SoilTrEC

Soil Transformations in European Catchments

Coordinating Action: Large-Scale Integrating Project

Grant Agreement No. 244118

Coordinator: Steve Banwart, U. Sheffield, UK

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

The Critical Zone: Treetop to Bedrock

Photo courtesy of NERC Centre for Ecology and Hydrology, Bangor, Wales, UK

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 Soil Functions

Impact chain – changing soil functions impacts the entire Critical Zone

Food and fibre production

Carbon Storage

Nutrient Transformation

Biological Habitat

Gene Pool

Runoff to rivers

Filtering Water

Parent Material – forming soil

Baseflow to rivers

Attenuating contaminants

Storing and transmitting wate

Photo courtesy of NERC Centre for Ecology and Hydrology, Bangor, Wales, UK

Soil threats - soil erosion

Satellite image, ERDF Deltanet Project: www.deltanet-project.ec

Soil threats - desertification, the loss of soil carbon

Soil threats – changing biodiversity




Soil threats - loss of fertility

- Compaction

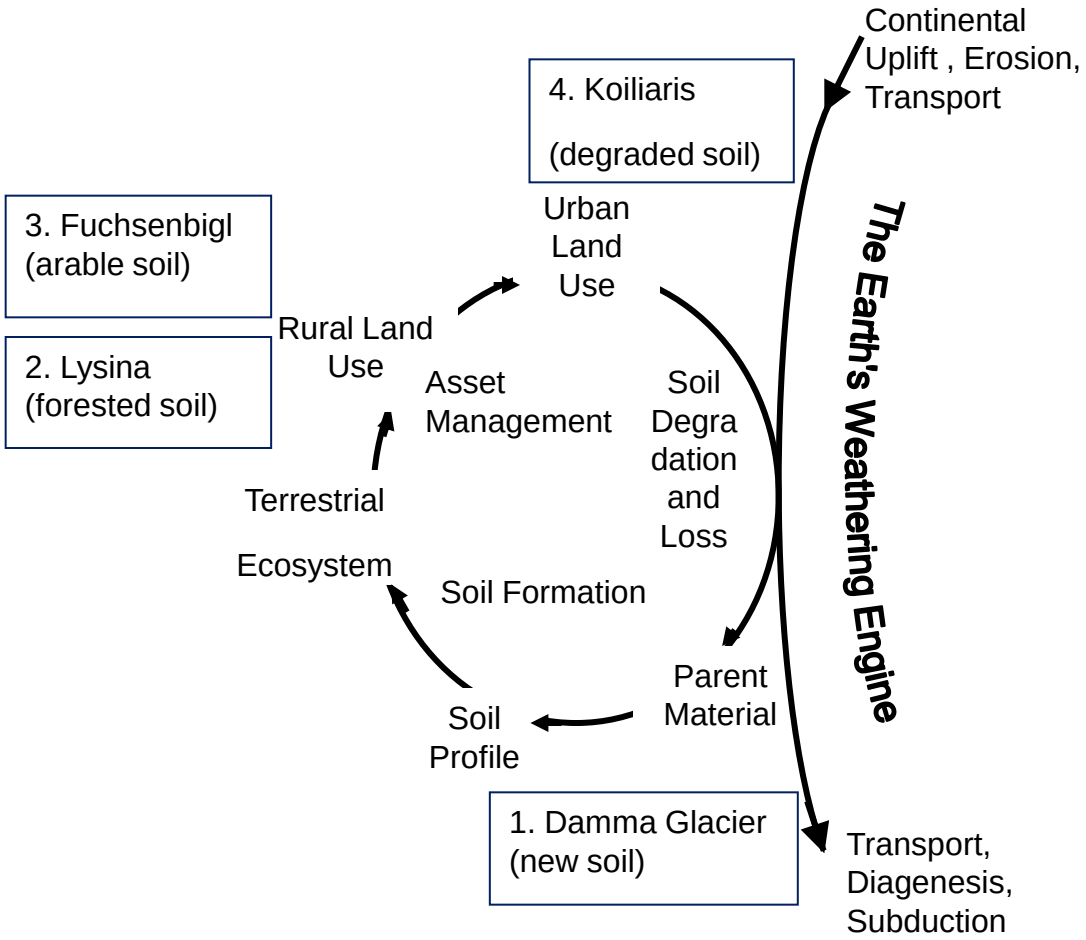
- Salinisation

- Sealing

- Contamination

Critical Zone Observatories

research sites selected along the life cycle of soil function



Banwart et al. (2011). Vadose Zone Journal, CZO special issue, 10, 974–987 .

The Golden Aggregate

Empirical evidence of an “agronomically favourable” soil structure

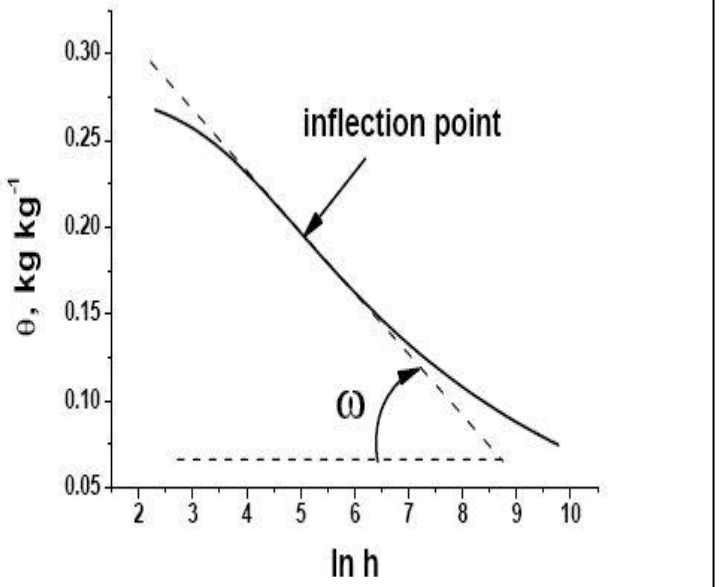


Fig. 3. Soil water retention curve showing water content θ vs. pressure head h (cm). The inflection point is where the slope (S=tanω) changes from positive to negative.

- Described by water retention curve
- $0.25mm < d_p < 10mm$
- >60% of particle mass in this range
- Aggregates of
  - Parent rock
  - clay minerals
  - Nanometric oxides
  - organic matter
- Ionic composition of soil water

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.

Damma Glacier CZO Switzerland

Fuchsenbigl-Marchfeld CZO, Austria

PIs: Winfried Blum and Georg Lair, 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

Simulation Results

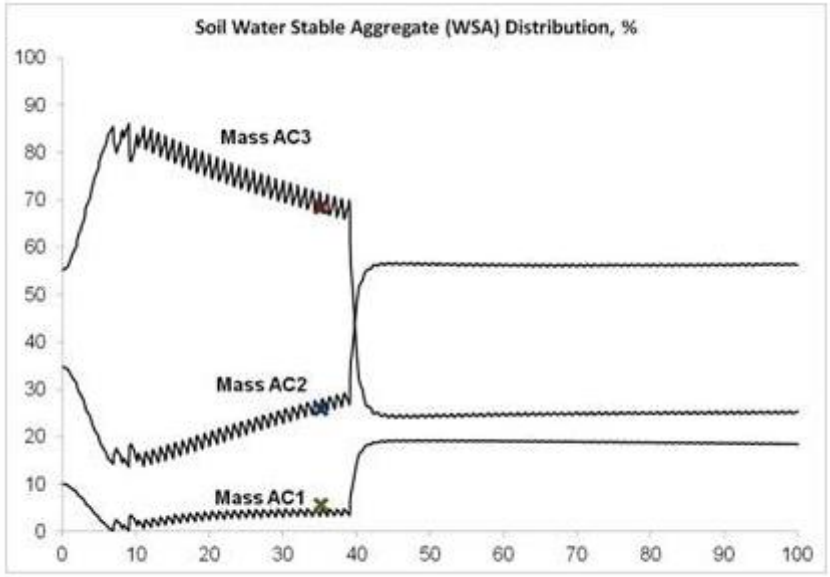
Soil carbon and aggregate dynamics with land use change

Fotini Stamati and Nikolaos Nikolaidis, Technical U. Crete

Arable land converted to set aside land use

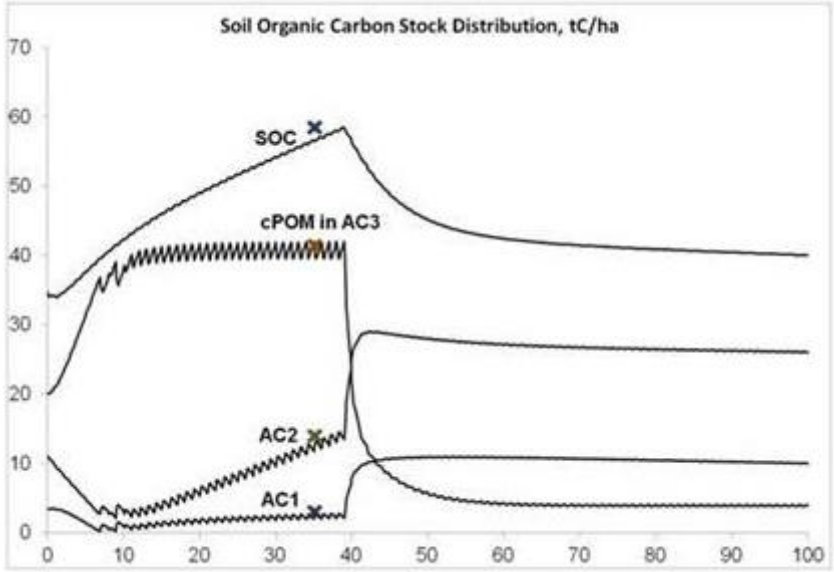
1. Arable land converted to set aside at t=0
2. Set-aside non-tilled for 40 years
3. Conversion back to arable land after 40 years

Aggregate Size Dynamics



Time, years

Carbon Dynamics by Aggregate Size



Time, years

Banwart et al., 2012, Comptes Rendus Geoscience, in press.

International CZO Networks

International Critical Zone Observatory Workshop

U. Delaware, 9-11 November, 2011

Collaboration on:

- Shared sites and data
- Numerical simulation approaches
- PhD and post-doc training

Shared experimental design to tackle 6 key science questions

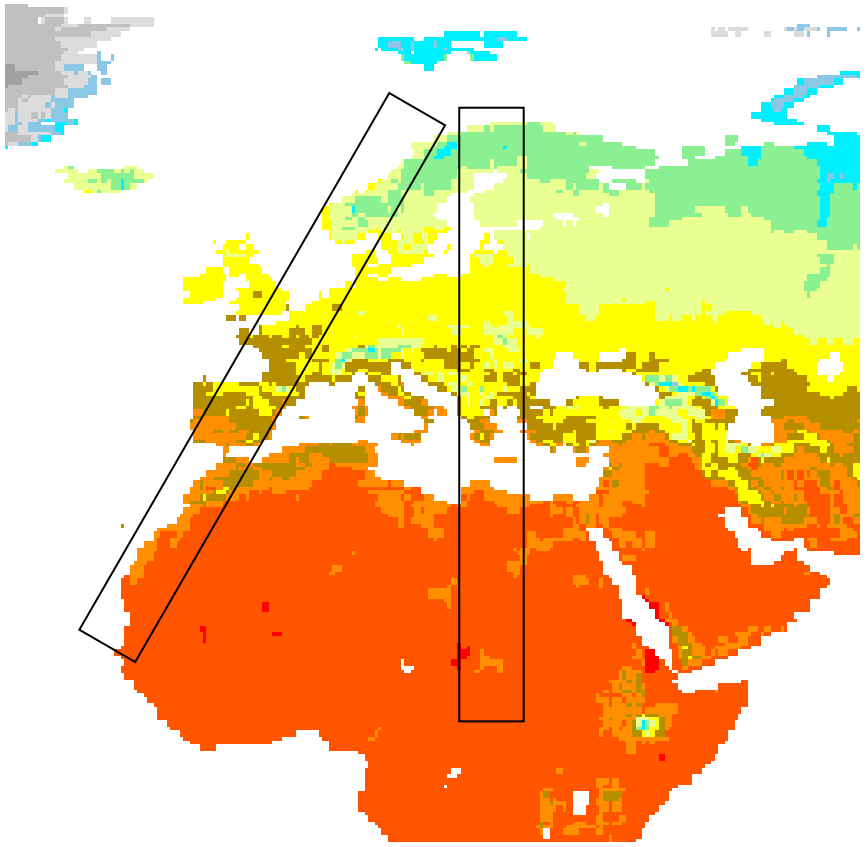
- Networks of CZOs along global environmental gradients
- Study sensitivity of CZ architecture and soil functions to environmental change
- Link with other initiatives, broaden geographical footprint along gradients

International CZO Networks

Critical Zone Observatories and associated field sites attending the U. Delaware, USA international Workshop November, 2011

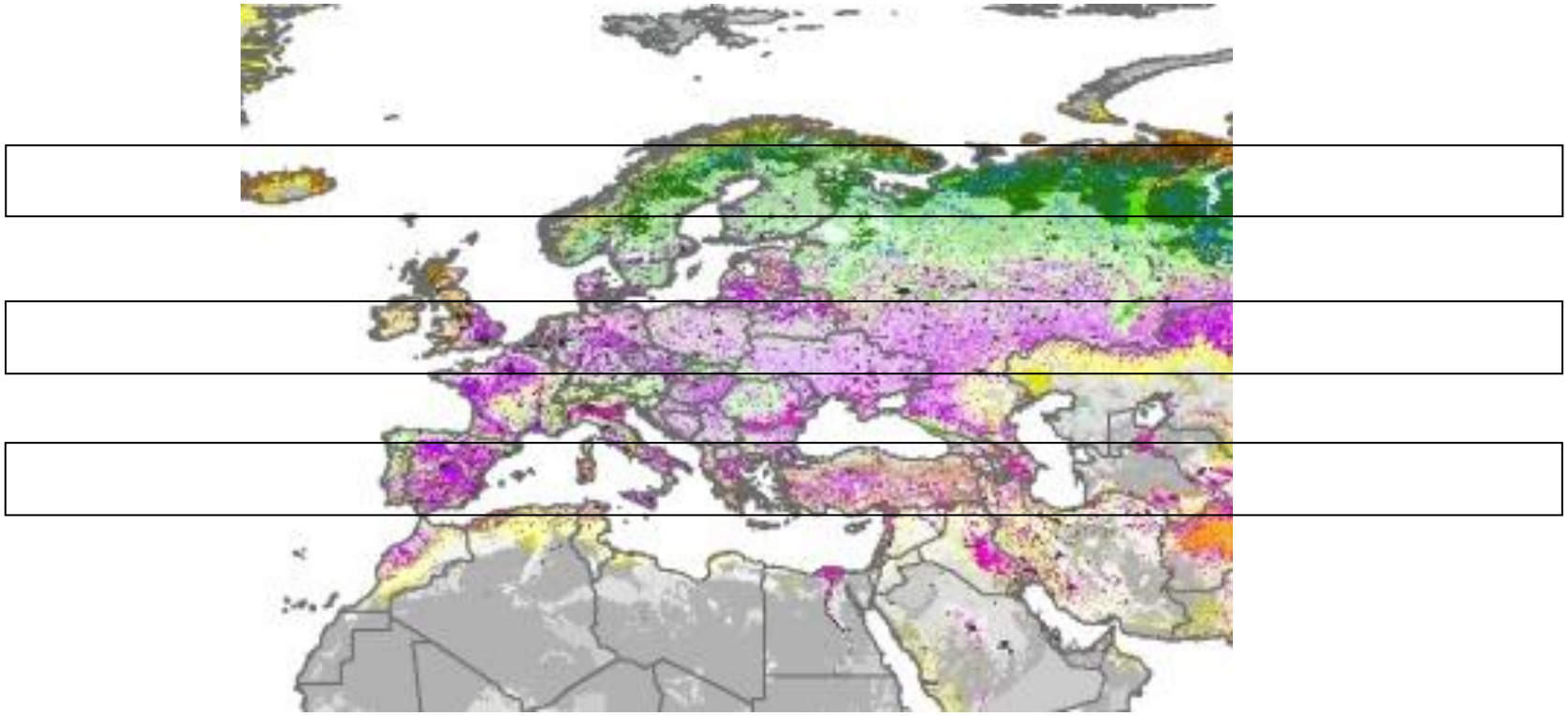
Global Environmental Gradient Experiment

CZOs Selected Along Planetary Gradients of Climate



Global Environmental Gradient Experiment

CZOs Selected Along Planetary Gradients of Land Use



Progress and Plans

Current status

- Integrated model is running
- Data compiled for 4 main CZOs
- Frameworks in place for decision support using LCA and ecological ecomomics

- Next 12 months
- Expand integrated model to catchment scale
- Upscale to assess soil threats
- Develop case studies using decision support tools

SoilTrEC Overview Publications

1. Banwart S.A. (2011). Save our soils. Commissioned Comment article ,Nature, 474, 151-152, 9th June.
2. Banwart S.A. et al. (2011). Assessing soil processes and function across an international network of critical zone observatories: research hypotheses and experimental design. Invited contribution to special issue on Critical Zone Observatory research,Vadose Zone Journal, 10, 974-987.
3. Nikolaidis N. and Bidoglio G. (2011). Modeling of Soil Organic Matter and Structure Dynamics. Sustainable Agriculture Reviews, in press.
4. Banwart S.A. et al. (2012). Assessing soil processes and function across an international network of critical zone observatories: introduction to experimental methodology and initial results. Invited contribution to special issue on erosion and alteration. Comptes Rendu Geosciences, special issue on land erosion and transformation, in press

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