Shrub clearing as Active Management strategy to control land abandonment in the Central Spanish Pyrenees: The effects and the limits

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Background

- In the Mediterranean basin, land abandonment has been one of the most important land use and land cover changes during the last decades (Weisteiner et al., 2011).
- More than 80% of cultivated land in the Spanish Pyrenees has been abandoned (Lasanta, 1988)
- The first effect of land abandonment is the subsequent natural revegetation process in these lands that have important consequences on water resources and soils (García-Ruiz and Lana-Renault, 2011; de Baets et al., 2013; Nadal-Romero et al., 2016).
- The revegetation process after land abandonment affects evapotranspiration, throughfall, infiltration, soil storage and runoff processes, with marked changes in the main components of the hydrological cycle (Llorens and Domingo, 2007; Beguería et al., 2003; López-Moreno et al., 2011).
- Shrub clearing of abandoned cropland could be an efficient management strategy to deal with abandoned cropland areas (Khorchani et al. 2020).
- The Regional Hydro-Ecological Simulation System (RHESSys) (Tague and Band, 2004) is one of the numerous models widely used during the last years to assess the effects of land use changes on hydrological dynamics (Godsey et al., 2014; Bart et al., 2016; Peng et al., 2016).

Hereafter please follow marks for author's chronological presentation of the study.

1

We used the Regional Hydro-Ecological Simulation System RHESSys to simulate the effects of forest succession (FS) and shrub clearing (SC) on the hydrological dynamics of a Spanish Pyrenees watershed (Fig 1).

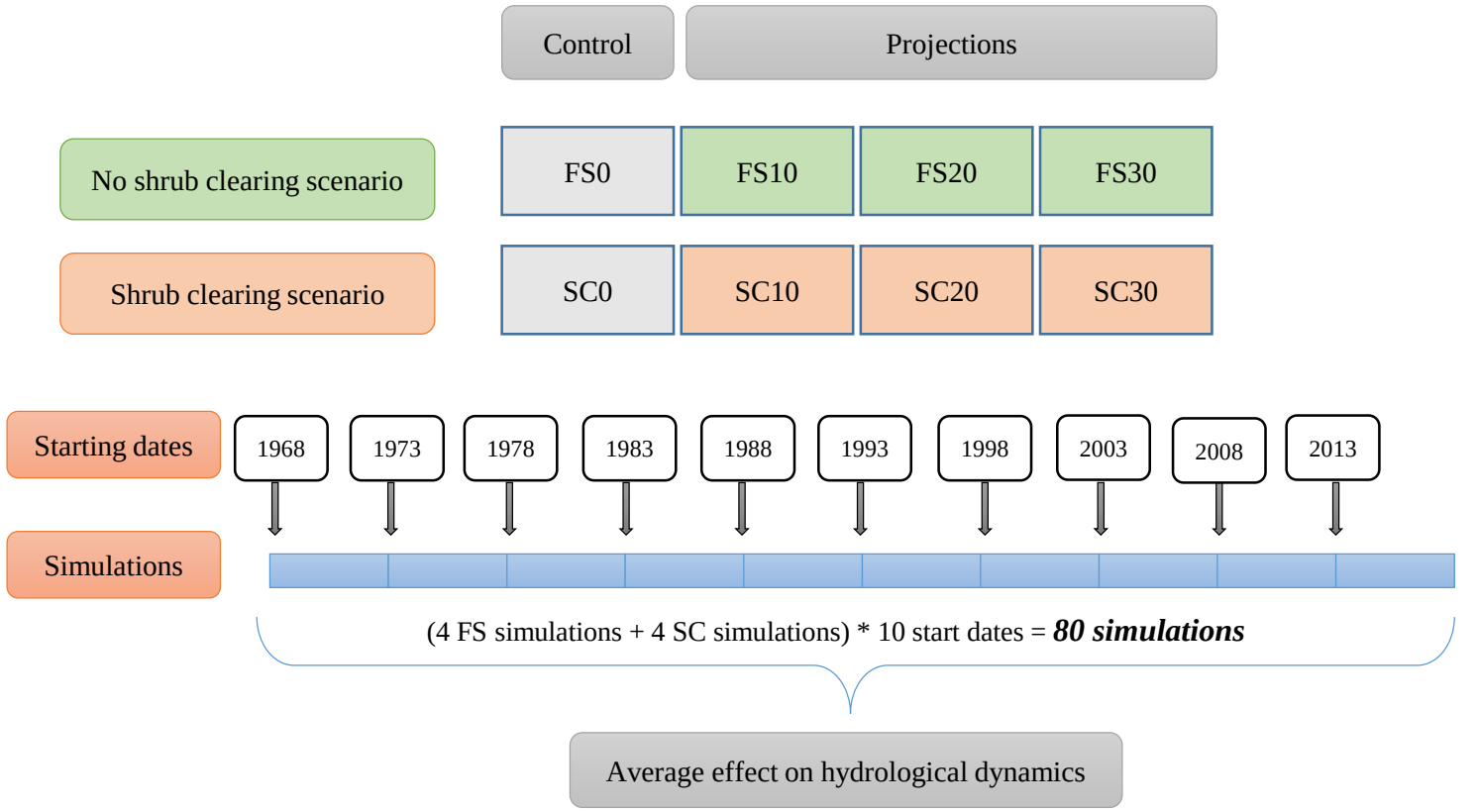

Fig 2. Workflow of the study

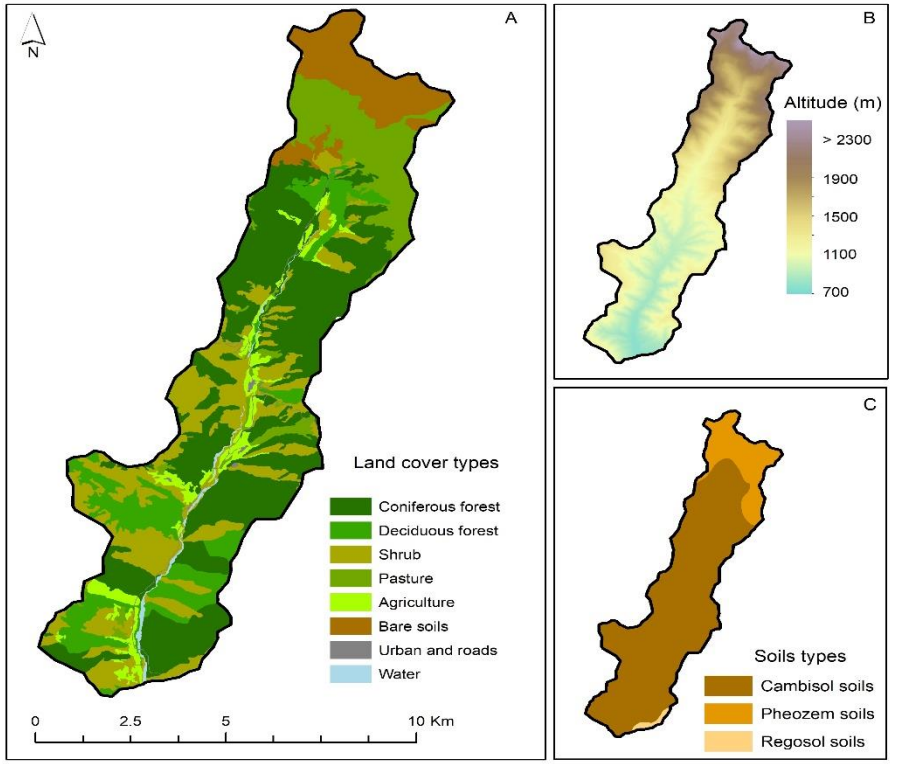

Fig 1. The Aísa watershed

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- We compare between management (shrub clearing, SC) and the no management (forest succession, FS) of abandoned cropland areas (Fig 2).
- We vary the start dates of the simulations to account for climate variability (Fig 2).

3

FS0 current situation of forest succession. FS10,FS20 and FS30 projections of FS0 accounting for 10, 20 and 30 more years of forest succession. SC0,SC10,SC20 and SC30 their correspondent shrub clearing management plans (Fig 2).

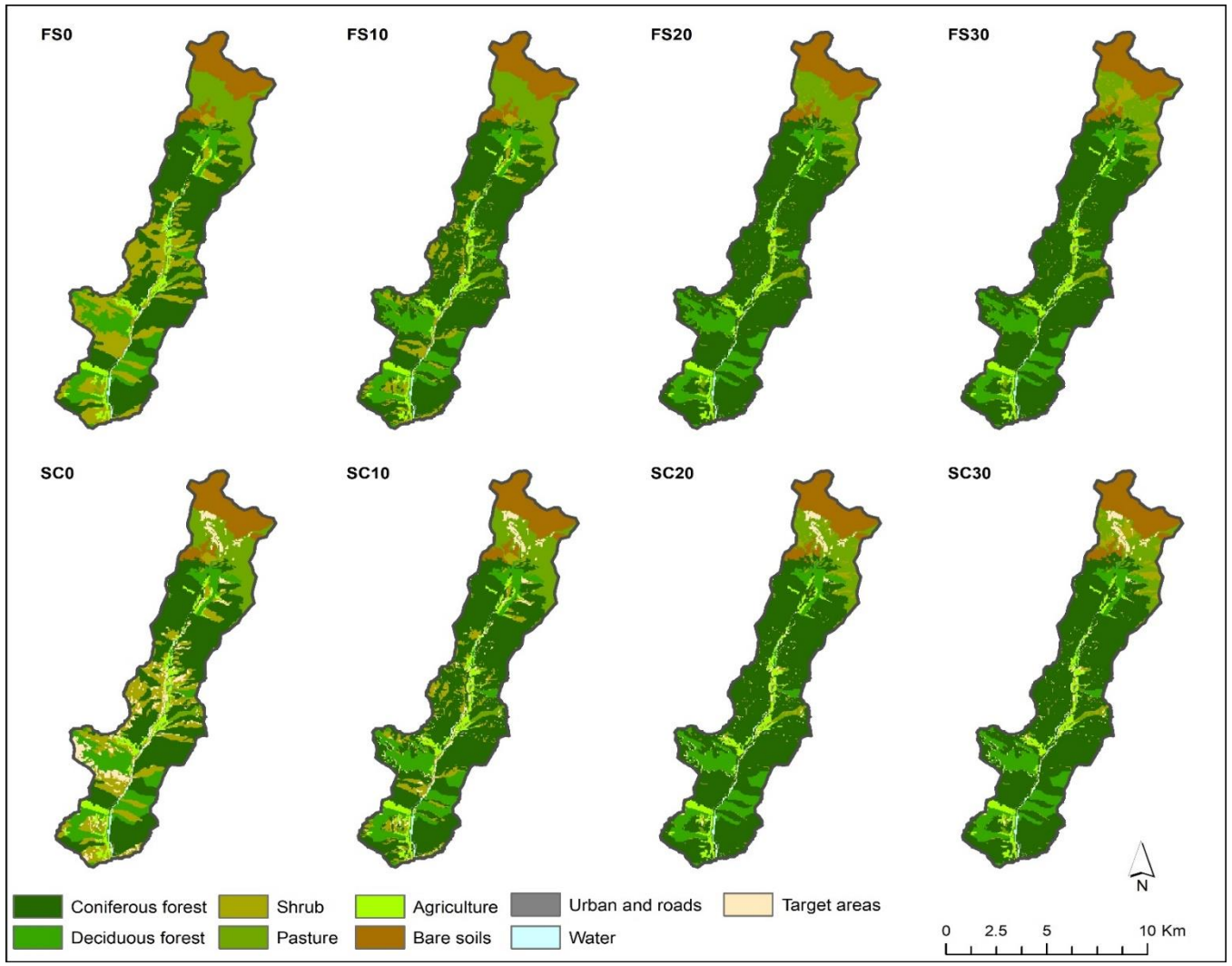

Fig 3 Forest succession projections and their correspondent shrub clearing plans

Tab 1. Type conversion as results of forest succession

	Type conversion (%)		
Projections	FS10	FS20	FS30
Shrub to forest	60.7	98.9	99.8
Grass to shrub	0.0	19.6	35.7

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- 60.7% of the FS0 shrubs could be converted to forest within 10 years of forest succession. 99.8% Within 30 years of no management strategy (Tab 1).

Tab 2. Correspondent target area of each forest succession projection

	Forest succession			
	FS0	FS10	FS20	FS30
Target area (%)	7.5	3.7	2.9	2.9
Reduction from FS0 (%)		-61.1	-72	-72

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- Type conversion as result of forest succession will limit target areas for shrub clearing management.
- Within 30 of forest succession only 2.9% of the study area would be available for shrub clearing (Tab 2).

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- Under SC0, shrub clearing would increase annual streamflow by 6.1% and decrease annual evapotranspiration by 6.1% during the first five years following management (Tab 3).
- The target area for shrub clearing will decrease with forest succession. Meanwhile the efficiency of shrub clearing on hydrologic dynamics will decline as well (Tab 3).

Tab 3. Type conversion as results of forest succession

Year	Streamflow (%)	Evapotranspiration (%)
SC0	6.1	-6.1
SC10	3.2	-2.7
SC20	1.9	-1.1
SC30	2.1	-1.3

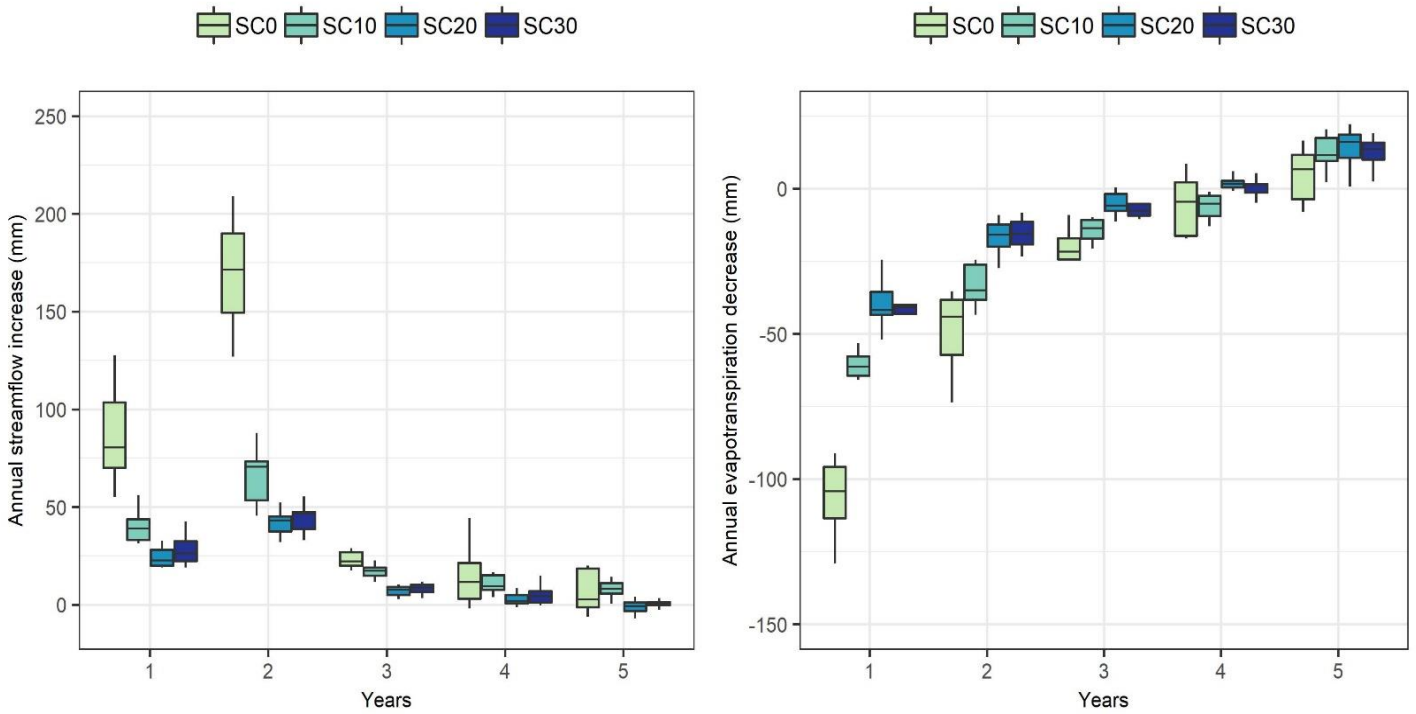

Fig 4. Boxplots of the resultant effect of shrub clearing on streamflow and evapotranspiration under the different management projections

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- The impact of shrub clearing would drastically change with forest succession over the first five years following management (Fig 4).
- The highest changes to hydrological dynamics would strongly decline with forest succession (Fig 4).

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