



CONCEPTOS DE GEOBOTANICA EN CLIMAS FRIOS

Determinación de la edad de depósitos y procesos geológicos con técnicas de phytoindicación

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Disertación para Alumnos

Study area







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**SOUTHERN YAMAL**

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**SOUTHERN GYDAN**



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CENTRAL YAMAL



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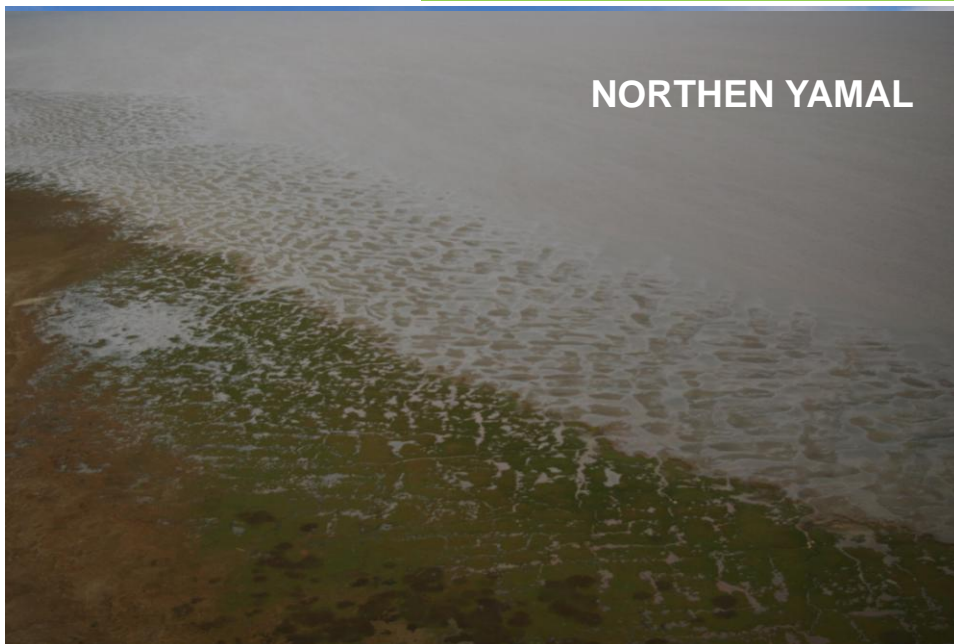
CENTRAL GYDAN



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NORTHEN YAMAL



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Methodological base

Indicator parameters of vegetation:

- habitus (appearance) of the plants
- species composition of the plant communities
- structure of the plant communities
- vegetation dynamics
- remote sensing data (texture, NDVI, etc.)



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Methodological base

Objects of phytoindication:

- climate parameters
- soil characteristics
- groundwater characteristics
- active layer and permafrost characteristics
- geological structure, deposits pattern and age
- geological processes



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Geological processes

Exogenous geological processes on Yamal and Gydan peninsulas

- cryogenic landslides
- deflation
- frost boil
- erosion
- thermal erosion
- solifluction
- melting of tabular ice
- abrasion and thermal abrasion



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Geological processes

CRYOGENIC LANDSLIDES

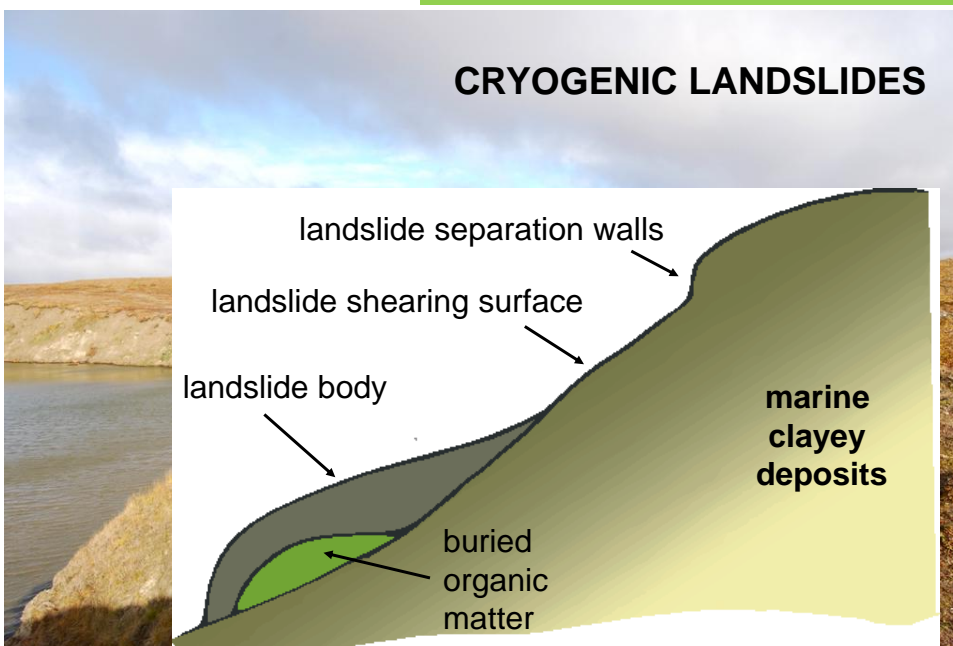


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Geological processes

CRYOGENIC LANDSLIDES





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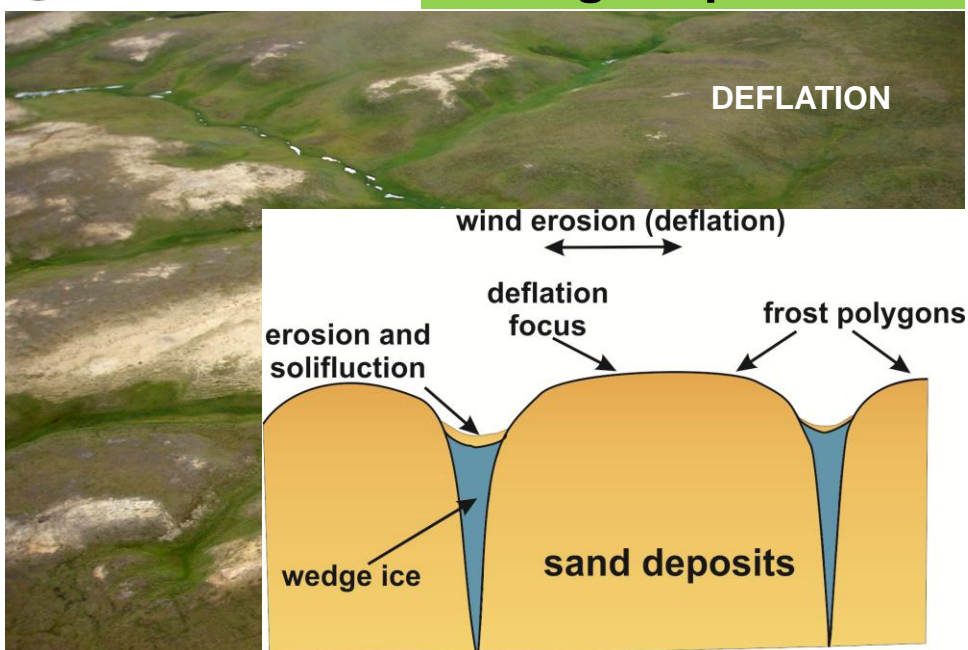
Geological processes



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Geological processes





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Disertación para Alumnos

Research

measuring active layer thawing



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Research

describing soils

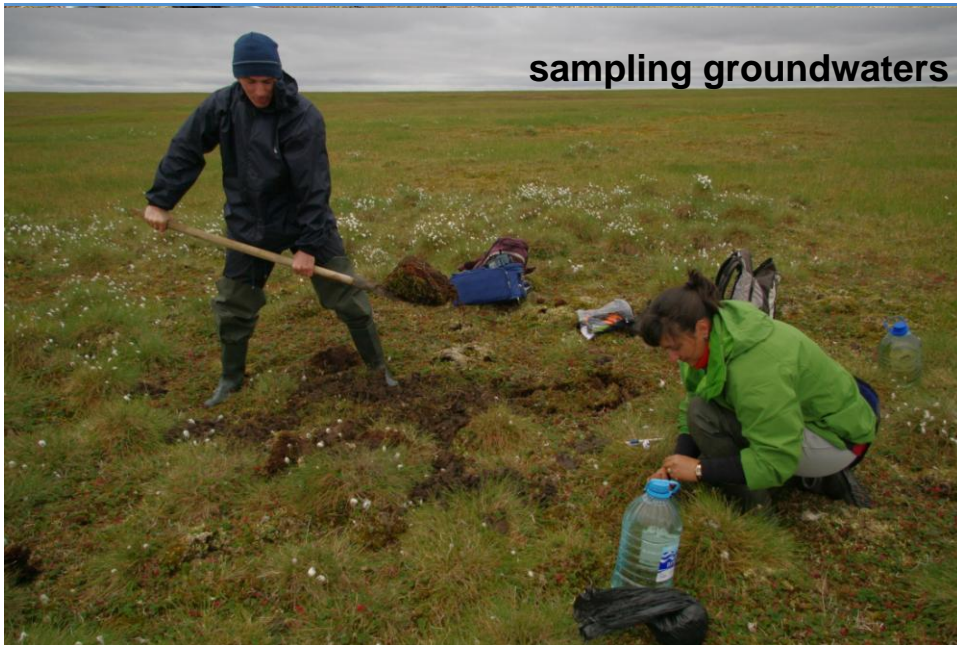




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Research



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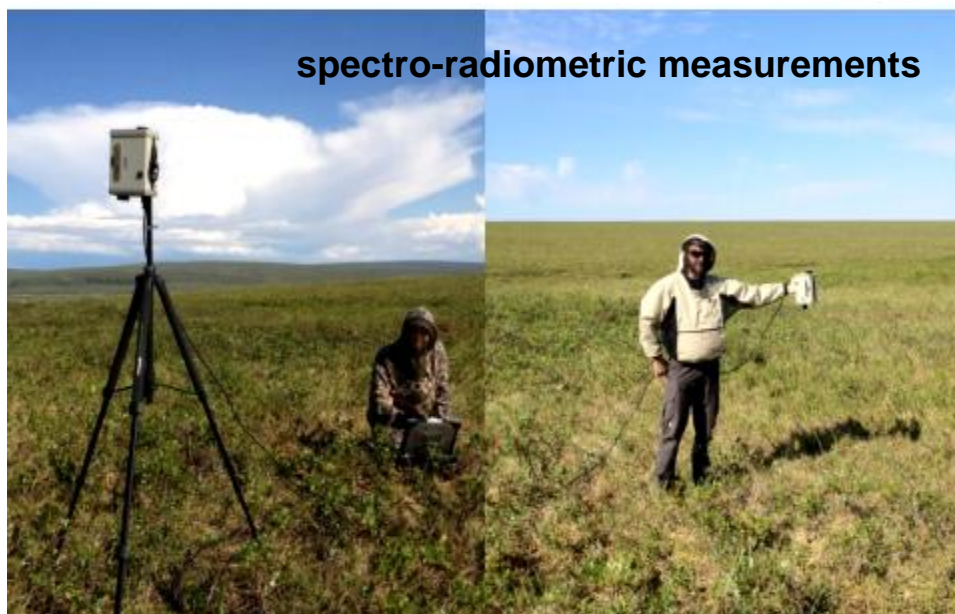




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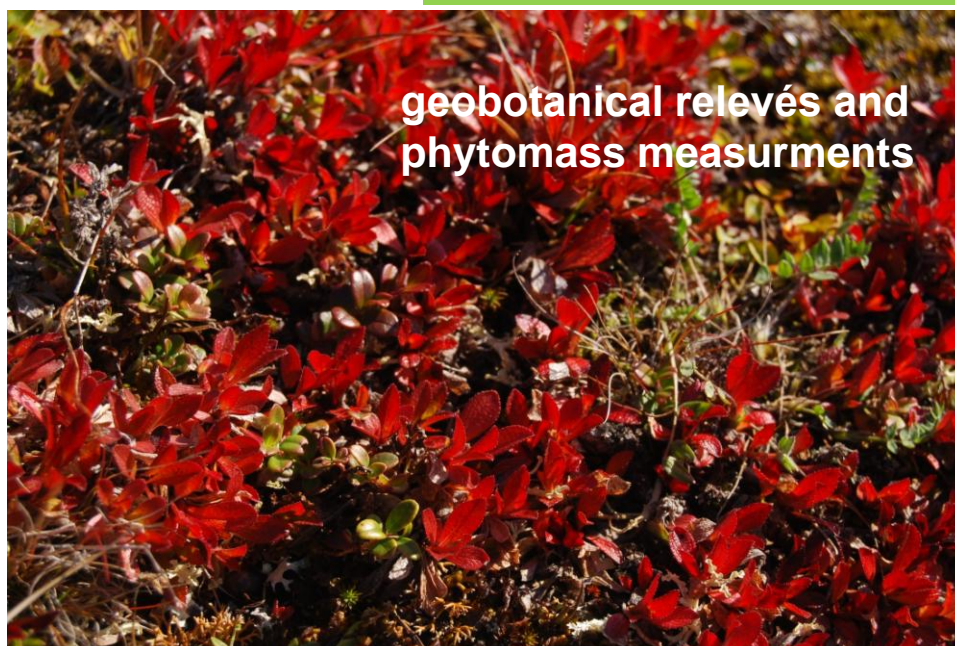
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helicopter observations



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helicopter observations

database of 4607 photos taken
of helicopter in ARCGIS project
+ GPS coordinates
+ orientation of photos

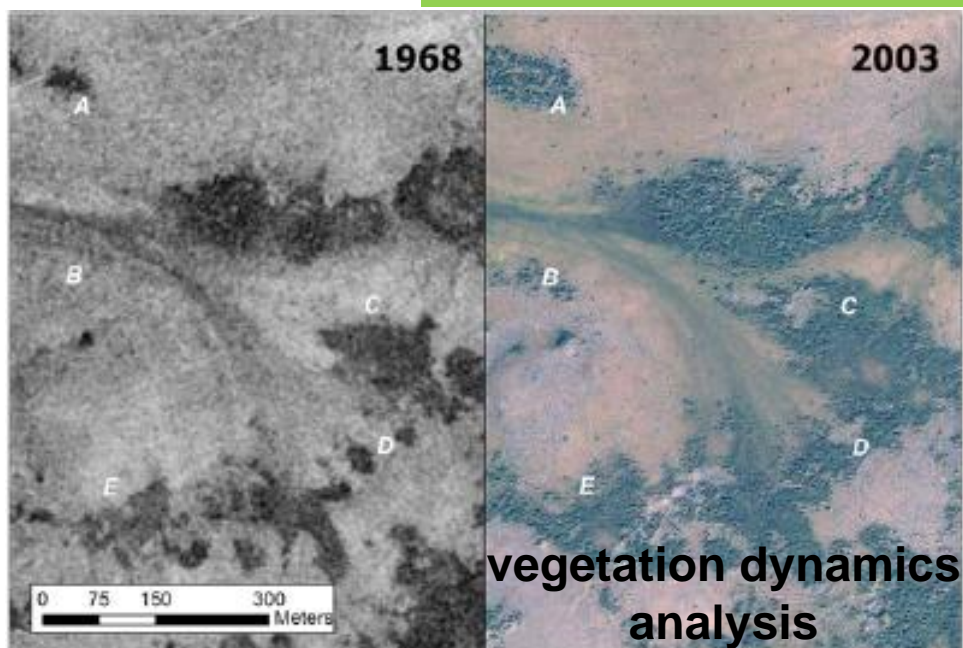




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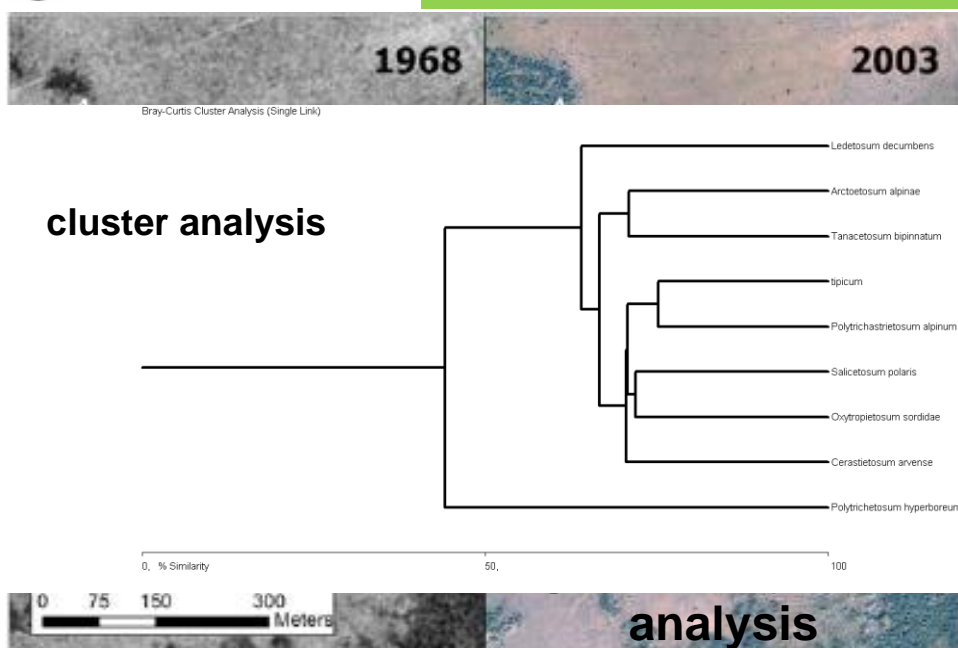
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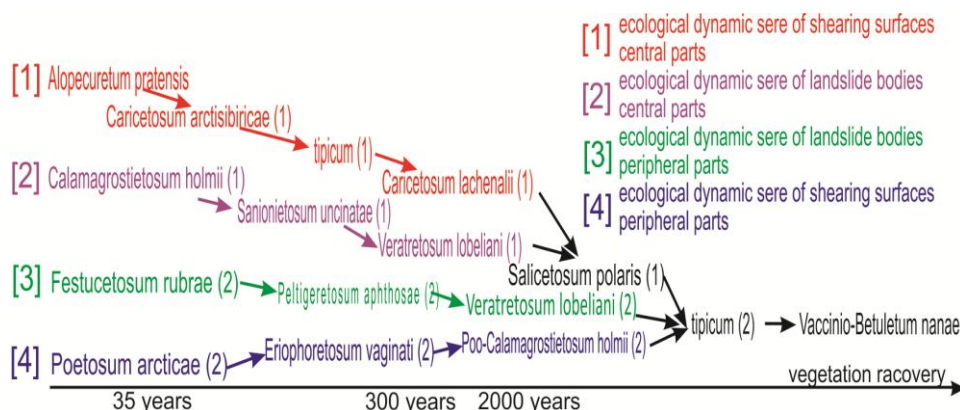
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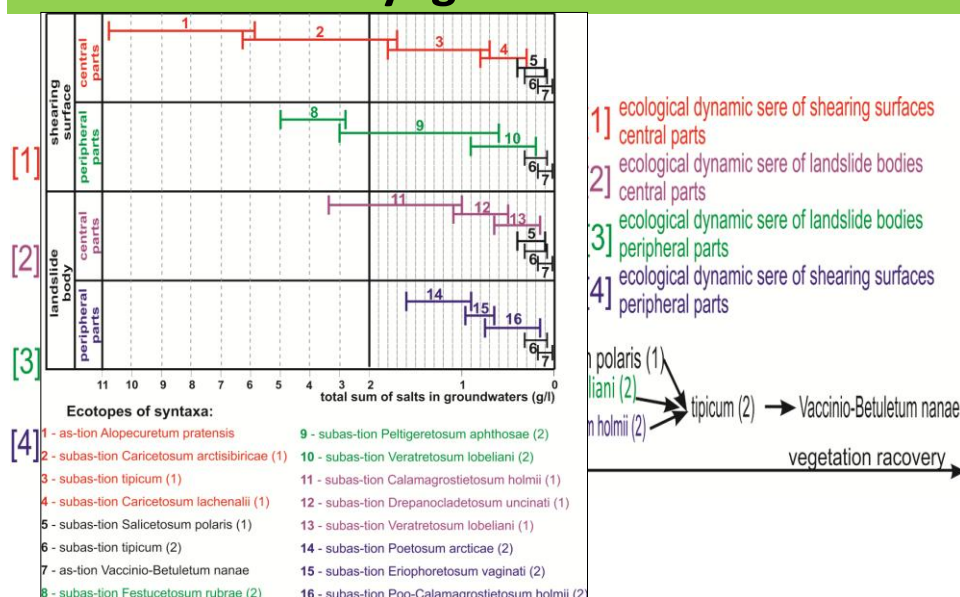




Phytoindication of the cryogenic landslides

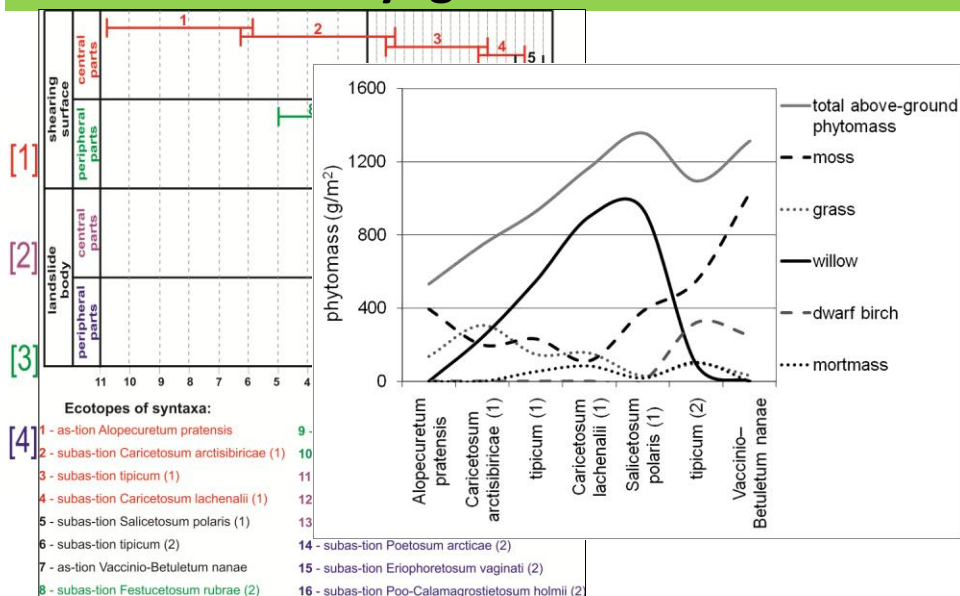


Phytoindication of the cryogenic landslides





Phytoindication of the cryogenic landslides



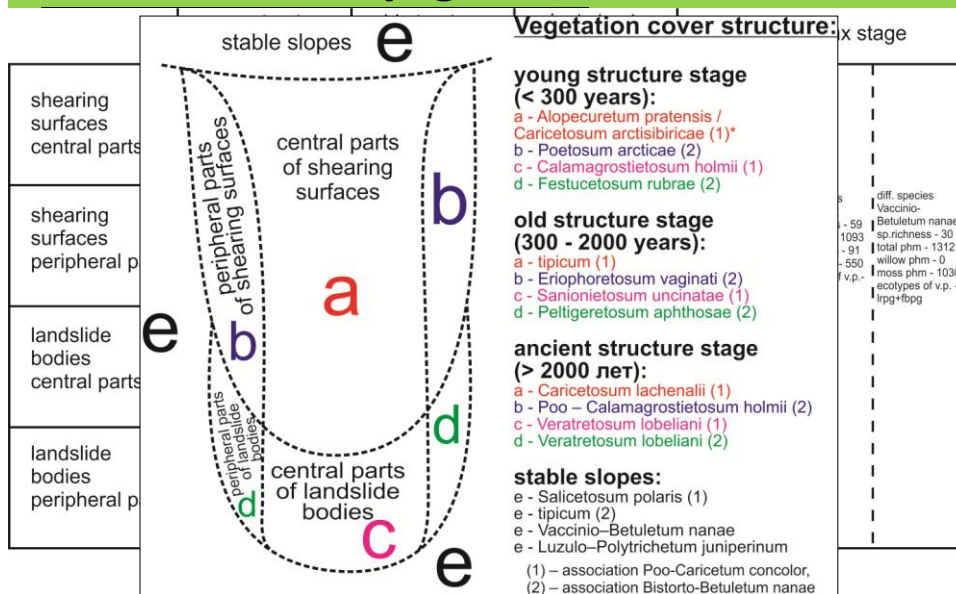
Phytoindication of the cryogenic landslides

	young structures stage	old structures stage	ancient structures stage	subclimax stage
shearing surfaces central parts	diff. species <i>Alopecuretum pratensis</i> ; sp. richness - 34; total phm - 532; willow phm - 0; moss phm - 386; ecotypes of v.p. - lrg+lbpg	diff. species <i>Caricetosum arctisibiricae</i> (1); sp. richness - 22; total phm - 746; willow phm - 24; moss phm - 200; ecotypes of v.p. - lrg+lbpg	diff. species <i>Caricetosum lachenalii</i> (1); sp. richness - 36; total phm - 1167; willow phm - 900; moss phm - 113; ecotypes of v.p. - lrg+lrpg+srpg	diff. species <i>Salicetosum polaris</i> (1); ind. species - <i>Dryas octopetala</i> ; sp. richness - 46; total phm - 1356; willow phm - 941; moss phm - 384; ecotypes of v.p. - lrg
shearing surfaces peripheral parts	diff. species <i>Poetium arcticae</i> (2); ind. species - <i>Dupontia fisheri</i> ; sp. richness - 20; total phm - 830; willow phm - 470; moss phm - 170; ecotypes of v.p. - lrg+hs+lbpg	diff. species <i>Eriophoretum vaginatum</i> (2); ind. species - <i>Stellaria palustris</i> ; sp. richness - 31; total phm - 1029; willow phm - 550; moss phm - 230; ecotypes of v.p. - lrg+hs	diff. species <i>Poo-Calamagrostetosum holmii</i> (2); sp. richness - 34; total phm - 1230; willow phm - 626; moss phm - 277; ecotypes of v.p. - hs+lrpg	diff. species <i>tipicum</i> (2); sp. richness - 59; total phm - 1093; willow phm - 91; moss phm - 550; ecotypes of v.p. - lrg+hs
landslide bodies central parts	diff. species <i>Calamagrostetosum holmii</i> (1); sp. richness - 46; total phm - 1016; willow phm - 698; moss phm - 26; ecotypes of v.p. - lrg	diff. species <i>Drepanocladus uncinatus</i> ; sp. richness - 38; total phm - 1329; willow phm - 1077; moss phm - 95; ecotypes of v.p. - lrg	diff. species <i>Veratretosum lobeliani</i> (1); sp. richness - 27; total phm - 1386; willow phm - 1014; moss phm - 270; ecotypes of v.p. - lrg	diff. species <i>Salicetosum polaris</i> (1); ind. species - <i>Dryas octopetala</i> ; sp. richness - 46; total phm - 1356; willow phm - 941; moss phm - 384; ecotypes of v.p. - lrg
landslide bodies peripheral parts	diff. species <i>Festucetosum rubrae</i> (2); sp. richness - 35; total phm - 993; willow phm - 478; moss phm - 110; ecotypes of v.p. - lrg+hs	diff. species <i>Peltigera aphthosa</i> (2); ind. species - <i>Peltigera aphthosa</i> ; sp. richness - 25; total phm - 1324; willow phm - 520; moss phm - 388; ecotypes of v.p. - lrg+hs	diff. species <i>Veratretosum lobeliani</i> (2); sp. richness - 42; total phm - 1725; willow phm - 800; moss phm - 446; ecotypes of v.p. - lrg+hs	

Salix dulauca

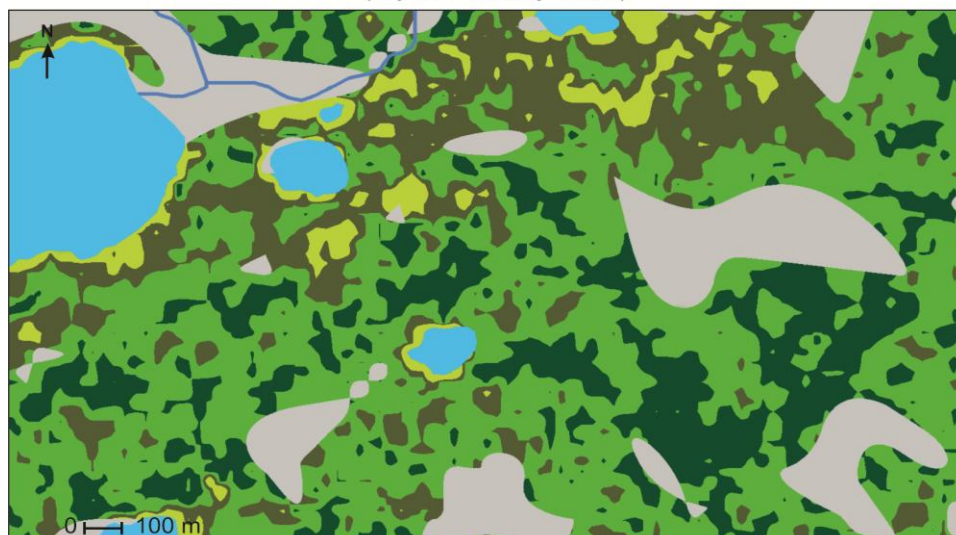


Phytoindication of the cryogenic landslides



Phytoindication of the cryogenic landslides

Phytoindication map of cryogenic landslide process
(key site "Vaskiny dachi")





Phytoindication of the cryogenic landslides

Legend 1

vegetation cover structure	total sum of salts and Cl ⁻ content in groundwaters (g/l)	sum of salts Cl ⁻ content	sum of salts Cl ⁻ content	sum of salts Cl ⁻ content	sum of salts Cl ⁻ content
		0,01 0,1 1 10	0,01 0,1 1 10	0,01 0,1 1 10	0,01 0,1 1 10
a	complex: Alopecuretum pratensis Caricetosum arctisibiricae (1) Poetosum arcticae (2) Calamagrostietosum holmii (1) Festucetosum rubrae (2)	total phytomass Salix glauca phytomass moss phytomass 0 1000 2000 g/m ²			
b	complex: tipicum (1) Eriophoretosum vaginati (2) Drepanocladetosum uncinati (1) Peltigeretosum aphthosae (2)		total phytomass Salix glauca phytomass moss phytomass 0 1000 2000 g/m ²		
c	complex: Caricetosum lachenalii (1) Poo-Calamagrostietosum holmii (2) Veratretosum lobeliani (1) Veratretosum lobeliani (2)			total phytomass Salix glauca phytomass moss phytomass 0 1000 2000 g/m ²	
d	complex: Salicetosum polaris (1) tipicum (2) Vaccinio-Betuletum nanae				total phytomass Salix glauca phytomass moss phytomass 0 1000 2000 g/m ²
NDVI		0,00 - 0,27	0,34 - 0,40	>0,40	0,27 - 0,34
stages of vegetation recovery after landslide event		initial stage	middle stage (< 300 лет)	late stage (300 - 2000 лет)	subclimax stage

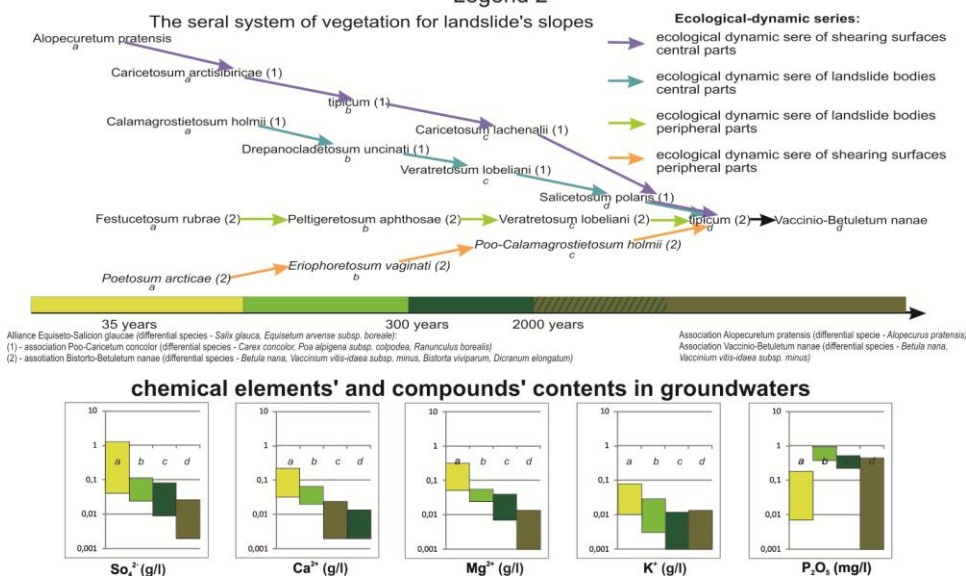
(1) - association Poo-Caricetum concolor, (2) - association Bistorto-Betuletum nanae

water streams lakes other vegetation



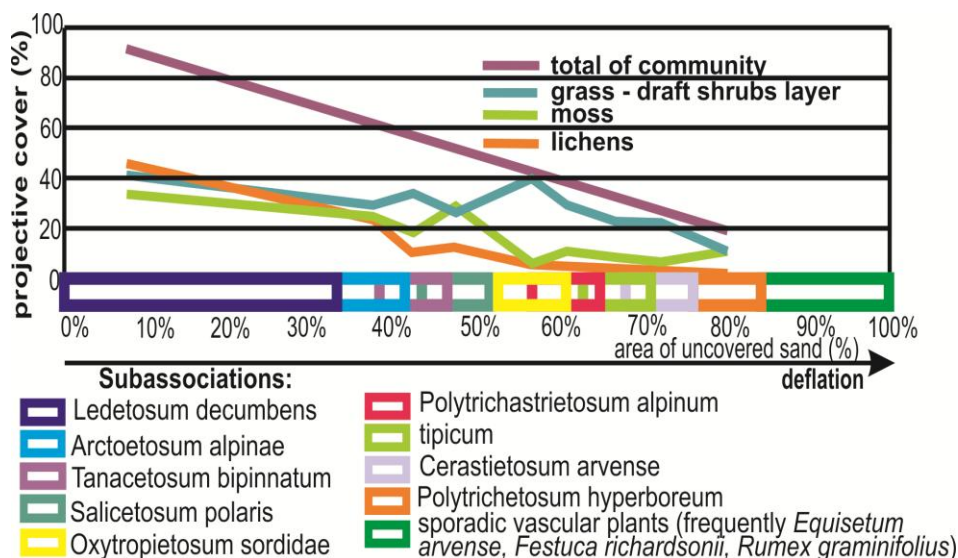
Phytoindication of the cryogenic landslides

Legend 2





Phytoindication of deflation processes



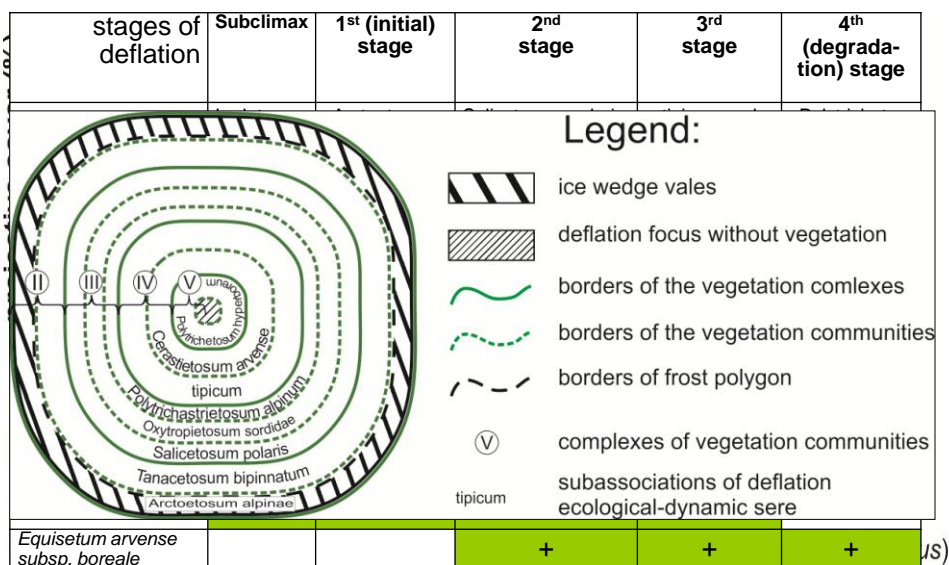
Phytoindication of deflation processes

stages of deflation	Subclimax	1 st (initial) stage	2 nd stage	3 rd stage	4 th (degradation) stage
syntaxa	Ledetosum decumbens	Arctoetosum alpinae and Tanacetosum bipinnatum	Salicetosum polaris, Oxytropietosum sordidae and Polytrichastrietosum alpinum	tipicum and Cerastietosum arvense	Polytrichetosum hyperboreum
<i>Ledum decumbens</i>	+				
<i>Pedicularis hirsuta</i>	+				
<i>Vaccinium vitis-idaea</i> subsp. minus	+				
<i>Polytrichum piliferum</i>	+				
<i>Cetraria nigricans</i>	+				
<i>Ochrolechia frigida</i>	+				
<i>Peltigera scabrosa</i>	+				
<i>Thamnolia vermicularis</i>	+	+	+		
<i>Bryocaulon divergens</i>	+	+	+	+	
<i>Equisetum arvense</i> subsp. boreale			+	+	+

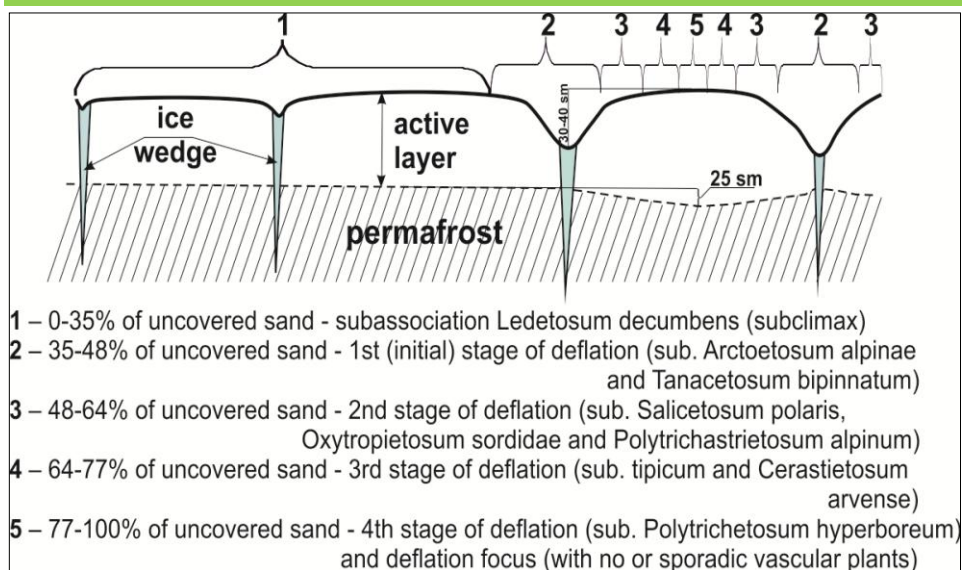
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Phytoindication of deflation processes



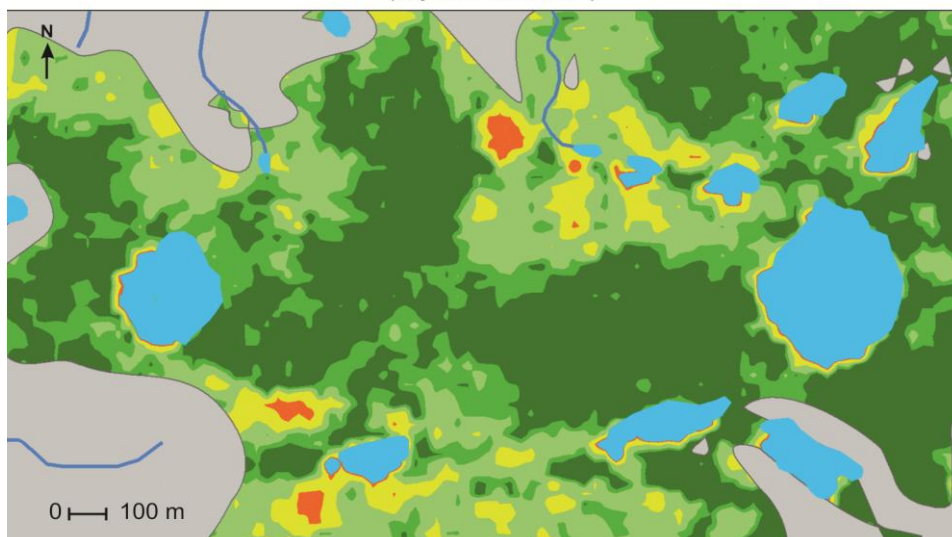
Phytoindication of deflation processes





Phytoindication of deflation processes

Phytoindication map of deflation process
(key site "Khalevto")



Phytoindication of deflation processes

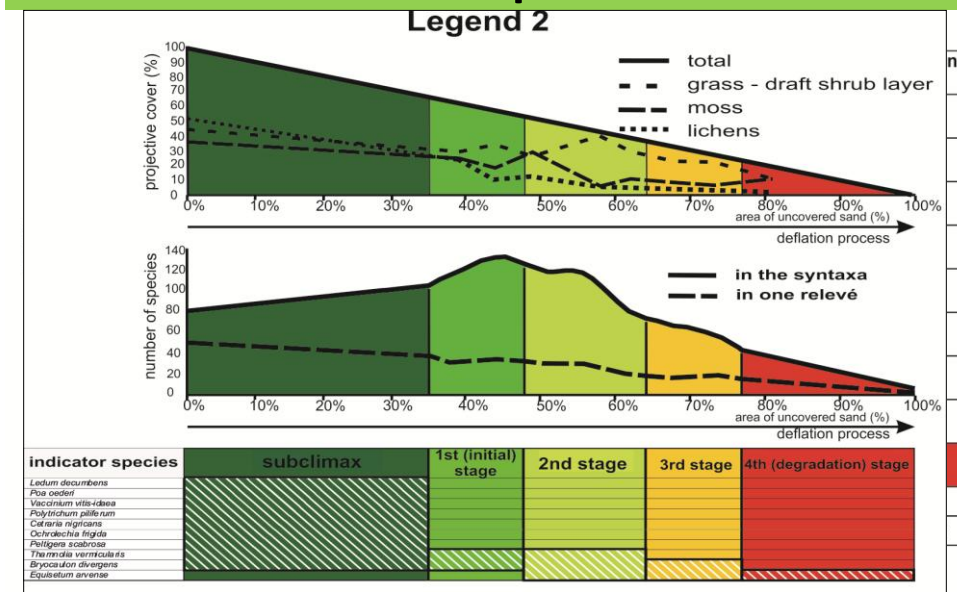
Legend 1

stages		suclimax	1st (initial) stage	2nd stage	3rd stage	4th (degradation) stage
association <i>Salicetum nummulariae</i> (<i>Salix verticillata</i> , <i>Thymus</i> spp., <i>Polygonum hydropiper</i>)	Ledetosum decumbens (<i>Cetaria nigricans</i> , <i>Vaccinium vitis-idaea</i> , <i>Lactuca decumbens</i> , <i>Phedonum sordidum</i> , <i>Polygonum viviparum</i> , <i>Polygonum viviparum</i> , <i>Chamaecyparis</i>)					
	Arctosetosum alpinum (<i>Arctostaphylos</i>)					
	Tanacetosum bipinnatum (<i>Tanacetum bipinnatum</i> , <i>Conium maculatum</i>)					
	Salicetosum polaris (<i>Salix rosmariniifolia</i> , <i>Salix rosmariniifolia</i> , <i>Salix rosmariniifolia</i> , <i>Salix rosmariniifolia</i> , <i>Salix rosmariniifolia</i>)					
	Oxytropetosum sordidae (<i>Oxytropis sordida</i> , <i>Polygonum viviparum</i>)					
	Polytrichastrietosum alpinum (<i>Polytrichum alpinum</i> var. <i>flagellum</i>)					
association <i>Rumicetum graminifolius</i> (<i>Rumex graminifolius</i>)	tipicum					
	Cerastietosum arvense (<i>Cerastium arvense</i> , <i>Cerastium arvense</i> , <i>Cerastium arvense</i>)					
	Polytrichetosum hyperboreum (<i>Polytrichum hyperboreum</i> , <i>Polytrichum hyperboreum</i> , <i>Polytrichum hyperboreum</i> , <i>Polytrichum hyperboreum</i> , <i>Polytrichum hyperboreum</i>)					
% of uncovered sand		0 - 35%	35 - 48%	48 - 64%	64 - 77%	77 - 100%
NDVI		> 0,25	0,2 - 0,25	0,1 - 0,2	-0,03 - 0,1	-0,069 - -0,03

water streams lakes other vegetation



Phytoindication of deflation processes



THANK YOU!!!

