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P mobilization by an exceptional rainfall event and its spatial variability in an agroforestry catchment

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BACKGROUND

High intensity rainfall events produce significant soil losses and nutrient losses in particular, phosphorous (P) is an important source of water pollution.

P losses and its mobilization are influenced not only by rainfall characteristics but also by land use and soil properties.

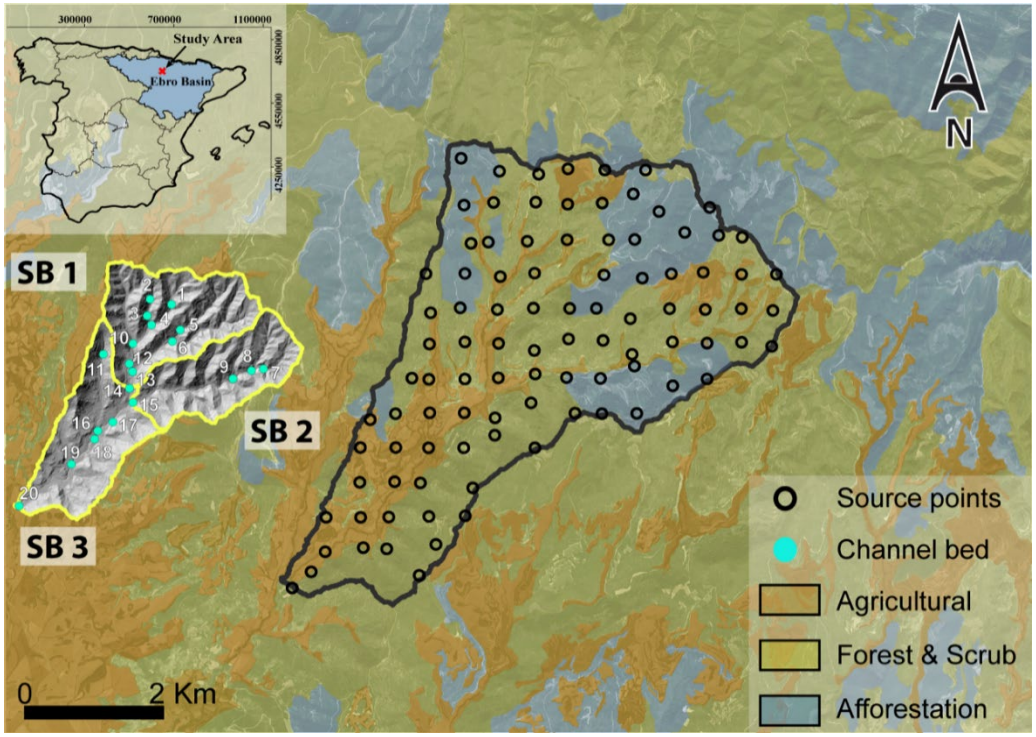
Agricultural lands have been identified as main contributors to P export but other landscape elements as channel banks can be also important non point sources.

OBJECTIVES

- Evaluate the effects of an exceptional 235 mm event on P mobilization in areas under different land uses in an agroforestry catchment
- Assess P variability and enrichment in streambeds sediments along different order streams in three nested subcatchments.

MATERIAL AND METHODS

- P concentrations are analysed before and after the exceptional event
- P-binds are related to soil and sediment properties



Soil sampling

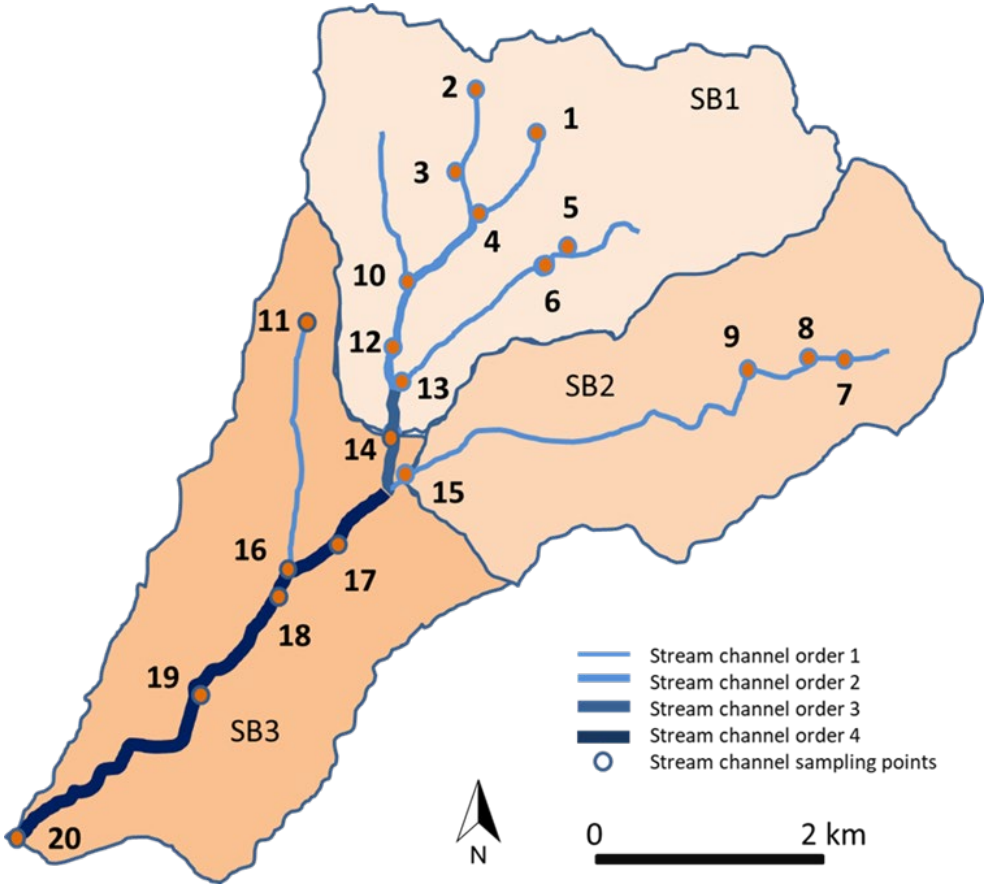
Land use	Sampling points number	
Agricultural		19
Woodland	Open forest	15
	Afforested	15
	Scrubland	46
Channel bank		22
Barren land		15
total		117

MATERIAL AND METHODS

Land uses, streambed sampling and soil and sediment analysis

Land use (%)	SB1	SB2	SB3
Agricultural	13.8	11.2	29.7
Woodland	82.2	84.2	67.4
Channel bank	1.6	1.2	1.9
Barren land	2.4	3.4	1.0

Subcatchment	Streambed sediment sampling points	
	Stream order	number
SB1	1	7
	2	2
SB2	1	4
SB3	1	1
	3	2
	4	4
total		20

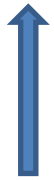


Soil and streambed analysis		
Clay	P	χLF
Silt	Si	^{137}Cs
Sand	Ca	OM

RESULTS

Soil characteristics under each land use

Land use	Clay (%)	Silt (%)	Sand (%)	OM (%)	P (mg/kg)	Ca (mg/kg)	Si (mg/kg)	^{137}Cs (Bq kg^{-1})	χLF (10^{-8} m^3/kg)
Agricultural	15.88	77.88	6.24	2.41	1118	160203	176439	4.39	47.7
Open forest	16.82	73.95	9.23	5.38	1029	114427	194306	16.31	70.0
Afforested	15.94	75.78	8.28	4.89	912	147082	176512	9.87	58.2
Scrubland	15.54	76.38	8.08	4.06	975	150945	175355	11.62	51.9
Barren land	13.42	72.36	14.22	1.28	1081	154932	181704	2.25	23.7
Channel bank	12.55	73.63	14.38	1.02	764	172585	164662	1.62	19.1

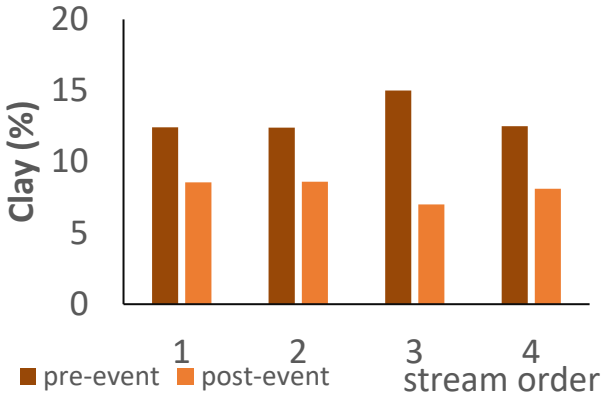

RESULTS

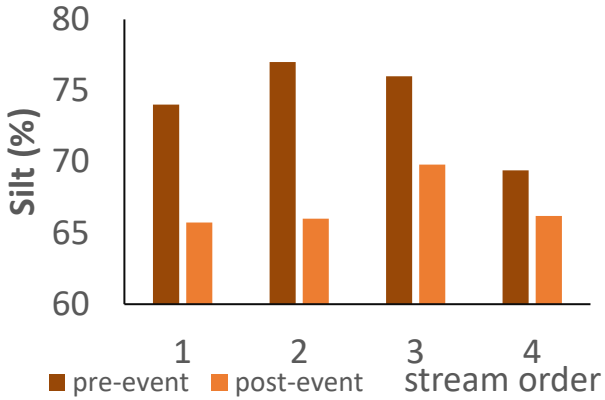
- P was mostly linked to the mineral fraction (mainly to silicates), while the binding between P and OM was only observed in soils under forest land use.

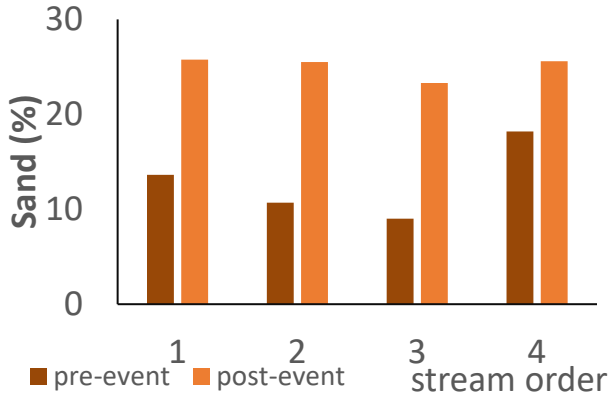
- The high intensity of the rainfall event produced a significant change in the particle size distribution with the loss of fine material (clay and silt) and OM leading to an enrichment of the sediments in sand fractions and P.

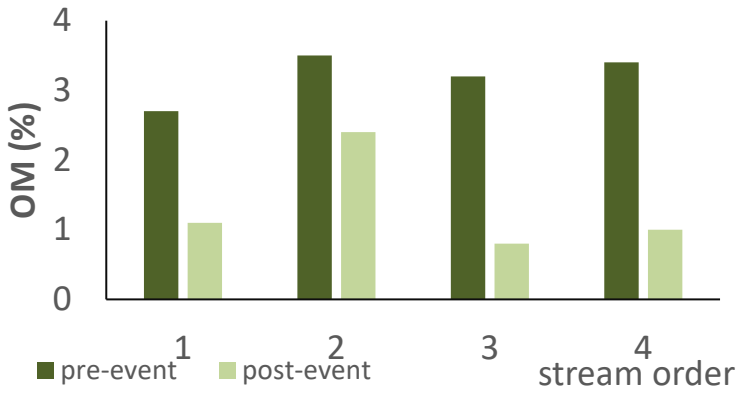
RESULTS

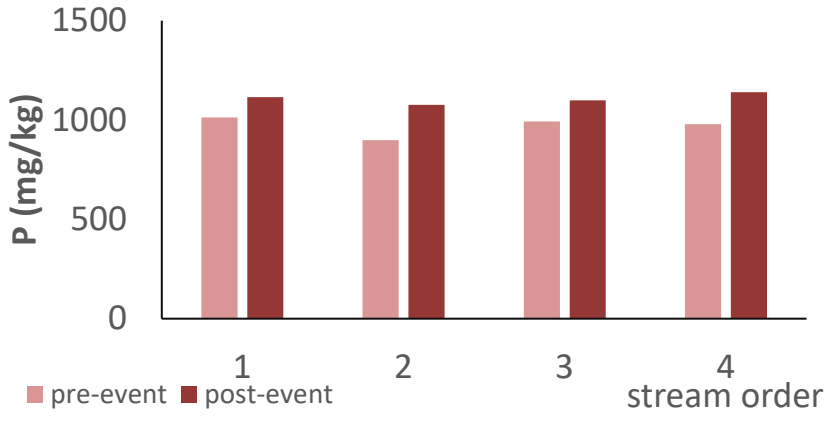
Average changes in the streambed composition of different order streams after the exceptional rainfall event



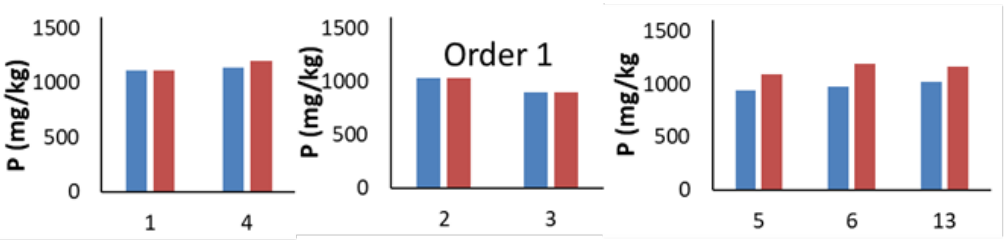


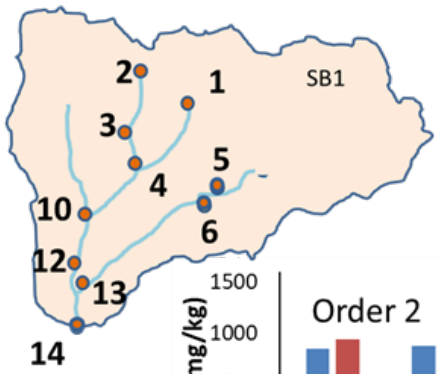


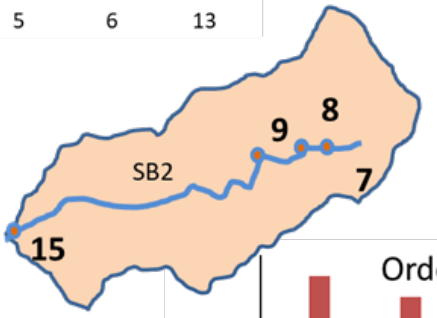


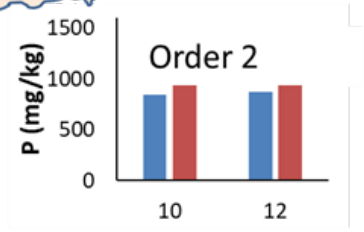


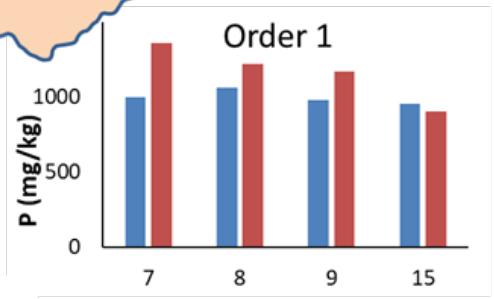
RESULTS





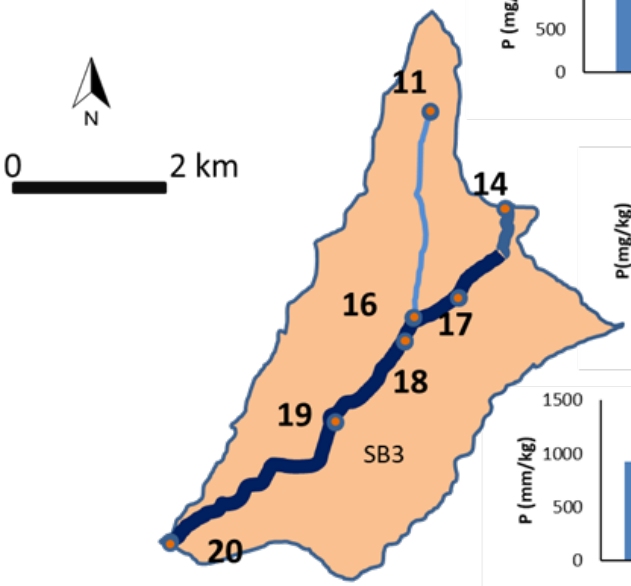


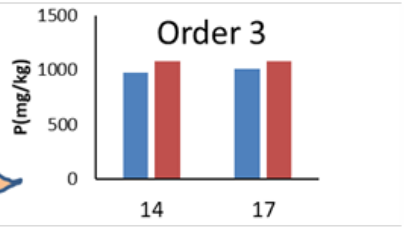


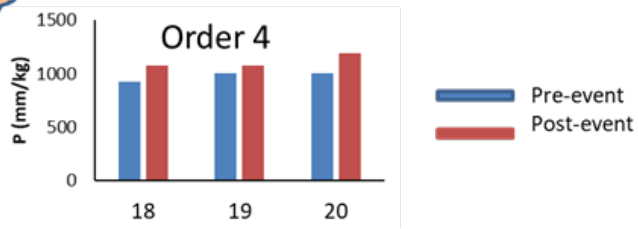


P enrichment in the streambed sediments

SB	order	P EF	Land Use
SB1	1	1.08	Forest
	2	1.25	Forest Agric.
	1	1.18	Forest
SB2	1	1.14	Forest
SB3	1	1.01	Agric.
	3	1.09	Forest Agric.
	4	1.17	Agric.







CONCLUSIONS

- Agricultural lands with highest P concentration and more prone to suffer erosion contributed significantly to P release to the streams. The channel banks and the own beds of the streams should be considered also as main contributors to P exportation.

- The higher P concentration in the streambeds after the exceptional event leads to higher P levels exposed to be eroded.

- The variability of P concentration along the nested streams was in agreement with the increase of magnitude of the erosion processes from the headwaters to the catchment outlet.