Correlation coefficients between residual tree ring chronology and meteorological and modelled variables

Supplementary materials for the article: Kalvāns, Dauškāne: Coupling and decoupling of hydrological regime at hydric hemiboreal forest sites inferred from soil water model and tree ring chronology

Table S1. Model performance metric (msd – mean signed difference; rmse – root mean squared error; rsq – r-square) for model instances with given groundwater exfiltration rate (SeepIn) and active proportion of the leaf area (kLAI) and respective observed parameters (h_10cm, h_30cm and h_60cm – water potential respectively at 10, 30 and 60 cm depth; h_240cm groundwater head at 240 cm depth; h_60cm water potential at 60cm depth; theta_10cm and theta_60c – volumetric soil water content at respectively 10 cm and 60 cm depth).

Site	**SeepIn (cm day-1)**	**Parameter**	**Metric**	**kLAI**			**Unit**
				0.5	0.75	1	
Plot_1	0	h_10cm	msd	1500	1500	1600	cm
Plot_1	0.01	h_10cm	msd	1500	1500	1600	cm
Plot_1	0.03	h_10cm	msd	54	1500	1600	cm
Plot_1	0.05	h_10cm	msd	-240	-230	1600	cm
Plot_1	0	h_10cm	rmse	2700	2800	2800	cm
Plot_1	0.01	h_10cm	rmse	2700	2800	2800	cm
Plot_1	0.03	h_10cm	rmse	340	2800	2800	cm
Plot_1	0.05	h_10cm	rmse	290	280	2800	cm
Plot_1	0	h_10cm	rsq	0.13	0.13	0.12	-
Plot_1	0.01	h_10cm	rsq	0.13	0.13	0.12	-
Plot_1	0.03	h_10cm	rsq	0.00068	0.13	0.12	-
Plot_1	0.05	h_10cm	rsq	0.42	0.38	0.12	-
Plot_1	0	h_240cm	msd	240	280	310	cm
Plot_1	0.01	h_240cm	msd	190	230	270	cm
Plot_1	0.03	h_240cm	msd	49	150	200	cm
Plot_1	0.05	h_240cm	msd	-17	-4.7	140	cm
Plot_1	0	h_240cm	rmse	250	280	320	cm
Plot_1	0.01	h_240cm	rmse	200	240	270	cm
Plot_1	0.03	h_240cm	rmse	74	170	210	cm

Plot_1	0.05	h_240cm	rmse	29	18	160	cm
Plot_1	0	h_240cm	rsq	0.021	0.0089	0.014	-
Plot_1	0.01	h_240cm	rsq	0.057	0.029	0.018	-
Plot_1	0.03	h_240cm	rsq	0.29	0.11	0.081	-
Plot_1	0.05	h_240cm	rsq	0.84	0.76	0.15	-
Plot_1	0	h_60cm	msd	4800	4800	4800	cm
Plot_1	0.01	h_60cm	msd	4800	4800	4800	cm
Plot_1	0.03	h_60cm	msd	29	4800	4800	cm
Plot_1	0.05	h_60cm	msd	-210	-150	4800	cm
Plot_1	0	h_60cm	rmse	4800	4800	4800	cm
Plot_1	0.01	h_60cm	rmse	4800	4800	4800	cm
Plot_1	0.03	h_60cm	rmse	88	4800	4800	cm
Plot_1	0.05	h_60cm	rmse	240	190	4800	cm
Plot_1	0	h_60cm	rsq	0.15	0.0089	0.0077	-
Plot_1	0.01	h_60cm	rsq	0.18	0.011	0.013	-
Plot_1	0.03	h_60cm	rsq	0.89	0.18	0.00041	-
Plot_1	0.05	h_60cm	rsq	0.0033	0.13	0.021	-
Plot_1	0	theta_10cm	msd	0.079	0.089	0.1	$cm^3\ cm^{-3}$
Plot_1	0.01	theta_10cm	msd	0.07	0.089	0.1	$cm^3\ cm^{-3}$
Plot_1	0.03	theta_10cm	msd	-0.073	0.067	0.1	$cm^3\ cm^{-3}$
Plot_1	0.05	theta_10cm	msd	-0.3	-0.22	0.081	$cm^3\ cm^{-3}$
Plot_1	0	theta_10cm	rmse	0.094	0.1	0.12	$cm^3\ cm^{-3}$
Plot_1	0.01	theta_10cm	rmse	0.087	0.1	0.12	$cm^3\ cm^{-3}$
Plot_1	0.03	theta_10cm	rmse	0.17	0.09	0.11	$cm^3\ cm^{-3}$
Plot_1	0.05	theta_10cm	rmse	0.31	0.26	0.1	$cm^3\ cm^{-3}$
Plot_1	0	theta_10cm	rsq	0.33	0.35	0.32	-
Plot_1	0.01	theta_10cm	rsq	0.35	0.34	0.32	-
Plot_1	0.03	theta_10cm	rsq	0.19	0.32	0.34	-
Plot_1	0.05	theta_10cm	rsq	0.87	0.4	0.34	-
Plot_1	0	theta_30cm	msd	0.03	0.035	0.041	$cm^3\ cm^{-3}$
Plot_1	0.01	theta_30cm	msd	0.026	0.034	0.041	$cm^3\ cm^{-3}$
Plot_1	0.03	theta_30cm	msd	-0.018	0.023	0.041	$cm^3\ cm^{-3}$

Plot_1	0.05	theta_30cm	msd	-0.059	-0.047	0.03	$cm^3\ cm^{-3}$
Plot_1	0	theta_30cm	rmse	0.036	0.041	0.047	$cm^3\ cm^{-3}$
Plot_1	0.01	theta_30cm	rmse	0.033	0.04	0.047	$cm^3\ cm^{-3}$
Plot_1	0.03	theta_30cm	rmse	0.041	0.039	0.046	$cm^3\ cm^{-3}$
Plot_1	0.05	theta_30cm	rmse	0.059	0.052	0.043	$cm^3\ cm^{-3}$
Plot_1	0	theta_30cm	rsq	0.41	0.38	0.34	-
Plot_1	0.01	theta_30cm	rsq	0.39	0.38	0.34	-
Plot_1	0.03	theta_30cm	rsq	0.31	0.26	0.35	-
Plot_1	0.05	theta_30cm	rsq	0.86	0.46	0.27	-
Plot_1	0	theta_60cm	msd	0.066	0.075	0.082	$cm^3\ cm^{-3}$
Plot_1	0.01	theta_60cm	msd	0.055	0.072	0.081	$cm^3\ cm^{-3}$
Plot_1	0.03	theta_60cm	msd	0.016	0.057	0.075	$cm^3\ cm^{-3}$
Plot_1	0.05	theta_60cm	msd	-0.0057	-0.0041	0.059	$cm^3\ cm^{-3}$
Plot_1	0	theta_60cm	rmse	0.071	0.08	0.087	$cm^3\ cm^{-3}$
Plot_1	0.01	theta_60cm	rmse	0.067	0.077	0.086	$cm^3\ cm^{-3}$
Plot_1	0.03	theta_60cm	rmse	0.03	0.07	0.082	$cm^3\ cm^{-3}$
Plot_1	0.05	theta_60cm	rmse	0.019	0.012	0.074	$cm^3\ cm^{-3}$
Plot_1	0	theta_60cm	rsq	0.18	0.12	0.091	-
Plot_1	0.01	theta_60cm	rsq	0.14	0.13	0.091	-
Plot_1	0.03	theta_60cm	rsq	0.31	0.11	0.092	-
Plot_1	0.05	theta_60cm	rsq	0.23	0.88	0.09	-
Plot_3	0	h_240cm	msd	170	280	450	cm
Plot_3	0.01	h_240cm	msd	120	230	300	cm
Plot_3	0.03	h_240cm	msd	24	160	230	cm
Plot_3	0.05	h_240cm	msd	-13	75	190	cm
Plot_3	0	h_240cm	rmse	170	280	460	cm
Plot_3	0.01	h_240cm	rmse	120	230	300	cm
Plot_3	0.03	h_240cm	rmse	31	160	230	cm
Plot_3	0.05	h_240cm	rmse	42	78	200	cm
Plot_3	0	h_240cm	rsq	0.17	0.22	0.3	-
Plot_3	0.01	h_240cm	rsq	0.57	0.16	0.034	-
Plot_3	0.03	h_240cm	rsq	0.83	0.23	0.15	-

Plot_3	0.05	h_240cm	rsq	0.46	0.72	0.39	-
Plot_3	0	theta_30cm	msd	-0.1	-0.083	-0.061	$cm^3\ cm^{-3}$
Plot_3	0.01	theta_30cm	msd	-0.11	-0.083	-0.062	$cm^3\ cm^{-3}$
Plot_3	0.03	theta_30cm	msd	-0.24	-0.089	-0.064	$cm^3\ cm^{-3}$
Plot_3	0.05	theta_30cm	msd	-0.26	-0.15	-0.064	$cm^3\ cm^{-3}$
Plot_3	0	theta_30cm	rmse	0.13	0.11	0.097	$cm^3\ cm^{-3}$
Plot_3	0.01	theta_30cm	rmse	0.14	0.11	0.097	$cm^3\ cm^{-3}$
Plot_3	0.03	theta_30cm	rmse	0.24	0.12	0.097	$cm^3\ cm^{-3}$
Plot_3	0.05	theta_30cm	rmse	0.26	0.16	0.097	$cm^3\ cm^{-3}$
Plot_3	0	theta_30cm	rsq	0.2	0.39	0.42	-
Plot_3	0.01	theta_30cm	rsq	0.3	0.39	0.44	-
Plot_3	0.03	theta_30cm	rsq	0.75	0.36	0.47	-
Plot_3	0.05	theta_30cm	rsq	0.93	0.66	0.48	-
Plot_3	0	theta_60cm	msd	0.22	0.27	0.29	$cm^3\ cm^{-3}$
Plot_3	0.01	theta_60cm	msd	0.18	0.27	0.29	$cm^3\ cm^{-3}$
Plot_3	0.03	theta_60cm	msd	0.065	0.25	0.29	$cm^3\ cm^{-3}$
Plot_3	0.05	theta_60cm	msd	0.052	0.12	0.29	$cm^3\ cm^{-3}$
Plot_3	0	theta_60cm	rmse	0.22	0.27	0.3	$cm^3\ cm^{-3}$
Plot_3	0.01	theta_60cm	rmse	0.18	0.27	0.3	$cm^3\ cm^{-3}$
Plot_3	0.03	theta_60cm	rmse	0.073	0.25	0.29	$cm^3\ cm^{-3}$
Plot_3	0.05	theta_60cm	rmse	0.057	0.13	0.29	$cm^3\ cm^{-3}$
Plot_3	0	theta_60cm	rsq	0.9	0.8	0.59	-
Plot_3	0.01	theta_60cm	rsq	0.84	0.8	0.61	-
Plot_3	0.03	theta_60cm	rsq	0.86	0.84	0.63	-
Plot_3	0.05	theta_60cm	rsq	0.91	0.55	0.64	-

Table S2. Pearson correlation coefficients of the meteorological parameters and residual tree ring chronology: Wind – wind speed km/day; Temp – air temperature (C); Rad – solar radiation (MJ/m2/day), Prec – precipitation (cm) ; M – May; MJ – May-June; MJJ – May-July; MJJA – May-August; JJA – June-August; JA – July-August; A – August.

Study site	Season	Prec	Rad	Temp	Wind
	M	-0.11	0.28	0.18	-0.04
	MJ	0.00	0.15	0.01	0.01
	MJJ	0.25	-0.14	-0.09	0.2
	MJJA	0.12	-0.07	-0.07	0.05
	JJA	0.18	-0.23	-0.18	0.09
	JA	0.16	-0.24	-0.12	0.05
Plot_1	A	-0.16	0.13	0.03	-0.21
	M	0.06	0.2	0.27	-0.15
	MJ	0.23	0.21	0.26	-0.4*
	MJJ	0.37*	0.15	0.32	-0.3
	MJJA	0.33	0.19	0.4*	-0.33
	JJA	0.33	0.1	0.35*	-0.34
	JA	0.25	0.05	0.38*	-0.17
Plot_3	A	0.07	0.12	0.42*	-0.25

* significant at 0.05 level

** significant at 0.01 level

Table S3. Pearson correlation coefficients between modelled soil water parameters and residual tree ring chronology: GWdepth – mean depth to groundwater (cm); rangeGWdepth – difference between maximal minimal GWdepth (cm); vRoot – modelled mean actual root water uptake (cm/day); vRoot_rRoot – ration between modelled mean actual and potential root water uptake; M – May; MJ – May-June; MJJ – May-July; MJJA – May-August; JJA – June-August; JA – July-August; A – August. Missing data are model instances where at more than 20 years depth to groundwater (GWdepth) was not estimated as the water potential at 240 cm depth was negative.

Study site	GW exfiltration (cm day^{-1})	kLAI	0.4				0.5				0.7			
		Modeled parameter / Season	GWdepth	range GWdepth	vRoot	vRoot_rRoot	GWdepth	GWdepth	range GWdepth	vRoot	GWdepth	range GWdepth	vRoot	vRoot_rRoot
Plot_1	0.00	M	0.04	NA	0.40*	0.27	0.19	NA	0.48**	0.30	0.28	NA	0.55**	0.36*

Study site	GW exfiltration (cm day^{-1})	kLAI	0.4				0.5				0.7			
		Modeled parameter / Season	GWdepth	range GWdepth	vRoot	vRoot_rRoot	GWdepth	GWdepth	range GWdepth	vRoot	GWdepth	range GWdepth	vRoot	vRoot_rRoot
		MJ	0.11	NA	0.30	0.31	0.52**	NA	0.45**	0.40*	0.25	NA	0.40*	0.27
		MJJ	0.38*	NA	0.12	0.18	0.42*	NA	0.34	0.41*	NA	NA	0.35*	0.38*
		MJJA	0.16	NA	0.05	0.11	0.33	NA	0.35*	0.42*	NA	NA	0.37*	0.39*
		JJA	0.13	NA	-0.01	0.10	0.31	NA	0.28	0.42*	NA	NA	0.17	0.30
		JA	0.06	NA	-0.14	-0.02	0.25	NA	0.13	0.34	NA	NA	0.15	0.33
		A	-0.02	NA	-0.13	-0.09	0.16	NA	0.17	0.26	NA	NA	0.10	0.20
Plot_1	0.01	M	0.06	0.21	0.36*	0.22	0.06	0.39*	0.41*	0.28	0.11	NA	0.51**	0.29
		MJ	0.10	0.33	0.26	0.27	0.15	0.43*	0.36*	0.35*	0.38*	NA	0.45**	0.33
		MJJ	0.37*	0.12	0.11	0.17	0.33	0.10	0.16	0.23	NA	NA	0.38*	0.40*
		MJJA	0.26	-0.01	0.05	0.10	-0.12	0.02	0.11	0.18	NA	NA	0.39*	0.41*
		JJA	0.23	-0.04	0.00	0.10	-0.15	-0.07	0.05	0.17	NA	NA	0.24	0.37*
		JA	0.18	-0.21	-0.11	0.00	-0.19	NA	-0.10	0.06	NA	NA	0.12	0.31
		A	0.10	NA	-0.11	-0.07	-0.22	NA	-0.06	0.01	NA	NA	0.10	0.18
Plot_1	0.01	M	0.05	-0.07	0.26	0.13	0.05	0.01	0.33	0.20	0.05	0.42*	0.42*	0.26
		MJ	0.01	0.08	0.17	0.19	0.09	0.25	0.27	0.27	0.17	0.41*	0.40*	0.37*
		MJJ	-0.01	0.03	0.06	0.10	0.10	0.11	0.14	0.19	0.41*	0.28	0.32	0.37*
		MJJA	-0.04	-0.03	0.01	0.04	0.25	0.01	0.07	0.13	0.28	0.25	0.32	0.37*
		JJA	-0.05	-0.01	-0.03	0.05	0.23	0.00	0.03	0.13	0.27	0.14	0.27	0.38*
		JA	-0.05	-0.04	-0.10	-0.02	0.18	-0.15	-0.09	0.02	0.23	-0.05	0.15	0.31
		A	-0.07	-0.13	-0.13	-0.10	0.10	-0.20	-0.13	-0.07	0.18	NA	0.18	0.24
Plot_1	0.05	M	0.12	0.30	0.34	0.18	0.03	0.01	0.26	0.11	0.01	-0.02	0.31	0.18
		MJ	0.07	0.04	0.10	0.10	-0.02	0.02	0.15	0.16	0.10	0.28	0.33	0.33
		MJJ	-0.05	-0.07	-0.05	-0.04	-0.04	-0.01	0.05	0.09	0.12	0.15	0.21	0.26
		MJJA	-0.11	-0.10	-0.11	-0.11	-0.06	-0.03	0.01	0.05	0.29	0.06	0.16	0.22

Study site	GW exfiltration (cm day^{-1})	kLAI	0.4				0.5				0.7			
		Modeled parameter / Season	GWdepth	range GWdepth	vRoot	vRoot_rRoot	GWdepth	GWdepth	range GWdepth	vRoot	GWdepth	range GWdepth	vRoot	vRoot_rRoot
		JJA	-0.12	-0.11	-0.15	-0.11	-0.07	-0.01	-0.02	0.06	0.27	0.07	0.13	0.23
		JA	-0.14	-0.09	-0.21	-0.18	-0.07	-0.01	-0.08	0.01	0.22	-0.12	-0.01	0.12
		A	-0.15	-0.09	-0.22	-0.22	-0.08	0.05	-0.09	-0.04	0.14	NA	-0.02	0.04
Plot_3	0.00	M	-0.17	0.18	0.07	-0.22	-0.05	NA	0.18	-0.06	NA	NA	0.24	0.15
		MJ	-0.12	0.24	0.02	-0.16	-0.06	NA	0.11	-0.07	NA	NA	0.26	0.10
		MJJ	-0.11	0.09	-0.05	-0.16	-0.09	NA	-0.02	-0.23	NA	NA	0.29	0.14
		MJJA	-0.12	-0.01	-0.03	-0.16	-0.19	NA	0.01	-0.24	NA	NA	0.33	0.15
		JJA	-0.10	-0.12	-0.06	-0.13	-0.21	NA	-0.05	-0.25	NA	NA	0.25	0.14
		JA	-0.11	-0.12	-0.07	-0.09	-0.24	NA	-0.09	-0.25	NA	NA	0.18	0.10
		A	-0.15	0.07	0.03	-0.07	-0.26	NA	0.07	-0.11	NA	NA	0.20	0.14
Plot_3	0.01	M	-0.16	0.19	0.07	-0.17	-0.18	NA	0.13	-0.09	NA	NA	0.24	0.27
		MJ	-0.10	0.23	0.05	-0.10	-0.16	NA	0.08	-0.08	NA	NA	0.25	0.09
		MJJ	-0.08	0.10	-0.02	-0.08	-0.18	NA	-0.04	-0.24	NA	NA	0.27	0.11
		MJJA	-0.11	-0.01	-0.01	-0.10	-0.14	NA	-0.02	-0.28	NA	NA	0.32	0.12
		JJA	-0.09	-0.12	-0.03	-0.07	-0.14	NA	-0.07	-0.29	NA	NA	0.24	0.11
		JA	-0.11	-0.12	-0.05	-0.05	-0.16	NA	-0.11	-0.33	NA	NA	0.15	0.08
		A	-0.16	0.13	0.02	-0.09	-0.16	NA	0.03	-0.24	NA	NA	0.20	0.12
Plot_3	0.03	M	-0.13	0.09	0.11	-0.06	-0.16	0.21	0.08	-0.18	-0.16	NA	0.23	-0.13
		MJ	-0.03	0.15	0.11	0.04	-0.12	0.23	0.01	-0.16	-0.15	NA	0.22	0.10
		MJJ	-0.01	0.04	0.03	0.01	-0.10	0.10	-0.03	-0.13	NA	NA	0.18	0.04
		MJJA	-0.07	-0.07	0.03	-0.02	-0.09	0.05	0.01	-0.09	NA	NA	0.26	0.10
		JJA	-0.05	-0.17	0.01	-0.01	-0.07	-0.09	0.00	-0.06	NA	NA	0.19	0.10
		JA	-0.08	-0.17	-0.05	-0.04	-0.06	-0.15	0.01	0.02	NA	NA	0.10	0.07
		A	-0.15	0.15	0.01	-0.08	-0.08	-0.01	0.12	0.10	NA	NA	0.21	0.15
Plot_3	0.05	M	-0.07	0.13	0.13	0.01	-0.11	0.15	0.11	-0.06	-0.09	0.26	0.23	0.08
		MJ	0.03	0.13	0.15	0.10	-0.04	0.19	0.09	-0.01	-0.10	0.18	0.18	0.08

Study site	GW exfiltration (cm day^{-1})	kLAI	0.4				0.5				0.7			
		Modeled parameter / Season	GWdepth	range GWdepth	vRoot	vRoot_rRoot	GWdepth	GWdepth	range GWdepth	vRoot	GWdepth	range GWdepth	vRoot	vRoot_rRoot
		MJJ	0.04	0.04	0.07	0.07	-0.02	0.08	0.03	0.00	-0.08	0.13	0.09	-0.05
		MJJA	-0.04	-0.05	0.04	0.00	-0.05	-0.02	0.04	-0.02	-0.13	0.10	0.10	-0.09
		JJA	-0.03	-0.14	0.02	0.01	-0.03	-0.17	0.02	0.00	-0.17	0.09	0.03	-0.10
		JA	-0.07	-0.17	-0.05	-0.06	-0.06	-0.17	-0.02	0.00	-0.23	0.04	-0.03	-0.11
		A	-0.14	0.11	-0.03	-0.16	-0.12	0.08	0.03	-0.05	-0.27	NA	0.05	-0.10

* significant at 0.05 level

** significant at 0.01 level