

Soil Treats, Gaps, and Technical Assessment

***Agricultural University of Athens
Costas Kosmas***

Identified important threats to European soils

The European Commission adopted a Soil Thematic Strategy (COM(2006) 231)

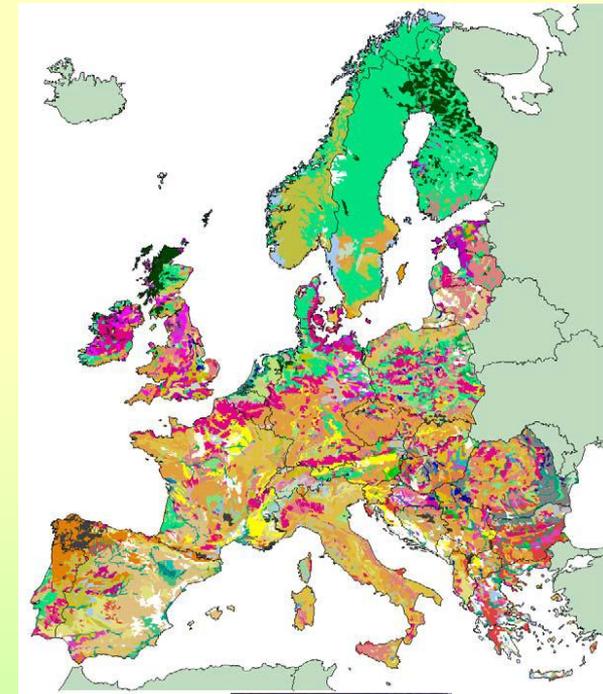
A proposal for a Soil Framework Directive (COM(2006) 232) with the objective to protect soils across the EU.

The Strategy and the proposal have been sent to the other European Institutions for the further steps in the decision-making process.

Identified important threats to European soils

1. Soil erosion
2. Loss in organic matter
3. Chemical contamination
4. Loss in biodiversity
5. Soil salinization
6. Soil compaction
7. Soil sealing
8. Landslides
9. Land desertification?? (S. EU)

Soil map for Europe



1. Soil erosion

About 75% of international cultivated soils have been degraded or are expected to be degraded by soil erosion.

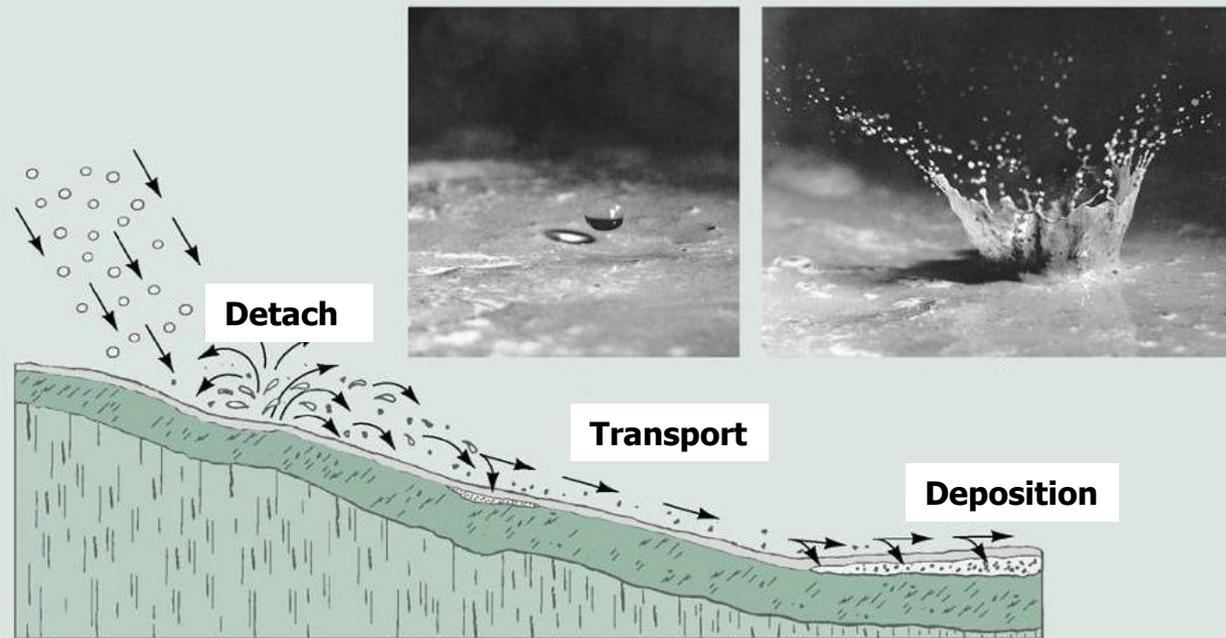
In northern Mediterranean region this percentage is even higher.



1. Soil erosion

Types of soil erosion

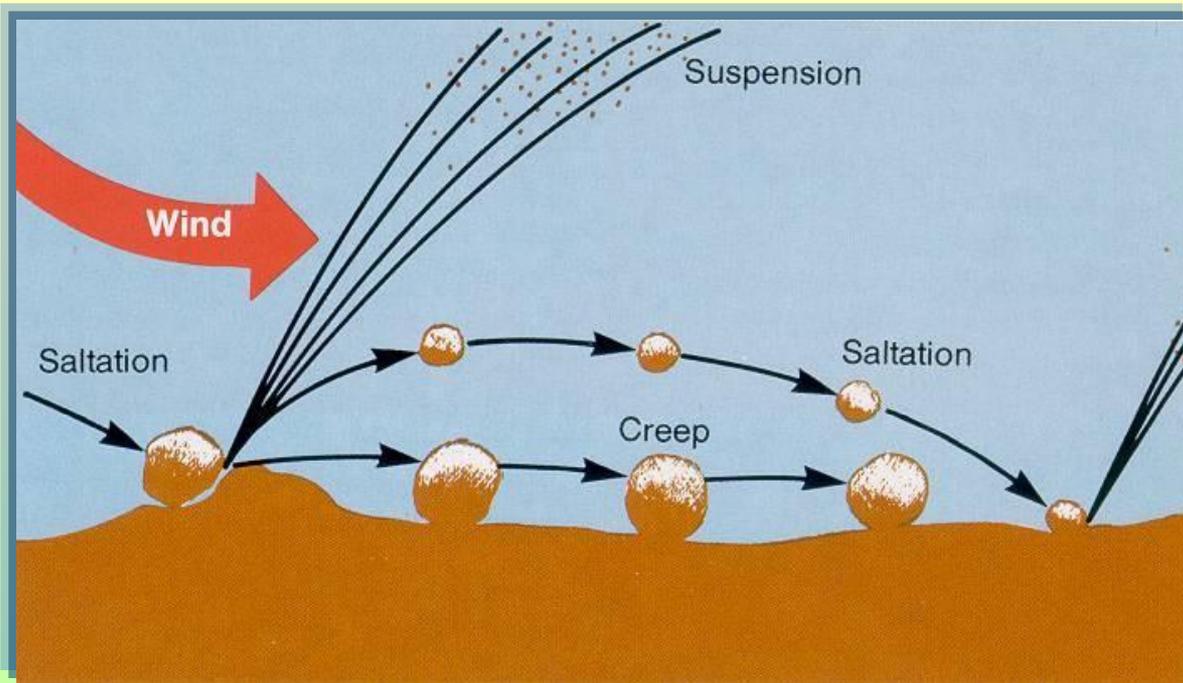
A. Water erosion



1. Soil erosion

Types of soil erosion

B. Wind erosion



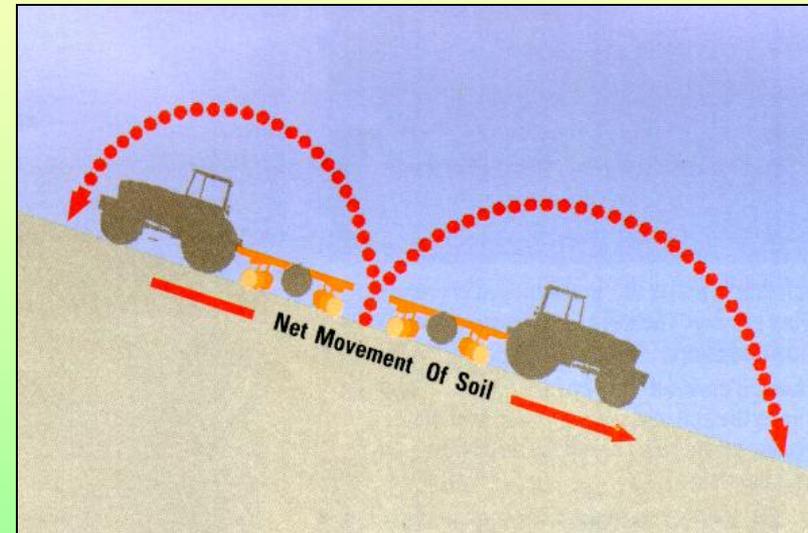
1. Soil erosion

Types of soil erosion

C. Tillage erosion

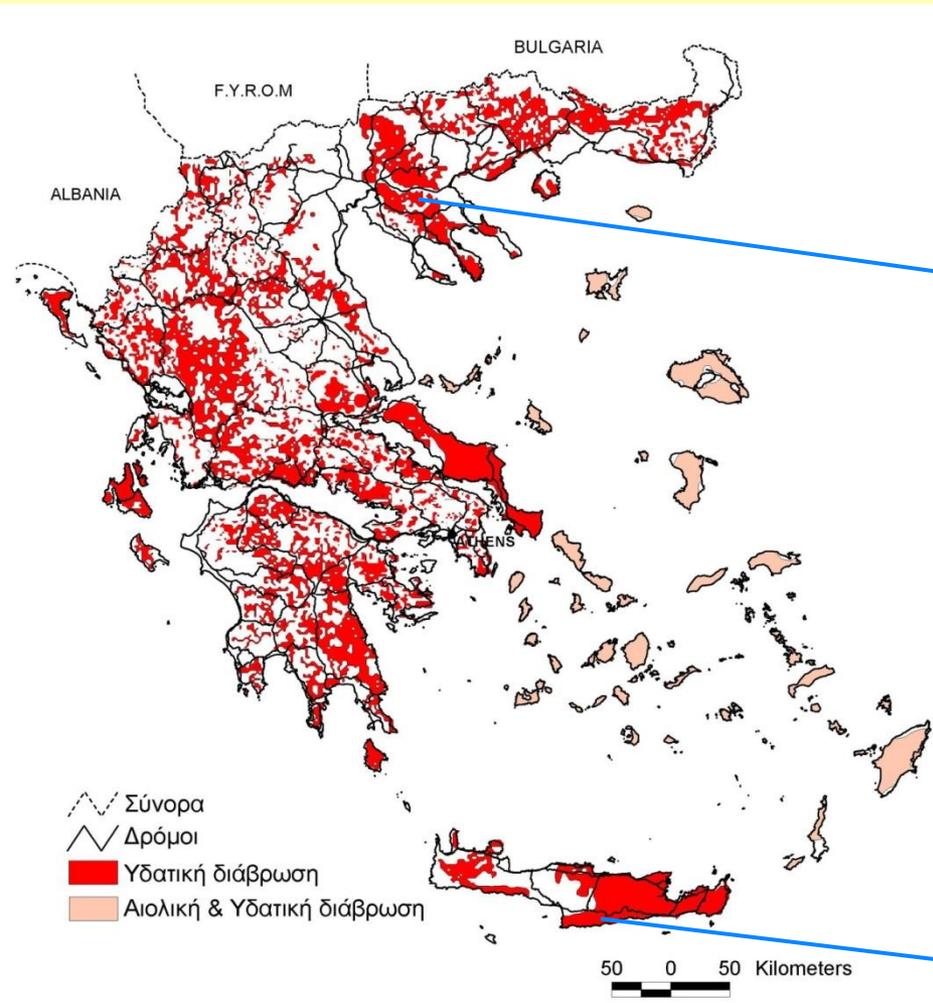
The down slope displacement due to ploughing the land

Soil loss is estimated to 0.2-1.5 cm per year in sloping areas



1. Soil erosion

Hot spots of soil erosion in Greece

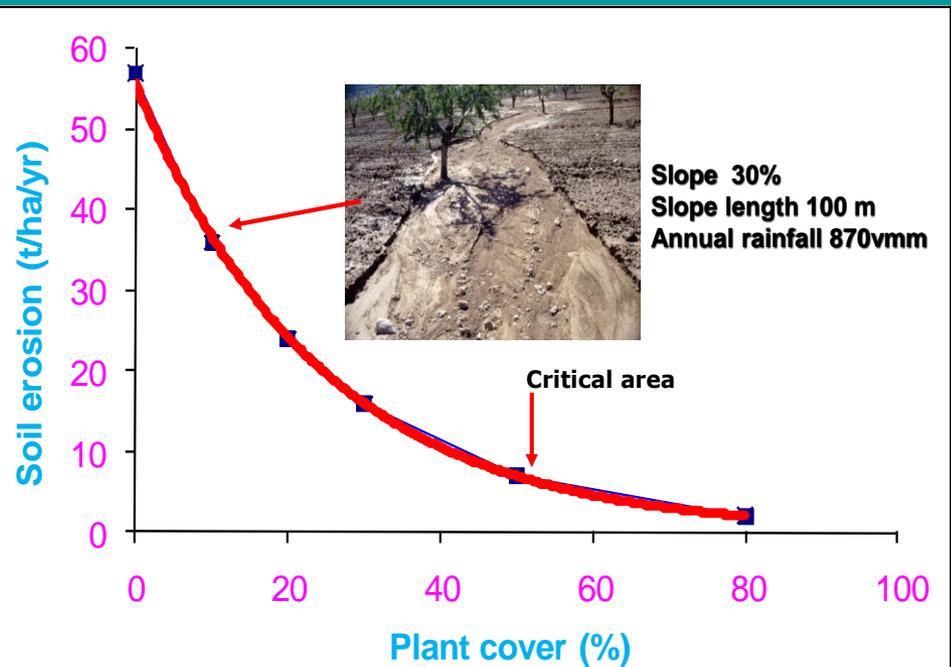


1. Soil erosion

Important factors adversely affecting soil erosion

Lack of adequately plant cover

A value of 45-50% plant cover is considered crucial



1. Soil erosion

Important factors adversely affecting soil erosion



Intensive cultivation of land

- Physical properties deterioration



1. Soil erosion

Important factors adversely affecting soil erosion



Animals overgrazing the land remove selectively palatable species and expanding non-palatable species reducing biodiversity

Intensive grazing of pastures

The allocation of EU subsidies favored increase of grazing animals two or three times than the sustainable grazing capacity



1. Soil erosion

Important factors adversely affecting soil erosion

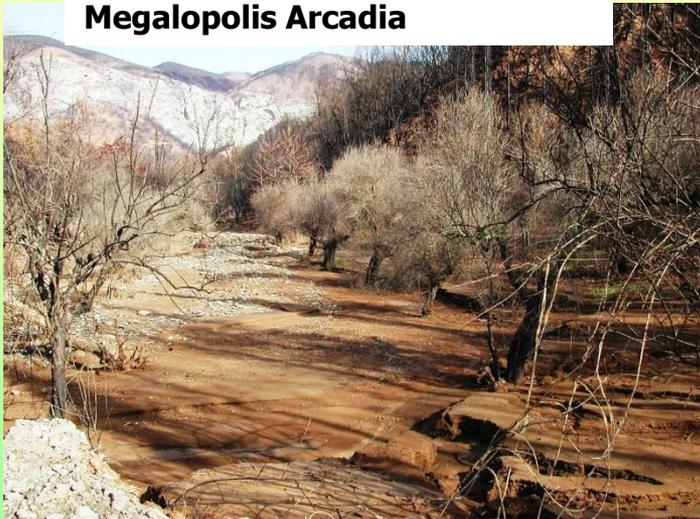
Kallithea Elias



Extensive forest fires

Forest fire frequency has increased in the last decades due to various economic factors (land use change, generating new vegetation for grazing animals)

Megalopolis Arcadia



1. Soil erosion

Important factors adversely affecting soil erosion

Land abandonment

Positive and negative impacts on land degradation depending on the stage of land at the time of abandonment

8 to 15% of agricultural land in the Mediterranean European has been degraded and it must be abandoned.

In many cases degraded land remains in agriculture due to the allocated subsidies.

A cultivated hilly agricultural area must be abandoned before the soil achieves the critical soil depth **of about 30 cm.**



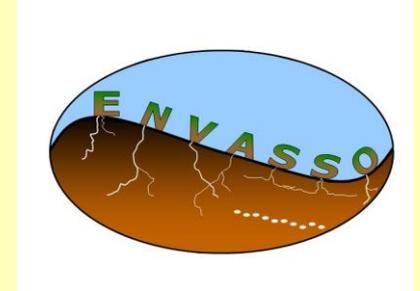
Agricultural degraded land in Portugal



1. Soil erosion

Soil erosion assessment

ENVASSO methodology by using indicators



A. Water erosion

1. ERO1- Estimated soil erosion by water runoff ($\text{t ha}^{-1} \text{ year}^{-1}$) (PESERA model)
2. ERO2- Measured soil erosion by water runoff ($\text{t ha}^{-1} \text{ year}^{-1}$)

B. Wind erosion

3. ERO5- Estimated soil erosion by wind ($\text{t ha}^{-1} \text{ year}^{-1}$)

C. Tillage erosion

4. ERO7- Estimated soil erosion by tillage ($\text{t ha}^{-1} \text{ year}^{-1}$) (TERON methodology)

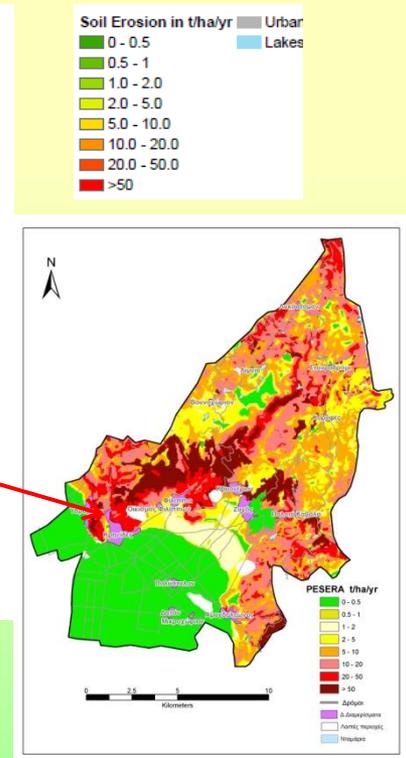
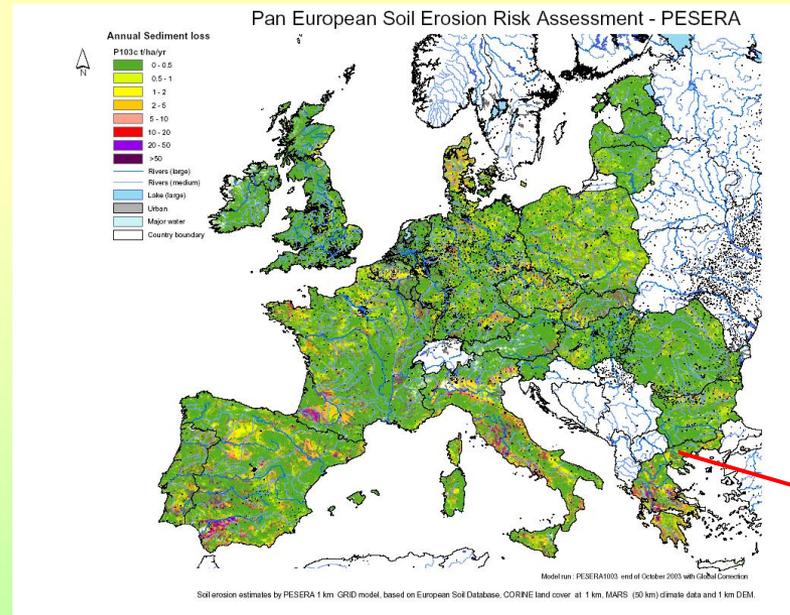
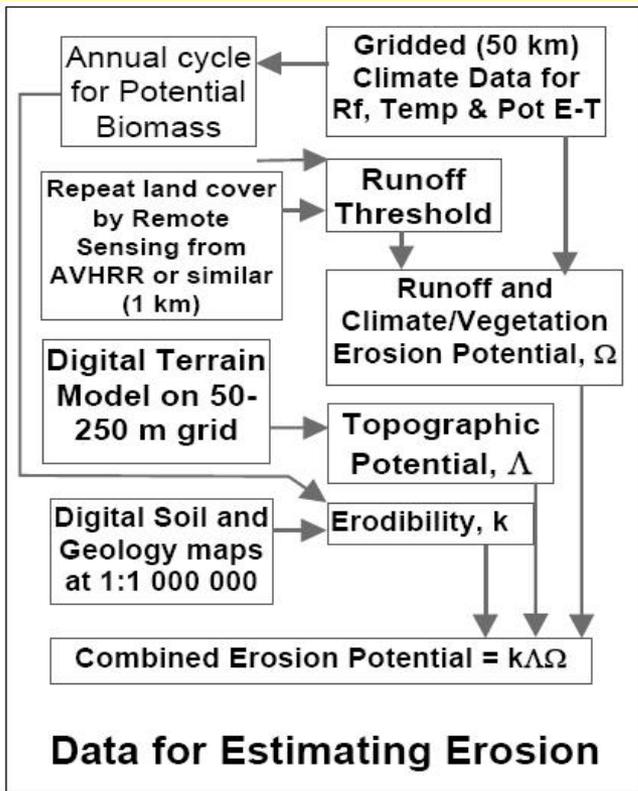
1. Soil erosion

Soil erosion assessment



Main gaps in assessing soil erosion

1. Limited experimental data for model validation
2. Limited soil, vegetation, and climate data.



1. Soil erosion

Main gaps for threat “soil erosion”

1. Limited soil, vegetation, and climate data
2. Lack of environmental policy implementation
3. Lack of drivers for farmers to apply sustainable land management practices
4. Environmental policy in contradiction with allocated subsidies
5. Limited knowledge transfer to land users

2. Loss in soil organic matter

It plays a central role in maintaining key soil functions, an essential factor of erosion resistance and soil fertility.

According to the European Soil Bureau, nearly 75% of the total area analysed in Southern Europe has a low (3.4%) or very low (1.7%) soil organic matter content.

Organic matter content has decreased in the last decades for about 50% due to intensive cultivation of the land.

Loss in organic matter content contributes to greenhouse gases and climate change.



2. Loss in soil organic matter

Organic soils are not widely extended in Europe but they are associated with wetlands.

The management of organic soils for growing crops involves drainage of the soil and facilitation of equipments.

However when such soils are drained they oxidize and subside making further drainage difficult.

The rate of subside measured in Greece was found between 5-8 cm per year.

Kabala, Macedonia Greece

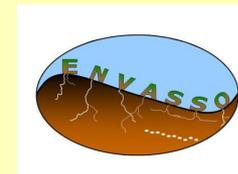


2. Loss in soil organic matter

Method of assesement in organic matter decline

Chemical - dry combustion

Top soil organic matter content, % (w/w),



Main gaps for threat “loss in iorganic matter”

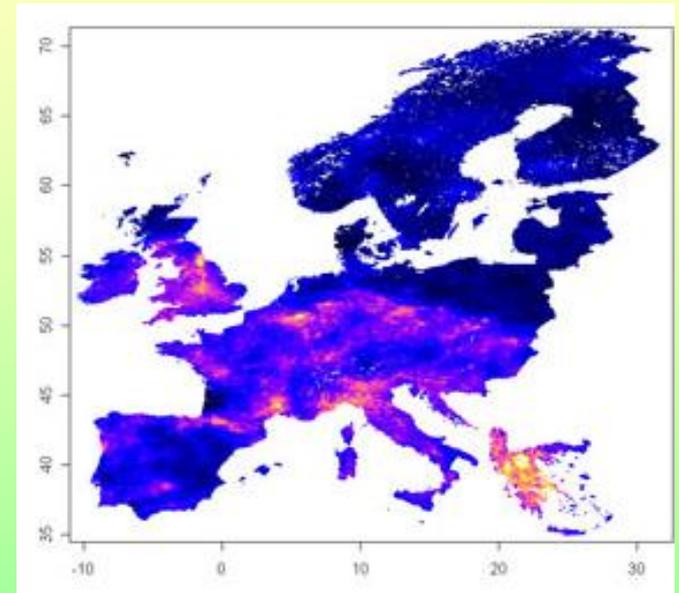
1. Lack of environmental policy implementation.
2. Lack of information to the farmers for the importance of avoiding burning plant residues.

3. Chemical contamination

Soil contamination is the occurrence of pollutants in soil above a certain level causing a deterioration or loss of one or more soil functions.

Contamination typically arises from a very wide range of contaminants, introduced via atmospheric deposition, flooding, waste spreading, and direct additions (fertilizers, pesticides, etc.)

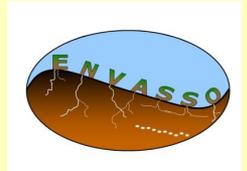
Main heavy metals: arsenic, cadmium, chromium, copper, mercury, nickel, lead, and zinc



3. Chemical contamination

Method of assesement of chemical contamination

Heavy metal contents in soil (%)

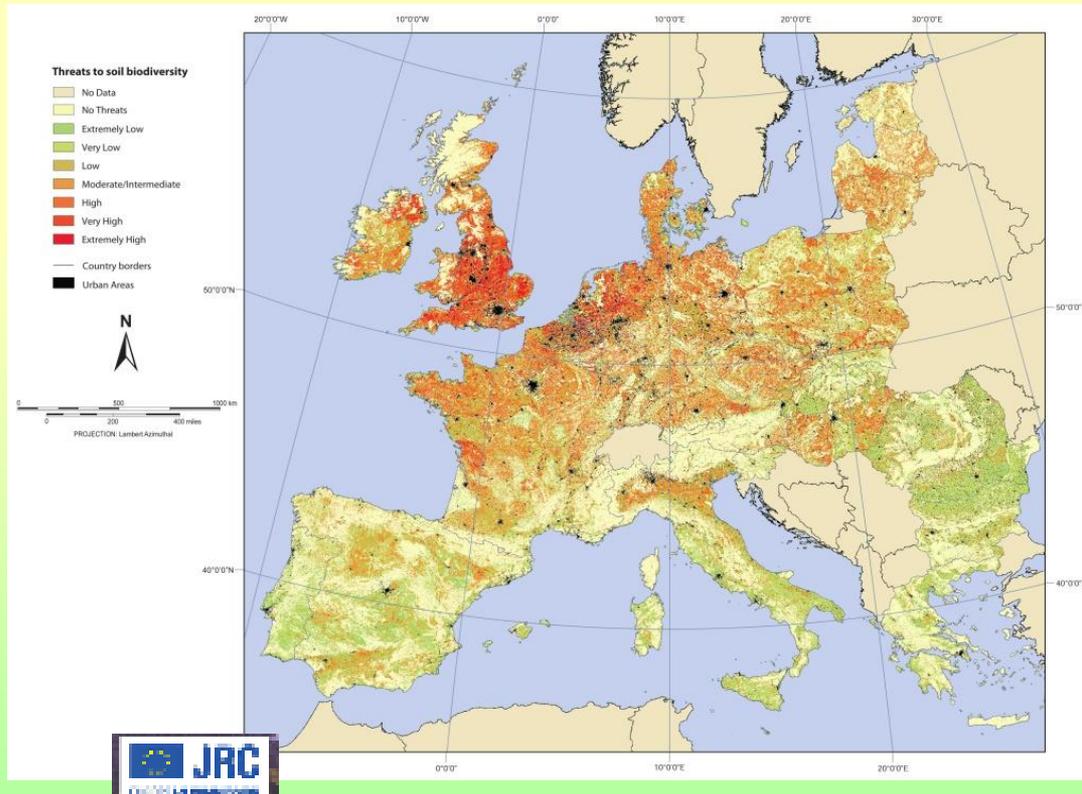


Main gaps for threat "chemical contamination"

1. Lack of environmental policy implementation
2. Lack of data on heavy metal contamination in European soils
3. Allowed levels of heavy metals in soils

4. Loss in biodiversity

1. Soil biota is exceptionally diverse of great importance to soil functionality
2. Limited level of knowledge about its functions
3. Indicators for biota decline are not clearly defined.



Areas where soil biodiversity is most under threat

4. Loss in biodiversity

Method of assesement of loss in biodiverisity

- 1. Species diversity in earthworms and collembola (which may not be fully applicable to soils in drier regions)**
- 2. Soil respiration rate as a measure of overall biological function.**

Main gaps for threat “loss in biodiverisity ”

- 1. Limited level of knowledge about its functions**
- 2. Limited data on soil biota**

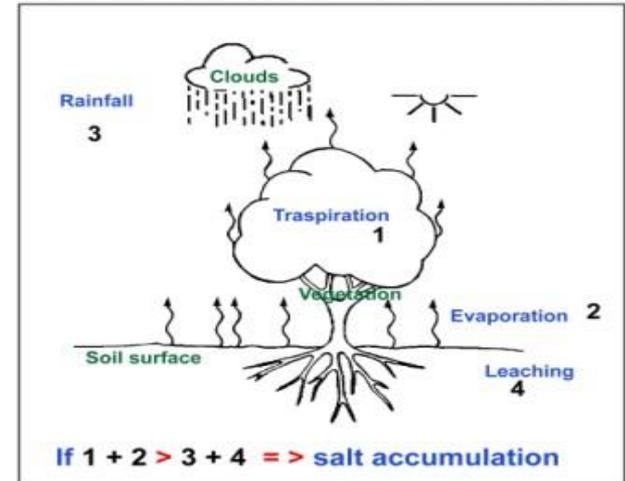
5. Soil salinization

Salinisation is a process of salt accumulation in the soil.

It occurs especially in arid and semiarid areas where soluble salts precipitate within or on the surface of the soil.

Increasing salt levels in the top soil layers can negatively affect plant growth and productivity to the point of plant death.

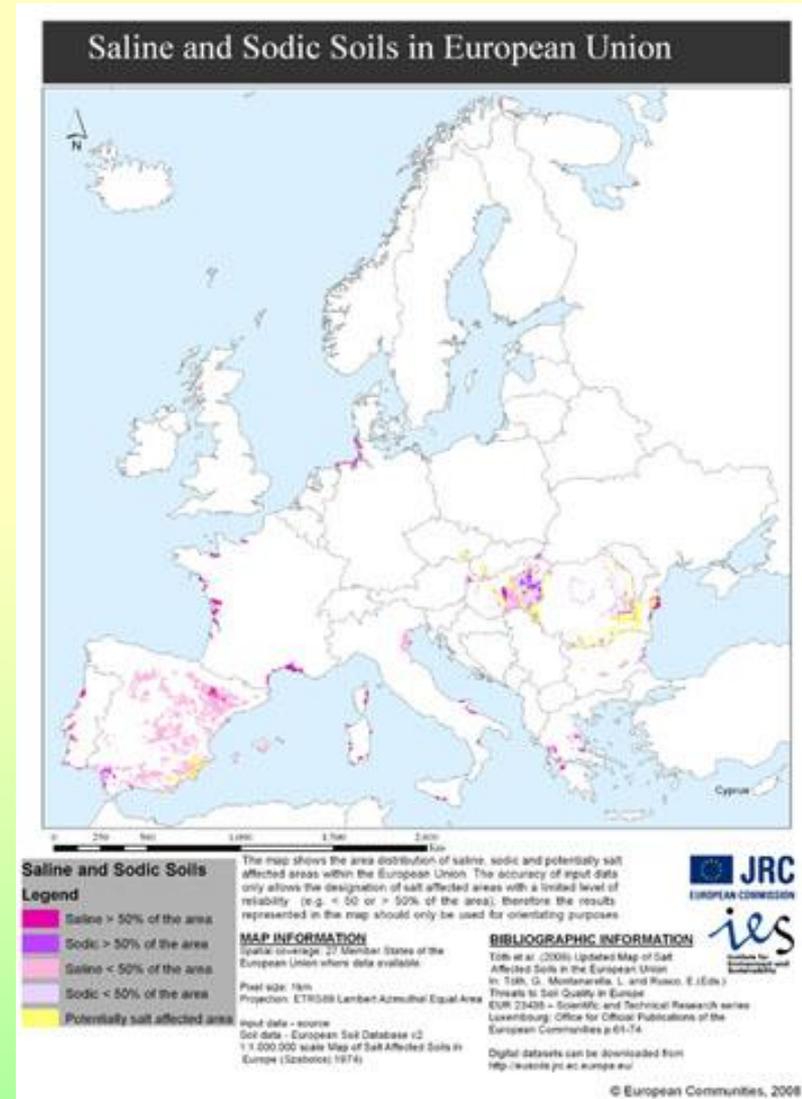
Factors influencing salt accumulation in soil surface layers



5. Soil salinization

Soil salinisation affects an estimated 1 to 3 million hectares in the enlarged EU, mainly in the Mediterranean countries (25% of irrigated cropland).

It is regarded as a major cause of desertification and therefore is a serious form of soil degradation.

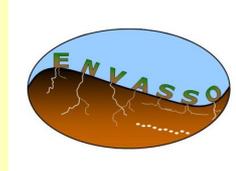


5. Soil salinization

Method of assesement soil salinization

Salt profile (% S m⁻¹)

Potential soil salinization: ground water or irrigation water salt content mg l⁻¹, SAR



Main gaps for threat “soil salization”

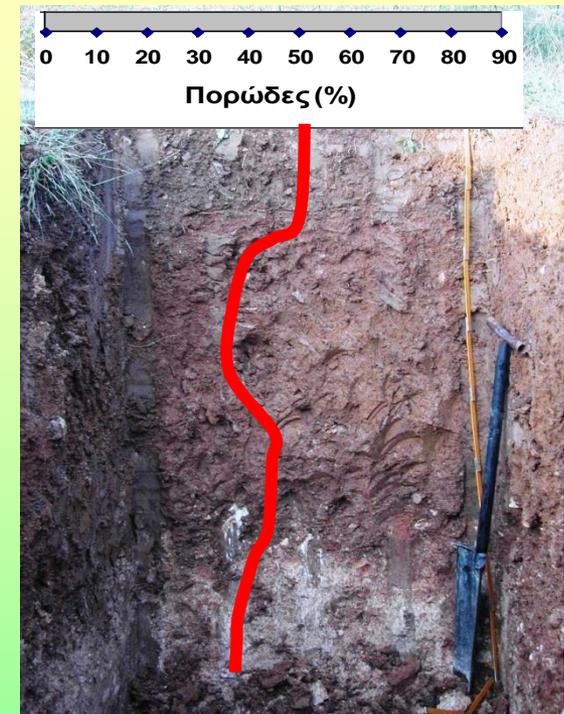
1. Lack of environmental policy implementation
2. Better water resources management
3. Promotion of crops of low water requirements

6. Soil compaction

Soil compaction is the rearrangement of soil aggregates and/or particles in a denser way.

It is a response to external forces arising from surface loadings, tillage operations, and high grazing densities.

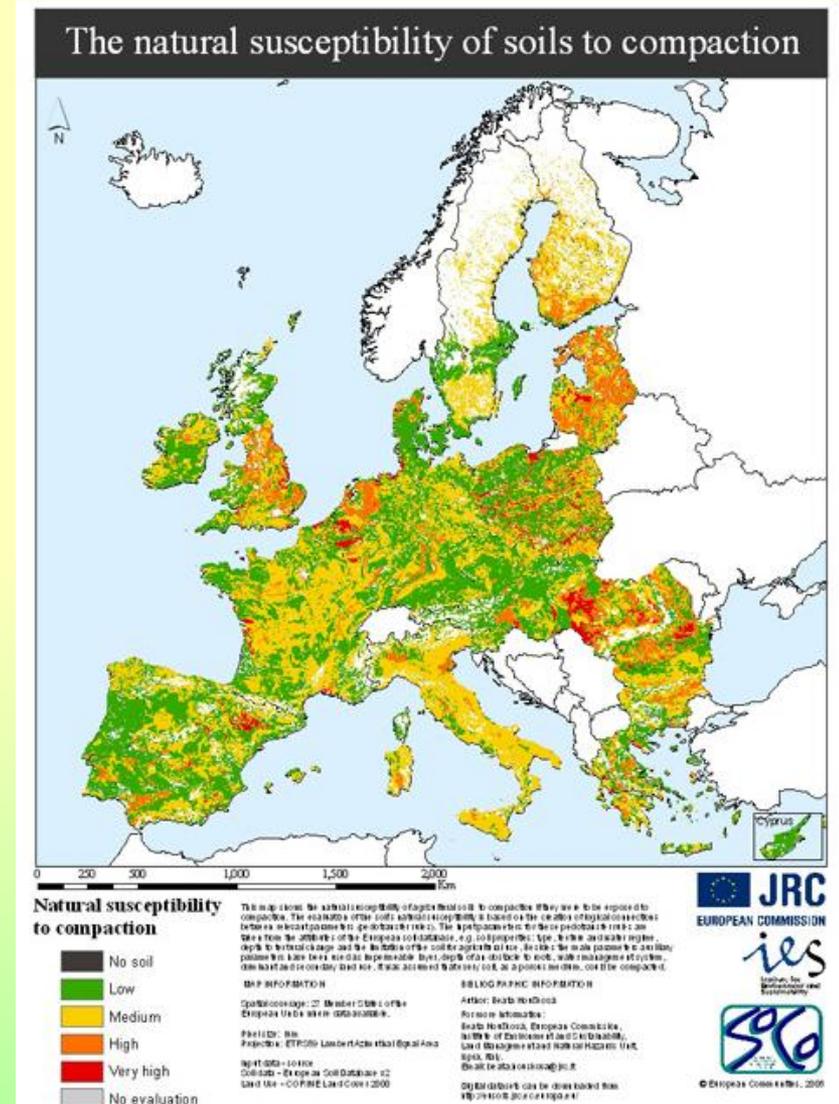
Compaction impose restrictions to the flow of water and gases as well as constraints on root extension and movement of biota.



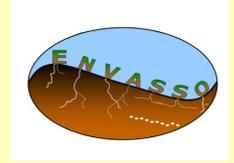
6. Soil compaction

Soil susceptibility to compaction is the probability that soil becomes compacted when exposed to compaction risk.

It can be low, medium, high and very high depending on soil properties and a set of external factors like climate, soil use, etc.



6. Soil compaction



Method of assessment of soil compaction

Bulk density g cm^{-3} (A value of 1.6 g cm^{-3} or higher can be considered as an excessive bulk density)

Total porosity ($\%$, v v^{-1}) (A 40% porosity or lower is considered as restrictive porosity)

Main gaps for threat “soil compaction”

- 1. Lack of environmental policy implementation**
- 2. Promotion of sustainable land management practices**
- 3. Lack of knowledge to the farmers on cultivation practices**

7. Soil sealing

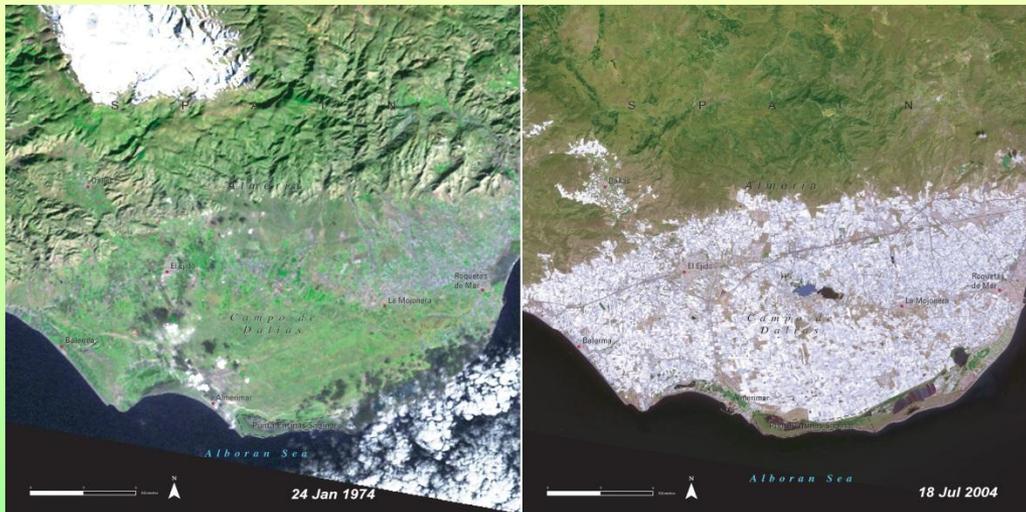
Expansion of urban and industrial areas in productive agricultural soils leads to complete or partial sealing of soil surfaces.

Degradation of wider soil functionality (slowing or eliminating infiltration of water, gaseous exchange with the atmosphere, etc).

Built-up areas now cover nearly 40% of the Mediterranean coastline.

3.9 million people are added to the Southern and Eastern Mediterranean countries each year.

Drastic land use changes in the Campo de Dalías in Andalusia, Spain over a 30 years



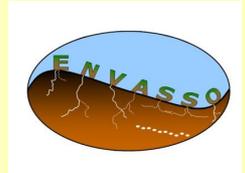
The Tevere River plain in Rome



7. Soil sealing

Method of assesement of soil compaction

The area of bio-productive, semi-natural, or natural land consumed by extension of the built environment (%).



Main gaps for threat “soil compaction”

1. Lack of environmental policy implementation
2. Lack on land use planning

8. Land desertification

An extreme stage of land degradation caused mainly by the soil degradation processes of soil erosion and salinization.

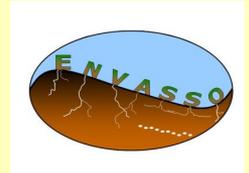


Especially important for Mediterranean Europe (Annex IV) and eastern Europe (Annex V).

8. Land desertification

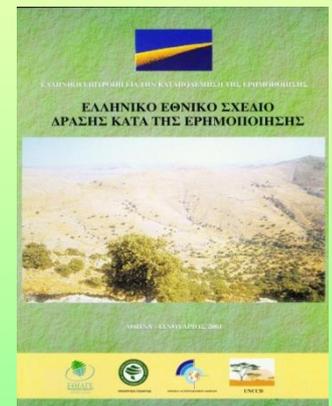
Method of assessement of soil compaction

1. Vulnerability to desertification - MEDALUS III methodology including the qualities soil, vegetation, climate and land management
2. Wild fires (burned area km² year⁻¹)



Main gaps for threat “soil compaction”

1. Lack of environmental policy implementation
2. Inadequate drivers for farmers to apply sustainable land management practices
3. National action plans not implemented
4. Limited knowledge transfer to land users



Some of the most important EU research projects on land degradation (especially on soil erosion, soil salinization, land desertification)

MEDALUS I, II, III - 1991/1998 - <http://www.medalus.demon.co.uk>



MEDACTION - 2001/2004 <http://www.icis.unimaas.nl/medaction/>



DESERTLINKS - 2001/2004 <http://kcl.ac.uk/projects/desertlinks/>



MEDRAP Regional action plan for Annex IV countries 2001/2004



LADAMER - 2002-2005

<http://www.ladamer.org/ladamer/>



REACTION

- 2003-2005 <http://www.gva.es/ceam/reaction/>



DESURVEY 2005/2010 <http://www.desurvey.net/>



DESIRE – 2007/2012 <http://www.alterra.wur.nl>



LEDDRA 2010/2014 <http://leddra.aegean.gr>



THANK YOU

***Σας Ευχαριστώ για την προσοχή
σας***