Evaluation of changes in soil erosion rates in Andalucía between 1956 and 2018

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BACKGROUND AND OBJECTIVES

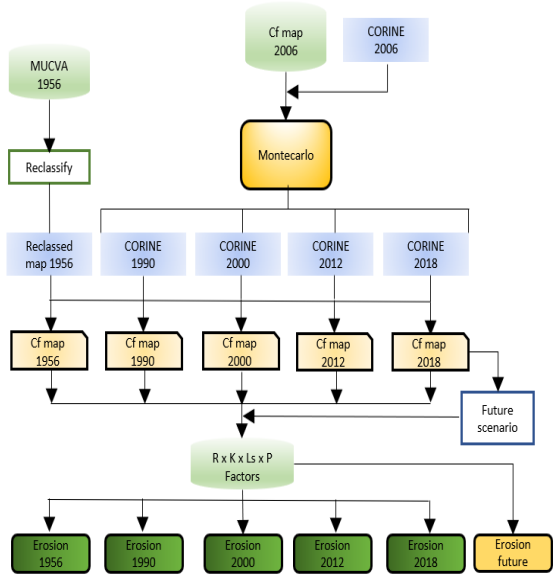
Land use and land cover changes (LULC) impact significantly on soil erosion rates. Land use types such as permanent grasslands (PG) are typically associated with low erosion rates but are under pressure to LULC in the EU. It is important to evaluate their importance in terms of erosion protection. The main objective was to analyze the temporal evolution of soil erosion rates in relation to LULC in Andalusia, Spain. In particular, we are interested in the importance of soil erosion in permanent grasslands (PG). For this, we (i) analyzed historical soil erosion rates between 1956 and 2018, and (ii) evaluated different future scenarios of LULC.

MATERIALS AND METHODS

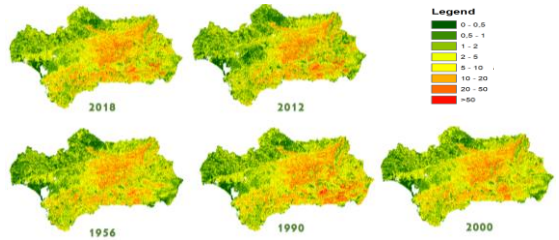
The study was carried out at regional level in Andalusia. RUSLE factors were taken from the European Soil Erosion Map 2006 (Panagos et al., 2015). The cover management factor C was then calculated for all years of the study and for the future scenario by a Monte Carlo approach in four steps:

1. Analysis of land use based on CORINE maps (1990,2000,2012 and 2018) + adaptation of Landuse map of 1956 (MUCVA) to CORINE's codes
2. Analysis of frequency distribution of C factor for every land use category in 2006 from ESEM2006.
3. Assignation of new C factors using Monte Carlo
4. Construction of most probable future LULC scenario based on expert interviews.

MODEL DESCRIPTION



New Erosion maps



The model was developed to show the importanc LULC and the policy interventions along the years the cover management C, thus we assumed cons all the other RUSLE factors. The selected scale is 10 pixel size.

ANALYSIS OF HISTORICAL LULC

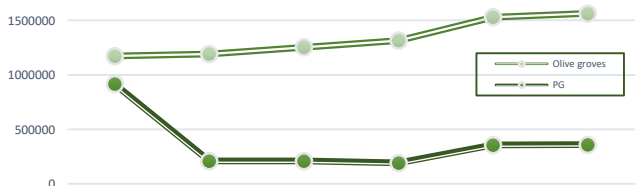
overall, the erosion rate increased since '1956, but we observed a solidly decreasing of erosion rate for the agriculture land and an increasing rate for the forestry area. This is attributable to a sharp increase in the Agroforestry system and of bigger exploitation of flat land. While, within forestry classes, it has been observed a high enlargement of burned area and poor vegetated area.

Historical data of agriculture and forestry classes

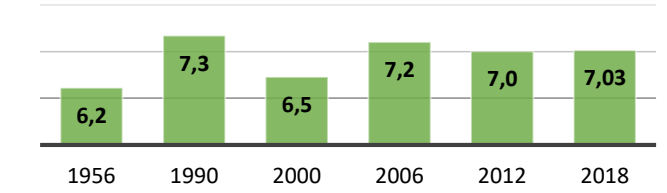
Land use	1956	1990	2000	2006	2012	2018
Agriculture(t ha−1 yr−1)	9,9	8,6	8,5	8,4	7,5	8,5
Agriculture area (ha)	3768686	4707741	4789281	4758397	4950752	4881877
Forestry(t ha−1 yr−1)	3,1	5,7	3,7	5,6	6,3	5,0
Forestry area (ha)	4420773	3657459	3616080	3491906	3348488	3383710

While soil loss rate seems stable along the last 18 years, agriculture area increased significantly agricultural extension grows significantly in comparison to forestry extension. Nevertheless, since 1990, a sharp increase in olive groves cultivation and a slight increment of the Permanent Grassland (PG) can be observed , especially after 2006.

PG and Olive groves area (ha) in Andalucia 1956-2018



Soil loss rate in Andalucia 1956-2018 (t ha−1 yr−1)



FUTURE SCENARIO

Experts agreed on two main future scenarios: Climate change is expected to the replacement of PG by sparsely vegetated areas or transitional woodland and shrubs. On the other hand, politics and economic reasons will replace PG by more profitable crops such as olive groves and fruit trees. This is shown below.

Erosion rates (t ha−1 yr−1) under future scenarios of partial and total replacement of the PG surface.

PG change	25%	50%	75%	100%	2018
Transition woodland shurbs	7,5	7,5	7,5	7,5	7,3
Fruit trees	7,7	8,0	8,1	8,3	
Olive grooves	7,7	8,0	8,1	8,3	
Sparsely vegetated area	7,9	8,2	8,5	8,8	

Andalucia map total change PG to Olive groves

Red color represents the Olive grove extension in Andalusia. On the right Olive groves in 2018, on the left olive grove extension after a hypothetical land-use change of 100% PG

CONCLUSION

The model shows the importance of land management and the rural policy on the agricultural and forestry sector. By this model, it is possible to have a wider view of the historical soil loss rate, which in Andalucia seems have increased almost 1 (t ha−1 yr−1) since 1956. With the future land-use scenarios, forestry and PG in particular, turn out to be essential for erosion mitigation. Since 2000, PG growth contributed to mitigate the ongoing soil loss rate caused by the expansion of the agriculture area.

ACKNOWLEDGMENTS

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