**Internal report**

# Mapping sensitivity to desertification (DISMED)

## Final report

**Prepared by:**
Jaume Fons-Esteve, Ferran Páramo

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**Project manager:**
Anna Rita Gentile

European Topic Centre
Terrestrial Environment

Universitat Antònoma de Barcelona
Edifici C – Torre C5
4ª planta
08193 Bellaterrra (Barcelona)
Spain

Contact: etcte@uab.es

European Environment Agency

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# 1 BACKGROUND AND SCOPE OF THE REPORT

The European Topic Centre on Terrestrial Environment (ETC-TE) has been asked by the European Environment Agency (EEA) to support the development of a sensitivity mapping on desertification and drought in the Mediterranean countries at scale 1 : 1.000.000. This is part of the project Desertification Information System to Support National Action Programmes in the Mediterranean (DISMED), where the EEA is involved.

Since March 2002 a Working group on sensitivity mapping on desertification and drought has been established with the mandate of defining technical specification of the cartography.

By the end of June 2003 the ETC prepared an assessment report on the feasibility of the map where it was concluded that a minimum data sets and methodology existed for Europe except for the socio-economic layer. Since no new data has been available, the map developed correspond to the minimum requirements described in the above mentioned report.

# 2 METHODOLOGY

## 2.1 OVERVIEW

The adopted methodology is inspired by the one developed in the framework of the MEDALUS project (Mediterranean Desertification And Land Use). Sensitivity to the desertification of the different spatial homogeneous units is defined by an index (ISD: index of sensitivity to the Desertification) obtained from the geometrical average of three indexes of the soil quality, climate and vegetation. Land planning and socio-economic aspects have not been included because further work is required in order to test methodlogies implemented at regional or national level.

## 2.2 CLIMATE QUALITY INDEX

Climatic aspects has been analysed trough the Aridity Index (AI), using the methodology developed by FMA in accordance with the following formula

$$AI = P / PET$$

where:

AI = Aridity index
P = Yearly mean rainfall
PET = Yearly mean potential evapotranspiration

Within this index, the territory is classified as showed in the following table:

| CQI | Climatic zones | Classification |
|---|---|---|
| < 0.05 | Iper – arid | 2 |
| 0.05 – 0.20 | Arid | 1,75 |
| 0.20 – 0.50 | Semi – arid | 1,50 |
| 0.50 – 0.65 | Dry sub – humid | 1,25 |
| > 0.65 | Humid | 1 |

## 2.3 SOIL QUALITY INDEX

The soil quality index (SQI), developed by OSS, is based on four parameters:

- parental material
- soil depth
- texture
- slope

SQI is given by the geometric average of the indexes for the four parameters.

$$SQI : (Parental\ Material \times Depth \times Texture \times slope)^{1/4}$$

In case local data are not available for a single parameter, only the remaining parameters were used.

### 2.3.1 Parent material

Parental material has been classed in three classes as below:

| parental material | score |
|---|---|
| Coherent parental material :<br>limestone, dolomite, non friable sandstone, hard limestone layer | 1 |
| Parental material moderately coherent :<br>Marno-limestone, friable sandstone | 1.5 |
| Parental material soft to friable :<br>Calcareous clay, clay, sandy formation, alluvium and colluviums, | 2 |

### 2.3.2 Soil depth

The following classes were proposed:

| Classes | Description | Score |
|---|---|---|
| Very deep | Soil thickness higher than 1.2m with a substrate non penetrable by the roots or thickness higher than 1m on a movable substrate | 1 |
| Moderate to deep | Depth from 0.8 to 1.2m with a coherent substrate or from 0.5 to 1m with a movable substrate | 1.33 |
| Not deep | Depth from 0.5 to 0.8m with a coherent substrate or from 0.3 to 0.5m with a movable substrate | 1.66 |
| Very thin | Depth lower than 0.3m | 2 |

Because soil depth is not included in the Soil Database, and pedotransfer rules were not available, the following approach was adopted

| parental material | score |
|---|---|
| Fluvisols | 1 |
| All other groups | 1.5 |
| Leptosols and regosols | 2 |

### 2.3.3 Soil texture

Soil texture was grouped as follows:

| Classes | Description | Score |
|---|---|---|
| Texture not very light to average | loamy-sandy, sandy-loamy, balanced | 1 |
| Texture thin to average | loamy-clayey, clayey-sandy, sandy-clayey | 1.33 |
| Thin texture | clayey clayey-loamy | 1.66 |
| Coarse texture | Sandy to very sandy | 2 |

When two classes concurred in the same polygon the arithmetic mean was used.

### 2.3.4 Slope

The following classes were proposed:

| Classes | Description | Score |
|---|---|---|
| < 6 | Gentle | 1 |
| 6 – 18 | Not very gentle | 1.33 |
| 9 – 35 | Abrupt | 1.66 |
| > 35 | very abrupt | 2 |

Because the classes given by the Soil Database didn't fit to the ones proposed, the final classification adopted was as follows:

| Class | Description | Score |
|---|---|---|
| a | Level (dominant slope ranging from 0 to 8 %) | 1 |
| b | Sloping (dominant slope ranging from 8 to 15 %) | 1.33 |
| c | Moderately steep (dominant slope ranging from 15 to 25 %) | 1.66 |
| d | Steep (dominant slope over 25 %) | 2 |

When two classes concurred in the same polygon the arithmetic mean was used.

## 2.4 VEGETATION QUALITY INDEX

For the Vegetation Quality Index, a subgroup of WG! submited a reclassification of Corine Land Cover (CLC90) third level classes, assigning each CLC class a value for each of these 4 parameters:

- erosion protection,
- resistance to drought,
- ground coverage,
- resistance to fire,

using the same range of values for all 4 parameters:

- 0 (excluded from further consideration);
- 1 (good)
- 1.5 (moderate)

- 2 (bad)

VQI is given by the geometric average of the indexes for the four parameters.

$$VQI : (ErosionProtection \times ResistDrought \times Coverage \times ResistFire)^{1/4}$$

## 2.5 FINAL LAYER

The final overall ISD index is obtained as a geometrical average of the quality indexes.

$$ISD = (SQI * CQI * VQI)^{1\backslash 3}$$

Finally the ISD is grouped according to the following classes of sensitivity to desertification:

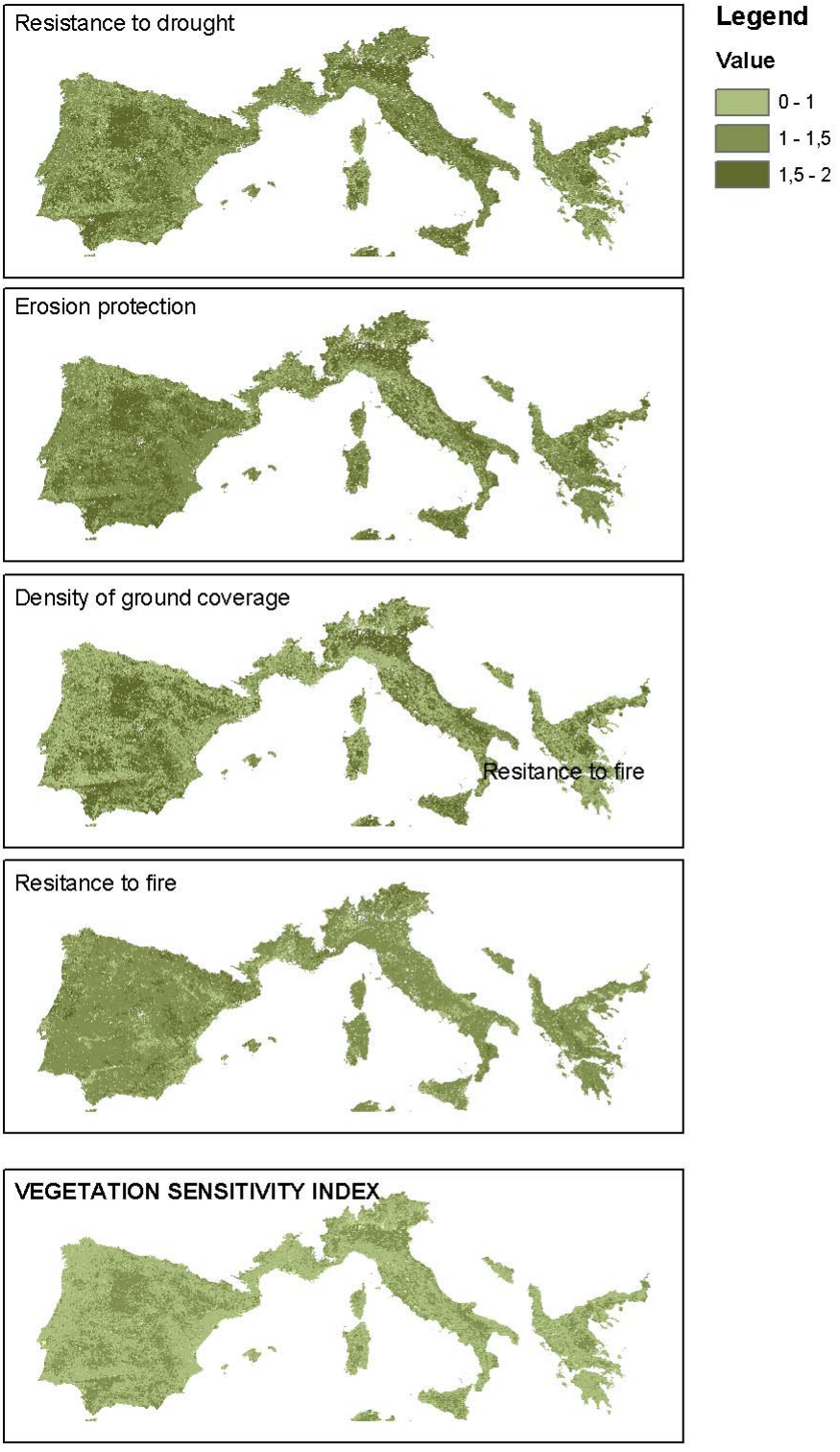
| Classes | SDI (Sensitivity desertification index) | Description |
|---|---|---|
| 1 | < 1,2 | Non affected areas or very low sensitive areas to desertification |
| 2 | 1,2 ≤ ISD < 1,3 | Low sensitive areas to desertification |
| 3 | 1,3 ≤ ISD < 1,4 | Medium sensitive areas to desertification |
| 4 | 1,4 ≤ ISD < 1,6 | Sensitive areas to desertification |
| 5 | ISD ≥ 1,6 | Very sensitive areas to desertification |

# 3 DATA SOURCES FOR THE MAP

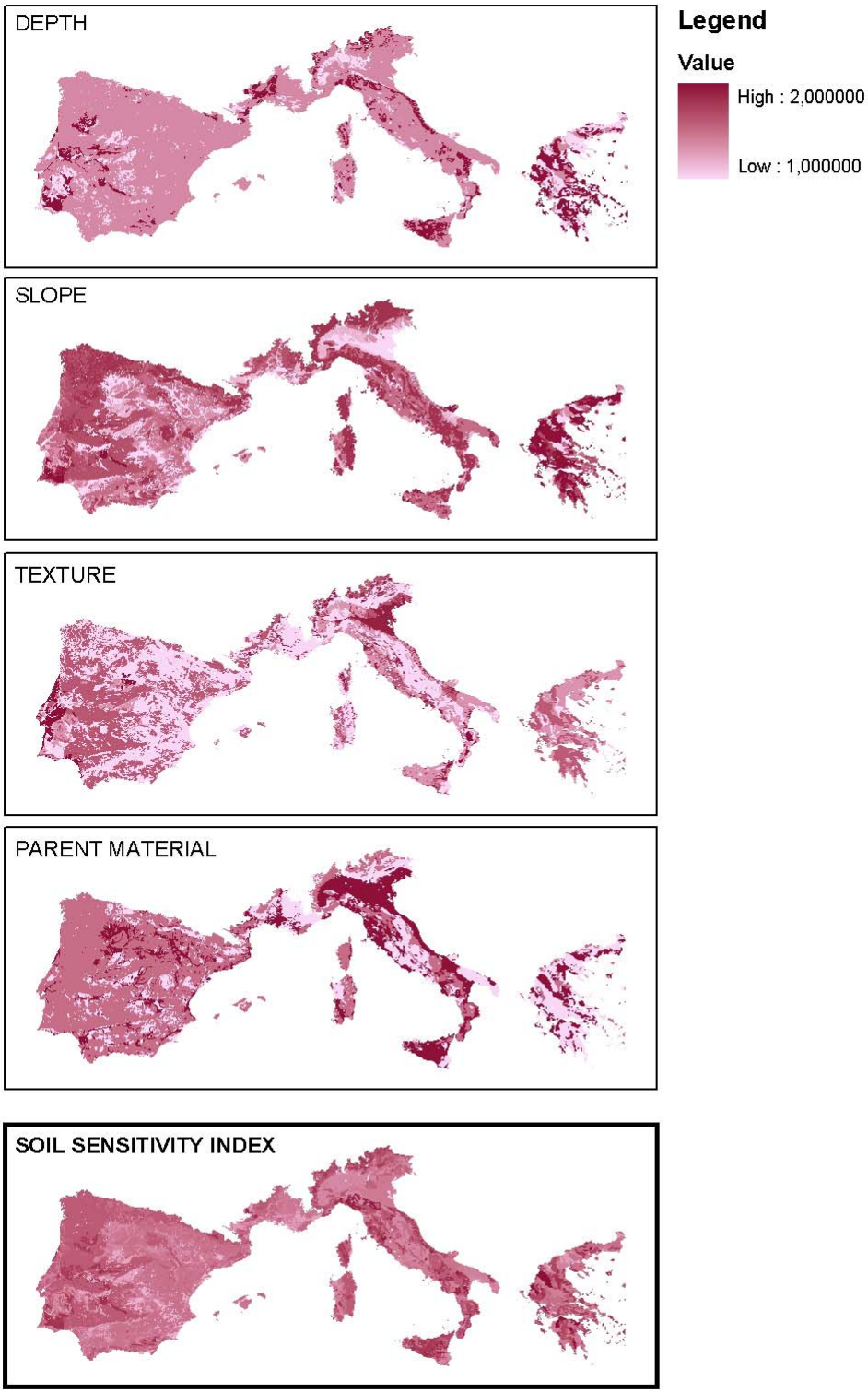
| | Climate | Soil | Vegetation |
|---|---|---|---|
| *Database name* | Aridity index | Soil quality index | Vegetation index |
| *Produced by* | FMA | ETC-TE | ETC-TE |
| *Geographic extent* | Mediterranean Basin | Italy, Spain, Portugal, Greece | Italy, Portugal, Spain, Greece and small areas of Morocco and Tunisia |
| *Format* | ArcInfo GRID | ArcInfo Coverage | ArcInfo GRID |
| *Data model* | Raster | Vector | Raster |
| *Projection* | Geographic (decimal degrees)<br>Parameters unknown (Spheroid & datum) | Lambert Azimuthal | Lambert Azimuthal |
| *Source* | • Temp. events (FAOCLIM Meteorological stations)<br>• Rainfall events (FAOCLIM Meteorological stations)<br>• DEM (GTOPO30)<br>• Sea distances database (FMA)<br>• Lat/Long database (FMA) | Soil Map (JRC). Available at EEA. | CLC 90 (EEA) |

# 4 MAPS

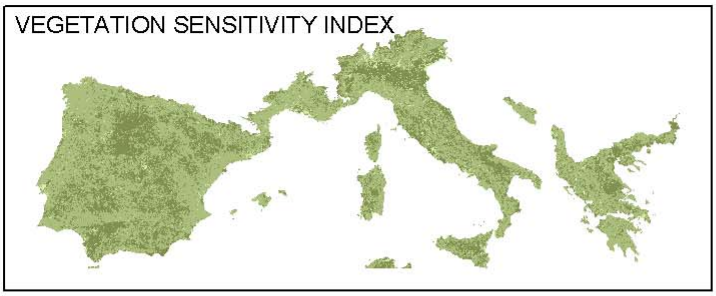
## 4.1 VEGETATION LAYER



## 4.2 SOIL LAYER



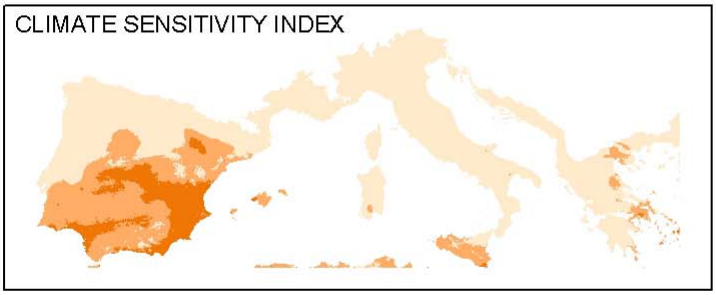
## 4.3 FINAL MAP




**Legend**

Value

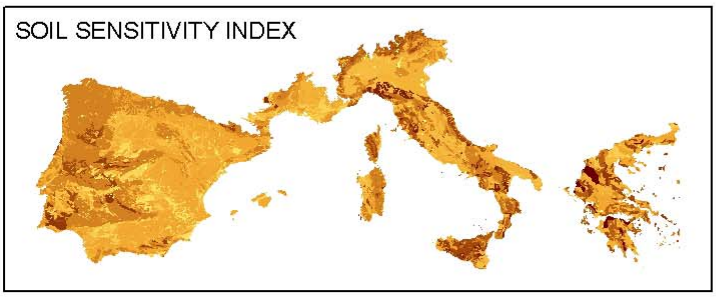
- 0 - 1
- 1 - 1,5
- 1,5 - 2




**Legend**

Value

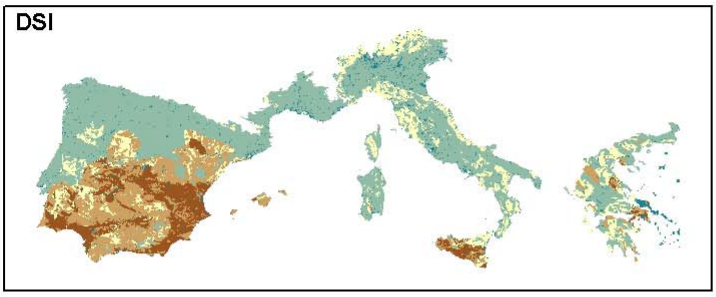
- 1
- 1,25
- 1,5




**Legend**

Value

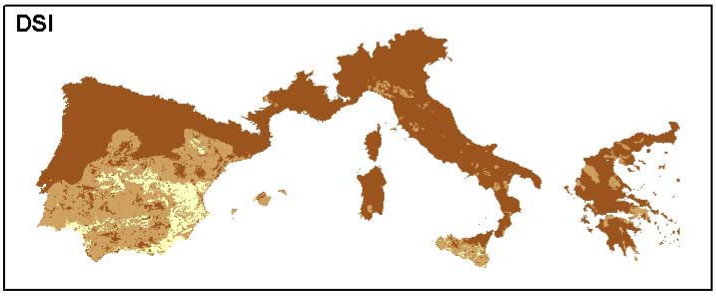
- High : 1,830000
- Low : 0,000000




**Legend**

Value

- 0
- 0 - 1,164713264
- 1,164713265 - 1,21361804
- 1,213618041 - 1,267746806
- 1,267746807 - 1,37153399




**Legend**

Value

- < 1,2
- 1,2 - 1,3
- 1,3 - 1,4
- 1,4 - 1,6
- > 1,6

# ANNEX 1. ACRONYMS

| | |
|---|---|
| CLC | Corine Land Cover |
| DEM | Digital Elevation Model |
| EEA | European Environment Agency |
| ESB | European Soil Bureau |
| ETC-TE | European Topic Centre on Terrestrial Environement |
| FMA | Applied Meteorological Foundation |
| JRC | Joint Research Center |
| OSS | Sahara and Sahel Observatory |