Dominant controls of transpiration along a hillslope transect inferred from ecohydrological measurements and thermodynamic limits

(Supplemental Online Material)

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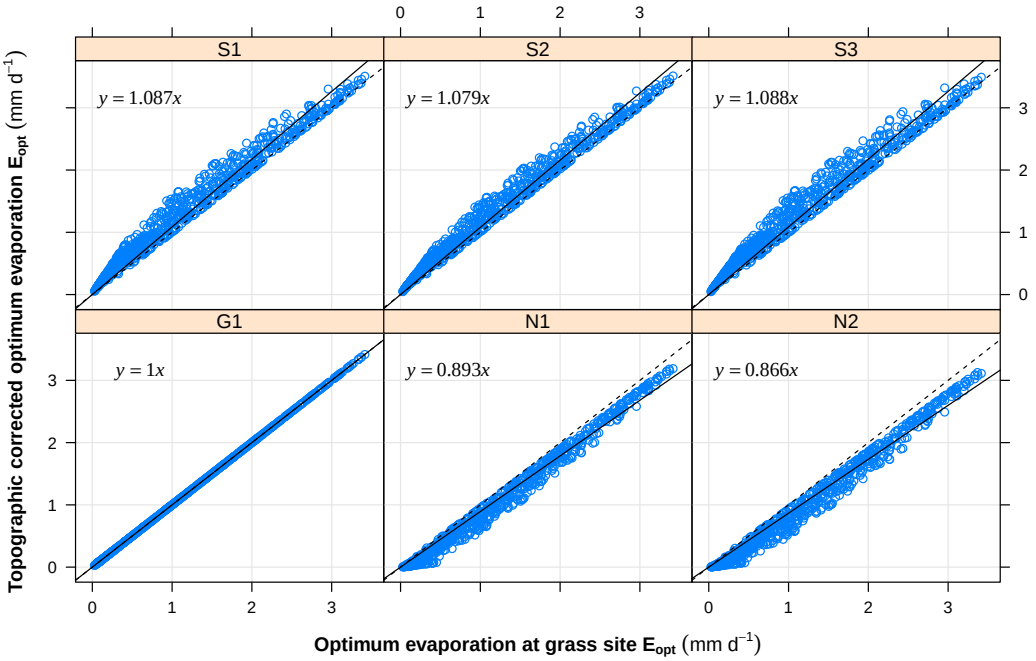

Figure S1: Comparison of daily values of optimum evaporation for all sites. x-axis E_{opt} with radiation at grass site. y-axis E_{opt} estimated from topographically altered radiation (aspect, slope, shading via r.sun).

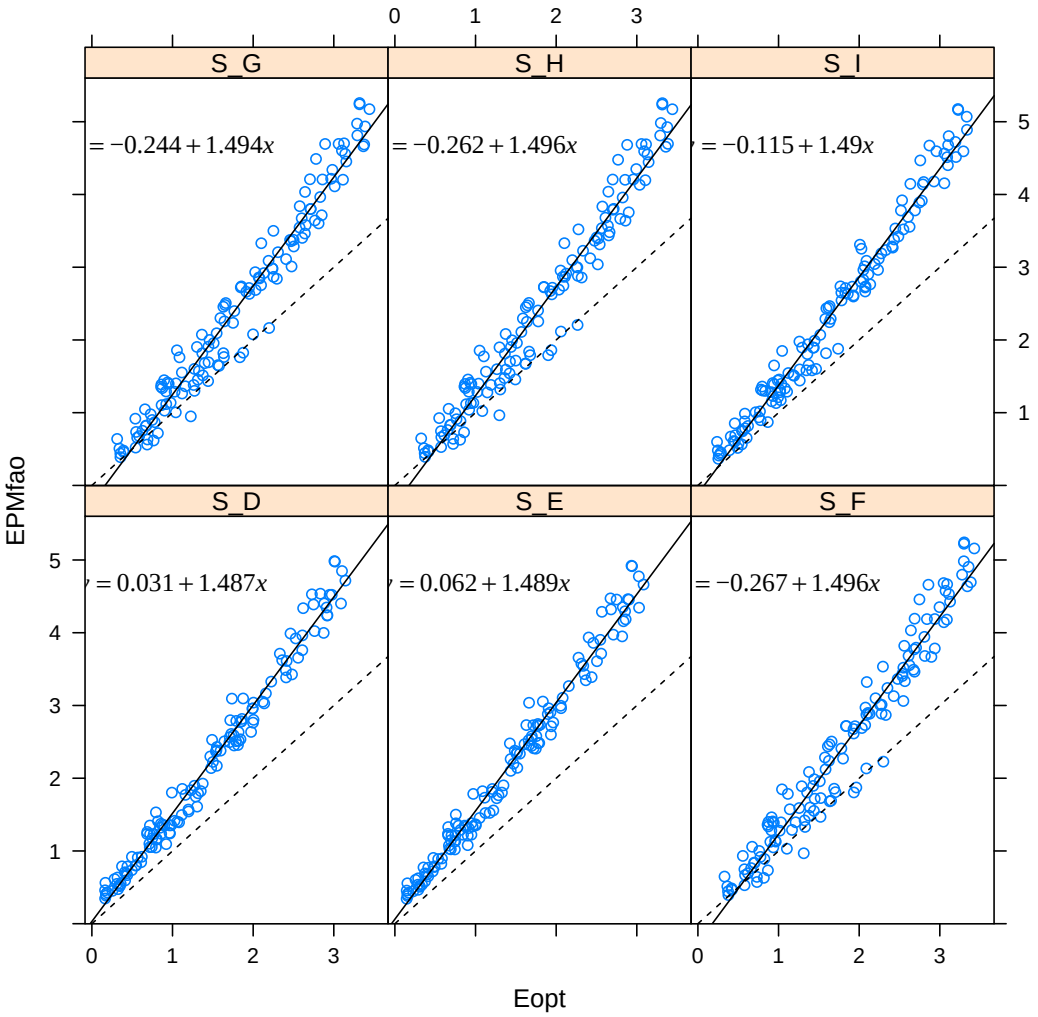

Figure S2: Comparison of potential evaporation estimates for vegetation period in 2013 for each site. The FAO Penman-Monteith grass reference evaporation is plotted as a function of E_{opt}.

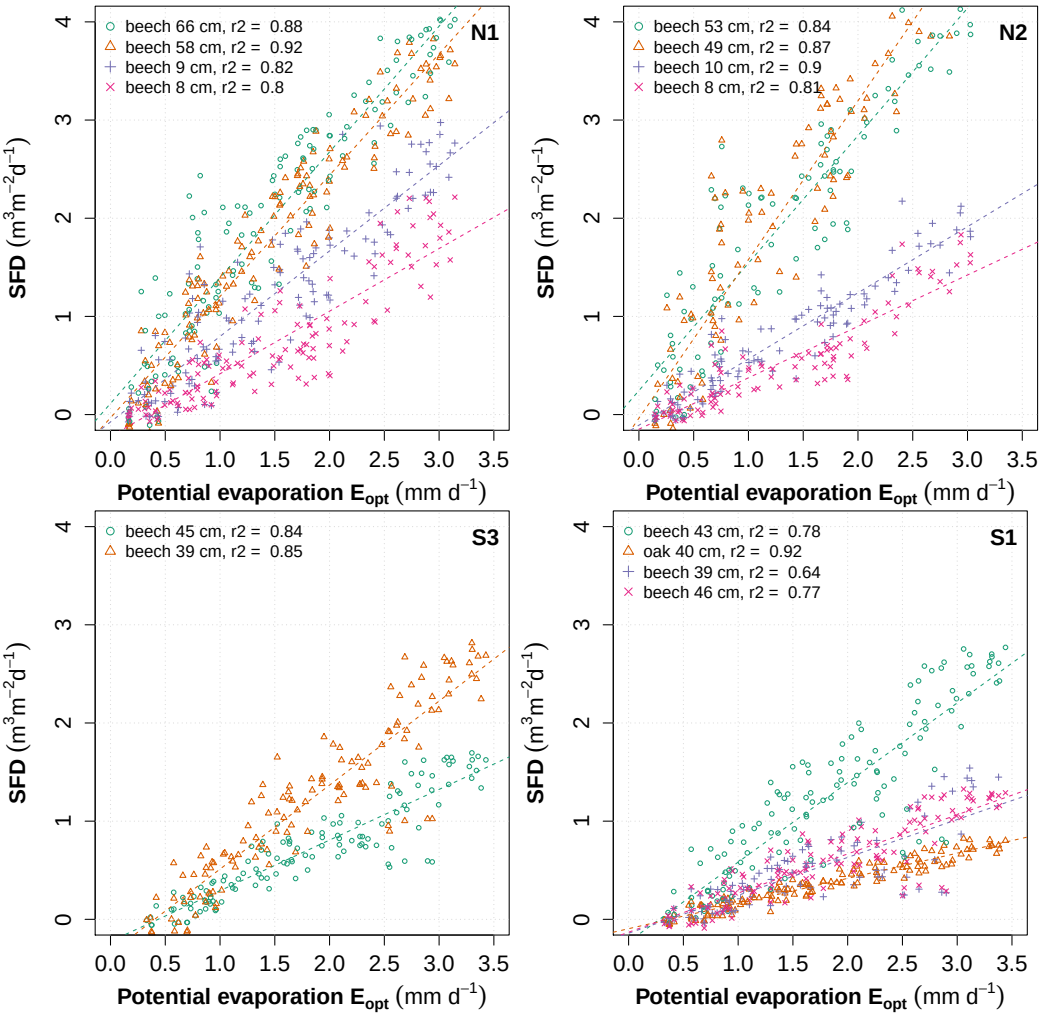

Figure S3: Daily tree average sap flux density as function of site-average E_{opt} at four sites (per panel) during the vegetation period (10.June - 20.October) in 2013. Colors and symbols depict different trees. The dashed lines depicts the linear regression line reported in Table 3 of the main text.

Table S1: Depth below surface in cm of installed soil moisture sensors.

site	pid	(0,20]	(20,40]	(40,60]	(60,80]
G1	1	7	27	50	
G1	2	10	30	55	
G1	3	10	29	50, 60	
N1	1	10	30	50	
N1	2	10	30	50	70
N1	3	10	30	50	
N2	1	10	30	50	
N2	2	10	30	50	
N2	3	10	30	50	
S1	1	10	30	50	
S1	2	10	30	50	
S1	3	10	30	50	77
S2	1	10	33	50	65
S2	2	10	30	45	
S2	3	10	30	50	
S3	1	10	30	44	
S3	2	10	35	50	
S3	3	10	30	50, 58	

Table S2: Number of days retained by the filter criteria for root water uptake at the soil moisture sensor level for the growing season 2013. In bracket is the number of days with complete measurements of soil moisture. Blank cells refer to no / broken sensors.

site	pid	(0,20]	(20,40]	(40,60]	(60,80]
G1	1	25 (133)	43 (133)	40 (133)	
G1	2	22 (133)	30 (118)	40 (133)	
G1	3		42 (133)	42 (133)	
N1	1	35 (133)	39 (133)	38 (133)	
N1	2	0 (0)	40 (133)	40 (133)	44 (133)
N1	3	42 (133)	37 (133)	44 (133)	
N2	1	41 (132)	41 (132)	41 (132)	
N2	2	0 (0)	31 (112)	44 (132)	
N2	3	40 (132)	40 (132)		
S1	1	27 (133)	40 (133)	43 (133)	
S1	2	0 (0)	40 (133)	43 (133)	
S1	3	5 (11)	44 (133)	44 (133)	44 (133)
S2	1	32 (112)	32 (112)	34 (112)	35 (112)
S2	2	24 (112)	34 (92)	34 (112)	
S2	3	31 (112)	34 (112)	35 (112)	
S3	1	38 (133)	42 (133)		
S3	2	35 (133)	42 (133)		
S3	3	37 (133)	31 (133)	33 (94)	

Table S3: Regression statistics of E_{RWU} as dependent variable and E_{opt} as independent variable. Data for each soil profile (pid) per site and during the growing season of 2013. z_{max} reports depth of the deepest sensor. b_{RWU} is the slope of the linear regression with $\pm\sigma$ reporting the estimated standard deviation of the coefficient. r^2 is the linear squared correlation. The last three columns report the adjusted explained variance of a linear regression of the residuals of sap flux density to E_{opt} for the variables daily site-average volumetric water content (R^2_θ), daily average vapor pressure deficit (R^2_{VPD}), and daily average windspeed (R^2_u).

site	pid	z_{max}	n	b_{RWU}	intercept	r^2	R^2_{VPD}	R^2_u	R^2_θ
N1	1	50	26	0.62 ± 0.18 **	0.52 ± 0.33	0.36	0.01	-0.04	0.36 **
N1	2	70	35	0.92 ± 0.17 ***	0.21 ± 0.30	0.42	0.05 **	0.09 *	0.55 ***
N1	3	50	36	0.68 ± 0.14 ***	-0.03 ± 0.20	0.60	0.03	0.03	0.50 ***
N2	1	50	36	1.17 ± 0.20 ***	-0.04 ± 0.48	0.69	-0.02	0.04	0.24
N2	2	50	0						
N2	3	50	35	0.35 ± 0.12 **	0.46 ± 0.17 *	0.34	-0.03	-0.02	-0.03
S3	1	44	37	0.48 ± 0.12 ***	-0.14 ± 0.19	0.30	0.03 **	0.13	0.62 ***
S3	2	50	33	0.33 ± 0.06 ***	0.07 ± 0.18	0.39	-0.03	0.06	0.56 ***
S3	3	58	25	0.97 ± 0.37 *	-0.69 ± 0.57	0.45	-0.04	0.29 *	0.32 **
S2	1	65	26	0.70 ± 0.07 ***	-0.25 ± 0.15	0.69	-0.00	-0.02	-0.01
S2	2	45	22	0.34 ± 0.15 *	0.49 ± 0.14 **	0.22	-0.02	0.01	0.46
S2	3	50	28	0.36 ± 0.15 *	0.49 ± 0.54	0.19	-0.02	0.12	0.56 *
S1	1	50	24	0.59 ± 0.05 ***	-0.29 ± 0.13 *	0.73	-0.05	0.01	0.35 **
S1	2	50	38	0.24 ± 0.05 ***	0.56 ± 0.17 **	0.20	-0.03	0.10 **	0.03
S1	3	77	43	0.51 ± 0.04 ***	0.04 ± 0.07	0.73	0.01	0.00	-0.01
G1	1	50	24	0.73 ± 0.33 *	0.48 ± 1.01	0.29	-0.05	-0.04	0.71 ***
G1	2	55	15	0.15 ± 0.48	1.81 ± 1.29	0.00	0.06 *	-0.07	0.72 ***
G1	3	60	0						

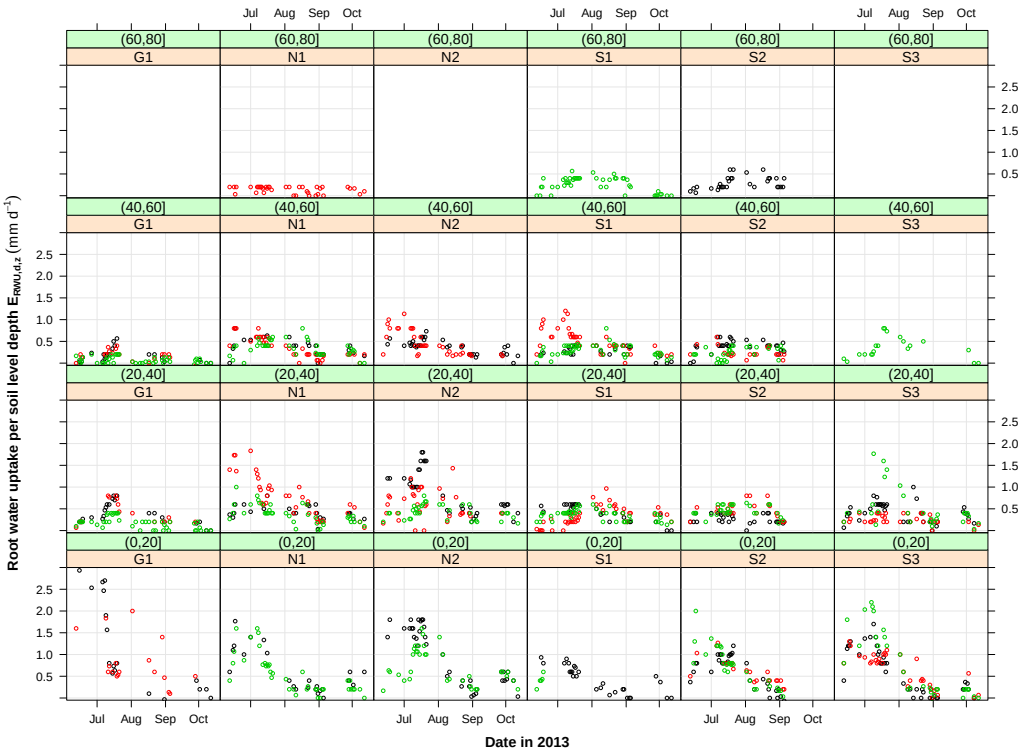

Figure S4: Estimated daily root water uptake per site and representative soil level (indicated by the header of each panel in cm below surface) of each soil moisture sensor for the growing season 2013. Colors represent the three different soil profiles per site.

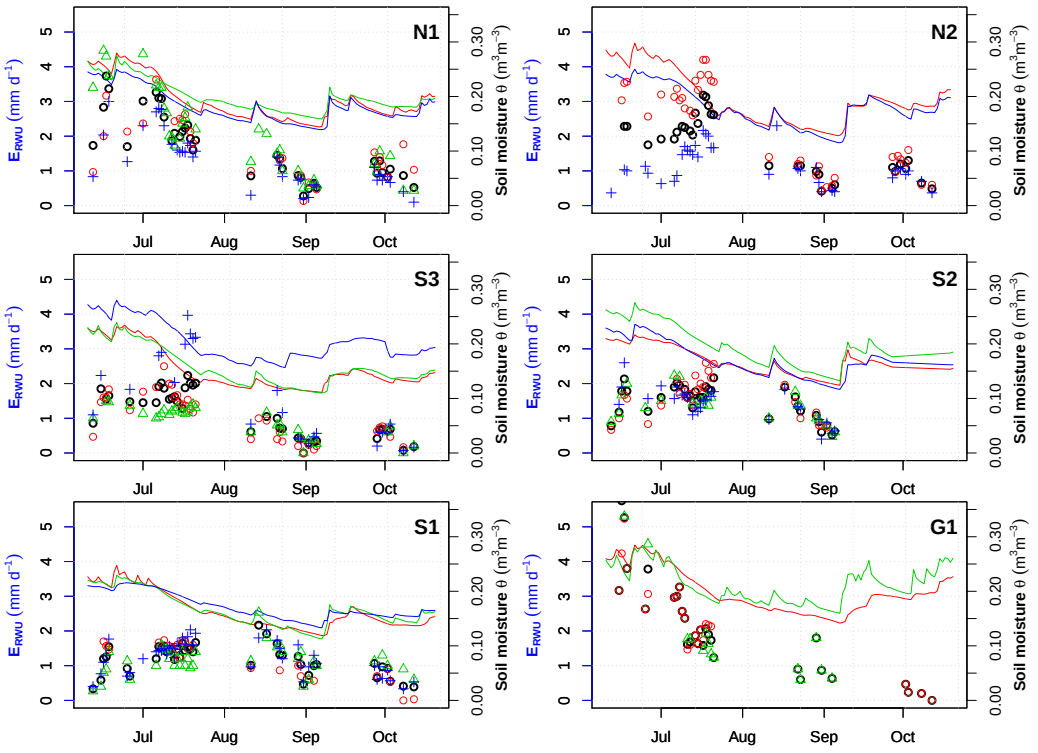

Figure S5: Time series of estimated root water uptake per profile (color coding) and the respective site-average (bold points). Profile average soil moisture is shown with axis on the right.

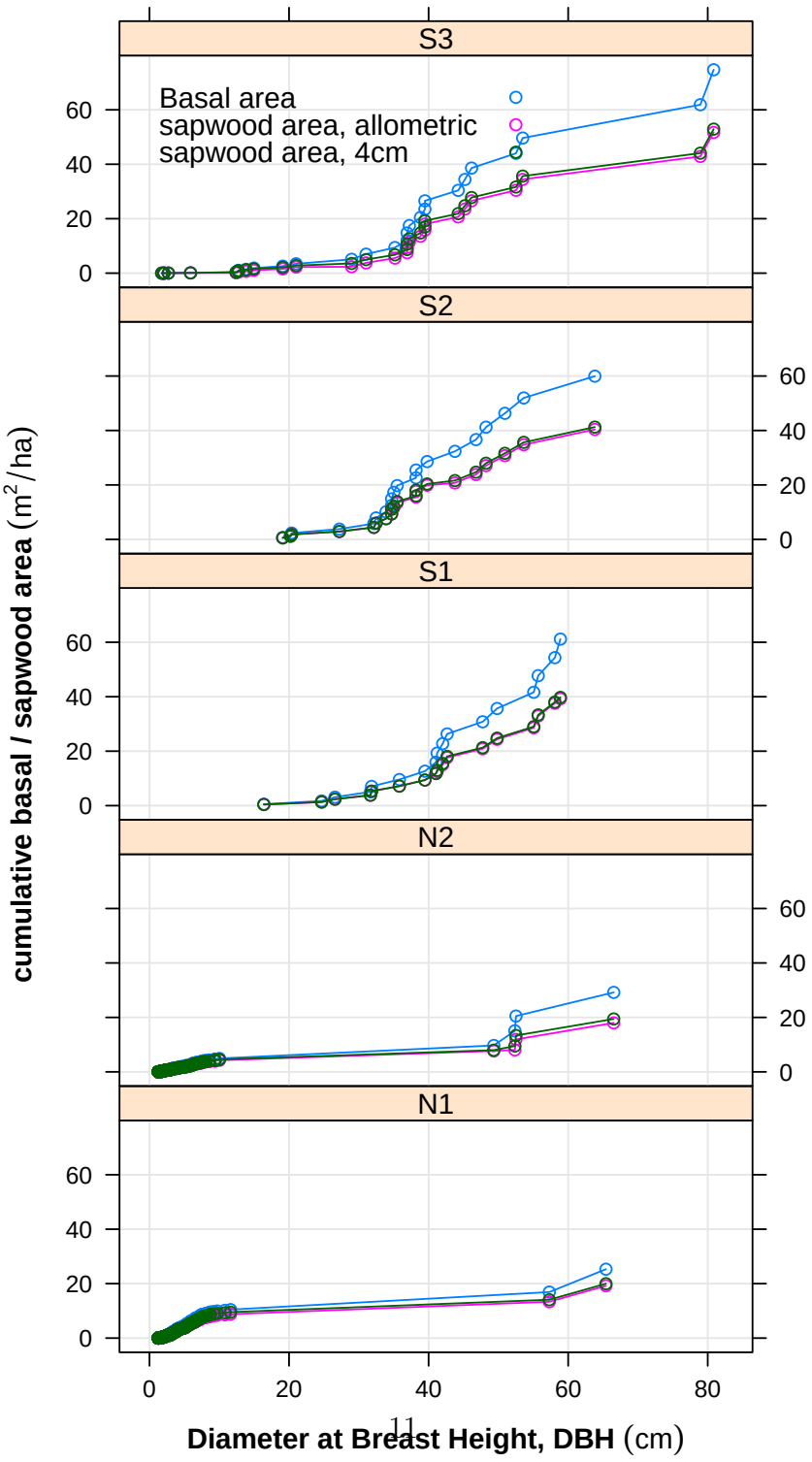

Figure S6: Cumulative distribution of basal area A_b and sapwood area A_s as a function of DBH for each site. Data is from the forest inventory explained in the main text section 2.5. Sapwood area is derived from species-specific allometric relationships (red) and for comparison with a fixed maximum depth of 4 cm (green).

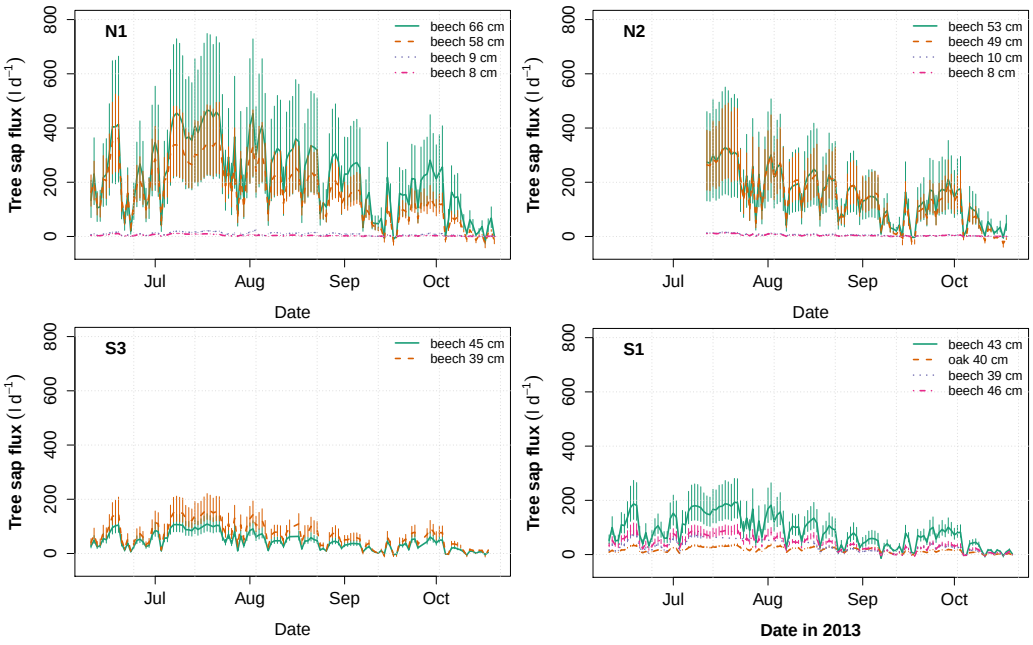

Figure S7: Daily tree-based sap flux rates for each tree (color coded) for the growing season in 2013 at site N1, N2, S3 and S1. Sap flux was obtained by integrating the product of measured SFD and the representative area of each reading at a sensor depth. The bold lines represent a linear decline of SFD towards the estimated heartwood radius. The thin vertical lines represent the minimal and maximal sap flux density profiles in the inner sapwood, see main text section 2.6