Supporting Information for "Using data assimilation to understand the effect of disturbance on the carbon dynamics of a managed woodland"

Ewan M. Pinnington,[1] Eric Casella,[3] Sarah L. Dance,[1,2] Amos S. Lawless,[1,2,4] James I. L. Morison,[3] Nancy K. Nichols,[1,2,4] Matthew Wilkinson,[3] Tristan L. Quaife,[1,4]

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1. Table S1

Corresponding author: E. M. Pinnington, (e.m.pinnington@pgr.reading.ac.uk)

[1]Department of Meteorology, University of Reading, Reading, UK

[2]Department of Mathematics and Statistics, University of Reading, Reading, UK

[3]Centre for Sustainable Forestry and Climate Change, Forest Research, Alice Holt, Farnham, UK

[4]National Centre for Earth Observation, University of Reading, Reading, UK

2. Figures S1 to S12

Introduction

In Figures S1-S10 we present extra plots from the three experiments outlined in the paper (A, B & C), we also add plots for a fourth experiment (labelled experiment D here) where only LAI, leaf mass per area and woody biomass are assimilated with the DALEC2 model. The summary statistics for experiment D are also included in table S1.

In Figure S11 we show the prior model trajectory and observations of daytime NEE for 2012-2013, this is the period in which the prior model was calibrated.

Figure S12 shows phenocam observations of green fraction taken at the Alice Holt flux site, The LAI as predicted by experiment C is also shown on this figure.

References

Mizunuma, T., M. Wilkinson, E. L Eaton, M. Mencuccini, J. IL Morison, and J. Grace (2013), The relationship between carbon dioxide uptake and canopy colour from two camera systems in a deciduous forest in southern england, *Functional Ecology*, *27*(1), 196–207.

Pinnington, E. M., E. Casella, S. L. Dance, A. S. Lawless, J. I. Morison, N. K. Nichols, M. Wilkinson, and T. L. Quaife (2016), Investigating the role of prior and observation error correlations in improving a model forecast of forest carbon balance using four-dimensional variational data assimilation, *Agricultural and Forest Meteorology*, *228229*, 299 – 314, doi:http://dx.doi.org/10.1016/j.agrformet.2016.07.006.

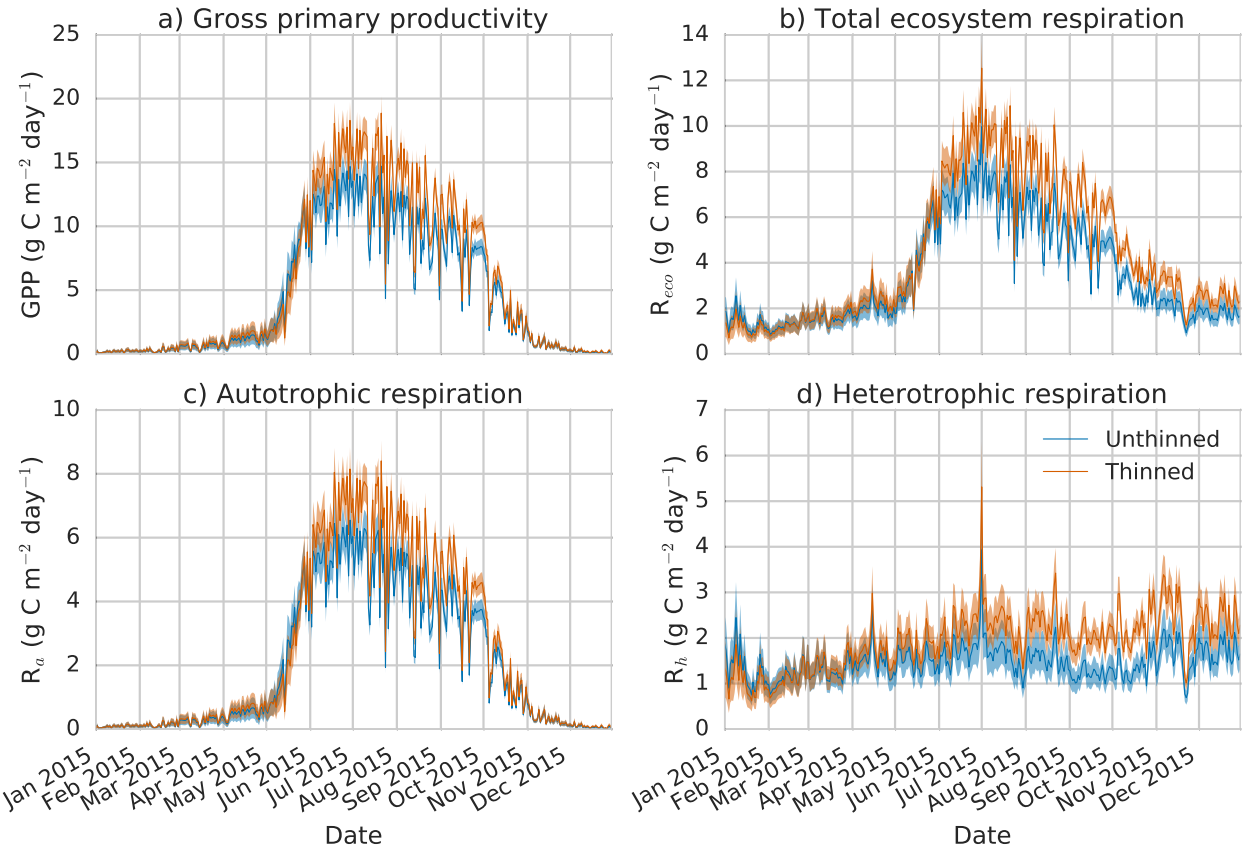

Figure S1. Experiment A: 2015 unthinned and thinned forest model trajectories after assimilation. Blue line: model trajectory after assimilation of unthinned forest data, blue shading: uncertainty in model trajectory after assimilation (± 1 standard deviation), orange line: model trajectory after assimilation of thinned forest data, orange shading: uncertainty in model trajectory after assimilation (± 1 standard deviation).

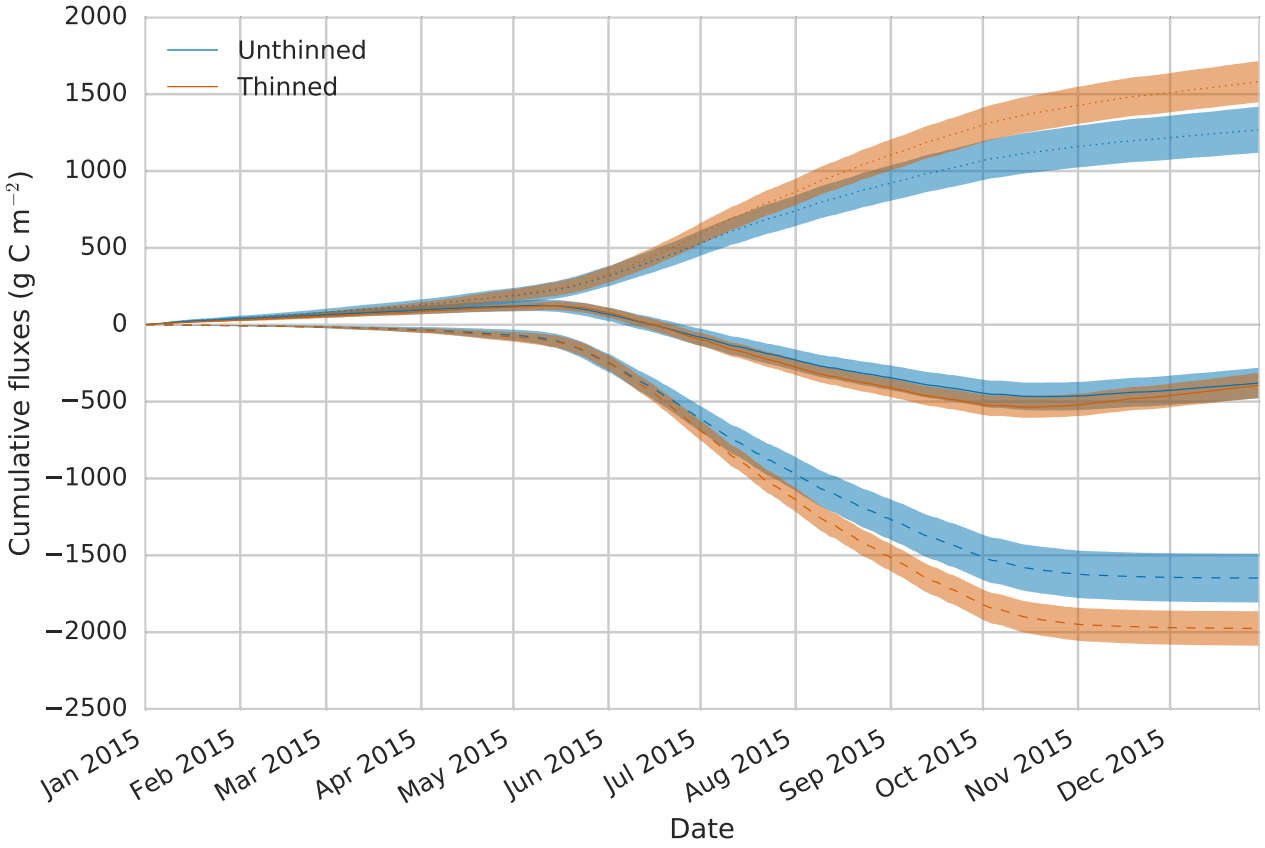

Figure S2. Experiment A: 2015 unthinned and thinned forest model trajectories for cumulative fluxes after assimilation. Solid line cumulative NEE, dotted line: cumulative ecosystem respiration, dashed line: cumulative GPP (NEE=-GPP+RT). Colour and shading has the same meaning as in Figure S1.

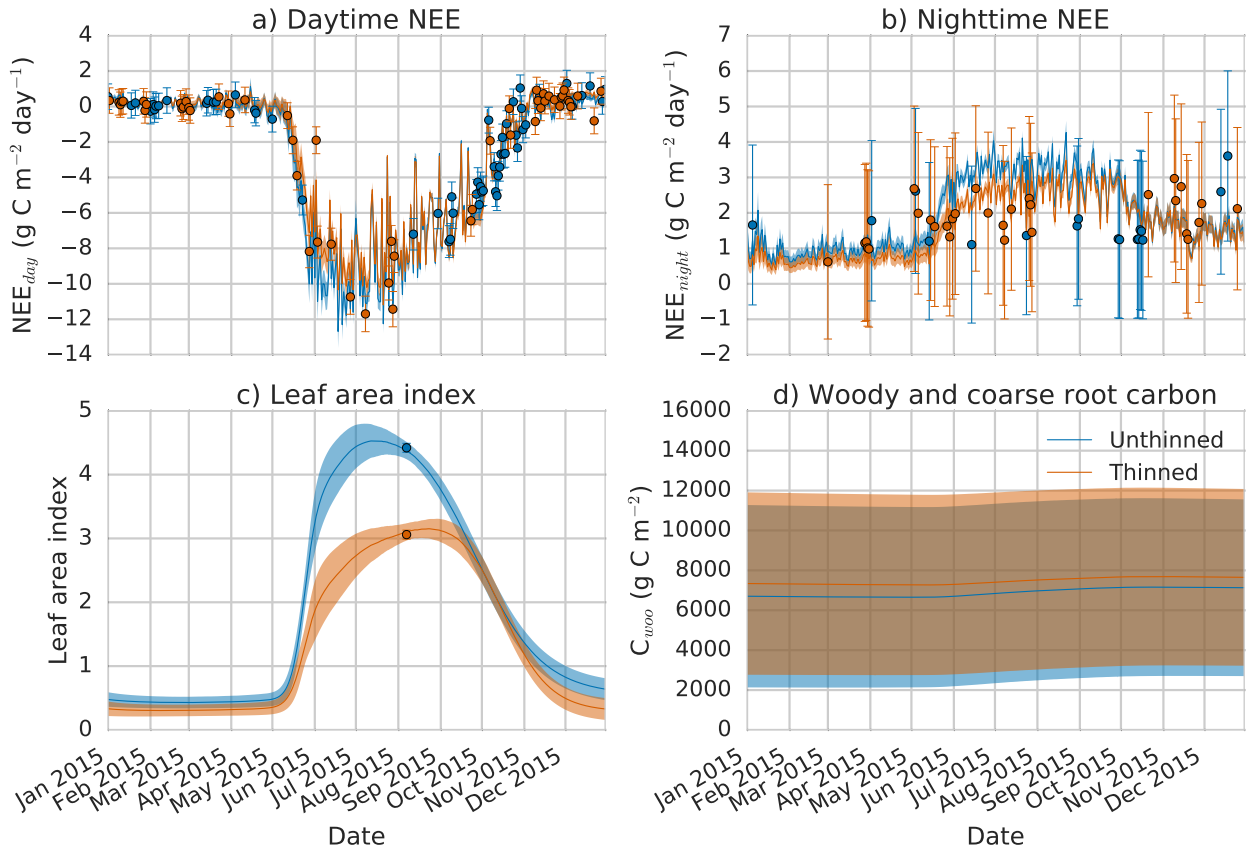

Figure S3. Experiment B: 2015 unthinned and thinned forest observations and model trajectories after assimilation. Blue line: model trajectory after assimilation of unthinned data, blue shading: uncertainty in model trajectory after assimilation (± 1 standard deviation), blue dots: unthinned observations with error bars, orange line: model trajectory after assimilation of thinned data, orange shading: uncertainty in model trajectory after assimilation (± 1 standard deviation), orange dots: thinned observations with error bars.

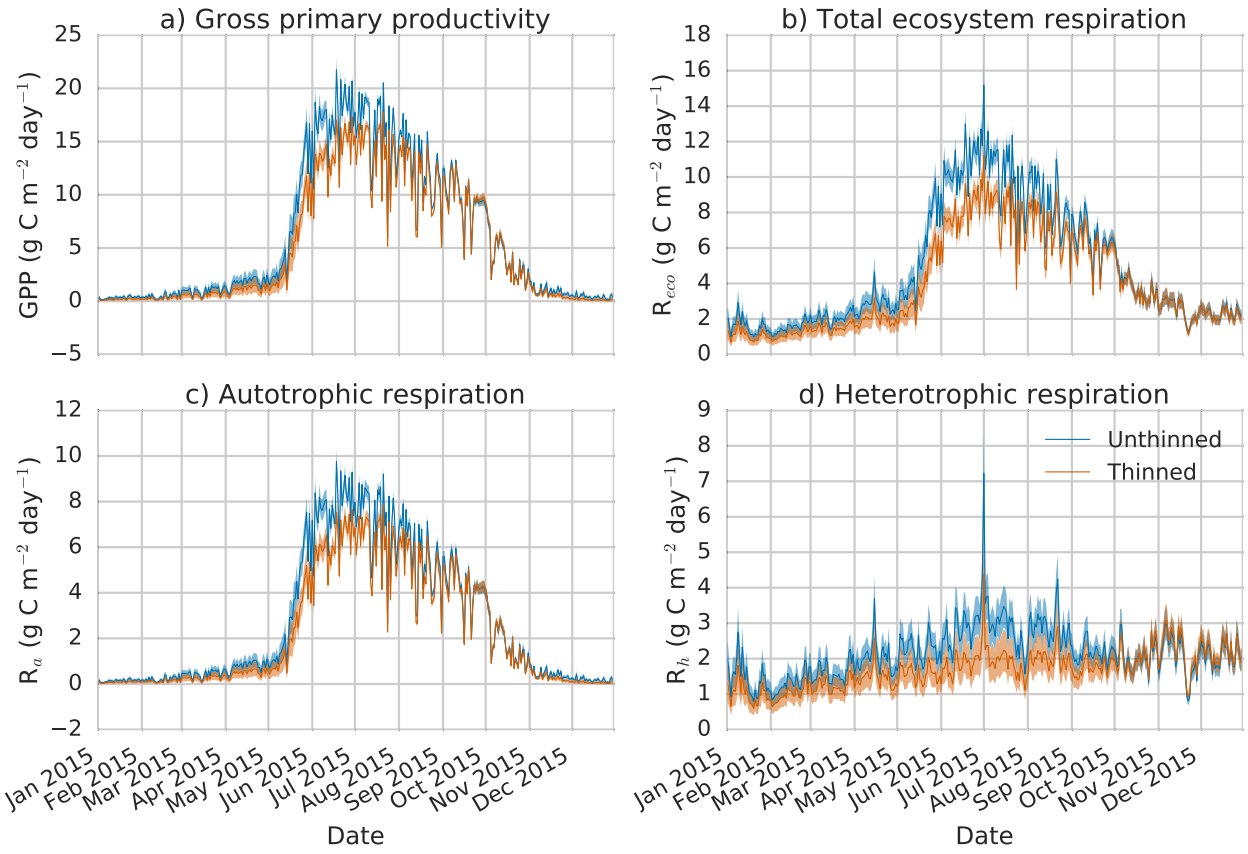

Figure S4. Experiment B: 2015 unthinned and thinned forest model trajectories after assimilation. Colour and shading has the same meaning as in Figure S1.

Table S1. Fit to observations after data assimilation for experiments.

Unthinned side						
	NEE_{day}		NEE_{night}		LAI	C_{woo}
Exp.	RMSE	r^2	RMSE	r^2	RMSE	RMSE
A	0.61	0.97	0.83	0.31	2.16	6361
B	0.75	0.90	0.93	0.64	0.04	5987
C	0.75	0.90	0.93	0.64	0.04	0.16
D	1.22	0.74	1.00	0.89	0.0004	0.19
Thinned side						
	NEE_{day}		NEE_{night}		LAI	C_{woo}
Exp.	RMSE	r^2	RMSE	r^2	RMSE	RMSE
A	0.63	0.97	0.54	0.33	0.55	2505
B	0.63	0.97	0.56	0.27	0.04	2241
C	0.63	0.97	0.56	0.27	0.04	0.07
D	1.24	0.88	0.60	0.17	0.001	0.07

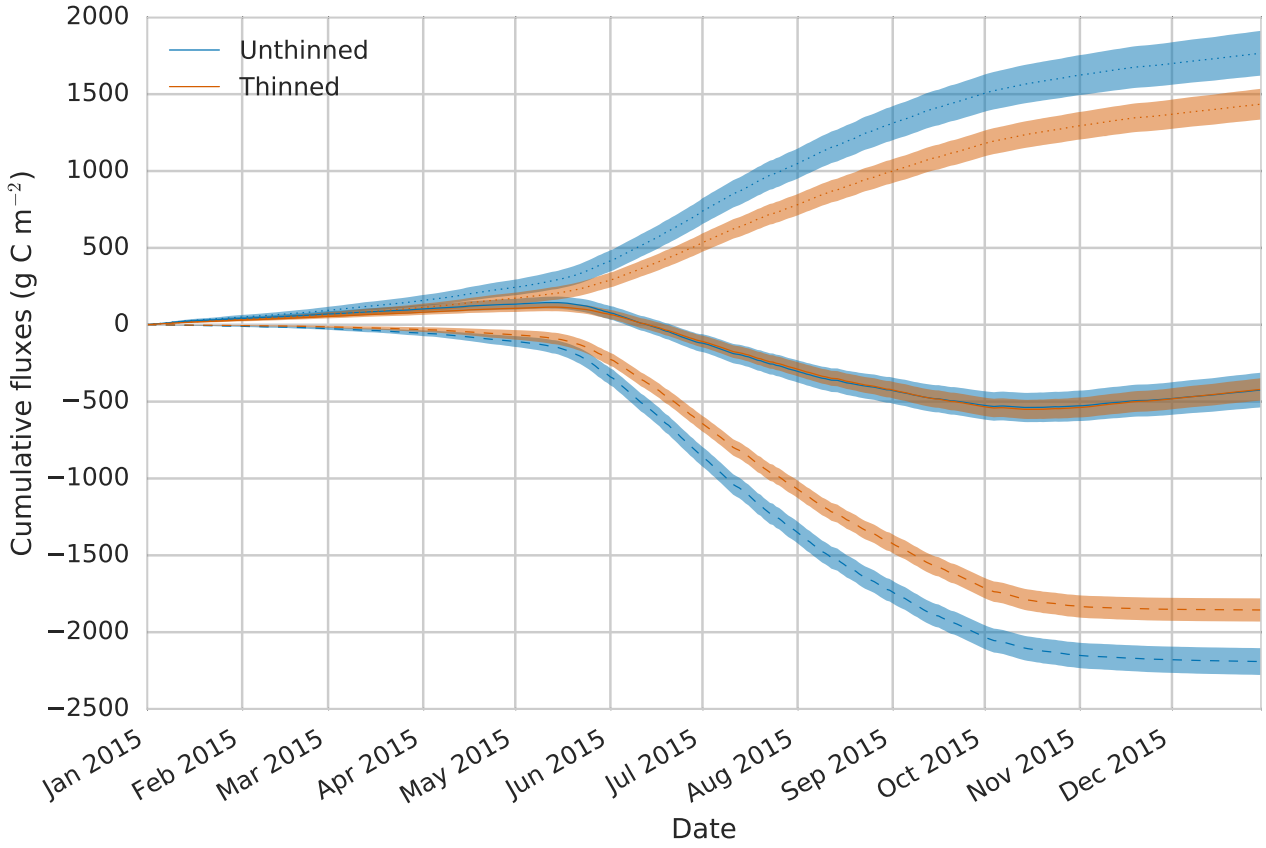

Figure S5. Experiment B: 2015 unthinned and thinned forest model trajectories for cumulative fluxes after assimilation. Solid line cumulative NEE, dotted line: cumulative ecosystem respiration, dashed line: cumulative GPP (NEE=-GPP+RT). Colour and shading has the same meaning as in Figure S1.

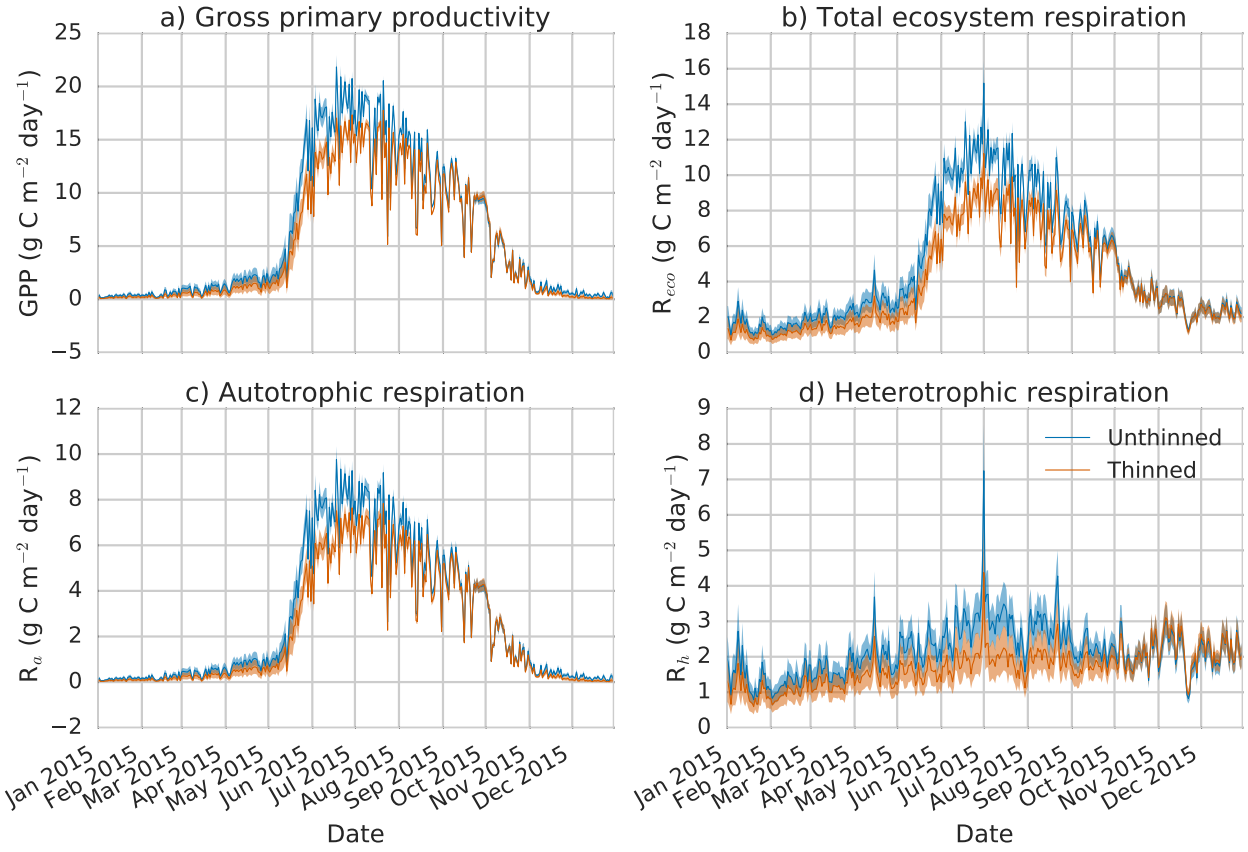

Figure S6. Experiment C: 2015 unthinned and thinned forest model trajectories after assimilation. Colour and shading has the same meaning as in Figure S1.

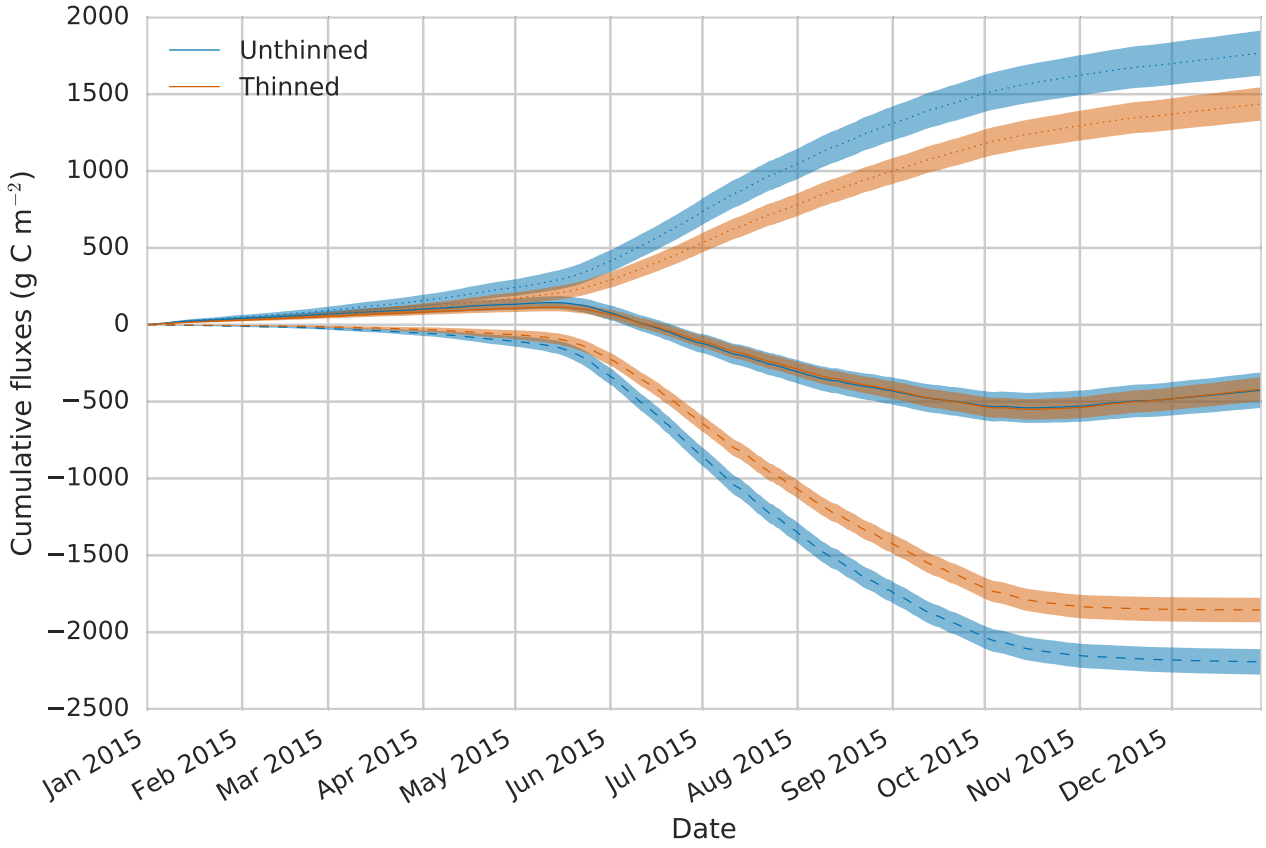

Figure S7. Experiment C: 2015 unthinned and thinned forest model trajectories for cumulative fluxes after assimilation. Solid line cumulative NEE, dotted line: cumulative ecosystem respiration, dashed line: cumulative GPP (NEE=-GPP+RT). Colour and shading has the same meaning as in Figure S1.

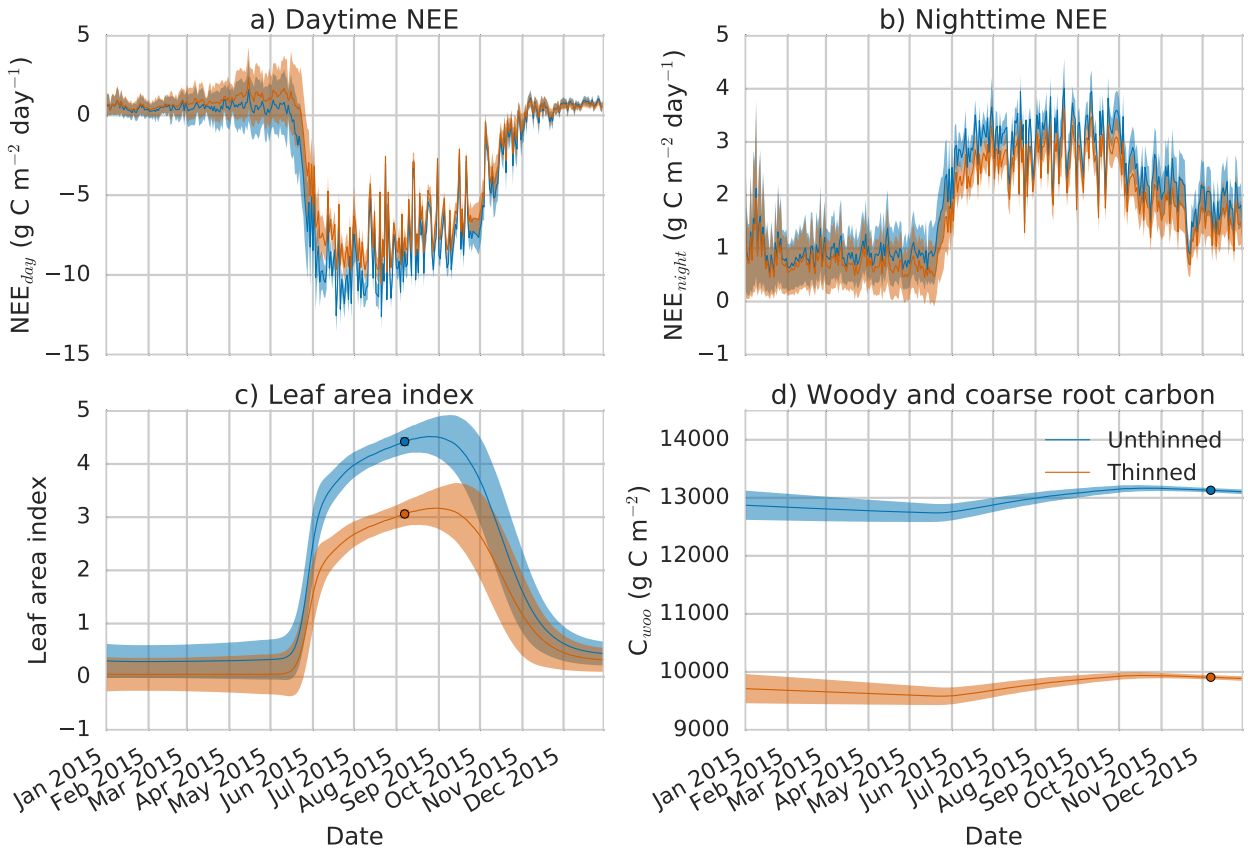

Figure S8. Experiment D: 2015 unthinned and thinned forest observations and model trajectories after assimilation. Blue line: model trajectory after assimilation of unthinned data, blue shading: uncertainty in model trajectory after assimilation (± 1 standard deviation), blue dots: unthinned observations with error bars, orange line: model trajectory after assimilation of thinned data, orange shading: uncertainty in model trajectory after assimilation (± 1 standard deviation), orange dots: thinned observations with error bars.

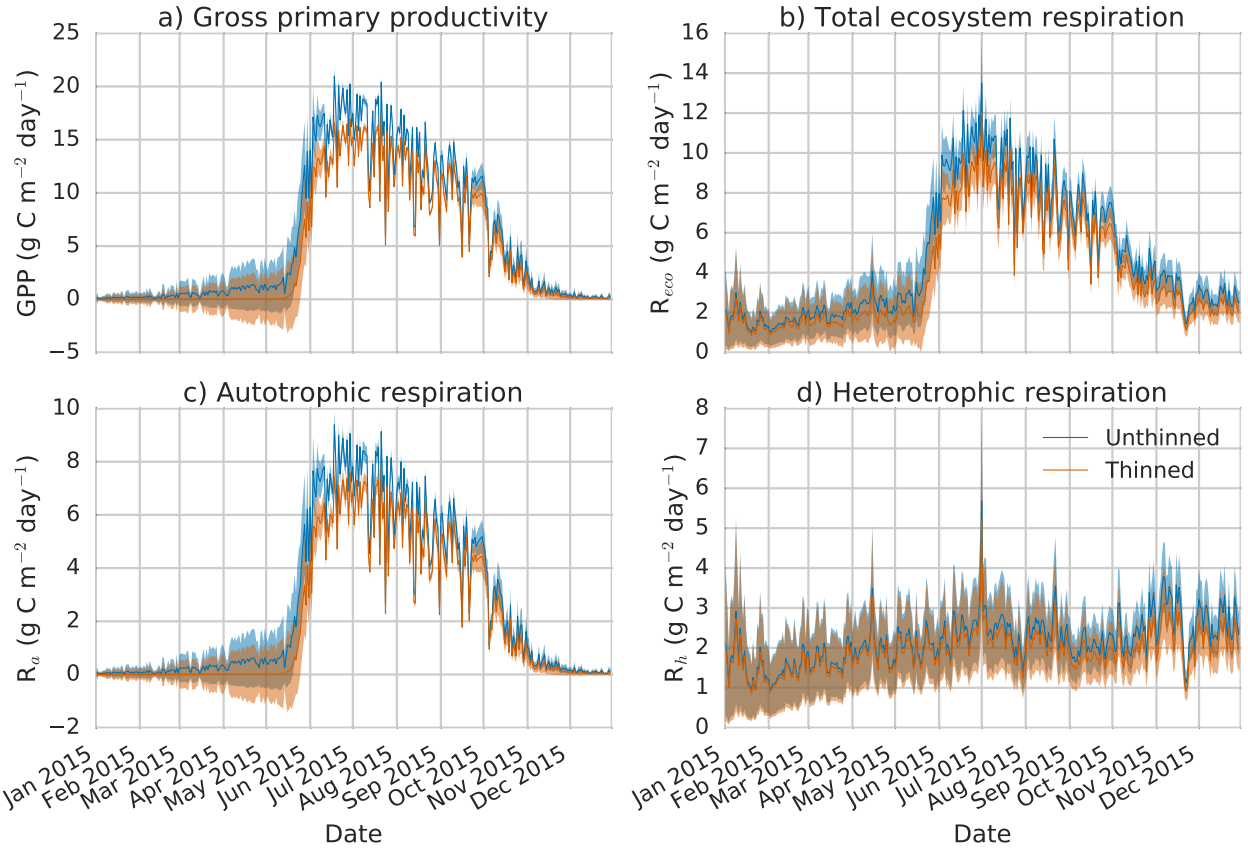

Figure S9. Experiment D: 2015 unthinned and thinned forest model trajectories after assimilation. Colour and shading has the same meaning as in Figure S1.

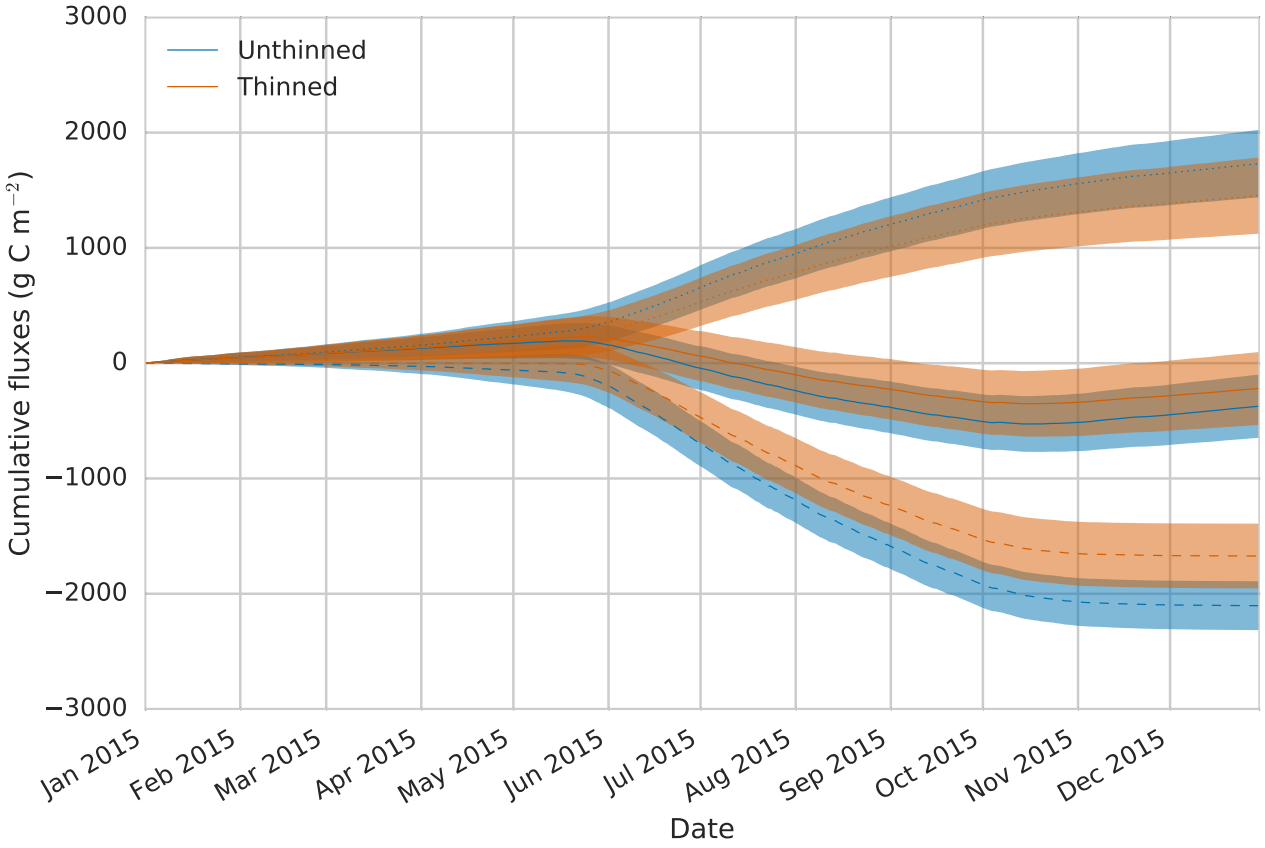

Figure S10. Experiment D: 2015 unthinned and thinned forest model trajectories for cumulative fluxes after assimilation. Solid line cumulative NEE, dotted line: cumulative ecosystem respiration, dashed line: cumulative GPP (NEE=-GPP+RT). Colour and shading has the same meaning as in Figure S1.

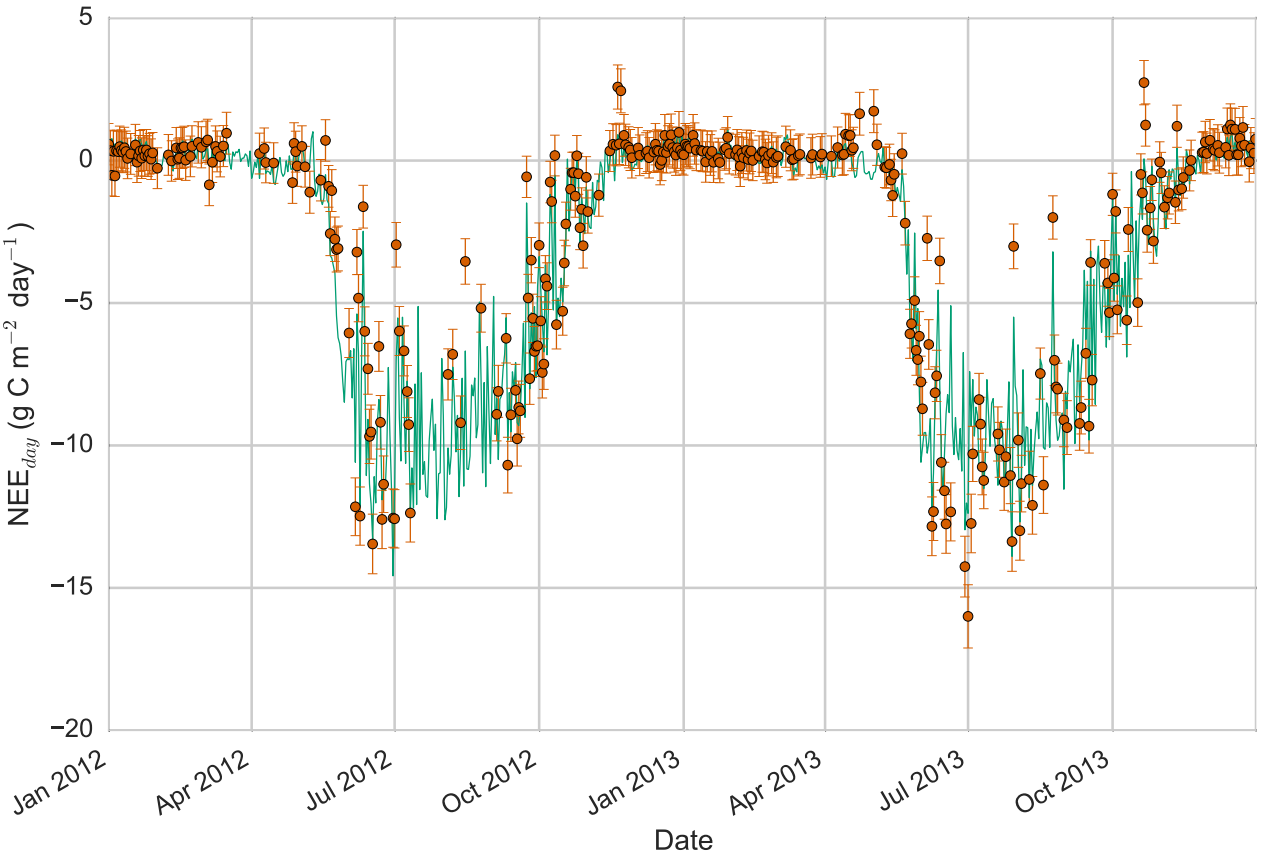

Figure S11. Prior model prediction and observations of daytime NEE for 2012-2013. Green line: model predicted value, orange dots: observations with error bars. The prior model has a correlation coefficient of 0.96 in this case.

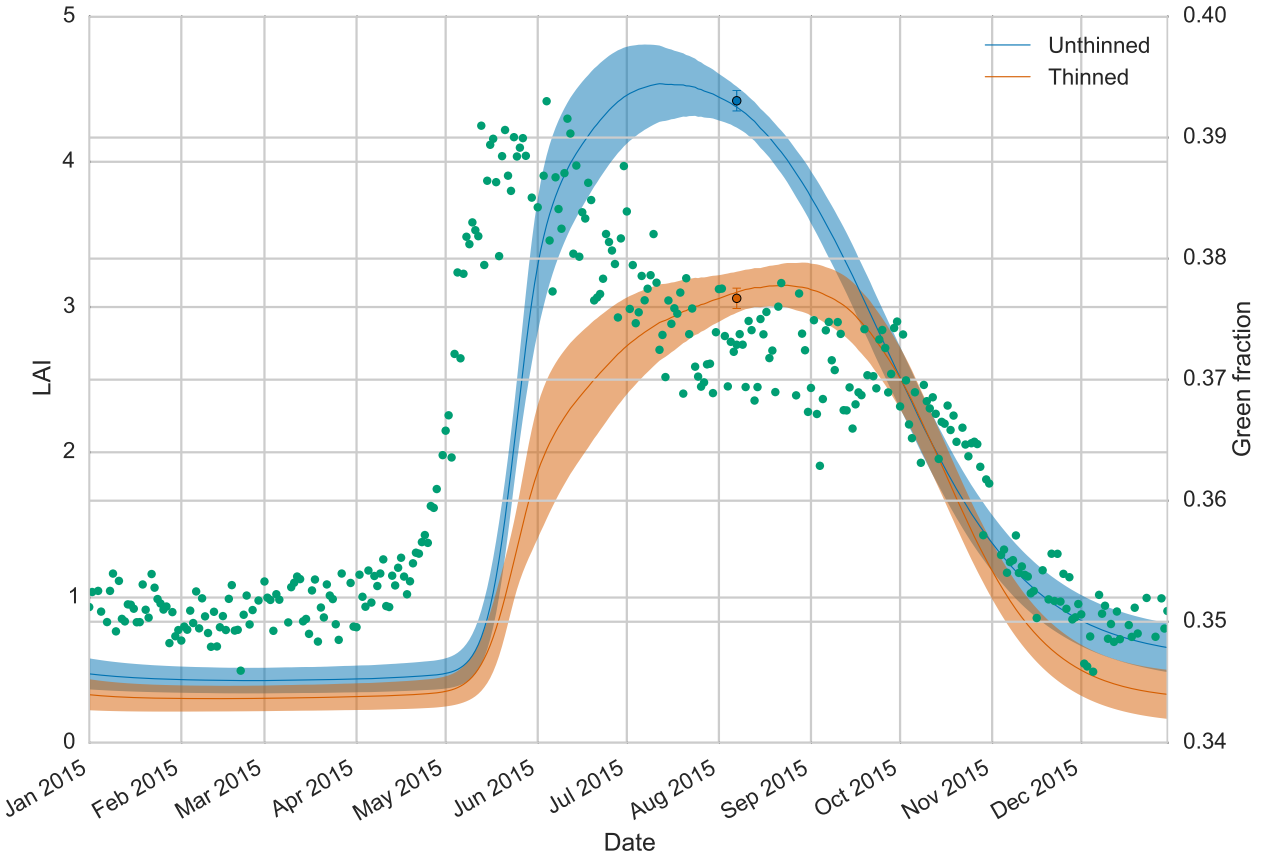

Figure S12. Model predicted LAI for experiment C and Alice Holt phenocam observations of green fraction (green dots), calculated for the canopy region of interest using red-green-blue digital numbers for each pixel, see *Mizunuma et al.* [2013] for more details.

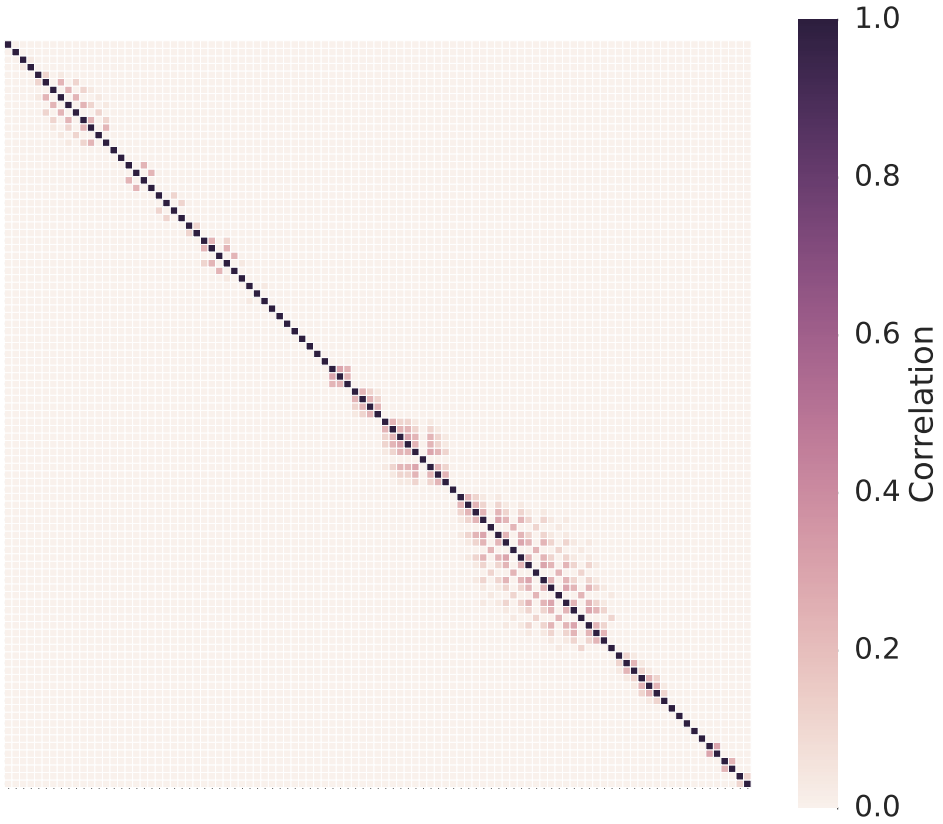

Figure S13. Observation error correlation matrix for thinned forest used in experiment C data assimilation. For more details see *Pinnington et al.* [2016].

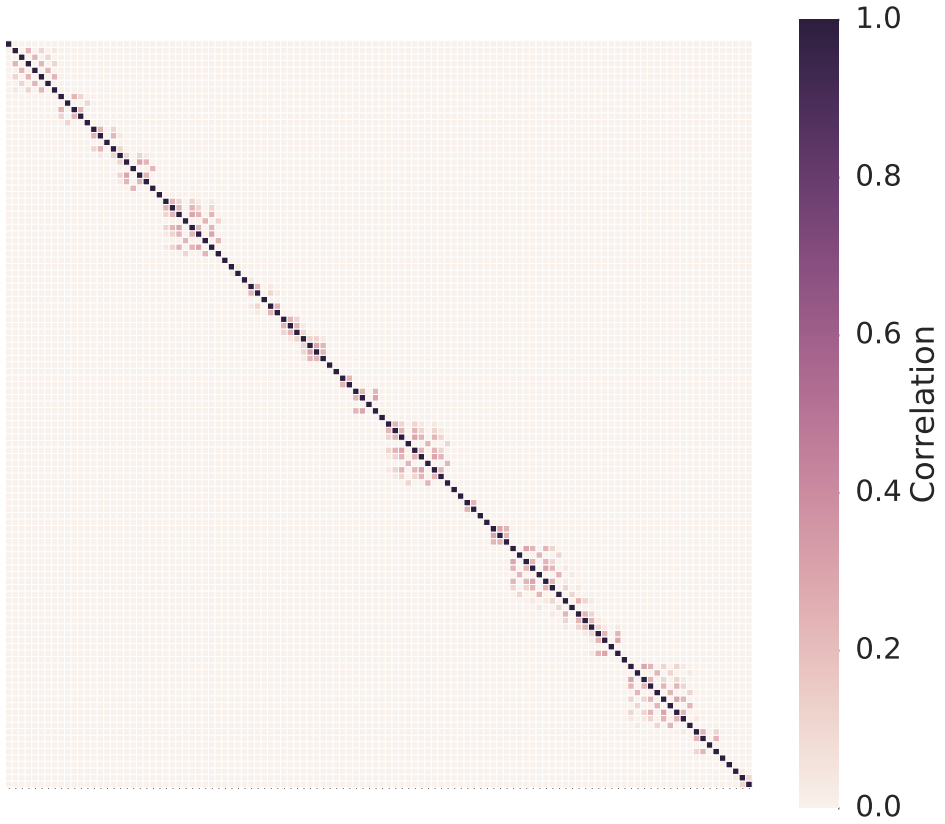

Figure S14. Observation error correlation matrix for unthinned forest used in experiment C data assimilation. For more details see *Pinnington et al.* [2016].