

Additional file

Managing climate change in drinking water reservoirs: Potentials and limitations of dynamic withdrawal strategies

Johannes Feldbauer, David Kneis, Tilo Hegewald, Thomas U Berendonk,
Thomas Petzoldt

Additional plots

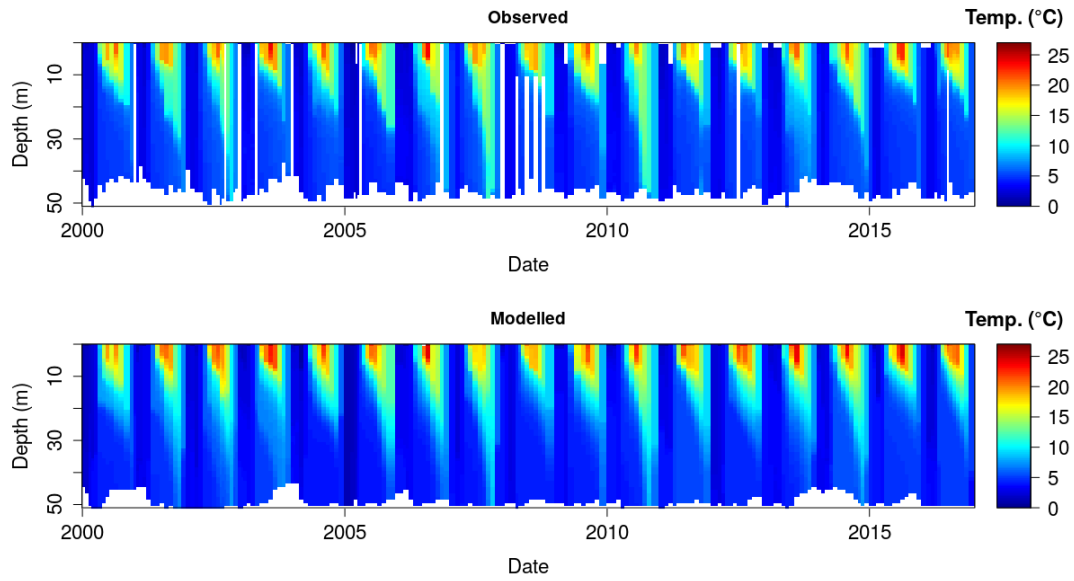


Figure S.1: Water temperatures for the whole simulation duration showing observed (top) and simulated (bottom, using the reference strategy) Temperatures for Eibenstock Reservoir (ES).

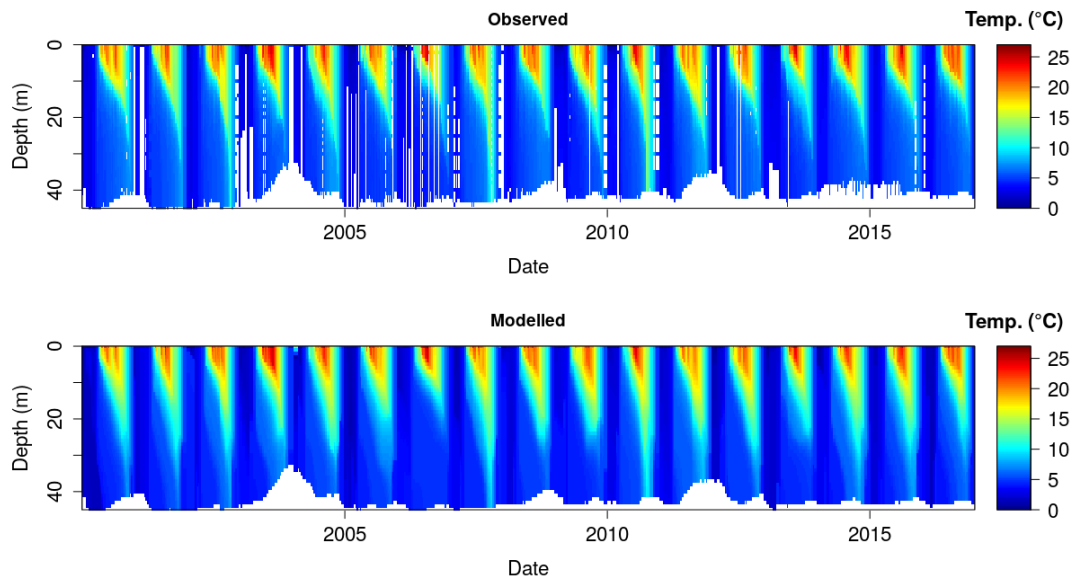


Figure S.2: Water temperatures for the whole simulation duration showing observed (top) and simulated (bottom, using the reference strategy) Temperatures for Saidenbach Reservoir (SB).

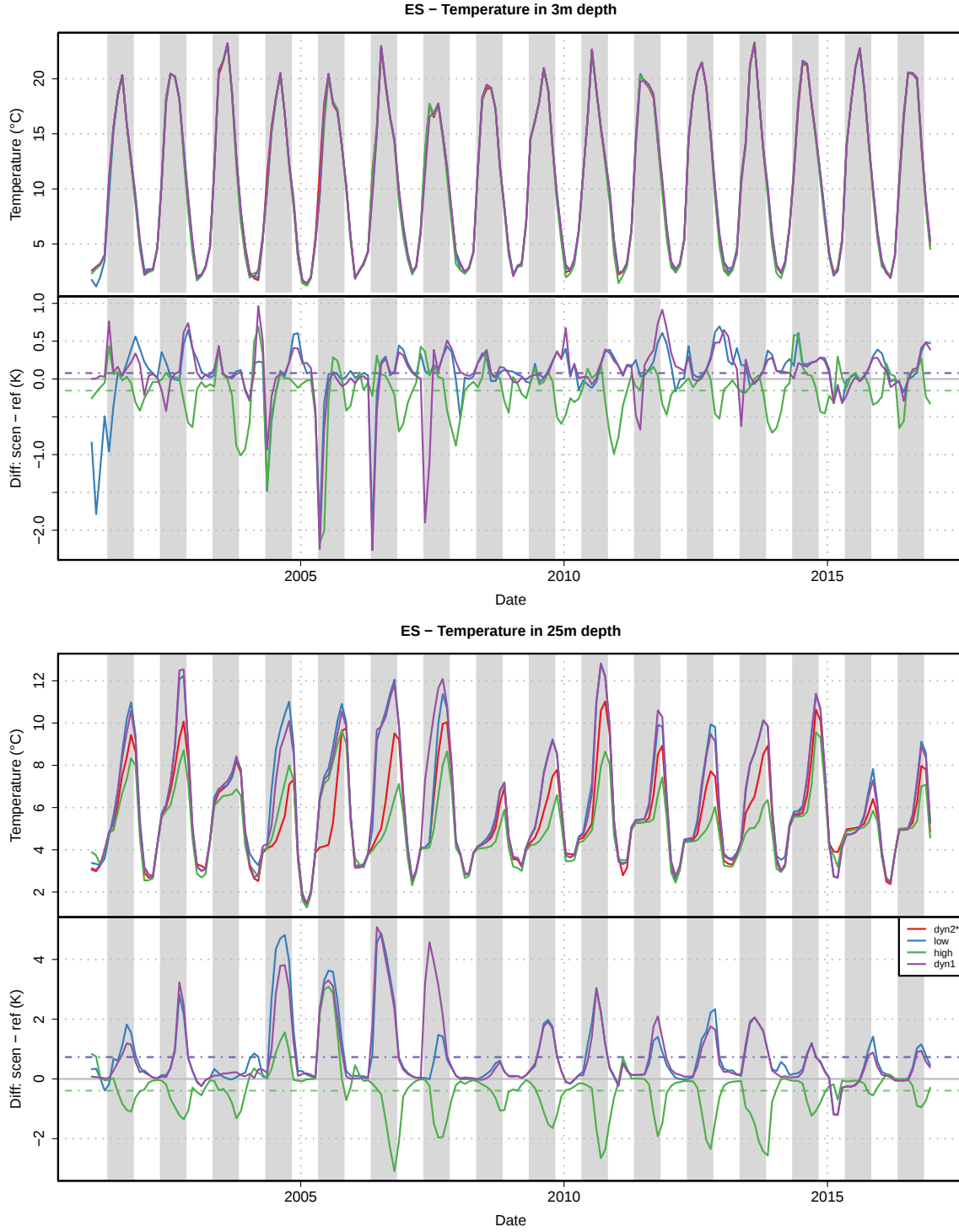


Figure S.3: Monthly average temperature 3 (top) and 25 m (bottom) below the surface for all four withdrawal strategies for Eibenstock Reservoir and difference between the strategies and the reference strategy *dyn2* (bottom). The gray shaded areas indicate summer time as defined for the period from first of May to first of November.

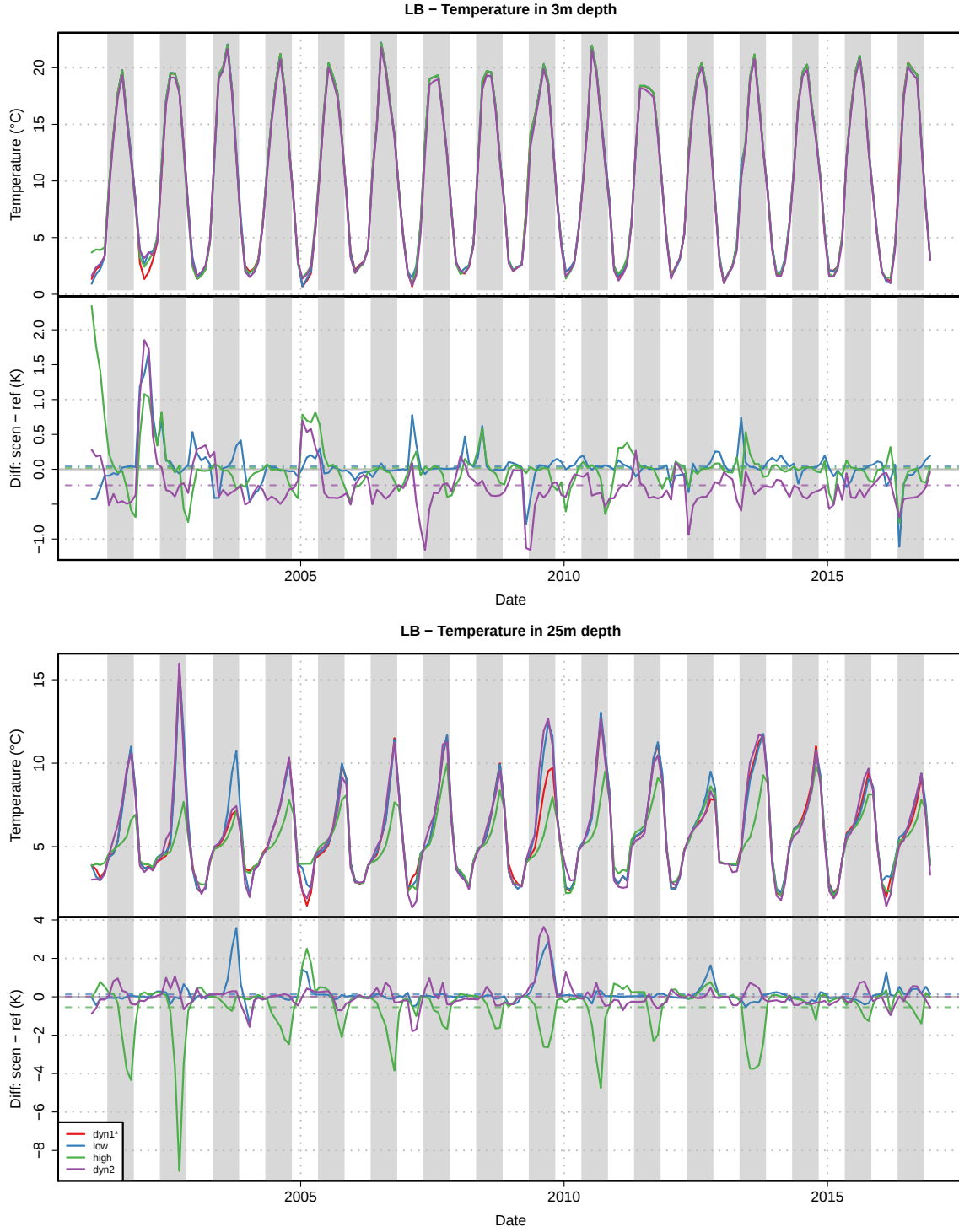


Figure S.4: Monthly average temperature 3 (top) and 25 m (bottom) below the surface for all four withdrawal strategies for Lichtenberg Reservoir and difference between the strategies and the reference strategy *dyn1* (bottom). The gray shaded areas indicate summer time as defined for the period from first of May to first of November

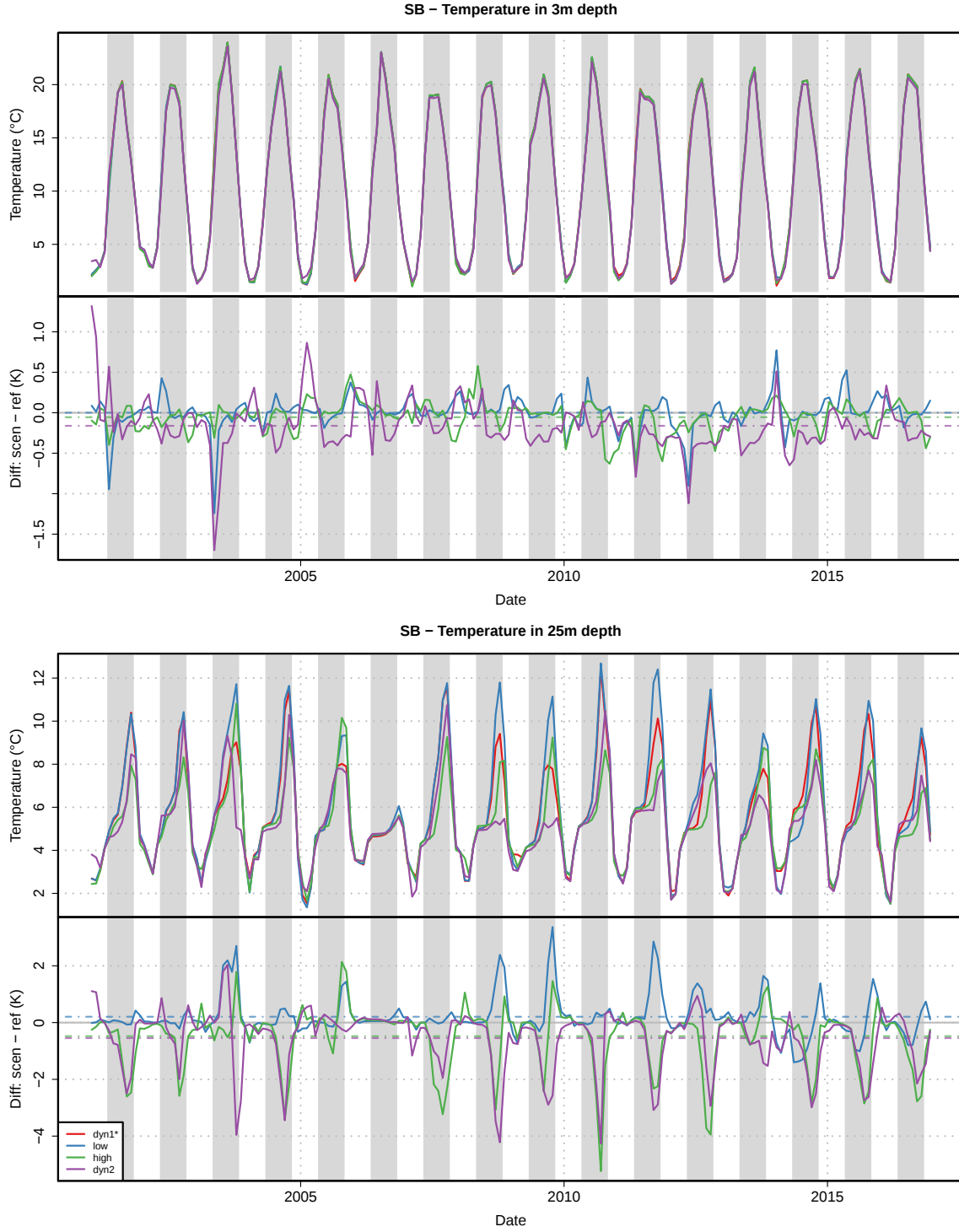


Figure S.5: Monthly average temperature 3 (top) and 25 m (bottom) below the surface for all four withdrawal strategies for Saidenbach Reservoir and difference between the strategies and the reference strategy *dyn1* (bottom). The gray shaded areas indicate summer time as defined for the period from 1. May to 31. October.

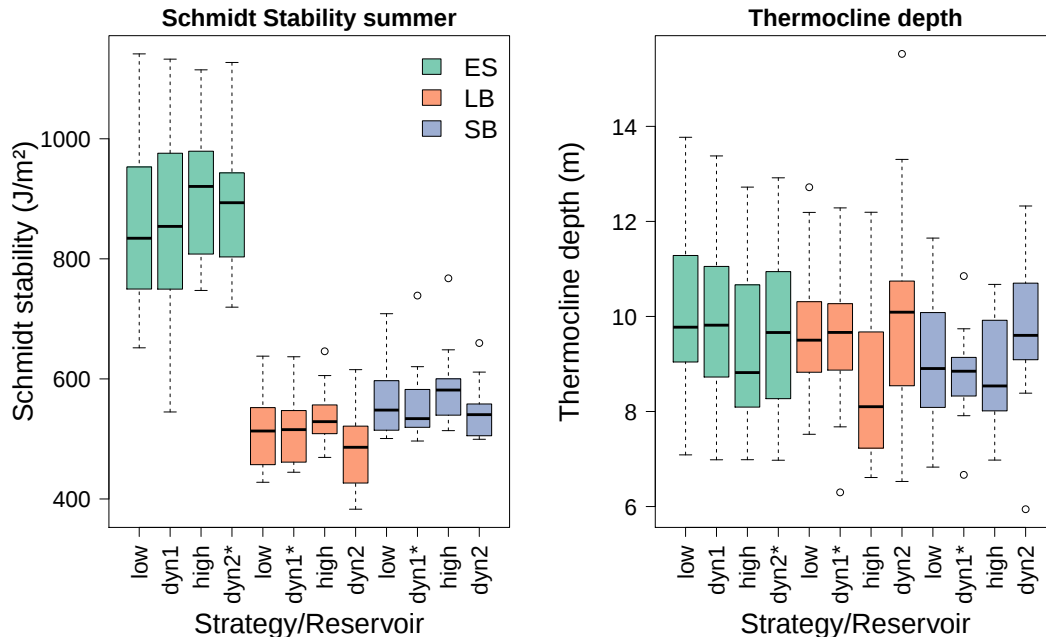


Figure S.6: Summer Schmidt stability (as defined from 1. May to 31. October) and thermocline depth for all four scenarios and all three reservoirs. The individual boxplots represent annual averages of 16 years. The scenarios annotated with an asterisk indicate the reference scenario for the respective reservoirs. For description of the reservoirs see Table 1, for description of the strategies see Section Management strategies

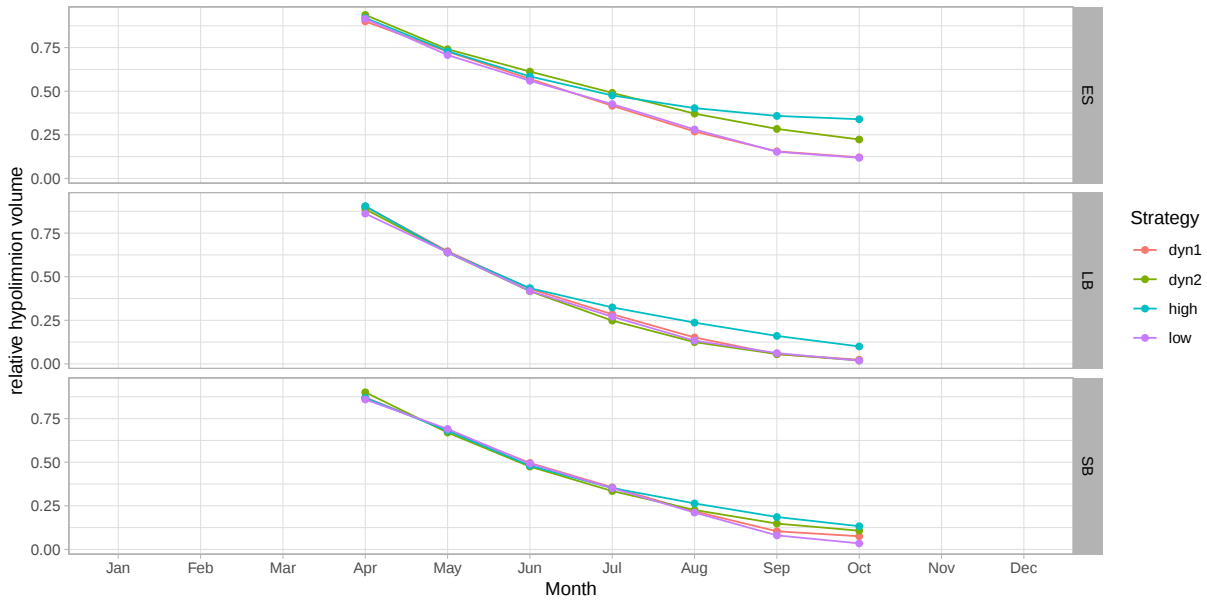
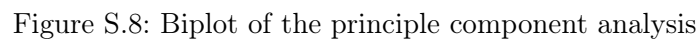


Figure S.7: Monthly relative hypolimnion volume (volume of hypolimnion divided by total volume) averaged over all 16 years for all three reservoirs and all four withdrawal strategies. For description of the reservoirs see Table 1, for description of the strategies see Section Management strategies

The data cluster according to the reservoirs and LB and SB are more similar than ES. The larger part of the variance comes from the difference between the years and not so much from the different withdrawal strategies. Major difference between the reservoirs is start and end of stratification.



Full linear model

Table S.1: Parameters of full linear model between modeled reservoir features and external predictor variables. See table 3 and 4 in for explanation of features and predictor variables. Colons (e.g. AT_sum:R.SB) indicate interaction terms. The values provided are the corresponding slopes and intercepts of the linear models described in equation 3, if the values are depending on the reservoir or used strategy the default values (β_0 , and β_i) correspond to reservoir ES and strategy *dyn1*.

Term (predictor variables & interaction)	Characteristic features (response variables)					
	Int. heat energy	Temp. 3 m	Temp. 25 m	Begin strat.	End strat.	Ice-off
Intercept (β_0)	1.14	8.83	15.3	-59	332	188
Predictor variables (β_i)						
AT_sum	-0.00484	0.375	-0.273	8.53	1.12	6.54
AT_win	0.00546	0.111	-0.0354	-1.9	1.51	-20.5
Qout	0.000783	0.000203	0.0171	-0.0236	0.01	0.0878
Qrw	0.00685	-0.0525	0.16	1.68	0.404	1.3
V	-0.00841	-0.0154	-0.16	0.299	0.0656	-3.44
wind	-0.0333	-0.866	0.000527	0.435	-17.7	4.01
Reservoir (β_r)						
R.LB	-0.509	1.09	-8.25	78.7	-119	-27.9
R.SB	-0.257	1.68	-4.71	0.984	54.4	69.2
Strategy (β_s)						
S.dyn2	-0.0934	-0.683	-3.36	-7.06	14.4	-133
S.high	-0.213	-0.73	-4.02	9.01	27.9	-2.4
S.low	0.0186	0.321	0.544	15.4	9.39	-33.5
Reservoir:Strategy ($\beta_{r:s}$)						
R.LB:S.dyn2	0.0777	0.558	2.23	4.36	-27.6	50.7
R.SB:S.dyn2	0.0639	0.603	1.33	3.37	-18.6	43.1
R.LB:S.high	0.173	0.788	2.32	-5.29	-12.4	19.5
R.SB:S.high	0.149	0.619	1.78	-3.82	-11	18.1
R.LB:S.low	-0.0292	-0.0176	-1.08	-6.55	5.52	4.04
R.SB:S.low	-0.0297	-0.0188	-0.996	-5.36	0.813	3.98
Interaction Reservoir ($\beta_{i:r}$)						
AT_sum:R.LB	-0.00498	-0.35	0.0917	0.307	1.83	-2.66
AT_sum:R.SB	-0.0114	-0.147	-0.125	0.0917	-1.27	-11.8
AT_win:R.LB	0.00933	0.113	0.198	-1.21	1.82	10.2
AT_win:R.SB	0.00601	0.0201	0.15	-0.237	1.39	10.3
Qout:R.LB	0.00147	0.0109	0.0369	-0.154	-0.689	0.889
Qout:R.SB	0.000195	0.00989	0.00256	0.18	-0.367	-0.755
Qrw:R.LB	0.014	0.426	-0.181	-8.46	6.71	-3.58
Qrw:R.SB	-0.00574	0.072	-0.136	-1.49	-1.46	-0.784
V:R.LB	0.00449	-0.0419	0.0715	2.68	5.79	-7.13
V:R.SB	0.0021	-0.0822	0.0589	0.846	0.459	0.238
wind:R.LB	-0.0217	-0.751	0.769	2.38	-22.4	-2.06
wind:R.SB	0.00549	-0.304	0.926	17.3	-20.9	-18.1
Interaction Strategy ($\beta_{i:s}$)						
AT_sum:S.dyn2	0.00235	-0.0182	0.142	0.0535	0.745	7.18
AT_sum:S.high	0.00124	-0.0127	0.0879	-0.28	-0.784	-0.428
AT_sum:S.low	0.00223	-0.0105	0.0671	-0.664	-1.44	2.74
AT_win:S.dyn2	-0.00154	-0.0163	-0.0452	0.276	-0.0837	-0.817
AT_win:S.high	0.000295	0.00809	0.0249	-0.0401	-1.22	1.11
AT_win:S.low	-0.00312	0.043	-0.0897	-0.176	-0.298	0.00978
Qout:S.dyn2	-0.000309	-0.00029	-0.00766	-0.00686	0.000607	-0.0726
Qout:S.high	-0.000567	-0.00129	-0.0145	0.00347	-0.0433	-0.00749
Qout:S.low	-0.000107	0.00301	-0.00259	-0.0151	-0.0134	0.051
Qrw:S.dyn2	0.000373	-0.0154	-0.00218	-0.00594	0.00828	-0.748
Qrw:S.high	0.000246	-0.000426	0.0449	0.00464	-1.06	-0.464
Qrw:S.low	0.0009	-0.0122	0.0476	0.0896	-0.25	-0.381
V:S.dyn2	0.00139	0.0189	0.0417	0.0526	-0.601	1.38
V:S.high	0.00335	0.0124	0.043	-0.0899	-0.0104	0.599
V:S.low	-0.000823	-0.00238	-0.0331	-0.106	0.254	0.0217
wind:S.dyn2	-0.0198	0.0513	-0.589	1.43	5.12	-14.6
wind:S.high	-0.0124	0.0054	-0.42	0.194	6.52	-9
wind:S.low	-0.00208	-0.0612	-0.023	0.432	1.49	-3.06
Model quality						
BIC	-732	298	416	1354	1462	1780
R ²	0.927	0.738	0.693	0.603	0.85	0.657