

# Spatially variable hydrologic impact and biomass production tradeoffs associated with Eucalyptus cultivation for biofuel production in Entre Rios, Argentina

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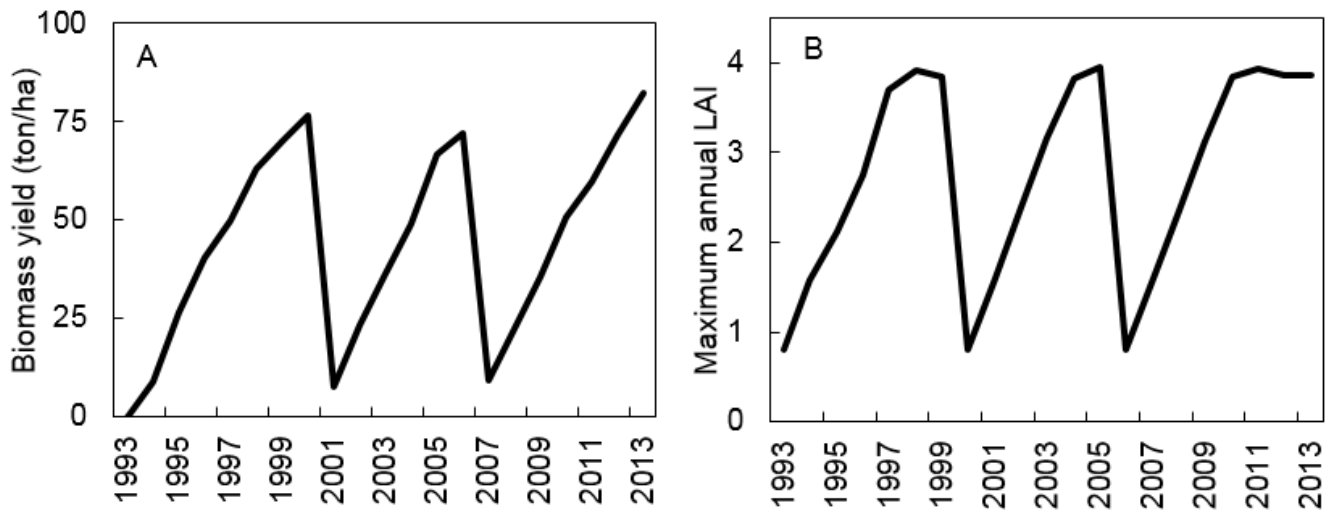
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## Supplemental Information.



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Figure S1: A) Simulated annual biomass production for the intensive scenario, and B) Simulated LAI development for the intensive scenario.

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**Table S1: Land cover/land use change during the period 2002-2013.**

Land Cover	Land cover portion of the watershed		
	2002	2005	2013
Orchard-Orange	4.9%	3.5%	1.1%
Agriculture	20.2%	23.4%	21.7%
Mixed Forest	12.0%	6.5%	3.6%
Eucalyptus	10.9%	13.0%	22.0%
Rangelands	34.5%	36.2%	34.2%
Wetlands and rivers	17.4%	17.4%	17.4%

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**Table S2: Modified parameters for hydrological model calibration and their final values.**

Parameter	Description	Default value	Final value	Range
<i>CN2</i>	SCS runoff curve number	80	56.9	+/- 30%
<i>CH_K2</i>	Effective hydraulic conductivity (mm/hr)	0	16.8	0 - 25
<i>ALPHA_BF</i>	Baseflow alpha factor (days)	0.048	0.75	0.01- 0.9
<i>ALPHA_BF_D</i>	Baseflow alpha factor for deep aquifer (days)	0.01	0	0 – 0.1
<i>GWQmin</i>	Threshold depth of water in the shallow aquifer required for return flow to occur (mm H <sub>2</sub> O)	1000	1060.5	200 - 2000
<i>Rchrg_dp</i>	Deep aquifer percolation fraction	0.05	0.62	0 - 1
<i>CANMAX_Euca</i>	Maximum Canopy Storage (mm H <sub>2</sub> O)	0	4	0 - 10
<i>CANMAX_Oran</i>	Maximum Canopy Storage (mm H <sub>2</sub> O)	0	4	0 - 10

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5 **Table S3: Plant growth parameters in SWAT database used for eucalyptus growth simulation.**

Parameter	Description	Default value	Final Value
<i>BLAI</i>	Maximum potential leaf area index	2.5	4
<i>FRGRW1</i>	Fraction of the plant growing season corresponding to the 1 <sup>st</sup> point on the optimal leaf area development curve	0.1	0.05
<i>LAIMX1</i>	Fraction of the maximum leaf area index corresponding to the 1 <sup>st</sup> point on the optimal leaf area development curve	0.15	0.05
<i>FRGWRW2</i>	Fraction of the plant growing season corresponding to the 2 <sup>nd</sup> point on the optimal leaf area development curve	0.5	0.2
<i>LAIMX2</i>	Fraction of the maximum leaf area index corresponding to the 2 <sup>nd</sup> point on the optimal leaf area development curve	0.75	0.95
<i>HVSTI</i>	Harvest index for optimal growing condition.	0.1	1
<i>DLAI</i>	Fraction of growing season when leaf area begins to decline	0.99	1
<i>Mat_yrs</i>	Number of years required for trees to reach maturity	10	5
<i>Bio_E</i>	Radiation use efficiency	15	26
<i>EXT_coef</i>	Light extinction coefficient	0.65	0.4
<i>Bio_Leaf</i>	Tree biomass accumulated each year that is converted to residue	0.3	0.2
<i>BIO_INIT</i>	Initial dry weight biomass (kg/ha)	0	0.5
<i>CURYR_MAT</i>	Current age of trees (years) at time of planting	0	1

10 **Table S4: Calibration and validation statistics for streamflow simulations.**

Time step	Calibration Period (1993-2005)			Validation period (2005-2013)		
	Metric					
	<i>NS</i>	<i>Pbias</i>	<i>RSq</i>	<i>NS</i>	<i>Pbias</i>	<i>RSq</i>
Monthly	0.58	-7.60	0.58	0.62	6.77	0.51

**Table S5: Results of the optimization model to select combinations of sub-basins for maximum biomass and limited water impact.**

Solution Number	Additional Biomass (above Base case) (10 <sup>6</sup> ton)	Total Biomass (10 <sup>6</sup> ton)	Yield (ton/ ha/ rotation)	Area Eucalyptus (km <sup>2</sup> )	% Change in total flow	A	B	C	D	E	F	G	H
1	0.3	1.9	77.9	79.9	-1.1%	0	0	0	0	1	0	0	0
2	0.6	2.1	74.8	93.9	-2.5%	0	0	0	0	0	1	0	0
3	0.8	2.4	74.4	107.1	-2.7%	0	0	1	0	0	0	0	0
4	1.0	2.5	76.7	109.8	-3.0%	1	0	0	0	0	0	0	0
5	1.2	2.7	76.2	118.4	-3.8%	0	0	1	0	1	0	0	0
6	1.3	2.8	78.2	121.1	-4.2%	1	0	0	0	1	0	0	0
7	1.6	3.1	72.8	144.0	-5.3%	0	1	0	0	1	0	0	0
8	1.8	3.4	75.7	148.3	-5.7%	1	0	1	0	0	0	0	0
9	1.8	3.4	75.9	149.0	-6.1%	0	0	0	1	0	0	0	0
10	2.1	3.7	76.9	159.6	-6.9%	1	0	1	0	1	0	0	0
11	2.3	3.8	72.9	173.9	-7.2%	1	1	0	0	0	0	0	0
12	2.7	4.2	75.3	187.5	-8.8%	0	0	1	1	0	0	0	0
13	3.1	4.6	72.9	212.4	-9.9%	1	1	1	0	0	0	0	0
14	3.1	4.7	77.5	201.5	-10.3%	1	0	0	1	1	0	0	0
15	3.7	5.2	75.9	228.7	-11.8%	1	0	1	1	0	0	0	0
16	4.0	5.5	76.8	240.0	-13.0%	1	0	1	1	1	0	0	0
17	4.1	5.6	74.0	254.3	-13.3%	1	1	0	1	0	0	0	0
18	4.4	6.0	74.8	265.6	-14.4%	1	1	0	1	1	0	0	0
19	4.9	6.5	73.8	292.8	-16.0%	1	1	1	1	0	0	0	0
20	5.3	6.8	74.6	304.1	-17.1%	1	1	1	1	1	0	0	0
21	5.5	7.0	73.8	318.1	-18.5%	1	1	1	1	0	1	0	0
22	5.8	7.4	74.5	329.4	-19.6%	1	1	1	1	1	1	0	0
23	6.0	7.5	75.9	331.4	-21.1%	1	1	1	1	1	0	1	0
24	6.2	7.8	75.2	345.4	-22.4%	1	1	1	1	0	1	1	0
25	6.6	8.1	75.7	356.7	-23.5%	1	1	1	1	1	1	1	0
26	6.7	8.3	76.1	363.7	-24.8%	1	1	1	1	1	1	0	1
27	6.9	8.5	77.3	365.7	-26.3%	1	1	1	1	1	0	1	1

28	7.2	8.7	76.6	379.7	-27.6%	1	1	1	1	0	1	1	1
29	7.5	9.0	77.1	391.0	-28.8%	1	1	1	1	1	1	1	1
Times						22	16	19	18	15	8	6	4
Selected													