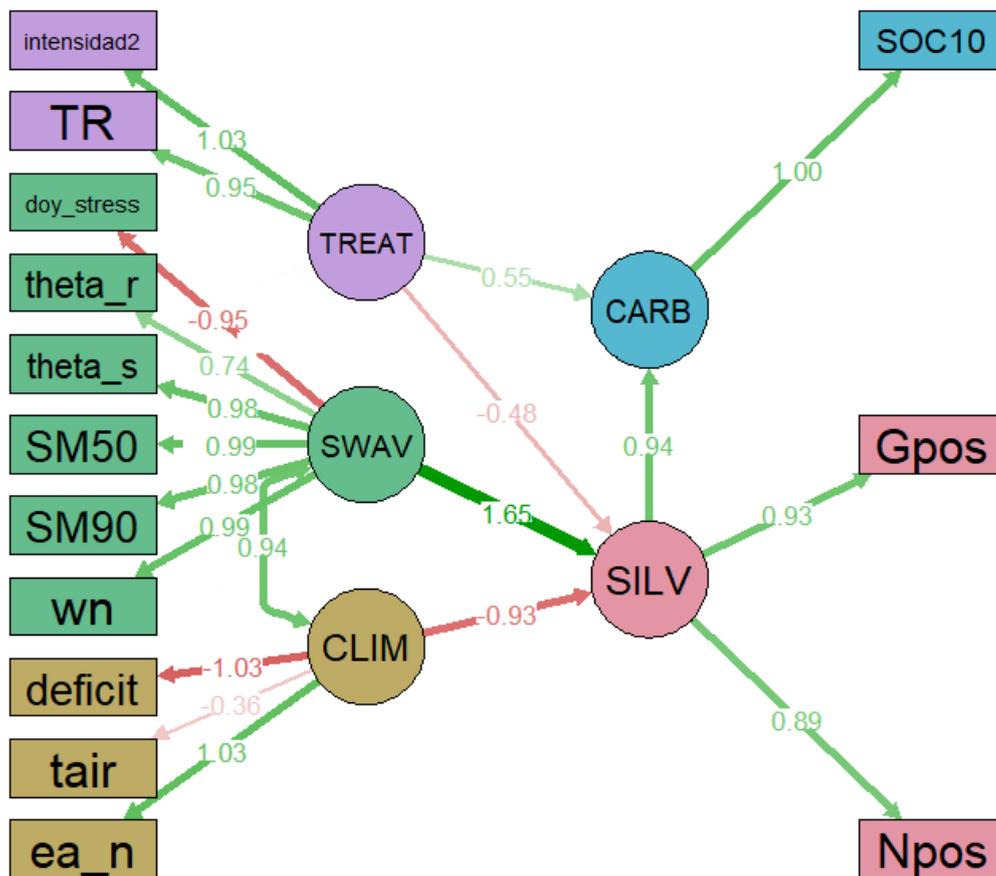


**Figure S1.** Correlation matrix computing the correlation coefficients between environmental and silvicultural variables with response indicators of interest. Features with high potential are identified by color legend. See variables description in Table S3.



**Figure S2.** Structural Equation Model path describing effects of multiple predictors in carbon stock and dasometric variables after treatments. Only significant effects or covariances were showed. Nodes represent different categories of predictors and endogenous variables: CLIM = Climatic variables; SWAV = Soil water availability; TREAT = Treatment variables; SILV = Silvicultural status of forest after treatment; CARB = SOC10, and environmental variables (see Table S3). Red arrows mean negative effect. Green arrows mean positive effect.

**Table S1.** Site descriptions and characteristics of selected stands. Values are means  $\pm$  SD.

Species	Study site	Latitude N	Longitude W	Aspect	Slope (%)	Elevation (masl)	Type of forests	Time span	Management	Thinning year
<i>Pinus halepensis</i>	La Hunde	39° 05'	1° 12'	Flat	5-10	950	Plantation	1960-2018	shelterwood method	2008
	Los Cuadros	38° 05'	1° 07'	N-S	5-10	140	Plantation	1970-2015	shelterwood method	2004
	Cortijo Conejo	37° 23'	3° 04'	E-W	5-10	1115	Plantation	1994-2020	thinning	2005
<i>Pinus nigra</i>	Monte Alto	42° 34'	1° 06'	W	20	705				1994
	Cuenca	40° 02'	1° 59'	Flat	3-5	1250	Natural forest	1836-2012	shelterwood method	2007
	Filabres	36° 43'	4° 58'	N		1450	Plantation	1979–2018	shelterwood method	2009
<i>Pinus sylvestris</i>	Aspurz	42° 43'	1° 09'	N	7	625	Natural forests	1985-2013		1999
	Garde	42° 49'	0° 52'	NE	40	1335	Natural forests	1985-2013		1999
	Filabres	36° 43'	4° 58'	N		1600	Plantation	1979–2018	shelterwood method	2009
	Añón-Mocanyo	41° 45'	0° 45''			1178-1998	Natural forests			

**Table S2.** Selected biomass models from SUR fitting statistics for softwood species (Ruiz Peinado et al., 2011)

<i>Pinus halepensis</i>	Equations
Stem	$W_s = 0.0139*d^2*h$
Stem Thick branches If $d \leq 27.5$ cm then $Z = 0$ ; If $d > 27.5$ cm then $Z = 1$	$W_{b7} = [3.926*(d-27.5)]*Z$
Medium branches	$W_{b27} = 4.257 + 0.00506*d^2*h - 0.0722*d*h$
Thin branches + needles	$W_{b2+n} = 6.197 + 0.00932*d^2*h - 0.0686*d*h$
Roots	$W_r = 0.0785*d^2$
<i>Pinus nigra</i>	Equations
Stem	$W_s = 0.0403*d^{1.838}*h^{0.945}$
Stem Thick branches If $d \leq 32.5$ cm then $Z = 0$ ; If $d > 32.5$ cm then $Z = 1$ ;	$W_{b7} = [0.228*(d-32.5)^2]*Z$
Medium branches	$W_{b27} = 0.0521*d^2$
Thin branches + needles	$W_{b2+n} = 0.0720*d^2$
Roots	$W_r = 0.0189*d^{2.445}$
<i>Pinus sylvestris</i>	Equations
Stem	$W_s = 0.0154*d^2*h$
Stem Thick branches If $d \leq 37.5$ cm then $Z = 0$ ; If $d > 37.5$ cm then $Z = 1$	$W_{b7} = [0.540*(d-37.5)^2 - 0.0119*(d-37.5)^2*h]*Z$
Medium branches	$W_{b27} = 0.0295*d^{2.742}*h - 0.899$
Thin branches + needles	$W_{b2+n} = 0.530*d^{2.199}*h - 1.153$
Roots	$W_r = 0.130*d^2$

Ws: Biomass weight of the stem fraction (kg). Wb7: Biomass weight of the thick branch fraction (diameter larger than 7 cm) (kg). Wb2-7: Biomass weight of medium branch fraction (diameter between 2 and 7 cm) (kg). Wb2+n Biomass weight of thin branch fraction (diameter smaller than 2 cm) with needles (kg). Wr: Biomass weight of the belowground fraction (kg); d: dbh (cm). h: tree height (m).

**Table S3.** Environmental data used to predict the effect of thinning on soil C sequestration (SOC<sub>10</sub>).

Ho	mean annual extraterrestrial solar irradiation	J m <sup>-2</sup>
hn	mean annual net radiation	J m <sup>-2</sup>
qn	mean annual photosynthetic photon flux density	mol m <sup>-2</sup>
wn	mean annual soil moisture	mm
ea n	annual actual evapotranspiration	mm
ep n	annual potential evapotranspiration	mm
SM	mean annual soil volumetric water content	% vol.
SM90	max. annual soil volumetric water content calculated as the 90 quantile of daily	% vol.
SM50	wieghthed mean soil volumetric water content calculated as the 50 quantile of daily	% vol.
SM10	min. annual soil volumetric water content calculated as the 90 quantile of daily	% vol.
ks	saturated hydraulic conductivity	cm d <sup>-1</sup>
theta s	saturated soil volumetric water content	% vol.
theta r	saturated soil volumetric water content	% vol.
kh	saturated hydraulic conductivity	cm d <sup>-1</sup>
h	pressure heads h calculated from water retention curve	cm
doy_max	day of the year with maximum soil moisture stress	Day
doy_min	day of the year when moderate soil moisture stress starts	Day
doy_stress	total number of days under soil moisture stress	days