

Supplementary Materials

Table S1. LiDAR predictor metrics used and selected by the Boruta variable selection method.

Predictor Class	Description	(V)olume/ (B)iomass Model
Canopy Cover	(All Returns Above Mean ht/total 1st returns) * 100	V B
Canopy Cover	(All Returns Above Mode ht/total 1st returns) * 100	
Canopy Cover	((mean ht - min ht)/(max ht-min ht))	
Canopy Cover	Percentage 1st returns above 2m	V B
Canopy Cover	Percentage 1st returns above mean ht	V
Canopy Cover	Percentage 1st returns above mode ht	
Canopy Cover	Percentage All returns above 2m	V B
Canopy Cover	Percentage All returns above mean ht	
Canopy Cover	Percentage All returns above mode ht	
Canopy Cover	(All returns above 2m / Total 1st returns) * 100	V B
Statistical	Average absolute deviation (AD) of ht	B
Statistical	Coefficient of variation	
Statistical	Interquartile distance	B
Statistical	Kurtosis	
Statistical	First L moment	
Statistical	Second L moment	B
Statistical	L-moment coefficient of variation	
Statistical	L-moment kurtosis	
Statistical	L-moment skewness	
Statistical	Median of the AD from the overall median	
Statistical	Median of the AD from the overall mode	B
Statistical	Mode ht	B
Statistical	Quadratic mean of ht	
Statistical	Standard deviation of ht	
Statistical	Skewness of ht	
Statistical	Variance of ht	
Height	Xth percentile of height distribution (10,20,25,30,40,50,60,70,75,80,90,95)	V – 10 B – 95
Density	Cumulative percentage of returns in the Xth decile (1-9)	B – 6, 7

Table S2. Mixed effect model F and P-value results between treatments for volume and biomass cumulative increments with subset plot trees or all plot trees.

Attribute	Year	Trees	Degrees Freedom	Treatment Effect F-value (P-value)
Volume	2008	Subset	4	0.49 (0.52)
Volume	2011	Subset	4	0.91 (0.39)
Volume	2016	Subset	4	0.05 (0.84)
Biomass	2008	Subset	4	0.11 (0.76)
Biomass	2011	Subset	4	0.00 (0.99)
Biomass	2016	Subset	4	1.41 (0.30)
Volume	2008	All	4	0.78 (0.43)
Volume	2011	All	4	1.28 (0.32)
Biomass	2008	All	4	0.43 (0.55)
Biomass	2011	All	4	0.03 (0.87)

Table S3. Mixed effect model F and P-value results between treatments for volume and biomass periodic annual increments with all plot trees or subset plot trees.

Attribute	Year	Trees	Degrees Freedom	Treatment Effect F-value (P-value)
Volume	2008	Subset	4	0.49 (0.52)
Volume	2011	Subset	4	1.25 (0.33)
Volume	2016	Subset	4	0.05 (0.84)
Biomass	2008	Subset	4	0.10 (0.76)
Biomass	2011	Subset	4	0.05 (0.83)
Biomass	2016	Subset	4	1.05 (0.36)
Volume	2008	All	4	0.78 (0.43)
Volume	2011	All	4	1.64 (0.27)
Biomass	2008	All	4	0.43 (0.55)
Biomass	2011	All	4	0.01 (0.92)

Table S4. Plot level stem volumes (m^3ha^{-1}), periodic annual volume increments ($\text{m}^3\text{ha}^{-1}\text{yr}^{-1}$), and control (C) or fertilized (F) treatment averages for the subset trees in the plots, as well as all trees.

			Subset Trees				All Trees			
			2004	2005-2008	2009-2011	2012-2016	2004	2005-2008	2009-2011	2012-2016
Plot	Treat	Volume	PAI	PAI	PAI	PAI	Volume	PAI	PAI	PAI
1.1	C	516.8	8.7	15.8	18.2		651.1	10.0	17.1	-10.5
8.3	C	338.8	6.6	10.7	16.2		446.5	8.6	13.0	-8.3
10.2	C	491.1	10.3	17.7	4.7		580.6	12.1	19.7	-15.8
Average	C	448.9	8.5	14.8	13.0		559.4	10.2	16.6	-11.5
(SE)		(55.6)	(1.1)	(2.1)	(4.2)		(60.2)	(1.00)	(2.0)	(2.2)
4.1	F	520.0	8.6	15.9	12.9		588.9	10.4	17.9	-3.6
5.1	F	461.9	9.8	17.5	17.0		576.1	11.5	19.3	-8.3
6.1	F	487.6	9.6	18.4	5.8		641.3	11.6	20.6	-27.9
Average	F	489.9	9.3	17.2	11.9		602.1	11.2	19.3	-13.3
(SE)		(16.8)	(0.4)	(0.7)	(3.3)		(19.9)	(0.4)	(0.8)	(7.4)

Table S5. Plot level stem biomass (Mg ha^{-1}), periodic annual biomass increments ($\text{Mg ha}^{-1}\text{yr}^{-1}$), and control (C) or fertilized (F) treatment averages for the subset trees in the plots, as well as all trees.

			Subset Trees				All Trees			
			2004	2005-2008	2009-2011	2012-2016	2004	2005-2008	2009-2011	2012-2016
Plot	Treat	Biomass	PAI	PAI	PAI	PAI	Biomass	PAI	PAI	PAI
1.1	C	149.7	3.3	6.1	3.1		189.2	3.8	6.7	-5.6
8.3	C	94.0	2.2	3.6	2.8		125.3	2.9	4.5	-4.6
10.2	C	139.7	3.4	6.1	-0.02		164.6	4.1	6.9	-6.0
Average	C	127.8	3.0	5.3	2.0		159.7	3.6	6.0	-5.4
(SE)		(17.2)	(0.4)	(0.8)	(1.0)		(18.6)	(0.4)	(0.8)	(0.4)
4.1	F	128.9	2.8	5.3	3.9		146.2	3.3	5.9	-0.4
5.1	F	108.9	2.7	5.1	5.0		136.1	3.2	5.7	-1.2
6.1	F	124.4	3.0	6.0	1.4		161.6	3.6	6.7	-6.9
Average	F	120.7	2.8	5.5	3.4		148.0	3.4	6.1	-2.8
(SE)		(6.1)	(0.1)	(0.3)	(1.1)		(7.4)	(0.1)	(0.3)	(2.1)

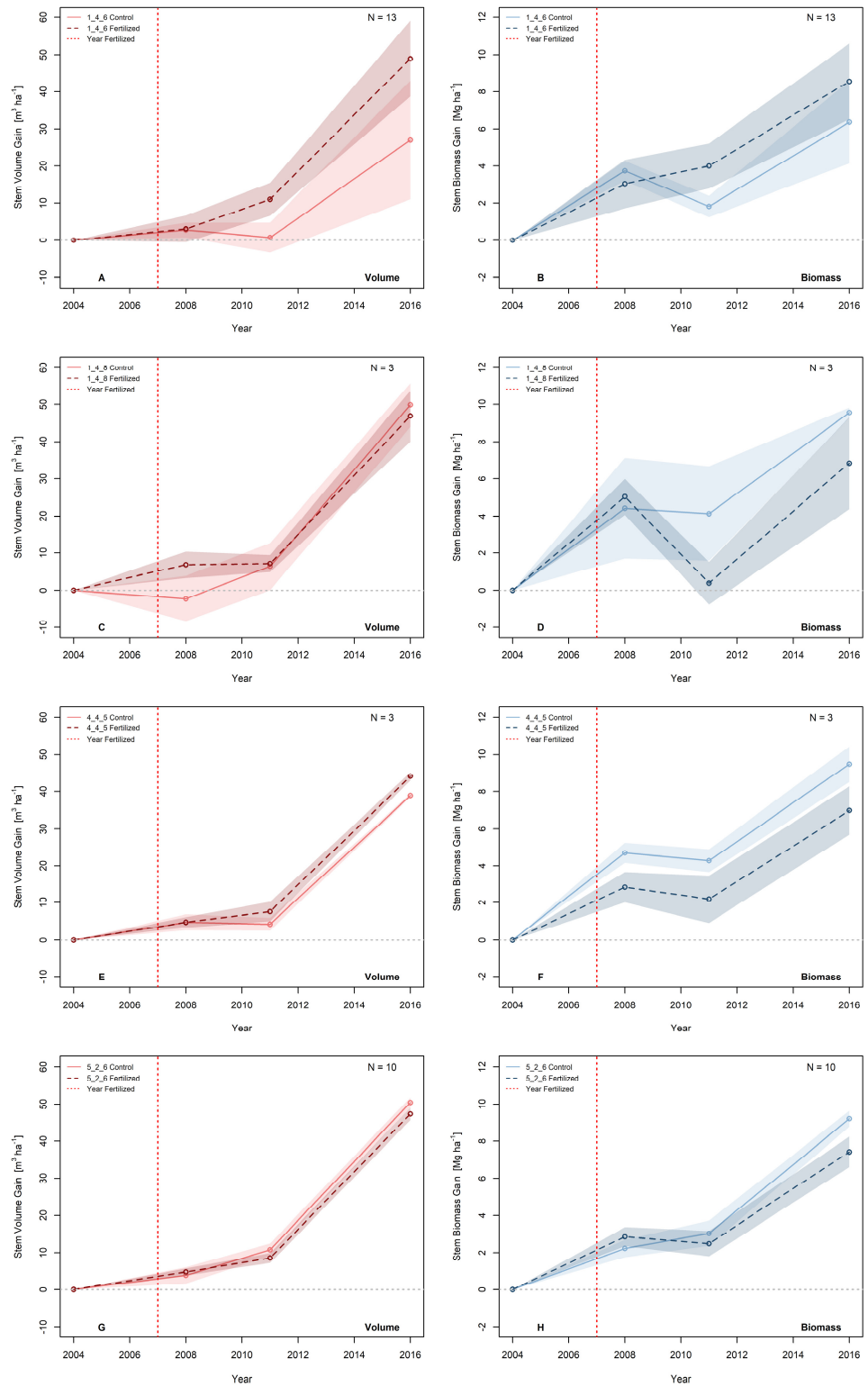


Figure S1: LiDAR block-level average (line) and standard error (shadow) stem volume (left) and biomass (right) increments for control blocks (solid) and fertilized blocks (dashed) in AU 146 (A,B), AU 148 (C,D), AU 445 (E,F), AU 526 (G,H).

Table S6: Mixed effect model F and P-value results between treatments for volume and biomass increments in the LiDAR blocks across all AUs.

Attribute	Year	AU	Degrees Freedom	Treatment Effect F-value (P-value)
Volume	2008	All	28	0.53 (0.47)
Volume	2011	All	28	2.33 (0.14)
Volume	2016	All	28	2.79 (0.11)
Biomass	2008	All	28	0.11 (0.74)
Biomass	2011	All	28	0.06 (0.80)
Biomass	2016	All	28	0.04 (0.85)

Table S7: Mixed effect model F and P-value results between treatments for volume and biomass increments in the LiDAR for individual AUs.

Attribute	Year	AU	Degrees Freedom	Treatment Effect F-value (P-value)
Volume	2008	146	12	0.01 (0.93)
Volume	2011	146	12	3.60 (0.08)
Volume	2016	146	12	3.98 (0.07)
Biomass	2008	146	12	0.34 (0.57)
Biomass	2011	146	12	4.35 (0.06)
Biomass	2016	146	12	2.03 (0.18)
Volume	2008	148	2	10.00 (0.09)
Volume	2011	148	2	0.02 (0.89)
Volume	2016	148	2	2.78 (0.24)
Biomass	2008	148	2	0.08 (0.81)
Biomass	2011	148	2	1.81 (0.31)
Biomass	2016	148	2	1.19 (0.39)
Volume	2008	445	2	0.00 (1.00)
Volume	2011	445	2	1.16 (0.39)
Volume	2016	445	2	32.37 (0.03)
Biomass	2008	445	2	3.57 (0.20)
Biomass	2011	445	2	4.48 (0.17)
Biomass	2016	445	2	46.21 (0.02)
Volume	2008	526	9	0.15 (0.71)
Volume	2011	526	9	1.24 (0.29)
Volume	2016	526	9	2.05 (0.19)
Biomass	2008	526	9	0.83 (0.39)
Biomass	2011	526	9	0.36 (0.56)
Biomass	2016	526	9	4.44 (0.06)

Table S8: Mixed effect model F and P-value results between treatments for volume and biomass periodic annual increments in the LiDAR blocks across all AUs.

Attribute	Year	AU	Degrees Freedom	Treatment Effect F-value (P-value)
Volume	2008	All	28	0.53 (0.48)
Volume	2011	All	28	1.74 (0.20)
Volume	2016	All	28	0.70 (0.41)
Biomass	2008	All	28	0.11 (0.74)
Biomass	2011	All	28	0.26 (0.61)
Biomass	2016	All	28	0.23 (0.64)

Table S9: Mixed effect model F and P-value results between treatments for volume and biomass periodic annual increments in the LiDAR blocks for individual AUs.

Attribute	Year	AU	Degrees Freedom	Treatment Effect F-value (P-value)
Volume	2008	146	12	0.01 (0.93)
Volume	2011	146	12	6.09 (0.03)
Volume	2016	146	12	0.87 (0.37)
Biomass	2008	146	12	0.34 (0.57)
Biomass	2011	146	12	5.88 (0.03)
Biomass	2016	146	12	0.00 (0.99)
Volume	2008	148	2	10.00 (0.09)
Volume	2011	148	2	8.82 (0.10)
Volume	2016	148	2	0.38 (0.60)
Biomass	2008	148	2	0.08 (0.81)
Biomass	2011	148	2	2.76 (0.24)
Biomass	2016	148	2	0.21 (0.69)
Volume	2008	445	2	0.00 (0.997)
Volume	2011	445	2	1.03 (0.42)
Volume	2016	445	2	0.32 (0.63)
Biomass	2008	445	2	3.57 (0.20)
Biomass	2011	445	2	0.01 (0.92)
Biomass	2016	445	2	0.28 (0.65)
Volume	2008	526	9	0.15 (0.71)
Volume	2011	526	9	3.12 (0.11)
Volume	2016	526	9	0.38 (0.55)
Biomass	2008	526	9	0.83 (0.39)
Biomass	2011	526	9	2.25 (0.17)
Biomass	2016	526	9	4.08 (0.07)

Table S10: Mixed effect model F and P-value results between treatments for 95th percentile of LiDAR height increments and periodic annual increments in the LiDAR blocks across all AUs.

Attribute	Year	AU	Degrees Freedom	Treatment Effect F-value (P-value)
95 th - Inc	2008	All	28	3.30 (0.08)
95 th – Inc	2011	All	28	6.29 (0.02)
95 th – Inc	2016	All	28	14.18 (0.001)
95 th – PAI	2008	All	28	3.30 (0.08)
95 th – PAI	2011	All	28	4.15 (0.05)
95 th – PAI	2016	All	28	6.48 (0.02)

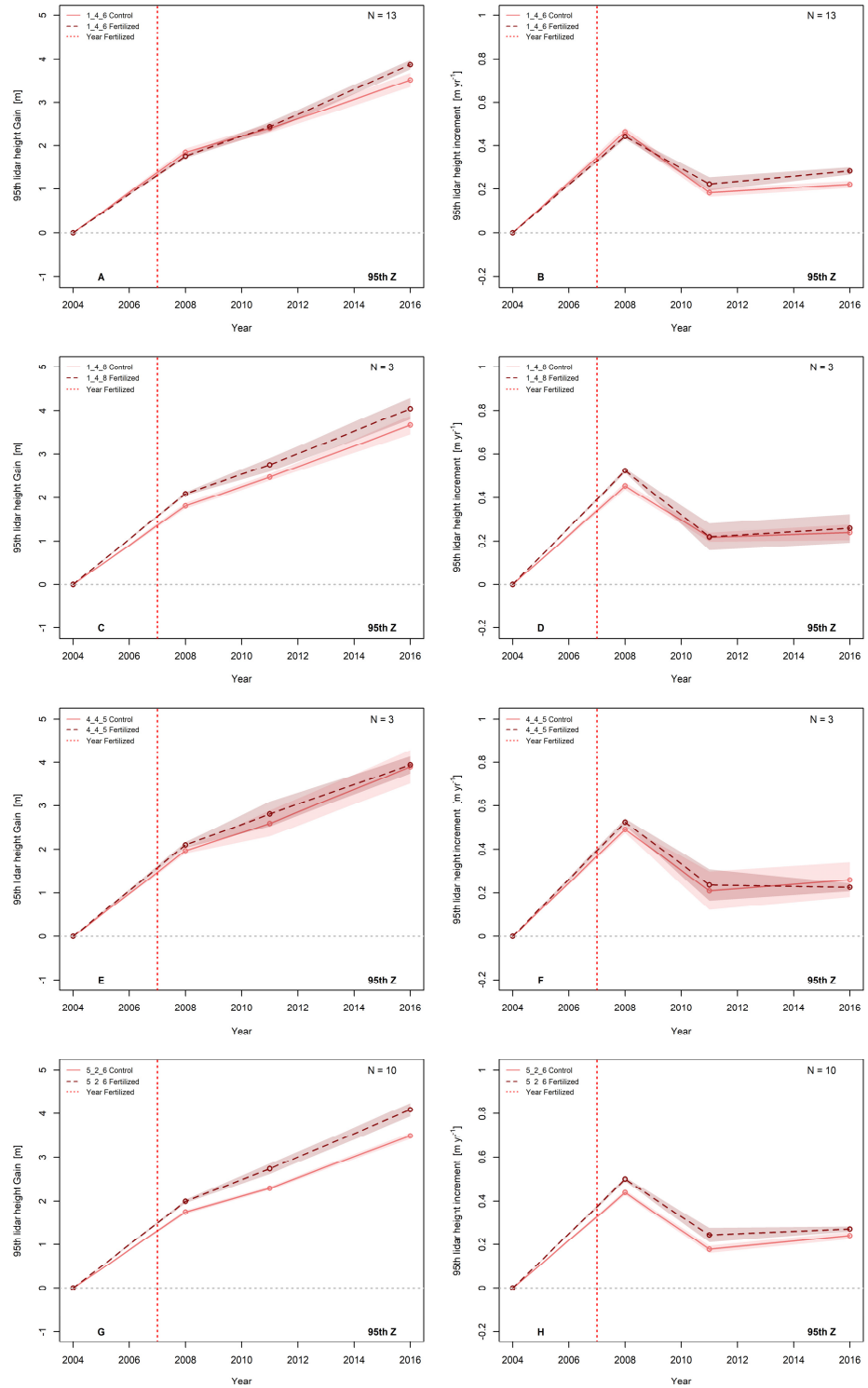


Figure S2: LiDAR block-level average (line) and standard error (shadow) 95th percentile of LiDAR height cumulative (left) and periodic annual (right) increments for control blocks (solid) and fertilized blocks (dashed) in AU 146 (A,B), AU 148 (C,D), AU 445 (E,F), AU 526 (G,H).

Table S11: Mixed effect model F and P-value results between treatments for 95th percentile of LiDAR height increments and periodic annual increments in the LiDAR blocks for individual AUs.

Attribute	Year	AU	Degrees Freedom	Treatment Effect F-value (P-value)
95 th - Inc	2008	146	12	1.32 (0.27)
95 th - Inc	2011	146	12	0.09 (0.76)
95 th - Inc	2016	146	12	4.61 (0.05)
95 th - PAI	2008	146	12	1.32 (0.27)
95 th - PAI	2011	146	12	1.44 (0.25)
95 th - PAI	2016	146	12	8.64 (0.01)
95th - Inc	2008	148	2	65.07 (0.02)
95th - Inc	2011	148	2	2.68 (0.24)
95th - Inc	2016	148	2	4.15 (0.18)
95th - PAI	2008	148	2	65.07 (0.02)
95th - PAI	2011	148	2	0.001 (0.98)
95th - PAI	2016	148	2	0.39 (0.60)
95th - Inc	2008	445	2	2.07 (0.29)
95th - Inc	2011	445	2	0.28 (0.65)
95th - Inc	2016	445	2	0.01 (0.93)
95th - PAI	2008	445	2	2.07 (0.29)
95th - PAI	2011	445	2	0.07 (0.82)
95th - PAI	2016	445	2	0.27 (0.65)
95th - Inc	2008	526	9	19.29 (0.002)
95th - Inc	2011	526	9	12.50 (0.01)
95th - Inc	2016	526	9	13.49 (0.01)
95th - PAI	2008	526	9	19.29 (0.002)
95th - PAI	2011	526	9	3.88 (0.08)
95th - PAI	2016	526	9	2.20 (0.17)

Table S12. Treatment effect method comparison showing weighted values $([\text{Fertilized}/2004 \text{ Fertilized} \times 100] - [\text{Control}/2004 \text{ Control} \times 100])$ in pre and post treatment periods for stem volume ($\text{m}^3 \text{ ha}^{-1}$), stem biomass (Mg ha^{-1}), and height (m) cumulative increment (gain) for plot subset trees and LiDAR blocks, and above ground biomass carbon gain (Mg C ha^{-1}) from a model reconstruction approach using plot tree ring growth curves. Comparisons are also shown for periodic annual increment (PAI) of above ground biomass carbon ($\text{Mg C ha}^{-1} \text{ yr}^{-1}$) from tree-ring curves for the same periods as volume growth ($\text{m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$) in [22]. * Note: Plot tree ring growth curve PAI and Plot crop tree volume growth PAI values weighted as $[\text{Post-treat F}/\text{Pre-treat F} \times 100] - [\text{Post-treat C}/\text{Pre-treat C} \times 100]$

Source	Attribute	Period	Pre-Treat	Post-Treat
Plot Subset Trees	Stem volume gain	Pre: 2005-2008	0%	0.6%
		Post: 2005-2011		
	Stem biomass gain	Pre: 2005-2008	0%	1%
		Post: 2005-2011		
Lidar All Blocks	Stem volume gain	Pre: 2005-2008	0.2%	0.7%
		Post: 2005-2011		
	Stem biomass gain	Pre: 2005-2008	-0.2%	0.1%
		Post: 2005-2011		
	Height gain	Pre: 2005-2008	0%	0.7%
		Post: 2005-2011		
Plot Tree-ring growth curves	Biomass carbon gain	Pre: 2005-2008	0.2%	0.8%
		Post: 2005-2011		
	Biomass carbon PAI*	Pre: 2002-2006	-	28%
		Post: 2007-2011		
Plot crop trees [22]	Volume growth PAI*	Pre: 2002-2006	-	34%
		Post: 2007-2011		