Integration of tree hydraulic processes and functional impairment to capture the drought resilience of a semi-arid pine forest.

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Tables:

Table S1: LandscapeDNDC soil initialization for Yatir forest

Depth	**clay content**	**field capacity**	**wilting point**	**soil organic content**	**bulk density**	**sceleton content**	**saturated water conductivity**
(cm)	(%)	%	%	%	g cm^{-3}	%	cm min^{-1}
2-0	0	70	8	40	0.3	0	1.5.
0-5	30	30	8	3	1.65	0	0.09
5-15	30	30	8	2	1.57	5	0.09
15-25	40	27.5	8	2	1.61	10	0.10
25-35	42	27.5	9	1	1.54	20	0.11
35-50	42	27.5	11	1	1.54	20	0.11
50-100	42	28	11	1	1.54	30	0.11

Table S2: LandscapeDNDC parameters for *Pinus halepensis* regarding photosynthesis, phenology and allometry.

Description	**unit**	**abbreviation**	**value**	**source**
Photosynthesis				
activation energy for electron transport	J mol^{-1}	aejm	57550.0	Simioni et al. (2016)
activation energy for Michaelis-Menten constant for CO_2	J mol^{-1}	aekc	79430.0	Simioni et al. (2016)
activation energy for Michaelis-Menten constant for O_2	J mol^{-1}	aeko	36380.0	Simioni et al. (2016)
activation energy for dark respiration	J mol^{-1}	aerd	84450.0	Simioni et al. (2016)
activation energy for photosynthesis	J mol^{-1}	aevc	67390.0	Simioni et al. (2016)
relation between maximum electron transport rate and RubP saturated rate of carboxylation	--	qjvc	1.5	Maseyk et al. (2008a)

relation between dark respiration rate and RubP saturated rate of carboxylation at 25 ^{o}C	µmol m^{-2} s^{-1}	qrd25	0.011	Sperlich et al. (2015)
maximum stomata conductivity	mmolH_2O m^{-2} s^{-1}	gsmax	115.0	Baquedano and Castillo (2007)
deactivation energy (for electron transport processes)	J mol^{-1}	hdj	200000.0	Simioni et al. (2016)
entropy term of electron transport	J mol^{-1} °C^{-1}	sdj	685.0	calibrated *
maximum RubP saturated rate of carboxylation at 25 ^{o}C for sun leaves	µmol m^{-2} s^{-1}	vcmax25	38.8	Kuusk et al. (2018)
slope of foliage conductivity in response to assimilation in the BERRY-BALL model	--	slope_gsa	5.04	Maseyk et al. (2008a)
Phenology/ Turnover				
minimum temperature sum for foliage activity onset	^{o}C	gddfolstart	0	Maseyk et al. (2008b)
total leaf longevity from the first day of the emergent year	days	dleafshed	1365	Maseyk et al. (2008b)
time interval necessary to complete growth of new foliage	days	ndflush	180	Maseyk et al. (2008b)
time interval necessary to complete litterfall of foliage	days	ndmorta	300	Maseyk et al. (2008b)
fraction of current fine root biomass that dies daily	--	tofrtbas	0.0005	Simioni et al. (2016)
fraction of current sapwood biomass that can die per day	--	tosapmax	0.00025	Cohen et al. (2008)
Allometry				
foliage biomass under optimal, closed canopy condition	kg m^{-2}	mfolopt	0.86	Maseyk et al. (2008b)
distribution parameter for foliage biomass	--	pfl	1.3	Zinsser (2017)
distribution parameter for fine root biomass	--	psl	0.91	Preisler et al. (2019)
ratio between fine root- and foliage biomass under standard conditions	--	qrf	0.41	Klein and Hoch (2015)
Minimum sapwood area to leaf area ratio (Huber value)	m^2 cm^{-2}	qsf	4.1	Froux et al. (2002)

***** calibrated for this study to the relation between observed photosynthesis and simulated temperature. This is preferred over using a standard value of 642 (Maseyk et al., 2008a) since the estimation of leaf temperature in LandscapeDNDC is subject to high uncertainty.

Table S3: Prior distribution implemented in the model inverse Bayesian calibration. Given are the mean and the standard deviation, as well as the upper and lower bounds for each parameter following a truncated gaussian distribution. *RPMIN* is the minimum whole-plant resistance to water flow; *ANSL* is the shape coefficient and ΨNSL is the reference $\Psi_{canopy,PD}$ coefficient of the drought impact function to assimilation; $\Psi_{disconnect}$ is the soil water potential at which roots do not re-equilibrate their water potential with soil water potential overnight; and *KSPEC* is the maximum root-to-canopy conductance per unit of leaf area, and V_{cmax25} is the maximum carboxylation velocity at 25°C.

Parameter	Mean	SD	Lower bound	Upper bound
RPMIN	4.5	0.5	1.5	8
ANSL	4	0.25	3	6
ΨNSL	-1.3	0.1	-2	-1
$\Psi_{disconnect}$	-2	0.3	-1.5	-2.5
KSPEC	1.5	0.3	0.5	3.0
$V_{cmax,25}$	50	5	30	70

Figures

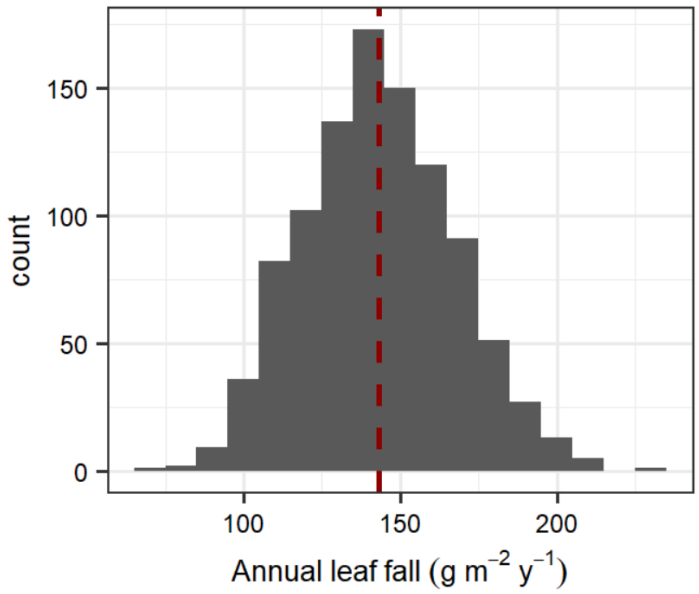

Figure S1: Bootstrapped reconstruction of the cumulated average annual leaf fall (g m^{-2} y^{-1}) in Yatir for the 2003 - 2012 period from leaf trap collection observations. Vertical dashed line indicates the median value, which is the value that has been considered in the main text of the document to compute the total leaf biomass in Yatir.

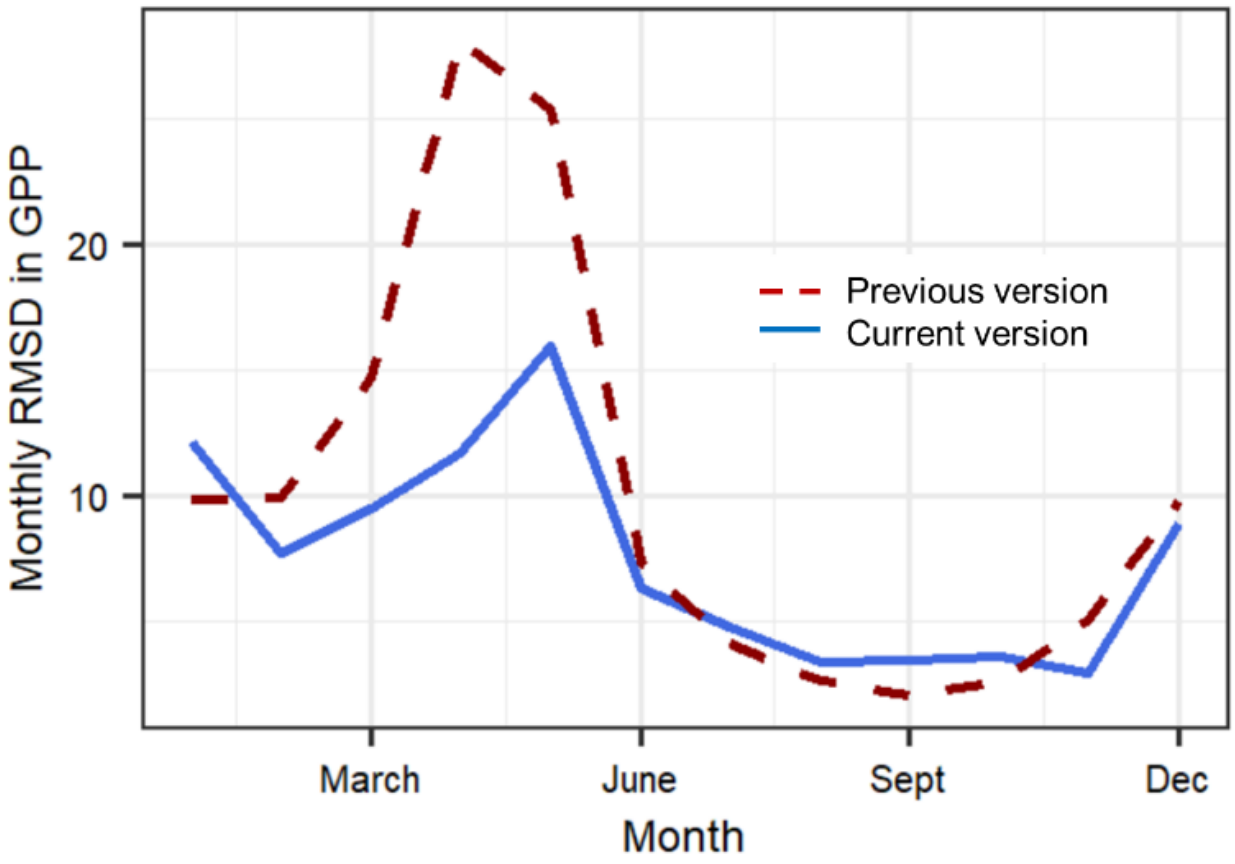

Figure S2: Comparison of the performance in simulating GPP of the current LandscapeDNDC model version including the new hydraulic module with a previous version of the model (Nadal-Sala et al., 2021). The monthly root mean square difference (RMSD) is given for the current (blue line) and the previous (dashed LandscapeDNDC version comparing model output with GPP observations (n = 737) at Yatir from 2013 – 2015. Note the larger the RMSD, the larger the mismatch between model projections and GPP observations.

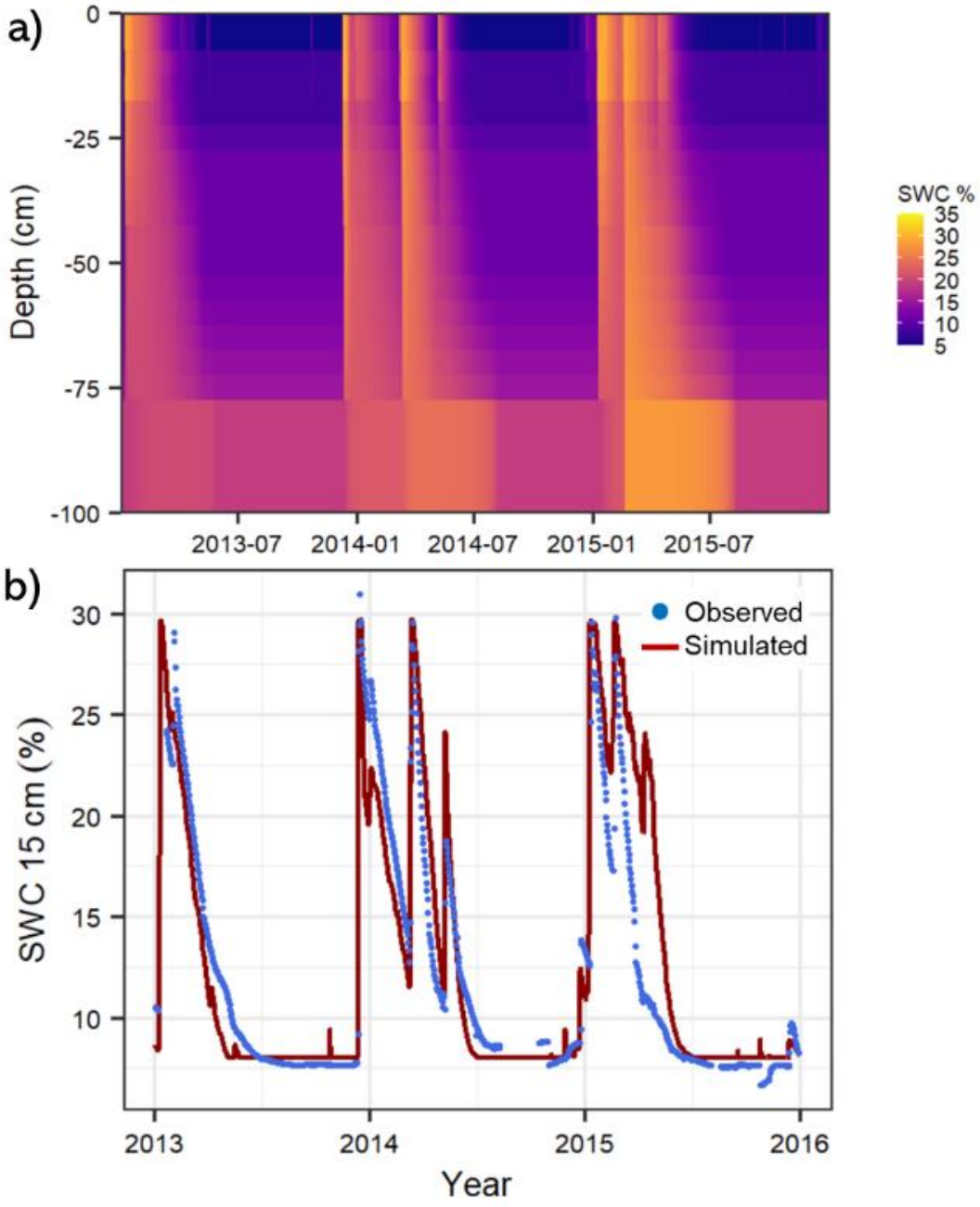

Figure S3: Daily simulated soil water content dynamics in Yatir with calibrated LandscapeDNDC for the 2013 - 2015 period down to 1 m depth, in (a). Comparison of simulated -red line- and measured-blue dots- daily soil water content (SWC, in %) dynamics at the 15 cm soil layer in Yatir for the 2013 - 2015 period, in (b).

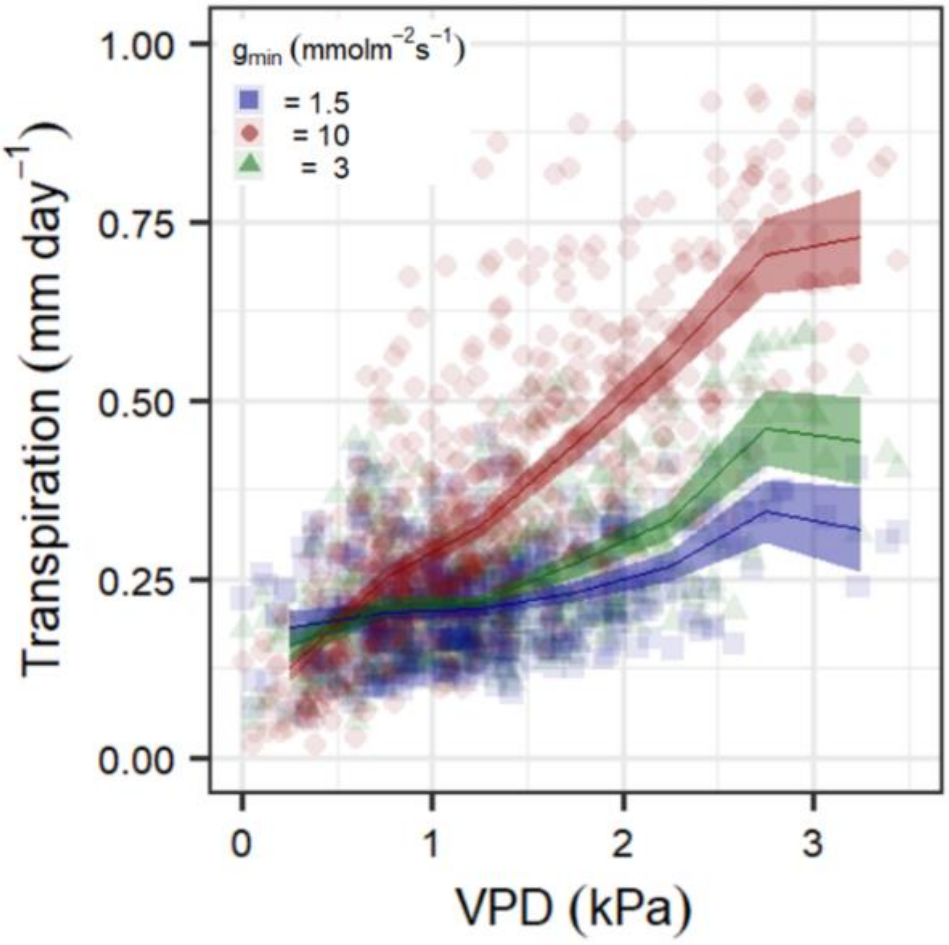

Figure S4: Sensitivity of simulated transpiration to variations in g_{MIN} given for the dry summer period when soil water content was < 11% - corresponding to the point at which roots disconnected from the soil. Given is the daily cumulated transpiration simulated with three different values of g_{MIN} (1.5, 3 and 10 mmol m^{-2} s^{-1}) in relation to changes in daily-averaged vapor pressure deficit in Yatir forest for 2013-2015. Shaded area represents the 0.5 VPD-binned transpiration averages ± 1.96 SE for each g_{MIN}.

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