**Introduction**

Hydrological and soil erosion models allow mapping and quantifying runoff volumes and soil redistribution for different land uses and climatic scenarios.

Mediterranean soils are threatened by marked seasonal changes in the climatic parameters, thus soil and vegetation factors and modelling predictions at monthly scale are required.

**Objectives:**

1. Run the semi-physically-based SERT model in a Mediterranean agro-ecosystem.
2. Validate the predicted rates of soil redistribution with quantified 137Cs.

**Study Area**

The study area is the small so-called Pilot catchment (0.73 ha), of the Estaña Lakes catchment which is located in the Spanish Pyrenean Marginal Ranges and within the Ebro River Basin.

The land uses and the physiographic characteristics are those typically found in Mediterranean rain-fed agricultural systems.

Steep slopes (52.2%°) occupy 28% of the study area and are associated with the walls of the sinkhole whereas gentle slopes are cultivated with winter wheat and barley (≤ 8%°) and cover 18%.

Climate is continental Mediterranean with two humid periods (spring and autumn). The mean annual rainfall was 520 mm for the reference period 1961-1990 whilst over the last fifteen years (1997-2011) it was 454 mm.

**Surface Hydrology**

Q₀ and Qₛ₀ reveal significant variations in time and space. Variability of time to ponding, initiation of runoff and total runoff depth explain the variability in the runoff coefficients.

**Soil Erosion**

Cultivated (CLhα and CLhα + LPhα) and bare (CLhα + LPhα) soils are affected by intense processes of soil erosion: 20 and 10 Mg / ha yr on average. These rates exceed the tolerable rate of 1.4 Mg / ha yr for European cultivated lands.

Soil erosion was minimum in February (0.08 Mg / ha month) and 23 times higher in November.

**Soil Redistribution**

Stable areas, without processes of soil loss neither deposition, are frequent in Jan. (22% of the total surface), Feb. (21%), Mar. (23%), Nov. (11%) and Dec. (24%), whereas for the other seven months the percentage remains below 10%

Predominant processes of soil loss take place between Jun. and Sep. (15% of the total area), whereas soil deposition extend over larger areas in Apr., May, Oct. and Nov.

**Validation with 137Cs**

Validation was carried out with 133 control points (CPs) located every 10 m x 10 m metre grid: 45 CPs for the cultivated area, 60 for the oak forest, 5 for the scrublands, 9 for the pastures and 4 for the wetland, and 13 areas of bare soil, and the Cs-137 activities were measured using a coaxial gamma-ray detector.

**Soil redistribution in a small Mediterranean agro-ecosystem: modelling predictions calibrated with Cs-137 derived rates**

**The SERT Model**

The SERT model divides the simulation procedure into four modules:

1. Surface hydrology (SERT-Hy)
2. Soil erosion (SERT-En)
3. Soil redistribution (SERT-Rd)
4. Modelling validation (SERT-V)

The SERT model has the conceptual basis and part of the equations of the DR2 (López Vicente and Navas, 2012), RUSLE (Morgan, 2001) and IC (Boselli et al., 2006) models, to which the water balance factor (α) and the time of runoff after the end of the rainfall event (ΔT_pred) are added in the SERT-Hy module, and the sediment balance (β) and the remaining runoff transport capacity (TDI) factors in the SERT-En and SERT-Rd modules, respectively.

### Discussion:

- **The performance of the model is satisfactory and provides statistically significant correlations for total soil redistribution (Pearson’s r = 0.769), soil loss (Pearson’s r = 0.652), and soil deposition (Pearson’s r = 0.564).**
- **Considering each sampling point as a test point, the Nash-Sutcliffe coefficient is 0.48, indicating the good prediction ability of the SERT model.**
- **The performance of the SERT model has to be evaluated taking into mind that the analytical precision of the measurements done with Cs-137 is approximately 15%.**
- **The predicted sediment balance, > 1.15 Mg m⁻² yr⁻¹, can be considered as a good estimation as the study area is an endorheic area affected by moderate karst processes.**

### Conclusions:

- **The SERT model is an accurate model for small and medium-scale catchments to estimate monthly and annual rates of runoff depth, soil erosion and sediment redistribution taking advantage of current GIS-based techniques.**
- **The new model discriminates stable areas and predicts different spatial and temporal patterns of initial and total runoff and soil redistribution.**
- **The four-model structure makes it adaptable to any method that can provide accurate rates of cumulative runoff and net soil loss and deposition throughout the catchment at the outlet.**
- **We are currently developing a module for open-source and free SAGA GIS software the SERT2013 SAGA v1.0. This module is presented in a user-friendly interface and will be available at our research centre website in autumn 2013.**

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### References