

Workshop on Land Productivity Indicators in Drylands

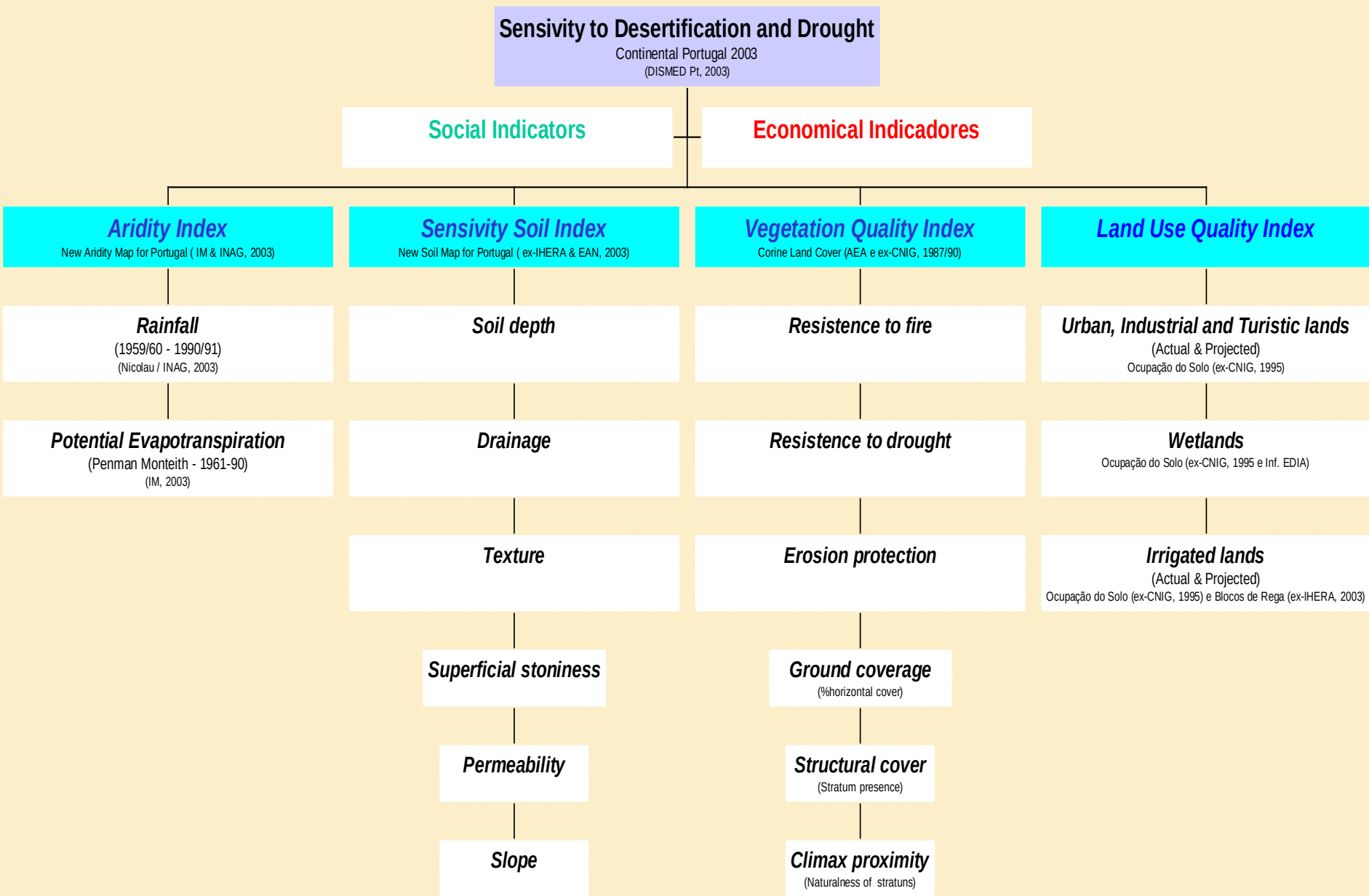
UNCCD Indicators Application on the Portuguese NAPCD

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(lucio.rosario@icnf.pt)

Bonn, 7 - 9 july 2014

Parameters, Indicators and Indexes for the Maps of Sensivity to Desertification and Drought in Portugal





Climatic Sensitivity to Desertification

Aridity Index Structural analysis 1961 - 1990

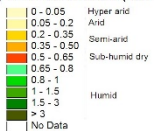
Scale 1:5000000



0 125 250 500 Kilometers

Data analysis and map elaboration:
DISMED Project
Foundation for Applied Meteorology (FAM)
Institute of Biometeorology
of the National Research Council (IRMET-CNR)
Florence, ITALY - November 2003
<http://dismed.unife.it/>

Aridity Index Classification (Rainfall/PET)



Projection : Lambert Conformal Conic

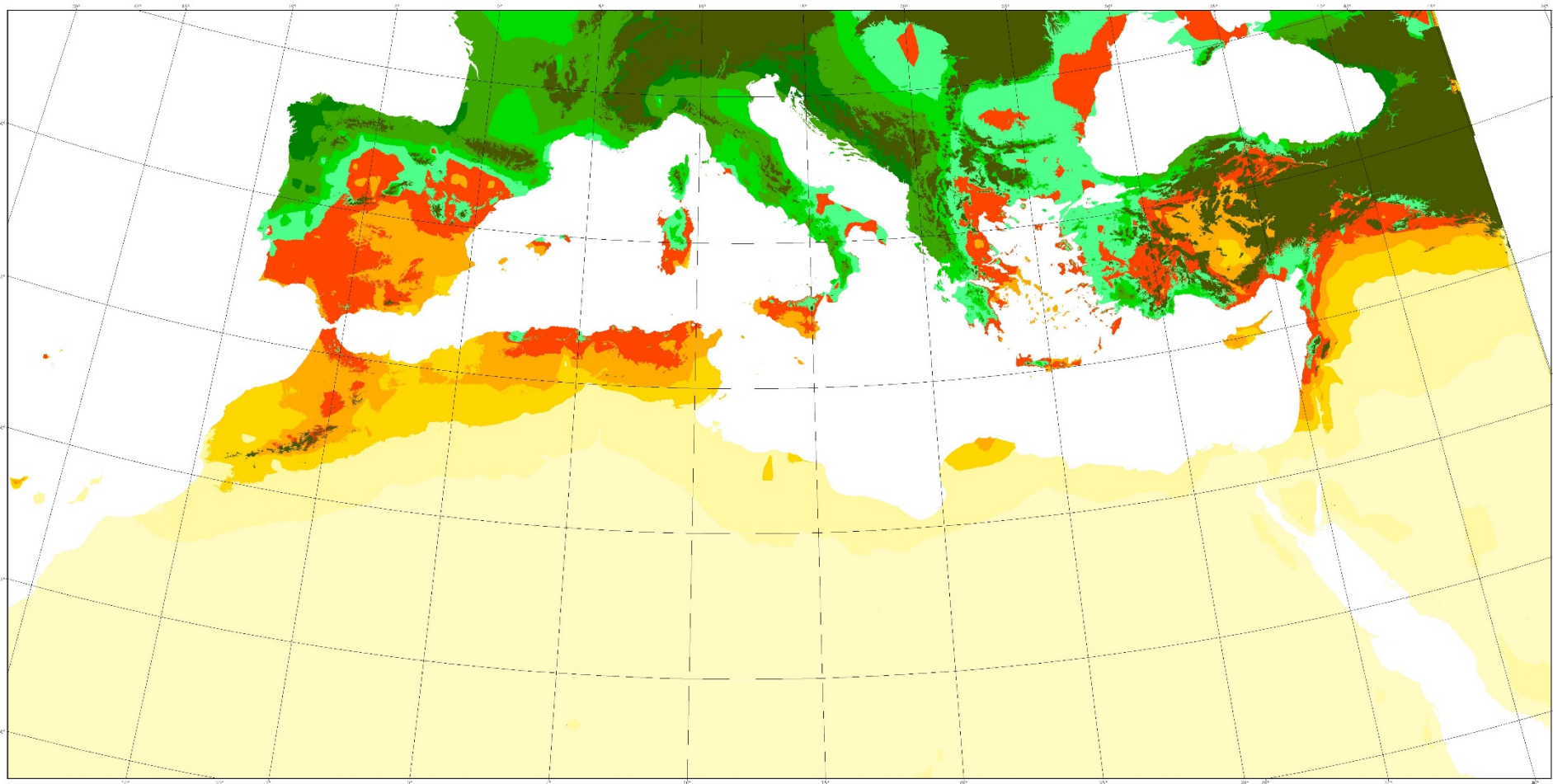
Spheroid : WGS 84
Central Meridian : 12
Reference Latitude : 33
Standard Parallel 1 : 20
Standard Parallel 2 : 47

Data spatialization procedures:

Rainfall spatialization procedure:
- Kriging interpolation
- TM (Triangulation with Linear Interpolation)
Temperature spatialization procedure:
- Multilinear regression using DEM, Latitude, Longitude
and sea distance
PET calibration procedure:
- monthly calibration of Thornthwaite PET values
with Panmou-Borrelli PET values: comparison
with multilinear regression (using DEM, Latitude,
Longitude and sea distance) of the ratio between
the two estimated PET to obtain 12 correction grids

Data sources

Coast Layer:
- ESR Digital Chart of the World 1:1M
DEM (Digital Elevation Model):
- USGS SRTM30 PLUS
Rainfall data:
- FAOCLIM 2 database (version 2.01)
- IPCC CRU Global Climate Dataset 0.5 degrees 1961-90 Mean
Monthly Climatology
- Greek National Meteorological Service
- MeteoNet database Italy
- Portuguese Meteorological Institute
- Spanish Meteorological Institute (only for 1971-2000 period)
- Institut National de la Météorologie - Tunisie
Temperature data:
- FAOCLIM 2 database (version 2.01)
- Greek National Meteorological Service
- MeteoNet database Italy
- Portuguese Meteorological Institute
- Spanish Meteorological Institute (only for 1971-2000 period)
- Institut National de la Météorologie - Tunisie
Petroleum values:
- FAOCLIM 2 database (version 2.01)
- Portuguese Meteorological Institute (for Portugal only)
- Institut National de la Météorologie - Tunisie (for Tunisia only)



PROPOSED INDICATORS FOR UNCCD

EO	Strategy Core Indicator	Recommended set of impact indicators	Proposed refinement indicators to test	PT aplic
1 - To improve the living conditions of affected populations	S1/2/3 - Improving conditions of population affected by processes of DLDD	I – Water availability per capita in affected areas (n&g)	1 - Water stress (g/n)	4
			2 – Pressure on water resources (g/n)	4
			3 – Water availability (n/l)	5
			4 – Water availability and use (n/l)	5
			5 - % of Rural Population with access to (safe) drinking water (n/l)	4
			6 – Access to improved drinking water based on change in water quality (n/l)	4
		II – Change in land use (n) (also 2 S4)	7 – Land-use system (LUS) and sustainable land management (SLM) (n/l)	5
			8 – Land-use system (LUS) and changes in land use (g/n/l/p)	5
		III – Proportion of the population in affected areas living above the poverty line (n&g) (also 3)	9 - Rural poverty rate (g/n/l)	4
		IV – Childhood malnutrition and/or food consumption / calorie intake per capita in affected areas (n)	10 - % chronically undernourished children < age of 5 in rural areas (n/l)	2
			11 – Maternal mortality ratio (or rate) (MMR) (n/l)	4
		V – The HDI as defined by UNDP (g)	? GLADIS (Soil Health Status)	2

X – Applied under the DesertWatch process; 5 – Applied without limitations; 4 – Applied with some restrictions; 3 – Possible application with limitations; 2 – Difficulties for application; 1 – Not applied or big difficulties for application

PROPOSED INDICATORS FOR UNCCD

EO	Strategy Core Indicator	Recommended set of impact indicators	Proposed refinement indicators to test	Portuguese application
2 – To improve the conditions of ecosystems	S4 - Reduction in total area affected by DLDD	VI - Level of land degradation (including salinization, water and wind erosion, etc.) (n)	12 – Level of land degradation (/ecosystem services provision capacity (g/n/l))	5
			13 – Level of land degradation (n/l/p)	5
			16 – Trends in seasonal precipitation	5
	S5 – Increases in net primary productivity in affected areas	VII – Plant and animal biodiversity (n) (also 3)	14 – Crop and livestock diversity (agro-biodiversity) (gn)	3
			15 – Trends in abundance and distribution of selected species (g/n/l/p)	5
			? Soil biodiversity	1
		VIII – The Aridity Index (n)	16 – Trends in seasonal precipitation (n/l)	5
			17 - Aridity trends and rainfall variability (n/l)	5
			? SPI (Drought standard Index)	5
		IX – Land cover status (n&g)	18 - Land cover (g/n/l/p)	5
			19 – Land productivity (g/n/l/p)	4
3 - To generate global benefits through effective implementation of the UNCCD	S6 – Increases in carbon stocks	X – Carbon stocks above and below ground (n)	20a – Above ground organic carbon stocks (g/n/l/p)	5
			20b – Below ground organic carbon stocks (g/n/l/p)	5
	S7 – Areas under sustainable management		21 – LUS & SLM practcies (g/n/l/p) (development of 7)	5
		XI – Land under SLM (n&g)	22 – Land under SLM (n/l/p)	4

X – Applied under the DesertWatch process; 5 – Applied without limitations; 4 – Applied with some restrictions; 3 – Possible application with limitations; 2 – Difficulties for application; 1 – Not applied or big difficulties for application

*Minimum set of provisionally adopted **progress** indicators*

(COP 11 – Windhoek 2013)

Strategic Objective 1: To improve the living conditions of affected populations

i1 - Poverty rate/Relative income (including a rural component) - Poverty rate: with the understanding of moving towards the poverty gap or poverty severity indicators as identified in and to be streamlined with the World Bank; the poverty severity indicator takes into account not only the distance separating the poor from the poverty line (poverty gap), but also the inequality among the poor; Relative income: chosen as an alternative to the 'poverty rate' indicator for those countries where poverty is no longer an issue, and SO1 has in this sense already been reached

i2 - Water availability (including access for humans and animals) - with the 'health warning' that this indicator cannot be aggregated, i.e. adding the context-specific stor(y)(ies) will be of utmost importance to understand/interpret this indicator

Strategic Objective 2: To improve the condition of ecosystems

i3 - Changes in land cover status - this indicator relates specifically to the ecosystem condition by characterizing the spatial structure of land cover and its implications for ecosystem conditions; it should explicitly include a specific class on natural habitats (quantity, and if possible quality)

i4 - Changes in land productivity - in contrast to the 'land cover status' indicator, this indicator focusses on services provided, and should include the change in quality and quantity of productive lands; if available, to be streamlined with estimates under the World Atlas of Desertification initiative

Strategic Objective 3: To generate global benefits through effective implementation of the UNCCD

i5 - Changes in soil organic carbon stock / total terrestrial system carbon stock - if operational, to be streamlined with the GEF-co-financed/UNEP Carbon Benefits Project

i6 - Trends in abundance and distribution of selected species, in particular the Global Wild Bird Index component - as identified in and to be streamlined/coordinated with the indicator process of the Convention on Biological Diversity (CBD)

By UNCCD COP 11 the following **categories of affected and threatened areas are recommended to be distinguished:**

Potentially affected: where desertification is possible, but SLM strategies are sufficient;

At risk (of being affected): where a concentration of desertification drivers has been detected. Prevention measures to increase options and deactivate drivers are required;

(Actually) affected: where growing evidence of land degradation can be reported and drivers of desertification are active. Explicit adaptation, removal of drivers and land rehabilitation are urgent;

Inherited (desertification): where desertification drivers have disappeared and their land degradation sequels/symptoms remain. Land rehabilitation/restoration is only necessary in those areas where natural recovery is impossible or too slow.

i0i – Susceptibility to desertification

areas

Índice Aridez
Mediterrâneo (1950 / 2000)
FAO (PM)

Índice de Aridez FAO (PM)
1950 - 2000

ai_yr
VALUE



WorldClim Global Climate Data (Hijmans *et al.* 2005)

Índice Aridez
RA Açores (1950 / 2000)
FAO (PM)

Índice de Aridez FAO (PM)
1950 - 2000



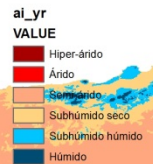
Índice Aridez
RA Madeira (1950 / 2000)
FAO (PM)

Índice de Aridez FAO (PM)
1950 - 2000

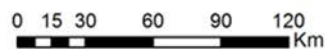
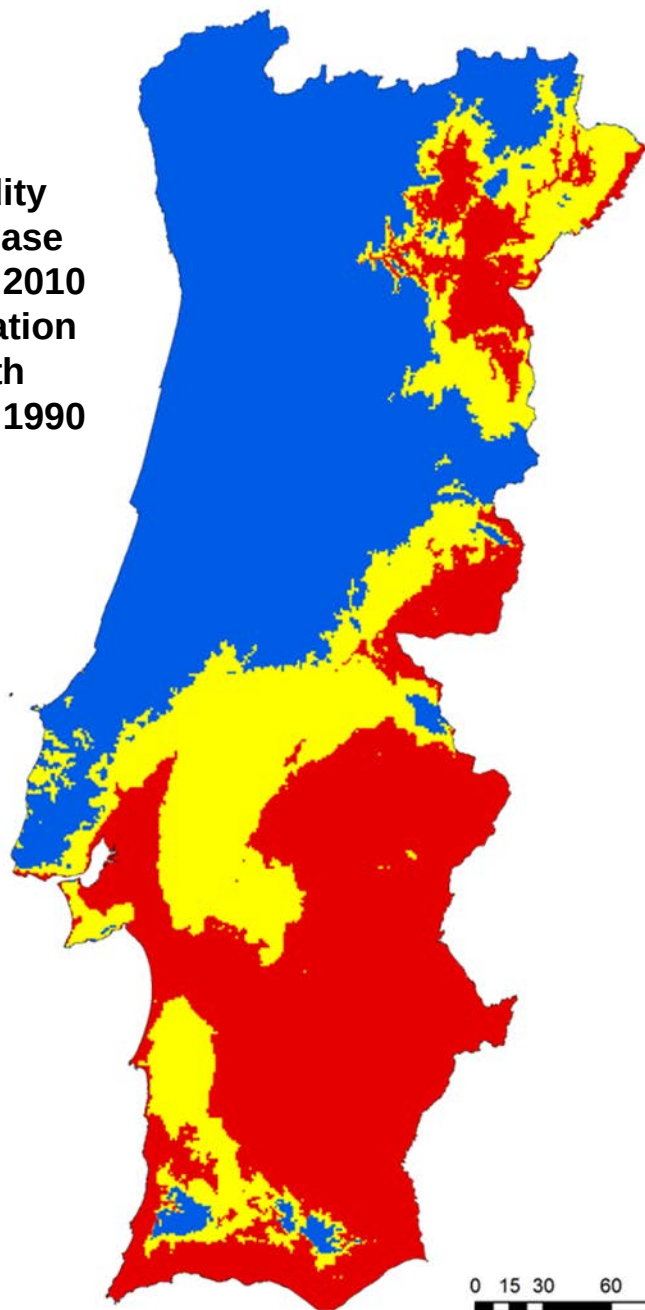


Índice Aridez
Luso - Espanhol (1950 / 2000)
FAO (PM)

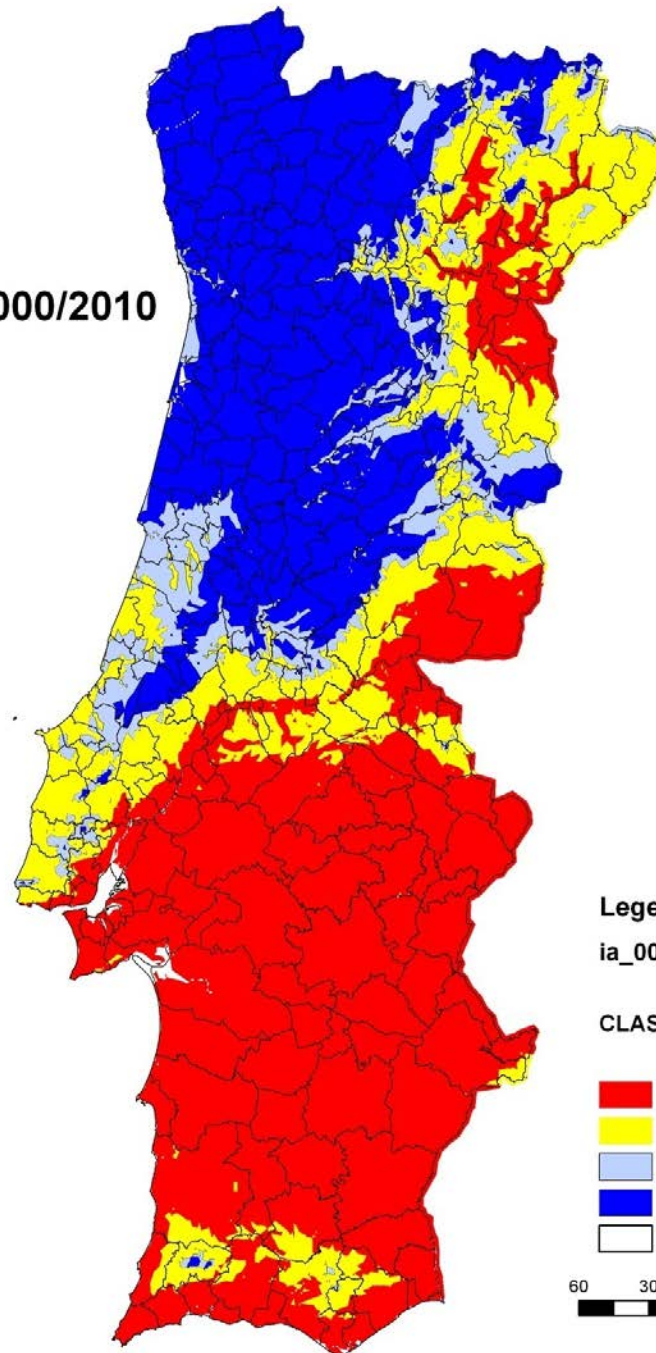
Índice de Aridez FAO (PM)
1950 - 2000



Aridity
increase
1980 / 2010
In relation
with
1960 / 1990



2000/2010



Legenda

ia_00_10

<all other values>

CLASS_NAME



concelhos



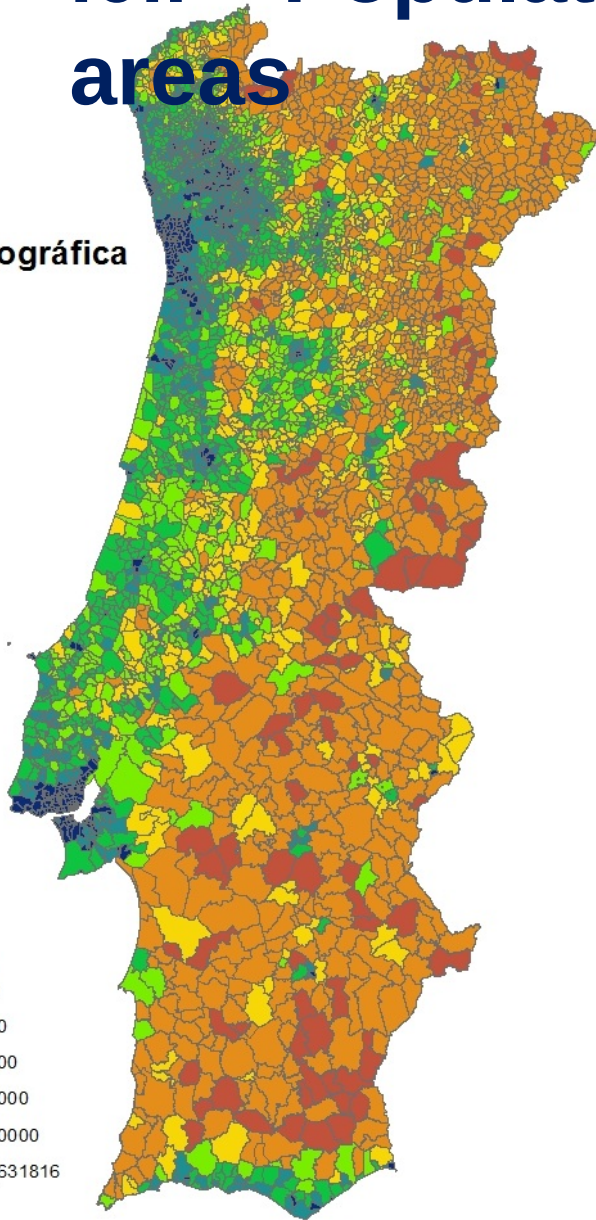
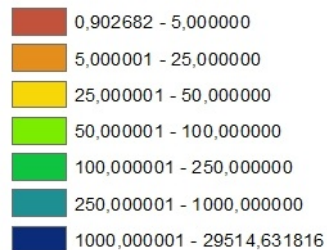
Desertification Suscetibility Areas Evolution in Portugal Continental on the last 50 years

Aridity classes	1960 – 1990 %	1970 – 2000 %	1980 – 2010 %	2000 – 2010 %
Semi-arid	28	24	31	45
Dry Sub-humid	8	29	28	18
Dry Areas	36	53	58	63
Wet Sub-humid		9	10	9
Wet		37	33	29
Wet Areas	64	46	42	37

i0ii – Population of the affected areas

**Densidade Demográfica
2011**

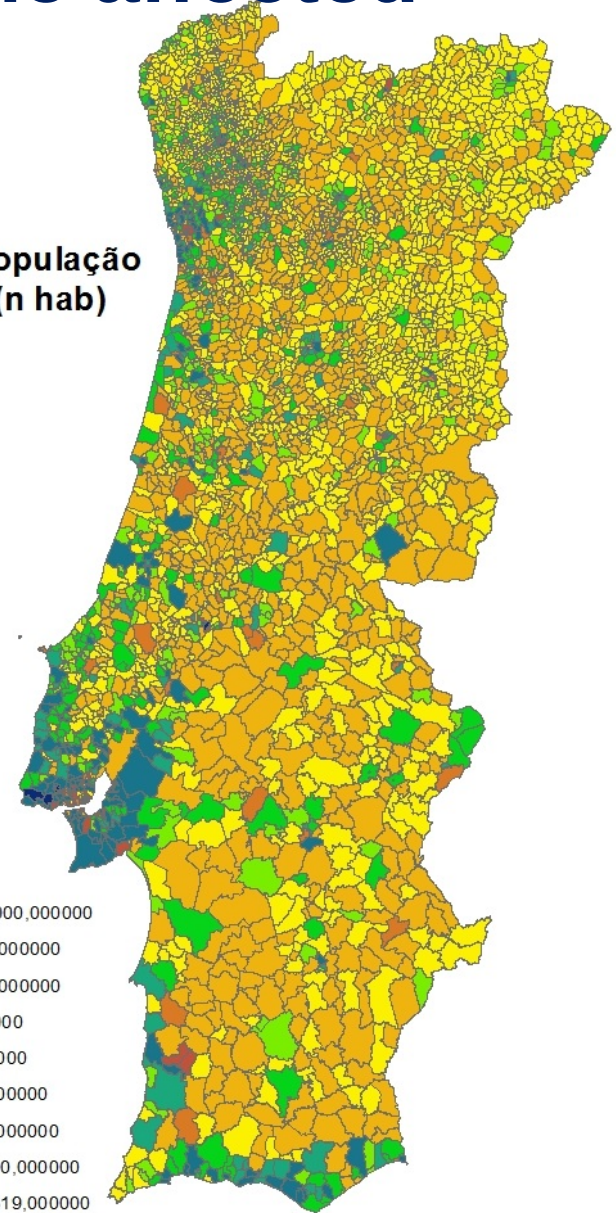
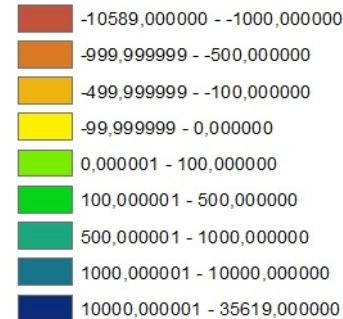
Hab/Km2



**Variação da População
2001 - 2011 (n hab)**

n Habit Resid

HMdif



Per capita Purchasing Power / Municipality

**Poder de Compra
per capita
2009
(INE 2011)**

Legenda

Susceptibilidade à Desertificação

IAridez

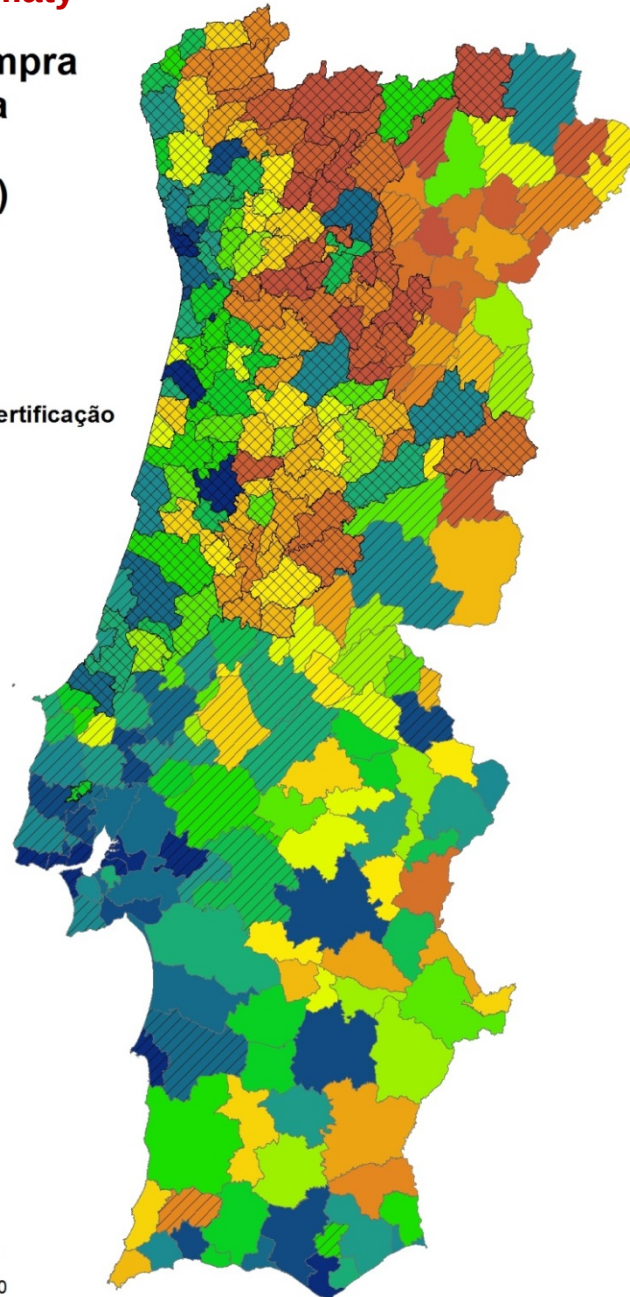
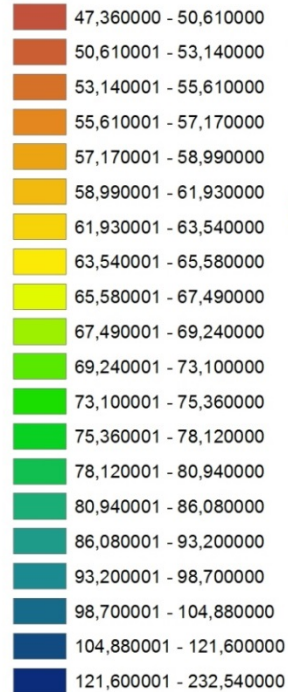
 Húmido

 Subhúmido seco

SemiÁrido

CensosPC2011

IpC2009



I1 - Poverty rate/Relative income

i2 - Water availability (including access for humans and animals)

Índice de Cobertura
de Abastecimento Público
de Água 2009
(INSAAR 2011)

Legenda

Susceptibilidade à Desertificação

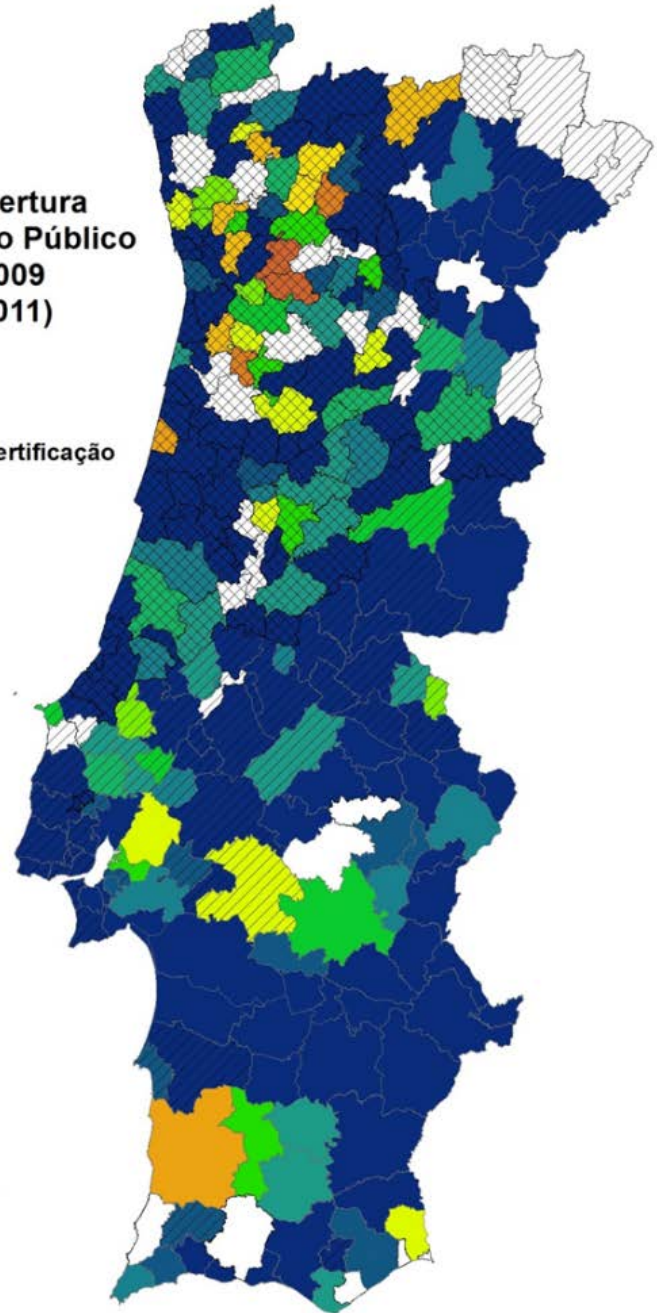
IAridez

-  Húmido
-  Subhúmido seco
-  SemiÁrido

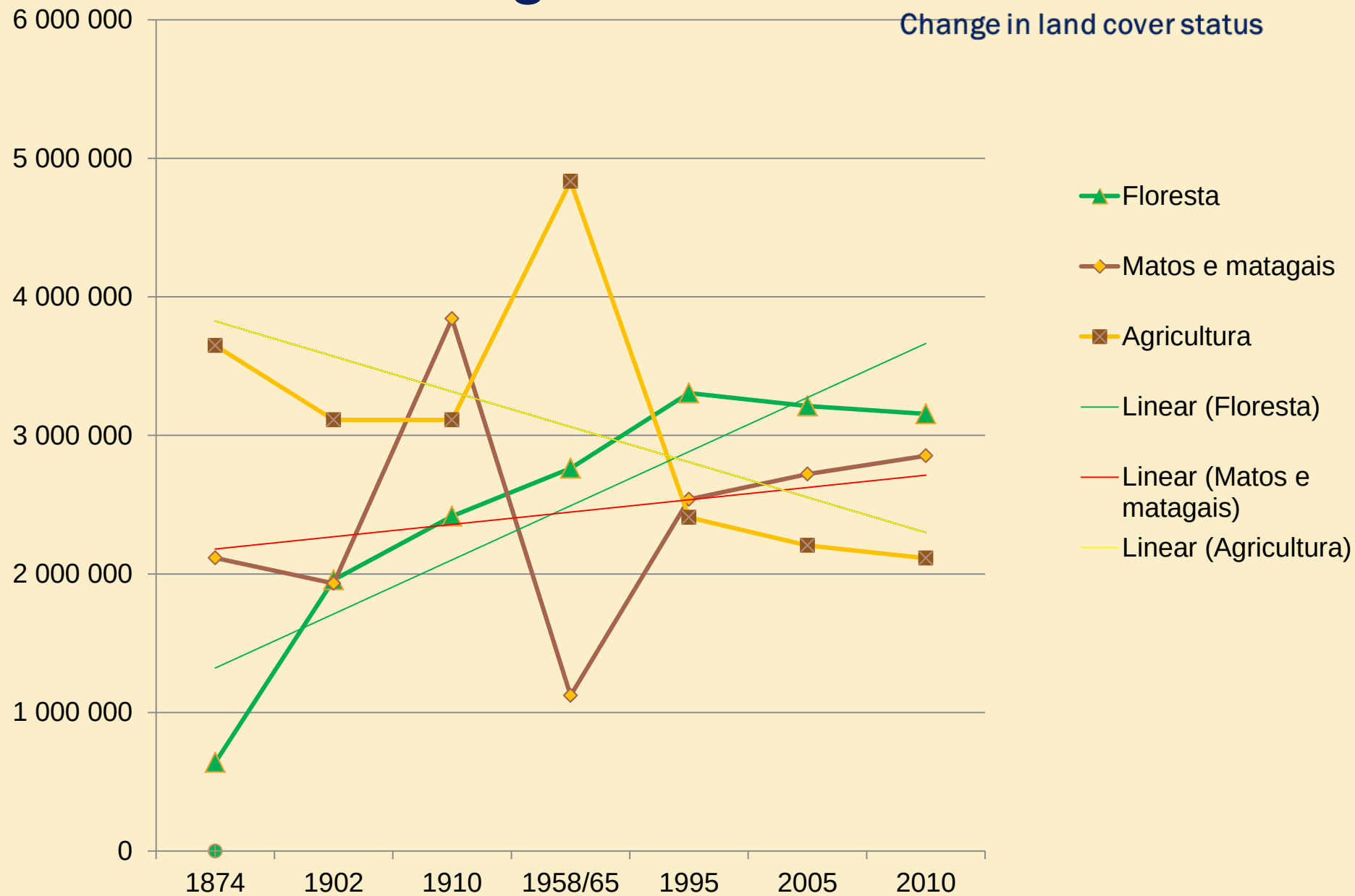
CensosPC2011

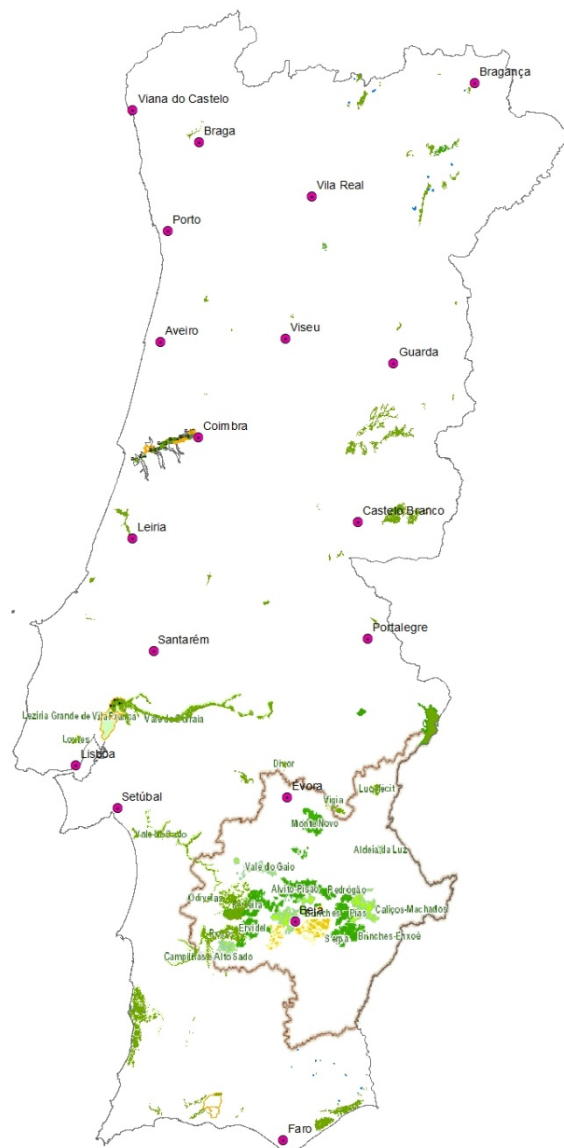
icaw2009

-  -9,000000
-  -8,999999 - 42,000000
-  42,000001 - 58,000000
-  58,000001 - 69,000000
-  69,000001 - 73,000000
-  73,000001 - 75,000000
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-  82,000001 - 84,000000
-  84,000001 - 87,000000
-  87,000001 - 89,000000
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-  91,000001 - 94,000000
-  94,000001 - 96,000000
-  96,000001 - 98,000000
-  98,000001 - 100,000000

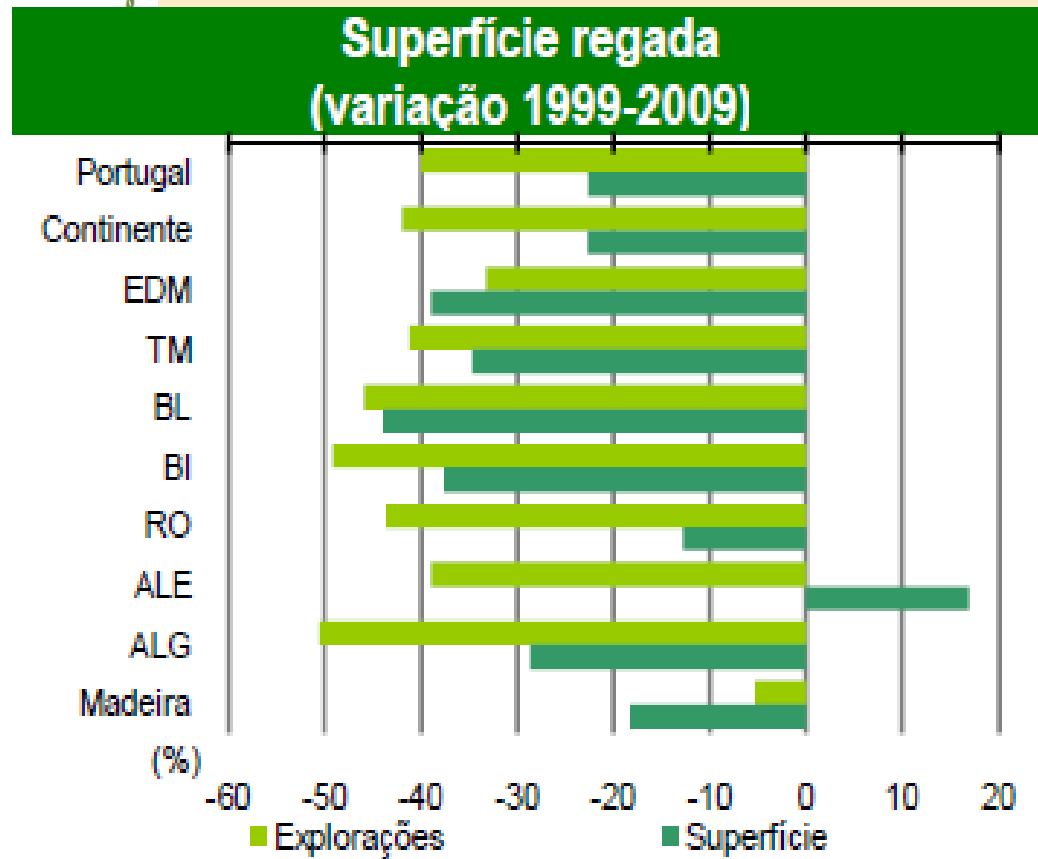


i3 - Changes in land cover status

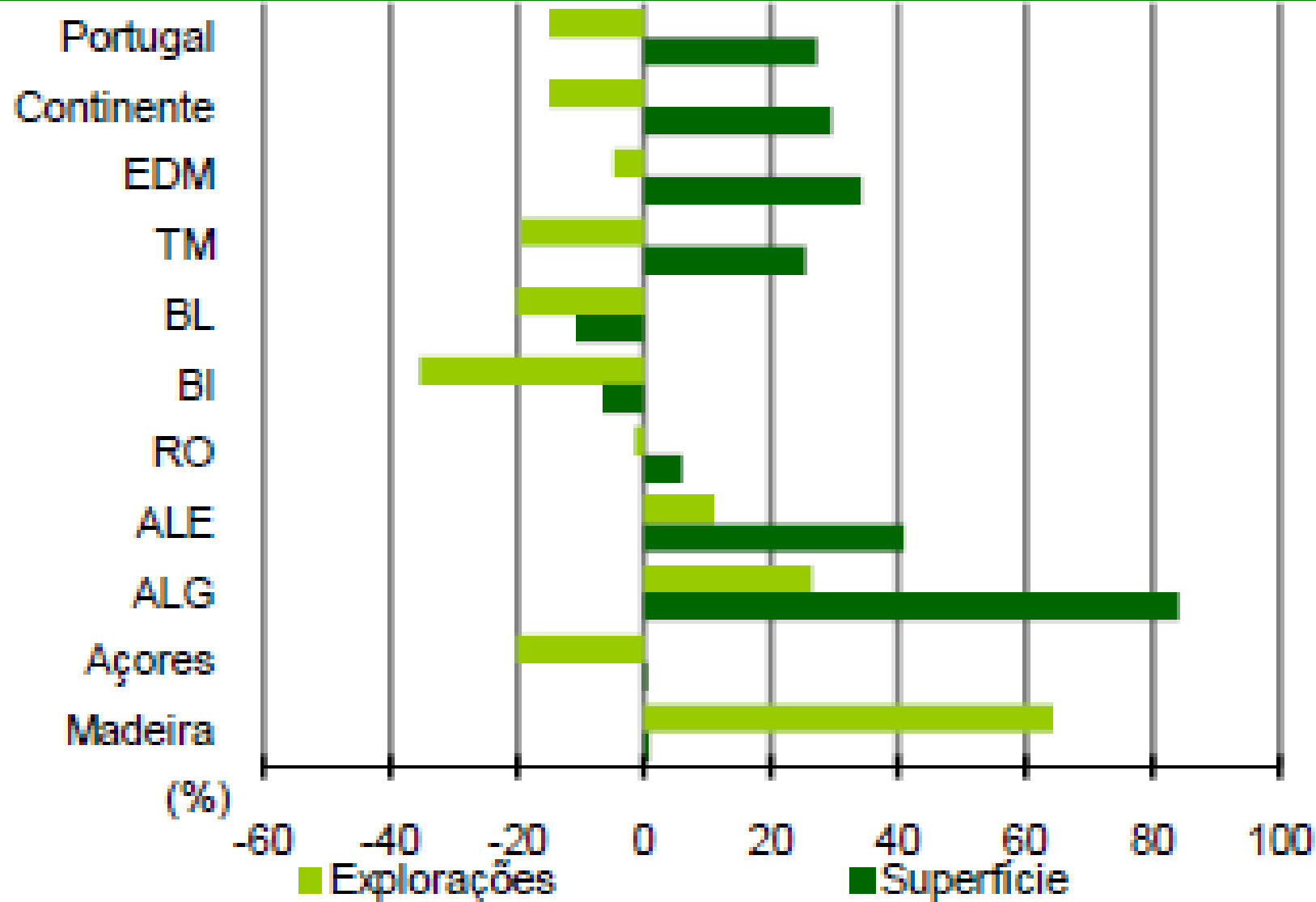


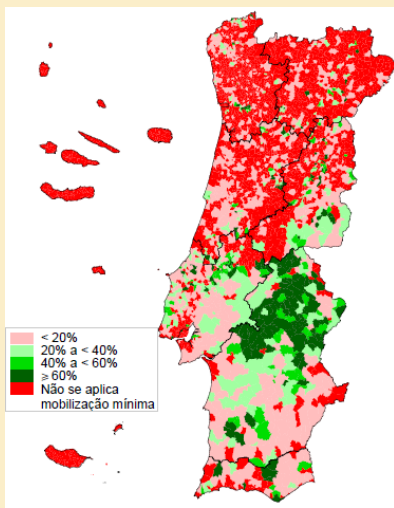


Irrigated areas

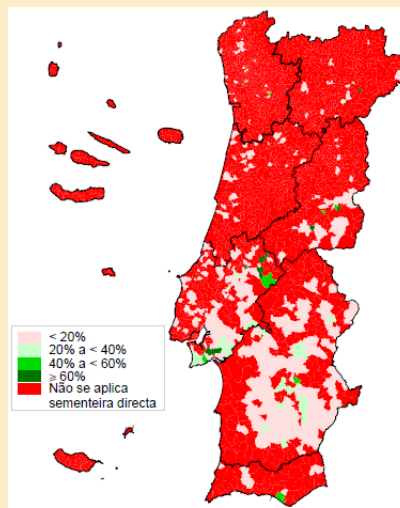


Prados e pastagens permanentes (variação 1999-2009)

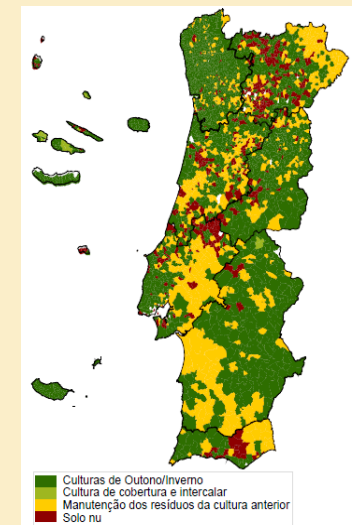




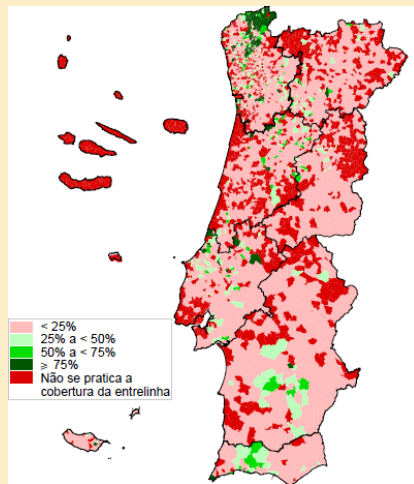
Mobilização mínima no total das culturas temporárias mobilizadas



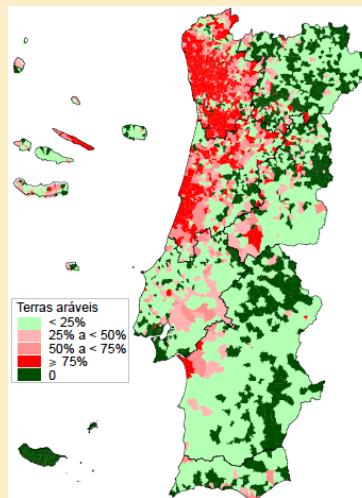
Sementeira directa no total culturas temporárias mobilizadas



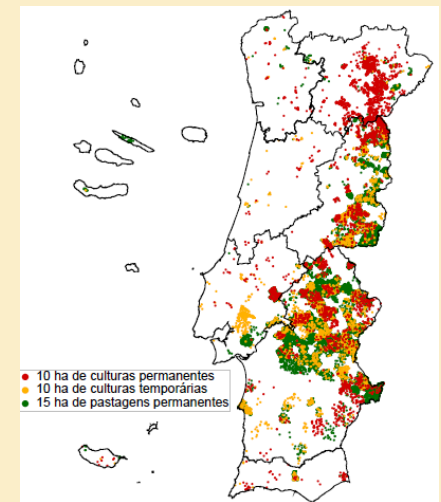
Cobertura do solo nas terras aráveis no Inverno 2008/2009



Culturas permanentes com enrelvamento de entrelinhas



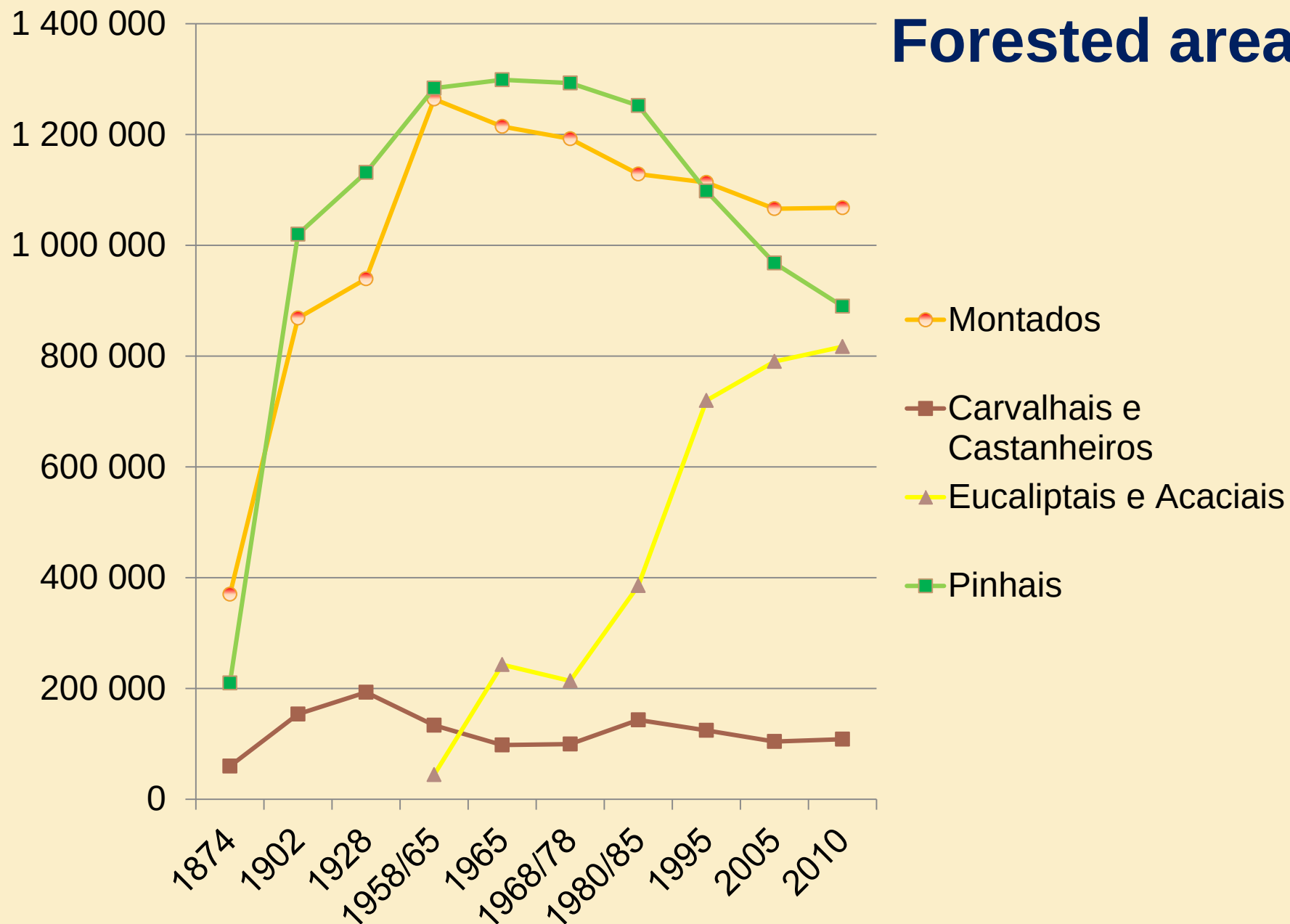
Terras aráveis com mesma cultura últimos 3 anos até 2009



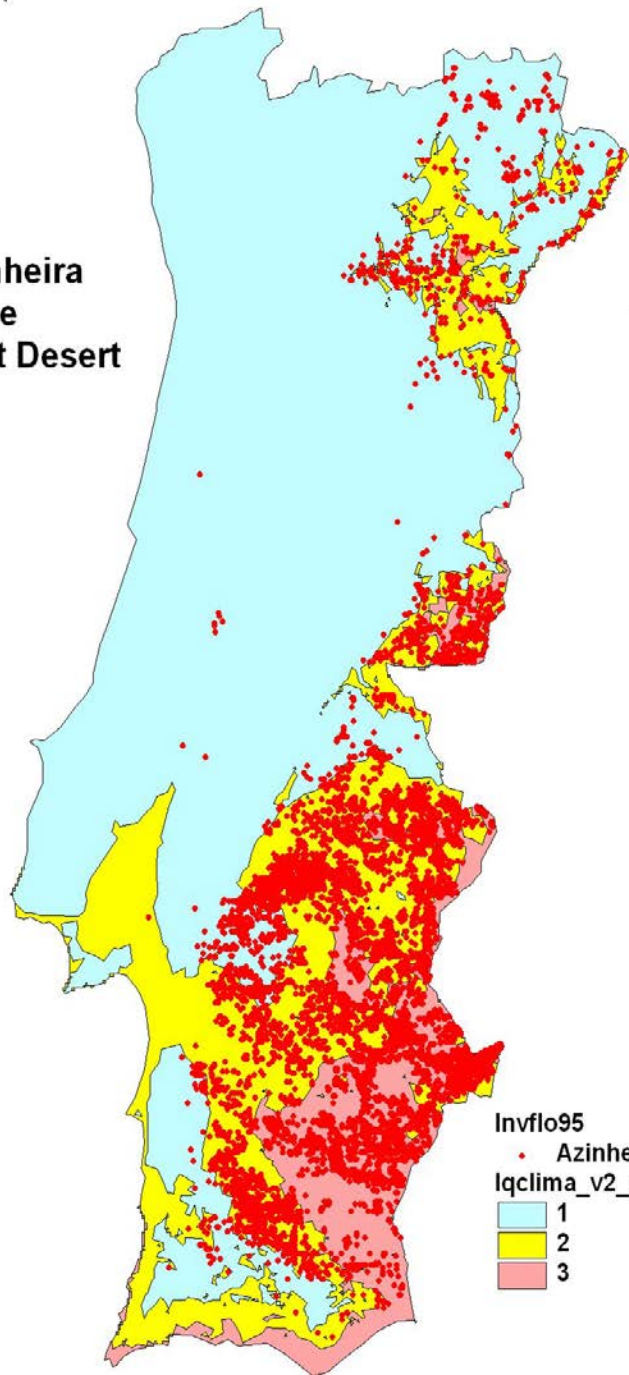
SAU modo produção biológico por tipo

Ecological

Forested areas



Azinheira e Suscet Desert



Invflo95
• Azinheira
lqclima_v2_diss
1
2
3

Índice de Aridez 2000/2010 G. del Barrio et al. 2011 & Vegetação Associada

Legend

IFN 95_98

• <all other values>

OP

• Sobreiro

• Azinheira

Juniperus oxycedrus

<all other values>

JUNIOXYC

1

Juniperus turbinata

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JUNITURB

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Juniperus navicularis

<all other values>

JUNINAVI

1

ia_00_10

<all other values>

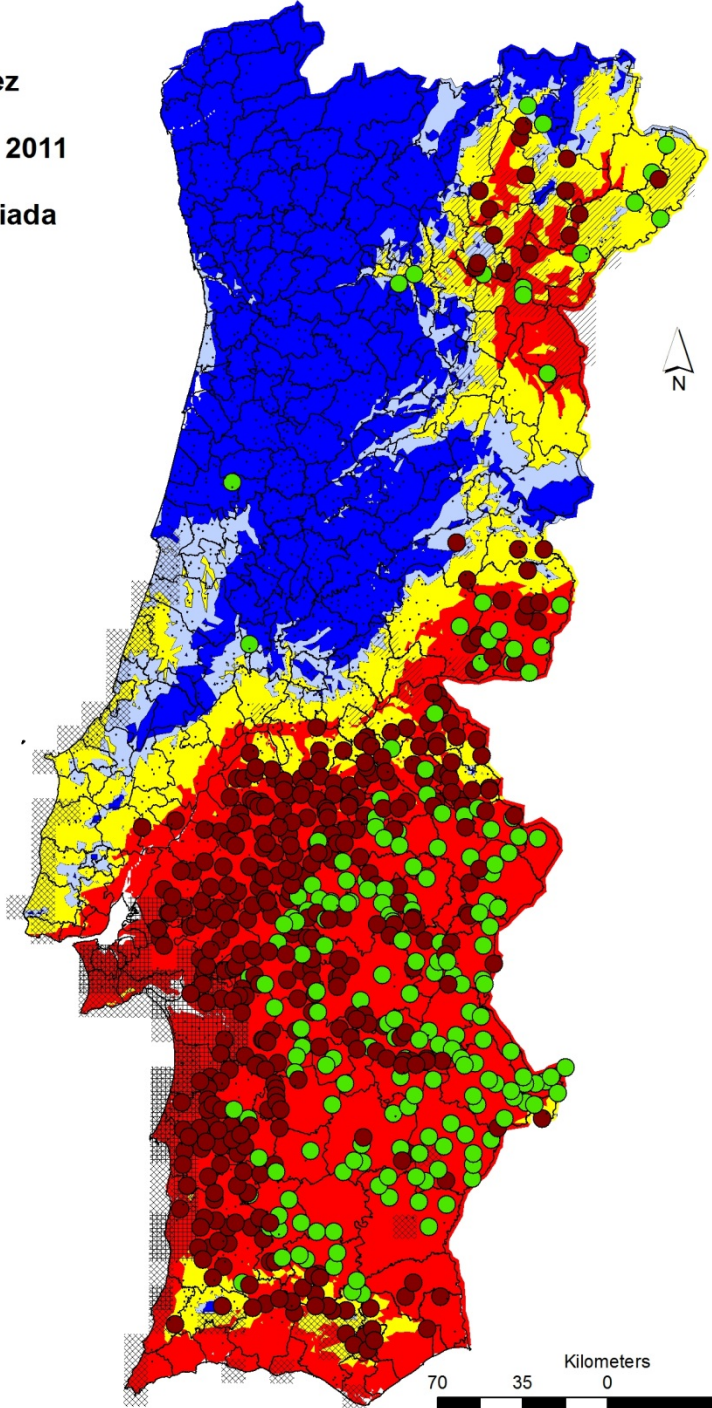
CLASS_NAME

• Semi-arid

• Dry sub-humid

• Wet sub-humid

• Humid



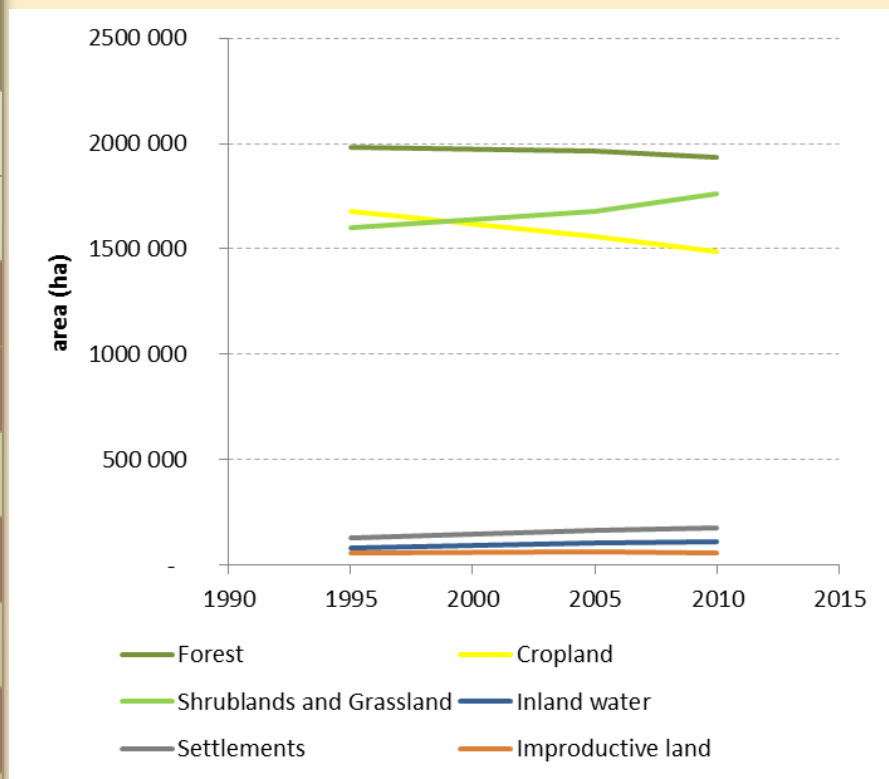
Kilometers
70 35 0 70

FOREST COVER TYPES / SD AREAS 2000 / 2010

Land Cover	Plots Total PC	%	Plots SD areas	%	% Total U Territory
Quercus suber	26.748	21,31	26.572	34,98	93,34
Quercus ilex	11.332	9,03	11.261	14,82	99,37
Other Quercus	5.902	4,70	1.924	2,53	32,60
Castanea sativa	1.196	0,95	479	0,63	40,05
Eucaliptus sp.	30.833	24,56	14.313	18,84	46,42
Acícias sp.	197	0,16	37	0,05	18,78
Other leved trees	3.737	2,98	1.621	2,13	43,38
Pinus pinaster	32.177	25,63	7.986	10,51	24,82
Pius pinea	4.094	3,26	4.005	5,27	97,83
Other conifers	804	0,64	323	0,43	40,17
New formations	7.311	5,82	6.581	8,66	90,02
Other forest	1.211	0,96	864	1,14	71,35
TOTAL	125.542	100,00	75.966	100,00	60,51

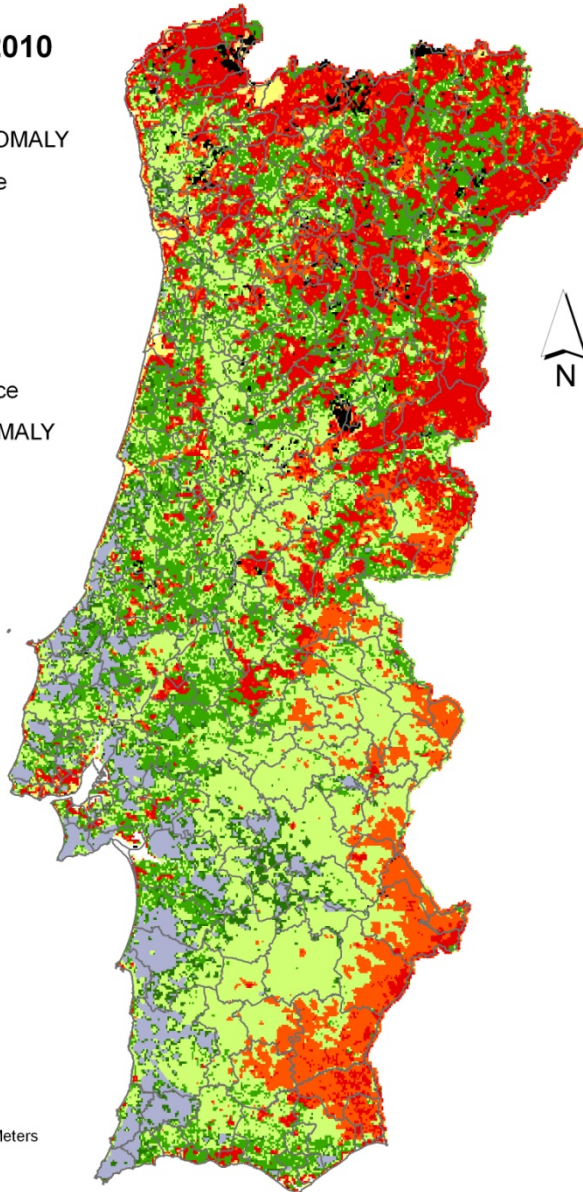
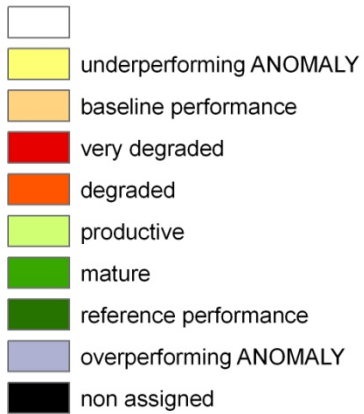
FOREST COVER TYPES 1995-2005 / SD AREAS 2000-2010

Tree species	Portugal	Susceptible to desertification areas	
	(1000 ha)	(1000 ha)	(%)
Maritime pine	714	192	27%
Eucaliptus	812	364	45%
Cork oak	732	732	99%
Evergreen oak	331	330	100%
Other oaks	67	20	31%
Umbrela pine	176	173	98%
Chestenut	41	12	29%
Carobe tree	12	12	100%
Acacias	5	1	21%
Other folhosas	178	67	38%
Other resinosas	73	30	42%

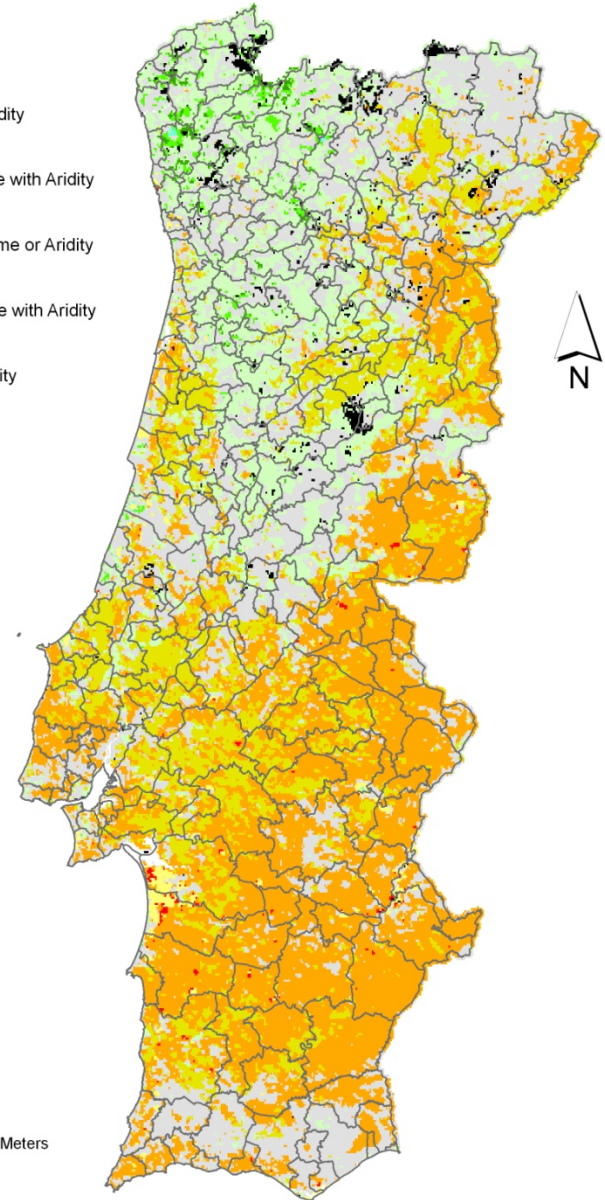
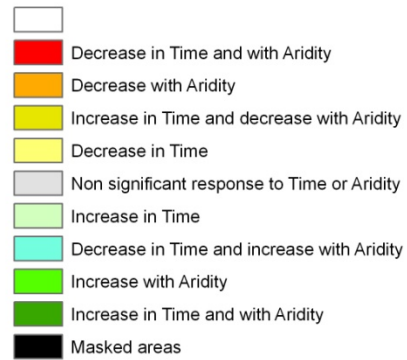


Changes in land productivity

Assessment 2000 2010



Land trends 2000 2010



**Land Assessment
2000/2010
G. del Barrio et al. 2011**

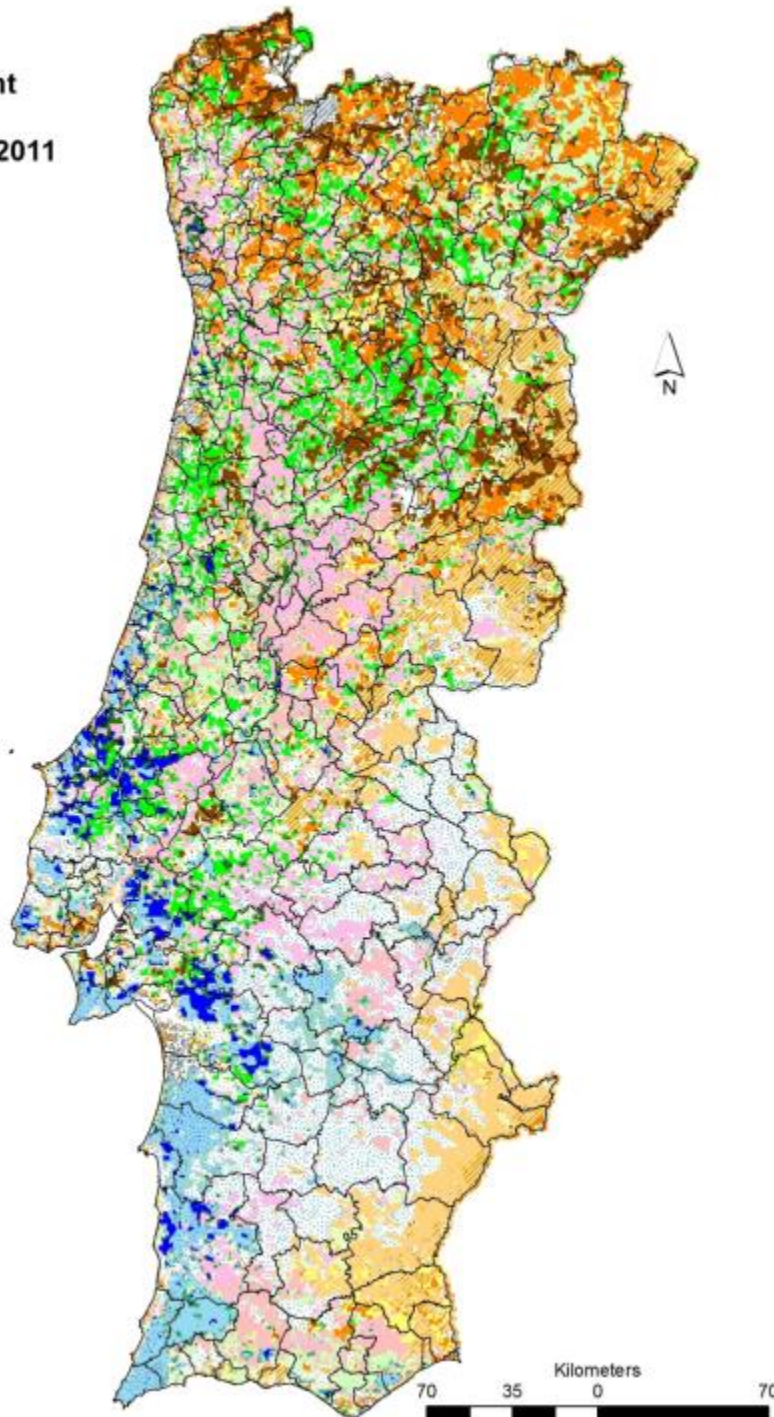
Legend

landcond2010

<all other values>

CLASS_NAME

-  OVERP A IMPROVING
-  OVERP A STATIC
-  OVERP A FLUCTUATING
-  OVERP A DEGRADING
-  REFERENCE P IMPROVING
-  REFERENCE P STATIC
-  REFERENCE P FLUCTUATING
-  REFERENCE P DEGRADING
-  MATURE IMPROVING
-  MATURE STATIC
-  MATURE FLUCTUATING
-  MATURE DEGRADING
-  PRODUCTIVE IMPROVING
-  PRODUCTIVE STATIC
-  PRODUCTIVE FLUCTUATING
-  PRODUCTIVE DEGRADING
-  BASELINE P IMPROVING
-  BASELINE P STATIC
-  BASELINE P FLUCTUATING
-  BASELINE P DEGRADING
-  DEG IMPROVING
-  DEG STATIC
-  DEG FLUCTUATING
-  DEG DEGRADING
-  VERY DEG IMPROVING
-  VERY DEG STATIC
-  VERY DEG FLUCTUATING
-  VERY DEG DEGRADING
-  UNDERP A IMPROVING
-  UNDERP A STATIC
-  UNDERP A FLUCTUATING
-  UNDERP A DEGRADING
-  NON ASSIGNED



Areas Affected by Desertification 2000 – 2010 in Portugal Continental

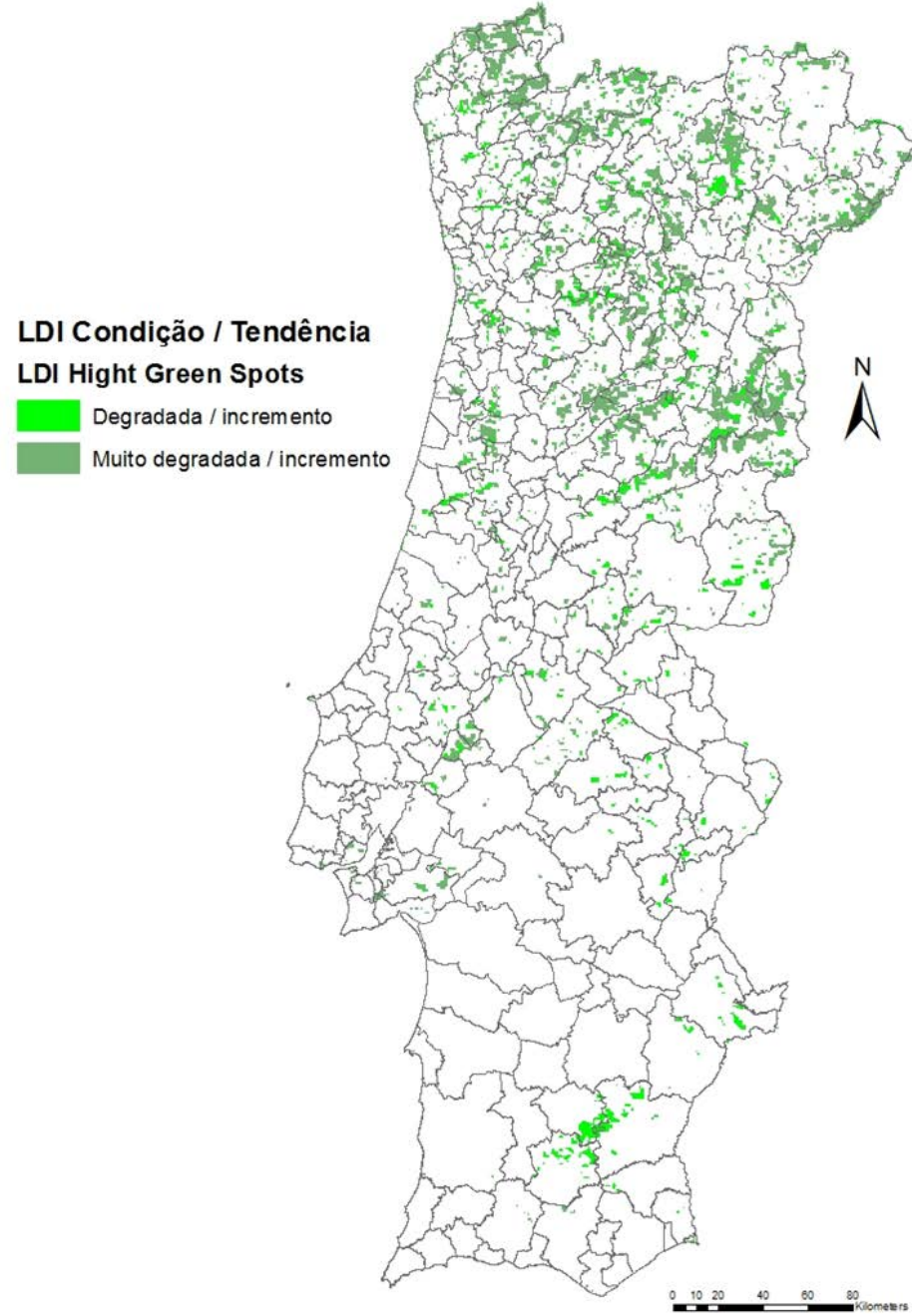
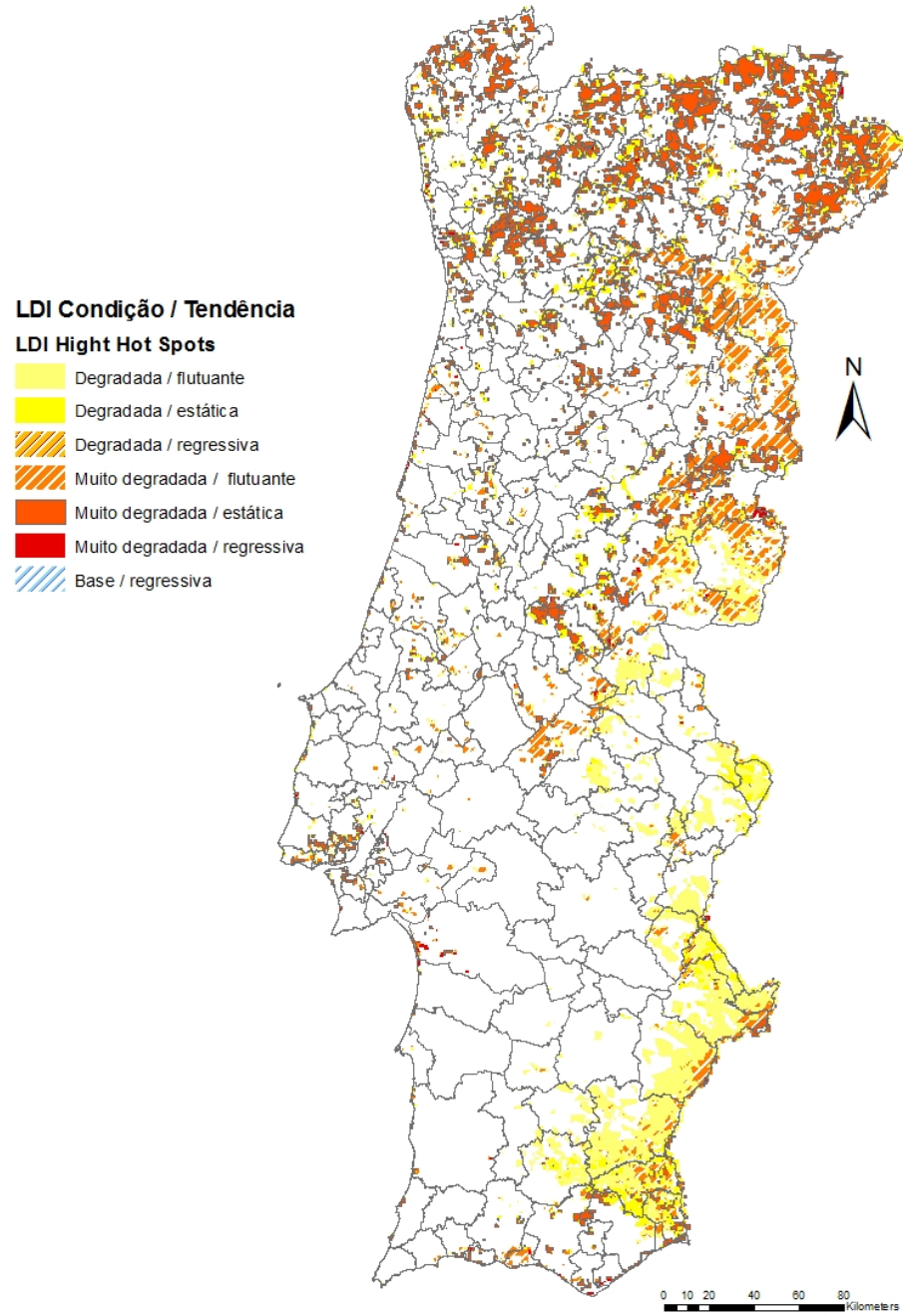
Sanjuan *et al.* 2011

DESERTIFICATION AFFECTED AREAS IN PORTUGAL CONTINENTAL (2000 / 2010)

Areas (ha)	Degrading	Fluctuating	Static	Improving	Total
Underp	1.575,37	3.874,32	6.014,36	2.492,35	13.956,40
%	0,03	0,07	0,11	0,04	0,25
Baseline	156,76	3.074,89	1.035,94	905,91	5.173,50
%	0,00	0,06	0,02	0,02	0,10
Very degraded	9.400,01	412.188,84	202.518,91	201.972,10	826.079,86
	0,02	7,39	3,63	3,62	14,66
Degraded	10.267,03	545.318,99	120.669,82	90.452,64	766.708,48
	0,18	9,78	2,16	1,62	13,74
Productive	18.186,60	1.261.350,23	410.269,43	482.075,50	2.171.881,76
%	0,33	22,62	7,36	8,65	38,96
Mature	30.923,30	307.928,52	338.133,25	267.783,90	944.768,97
%	0,55	5,52	6,06	4,80	16,93
Reference	7.953,75	142.595,20	58.694,55	62.984,16	272.227,66
%	0,14	2,56	1,05	1,13	4,88
Overpassed	24.550,49	201.360,81	167.517,90	118.348,20	511.777,40
%	0,44	3,61	3,00	2,12	9,17
Non assigned					16.034,72
%					0,29
Em branco					47.071,20
%					0,84
Total	103.015,00	2.877.743,41	1.304.877,55	1.227.036,76	5.512.672,72
%	1,69 % SD (1,1% PC)	51,61	23,39	22,00	99,82

1.592.788,34
28,40% SA
(17,9%PC)

1.216.996,63
21,81 % SA



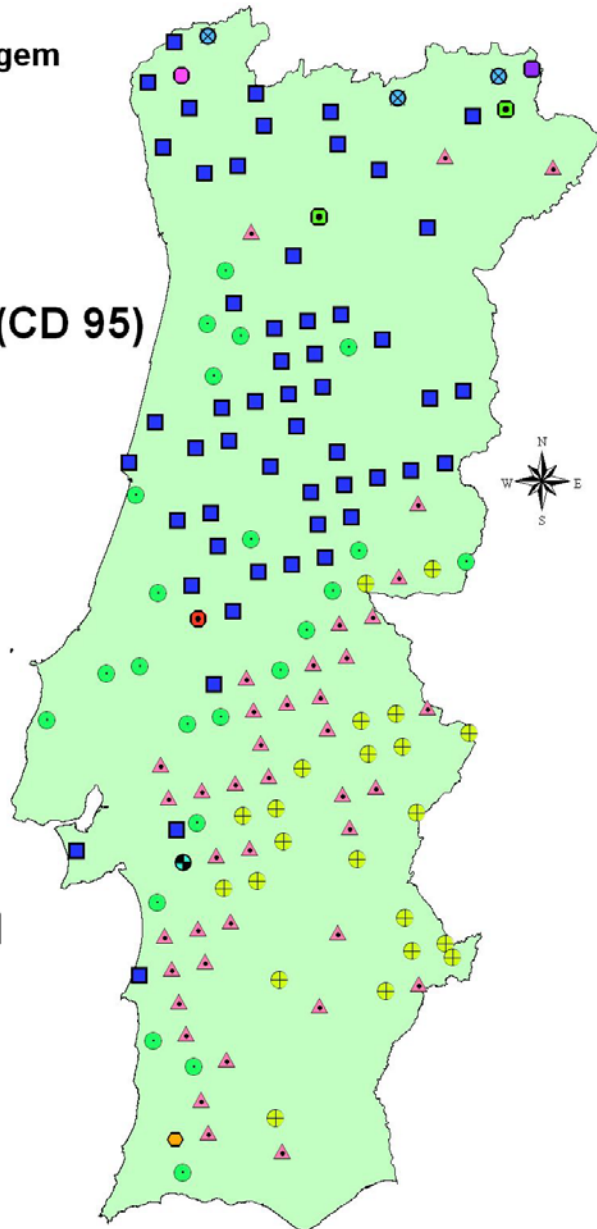
i5 - Changes in soil organic carbon stock / total terrestrial system carbon stock

Rede de Amostragem
Florestal
(16 x 16 Km)

Cob florestal (CD 95)

- Bt
- Cx
- Ec
- Md
- Pb
- Pm
- Ps
- Qf
- Qi
- Qp
- Qs

Portugal

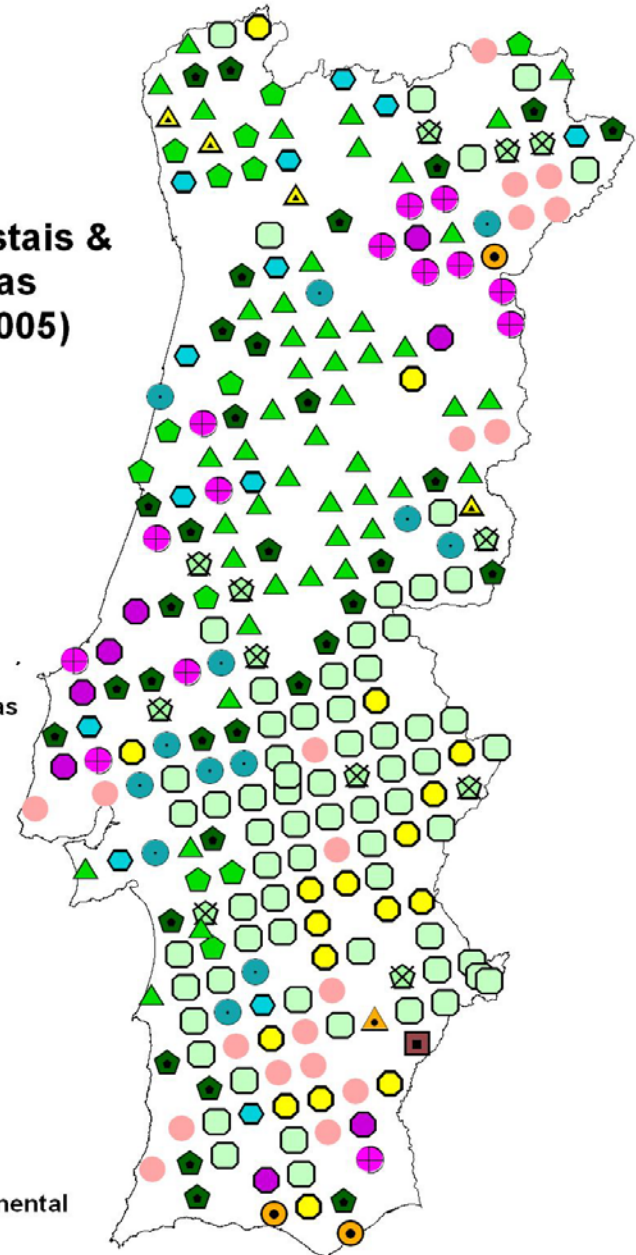


RFE
Plots Florestais &
Agrícolas
(1995 e 2005)



Corgpt0595glb.shp

- ▲ Resinosas
- Folhosas
- Florestas mistas
- Montado
- Matos
- ▲ Incultos
- Pastagem
- Olival
- Amendoal
- Hortas
- Vinha
- Pomar
- Cereais
- Milho
- ▲ Girassol
- Portugal Continental



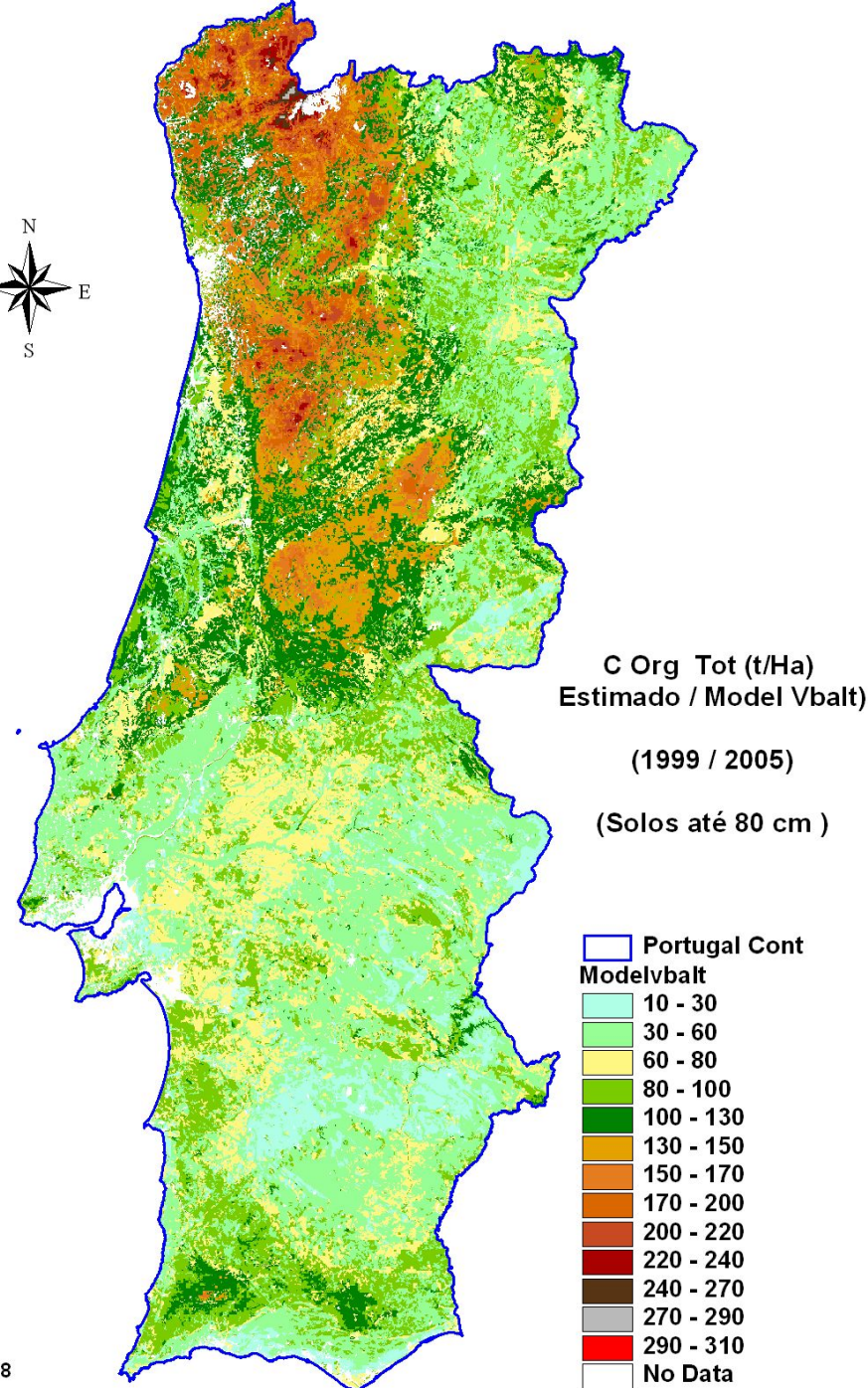
STEPWISE REGRESSION MODEL FOR CO₂ IN PORTUGUESE SOILS (2005/1999)

✗ $C_{1^5HaTot} = 5,391$
 $+0,071 \cdot RyMy + 20,925 \cdot Fac_AF -$
 $0,004 \cdot Rmcd + 4,659 \cdot Mprc$

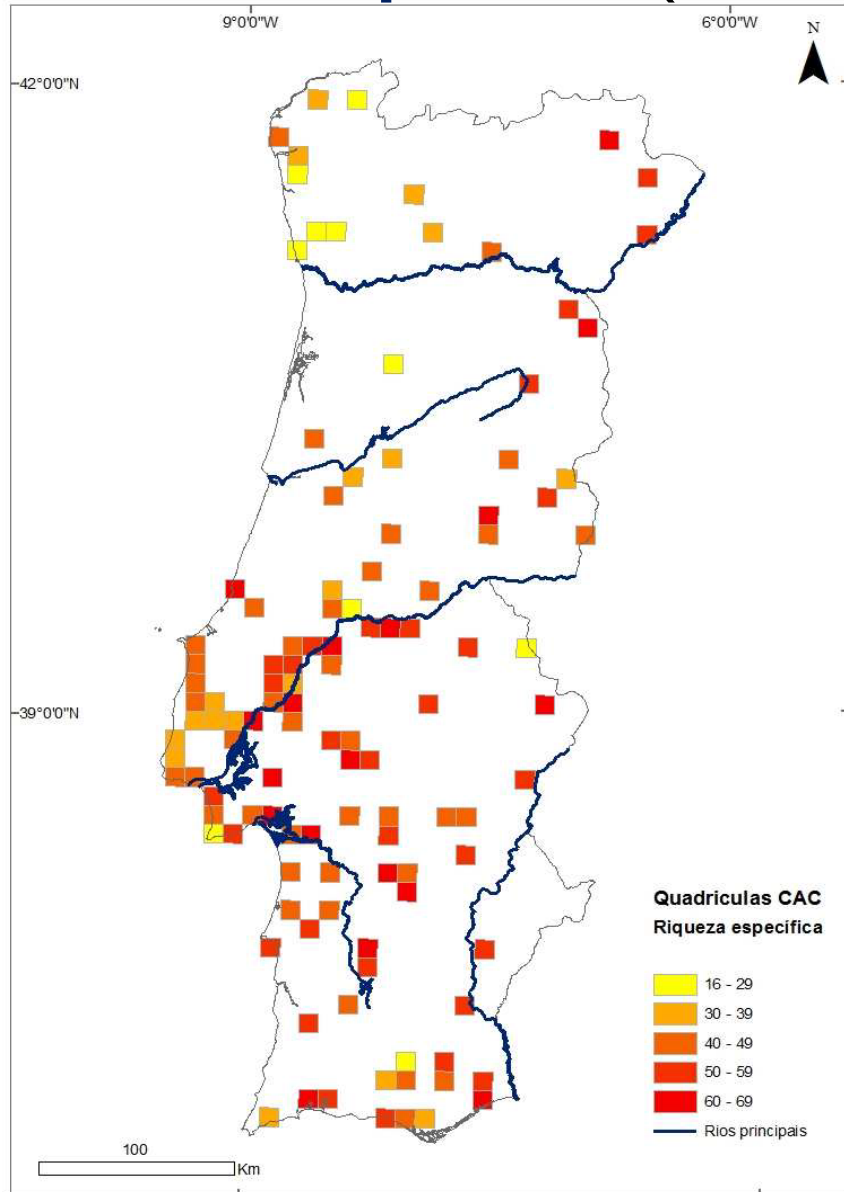
✗ $R^2 = 0,580$ (N=210) DW=1,876 (dL=1,745;
dU=1,803)

Changes in soil organic carbon
stock/total terrestrial system carbon
stock

1:2101988



i6 - Trends in abundance and distribution of selected species (the Global Wild Bird Index)



REFERENCES

- ✗ ENNE, Giuseppe & Claudio Zucca (2000) - *Desertification indicators for the European Mediterranean Region. State of the art and possible methodological approaches*, ed. ANPA, Roma.
- ✗ GENÉSIO, Lorenzo (2003) – *Aproximações à cartografia do Índice de Aridez para a Região Mediterrânica*, com. apresentada ao Workshop DISMED “Necessidades dos Decisores e Cartografia das Dinâmicas da Desertificação, em 11 a 14 de Junho, Sesimbra.
- ✗ INE (2009) – Recenseamento da Agricultura, Lisboa.
- ✗ ROSÁRIO, Lucio do (2004) – *Indicadores de desertificação para Portugal Continental*, Ed. DGF, Lisboa.
- ✗ ROSÁRIO, Lúcio & Paulo SILVA (2013) Territorial experiences on woodland ecosystems management in the Mediterranean Region: ForClimadapt case study in Portugal – Vale do Guadiana / Mértola Project, in III Mediterranean Forest Week, Tlemcen /Algerie).
- ✗ ROXO, M. J., J. M. MOURÃO, L. RODRIGUES & P. CASIMIRO (1999) – “The Alentejo region (Mértola municipality, Portugal”, in *The MEDALUS project. Mediterranean Desertification and land use - Manual on key indicators of desertification and mapping environmentally sensitive areas to desertification*: 80- 84, Ed. European Commission, Brussels.
- ✗ UVA, José (2013) – IFN6 – Áreas dos usos dos solos (Resultados preliminares), ICNF, Lisboa.