Regional and landscape analysis of the Páramo-Bosque ecotone in the Venezuelan Andes under climatic change scenarios.

LEAF: From Landscape to Ecosystem: Across-scales Functioning in Changing Environments

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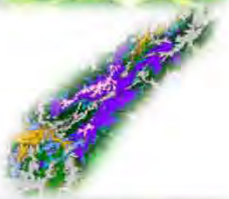
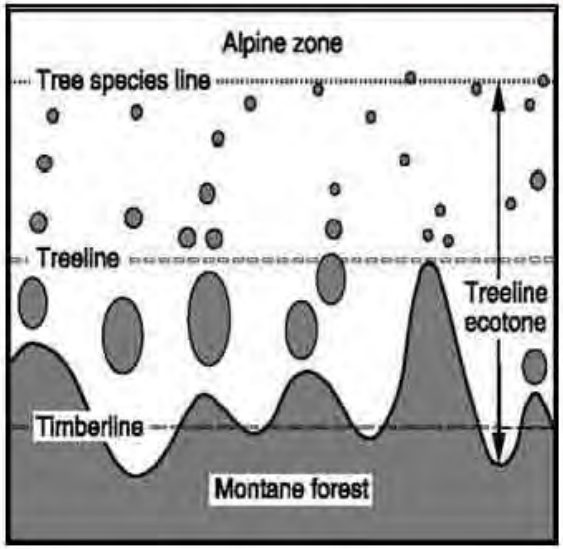


Study of the forest-páramo ecotone into the global and local change (climatic and human factors)



LEAF: Integration of analyses scales

LEAF!

Regional-Global

Landscapes

Gradients

Ecosystems

Niche local

Individuos

metros

0,1 1 10 100 1000 10000 100000

Spatial scale

- Temperate forest (Can)
- Paramo – forest (Ven)
- Campos – forest (Bra)
- Grassland – forest (Cor)
- Steppe – forest (Men)

LEAF: From Landscape to Ecosystem: Across-scales Functioning in Changing Environments

Objetives-works relationship





Changes in the forest/open vegetation regional boundary

- Landscape changes in the Páramo-Cloud Forest transitional boundary.

Analysis of ecosystem functional diversity at landscape and regional levels.

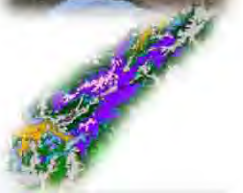
- Distribution Model of Páramo-Forest ecotone in the Venezuelan Andes.

Vegetation changes along environmental gradients and across landscapes.

- Plants life forms spatial distribution along of altitudinal gradient.








Integration





Life form distribution

Ecotone distribution model

Rate of Landscape change

Model of Ecosystems change under climatic scenarios?



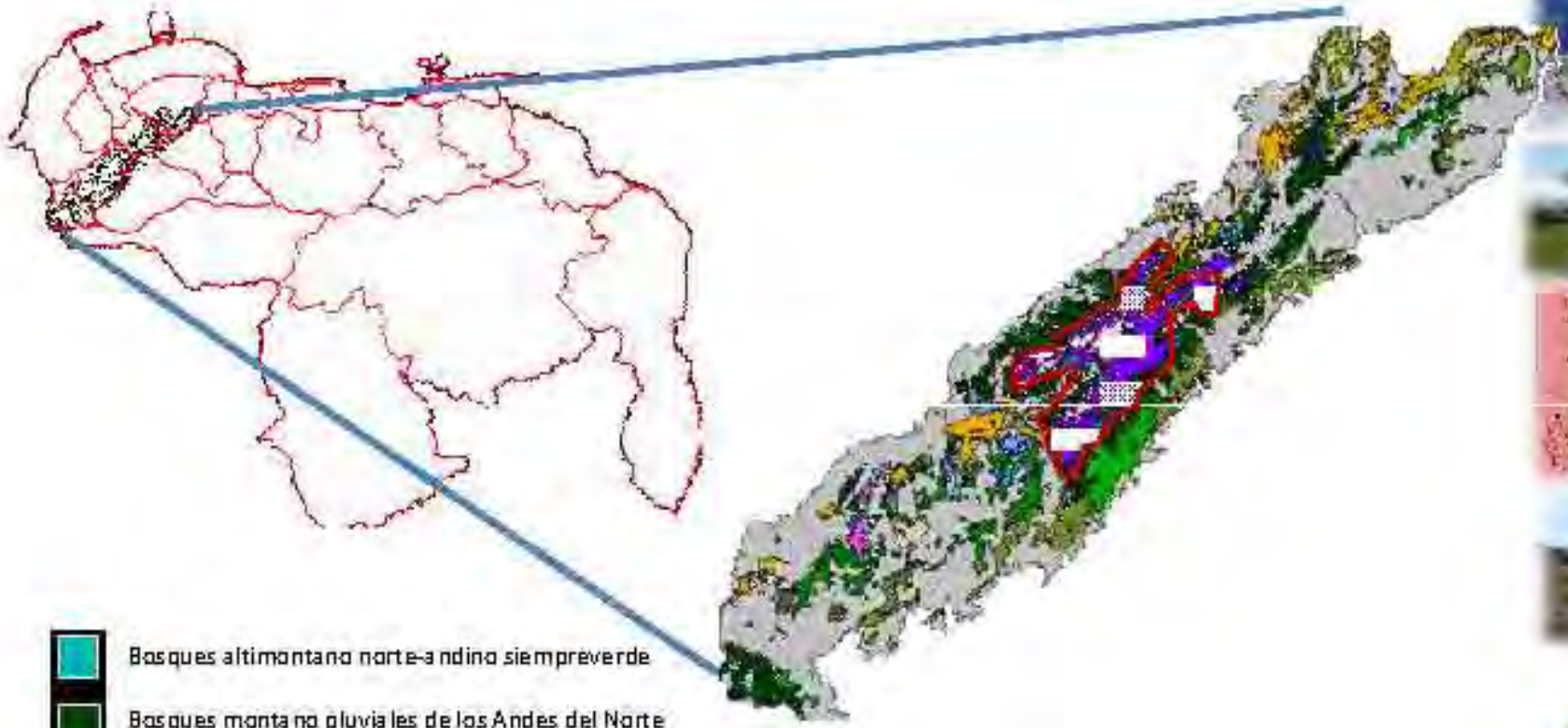


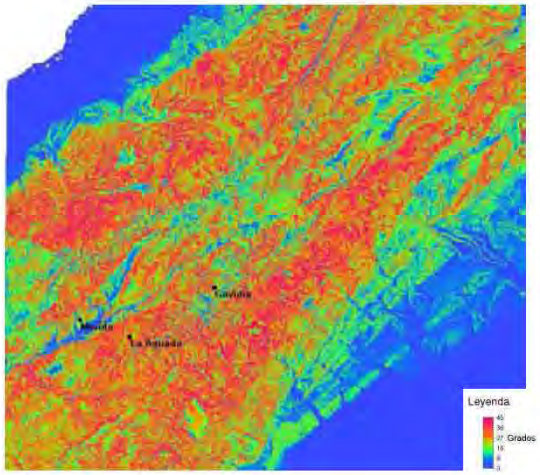

DISTRIBUTION MODEL OF THE PÁRAMO-FOREST ECOTONE IN THE VENEZUELAN ANDES

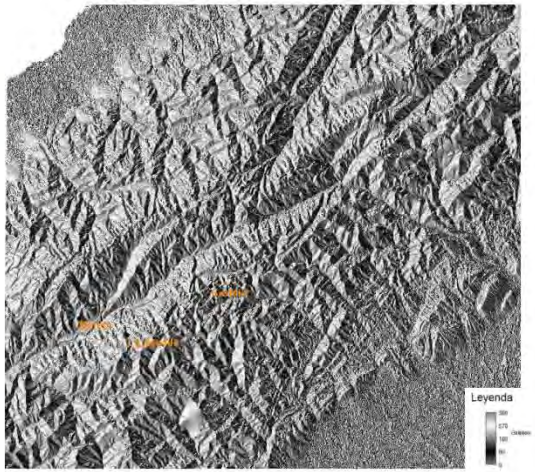
Suárez del Moral, P. and Chacón-Moreno, E.

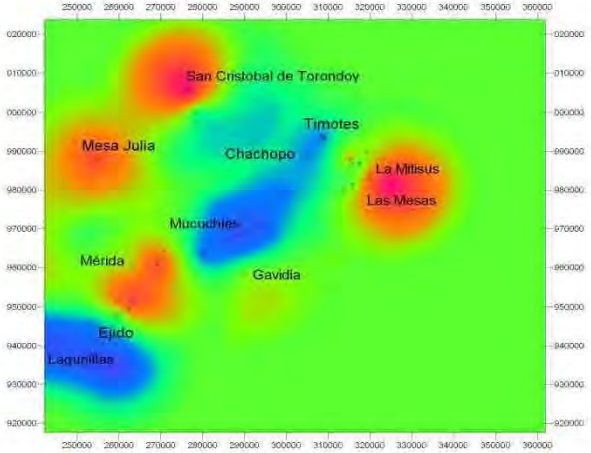
Objetive: To determine at regional scale the distribution pattern of the forest – Páramo boundary and the relationship between the boundary location with the temperature, rainfall, slope and exposition. From this results create models of the boundary distribution and evaluate that in climate change scenarios.

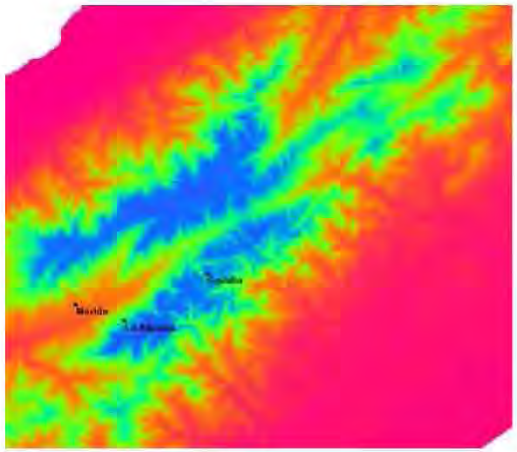
Study area

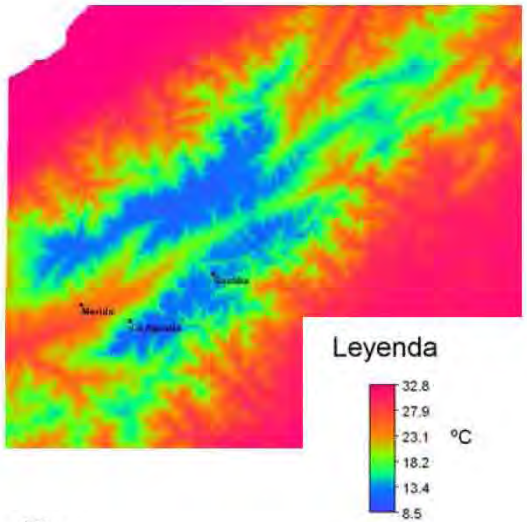

Bosques altimontano norte-andino siempreverde
Bosques montano pluviales de los Andes del Norte
Bosques montanos pluviestacionales de los Andes del Norte
Arbustales y Frailejonales altimontanos paramunos

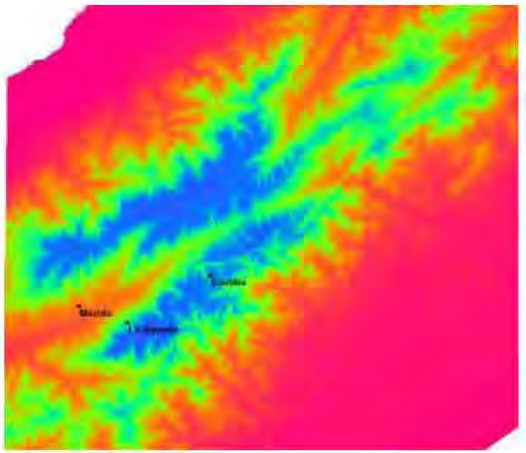

Leyenda
Grados


Leyenda

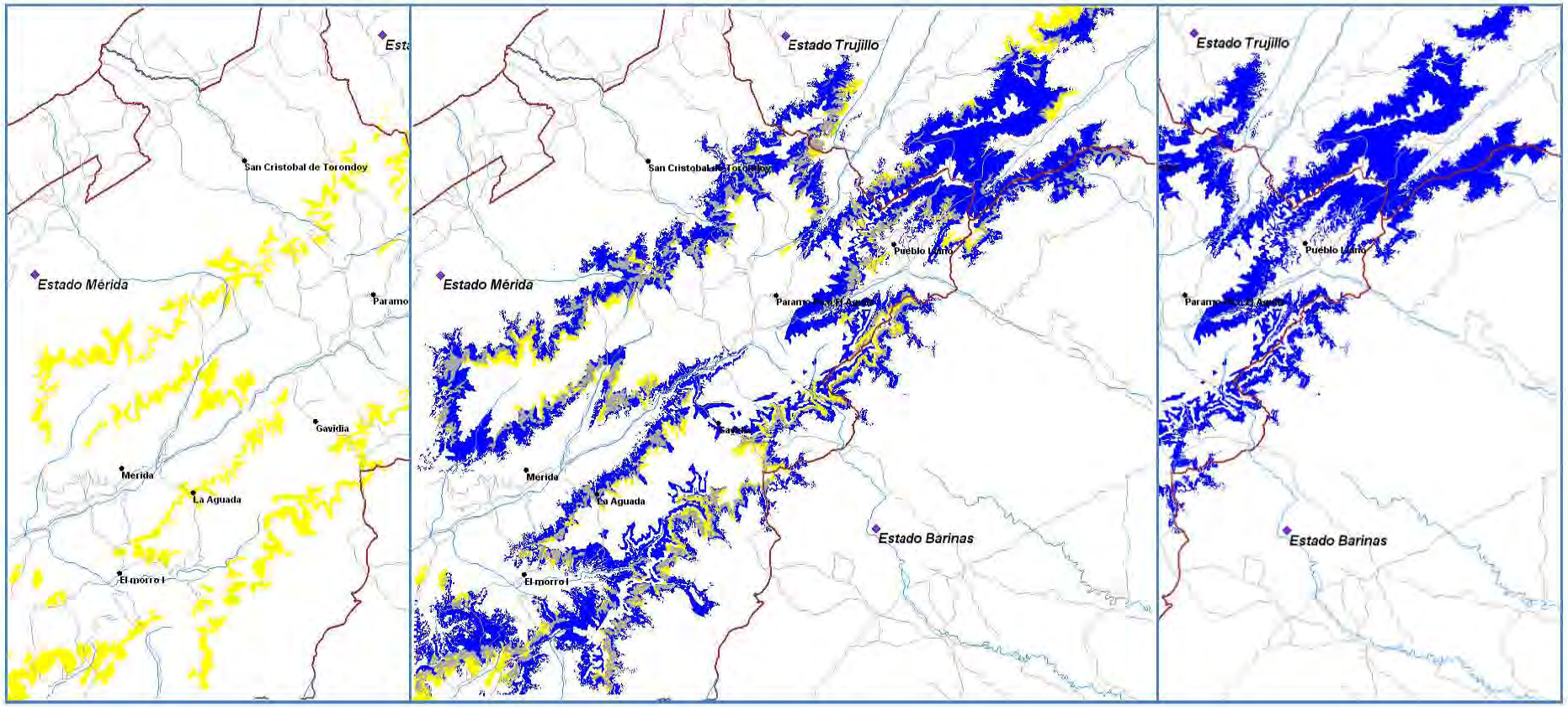

San Cristobal de Torondoy
Timotes
Mesa Julia
Chachopo
La Mitisus
Las Mesas
Mucuchies
Mérida
Gavidia
Ejido
Lagunillas




Leyenda
32.8
27.9
23.1
18.2
13.4
8.5
°C

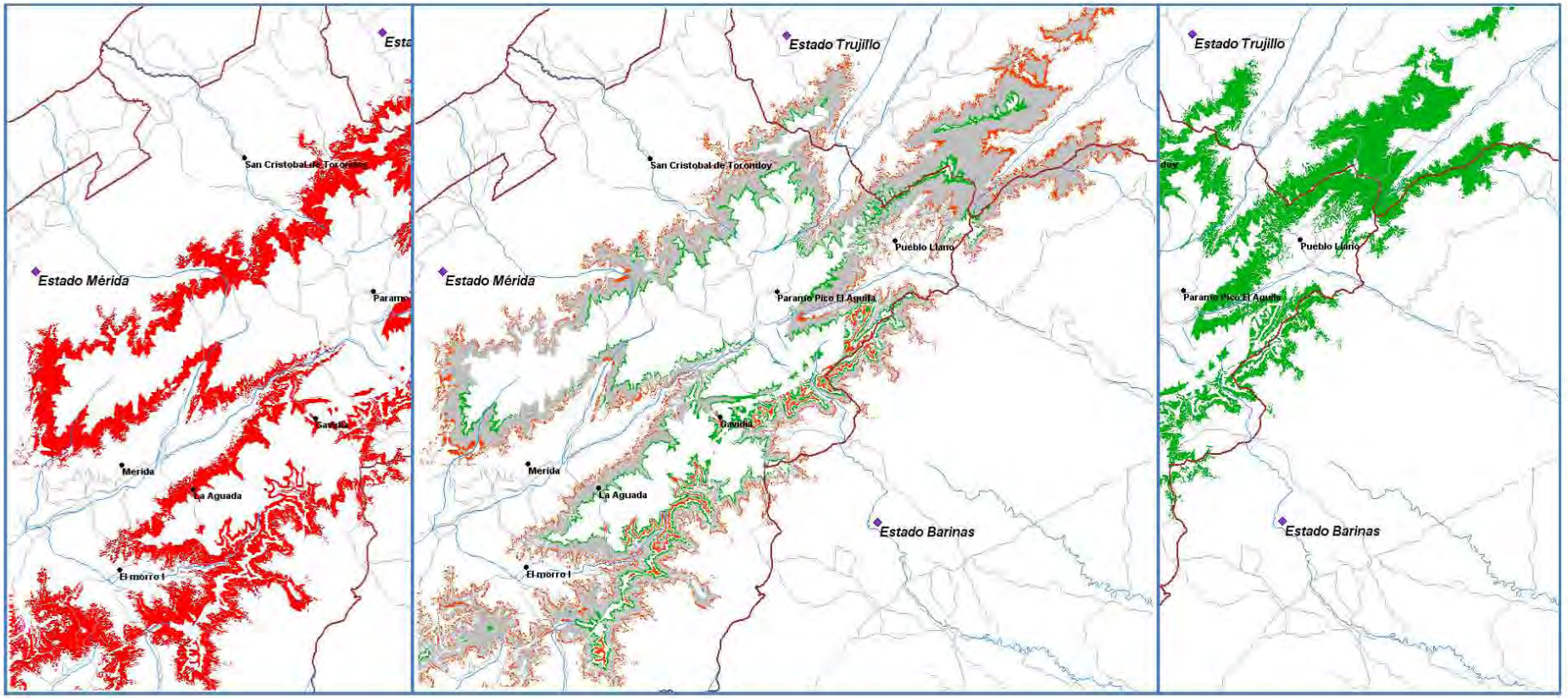


A B C



Preparamo forest distribution from the Ecosystems Map of Los Andes

Preparamo forest potencial distribution from model

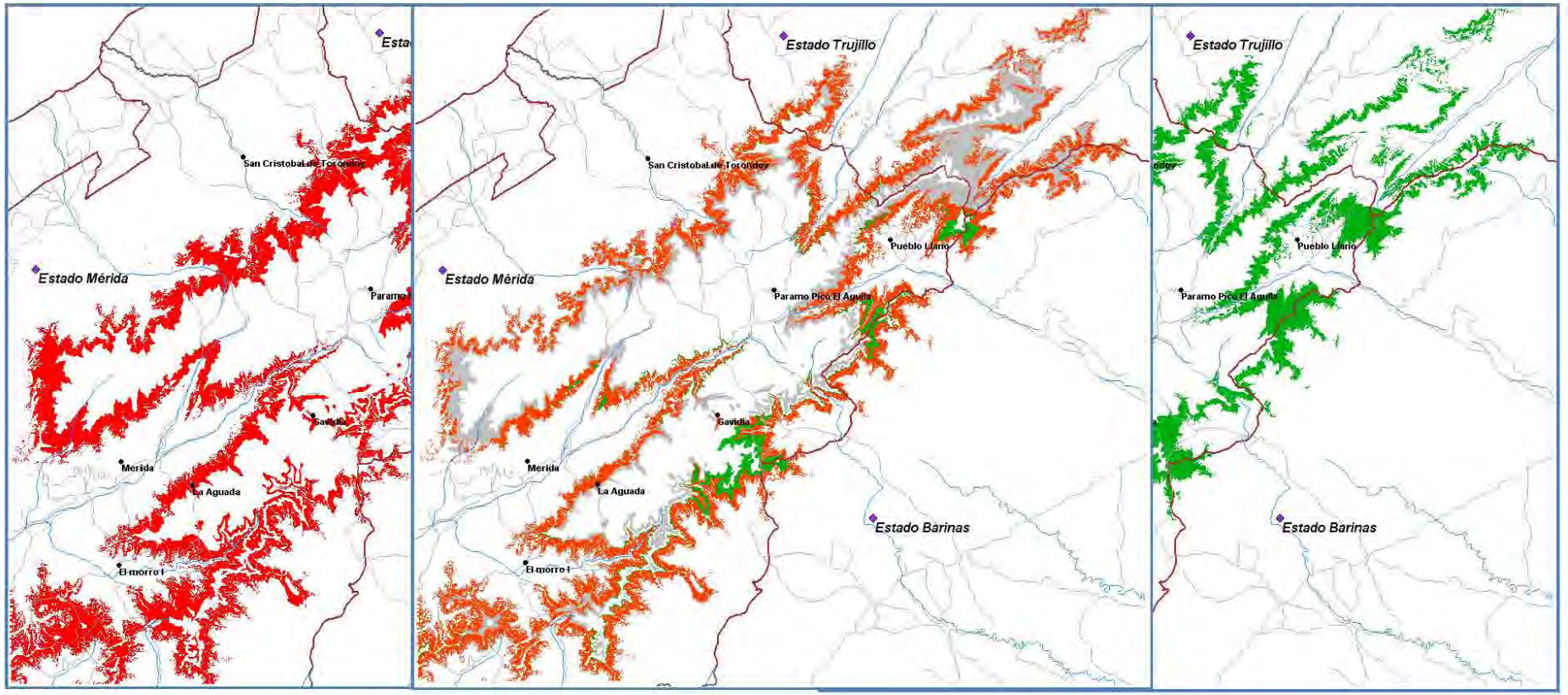


Preparamo forest potencial distribution from model

Preparamo forest potencial distribution under cliamtic change scenario (UKMO)

For the next 40 years in an optimistic scenario

- Temperatura elevation of 0.7 ºC.
- Without rainfall variations



Preparamero forest potencial distribution from model

Preparamero forest potencial distribution under climatic change snenario (CCCMA - Canadá)

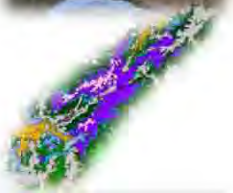
For the next 40 years in an optimistic scenario
- Temperature elevation of 0.4 ºC.
- Rainfall decrease in 350 mm.

LANDSCAPE CHANGES IN THE PÁRAMO-CLOUD FOREST ECOTONE OF THE AGUADA SECTOR, SIERRA NEVADA, MÉRIDA

Santaella, W. and Chacón-Moreno, E.

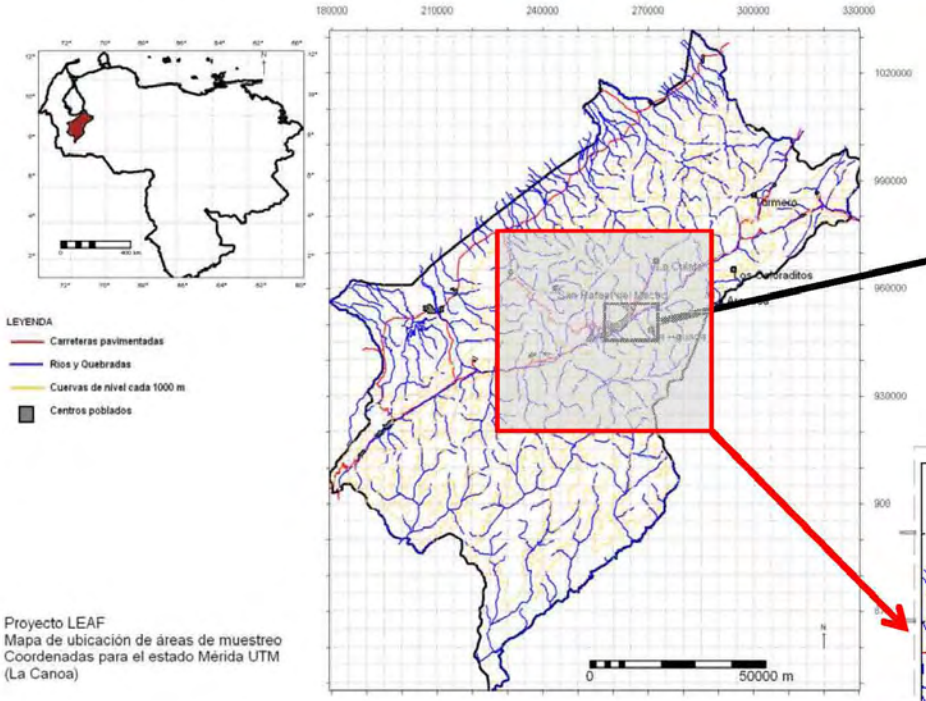


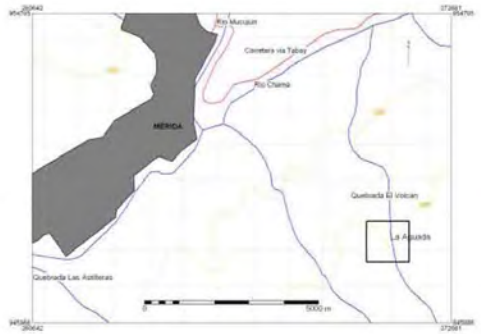


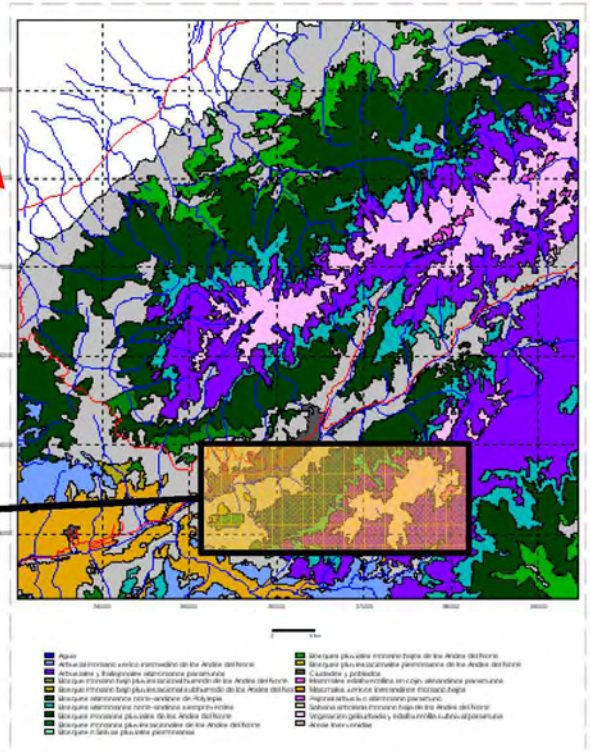


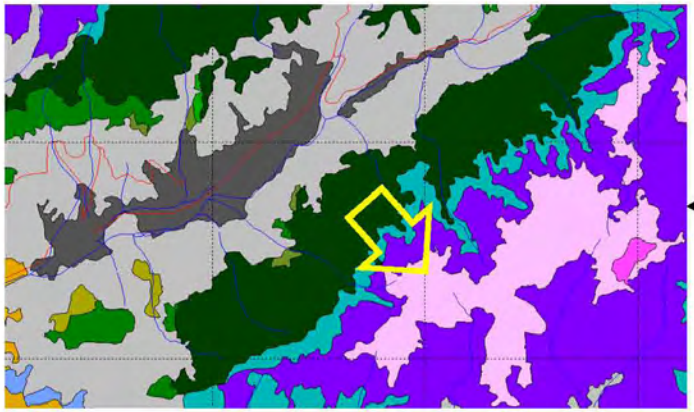

- **General objective:** Analyze the landscape ecological units changes in the transitional zone between Páramo and cloud forest, at the Sierra Nevada National Park ocurred between 1952 and 1998, through an retrospective ecological survey .
- **Specific objectives:**
  - Elaboration of aerial ortho-photomaps (georeferentiation).
  - Aerial photo-interpretation
  - Ecological survey and maps elaboration of the study area.
  - Comparative analysis of the landscape changes

Study area


LEYENDA
Carreteras pavimentadas
Rios y Quebradas
Cuervas de nivel cada 1000 m
Centros poblados
Proyecto LEAF
Mapa de ubicación de áreas de muestreo
Coordenadas para el estado Mérida UTM
(La Canoa)
180000
210000
240000
270000
300000
330000
1020000
990000
960000
930000
900
0
50000 m


MERIDA
Río Mucujun
Carretera via Tabay
Río Chama
Quebrada El Volcan
La Aguada
Quebrada Las Antiberas
0
5000 m





Data and methods





Aerial photographs:
•Mision A-34, Photo 187, scale 1:40000 , year 1952
• Misión 010493, photo 135, scale 1:65000, year 1998.
•DEM from topographical isolines digitezed in ICAE from maps 1:25000

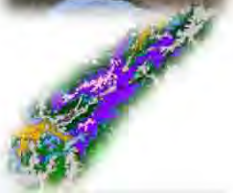
Photointerpretation: It was carried out using screen interpretation based on the diferentation of the main photo elements (tone, texture, patterns, etc.) (Pernía, 1991).

Georeference: Using ILWIS and Tie Points tools (92 total points, 40 points from topographical maps 5941-I-SE y NE and 52 field points taked with GPS) photos were georeferenced using Mercator Transversal (UTM) provisional South American 1956 projection (Datum La Canoa)

Legend of the spatial vegetation units (Unidades de vegetación)



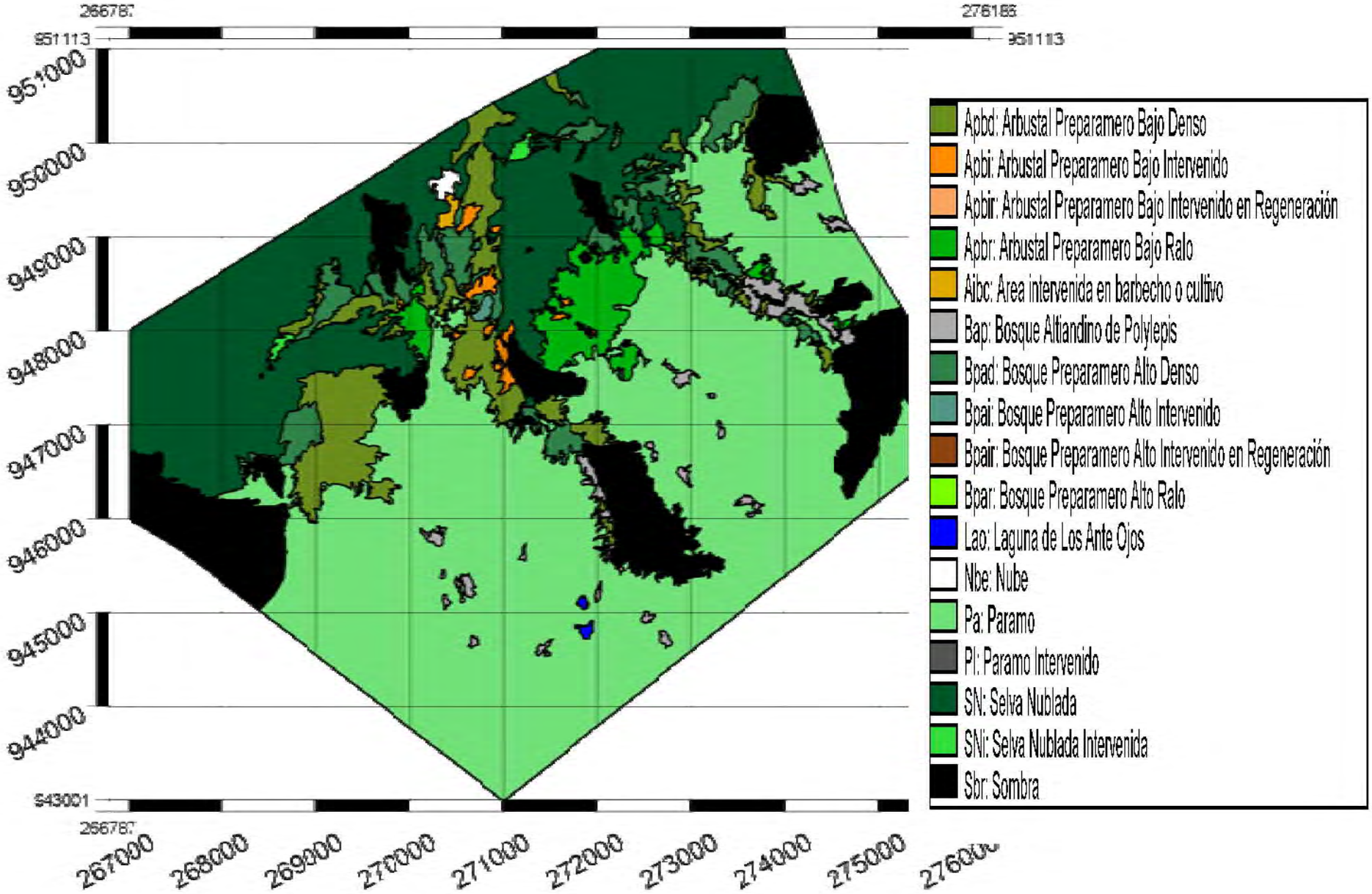




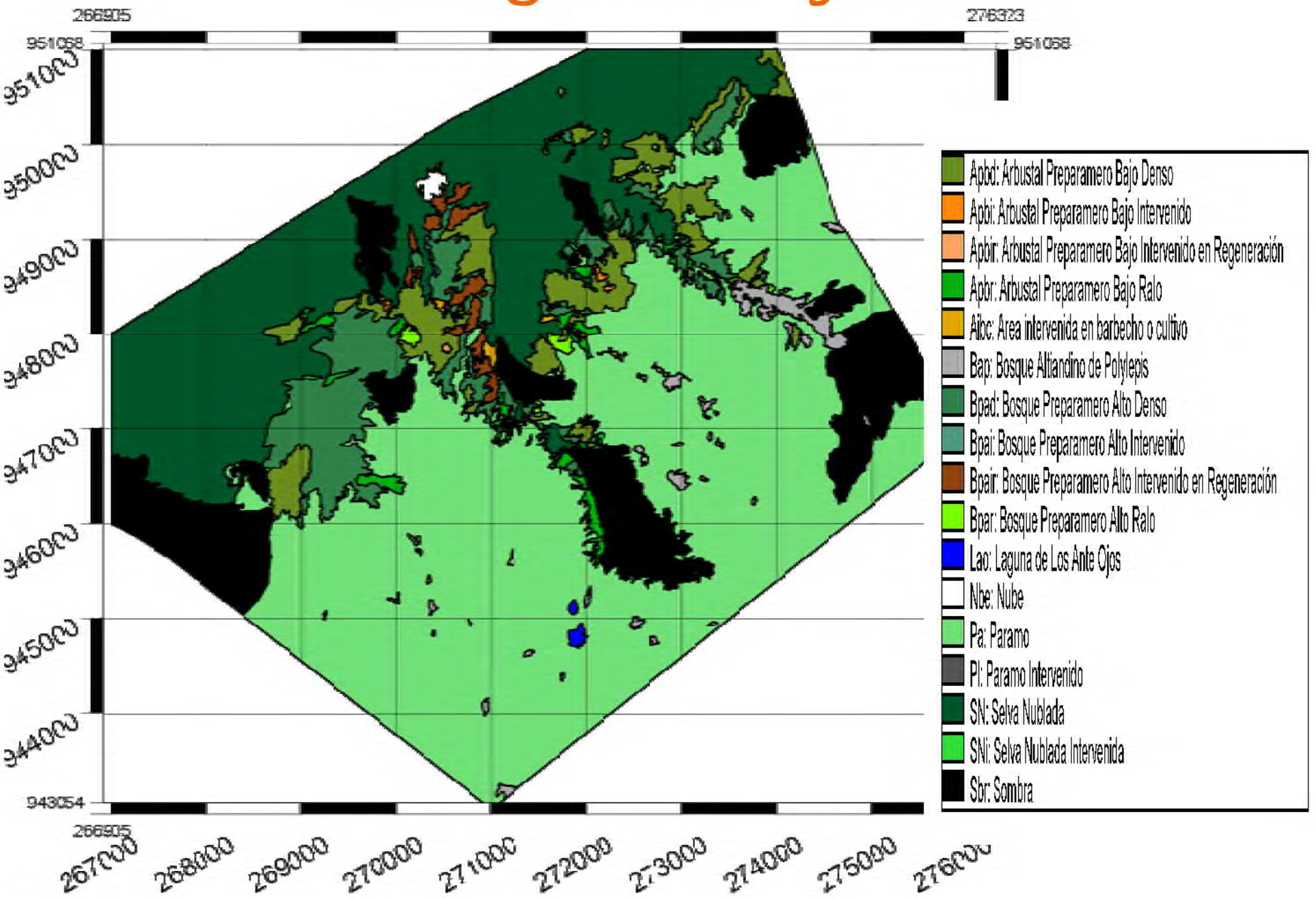

Results

Code	Vegetation Unit (cover)	Description
Pa	**Páramo**	Natural vegetation with predominance of rosetts and shrubs
Apbr	**Low and sparse Preparamo Shrubland**	Shrubs dominance, some herbs, few rosettes. Canopy cover of 25-50%
Apbd	**Low and dense Preparamo Shrubland**	Shrubs dominance, some herbs, few rosettes. Canopy cover > 75%
Bpar	**Tall and sparse Preparamo Forest**	Tree dominance > 5 m. Canopy cover of 25-50%
Bpad	**Tall and dense Preparamo Forest**	Tree dominance > 5 m. Canopy cover > 75%
SN	**Cloud forest**	Predominance of tree cover, canopy between 10-30m high.
Bap	**Polylepis altoandino forest**	Predominance of *Polylepis sericea* populations.
SIN	**Secondary Cloud forest**	Cloud forest with intervention
Apbi	**Secondary low Preparamo Shrubland**	Shrub cover with a grade of intervention
Apbir	**Secondary low Preparamo Shrubland in regeneration**	Shrub cover with a grade of intervention and regeneration processes
Bpai	**Secondary tall Preparamo Forest**	Tree cover > 5m, with intervention
Bpar	**Secondary tall Preparamo Forest in regeneraion**	Tree cover > 5m, with intervention and regeneration processes
Aibc	**Fallow or crop area**	Grassland, or crops, or fallow vegetation

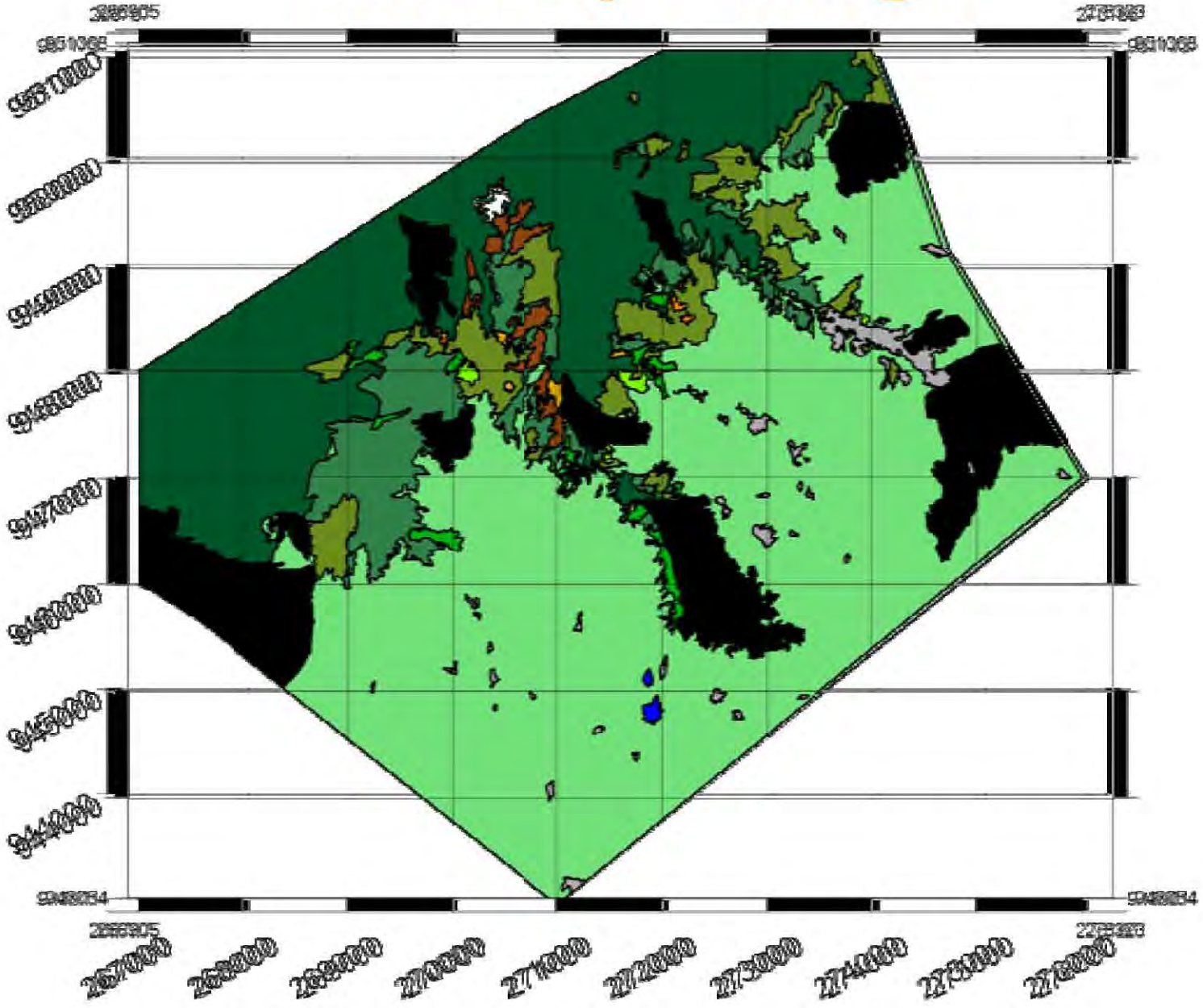
Ecological survey 1952



Ecological survey 1998



Landscape change



Landscape Change (38,856 ha)

Vegetation Unit	Area 1952 (ha)	% Area 1952	Area 1998 (ha)	% Area 1998	Change 1952-1998 (ha)	% Change 1998-1952	% change to total area
SN	9906.4	25.5	10427.4	26.8	521	5.3	1.34
SIN	95.9	0.2	9	0.0	-86.9	-90.6	-0.22
Bpad	1887.2	4.9	2854	7.3	966.8	51.2	2.49
Bpar	0	0.0	80	0.2	80	100.0	0.21
Bpai	62	0.2	14	0.0	-48	-77.4	-0.12
Bpair	0	0.0	393	1.0	393	100.0	1.01
Apbd	3115.2	8.0	2392	6.2	-723.2	-23.2	-1.86
Apbr	1369.8	3.5	432	1.1	-937.8	-68.5	-2.41
Apbi	246.1	0.6	35	0.1	-211.1	-85.8	-0.54
Apbir	0	0.0	7	0.0	7	100.0	0.02
Pa	21519.9	55.4	21644	55.7	124.1	0.6	0.32
Aibc	55.4	0.1	62	0.2	6.6	11.9	0.02
Bap	598.2	1.5	507	1.3	-91.2	-15.2	-0.23

PLANTS LIFE FORMS SPATIAL DISTRIBUTION ALONG OF ALTITUDE GRADIENT.

Arzac Peña, A., Chacón-Moreno, E., Llambí, L.D. and Dulhoste, R.

- To analyze the environmental factors – plant life forms distribution relationships, along the altitudinal-thermic gradient in the open páramo ecosystem above the upper boundary of the forest

- To evaluate the climatic change effect on the plant life form spatial distribution through the elaboration of model distribution under climatic change scenarios.

Specific objectives





- To define the plant life forms of the study area based on the taxonomic and morphologic characteristics.

- To determine the environmental factors (altitude, horizon A wide, slope and orientation) – life forms distribution relationship in the study area.

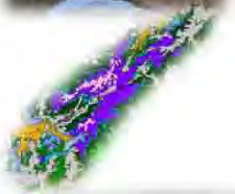
- To create life forms responses model related to the main environmental factors of the area.

- Create maps of the life form distribution using the ecological responses model using GIS to characterize the spatial variables.

- Modeling of life form spatial distribution under climatic change scenarios.







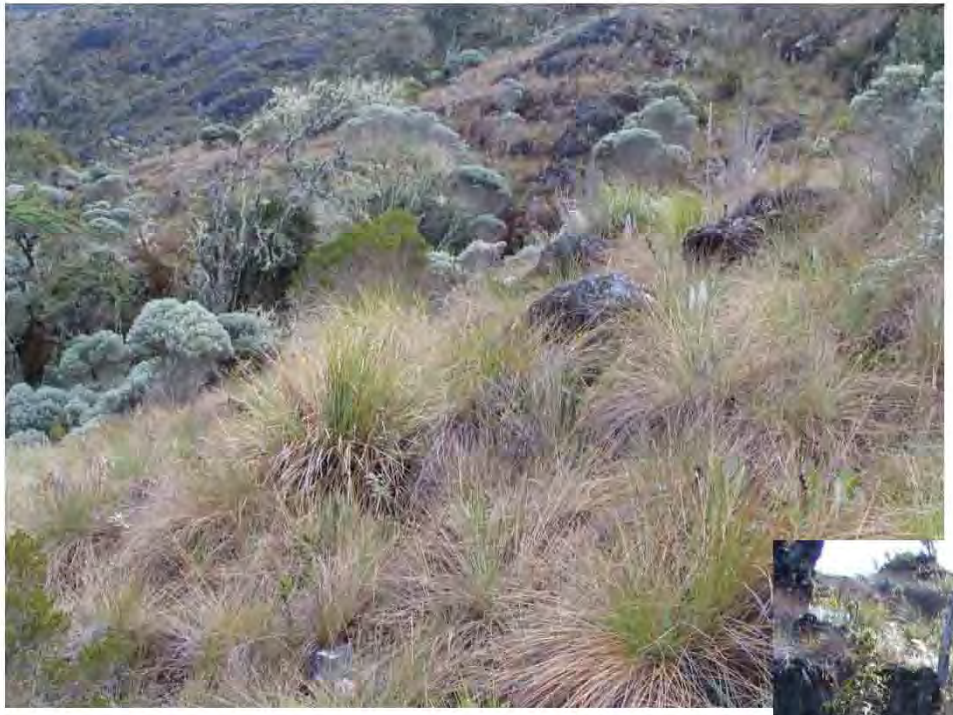

Study area

ation

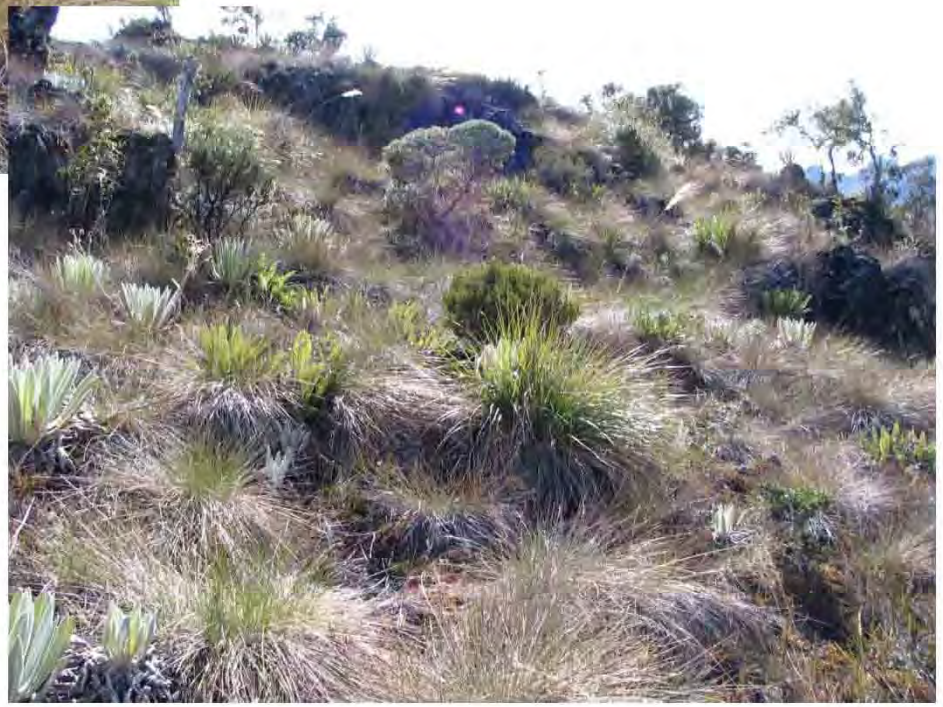
Para
ecot
3.55

Study area

Vegetation



Pajonal



Pajonal rosetal

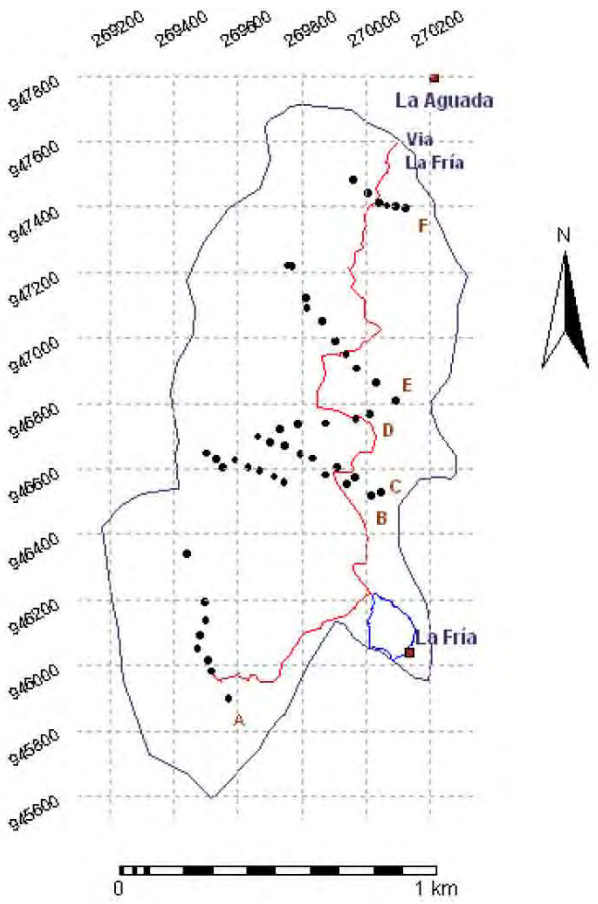
Study area

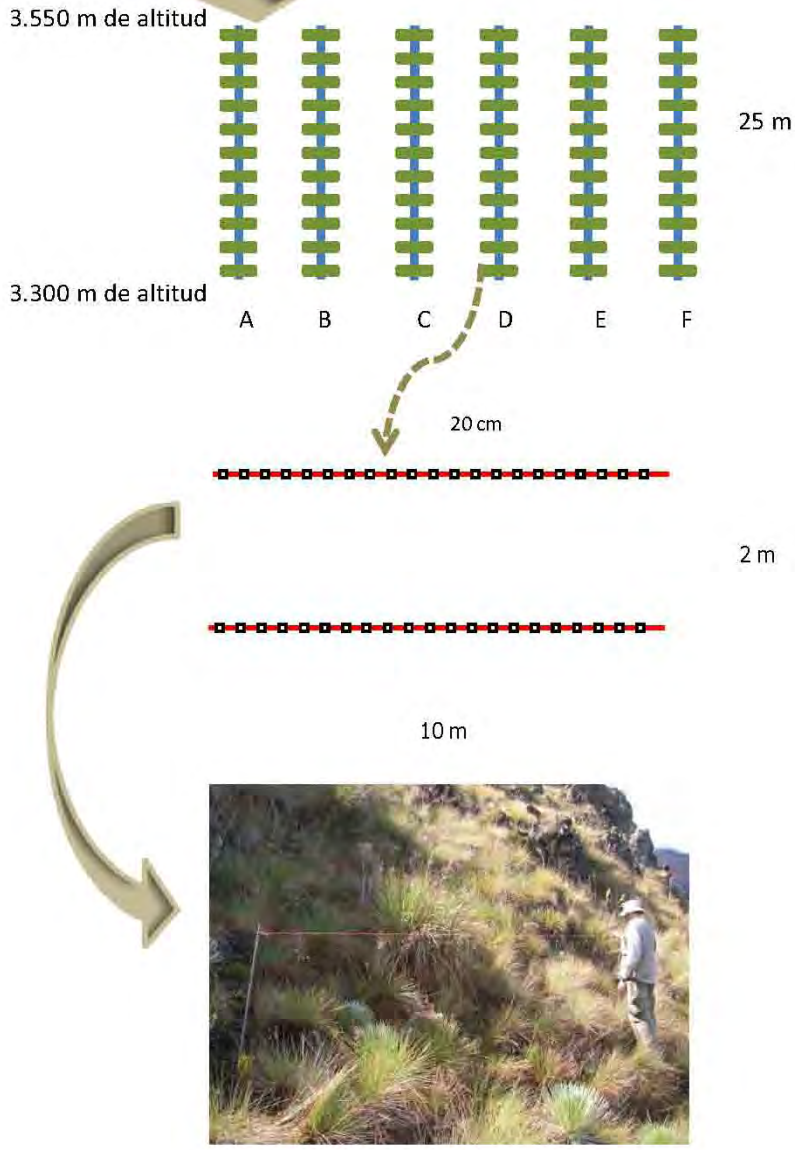
Vegetation

Rosetas Caulescentes

Shrubs

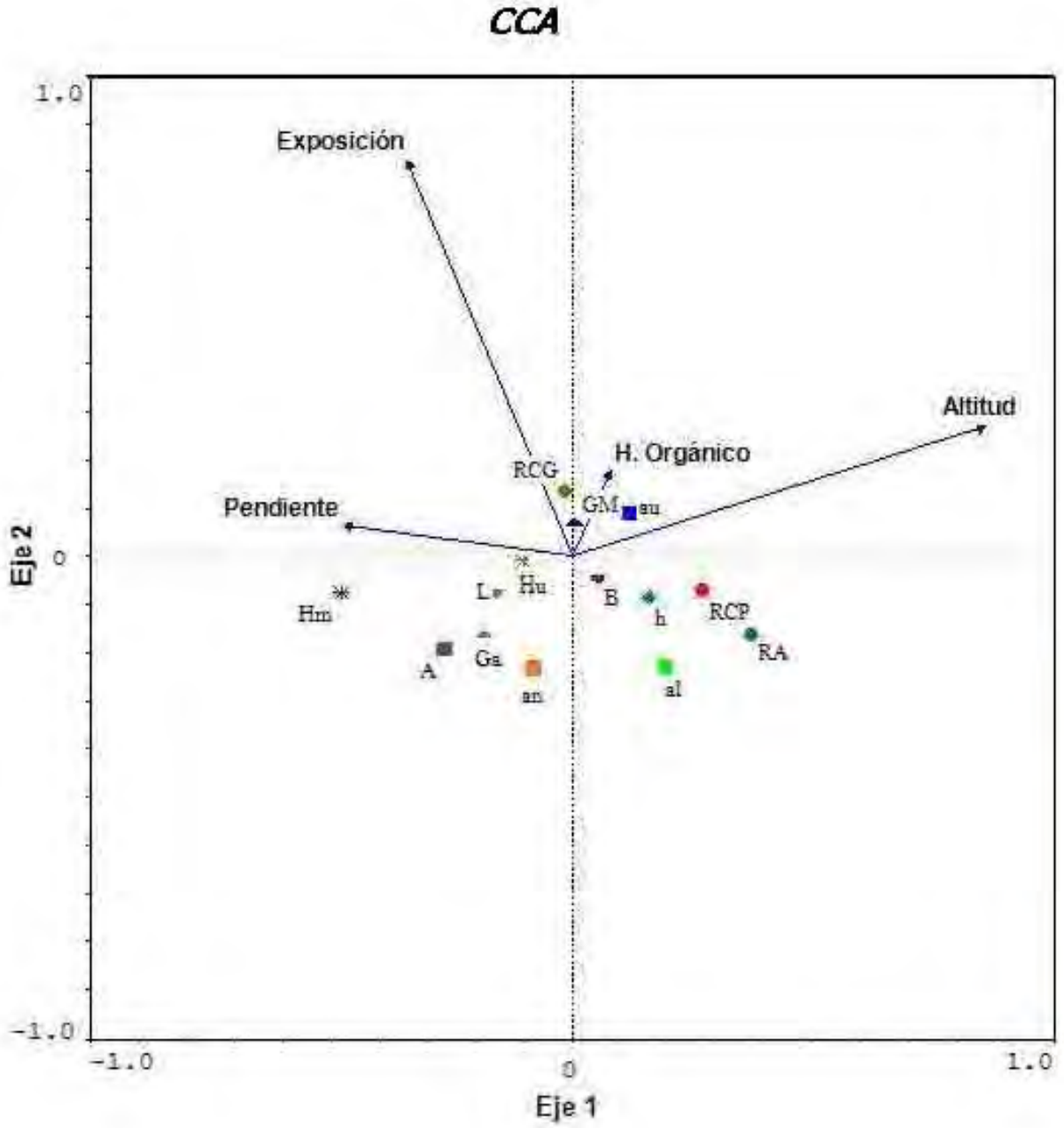
Sampling method





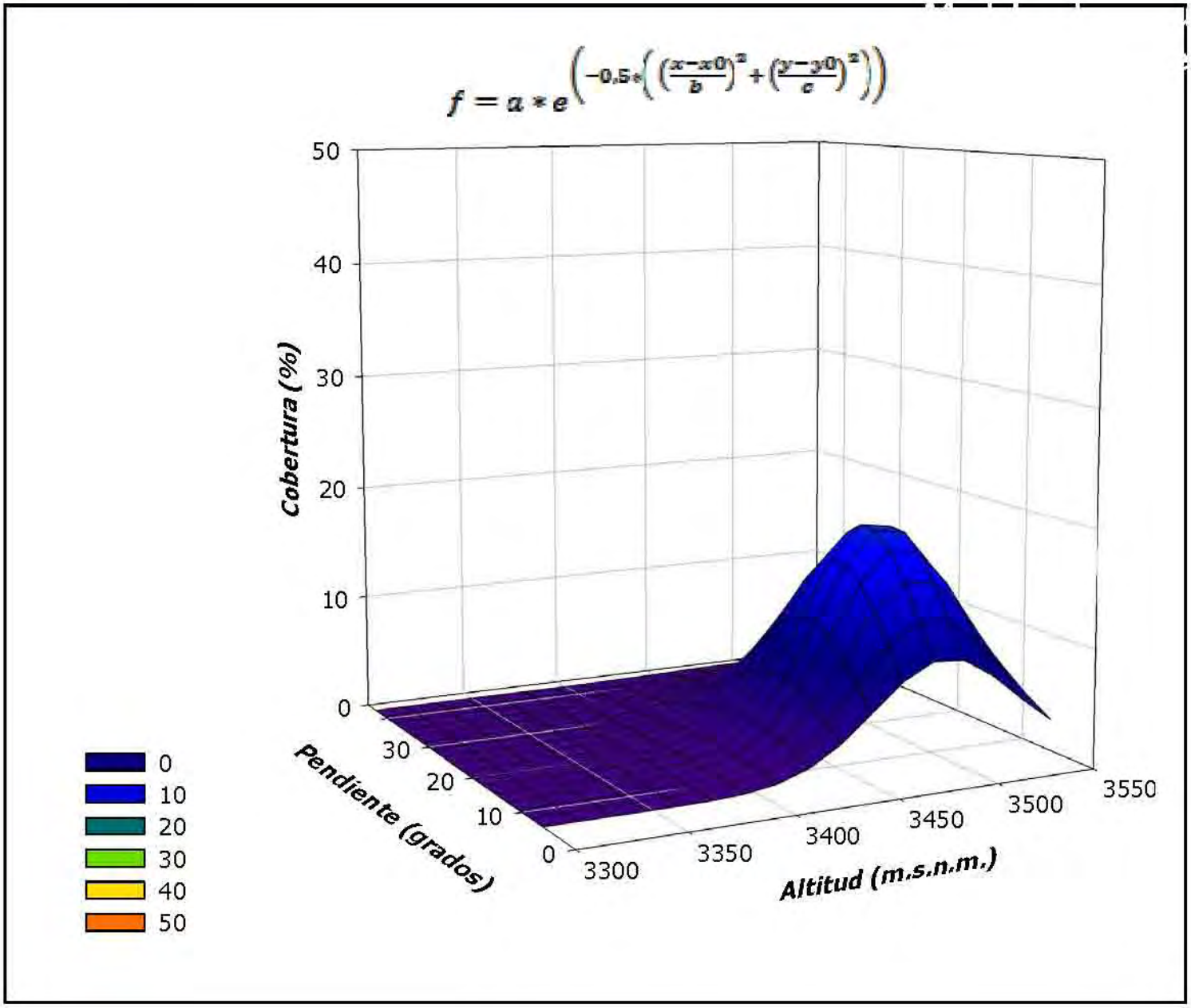
Results

Ordering Analysis (cca)

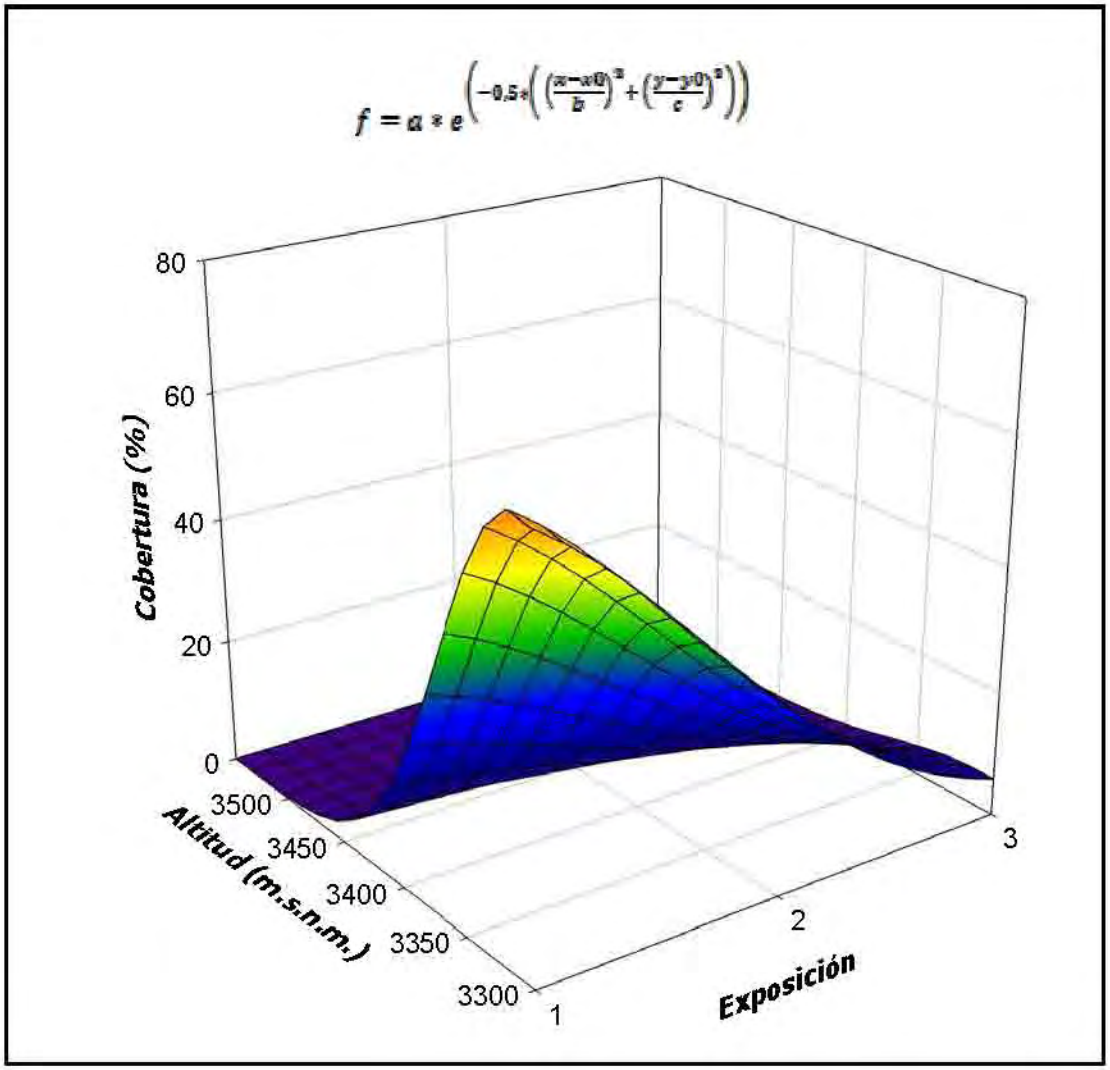


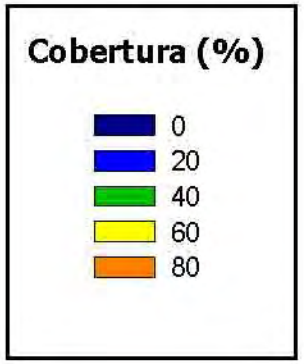
Axe1 (altitud), Axe 2 (exposición). Axis 1 and 2 explain 90,5 % of the variance

RCG: Rosetas caulescentes glabras
RCP: Rosetas caulescentes pubescentes
RA: Rosetas acaulescentes
h: Hierbas
au: Arbustos microfilos
an: Arbustos nanófilos
al: Arbustos leptófilos
A: Árboles
Hm: Helechos mesófilos
Hu: Helechos microfilos
B: Briófitos
L: Líquenes
Ga: Gramineas arbustivas
GM: Gramineas en macolla


$f = a * e^{\left(-0.5*\left(\left(\frac{x-x0}{b}\right)^2+\left(\frac{y-y0}{c}\right)^2\right)\right)}$
Cobertura (%)
50
40
30
20
10
0
Pendiente (grados)
0
30
20
10
0
Altitud (m.s.n.m.)
3300
3350
3400
3450
3500
3550
0
10
20
30
40
50

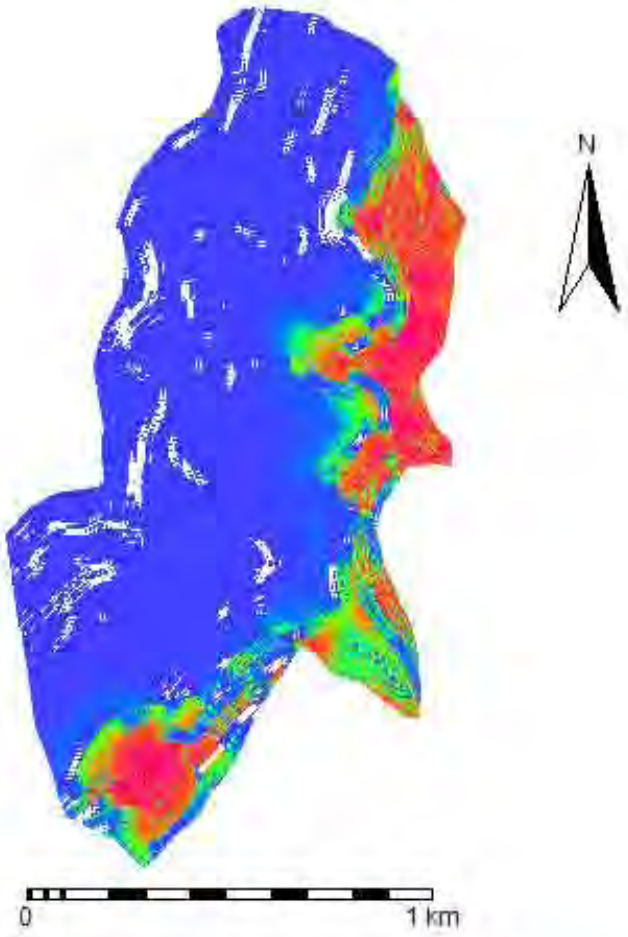
Trees cover percentage in relation to altitude and exposition (R^2= 0,78; P<0,001)



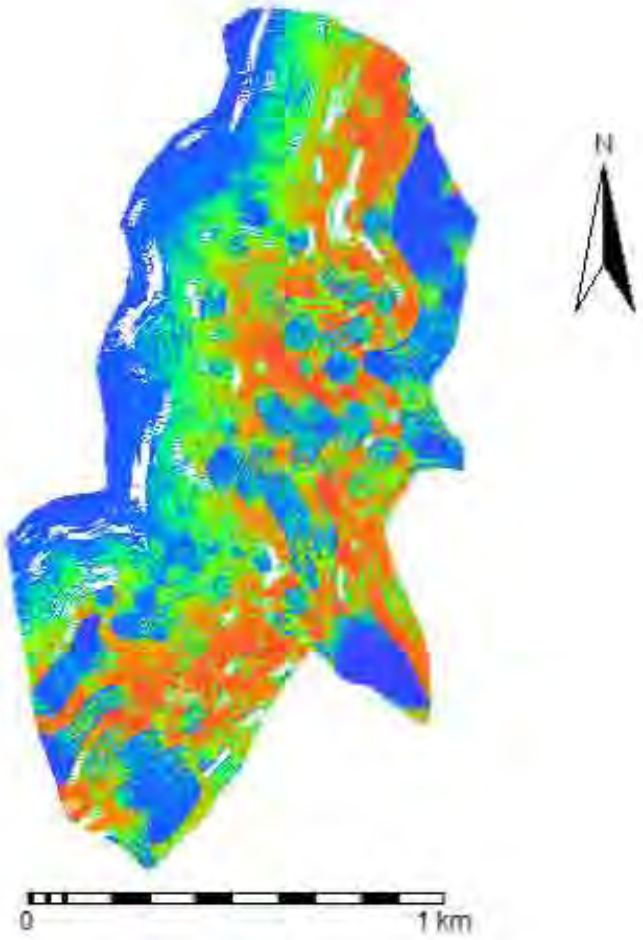


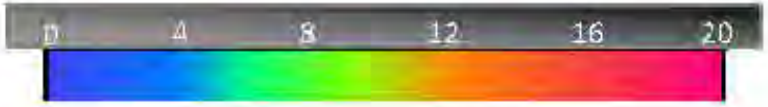
Model of Rosetas Caulescentes spatial distribution

Pubescentes

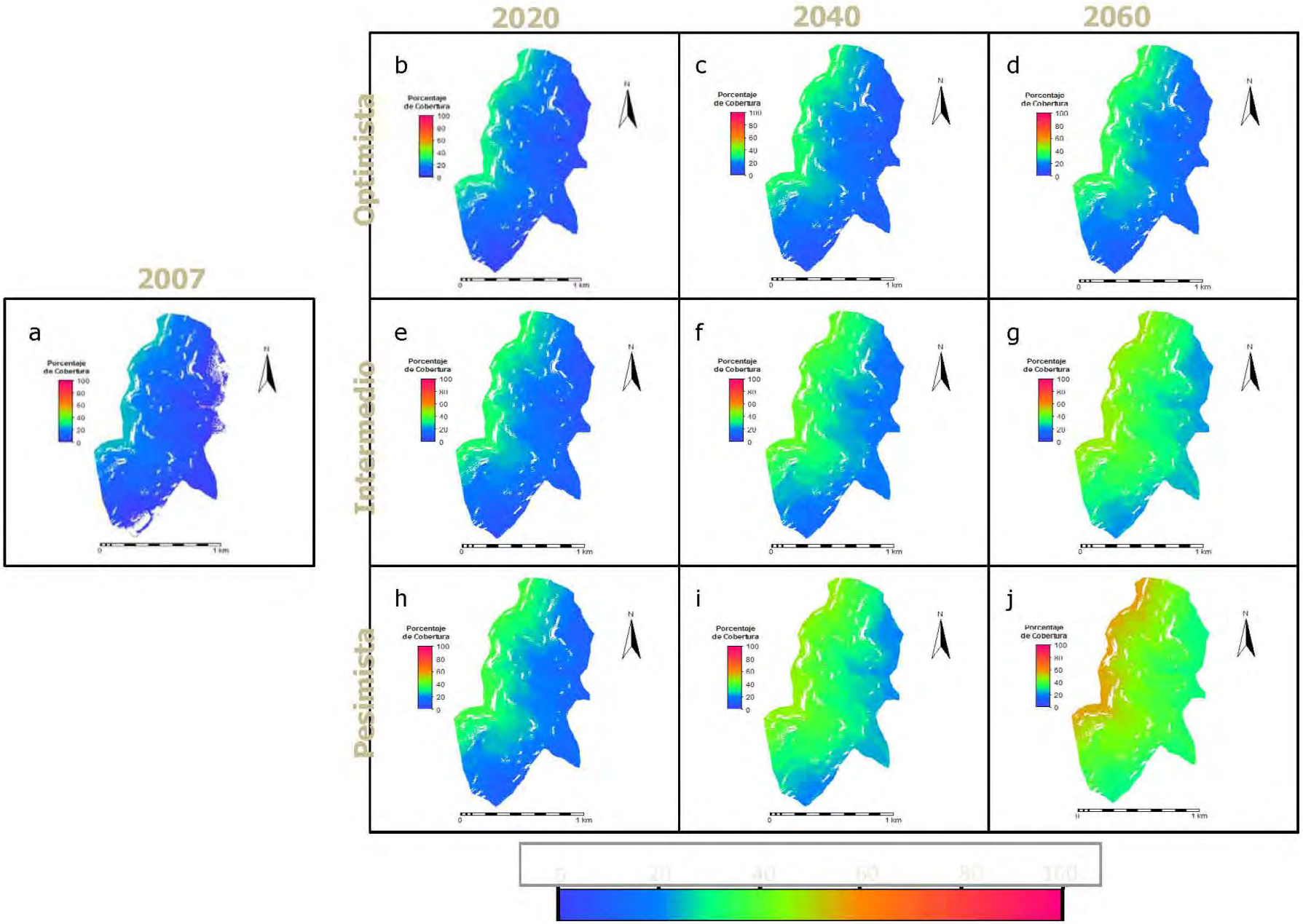


Glabras





Probable tree pattern distribution under climatic change scenarios (UKTR)



Data analysis

Code	Vegetation Unit (cover)	Condensed VU	C_Code
SN	Cloud forest	Cloud forest	SN
Bpar	Tall and sparse Preparamo Forest	Preparamo Forest	Bp
Bpad	Tall and dense Preparamo Forest		
Bpar	Secondary tall Preparamo Forest in regeneraion		
Apbr	Low and sparse Preparamo Shrubland	Preparamo Shrubland	Ap
Apbd	Low and dense Preparamo Shrubland		
Apbir	Secondary low Preparamo Shrubland in regeneration		
SIN	Secondary Cloud forest	Secondary areas	I
Apbi	Secondary low Preparamo Shrubland		
Bpai	Secondary tall Preparamo Forest		
Aibc	Fallow or crop area		
Pa	Páramo	Páramo	Pa
Bap	Polylepis altoandino forest	Polylepis altoandino forest	Bap

Rate of change

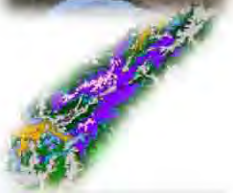




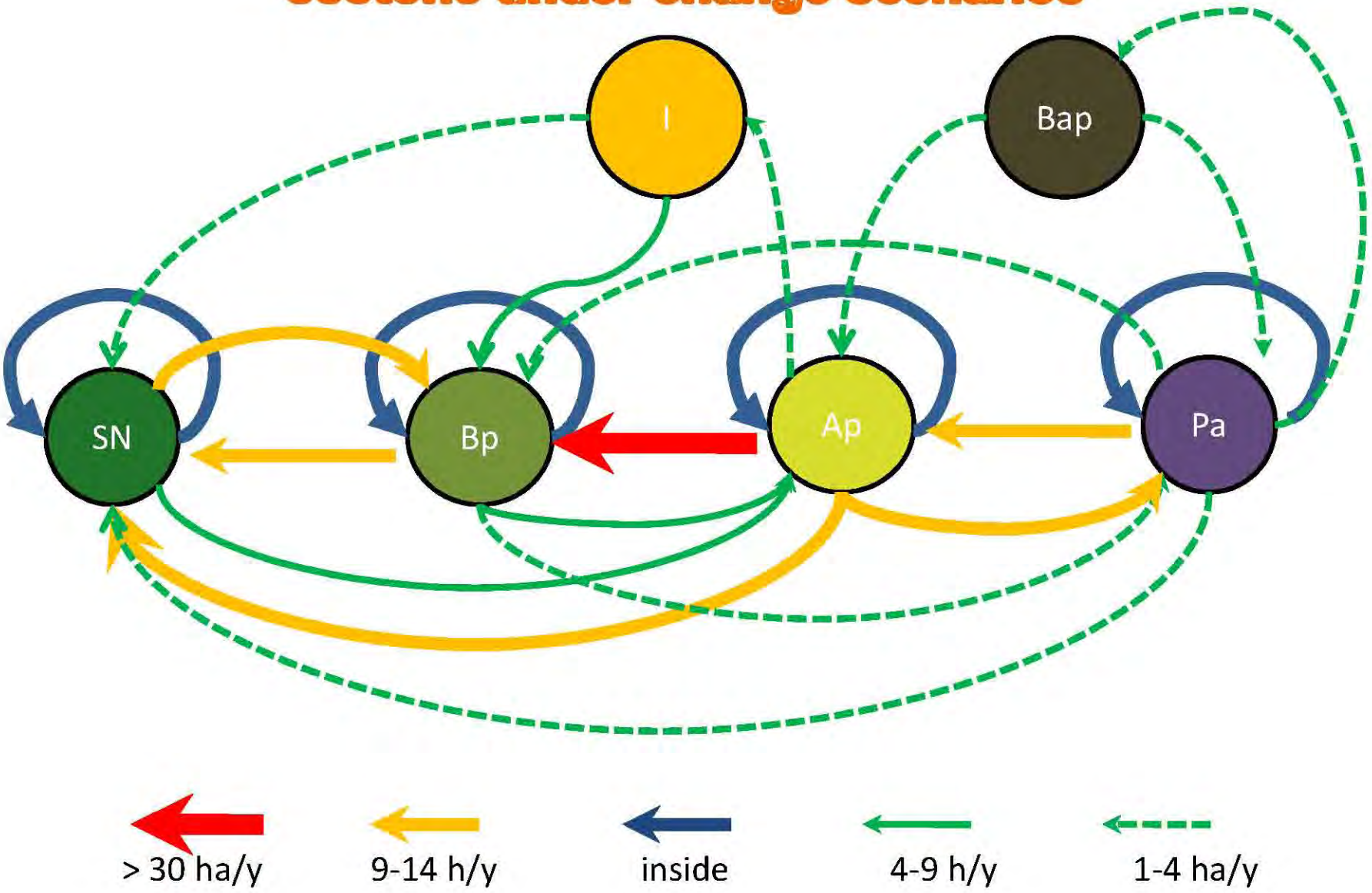
UV	SN	Bp	Ap	Pa	I	Bap
SN	199.5	11.5	12.1	1.0	2.5	0.0
Bp	9.3	20.5	33.9	3.3	4.8	0.5
Ap	6.3	6.4	35.8	10.8	0.7	1.5
Pa	0.3	2.2	13.7	449.8	0.5	4.0
I	0.0	0.1	0.9	0.2	1.4	0.0
Bap	0.0	0.3	1.0	2.8	0.0	7.0

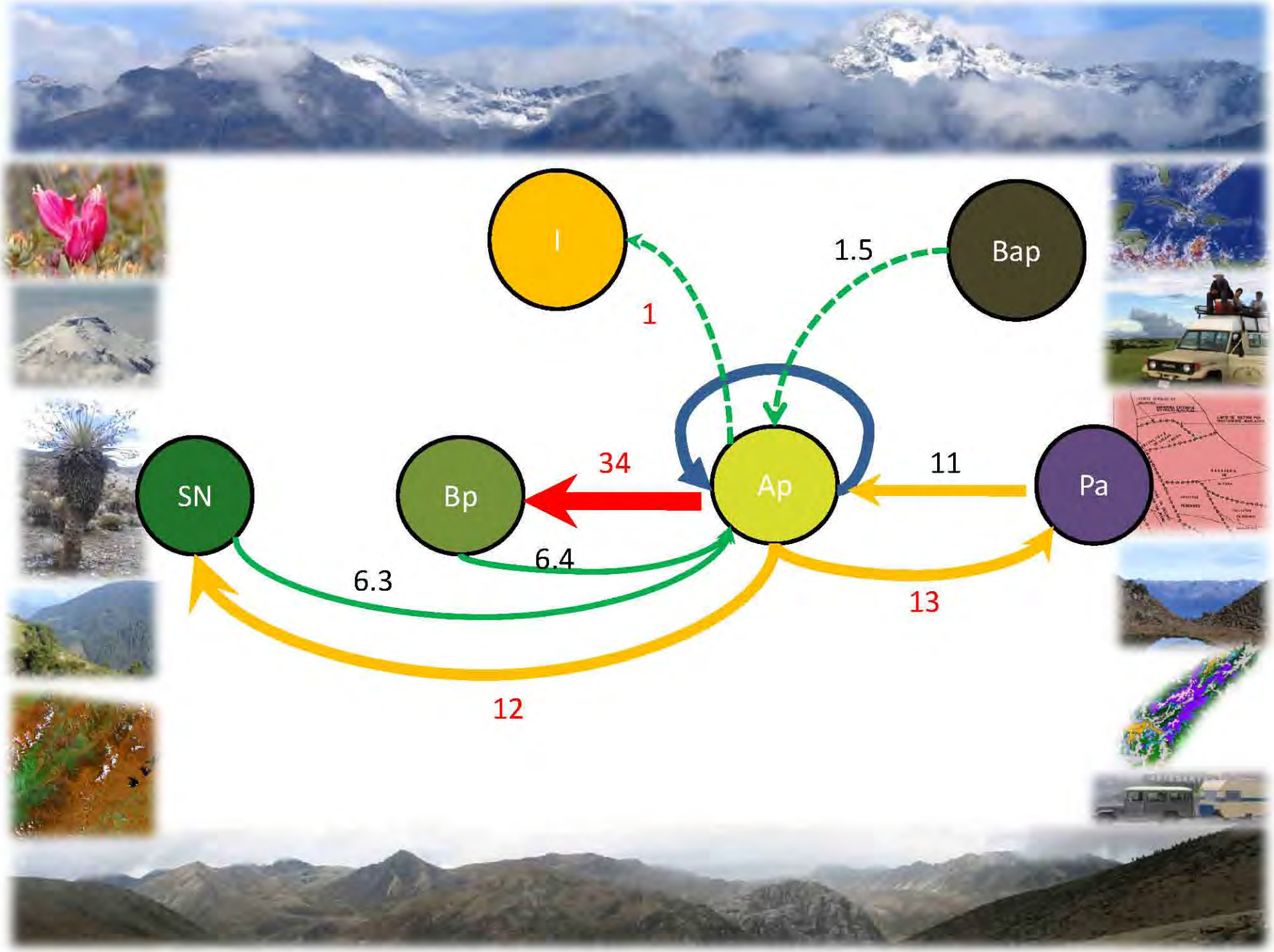






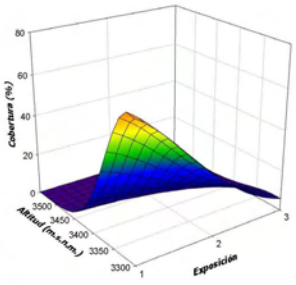

Conceptual model of states and transitions for the ecotone under change scenarios

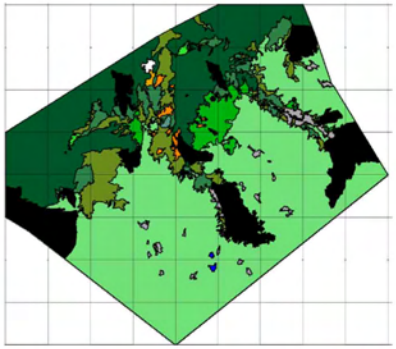


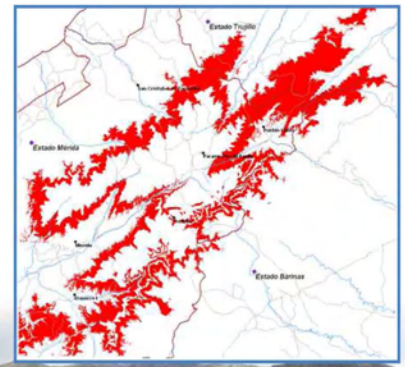

I
Bap
1.5
1
SN
Bp
Ap
Pa
34
11
6.3
6.4
13
12

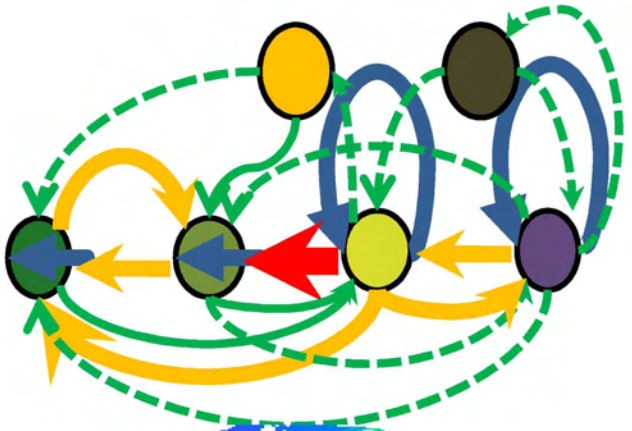
Integration

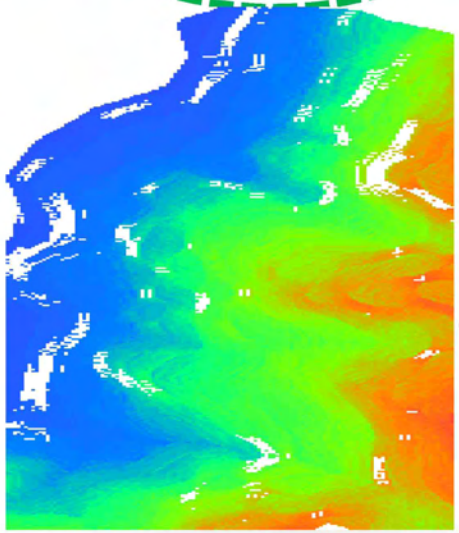
Model of ecosystems change under scenarios?



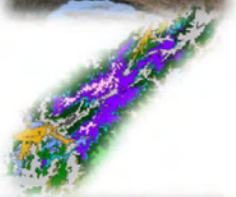








Model of Ecosystem change?



Muchas Gracias