

Supporting information for “Estuarine forecasts at daily weather to subseasonal time scales”

Andrew C. Ross^{1,2}, Charles A. Stock², Keith W. Dixon², Marjorie A. M.

Friedrichs³, Raleigh R. Hood⁴, Ming Li⁴, Kathleen Pegion⁵, Vincent Saba⁶,

Gabriel A. Vecchi^{7,8}

¹Princeton University, Program in Atmospheric and Oceanic Sciences, Princeton, NJ, 08540, USA.

²NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, 08540, USA.

³Virginia Institute of Marine Science, William & Mary, Gloucester Point, VA 23062, USA.

⁴University of Maryland Center for Environmental Science, Cambridge, MD, 21613, USA.

⁵George Mason University, Fairfax, VA, 22030, USA.

⁶NOAA Northeast Fisheries Science Center, Geophysical Fluid Dynamics Laboratory, Princeton, NJ, 08540, USA.

⁷Princeton University, Department of Geosciences, Princeton, NJ, 08540, USA.

⁸Princeton University, Princeton Environmental Institute, Princeton, NJ, 08540, USA.

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Corresponding author: A. C. Ross, Princeton University, Program in Atmospheric and Oceanic Sciences, Princeton, NJ, 08540, USA (andrew.c.ross@noaa.gov)

Introduction

This supporting information provides an evaluation of the hindcast simulation (Tables S1–S5) and details about how the evaluation was conducted (Text S1). Also, Figures S1–S2 provide alternate versions of two figures from the main text where the climatological reference forecast has been replaced with the anomaly persistence reference forecast.

Text S1.

In Tables S1 through S5, the hindcast is compared with observations at 39 monitoring locations included in the Chesapeake Bay Program database. These locations are the same as those included in the evaluation of the ChesROMS model by Xu et al. (2012), with the addition of the CB4.1E location. We also calculated similar metrics, including the observed and model mean, the root mean square error (RMSE), the mean absolute error (MAE), the mean bias, and the correlation coefficient (R). We also provide the standard deviation of the observations (σ_o). To isolate the model's predictive capability during the time period studied in the paper, the hindcast evaluation used only modeled and observed data during April through August of 1999 to 2015. For all comparisons, the time of each observation was rounded to the nearest hour, and the corresponding value from the hindcast simulation was selected.

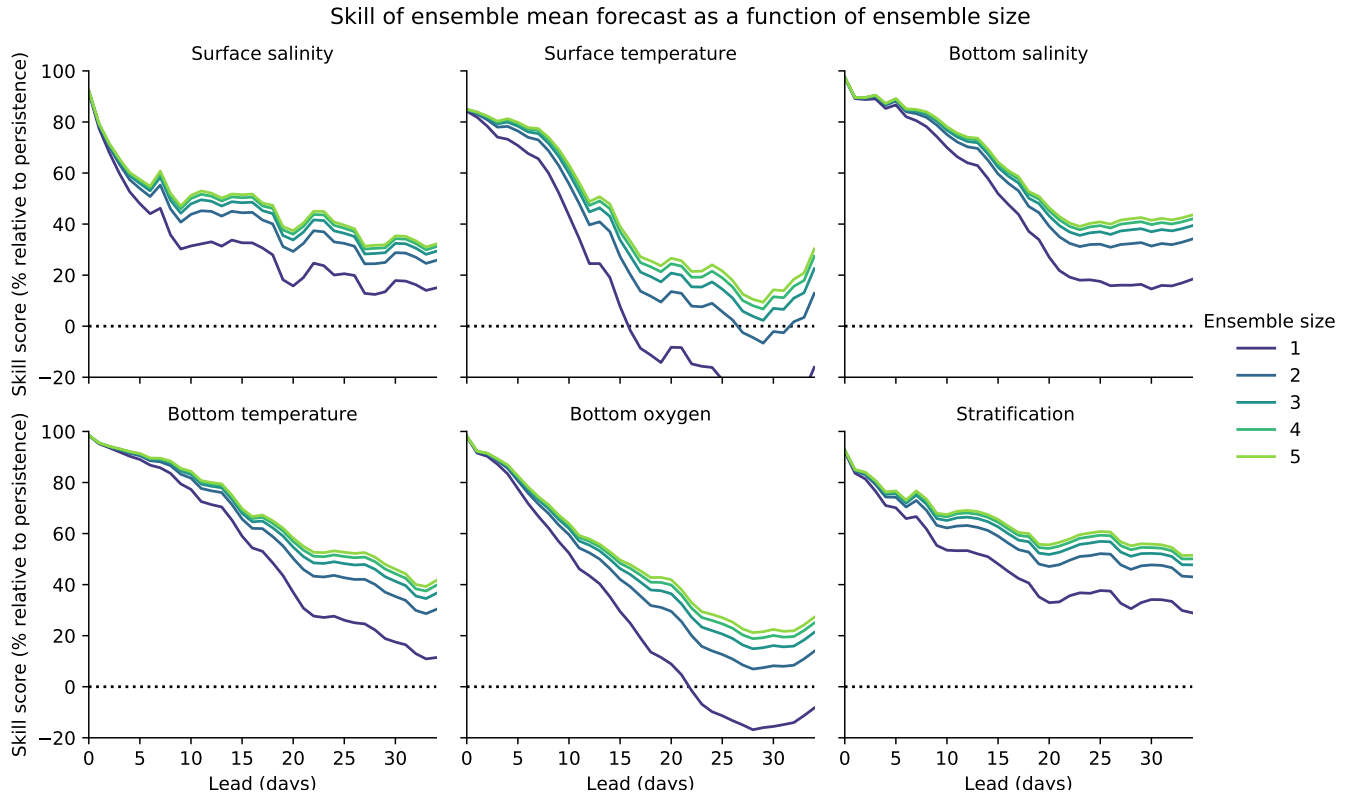


Figure S1. Skill of the ensemble mean ocean model reforecasts evaluated against the hindcast simulation as a function of the size of the ensemble. In this figure, skill is calculated against the persistence reference forecast. The skill was calculated for the average MSE of forecasts from stations in the center of the bay (Figure 1). For ensemble sizes between 1 and 4, the MSE was also averaged for ensemble mean forecasts from ensembles representing all possible combinations.

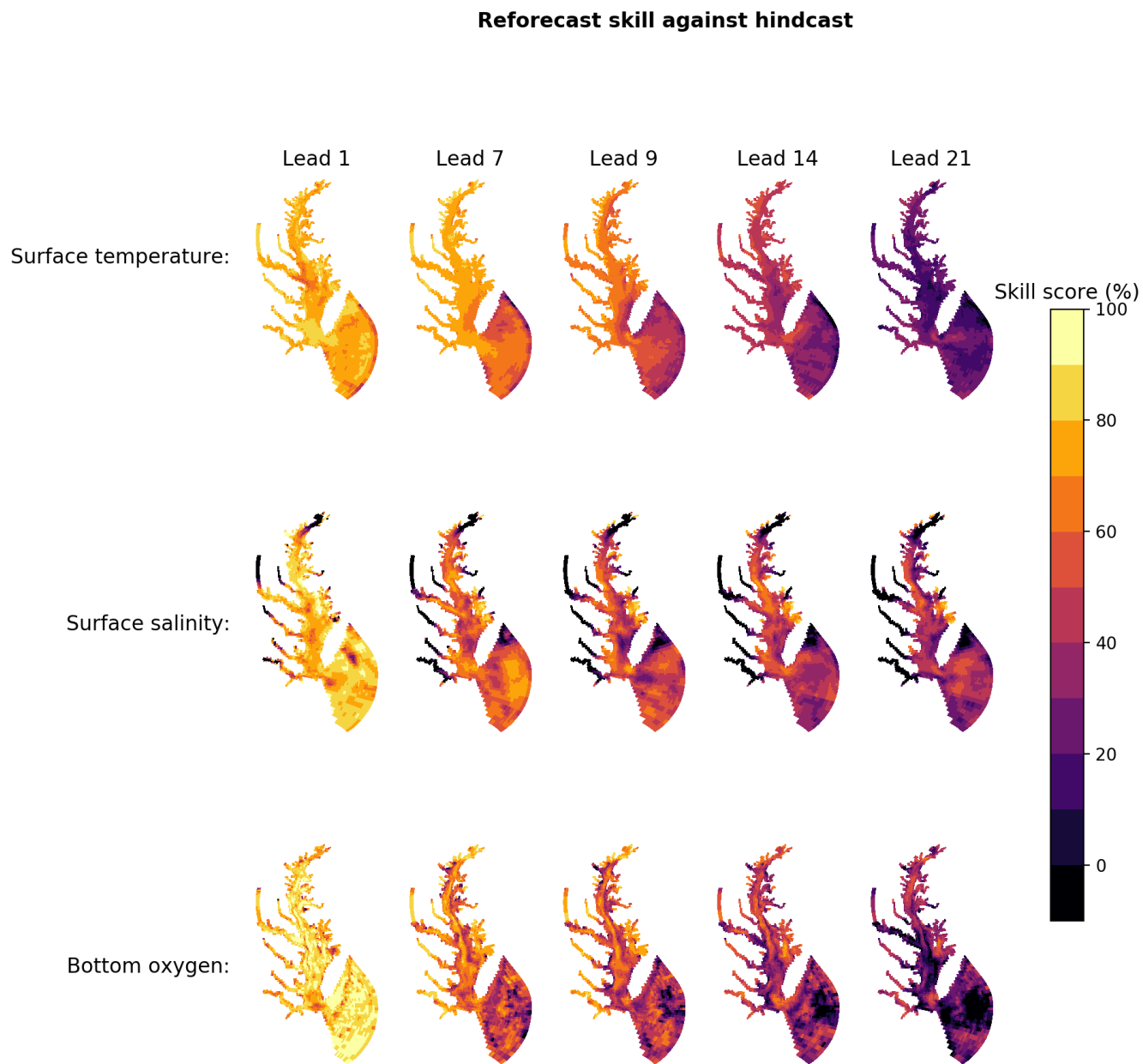


Figure S2. Skill of ensemble mean forecasts evaluated against the hindcast simulation at all model grid points. In this figure, skill is calculated against the persistence reference forecast.

Table S1. Evaluation of hindcast simulation for surface temperature. Temperature is reported in degrees Celsius.

Station	Observed mean	Model mean	RMSE	MAE	Bias	R	σ_o
CB1.1	23.05	22.45	2.05	1.70	-0.61	0.95	6.29
CB2.1	22.57	21.90	1.41	1.12	-0.68	0.98	5.91
CB2.2	21.95	21.52	1.16	0.91	-0.43	0.98	5.97
CB3.1	21.63	21.30	1.21	0.95	-0.33	0.99	5.85
CB3.2	21.41	21.36	1.03	0.84	-0.05	0.99	5.97
CB3.3C	21.45	21.37	1.02	0.82	-0.08	0.99	6.12
CB3.3E	21.56	21.63	1.07	0.87	0.07	0.99	5.99
CB3.3W	21.78	21.56	1.05	0.84	-0.22	0.99	5.98
CB4.1C	21.35	21.75	1.06	0.87	0.41	0.99	6.15
CB4.1E	21.57	21.83	1.02	0.86	0.27	0.99	5.97
CB4.1W	21.74	21.78	0.89	0.75	0.04	0.99	6.00
CB4.2C	21.40	21.88	0.93	0.77	0.49	0.99	6.09
CB4.2E	21.64	22.32	1.05	0.88	0.68	0.99	6.04
CB4.2W	21.52	21.90	0.87	0.75	0.38	0.99	6.00
CB4.3C	21.44	21.80	0.84	0.69	0.36	0.99	6.12
CB4.3E	21.49	21.99	0.92	0.80	0.49	0.99	6.02
CB4.3W	21.67	21.97	0.90	0.75	0.31	0.99	5.82
CB4.4	21.64	22.01	0.93	0.78	0.37	0.99	6.15
CB5.1	21.70	21.84	0.90	0.73	0.14	0.99	6.15
CB5.1W	20.88	21.23	0.95	0.77	0.35	0.99	6.42
CB5.2	21.59	21.94	0.81	0.67	0.35	1.00	6.18
CB5.3	21.65	22.01	0.84	0.71	0.36	0.99	5.97
CB5.4	22.95	23.30	0.84	0.69	0.35	0.99	5.72
CB5.4W	23.92	24.24	0.90	0.76	0.32	0.99	5.29
CB5.5	23.05	23.37	0.84	0.71	0.31	0.99	5.57
CB6.1	23.36	23.42	0.84	0.66	0.06	0.99	5.66
CB6.2	23.26	23.37	0.74	0.62	0.11	0.99	5.63
CB6.3	23.21	23.27	0.77	0.62	0.06	0.99	5.54
CB6.4	22.98	23.13	0.69	0.56	0.16	0.99	5.39
CB7.1	23.29	23.36	0.76	0.61	0.07	0.99	5.58
CB7.1N	22.89	23.65	1.07	0.91	0.76	0.99	5.61
CB7.1S	23.43	23.36	0.72	0.57	-0.06	0.99	5.57
CB7.2	23.20	23.19	0.72	0.61	-0.02	0.99	5.49
CB7.2E	23.02	22.84	0.73	0.57	-0.18	0.99	5.43
CB7.3	22.58	22.35	1.06	0.78	-0.23	0.98	5.21
CB7.3E	22.31	22.12	0.99	0.80	-0.20	0.98	5.25
CB7.4	21.29	21.21	1.15	0.88	-0.07	0.97	5.05
CB7.4N	21.12	20.19	1.89	1.38	-0.93	0.95	5.21
CB8.1	22.43	22.64	0.85	0.68	0.22	0.99	4.98

Table S2. Evaluation of hindcast simulation for surface salinity. Salinity is reported in

practical salinity units.

Station	Observed mean	Model mean	RMSE	MAE	Bias	R	σ_o
CB1.1	0.00	0.00	0.00	0.00	0.00	NA	0.00
CB2.1	0.31	0.10	0.66	0.26	-0.22	0.61	0.74
CB2.2	1.61	2.82	2.27	1.65	1.21	0.70	1.75
CB3.1	3.86	8.72	5.43	4.88	4.86	0.64	2.63
CB3.2	5.83	8.51	3.24	2.76	2.68	0.79	2.78
CB3.3C	8.13	10.26	2.76	2.35	2.13	0.80	2.71
CB3.3E	8.52	10.62	2.78	2.36	2.09	0.80	2.75
CB3.3W	7.88	9.70	2.45	2.07	1.82	0.82	2.64
CB4.1C	9.91	11.57	2.15	1.86	1.66	0.83	2.31
CB4.1E	10.16	12.08	2.44	2.06	1.92	0.79	2.36
CB4.1W	9.41	10.91	1.99	1.73	1.50	0.88	2.56
CB4.2C	10.40	11.91	1.95	1.68	1.51	0.86	2.34
CB4.2E	10.63	12.30	2.09	1.83	1.68	0.85	2.36
CB4.2W	10.38	11.90	2.08	1.75	1.52	0.86	2.45
CB4.3C	10.84	12.05	1.69	1.41	1.22	0.88	2.41
CB4.3E	11.17	12.47	1.79	1.48	1.30	0.84	2.25
CB4.3W	10.76	12.23	2.00	1.68	1.47	0.86	2.39
CB4.4	11.54	12.40	1.53	1.23	0.86	0.84	2.28
CB5.1	12.07	12.82	1.42	1.11	0.75	0.85	2.21
CB5.1W	11.87	12.50	1.38	1.07	0.64	0.89	2.20
CB5.2	12.72	13.70	1.53	1.23	0.98	0.87	2.23
CB5.3	13.29	14.61	1.83	1.51	1.32	0.85	2.26
CB5.4	14.29	15.41	1.64	1.34	1.12	0.87	2.23
CB5.4W	14.16	15.23	1.44	1.17	1.07	0.92	2.12
CB5.5	15.22	16.55	2.12	1.67	1.33	0.80	2.41
CB6.1	15.73	17.08	2.00	1.61	1.35	0.79	2.30
CB6.2	16.32	17.04	1.53	1.16	0.72	0.84	2.34
CB6.3	17.03	17.51	1.53	1.23	0.49	0.83	2.52
CB6.4	19.08	19.53	1.48	1.14	0.45	0.86	2.71
CB7.1	17.41	18.79	1.91	1.59	1.37	0.81	2.24
CB7.1N	16.47	17.76	1.60	1.38	1.29	0.87	1.84
CB7.1S	17.25	18.66	2.15	1.76	1.41	0.77	2.53
CB7.2	17.78	19.27	2.55	1.96	1.50	0.70	2.64
CB7.2E	19.73	21.37	2.52	2.00	1.64	0.79	2.82
CB7.3	21.24	21.77	2.11	1.67	0.53	0.76	2.83
CB7.3E	22.57	23.66	2.20	1.74	1.09	0.71	2.49
CB7.4	24.63	24.32	2.47	2.00	-0.32	0.64	2.83
CB7.4N	27.37	27.79	2.26	1.81	0.42	0.63	2.69
CB8.1	21.31	20.88	1.56	1.26	-0.42	0.83	2.37

Table S3. Evaluation of hindcast simulation for bottom temperature. Temperature is reported in degrees Celsius.

Station	Observed mean	Model mean	RMSE	MAE	Bias	R	σ_o
CB1.1	22.87	22.45	1.96	1.61	-0.42	0.95	6.23
CB2.1	22.48	21.91	1.36	1.07	-0.57	0.98	5.91
CB2.2	21.54	21.47	1.07	0.82	-0.07	0.99	6.25
CB3.1	20.11	21.24	1.57	1.28	1.13	0.99	6.55
CB3.2	19.43	20.52	1.49	1.24	1.08	0.99	6.59
CB3.3C	18.01	19.30	1.61	1.37	1.29	0.99	6.47
CB3.3E	20.20	20.06	1.39	1.04	-0.14	0.98	6.38
CB3.3W	19.83	19.73	1.52	1.18	-0.10	0.98	6.46
CB4.1C	18.24	19.24	1.40	1.17	1.00	0.99	6.42
CB4.1E	18.60	20.66	2.45	2.08	2.05	0.98	6.39
CB4.1W	20.18	19.95	1.36	1.08	-0.23	0.98	6.26
CB4.2C	18.53	19.23	1.12	0.91	0.70	0.99	6.32
CB4.2E	20.78	19.80	1.85	1.41	-0.98	0.97	6.07
CB4.2W	20.42	20.99	1.25	1.05	0.57	0.99	6.16
CB4.3C	18.56	19.18	1.08	0.86	0.62	0.99	6.31
CB4.3E	18.77	19.76	1.30	1.09	0.98	0.99	6.27
CB4.3W	20.44	20.86	1.25	1.05	0.42	0.99	6.06
CB4.4	18.69	19.29	1.04	0.85	0.60	0.99	6.25
CB5.1	18.80	19.32	1.03	0.83	0.52	0.99	6.20
CB5.1W	20.03	19.54	1.30	1.02	-0.49	0.99	6.36
CB5.2	19.19	19.53	0.84	0.65	0.34	0.99	6.14
CB5.3	19.80	19.89	0.75	0.59	0.10	0.99	6.02
CB5.4	20.87	20.83	0.87	0.69	-0.04	0.99	5.66
CB5.4W	23.50	24.34	1.26	1.03	0.84	0.99	5.27
CB5.5	21.27	20.79	0.97	0.77	-0.48	0.99	5.56
CB6.1	21.19	20.70	1.03	0.80	-0.48	0.99	5.51
CB6.2	21.36	20.72	1.17	0.91	-0.64	0.98	5.45
CB6.3	21.32	20.64	1.17	0.96	-0.68	0.98	5.37
CB6.4	21.10	20.29	1.55	1.17	-0.81	0.97	5.28
CB7.1	21.43	21.59	0.75	0.58	0.17	0.99	5.57
CB7.1N	22.23	23.02	1.16	0.95	0.79	0.99	5.58
CB7.1S	21.22	20.75	1.01	0.83	-0.47	0.99	5.42
CB7.2	20.89	20.33	1.24	0.96	-0.56	0.98	5.24
CB7.2E	21.50	21.08	1.02	0.79	-0.41	0.98	5.30
CB7.3	19.45	18.99	1.78	1.36	-0.46	0.94	4.99
CB7.3E	21.11	20.32	1.55	1.16	-0.79	0.96	5.07
CB7.4	18.00	17.47	2.05	1.57	-0.53	0.92	4.96
CB7.4N	20.50	19.40	2.25	1.69	-1.10	0.93	5.19
CB8.1	19.77	19.11	1.87	1.42	-0.66	0.94	4.97

Table S4. Evaluation of hindcast simulation for bottom salinity. Salinity is reported in practical salinity units.

Station	Observed mean	Model mean	RMSE	MAE	Bias	R	σ_o
CB1.1	0.00	0.00	0.00	0.00	-0.00	0.96	0.00
CB2.1	0.44	0.13	0.87	0.38	-0.31	0.47	0.92
CB2.2	3.80	3.92	3.02	2.20	0.12	0.59	3.25
CB3.1	9.76	9.45	2.61	2.08	-0.32	0.62	3.08
CB3.2	11.97	13.10	2.32	1.94	1.13	0.67	2.70
CB3.3C	16.95	16.67	1.62	1.29	-0.28	0.69	2.16
CB3.3E	11.49	15.34	4.46	3.92	3.86	0.59	2.75
CB3.3W	12.19	15.72	4.40	3.86	3.53	0.52	3.06
CB4.1C	18.45	17.96	1.62	1.25	-0.49	0.68	2.05
CB4.1E	16.74	15.76	2.09	1.64	-0.98	0.61	2.12
CB4.1W	11.94	15.86	4.30	3.92	3.92	0.72	2.55
CB4.2C	18.87	19.16	1.51	1.19	0.29	0.71	2.04
CB4.2E	12.77	18.21	5.72	5.44	5.44	0.70	2.42
CB4.2W	12.04	14.34	2.70	2.39	2.29	0.81	2.44
CB4.3C	19.10	19.69	1.62	1.30	0.59	0.71	2.10
CB4.3E	18.61	18.82	1.50	1.16	0.21	0.72	2.11
CB4.3W	12.48	15.19	3.16	2.83	2.71	0.77	2.54
CB4.4	19.93	20.41	1.56	1.27	0.48	0.72	2.10
CB5.1	20.31	21.07	1.63	1.33	0.76	0.73	2.07
CB5.1W	13.37	17.08	4.15	3.71	3.70	0.65	2.36
CB5.2	20.52	21.83	2.00	1.65	1.31	0.69	2.04
CB5.3	20.90	22.80	2.46	2.06	1.90	0.72	2.25
CB5.4	21.60	23.61	2.44	2.10	2.01	0.73	1.97
CB5.4W	14.53	15.31	1.26	1.02	0.78	0.91	2.15
CB5.5	21.06	24.06	3.45	3.10	3.01	0.62	2.09
CB6.1	21.68	24.23	2.94	2.63	2.55	0.69	1.89
CB6.2	21.76	24.33	3.21	2.65	2.57	0.53	2.20
CB6.3	22.37	24.68	2.84	2.40	2.31	0.57	1.95
CB6.4	23.42	25.56	3.04	2.36	2.14	0.49	2.44
CB7.1	21.16	22.79	2.21	1.84	1.63	0.72	2.16
CB7.1N	18.48	19.78	1.81	1.55	1.30	0.80	2.06
CB7.1S	23.00	25.19	2.62	2.32	2.19	0.69	1.97
CB7.2	25.40	26.40	1.94	1.58	1.00	0.55	1.89
CB7.2E	23.45	25.53	2.45	2.12	2.08	0.73	1.84
CB7.3	28.24	28.48	1.41	1.11	0.24	0.61	1.60
CB7.3E	26.54	27.29	1.93	1.57	0.75	0.60	2.18
CB7.4	30.21	29.73	1.23	0.93	-0.48	0.64	1.28
CB7.4N	28.93	29.08	2.08	1.63	0.15	0.30	2.01
CB8.1	26.18	26.54	2.40	1.81	0.37	0.66	2.97

Table S5. Evaluation of hindcast simulation for bottom oxygen. Oxygen is reported in mg/l.

Station	Observed mean	Model mean	RMSE	MAE	Bias	R	σ_o
CB1.1	8.05	8.73	1.18	1.00	0.68	0.86	1.72
CB2.1	7.91	8.79	1.34	1.13	0.88	0.83	1.71
CB2.2	6.09	8.26	2.63	2.28	2.17	0.58	1.81
CB3.1	3.26	7.00	4.15	3.79	3.74	0.43	1.85
CB3.2	2.34	3.49	1.92	1.56	1.15	0.63	1.82
CB3.3C	1.25	1.43	1.23	0.83	0.18	0.72	1.75
CB3.3E	4.52	2.36	2.99	2.44	-2.16	0.46	2.21
CB3.3W	3.93	2.20	2.76	2.24	-1.73	0.47	2.39
CB4.1C	1.33	0.99	1.21	0.69	-0.33	0.78	1.86
CB4.1E	1.38	2.80	2.15	1.72	1.42	0.64	1.88
CB4.1W	3.93	2.18	2.71	2.05	-1.75	0.60	2.61
CB4.2C	1.58	0.89	1.37	0.81	-0.69	0.84	2.09
CB4.2E	5.32	1.35	4.40	3.97	-3.97	0.73	2.74
CB4.2W	4.54	4.32	2.17	1.60	-0.22	0.73	3.17
CB4.3C	1.71	0.94	1.46	0.89	-0.77	0.85	2.21
CB4.3E	1.64	1.36	1.21	0.72	-0.28	0.85	2.17
CB4.3W	4.35	3.96	2.34	1.77	-0.39	0.72	3.36
CB4.4	2.03	1.39	1.38	0.91	-0.64	0.87	2.44
CB5.1	2.13	1.50	1.43	0.93	-0.63	0.86	2.47
CB5.1W	5.99	3.54	3.14	2.58	-2.44	0.67	2.62
CB5.2	2.54	1.97	1.35	0.94	-0.58	0.88	2.58
CB5.3	3.24	2.71	1.31	0.97	-0.53	0.88	2.55
CB5.4	3.36	2.92	1.44	1.07	-0.44	0.85	2.59
CB5.4W	7.58	7.59	1.46	1.05	0.01	0.77	2.07
CB5.5	3.95	3.44	1.85	1.47	-0.50	0.78	2.77
CB6.1	4.18	3.87	1.66	1.31	-0.32	0.78	2.57
CB6.2	4.96	4.38	1.61	1.25	-0.59	0.80	2.41
CB6.3	5.29	4.81	1.36	1.01	-0.48	0.81	2.13
CB6.4	5.91	5.18	1.68	1.31	-0.73	0.71	2.15
CB7.1	4.75	4.03	1.54	1.23	-0.72	0.81	2.29
CB7.1N	5.51	5.34	1.27	0.99	-0.17	0.82	2.21
CB7.1S	4.96	4.45	1.35	1.05	-0.51	0.80	2.07
CB7.2	5.63	5.67	1.04	0.80	0.04	0.79	1.68
CB7.2E	5.99	5.93	1.06	0.81	-0.06	0.81	1.77
CB7.3	7.14	6.95	0.84	0.64	-0.19	0.81	1.34
CB7.3E	6.67	6.76	0.89	0.67	0.09	0.85	1.56
CB7.4	7.43	7.35	0.67	0.52	-0.08	0.81	1.13
CB7.4N	7.70	7.61	0.52	0.41	-0.10	0.89	1.07
CB8.1	7.01	6.47	0.96	0.77	-0.54	0.84	1.44