Reduction of the peak streamflow as a result of vegetation rehabilitation in the “Yesos of Barrachina” protected area.

CENTRO DE ESTUDIOS DEL JILOCA

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INTRODUCTION

The mainly objective of this paper was to evaluate the impact of a simulated vegetation rehabilitation process in the “Yesos of Barrachina” protected area on its catchment streamflow, using a modelling approach.

MATERIAL AND METHODS

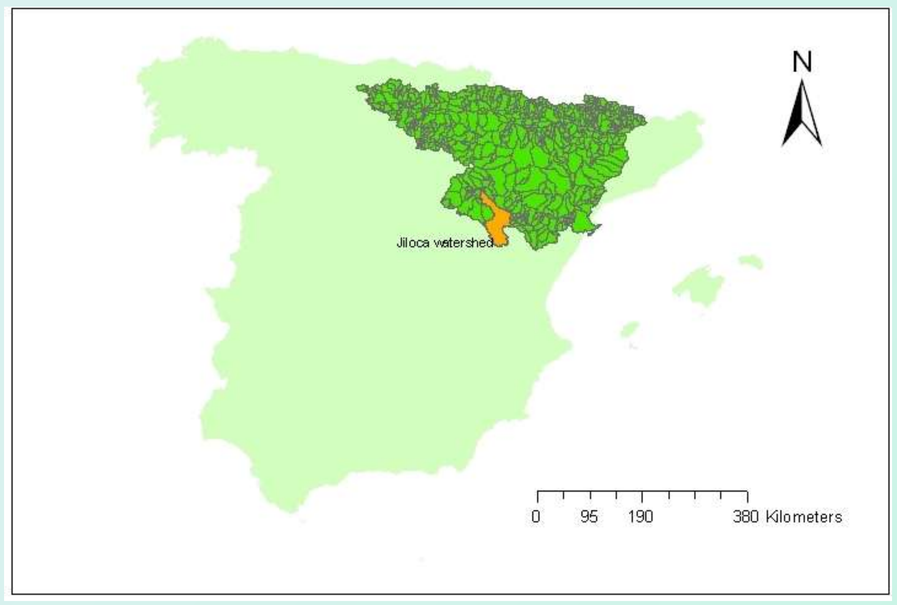

Figure 1. Jiloca watershed location.

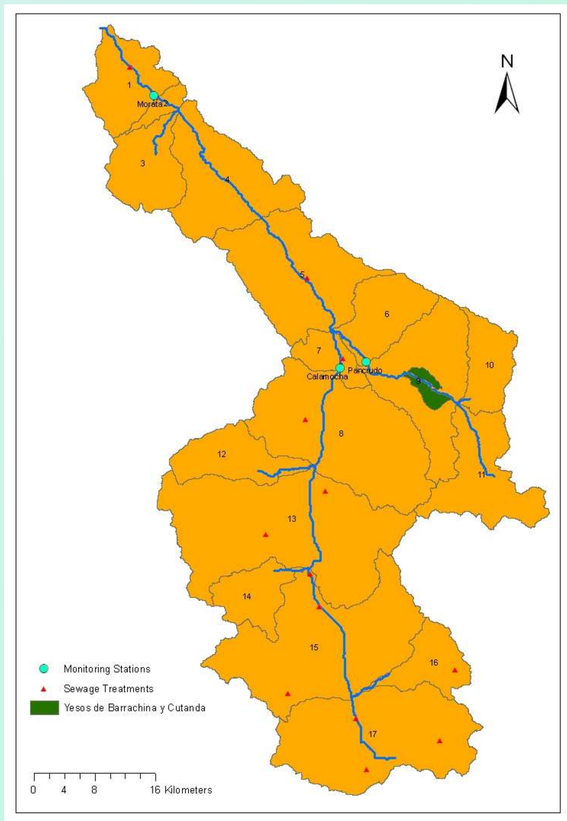

Figure 2. Main subbasins, monitoring and sewage treatments stations in the Jiloca watershed

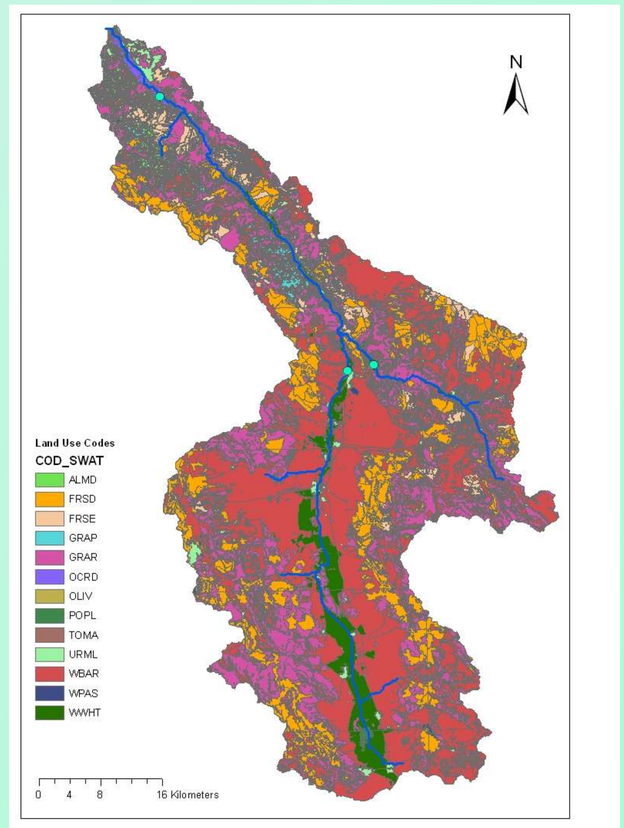

Figure 3. Soil Map Use in the Jiloca watershed

Swat model setup

We use the ArcSWAT 2.3.4 for ArcGIS 9.3 SP1 Install, released 9/21/2009.

Model calibration and evaluation

The model was calibrated and validated taking into account the evaluation guidelines described by Moriasi et al. (2007). The model was calibrated for monthly and yearly streamflow in the three monitoring stations using an 8-year data record (1993-2000). The model was validated for monthly and yearly streamflow in the three monitoring stations using a 2-year data record (2001-2002).

Rehabilitation process.

We present the Pancrudo subbasin results, where the protected area is located.

The calibration scenario represents conditions of the subbasin prior to the implementation of rehabilitation treatments, while the Vegetation Scenario represents the conditions of the watershed after a simulated rehabilitation process.

In order to simulate the rehabilitation process, the HRUs located in the subbasin 9 were reassigned as follows: (i) winter barley (WBAR) to grarigue (GRAR) and (ii) grarigue (GRAR) to forest deciduous (FRSD). The SWAT associated parameters (CN2, CAN_MAX, OV_N) were changed in the subbasin 9.

Table 1. Land use codes used for SWAT, MCA, land use types and percentage of area in the Jiloca watershed.

Code Land Use SWAT	Land Use Type	Percentage (%)	Code Land Use MCA.
OCRD	Orchard	0.63	ME, CE, CI, MA, PE
ALMD	Almonds	1.93	AL, NO, AL+V
WWHT	Winter Wheat	5.41	CH
TOMA	Tomato	0.08	H, H+CH
GRAP	Vineyard	1.83	V
WBAR	Winter Barley	40.77	L
OLIV	Olives	0	OL
WPAS	Winter Pasture	0.33	P
GRAR	Grarigue	28.06	M, P/M
FRSE	Forest Evergreen	3.45	PH
POPL	Poplar	0.57	PO
FRSD	Forest Deciduous	15.38	QI
URML	Residential-Med/Low Density	1.55	I

RESULTS AND DISCUSSION

Model calibration and evaluation

Taking into account the evaluation guidelines described by Moriasi et al. (2007), the model simulation for the Jiloca watershed can be judged as satisfactory (Table 2).

The Jiloca watershed model simulated streamflow adequately in the Pancrudo River when the rainfall events were generated by active or non-active Atlantics fronts. However the events occasioned by high intensity convective thunderstorms were not detected by model. In fact, although the flow gauge registered 2 peaks in the Pancrudo River (Figure 4), the rain gauges used in the area did not register the high intensity precipitations and the model could not simulate correctly the runoff response. In general, the convective thunderstorms were generated in small areas and it is possible that the rain was not registered accurately. In order to evaluate the simulated process of vegetation rehabilitation and test its effect during the convective thunderstorms, we added 2 precipitation storms (60 mm depth in 24 hours at 08/22/1997 and 06/06/1998) in a new calibration scenario: “Simulated storm”.

Table 2. Annual and monthly data obtained in the evaluation of the Jiloca watershed.

	Annual			Monthly		
Monitoring Stations (Calibration Scenarios)	**NSE**	**RSR**	**PBIAS (%)**	**NSE**	**RSR**	**PBIAS (%)**
Acceptable limits (Moriasi *et al.* (2007)	**>0.5**	**<0.7**	**± 25**	**>0.5**	**<0.7**	**± 25**
Pancrudo (no Storm)	0.67	0.57	19.3	0.52	0.69	18.83
Calamocha (no Storm)	0.54	0.68	5.27	0.63	0.60	5.27
Morata (no Storm)	0.45	0.74	21.9	0.58	0.64	22.67
Pancrudo (Simulated Storm)	0.76	0.49	13.2	0.59	0.64	12.8

Rehabilitation process.

The vegetation rehabilitation reduced the flow in the peaks generated by active Atlantics and high intensity convective events, while the flow generated by weakly rains or non rains days were not modified substantially (Figure 4: see diagrams after peak and Table 3).

Table 3. Daily flow in the Pancrudo station and mean flow in the total period.

		Calibration Scenario ($m^3\ s^{-1}$)	Vegetation Scenario ($m^3\ s^{-1}$)	Flow Difference ($m^3\ s^{-1}$)	Percentage (%)
Active Atlantic Fronts	01/08/1997	5.504	0.753	4.751	86.3
	01/09/1997	7.090	1.453	5.637	79.5
	Mean Value	6.297	1.103	5.194	82.9
Convective Thunderstorm	08/22/1997	1.844	1.167	0.677	36.7
	06/06/1998	5.776	3.588	2.188	37.9
	Mean Value	3.810	2.378	1.433	37.3
Mean total period (1993-2002)		0.086	0.063	0.022	26.2

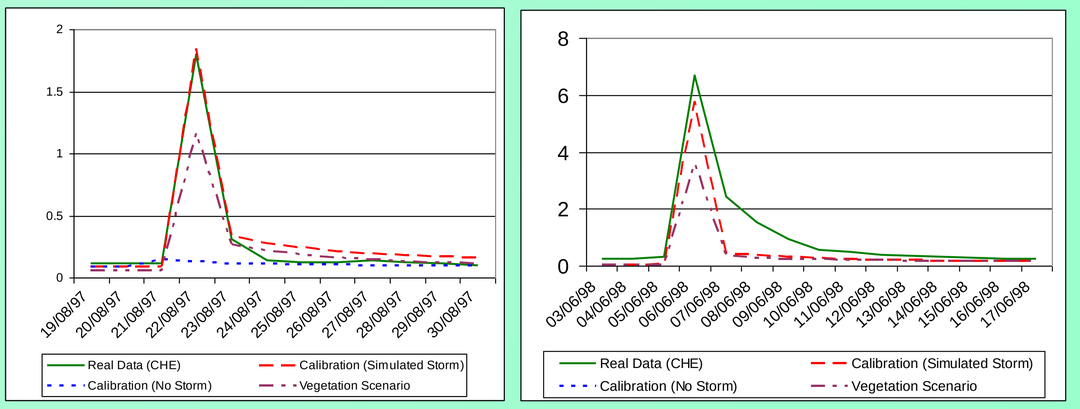

Figure 4. Flow in the Pancrudo Station (m3 s-1) at 08/22/1997 and 06/06/1998.

CONCLUSION

Our results reflected a reduction of the peak streamflow as a result of vegetation rehabilitation.

ACKNOWLEDGEMENTS

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