# SoilTrEC

## Soil Transformations in European Catchments

Coordinating Action: Large-Scale Integrating Project

Grant Agreement No. 244118

Coordinator: Steve Banwart, U. Sheffield, UK

and

Prof. Nikolaos Nikolaidis, Technical U. Crete

# SoilTrEC Partners

University of Sheffield, UK

N. Poushkarov Institute for Soil Sciences, Sofia, Bulgaria

Technical University of Crete

Deltares, The Netherlands

European Commission Joint Research Centre

University of Iceland

Wageningen University, The Netherlands

Austrian University of Natural Resources and Applied Life Sciences

NERC – Centre for Ecology and Hydrology, UK

Swiss Federal Institute of Technology (Zurich)

Czech Geological Survey

Chinese Academy of Agricultural Sciences

The Pennsylvania State University

Swedish University of Agricultural Sciences

Centre National de la Recherche Scientfique, Strasbourg, France

# SoilTrEC Objectives

The aims of SoilTrEC are to address the priority research areas identified in the EU Soil Thematic Strategy and to provide leadership for a global network of Critical Zone Observatories (CZOs) committed to soils research.

Specific Objectives are:

1. Describe from 1st principles how soil structure impacts processes and function in soil profiles,
2. Establish 4 EU Critical Zone Observatories to study soil processes at field scale,
3. Develop a Critical Zone Integrated Model of soil processes and function,
4. Create a GIS-based modelling framework to delineate soil threats and assess mitigation at EU scale,
5. Quantify Impacts of changing land use, climate and biodiversity on soil function and economic value,
6. Form with international partners a global network of CZOs for soils research, and
7. Deliver a programme of public outreach and research transfer on soil sustainability.

# The Critical Zone: The EU's Natural Capital

**Soil Functions**

- Food and fibre production
- Filtering water
- Transforming nutrients
- Carbon storage
- Biological habitat
- Gene pool

EU Thematic Strategy for Soil Protection, EC (2006) outlines soil functions and soil threats.

# Critical Zone Ecosystem Services

## Economic Flows - The Chain of Impact

GHGs and Climate Regulation

Food and fibre production

Carbon Storage

Nutrient Transformation

Biological Habitat
Gene Pool

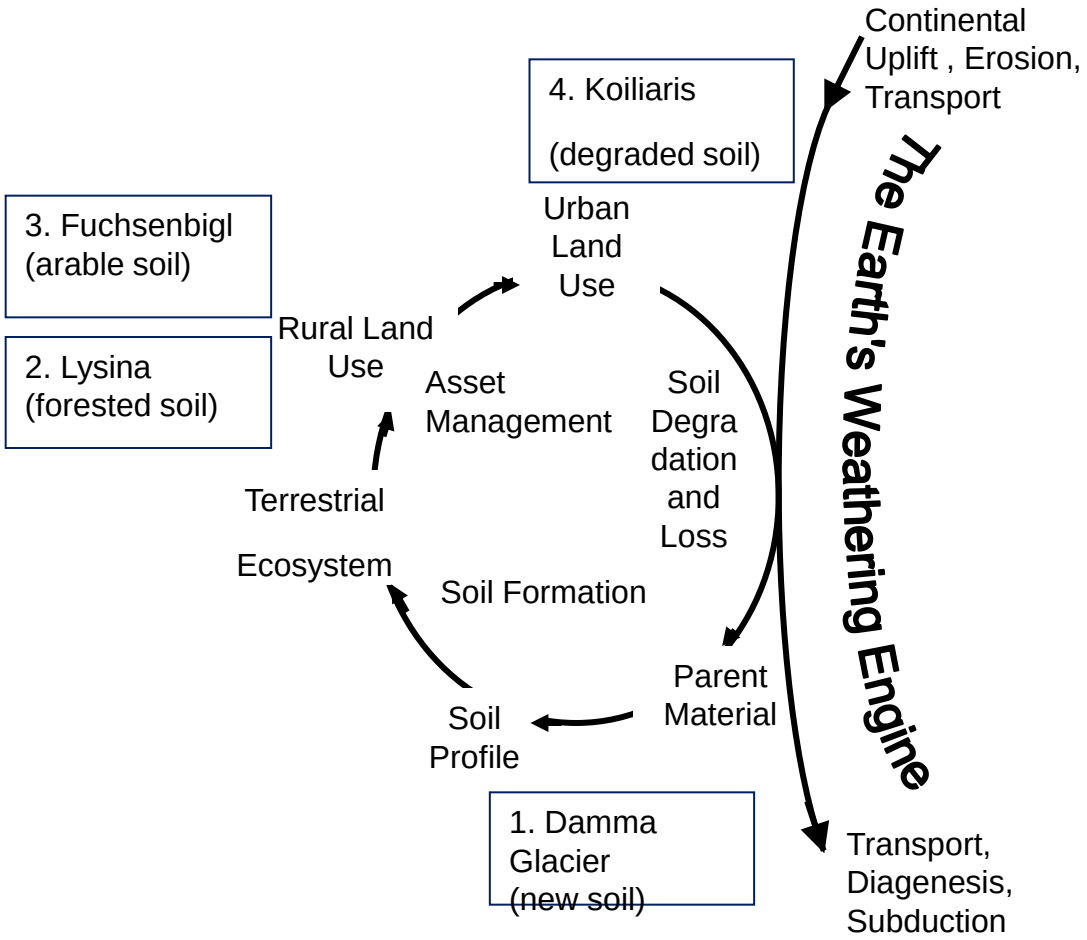
Filtering Water

Parent Material – forming soil


*Baseflow to rivers*

Attenuating contaminants
Storing and transmitting water

# Critical Zone Observatories




Banwart et al. (2011). Vadose Zone Journal, CZO special issue, accepted.

# Damma Glacier CZO Switzerland

# Fuchsenbigl-Marchfeld CZO, Austria

PI: Winfried Blum, BOKU

# Lysina CZO, Czech Republic

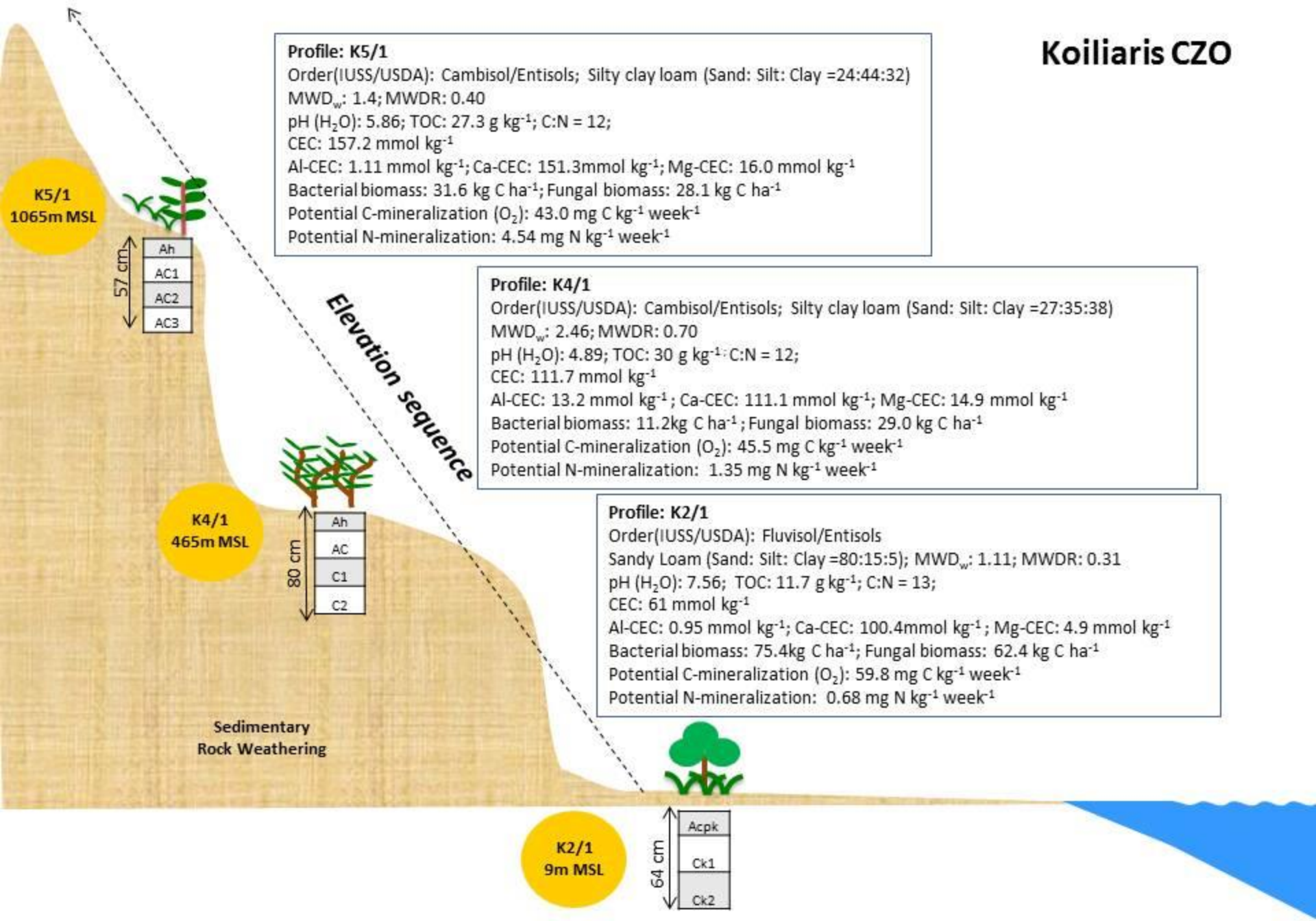
Even-Aged Norway Spruce Plantation at Lysina

Czech Geological Survey
Pis: Martin Novak, Pavel Kram

# Koiliaris CZO, Crete, Greece

PI: Nikolaos Nikolaidis, TUC

# Koiliaris CZO




Note: Not to Scale

# Soil Function Status of Koiliaris CZO

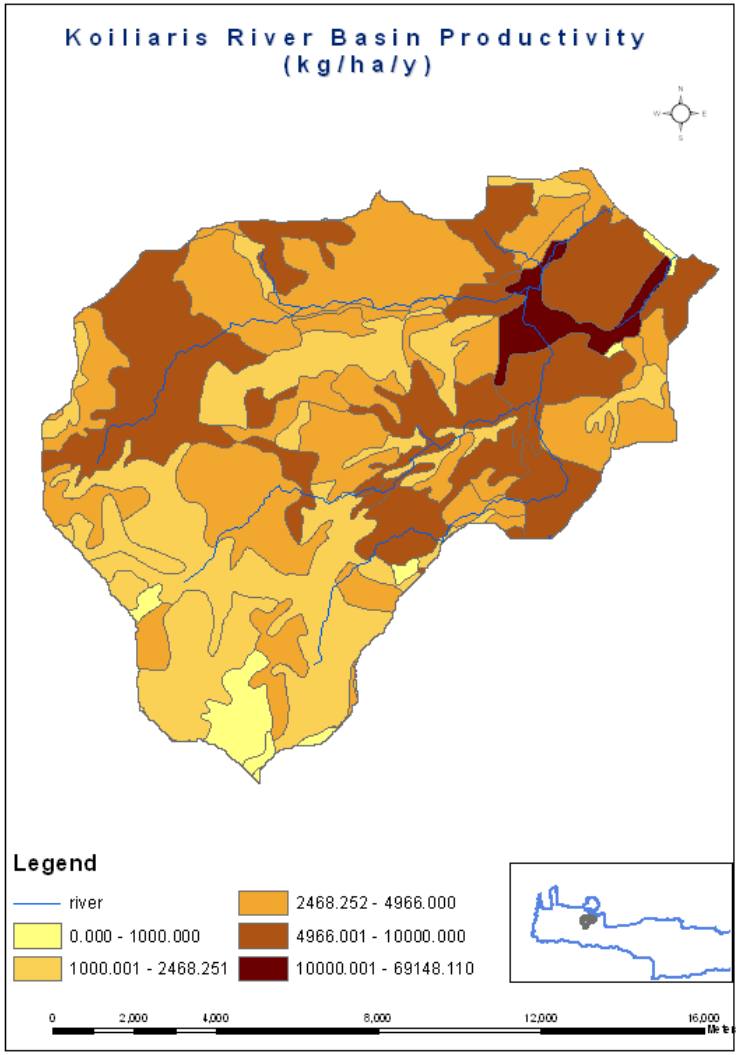
1. Biomass Production
2. Biodiversity
3. Carbon Storage
4. Water Filtration and Transformation

# Soil Threats Status of Koiliaris CZO

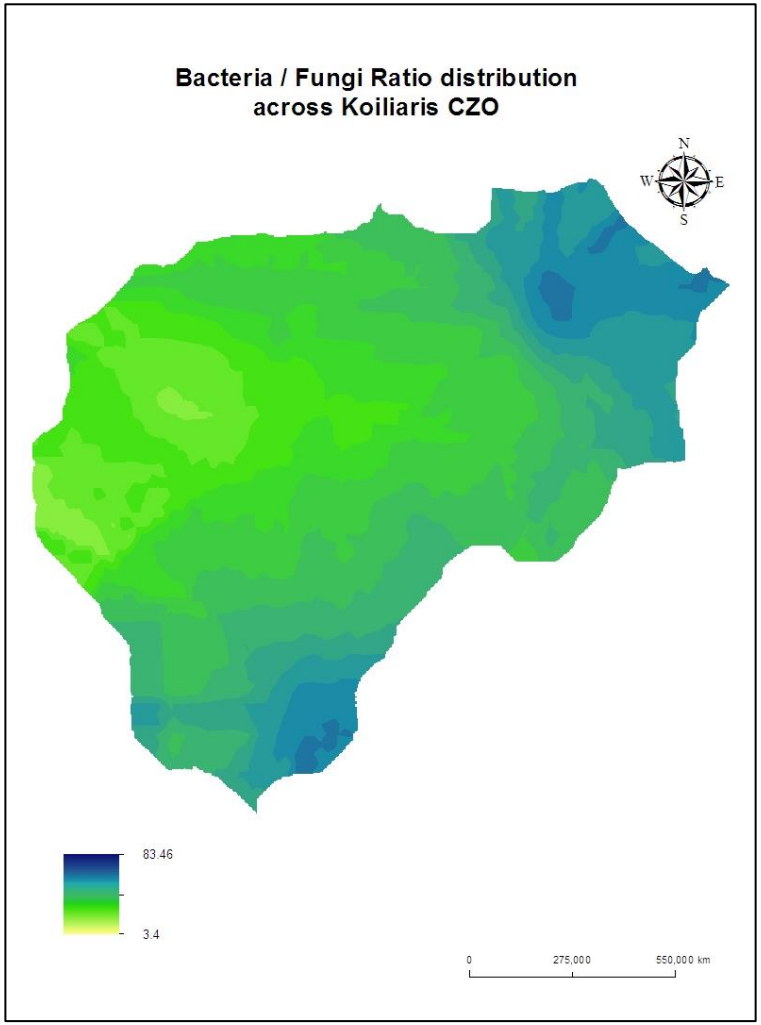
1. Erosion
2. Loss of Biodiversity
3. Loss of Carbon
4. Pollution

# Soil Function Status of Koiliaris CZO

## Biomass Production

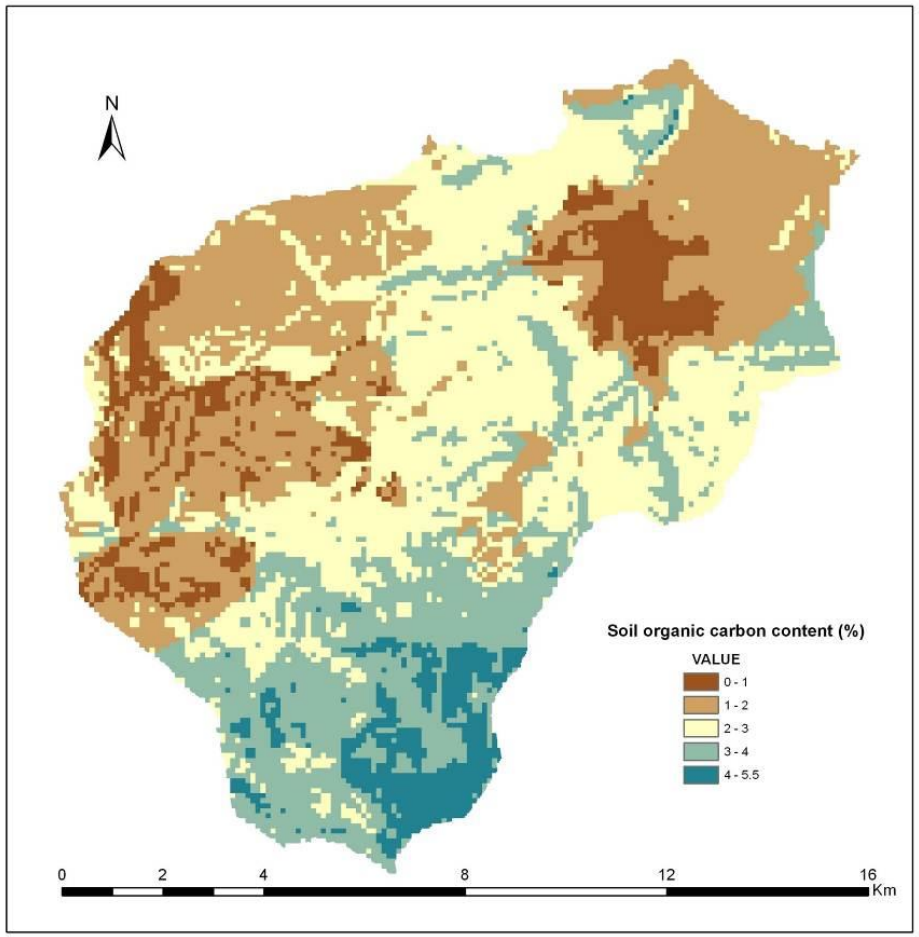



## Biodiversity

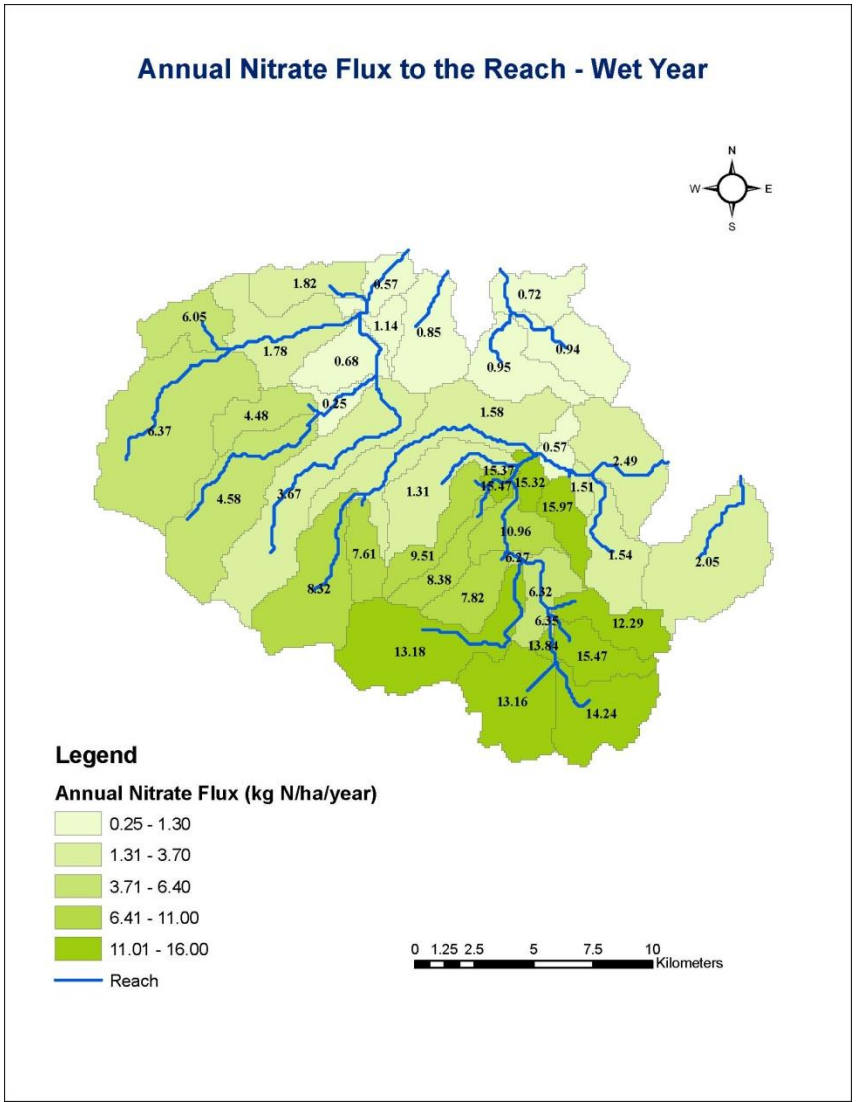


# Soil Function Status of Koiliaris CZO

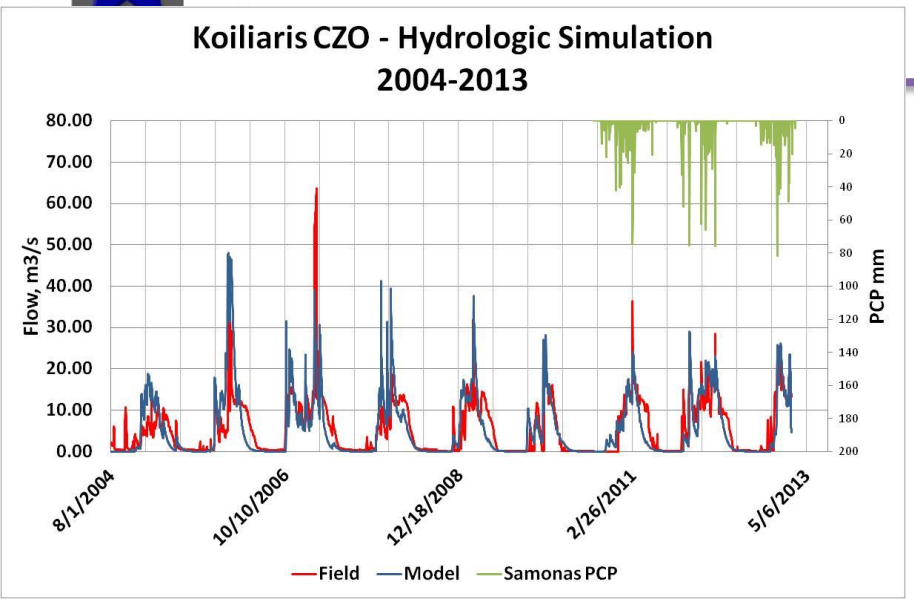
## Carbon Sequestration



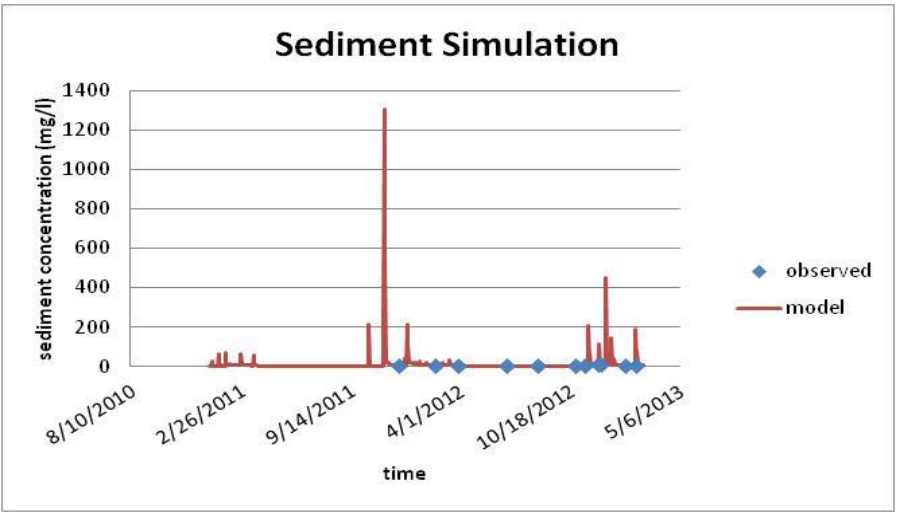

## Water Filtration and Transformation

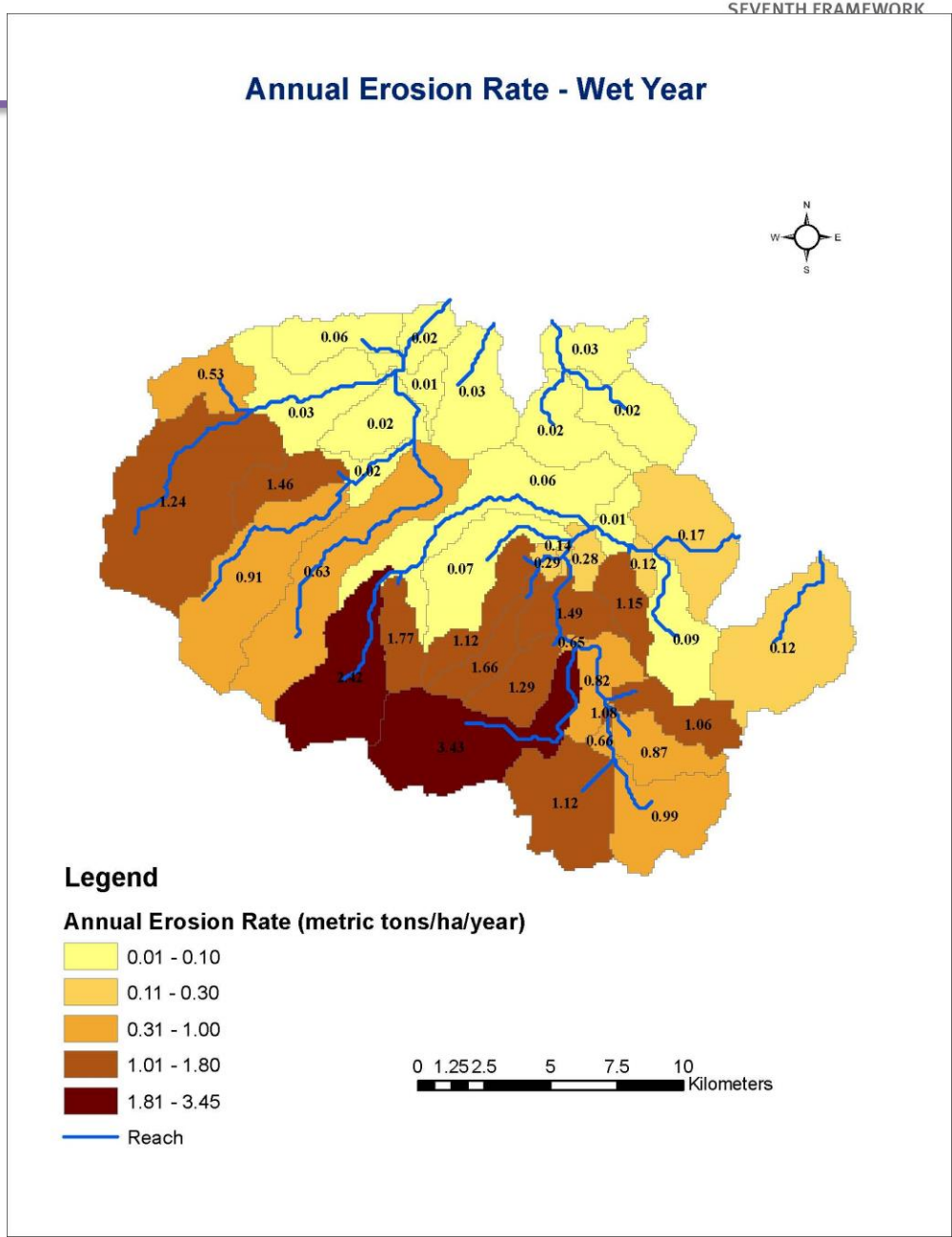


# Soil Threats – Erosion at Koiliaris CZO

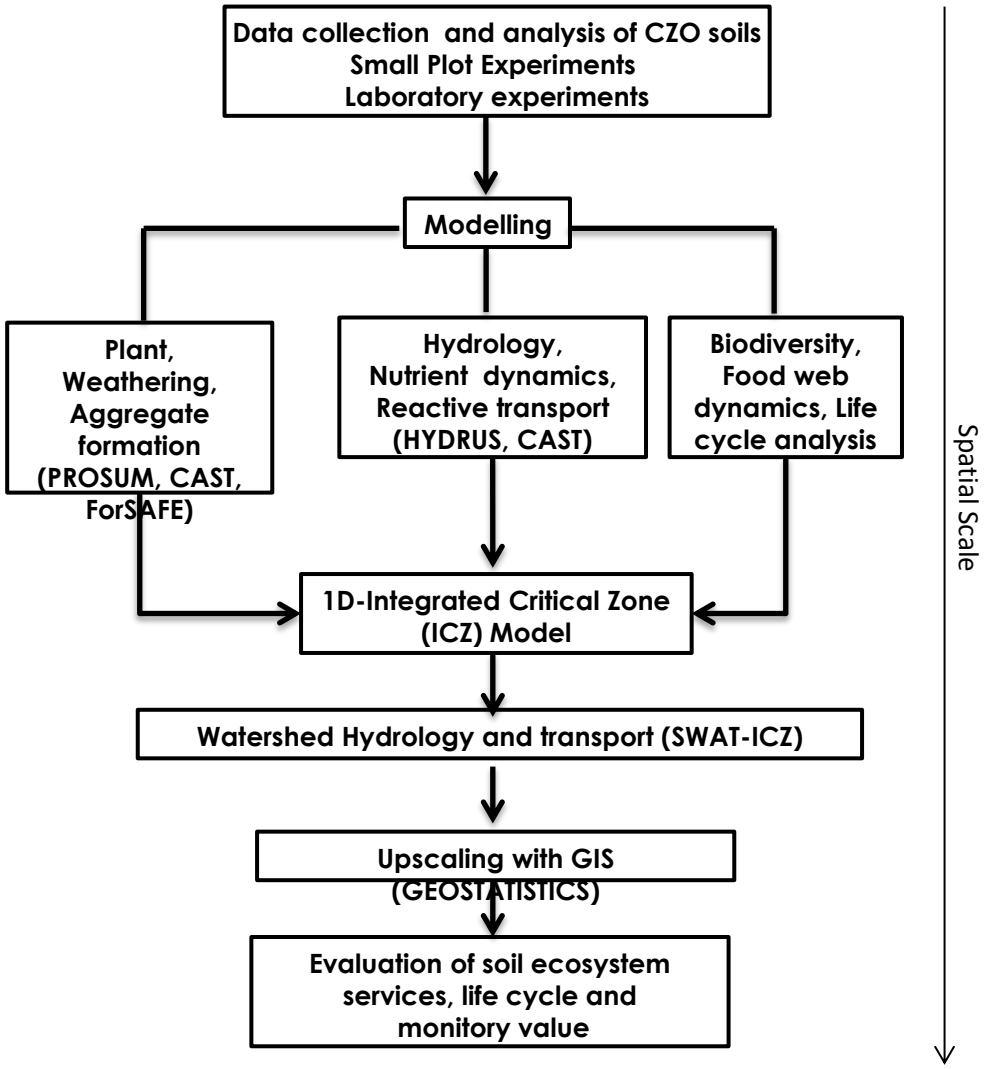



## SWAT Model Simulations

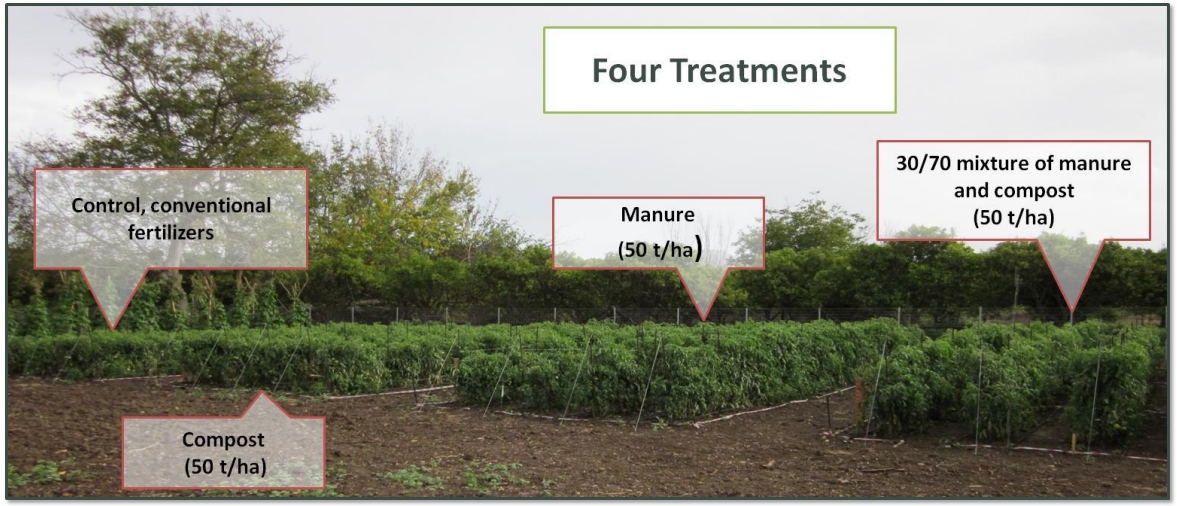


# Modelling Structure in SoilTrEC

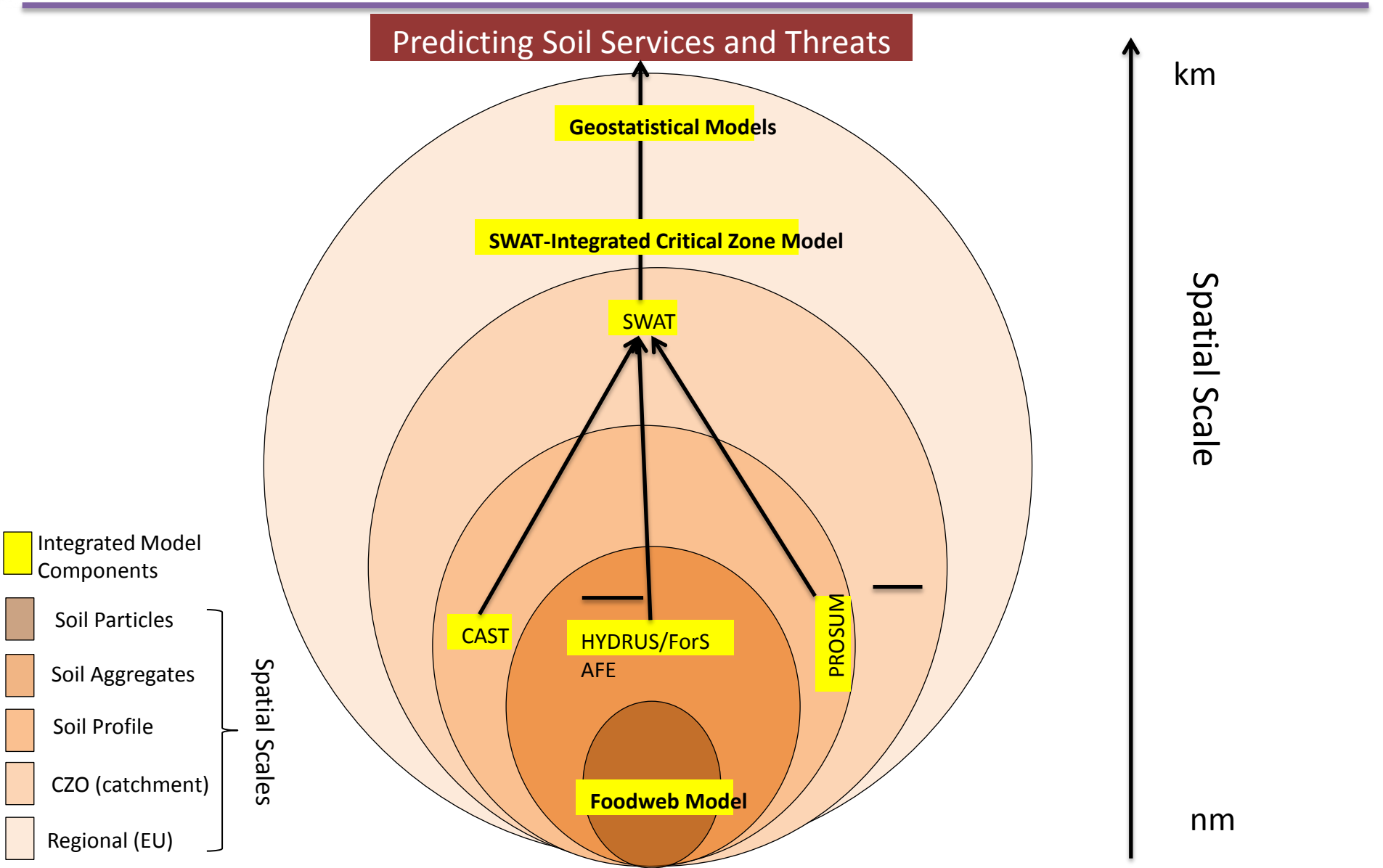


# Carbon Amendments – Soil Fertility and Structure




| Properties |
|---|
| Water content profiles |
| Field capacity |
| Bulk density |
| Soil texture |
| WSA determination |
| Soil pH and electrical conductivity |
| Organic C and total N |
| Extractable P |
| PMN (Potential Mineralizable Nitrogen) |
| EMN (Exchangeable Mineral Nitrogen) |
| Net N mineralization rate |
| Net nitrification rate |
| Bulk chemical analysis |

# Upscaling Data and Model Results to Assess Threats at EU Scale



# Dissemination and Exploitation Plan

- Partners as hubs for stakeholder network
  - Stakeholders
  - Materials
  - Activities
- Network comprises currently:
  - 4 International: GSP, FAO; UNEP, SCOPE, CLRTAP
  - 22 national and regional agencies and advisory bodies
  - 22 land use and farming producers associations, NGOs, and supply chain companies
  - 14 professional societies and academic organisations with dissemination

# Materials and Activities

- Building dissemination materials by work package
  - Overview of challenges and rationale for RTD
  - Key results and implications for soil management
- Centrally hosted by Coordinator
  - Stakeholder database
  - Web pages organised by work package
  - Science summaries and policy briefs as downloads
  - Electronic dissemination to stakeholder network
- Road show in final year
  - Presentation and materials in English
  - Looking for large annual pan-European meetings of Soil and Farming Associations

# International CZO Networks

International Critical Zone Observatory Workshop, 9-11 November, 2011

Collaboration on:

- Shared sites, data and computational simulation approaches
- PhD and post-doc training
- Dissemination and commercial translation

Shared experimental design to tackle global challenge of critical zone adaptation to environmental change

- European leadership on adaptation science for land use, water resources, agriculture
- Capacity to forecast change and design strategies to mitigate and adapt
- Critical Zone Observatories along gradients of environmental change
  - Advanced facilities to focus multidisciplinary expertise for rapid advances
  - RTD translation and commercial development, testing and demonstration
  - Centres for dissemination, training and global leadership and collaboration

# Nature, 474, 151-152, 9 June, 2011

# COMMENT



G. MCDOWELL/NATUREPL.COM

When water is scarce, dust storms strip away the scant soil in Mali.

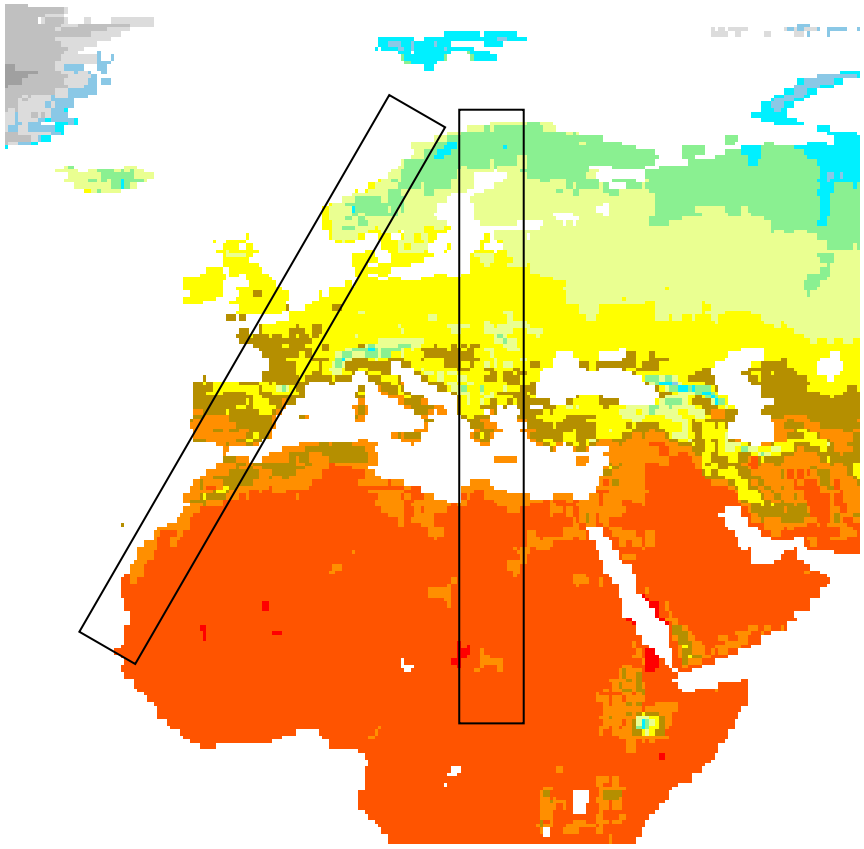
# Save our soils

Researchers must collaborate to manage one of the planet's most precious and threatened resources — for food production and much more, says **Steve Banwart**.

# International CZO Networks

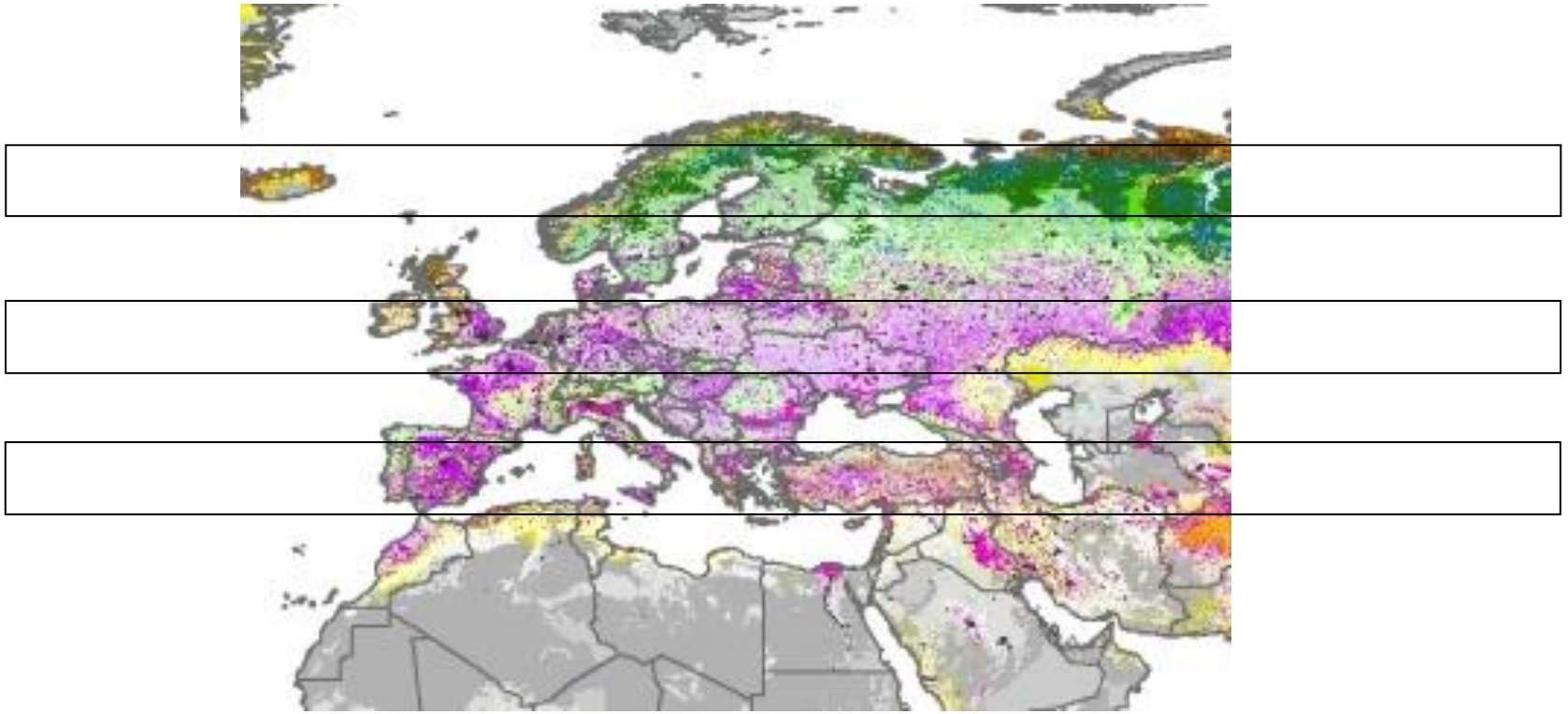
# Global Environmental Gradient Experiment

## CZOs Selected Along Planetary Gradients of Climate



# Global Environmental Gradient Experiment

## CZOs Selected Along Planetary Gradients of Land Use



# Future Priorities

Horizon 2020 should prioritise RTD for:

- Diagnois - key processes and metrics defining soil threats and soil functions and how to monitor and interpret these

  Priorisiation of urban soil, land use and ecosystems at city level

- Action step - what kind of agro-ecological strategies do we apply
  - restoration,
  - preservation
  - enhancement of soil functions and safe intensification of land use

- Linking networks and infrastructure

  Critical Zone Observatories (SoilTrEC), Long-Term Observatories (EcoFINDERS), Global Soil Biodiversity Initiative, Global Soil Partnership, TERENO (Germany), CRITEX-RBV (France), EXPEER (EC infrastructure), … and many others

# RTD Opportunities for Horizon 2020

## from SoilTrEC International Workshop

1. Integrate sensing technology, e-infrastructure and modelling for simulation, forecasting , mapping and monitoring of essential terrestrial variables for water supplies, food production, biodiversity and other major benefits

   – a present and future inventory of European natural capital.

2. Integrate theory, data and mathematical models from the natural- and social- sciences, engineering, and technology to simulate, value, and manage Critical Zone goods and services and their benefits to people

   - process understanding to manage the inventory.

3. Quantify by observations the resilience, response and recovery of the CZ and its integrated geophysical-geochemical-ecological functions to perturbations such as climate and land use changes using Critical Zone Observatories along climatic and land use gradients

   - management to mitigate and adapt to environmental change.

# SoilTrEC Overview Publications


Banwart S.A. and SoilTrEC Partners (2011). Save our Soils. Comment article, Nature, 474, 151-152, 9th June.

Banwart S.A. et al. (2011). Assessing soil processes and function across an international network of critical zone observatories: research hypotheses and experimental design. Special Issue on Critical Zone Observatory research, Vadose Zone Journal, 10, 974–987.

Banwart S.A. et al. (2012). Soil processes and functions across an International Network of Critical Zone Observatories: introduction to experimental methods and initial results. Special issue on erosion and weathering. Comptes Rendus Geoscience, 344, 758-772

Nikolaidis N. and Bidoglio G. (2011). Modeling of Soil Organic Matter and Structure Dynamics. Sustainable Agriculture Reviews, in press.

SOILTREC

SEVENTH FRAMEWORK PROGRAMME

# END