



Estación Experimental de Aula Dei

JRC - Erosion Modelling Workshop, Ispra  
2017



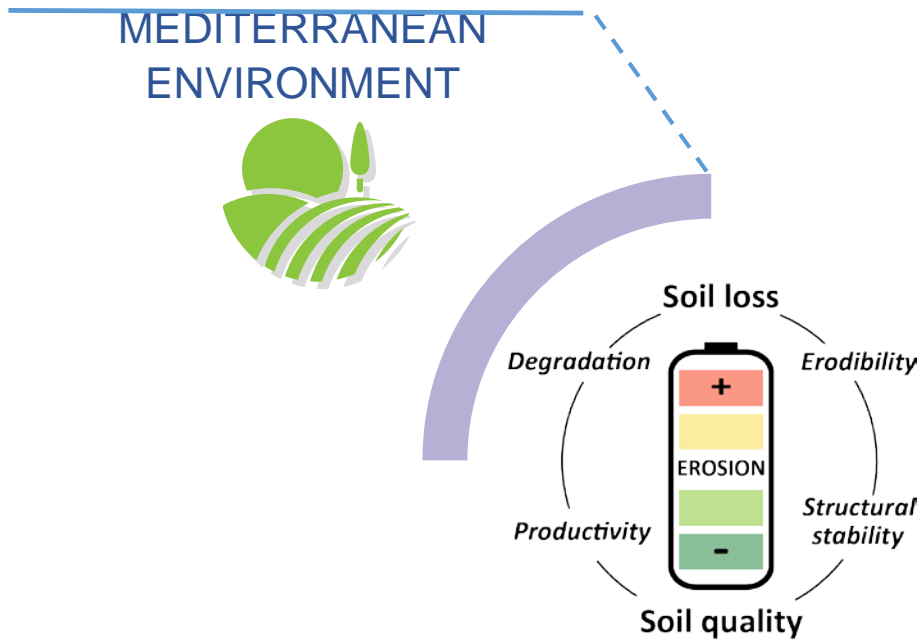
# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

**Laura Quijano**

**Erosion, and Soil and Water Evaluation Group EEAD-CSIC, Spain**



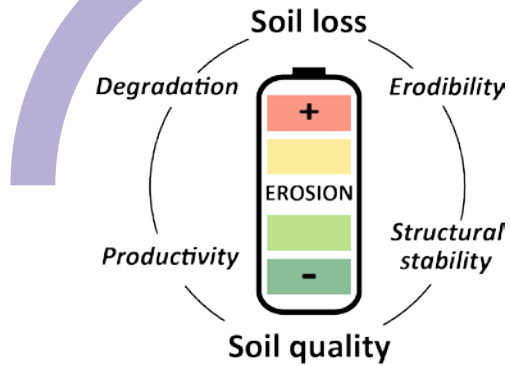
# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems



# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

Prolonged dry periods followed by heavy erosive rains on steep slopes

MEDITERRANEAN ENVIRONMENT



# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

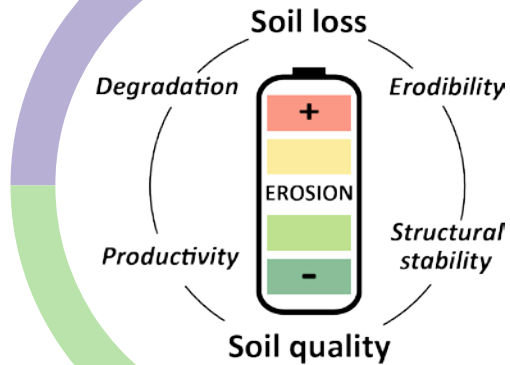
Prolonged dry periods followed by heavy erosive rains on steep slopes

MEDITERRANEAN ENVIRONMENT



Agricultural mismanagement, deforestation, overgrazing, forest fires, and construction activities

LAND MANAGEMENT



# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

Prolonged dry periods followed by heavy erosive rains on steep slopes

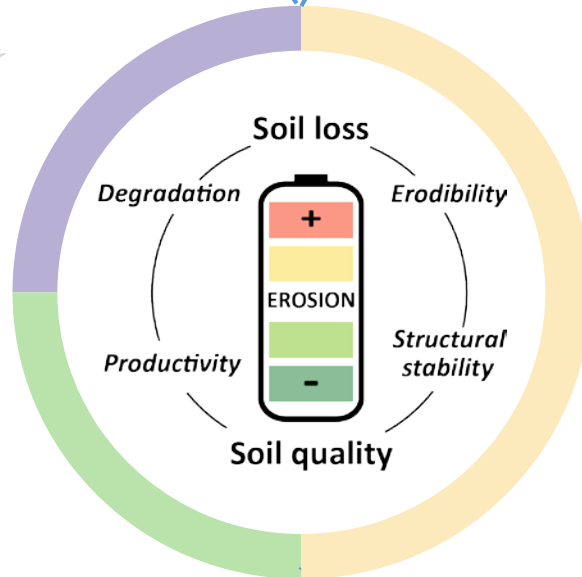
MEDITERRANEAN ENVIRONMENT



Agricultural mismanagement, deforestation, overgrazing, forest fires, and construction activities

LAND MANAGEMENT

The significance of soil erosion on soil particles distribution and associated SOC and  $^{137}\text{Cs}$



# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

Prolonged dry periods followed by heavy erosive rains on steep slopes

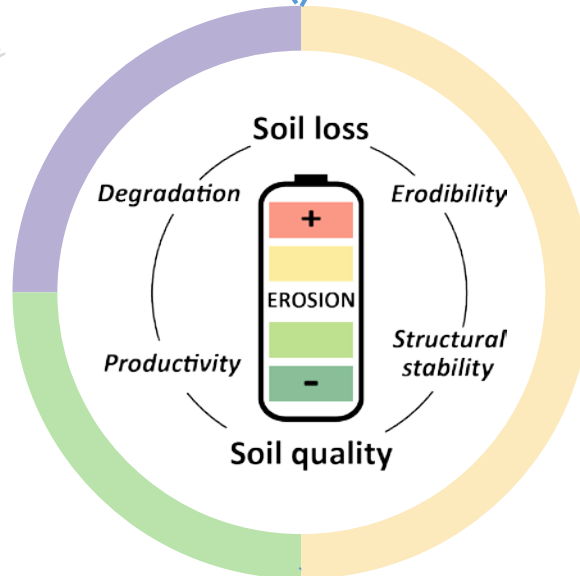
MEDITERRANEAN ENVIRONMENT



Agricultural mismanagement, deforestation, overgrazing, forest fires, and construction activities

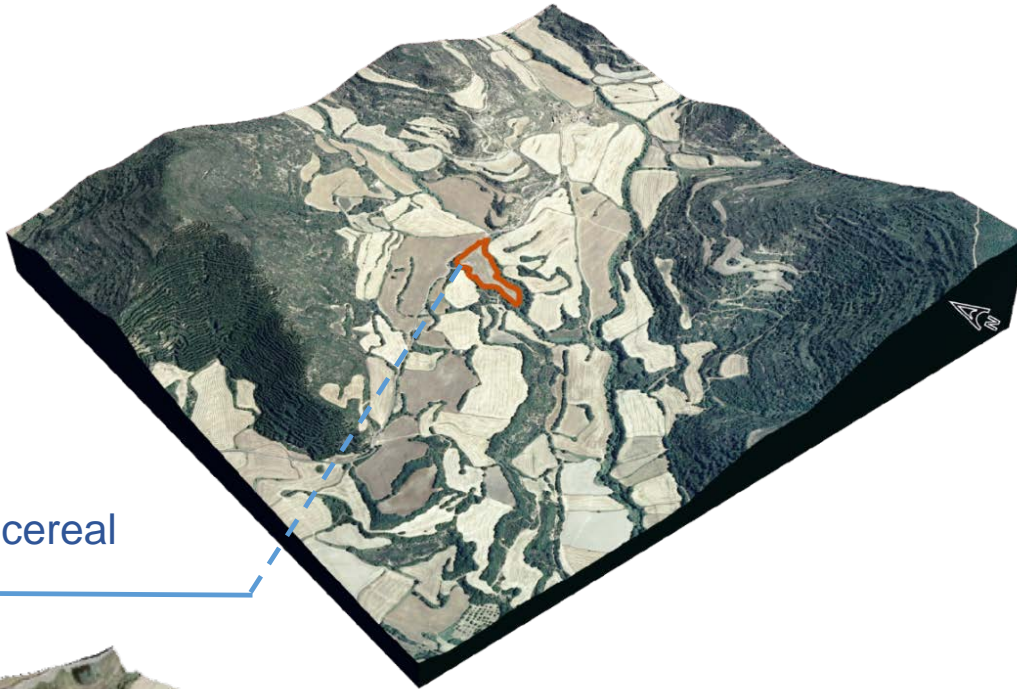
LAND MANAGEMENT

The significance of soil erosion on soil particles distribution and associated SOC and  $^{137}\text{Cs}$



Modelling to evaluate the effect of changes in land management on SOC stocks and lateral carbon fluxes

# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems



1.6 ha cereal field



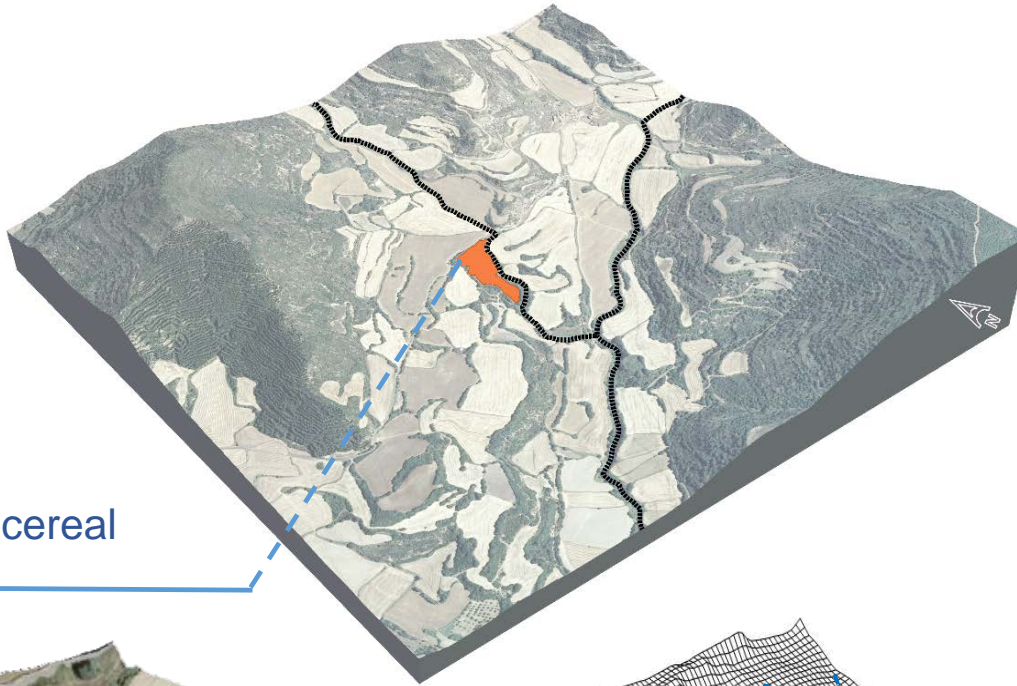
Elevation min: 622 max: 636  
Slope min 1 % max: 19 %



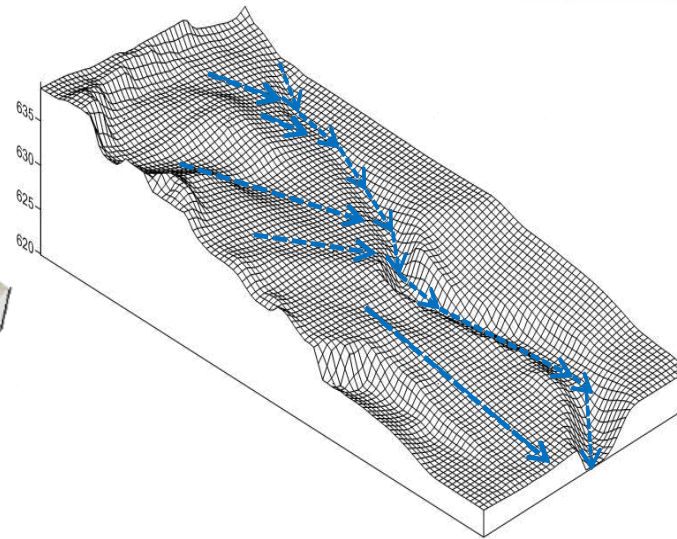
Mean annual T: 13 °C  
Mean annual P: 500



# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems



1.6 ha cereal field



Elevation min: 622 max: 636  
Slope min 1 % max: 19 %



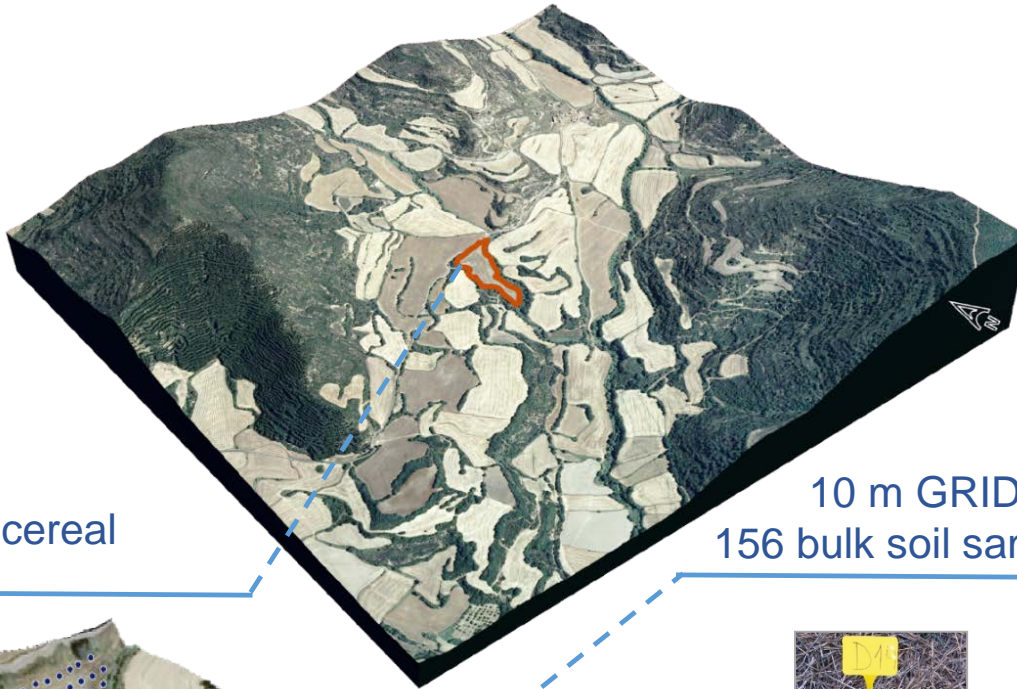
CONTINENTAL MEDITERRANEAN

Mean annual T: 13 °C  
Mean annual P: 500





# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems



Mean annual T: 13 °C  
Mean annual P: 500



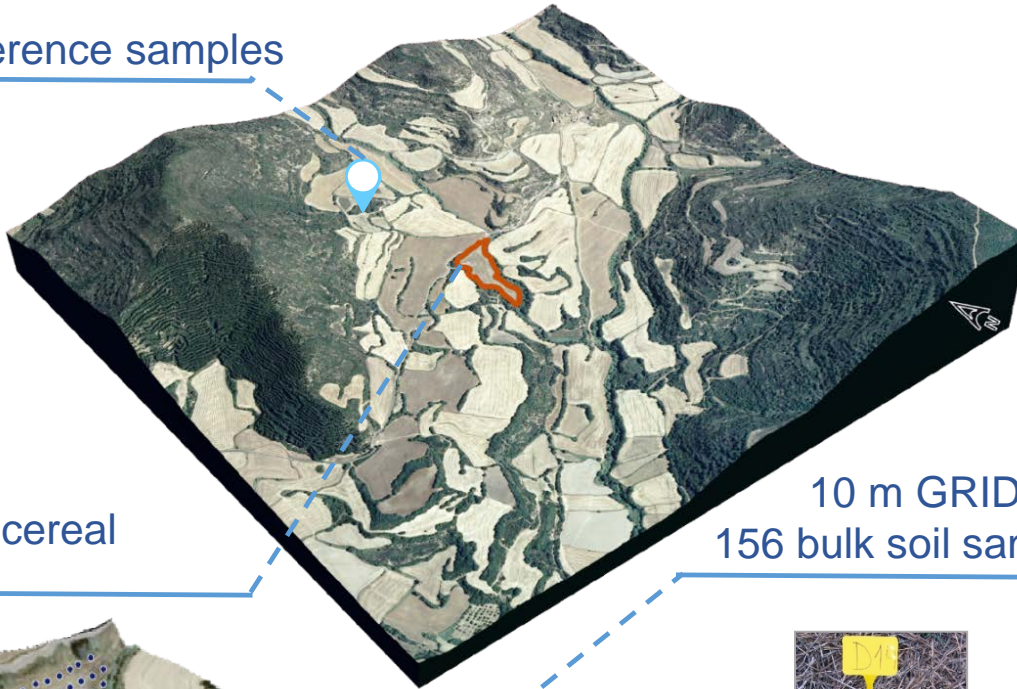
Calcisols



Elevation min: 622 max: 636  
Slope min 1 % max: 19 %

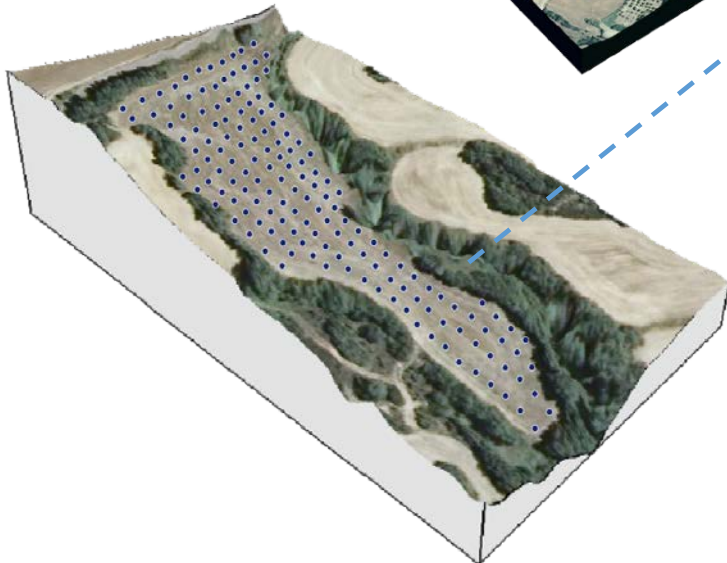
# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

21 reference samples



1.6 ha cereal field

10 m GRID  
156 bulk soil samples



Calcisols



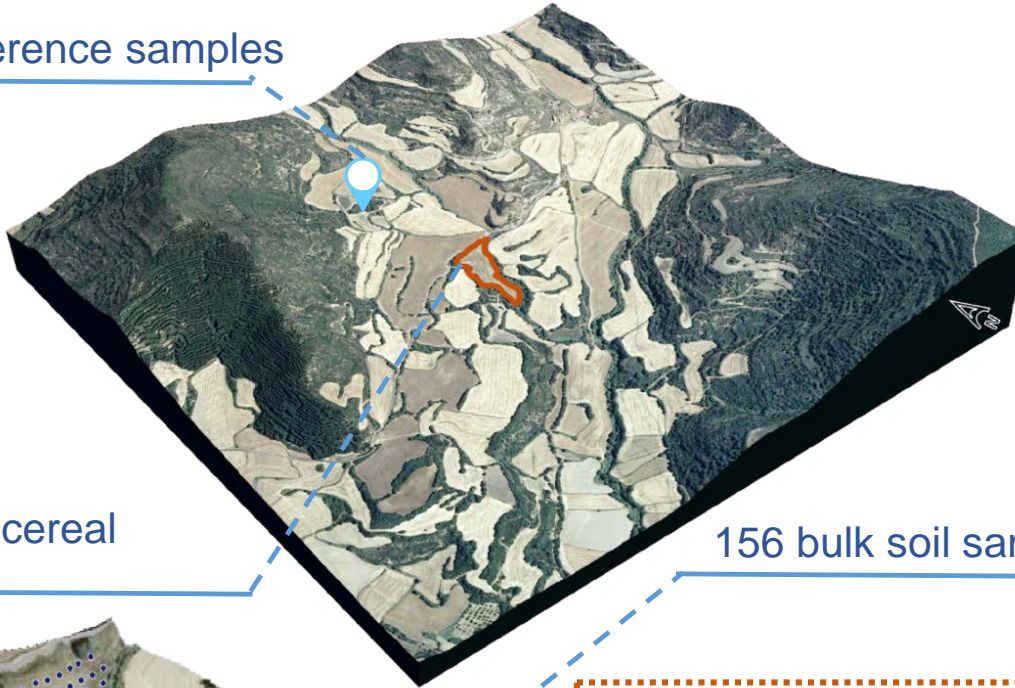
Mean annual T: 13 °C  
Mean annual P: 500



Elevation min: 622 max: 636  
Slope min 1 % max: 19 %

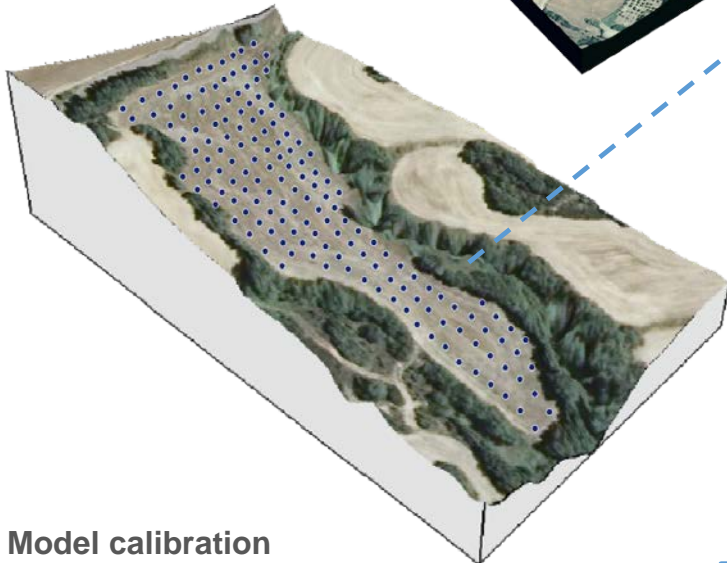
# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

21 reference samples



1.6 ha cereal field

156 bulk soil samples



Mean annual T: 13 °C  
Mean annual P: 500



## 2D Spatial analysis

Relate soil movement traced with  $^{137}\text{Cs}$  with the lateral variations of SOC



## SPEROS-C Van Oost et al. 2005

Simulate soil redistribution and its effect on SOC within the soil profile

### Model calibration

spatially distributed data  $^{137}\text{Cs}$  derived rates

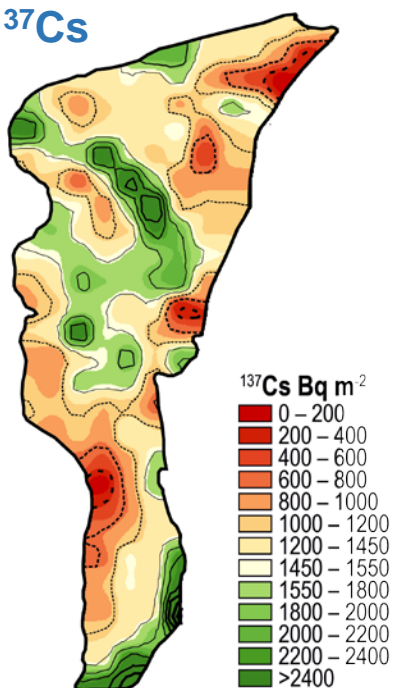
SOC stocks measured in the study samples

SPEROS model (Van Oost *et al.*, 2003)

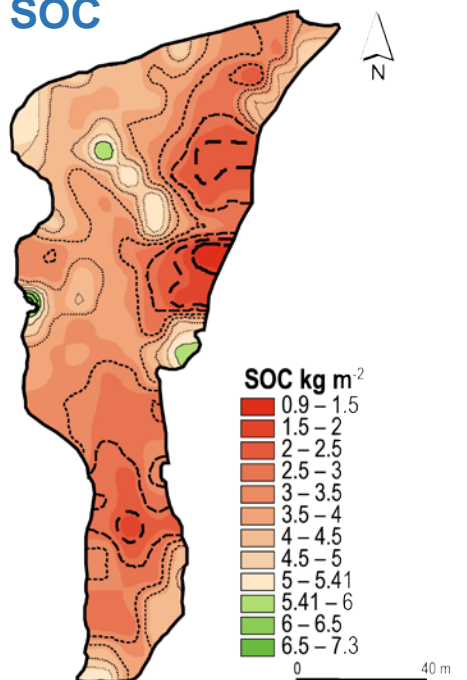
ICBM, Andrén and Käätterer, 1997).

# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

**$^{137}\text{Cs}$**



**SOC**

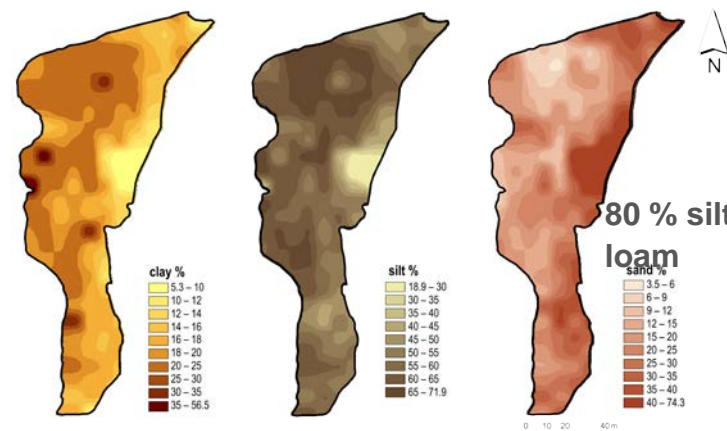
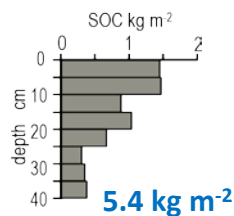
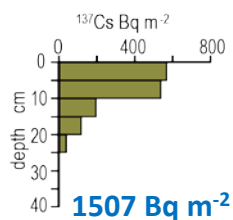
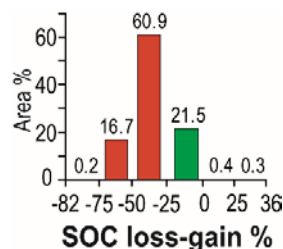
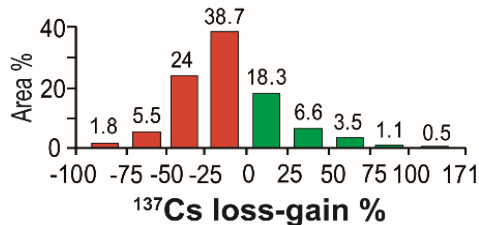


Contents lists available at ScienceDirect  
**Soil & Tillage Research**  
 Journal homepage: [www.elsevier.com/locate/still](http://www.elsevier.com/locate/still)

Spatial patterns of SOC, SON,  $^{137}\text{Cs}$  and soil properties as affected by redistribution processes in a Mediterranean cultivated field (Central Ebro Basin)  
 Laura Quijano<sup>a,\*</sup>, Leticia Gaspar<sup>b</sup>, Ana Navas<sup>a</sup>

Contents lists available at ScienceDirect  
**Catena**  
 Journal homepage: [www.elsevier.com/locate/catena](http://www.elsevier.com/locate/catena)

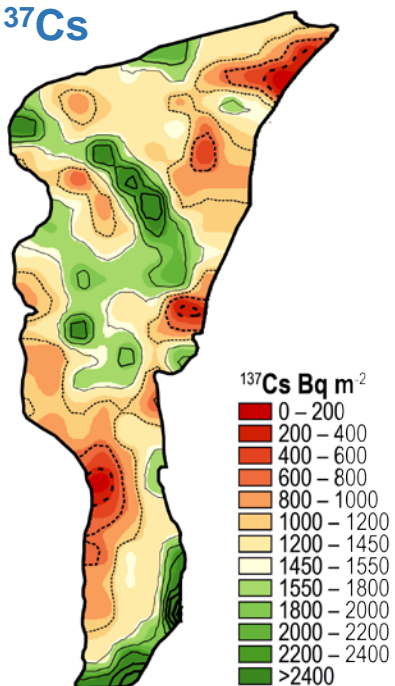
Estimating erosion rates using  $^{137}\text{Cs}$  measurements and WATEM/SEDEM in a Mediterranean cultivated field  
 Laura Quijano<sup>a,\*</sup>, Santiago Begeria<sup>a</sup>, Leticia Gaspar<sup>b</sup>, Ana Navas<sup>a</sup>



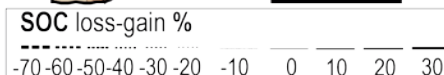
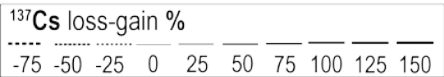
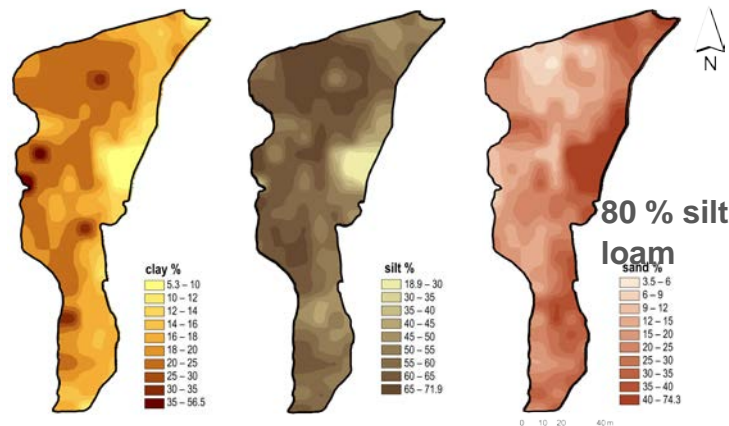
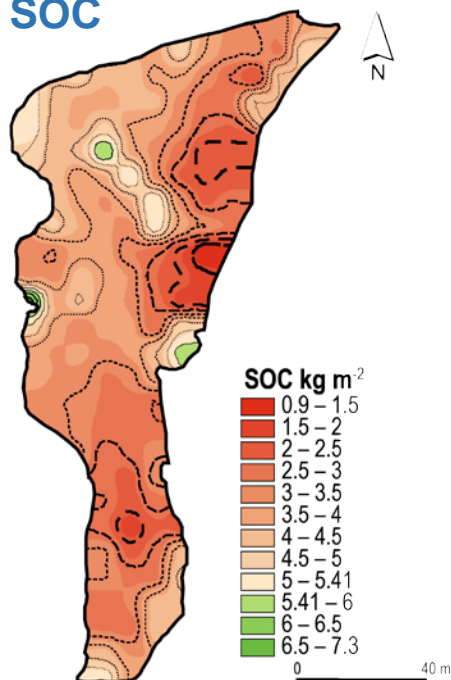
n=156	> 2 mm	Clay	Silt	Sand	CO <sub>3</sub> <sup>2-</sup>	$^{137}\text{Cs}$	$^{137}\text{Cs}$
kg m <sup>-2</sup>	%	%	%	%	%	Bq kg <sup>-1</sup>	Bq m <sup>-2</sup>
SOC	-0.275*	0.310*	0.267*	-0.340*	-0.186*	0.327*	0.411*

# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

<sup>137</sup>Cs

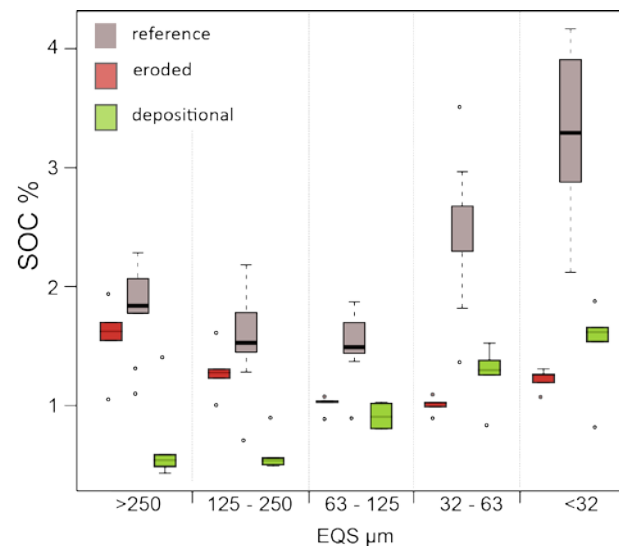
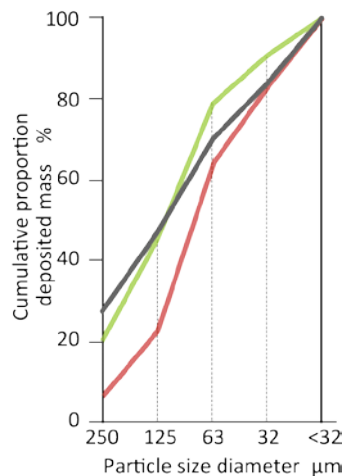


SOC



n=156	> 2 mm	Clay	Silt	Sand	CO <sub>3</sub> <sup>2-</sup>	<sup>137</sup> Cs	<sup>137</sup> Cs
kg m <sup>-2</sup>	%	%	%	%	%	Bq kg <sup>-1</sup>	Bq m <sup>-2</sup>
SOC	-0.275*	0.310*	0.267*	-0.340*	-0.186*	0.327*	0.411*

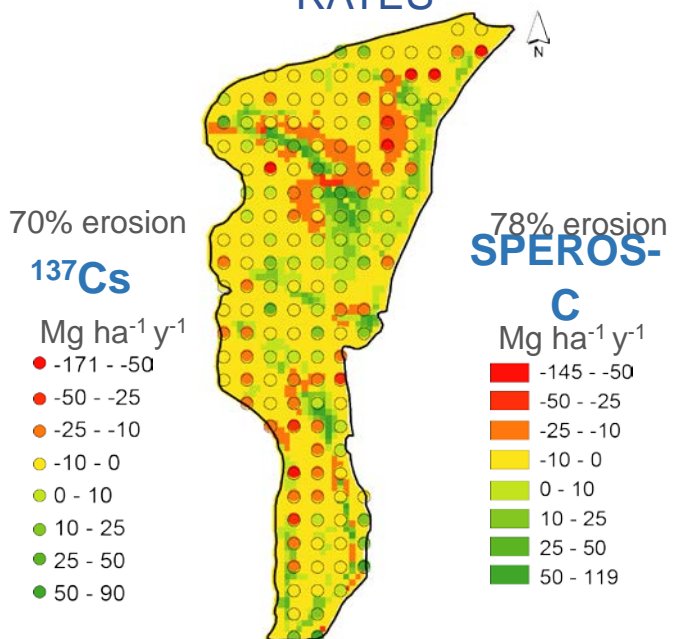
## Velocity settling tubes



Information on grain size aggregates distribution and sediment properties that can be used in soil erosion modelling

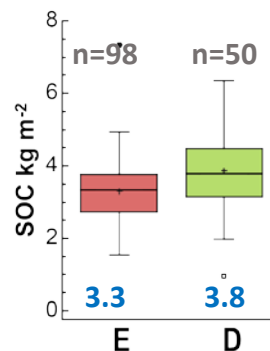
# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

## SOIL REDISTRIBUTION RATES

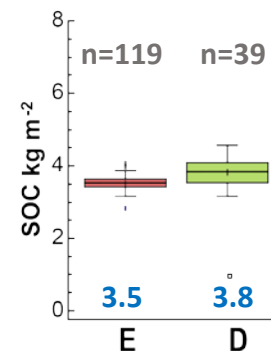


LAND DEGRADATION & DEVELOPMENT  
*Land Degrad. Develop.* 28: 515-523 (2017)  
 Published online 7 December 2016 in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/ldr.2637  
**MODELLING THE EFFECT OF LAND MANAGEMENT CHANGES ON SOIL ORGANIC CARBON STOCKS IN A MEDITERRANEAN CULTIVATED FIELD**  
 Laura Quijano<sup>1\*</sup>, Kristof Van Oost<sup>2</sup>, Elisabet Nadeu<sup>2</sup>, Leticia Gaspar<sup>3</sup>, Ana Navas<sup>1</sup>

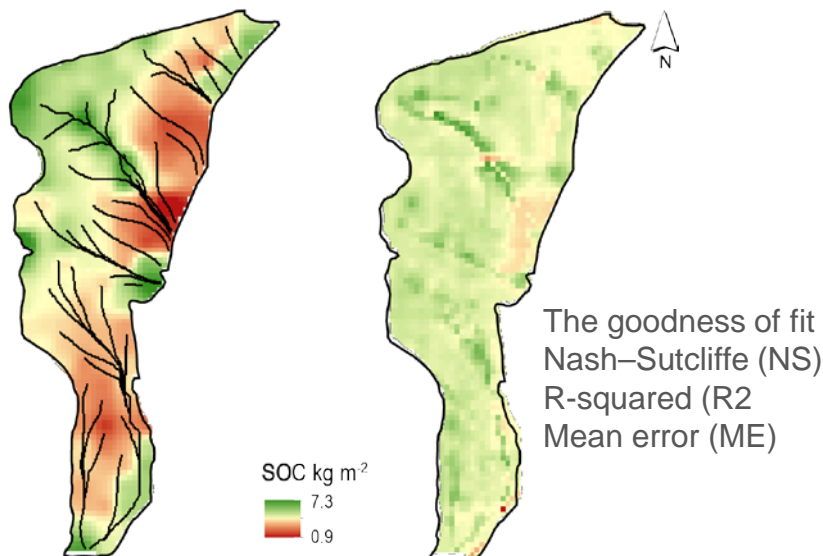
### $^{137}\text{Cs}$



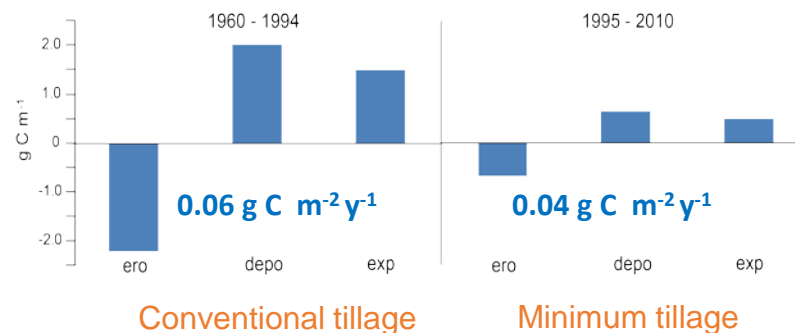
### SPEROS-C



## SOC REDISTRIBUTION



n=156	Mean	S.D.	CV%	Min	Max
SOC obs	3.49	0.97	27.82	0.96	7.34
SOC mod	3.59	0.26	7.25	2.82	4.55



- The main factor for soil redistribution is runoff through the gully system triggering **the selective removal of finer soil particles** mobilized the rich carbon fine fraction affects the depletion of soil particles and, therefore, SOC.
- **Settling velocity measurements** provide direct information on soil aggregate distribution with implications on soil and SOC transportability that can be used in soil erosion modelling.
- The combination of the spatially distributed **SPEROS-C** model combined with  **$^{137}\text{Cs}$  measurements** is a potential tool to evaluate erosion induced carbon fluxes.



JRC - Erosion Modelling Workshop, Ispra  
2017



# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

[Iquijano@eead.csic.es](mailto:Iquijano@eead.csic.es)

Erosion, and Soil and Water Evaluation Group EEAD-CSIC,  
Spain

Thank you for your attention







JRC - Erosion Modelling Workshop, Ispra  
2017



# SOC dynamics and soil redistribution modelling in Mediterranean agroecosystems

[lquijano@eead.csic.es](mailto:lquijano@eead.csic.es)

Erosion, and Soil and Water Evaluation Group EEAD-CSIC,  
Spain

Thank you for your attention

SSS6.8/BG9.56 The impact of soil organic carbon loss on environmental

Convener: Laura Quijano Co-convener: Nikolaus J. Kuhn, Leticia Gaspar, Ana Navas, Manuel Seeger,  
Chantal Hendriks

Wed 26 April



European Geosciences Union  
General Assembly 2017

Vienna | Austria | 23-28 April 2017