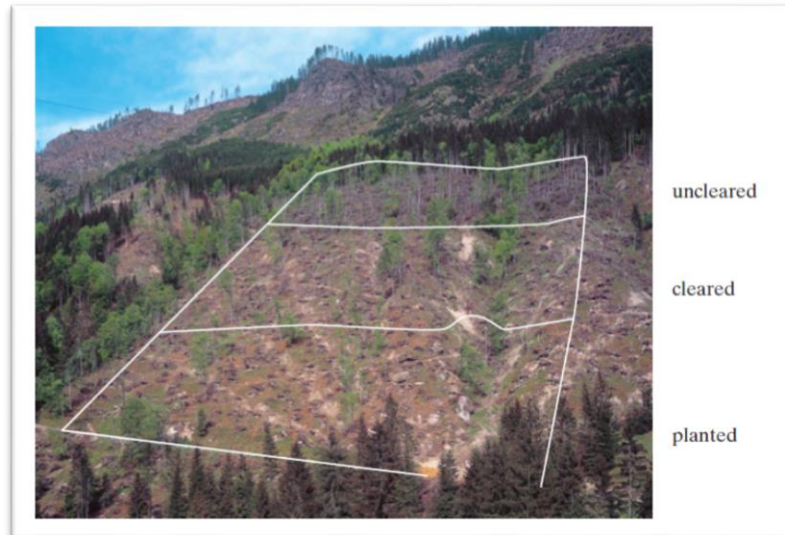


Model ¹⁾	Description	Danger	Difficulties in fire suppression
10	Low Load Activity Fuel	High	High
11	Moderate Load Activity Fuel or Low Load Blowdown	Medium	Medium
12	High Load Activity Fuel or Moderate Load Blowdown	High	Very high
13	High Load Blowdown	Very high	Very high

Monitoring

Long Term Ecological Research

Post-disturbance interventions



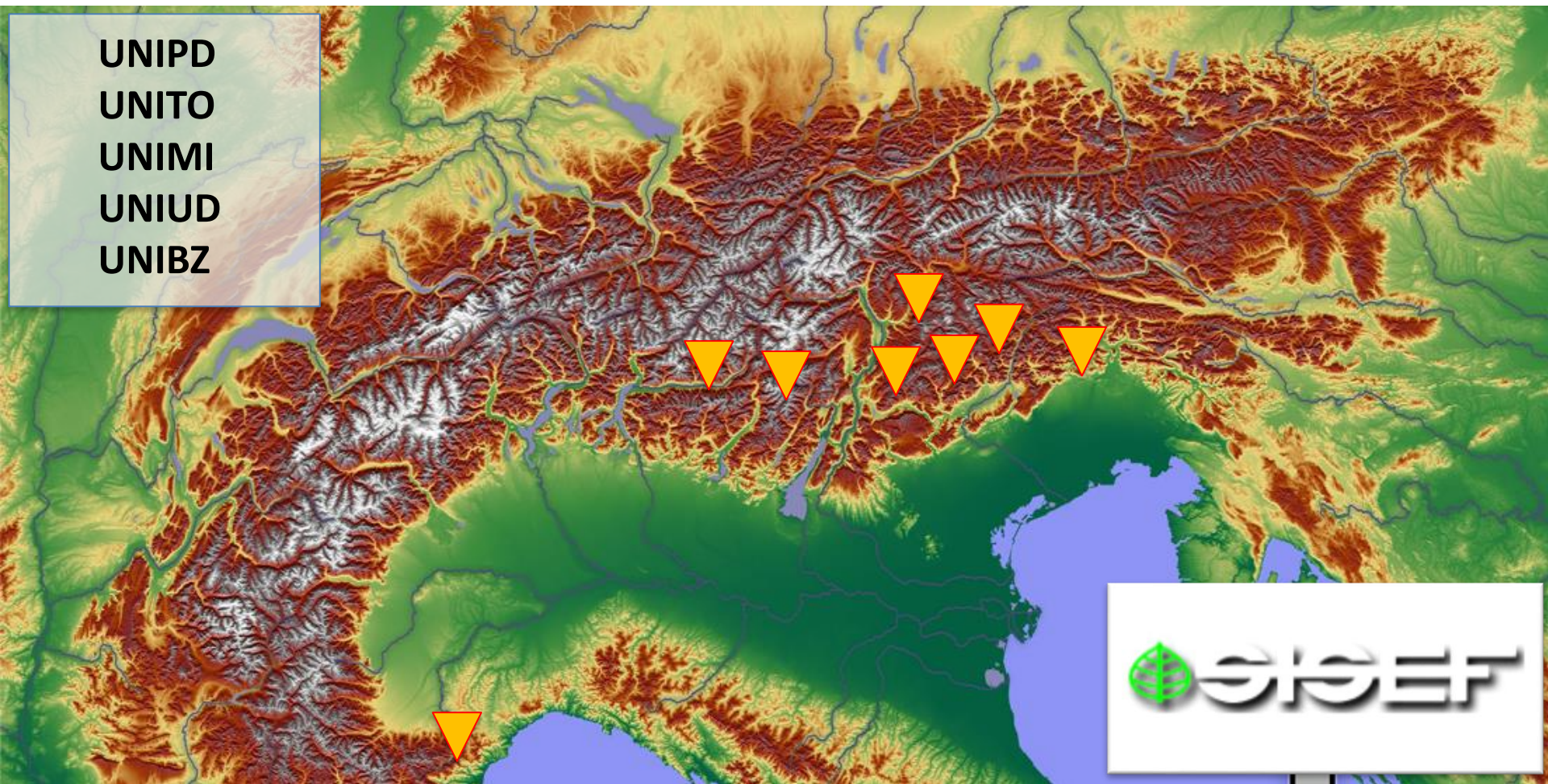
Schönenberger 2002

Network – VAIA.net

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Opportunities

Forest management

Forestry sector

Logistic planning

Awareness and preparedness

***More harmonized and
reliable data on our forests....***



Recommendations

No “one size fits all” management approach, but it is advisable to adopt site and case specific tailor-made solutions.

Neighbours suffered the same, learn from their experience.

Do not take decisions based only on the emotional wave.







Das ist die Zukunft
unseres Waldes!



nach einer Karikatur von H. Haitzinger (1997)

Idee: Hannes Burger

Auf den Blickwinkel kommt es an!

CONCLUSIONS



Climate is changing

Land use is changing

Disturbance regimes are changing

.....

Forest Management has to change too!



Thanks for the attention

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