Applicable soil thematic maps on soil degradation threats

Interreg Alpine Space

EUROPEAN UNION

Links4Soils

EUROPEAN REGIONAL DEVELOPMENT FUND

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Caring for Soils – Where Our Roots Grow.

Introduction

Project and funding

Links4Soils (ASP399); EU Interreg Alpine Space

WP, Deliverable

WPT3, D.T3.1.1

Project partners

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Date

April 2020

Introduction

Soil management is inherent part of various sectors, such as forestry, agriculture, spatial planning, construction etc. To prevent soil degradation while performing sectors activities we need diverse information.

Hereafter are presented maps of different information, used in different sectors. Use of specific maps help improve management to minimize soil threats (e.g. erosion, contamination, biodiversity loss).

Content

1 Soil compaction map – Slovenia, Pokljuka

Forest harvesting operation (FHO) suitability map for Pokljuka plateau (1:25 000) with three categories of FHO use:

- CAT 1: FHO is allowed with no restrictions

  Shallow soils, drained soils on compact parent material

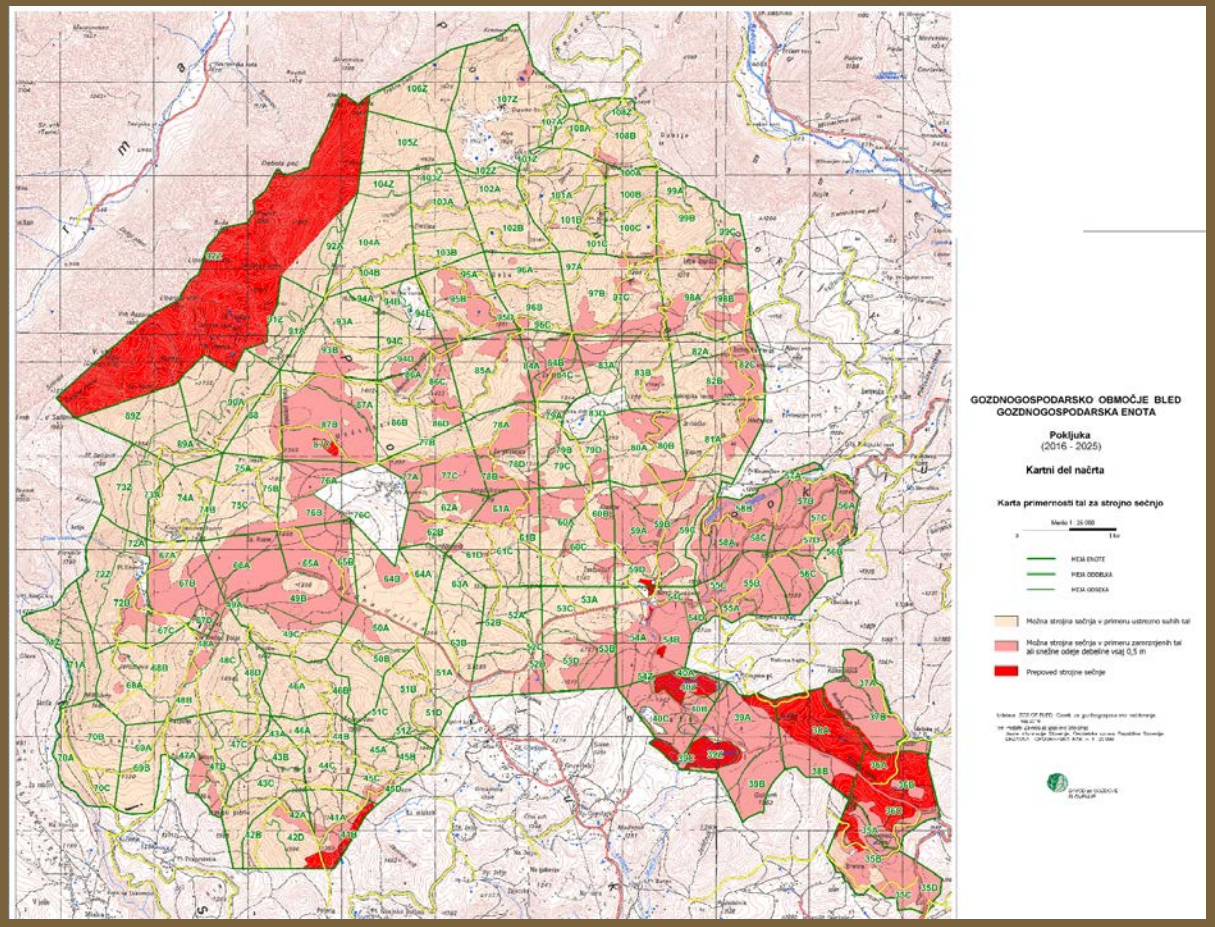
- CAT 2 : FHO is restricted by weather condition The use of FHO is allowed only when soil is frozen or snow cover is higher than 0.5 m

  Developed soils with organic and mineral horizons

- CAT 3: FHO is not allowed in any condition

  Rare soil types and organic soils: f.e. podzols, peat bogs

1 Soil compaction map – Slovenia



Forest harvesting operation (FHO) suitability map for Pokljuka plateau

2 Soil compaction map – Austria, Prägraten

Municipality of Prägraten
Forest area: 1368.4 ha

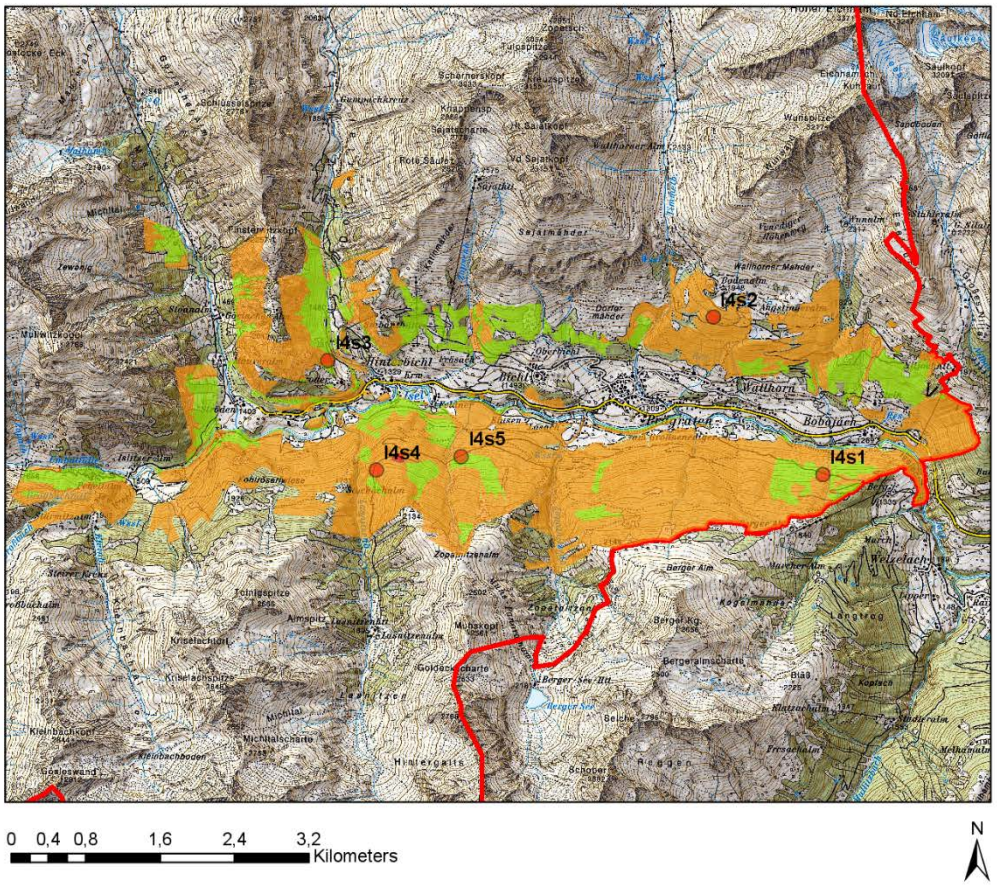
Division on compaction risk categories:

- NO RISK
- OCCASIONALLY CRITICAL
- LOCATIONS AT RISK

based on:

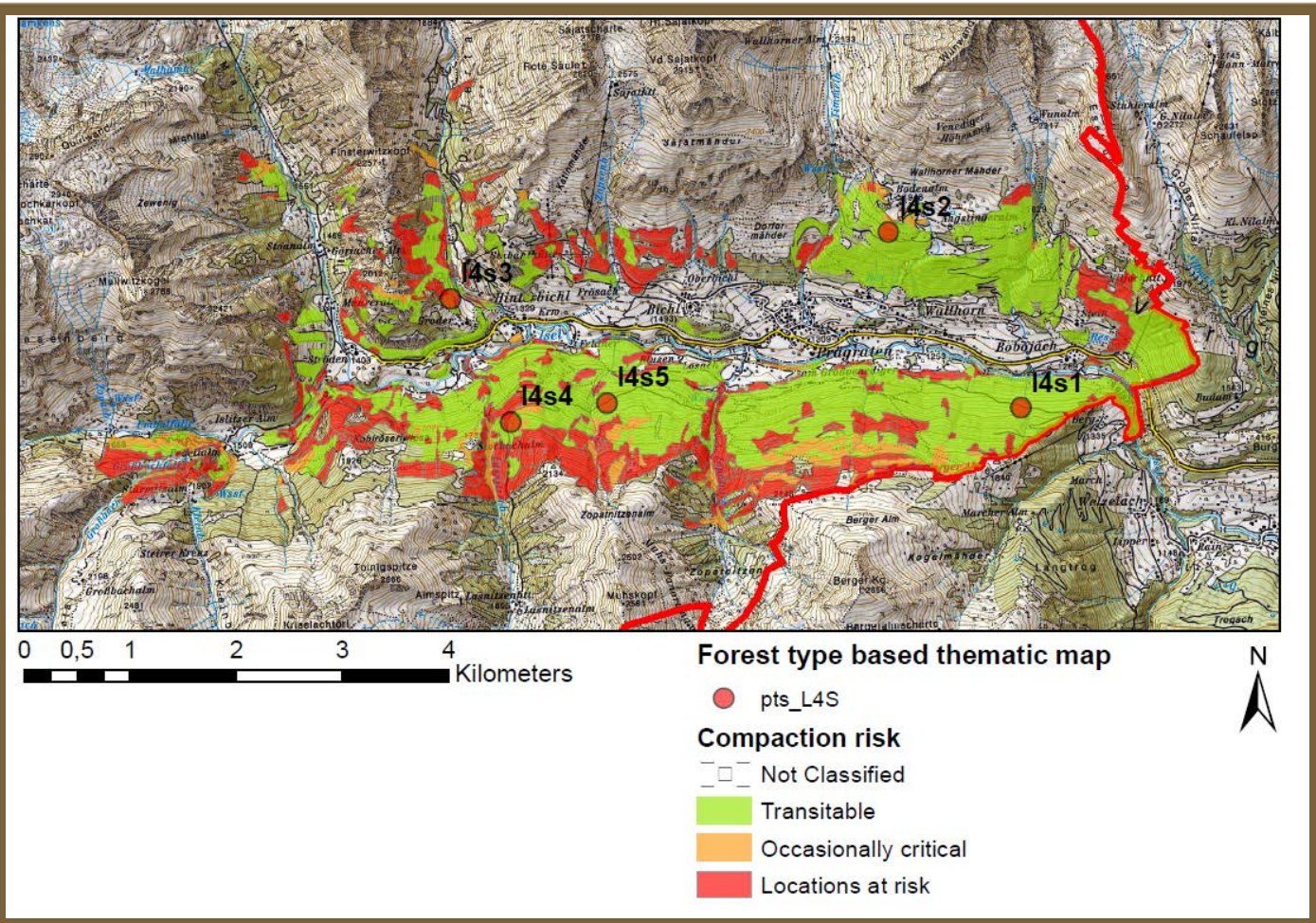
- FOREST TYPES
- SUBSTRATE GROUP

2 Soil compaction map – Austria, Prägraten



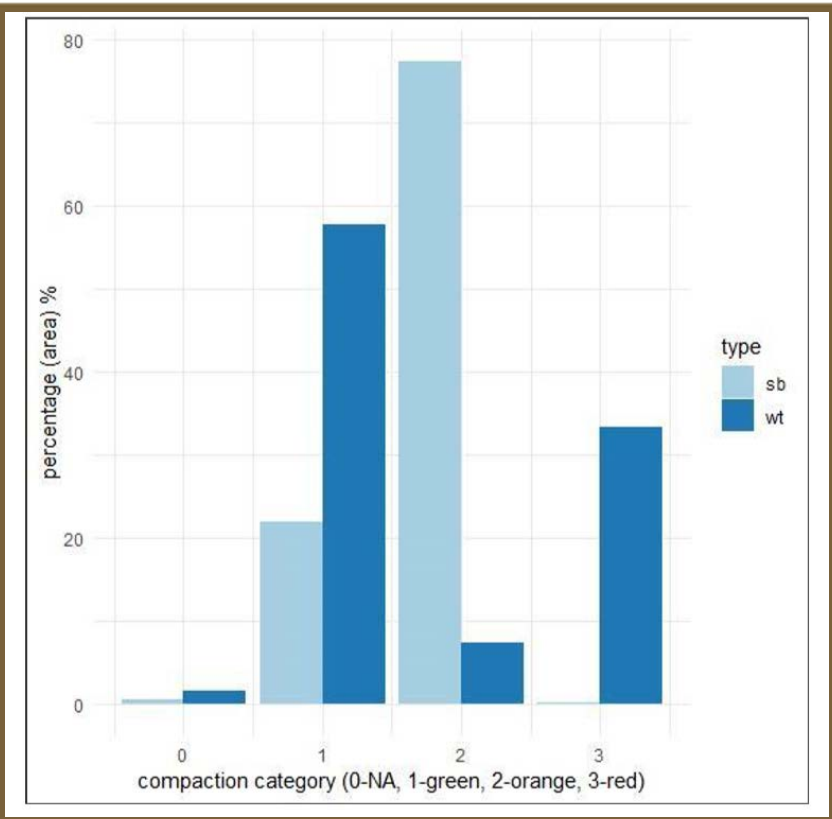
Compaction risk map based on substrate unit for Prägraten municipality

2 Soil compaction map – Austria, Prägraten



Compaction risk map based on forest type for Prägraten municipality

2 Soil compaction map – Austria



Comparison between percentages of Prägraten area classified for compaction risk, based on substrate unit (sb) and forest type (wt)

Forest type	Substrate group based categories – compaction risk Area (%)				Compaction risk Category FT
	perc.green	perc.orange	perc.red	Not classified	
Er2	66,02	33,98	0	0	orange
Er4	38,31	61,69	0	0	orange
Fi1	21,92	78,07	0	0,01	green
Fi10	13,09	86,91	0	0	red
Fi12	39,9	60,1	0	0	red
Fi13	96,81	3,19	0	0	red
Fi14	86,72	13,28	0	0	red
Fi18	1,26	98,74	0	0	green
Fi19	49,77	50,23	0	0	orange
Fi2	18,31	81,69	0	0	green
Fi20	34,8	58,71	0	6,49	red
Fi3	34,68	65,32	0	0	green
Fi4	0	100	0	0	green
Fi5	29,23	70,76	0	0,01	green
Fi6	18,16	81,83	0	0,01	green
Fi7	23,04	52,32	0	24,63	green
Fi8	23,41	76,4	0	0,19	green
Fi9	0,04	99,96	0	0	orange
Fs1	35,36	64,64	0	0	green
Fs10	0	100	0	0	orange
Fs17	0	99,98	0	0,02	green
Fs2	0,54	99,46	0	0	green
Fs3	0	100	0	0	green
Fs4	0	100	0	0	green
Fs5	16,23	80,84	2,93	0	orange
Fs6	18,7	81,27	0,02	0,01	green
Fs7	4,07	95,85	0	0,08	green
Fs8	4,59	95,06	0,33	0,02	red
Fs9	28,9	71,1	0	0	orange
La1	8,5	91,49	0	0,01	orange
La2	4,83	95,17	0	0	red
La3	5,47	94,53	0	0	green
La4	0	100	0	0	green
La6	0	99,99	0	0,01	orange
Zi1	0	99,99	0	0,01	red
Zi2	0,73	99,2	0	0,07	red
Zi4	0	100	0	0	red

Compaction risk categories of forest types with respective areal subdivision on substrate unit-based classification

3 Soil erosion map – Slovenia

4 subtypes of soil erosion:
(Zorn, 2015)

- Interglacial erosion or surface flushing (sheet erosion)
- Rill erosion
- Gully erosion
- Soil piping

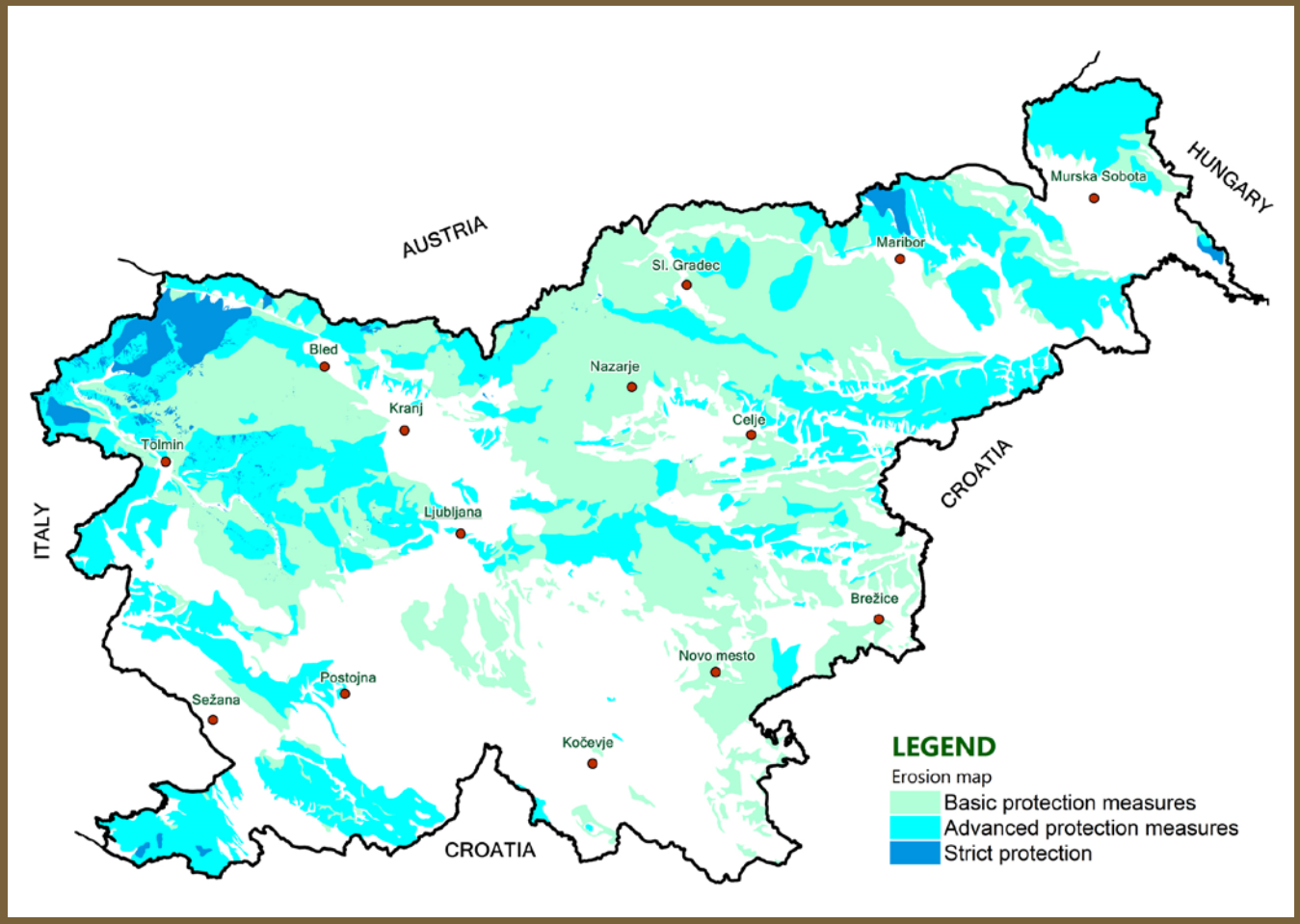
Erosion can be divided according to the factors that cause it; these are mostly water and wind.

In most countries, few actual measurements of water erosion and even less wind erosion were made.

Their existence is evidenced by events that have been recorded, described or photographed. There are too few systematic censuses for statistical analysis.

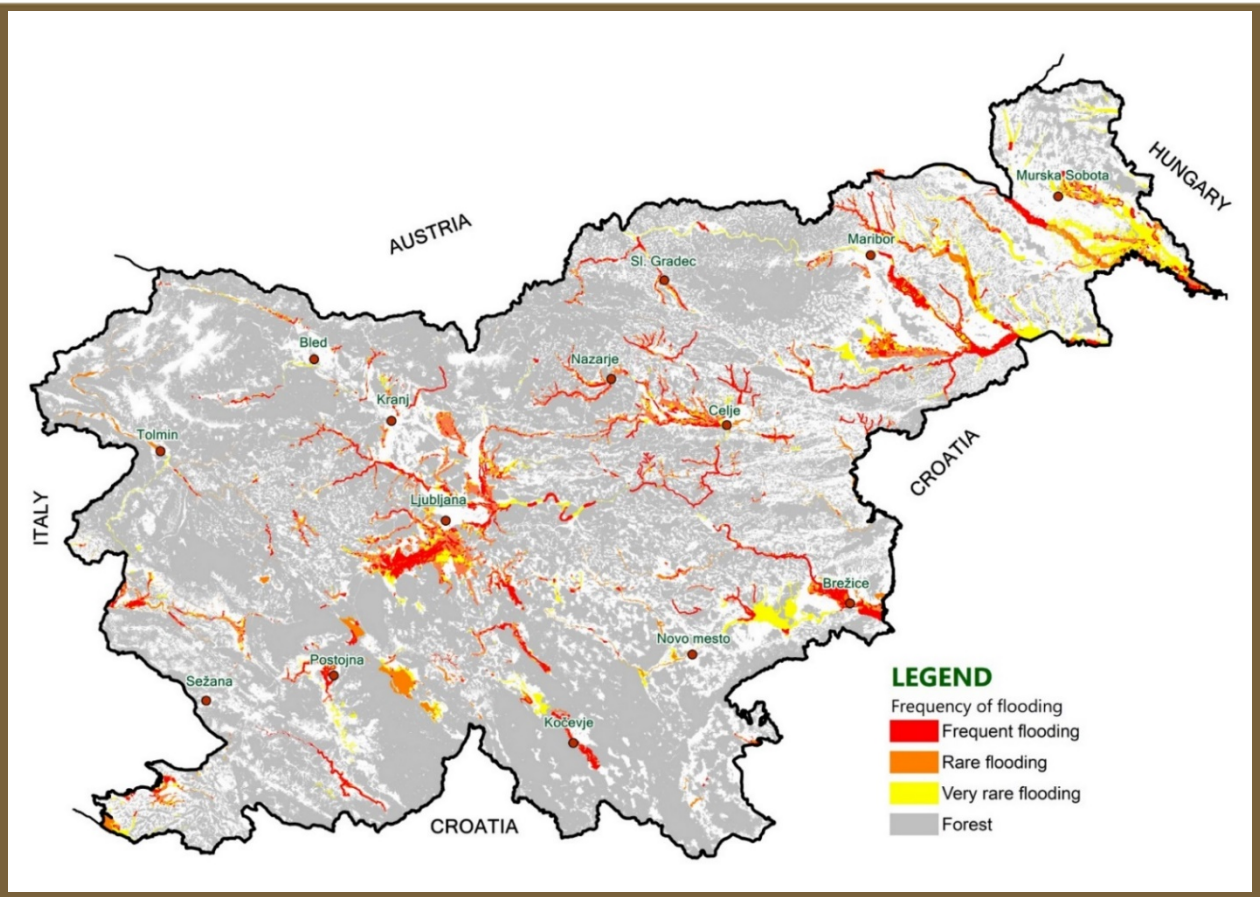
The area exposed to wind erosion in Slovenia is due to the occurrence of the Vipava Valley (Zorn, 2015).

3 Soil erosion map – Slovenia



Warning erosion map (PUH – Company for streams regulation, 2011)

4 Flood hazard – Slovenia



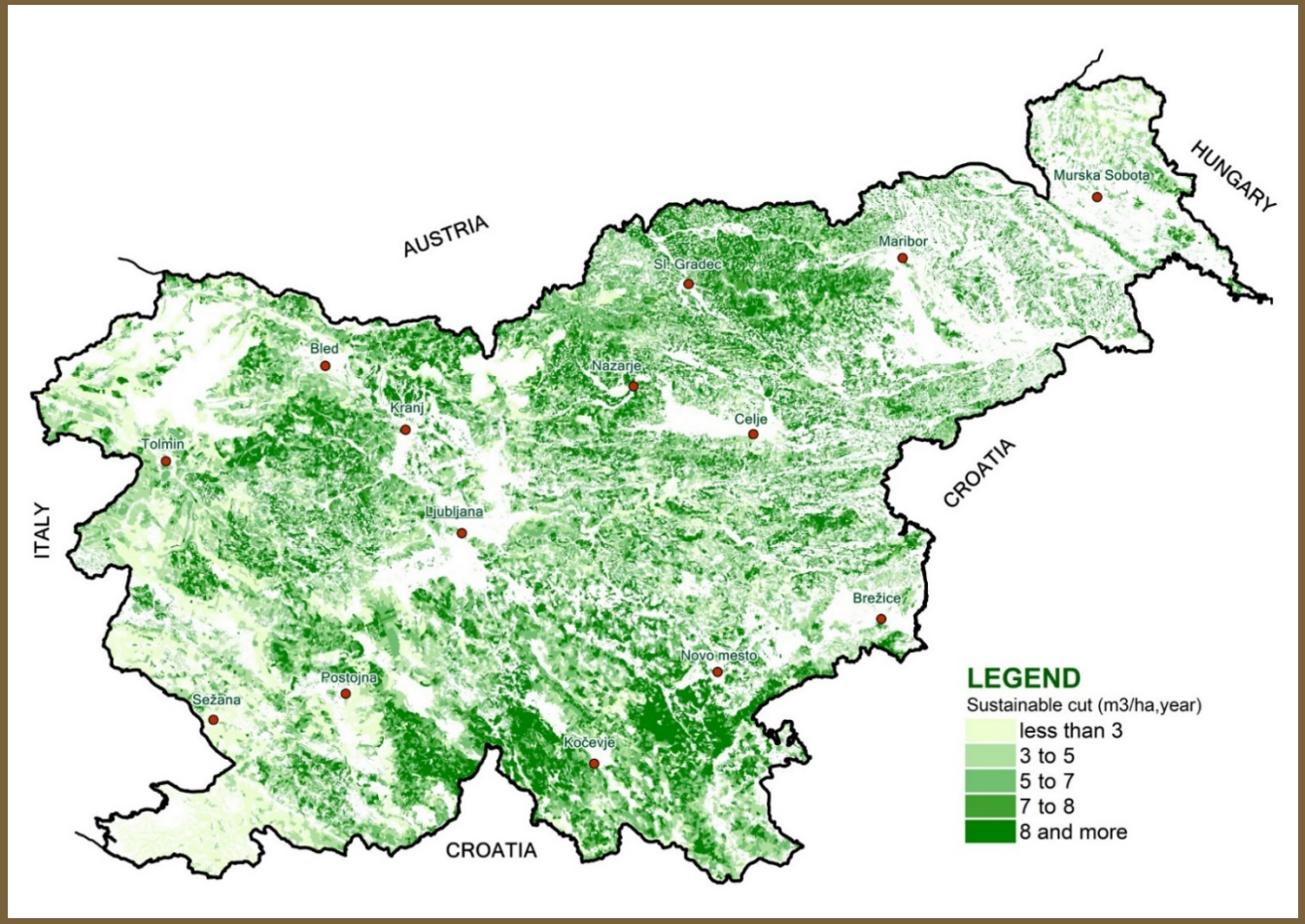
Flood hazard map shows areas where soils are exposed to water and respective processes.
Soil erosion is also possible.

Integral map flood hazard classes (IKRPN), Ministry of Environment and Spatial Planning Chamber of the republic of Slovenia for water

5 Sustainable harvest management map – Slovenia

- Sustainable harvesting can be defined as a method of harvesting that provides a constant supply of wood resources throughout the landscape.
- Ecological sustainability goes hand in hand with economic sustainability, as it maintains the stability of natural functions, populations, successional patterns and carbon storage in the forest.
- The approach treating forest as an ecological system performing multiple functions is close-to-nature forest management. It is a flexible, continually developing approach.
- It has beneficial environmental impact and long-term economic sustainability.

5 Sustainable harvest management map – Slovenia



Sustainable harvesting map of Slovenia (Slovenia Forest Service)

6 Sustainable harvest management map – Austria, Prägraten

Municipality of Prägraten
Forest area: 1368.4 ha

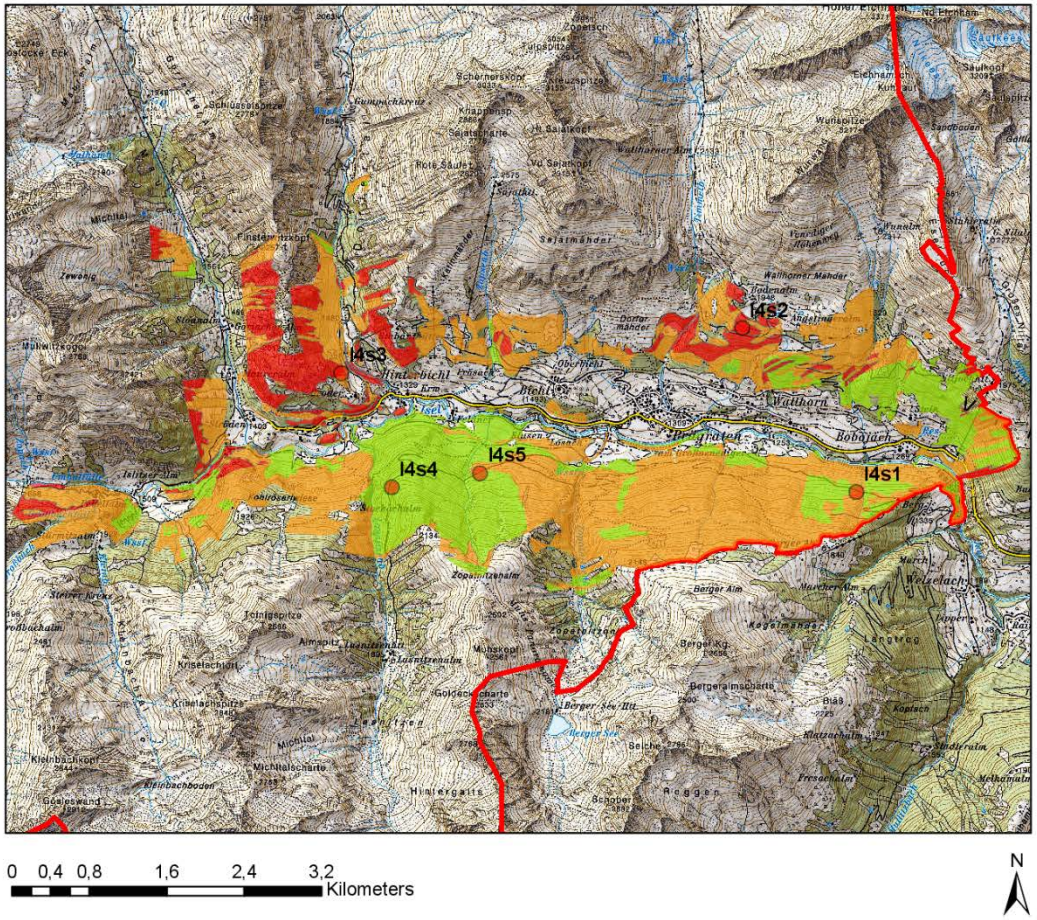
Division on 3 categories for harvest management:

- MINOR NEGATIVE EFFECT
- INTERMEDIATE NEGATIVE EFFECT
- STRONG NEGATIVE EFFECT

based on:

- FOREST TYPES
- SUBSTRATE GROUP

6 Sustainable harvest management map – Austria, Prägraten



Substrate unit based thematic map

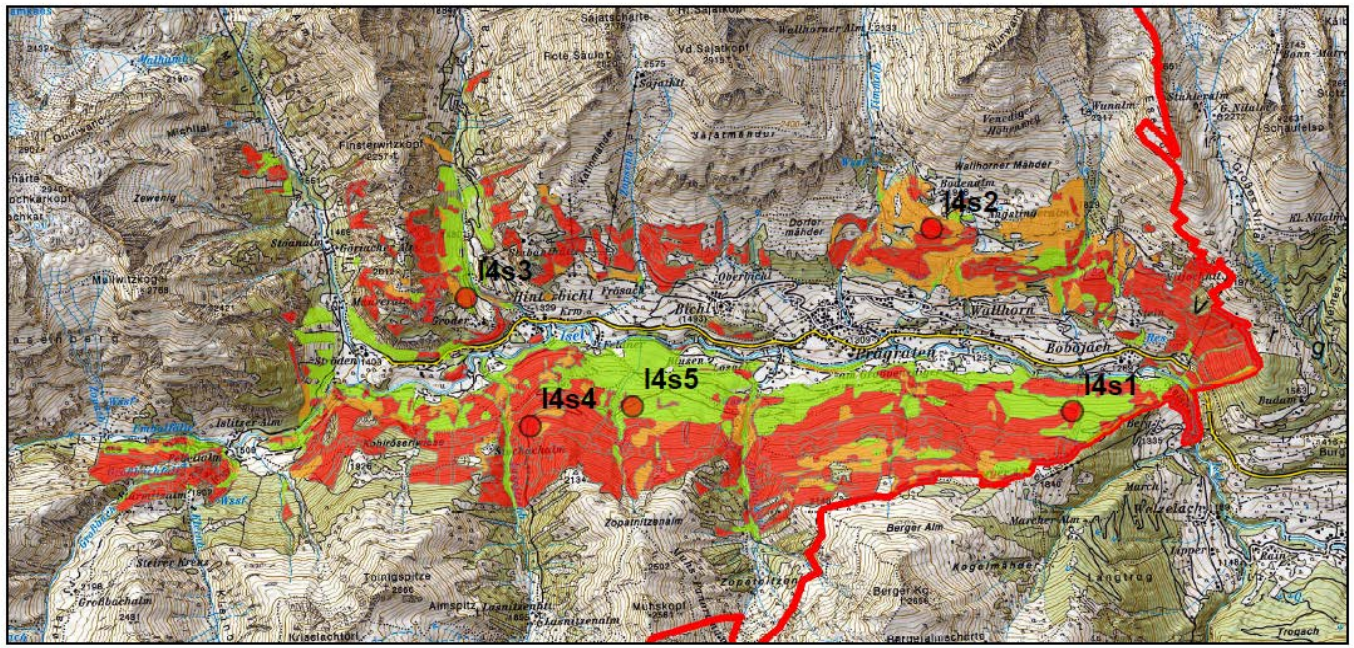
pts_L4S

Biomass removal

- Not Classified
- Minor negative effects
- Intermediate negative effects
- Strong negative effects

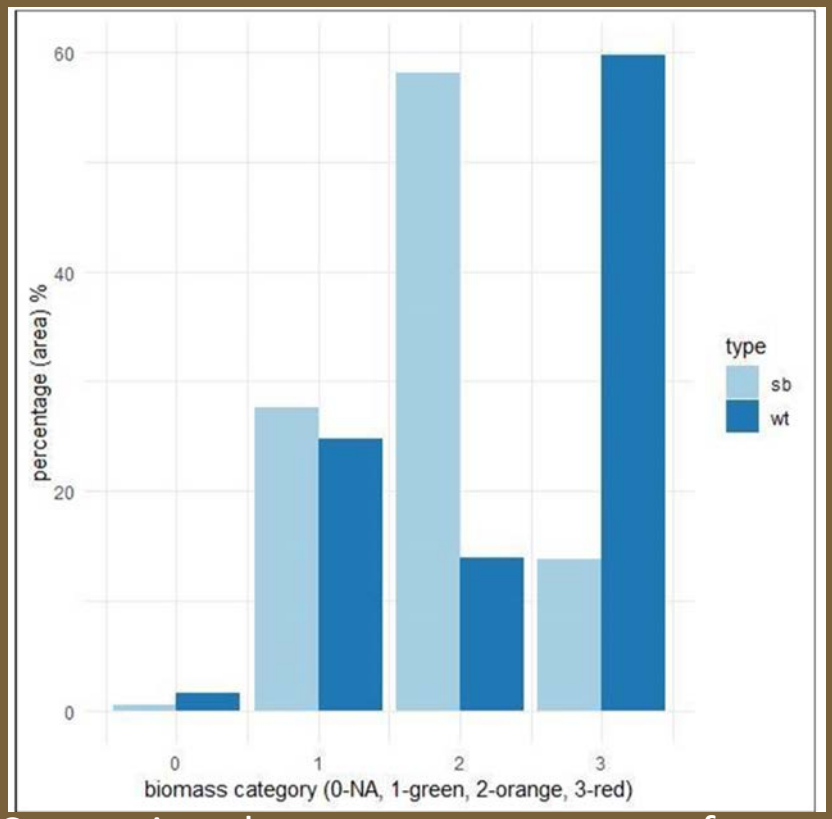
Sustainable harvesting map based on substrate unit for municipality of Prägraten

6 Sustainable harvest management map – Austria, Prägraten



Sustainable harvesting map based on forest type for municipality of Prägraten

6 Sustainable harvest management map – Austria

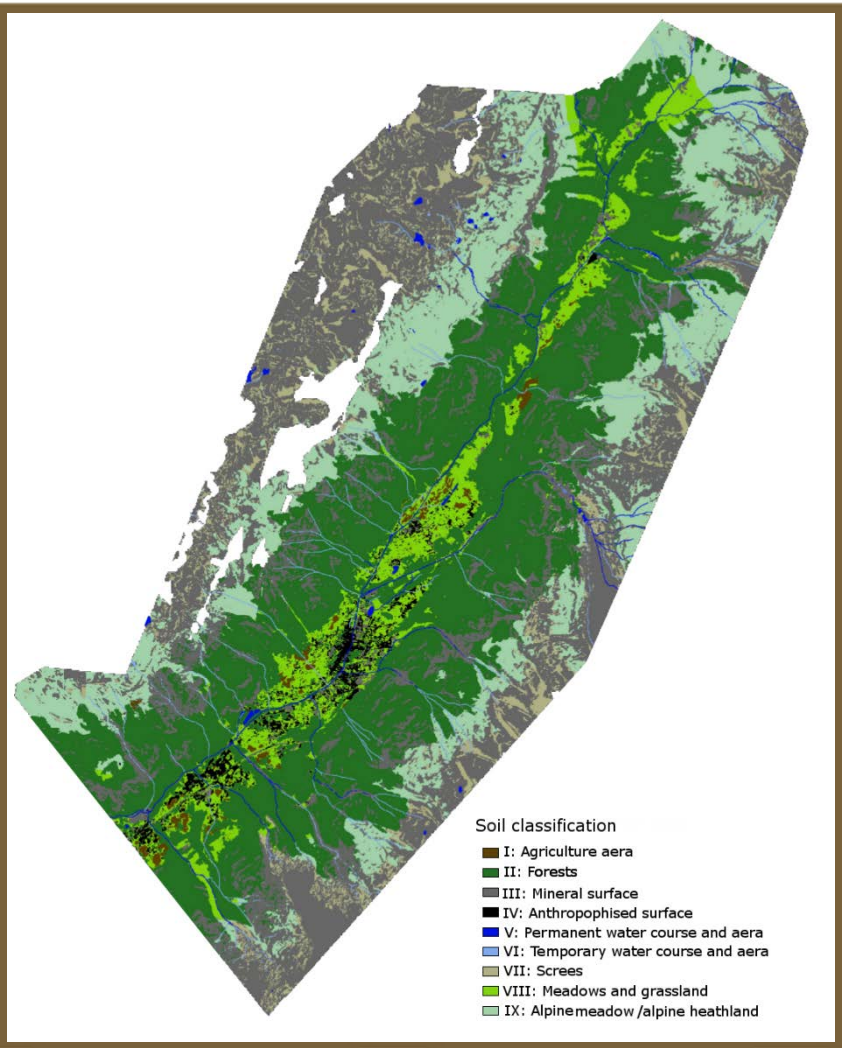


Comparison between percentages of Prägraten area classified for biomass use categories, based on substrate unit (sb) and forest type (wt)

Forest type	Substrate group based categories - biomass use Area (%)				Biomass use Category FT
	perc.green	perc.orange	perc.red	Not classified	
Er2	58,02	23,59	18,39	0	orange
Er4	38,45	23,69	37,85	0	red
Fi1	52,35	42,79	4,85	0,01	green
Fi10	22,65	51,13	26,21	0	orange
Fi12	100	0	0	0	red
Fi13	26,95	72,65	0,4	0	red
Fi14	32,19	63,97	3,84	0	red
Fi18	1,26	92,51	6,23	0	red
Fi19	49,77	50,23	0	0	green
Fi2	0	88,04	11,96	0	red
Fi20	46,7	41,05	5,76	6,49	green
Fi3	31,8	62,58	5,62	0	orange
Fi4	42,86	0,57	56,56	0	red
Fi5	37,67	59,75	2,56	0,01	green
Fi6	30,29	68,09	1,61	0,01	red
Fi7	16,91	46,35	12,1	24,63	green
Fi8	36,94	32,47	30,41	0,19	red
Fi9	0,04	99,96	0	0	orange
Fs1	14,55	77,13	8,32	0	red
Fs10	0	96,87	3,13	0	green
Fs17	3,2	96,79	0	0,02	green
Fs2	1,21	92,79	5,99	0	orange
Fs3	0	100	0	0	red
Fs4	0	100	0	0	red
Fs5	31,16	66,18	2,66	0	orange
Fs6	33,09	64,95	1,95	0,01	red
Fs7	16,12	23,55	60,24	0,08	red
Fs8	30,62	69,36	0	0,02	red
Fs9	26,42	67,47	6,11	0	green
La1	27,52	50,08	22,39	0,01	orange
La2	31,82	46,01	22,16	0	red
La3	39,38	29,65	30,96	0	red
La4	13,94	4,13	81,93	0	red
La6	0	93,9	6,1	0,01	green
Zi1	0	99,99	0	0,01	red
Zi2	14,86	85,08	0	0,07	red

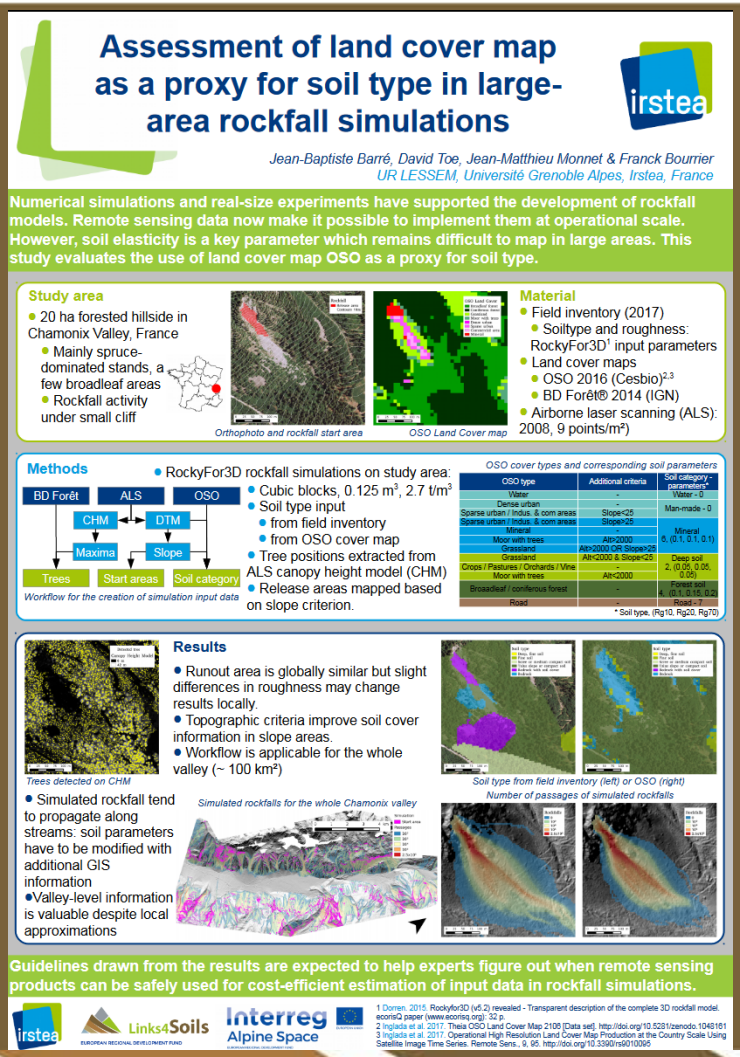
Biomass use categories of forest types with respective areal subdivision for substrate unit-based classification (Forest types of Tirol region, 2019)

7 Land cover map as a proxy for soil type – France, Chamonix



Map of soil classification using the remote sensing method.

7 Land cover map as a proxy for soil type – France, Chamonix



Assessment of land cover map as a proxy for soil type in large-area rockfall simulations

Jean-Baptiste Barré, David Toe, Jean-Matthieu Monnet & Franck Bourrier
UR LESSEM, Université Grenoble Alpes, Irstea, France

Numerical simulations and real-size experiments have supported the development of rockfall models. Remote sensing data now make it possible to implement them at operational scale. However, soil elasticity is a key parameter which remains difficult to map in large areas. This study evaluates the use of land cover map OSO as a proxy for soil type.

Study area

- 20 ha forested hillside in Chamonix Valley, France
  - Mainly spruce-dominated stands, a few broadleaf areas
  - Rockfall activity under small cliff

Orthophoto and rockfall start area *OSO Land Cover map*

Material

- Field inventory (2017)
  - Soiltype and roughness: RockyFor3D[1] input parameters
- Land cover maps
  - OSO 2016 (Cesbio)[2,3]
  - BD Forêt® 2014 (IGN)
- Airborne laser scanning (ALS): 2008, 9 points/m²)

Methods

- RockyFor3D rockfall simulations on study area:
  - Cubic blocks, 0.125 m³, 2.7 t/m³
  - Soil type input
    - from field inventory
    - from OSO cover map
  - Tree positions extracted from ALS canopy height model (CHM)
  - Release areas mapped based on slope criterion.

BD Forêt, ALS, OSO → CHM, DTM → Maxima, Slope → Trees, Start areas, Soil category

Workflow for the creation of simulation input data

OSO cover types and corresponding soil parameters

OSO type	Additional criteria	Soil category - parameters*
Water	-	Water - 0
Dense urban	-	Man-made - 0
Sparse urban / Indus. & com areas	Slope<25	
Sparse urban / Indus. & com areas	Slope>25	
Mineral	-	Mineral 5, (0.1, 0.1, 0.1)
Moor with trees	Alt>2000	
Grassland	Alt>2000 OR Slope>25	
Grassland	Alt<2000 & Slope<25	Deep soil 2, (0.05, 0.05, 0.05)
Crops / Pastures / Orchards / Vine	-	
Moor with trees	Alt<2000	
Broadleaf / coniferous forest	-	Forest soil 4, (0.1, 0.15, 0.2)
Road		Road - 7

* Soil type, (Rg10, Rg20, Rg70)

Results

- Runout area is globally similar but slight differences in roughness may change results locally.
- Topographic criteria improve soil cover information in slope areas.
- Workflow is applicable for the whole valley (~ 100 km²)

Trees detected on CHM

Soil type from field inventory (left) or OSO (right)

Number of passages of simulated rockfalls

- Simulated rockfall tend to propagate along streams: soil parameters have to be modified with additional GIS information
- Valley-level information is valuable despite local approximations

Simulated rockfalls for the whole Chamonix valley

Guidelines drawn from the results are expected to help experts figure out when remote sensing products can be safely used for cost-efficient estimation of input data in rockfall simulations.

1 Dorren. 2015. Rockyfor3D (v5.2) revealed - Transparent description of the complete 3D rockfall model. ecorisQ paper (www.ecorisq.org): 32 p.
2 Inglada et al. 2017. Theia OSO Land Cover Map 2106 [Data set]. http://doi.org/10.5281/zenodo.1048161
3 Inglada et al. 2017. Operational High Resolution Land Cover Map Production at the Country Scale Using Satellite Image Time Series. Remote Sens., 9, 95. http://doi.org/10.3390/rs9010095

Evaluation of soil type could be done by using different sources of GIS data, one of it is land cover maps.

This simulation assesses the relevance of the remote sensing inventory to the In-situ inventory by comparing the surface areas of the soil types and the probabilities of damage.

8 Potential protection function of forests – France,Chamonix

This type of forest, called protective forests, are of outstanding importance in the global reduction of natural hazards and risks, but above all in the Alpine Space.

Forest is considered to have a protective function against rock fall when a block propagating through a forest manages to reach an issue. One of the most important protective function of forests is related to soil and water resources. Forests reduce runoff velocity and surface erosion.

However, the challenge of identifying rock fall protection forests on large scale is based in particular on the assessment of soil types at such scale due to the absence of relevant data. Forests can increase slope stability and reduce risk to an acceptable level.

The main limitation of this approach is that it does not take into account the topography and different soil types that can lead to an overvaluation of forests with a protective function.

8 Potential protection function of forests – France,Chamonix

- Soil plays a key role in most natural hazards.
- Its role can be direct when the soil is directly involved in the risk phenomenon, such as in the case of landslide or an erosion phenomenon, or indirect, like its influence on rock fall propagation.
- The soil characteristics that come into play during a natural hazards are diverse such as texture, permeability, physical-chemical composition or depth (thickness at the bedrock).
- Key parameter in rock fall hazards is soil elasticity but it is hard to obtain in situ.

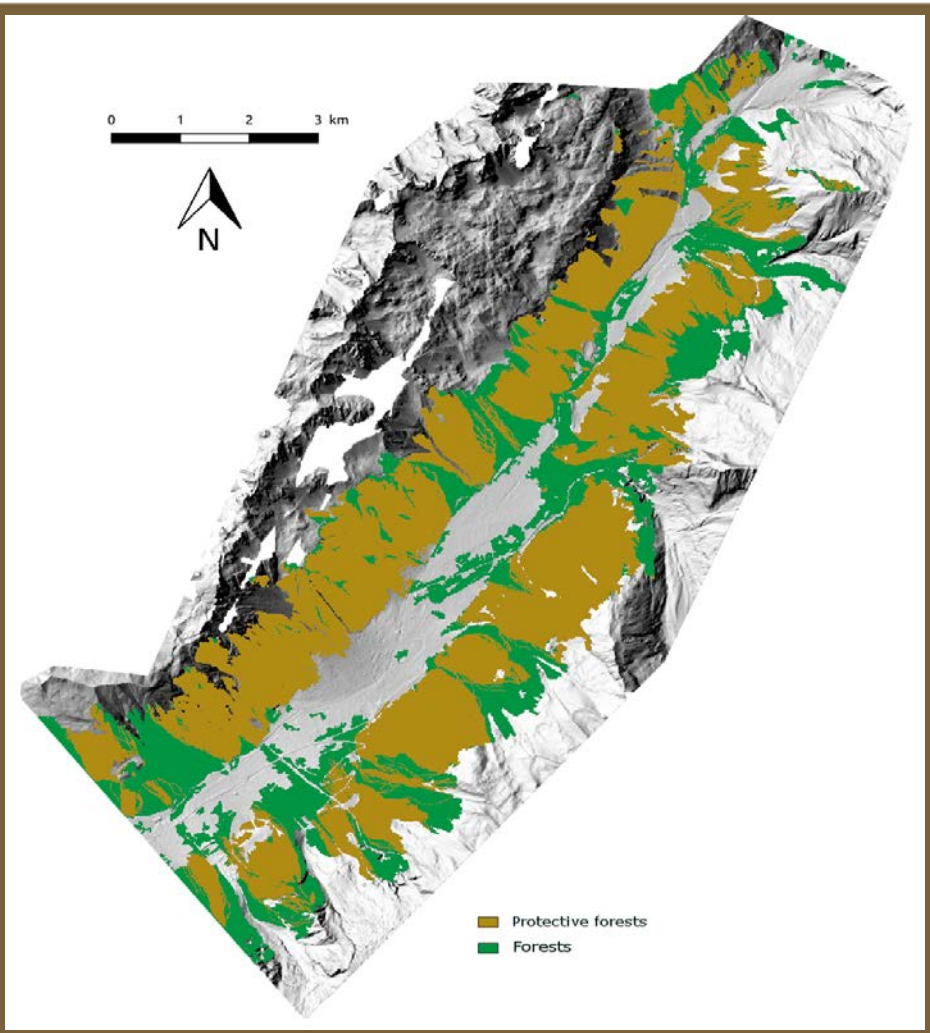
8 Potential protection function of forests – France,Chamonix

- Different soil types and their corresponding dumping behavior for rock fall
- Mechanical properties of soils are input for risk prevention plan

Class	Type	R_n range	R_t range
I	Agricultural area	0.23 - 0.31	0.05 - 0.18
II	Forest	0.30 - 0.42	0.05 - 0.23
III	Mineral surface	0.39 - 0.58	0.05 - 0.13
IV	Anthropophised surface	0.32 - 0.39	0.10 - 0.58
V	Permanent water course and aera	0	0
VI	Temporary water course and aera	0.30 - 0.42	0.40 – 0.48
VII	Screes	0.39 - 0.58	0.15 - 0.33
VIII	Meadows and grassland	0.30 - 0.42	0.05 - 0.18
IX	Alpine meadow/alpine heathland	0.39 - 0.58	0.05 - 0.13

Definition of the soil classes and their corresponding restitution coefficient

8 Potential protection function of forests – France,Chamonix

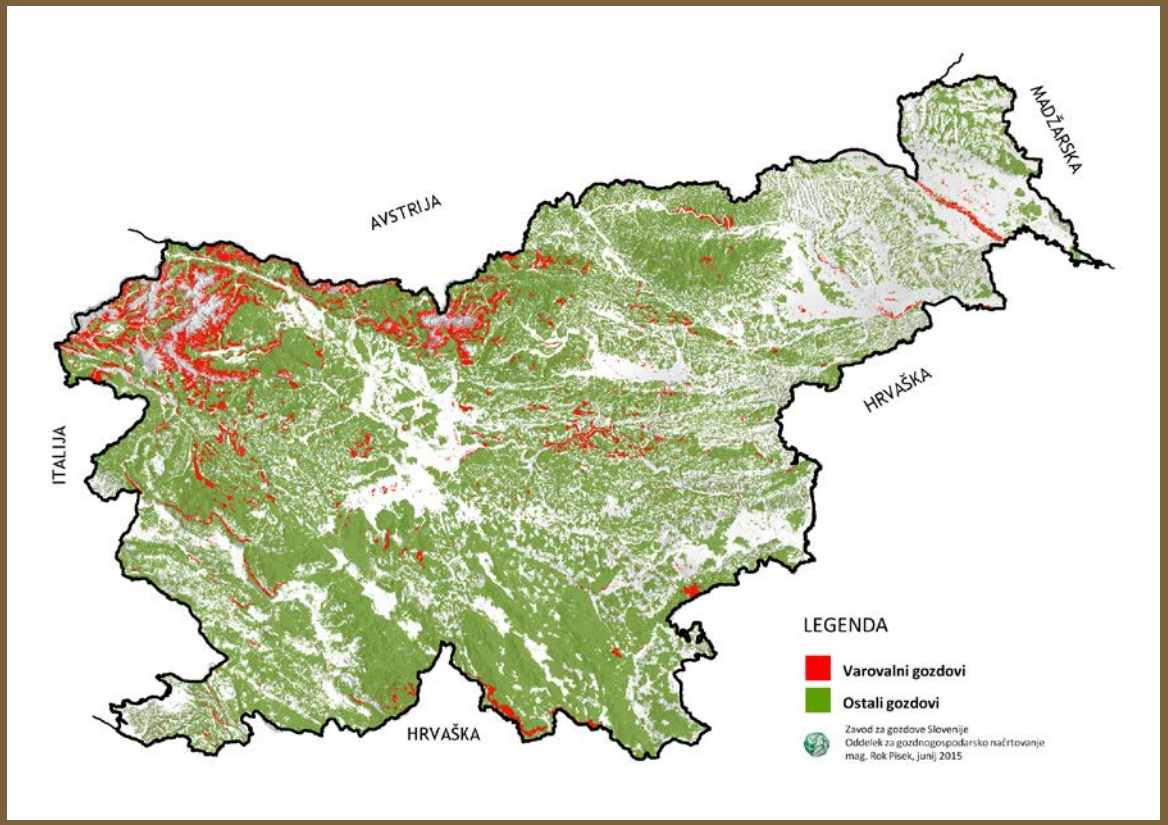


Identification of forests with a potential protection function in the Chamonix valley.

INTERESTING FACT: Many countries have identified and given special status to protective forest areas. (Global Forest Resources Assessment 2010).

9 Protective forests – Slovenia

Around 8 % of forest area in Slovenia (red colour)



Protective forests (Slovenia Forest Service)

CHARACTERISTICS:

- On extreme site conditions (upper tree border included),
- On very steep slopes and riverbanks

FUNCTIONS:

- Protect areas bellow them,
- Reduce water runoff,
- Protect landslide areas,
- Reduce wind speed and wind erosion,
- Extraordinary environmental value

9 Protective forests – Slovenia

Forest management differs from non-protected forest areas.

Measures:

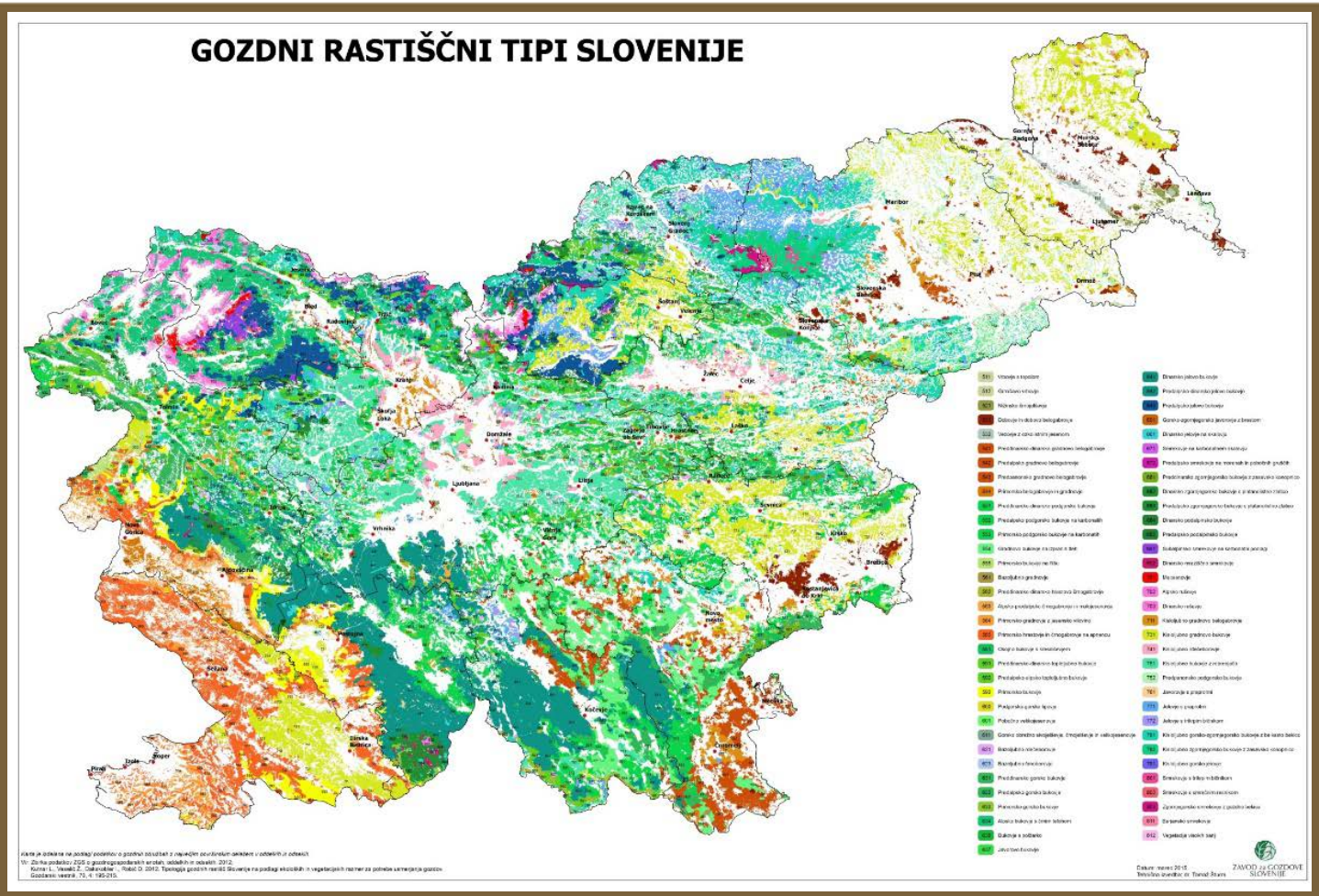
- Regularly cutting of old, non-vital trees,
- Small scale regeneration cuts,
- Higher stumps,
- Prescribed harvesting machinery technics,
- Restoration of damaged soils,
- Removal od trees out of the streams,
- Use of biodegradable oils

INTERESTING FACT: Eight percent of the world's forests have protection of soil and water resources as their primary objective. Around 330 million hectares of forest are designated for soil and water conservation, avalanche control, sand dune stabilization, desertification control or coastal protection (Global Forest Resources Assessment 2010).

10 Forest site types – Slovenia

- Division is based on phytocenological inventory
- Soil information is indirectly included in forest management,
- Management measures and imitations differs among forest site types (e.g. felling quota, site preparation, choice of tree species, provenance, spacing, thinning regimes, and regeneration method, prescribed machinery use for wood harvesting)

10 Forest site types – Slovenia



Forest site types (Slovenia Forest Service)